July 24, 2015

Mr. James M. DiLorenzo
Remedial Project Manager
United States Environmental Protection Agency
Office of Site Remediation and Restoration
5 Post Office Square, Suite 100, Mail code: OSRR07-4
Boston, Massachusetts 02109-3912

Subject: Final Remedial Investigation Report,
Human Health and Ecological Risk Assessments
Operable Unit 1 and Operable Unit 2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Dear Mr. DiLorenzo:

On behalf of Olin Corporation, Amec Foster Wheeler Environment and Infrastructure, Inc. (formerly AMEC Environment and Infrastructure, Inc.) is submitting 2 hard copies and 3 additional electronic copies (CDs) of the document titled *"Final Remedial Investigation Report Operable Unit 1 and Operable Unit 2, Olin Chemical Superfund Site, Wilmington, Massachusetts".* This submittal includes the complete Final Remedial Investigation Report.

Each hardcopy of the report includes three binders (first, the RI Report text, tables, and figures, second, Appendix M of the Remedial Investigation Report (Baseline Human Health Risk Assessment), and third, Appendix N of the Remedial Investigation Report (Baseline Ecological Risk Assessment). A CD that includes the entire Remedial Investigation Report (including the risk assessments and all attachments and appendices that are being submitted only in electronic format) is included in each of the three binders for each copy of the report. Four copies (CDs) of the electronic data deliverable are also included.

These documents are being submitted in accordance with the requirements specified in Section V.A and Sections 7.I.A and 7.I.B of the Final Statement of Work (SOW) for the Olin Chemical Superfund Site. The SOW is incorporated by reference into the Administrative Settlement Agreement and Order of Consent for Remedial Investigation and Feasibility Study for the Olin Chemical Superfund Site, Wilmington, MA (USEPA CERCLA Docket No. 01-2007-0102).

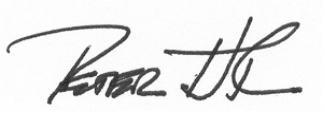
At your request, we are providing copies of these deliverables directly to the following recipients:

Joseph Coyne – MassDEP (one electronic copy)
Heather Ford – Nobis Engineering, Inc. (2 hardcopies, 3 electronic copies)
Jeffrey Hull – Town of Wilmington (2 hardcopies, 2 electronic copies)
Martha Stevenson – WERC (2 hardcopies, 2 electronic copies)

If you have any questions concerning this deliverable, please do not hesitate to contact Mr. James Cashwell, Olin Corporation, at 423-336-4012.

Sincerely,

Amec Foster Wheeler Environment & Infrastructure, Inc.



Peter H. Thompson
Project Manager

Michael J. Murphy
Project Principal

cc: James Cashwell - Olin
Joseph Coyne – MassDEP
Heather Ford – Nobis Engineering, Inc.
Jeffrey Hull – Town of Wilmington
Martha Stevenson – WERC

Amec Foster Wheeler Environment & Infrastructure, Inc
271 Mill Road
Chelmsford, Massachusetts 01824
Tel: (978) 692-9090 | Fax: (978) 692-6633 www.amecfw.com

FINAL
REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 1 & OPERABLE UNIT 2

OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSACHUSETTS

Prepared for:

Olin Corporation
3855 North Ocoee Street; Suite 200
Cleveland, TN 37312

Prepared by:

AMEC Environment & Infrastructure, Inc.
271 Mill Road
Chelmsford, MA 01824

Project No. 6107140016.001

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ATTACHMENTS

A Remediation General Permit
B Deed Restrictions
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D North Pond Memorandum
E Groundwater Summary Table and Location Figure

LIST OF ACRONYMS

µmhos/cm	micromhos per centimeter
ADAF	Age-Dependent Adjustment Factor
AMEC	AMEC Environment & Infrastructure, Inc.
Amec Foster Wheeler	Amec Foster Wheeler Environment and Infrastructure, Inc.
AOC	Administrative Order on Consent
ARCS	Assessment and Remediation of Contaminated Sediments
AS/SVE	air sparging/soil vapor extraction
AST	above ground storage tanks
BEHP	bis(2-ethylhexyl)phthalate
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BHHRA	Baseline Human Health Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chain-of-custody
COI	chemical of interest
COPCs	chemicals of potential concern
COPEC	chemicals of potential ecological concern
cPAH	carcinogenic polycyclic aromatic hydrocarbons
CRA	Conestoga Rovers Associates
C-RAM	construction-related release abatement measure
CSL	Calcium Sulfate Landfill
CSM	conceptual site model
CTE	Central Tendency Exposure
cy	cubic yards
DAPL	dense aqueous phase liquid
EJ	Environmental Justice
EOEA	Executive Office of Environmental Affairs
EPC	Exposure Point Concentration
EPH	Extractable Petroleum Hydrocarbon
ESI	EnviroSystems, Inc.
F	Fahrenheit
FDR	field data record
FRI	Focused Remedial Investigation Report
FSP	Field Sampling Plan
ft	feet
GEI	Geotechnical Engineers, Inc.
IRA	Immediate Response Action
IRSWP	Interim Response Steps Work Plan
MACTEC	MACTEC Engineering and Consulting, Inc.
MassDEP	Massachusetts Department of Environmental Protection

MBTA	Massachusetts Bay Transportation Authority
MCP	Massachusetts Contingency Plan
MDC	Metropolitan District Commission
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MMB	Maple Meadow Brook
MMBA	Maple Meadow Brook Aquifer
MMBW	Maple Meadow Brook Wetland
MSL	mean sea level
MWRA	Massachusetts Water Resources Authority
MWSW	Municipal Water Supply Wells
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Contingency Plan
NDMA	N-nitrosodimethylamine
NDPA	N-nitrosodiphenylamine
NDPrA	N-nitrosodipropylamine
NEPCO	New England Pollution Control Company
ng/L	nanograms per liter
NOAA	National Oceanic and Atmospheric Administration
NPI	National Polychemicals, Inc.
NPL	National Priorities List
NTP	National Toxicology Program
O_2	oxygen
OCSS	Olin Chemical Superfund Site
off-PWD	off-Property West Ditch
Olin	Olin Corporation
on-PWD	on-Property West Ditch
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PCMP	post-construction monitoring plan
PECs	probable effects concentrations
PID	photo-ionization detector
ppmv	parts per million by volume
Property	Olin Property
QAPP	Quality Assurance Project Plan
RAM	Release Abatement Measure
RGP	Remediation General Permit
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
RSL	Regional Screening Levels
SFF	site foraging frequency

SMB	Sawmill Brook
SOP	Standard Operating Procedure
SOW	Statement of Work
SQL	sample quantitation limit
SVOC	Semi-volatile organic compounds
SWMU	Solid Waste Management Units
the Site	Olin Chemical Superfund Site
TMPs	trimethylpentenes
TM-1-P	trimethyl-1-pentene
TM-2-P	trimethyl-2-pentene
TRV	Toxicity Reference Value
UCL	upper confidence limit
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compounds
WSL	Woburn Sanitary Landfill

EXECUTIVE SUMMARY

This Executive Summary describes the Final Remedial Investigation (RI) Report and associated Human Health and Ecological Risk Assessments for Operable Units 1 and 2 (OU1 and OU2) prepared for the Olin Chemical Superfund Site (the Site or OCSS) at 51 Eames Street in Wilmington, Massachusetts on behalf of Olin Corporation (Olin) by Amec Foster Wheeler Environment and Infrastructure (formerly AMEC Environment & Infrastructure, Inc. (AMEC) (**Figure ES-1**). The Site is comprised of the Olin Property (Property), an approximately 50-acre parcel (**Figure ES-1**), and adjoining off-Property areas impacted by manufacturing and waste disposal activities at the Property. The northern part of this property was formerly the site of a chemical manufacturing facility.

The Site was listed on the National Priorities List (NPL) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 105, 42 U.S.C. 9605 on April 19, 2006 (71 FR 20,016). In September 2005, when the United States Environmental Protection Agency (USEPA) identified the Site as a Proposed Site for the NPL; the primary substance used by USEPA to score the Site was N-nitrosodimethylamine (NDMA) (USEPA, 2005). The primary exposure pathway evaluated by USEPA was groundwater. Soil, sediment, and surface water at the site have likewise been impacted by various mechanisms. Prior to the NPL listing, the Site has been the subject of many years of investigations and response activities carried out by Olin Corporation, 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 Site has been a Priority site under the MCP since 1993, and a Tier I site since 1994.

Olin Corporation, American Biltrite Inc., and Stepan Company, as Co-Respondents, have voluntarily entered into an Administrative Settlement Agreement and Order on Consent (AOC) with the USEPA to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site (USEPA, 2007a). The effective date of the AOC is July 3, 2007. The Scope of the RI/FS is described in the Statement of Work (SOW), Remedial Investigation and Feasibility Study, Olin Chemical Superfund Site, prepared by the USEPA Region I – New England and dated June 28, 2007 (USEPA, 2007b).

USEPA has subdivided the Site into three OUs described as follows (see **Figure ES-2**).

OU1: defined in the AOC/SOW as the approximately 50-acre Olin Property including the former facility area, the established conservation area, the on-Property ditch system, the Calcium Sulfate Landfill, and the Slurry Wall Containment Area. The RI/FS evaluates soil, surface water, sediment and potential vapor intrusions into OU1 buildings. It should be noted that soils in the vadose zone are evaluated in this report; soils located within the water table are evaluated under OU3.

OU2: defined in the AOC/SOW as off-Property surface water and sediment areas, including the off-Property East Ditch, a small portion of the South Ditch, the off-Property West Ditch (off-PWD), portions of the Maple Meadow Brook Wetland, and North Pond. Landfill Brook was investigated as part of OU2 and was found to be impacted by the Woburn Sanitary Landfill, (WSL) rather than the OCSS.

OU3: defined in the AOC/SOW as all on- and off-Property groundwater areas including Maple Meadow Brook Aquifer, groundwater beneath the Olin Property, and groundwater located south and east of the Olin Property. Soils located within the water table are evaluated under OU3.

This Final RI Report for OU1 and OU2 incorporates the final deliverables for the Human Health and Ecological Risk Assessments in accordance with the SOW for the Site. The first submittal

of this document to USEPA, on April 19, 2013, included Draft Sections 1-5 of the Draft RI, and the first interim deliverables for the Human Health and Ecological Risk Assessments. The second interim deliverable submittal for the Human Health and Ecological Risk Assessments was submitted on July, 26 2013. The third interim risk assessment deliverable, revised sections of the RI Report and the final risk assessment deliverables are incorporated into in this final submittal. Subsequent to these submittals, Olin and USEPA have corresponded and met to discuss and resolve comments of the draft RI documents. This has included submitting written responses to USEPA comments on July 26, 2013, and a separate response (September 13, 2013) to other supplemental stakeholder comments on the initial draft submittal. On September 30, 2013, USEPA provided a second set of separate comments on the RI and the second Interim risk assessment deliverables, to which Olin responded in writing on March 24, 2014 (see **Appendix L**). Olin submitted the Draft Final RI report for USEPA review on April 10, 2014, and USEPA provided their comments on November 11, 2014. A written response to USEPA comments was issued by Olin on December 12, 2014; the Final RI report incorporates these responses to comments. w This Final RI report incorporates relevant and appropriate historical data collected under the MCP presented in the Focused Remedial Investigation Report (FRI) (MACTEC Engineering & Consulting, Inc. [MACTEC], 2007a), in addition to more recent data collected in accordance with the approved RI Work Plan (MACTEC, 2009a) including Addenda I, II, and V and an approved Supplemental RI Work Plan (Olin, 2012, 2013) that addressed data gaps agreed upon by Olin and USEPA.

Site Description and Site History

The following subsections provide a summary of the Site Description and History.

Site Description

The Site encompasses the Property and surrounding areas to the west, east and south, where contaminants have migrated by surface water, sediment, and/or groundwater transport. The Property is bounded on the east by the Massachusetts Bay Transit Authority tracks, on the south by the Woburn/Wilmington Town Line and WSL, on the west by an inactive Boston and Maine Railroad spur, and on the north by Eames Street (**Figure ES-2**). The Property is located in an industrialized area of Wilmington within a General Industrial zone (Zoning District Map, September 2009). Intensive industrial land use occurs on the eastern, northern, and western sides of the Property. The southern side of the property is bounded by the WSL, a former municipal solid waste landfill that has been closed. Another landfill, constructed and owned by the Spinazzola Trust, is located northwest of the WSL. Residential properties are located along Main Street and Cook Avenue to the west of the Property, and along Eames Street before it intersects with Woburn Street.

The former facility was located on the northern half of the Property, which is currently unused and contains a vacated office building, a small metal butler building, a former guard shack, two vacant warehouses, paved and grassed areas, and concrete slabs from other former buildings (**Figure ES-5**). In 2006, Olin installed a forty-foot office trailer and two metal storage trailers in the north east quarter of the Property near Plant B, which houses a groundwater treatment system.

The Plant B groundwater recovery/treatment system has been in operation since 1981 with continued operation from 1997 to present as an Immediate Response Action (IRA) under the MCP. The system was installed to prevent seepage of a light non-aqueous phase liquid (LNAPL) into the East Ditch, which is located along the eastern perimeter of the former facility property. The LNAPL was released during operations of former property owners prior to Olin's

ownership. Groundwater extracted by the system is treated to remove iron and ammonia, as well as dissolved organic compounds. The treated groundwater is discharged to surface water on-Property in compliance with a Remediation General Permit (RGP).

The Site also contains a Slurry Wall/Cap containment structure that was constructed in 2000/2001 as a Release Abatement Measure (RAM) approved by MassDEP while the site was regulated under the MCP. The intent of this source control action was to eliminate, to the extent feasible, the on-Property Dense Aqueous Phase Liquid (DAPL) source material as a source of dissolved constituents to groundwater. The containment structure is comprised of a perimeter slurry wall installed into the weathered bedrock surface, and a temporary cap to minimize infiltration of precipitation into the containment area. Prior to slurry wall placement, weathered bedrock in the excavation was removed to the extent possible with an excavator. The bedrock surface was scarified during that process. The slurry wall was installed by continuous mud-wave methods as excavation progressed. The temporary cap is a scrim-reinforced polyethylene sheet cover, with sewn seams, held in place by sandbags and gravel ballast along the edges. A water table equalization window within the slurry wall allows the groundwater surface within and outside the slurry wall to equilibrate.

The southern half of the Property is forested, except in the southwestern corner where the closed Calcium Sulfate Landfill (CSL) is located. 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 that portion of the Property.

The CSL location and construction plans were approved by the Massachusetts Department of Public Health (MADPH) and the Town of Wilmington Board of Health in 1974. The CSL is approximately 2.5 acres in size, was capped in 1988, and has received final closure certification in accordance with the Massachusetts Solid Waste Management Regulations (310 CMR 19.000). The CSL is in the 25th year of a 30-year post-closure monitoring period. The CSL is considered part of OU1, as defined by the SOW.

The Site also contains both on-Property and off-Property surface water bodies. The on-Property surface water includes a ditch system of natural drainages that were modified in the early 1950s (the on-Property West Ditch and the on-Property South Ditch), and a natural wetland drainage complex (Ephemeral Drainage). A surface water body, known as the Central Pond, and a large wetland area known as the Central Wetland, are located north of, and adjacent to, the Lower South Ditch. Central Pond does not discharge to South Ditch. A storm water detention basin is present between the containment area and South Ditch. The on-Property ditch system is connected with two other off-Property ditches (the off-Property West Ditch and the East Ditch). These drainages are all part of the Aberjona River watershed. Other surface water bodies at the Site include the Maple Meadow Brook (MMB) and Sawmill Brook (SMB) to the west, which are located on the other side of a groundwater/surface water divide, and are within the Ipswich River watershed.

Site History

Manufacturing activities were conducted at the Site from 1953 until 1986. Olin purchased and began operating the property in 1980. From 1953 onward, the facility expanded incrementally (additional buildings were constructed) as additional products and processes were added and as processes were modified. The facility produced chemical products for use in the rubber and plastics industries (particularly nitrogen blowing agents Opex® (dinitrosopenta-methylenetetramine) and Kempore® (azodicarbonamide), Nitropore OT, and Nitropore 5PT), but also included blowing agent activators, polymerization initiators, antioxidants/stabilizers (dioctyldiphenylamine or Wytox ADP, trisnonylphenyl phosphite or Wytox 312, alkylated phenol

or Wytox Pap), retarders (N-nitrosodiphenylamine), processing aids, phthalate plasticizers (di-n-octylphthalate and dibutyl phthalate), and chemical intermediates (such as hydrazine) and phenolic resins (phenol-formaldehyde resin). Available information indicates that the latter products were not associated with any substantial amounts of liquid waste materials. Two particular nitrogen blowing agents, Opex® and Kempore®, were by far the largest volume products manufactured at the facility; both products were manufactured from the 1950s through 1986.

Raw materials utilized during the operating history of the Property included diphenylamine, di-n-octylphthalate, bis(2-ethylhexyl)phthalate (BEHP), diisobutylene (trimethylpentene (TMP) mixture used at Plant B in the manufacture of dioctyldiphenylamine or Wytox ADP), #415 Process Oil, nonylphenol, formaldehyde (formalin), dimethylformamide, dinonylphenol, sodium nitrite, 2-ethylhexoic acid, butanol, ammonia (likely anhydrous), hydrazine, sodium dichromate, chlorosulfonic acid, diphenyl oxide, and ammonium hydroxide, benzonitrile, sodium nitrite, hydrochloric acid, sulfuric acid, phenol, and nonylphenol. Sodium dichromate was used as a catalyst in the manufacture of Kempore® until 1967, when its use was discontinued.

Constituents in liquid waste streams and unintentional releases included chromium, bis(2-ethylhexyl)phthalate, N-Nitrosodiphenylamine (NDPA), N-nitrosodipropylamine (NDPrA), diisobutylene (mixture of 2,4,4,-trimethyl-1-pentene and 2,4,4,-trimethyl-2-pentene), formaldehyde, dimethylformamide, Opex, and Kempore, sulfuric acid, hydrochloric acid, and numerous salts of sodium and ammonium (sulfates, chlorides, nitrates, and nitrites). Calcium sulfate (gypsum) was produced and precipitated when wastewaters were neutralized with lime (calcium hydroxide) – after the use of sodium dichromate had been discontinued. Polychlorinated biphenyls (PCBs) were used in electrical transformers at OU1 and some release to soil has been documented. Processing oil was released to soil and the subsurface in the area of the Plant B Tank Farm.

The chemicals identified in the preceding paragraphs are considered primary chemicals of interest (COIs) for the Site, or chemicals that have been associated with the former facility (as a raw material, product, or a constituent of waste streams or accidental releases), and that have been released to one or more environmental media.

The Site was listed on the NPL primarily due to the presence of NDMA in groundwater within the Maple Meadow Brook (MMB) aquifer in proximity to the municipal water supply wells. However, NDMA has not been identified as a raw material, a manufactured product, or a waste stream constituent in any of the operational history documentation. NDMA has been identified in DAPL, groundwater, and surface water samples. The formation mechanism for NDMA for this site has not been identified. Experts who have published articles concerning NDMA formation in wastewaters and disinfected drinking waters have been consulted by Olin. The generally accepted mechanisms for NDMA formation occur at low pH via nitrosation, which involves the formation of nitrosyl cation or similar nitrogen-containing species, during acidification of nitrite. The nitrosyl cation then reacts with an amine, such as dimethylamine, to form NDMA. Since the conditions within the chemical manufacturing processes that occurred over the history of operations at the facility cannot be replicated, it is unknown whether NDMA could have formed in those processes. None-the-less, NDMA is, in addition to those chemicals identified in the preceding paragraphs, a COI for the Site.

Study Area Investigations (OU1/OU2) and Response Actions (OU1/OU2)

The following subsections summarize historical investigations and monitoring in addition to remedial / response actions completed under the MCP. This summary is followed by discussion of the CERCLA RI program for OU1 and OU2.

Summary of Historical Investigations and Monitoring

Investigations have been conducted at the Site by several parties since the mid-1970s, including media currently considered part of OU1, OU2, and OU3. Olin became involved in the investigation and remedial activities at the Site after its purchase of the facility in 1980. Most of the pre-1980 investigations were related to wastewater, groundwater, and surface water as well as the development and operation of the Calcium Sulfate Landfill (CSL). Earlier investigations and associated reports included groundwater and surface water investigations along the eastern boundary of the facility concerning the LNAPL release in that area, and a USEPA's Site Inspection Report for the Facility in December 1980 which focused on water pollution control and RCRA compliance. A Phase I Site Inspection Report for the Facility was prepared for the Massachusetts Department of Environmental Quality Engineering (MADEQE) in 1986. Olin conducted response actions to mitigate and control migration of LNAPL at the Plant B area in response to the 1980 Site Inspection Report, including the installation of the Plant B groundwater recovery/treatment system for LNAPL in 1981.

The Site was officially identified as a site subject to the Massachusetts Contingency Plan (MCP) in a Notice of Responsibility letter from MassDEP on May 28, 1992 (MassDEP Release Tracking Number 3-0471). Prior to CERCLA, investigations and response actions at the Site have been conducted per the requirements of the MCP. The MCP requires a phased approach to site investigation and remediation that is modeled after the USEPA's National Contingency Plan (NCP). A Comprehensive Site Assessment (CSA) Report for the Site was prepared in 1993, and was focused on potential sources or release areas identified as Solid Waste Management Units (SWMUs) (CSA, 1993). This CSA was referred to as the "Phase II Comprehensive Site Assessment". This MCP submittal was subsequently augmented by supplemental investigations intended to further delineate nature and extent of contamination to support risk characterizations and evaluation of remedial requirements. These supplemental investigations were conducted in a manner that is in substantive compliance with both the National Contingency Plan (NCP) and the Massachusetts Contingency Plan (MCP).

The 1997 Supplemental Phase II Report was a comprehensive report of the supplemental investigations conducted for the MCP Site (Smith, 1997). Supplemental Phase II investigations have continued since the 1997 Supplemental Phase II Report. During that time, a number of response actions (including investigations, risk assessments, removal actions, and other remedial activities) were conducted. These actions consisted of two types of MCP interim response actions: Immediate Response Actions (IRAs); and Release Abatement Measures (RAMs). A number of monitoring programs were also implemented in conjunction with these IRAs. The MCP investigations and response actions were directed by MassDEP Licensed Site Professionals (LSPs) and the work was performed consistent with scopes of work that were approved by MassDEP.

Previous investigations have included the following: characterization of surface features; contaminant source investigations and removal actions; meteorological investigations; surface water and sediment investigations; geological investigations; soil and vadose zone investigations; groundwater investigations; indoor air investigations; biota sampling and analysis; human population surveys; and ecological surveys.

The historical investigations were comprehensive and were conducted using techniques and procedures that are consistent with standard practice in the environmental investigation industry. Samples were analyzed using USEPA and MassDEP chemical analytical methods applied by certified laboratories, and the analytical data have undergone chemist reviews and data validation.

Response Actions

Response actions have been conducted and some continue for impacted media at OU1. The response actions (primarily IRAs and RAMs under the Massachusetts Contingency Plan) focused on source areas, highly impacted media, and some localized contamination and they have had a substantial impact in reducing the amount of contamination in soil and sediment within OU1. These response actions resulted in removal of impacted soils, waste materials, oil, and volatiles from soils and sediment, resulting in a positive impact with respect to nature and extent of soil contamination at the Property (see **Figure ES-3**). The following actions were conducted to remove impacted soil/sediment and LNAPL from the Property, to remove TMPs from subsurface soils, and to limit migration from the DAPL/diffuse groundwater to surface water:

- The Plant B groundwater recovery/treatment system for LNAPL has been operated by Olin since 1981 to prevent reoccurrence of LNAPL seepage and related sheen to the East Ditch in the vicinity of Plant B.
- There are currently three recovery wells in operation (IW-12, IW-11 and IW-13). The LNAPL removal has been augmented with in-situ bio-stimulation and air sparging (AS).
- On June 9 and 10, 1994, a vacuum truck was used to remove the flocculant (floc) precipitate from the off-Property west Ditch.
- From 2000 to 2005 Olin operated an AS/soil vapor extraction (SVE) system located west of the groundwater extraction and product recovery system that removed more than 2,000 pounds of TMP from subsurface soils at the extractable petroleum hydrocarbon/volatile petroleum hydrocarbon (EPH/VPH) area at Plant B. The principal contaminants in this area were trimethylpentenes.
- In 2000, drums, debris, and impacted soil were excavated from Drum Area A, Drum Area B, and the Buried Debris Area.
- In 2000 and 2001 the Slurry Wall/Cap containment structure was constructed, encompassing the on-Property DAPL pool. The remedial objective for the containment structure was eliminating, to the extent feasible, the on-Property DAPL as a source of the dissolved plume that was contributing constituents in the ditches through groundwater discharge. Stormwater from above the cap is collected and flows to the Storm Water Detention Basin.
- From 2000 to 2004, soils were excavated from the former Lake Poly area and disposed off-site. These excavations were conducted to remove soils impacted by chromium, ammonia, and Kempore.
- In 2000 and 2001, sediments were excavated from the Upper South Ditch (including the delta area), the on-Property West Ditch, the on-Property West Ditch Wetland and Central Pond. Sediments were disposed off-site. Excavations of sediment addressed chromium, other metals, and semi-volatile organic (SVOC) impacts.

CERCLA Remedial Investigation and Monitoring

The CERCLA Remedial Investigation has been conducted per the USEPA-approved RI/FS Work Plan (MACTEC, 2009a), Addenda I, III, and V of that Work Plan, and the Supplemental Remedial Investigation Work Plan (Olin, 2012), which was revised and finalized in 2013 (Olin, 2013). Additional monitoring of groundwater and OU1 surface water and sediment has been conducted per the USEPA-approved Final Interim Response Steps Work Plan (MACTEC, 2008) referred to as the IRSWP. The OU1 and OU2 investigation program objectives and sampling events are summarized below.

OU1

OU1 sampling objectives, contained in Volume III-A of the Final RI/FS Work Plan (2009-2013), were to:

- Confirm and refine previous investigation findings;
- Confirm the nature and extent of site-related contaminants (including the area south of the South Ditch);
- Investigate the manufacturing process areas; and
- Collect additional data for the human health and ecological risk assessments.

The RI sampling (2009-2013) in OU1 included the following sampling events:

- August/September 2009 – soil borings (surface, shallow subsurface, and deep subsurface soil samples) per the RI/FS Work Plan (MACTEC, 2009a)
- September 2009 – surface soil sampling per the RI/FS Work Plan (MACTEC, 2009a)
- November 2010 – soil borings in area of SB-405 and area east of the Plant B Treatment Building (surface, shallow subsurface, and deep subsurface soil samples), per Addendum V of the RI Work Plan (MACTEC, 2010b)
- December 9-10, 2010 – surface water and sediment sampling in South Ditch per the RI/FS Work Plan (MACTEC, 2009a)
- June 6, 2011 - surface water and sediment sampling in South Ditch per 2009 Field Sampling Plan (FSP)
- November/December 2012 – soil borings and surface soil samples to fill data gaps per the November 16, 2012 Supplemental Work Plan (Olin, 2012)
- December 2012 – surface water and sediment sampling in Central Pond and Stormwater Detention Basin per the November 16, 2012 Supplemental Work Plan (revised and resubmitted March 2013)
- June 2013 – soil sampling to delineate PCB area.

Sampling for the IRSWP (2007-2013) (MACTEC, 2008) included the following:

- Slurry Wall/ Cap: Quarterly groundwater, surface water, groundwater elevation measurement, and annual sediment sampling. This monitoring was directly related to groundwater/ South Ditch surface water interaction, and therefore directly related to OU1/OU2.
- Plant B: The groundwater elevation measurement and LNAPL gauging are related to the effectiveness of the Plant B groundwater recovery/treatment system for containing and removing LNAPL and preventing migration of LNAPL to the East Ditch. These activities are directly related to OU1/ OU2.
- Plant B: Quarterly groundwater sampling and LNAPL gauging related to the operation of Plant B. This activity is directly related to OU3.

OU2

OU2 sampling objectives, contained in Volume III-A of the final RI Work Plan (MACTEC, 2009a) (2009-2013), were to:

- Confirm and refine previous investigation findings;
- Confirm the nature and extent of site-related contaminants;
- Collect surface water flow measurements in the MMB wetland area; and
- Collect additional data for the human health and ecological risk assessments.

The OU2 RI sampling program (2010-2013) included the following sampling events:

- November 2010 – Temperature profiling of surface water within the Maple Meadow Brook wetland and Sawmill Brook
- December 2010 and June 2011 – (2 events) surface water sampling within Maple Meadow Brook, Sawmill Brook, off-Property West Ditch, East Ditch, and Landfill Brook
- December 2010 – (1 event) sediment sampling (0-6 inches bgs) within Maple Meadow Brook, Sawmill Brook, off-Property West Ditch, East Ditch, and Landfill Brook
- April 2011 through March 2012 – monthly stream gauging for Maple Meadow Brook wetland
- June 2010 and June 2012 – soil sampling within off-Property areas adjacent to the Property
- March and June 2013 – soil, sediment, and surface water sampling at North Pond.

Physical Characteristics of the Study Area and Land Use

The northern portion of the Property was formerly the site of a chemical manufacturing facility. The former administration office building and laboratory, a small butler building, a guard shack, the East and West warehouses, the Plant B Treatment Building and a temporary office trailer are currently present on the property. All of these structures except for Plant B and the office trailer are unoccupied with Do Not Enter signs posted. Most of the former plant buildings and other structures (Plant A, Plant B, Plant C, and Plant D) have previously been demolished and removed from the Property, with only concrete slabs remaining at these locations.

The southern portion of the Property is undeveloped, consists largely of wetlands and mature forest lands, and has slightly more topographic relief as compared to the more developed northern portion. The topographic features include an east-west trending, low-lying area that forms the South Ditch and Ephemeral Drainage and includes Central Pond, as well as a storm water detention pond located between the containment area and South Ditch. This low-lying area is intersected at the Property boundaries by the East and West Ditches. These features are part of the interconnected drainage system that border two sides of the Property and that cross the center of the Property.

The topography adjacent to the Property ranges from low-lying wetlands to flat paved industrial areas. The land north of the Property is developed and is generally flat. The MBTA rail line creates and occupies a topographic low along the eastern side of the Property. A low ridge runs along the southern boundary of the Property where the CSL was constructed. The WSL is located immediately south of the property, beyond which the land becomes lower in elevation, and flatter, draining to wetlands to the southwest, toward Landfill Brook and Halls Brook.

The area immediately west of the northern portion of the Property includes commercially developed lots along Jewel Drive and Eames Street, and residential lots along Main Street that are all relatively flat. The area immediately west of the southern portion of the Property includes a small hill or knoll that includes several residences along Cook Avenue and Border Avenue in Wilmington. Additional residential development is present further to the southwest in North Woburn. To the northwest of the Property, on the western side of Main Street in Wilmington, the topography drops to lower elevations near, and within, the MMB wetland. The MMB wetland is bordered by upland areas to the west of Chestnut Street, and to the north by a broad ridge that runs parallel to Butters Row.

The Property is not in any current active commercial or industrial use. Two full-time employees maintain the Property, operate the Plant B treatment system, and participate in investigation and remedial activities. The Property land uses are controlled by two legally-binding documents.

Those documents are the 2006 Environmental and Open Space Restriction, and the 2012 Notice and Declaration of Restrictive Covenant, as described below.

The 2006 Environmental and Open Space Restriction was recorded with the land records of Middlesex County on November 7, 2006. That restriction, negotiated between Olin and the Town of Wilmington through its Conservation Commission, requires that the portion of the Property located south of the South Ditch be preserved in its natural, undeveloped condition, subject to rights reserved to perform and maintain response actions required by MassDEP and/or USEPA. The area subject to the Environmental and Open Space Restriction is identified in **Figure ES-4**. The restriction prohibits construction or placement of any building, tennis court, landing strip, mobile home, swimming pool, fences, asphalt or concrete pavement, sign, billboard or other advertising display, antenna, utility pole, tower, conduit, line or other temporary or permanent structure or facility in, on, under, through or above the restricted area unless such construction or placement is required in connection with response actions. The restriction also prohibits agricultural activity or cultivation of fruits, vegetables or other plants destined for human consumption. The restriction also prohibits use of groundwater or surface water for private water supply, or any other potable or non-potable use, without prior written approvals from MassDEP, USEPA or other cognizant government agency.

The Notice and Declaration of Restrictive Covenant was filed in the land records of Middlesex County on October 9, 2012 and will run with the property, and be binding upon all parties having any right, title, or interest in the Property. The areas subject to the Notice and Declaration of Restrictive Covenant are identified in **Figure ES-5**. The deed restriction indicates that "the Property, or any portion thereof, shall not be used for any residential, school, child day care center, playground, or public recreation purposes. The Property shall be used solely for commercial or industrial purposes." Further, the deed indicates that no excavation of any kind shall occur within the Containment Area or the Calcium Sulfate Landfill except such excavation necessary to maintain the contours of the existing cap on the CSL, and shaping and grading as required to install a cap on the Containment Area. The current Containment Area cap is internally sloped to drain to a central collection sump rather than positively graded for run-off. This cap was constructed by adding fill, not excavating, resulting in acceptable grades for drainage. Excavation in other areas of the site is permitted only: 1) consistent with the Environmental and Open Space Restriction (October 2006), where applicable, and 2) in conformance with an appropriate soil management plan to address construction worker safety and soil management. The Restrictive Covenant also prohibits extraction of groundwater from beneath the Property for any purpose, except to monitor the groundwater, or as part of an action to address groundwater conditions. This Declaration of Restrictive Covenant is described in the filing as a perpetual covenant.

The human health risk assessment contained in this report, and the exposure assessment in particular, is based on the current zoning and anticipated future land use. The placement of the deed restrictions on the property were voluntary restrictions enacted by Olin and are not considered for and do not circumvent the baseline risk assessment process.

Nature and Extent of Contamination

OU1

Soil

Investigations have provided adequate spatial coverage to define the nature and extent (horizontal and vertical) of environmental impacts at the Site. These investigations supplement

and confirm findings of previous investigations and remedial actions conducted under the MCP. The findings of these investigations are presented below.

The investigations have been conducted in accordance with the USEPA-approved statement of work and subsequent agreements between USEPA and Olin. The investigations have delineated nature and extent of contamination to non-detect or background concentrations for soil, where feasible. The investigations have utilized both historical and recent analytical data that are representative of current site conditions. In addition, the extent of contamination has also been evaluated using USEPA risk-based Industrial Regional Screening Levels or Industrial RSLs (USEPA, 2013) for industrial land use. The Industrial RSLs represent concentrations associated with de minimis levels of human health risk (i.e., excess lifetime cancer risk of $1x10^{-6}$). Chemicals with concentrations below those levels are not of concern for direct soil exposures. For chemicals with concentrations above those levels, further evaluation of background levels and comparison of calculated health risks to CERCLA risk criteria are required to evaluate the need for remediation.

Analytical parameters detected most frequently in soil samples include SVOCs (BEHP and other phthalates, NDPA, and higher molecular weight polycyclic aromatic hydrocarbons), metals and inorganics (chromium, calcium, sodium, sulfate, chloride, and ammonia), many of which are naturally occurring, and oil constituents or fractions (primarily C11-C22 Aromatic Hydrocarbons). In general, volatile organic compounds (VOCs) were not frequently detected. However, trimethylpentenes were detected frequently in soil samples collected in areas in the vicinity of the former Plant B and the Plant B tank farm.

Horizontal and vertical delineation of COIs has been accomplished at the perimeter and in the interior of the Property (OU1) for surface soil, shallow subsurface soil (1 – 10 ft below ground surface), and deep subsurface soil. Most of the detected analytes in soil samples from OU1 had concentrations below the USEPA Industrial RSLs, and each of those analytes, by itself, is unlikely to pose a substantial health concern for direct soil exposures for current and foreseeable future land use. None-the-less, to address the cumulative effect of multiple chemical exposures, the human health risk assessment evaluates all analytical parameters with any concentrations greater than industrial RSLs based on cancer risk of 1×10^{-6} or those based on hazard quotient of 0.1. Chemicals with maximum concentrations that are greater than corresponding USEPA Industrial RSLs (triggering comparison to background and/or evaluation of risks) include (Site primary COIs are bolded):

- Surface soil - **BEHP, NDPA**, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, **Aroclor-1260**, arsenic, and **hexavalent chromium**. USEPA Industrial RSLs are not available for several detected parameters including 3&4-methylphenol, acenaphthylene, benzo(g,h,i)perylene, carbazole, dimethylphthalate, diphenyl ether, phenanthrene, alpha chlordane, delta-BHC, endosulfan I, endosulfan II, endrin ketone, **calcium,** magnesium, potassium**, sodium, chloride, sulfate, and ammonia**.
- Shallow subsurface soil – **trimethylpentenes, BEHP, NDPA**, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, hydrazine, arsenic, **hexavalent chromium**, and **C11-C22 aromatic hydrocarbons**. USEPA Industrial RSLs are not available for several detected parameters including 4-isopropyl toluene, sec-butylbenzene, 3&4-methylphenol, 4-chlorophenyl phenyl ether, acenaphthylene, benzo(g,h,i)perylene, carbazole, diphenyl ether, phenanthrene, **calcium,** magnesium, potassium, **sodium, chloride, ammonia**, and **sulfate**.
- Deep subsurface soil - **trimethylpentenes, BEHP**, arsenic, and **hexavalent chromium**. USEPA Industrial RSLs are not available for several detected parameters including 4-isopropyl toluene, 4-bromophenyl phenyl ether, 4-chlorophenyl phenyl ether,

benzo(g,h,i)perylene, diphenyl ether, diphenylmethanone, phenanthrene, **calcium**, magnesium, potassium, **sodium, chloride**, **ammonia,** and **sulfate**.

Areas within OU1 that contain elevated concentrations of one or more of these constituents include areas surrounding, or downgradient and in proximity to, former disposal and operation areas that have previously been remediated. These include areas in the vicinity of former Lake Poly and the adjacent former Drum Storage Area; the area east of, and adjacent to, the former Plant B tank farm; and an area of trimethylpentenes in soil under the administrative building parking lot near the former Plant B production area. The un-remediated portion of lower South Ditch that occurs both on and just off the Olin property (within the boundaries of both OU1 and OU2), also contains elevated concentrations of certain COIs.

NDMA was not detected in any soil samples from OU1. The only Site primary COIs that were detected in soil, and for which USEPA Industrial RSLs (or equivalent risk-based values) are not available, are ammonia, calcium, sulfate, sodium, and chloride.

Aroclor-1260 was detected in one area, the northwest quadrant of the Property, in the area of a historical pole-mounted transformer. Olin completed a process of staged collection and analysis of PCBs in soil to determine areal extent and depth. The depth of detected concentrations ranges from surface soils to four feet below ground surface. The data are evaluated in this RI report.

An on-Property soil background data set was identified and approved by USEPA (**Table 2.4-1**). Nine surface soil samples were analyzed and summary statistics were prepared for the data set. In addition, a site-specific background concentration (95% Upper Predictive Limit) was identified for metals/inorganics, and polycyclic aromatic hydrocarbon (PAH) compounds.

Although arsenic was detected in most soil samples at concentrations above the corresponding Industrial RSL (1.6 mg/kg), the majority of the reported concentrations are less than the Site-specific background value of 11.6 mg/kg. Further, those concentrations that are above the Site-specific background value are not located in a cluster or clusters. The operational history does not indicate that arsenic was a raw material, waste product, or manufactured product at the facility. Therefore, it is concluded that arsenic is not a COI for the Site.

Surface Water

OU1 surface water samples were collected from the South Ditch, the Stormwater Detention Basin, and Central Pond.

For the South Ditch, the historical data and RI data show a consistent identification of constituents detected in the surface water samples. Among metals and inorganics, the most frequently detected parameters include aluminum, barium, chloride, chromium, cobalt, copper, iron, magnesium, manganese, nickel, sodium, potassium, calcium, sulfate, and ammonia. NDMA, NDPA, and NDPrA were also detected in South Ditch surface water samples. Low concentrations of BEHP, 2-nitrophenol, 4-nitrophenol, benzoic acid, diphenyl ether, bromoform, and diphenylmethanone were also detected in surface water samples. TMPs were also detected frequently, but at trace concentrations. The available hydrogeologic information, groundwater data, groundwater elevation measurements in the surrounding well pairs and piezometers, and surface water data indicate that solutes in surface water of the South Ditch are primarily related to solutes present in diffuse groundwater underlying the Upper South Ditch and shallow groundwater migrating to the stream. Some of the constituents, such as TMP, are related to shallow groundwater originating in the vicinity of former Lake Poly and the Debris Disposal Area located to the north of the Containment Area.

The Stormwater Detention Basin was designed to receive storm water flow that is collected from the Containment Area cap and piped to the basin. Since the storm water detention basin was excavated from bedrock, it also likely receives groundwater discharge seasonally depending on the water elevation in the basin relative to surrounding groundwater elevations. The Detention Basin has an outlet control structure consisting of a 4-inch vertical PVC pipe that has an invert elevation and a screen to keep it from clogging. The outlet structure's discharge elevation is 80.32 feet. For the Stormwater Detention Basin, detected parameters include metals and inorganics at relatively low concentrations including aluminum, barium, chloride, chromium, hexavalent chromium, copper, iron, lead, manganese, magnesium, sodium, vanadium, zinc, potassium, calcium, chloride, sulfate, and ammonia. NDPrA was also detected.

Central Pond has no surface water inlet or outlet, and the surface water present is an expression of the unconfined overburden groundwater table. The analytes detected in the surface water samples from the pond are limited to metals and inorganics including aluminum, barium, chloride, chromium, iron, lead, magnesium, manganese, sodium, nickel, potassium, calcium, sulfate, and ammonia at concentrations lower than the South Ditch, but higher than the Stormwater Detention Basin. NDMA was not detected in Central Pond surface water samples.

Sediment

OU1 sediment samples were collected from the South Ditch, Stormwater Detention Basin, Central Pond, and the on-Property West Ditch Wetland.

For the South Ditch, the historical data and the 2009 through 2013 RI data show a consistent identification of constituents found in sediment samples. The most frequently detected parameters include BEHP, TMPs, three EPH fractions, 3&4-methylphenol, formaldehyde, metals and inorganics including: aluminum, chromium, iron (which have been associated with floc in the South Ditch), as well as hexavalent chromium, sulfate, and ammonia. The EPH fractions were detected in samples collected from the Lower South Ditch (sample locations SD-1 (OU1) and ISCO-2 (OU2)).

For the on-Property West Ditch Wetland, constituents detected in sediment samples are similar COIs, including: chromium (and most other metals), BEHP, and TMPs (at low frequency).

For the Stormwater Detention Basin, detected analytes in sediment samples include TMPs, BEHP, phenols, NDPhA, and one PAH at low concentrations, in addition to metals and inorganic constituents; detected analytes appear to be consistent with potential impacts from groundwater.

For Central Pond, detected analytes in sediment samples include TMPs, phenols, and four PAHs at low concentrations, in addition to metals and inorganic constituents.

OU2

Surface Water

Background surface water samples were collected at several reference locations to characterize background conditions as described in the Field Sampling Plan (MACTEC, 2009a), Addenda I, III, and V of that Work Plan, and the Supplemental Remedial Investigation Work Plan (Olin, 2012) that was revised and finalized in 2013.

Off-Property surface water samples were collected during two sampling events as part of the OU2 RI. Surface water samples were collected from the off-Property West Ditch (off-PWD), East Ditch, Landfill Brook, and the Maple Meadow Brook Wetland (including Maple Meadow

Brook and Sawmill Brook). North Pond surface water has been sampled and analyzed per Addendum I to the RI Work Plan.

For the off-PWD, metals and inorganics detected in surface water include ammonia, chromium, hexavalent chromium, calcium, sulfate, and chloride. NDMA was detected in five of six surface water samples collected in the off-PWD. Phenols and benzoic acid were also detected in surface water samples. There were several PAH compounds detected in surface water samples which are attributed to the presence of deteriorated creosote preserved railroad ties.

For the East Ditch, site-related inorganics and metals detected in surface water samples include ammonia, chromium, hexavalent chromium, calcium, sulfate, and chloride. Vanadium has also been detected at concentrations above reference sample concentrations; however, based on the historic operations and contaminant sources, vanadium is not considered to be a COI. Vanadium is broadly associated with fossil fuels. Ammonia was detected at all surface water locations with the highest concentrations detected in South Ditch which flows into East Ditch. Consequently, the highest concentrations in East Ditch samples are reported at EDSD/SW5 located downstream of South Ditch. The ammonia concentrations in the lower portion of the East Ditch decrease to a concentration equivalent to that detected in Landfill Brook surface water prior to it flowing into the East Ditch.

VOCs detected in surface water samples from East Ditch include 2,4,4 Trimethyl-1-pentene (TM-1-P), chlorinated solvents (1,1,1-trichloroethane (TCA), 1,1-dichloroethane (DCA), 1,1-dichloroethene (DCE), cis-1,2-DCE, trichloroethene (TCE), and tetrachloroethene (PCE), m,p-xylene, toluene and methyl tert-butyl ether (MTBE). The chlorinated solvents and MBTE are compounds that appear to be associated with other sources along East Ditch. The highest surface water concentration of TMP in East Ditch was detected at location EDSD/SW2 (downstream of the current Plant B treatment building). TMP was not detected upstream (EDSD/SW1 and EDSD/SW0) and downstream (EDSD/SW4 and EDSD/SW7) of that location.

Among SVOCs, NDMA, NDPrA, three PAH compounds, BEHP, benzoic acid, and caprolactum were detected in East Ditch surface water samples collected during the two RI sampling rounds. NDMA concentrations decrease downstream, and NDMA is detected inconsistently at farthest downstream sample location EDSD/SW7. This inconsistent detection frequency suggests the expected extent of NDMA in surface water has been defined and is understood, recognizing that NDMA is destroyed rapidly through photolysis when exposed to sunlight. Comparison of historical and RI data for NDMA in surface water samples from the South Ditch and the East Ditch also indicate a decreasing concentration gradient from the lower end of South Ditch (upstream) to the lower end of the East Ditch (downstream). NDMA-containing groundwater discharges to the South Ditch surface water. South Ditch surface water then flows into the East Ditch, and NDMA subsequently attenuates as it flows southward towards the Halls Brook Holding Area. Shallow overburden groundwater downstream samples along the east side of East Ditch do not contain detectable concentrations of NDMA. This observation further supports the conclusion that groundwater discharges to South Ditch surface water and the surface water from South Ditch is the primary source of NDMA in East Ditch surface water.

Landfill Brook is a wetland/ surface water body located off-Property south of the WSL. The water body flows in a west to east direction starting within several small wetland areas in a residential neighborhood, and ending in an industrial/commercial area, where it discharges to the New Boston Street Drainway. Landfill Brook surface water samples contain fuel-related compounds and 1,1-DCA at low concentrations. These compounds do not originate from the OCSS. TMPs were not detected in Landfill Brook surface waters. SVOCs detected in surface water samples from Landfill Brook include several PAHs, BEHP, benzoic acid and phenols. Neither NDMA nor NDPA were detected in surface water samples from Landfill Brook. The

concentrations of chloride in groundwater at the Olin Calcium Sulfate Landfill (CSL) are typically two orders of magnitude less and the concentration of sodium is typically an order of magnitude less than in surface water nearby in the headwaters of Landfill Brook. Therefore the CSL cannot be considered to have significant contribution of either sodium or chloride to Landfill Brook. In addition, the concentrations of both calcium and sulfate in historical groundwater at and around the WSL are in the same range as calcium and sulfate in the headwaters (surface water) of Landfill Brook. An assessment of hydrologic and geochemical conditions surrounding Landfill Brook is included in the RI report, and concludes the surface water quality in Landfill Brook reflects its immediate proximity to the WSL and adjacent commercial automotive businesses.

The MMB Wetland area is represented by the wetland area located west and northwest of Main Street (west of the Property) including Sawmill Brook and MMB. For the MMB Wetland, the concentrations of metals (chromium, hexavalent chromium, and calcium) in surface waters are consistent with background sample concentrations. Aluminum and iron had elevated concentrations when compared to background concentrations. Detectable levels of inorganic constituents, ammonia, chloride, and sulfate in MMB and Sawmill Brook surface water appear consistent and comparable to background concentrations. Based on the concentrations of metals and inorganic constituents detected in surface water and distribution of these analytes, MMB and Sawmill Brook do not appear to be impacted by metals or inorganic compounds associated with the OCSS.

The VOCs including toluene, MTBE, cis-1,2-DCE, and TCE were detected in three surface water sample locations in the MMB wetland. These constituents are not associated with releases from the OCSS. Among SVOCs, benzoic acid and PAHs were detected in surface water samples from the MMB wetland at concentrations consistent with background conditions. NDMA was detected in only one surface water sample from the MMB wetland, at an estimated concentration of 0.47 nanograms per liter (ng/L). The 2011 surface water data, in conjunction with corresponding shallow groundwater data, indicate there may be an isolated area where shallow groundwater containing trace levels of NDMA may discharge to surface water. This low, estimated concentration is more than 6 orders of magnitude below the ecological screening benchmark of 0.117 milligrams per liter (mg/L) (117,000 ng/L) from USEPA Region III July 2006 BTAG Screening Benchmarks for Freshwater.

North Pond is currently a small water body located east of the Site and East Ditch. Historically, North Pond occupied a larger area that was modified to accommodate industrial and commercial development over many years. In the time period of 1984 to 1986 all sediment from the pond was excavated or dredged, and removed pursuant to an Order of Conditions issued by the Massachusetts Department of Environmental Quality Engineering (now MassDEP) during the most recent development. This area was evaluated in accordance with Addendum I of the approved RI Work Plan. The sampling program included installation of borings to investigate potential presence of historical sediment under developed areas around the pond, and collection of modern sediment and surface water from within the pond. The samples were collected to determine if there was evidence of an historical or current impact to the North Pond that may have resulted from a possible historical surface water connection to the Site. There is no current surface water connection between the Site and North Pond.

A memorandum was prepared and reviewed by USEPA concerning the findings. That memorandum has been updated to address USEPA comments, and is included in **Attachment D**. The data supports a conclusion that North Pond surface water is not impacted by the OCSS. Surface water data from North Pond is consistent with water quality of surface water that originates from nearby industrialized areas and enters North Pond. The data contained in **Attachment D** also does not indicate impacts from groundwater. The compounds detected in surface water include SVOCs (PAHs and several phthalates, including BEHP and Di-n-

butylphthalate), metals, and inorganics. There were known historical releases of phthalates to North Pond from the former Ritter Trucking Site, and site data is consistent with other anthropogenic impacts associated with urban and industrial facilities located to the north. Although it is Olin's position that there is no current connection between the OCSS and North Pond, and there exists no compelling data supporting an historical connection beyond one questionable aerial photograph, Olin agreed to include North Pond in the human health and ecological risk assessment. The details of the risk assessments are discussed in Appendices M and N. The risk assessments concluded that risk to ecological receptors exposed to surface water and sediment was unlikely, and that trespasser exposures to surface water and sediment were below the CERCLA acceptable risk range and hazarded index of 1.

Sediment

Background sediment samples were collected from two reference locations to characterize background conditions as described in the Field Sampling Plan (MACTEC, 2009a). The background sediment sample results are applicable to the East Ditch, the Maple Meadow Brook, and Landfill Brook. Background sample locations could not be identified and are not available for the off-Property and on-Property ditch system.

Off-Property sediment samples were collected from one comprehensive sampling event during the OU2 RI. Sediment samples were collected from the off-PWD, East Ditch, Landfill Brook and the Maple Meadow Brook Wetland (including Maple Meadow Brook and Sawmill Brook). Sediment samples are planned for the North Pond area. Results of that sampling will be added to this report at a later date.

Aluminum, calcium, chromium, copper, nickel, potassium, sodium and vanadium were detected in off-PWD sediment samples. TMPs, 1,2,4-trichlorobenzene, and 2-butanone were the VOCs detected in the off-PWD sediment samples. Among SVOCs, eleven PAHs, BEHP, NDPA, diphenyl ether, benzoic acid, and 4-chlorophenyl phenyl ether were detected in sediment samples from the off-PWD.

The East Ditch area is located to the east of the property boundary along the western border of the MBTA commuter rail line. Sediment sampling during the RI was difficult in the ditch due to the presence of railroad ballast and rip-rap that was a component of previous remediation of the New Boston Street Drainway. Only two of five planned RI sediment samples were collected because natural accumulations of sediment were not present. In general, very little natural sediment is currently present in the East Ditch adjacent to the Site.

Metals and inorganic compounds detected in the East Ditch sediment, where present, include, but are not limited to: aluminum, arsenic, barium, calcium, chromium, cobalt, copper, hexavalent chromium, iron, lead, manganese, mercury, nickel, vanadium, zinc, and ammonia. Among VOCs, Trimethyl-2-pentene (TM-2-P), 2-butanone, acetone, 1,1,2-trichloro-1,2,2-trifluoroethane, and TCE were each detected in one sediment sample from the East Ditch. Among SVOCs, 2-methylnaphthalene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzoic acid, benzo(k)fluoranthene, BEHP, chrysene, dibenz(a,h)anthracene, dibenzofuran, diphenyl ether, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, phenol, and pyrene were detected in one or more East Ditch sediment samples.

Sediment samples were collected from three locations (LB-1, LB-2, and LB-3) within Landfill Brook at locations upstream of its discharge into the East Ditch (New Boston Street Drainway).

Metals and inorganics were detected in all three sediment samples from Landfill Brook. VOCs that were detected in sediment samples from Landfill Brook are associated with the WSL. Among SVOCs, several cPAHs, BEHP, and NDPA were detected in one or more sediment

samples from Landfill Brook. The presence of BEHP and NDPA is also associated with the WSL.

For the MMB Wetland, the concentrations and distribution of inorganic parameters and metals in MMB and Sawmill Brook sediment samples are consistent with naturally occurring concentrations, and are not indicative of OCSS-related impacts. The presence of elevated concentrations of a few metals in sediment may be associated with the Spinazzola Trust Landfill. Two VOCs, 2-butanone and acetone, were reported at low, estimated concentrations in most of the sediment samples, and were also reported in background samples. Sediment samples representative of current conditions in the MMB detected at low, estimated concentrations include a large number of PAH compounds at moderate frequency of detection, two phenols at very low frequency (1 or 2 detections), and BEHP and benzoic acid at the highest frequency. The PAHs, BEHP, and benzoic acid were detected at similar concentrations and similar frequencies in the background data. At the low frequency of detection and low, estimated concentrations, the detection of phenol compounds do not indicate the presence of site-related impacts.

North Pond modern and historic sediment was evaluated through a program of sediment sampling in the current North Pond, and soil borings within portions of the former extent of North Pond that have been filled and developed. Sediment and soil boring data collected indicates that the current and historic sediment in North Pond is not impacted beyond what would be expected from known historical releases from adjacent industrial facilities and run-off from adjacent areas. The results of the study are appended to and discussed in this RI report. The data support a conclusion that North Pond sediment is not impacted from the OCSS, and is consistent with other anthropogenic impacts associated with urban and industrial run-off. Even so, Olin has agreed to and did evaluate human health and ecological risks from exposure to North Pond sediment.

Four sediment samples from the current North Pond were collected at previously identified locations shown in Addendum I of the approved RI Work Plan (Olin, 2013). Sediment analytical results identified four VOCs, 14 SVOCs, 24 metals, and four inorganics in at least one or more of the 2013 sediment samples. Most of the SVOC detections were PAHs, consistent with the industrialized setting of the area and storm water runoff from the industrialized area. Both TM-1-P and BEHP were detected in one of five samples at low, estimated concentrations at different locations, whereas chromium, hexavalent chromium, and ammonia, as well as other metals were detected in most samples at low concentrations. The ammonia concentration increases with increasing organic content of the sediment indicating the presence of ammonia is related to organic matter in the sediment (and likely related to biological activity). As indicated previously in the discussion of surface water, BEHP was clearly released to North Pond via to the drainage to the north (from Ritter Trucking), and the one detection of BEHP in current sediment was at SW/SD-602, where the outfall of that drainage feature enters North Pond. The source of the one low-level detection of TM-1-P is unknown, although it appears to be present in only recent sediment. The fact that it was only detected once, in one media (recent sediment), at a low, estimated concentration, indicates that it is not present as a result of historic impacts attributable to the OCSS.

Six soil borings were advanced within the historic bounds of North Pond and identified an organic layer representing historic sediment. Analytical results identified eight VOCs, six SVOCs, 22 metals, and four inorganics in the historic sediment. The VOCs detected in soil are not COIs and are not attributable to the OCSS. The SVOCs detected in historic sediments are all PAHs and were detected at low frequency. The concentrations and types of constituents detected do not indicate impact to the historic North Pond sediment from the OCSS.

Additional details are described in the North Pond Technical Memorandum located in **Attachment D**.

Soil

OU2 soil samples were collected from the property located between the Property eastern boundary and the East Ditch, and also from the property immediately west of the western boundary of the Property (PanAM Railroad property). Samples from beyond the eastern boundary of the Property were collected from locations north and south of the South Ditch. This low-lying area was investigated historically to delineate concentrations of chromium in soil. It was postulated that chromium had been deposited (as floc and sediment particulates) on soils during historical flooding of the South Ditch. The samples collected to the west of the Property were collected as part of the approved Work Plan delineation activities. OU2 soil samples were also collected within the historic bounds of North Pond to identify an organic layer that may represent historical North Pond sediments, as well as to evaluate evidence of impacts to the North Pond from potential discharges from the Site.

Property East of the 51 Eames Street Property

The most frequently detected VOCs in surface soil samples collected immediately east of the Property along South Ditch were acetone, methylene chloride, and toluene. TM-2-P was detected in soil samples, with a detected concentration well below the calculated Industrial RSL. Among SVOCs, BEHP and several high molecular weight PAHs, NDPA, diphenyl ether, and phenol were most frequently detected. Maximum concentrations of BEHP, benzo(a)anthracene, benzo(a)pyrene, and NDPrA were greater than corresponding Industrial RSLs. The maximum concentration of C11–C22 Aromatics was greater than the MassDEP MCP S-2 soil standard (relevant for industrial/commercial land use). Among specialty compounds, formaldehyde was the most frequently detected compound. In addition, maximum concentrations of arsenic and hexavalent chromium in surface soil samples were also greater than corresponding Industrial RSLs. No specific sources of arsenic in soils at OU1 have been identified. The large majority of arsenic concentrations are consistent with background conditions, and are considered background.

Contaminant Fate and Transport/Conceptual Site Model

For current conditions at OU1 and OU2, there are few complete migration pathways. There is no evidence of any erosional transport of impacted soils due to storm water runoff. The LNAPL in the area of the former Plant B tank farm is contained (not migrating) by the Plant B groundwater recovery/treatment system in operation since 1981. The volatiles (primarily TMPs) that have been reported in subsurface soils are not located at occupied structures, and therefore are not part of a complete vapor intrusion pathway. Evaluations of surface and subsurface soil data, as well as shallow groundwater data, indicate that leaching of COIs from soil to groundwater is not a substantial concern.

Groundwater at the Site as defined by OU3 includes groundwater within two watersheds. The divide between the watersheds roughly follows Eames Street, its intersection with Main Street, and then south, parallel to Main Street. Areas to the east of the divide are within the Aberjona watershed, and areas to the west, the Ipswich watershed. For OU1 and OU2 within the Aberjona watershed, the current complete migration pathway involves the transport of COIs that are present in groundwater, via advective groundwater flow with subsequent discharge to the off-Property West Ditch, South Ditch, and East Ditch. The surface water follows a flow path from the off-Property West Ditch to the South Ditch to the East Ditch which flows to the south from the Site. The primary COIs detected in this migration pathway include ammonia, sulfate,

calcium, chloride, sodium, chromium, iron, aluminum, other metals, TMPs, NDMA, NDPA, and phenols.

When groundwater discharges to surface water of the South Ditch, the change in pH (low in groundwater) to the more neutral values in surface water result in the flocculation of dissolved metals (particularly aluminum, iron, chromium). The floc material is stable in the surface water environment.

Within the Ipswich watershed, groundwater impacts are associated with deep groundwater within the Western Bedrock Valley under the MMB wetland. Shallow groundwater underlying the MMB wetland is not impacted to any appreciable extent, and OU2 surface water and sediment is not impacted by OCSS. NDMA has been detected in one of two RI sampling events at one surface water sample location in MMB. The concentration detected was less than the reporting limit of 2.0 ng/L.

The distribution of COIs in environmental media at OU1 and OU2 is consistent with the physical/chemical and fate and transport characteristics of those chemicals. In general, BEHP, chromium, and TMPs are not highly water soluble and have generally been adsorbed by soils and sediments. On the other hand, ammonia, calcium, chloride, sodium, and sulfate, and NDMA are highly water soluble and are therefore highly mobile, as evidenced by their transport in the groundwater/surface water interaction discussed above. Although the TMPs are highly volatile, their location in subsurface soils has not been associated with any complete vapor intrusion pathway.

Most of the Site COIs are persistent chemicals, with little or no biotic or abiotic degradation in the natural environment. NDMA in surface water is naturally degraded by ultraviolet light in sunlight.

Summary of Risk Assessments

The following subsections summarize the scope, development, and conclusions of the human health and ecological risk assessments.

Human Health Risk Assessment

The Baseline Human Health Risk Assessment (BHHRA) has been developed for OUs 1 and 2, which Olin and USEPA have agreed to address in this combined RI Report.

OU1 is defined in the SOW as the approximately 50-acre Olin Property (hereafter, the “Olin Property” or “Property”), including the former facility area, the established conservation area, the on-Property ditch system, the calcium sulfate landfill, and the slurry wall/containment area. The evaluation of OU1 includes soil and On-Property surface water and sediment. OU2 is defined as off-Property surface water and sediment areas, including, at a minimum, the off-Property East Ditch, South Ditch and West Ditch. The BHHRA also considered North Pond.

The objective of the BHHRA is to characterize health risks to human populations that are assumed to be potentially exposed to COIs associated with historical operations at the Property under the current and foreseeable future uses of the Site, in the absence of any additional remedial measures. The results of the BHHRA will be considered with other regulatory and technical information, to evaluate the need for remedial action at OU1 and OU2, and if remedial action is required, to develop and evaluate remedial alternatives.

The BHHRA is completed using a four-step process, consistent with the framework for risk assessment described in *RAGS* (USEPA, 1989). The four steps include Data Evaluation

(sometimes also referred to as Hazard Identification), Exposure Assessment, Toxicity Assessment, and Risk Characterization.

For the purposes of this BHHRA, it is assumed the northern portion of the Property will remain in industrial/commercial use, and an institutional control prohibits more sensitive land uses. Some portions of the Property have no active use, and it is expected that in the future, some areas will continue to have no active use. Approximately 20 acres of the Property, located to the south of the South Ditch, is subject to a conservation restriction; therefore, neither development nor active or passive recreational use is allowed for that portion of the Property. Other portions of the Property include resource areas and associated buffer zones within which construction, development, and active uses are not expected (but are none-the-less evaluated). Given that information and working assumptions, the following human receptors are considered for the BHHRA for OU1 and OU2.

- Current and future land use – indoor and outdoor industrial/commercial workers (adults)
- Future land use – construction (including excavation) workers (adults)
- Current and future land use – trespassers (adolescents and adults)

An exposure pathway is the course a chemical takes from its source to the person being contacted. Exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of human exposure. Exposure pathways generally consist of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium, (3) a point of potential human contact with the contaminated medium (known as the exposure point), and (4) an exposure route at the contact point (e.g., ingestion of soil, inhalation of vapors) (USEPA, 1989). For the exposure pathway to be considered potentially complete, all four elements must be present.

The BHHRA exposure areas for OU1 and OU2 reflect current and future receptors, and the current and future uses of the various areas (considering resource areas and associated buffer zones as potential determinants of future land use as well as the institutional control that will maintain the northern portion of the Property as an industrial/commercial property).

Environmental media evaluated quantitatively for OU1 and OU2 in this BHHRA (exposure media) include surface soil (and airborne dust), subsurface soil (and airborne dust), surface water and sediment. Potential outdoor air (potential vapors released from soil during future excavation activities) and indoor air (potential vapor intrusion of VOCs in soils) exposures have been evaluated qualitatively.

Exposure routes are the mechanisms by which people are exposed to environmental media. Exposure routes that are typically evaluated in environmental risk assessments include ingestion of the environmental medium, skin (dermal) contact with the environmental medium, and inhalation of outdoor or indoor air.

The exposure pathways associated with Site-wide groundwater will be evaluated in the RI/FS for OU3. There is currently no use of groundwater for any purpose at the Property.

Hazard Identification

The hazard identification includes 1) the evaluation, selection, and summarization of analytical data for the BHHRA, and 2) the selection of Chemicals of Potential Concern (COPCs). These two activities are described below.

Data Evaluation

The entire body of available medium-specific analytical laboratory data for soil, surface water, and sediment for OU1 and OU2 have been evaluated to determine the subsets of data that are appropriate to characterize human health risks for current and foreseeable future land uses and site conditions for OU1 and OU2.

Some of the analytical data were not selected for use in the BHHRA. Those data were not selected because they are no longer representative of site conditions (they represent pre-remedial conditions), or the medium (soil or sediment) that was sampled has been excavated and is no longer present, or because there are elevated reporting limits for non-detects for certain samples that are not suitable for use in the BHHRA.

The exposure areas have been identified based on the current and foreseeable future land uses and activities (considering the deed restriction (Notice and Declaration of Restrictive Covenant) for the entire 51 Eames Street Property and the Environmental and Open Space Restriction (Environmental Restriction) for the southern portion of the Property), physical configuration of OU1 and OU2, degree of development, the presence and location of environmental resource areas (wetlands and buffer zones), spatial coverage of environmental sampling, and the distribution of contaminant concentrations in soil.

The exposure areas for OU1 have been identified as EA1, EA2, EA3, EA4, EA6, EA7, the Containment Area, South Ditch, on-PWD, Stormwater Detention Basin, and Central Pond (**Figure ES-6**). The exposure areas for OU2 have been identified as EA5, Off-PWD, East Ditch, MMBW, and North Pond. As discussed in the RI, impact to MMBW surface water and sediment are negligible but this area is evaluated in the BHHRA. As discussed in Section 4, Landfill Brook is impacted by the WSL, not by COIs released from OU1. Therefore, Landfill Brook has been evaluated, at the request of USEPA, only through the COPC selection step of the BHHRA.

COPC Selection

The chemicals considered to be likely to pose more than a *de minimis* level of risk are identified, and subsequently included in the quantitative BHHRA. The COPCs are selected by reducing the number of chemicals to be considered by applying a concentration/toxicity screen and by eliminating essential nutrients. The procedure used to select COPCs for the BHHRA is summarized as follows, and the risk-based screening step is consistent with *USEPA Region I Risk Update Number 3* (USEPA, 1995).

Concentration-Toxicity Screening

- Selected as a COPC in soil if the maximum detected concentration is greater than the USEPA RSL (adjusted) for industrial soils (USEPA, 2013a).
- Selected as a COPC in surface water if the maximum detected concentration is greater than the Ambient Water Quality Criteria (AWQC) for consumption of organisms only (USEPA, 2009) or the USEPA RSL (adjusted) for tap water (USEPA, 2013a).
- Selected as a COPC in sediment if the maximum detected concentration is greater than the USEPA RSL (adjusted) for industrial soils (USEPA, 2013a).

Chemicals for which no screening value is available are retained as COPCs unless they are essential nutrients.

The risk assessment dataset derived through the data evaluation process was utilized to produce subsets of data to be used for selecting COPCs for 1) surface soil (all of OU1 and OU2, excluding the background data), 2) shallow subsurface soil (all of OU1 and OU2), 3) surface water (combined dataset, including: South Ditch, Central Pond, Detention Basin, East Ditch, Off-

PWD, MMBW, and North Pond - Landfill Brook is evaluated separately), and 4) sediment (combined dataset including: On-PWD/West Ditch Wetland, South Ditch, Central Pond, Detention Basin, East Ditch, Off-PWD, MMBW, and North Pond - Landfill Brook is evaluated separately). COPCs were selected Site-wide for surface and subsurface soil because the source of contamination for each exposure area is similar. The COPC screening is based on the maximum detected concentration of each analyte (using site-wide data is a conservative, health-protective approach). COPCs were selected for Landfill Brook surface water and sediment separately because this area is not impacted by COIs that were released from OU1. Low frequency of detection (less than 5%) is typically used to eliminate COPCs. Low frequency of detection was not used in this BHHRA because COPCs were selected Site-wide, and using that criterion might mask a higher frequency in one portion of the Site.

Exposure Assessment

For OU1 and OU2, the exposure media evaluated quantitatively in the BHHRA include surface and subsurface soil, surface water, and sediments. The vapor intrusion pathway is addressed qualitatively. In the OU3 RI report, the groundwater-related vapor intrusion pathway will be evaluated quantitatively.

Based on the current and assumed future land uses for the EAs, receptors evaluated include:

Current Land Use – OU1

- Outdoor Worker – Surface Soil at EA1, EA2, EA3, EA6, and EA7
- Trespasser – Surface Soil at EA1, EA2, EA3, EA4, EA6, and EA7
- Trespasser – Surface Water at South Ditch, Central Pond and Stormwater Detention Basin
- Trespasser – Sediment at on-PWD, South Ditch, Central Pond and Stormwater Detention Basin

Current Land Use – OU2

- Trespasser – Surface Soil at EA5
- Trespasser – Surface Water at EA5, Off-PWD, East Ditch, MMBW, and North Pond
- Trespasser – Sediment at EA5, Off-PWD, East Ditch, MMBW and North Pond

Future Land Use – OU1

- Indoor Worker – Surface Soil at EA1,EA3 and EA7
- Indoor Worker – Subsurface Soil at EA1, EA3 and EA7
- Outdoor Worker – Surface Soil at EA1, EA2, EA3, EA6, EA7, and Containment Area
- Outdoor Worker – Subsurface Soil at EA1, EA3, and EA7
- Construction Worker – Surface Soil at EA1, EA2, EA3, EA6, and EA7
- Construction Worker – Subsurface Soil at EA1, EA3, and EA7
- Trespasser – Surface Soil at EA1, EA2, EA3, EA4, EA6, EA7, and Containment Area
- Trespasser – Subsurface Soil at EA1, EA3, and EA7
- Trespasser – Surface Water at South Ditch, Central Pond and Stormwater Detention Basin
- Trespasser – Sediment at on-PWD, South Ditch, Central Pond and Stormwater Detention Basin
- Future Land Use – OU2
- Outdoor Worker – Surface Soil at EA5

- Construction Worker – Surface Soil at EA5
- Trespasser – Surface Soil at EA5
- Trespasser – Surface Water at EA5, Off-PWD, East Ditch, Maple Meadow Brook, and North Pond
- Trespasser – Sediment at EA5, Off-PWD, East Ditch, Maple Meadow Brook, and North Pond

In accordance with USEPA guidance, Reasonable Maximum Exposure (RME) EPCs for surface soil, shallow subsurface soil, surface water, and sediment are based on the lesser of the 95 percent UCL on the arithmetic mean concentration (95% UCL value), or the maximum detected concentration in the data set. The 95% UCL values are calculated using the ProUCL software (Version 5.0.00, USEPA, 2013b). The ProUCL software performs a goodness-of-fit test for data sets with or without non-detects to identify the distribution type for the data set (e.g., normal, lognormal, gamma, or non-discernable), and then calculates a conservative and stable 95 percent UCL value in accordance with USEPA guidance.

Exposures (average daily doses or average air concentrations) to COPCs were quantified by using numerical parameters that include ingestion rates, dermal contact areas, body weights, exposure times, exposure frequencies, and exposure durations. Using receptor scenarios that are protective for all potentially exposed populations associated with a given land use, with numerical parameters that are generally based on the upper-end distributions, results in exposure scenarios are referred to as the RME.

Toxicity Assessment

The objective of the toxicity assessment is to identify potential health impacts of COPCs and to quantify the relationship between the intake, or dose, of COPCs and the likelihood of adverse health effects associated with exposure to the COPCs.

The BHHRA evaluates the potential for both carcinogenic (cancer) and non-carcinogenic health effects. Non-carcinogenic health effects refer to toxicological effects other than cancer, such as toxicity to the liver, skin, or central nervous system. Following USEPA guidance (USEPA, 1989), both non-carcinogenic and carcinogenic effects are evaluated separately.

There are numerous detected parameters that were selected as COPCs because there were no RSLs available. For most of those COPCs, there are no readily available published toxicity values. Those COPCs include, but are not limited to, ammonia, sulfate, bromide (detected in surface water only), chloride, nitrate, urea, nonylphenol (detected in surface water only), diphenylether, and diphenylmethanone (detected in surface water and sediment only). Since the lack of toxicity values prevents calculation of risks, the BHHRA underestimates risk for those parameters and is discussed in the BHHRA.

Risk Characterization

Quantitative estimates of both carcinogenic and non-carcinogenic risks are calculated for each exposure scenario selected for evaluation in the exposure assessment, in accordance with USEPA guidance.

An estimate of the excess lifetime cancer risk (ELCR) associated with exposure to each COPC in a given medium was calculated. The ELCR represents an upper bound of the probability of an individual developing cancer over a lifetime as the result of exposure to a COPC. The ELCR is calculated for each carcinogenic COPC for each medium and exposure route combination for each receptor at each exposure area. The ELCR for all COPCs in a given medium are summed to identify a route-specific total ELCR (e.g., soil ingestion), and the ELCR for all exposure routes

for a given receptor/medium combination (e.g., soil ingestion and dermal contact) are summed to yield a total medium ELCR (e.g., for surface soil).

The non-cancer hazard quotient (HQ) associated with exposure to each COPC is calculated by dividing the exposure route pathway-specific average daily dose or exposure concentration by its exposure route-specific RfD or RfC.

The HQ was calculated for each COPC for each medium and exposure route combination for each receptor at each exposure area. For a given medium/receptor/age group combination (e.g., surface soil and adult outdoor worker), HQs for all COPCs are summed by route (e.g., dermal contact) to identify a medium/route HI, and the HIs for multiple exposure routes (e.g., incidental ingestion and dermal contact) are summed to identify a medium-specific total HI (e.g., for surface soil ingestion and dermal contact An HI less than 1 indicates that non-carcinogenic toxic effects are unlikely to occur as a result of COPC exposure. HIs greater than 1 may be indicative of a possible non-carcinogenic toxic effect. As the HI increases above 1, so does the likelihood of adverse effects.

The cancer risk estimates were compared to the cancer risk range of 10^{-6} (one in a million) to 10^{-4} (one in ten-thousand). Risks at or below 10^{-4} do not generally warrant a response action. Risks greater than 10^{-4} generally warrant development and evaluation of remedial alternatives. Non-cancer risks are compared to a HI value of 1, which corresponds to levels of exposure that people (including sensitive individuals) could experience without expected adverse effects.

Risk Characterization for Vapor Intrusion from Soil

There are chemicals present in shallow subsurface soils (1-10 ft bgs) that have sufficient volatility and toxicity to warrant evaluation of vapor intrusion from soil to indoor air. However, there are no current occupied buildings located in the vicinity of these chemicals in shallow subsurface soils. Therefore, the vapor intrusion pathway is not complete for current site uses.

In the future it is possible for redevelopment of the Property to occur and new industrial/commercial buildings could be constructed. Four areas were identified where there is the potential for future vapor intrusion if buildings were to be constructed. These areas include: EA7 (including the former EPH/VPH area), EA3, the area of the former Lake Poly, and the containment area. There is no foreseeable construction and occupancy of buildings in the containment area. The remaining three areas (EA7, EA3, and the former Lake Poly) have the potential for future buildings to be constructed.

There are no USEPA-published soil screening values which are protective of future vapor intrusion exposures. In addition, it is very difficult to quantitatively evaluate risks for future vapor intrusion from soil. Therefore, it is recommended that if future industrial/commercial buildings are contemplated in the three areas listed above that vapor migration be addressed by additional investigation/risk assessment, or by institutional or engineering controls included in building design.

Human Health Risk Assessment Conclusions

The current and foreseeable future use of the portion of OU1 located north of the South Ditch is industrial/commercial. A deed restriction (Notice and Declaration of Restrictive Covenant) is on file with the Registry of Deeds which will maintain that use and prohibit more sensitive land uses. The portion of OU1 at the Property is subject to the Environmental and Open Space Restriction (Environmental Restriction) that maintains the area as a conservation land and prohibits development and passive and active recreational use of that area. The areas within OU2 have also been evaluated in the BHHRA. Consistent with the current and foreseeable future land use, the BHHRA has evaluated potential exposures and risks.

A screening evaluation has also been conducted to assess the potential vapor intrusion pathway associated with volatiles in surface soil and shallow subsurface soil for current and future occupied buildings at the Property. This BHHRA for OU1 and OU2 has not evaluated risks associated with direct contact with groundwater nor with any potable or non-potable uses of groundwater. The BHHRA for OU3 will address those potential exposures and risks. The BHHRA did not identify any carcinogenic risks associated with OU1 and OU2 above the CERCLA acceptable risk range or a non-cancer HI of 1.

The conclusions of the BHHRA can be summarized as follows:

- The cancer risk estimates for the current and future trespasser, current and future industrial/commercial outdoor worker and indoor worker, and the future construction worker at the OU1 exposure areas (EA1, EA2, EA3, EA4, EA6, EA7, on-PWD, South Ditch, Central Pond, and the Stormwater Detention Basin), are within or below the CERCLA acceptable risk range.
- The non-cancer HI estimates for the current and future trespasser, current and future industrial/commercial outdoor worker and indoor worker, and the future construction worker at the OU1 exposure areas (EA1, EA2, EA3, EA4, EA6, EA7, on-PWD, South Ditch, Central Pond, and the Stormwater Detention Basin), are below a value of 1.
- The cancer risk estimates for the current and future trespasser, current and future industrial/commercial outdoor worker, and the future construction worker at the OU2 soil exposure area (EA5) and for the current and future trespasser at the OU2 surface water/sediment exposure areas (Lower South Ditch, East Ditch, Maple Meadow Brook, and North Pond) are within or below the CERCLA acceptable risk range.
- The non-cancer HI estimates for the current and future trespasser, current and future industrial/commercial outdoor worker, and the future construction worker at the OU2 soil exposure area (EA5) and for the current and future trespasser at the OU2 surface water/sediment exposure areas (East Ditch, Maple Meadow Brook, off-PWD, and North Pond) are below a value of 1.
- The cancer risk estimate for the trespasser exposed to sediment and surface water in the off-PWD is above the CERCLA acceptable risk range. However, the predominant risk contributors are PAH compounds detected in surface water that are unrelated to historical activities or releases at the Property.
- Based on CERCLA criteria, the calculated human health risks associated with potential exposures to surface soil, shallow subsurface soil, surface water, and sediment at OU1 indicate that the northern portion OU1 (EA1, EA2, EA3, EA6, EA7, on-PWD, South Ditch, Central Pond, and the Stormwater Detention Basin is suitable for current and future industrial/commercial use (more sensitive land uses are not foreseeable per the Notice and Declaration of Restrictive Covenant), and the southern portion of OU1 (EA4) is suitable for use as a conservation area (more sensitive land uses are not foreseeable per the Environmental and Open Space Restriction).
- Based on CERCLA criteria, the calculated human health risks associated with potential trespasser exposures to OU2 surface water and sediment at Lower South Ditch, East Ditch, Maple Meadow Brook, off-PWD, and North Pond do not warrant further investigation nor evaluation in a Feasibility Study.
- Based on CERCLA criteria, the calculated human health risks associated with potential trespasser, industrial/commercial worker, and construction worker exposures to OU2 surface soil at EA5 indicate the area is suitable for industrial/commercial use (more sensitive land uses are not foreseeable given the physical conditions and the close proximity to the commuter rail line).

Based on a qualitative evaluation of potential future conditions, concentrations of VOCs (primarily TMPs) in subsurface soils at EA3, EA7 and at one location in EA1 (former Lake Poly area) indicate that inhalation non-cancer risks potentially associated with vapor intrusion for future buildings (indoor workers) and for future excavation of soils (construction workers) should be controlled via institutional and engineering controls such as the incorporation of vapor mitigation features into building design.

Ecological Risk Assessment

The Baseline Ecological Risk Assessment (BERA) has been developed for OUs 1 and 2, which Olin and USEPA have agreed to address in this RI Report. The objective of the BERA is to characterize risk to ecological receptors that are assumed to be potentially exposed to COIs associated with the Site. The results of the BERA will be considered with other regulatory and technical information, to evaluate the need for remedial action at OU1 and OU2, and if remedial action is required, to develop and evaluate remedial alternatives. COIs are identified above in the executive summary of this RI Report.

The BERA is performed using USEPA CERCLA guidance for risk assessment. The BERA is completed using an eight-step process, consistent with the framework for risk assessment described in *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997). The BERA consists of a problem formulation, exposure and effects assessment, risk characterization, and conclusions.

Problem Formulation

The problem formulation provides the framework upon which the risk assessment is organized. The problem formulation is based on the findings of numerous investigations, risk assessments, and remedial actions conducted since 1978 to develop an understanding of the nature and extent of environmental impacts at OU1 and OU2.

Exposure Areas

The BERA evaluated risk to ecological receptors in OU1 in two terrestrial exposure areas including EA2 and EA4 (this exposure area includes the BHHRA exposure areas EA4 and EA6). The BERA did not evaluate ecological risk for terrestrial exposure areas EA1 or EA3 as those areas are heavily developed and do not provide significant habitat. The exposure Areas for the BERA are shown in **Figure ES-7**.

The BERA evaluated ecological risk in OU1 in five aquatic exposure areas:

- Central Pond;
- Storm Water Detention Basin;
- On-PWD/WDW;
- Upper South Ditch; and
- Lower South Ditch.

The on-Property and off-Property portions of the Lower South Ditch were evaluated together as a single exposure area.

The BERA evaluated ecological risk in OU2 in one terrestrial exposure area:

- Exposure Area 5 (EA5)

The BERA evaluated ecological risk in OU2 in three aquatic exposure areas:

- Off-PWD;
- MMB Wetland;
- North Pond; and
- Landfill Brook (only through selection of chemicals of potential ecological concern (COPEC)).

North Pond has been evaluated per request from USEPA. There is no current complete exposure pathway between the Property and North Pond.

As decided upon during the March 7, 2013 meeting with the USEPA and MassDEP, the East Ditch is assessed in a separate SLERA. The East Ditch SLERA is contained in an Appendix within the BERA.

An on-Property soil background area and an off-Property reference location were also identified for OU1 and OU2 and were incorporated in the risk characterization:

- Terrestrial Background; and
- MMB Wetland Aquatic Background (or Reference) Area.

Ecological Receptors

Ecological receptors were selected by focusing on species and communities that:

- Are indigenous to the area (taking into consideration the habitat types and areas available within the site);
- Are likely to be highly exposed to COPECs due to their habitat preference, behavioral traits, and home range; and
- Are representative of various feeding guilds or trophic levels (e.g., herbivore, invertivore, carnivore);

Terrestrial, aquatic, and semi-aquatic receptors were selected based on their observed or likely presence in OU1 and OU2 and on indicator species previously evaluated in prior ecological risk assessments conducted for the Olin Property.

Terrestrial receptors for OU1 and OU2 consisted of:

- Terrestrial plant community;
- Soil invertebrate community;
- American robin (*Turdus americanus*) populations, representing omnivorous songbirds;
- Red-tailed hawk (*Buteo jamaicensis*) populations, representing carnivorous birds of prey;
- Northern short-tailed shrew (*Blarina brevicauda*) populations, representing omnivorous small mammals; and
- Red fox (*Vulpes vulpes*) populations, representing carnivorous mammals.

Semi-aquatic receptors for OU1 and OU2 consisted of:

- Benthic macroinvertebrate community;
- Green frog (*Rana clamitans*) populations, representing amphibians;
- Marsh wren (*Cistothorus palustris*) populations, representing invertivorous songbirds;
- Green heron (*Butorides virescens*) populations, omnivorous semi-aquatic birds;
- Muskrat (*Ondatra zibethicus*) populations, representing herbivorous mammals; and
- Raccoon (*Procyon lotor*) populations, representing omnivorous mammals.

Fish were not included as receptors because Central Pond, the Storm Water Detention Basin, the on-PWD/WDW, South Ditch, and the off-PWD do not support fish.

Consultation with the USFWS and Massachusetts Natural Heritage and Endangered Species Program indicated that there are no specially protected species and no estimated or priority habitats in the vicinity of OU1 or OU2.

Complete Exposure Pathways

Chemicals may move from environmental media to ecological receptors through several major biological exposure mechanisms, which were considered in the BERA including:

- Uptake of chemicals from soil through roots (plants);
- Ingestion of chemicals bound to soil (terrestrial invertebrates, birds, mammals);
- Ingestion of chemicals bound to sediment (benthic invertebrates, amphibians, semi-aquatic birds, mammals);
- Ingestion of dissolved and particulate chemicals in surface water (benthic invertebrates, amphibians, semi-aquatic birds, mammals);
- Ingestion of chemicals through consumption of contaminated plants (herbivores, omnivores); and
- Ingestion of chemicals through consumption of contaminated prey (all predators).

Although inhalation and dermal absorption pathways are possibly complete for some receptors, the BERA considered these pathways to be minor compared to dietary ingestion and are not evaluated.

Assessment and Measurement Endpoints

Assessment endpoints in the BERA define ecological attributes that are to be protected. Measurement endpoints are measurable characteristics of those attributes that can be used to gauge the degree of impact that has occurred or may occur. Measurement endpoints are related to the assessment endpoint and the effects that can be measured or observed (e.g., toxicity in invertebrate bioassays). Measurement endpoints are most often used as surrogates for assessment endpoints since in most cases the assessment endpoint itself cannot be readily measured or observed.

The BERA evaluated ten assessment and measurement endpoints that pertain to the sustainability of:

- terrestrial plant communities, soil invertebrate communities, invertivorous birds, omnivorous small mammals, birds of prey, and carnivorous mammals,
- aquatic benthic invertebrate communities, amphibians, and
- semi-aquatic birds and mammals.

COPEC Selection

Data used in the BERA consisted of soil, surface water and sediment chemistry data, and sediment toxicity tests data. Available data were selected for use in the BERA using the criteria established by USEPA. Contaminants of potential ecological concern (COPECs) were selected by the comparing maximum detected concentrations to screening benchmarks by exposure area and media. Constituents with maximum detected concentrations greater than their corresponding screening benchmarks were identified as COPECs. COPECs represent chemicals that are present in environmental media at concentrations that could pose more than a negligible risk to ecological receptors and, therefore, are carried through the risk assessment

for quantitative evaluation of potential risks. Concentrations of chemicals below conservative screening benchmarks are considered to pose negligible risk to ecological receptors.

Depending on exposure area and medium, COPECs identified for further evaluation consisted of VOCs, SVOCs (including PAHs), EPH, pesticides, metals, other inorganics, and miscellaneous specialty compounds (*e.g.* hydrazine).

Ecological screening benchmarks for chemicals detected in surface water, sediment, and soil were obtained from published regulatory sources and peer-reviewed scientific literature.

Detected concentrations of ammonia in many surface water samples collected from the Site were above their respective screening criterion. Ammonia originates from a variety of man-made point source discharges as well as natural and man-made non-point sources, making it difficult to attribute detected concentrations at the Site to any one particular source. Given the large number of point, non-point, and natural sources of ammonia in the aquatic environment, it is unlikely that the ammonia detected in surface water at MMBW and North Pond is, in fact, attributable to releases at or from the Property.

Exposure and Effects Assessment

The BERA evaluated risk to ecological receptors from exposure to COPECs by:

- Comparison of concentrations in environmental media to effects benchmarks and reference concentrations;
- Sediment toxicity tests (Lower South Ditch only); and
- Food chain modeling and TRV-based risk calculations.

The BERA evaluated risk to ecological receptors using Reasonable Maximum Exposure (RME) and Central Tendency Exposure (CTE) Exposure Point Concentrations (EPCs). The RME EPC provides an upper estimate of exposure concentrations. In accordance with USEPA guidance RME EPCs used in the BERA are based on the lesser of the 95% Upper Confidence Limit (UCL) on the arithmetic mean concentration or the maximum detected concentration. The 95% UCL values are calculated using the ProUCL software.

The CTE represents the concentration to which a population of receptors would most likely be exposed across an exposure area and over time. CTE EPCs are average (arithmetic mean) concentrations calculated using ½ the standard quantitation limit (SQL) for non-detects. If the average concentration of a COPEC in an exposure area is greater than the maximum concentration, as occurs where the frequency and magnitude of detections is minimal, the lesser of the maximum or RME EPC was used as the CTE EPC.

Effects Benchmark Comparison Methods

For measurement endpoints 1A, 2A, 7A and 8A, RME and CTE EPCs were compared to effects benchmarks to calculate HQs. Effects benchmarks represent concentrations at or above which adverse effects are likely to occur. Effects benchmarks are typically based on toxicity tests and experimental observations published and summarized in the scientific literature. Effects benchmarks are typically reported based on the degree of measured response observed and differ from screening benchmarks that identify concentrations below which adverse effects are not expected to occur.

Ecological effects benchmarks for chemicals detected in surface water, sediment, and soil (identified for plant and invertebrate) were obtained from published regulatory sources and peer-reviewed scientific literature using a multi-tiered hierarchy. In soil, separate effects benchmarks were identified for terrestrial plant and soil invertebrate receptors.

Hazard quotients (HQs) were calculated by comparing EPCs to effects benchmarks, as shown:

Hazard Quotient = EPC / Benchmark

Where:

EPC = RME EPC or CTE EPC
Benchmark = Effects Benchmark

An RME EPC coupled with a screening benchmark provides a conservative estimate of risk, while a CTE EPC coupled with an effects benchmarks provides a more realistic estimate of risk. Therefore, an HQ less than 1 based on a RME and a screening benchmark indicates that the contaminant alone is unlikely to cause adverse ecological effects, while an HQ greater than 1 based on a CTE and effects benchmark suggests that a COPEC may be present at a concentration at which adverse effects may occur.

The risk characterization also includes an evaluation of incremental risks, which take into account the contribution of reference concentrations to the overall site risks.

Food Chain Modeling Methods

Exposure of terrestrial and semi-aquatic wildlife (*i.e.*, birds and mammals) to COPECs was estimated using food chain models. Soil, sediment, and surface water EPCs were entered into the food chain model to calculate an estimated daily intake (EDI) to which the receptor may be exposed. EPCs for prey items (tissue) were estimated using literature based bioaccumulation factors (BAFs), except for estimating chromium concentrations in invertebrate tissue. Chromium is a site-related COI frequently detected in site media and was therefore carefully evaluated. The scientific literature indicates there is no meaningful positive correlation between soil/sediment concentration and invertebrate tissue concentrations (Sample *et al.*, 1998a,b; USEPA, 1999). Because no defensible soil- or sediment-to-invertebrate chromium BAFs are available in the scientific literature, a fixed value of 20 mg Cr/kg invertebrate tissue dry weight (equivalent to 4 mg/kg wet weight assuming invertebrates are 80% water) is used instead. The rationale for this approach is discussed in detail in **BERA Section 4.7 (Uncertainty)** and in **BERA Attachment 5** and **Attachment 8**.

Models incorporate a site foraging frequency (SFF), which accounts for the proportion of a receptor's diet and incidental ingestion of soil or sediment that is obtained from an exposure area. If the exposure area is larger than the receptor's foraging range, it is assumed that the receptor obtained all of its food from within that exposure area. If the exposure area is smaller than the receptor's foraging range, it is assumed to obtain a fraction of its food from the exposure area. That fraction is calculated by dividing the exposure area by the foraging range.

Estimated Daily Intakes (EDIs) for individual COPECs were compared to wildlife TRVs to evaluate the effect of exposure on representative species. The comparison was quantified using the HQ approach, as shown:

Hazard Quotient = EDI / TRV

Where:

EDI = Estimated daily intake calculated from the food chain model (mg/kg BW-day)
TRV = Toxicity Reference Value (mg/kg BW-day)

TRVs were obtained from studies published in primary literature resources or review articles. The details of the food chain models, including exposure assumptions, BAFs, and TRVs, are provided in the BERA along with the food chain modeling spreadsheets. Incremental risks were also calculated for food chain risks.

Sediment Toxicity Test Methods & Results

In 2011, one sediment sample was collected from location ISCO-2 in Lower South Ditch, and from two reference locations (SDBK-002 and MMB-SW/SD-1) for toxicity testing. All three samples were submitted to EnviroSystems, Inc. (ESI) laboratory in Hampton, NH for a 42-day survival, growth and reproduction test using *Hyalella Azteca.*

ISCO-2 was selected to represent Lower South Ditch because it had the highest sediment HQs, calculated using ecological screening benchmarks.

Survival was measured on the 28th day of the test. Survival in ISCO-2 (42%) was below the laboratory control (93%) and below both reference samples (96% and 95%), a statistically significant reduction ($p<0.05$). Details of the study are presented with the BERA.

Uncertainty Analysis

There is uncertainty associated with estimates of risk in any BERA because the risk estimates are based on a number of assumptions regarding exposure and toxicity. There is uncertainty associated with the exposure and modeling assumptions, toxicological data, and risk characterization. The BERA considered major uncertainties and assumptions, well as steps taken to minimize uncertainty.

Risk Characterization

Risk characterization includes three major components: risk estimation, risk description, and uncertainty analysis. Risk estimation consists of integrating the exposure profiles with the effects information. Risk description provides information important for interpreting the risk results. The uncertainty analysis discusses potential sources of uncertainty, and the relative certainty associated with estimates of risk. The BERA reviews each of the assessment endpoints, analyzes results for measurement endpoints, and considers the relationship between assessment and measurement endpoints, including the confidence in the relationships relative to characterizing risk. The BERA used a weight of evidence approach to make conclusions regarding overall risk of harm.

The likelihood of adverse population level effects was determined using a Four-Way Interpretative Risk Matrix developed for USEPA Region I that incorporates all four EPC/TRV combinations. When possible, incremental risk HQs from food chain models have been used as the basis for the risk characterization.

HQs calculated for terrestrial plants, soil invertebrates, benthic invertebrates and amphibians were based on effects benchmarks factored with the RME and CTE scenarios, so only two sets of HQ conditions were calculated. In such cases, the Two-Way Interpretative Risk Matrix, also developed for USEPA Region I, was used as a guide to address the range of risk conclusions and confidence levels.

The Four-Way and Two-Way risk matrices were the first steps to estimate and characterize risk. Then, underlying assumptions and uncertainties and site-specific factors such as robustness of sample size, bioavailability, or confidence in an individual benchmark, were considered to derive final risk conclusions.

The BERA characterized risk by exposure area and assessment/measurement endpoints, beginning with the terrestrial exposure areas and concluding with the semi-aquatic exposure areas, as summarized below:

EA-2. All of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptor populations and communities exposed to EA-2 soil.

EA-4. All of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptor populations and communities exposed to EA-4 soil.

EA-5. Most of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 may be possible for ecological receptor populations and communities exposed to EA-5 soil. Food chain models for robins and shrews, and plant and invertebrate effects benchmark comparisons all indicated that adverse site-related effects may be possible from chromium in EA-5 soil. Adverse effects from BEHP to robins and shrews may also be possible.

Central Pond. Most of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptor populations and communities exposed to media in Central Pond.

Storm Water Detention Basin. Most of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptor populations and communities exposed to media in the Storm Water Detention Basin.

On-PWD/WDW. All of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptor populations and communities exposed to On-PWD sediment.

South Ditch. In the Upper South Ditch, most of the measurement endpoints found that adverse effects are unlikely for ecological receptor populations and communities exposed to sediment there. The sediment benchmark comparison found that risks to benthic invertebrate and amphibian communities from the C11-C22 aromatic EPH fraction are uncertain, and the sediment benchmark comparison carries a low inference weight. Other medium/high weighted measurement endpoints (food chain models) found that adverse effects from COPECs in Upper South Ditch were unlikely. The overall weight-of-evidence indicates that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptor populations and communities exposed to Upper South Ditch sediment. The surface water benchmark comparison indicates that adverse effects associated with releases at or from OU1 and OU2 to ecological receptors from chromium and ammonia may be possible.

In the Lower South Ditch, most of the measurement endpoints found that adverse effects may be possible for ecological receptor populations and communities exposed to surface water and sediment. The sediment benchmark comparison found that there may be effects to benthic invertebrate and amphibian communities from chromium, silver; and the EPH fraction. The sediment benchmark comparison carries a low inference weight. The sediment toxicity test, which carries a medium/high inference weight, indicated that for the worst-case conditions in the Lower South Ditch adverse effects to the benthic community may be possible. The marsh wren food chain model, which also carries a medium/high inference weight, suggested that BEHP may pose a risk. Three other food chain models (green heron, muskrat, raccoon), also carrying a medium/high inference weight found that adverse effects from COPECs in Lower South Ditch are unlikely. The overall weight-of-evidence indicates that adverse effects associated with releases at or from OU1 and OU2 for ecological receptor populations and communities exposed to Lower South Ditch sediment may be possible from BEHP and chromium. The surface water benchmark comparison indicates that adverse effects associated with releases at or from OU1 and OU2 for ecological receptors from chromium and ammonia may be possible.

Off-PWD. Most of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptor populations and communities exposed to media in the Off-PWD

Maple Meadow Brook Wetland. All of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptor populations and communities exposed to MMB Wetland surface water and sediment.

North Pond. Most of the measurement endpoints found that adverse effects associated with releases at or from OU1 and OU2 are unlikely for ecological receptors populations and communities exposed to media at North Pond.

North Pond has been evaluated per request from USEPA. There is no current complete exposure pathway between the Olin Property and North Pond, including groundwater. The historic sediment encountered in soil borings is not impacted by releases from the OCSS. The current sediments have only existed in North Pond since the 1984-1986 time frame and could not have been impacted by the OCSS.

Conclusions

This BERA for OU1 and OU2 found that adverse effects associated with releases at or from OU1 and OU2 to ecological receptors is unlikely in the following exposure areas and media:

- EA-2 soil;
- EA-4 soil;
- Central Pond surface water and sediment;
- Storm Water Detention Basic surface water and sediment;
- On-PWD/WDW surface water and sediment;
- Upper South Ditch sediment;
- Off-PWD surface water and sediment;
- Maple Meadow Brook surface water and sediment; and
- North Pond surface water and sediment.

The BERA for OU1 and OU2 of the OCSS also found that adverse effects may be possible in the following exposure areas and media:

- EA-5 soil, due to chromium and BEHP;
- Upper South Ditch surface water, due to chromium and ammonia; and
- Lower South Ditch surface water due to chromium and ammonia and sediment, due to chromium and BEHP.

North Pond was evaluated per request from USEPA. Adverse effects to populations and communities of ecological receptors exposed to chromium in North Pond surface water and sediment are unlikely.

RI Report Recommendations and Conclusions

The nature and extent of contamination for on-Property soil, surface water, and sediment of OU1 and the off-Property surface water and sediment of OU2 has been well characterized and defined. The data are adequate to support risk characterization and risk management decisions. The conclusions of the RI include:

- The human health risk assessment indicates the Property overall is suitable for industrial/commercial use.

- One small area of surface soil has reported concentrations of PCBs but does not pose unacceptable risks to current or future workers.
- The TMPs in soil in the northeast corner of the property associated with EA3 and EA7, and to a lesser extent former Lake Poly area, could pose potential vapor intrusion risks for future building construction and occupancy. Therefore, this portion of the Site should be evaluated in a Feasibility Study for potential engineering controls and requirements to mitigate potential future VI concerns. There is no current VI issue for existing buildings.
- The ecological risk assessment indicates there are no ecological risk concerns in exposure areas EA1, EA3, and EA7.
- The BERA for OU1 and OU2 also found that adverse site-related effects may be possible for Lower South Ditch sediment and EA-5 soil, due to chromium and BEHP. Therefore, these areas should be evaluated in a Feasibility Study to address chromium and BEHP.
- Surface water in South Ditch shows potential adverse effects to ecological receptors primarily due to ammonia and chromium, and should be evaluated in the OU1 / OU2 / OU3 Feasibility Study.

1.0 INTRODUCTION

This Final Remedial Investigation (RI) Report has been prepared for Operable Unit 1 (OU1) and Operable Unit 2 (OU2) of the Olin Chemical Superfund Site (OCSS) in Wilmington, Massachusetts by Amec Foster Wheeler Environment and Infrastructure (formerly AMEC Environment and Infrastructure, Inc.) on behalf of Olin Corporation (Olin). A Site location map of OU1 and OU2 areas is shown as **Figure 1.0-1**.

OU1 is defined as the approximately 50-acre Olin Property (hereafter, the "Property"), including the former facility area, the established conservation area, the on-Property ditch system, the Calcium Sulfate Landfill (CSL), and the Slurry Wall/Containment Area. OU1 includes soil, surface water, and sediment within the Property boundary. The northern portion of the Property was formerly the site of a chemical manufacturing facility. The Property area is shown in **Figure 1.0-2**.

OU2 is defined as the off-Property surface water and sediment areas, including the off-Property East Ditch, South Ditch, off-Property West Ditch (off-PWD), Landfill Brook (LFB), and the Maple Meadow Brook Wetland (MMBW), which includes Maple Meadow Brook (MMB) and Sawmill Brook and surrounding areas. Consistent with the United States Environmental Protection Agency (USEPA)-approved RI/FS Work Plan Addendum I (MACTEC, 2009b) and the USEPA-approved Addenda I, III, and V of that Work Plan, and the Supplemental Remedial Investigation Work Plan (Olin, 2012) that was revised and finalized in 2013 (Olin, 2013), OU2 includes surface water and sediment outside the “Property” boundaries. OU2 surface water drainages are identified by name in **Figure 1.0-2**. In recent discussions with USEPA, it has been agreed that OU2 includes soils, surface water, and sediment of the off-Property portion of the South Ditch.

OU3, which will be evaluated in a separate RI report, is defined in the AOC/SOW as all on- and off-Property groundwater areas, including Maple Meadow Brook Aquifer, groundwater beneath the Olin Property, and groundwater located south and east of the Olin Property. Soils located within the Olin property but located below the water table will also evaluated under OU3.

The Site was listed on the National Priorities List (NPL) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 105, 42 U.S.C. 9605 on April 19, 2006 (71 FR 20,016). Prior to the NPL listing, the Site has been the subject of many years of investigations and remedial actions/response activities carried out by Olin and supervised by Massachusetts Department of Environmental Protection (MassDEP), and its predecessor agency, under Chapter 21E of the General Laws of Massachusetts and the Massachusetts Contingency Plan (MCP). The Site has been a Priority site under the MCP since 1993, and a Tier I site since 1994.

Olin, American Biltrite Inc., and Stepan Company (all Co-Respondents) have voluntarily entered into an Administrative Order on Consent (AOC) with the USEPA to conduct a Remedial Investigation/Feasibility Study (RI/FS) for the Site (USEPA, 2007a). The effective date of the AOC is July 3, 2007. This RI report has been prepared in general conformance with the Statement of Work (SOW), RI/FS, Olin Chemical Superfund Site, dated June 28, 2007 (USEPA, 2007b).

This Final RI Report for OU1 and OU2 incorporates staged interim deliverables for the Human Health and Ecological Risk Assessments in accordance with the SOW for the Site. The first submittal of this document to USEPA, on April 19, 2013, included Draft Sections 1-5 of the Draft RI, and the first interim deliverables for the Human Health and Ecological Risk Assessments. The second interim deliverable submittal for the Human Health and Ecological Risk Assessments was submitted on July, 26 2013. The third interim risk assessment deliverable,

revised sections of the RI Report and the final risk assessment deliverables are incorporated into in this final submittal. Subsequent to these submittals, Olin and USEPA have corresponded and met to discuss and resolve comments of the draft RI documents. This has included submitting written responses to USEPA comments on July 26, 2013, and a separate response (September 13, 2013) to other supplemental stakeholder comments on the initial draft submittal. On September 30, 2013, USEPA provided a second set of separate comments on the RI and the second Interim risk assessment deliverables, to which Olin responded in writing on March 24, 2014 (see **Appendix L**). Olin submitted the Draft Final RI report for USEPA review on April 10, 2014, and USEPA provided their comments on November 11, 2014. A written response to USEPA comments was issued by Olin on December 12, 2014; the Final RI report incorporates these responses to comments. This Final RI report incorporates relevant and appropriate historical data collected under the MCP presented in the Focused Remedial Investigation Report (FRI) (MACTEC Engineering & Consulting, Inc. [MACTEC], 2007a), in addition to more recent data collected in accordance with the approved RI Work Plan (MACTEC, 2009a) including Addenda I, II, and V and an approved Supplemental RI Work Plan (Olin, 2012, 2013) that addressed data gaps agreed upon by Olin and USEPA.

Organization of this document is summarized below.

This introduction (Section 1) describes the purpose of this RI report, provides Site background information, a Site description, describes the Site history, including ownership and former facility operations and discusses the organization of the remainder of this report. Details of the organization of the remainder of this report are provided in Section 1.5.

1.1 Objectives of Report

The objectives of this report are to:

1) define sources, nature, and extent of contaminants using historical data, and new investigation results from the period 2009 through 2013, including analytical data for surface soil, subsurface soil, sediment, and surface water, with previously compiled environmental reports, results, and relevant information in the OU1 and OU2 areas;

2) assess potential human health and ecological risks associated with environmental media included in OU1 and OU2 in a manner consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300) and relevant guidance, as defined in the (USEPA, 2007a), ; and,

3) provide sufficient information for development of a Feasibility Study.

The OU1 and OU2 investigation programs were completed in several phases in conformance with the USEPA-approved *Final Remedial Investigation/Feasibility Study Work Plan*, *Field Sampling Plan* contained in Volume III-A of the August 2009 Work Plan (MACTEC, 2009a) and with the *Addendum III – Field Sampling Plan Analysis of Deep Soil Samples* (MACTEC, 2010a), an OU1 Work Plan Addendum (MACTEC, 2010b) and an OU1 / OU2 Supplemental Work Plan (Olin, 2012 and 2013). The RI investigation program for OU1 included soil borings, surface soil, surface water and sediment sampling. Soil borings and surface soil samples were completed throughout the former portion of the property used for manufacturing to delineate the nature and extent of site–related constituents in soil. Surface soil samples were also collected in portions of the property removed from manufacturing operations and are used to establish background concentrations for soils of constituents that are naturally occurring or have other anthropogenic sources. The OU1 surface water and sediment sampling included South Ditch, Central Pond, and the storm water detention basin. The RI investigation program for OU2 included investigation of off-Property surface water and sediment within the off-PWD, off-Property

portions of South Ditch, East Ditch, Maple Meadow Brook, Sawmill Brook, Landfill Brook and floodplain soils associated with off-Property portions of South Ditch.

1.2 Site Background

The OCSS includes the approximate 50-acre Olin Property (the Property) and 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. In 1953 the chemical manufacturing facility was constructed and was operated by National Polychemicals, Inc. (NPI). From 1953 to 1968 the business conducted by NPI was owned by three different corporations: American Biltrite Rubber Co., Fisons Limited, and Fisons Corporation, now known as NOR-AM Agro LLC. In 1968 Stepan Chemical Company bought the business, and continued to operate the facility until 1980, when the facility was purchased by Olin. Olin submitted closure plans for the plant facilities to Massachusetts Department of Environmental Protection (MassDEP) and USEPA in April 1986 and closed the facility in the same year. Olin remains the current owner.

During past ownership, manufacturing and waste disposal activities resulted in environmental contamination to on-Property soil, groundwater, sediment, and surface water. 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 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. A detailed summary of prior environmental investigations and remedial activities is presented in Section 2.1 and **Appendix A** of this document.

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 those soils and sediments disposed off-site 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 Extractable Petroleum Hydrocarbon (EPH)/ Volatile Petroleum Hydrocarbon (VPH) area (referring to EPH and VPH analyses) and located near the historical Plant B was identified and remediated using an air sparging/soil vapor extraction (AS/SVE) system. This AS/SVE system was closed and partially 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, and most recently, as an Interim Response Step, consistent with the Final Interim Response Steps Work Plan (IRSWP) (MACTEC, 2008). The Plant B groundwater recovery/treatment system was installed in response to the seepage of 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 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 (identified on **Figure 1.3-1**) in compliance with a Remediation General Permit (RGP) that can be found online and is attached as **Attachment A**.

In 2000/2001, Olin constructed a Slurry Wall/Cap around the on-Property portion of the Upper dense aqueous phase liquid (DAPL) Pool as a Release Abatement Measure (RAM) consistent with the MCP. This area is referred to as the Containment Area. The intent of this source control action was to eliminate, to the extent feasible, the on-Property DAPL as a source of dissolved constituents to groundwater. The Containment Area is comprised of a perimeter slurry wall installed into the weathered bedrock and a temporary cap to minimize infiltration of precipitation.

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 (not within OU1), forming an aquifer underlying Maple Meadow Brook (MMB) and Sawmill Brook known as the Maple Meadow Brook Aquifer (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 samples from four of the five MMBA municipal water supply wells (MWSWs). NDMA was not detected in the Town Park Well sample. Olin and the other respondents funded construction of a new pipeline to the Massachusetts Water Resources Authority (MWRA) system in 2008.

In September 2005, USEPA identified the Site as a Proposed Site for the 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.

Currently, the Property is not in active use. 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.

1.3 Site Description

The Site encompasses the approximate 50 acre Olin Property and surrounding areas to the west, east and south, where contaminants have migrated by surface water and/or groundwater transport. The current site features on the Property are shown in **Figure 1.3-1**. This figure also identifies former disposal features and drain and sewer lines. The current activities at the Property are associated with site investigations, remedial actions, and property maintenance. The Plant B Treatment Building is the only regularly occupied permanent structure at the Property. The Plant B operator is stationed in that building. There is a temporary, above-ground office trailer where the Site Manager is located and where meetings may be held occasionally. The Plant B Treatment Building and the office trailer have electric service and municipal water. The former Guard Shack is sometimes used as a staging area for site investigation activities. There are no active utilities in the former laboratory/office building, the Guard Shack or in the east and west warehouses and those structures are locked to limit access. Most of the former plant buildings (manufacturing area) and other structures (former wastewater treatment plant) have previously been demolished and removed from the Property with only concrete slabs remaining at several of those locations.

The southern half of the Property is forested, except in the southwestern corner where the closed Calcium Sulfate Landfill is located. Approximately 20 acres within this forested area is subject to the terms of the Environmental and Open Space Restriction as described above.

The Site also contains both on-property and off-Property surface water bodies. On-Property surface water includes a ditch system: on-Property West Ditch and on-Property South Ditch. Other water bodies include the natural wetland drainage complex (Ephemeral Drainage); Central Pond, and Central Wetland (located within proximity of the South Ditch). A storm water detention basin is also present near the South Ditch (**Figure 1.3-1**). The on-Property ditch system is connected with two other off-Property ditches (the off-Property West Ditch and the East Ditch) and these drainages are all part of the Aberjona River watershed.

The Property is bounded on the east by the Massachusetts Bay Transit Authority rail tracks, on the south by the Woburn/Wilmington Town Line and Woburn Sanitary Landfill (WSL), on the west by an inactive Boston and Maine Railroad spur (PanAM), and on the north by Eames Street. The Property is located in an industrialized area of Wilmington within a General Industrial zone. Intensive industrial land use occurs on the eastern, northern and western sides of the Property. The southern side of the property is bounded by the WSL, a former municipal solid waste landfill that has been closed. Residential properties are located along Main Street and Cook Avenue located to the west of the Property and along Eames Street before it intersects with Woburn Street. A more detailed description of the surrounding land use and socioeconomic setting is provided in Section 3.0 of this report. The following paragraphs describe previous and existing site features relevant to understanding site conditions and environmental setting.

1.3.1 Plant B Groundwater Extraction and Treatment System

The Plant B groundwater recovery/treatment system has been in operation since 1981 with continued operation from 1997 to present as an IRA under the MCP. The system was installed in response to the seepage of a LNAPL, from spills of previous owners, into the East Ditch that is located at the eastern perimeter of the former facility property. The LNAPL is a processing oil that contains BEHP, NDPA and TMPs. The system was designed to create a groundwater cone of depression to prevent migration of the LNAPL and allow for mechanical LNAPL removal. Any groundwater capture of dissolved constituents is incidental to this objective. The system operation includes three extraction wells operating at a combined rate of less than 10 gallons per minute. Groundwater extracted during operation of the system is pre-treated with granular activated carbon to remove iron as well as dissolved organic compounds and then ammonia by break point chlorination by sodium hypochlorite addition. After the removal of ammonia, the water is polished through a second granular activated carbon bed followed by an ion exchange media to remove arsenic, if present. The treated groundwater is discharged to surface water (discharge location shown on **Figure 1.3-1**) on the former facility property in compliance with a RGP. The Plant B groundwater extraction and treatment system includes a larger building which houses the treatment plant and a smaller building which houses a transfer pump and electrical panels. This system makes use of several pre-existing insulated above ground storage tanks (ASTs) for storing treated and untreated water. Two other non-insulated ASTs exist but are not used in the treatment system, except to store or circulate water over weekend periods. Two small tanks are located within the treatment building and are used as pre-carbon treatment hold tank and a residence tank. Olin has installed two new vertical tanks to store treated groundwater prior to discharge. Treated groundwater is discharged to the South Ditch via the on-PWD. Treated groundwater is discharged in batches daily between Monday and Friday during normal working hours. Groundwater extracted on weekends is stored in tanks on the Olin property for Monday discharge.

1.3.2 Slurry Wall / Cap Containment Area

The Slurry Wall/Cap is a containment structure that was constructed in 2000/2001 as a RAM consistent with the MCP and approved by MassDEP. The Slurry Wall/Cap is depicted on **Figure 1.3-1.** The design and construction of the slurry wall is described below and in Section 2.1.2.2.2 of **Appendix A**.

Between October 24 and December 9, 2000, a 3-foot wide soil-bentonite containment wall (referred to as the slurry wall) was installed from ground surface to the top of bedrock in the southwestern portion of the property. The maximum depth of the slurry wall was approximately 35 feet below ground surface. The slurry wall is comprised of a mixture of 65 percent excavated soil, 30 percent imported clayey glacial till, 3 percent processed attapulgite clay, and 2 percent bentonite clay. The excavation was supported by a bentonite slurry while the backfill material was placed using continuous mud wave techniques. Laboratory tests of backfill material indicate a permeability of 5.0×10^{-8} centimeters per second (cm/sec) using both water and DAPL as permeants.

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 pre-design boring program is summarized in the C-RAM Status Report No. 8 (GEI, 2004). The compatibility testing indicated that the hydraulic conductivity of the design slurry mix decreased over a six month period while in contact with DAPL material. These results suggest that hydraulic performance of the design slurry mixture improves when in contact with DAPL material. Along the northern, eastern and southern portions of the slurry wall, the DAPL surface elevation within the perimeter of the slurry wall is lower than the elevation of the intersection of the slurry wall and the bedrock surface. The slurry wall, working with the geometry of the bedrock depression, serves as a barrier to migration of dissolved DAPL constituents via overburden groundwater (diffuse layer). Additional description of the slurry wall/cap construction is provided in Section 2.1.2.2.2 of **Appendix A** and also in C-RAM Status Report No. 8 (GEI, 2004).

The containment structure was constructed with an equalization window on its western side to allow movement of shallow groundwater in and out of the structure, and equalize hydraulic pressure with surrounding groundwater. The equalization window is a gravel backfill section within the slurry wall located at an elevation corresponding to the water table. The equalization window is instrumented with two wells that allow measurement of water levels and collection of water quality samples to assess flux of groundwater and solutes through the window.

In 2000, a Post-Construction Monitoring Plan (PCMP) was prepared and monitoring was initiated to assess the performance of the subsurface containment structure in encompassing the DAPL and the temporary cap in minimizing the influx of precipitation and storm water into the containment structure. Under the CERCLA program, this sampling has been conducted under the USEPA approved interim Response Steps Work Plan (IRSWP) (MACTEC, 2008). Since 2001, on a semi-annual basis, Olin has prepared a status report which has documented the post-construction performance monitoring for the containment structure.

The temporary cap was completed in April 2001 over the entire Containment Area using 6-mil reinforced polyethylene sheeting. A gravel roadbed was installed around the eastern and southern perimeter of the temporary cap and slurry wall to allow vehicle access to the southwest area of the Site. The 6-mil sheeting was replaced in 2003 with an 8-mil polyethylene sheeting in which the seams sewn with ultraviolet resistant thread to reduce potential leakage of precipitation. The new sheeting was ballasted with sandbags on a grid pattern to minimize potential wind uplift and damage. Olin instituted quarterly inspections to monitor the integrity of

the temporary cap material, evaluate the need for periodic maintenance and document maintenance activities and repairs.

The Temporary Cap is inspected quarterly and maintained as part of the IRSWP. Quarterly cap inspection activities are summarized below:

- Walking and inspecting the scrim reinforced polyethylene cover for damage (tears and perforations) and that the cap remains flexible;
- Checking the sewn seams for evidence of deterioration of the UV–resistant thread;
- Observing areas of sewn seams that were in low spots;
- Checking sand bags where vegetation has rooted to verify that roots do not penetrate the polyethylene cover;
- Investigating areas of vegetation growth above the cap to ensure cap material has not been compromised;
- Checking for standing water on the cap surface;
- Checking that the internal drain grate is free of vegetation, so that the cap can properly drain surface water;
- Checking that sandbags are not deteriorating and/or have been replaced and continue to hold the cap in place; and
- Providing photo-documentation of typical cap conditions.

Details on quarterly cap inspections and specific repairs are summarized in the Semi-Annual Status Reports.

A deed restriction has been placed on the property that prohibits disturbing the soils underlying the temporary cap, and thereby limits future exposure to those soils. A copy of the Declaration of Restrictive Covenant for the Containment Area and CSL along with the Environmental and Open Space Restriction (environmental conservation deed restriction) are provided in **Attachment B**.

1.3.3 On-Property Ditch System and Other Surface Water Bodies

As defined in the SOW, the RI for OU1 addresses on-Property soil, surface water, and sediment. In discussion of nature and extent of site contamination several surface water bodies that are included in OU2 is discussed with the OU1 surface water bodies described below. These surface water bodies form an interconnected network of drainage ditches that flow onto and through the property, all of which are within the Aberjona River watershed. The on-Property ditch system consists of natural drainages that were modified in the early 1950s to improve drainage during site development (the on-PWD and the on-Property South Ditch). The South Ditch flows within a natural wetland drainage complex that includes an intermittent stream called the Ephemeral Drainage. The on-Property South Ditch is subdivided into the Upper South Ditch (the Delta Area and west of the Delta Area) and the Lower South Ditch (east of the Delta Area). The Ephemeral Drainage is a natural intermittent surface water feature that flows periodically in response to precipitation, and outlets into the Lower South Ditch. These features are shown in **Figure 1.3-1**. The on-PWD is also an intermittent drainage that originates in the northwest corner of the Olin property and flows along the western side of the property to the Upper South Ditch. The on-PWD flows through a culvert on the west side of the Containment Area which discharges to South Ditch just downstream of the weir.

A storm water detention basin is located south of the Containment Area on the north side of South Ditch just east of the weir. The storm water detention basin was excavated into bedrock prior to construction of the Slurry Wall. A concrete retaining wall was constructed on the northern side of the detention basin and bounds the southern side of the Slurry Wall. The

temporary cap in the Containment Area is sloped inwardly to a water collection sump that is connected to the detention basin by a subsurface gravity drain pipe that that exits through the retaining wall. Water collected from the temporary cap flows to the detention pond and is discharged to Upper South Ditch. The storm water detention basin has an outlet control structure that controls the water level (80.32 feet mean seal level [MSL]) and discharge from the basin.

A small pond, known as the Central Pond, and a large wetland area known as the Central Wetland are located north of and adjacent to the South Ditch. Central Pond does not have a surface water inlet or an outlet and the surface water elevation is that of surrounding groundwater.

The South Ditch receives surface water flow from the off-PWD and the on-PWD. Treated groundwater from Plant B is piped underground to an outfall located approximately 100 feet west of the West Warehouse. Treated water from the outfall flows into the on-PWD and then to the South Ditch. The on-PWD terminates in a concrete outlet structure that functions like a broad crested weir, allowing the water to flow out and over a gravel apron into the Upper South Ditch. This confluence is located immediately downstream of a concrete weir that was constructed in the Upper South Ditch in 2000. The weir controls water levels in the upstream off-PWD System, which flows into the on-Property South Ditch.

The on-PWD flows intermittently in response to precipitation events and spring run-off. Both the off-PWD and the South Ditch are perennial surface water features and both receive discharge from overburden groundwater.

1.3.4 Established Conservation Area

The southern half 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.

1.3.5 Calcium Sulfate Landfill

The CSL location and closure plans were approved by the Massachusetts Department of Public Health and the Town of Wilmington Board of Health in 1974. The Site was operated as a mono-fill from 1975 to 1987, receiving fine-grained gypsum sediment removed from the former facility settling ponds. The CSL is approximately 2.5 acres in size with a volume of approximately 37,000 cubic yards (cy). In 1987 the CSL was capped, covered with top soil, and seeded with final closure status requested in 1988. Final closure certification of the CSL and approval of a Post Closure Monitoring Plan in accordance with the Massachusetts Solid Waste Management Regulations (310 CMR 19.000) was issued by MassDEP on January 9, 2009 (MassDEP, 2009). An approval of a modification of the Post Closure monitoring plan was issued by MassDEP on March 3, 2011 (MassDEP, 2011). The most recent CSL Biennial Post-Closure Monitoring Report is included in **Attachment C**. The monitoring well network monitors groundwater on the southern side of the CSL adjacent to the WSL (SL-3), along its eastern downgradient side (SL-5, SL-6) along a northern perimeter with locally elevated bedrock (SL-7, SL-8) and along its western side (SL-1D and SL-2) which may receive some component of groundwater flow from the CSL, The current monitoring program includes semi-annual collection of groundwater samples and groundwater elevations from these seven monitoring wells, two of which have consistently been dry (SL-7, SL-8). The CSL analytical parameters include calcium, sulfate, aluminum, chromium, iron, manganese, nickel, sodium, chloride, alkalinity (total, bicarbonate, and carbonate), and total dissolved solids.

1.3.6 Off-Property Surface Water

Off-Property surface water bodies included within OU2 are located to the east and west of the Olin Property. As described previously, a ditch system known as the off-PWD is located on the west side of the Property and flows into the on-Property South Ditch (**Figures 1.0-2 and 1.3.1**). The off-PWD drainage was constructed east of Jewel Drive as surface water drainage features behind and adjacent to several developed lots. This ditch system is connected by a culvert under Jewel Drive to several shallow storm water sedimentation ponds located immediately south of the former Sanmina property on the west side of Jewel Drive. The off-PWD is located west of the PanAM railway tail track which forms a topographic divide from the Olin Property which isolated the off-PWD from surface water run-off from the Olin Property. The off-PWD flows through a culvert under the PanAM property into South Ditch. The off-Property portion of the South Ditch (east of the Property) flows east and discharges to a railroad drainage ditch known as the East Ditch that flows along the eastern side of the Olin property and along the eastern side of the adjacent property. A topographic divide occurs in the East Ditch at or slightly north of the Eames Street Bridge. Surface water flows northwest, north of the divide and southeast, south of the divide. From here the East Ditch flows southeast and south into the New Boston Street Drainway. Further south, Landfill Brook joins the New Boston Street Drainway and continues to flow south. Further description of Landfill Brook's headwaters is summarized in Section 4.2.5.4. The North Pond is located southeast of the Olin facility on the boundary of Wilmington and Woburn just south of Presidential Way. In 1955, the area surrounding North Pond was largely undeveloped. Between 1960 and 1980 the area was developed by other business entities to accommodate various commercial and industrial facilities. In 1980, the North Pond area was reworked by non-Olin entities, sediments were excavated and the area filled to construct Presidential Way and to develop areas on the south edge of North Pond and Presidential Way per a Superseding Order of Conditions issued by the Massachusetts Department of Environmental Quality in July 1984. Each of the surface water features described above flow within the Aberjona River watershed.

A large wetland complex is located further to the west of the Olin property on the western side of Main Street and includes two named streams including Sawmill Brook which joins MMB and west of the former Middlesex canal (**Figure 1.0-2**). This wetland complex, called the MMB Wetland has its head waters farther to the west. The MMB continues to flow northeast from the confluence with Sawmill Brook and passes through a series of wetlands flowing toward the Ipswich River. Surface water within the MMB Wetland is within the Ipswich watershed and is separated from the Aberjona watershed by topographic divides and a groundwater divide that has been mapped during the OU3 investigation and is discussed later in this report. The MMB and Sawmill Brook surface water and sediment are not connected by surface water pathways to the Olin Property; however, groundwater migration is a potential pathway to surface water in this part of OU2 that required evaluation. The pathway would be related to disposal activities on the Olin Property that resulted in the formation of DAPL and the migration and emplacement of DAPL within bedrock depressions within the Western Bedrock Valley located west of the property. The transport of DAPL is associated with convective mixing that generated a broader area of Diffuse Layer material within deeper portions of the MMB Aquifer. Due to the large thickness of the saturated overburden aquifer underlying the MMB wetland, this pathway is largely incomplete since shallow groundwater, immediately underlying the streams, is relatively un-impacted by the deeper groundwater.

1.3.7 Wilmington Maple Meadow Brook Aquifer Municipal Well Field

The MMB Wetland overlies a buried bedrock valley in-filled with glacial till and outwash deposits, known as the MMBA (**Figure 1.0-2**). In 1960 Wilmington installed a municipal water supply well, known as the Chestnut Street well, at the northwestern end of this wetland,

screened at shallow depth (31-36 feet). This well was supplemented by the Town Park Well in 1965 (screened at 40 feet), the Butters Row #1 well in 1971 (screened at 42-52 feet), and the Butters Row # 2 well in 1979 (screened at 36-46 feet). In 1981, Wilmington built a treatment plant on the Butters Row Site for treatment of groundwater extracted from these four wells, and several other wells from other well fields in town. The average combined pumping rate from these wells was approximately 1,600 gallons per minute (2.35 million gallons per day). Use of these municipal wells was discontinued indefinitely in February 2003 after discovery of NDMA in groundwater near the supply wells.

1.3.8 Dense Aqueous Phase Liquid (DAPL) Pools

Process water disposal practices by predecessor companies at the Site resulted in releases to groundwater through several unlined lagoons or ponds. These releases resulted in the formation of a DAPL that migrated by gravity to low areas in the underlying bedrock surface where it formed pools. A prominent feature of the bedrock topography at the Site is the presence of a buried bedrock valley known as the Western Bedrock Valley that forms the MMB Aquifer and originates at shallower depth near the western side of the Olin Property.

Three DAPL pools have been identified and characterized within the Western Bedrock Valley. Each DAPL pool is contained by a bedrock ridge or saddle aligned across the bedrock valley, forming a bedrock depression. These areas include an Upper DAPL Pool, the Main Street DAPL pool, and a very small Lower Pool with DAPL-like characteristics. The Upper DAPL pool straddles the Olin Property, and Olin has contained the on-Property portion within the Slurry Wall /Containment area. The remainder of this DAPL pool lies between Jewel Drive and the Property. The Main Street DAPL pool is located between the Upper DAPL Pool and Main Street. A pilot study to evaluate removal of DAPL by low flow rate pumping has been completed.

DAPL is an aqueous phase, liquid material that has a specific gravity greater than that of water (1.025), with an acidic pH. The DAPL contains chromium and a high concentration of dissolved solids. Typical constituents associated with DAPL include ammonia (concentrations generally greater than 1,250 milligrams per Liter [mg/L]), chloride (concentrations generally greater than 2,800 mg/L), magnesium (concentrations generally greater than 270 mg/L), sodium (concentrations generally greater than 1,700 mg/L), sulfate (concentrations generally greater than 16,000 mg/L), and specific conductance greater than 20,600 micromhos per centimeter (µmhos/cm). DAPL also contains low and trace concentrations of other metals, TMPs, semi volatile organic compounds (SVOCs) (mostly phthalates) and NDMA with concentrations up to approximately 25 ug/L (25,000 ng/L). The OU3 RI Report will compile and tabulate data on DAPL constituents. The primary transfer mechanism of constituents from DAPL to overlying groundwater is chemical diffusion. This diffusion results in the presence of a “Diffuse Layer” which is a three to five foot thick layer of groundwater that overlies the DAPL, and is defined by specific conductance between 20,600 and 3,000 µmhos/cm. The majority of existing dissolved phase contaminants in groundwater resulted from convective mixing during initial migration of the dense fluids while the facility was being operated.

The nature and extent of groundwater impacts associated with DAPL and diffuse layer material will be described in a separate OU3 RI report. This OU1 /OU2 report will describe in general terms the nature of surface water interaction with impacted groundwater to the extent that such interaction has resulted in impacts to surface water.

1.3.9 Watershed Divides

The Site is bisected by a sub-regional watershed divide located south of and in proximity to Eames Street to the north and generally east of and along Main Street to the west of the

Property. Since the streams in the Wilmington area are supported by discharge of shallow groundwater to them (IEP, 1990); the direction of surface water flow and that of shallow groundwater flow patterns are consistent. The earliest effort to identify groundwater divides was a water supply study prepared for the Town of Wilmington by IEP to identify the zone of contribution to the town water supply wells in the MMBA. Location of this divide has been refined by OU3 synoptic water level data. Surface water (and groundwater) to the north and west of this divide flows to the Ipswich River Watershed. Surface water (and groundwater) south and east of this divide flows to the Aberjona River Watershed. This information and interpreted groundwater potentiometric surfaces are discussed in Section 3.

1.4 Site History

1.4.1 Manufacturing, Products, Raw Materials, Wastes

The various historical configurations of the Facility and the activities conducted at the Facility are important to the investigation of nature and extent of contamination, assessment of human health and ecological risks, and the identification of remedial requirements. The following text and associated Tables and Figures summarize the activities and Facility configurations. This information has been used to identify known and potential chemical release areas and migration pathways that were incorporated into the RI Work Plan, and in particular, to the Field Sampling and Analysis Plan for the identification of sampling locations and appropriate analytical parameters.

Manufacturing activities were conducted at the Site from 1953 until 1986 when manufacturing operations ceased. The facility expanded incrementally (additional buildings were constructed) as additional products and processes were added and as processes were modified. The facility produced chemical products for use in the rubber and plastics industries (particularly nitrogen blowing agents, but also including blowing agent activators, polymerization initiators, antioxidants/stabilizers, retarders, processing aids, phthalate plasticizers, and chemical intermediates) and it also produced phenolic resins (phenol-formaldehyde resin). Available information indicates that the latter products were not associated with any substantial amounts of liquid waste materials. Two particular nitrogen blowing agents, Opex® and Kempore®, were by far the largest volume products manufactured at the facility. Both products were manufactured from the 1950s through 1986 when operations ceased.

Table 1.4-1 presents a chronology of the major manufacturing operations (and associated product lines) that were conducted at the facility. Former manufacturing operations were conducted in Plant A, Plant B, Plant C-1, C-2, C-3, Plant D (D-1 (used as a process plant and as a Pilot Plant), D-2, and D-3), and the Pilot Plant. **Table 1.4-1** indicates major operations for which information was available, but is not inclusive of all operations and therefore not all the subsidiary pilot plants have been included. **Figure 1.3-1** shows the configuration of the facility at the time that operations ceased in 1986 and it also includes several historical waste disposal features that are no longer present at the Site. **Figure 1.3-2** identifies storage tanks, septic tanks, and transformers that existed during the facility operations. **Figure 1.3-3** is a photograph of the facility in 1986 near the end of its operational life. That photograph identifies buildings by name and by building number. **Table 1.4-2** presents a summary of the manufacturing products for the facility, including the identification of raw materials and waste products for each major product and the disposition of the waste products. **Table 1.4-3** identifies the buildings that have been located at the facility over time. The following section identifies the physical configuration of the facility and discusses the buildings and other structures (such as storage tanks, waste disposal processes and associated structures and features (such as process sewers), and other site features (such as transformers) that are of potential interest from a site investigation perspective.

1.4.2 Historic Site Structures and Physical Configuration

1.4.2.1. Buildings

The buildings at the facility included chemical manufacturing/processing buildings, warehousing/storage buildings, boiler plants, maintenance buildings, pump houses, office space, and laboratory space. The manufacturing/processing buildings included Plants A through D and the Pilot Plant. The buildings are identified in **Table 1.4-3** and the locations are shown in **Figure 1.3-1** and **Figure 1.3-2**. **Figure 1.3-3** is a photograph showing the appearance of those buildings in 1986 prior to facility shutdown.

The buildings at the facility were constructed and operated over time. The facility expanded from 1953 until approximately 1986 when operations ceased. The building currently known as the current Plant B Treatment Building was the last building to have been constructed. The manufacturing buildings are discussed in the next subsection. The initial configuration of the facility (for Opex® production) included Buildings 1, 2, 3 (three storage buildings), 4 (office/lab - including Boiler House "A"), 6 (Plant A) and 6A (ice house). Plant B was constructed and began production of phthalate plasticizers in 1955 (also produced hexamine (HEXA) for the Opex® process until 1970). The Plant B Tank Farm was also in place by 1955 and the Boiler House was also in place by April 1955. Plant C-1 was constructed and began Kempore® production in 1956. Plant C-2 was constructed and processed Kempore® solids in 1962. Plant C-3 was constructed in 1962 and produced Hydrazine for the Kempore® process. Plant D was constructed in 1968 – 1969 and began production of Nitropore OT in 1969 and Nitropore OBSH in 1970.

The original office building and lab (Building 4) were not used for chemical production activities. Boiler House "A" was immediately adjacent to this building as part of the initial facility configuration. The general purpose building (Building 5) housed the Superintendent's office, laboratories, and the Pilot Lab (also referred to as the Pilot Plant). An additional office building (Building 4A) was used solely for office space. The butler building (Building 12) and the Guard Shack were not used for any manufacturing activities.

Three buildings (Buildings 1, 2 and 3) built early in the facility's history were used for storage of finished product materials that were produced at the facility. The West Warehouse (Building 15 and 15A) and the East Warehouse (Building 16) were built in 1964. These buildings were used for storage of raw materials and products. In addition, Hi-Lite fertilizer was formulated in the East Warehouse from 1966 to 1968. The raw materials for this process included peat, urea, potash, diammonium phosphate, and ammonium sulfate.

The Maintenance Shop/Boiler House (Building 10), Stock Room (Building 10A), and the Pump House (Building 11) were not used for any chemical manufacturing activities. The fuel oil storage tanks at the boiler house are discussed in the following subsection.

Existing structures currently on the Site include: Office Building (4A), Office and Lab (4), General Purpose/ Pilot Lab/ Boiler House A (5), Guard Shack, Butler Building (12), Plant B Tank Farm, Water Tower, East Warehouse (16) and West Warehouse (15), paved and grassed areas, and concrete slabs from other former buildings. In 2006, Olin installed a forty-foot office trailer and two metal storage trailers in the northeast quarter of the Property near Plant B treatment building (which houses a groundwater recovery and treatment system).

1.4.2.2. Storage Tanks and Transformers

Figure 1.3-2 shows the locations of historical site features such as storage tanks, leach fields, and transformers. These features are identified from a due diligence perspective with respect to potential releases from these features and the field sampling and analysis plan approach.

There were several large, above-ground bulk chemical storage tanks and structures, building-related storage tanks (both inside and outside buildings), underground fuel oil storage tanks, and five electrical transformers (potential for polychlorinated biphenyl [PCB] release) identified at the facility. The large, above-ground storage tanks were located in the Plant B Tank Farm and the Plant D Tank Farm. The large urea silo was located between the Boiler House and Plant D. **Figure 1.3-2** identifies above-ground tanks by number for ease of reference.

The Plant B Tank Farm included six large storage tanks identified as Tanks 1 through 6 and also another tank identified as Tank 7. Those six tanks may have stored different raw materials over time, but they did contain, at a minimum, during some periods of time, diphenylamine, di-n-octylphthalate, BEHP, diisobutylene (trimethylpentene (TMP) mixture), #415 Process Oil, nonylphenol, and formaldehyde (formalin), and they may have also stored other Plant B raw materials dimethylformamide, dinonylphenol, sodium nitrite, 2-ethylhexoic acid, and butanol, and Tank 7 stored ammonia (likely anhydrous). A 150,000 gallon water storage tank is located immediately south of the Plant B Tank Farm. This storage tank was constructed between 1956 and 1962.

The Plant D Tank Farm initially included four 10,000 gallon above-ground tanks (Tanks 20 -23) that contained chlorosulfonic acid, hydrazine, diphenyl oxide, and ammonium hydroxide to support production of Nitropore OBSC and OBSH. An additional tank identified as hydrazine storage was also present at a location between the Plant D Tank Farm and the Plant D building. After Nitropore OBSH production had ceased, Plant D produced Nitropore 5 PT. That process required the liquids benzonitrile, sodium nitrite, dimethylformamide, and hydrochloric acid.

There were also several process-specific or building-specific storage tanks of various sizes as shown on **Figure 1.3-2**. These tanks included Tank 8 (formaldehyde) near Plant B, Tank 9 (hydrazine day tank) and Tank 10 (caustic storage) at Plant C-3, Tank 11 (Wytox storage), Tank 12 (nonylphenol storage), Tank 13 (hydrazine day tank), Tank 14 (sodium chlorate storage), Tank 15 (sulfuric acid storage), and Tank 16 (sulfuric acid storage) at Plant C-1, Tank 17 (hydrochloric acid storage) and Tank 18 (sodium nitrite storage) at Plant A.

Three underground fuel storage tanks were located immediately to the east of the Boiler House. Two underground 12,600 gallon No. 6 fuel oil tanks and one underground 6,000 gallon No. 2 fuel oil tank stored fuel for the Boiler House. Wilmington Fire Department records document that two tanks were removed on July 11, 1986 (one 5,000 gallon tank and one 12,600 gallon tank). It appears the 5,000 gallon tank may have been the No. 2 fuel oil tank. The 1993 Phase II Field Investigation Report (Conestoga-Rovers & Associates, 1993) identified a “removed fuel tank” in the vicinity of the former Boiler House A that had been located in or immediately adjacent to the General Purpose Building (Building 5 as shown on **Figure 1.3-3**).

Five electric transformers (identified as Transformer #1 through Transformer #5 on **Figure 1.3-2**) were identified at the facility. These transformers were located near the General purpose Building, near the Plant B tank farm, to the east of the urea silo, adjacent to the East Warehouse, and at the south side of Plant D. These historical transformer locations were evaluated during this RI to determine potential releases of PCBs. See Section 4.1.3 for a summary of PCB results and delineation.

A drum storage area was located to the west of Lake Poly. Drums were stored on this asphalt paved upland area.

1.4.2.3. Surface Waste Disposal Structures, Conveyances, and Other Disposal Features

Several of the former manufacturing processes generated liquid wastes which contained sulfuric acid, sodium chloride, sodium sulfate, ammonium chloride, ammonium sulfate, chromium

sulfate, and other constituents. During the operation of the facility, there were four time frames with notable liquid waste disposal configurations.

- 1953 – 1958 liquid wastes to Lake Poly (Plants A, B, and C-1)
- 1958 – 1965 liquid wastes to Lake Poly and East and West Pits (Plants C-2 and C-3 added in 1962)
- 1965 – 1972 liquid wastes Lake Poly (through 1969) and Acid Pits (3) – Plant D added built 1968, operated 1969)
- 1972 – 1986 process liquid wastes to Pretreatment Plant (neutralization of acid), Lined Lagoons and Metropolitan District Commission (MDC) Sewer, Calcium Sulfate Landfill
    - MDC Sewer Connection 1972
    - Lined Lagoon I 1972
    - Lined Lagoon II 1973
    - Calcium Sulfate Landfill 1974

Between 1953 and approximately 1970, all liquid wastes generated at the facility were disposed of in unlined pits on the northern half of the property. These pits included Lake Poly, East and West Pits and the three Acid Pits **(Figure 1.3-2). Table 1.4-1** shows the periods of operation of the liquid waste disposal features and the timeframes for the manufacture of each of the major products at the facility.

Lake Poly. Lake Poly was an unlined surface impoundment approximately one-fifth of an acre in size located near the on-PWD. It has been reported (Smith, 1997) that the liquid waste stream to Lake Poly included process wastes, cooling tower and boiler blow down waters, discharge from yard and floor drains, and the laboratory. Sodium dichromate was used in the Kempore® process and acidic wastes containing chromium were discharged to unlined pits until 1967. After 1967 sodium dichromate was no longer used. Most of these wastes percolated through the porous soil underlying the pits and some wastes overflowed into the ditch system. From Lake Poly, overflows entered the on-PWD and flowed into the South Ditch which traverses the property from west to east and flows into the East Ditch. Lake Poly was closed in 1969. Lake Poly has been the subject of several investigations and multiple soil removal actions as described in the 2007 Focused Remedial Investigation Report (MACTEC, 2007), and documented in several submittals to the MassDEP.

East and West Acid Pits. Prior to 1964, the West and East Pits also received the Kempore® process and acidic liquid wastes (Smith, 1997). These pits were filled in 1964 prior to construction of the West and East Warehouses. The three Acid Pits, located further to the south, replaced the East Pit and West Pit as waste disposal features in the 1964 – 1965 time frame and were used until their closure in 1971. The Acid Pits were three unlined pits located between the warehouses and the South Ditch. As shown on **Figure 1.3-2**, the west Acid Pit, the central Acid Pit, and most of the east Acid Pit are within the footprint of the slurry wall containment area. The slurry wall contains the on-property DAPL in the subsurface and there is a temporary cap in place to prevent direct contact with soils and to minimize infiltration of water into the containment structure. It is expected that the temporary cap is replaced in the future with a permanent cap.

In approximately 1972, two lined lagoons and an acid treatment and neutralization system were added to the facility to replace the unlined Acid Pits and Lake Poly. The lined lagoons received mainly acidic wastes that did not contain sodium dichromate wastes and were neutralized with lime. The acid treatment and neutralization system initially discharged to on-Property ditches. In approximately 1972 the system was connected to a municipal (MDC) sewer. The acid neutralization in the lined lagoons resulted in precipitation of calcium sulfate (gypsum) and the lagoons were periodically dredged of this material. The gypsum dredge spoils were managed at

the Calcium Sulfate Landfill. According to monitoring data from the late 1970s, the lined lagoons were leaking. Upon purchase of the property in 1980, Olin made several improvements to the facility. The lagoons were re-lined in approximately 1981 and 1983. The original liners were polyvinyl chloride (PVC) and replaced by Olin with 36 mil thickness hypalon liners. Leaks in process sewer lines were also repaired in approximately 1983 and 1984.

The former facility also contained buried drum areas and a buried debris area that predated Olin's ownership of the facility (**Figure 1.3-1**), but were discovered by Olin during 1980 maintenance activities (relining of Lagoon II) and post closure environmental assessments. Drum Area A consisted of drums and miscellaneous waste containing NDPA, BEHP, TMPs, and chromium. Drum Area B consisted of drums, laboratory bottles, and miscellaneous wastes containing NDPA, BEHP, phthalates, and chlorobenzenes. The buried drum areas also contained Opex® and Kempore®. The Buried Debris Area contained materials similar to those disposed in Lake Poly (Smith, 1997). The remedial activities for the Drum and Debris areas were summarized in the 2001 Drum Removal Release Abatement Measure Status Report No. 2 and Completion Statement (Geotechnical Engineers, Inc. [GEI], 2001) and the 2004 Part 2 Construction-Related RAM (C-RAM) Status Report No. 8 (GEI, 2004). Soils (4,350 cubic yards excavated, 200 cubic yards disposed), metal debris (54 tons), and 163 overpacks of old drums were excavated and shipped off-site for disposal. Confirmatory sampling of base and sidewalls of the excavations was conducted. The excavations were backfilled with suitable on-site borrow and excavated soil. Drum Area A and Drum Area B are located within the footprint of the current slurry wall containment area and associated temporary cap.

Central Pond. The Central Pond is a small feature located south of the manufacturing areas and immediately north of the South Ditch (**Figure 1.3-1**). Olin does not have records of the Central Pond construction or its use. The Central Pond sediments and shoreline soils have been the focus of removal actions that were conducted in 2000, 2001, 2003, and 2004. Sediments were removed to address chromium and phthalates and shoreline soils were removed to address oily soil. The remedial activities were summarized in the 2001 Status Report No. 2, Part 2 C-RAM (GEI, 2001) and the 2004 Part 2 C-RAM Status Report No. 8 (GEI, 2004). The remedial actions included initial excavations of sediment and surface soil to a depth of up to 4 feet in Central Pond and the Central Pond Drainage Area (2,400 cubic yards), confirmatory sampling (68 samples), and subsequent additional excavation activities (to address residual chromium concentrations and observed oily soil on the bank). All of the organic sediments from Central Pond were removed during these activities. The excavated sediment and soils were shipped off-Property for disposal. The wetlands in the area were restored in May and June 2001.

1.4.2.4. Sewer Systems

The first or "early" sewer system for facility operations included process wastes from Plant A and Plant B piped directly to Lake Poly through plant sewers. Beginning in 1957, process wastes were being piped to Lake Poly and the East and West Pits (GEI, 2004). In 1964, Lake Poly and the three acid pits were receiving piped process wastes and the East and West Pits had been closed. During some or all of this period, Plants A, B, and C were in operation.

1.4.2.4.1. Second Sewer System (August 1969)

An upgrade of the sewer system for the facility was completed on August 15, 1969 (Badger, 1969). Lake Poly was closed in 1969. Upon completion of this upgrade, there were three distinct sewer systems: sanitary sewer system; process sewer system; and the yard and floor drainage system. **Figure 1.3-1** presents a schematic view of the sewer system as of 1970. This system operated as described below until the lined lagoons and pretreatment plant were constructed and the pretreatment plant was subsequently connected to the MDC sewer system in 1972.

Sanitary Sewer. The sanitary sewer conveyed sanitary sewage from various locations to septic tanks where solids removal occurred. The liquids from the septic tanks leached into the ground via conventional tile field systems. Septic tanks were located to the west of the General Purpose Building and to the east of Plant B. The septic tanks are discussed further in the following section.

Process Sewer. The process sewer was comprised of two components: the acid sewer; and the dilute waste system. The acid sewer was constructed with 4" – 6" Bondstream series 5000 epoxy pipe and it conveyed concentrated acid waste from Plants C-1, C-3, and D to the acid pits located at the southeast portion of the facility. The dilute waste system was constructed of cast iron and clay piping and it conveyed all process wastes other than strong acids to the acid pits.

Yard and Floor Drainage System. Beginning in August 1969, the yard drainage and process area floor drainage was collected in trench drains and routed to a "sewer" that was installed in the area of the former Lake Poly. The "sewer" was also identified as an "oil basin" that could be used to remove light solid material from the yard drainage. Although some drawings show the concrete structure at this location as a "septic tank" there is no indication that sanitary wastes were conveyed to this structure. The "sewer" discharged to the on-PWD that flowed to the South Ditch.

1.4.2.4.2. Third Sewer System Configuration

The 1969 sewer upgrade was in place until 1970. In 1970, the wastewater neutralization system was constructed. In December 1971 the first lined lagoon replaced the three acid pits. During the closure of the acid pits in 1971 and the construction of the lined lagoon in 1971 and 1972, the treated wastewater was discharged to the ditch system at the facility. In 1972, the process sewer system was connected to the MDC sewer system. At that point, the supernatant from the lagoon was discharged to the MDC sewer. The solids from the lined lagoon(s) were placed in the Calcium Sulfate Landfill beginning in January 1975.

In 1975, the sewer system for Plant A was abandoned and replaced. In 1981, the treatment effluent sewer line connecting the pretreatment plant to the MDC sewer was replaced.

As of 1983, the drawings still show yard drainage going to the "sewer" in the former Lake Poly area. The drawings do not specifically show any sanitary wastes lines going to the MDC sewer.

1.4.2.5. Septic Tanks/Systems

There is documentation of septic systems for sanitary wastes in two locations at the facility, as shown on **Figure 1.3-2**: to the west of the General Purpose Building (Building 4); and to the east of Plant B (Building 7). The septic tank cover west of the General Purpose Building remains in place. The leach field for that septic system runs in a southeast to northwest direction from the septic tank cover. There is no visual surface evidence of a septic tank in the area of the former Plant B (Building 7).

An additional drawing from 1983 (**Figure 1.3-4**) identifies a concrete pit and open trench that is the point of discharge to the on-PWD or on-PWD wetland. However, the drawing indicates that the structure drains subsurface lines that connect catch basins for the area to the west of the former Plant A and Plant C-1 and in the area between the warehouses and the former Plant C-1 (non-process yard drainage). There is no indication on the drawing that the concrete pit was connected by any subsurface pipeline to any buildings that may have generated sanitary waste or process waste streams. There is no current visual surface evidence of a septic tank or septic tank cover in that area. This feature is not a septic tank, but rather the "Lake Poly sewer" that was constructed in 1969 to receive non-process yard drainage and floor drainage.

In addition, there is a surface feature to the southeast of the 150,000 water storage tank that has the appearance of a concrete septic tank cover. This feature was not observed on any of

the site drawings that have been reviewed to date. Inspection of this structure on July 17, 2008 indicated the structure is not a septic tank, but rather a cover for a junction box for underground electrical lines. There is also a manhole located to the east of this feature that appears to be a manhole for the sewer line that runs to the north and connects to the sewer line at Eames Street.

1.5 Report Organization

As discussed previously, the purpose in preparing this RI Report for OU1 and OU2 is to combine new investigation results, including analytical data for on-property soil, sediment, and surface water, with previously compiled environmental reports, results, and relevant information in the OU1 and OU2 areas. This combination of information is utilized to characterize the nature and extent of contamination and the human health and ecological risks associated with OU1 and OU2. This report is organized in accordance with the USEPA Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA Interim Final (USEPA, 1988), and organized as follows:

Section 2 Study Area Investigations

Section 2 presents summaries of previous Property-wide investigations and focused investigations and/or removal actions for Lake Poly, Plant B, Former Drum and Debris Areas, Acid Pits, the Sewer System, on-PWD Wetland, South Ditch, Central Pond, the AS/SVE system at Plant B, and the CSL. These historical investigations and removal/remedial actions were discussed in extensive detail in the 2007 Draft Focused RI Report (MACTEC, 2007). Section 2 provides information and conclusions concerning the nature, environmental stability and bioavailability of Floc. This section also summarizes 2009 thorough 2012 OU1 and OU2 field investigations, conducted per the 2009 RI/FS Work Plan and associated addenda and supplemental work plans, including: three soil boring programs and surface soil sampling events and surface water and sediment sampling programs related to the on-Property and off-Property water bodies including: the on-Property South Ditch, Detention Basin, and Central Pond, and off-Property South Ditch, East Ditch, off-PWD, Landfill Brook, MMB Wetland area, and background locations.

Section 3 Physical Characteristics of the Study Areas and Land Use

Section 3 describes the physical characteristics of OU1 and OU2 including topography, geology, hydrogeology, surface water, meteorology, demography, land use, and ecology. It was agreed between USEPA and Olin that the current MassDEP groundwater classifications that pertain to the Site are to be discussed in OU3 and are not addressed in this report. Based on previous meetings, analysis and submittals, OU1 soil is not considered to be an ongoing source to groundwater. At the request of and as discussed with USEPA, a leaching evaluation was completed and is included in **Appendix J**.

Section 4 Nature and Extent of Contaminants

Section 4 presents the nature and distribution of chemical constituents and Site-related contaminants in OU1 and OU2 for soil, surface water, sediment. Tables of detected analytes and a brief discussion of background conditions where appropriate are presented for each of these media. The nature and extent of detected analytes is summarized by chemical class and distribution of analytes. Figures have also been included as major indicator parameters that have been developed for the Site. The figures are not inclusive of every detected compound, rather those that contribute to an understanding of the nature and extent of site-related impacts. The objective of this section is to present the analytical data that are representative of current conditions (conditions after the previously conducted response actions). This section also

discusses Vapor Intrusion assessment for TMPs in the north eastern corner of the former facility area.

Section 5 Contaminant Fate and Transport/Conceptual Site Model

Section 5 presents discussion of contaminant fate and transport and the current conceptual site model (CSM) for OU1 and OU2. This discussion relates potential sources of contamination with the hydrologic setting in discussion of potential routes of contaminant migration and exposure including, surface water, sediment, and air. The chemical and physical properties of contaminants and their setting are discussed in the context of contaminant persistence and ultimate environmental fate. Contaminant migration is summarized and a discussion of groundwater/surface interaction (**Figure 1.0-4**) is included.

Section 6 Human Health Risk Assessment

Section 6 summarizes previous results and presents current results from the OU1 and OU2 RI Investigation for the human health risk assessment (BHHRA). Section 6 has been prepared based upon the completed phased risk assessment submittals. The final BHHRA is attached as **Appendix M**.

Section 7 Baseline Ecological Risk Assessment

Section 7 summarizes previous results and presents current results from the OU1 and OU2 RI Investigation for the baseline ecological risk assessment (BERA). Section 7 has been prepared based upon the completed phased risk assessment submittals. Section 7 also summarizes results of toxicity testing that has been completed at the Site. The final BERA is attached as **Appendix N**.

Section 8 Summary and Conclusions

The final section presents the summary and conclusions for the OU1 and OU2 RI: nature and extent of contaminants, fate and transport of contaminants, and risks to human health and ecological receptors for current and reasonably foreseeable land uses and conditions.

2.0 STUDY AREA INVESTIGATIONS

Investigations have been conducted at the Site by several parties since the mid-1970s. Olin became involved in the investigation and remedial activities at the Site after its purchase of the facility in 1980. Most of the pre-1980 investigations were related to wastewater, groundwater, and surface water as well as the development and operation of the CSL. Earlier investigations and associated reports included groundwater and surface water investigations described in the document titled *Report on Groundwater and Surface Water Study, Stepan Chemical Company, Wilmington, Massachusetts* (GEI, 1978), soil and groundwater investigations along the eastern boundary of the facility concerning the LNAPL release in that area (New England Pollution Control Company [NEPCO], 1980), and the USEPA's Site Inspection Report for the Facility in December 1980 (Ecology & Environment, 1980) which focused on water pollution control and RCRA compliance. A Phase I Site Inspection Report for the Facility was prepared for the Massachusetts Department of Environmental Quality Engineering in 1986 (Wehran Engineering Corp., 1986). Olin conducted response actions to mitigate and control migration of LNAPL at the Plant B area in response to the 1980 Site Inspection Report. The Plant B groundwater recovery/treatment system for LNAPL was installed in 1981.

The Site was officially identified as a site subject to the MCP in a Notice of Responsibility letter from the MassDEP on May 28, 1992 (MassDEP Release Tracking Number 3-0471). Consequently, between that time and the listing of the Site on the NPL in 2006, investigations and response actions at the Site were conducted per the requirements of the MCP. The MCP requires a phased approach to site investigation and remediation that is modeled after the USEPA's NCP.

The 1993 Comprehensive Site Assessment Report, hereafter referred to as the 1993 CSA (Conestoga Rovers Associates [CRA], 1993), was focused on potential sources or release areas identified as Solid Waste Management Units (SWMUs). This report was not prepared in accordance with MCP requirements or terminology with respect to a Comprehensive Site Investigation Report (but more in line with a RCRA Facility Investigation Report). The associated investigations had been planned and initiated independent of the MCP Notice of Responsibility (NOR). The 1993 CSA was subsequently augmented by investigations intended to delineate nature and extent of release of oil and/or hazardous materials and to characterize the representative concentrations in environmental media to support risk characterizations and evaluation of remedial requirements. These supplemental investigations were conducted in a manner that is in substantive compliance with both the NCP and the MCP. In 1997, the *Supplemental Phase II Report; Wilmington Massachusetts, Olin Corporation. MassDEP RTN: 3-0471 (Smith, 1997)* was submitted to MassDEP per the MCP and approved. This Supplemental Phase II Report is referred to as the MCP "Phase II Comprehensive Site Assessment".

Additional MCP activities (including supplemental Phase Investigations, RAMs, Immediate Response Actions (IRAs), and monitoring activities associated with investigations, IRAs. and RAMs continued until the Site was listed on the NPL.

2.1 Previous Investigations and Response Actions

Previous investigations (conducted through 2006) and historical response actions for the Site have been reported in detail in the Focused Remedial Investigation Report (FRI) (MACTEC, 2007). This subsection (2.1) addresses previous investigations and response actions. As agreed with USEPA, the previous investigations and response actions are summarized in detail in the attached Section 2.1 of **Appendix A**, which is a reproduction of Sections 2.1 through 2.5 of the FRI (text and associated tables, figures, as well as Appendix A and B of the FRI that are

referred to in Section 2 of the FRI). Section 2.1 of **Appendix A** of this Draft RI Report summarizes previous investigations and response actions for OU1 and OU2. Section 2.2 summarizes monitoring programs for groundwater, surface water and sediment, including the Post-Construction Monitoring Plan (PCMP) activities related to the installation of the slurry wall/cap. The PCMP activities have continued as part of the Interim Response Steps Work Plan. Section 2.3 is a summary of the development, evolution, and application of groundwater models at the Site. Section 2.4 is a summary of the historical analytical programs and Section 2.5 is the analytical data quality review. **Appendix A** includes its own list of references.

Previous investigations summarized in Section 2.1 of **Appendix A** include the following: surface features characterization; contaminant source investigations and removal actions for (Lake Poly, Dense Aqueous Phase Liquid, Plant B, Former Drum and Debris Areas, Warehouse Investigations (acid pits), on-property sources of NDMA, Calcium Sulfate Landfill and Source Area Removals); meteorological investigations; surface water and sediment investigations for (on-PWD, South Ditch, off-PWD, East Ditch, Central Pond, North Pond, and Maple Meadow Brook Wetland); geological investigations; soil and vadose zone investigations (Initial CRA Investigation, Supplemental Phase II Investigations, and North Pond Investigation); groundwater investigations; indoor air investigations; biota; human population surveys; and ecological surveys.

The response actions (primarily IRAs and RAMs) described in Section 2.1.2 of **Appendix A** focused on source areas, highly impacted media, and some localized contamination and they have had a substantial impact in reducing the amount of contamination in soil and sediment within OU1. These response actions resulted in removal of impacted soils, waste materials, oil, and volatiles from soils and they have had a positive impact with respect to nature and extent of soil contamination at the Property. In particular, the following actions were conducted to remove impacted soil/sediment, TMPs from subsurface soil, and LNAPL from the Property:

Plant B. The Plant B groundwater recovery/treatment system for LNAPL has been operated by Olin since 1981 under an IRA in accordance with the MassDEP Conditional Approval since July 3, 1997. The system has been operated to prevent re-occurrence of LNAPL seepage and related sheen to the East Ditch in the vicinity of Plant B and system operations are also described in Section 1.3.1. There are currently three recovery wells in operation (IW-12, IW-11 and IW-13). The LNAPL removal was augmented with in-situ biostimulation and air sparging. The Plant B groundwater recovery and treatment system is operated continuously except for maintenance and repair activities. The containment of groundwater in the vicinity of Plant B is incidental to the primary objective of the system which is to maintain a cone of depression to prevent migration of the LNAPL toward East Ditch. The majority of LNAPL, which was a process oil, is mechanically recovered from IW-11. LNAPL recovery has varied from 1.8 to 3.2 gallons per year over the last five years (2010-2014). The three extraction wells operate at a combined flow rate of less than 10 gpm. Influent groundwater is pretreated with granular activated carbon to remove iron as well as dissolved organics. Ammonia is then treated by break point chlorination by hypochlorite addition. After ammonia removal, the water passes through a second granular activated carbon bed and finally an ion exchange resin to remove arsenic if present. Treated groundwater is discharged to the South Ditch below the weir via the on-PWD (**Figure 1.3-1**) under the conditions as set forth in the RGP number MAG910000 which is contained in **Attachment A.** Treated groundwater is discharged daily between Monday and Friday. Groundwater extracted on weekends is stored in tanks on the Olin property for treatment and discharge. Reporting for Plant B is included in the IRSWP Semi-annual Status reports.

Slurry Wall/Cap Containment Area. The installation of a containment structure was first evaluated in a Focused Feasibility Study in 2000, as one of several alternatives to achieve a permanent source control measure for on-Property DAPL, consistent with requirements of the

MCP. The remedial objective for the containment structure was eliminating, to the extent feasible, the on-Property DAPL as a source of the dissolved plume that was impacting ditches in the immediate vicinity of the area through groundwater discharge (GEI, 2000). The design of the slurry wall was based on a series of perimeter borings advanced to define the bedrock surface. Prior to constructing the slurry wall, a detention basin was constructed to manage surface water run-off. This structure required excavation into shallow bedrock. In December 2000, a three foot thick slurry wall was installed into the weathered bedrock surface to the extent bedrock could be removed by construction equipment. The containment structure was constructed with an equalization window on its western side to allow movement of shallow groundwater out of the structure, should head buildup occur from leakage of precipitation through the temporary cap. The location of the containment area is shown on **Figure 1.3-1**. The temporary cap was completed in April 2001 over the entire containment area using 6-mil reinforced polyethylene sheeting. A gravel roadbed was installed around the eastern and southern perimeter of the temporary cap to allow vehicle access to the southwest area of the Site. The 6-mil sheeting was replaced in 2003 with an 8-mil polyethylene sheeting utilizing ultraviolet resistant thread for sewn seams. Olin conducts quarterly inspections to monitor the integrity of the temporary cap material, evaluate the need for periodic maintenance and document maintenance activities and repairs.

Former Lake Poly. The former Lake Poly was a source area that had been the subject of several investigations and remedial actions. This area was an unlined pond that received acidic, chromium-containing liquid manufacturing wastes from manufacturing operation. Details of the investigation approvals and remedial actions are discussed in Section 2.1.2.1 of **Appendix A**. The initial remedial action at Lake Poly was intended to remove soil impacted with chromium and was conducted on November 17, 2000. The excavation was 10 feet wide, 10 feet long and 10 feet deep. The post-excavation confirmatory sample results indicated that additional excavation was required for the Lake Poly area.

Pursuant to additional investigations, the MassDEP approved the final scope of work and extent of additional excavations in the Lake Poly area on April 28, 2004. Consistent with that approved scope of work for the C-RAM, between June 7 and June 15, 2004 approximately 600 cubic yards (cy) of subsoil was excavated and disposed off-site in order to eliminate soil concentrations of ammonia and chromium above corresponding MCP soil upper confidence limits.

On-Property West Ditch and Adjacent Wetlands. Removal actions for shallow soil and sediment were also completed from adjacent portions in the on-PWD and adjacent wetland in (2000-2001). Removal of soil from most of the off-PWD wetlands adjacent to SWMU-27 and Lake Poly (C-RAM) occurred at this time in addition to removal and off-site disposal of 275 cy on-PWD sediments to address chromium, SVOCs, and metals.

Drum Disposal Area A, B and Buried Debris Area. The former Drum Disposal Areas were initially identified in the initial 1991-1993 CSA (CRA, 1993) by a magnetometer survey and follow-up test pit activities. Drum Area A and Drum Area B were evaluated by an MCP IRA from 1994 through 1996 and subsequently, in an MCP RAM during 2000 and 2001. The excavation and removals for Drum Area A and Drum Area B were conducted per the MassDEP approved January 24, 2000 RAM Plan. Between August 7 and December 9, 2000 approximately 3,200 cy of soil, 160 overpacks of old drums, crushed drums, and drum parts, and 34 tons of metal debris were excavated from Drum Area A. In addition, approximately 1,150 cy of soil, 3 overpacks of drum parts, and 2 tons of metal debris were excavated from Drum Area B. The debris materials were removed for off-site disposal and soils were segregated according to visual inspection according to the degree of poetical impact. These soils were then sampled, tested and evaluated for disposal off-site or re-use as excavation backfill. The Drum Area A

excavation was backfilled with a mixture of excavated soil, blast rock and on-property borrow. Drum Area B was backfilled with a mixture of excavated soil and on-property borrow.

During September and October 2000, 2,315 cy of impacted peat and sediment were excavated and removed for off-site disposal from the Buried Debris Area.

Central Pond. During 2000 and 2001 approximately 2470 cy of sediment and underlying soil were excavated and removed for off-site disposal from Central Pond to address chromium, SVOCs, and metals. In addition, a removal action for 12 cy was undertaken for the removal of oil-impacted soils from the banks of Central Pond during the C-RAM. Final restoration of Central Pond was completed in 2001.

South Ditch. Under the C-RAM removal of sediments was conducted along the entire Upper South Ditch including the Delta and resulted in the removal of 430 cy of sediment down to the underlying mineral soil to address chromium, SVOCs, and metals in 2000 and 2001. The excavation included removal of adjacent bank material, and restoration by placement of jute mat and other erosion control materials and placement or an organic wetland sediment/soil. Hay bale check dams were installed to help control water velocities along various reaches of the stream. All the sediment was disposed off-site at a facility licensed to receive such material.

Off-Property West Ditch. On June 9 and 10, 1994, a vacuum truck was used to remove the floc precipitate from the off-PWD. Approximately 18,000 gallons of sediment/water were collected from the ditch and were stored on-Site in a FRAC tank for waste characterization results and off-site disposal.

RSO-6 and A8-CW-1. Removal of soil at locations RSO-6 (50 cy removed) and A8-CW-1 (10 cy removed to address polycyclic aromatic hydrocarbons [PAHs]) were conducted in 2000 and are discussed in Section 2.1.6.1.2.8 of **Appendix A**. These removal actions do not have any implications concerning the adequacy of PAH characterization data. The A8CW-1 excavation was 10 feet wide, 10 feet long and 3 feet deep. The RSO-6 excavation was 12 feet wide, 14 feet long and 8 feet deep. Four confirmatory sidewall samples (A8CW-1-N, A8CW-1-E, A8CW-1-S, A8CW-1-W and RSO-06-N,RSO-06-E, RSO-06-S, RSO-06-W) and one bottom of excavation sample (A8CW-1-B and RSO-06-B) were collected. The locations of the confirmation samples are shown on **Figure 4.1-1**.

EPH/VPH Area. From 2000 to 2005 Olin operated an AS/SVE system located west of the groundwater extraction and product recovery system **(Figure 1.3-1)** that removed more than 2,000 pounds of TMP from subsurface soils at the EPH/VPH area at Plant B. The principal contaminants in this area were TMPs. Treatment of the EPH/VPH area was modified in 2002 to include a shut down test for the AS/SVE system in the EPH/VPH area that was conducted in July 2004. In a letter dated March 21, 2005 the MassDEP approved the request to discontinue the operation of the AS/SVE system in the EPH/VPH area and the system was subsequently shut down and a portion of the system was dismantled in August 2005. The MassDEP concurred that the system had significantly reduced concentrations of volatiles in the soil and that the system had achieved or approached background conditions for volatile contaminants in groundwater within the EPH/VPH area. The remaining portion of the AS/SVE system located immediately adjacent to Plant B Tank farm is not currently operating with USEPA concurrence in anticipation of a proposed “Plant B Pumping Rate Reduction Test” which is currently on hold. Further detail can be found in Section 2.1.2.3.2 of the FRI (**Appendix A)** and Section 3.2.2 of the IRSWP (MACTEC, 2008).

BioCell. The Biocell is located adjacent to the CSL and was designed and constructed as a biological treatment location for SVOCs impacted sediment from South Ditch. Due the presence of chromium in the sediment, use of the Biocell was infeasible and the facility was not used. The facility was constructed with HDPE liner and a filter sand that both still remain. In 2002,

2003 and 2004, the drainage sands were sampled and evaluated for eventual use as upland fill for future redevelopment. In 2002, DEP granted approval to penetrate the liner to allow precipitation in the Biocell in infiltrate to groundwater.

OU1 Response Action Summary. In summary, a total of 10,887 cy of soil/sediment were excavated during these activities and approximately 7,850 cy were disposed at licensed off-Site facilities. Soil/sediments from some excavations remain on-Site to date. Approximately 50 cy of sediment excavated from the delta area in October 2000 was tested for re-use and was used as shallow fill in the Containment Area; approximately 250 cy of granular material excavated from the Buried Debris Area was used as backfill in the Containment Area in November 2000; approximately 3,000 cy of topsoil stripped from the Containment Area in August and September 2000 remain stockpiled at the Property.

As documented in Appendix B of Status Report No. 2, Part 2 Construction-related RAM, Olin Wilmington-Property, 51 Eames Street, Wilmington, MA, Release Tracking No. 3-0471 (GEI, 2001), those stockpiled soils were sampled (11 samples) and submitted for laboratory analysis for VOCs, SVOCs, metals, pesticides, TPH, and additional disposal analytical requirements. MassDEP approved the re-use of those soils as upland fill at the Property (MassDEP, 2000). A summary of the soil removal activities and disposition of the soil material is provided in the table below.

Summary of Disposition of Soil Materials from Previous Remedial Actions

Remediation Area or Action	Excavated Material (cy)	Disposed Off-Site (cy)	Returned to Excavation (cy)	Stockpiled (cy)
Containment Area Topsoil – Stripped and Tested	2,700 – 3,000	0	0	2,700 – 3,000 (approved by MassDEP for on-site upland re-use)
Drum Area A (1)	3,200 (segregated and tested)	Drums, drum pieces, clearly impacted soil	500 (in DA-B) ~2,500 (in DA-A)	0
Drum Area B (1)	1,150 (segregated and tested)	Drums, drum pieces, clearly impacted soil	500 - peat stabilized with cement used as shallow backfill 650 - backfill	
Buried Debris Area (1)	2,565 (segregated and tested)	2,315 (April-July 2001)	250 (granular material to Containment Area)	0
on-PWD (tested)	275	275 (May 2001)	0	0
on-PWD Wetland (tested pre-excavation and for disposal	510	510 (May 2001)	0	0
South Ditch (tested)	530 + 50 (remediated sed plus floc)	530	50 (shallow fill in Containment Area)	0
Central Pond (tested)	2,600	2,600 (May – July 2001)	0	0
Slurry Wall – spoil and excess slurry, top two feet of wall removed and stabilized with cement	Volume not discussed	0	All – managed in the Containment Area as backfill	0
Lake Poly (tested for disposal)	Volume not discussed	All excavated material	0	0
Stormwater detention basin blast rock	Not reported	0	Bottom layer of backfill Drum Area A	0
Total Project Off-Site Disposal		1,300 Model city, NY		
Total Project Off-Site Disposal		5,950 (Turnkey Landfill, NH)		

Notes: Excavated material includes both soil and non-soil (drums, deteriorated drums, metal debris, etc) materials

Floc Composition, Stability and Bioavailability. Another important study that was historically conducted pertains to floc that forms in the ditch system in response to groundwater discharge. The floc that has been observed within the ditch system has been characterized and investigated in order to evaluate the fate and transport of the material, to assess potential bioavailability and potential risks of the material to aquatic receptors, if any, and to evaluate remedial requirements, if any. Details of the Floc investigations from the FRI are provided in Section 2.1.4.1.2.1.2 of the FRI provided in **Appendix A**.

Three investigations were conducted concerning the chemical, physical, and mineral composition of the floc material collected from the ditch system. It was observed that the physical appearance and chemical composition of floc was not consistent throughout the ditch system. Samples were therefore collected over several periods from off-PWD, South Ditch and East Ditch. To understand morphology of minerals present several samples were analyzed by Electron Micrograph Analysis (EMPA) at the University of Colorado at Boulder

The EMPA concluded the “white floc” consisted of pure aluminum hydroxide (gibbsite) and trivalent chromium was present with a composition of between 0.8% and 2%. The “red floc” (also referred to as “iron floc”) characterization suggested the material was similar to the mineral redingtonite (containing iron, chromium, aluminum, and sulfate) with a chromium content of 5% - 10%. The laboratory analysis indicated that the “white floc” sample contained 2,500 milligrams per kilogram (mg/kg; 0.25% by weight) total chromium while aluminum was the metal with the highest concentration (77,000 mg/kg) and the “red floc” sample contained 35,000 mg/kg (3.5% by weight) while iron was the predominant metal (180,000 mg/kg). The aluminum concentration in the “white floc” sample and the “red floc” sample were very similar. The “white floc” sample contained no detectable sulfate while the “red floc” sample contained 740 mg/kg sulfate.

The total chromium concentrations in five samples (Floc-1 through Floc-5) were 19,000 mg/kg, 7,400 mg/kg, 18,000 mg/kg, 930 mg/kg, and 5,200 mg/kg respectively. Sample Floc-1 was collected from the upper South Ditch, Floc-2 from between the weir and the Central Pond location, Floc-3 from the South Ditch near the eastern property boundary, and Floc-4, Floc-5, and Floc-6 from the wet area between the eastern property boundary and the East Ditch. It was concluded that “the existence of these precipitates in the floc samples indicates that these phases are thermodynamically stable under neutral, oxidizing conditions of the surface water environment” (Geomega, 1996 - **Appendix A** References).

An investigation of the stability of floc material was conducted beginning in June 2003 (Geomega, 2004 – **Appendix A** References). The study determined the chemical composition of each of the floc types and also determined the solubility of the floc constituents over a range of pH conditions. All of the floc types were “observed to have low metal solubility for iron, aluminum, manganese, and chromium over the range of pH conditions likely to occur at the site.” The report also concluded that none of the flocs are reported to contain any significant hexavalent chromium concentrations and no hexavalent chromium was detected in any of the water samples associated with the study. These studies concluded the floc is expected to be stable within the ditch system surface water. Collectively all the studies of floc indicate it is unlikely to represent an ecological risk to aquatic organisms due to the low solubility and bioavailability in surface water.

Ephemeral Drainage Area. Seven sediment samples were collected in January 2000 in this general area (RSD-09 through RSD-15) and is discussed further in the BHHRA. The only organics detected in any of the samples were TMPs (low concentrations only in RSD-09), acetone, and BEHP (only in RSD-10). There were no organic COIs detected in any of the RSD samples collected from the soil background area. Metal and inorganic concentrations in samples collected from samples RSD-11 through RSD-15 do not indicate evidence of any Site-

related impacts. Therefore, these sediment samples are considered representative of an area where no manufacturing activities are known to have occurred and where impacts did not occur.

2.2 OU1 Remedial Investigations

The following section identifies the OU1 and OU2 investigation activities that have been conducted since the USEPA approval of the Final IRSWP in August, 2008 and the USEPA conditional approval of the April 30, 2009 Draft Final RI/FS Work Plan (MACTEC, 2009c) on July 16, 2009 (USEPA, 2009).

For the RI, soil borings were advanced at 130 locations, with 398 samples submitted for laboratory analysis; surface soil samples were advanced at 90 locations with 90 samples submitted for laboratory analysis; sediment samples were advanced at 27 locations with 48 samples submitted for laboratory analysis; surface water samples were collected at 29 locations with 84 samples submitted for laboratory analysis.

Consistent with the Field Sampling Plan (FSP) contained in Volume III-A of the August 2009 Final RI/FS Work Plan (MACTEC, 2009a) the 2009 through 2013 RI sampling objectives for OU1 were to:

- Confirm and refine previous investigation findings;
- Confirm the nature and extent of site related contaminants (including the area south of the South Ditch);
- Investigate the manufacturing process areas; and
- Collect additional data for the human health and ecological risk assessments.

The 2009 through 2013 RI sampling in OU1 included the following sampling events:

- August/September 2009 – soil borings (surface, shallow subsurface, and deep subsurface soil samples) per 2009 FSP
- September 2009 – surface soil sampling per 2009 FSP
- November 2010 – soil borings in area of SB-405 and area east of the Plant B Treatment Building (surface, shallow subsurface, and deep subsurface soil samples) per Addendum V of the RI Work Plan (MACTEC, 2010b)
- November/December 2012 – soil borings and surface soil samples to fill data gaps per the November 16, 2012 Supplemental Work Plan (Olin, 2012)
- December 9-10, 2010 – surface water and sediment sampling in South Ditch per 2009 FSP
- June 6, 2011 - surface water and sediment sampling in South Ditch per 2009 FSP
- December 2012 – soil, surface water and sediment sampling in Central Pond and Storm Water Detention Basin per the November 16, 2012 Supplemental Work Plan (revised and resubmitted March 2013)
- June 17, 2013 – additional soil sampling to delineate PCBs

The 2007 through 2013 IRSWP (MACTEC, 2008) sampling in OU1 included the following sampling events:

- Quarterly groundwater, surface water, and sediment (annual) sampling related to the slurry wall/cap
- Quarterly groundwater sampling related to the operation of Plant B

The 2009 though 2012 RI sampling in OU1 included 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 was also collected from the Lower South Ditch and from a reference location for toxicity testing. The sediment analytical results have been used to select a sample location for the sediment toxicity testing. The analytical data associated with that sampling and analysis and the sediment toxicity testing results, in conjunction with previously collected data, is used to support evaluations in the RI, human health and ecological risk assessments, and development and evaluation of remedial alternatives in the FS.

Post-remedial subsurface soil confirmatory sampling and analysis in the EPH/VPH area west of Plant B was conducted to document post-remediation (AS/SVE for TMP removal) conditions in that remediated area. Additional surface soil sampling and analysis was conducted in the Lower South Ditch to complete the characterization of the nature and distribution of SVOC contamination in surface soil in that area (previous investigations had focused on chromium extent).

Based on the findings of the summer 2009 and May 2010 sampling associated with the 2009 FSP, additional soil sampling and analysis via a soil boring program was proposed in the 2010 *Addendum V – OU1 Remedial Investigation Work Plan Addendum* (MACTEC, 2010b). The objectives of that soil boring program were to complete the delineation of TMPs in soil in the vicinity of soil boring SB-405 (located in the parking lot at the northeast corner of the Property) and to complete the delineation of TMPs and EPH/VPH in subsurface soil in the area to the east of the perimeter fence near the Plant B treatment building. Those additional investigations were completed in November 2010.

A supplemental OU1 /OU2 work plan for additional soil sampling and analysis that included a soil boring program was proposed and approved by USEPA on December 12, 2013. This field work was completed in December 2012 in accordance with the approved work plan. The objectives of the soil boring program were to collect additional soil samples to delineate PCBs in the vicinity of SS-403 and SS-404 (located near a former transformer in the northwest portion of the Property); collect additional subsurface samples for TMP analysis in the vicinity of soil boring SB-405 (located in the parking lot at the northeast corner of the Property); delineate EPH in soils around former Plant A and Plant C-1; analyze soils for hexavalent chromium (in the former manufacturing areas); delineate soils for VOCs, SVOCs, EPH, and metals in the vicinity of SB-459; and, collect additional soil samples for VOCs, SVOCs, EPH, and metals in the west ditch wetland. An additional 16 surface soil samples were collected for hexavalent chromium analysis in the wetland areas and around the South Ditch. Surface water and sediment samples were also collected in the South Ditch, Storm Water Detention Pond and Central Pond. During this investigation, soil samples were collected off-Property (east of the Olin Property) and is discussed in the OU2 Section of this RI.

The following subsections describe the work completed for surface and subsurface sampling, surface water sampling, and sediment sampling conducted since USEPA conditional approval of the April 2009 RI/FS Work Plan. Each of these field activities were completed in accordance with the FSP contained in Volume III-A of the August 2009 Work Plan, the *Quality Assurance Project Plan* (QAPP) contained in III-B of the August 2009 Work Plan (MACTEC, 2009a), the *Addendum III – Field Sampling Plan Analysis of Deep Soil Samples* (MACTEC, 2010a)*, and Addendum V – OU1 Remedial Investigation Work Plan Addendum* (MACTEC, 2010b) or in the Final IRSWP (MACTEC, 2008). **Tables 2.2-1, 2.2-2 and 2.2-3** identify all of the RI soil samples collected in 2009 through 2013 for OU1. These tables identify samples collected within the 0–1 feet (ft) below ground surface (bgs) interval, within the 1–10 ft bgs interval, and within the greater than 10 ft bgs interval, the sample identification, sample location, sample date, and the laboratory analyses requested for each sample.

2.2.1 August/September 2009 Soil Sampling and Analysis

In August and September 2009, AMEC conducted a soil sampling and analysis program consistent with the USEPA-approved August 14, 2009 FSP. The FSP required soil borings with sampling of surface soil (0-1 ft bgs), shallow subsurface soil (within the 1-10 ft bgs interval), and deep soil (deeper than 10 ft bgs) as well as surface soil sampling (hand tools) and analysis to further define nature and extent of contamination for Site soils. For surface soil, shallow subsurface soil, and deep subsurface soil respectively, **Tables 2.2-1, 2.2-2, and 2.2-3** identify all of the RI soil samples (including those from August/September 2009) collected in 2009 through 2013 for OU1 and also identify the laboratory analysis completed for each sample. In those tables, the 2009 through 2013 OU1 RI soil samples are those samples listed with sample dates of August 18, 2009 and later. The samples in those tables are listed in chronological order. Copies of the soil boring Field Data Records (FDRs) are presented in **Appendix B**.

Section 4.1 of the FSP outlined the surface soil investigation. Table 4.1-1 of the FSP summarized the surface soil sampling locations (proposed surface soil sample locations from soil borings begin with the designation “SB” and proposed surface soil sample locations from the “surface soil sampling program” begin with the designation “SS”) and analytical parameters for each location. Figure 4.1-1 of the FSP depicted the proposed surface soil sampling locations. The majority of the proposed sampling program was conducted in September 2009. Copies of the surface soil Field Data Records (FDRs) are presented in the **Appendix C** and chains of custody are included in the Data Validation Memoranda included in **Appendix E**.

Figure 2.2-1 identifies the locations of surface and subsurface soil samples collected during the 2009 through 2013 OU1 RI. It should be noted that surface soil samples collected from soil borings have sample identifiers that contain the soil boring location identification (e.g., SB-405). Surface soil samples that were collected using manual sampling equipment have sample identifiers that contain the surface soil sample location identification (e.g., SS-404). The soil boring program was completed in August and September 2009, with minor modifications, as described in Section 2.3. Off-Property surface soil locations were sampled in 2010 when access agreements for adjacent properties were obtained. Two additional direct-push investigation programs were also completed in 2010 and 2012, and the results are summarized in Sections 2.2.2 and 2.2.3

All soil samples were collected in accordance to the Standard Operating Procedure (SOP) summarized in the FSP. As each boring was advanced to bedrock or refusal, soil logging was conducted (soil type and composition was identified according to the Unified Soil Classification System and the following observations were documented in the boring log prepared for each boring to aid in further defining OU1 geology: depth to water; depth to bedrock, visual evidence of staining, presence or absence of odors, and presence or absence of Non-aqueous Phase Liquid (NAPL) or other non-soil material) were recorded in boring logs. Visual appearance of each four-foot soil sleeve (rotosonic rig) recovered at each soil boring location was photo-documented. In addition, the soil recovered from the borings was screened for volatiles using a photo-ionization detector (PID). PID readings were recorded and incorporated into the boring logs and are summarized on **Table 2.2-4**. Soil sample collection, description, documentation, and shipment, and decontamination procedures were completed per the SOPs found in the RI FSP and the QAPP.

Soil samples were collected from each soil boring as follows:

- The surface soil sample was collected from within the top foot of the first four-foot sleeve recovered from the boring. If VOC and/or VPH analysis was required, the soil sample for VOC and/or VPH analysis was collected, prior to disturbance of the soil, using dedicated syringes for each sample.

- A shallow subsurface soil sample was collected from a two-foot interval within the 1 to 10 foot bgs interval.
- A deep subsurface soil sample was collected from a two-foot interval at a depth between 10 ft bgs and refusal (provided refusal was deeper than 10 feet).

Soil sample designations were assigned consistent with section 7.1 of the FSP. After the borings were logged and soil samples collected, sample containers were immediately placed into a cooler containing ice under proper chain-of-custody (COC) as described in the FSP. All samples were shipped or transferred to the laboratory courier under chain of custody. Copies of the soil boring logs can be found in the **Appendix B** and chains of custody are included in the Data Validation Memoranda included in **Appendix E**.

Many of the soil borings were advanced using a mini-rotosonic drill rig with 6-inch outer diameter drill casing and a 4-7/8 inch diameter inner casing/sleeve. Several borings were advanced using a direct-push track-mounted GeoProbe for areas where the mini-sonic rig would not fit (behind Plant B, the Butler Building, and resource areas/buffer zone to minimize impacts to the environment). A portable direct-push drill probe was used inside the Former Lab, inside the Former Pilot Lab, and inside the Former Office Building due to space/access constraints. Soil borings were advanced using three to five foot steel casing while soil samples were collected in three to five foot acetate sleeves.

Soils samples collected from the surface soil and 1-10 ft bgs interval were analyzed for all parameters identified in the FSP. For the deeper soils, samples were collected and extracted by the laboratory. In accordance with Addendum III of the RI/FS Work Plan, Analysis of Deep Soil Samples (MACTEC, 2010a), the preliminary results for the 1-10 interval sample were reviewed for detections above the industrial screening levels or the presence of tentatively identified compounds in the case of SVOCs, and the deeper soils sample extracts were then submitted for analysis based on those criteria.

2.2.2 November 2010 Soil Sampling and Analysis

To delineate nature and extent of contamination in two areas identified by the August and September 2009 soil sampling and analysis program, an additional 27 borings were advanced via direct-push methods in November 2010. The two target investigation areas include: East of Plant B, near soil boring SB-427; and the northeast portion of the Property near soil boring SB-405. This work was completed specifically in accordance with *Addendum V – OU1 Remedial Investigation Work Plan* (MACTEC, 2010b), and other RI Work Plan requirements. **Tables 2.2-1 through 2.2-3** identify all of the November 2010 RI soil samples for OU1 (samples in those tables are listed in chronological order) and identify the laboratory analysis completed for each sample. Soil samples were collected from 0–1 ft bgs; 1–10 ft bgs, and > 10 ft bgs). Soil borings were screened, logged, and samples collected, preserved and shipped under appropriate COC in accordance with the FSP.

As shown in **Figure 2.2-2**, five additional soil borings (SB-474 through SB-478) were advanced to delineate horizontal and vertical extent of soil impacted by VOCs (TMPs), SVOCs including BEHP, and EPH/VPH along the eastern property boundary behind Plant B. The borings were advanced to refusal using direct-push technology as described in Section 2.2.1 above. Depth of refusal varied from 12–18 ft bgs. Copies of the soil boring logs are contained in the **Appendix B** and chains of custody are included in the Data Validation Memoranda included in **Appendix E**. Borings were not advanced further north or south due to inaccessibility of the steep embankment slope and thick vegetation. Borings could not be advanced further east due to steep topography of the embankment adjacent to East Ditch and the Massachusetts Bay Transportation Authority (MBTA) commuter railway.

In the area of SB-405 (parking lot east of the unoccupied office building), a step-wise investigation was completed to delineate horizontal and vertical extent of soil impacted by TMPs and BEHP as shown on **Figure 2.2-2**. The step-wise program started at location SB-405, and stepped-out in a grid-like pattern in all directions (north, east, south, and west). If PID screening levels were greater than 20 parts per million by volume (ppmv), no samples were collected for laboratory analysis and the next boring was stepped-out 25-feet (in all directions). This process was continued until PID screening values were less than 20 ppmv in all directions starting from SB-405. In total, 22 soil borings were advanced to refusal using direct-push technology as described in Section 2.2.1 above. Depth of refusal varied from 6–13 ft bgs. Three soil borings were advanced inside the basement of the office building (SB-500, SB-501, SB-502). The basement floor was approximately 6.5 ft bgs. Refusal inside the basement varied from 3–5 ft bgs. The concrete basement slab was approximately 0.5 feet thick. Soil logging and screening included bag head space PID measurements. Requested analyses on the 10 soil boring locations (SB-490, SB-494, SB-495, SB-488, SB-496, SB-479, SB-500, SB-501, SB-502, and SB-485) included VOCs (including TMPs), SVOCs, and EPH/VPH. These 10 borings were considered to be the delineation samples for the area. Copies of the soil boring logs are included in **Appendix B** and chains of custody are included in the Data Validation Memoranda included in **Appendix E**.

2.2.3 November/ December 2012 Soil Sampling and Analysis

In response to Olin's submittal of a Preliminary OU1 RI Report (AMEC, 2011), USEPA provided comments concerning perceived data gaps in a series of comment letters to which Olin responded. This sequence of communication led to an agreement concerning the remaining data gaps that were required to fulfill the data needs to prepare an RI report. Olin submitted a Supplemental RI/FS Work Plan to address the remaining OU1/OU2 data gaps on November 16, 2012. USEPA provided a conditional approval letter on December 12, 2012. The work plan included an additional 30 soil borings to be advanced via direct-push methods. This work was completed from December 10 through December 14, 2012. The investigation objectives included: delineation of PCBs in the vicinity of SS-403 and SS-404 (located in the former electrical substation area on the northwest portion of the Property); collection of additional subsurface samples for TMP analysis located in the parking lot at the northeast corner of the Property; delineation of EPH in soils around the former Plant A and Plant C-1; soils analysis for hexavalent chromium (in the former manufacturing areas); delineation of soils for VOCs, SVOCs, EPH, and metals in the vicinity of SB-459; and, collection of additional soil samples for VOCs, SVOCs, EPH, and metals in the on-PWD wetland. An additional 16 surface soil samples were collected for hexavalent chromium analysis in the wetland areas and around the South Ditch to determine presence or absence. Surface water and sediment samples were also collected in the South Ditch, Stormwater Detention Basin, and Central Pond as discussed below. During this investigation soil samples were collected off-Property (east of the Olin Property) in flood plain adjacent to lower South Ditch and is discussed in the OU2 Section of this RI. **Tables 2.2-1 through 2.2-3** identify all of the RI soil samples collected in 2009 through 2013 for OU1.

As shown in **Figure 2.2-1**, additional soil samples (SS-501 through SS-509) were collected (0-1 ft bgs) and (SB-530 and SB-531) were collected (1-3 ft bgs) to delineate horizontal and vertical extent of soil impacted by PCBs in the area of the former Electrical Substation located on the north western portion of the property. Copies of the surficial soil logs are located in **Appendix C**. In the parking lot area, east of the unoccupied office building, soil borings were advanced at previously identified locations to further delineate vertical extent of soil impacted by TMPs from 1-10 ft bgs (SB-480, SB-484, SB-486, and SB-491) as shown on **Figure 2.2-2**. Soil samples were screened by bag head space PID methods in two foot intervals to select locations for intervals for analytical samples. Soil boring logs are presented in **Appendix B**. Soil

samples were collected and submitted for TMP analysis consistent with the approved Supplemental Work Plan

Figure 2.2-1 identifies additional boring locations to assess and delineate nature and extent of impacted soils at the site. Locations SB-532, SB-533, and SB-534 were used to delineate EPH in soils around the former Plant A and Plant C-1. Soil borings SB-503 through SB-513 were advanced to delineate hexavalent chromium around the former manufacturing areas. Four soil borings (SB-414 through SB-417) were advanced to delineate horizontal and vertical extent of VOCs, SVOCs, and EPH of soil in the vicinity of SB-459. Soil borings SB-518 through SB-522 were advanced to delineate VOCs, SVOCs, and hexavalent chromium proximate to the West Ditch Wetland area. Three soil borings (SB-523 through SB-525) were advanced to delineate the extent of hexavalent chromium south of the former manufacturing area.

Copies of the soil boring logs are presented in the **Appendix B**. Requested laboratory analyses included one or a combination of the following: VOCs (including TMPs), SVOCs, EPH, hexavalent chromium, tin, tributyl tin, and PCBs. Copies of the chains of custody are included in the Data Validation Memoranda in **Appendix E**. The finalized *Supplemental Work Plan – Operable Unit 1, Olin Chemical Superfund Site, Wilmington, MA* (originally submitted November 16, 2012 and conditionally approved by USEPA) was submitted to USEPA on March 19, 2013.

Surface soil, surface water, and sediment samples collected during the November and December 2012 investigation are described in the following sections below. The November sample was the last surface water and sediment sample scheduled for collection in East Ditch.

2.2.4 Surface Water and Sediment Sampling

Sections 4.3 and 4.4 of the FSP outlined the surface water and sediment investigations, respectively. **Tables 2.2-5 through 2.2-8** identify the samples, location identification, sample date, and chemical analyses completed for each of the RI surface water and sediment samples. **Figure 2.2-3** identifies the 2010 OU1 RI surface water sample locations and **Figure 2.2-4** identifies the 2010 OU1 RI sediment sample locations.

On December 9th and 10th, 2010, five surface water samples (ISCO-2, SD-1, PZ-16RR, PZ-17RR, and ISCO-1) and five sediment samples (ISCO-2, SD-1, SDSW-E, SD-SD3, and SD-SD2) were collected within the South Ditch. The samples were collected from down-stream to up-stream in accordance with the FSP. All field parameter measurements (temperature, specific conductivity, dissolved oxygen (O_2), pH, oxidation/reduction potential, and turbidity) and notes are documented in a field log book and on the surface water/sediment FDRs located in **Appendix D**.

Surface water samples were collected using the direct-dip method, where sample containers are gently lowered into the water with container openings oriented upstream, allowing the samples to be collected directly into the container. Containers were never completely submerged to prevent the loss of sample preservatives. Sediment samples were collected using a stainless steel hand auger. After advancing the auger from the sediment surface to 0.5 ft bgs, the auger was then removed and sediment was collected from the auger and placed into a stainless steel bowl. To meet sediment volume needs, multiple advancements were required from the same depth interval in areas immediately adjacent to the initial sample location. Following sample collection, and before shipment of the sample to the laboratory, additional water was decanted from the sample to increase the effective solids content.

On June 6, 2011, a second round of surface water sample collection was completed from the same five locations. Samples were collected and analyzed for the same parameters as described above. **Tables 2.2-5 through 2.2-8** summarizes surface water and sediment samples collected and laboratory analysis completed on each sample. Copies of the surface

water/sediment FDRs can be found in the **Appendix D** and chains of custody are included in the Data Validation Memoranda included in **Appendix E.**

On December 17, 2012 two sediment samples (OC-SD-SD-501-XXX and OC-SD-SD-502-XXX) and one surface water sample (OC-SW-SD-501-XXX) were collected from the Central Pond and two sediment samples (OC-SD-SD-503-XXX and OC-SD-SD-504-XXX) and one surface water sample (OC-SW-SD-503) were collected from the Stormwater Detention Basin. In addition, two surface water samples (OC-SW-SD-1-XXX and OC-SW-PZ-17RR-XXX) were collected from the South Ditch. **Tables 2.2-5 through 2.2-8** identify the laboratory analysis completed for each of the surface water and sediment samples respectively. Copies of the surface water/sediment FDRs can be found in the **Appendix D** and chains of custody are included in the Data Validation Memoranda included in **Appendix E.**

2.2.5 Periodic Monitoring

Periodic monitoring of surface water and sediment sampling from the South Ditch area has been conducted over the past several years. These activities have been completed consistent with the requirements and procedures contained in the *Final IRSWP, Olin Chemical Superfund Site, 51 Eames Street, Wilmington, Massachusetts* (MACTEC, 2008) and the *Volume IIIB, the Quality Assurance Project Plan, of the Final RI/FS Work Plan* (MACTEC, 2009a).

Surface water samples have been collected from the South Ditch and submitted for laboratory analysis on a quarterly basis (February/March, May, August, and November) under the IRSWP (MACTEC, 2008). Sample locations are identified as: ISCO-1, ISCO-2, PZ-16RR, PZ-17RR, PZ-18R, and SD-17 (**Figure 2.2-3**). Surface water sampling has been conducted in the same manner as described above in Section 2.2.4, with the exception of a field filtering for metals analysis. Copies of the surface water FDRs can be found in the **Appendix D**. Data Validation Memoranda (including COCs) concerning the IRSWP surface water and sediment field programs have previously been submitted in the Semi-Annual Status Reports (No. 6 through No. 11) for the Site (MACTEC, 2010c; AMEC, 2011a,b,c, 2012, 2013). Field Activity Reports documenting the sampling activities for these events have also been included in the Semi-Annual Status Reports. Surface water samples collected and laboratory analysis completed on each sample are summarized in **Table 2.2-5**.

IRSWP sediment samples have been collected annually (November) from the Upper West Ditch, South Ditch and Central Pond areas. Sample locations are identified as SD-SD-1, SD-SD-2, SD-SD-3, SD-SD-4, and SD-SD-5 (**Figure 2.2-4**). Sediment sampling procedures are the same as described above in Section 2.2.4, with the exception that the sample equipment used was a shovel. Copies of the sediment FDRs can be found in the **Appendix D**. Sediment samples collected and laboratory analysis completed on each sample are summarized in **Table 2.2-5**.

2.2.6 Air Monitoring

Section 4.5.2 of the FSP indicated that air monitoring of the work environment would be undertaken during intrusive activities (soil borings, well installation, and sampling activities) to ensure that the personal protective equipment and engineering controls utilized at the Site are sufficient to ensure worker safety. During the first week of drilling, downwind air was monitored periodically with a respireable dust meter to verify drilling did not create a fugitive dust concern. During the OU1 RI soil boring and surface soil sampling the health and safety air monitoring was conducted using a MiniRae 2000 PID to monitor the breathing zone in the vicinity of the drilling rig for VOCs and a Vrae Multi-Gas Monitor PGM 7800 (soil borings only) to monitor the breathing zone for carbon monoxide (CO), per cent O_2, hydrogen sulfide and Lower Explosive Limit for combustible gases. Air monitoring results were documented primarily in the Health and

Safety Logbook but notes were also included on FDRs and in the OU1 soil boring logbook. During the 2009 through 2013 OU1 RI, no hazardous conditions were identified or observed during drilling air monitoring activities.

2.2.7 Sediment Toxicity Testing

Section 4.4.1 of the FSP called for selection of the sediment sampling location with the highest hazard index in the Lower South Ditch area for a 42-day chronic exposure *Hyalella azteca* whole sediment toxicity testing for survival, growth, and reproduction. On February 17, 2011, sediment was collected in the South Ditch to be used for the Sediment Toxicity testing at location ISCO-2. Sediment was collected as described in Section 2.2.2 and in accordance with the FSP. The collected sediment was transferred, at the Property and under COC, to a representative of Envirosystems, Inc. on the day of sample collection. The toxicity testing report is included as **Appendix G** of this report, and is discussed in Section 7 and in the BERA (BERA Attachment 6 in **Appendix N**). Appendix G has been supplemented by addition of two tables that provide additional summary of the results and identification of the statistical tests and P-values for the test endpoint comparisons. **BERA Attachment 9** includes the South Ditch Toxicity Test Memorandum previously submitted to USEPA and dated April 29, 2015. The memorandum provides a summary of the sediment samples, the test procedures, and the results of the test.

2.2.8 Vapor Intrusion Screening

Consistent with Section 4.5.3.1 of the FSP, a Tier I screening of groundwater and unsaturated zone soil analytical data for VOCs and volatile SVOCs to address potential for vapor intrusion has been conducted using available soil data and shallow groundwater data from the May 2010 groundwater sampling program. Section 6.0 discusses and summarizes results and risks from the vapor intrusion screening for the TMP area, Plant B area, and areas for potential future construction.

2.3 OU2 Remedial Investigations

Consistent with the FSP contained in Volume III-A of the August 2009 Work Plan (MACTEC, 2009a) the 2009 through 2013 RI sampling objectives for OU2 were to:

- Confirm and refine previous investigation findings;
- Confirm the nature and extent of site related contaminants;
- Collect surface water flow measurements in the MMB wetland area; and
- Collect additional data for the human health and ecological risk assessments

The OU2 investigation consists of soil sampling from off-Property areas adjacent to the Property, sampling surface water (two events), sampling sediment (from 0-6 inches bgs) (one event) within Maple Meadow Brook, Sawmill Brook, off-PWD, East Ditch, and Landfill Brook, and stream gauging data from off-Property locations.

The following subsections describe the work completed for soil sampling, surface water sampling, sediment sampling, and surface water flow measurements conducted for OU2 in the RI. Each of these field activities were completed in accordance with the FSP contained in Volume III-A of the August 2009 Work Plan (MACTEC, 2009a) that was approved by USEPA and the *Quality Assurance Project Plan* contained in III-B of the August 2009 Work Plan (MACTEC, 2009a). **Table 2.3-1** identifies the RI soil samples collected in 2009 through 2013 for OU2 collected from the 0-1 and 1-3 ft bgs interval, the sample identification, sample location, sample date, and the laboratory analyses requested for each sample.

2.3.1 OU2 Soil Sampling June 2010, June 2011, December 2012, and March 2013

As described in Section 2.2.3, off-Property surface soil samples were collected to further define nature and extent of contamination associated with the site. In June 2010, off-Property surface soil samples were collected in an area east of the site, adjacent to the lower South Ditch. Surface soil locations are identified as SS-438, SS-439, SS-441, and SS-443 through SS-437. In June 2011, off-Property surface soil samples were collected west of the site, along the former PanAM Railway. Surface soil locations are identified as SS-433, SS-448, and SS-452. In December 2012, additional off-Property surface soil samples were collected in the Lower South Ditch area to further determine nature and extent of results from the 2010 Investigation. Soil samples were collected from 0-1 ft bgs and 1-3 ft bgs at locations SB-526 through SS-529. **Figure 2.2-1** identifies the 2009 through 32012 OU2 RI soil sample locations. **Tables 2.3-1 and 2.3-2** identify all of the RI soil samples collected in 2009 through 32012 for OU2. The samples are listed in the table in chronological order. Copies of the surface soil FDRs are presented in **Appendix C** and chains of custody are included in the Data Validation Memoranda included in **Appendix E**.

In March 2013, additional investigation activities were completed at North Pond as described in Addendum I – North Pond Investigation January 29, 2010 of the approved RI Work Plan. A summary of all soil borings FDRs; results; tables; and figures are provided in **Attachment D**.

2.3.2 Surface Water Temperature Profiling

A surface water temperature profile (survey) was conducted at regular interval on three distinct reaches of Landfill Brook, Maple Meadow Brook, and Sawmill Brook in November 2010 prior to collecting surface water samples. The objective of the survey was to identify potential point discharge locations of groundwater along the reaches of the three brooks surveyed. The survey was conducted for the purpose of locating surface water and sediment samples in areas where groundwater was thought to be discharging to surface water. Surface water temperatures were measured along each reach in approximate 50 foot intervals with each measurement point located using a global positioning system with sub-meter accuracy. The results of the survey are presented in the Temperature Profile Trip Report dated January 27, 2011, attached in **Appendix H**.

Temperatures in Landfill Brook ranged from 5.7 Cº to 8.8 Cº. The expected groundwater temperature, based on recent groundwater sampling was approximately 11 to 12 Cº. The temperatures in Sawmill Brook ranged from 6.8 Cº to 10.3 Cº and in Maple Meadow Brook ranged from 6.8 Cº to 12.2 Cº. The expected ground water temperature in the vicinity of these brooks, based on recent groundwater sampling was approximately 9 to 12 Cº. While the seasonal timing of the profiling was set by access agreements, and was not ideal for temperature contrasts, the results of the survey did not identify any temperature anomalies that would be indicative of point discharges of groundwater to the brooks. This is consistent with the generally homogeneous nature of substrates in each stream channel. Two surface water and sediment sampling locations along Landfill brook were moved, based on field observations and property access issues. The lower (downstream) sample along Landfill brook was moved upstream to land owned by the Town of Woburn. The mid-point sample location was also moved upstream from its proposed location based on field observations (i.e. manmade structures adjacent to the brook channel).

The trip report was submitted to USEPA and a copy is included in **Appendix H**. No additional temperature survey work was recommended by the USEPA.

Piezometer Installation. In addition to the temperature profile, three drive point piezometers were installed in Maple Meadow Brook and Sawmill Brook to measure shallow groundwater gradients. Piezometers were installed at surface water and sediment sampling locations MMB-SW/SD-1, MMB-SW/SD-3, and MMB-SW/SD-5.

The installation and initial measurements of piezometers (co-located at surface water and sediment sampling locations) are identified in **Appendix H**. The piezometer installed at location MMB-SW/SD-1 did not show a shallow vertical groundwater gradient. This piezometer was installed in mineral versus organic sediments. The other two piezometers were installed within the Maple Meadow Brook wetland, where sediment is dominated by histic (organic) sediment. These piezometers were installed several times as initial installations did not yield water or were very slow to equilibrate and indicated apparently anomalous downward gradients. The piezometers installed in the organic substrate may not be reliable measurement devices for gradient observations. The sediment at these two locations is composed of sapric to fibric organic peat material, which does not readily give up water, due to its extremely high water holding capacity. However, follow up measurements collected during the May 2011 synoptic round, Spring 2011 OU2 Sampling and Fall 2011 synoptic round, showed that over time the piezometers in the peat material did equilibrate but are unlikely to be sensitive to dynamic changes in the water table. The piezometer water level measurements are provided in **Table 2.3-3.**

2.3.3 Surface Water and Sediment Investigations

Sections 5.1 and 5.2 of the FSP outlined the OU2 surface water and sediment investigations, respectively. **Tables 2.3-4 through 2.3-7** identify the samples, location identification, sample date and chemical analyses completed for each of the OU2 RI surface water and sediment samples. **Figure 2.2-3** identifies the 2009 through 2013 OU2 RI surface water sample locations and **Figure 2.2-4** identifies the 2009 through 2013 OU2 RI sediment sample locations.

During the first two weeks of December 2010, 11 surface water samples and 11 sediment samples were collected within Maple Meadow Brook Wetland, three surface water and three sediment samples were collected within the off-PWD, three surface water and three sediment samples were collected within Landfill Brook, and four surface water and two sediment samples were collected within the East Ditch. Access was not granted to the most southern sample location in the East Ditch until June 2012 when one surface water and one sediment sample was collected. During the first week in June 2011 and on November 6, 2012, a second round of surface water samples was collected from the same 22 locations. All samples were collected from down-stream to up-stream in accordance with the FSP. All field parameter measurements and notes were documented in a field log book and on the surface water/sediment FDRs.

Tables 2.3-4 through 2.2-7 summarizes surface water and sediment collected and laboratory analysis completed on each sample. Copies of the surface water/sediment FDRs can be found in the **Appendix D** and chains of custody are included in the Data Validation Memoranda included in **Appendix E**.

In June 2013, additional surface water and sediment investigation activities were completed at North Pond as described in Addendum I – North Pond Investigation January 29, 2010 of the approved RI Work Plan. A summary of all surface water and sediment FDRs; results; tables; and figures are provided in **Attachment D**.

2.3.4 Stream Gauging

Stream flow measurements were collected from three locations within the Maple Meadow Brook wetland complex on a monthly basis for one year beginning in April 2011 and ending in March 2012. Inflows to the wetland complex were measured at an upstream location where the main

branch of Sawmill Brook, crosses under Chestnut Street through a pair of culverts (Inlet 1) and at an upstream location where Maple Meadow Brook crosses the Spinazzola Landfill access road (Inlet 2). The discharge from the wetland complex was measured after the confluence of Maple Meadow Brook and Sawmill Brook at the former canal bridge structure (Outlet). See **Figure 2.2-3** for stream gauging locations.

Stream flow measurements were collected using a Marsh – McBirney (Flow Mate) Portable Flow Meter (Model 2000). The stream discharge (Q) at each of the three locations was measured using the Velocity-Area Procedure (USEPA, 1998). This method combines measurements of the mean velocity and flow cross-sectional area along evenly divided increments across a channel.

The results of the monthly stream flow measurements are summarized in **Table 2.3-8**. The results indicate the discharge from the wetland complex exceeds the combined inflows for eleven out of the twelve months, supporting the CSM that ground water is discharging to the wetland complex. Differences in discharge as compared to inflows ranged from a low of 1.3 ft^3/ second to a high of 22.4 ft^3/ second. The hydrology of groundwater / surface water interaction in the MMB Wetland is complex and difficult to monitor due to the thick sections of peat that underlie the wetland and the low hydraulic conductivity and water retention characteristics of the these types of peat deposits. The measurements collected in July indicate there was a 0.2 ft^3/ second less water discharging from the wetland complex, as compared to measured inflows. That data could indicate the wetland complex may lose surface water to groundwater in some summer months during lower periods of precipitation. The MMB area is a submerged or emergent wetland complex for most of the growing season. In addition to direct evaporation, transpiration of vegetation results in interception of groundwater available for discharge and loss of surface water used directly by aquatic plants. The effect of evapotranspiration is to reduce the volume of water available for outflow during the summer growing season. The apparent loss of outflow in summer months may reflect those effects. As discussed in Section 3.3, horizontal groundwater gradients in the underlying MMBA are very flat and vertical gradients are typically weak showing both divergent (including downward) gradients in some deep well pairs, and upward gradients in most shallow well pairs, indicating shallow groundwater discharge and a predominance of horizontal groundwater flow within the thicker aquifer sections. The discharge of groundwater to the surface water is likely to be moderated by the thick peat deposits and groundwater discharge will favor areas where the peats are thinner and stream substrate has lower organic (and more mineral) content.

One of the data limitations for calibration of the existing groundwater model was a limited data set on stream flows. While it is not possible to capture all the inputs in such a large and dynamic wetland complex, this data represents a substantial improvement in quantifying this surface water flux. Since stream piezometers installed in the peat under the stream do not provide reliable head data, and hydraulic gradients only indicate a head potential for groundwater movement, the approximate mass balance of stream flows provided lends a degree of confidence that the wetland complex represents a shallow groundwater discharge condition.

2.4 Off-Property Background Soil Samples

Section 3.2 of the FSP proposed the collection of surface soil samples at six off-Property locations to characterize soil background conditions. Those off-Property soil background soil samples were not collected in deference to an USEPA preference for collection of background samples within the same watershed and locality as the site. As explained in the *Addendum V – OU1 Remedial Investigation Work Plan* (MACTEC, 2010b) the analytical data associated with the summer 2009 surface soil samples (SS-434, SS-435, SS-449, SS-450, SS-451, SS-453,

SS-454, SS-455, and SS-460) collected in the conservation area is used as the background data set. USEPA has agreed with the use of this background dataset at a meeting on February 5, 2013. These background soil sample locations are shown on **Figure 2.4-1**. **Table 2.4-1** summarizes the sample identification, sample date, and laboratory analysis completed on each sample. **Table 2.4-2** summarizes statistics for detected parameters and data for background surface soil samples representative of current OU1 conditions. The background soil data summary memo is attached in **Appendix I**.

2.5 Background Surface Water and Sediment

Background surface water and sediment samples were collected to characterize background conditions as described in the FSP. The three background surface water locations (SDBK-001, SDBK-002, and SDBK-004) and four sediment locations (SDBK-001, SDBK-002, SDBK-004, and SDREF-012) are shown on **Figure 2.5-1**. By later agreement with USEPA, surface water and sediment samples from SDBK-002 and SDREF 012 will not be used as reference locations due their proximity to the Spinazzola Trust Landfill. Reference location SDBK-001is used for the East Ditch, and reference location SDBK-004 is used for MMBW. Background surface water and sediment data for the East Ditch are summarized in **Tables 2.5-2a** and **2.5-3a** respectively, while background sediment results for the MMBW are summarized in **Tables 2.5-2b** and **2.5-3b**, respectively. OU1 stream locations are head watered either entirely within the Site and on adjacent property and do not have upstream conditions suitable as a reference location. This includes the off-PWD, on-PWD and South Ditch, the Stormwater Detention Basin, Central Pond, Landfill Brook and North Pond.

2.6 Work Plan Modifications

During completion of the field programs, minor modifications were made to the proposed sampling plan and are summarized below. These changes were communicated to USEPA and agreed to in the field.

2.6.1 Soil Investigations

During the 2009 through 2013 soil investigations, the following deviations from the proposed soil sampling plan occurred.

- One angled boring was advanced at SB-450 to sample under a foundation that could not be penetrated.
- Track-mounted GeoProbe was used instead of rotosonic rig for borings in wetlands.
- Shallow depth of refusal of direct-push sampling equipment that was used within building structures (SB-401, SB-402, and SB-408 within the former laboratory and SB-400 within the Butler building)
- Boring SB-400: refusal was encountered at 7 ft bgs. The hand-mobile GeoProbe was replaced with a track-mounted GeoProbe to attempt further advancement of the boring however; refusal was encountered at 8 ft bgs. No samples were collected below the 5-7 ft bgs depth interval during the initial boring on August 26, 2009. Using a more powerful direct-push drill rig, a sample was collected on September 18, 2009 from the 17-19 ft bgs interval and submitted for laboratory analysis.
- Borings SB-427 and SB-428: moved several feet east and are located in the middle of the asphalt paved driveway.
- Boring SB-434: moved several feet to the southwest due to safety concerns with a power line.
- Boring SB-422: moved several feet west due to safety concerns with a power line.

- Boring SB-452: moved several feet east due to safety concerns with a power line.
- Boring SB-454: moved several feet north, where the loading dock and train tracks are located, instead of being drilled on the middle of the loading ramp.
- Surficial soil locations SS-456, SS-458, SS-459, and SS-461 were moved east, inside the Olin fence line.
- Surface soil locations SS-439, SS-441, SS-445, and SS-447 were moved slightly west, to the base of the railway berm.
- Off-Property surface soil locations along the CSL access road (SS-433, SS-448, and SS-452) were collected later in June 2011 due to a delay in access.
- Off-Property surface soil samples SS-438, SS-439, SS-441, SS-443, S-444, SS-445, SS-446, and SS-447 were collected in June 2010 due to timing of access.
- Based on field observations, analytical parameters were added to several samples in order to obtain analytical data related to field observations (evidence of oil or petroleum, for example). The list of samples and added parameters is included in **Table 2.6-1**.
- Boring SB-509 was moved to the east out of the wetland area.

In addition, deep soils samples were not collected from several locations due to shallow refusal, and while not technically a deviation from proposed work, these locations are noted below.

- Borings SB-504, SB-505, SB-509, SB-510, and SB-534: No samples were collected > 10ft bgs due to shallow refusal.
- Boring SB-401: refusal was encountered at 9.5 ft bgs. No samples were collected below the 7-9.5 ft bgs depth interval.
- Boring SB-402: refusal was encountered at 9.5 ft bgs. No samples were collected below the 7-9.5 ft bgs depth interval.
- Boring SB-408: refusal was encountered at 9 ft bgs. No samples were collected below the 7-9 ft bgs depth interval.
- Boring SB-431: refusal was encountered at 9 ft bgs. The rig was moved 5 feet south, and a second boring was advanced, however refusal was encountered at 8 ft bgs. No samples were collected below the 7-9 ft bgs depth interval

2.6.2 Surface Water/ Sediment Investigations

During the 2009 through 2013 surface water/ sediment investigations, the following deviations from the proposed soil sampling plan occurred.

- Property access was granted to collect surface water and sediment samples in December 2010 and June 2011.
- Background surface water and sediment samples were not collected at locations SDBK-003 and SDBK-014 as described previously.
- Access was not granted at location EDSD/SW8. Instead, surface water and sediment samples were collected upstream at location EDSD/SW7 in June and November 2012.
- Two surface water and sediment sampling locations along Landfill Brook were moved, based on field observations and property access issues. The most downstream sample (LB-SD/SW3) was moved upstream to land owned by the Town of Woburn. The mid-point sample (LB-SD/SW2) was moved upstream based on field observations (i.e. manmade structures adjacent to the brook channel).
- Sediment samples were not collected at locations EDSD/SW0, EDSD/SW1, and EDSD/SW5 in the East Ditch due to railroad ballast and lack of sediment to sample. Diligent efforts were made to locate sediment upstream and downstream of the

proposed locations, without success. Organic sediment is not currently present throughout most of the East Ditch adjacent to the MBTA line.

3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA AND LAND USE

The following subsections provide a general description of both the regional and local (i.e., site specific) physical features including topography, geology, hydrogeology, surface water, meteorology, land use and ecology. As noted in Section 2.0 of this report, a large number of investigations have been conducted at the Site primarily under regulatory authority of MassDEP and have contributed greatly to the current understanding of Site physical characteristics. Additional information is available in the 2007 Draft FRI (MACTEC, 2007).

3.1 Topography

The developed northern portion of the Property is essentially flat with the ground surface located at an elevation of approximately 85–95 feet above MSL. The undeveloped, southern portion of the Property consists largely of wetlands and mature forest lands and has slightly more topographic relief as compared to the more developed northern portion. The topographic features include an east-west trending low lying area that forms the South Ditch and Ephemeral Drainage and includes Central Pond, and a storm water detention pond located between the containment area and South Ditch. This low lying area is intersected at the Property boundaries by the East and West Ditches. These features are part of the interconnected drainage system that border two sides of the Property and that cross the center of the Property. Each of these surface water bodies occupies lower topographical areas and are shown on **Figure 3.1-1**. In the vicinity of the South Ditch and the Ephemeral Drainage, topography ranges in elevation from approximately 80 feet MSL in the west, sloping to an elevation of approximately 77 feet MSL to the east along the course of the East Ditch system. A small upland knoll is present between the South Ditch and the Ephemeral Drainage, and attains an elevation of 86 feet MSL.

The topography adjacent to the Property ranges from low lying wetlands to flat paved industrial areas. The land north of the Property is developed and is generally flat. The MBTA rail line creates and occupies a topographic low along the eastern side of the Property. Immediately east of the Property, across from the MBTA line the area is mostly commercially developed land that is paved or landscaped and generally flat but with a gradual topographic rise directly to the east attaining elevations approximately 115 feet above MSL. A low ridge runs along the southern boundary of the Property and reaches a maximum elevation of 108 feet MSL. The CSL was constructed on the western end of this ridge. The WSL is immediately south of the property beyond which the land becomes lower in elevation and flatter (80 feet MSL) draining to wetlands to the southwest, toward Landfill Brook and Halls Brook.

The area immediately west of the northern portion of the Property includes commercially developed lots along Jewel Drive, and Eames Street and then residential lots along Main Street that are all relatively flat. The area immediately west of the southern portion of the Property includes a small hill or knoll that extents to 140 feet MSL which includes several residences along Cook Avenue and Border Avenue in Wilmington. Additional residential development is present further to the southwest in North Woburn. To the northwest of the Property, on the western side of Main Street in Wilmington, the topography drops to lower elevations and is relatively flat at 80 feet MSL near and within the MMB wetland. The MMB wetland is bordered by upland areas to the west of Chestnut Street, and to the north by a broad ridge that runs parallel to Butters Row.

As described in the RI/FS Work Plan (MACTEC, 2009) an accurate delineation of the wetland boundary using the USACE, 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) was completed. This included 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 for OU1 and OU2. The flood plains have been determined to be immediately adjacent to the streams within the areas of mapped wetlands. South Ditch flood plains are included on **Figure 3.1-1**

3.2 Geology

This section summarizes the geology of the Site based on the available historical information and the additional information collected during the OU1 RI soil investigation. This section includes discussion of fill material including concrete foundation slabs where they were drilled to investigate underlying soils, and the confirmation of the backfill material in the former Lake Poly area.

3.2.1 Unconsolidated Overburden Deposits

The following paragraphs describe the overburden stratigraphy (from ground surface to bedrock) observed within the former facility areas of the Site during the 2009 and 2010 OU1 RI soil investigation. As described in Section 2.2, a total of 74 soil borings were advanced by sonic and direct-push methods to refusal and in November 2011, and December 2012 an additional 57 borings were advanced by direct-push methods for the purpose of collecting soil samples for chemical analysis and classifying the subsurface soils. Based on these borings, and information from existing borings, the native geologic sequence includes unconsolidated organic materials and quaternary glacial deposits (ice contact deposits, outwash deposits and glacial till) over igneous and metamorphic bedrock. These unconsolidated deposits are overlain by fill and the concrete foundation slabs. The observed thickness of the overburden at the former facility ranges from 6.5–37.5 feet from ground surface. The overburden ranges in thickness from 12–15 feet in the area of the former office building and the Plant B Production Area and thickens to 37.5 feet near the former wastewater treatment plant at the southern end of the East Warehouse. Additional detail on both overburden and bedrock geology for the Site in general is provided in the Draft FRI (MACTEC, 2007).

The location of completed soil borings is provided on **Figure 2.2-1**. The location of geologic and hydrogeologic cross sections is presented on **Figure 3.2-1**. The relationships and thickness of the unconsolidated deposits is depicted in three cross sections which are located on **Figures 3.2-2 and 3.2-3.** These sections were based primarily on new continuous soil borings installed as part of the RI/FS Work Plan. These sections were reviewed against the logs of older borings near the section alignments and are consistent with older geologic information. Additional cross sections were prepared for three on-Site areas: former Lake Poly **(Figure 3.2-4)**, the Plant B area **(Figure 3.2-5)** and the TMP area **(Figure 3.2-6)**. Cross sections for the MMBW that were presented in the RI/FS Work Plan are provided in **Figures 3.2-7** through **Figures 3.2-9**.

Concrete Slabs. Concrete slabs were drilled at 29 locations during the subsurface investigation. Typically, the concrete was exposed at the ground surface and was from 0.3 to 1 foot thick. The Plant D Tank Farm slab was thicker (1.4–1.6 feet) and the thickest concrete encountered (3 feet) was at the Plant C-1 area in SB-431. Based on the driller observations, the concrete appeared to be quite competent and rebar was not encountered. The concrete slabs therefore reduce the amount of precipitation infiltrating vertically over a portion of the former manufacturing facility.

Fill Material. Based on the depth and distribution of native soil deposits under the developed industrial portion of the property, fill soils were used to bring the ground surface to grade for construction. Fill soils may include some imported material and local soil that has been re-graded. Fill material was identified over the entire developed portion of the site ranging in thickness from 1–12 feet. The sub-grade material beneath the asphalt and concrete slabs is a well graded sand and gravel material (i.e., wide range of grain size). The sub-grade material is typically underlain by uniform sand that appears to be native soil or a locally reworked native soil. Unless debris or foreign materials were present in this uniform sandy material, it was often difficult to distinguish fill, including reworked native soil, from undisturbed native material.

The sub-grade material was typically 1–2 feet thick under asphalt pavement and 2–10 feet thick under the concrete slabs. The greatest thickness of fill (10–12 feet) was encountered beneath the East and West Warehouses. A fill thickness of 2–5 feet was encountered under the concrete slabs of the former Plant A/Plant C-1, Plant B Production Area, Plant C-2/Plant C-3/Maintenance Shop, Plant D, the Plant D Tank Farm, and the Finished Product Storage Buildings. Locally greater thicknesses of fill were encountered; particularly at Plant C-1, and the Plant B area.

Lake Poly Backfill. At the request of USEPA, soil boring SB-448 was drilled in the area of the Lake Poly backfilled soil excavation to confirm backfill that was placed and evaluate current soil conditions. The boring encountered geotextile fabric at 2.5 ft bgs, gravel rip-rap fill from 2.5–9 ft bgs and another layer of geotextile fabric at 9 feet. Sand and more riprap fill were encountered under the geotextile to a depth of approximately 13 ft bgs. The fill materials were underlain by the native soils consisting of sandy till with varying amounts of fines. Bedrock was encountered at approximately 19 ft bgs.

Peat/Organic Silts. Locally, peat deposits are encountered in the western portion of the former facility (west of and including soil borings SB-400, SB-404, SB-410, SB-430, SB-435, and SB-453) and the eastern portion of the facility located south of Plant B (east of soil borings SB-442, SB-451, SB-455, SB-468, SB-462, SB-467, SB-471, and SB-473. The organic peat layer is typically encountered at or just below the ground surface and ranges from very dark brown, organic peat to dark brown stratified organic silt and sand. In some low lying drainage swales, the peat is encountered at the ground surface but more typically the peat layer, where present, is overlain by fill material and/or sandy alluvial material and encountered at depth of 2–11 ft bgs.

The organic materials encountered on site were generally quite thin (less than 0.5 feet). However thicker units (2–4 feet in borings SB-429 and SB-430) were encountered at the edges of the facility property nearest the boggy swales. These deposits pinch out towards the center of the site.

Ice Contact and Outwash Deposits. These units are present below the peat, and in the former facility areas directly below the fill. These deposits are described as yellow-orange, light brown, tan, and gray and consist of layers of fine, clean sand interbedded with sand, gravel and cobbles. Sandy deposits, where present above the peat, are probably alluvial in origin.

Generally, the deposits underlying the fill at the site were composed of 2–10 feet of uniform fine to coarse sand which grade into a coarser sandy gravel material with depth, although the nature of these transitions vary locally. As little as 5 feet of fill and outwash material was encountered in the central part of the Property in the vicinity the former Plant B Production Area and over thirty feet of outwash deposits were encountered at the south end of the Property. Cross section S-N on **Figure 3.2-2** and Section E-W on **Figure 3.2-3** indicate that the overburden thickens in the southern and southeastern portions of the developed facility property in the vicinity of East Warehouse and Former Plant D. The thickest sequences of transmissive clean sandy gravels were encountered in SB-459, SB-461, SB-470, and SB-472 (see Section S-N).

Glacial Till. Both basal till and ablation till have been identified in the overburden soils within the site. Ablation till is deposited as stagnant ice melts through ablation or at the front or toe and sides of a glacier as it retreats (ablates), forming lateral and end moraines, which are often distinctive landforms. These ablation till deposits are generally loose and poorly sorted and consist of well graded sands and gravels with less silt and clay sized particles than basal tills.

The ablation till encountered at the site was characterized by the presence of cobbles and silt and was well graded compared to the relatively uniform gradation of the ice contact and outwash deposits. The depth to the top of the ablation till varied from 5–32 ft bgs across the former facility.

Basal, or lodgment till, is deposited at the base of the glacier through lodgment or melt-out processes, and tends to consist of well graded fine to coarse sand and gravel and may contain appreciable amounts of silt and clay-sized particles. Basal till is located directly over the bedrock and may have a lower transmissivity than the ablation till depending on its density and fines content.

The interpreted basal till encountered at the site was distinguished from the ablation till by the higher fines content, and, although it did not have the dense clay silt matrix typical of many basal tills, it generally had enough silt to appear as a cohesive soil. The distinction between basal till and ablation till at the site is often indistinct. The Rotosonic drilling method does not provide a relative measure of the density of the soils (such a penetration blow counts) and the classification of basal versus ablation till is subjective being based on the silt content and cohesive texture.

The basal till underlay the ablation till over much of the Property and was typically encountered in thicknesses of 1–6 feet. Basal till was not observed at sixteen locations across the central portion of the site in the area of Plant A and Plants C-1 through C-3. Greater than 10 feet of basal till was observed at two locations SB-430 (11') and SB-471 (19.5').

Subsurface soils under the on-site water bodies (on-PWD; South Ditch; Central Pond) are in general, similar to other areas on the Site. These soils include recent organic sediment; over uniform, fine to coarse glacial outwash sand w/some gravel. The Detention Basin was blasted into bedrock and sediment primarily consists of detritus from decayed vegetation.

3.2.2 Bedrock Geology

Generally, bedrock below the Site is associated with the Composite Platform of Southeast New England or more specifically the Milford-Dedham Zone (Smith, 1997). This zone includes late Proterozoic and early Paleozoic rocks that lie between the Bloody Bluff Fault and the Northern Boundary Fault of the Boston Basin. The area northwest of the Bloody Bluff Fault is called the Nashoba Zone and is predominantly made up of late Proterozoic mafic meta-volcanic and metavolcaniclastics (i.e. Andover Granites). The area southwest of the Bloody Bluff Fault is called the Milford-Dedham Zone and is predominantly made up of gabbro-diorites. The Milford-Dedham Zone and the Nashoba Zone were separate tectonic plates that were joined together at the Bloody Bluff Fault, creating a mylonite fault zone. The Burlington Mylonite Zone has been characterized as a 3-mile wide zone around the Bloody Bluff Zone where the bedrock has been severely deformed.

Geologic mapping has identified two primary classes of bedrock: mylonites and intrusives. Both may very texturally and in composition and both are found within the Site. The mylonites are formed within fault zones and are metamorphosed by the pressure and heat generated along the fault zone and locally include hornblende-biotite schists. The intrusives are igneous rocks that are formed by the cooling of molten rocks, and include gabbrodiorites that formed later in

dikes and fractures. However, in some areas they have been altered to metamorphic rocks, such as the hornblende-biotite schist identified in some rock cores (Smith, 1997).

The igneous rocks are predominantly gabbro and diorite complexes and include small intrusive bodies and dikes. The different gabbro-diorites include un-deformed or normal gabbro-diorites, gabbro-diorite cataclastics, and gabbro-diorite with granite intrusives. (Smith, 1997). The normal gabbro-diorites are fine-grained, weakly foliated and moderately resistant to weathering and erosion. The cataclastic gabbro-diorites are more easily weathered, and in turn are found in the topographically lower terrain with more gentle slopes. These rocks underlie the central portion of the facility and the South Ditch, as well as the area between Main Street and the east edge of the MMB Wetland, both north and west of Eames Street. The gabbro-diorite with granitic intrusions is the most competent bedrock type within the study area. These rocks outcrop at the elevated areas near the CSL and near Cook Avenue, between Jewel Drive and Main Street.

The OU1 soil investigation program expanded the number of data points available to interpret the depth and surface of underlying bedrock. These data points have been combined with existing data to update the interpretation of the bedrock surface under the former facility. The ground surface elevations of the soil borings are estimated based on existing topographic information. The updated bedrock surface is presented in **Figure 3.2-10** and is consistent with earlier interpretations, though the new data set provides additional detail in a number of areas. The former interpretation identified a broad bedrock high in the northern portion of the facility extending northward from Plants A and C. Bedrock south of Plant A and C then generally slopes downward to the south and southwest. The updated bedrock surface provides more detail on the shape of the bedrock high in the northern portion of the property and more detail on the sloping surface bounding the northern side of the on-Property DAPL pool.

Several studies have been conducted to characterize the underlying bedrock topography and to understand how the shape of the bedrock surface relates to both groundwater flow and the past migration of site-related contaminants. These studies, including the Supplemental Phase II investigation (Smith, 1977), which included completion of numerous borings and seismic reflection, and refraction surveys, additional seismic investigations of the MMB area, the Main Street Bedrock Saddle Investigations, and the off-Property West Ditch Seismic Investigation are described in Section 2.1.5.1 in **Appendix A**, and will be discussed in greater detail as part of the OU3 RI report.

The primary feature of the bedrock surface is the Western Bedrock Valley (WBV) that extends westward from the Property, and reaches depths of over 120 feet beneath the MMB wetlands. The slope of the bedrock valley is interrupted by two shallow transverse ridges or saddles that impeded the migration of DAPL within the WBV system and form two enclosed depressions in bedrock. The saddles include the Main Street Bedrock Saddle and the Jewel Drive Bedrock Saddle which form the down-slope perimeter of the Main Street DAPL pool located east of Main Street, and the Upper DAPL pool located east of Jewel Drive, respectively.

3.3 Overburden Groundwater and Surface Water Hydrogeology

The following section summarizes the occurrence and movement of shallow groundwater underlying OU1 and OU2 based on data collected during the OU3 synoptic groundwater level measurement events which took place in May and October 2011, and supplementary groundwater elevation data from OU3 groundwater sampling events. The purpose of this data is to assist in defining the location of the groundwater divide between the Aberjona and Ipswich watersheds as well as the boundary between OU1 (on-Property soils) and OU3 (Site groundwater). This section describes and presents evaluations designed to define the depth to

the groundwater surface across the on-property portion of the Site (OU1) and the general directions of groundwater flow across the entire Site.

The depth to groundwater on-Property varies seasonally in response changes in water table elevation. The interpreted depth to overburden groundwater on-Property is presented in **Figure 3.3-1**. Generally the water table is <1–2 ft bgs in proximity to South Ditch and adjoining wetlands in the southern portion of the Property and <1–2 feet adjacent to the on-PWD in the northwest portion of the property. The depth to groundwater increases from 2–3 ft bgs to approximately 8 ft bgs toward the northern and northeastern property boundaries. Depth to groundwater also increases south of the Ephemeral drainage and associated wetlands as the topography rises up along the ridge that forms the southern property boundary. As bedrock becomes shallower, overburden saturated thickness may become thin, as indicated by observations from wells SL-7 and SL-8 at the CSL, which are often dry.

Figure 3.3-2 and Figure 3.3-3 show the interpreted groundwater equipotential contours (potentiometric surface) across the entire Site based on the May 2011 and October 2011 synoptic water level data respectively. **Table 3.3-1** summarizes synoptic water level data including; well IDs, measuring point elevation, depth to groundwater, well screen elevation, and groundwater elevation. The synoptic water level data was subdivided into deep and shallow groundwater consistent with the definitions used in the RI/FS Work Plan (MACTEC, 2009a) (for overburden wells, the shallow wells screened to monitor shallow groundwater conditions (top twenty feet of the water table). The terms deep, medium, and shallow groundwater that have historically been used at the 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 vertically overlapping well screen sections. Where the saturated thickness is less than 20 feet, the shallow and deep monitoring intervals are a relative term. In on-Property areas, shallow groundwater is equivalent to shallow well screen pairs including unpaired wells of similar elevation. Within the MMBA, the upper 20 feet of the saturated aquifer represents shallow groundwater, including the shallowest screens underlying areas where thick sections of peat are present under the MMB wetland. Deep groundwater is classified as greater than 20 feet below the water table, and includes medium-depth screened wells.

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 groundwater data set.

The dominant hydrologic feature in the potentiometric surface is a groundwater divide that separates groundwater flow within two distinct watersheds, the Ispwich River watershed to the north and west, and the Aberjona River watershed to the south and east. Groundwater elevation changes in vicinity of the divide are very small (from 0.01 to 0.10 feet) and therefore the location of the divide is sensitive to seasonal differences in the groundwater surface and will shift laterally. The groundwater divide is influenced by both topography and the location of surface water drainage patterns. The overburden groundwater divide cuts across the northern portion of the Olin property, slightly south of and parallel to Eames Street. West up to Jewel Drive. Past Jewel Drive the divide fluctuates in position seasonally. In May, 2011 the divide was located north of Eames Street and west of Main Street. In October 2011, the divide was positioned slightly south of Eames Street and east of Main Street.

On the Olin property, the regional watershed divide is controlled by a bedrock high in the northern portion of property and a change in the drainage direction of East Ditch north of the

Eames Street Bridge. To the west the watershed divide is controlled by the prominent hill and underlying bedrock ridge under Cook Avenue. A local groundwater high is coincident with the shallow bedrock under the northern portion of the Olin property and promotes radial flow in the vicinity of the Former Lab and Office Building and the Former Plant B Production Area. On the northeast side of the Property just east of this groundwater high, groundwater is captured by the Plant B extraction system where a groundwater depression is evident. On the west side of the Property, groundwater flows south and south east by the western side of the containment area, ultimately turning and being captured by the South Ditch drainage area.

A very small localized groundwater high is associated with shallow bedrock and drainage swales at the CSL. Groundwater from there flows predominant east, with a small component of flow from the southwest corner of the Property that may flow to the south.

North and west of the regional watershed divide, groundwater flows within the Ipswich watershed to the MMB aquifer and MMB wetland complex, including MMB and Sawmill Brook. Northwest of the divide groundwater horizontal gradients are relatively flat, in part due to topography, and the configuration of the buried bedrock valley, but also the moderate to high hydraulic conductivity of the overburden aquifer. **Table 3.3-2** provides a summary of hydraulic conductivity data from Appendix A of the Draft FRI report (MACTEC, 2007). The location of OU3 groundwater wells is provided in **Attachment E**. The hydraulic characterization included both slug tests and pumping tests. Hydraulic conductivity (K) varies widely over four orders of magnitude depending on location and soil type. While statistical averages have not been computed, inspection of **Table 3.3-2** allows some general statements concerning ranges of K to be made. The silty glacial tills typically exhibited K values from less than 1 to several feet/day. Finer sandy and silty fine sand deposits more typical of on-Property areas tend to range from 3 to15 feet/day, and with increasing gravel stringers (including ice contact deposits) range up to 75 feet/day. The coarser sand and gravel deposits with cobbles, which predominate in the middle section of the MMB aquifer vary widely and K values are reported up to and over 500 feet per/day, but probably average closer to 140 to 250 feet/day depending on location. This is consistent with the 48 hour pumping test data from the Chestnut Street 1A/2 Wells reported on **Table 3.3-2**. Bedrock wells typically range from 0.003 to 0.60 feet/day.

Horizontal gradients representative of areas within the Ipswich and Aberjona water sheds are presented in **Table 3.3-3**. As shown on the **Figures 3.3-1 and 3.3-2** shallow groundwater horizontal gradients within MMB are flat in the range of 0.0008 ft/ft (GW 86S to GW 62S). The average horizontal gradient from the divide to South Ditch is approximately 0.001 ft/ft (GW-45S to GW-55S) and slightly steeper (0.008 ft/ft) from former Plant D to South Ditch (GW-308 to GW-50S).

Similar to horizontal gradients, vertical gradients within the Ipswich watershed are very flat **Table 3.3-4**). Vertical gradients measured in May 2011 are small (0.0002 to 0.002 ft/ft) and vary in direction and in some cases are divergent depending upon vertical and lateral location indicating the overall predominant flow component is lateral. Near the divide, shallow groundwater at GW-62 is recharging moderate depth groundwater while deep groundwater exhibits vertically upward gradients. Nearby at GW-58S the vertical gradient from deep to shallow groundwater is also vertically upward. Farther out in the wetland at GW-86, shallow groundwater shows a positive vertical gradient (discharge) while deeper gradients are downward. GW-84 near MMB, shows shallow upward gradients consist with discharging shallow groundwater conditions.

In contrast, horizontal groundwater gradients on the Aberjona side of the watershed divide are slightly steeper and vertical gradients in immediate vicinity of South Ditch tend to be more pronounced (**Table 3.3-4**). Near the divide at GW-45D/S the head differences were slight (0.03

feet) and gradient slightly downward (0.001 ft/ft) as expected near a divide. Closer to off-Property East ditch at GW-42D/S the relative head differences increase (0.08 ft) and the gradient is upward (0.036 ft/ft). Most wells within the upland portion of the Olin property typically exhibit downward vertical gradients between shallow and deep overburden groundwater (GW-6D/S, GW-3D/S, GW-17D/S) and exhibit upward gradients within or bordering wetland areas (GW-50D/S and GW-28D/S). Although, during this measurement period, the gradient at GW-55D/S was downward, the well pair often shows upwards gradients.

The South Ditch is predominantly a gaining surface water body that receives shallow discharging groundwater from OU3. The piezometer measurements from along South Ditch are provided in **Table 3.3-5** and include measurements (depth to water) inside the piezometers (PZ-16RR, PZ-17RR and PZ-18R) and outside to the stream surface. Most measurements indicate a positive upward gradient (depth to water inside is less than depth to water outside). In some cases the stream is indicated as dry at PZ-16RR, indicating a losing stream condition.

Bedrock conditions do not have a direct bearing on assessment of groundwater interaction with OU1 and OU2 since it is the shallow overburden groundwater that lies in contact and interacts with the surface water body itself. From a regional perspective, it is well established in New England that the bulk of groundwater recharge to bedrock ultimately discharges to the local overburden hydrologic system. For this reason the focus of OU3 and OU2 interaction is shallow overburden groundwater.

3.3.1 Bedrock Groundwater System

Based on extensive bedrock coring and mineralogical assessments (Smith 1997), and borehole geophysical investigations (Smith, 1997, and Geomega, 2001c and Geomega, 2001d) the bulk movement of bedrock groundwater is dominated by secondary porosity features, such as fractures and faults. Locally, orientation of fractures is dominated by past tectonic deformation and the presence of structures such as the Bloody Bluff Fault Zone giving rise to a dominance of the northeast-southwest fractures within the bedrock fabric. Groundwater hydraulic conductivities measured in the bedrock in GW-62BR ranged from 0.04 to 0.06 feet/day, and are consistent with K values from bedrock wells near the Spinazzola Trust landfill. These values are representative of typical conditions found elsewhere in New England metamorphic volcano-sedimentary rock. Because the measured horizontal flow in bedrock is lower than the transmissivity of the overburden water bearing zone, more than 95% of groundwater transport in this area of the Site is in the overburden with remaining flow most likely in the most shallow and most weathered portion of the bedrock (Geomega, 2001a).

3.3.2 OU1 and OU2 Surface Water

As discussed previously in Section 1, the Site contains a network of natural and manmade ditches, generally named for their physical location, relative to former operations. They include from upstream to downstream, the off-PWD (OU2), on-Property South Ditch and Ephemeral Drainage (OU1), on-PWD (OU1), the off-Property SD (OU2) and East Ditch (OU2). **Figure 3.3-4** indicates site wide directions of surface water flow. Landfill Brook is not considered part of the Site, although it was included in the RI/FS Work Plan to document water quality inputs into East Ditch. Central Pond and the Storm Water Detention Basin are also part of OU1. The North Pond is currently under investigation and is evaluated for inclusion in OU2 based on the investigation results.

Off-Property West Ditch. The off-PWD is a small, well defined drainage that includes ditches constructed to manage storm water run-off at the time of the development of Jewel Drive. The watershed for the off-PWD encompasses 38 acres of which about 20 acres are impervious areas (pavement) or standing water. Impervious areas are identified on **Figure 3.3-5**. The

storm water run-off ditches are perpendicular to Jewel Drive and are at the boundaries of adjacent private properties. A small culvert is present under Jewel Drive that allows surface water from a small storm water sedimentation pond to be conveyed to the ditch located on the south side of 8 Jewel Drive. These storm water run-off ditches connect to off-PWD which is parallel to and along the west side of the PanAm Railroad tail track that separates the Olin property from private properties along Jewel Drive. The off-PWD passes under the PanAM tail track in a stone culvert and becomes the headwater of the on-Property portion of SD. The off-PWD is separated topographically from the Olin Property and did not receive run-off from the Olin Property.

On-Property West Ditch. The on-PWD begins along the northwest border of the Facility and drains to the south. The on-PWD is the point of discharge for the current RGP discharge and enters the South Ditch along the western portion of the Site. The off-PWD collects surface runoff west of the Property boundary and flows into the South Ditch. The surface topography of the PanAM railroad bed prevents a direct connection of surface water between the on-PWD and off-PWD. Both on-PWD and off-PWD discharge into the South Ditch. As discussed in Draft FRI Report (MACTEC, 2007), sediment in much of the on-PWD and associated West Ditch Wetland has been remediated and the portion beneath the Slurry Wall/Temporary Cap has been reconstructed as a concrete culvert.

Ephemeral Drainage. The Ephemeral Drainage is an intermittent surface water feature located just south of and parallel to South Ditch and represents a low lying area that most likely represents the flood plain for South Ditch. During prolonged wet periods and following large precipitation events, flow in the drainage may develop and join the South Ditch in vicinity of the eastern Property boundary.

South Ditch. The South Ditch begins at the Property boundary along the west side, and receives surface flow from the off-PWD and the on-PWD. The South Ditch bisects the property flowing east across the center of the Property and discharging into the East Ditch. The hydrology of the ditch system was investigated and described by Smith (Smith, 1997) and conclusions from that study have changed little, although the hydrology has been modified slightly. These modifications include excavation and replacement of organic sediment from on-Property South Ditch, remediating, moving and culverting the on-PWD, and construction of the current weir, which replaced an earlier weir, similarly situated. During seasonal high groundwater conditions, there is constant base flow within the South Ditch indicating that it is a gaining stream that receives groundwater discharge. However during drier periods in summer months, the middle of the South Ditch may go dry, indicating that stream reach seasonally becomes a losing stream that recharges groundwater during these periods. Piezometer data from the south ditch are summarized in **Table 3.3-5**. The weir at the head of the south ditch creates a backwater condition in the upstream off-PWD that suppresses groundwater discharge and mitigates floc formation in that ditch system. The Upper South Ditch is generally a gaining stream reach, and is a consistent groundwater discharge area behind the weir, and for several hundred feet downstream. Additional discussion of surface water flow measurements is provided in Section 3.4 of the Draft FRI (MACTEC, 2007). Permitted discharge from Plant B to on-PWD that leads to South Ditch occurs in batches during most weekdays during normal working hours (Monday through Friday from morning to afternoon).

Flow measurements on the South Ditch were obtained by Smith (Smith, 1997) in a series of stainless steel flumes constructed to fit the ditch at each of five locations. The flow measurements were timed to preclude contribution from Plant B discharge. The general conclusions from the Smith South Ditch flow measurements were that the lower reach of the South Ditch (between Central Pond and the Property boundary) did not gain or lose flow during the majority of monitoring events from spring and winter periods. Summer and fall periods did

not provide conclusive data due to very shallow low flows experienced that were not easily quantified with a flow meter. The central reaches of the stream were variable, both gaining and losing at different monitoring events. The upper reaches of the stream were generally gaining; however the contribution to surface water flow from groundwater discharge was limited and averaged only +1.1gpm between the uppermost flume stations. The study also concluded that stage height had no relationship to whether the stream was gaining or losing. Smith estimated annual flows of 1.6 million cubic feet per year for the South Ditch system (Smith, 1997). These measurements and observations are consistent with the piezometer measurements.

East Ditch. Surface water in the railroad ditch referred to as the East Ditch, located to the east of the Property, flows southeastward from the Eames Street overpass bridge, parallel to the MBTA Commuter Rail Line (and the eastern Property boundary). A topographic divide occurs in the ditch near the bridge. North of the bridge surface water flows to the northwest. The East Ditch receives storm water runoff via sheet flow from abutting developed properties and adjacent wetlands. South of the Property, the East Ditch enters and exits a series of culverts eventually flowing into Halls Brook, which flows to Halls Brook Holding Area and eventually to the Aberjona River. The South Ditch (on-Property) surface water flows eastward into the East Ditch. The East Ditch is owned by or occupies right-of-ways controlled by the rail company and is regularly maintained to remove encroaching vegetation and debris from ballast that lines the ditches. Access to the East Ditch is restricted for protection of the public.

Central Pond. Central Pond is a shallow pond located north of South Ditch. The pond is generally round in shape and approximately 100 feet wide. The unconsolidated deposits in this portion of the property consist of fine to coarse sand and sand with gravel. Concurrent surface water elevation survey data and groundwater level data do not exist. Based on topographic and water table elevation information contained in the RI report, the elevation of the bank or land surface around the pond is approximately 80 feet MSL and the groundwater elevation in the vicinity of the pond is around 78 feet MSL. The water in the pond is typically several feet below the land surface. The nearby wells are water table wells (screened across the water table) and the pond elevation and the water table elevation appear to be the same. There is no indication geologically of silty material in the stratigraphy and the pond sediments were excavated to underlying soil (sandy unconsolidated deposits). Therefore, by all indications, the underlying aquifer is expected to be unconfined indicating that Central Pond is an expression of the shallow water table.

Stormwater Detention Basin. Detention Basin is a shallow pond located north of South Ditch. The pond is generally round in shape and approximately 50 feet wide. The Detention Basin receives drainage from Containment Area cap. The Detention Basin has an outlet control structure consisting of a 4-inch ID vertical PVC pipe with an invert elevation of 80.32 that controls the surface water elevation. The opening of the outlet structure has a screen to keep it from clogging. The pipe has a 90 degree elbow that allows it to turn toward and run under the southern berm, where it outlets to South Ditch.

Landfill Brook. Landfill Brook is located in Woburn and flows from west to east south of the WSL. The brook is approximately 2,600 long and ranges from 6 to 10 feet in width and varies from 6 inches to 1 foot deep. The stream bottom substrate when observed during sampling was composed mostly of unconsolidated mucky sediments. A reddish brown material that appeared to be iron oxide flocculent was generally observed throughout the entire reach of Landfill Brook (the entire section that fronts the WSL) that was surveyed during the temperature profile study. The brook is head watered in a series of small isolated wetlands south of Breed Avenue. A series of palustrine emergent wetlands also occur in several areas along the upper portion of the brook. Landfill Brook discharges into East Ditch immediately prior to East Ditch entering a

culvert that runs under New Boston Street to the west side of the MTBA rail line on the NSTAR property.

Maple Meadow Brook and Sawmill Brook. The MMB Wetland is located approximately 2,000 feet west and north of the Property and also west of Main Street and is an extensive wetland complex located between surrounding upland areas. Two brooks are defined within the wetland complex: Sawmill Brook and MMB. The main brook is MMB that flows to the north in the central portion of the wetland. Both streams are head watered and flow within the Ipswich watershed. Sawmill Brook flows from Mill Pond Reservoir and joins the MMB northwest of the Property in the central portion of the wetland area. Flow in MMB ranges from nearly stagnant condition to high flows in spring runoff and is dependent on the season and precipitation conditions. Stream flow measurements discussed in Section 2.3.4 in indicates that measured specific discharge of the combined streams increased during all but one monthly gauging event from the upstream to downstream reaches providing a strong line of evidence that wetland complex is a gaining system that receives discharging groundwater.

The portions of the brooks accessed for sampling range in width from a few feet to 15 feet. There were also segments where the brook channel becomes indistinct and indiscernible within emergent and scrub shrub vegetation that dominates the wetland. The depth of water ranges from several inches to 4 feet. The bottom substrate is composed primarily of unconsolidated, decaying, organic material, muck and peat. To the northeast where stream velocities are higher as the channel enters and passes through the bridge abutment to the former Middlesex canal, the bottom substrate increases in mineral content and contains a lower percentage of organics.

The surface waters of MMBW are topographically isolated from the Site and did not receive direct discharge from on-Property surface waters. Off-Property groundwater located west of the groundwater divide that separates the watersheds migrates within the western bedrock valley MMB Aquifer under the MMBW.

North Pond. Additional investigation activities were completed at North Pond as described in Addendum I – North Pond Investigation January 29, 2010. A summary of all soil borings FDRs, results, tables, and figures are provided in **Attachment D**. The North Pond is located southeast of the Olin facility on the border of Wilmington and Woburn just south of Presidential Way. In 1955, the area surrounding North Pond was largely undeveloped. From 1960 to 1980, this area was developed by other business entities to accommodate various commercial and industrial facilities. In 1980, the North Pond area was reworked by non-Olin entities, sediments were excavated and the area filled to construct Presidential Way, and to develop areas on the south edge of North Pond and Presidential Way per a Superseding Order of Conditions issued by the Massachusetts Department of Environmental Quality in July 1984.

The North Pond has been investigated at various times over the years. Historical (pre-1980) sediments were identified in 2003-2004. This was necessary to evaluate potential impacts to historical North Pond sediments from the Olin Site during operation of the plant. Surface soil, subsurface soil, and sediment samples were collected during the 2003/2004 investigation to assess conditions at that time. The data collected did not indicate impacts from the Site, but the samples were not analyzed for the extensive list of compounds prescribed by the RI work plan. Additional details are described in the North Pond Technical Memorandum located in **Attachment D**.

A camera study was completed in 2010, with oversight by USEPA, to assess the potential connection between North Pond and the Site through an existing culvert. The specifics of the camera study have been submitted under separate cover. The study did not show that the subject culvert creates a hydraulic connection between North Pond from the Site.

3.4 Meteorology

The climate in this area is described as humid and temperate with a fairly uniform monthly precipitation. Precipitation in the Wilmington area averaged 47 inches per year for the period from 1970 through 2000 (National Oceanic and Atmospheric Administration [NOAA]). In the nearby adjacent town of Reading, Massachusetts average annual precipitation data recorded at is in the range of 41 inches with October generally being the driest month and April being the wettest. It is estimated that approximately half of the precipitation leaves the Property as infiltration to groundwater or as surface water flows, and that the remaining half is lost to evapotranspiration (Geomega, 2001).

Mean January temperature is approximately 27 degrees Fahrenheit (F) and the mean July temperature is 74 degrees F. The mean annual temperature is 50 degrees F (CRA, 1993).

Prevailing wind direction is from the west northwest during the winter months and from the southwest during the summary months. The average wind speed is seven knots (CRA, 1993).

3.5 Demography and Land Use

This section presents the regional socio-economic conditions for the area surrounding the Site as well as the land use and groundwater classifications for areas within and around the Site.

3.5.1 Socioeconomic Setting

The Property is located in the southern part of Wilmington, Massachusetts and it lies on the border of The Town of Wilmington and the City of Woburn. Because of its proximity to Woburn, the demography of both municipalities is discussed in this Subsection.

Wilmington, Massachusetts. The Town of Wilmington is a 16.98 square mile mixed residential, commercial and industrial community located 16 miles northwest of Boston. The town has a population of 22,325 (2010 U.S. Census estimate) and median family income in Wilmington has $100,861/year (2007-2011) with 35.8% of the population college educated. The Town of Wilmington boasts a poverty level of 1.8%, well below the national average of 10.7%.

The town has a Caucasian majority of 92.3% and a minority population of 7.7%. The dominant minority is Asian at 3.7% with the Hispanic population at 1.8%. African American persons represent 0.8% and various other minorities comprise the remaining 1.4%.

Woburn, Massachusetts. The City of Woburn is a mixed residential, commercial and industrial community located 10 miles northwest of Boston and is located within the Mystic River Watershed. It has a population of 38,520 (2010 U.S. Census estimate) with a median family income in of $72,540/year (2007-2011) with 31.7% of the population educated through the college level. The City of Woburn currently has a poverty level of 5.7% which is below the national average. The city has a Caucasian majority of 81.7% and a minority population of 18.3%. The dominant minority is Asian at 7.3% with the Hispanic population at 4.5%. Persons of African-American descent represent 4.2% of the population, and various other minorities comprise the remaining 2.3%.

3.5.2 Surrounding Land Use

The property is immediately surrounded to the east, north, and west by industrial facilities and the Woburn Town Landfill abuts the Facility to the south. The MBTA Commuter Rail line immediately abuts the property to the east. Further to the west, along Main Street, Cook Avenue and Border Avenue, the primary land use is for single-family homes with some commercial and light industrial development.

Farther away from the property the land use is mixed residential and there is the MMB wetland is located further to the west.

Several commercial properties near the Property have reported independent environmental problems to the MassDEP. These include, but may not be limited to Altron Industries, Koch Membrane, United Tool and Die, Raffi and Swanson, Pepsi Cola, Jewel Drive Industrial Mall, the Getty Station, the Rutland Corporation and the City of Woburn. Several of these sites to the west of the property are listed as Downgradient Property Status properties under the MCP.

There are schools located within 2 miles of the site, which include Woburn's Altavesta Elementary School, located less than one half of a mile to the south, Linscott Rumford Elementary School at 1.2 miles to the south and Wilmington's Wildwood Early Childhood Center at 1.3 miles to the north.

A gym, called Gym Street USA that offers gymnastic instruction and hosts events is located on 1 Jewel Drive.

Public parks within 2 miles of the site include Ferullo Park in North Woburn and Wilmington's Town Park. Both are located on Route 38.

The MMBA is the location of one of several Town of Wilmington municipal well fields. Pumping of five of Wilmington's MWSWs was suspended in February 2003 subsequent to the detection of NDMA in the MMBA as discussed in Section 1. Olin and the respondents have funded construction of a new water line to the MWRA drinking water system built by the Town of Wilmington.

The areas around the property do not contain areas designated by the Massachusetts Executive Office of Environmental Affairs (EOEA) as "Environmental Justice Zones" (EJ). EJ zones were created by the EOEA to display neighborhoods across the state with high minority, non-English speaking and low-income populations (based on 2000 U.S. Census data). Such areas are identified and eligible to use state resources to ensure that EJ populations receive a strong voice in environmental decision-making.

3.6 Ecology

This section describes ecological characteristics, including natural communities and potential wildlife, which occur in the various on- and off-Property study areas related to the Site. Information presented in this section has been summarized from existing investigation reports.

3.6.1 Terrestrial Habitat

The approximately 50-acre Property includes both developed and undeveloped areas. The developed areas of the Property include office buildings, paved parking lot, several non-operational plant buildings and foundations of several former plant buildings and structures. The Slurry Wall-Containment Area (approximately five acre area covered with a heavy plastic/fabric cover) is included in the developed portion of the Property. The developed area on site comprises approximately 21 acres and provides no significant habitat for ecological receptors. The capped CSL encompasses approximately four acres in the southwestern corner of the property and is comprised of open managed grass habitat (i.e., routinely mowed) bordered by forested upland. The central undeveloped portion of the property, encompassing approximately 23-acres is comprised of a mix of forested upland and forested wetland habitats (ABB-ES, 1993). This portion of the site provides the most suitable habitat for ecological receptors. In addition, several of the aquatic habitats including South Ditch, Ephemeral Drainage, and Central Pond occur in this part of the Property.

The forested upland and wetland habitat (i.e., undeveloped portion of the site) consist of mixed stands of broad-leaved deciduous and needle leaved evergreen trees including northern red oak (*Quercus borealis*), green ash (*Fraxinus pennsylvanica*), white pine (*Pinus strobus*), and hemlock (*Thsuga canadensis*). The understory is dominated by saplings of the aforementioned tree species.

Terrestrial wildlife known to occur on the site include small mammals such as mice (*Peromyscus leucopus*), shrews (*Blarina brevicauda*), meadow voles (*Microtus pensylvanicus*), eastern cottontail (*Sylvilagus floridanus*), and woodchuck (*Marmota monax*). Large mammals observed or known to occur on site include eastern white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*) and red fox (*Vulpes vulpes*). Birds that frequent the site include mourning dove (*Zenaida maroura*), house finch (*Carpodacus mexicanus*), sparrow (*Spizella* sp.), American robin (*Turdus migratorius*) and American woodcock (*Scolopax minor*). Several higher tophic level avian species have been observed on site including red-tailed hawk (*Bueteo jamaicensis*) and sharp-shinned hawk (*Accipiter striatus*), as well as American kestrel (*Falco sparverius*).

3.6.2 Aquatic Habitat

The aquatic habitat located on the Property consists primarily of a network of shallow, man-made ditches and a small pond. The on-Property ditches include the on-PWD, South Ditch, Ephemeral Drainage, and Central Pond (a 0.2 acre pond). The pond and ditches on the Property do not support a diverse aquatic community. Off-Property surface water bodies include two additional ditches and a large wetland complex located approximately one-half mile northwest of the Site. The two ditches, off-PWD and East Ditch are located adjacent to west and east sides of the Property. Maple Meadow Brook (MMB) and Sawmill Brook (SMB) bisect the MMB wetland complex. The two brooks combine within the wetland complex and flow out as one brook (MMB) which eventually flows to the Ipswich River.

The on-site ditches and the East Ditch, which tend to go dry during summer months, are incapable of supporting a diverse aquatic community because they are generally of insufficient depth, temperature, and dissolved oxygen content to support populations of fish or sensitive benthic macroinvertebrates (e.g., mayflies, stoneflies). The aquatic fauna associated with these aquatic habitats consist primarily of stress-tolerant taxa such as crayfish, dragonfly nymphs, amphipods, and midge larvae. Emergent vegetation, algae, and phytoplankton have also been observed in these areas. During the various site walkovers and habitat surveys conducted throughout the numerous investigations, no fish have been observed in the ditches and no evidence of stressed biota attributable to the facility has been noted.

Wildlife and habitats associated with each feature are described below.

On-Property West Ditch. The on-PWD conveys treated groundwater from Plant B which is piped underground to an outfall located approximately 100 feet west of the West Warehouse. Treated water from the outfall flows into the on-PWD which flows as an open drainage along the western side of the Property for 150 feet then flows into a buried culvert along the western side of the Slurry Wall/Containment Area. The on-PWD culvert terminates in a concrete outlet structure at the South Ditch. The majority of the on-PWD is culverted or is a degraded ditch, neither of which provide significant wildlife habitat.

South Ditch. The South Ditch receives water from the off-PWD and on-PWD as well as storm water collected on the Slurry Wall-Containment Area cover. In 2000 a weir was constructed at the head of the ditch, to meter flow from the off-PWD. The flow from the on-PWD also flows through a level spreader prior to discharging to the ditch. Flow within the ditch is minimal and it

typically dries out during the summer months. The South Ditch discharges to the East Ditch off-Property.

Wetlands have been identified and delineated along south side of the entire reach of the south ditch and along north side of the ditch, east of the Central Pond. The wetlands bordering the ditch are classified as palustrine forested broad-leaved deciduous wetlands (PFO1), this classification is consistent with National Wetland Inventory classifications of the wetlands on-Property, however the area of delineated wetlands on the Property is larger than the NWI mapped areas, due to the scale of NWI mapping and methods used by NWI to map wetlands (i.e., aerial photograph interpretation).

The sapling and shrub layer in the upper portions of the ditch is dominated by speckled alder (*Alnus rugosa*) shrubs, while glossy buckthorn (*Rhamnus frangula*) dominates the shrub layer in lower portions of the South Ditch (MACTEC, 2005). The lower portion of South Ditch is dominated by red maple (*Acer rubrum*) with scattered gray birch (*Betula populifolia*) and has a relatively closed canopy. Arrowhead (*Sagittaria latifolia*) was observed in the open, dendritic portion of the South Ditch. Cattails (*Typha latifolia*), and purple loosestrife (*Lythrum salicaria*) have also been observed in the delta area. Other vegetation observed along or within the ditch has included jewelweed (*Impatiens capensis*), skunk cabbage (*Symplocarpus foetidus*), sensitive fern (*Onoclea sensibilis*), grasses, sedges, and mosses. Vegetation along the entire length of the ditch does not appear to be stressed.

Wildlife use in the South Ditch is limited to amphibians, as frogs are routinely observed in the South Ditch, fish however have not been observed in the ditch. The lack of fish is likely due to the ephemeral nature of flowing water in the ditch. In addition, it is unlikely that fish would move upstream into the ditch, as there is no suitable passage way for fish from the east ditch. It is likely that small mammals (i.e., shrews and raccoons) and birds are using the ditch as a source of water and to forage for food (i.e., invertebrates). No other wildlife has been directly observed in the South Ditch.

Ephemeral Drainage. The Ephemeral Drainage exists within an area delineated as palustrine forested broad-leaved deciduous wetland (PFO1), south of the South Ditch. The ephemeral drainage does not routinely contain ponded water, however during rain events storm water runoff has been observed in the drainage, which discharges to the South Ditch off-Property.

The Ephemeral Drainage does not hold surface water for long enough duration to support a fish population. Although the drainage dries for extended periods, it does provide habitat for macroinvertebrates as well as amphibians and reptiles. Amphibians (i.e., frogs) have been observed in the drainage during rain events. The drainage and bordering wetland also provide habitat for mammals including raccoons and deer, as well as transient predatory mammals (i.e., coyote and fox). The drainage and bordering wetland provides forage and nesting habitat for avian species from multiple trophic levels from insectivorous birds to predatory birds, all of which have been observed on the Property.

Central Pond. The Central Pond has an approximate area of 0.2 acres, and is centrally located on the property. The pond is not hydraulically connected to the South Ditch. The bottom of the pond is unconsolidated mud. The edges of the pond are vegetated with shrubs and herbaceous plant species. The north edge of the pond is heavily vegetated, dominated by grey birch (*Betula populifolia*), red maple (*Acer rubrum*), glossy buckthorn (*Rhamnus frangula*) and chokecherry (*Prunus virginiana*). The northern and eastern edges of Central Pond are dominated by a band of scrub-shrub dominated wetland. Vegetation that occurs in this area includes grasses, sedges, and shrubs, as well as scattered grey birch and red maple saplings.

The Central Pond was remediated in 2000, 2001, 2003, and 2004 to address contaminated sediment and contaminated soil along the edges of the pond. Contaminated sediment and soil was excavated and disposed of offsite. The pond was restored in May and June 2001.

Observations of wildlife use in the pond primarily include amphibians (i.e., frogs and turtles) and ducks (most commonly mallard ducks). Central Pond does not contain any fish nor does it have a hydrologic connection to fish containing waters. It is likely that the pond does provide habitat for a macroinvertebrate population, which would likely include mosquito, midge, and amphipod larvae.

Off-Property West Ditch. The off-PWD consists of three constructed drainage ditches that converge just west of the stone box culvert below the abandoned railroad spur that parallels the western property boundary. The West Ditch receives water from a detention basin locate west of jewel drive, from several roof and parking lot drainages, from surface runoff, and from groundwater discharge. Following the installation of the weir, the section of the West Ditch just east of the railroad culvert is typically inundated throughout most of the year. Red maple (*Acer rubrum*), and glossy buckthorn (*Rhamnus frangula*) dominate the West Ditch riparian zone (MACTEC, 2003). Emergent vegetation including purple loosestrife, cattails, rushes and sedges have also been observed within the West Ditch. The bottom substrate consists of a poorly drained mineral soil. The general poor quality of the manmade drainage system is not suitable for fish and the more sensitive macroinvertebrate species.

East Ditch. The East Ditch is a man-made drainage ditch that parallels the MBTA railroad tracks that border the east side of the property. The East Ditch downstream of the Property flows through several culverted sections and is eventually joined by Landfill Brook approximately 2800 feet downstream of the Property. The sides and bottom of the east ditch are lined with ballast from recent maintenance of the track along the MBTA right-of-way. The ditch is routinely maintained by the MBTA, maintenance may include excavation of sediments, placement of new ballast, vegetation cutting and vegetation spraying.

The east ditch does not provide suitable aquatic habitat as it is routinely maintained by the MBTA. The ditch receives little shading, due to the lack of tree or sapling canopy in most areas, which results in high water temperatures and no cover for wildlife. Fish have not been observed in the ditch. Stress-tolerant macroinvertebrates such as crayfish, dragonfly nymphs, amphipods, mosquito and midge larvae have been observed in the ditch, however the ditch currently does not provide suitable habitat for ecological receptors due to recent routine maintenance of the track ballast (ballast currently lines the west ditch).

Maple Meadow Brook/Sawmill Brook Wetland Complex. Maple Meadow Brook originates at Mill Pond Reservoir in Burlington, MA, and drains to the north. Sawmill Brook originates in Burlington one-quarter mile to the west of Maple Meadow Brook, and drains to the northeast before joining Maple meadow Brook approximately one-half mile northwest of the Property. The upper reaches of these brooks have well-defined stream channels with entrenched, steep, over-hanging banks; both brooks flow into a large, topographically low area approximately three-quarters of a mile upstream of their confluence.

This general area, referred to as the Maple Meadow Brook/Sawmill Brook Wetland Complex (MMB/SMB WC) is a complex of palustrine emergent, scrub-shrub, and forested wetlands. The wetland complex contains stream channels (i.e., Maple Meadow Brook and Sawmill Brook) as well as numerous small pockets of open water and small dendritic channels. The water regime within the wetland complex is seasonally flooded / saturated.

The entire MMB/SMB WC is saturated and typically inundated with water, in spots reaching over three feet in depth, water flow through the complex is negligible and only noticeable in the upper

channelized portions of Maple Meadow Brook and Sawmill Brook and the channel where Maple Meadow Brook flows out of the wetland complex. The substrate within the MMB/SMB WC is highly organic in nature with variable firmness and consistency. The organic sediment in the complex ranges from firm fibric organic material to lose highly decomposed sapric organic matter. Hydrogen sulfide odors have been routinely noted in many parts of the MMB/SMB WC.

The emergent wetland portion of the complex is dominated by persistent emergent vegetation, including sedges (tussock sedge [Carex strictia]) and grasses (reed canary grass [*Phalaris arundinacea*]). The scrub shrub portion of the wetland complex is dominated by button bush (*Cephalanthus occidentalis*) and the forested portions of the complex are dominated by red maples.

Vegetation in the emergent and scrub-shrub portions of the complex consists of a mixture of saplings, shrubs and herbaceous vegetation, but does include areas dominated by button bush. Common shrubs included speckled alder (*Alnus rugosa*), smooth alder (*Alnus serrulata*), red-osier dogwood (*Cornus stolonifera*), silky dogwood (*C. amomum*), winterberry (*Ilex verticilata*), sweet pepper bush (*Clethra alnifolia*), and swamp rose (*Rosa palustris*). Herbaceous vegetation observed included sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), purple loosestrife (*Lythrum salicaria*), tussock sedge (*Carex stricta*), iris (*Iris versicorlor*) and mosses. Portions of the wetland that are dominated by the aforementioned herbaceous plants are classified as emergent wetland, while the portions of the wetland that are dominated by the aforementioned shrubs are classified as emergent wetland.

Floating leaf and rooted aquatic vegetation in the MMB/SMB WC included duckweed *(Lemna minor*), water smartweed (*Polyganum* sp.), pickerelweed (*Pontedaria cordata*), naiad (*Najas* sp.), and waterweed (*Elodea* sp.). These species are common in the open ponded and open brook channels common within the wetland complex. Cattails (*Typha latifolia*) and common reed *(Phragmites australis*) have been observed along the edges of the wetland complex.

The forests bordering the MMB/SMB WC consist of a mixture of trees, shrubs, vines, and herbaceous vegetation. The tree layer is dominated by deciduous species including gray birch (*Betula populifolia*), black willow (*Salix nigra*), cherry *(Prunus* sp.), and red maple. At its borders, wetland vegetation transitions to communities more characteristics of uplands dominated by oaks (*Quercus* sp.) and white pine (*Pinus strobes*), and winterberry, cedar (*Juniperus* sp.), sweet fern (*Comtonia peregrina*), northern arrow-wood (*Viburnum recognitum*), and dogwoods in the shrub/sapling layer.

The MMB/SMB WC provides habitat for a myriad of wildlife species from invertebrates to higher trophic level predatory birds and mammals. Benthic macroinvertebrates have been routinely observed in the MMB/SMB WC include amphipods, chironomid midge larvae, snails, freshwater clams, beetles, freshwater oligochaetes, and dragonfly nymphs. Fish and amphibians (frogs and turtles) have also been routinely observed in the MMB/SMB WC. Avian species observed or expected in the MMB/SMB WC cover a broad range of species from song birds (i.e., cardinal [*Cardinalis cardinalis*]) to predatory birds (i.e., redtailed hawk [*Buteo jamaicensis*]). Large mammals including deer, coyote, red fox, and beaver are known to occur in the MMB/SMB WC, based on direct observation, observation of tracks, or observation of sign (i.e., gnaw marks observed at the base of trees). The MMB/SMB WC provides excellent habitat for ducks and geese, and both have been observed nesting in the wetland. Ducks observed in the wetland include mallard ducks (*Anus platyrhincos*), teals (*Anas crecca/discors*), and wood ducks (*Aix sponsa*), during peak migration it is likely that many other species of ducks use this wetland for stop over area. Canada geese (*Branta Canadensis*) are routinely observed in the wetland complex.

3.6.3 Threatened and Endangered Species

Consultations with the United States Fish and Wildlife Service (USFWS) have indicated that no federally-listed and proposed, endangered or threatened species are known to occur within the general vicinity of the site (MACTEC, 2002; Smith, 1997; and MACTEC, 2004). The Mystic Valley Amphipod (*Crangonyx aberrans*) has historically been reported as occurring in a wetland near the Hall's Brook drainage; however this species was recently delisted by the Massachusetts Natural Heritage and Endangered Species Program.

On March 13, 2013, AMEC reviewed the information available on the USFWS Information, Planning, and Conservation System and confirmed that there are currently no federally-listed rare, threatened or endangered species known to occur on or in the vicinity of OU1 or OU2. AMEC also reviewed the information available on the MassDEP Natural Heritage and Endangered Species Program Interactive Priority and Estimated Habitats Online Viewer and confirmed that there are no estimated or priority habitats of State-listed species on or in the vicinity of OU1 or OU2.

4.0 NATURE AND EXTENT OF CONTAMINATION

The analytical data from the investigations of OU1 and OU2 have been compiled, reviewed, and evaluated to characterize the nature and extent of contamination for each of the environmental media within those operable units.

4.1 OU1

OU1 includes on-Property soil, surface water, and sediment from the on-Property ditch system, Central Pond, and the Detention Basin **(Figure 1.3-1)**. With the addition of the field observations and the analytical data associated with the 2009 through 2013 OU1 investigations, a comprehensive body of data has been collected and is available to characterize the nature and extent of contamination. Nature and extent of contamination has been determined herein based on historical data that are representative of current Site conditions (this does not include data representative of soil that has been removed or treated to remove constituents) and the 2009 through 2013 RI data. The term "RI data" specifically refers to data collected in accordance with the Final RI/FS Work Plan, including data collected under the IRSWP. Historical data includes those data collected under the MCP program. Section 4.1 of the Draft FRI Report (MACTEC, 2007) summarized the historical analytical data and the distribution of constituents in soil, surface water, and sediment based on that data. The following section discusses the sources of contamination and the nature and distribution of contaminants in these media. Data Validation Memoranda for the 2009 through 2013 RI Investigations (soil, surface water, and sediment samples) are presented in **Appendix E**.

4.1.1 Sources of Contamination

As presented in Section 4.1 of the Draft FRI Report (MACTEC, 2007), potential contaminant source areas were historically identified and investigated, and remedial actions were successfully implemented to eliminate, control, or mitigate several of those sources. For OU1, potential sources that have been the subject of remedial actions include the Plant B Area (both the LNAPL Area and the EPH/VPH Area), Drum Area A and Drum Area B, the Buried Debris Area, the former Lake Poly, Central Pond, the West Ditch Wetland, and the on-Property DAPL (see **Figures 1.0-3** and **1.3-1**). The DAPL is located within OU3, and is a source of dissolved constituents in groundwater. The soluble constituents in DAPL diffuse vertically and form a diffuse layer several feet thick above the DAPL. This diffuse layer is subject to further vertical mixing and advective transport with groundwater with subsequent attenuation of dissolved constituents through dispersion, precipitation reactions, and diffusion (from groundwater back into low permeability strata). The diffuse layer represents a geochemical continuum between the DAPL and overlying groundwater and is also referred to as diffuse layer material. An envelope of diffuse layer material is present around the Upper DAPL pool, including the on-Property portion of the DAPL pool that is surrounded by the slurry wall. Locally, groundwater from OU3 discharges to OU1 surface water including the off-PWD, South Ditch, and East Ditch. Other potential source areas such as the East and West Pits, three Acid Pits located south of the East and West Warehouses, and the wastewater treatment plant (by East Warehouse which was used to pre-treat water that went to the MDC sewer) were investigated historically. The former Drum Areas were remediated, and their historical footprint, like the acid pits, are located within the area surrounded by the slurry wall. There are no known USTs at the Property that have not been closed in-place or removed. These historic source areas are identified on **Figure 1.3-1**; the known extent of the DAPL pools is presented on **Figure 1.0-3**.

Plant B remedial actions included an AS/SVE system for TMPs in the EPH/VPH area and LNAPL recovery. Removal actions were completed for Drum Area A and Drum Area B, the

Buried Debris Area, the former Lake Poly, and the On-PWD Wetland. The on-Property DAPL area has been isolated and contained by the Slurry Wall/Temporary Cap (the Containment Area) to eliminate, to the extent practical, migration of groundwater from within this area to surface water in the South Ditch.

4.1.2 Summary of Soil Analyte Detections by Depth Interval

The OU1 RI soil investigation included additional borings and surface soil samples to provide spatial coverage of contaminant extent, and to further investigate identified source areas. Sampling was also conducted as part of the field investigation to determine the potential for any on-going sources beneath remaining buildings and foundations. The OU1 RI soil investigations have not identified any substantial previously unidentified sources of contamination.

The analytical data associated with historic, and 2009 through 2013, OU1 soil investigations (samples representative of current site conditions) are summarized in the following Tables: Surface Soil (0–1 feet) **Table 4.1-1**; Shallow Subsurface Soils (1–10 feet) **Table 4.1-2**; and Deep Subsurface Soils (> 10 feet) **Table 4.1-3**. Each of those tables identifies, for each detected analytical parameter, the frequency of detection, the range of detected concentrations, the range of reporting limits for non-detects, the arithmetic mean concentration of all samples, the site-specific background concentration, and the Industrial USEPA Regional Screening Levels (RSLs), and the USEPA Soil Screening Levels (SSLs) that are leaching-based.

The 2009 through 2013 OU1 soil investigation analytical data both confirm the historical data (the number and frequency of Site-related constituents detected and their concentrations in soil) and complement the historical data (by providing additional horizontal and vertical spatial coverage). In addition to the inclusion of the historical data in the Draft FRI Report (MACTEC, 2007), the historical analytical data have also been provided to USEPA in electronic format. The historical data and the 2009 through 2013 RI data, in general, show a consistent identification of constituents in soil at the Site. The historical and RI soil sample locations are shown in **Figure 4.1-1**.

The available soil data representing current conditions have been summarized and compared to Industrial RSLs and to site-specific background concentrations calculated in **Appendix I**, to identify potentially Site-related constituents and graphically presented to evaluate the horizontal and vertical delineation of the nature and extent of contamination. The AOC and the SOW indicate that the investigations should delineate nature and extent of contamination to non-detect or background concentrations for soil. Where feasible this has been accomplished. The available historical and recent analytical data have been evaluated in this context, and in addition, the extent of contamination has also been evaluated using USEPA RSLs (USEPA 2013). Vertical delineation of soil considered Industrial RSLs.

In addition, **Appendix F** tables present all analytical results for detected parameters, and identify detected concentrations greater than the corresponding Industrial RSL or leaching-based SSL (including the risk based SSL and MCL based SSL). The sample results that exceed the industrial RSL are indicated by bold text, while the results that exceed the SSLs are indicated by colored shading. Data for inaccessible soils (i.e, soils under Central Pond, and soils under the Temporary Cap) are also presented in **Appendix F**.

As indicated in **Appendix F**, a wide variety of chemical compounds (VOCs, SVOCs, pesticides, metals) exceed the SSL criteria. These include phthalates, pesticides, PAHs, NDPA, fuel-related compounds (xylenes, toluene, trimethybenzenes), chlorinated benzene compounds, chlorinated ethanes and ethenes, as well as most metals. Many of these chemicals, particularly the PAHs, have exceedingly low solubility and are relatively immobile in groundwater, indicating the SSLs are not good indicators of leaching potential as a screening criteria. USEPA also

acknowledged that the SSLs are extremely conservative and limit their usefulness as reliable indicators of which contaminants will leach from soils resulting in an impact to groundwater. Therefore, Olin compared actual distribution of soil data to actual distribution of groundwater contaminant concentrations. These comparisons demonstrate that leaching of contaminants from soils located above the water table is not a pervasive problem, as suggested by soil concentrations exceeding the SSLs. Impacts to groundwater are present, but are related to specific process areas and historic disposal practices at the Site. Groundwater impacts are primarily associated with Plant B (TMP area), and soils located below the water table at former Lake Poly, and perhaps to a lesser extent the former Drum Storage Area and the Debris Disposal Area. The majority of current groundwater impacts are associated with diffuse groundwater and groundwater migration related to the locations of the DAPL pools. Based on these considerations, USEPA agreed with Olin that a point-by-point review and discussion of analyte concentrations exceeding SSLs was not warranted.

Figures 4.1-2 through 4.1-28 present the distributions of analyte concentrations in soil in order to facilitate visual evaluation of the delineation of extent of contamination, both along the property perimeter, but also within the property boundaries, where a locus of elevated concentrations might be present. For each analytical parameter included in this group of Figures, one Figure is presented for each of the three intervals of concern (0–1 ft bgs, 1–10 ft bgs, and >10 ft bgs). In each figure, sample location identifiers and analytical results (either the detected concentration or the reporting limit for non-detects) are presented. In addition, symbols have been assigned to each sample location to provide readily recognizable information concerning the analytical result (non-detects with reporting limits below the Industrial RSL are shown with a yellow cross, non-detects with reporting limits above the Industrial RSL are shown with a blue cross and detected concentrations have been assigned symbols based on the relationship of the detected concentration to Industrial RSLs, and to Site specific background concentrations).

The following subsections identify and discuss detected analytes in terms of frequency of detection for each soil group (surface soil, shallow subsurface soils, and deep subsurface soil). These discussion are ordered according to general analytes classes, including VOCs, SVOCs, metals and inorganics, and specialty compounds. Following these introductory discussions, Section 4.1.3 -further describes soil results by analyte group and the spatial distribution of COIs detected most frequently at concentrations above industrial RSLs or other criteria, such as background. These distribution discussions relate detected analytes to former sources and operational areas at the Facility.

4.1.2.1. Surface Soils (0-1 feet)

Table 4.1-1 includes summary statistics for detected constituents in surface soil samples that are representative of current OU1 conditions. Among the 23 VOCs detected, acetone, TM-1-P, TM-2-P, 1,1,1-trichloroethane, methylene chloride, and toluene were the most frequently detected of the VOCs. TM-1-P, the most frequently detected TMP, was detected in less than 6 % of the samples. As indicated in **Table 4.1-1**, no VOCs were detected at concentrations above Industrial RSLs. The distribution of TMPs is discussed under section 4.1.3.

Among the 42 individual SVOCs detected, BEHP, several high molecular weight PAHs, and NDPA were most frequently detected. Maximum concentrations of several SVOCs including carcinogenic PAHs (BEHP, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene) were greater than corresponding Industrial RSLs. The frequency of detection of carcinogenic polycyclic aromatic hydrocarbons (cPAHs) ranged from approximately 15 to 27%. The most frequently detected compound is BEHP, detected in approximately 75% of all samples. To provide additional context, BEHP was only

detected above the Industrial RSL in 19 samples, or somewhat less than 10% of the samples collected. NDPA is detected at a frequency of approximately 14%.

The maximum concentrations of Aroclor-1260 (a PCB), is located in soil in proximity to one former transformer location. USEPA RSLs are not available for a number of detected SVOCs and pesticides including 3&4-methylphenol, acenaphthylene, benzo(g,h,i)perylene, carbazole, dimethylphthalate, diphenyl ether, phenanthrene, alpha chlordane, delta-BHC, endosulfan I, endosulfan II, and endrin ketone.

Twenty-five metals, all of which are or can be naturally occurring, were detected in surface soils, including arsenic, chromium and hexavalent chromium. Of these, only arsenic and hexavalent chromium were detected above their corresponding Industrial RSLs in surface soil. Arsenic was detected in approximately 90% and hexavalent chromium 39% of the samples analyzed for each constituent. Of these, 8 surface soil samples contained hexavalent chromium above the RSL (14%). As discussed later in this report, arsenic distribution and concentrations appear to represent a background condition. Industrial RSLs are not available for some detected metals/ inorganics, including calcium, magnesium, potassium, sodium, chloride, sulfate, and ammonia, which are also frequently detected in shallow subsurface site soils.

Among specialty compounds, formaldehyde was the most frequently detected, being detected in a narrow range of very low concentrations in 98% of the samples collected. The maximum concentration detected was 5 orders of magnitude lower than the Industrial RSL. The high frequency of detection and extremely low concentrations suggests formaldehyde is widely distributed in the environment and its presence is likely due to anthropogenic sources. The USEPA Air Toxics Program fact sheet on formaldehyde reports it is detected in ambient air in urban areas nationwide from anthropogenic sources that include power plants and automobile exhaust. Other specialty compounds (hydrazine, acetaldehyde, and phthalic acid/phthalic anhydride) were detected in approximately 20-29% of the samples, at concentrations well below their respective Industrial RSLs.

The hexavalent chromium, BEHP, and NDPA distributions are discussed in greater detail below in Section 4.1.3.

4.1.2.2. Shallow Subsurface Soils (1–10 feet)

Table 4.1-2 provides summary statistics for detected parameters in shallow subsurface soil samples (1-10 feet) representative of current OU1 conditions. Among the 36 individual VOCs detected, TMPs had the highest frequency of detection ranging from 25 to 29%, and were the only VOC detected above its corresponding Industrial RSL (as calculated by MACTEC). Fuel-related compounds including benzene, toluene, ethyl benzene and xylenes were also detected at frequencies ranging from 2 to less than 12 %. Chlorinated VOCs were also detected, but very infrequently (<1% - <3% of the samples collected) and at very low concentrations, orders of magnitude below their corresponding Industrial RSLs. The detected VOCs include chloromethane, carbon tetrachloride, in addition to chlorinated benzene, chlorinated ethane and chlorinated ethene compounds.

Among 40 SVOCs detected, only BEHP, NDPA and several PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene) were present at concentrations greater than corresponding Industrial RSLs. The frequency of detection of the cPAHs was much lower (<3%) than in surface soils, and less than one percent of the samples with detected PAHs had concentrations that exceeded the RSLs. BEHP was detected in approximately 58% of the samples analyzed, but less than 5% (14 samples) of the detected concentrations were greater than the Industrial RSL. While NDPA was detected in approximately 14% of the samples, it was only detected above its Industrial RSL in two samples collected in 2001 at Lake

Poly (a frequency of < 1%). Some of the other more frequently detected SVOCs include diphenylamine (<14% of samples) diphenyl ether (8% of samples), and several phthalates at lower frequencies of detection (Di-n-octylphthalate <6%, Di-n-butylphthalate <6%, and butylbenzylphthalate <5%), and benzoic acid (5%). The remaining SVOCs were detected at frequencies ranging from <1 to <3%. Aroclor-1260 exceeded its Industrial RSL. Pesticides were infrequently detected and did not exceed Industrial RSLs; however, alpha-chlordane and endosulfan sulfate do not have corresponding Industrial RSLs. USEPA RSLs are not available for several detected parameters including 4-isopropyl toluene, sec-butylbenzene, 3&4-methylphenol, 4-chlorophenyl phenyl ether, acenaphthylene, benzo(g,h,i)perylene, carbazole, diphenyl ether, and phenanthrene,

Aroclor-1260 was detected in two samples at concentrations that exceeded its Industrial RSL, in the same area as surface soils. Nine pesticides were detected, but very infrequently (only one detection of each compound), and concentrations did not exceed Industrial RSLs. Alpha-chlordane and endosulfan sulfate do not have corresponding Industrial RSLs.

As in surface soils, twenty-five metals were detected in shallow subsurface soils. Of these, only arsenic and hexavalent chromium were detected at concentrations above their corresponding Industrial RSLs in surface soil. Arsenic was detected in approximately 78%, and hexavalent chromium 65%, of the samples analyzed for each constituent. Of these only 5 subsurface soil samples contained hexavalent chromium above the RSL (<14%). As discussed later in Section 4.1.3, a statistical assessment of the arsenic distribution indicates that arsenic in soil represents a background condition. Industrial RSLs are not available for some detected metals and inorganics, including calcium, magnesium, potassium, sodium, chloride, sulfate, and ammonia. Ammonia, sulfate, and chloride are also frequently detected in shallow subsurface site soils.

Among specialty compounds, formaldehyde had the highest frequency of detection (approximately 95%), but as discussed previously, was detected at concentrations more than 7 orders of magnitude lower than the Industrial RSL. Although formaldehyde is an important intermediary chemical in many manufacturing processes, it is ubiquitous in the environment due to numerous anthropogenic and natural sources, including initial decomposition of plant residues in soil, and oxidation of methane in the upper atmosphere in the presence of oxygen and sunlight. The maximum concentration of hydrazine was greater than its corresponding Industrial RSL in only one sample location (collected in 2003) within former Lake Poly.

The VPH and EPH analyses were targeted for known areas of former fuel usage, and TMPs. The resulting high frequency of detection of EPH and VPH fractions including C11–C22 Aromatics, C9-C18 Aliphatics, and C19-C36 Aliphatics is skewed by these targeted sampling objectives. The maximum concentration of C11-C22 Aromatics was greater than the MassDEP MCP S-2 soil standard (relevant for industrial/commercial land use) at only one sample location.

USEPA RSLs are not available for several detected parameters, including 4-isopropyl toluene, sec-butylbenzene, 3&4-methylphenol, 4-chlorophenyl phenyl ether, acenaphthylene, benzo(g,h,i)perylene, carbazole, diphenyl ether, phenanthrene, calcium, magnesium, potassium, sodium, chloride, ammonia, and sulfate.

4.1.2.3. Deep Subsurface Soils (> 10 feet)

Table 4.1-3 provides summary statistics for detected parameters in deep subsurface soil samples (>10 feet deep) representative of current OU1 conditions. Of the 21 VOCs detected, TMPs were the most frequently detected VOCs (frequency of detection ranging from 35 to 43%). Maximum concentrations of TMPs were greater than corresponding Industrial RSLs at five soil boring locations associated with Plant B; the samples are all at, or below, the water table. No other VOCs were detected at concentrations above an Industrial RSL. Of the

remaining VOCs, acetone and carbon disulfide were detected at frequencies of <14% and <12%, respectively. All other VOCs, which included chlorinated benzene compounds, TCE, fuel-related compounds, alcohols, chloromethane, dibromomethane, styrene, and tetrahydrofuran were detected in only one or two samples (a frequency of < 4%).

Of the 29 SVOCs detected, only BEHP was detected above an Industrial RSL. BEHP was also the most frequently detected SVOC (approximately 41%). Diphenylamine was the next most frequently detected SVOC (33%), followed by diphenyl ether (20%), NDPA (13%), biphenyl (10%) acetophenone (8%) benzoic acid (7%) and phenol (5%). The remaining SVOCs detected included methylated phenols, naphthalene, ethers, dibenzofuran, other phthalates, and PAHs which were all detected very infrequently (1-3%), and at very low concentrations. USEPA RSLs are not available for several detected parameters including 4-isopropyl toluene, 4-bromophenyl phenyl ether, 4-chlorophenyl phenyl ether, benzo(g,h,i)perylene, diphenyl ether, diphenylmethanone, and phenanthrene.

Consistent with surface and shallow soils, 23 metals were detected in deep subsurface soils. Of these, only arsenic and hexavalent chromium were detected at concentrations greater than their corresponding Industrial RSLs in surface soil. Arsenic was detected in approximately 99% of samples, and is considered to represent a background condition. Hexavalent chromium was detected in approximately 86% of the samples analyzed; of these, only 6 deep subsurface soil samples contained hexavalent chromium above the RSL (27%). Ammonia, sulfate, and chloride are also frequently detected in deep subsurface site soils. USEPA RSLs are not available for calcium, magnesium, potassium, sodium, chloride, ammonia, and sulfate.

For reasons discussed earlier (see Section 4.1.2.2), formaldehyde had the highest frequency of detection among specialty compounds (100%); however, the highest concentration was five orders of magnitude below the Industrial RSL. Hydrazine was detected at five of nine targeted locations sampled, but at concentrations below the Industrial RSL. Acetaldehyde was detected at a frequency of approximately 35%, but at concentrations more than two orders of magnitude below the Industrial RSL. Phthalic anhydride was detected in approximately 25% of the samples analyzed, but at concentrations nine orders of magnitude below the Industrial RSL.

4.1.3 Soil Results by Analyte/Analyte Group

4.1.3.1. Metals and Inorganics

Many inorganics and all metals are naturally occurring, and most of them, therefore, are detected at high frequency in soil samples, even in the absence of contamination. Therefore, all of the metals have been considered, and comparison of concentrations to RSLs and comparison to the site specific background levels are the primary means of evaluating the significance of the metals concentrations with respect to nature and extent of contamination and data requirements to support the risk assessment activities and the feasibility study. All chromium (trivalent chromium) concentrations in soil were below Industrial RSLs, however, soil distribution figures have been included since chromium is a COI.

Of the other metals that are frequently detected in surface soil, lead, vanadium, copper, cadmium, nickel, tin, and zinc have a small clustering of maximum concentrations on the east side of Plant C, at SB-447, at several nearby borings including SB-451, SB-439, SB-441, SB-446, and to a less frequent extent SB-450. Concentrations of these metals range from 2 times to 10 times background depending on the metal. The occurrence of these metals exceeding background in the vicinity of Plant C are limited to a small area, and restricted to surface soils only. They are associated (co-located) with areas of elevated PAHs in surface soil, and appear to be associated with boiler ash residues. As such, these metals are not associated with manufacturing processes or directly related products produced by the facility, but are related to

the former boiler location in Plant C. Although aluminum is also frequently detected in soil, and is a known component of floc in South Ditch, the maximum aluminum concentration is less than 2 times the maximum detected background concentration. The distribution of aluminum across OU1 and all soil depths is random, indicating that aluminum is not a COI released to soil at the Site due to manufacturing operations.

Arsenic and hexavalent chromium are the only inorganics/metals with soil concentrations that are greater than the corresponding Industrial RSL. **Figures 4.1-2** through **4.1-10** present the distributions of arsenic, chromium (total), and hexavalent chromium concentrations for the three intervals of concern (0-1 ft bgs, 1-10 ft bgs, and >10 ft bgs). Further discussion on the nature and extent of arsenic and hexavalent chromium follows.

4.1.3.1.1. Arsenic

Arsenic was detected at concentrations greater than the corresponding Industrial RSL in almost all soil samples. Statistical evaluation of the distributions of arsenic concentrations in soils was conducted to determine if there is evidence of a release, or if the distribution is consistent with a single (background) population. This information was developed and presented to the USEPA in Site meetings in response to comments on the Draft RI Report.

The Property arsenic soil data set appears to be consistent with background conditions as determined by the site-specific background data, with the exception of outliers identified below. The concentrations of arsenic in background soil samples have a range of 0.64 mg/kg to 10 mg/kg, with a mean of 5.0 mg/kg. The mean arsenic concentrations for site surface soil (8.2 mg/kg), shallow subsurface soil (4.4 mg/kg), and deep subsurface soil (3.4 mg/kg) are consistent with the mean of arsenic concentrations in the background soil samples. Box plots of the arsenic data are presented in **Figure 4.1-29**. This figure identifies raw data outliers, and compares sample distributions within individual exposure area groups. The box plots of the sample area groups indicate that all sample groups, except EA5 and the haul road on the former PanAM railway, are a single population. Further statistical assessment of the arsenic soil data set indicates that the arsenic soil concentrations appear to be log-normally distributed, and a normality plot indicates that there are several data points at the high end of the concentration scale that appear to be outliers with respect to the lognormal distribution. Those highest concentrations range from 21 mg/kg to 89 mg/kg. The highest concentration was reported in a sample collected at a depth of 4.3 feet (a confirmatory sample beneath Central Pond), with the remainder of the outlier concentrations associated with surface soil samples. Those samples were collected from SB-451 (near the Boiler House), at SS-428 (next to the temporary cap), and SS-430 (under the temporary cap). Five of the six background arsenic results are above the Industrial RSL. The majority of arsenic concentrations from non-background soil locations are also greater than the Industrial RSL (1.6 mg/kg).

Quantile-quantile graphs of the Site arsenic data with those outlier data points removed were also developed and compared to plots from a background study of arsenic in New England, prepared by the United States Geological Survey (USGS). Those graphs are reproduced in **Figure 4.1-30** and also indicate that the arsenic concentration distribution is consistent with a single background population.

The occurrence of elevated arsenic concentrations associated with railroad activities has been relatively well established in Massachusetts. As indicated in the MassDEP BMP-Development of Rail Trails*; "Railroads are known to have elevated metals, pesticides, (such as lead arsenate), and constituents of oil or fuel (petroleum products). It would not be uncommon to find arsenic (up to ten times natural background levels) present in the soil along a right-of-way from old railroad ties dipped in an arsenic solution, arsenic weed-control sprays, and arsenic laced slag used as the railroad bed fill."* This information suggests that sources and releases of

arsenic should be expected at the two off-Property locations (PanAM railroad bed and EA5) from railroad operations.

Therefore, it is concluded that arsenic is not a COI at the Site. Arsenic data is incorporated into the risk assessment, but does not warrant discussion in the uncertainty analysis.

4.1.3.1.2. Chromium and Hexavalent Chromium

Chromium (total) was detected in almost all soil samples, at all sample depths (0-1 ft bgs, 1-10 ft bgs, and > 10 ft. bgs) across the site; however, the concentrations were less than the Industrial RSL (**Figures 4.1-5** through **4.1-7**). The Industrial RSL for chromium (total) is orders of magnitude higher than the RSL for hexavalent chromium.

The concentrations of hexavalent chromium in soil (0-1 ft bgs, 1-10 ft bgs, >10 ft bgs) that are greater than the Industrial RSL (5.6 mg/kg) are centrally located within the former facility area around disposal features including the former East and West Pits, which are under the current East and West Warehouse buildings and, near Lake Poly, West Ditch Wetland and Buried Debris Area (**Figures 4.1-8** through **4.1-10**). Hexavalent chromium concentrations above the Industrial RSL ranged from 6.8 mg/kg to 17 mg/kg in soil from 0-1 ft bgs at eight locations. Shallow subsurface soil concentrations ranged from 5.7 mg/kg to 28 mg/kg from 1-10 ft bgs at five locations. Deep soil concentrations of hexavalent chromium ranged from 9.7 mg/kg to 48 mg/kg from greater than 10 ft bgs at eight locations. Hexavalent chromium concentrations are greater than the Industrial RSL in approximately 25% of deep subsurface soil samples submitted for analysis.

Hexavalent chromium is often non-detect in samples for which total chromium is relatively elevated, or the ratio of hexavalent chromium to total chromium is often quite low for the higher detections of total chromium. Box plots of total and hexavalent chromium were developed and are provided as Attachment 7 of the BHHRA Second Interim Deliverable, and indicate the spread of total chromium and hexavalent chromium are not consistent. These findings indicate a general lack of correlation between total chromium and hexavalent chromium concentrations in soil for OU1 and OU2. The body of data for chromium in soil is extensive, and clearly indicates that chromium contamination is associated with liquid disposal areas, such as Lake Poly, and receiving water bodies such as the on-Property ditch system, both of which have been extensively remediated for chromium. Outside of these areas in OU1 soil, an isolated hexavalent chromium detection occurs in surface soil above the Industrial RSL at SB-506, east of the former dry storage buildings. There is an extensive data set of total chromium surrounding this location and bordering the property boundary to the west which indicated the total concentration of chromium to be fairly uniform and low, indicating this area of the Site was not an area of a release of chromium. For soils representative of current conditions chromium does not exceed the Industrial RSL. While the body of data for hexavalent chromium is not as extensive, the 117 samples analyzed for this metal do provide an adequate understanding of the nature and distribution of hexavalent chromium in surface and subsurface soil. That data taken together with total chromium data indicates that former sources of chromium in soil have been delineated, and that hexavalent chromium is a subset of the chromium distribution, but its presence is dependent more on prevailing geochemical conditions than trivalent chromium concentrations. With the exception of the one very high concentration of hexavalent chromium in OU2 soils in EA5 in Lower South Ditch at SS-445 (1,100 mg/L), which could not be replicated by additional samples, most detections of hexavalent chromium above the Industrial RSL were only slightly higher than the RSL. These detections are clustered around or within the footprint of former Lake Poly, and downstream areas, and the East and West Pits, located under the current East and West Warehouses. In surface soil, hexavalent chromium is also present above Industrial RSLS within the un-remediated portion of Lower South Ditch in OU1 and OU2.

The un-remediated portion of South Ditch is that portion of the ditch located downstream of the "Delta" area identified on **Figure 1.3-1,** approximately 200 west of the property boundary.

While it is agreed between USEPA and Olin that the general nature and distribution of hexavalent chromium is adequately documented, the data set does result in some exposure areas having less than three values to evaluate exposure point concentrations. One of the purposes in defining the distribution of constituents is to support quantitative assessment of risk. Therefore, for exposure points with fewer than three hexavalent chromium results, Olin and USEPA have agreed that an estimate of the hexavalent chromium concentration be calculated in the BHHRA. The estimated hexavalent chromium concentration is calculated by applying a ratio to each total chromium result for a specific exposure point and medium. The ratio is the 95% UCL on the mean for the ratio of hexavalent chromium to total chromium for all samples in that medium that have both total chromium and hexavalent chromium analytical results.

4.1.3.2. VOCs

TMPs are the only VOCs detected in subsurface soil at concentrations above Industrial RSLs. TMP concentrations were below RSLs in surface soils. Therefore the nature and distribution of TMPs in relation to former releases and sources is discussed below. Other VOCs were not detected above RSLs in surface or subsurface soil.

4.1.3.2.1. TMPs

TMPs are not present in surface soils at concentrations above the Industrial RSL. Over most of the OU1 site, TMPs are not detected in surface soil, with the following exceptions: near the former Plant B Production Area, east of East Warehouse, along on-property West Ditch south of the former Drum Storage Area and former Lake Poly, and in one sample in lower South Ditch and Central Wetland (see **Figure 4.1-11**).

In shallow surface soil, TMPs are more widely distributed (**Figure 4.1-12**). Numerous low-level detections occur in the vicinity of former disposal areas including former Lake Poly, the Drum Storage Area, the Buried Debris Area, and within the Containment Area near former Drum Area A and Drum Area B. TMPs are also detected around the southwestern, southern, and eastern sides of the West and East Warehouses, east of former Plant D, within soils underlying Central Ponds, former Plant B production area, and east of Plant B. TMPs are present at concentrations above the Industrial RSL at the former Plant B production area and behind Plant B in soils from 1-10 feet and in deeper soils. TMPs are also present at a concentration above the Industrial RSL in shallow subsurface soil in one boring in the parking lot next to the former Administration Building (SB-405), where they were also found over a larger area in soil samples collected from within the 1-10 foot interval and from depths greater than 10 feet. Based on these higher TMP concentrations, the SB-405 area is separated from EA1 and a new exposure area (EA7) was added. One detection of TMPs above the Industrial RSL also occurs in shallow subsurface soil in former Lake Poly. The detection of TMPs at concentrations greater than the Industrial RSL in deep subsurface soil is restricted to the former Plant B production Area and East of Plant B. **Figures 4.1-11** through **4.1-13** summarize TMP data for soils east of the former office building proximate to SB-405, proximate to the former Plant B Production Area, and east of the former Plant B tank farm. A representative set of cross sections showing the geologic conditions and vertical distribution of TMPs for the former Lake Poly area, Plant B and the "TMP Area" are presented in **Figures 3.2-5** through **3.2-7**. The nature and extent of TMPs has been delineated.

4.1.3.3. SVOCs

Among SVOCs, Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene BEHP, and NDPA are most frequently detected at concentrations

greater than the corresponding Industrial RSL. **Figures 4.1-14** through **4.1-22** present Benzo(a)pyrene, BEHP, and NDPA distributions across the site. The distribution of other cPAHs is similar to the distribution of Benzo(a)pyrene, thus separate figures for those compounds are not presented but are discussed below.

4.1.3.3.1. Benzo(a)pyrene and other cPAHs.

As indicated in the previous section, several cPAHs are detected in surface soil and subsurface soil above Industrial RSLs. These compounds are associated with the former boiler locations, or are located near roadways and rail road beds, and are not associated with materials used, produced, or otherwise disposed at the facility. Benzo(a)pyrene and dibenzo(a,h)anthracene have the lowest Industrial RSL at 0.21 mg/kg. Benzo(a)anthracene and benzo(b)fluoranthene have the next lowest RSL at 2.1 mg/kg, and benzo(k)fluoranthene the highest at 21 mg/kg. The highest concentrations of benzo(a)pyrene in surface soil above the RSL ranged from 0.22 to 21 mg/Kg, and occurred in the vicinity of the former Plant C Boiler (SB-447,SB-451,SB-450 and SS-412) or in the vicinity of the former Laboratory Building Boiler near the Guard Shack (SB-410 and SS-404, Area-4 (composite)). Benzo(a)pyrene was also detected above the RSL in SS-401 in the North East corner of the Site near Eames Street, and at SS-459, SB-448, and SB-443 along or in the Haul Road along the former PanAM rail spur. Low concentrations of benzo(a)pyrene are detected near these areas, and generally across the Site, including background soil sample locations and near Lower South Ditch.

The maximum and next highest concentrations of benzo(a)pyrene, dibenzo(a,h)anthracene and benzo(b)fluoranthene in surface soil occur at SS-447 by the Plant C boiler, and at SS-410 by the Guard Shack and Laboratory Building Boiler. Following these two samples, cPAH concentrations decrease an order of magnitude. Benzo(b)fluoranthene is not detected above its RSL at other surface soil locations. Dibenzo(a,h)anthracene was detected above its RSL at the same locations where benzo(a)pyrene exceeds its RSL. In addition, dibenzo(a,h)anthracene was detected above the RSL at SS-400 in the NW corner of the property near Eames Street, at SS-406 near the junction of the Olin rail spur and PanAM rail line, and at SS-409.

The highest concentrations of benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene were detected in shallow subsurface soil at the former boiler at Plant C (RSO-06-N), and ranged from 17 to 23 mg/kg, respectively, and also occur in vicinity of the former boiler at Plant C (RSO-06-N). Benzo(b)fluoranthene and benzo(k)fluoranthene due not exceed RSLs in other subsurface soil samples. Benzo(a)pyrene was detected at concentrations slightly above RSLs in two other subsurface soil samples near the Plant C boiler (SVE-6B), and near the boiler at the Laboratory near the Guard Shack (SB-410).

The nature and extent of cPAHs with concentrations exceeding RSLs at the Site has been defined in surface and shallow subsurface soils, and are associated with areas adjacent to major roads (Eames Street), adjacent to former rail lines and in the vicinity of former boiler operations. The cPAHs are not detected above Industrial RSLs in deep subsurface soils, and are not associated with products manufactured or disposed at the Site. The wider distribution of PAHs below Industrial RSLs is a function of the ubiquitous nature of PAHs from anthropogenic sources in urban and industrialized areas.

4.1.3.3.2. BEHP

BEHP has been detected in surface soil, and both shallow and deep subsurface soil at concentrations greater than the Industrial RSL. In surface soils, the only locations that are above the Industrial RSL are within the on-Property ditch system, more specifically, in on-PWD south of former lake Poly and the former Drum Storage Area but outside the limits of excavation of the remediation conducted in on-PWD. These include surface soil sample locations SB-518,

and BD-C31 shown in **Figure 4.1-17**. SMU-27 has been removed from the data set since it was excavated during remedial activities. Two other sample locations detected BEHP above RSLs further downstream along the edge of upper South Ditch (BS-015) and in the un-remediated portion of Lower South Ditch (SDF-1). The low frequency of detection (2%) in surface soil at concentrations greater than the RSL reflects the extensive nature of remedial actions at former disposal locations and the on-property ditch system.

The distribution of soil BEHP concentrations above the Industrial RSL are associated with shallow subsurface soil is also consistent with known releases in the vicinity of former storage and disposal areas on the western side of the property including former Lake Poly, the former Buried Debris Area, and the Former Drum Storage Area. BEHP is also present in soil at concentrations above industrial RSLs in the general vicinity of the former Drum Disposal Area A. Subsurface soils with BEHP greater than the RSL in the area of the former Buried Debris Area (see **Figure 4.1-18**) are typically shallow samples collected from 2.9-3.8 feet (BD-C18, BD-C-19, and DB-C20). BD-C25 was collected at a deeper interval (6.8 feet). The depths of these samples are all generally consistent with the depth of shallow groundwater fluctuation adjacent to the on-PWD. The samples collected as confirmation samples from within former Lake Poly reflect the depth of the excavation bottom, including those with concentrations greater than the Industrial RSL as follows; LAKEPOLY1-02 (4.5 feet along the side slope) and LPB-10 (5.5-7.5 feet sample just below the bottom), LPB-8 (5-7 feet), LPB-16 (7.5-8.5 feet), and LPB-2 (8-9 feet). BH-10 was collected outside Lake Poly, and the BEHP reflects groundwater transport and sorption to soil (see cross section **Figure 3.2-4**). Please note that the cross section was drawn to reflect general conditions, and was intentionally not drawn through all the highest concentration points, which are also shown on **Figure 4.1-18** and cited in text above.

BEHP was detected in two soil sample locations in the former Plant B production area (borings BH-28 and BH-30) at depths of 4-6 feet and 8-10 feet respectively. Nearby samples from SB-421 and SB-425 were collected from similar depths with very low to non-detect concentrations. The detection of BEHP above the RSLs in former Plant C (BH-26) was from a sample depth of 7-9 feet, and is bounded by several borings sampled at similar depths. The remaining soils samples with BEHP above Industrial RSLs are located within the smear zone of LNAPL behind Plant B tank farm (BH-34, SB-477, SB-476, and SB-475), which is bounded north and south by SB-478 and SB-474. The depth of these samples range from 6-8 feet at BH-34 to 8-10 feet in the remaining samples. The geology and subsurface conditions at this location are also shown in cross section in **Figure 3.2-5**. The boundary of contamination cannot be investigated further to the east due to the steep slopes of the embankment. Impacted soil is below the water table and is associated with the LNAPL smear zone, and is more appropriately managed as part of OU3. Based on the hydrologic setting, the inferred boundary of contamination is the western side of East Ditch.

The isolated detection of BEHP above the RSL east of East Warehouse from 6-8 feet bgs in SB-459 has also been horizontally bounded by samples collected from the same depth interval.

BEHP is also widely distributed across OU1 shallow subsurface soils at concentrations below Industrial RSLs at Plant D, near the laboratory, Plant C, around and north of Plant B production area, and east of Plant B tank farm, the weight station and guard shack and one of the dry storage buildings. BEHP is also present at low concentrations below the Industrial RSL in soils within the Containment Area, soils under former on-PWD, South Ditch and Central Pond (**Figure 4.1-18**).

BEHP has been detected in deep subsurface soils at the same locations in former Plant C and Plant B production area and tank farm. The sample depth in SB-432 at Plant C was from 14-16 feet and is below the water table. The sample depth in SB-421 was 10.5 to 12.5 feet and

should be at or slightly below the water table. Behind Plant B, the sample depths in SB-476 and SB-478 ranged from 10-12 feet to 13-15 feet, respectively, and are below the water table. While the deep sample in SB-478 is not bounded to the north, the bedrock rises upward to the north and bedrock exposures are present east of the parking lot, and immediately north of Plant B, which places physical constraints on the extent of deep subsurface soil contamination to the north of SB-478.

4.1.3.3.3. NDPA

In surface soils, NDPA is widely distributed, is not detected above the Industrial RSL, and occurs primarily in the same areas as BEHP: near Plant C, Plant B, former Lake Poly, within the Containment Area, and to a more limited extent in vicinity of former Plant D and in flood plain soil in Lower South Ditch (**Figure 4.1-21**). NDPA has only been detected above the Industrial RSL in shallow subsurface soils near former Lake Poly (**Figure 4.1-22**). NDPA is present in three soil borings at concentrations above the Industrial RSL, including one boring in former Lake Poly excavation footprint (LAKEPOLY1-02) at a depth of 4.5 feet, and two borings just outside that footprint: LPB-10 from 5.5-7.5 feet, and BH-12 from 4-6 feet (see **Figure 4.1-21** and **Figure 3.2-4**).

NDPA was also detected at low concentrations below the Industrial RSL in shallow and deep subsurface soils in proximity to the former Plant B production area, former Lake Poly, and around the Debris Disposal Area (**Figures 4.1-22** and **4.1-23**). The nature and extent of NDPA has been sufficiently delineated.

4.1.3.4. Polychlorinated Biphenyls

PCBs have a low frequency of detection in the 0–1 ft bgs and 1–10 ft bgs depth intervals. Only one Aroclor (Aroclor-1260) was reported at a soil concentration greater than the Industrial RSL. This parameter was detected at a concentration greater than the Industrial RSL (0.74 mg/kg) in three surface soil samples (0-1 ft bgs) and one 1-3 ft bgs sample, immediately south of the Guard Shack adjacent to a former pole mounted transformer (in samples SS-403, SS-404, SS-501, and SB-530). Additional PCB investigation was completed in June 2013, which delineated the horizontal and vertical extent of PCB concentrations exceeding the Industrial RSL.

4.1.3.5. Petroleum Hydrocarbons

Where targeted for analysis, EPH/VPH hydrocarbons were detected frequently from the three different depth intervals. **Figures 4.1-26** through **4.1-28** show the distribution C11–C22 (adjusted) Aromatics concentrations that were greater than the corresponding MassDEP S-2 soil standard, including one historic sample location in surface soil in lower South Ditch (SDF-1) and two RI sample locations in shallow subsurface soil. One of these two samples was located at SB-432 at a depth from 5-7 feet beneath Plant A, and the second was behind Plant B at SB-477 at a depth of 8-10 feet, which is within the LNAPL smear zone at or below the water table. Where present in shallow and deeper subsurface soils at concentrations below RSLs, the C11-C-22 aromatic and other fractions were distributed in the vicinity for former Lake Poly and former Plant B production area, with several other detection in vicinity of Plant A, Plant D and east of East Warehouse. These locations are also consistent with the locations of other SVOCs. The nature and extent of petroleum hydrocarbon range compounds have been adequately delineated.

4.1.3.6. Specialty Compounds

Hydrazine was the only specialty compound detected in soil above an Industrial RSL. Hydrazine was detected at low concentrations in a number of the surface and shallow subsurface soil samples; primarily in vicinity of the Plant D Tank farm, Plant A, Plant C-1, and

near some of the historical disposal areas. **Figures 4.1-23** through **4.1-25** summarize hydrazine soil concentrations across the site. However, only one historical sample from 1-10 ft bgs had a qualified concentration greater than the Industrial RSL. This sample was LPB-48 in the former Lake Poly Area collected at a depth from 5-8 feet, and was qualified as having an elevated reporting limit. Based on the range of reported concentrations, and the distribution of locations where hydrazine was detected, the nature and extent of hydrazine is adequately defined.

4.1.4 Bounding of Soil Results Exceeding Industrial RSLs

In summary, the data in **Figures 4.1-1** through **4.1-28**, and discussions concerning contaminant distribution in the proceeding section indicate that horizontal and vertical delineation of contamination has been accomplished within and along the Olin property boundary.

Prior to the RI, the Olin property had been subject of numerous investigation and remedial actions for both soil and sediment under the MCP. The RI data set provides additional information in and around several previously remediated areas including former Plant B production area, Plant B tank farm, former Lake Poly, East and West Pits, and the former Debris Disposal Area. The RI soil data provides additional information along the property perimeter, surrounding and under foundations of other former production areas including Plant A, Plant C, and Plant D, and in flood plain soil with lower south Ditch. The only new area of contamination identified was the presence of TMPs under the administration building parking lot north of the former Plant B production area, and a small area of slightly elevated metals behind Plant C.

4.1.4.1. Property Perimeter

The sampling of surface and subsurface soil around the property perimeter indicates that there is no off-Property migration of impacts to soil located above the water table. The RI and historical data indicate that samples located along the property perimeter have non-detects or low concentrations that are below Industrial RSLs or below published background levels (arsenic). The use of this unbiased background data, adds to the conclusions that metals (including arsenic) represent background conditions at the Site. This has been further supported by statistical analysis of the on-site arsenic distribution. Two areas of elevated arsenic are present in surface soil associated with rail road activities on either side (east and west) of the property. One area is the Haul Road on the former PanAM railway tail track to the west of the property, the other is located in floodplain soils adjacent to South Ditch and the MBTA rail line on the east side of the property. Arsenic is considered a background condition on-site, and is not a COI.

4.1.4.2. OU1 Soils

The nature and extent of TMP impacts in shallow and subsurface soil under the parking lot located east of the Administration Building and north of the former Plant B production area has been bounded by soil sampling for VOCs and head space analysis using a PID.

The Plant B production area was a source of releases for both TMPs, BEHP at concentrations above Industrial RSLs and NDPA at concentrations below the RSL. The nature and extent of BEHP and TMP impacts has been defined in soil within the former Plant B production area the extent of these contaminants at concentrations above Industrial RSLs has been bounded.

The nature and extent of contaminants associated with the former Plant B tank farm has been delineated. This includes delineation of the SB-405 area for TMP and BEHP and the area east of Plant B (SB-427) for TMPs, BEHP, and EPH/VPH. It was not feasible to horizontally delineate further east of SB-474 through SB-478 due to topography and the steep slope down to the East Ditch and railway (approximately 15 feet below Plant B ground surface). The release to

soils here migrated in the form of an LNAPL along the sloping water table to East Ditch. Water elevation measurements on the opposite (eastern) side of East Ditch indicate groundwater flows toward East Ditch from the adjacent property. Therefore the western side of East Ditch is the boundary of soil impacts related to historical migration of LNAPL. TMPs at SB-478 (0-1 and 1-10 feet below grade) have been delineated and at the northern boundary are below RSLs. At a depth greater than 10 feet, soils are below the water table. Soil sample SB-478 (greater than 10 feet) was collected at 10 to 12 feet below grade (within the water table). Refusal was noted at 12 feet. The TMPs are associated with the LNAPL smear zone at Plant B and the northern most LNAPL extraction (EW-12) well has not historically recovered any significant LNAPL volume indicating this well is located near the northern edge of the release area and that the smear zone is not expected to extend much farther to the north. Further delineation to the north is hampered by heavily vegetated / wooded terrain that is uneven and would require clearing along the MBTA railroad right-of-way. A little further north are areas of bedrock outcrop indicating a limited extent of overburden providing a physical boundary to the potential northern extent of the former LNAPL smear zone. SB-474 is below Industrial RSLs for NDPA, BEHP, TMPs and C11-C22 Aromatics. Contamination is bounded to the south.

The nature and extent of BEHP, NDPA and TMPs detected above Industrial RSLs at and in the downgradient vicinity of former Lake Poly, including the distribution of BEHP and NDPA in the former Debris Disposal Area has been bounded horizontally and vertically. The presence of BEHP at the former Buried Debris area surface soil immediately adjacent to on-PWD wetlands has also been adequately investigated and bounded to the east side of drainage.

The nature and extent of cPAH compounds has also been delineated both horizontally and vertically in surface and shallow subsurface soil and these constituents are associated with former boiler operations in Plant C and the laboratory building just south of the guard shack. cPAHs are also associated with surface soils in vicinity of Eames Street, and the former PanAM railway tail track.

The analytical data for soil samples also identified several borings with elevated constituent concentrations above Industrial RSLs that required additional delineation for bounding. This included an area under the Plant C1 foundation (BH26) and east of East Warehouse (SB-459) where BEHP was detected above its RSL. Both areas have been bounded horizontally and vertically. C11-C22 Aromatics are also associated with the same area under Plant C1 (SB-432). Additional horizontal and vertical delineation has been accomplished for PCBs south of the Guard Shack.

The general nature and distribution of hexavalent chromium in soil is also sufficiently known to meet the delineation objectives for the RI. Hexavalent chromium is most prevalent at concentrations above the Industrial RSL in proximity to former disposal areas (Lake Poly and East and West Pits) and in surface soils the un-remediated portion of South Ditch which received releases from overflow from Lake Poly. Olin and USEPA are in agreement as to methods for evaluating risks posed by hexavalent chromium for exposure areas where data may be limited by the number of detections for this metal.

Finally, the small area of PCBs south of the Guard Shack has been delineated through a series of supplemental sampling events that were based on the prior sampling results.

4.1.5 Surface Water

The following subsections discuss the nature of constituents detected in OU1 surface water. These sections discuss compounds that are detected frequently, and also identifies those that are only detected infrequently. Where available the sections identify which constituents are present above an AWQC or background. If background is above an AWQC, that is also noted.

The 1999 ammonia AWQCs have been updated in 2013. The 1999 chronic criteria was based primarily on reproductive effects on the benthic invertebrate Hyalella or on survival and growth of fish early life stages (when present). The 2003 chronic AWQC for ammonia is 1.9 mg/L for waters of 20 degrees centigrade and pH 7 and takes into account several sensitive freshwater mussel species in the Family Unionidae and non-pulmonate (gill-bearing) snails which are also sensitive to the effects of ammonia. The toxicological effects of ammonia are pH dependent and the pH and temperature criteria from the 1999 AWQC remain valid. Since the ammonia AWQC requires calculation based on pH and temperature a value is not listed in the surface water data tables. In discussion of concentrations relative to ammonia AWQCs, the 2013 chronic value at standard conditions is used a reference point. The significance of concentrations and their effects is evaluated in the BERA.

The OU1 RI surface water investigation included collecting new surface water samples from historic sample locations along the length of the South Ditch with additional sampling in Central Pond and the Stormwater Detention Basin. The on-PWD is not a flowing ditch or stream and no surface water samples were identified for collection during the approved RI Work Plan. Older surface water data does not exist from the on-PWD. The South Ditch runs from the western Property boundary to the East Ditch. The Stormwater Detention Basin and Central Pond are both located north and adjacent to the South Ditch. The South Ditch has been monitored for a limited number of constituents on a quarterly basis prior to and since the installation of the slurry wall. The purpose for collecting the quarterly surface water samples was to evaluate the effectiveness of the Containment Area on surface water quality and to monitor sediment along the remediated portion of South Ditch for re-accumulation of chromium from deposition of floc. The purpose of the 2009 through 2013 surface water samples for the RI effort was is to, confirm and refine previous investigation findings, define nature and extent of site-related contaminants, and collect data to support human health risk and ecological risk assessments. **Figure 2.2-3** presents the historical and 2009 through 2013 RI surface water sample locations.

4.1.5.1. South Ditch

The analytical data associated with historic and 2009 through 2013 OU1 surface water sampling activities are presented in **Table 4.1-4**. This Table summarizes data, including each (detected) analytical parameter, frequency of detection, range of reporting limits for non-detects, range of detected concentrations, average concentration of all samples and individual sample results.

The South Ditch does not have a reference sample location due to the nature its headwaters in off-PWD area which is also affected by Site-impacted groundwater that discharges locally. Potential reference locations were explored across Jewel Drive in storm water drainages that flow into the off-PWD through a culvert under Jewel Drive but the characteristics of those surface water features were too dissimilar from either Off-PWD or South Ditch. In general, the historical data and RI data, show a consistent identification of constituents detected in the surface water samples.

Figures 4.1-29 through **4.1-36** show the surface water concentration distributions of ammonia, chromium, hexavalent chromium, calcium, sulfate, chloride, trimethylpentenes 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 to the East Ditch. The surface water feature upstream of South Ditch is the Off-PWD which is discussed in section 4.2.5.

4.1.5.1.1. Metals and Inorganics

Among metals many of which are common, naturally occurring constituents in natural surface water systems, the most frequently detected parameters include aluminum, barium, calcium,

chromium, cobalt, copper, iron, magnesium, manganese, nickel potassium, sodium, and zinc. Lead and barium were also frequently detected. Berryllium was detected in less than 42% of samples. Antimony, arsenic, mercury, silver, thallium and vanadium were infrequently detected. Arsenic and manganese were detected at concentrations above the AWQC.

Ammonia, sulfate, chloride are detected frequently in surface water and have been monitored quarterly since the construction of the Containment Area. The presence of these constituents in surface water are associated with discharge of both deep and shallow overburden groundwater both upstream and downstream of the weir, with the highest concentrations occurring south of the weir along the upper reach of the ditch adjacent to monitoring wells GW-202S/D to GW-79S. Ammonia is detected at concentrations above the chronic AWQC.

4.1.5.1.2. VOCs

VOCs detected most frequently in surface water include TMPs and chlorinated and brominated methane compounds (bromodichloromethane, bromoform, chlorodibromomethane, chloroform, and dibromomethane). 1,3-dichlorobenzene (DCB) was also detected, but at low frequency.

The TMPs are typically present in shallow groundwater at slightly higher concentrations than in deeper overburden groundwater. TMPs are not detected in either GW-78 or GW-79S on the north side of surrounding South Ditch on the downstream side of the Containment Area. The source of TMPs is, based on groundwater data, and soil data, residual concentrations in the former Lake Poly Area, and the former Debris Disposal Area, where the highest TMP soil concentrations are present. These areas of impacted soil are located below the water table.

The 1,3-DCB, bromodichloromethane, bromoform, chlorodibromomethane, chloroform, and dibromomethane detected in surface water are not associated with shallow groundwater. These compounds are detected in GW-202D, GW202BR, and GW-408D and associated with DAPL and Diffuse Layer material.

4.1.5.1.3. SVOCs

With the exception of NDMA and benzoic acid, the SVOCs most frequently detected in surface water are not detected in ISCO-1 but first occur downstream of the weir consistent with the CSM of groundwater discharge along South Ditch. These compounds, which include NDMA and benzoic acid, 2 –nitrophenol, 4-nitrophenol, diphenyl ether, diphenylmethanone, NDPrA, and NDPhA are all present in groundwater associated with Diffuse Layer material in GW-202D and GW-408D in proximity to South Ditch. Diphenyl ether and benzoic acid are more broadly detected in both deep and shallow overburden groundwater underlying OU1 at low, estimated concentrations including in GW-10DR; diphenyl ether is also present in GW-79S and GW-202S. Although BEHP is not detected frequently in surface water, it was detected once at PZ-17RR and at ISCO-2. BEHP is not frequently detected in overburden groundwater in vicinity of South Ditch, but is present in GW-408D and GW-10DR along the west side of the Containment Area, and is the presumed source of BEHP in surface water. One detection of BEHP was above the AWQC. Benzo(a)pyrene was detected once at a concentration above the AWQC.

4.1.5.1.4. Specialty Compounds

Specialty compounds including kempore, hydrazine, nonylphenol, and formaldehyde were also detected in the South Ditch.

As discussed previously in Section 3.3, the Upper South Ditch, behind and downstream from the weir, is a gaining stream, receiving discharging shallow and deeper overburden groundwater. The flows within South Ditch only increase slightly downstream, hence solute concentration in surface water tend to be fairly uniform over the entire reach, or slightly decreasing due to limited dilution. The depth to bedrock becomes shallower and the thickness

of the overburden groundwater system thinner under Upper South Ditch (approximately 20 feet) in the vicinity of GW-202D, and GW-55D; consequently, the South Ditch receives discharge from both deeper and shallow overburden groundwater. Historically, both deeper and shallow overburden groundwater surrounding South Ditch has exhibited chemical characteristics of Diffuse Layer material at certain locations (e.g., GW-201S, GW-79S, GW-55S, GW-202D and GW-55D). The Diffuse Layer may range from three to five feet in thickness, and is defined as having a specific conductance ranging from 20,600 µS/cm to 3,000 µS/cm. The Diffuse Layer also has elevated solute concentrations, and the pH of this material is also typically a little lower than that of overlying groundwater and may fall in the range of pH 5-6. The Diffuse Layer results from the upward diffusion of the dissolved constituents from DAPL. The VOCs and SVOCs detected in surface water at South Ditch sample locations PZ-17RR, and PZ-16RR are also most frequently detected in shallow overburden groundwater as well as deeper overburden groundwater. To help clarify the differences in groundwater solutes in both shallow and deep groundwater around South Ditch, an attachment (Table 1 in **Attachment E**) has been provided which presents groundwater data from several representative wells including GW-10DR/S, GW408D/S, GW-55D/S, GW-202D/S, GW-78S, and GW-79S.

Based on the results of the IRSWP sampling, and the RI sampling, the nature and extent of surface water impacts, as well as the origin of groundwater that results in these impacts have been well defined. These results are consistent with transport of dissolved contaminants in groundwater, and discharge of both deeper and shallow overburden groundwater to surface water along the South Ditch as a function of the surface water and groundwater interaction.

4.1.5.2. Central Pond

Central Pond has no surface water inlet or outlet, and the surface water present is an expression of the unconfined overburden groundwater table as described in Section 3.3.1.1. The analytical data associated with the surface water sampling activities in Central Pond are presented in **Table 4.1-5**.

4.1.5.2.1. Metals and Inorganics

The analytes detected are restricted to metals and inorganic compounds including aluminum, barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, silver, sodium, zinc, bromide, chloride, nitrate, nitrite, sulfate, and ammonia. The concentrations of these analytes are lower than adjacent water bodies (surface water location PZ-16RR) with the exception of calcium.

NDMA was not detected in Central Pond surface water. Central Pond surface water samples were not analyzed for specialty compounds. Groundwater data from nearby well GW-79S indicated the only specialty compound detected was 4-nonylphenol, but that it was detected consistently at concentrations below the chronic AWQC (6.6 ug/L) or the higher REACH screening criteria. **Figures 4.1-29** through **4.1-34** show the surface water concentration distributions of ammonia, chromium, hexavalent chromium, calcium, sulfate, and chloride, respectively. Manganese and ammonia are present at concentrations above the AWQC.

4.1.5.3. Stormwater Detention Basin

The Stormwater Detention Basin receives surface water run-off from the temporary cap through a drain in the concrete retaining wall that forms the basin's northern side. The basin has an outlet control structure consisting of a 4-inch vertical PVC pipe that has a fixed invert elevation and a screen to keep it from clogging. Water from the basin flows into South Ditch. The analytical data associated with the surface water sampling activities in the Stormwater Detention Basin are presented in **Table 4.1-6**. **Figures 4.1-29, 4.1-30, 4.1-31, 4.1-33, 4.1-34 and 4.1-36**

show the surface water concentration distributions of ammonia, chromium, calcium, sulfate, chloride, and NDMA, respectively

4.1.5.3.1. Metals and Inorganics

The analytes detected are primarily metals and inorganic compounds including aluminum, barium, calcium, chromium, hexavalent chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, silver, sodium, vanadium, zinc, chloride, nitrate, nitrite, sulfate, and ammonia. Manganese and ammonia are present at concentrations above the AWQC.

4.1.5.3.2. SVOCs

NDPrA and NDMA were the only SVOCs detected and were at low concentrations below the AWQC.

The Detention Basin's surveyed outlet structure discharge elevation is 80.32 feet MSL. Since construction of the Containment Area, groundwater elevations in GW-78S, which is located between the basin and South Ditch, have ranged from 78.72 to 82.17 feet MSL. The basin was excavated from a resistant bedrock ridge and its retaining wall poured prior to construction of the Slurry Wall. The nearby bedrock borehole for GW-202BR was sparsely fractured with low fracture hydraulic conductivity. Based on elevation data and hydrologic setting, the Detention Basin may receive input from groundwater; however the flux of groundwater is likely to be small relative to groundwater flux through adjacent saturated overburden. Ammonia and chloride are typically good indicators of groundwater / surface water interaction along South Ditch, and ammonia and chloride concentrations in the Detention Basin are quite low (7.5 mg/L and 9 mg/L respectively). Based on these considerations, the majority of water input into the Detention Basin appears to be storm water run-off.

4.1.6 Sediment

The OU1 RI sediment investigation included the collection of sediment from historic locations along the length of the South Ditch with additional sampling in Central Pond and the Stormwater Detention Basin. In addition, three sediment samples have been collected annually from South Ditch from 2009 through 2013 as part of the post construction monitoring program for the Containment Area to assess potential recontamination of the ditch sediment from floc deposition. Reference or background sediment locations do not exists for the same reason as surface water. Collectively, the RI data and historic data that is representative of current conditions are intended to confirm and refine previous investigation findings, define nature and extent of site-related contaminants, and provide chemical data to support human health risk and ecological risk assessments. **Figure 2.2-4** presents the historical and 2009 through 2013 RI sediment sample locations.

In general, sediment data for OU1 reflect historical inputs from disposal activities that overflowed to the ditch system or are currently discharged through groundwater and are retained at lower concentrations in more recent sediment and at higher concentrations in portions of Lower South Ditch that have not been remediated. Constituents that are COIs that are most frequently detected include chromium, hexavalent chromium, ammonia, sulfate, BEHP, TMP and low concentrations of some PAHs, in addition to other less frequently detected SVOCs, including phenols and NDPhA. Several VOCs are also detected that are not present in shallow and deep overburden groundwater surrounding South Ditch or under the Olin Property, and these constituents, which are also common laboratory contaminants, are not considered COIs and are likely laboratory-related. The VOCs ascribed to laboratory contamination include acetone, methylene chloride, and 2-butanone.

4.1.6.1. South Ditch

The analytical data associated with historic and recent RI OU1 sediment sampling activities are presented in **Table 4.1-7**. In general, the historical data and the 2009 through 2013 RI data, show a consistent identification of constituents found in sediment samples. The most frequently detected parameters include BEHP, TMPs, phenol, benzaldehyde, three EPH fractions, formaldehyde, several metals and inorganics including: aluminum arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, magnesium, manganese, nickel, potassium, silver, vanadium, and zinc. **Figures 4.1-37** through **4.1-42** show the distributions of sediment concentrations of ammonia, chromium, hexavalent chromium, chloride, sulfate, and BEHP respectively, for current conditions at OU1.

4.1.6.1.1. Metals and inorganics

The annual monitoring of South Ditch for the metals aluminum, iron and chromium, which are the primary constituents in floc, has been conducted to demonstrate there is no recontamination of sediment by chromium from floc formation that has continued to form after remediation of the Upper South Ditch. Hexavalent chromium has never been detected in the floc. The floc is inert and stable under natural conditions found in the stream, and is not biologically available. The distribution of chromium indicates that the concentrations of chromium are highest in off-PWD and the un-remediated portion of Lower South Ditch, compared to the Upper South Ditch. However, hexavalent chromium is only present in sediments in Lower South Ditch. In Central Pond and the Detention Basin, concentrations of chromium are similar, and hexavalent chromium was detected in Central Pond but not in the Detention Basin although redox and pH conditions are similar.

4.1.6.1.2. VOCs

Of the seven VOCs detected in sediment, the most frequently detected were TMPs and 2-butanone (50% of samples). Acetone, 4-isopropyltoluene, cis-1,2 DCE and trans1,2-DCE were each detected once. The TMPs and 2-butanone were detected at low concentrations at SD-2 just downstream of the weir, and ISCO-2 prior to the confluence with East Ditch. The concentrations at both locations were comparable to each other. The other VOCs were detected at ISCO-2, with the exception of acetone which was detected at SD-3.

4.1.6.1.3. SVOCs

Of the 28 SVOC detected in sediment, BEHP was the most frequently detected compound (100%), followed by phenol (67%), 3- and 4-methylphenol and NDPhA, Diphenylether and most PAHs (50%). Other compounds detected in at least one sample include 1,3-DCB, analine, caprolactam, di-n-octylphthalate, diphenylamine, and diphenylmethanone. The concentrations of BEHP are low in the formerly remediated portion of South Ditch (ranging from 0.12 to 0.72 mg/kg) and are present at concentrations several orders of magnitude higher in the un-remediated portion of South Ditch at SD1 and ISCO-2 (ranging from 210 - 480 mg/kg). Phenol, 3- and 4-methylphenol, caprolactam, and most PAHs were most commonly detected throughout the entire South Ditch from SD-2, downstream to SD-3, SDSW-E and ISCO-2.

4.1.6.1.4. Specialty Compounds

Four specialty compounds were reported including hydrazine, acetaldehyde, formaldehyde, and DMF. Formaldehyde was detected in all samples at uniformly low concentrations and for reasons discussed previously its presence is attributed to anthropogenic sources in the environment. Hydrazine and acetaldehyde were detected at low concentrations in 50% of the samples analyzed from the entire length of South Ditch from SD-2 downstream to ISCO-2.

4.1.6.2. West Ditch Wetland

The analytical data associated with the historical sediment sampling activities in the on-PWD Wetland are presented in **Table 4.1-8**. In general, constituents detected, are similar site-related compounds including: chromium, BEHP, and TMPs.

4.1.6.2.1. Metals and Inorganics

Seventeen metals were also detected including aluminum, arsenic, barium, beryllium, cadmium, chromium, calcium chromium copper, iron lead, magnesium, manganese, mercury, nickel, sodium, vanadium, and zinc. Of these, arsenic and beryllium were detected least frequently.

Inorganics detected include chloride, ammonia and sulfate.

4.1.6.2.2. VOCs

Of the eight VOCs detected, only TMPs were detected at a higher frequency (20%), and the detections are restricted to two samples collected from 2.7-3.1 feet bgs in 2000. Other VOCs reported included acetone, methylene chloride, chlorobenzene, benzene and xylenes.

4.1.6.2.3. SVOCs

Of the seven SVOCs reported, only BEHP was detected frequently (53%); di-n-butylphthalate was reported in approximately 6 % of the samples. The remaining SVOCs included NDPhA and 3 PAH compounds detected at a frequency of < 2%.

4.1.6.3. Central Pond

The analytical data associated with the sediment sampling activities in Central Pond are presented in **Table 4.1-9**. Detected analytes include TMPs, phenols, and four PAHs at low concentrations, in addition to metals and inorganic constituents. **Figures 4.1-37** through **4.1-41** show the sediment concentration distributions of ammonia, chromium, hexavalent chromium, chloride, and sulfate, respectively.

4.1.6.3.1. Metals and Inorganics

Twenty-two metals were also detected including aluminum arsenic, barium, beryllium, cadmium, chromium, hexavalent chromium, cobalt, calcium, copper, iron lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, tin vanadium, and zinc. Of these, arsenic and beryllium were detected least frequently.

4.1.6.3.2. VOCs

Of the six VOCs detected, 2-butanone and acetone were detected most frequently. TMPs, MTBE, and toluene were each detected once.

4.1.6.3.3. SVOCS

Of the eight SVOCs reported, 3- and 4-methylphenol, phenol acetophenone (a keytone), benzaldehyde were reported in both samples along with 2 PAHs. Two other PAHs were detected once. The compounds detected were either at low or low, estimated concentrations.

4.1.6.4. Detention Basin

The analytical data associated with the two sediment samples collected in the Detention Basin are presented in **Table 4.1-10**. **Figures 4.1-37 4.1-38,** and **4.1-40** through **4.1-42** show the sediment concentration distributions of ammonia, chromium, chloride, sulfate, and BEHP, respectively.

4.1.6.4.1. Metals and Inorganics

Twenty metals were also detected including aluminum arsenic, barium, beryllium, calcium cadmium, chromium, cobalt, copper, iron lead, magnesium, manganese, mercury, nickel, potassium, sodium, tin, vanadium, and zinc.

Detected inorganic constituents include chloride, sulfate, and ammonia.

4.1.6.4.2. VOCs

Four VOCs were detected in both sediment samples, including TMPs, 2-butanone and acetone.

4.1.6.4.3. SVOCS

Of the seven SVOCs reported, 3- and 4-methylphenol, phenol and benzaldehyde were reported in both samples while acetophenone, NDPhA, BEHP and benzo(a)pyrene were each detected once.

The concentrations of constituents detected in sediment are not elevated when compared to other sample locations such as Central Pond or South Ditch. As discussed in Section 4.1.5.3, groundwater elevations in GW-78S indicate that groundwater heads surrounding the Detention Basin are at times higher than the surface water level in the basin, favoring periodic movement of groundwater laterally and vertically into the Detention Basin. Constituents identified in sediment are also present in groundwater.

4.2 OU2

OU2 includes off-Property soil, surface water and sediment samples collected from the off-PWD, East Ditch, Landfill Brook and MMB wetland complex (MMB and SMB). These features are shown in **Figures 1.0-2 and 1.0-3.** Nature and extent of contamination is determined based on historical data that are representative of current Site conditions and the 2009 through 2013 RI data. Section 4.1 of the Draft FRI Report (MACTEC, 2007) summarized the historical analytical data and the distribution of constituents in soil, surface water, and sediment based on that data. The following section discusses the sources of contamination and the nature and distribution of contaminants in these media. Data Validation Memoranda for the 2009 through 2013 RI Investigations (soil, surface water, and sediment samples) are presented in **Appendix E**.

4.2.1 Sources of Contamination

These OU2 areas are off-Property areas, and did not directly receive surface water discharge from the Facility as was the case with On-PWD and South Ditch. Therefore “Sources” are not discussed as they are with respect to OU1 in Section 4.1. However, the Plant B area is a potential source for TMPs and EPH/VPH from groundwater discharge to the East Ditch. The East Ditch receives surface water from the South Ditch and continues to flow southerly and receive surface water from Landfill Brook. The Off-PWD flows into the South Ditch which ultimately discharges into the East Ditch. The two brooks in the MMB wetland are hydraulically isolated from surface waters on-Property. Landfill Brook, located south of the WSL is also physically isolated. The only migration pathway for site contaminants to surface water and sediment in the MMB area, Off-PWD and Landfill Brook is groundwater discharge.

4.2.2 Summary of Soil Analyte Detections by Depth Interval (0-1 feet and 1-10 feet)

Tables 4.2-1 and **Table 4.2-2** provide a summary of statistics for detected constituents in soil samples that are representative of off-Property soil conditions. **Figures 4.1-2**, **4.1-3, 4.1-5,**

4.1-6, 4.1-8, and **4.1-9** present (0-1 ft bgs and 1-10 ft bgs) off-Property soil sample concentrations for arsenic, chromium, and hexavalent chromium. Among VOCs, TM-2-P was the only VOC detected in soil samples, with the only detected concentration well below the calculated Industrial RSL. Among SVOCs, BEHP and several high molecular weight PAHs, and NDPA were most frequently detected. Maximum concentrations of BEHP, benzo(a)anthracene, benzo(a)pyrene, and NDPrA, were greater than corresponding Industrial RSLs. The maximum concentration of C11–C22 Aromatics was greater than the MassDEP MCP S-2 soil standard (relevant for industrial/commercial land use). Among specialty compounds, formaldehyde was the most frequently detected. In addition, maximum concentrations of arsenic and hexavalent chromium in surface soil samples were also greater than corresponding Industrial RSLs. There were several detected parameters for which RSLs are not available.

4.2.3 Soil Results by Analyte/Analyte Group

4.2.3.1. Metals and Inorganics

Arsenic concentrations greater than the Industrial RSL in soil samples from 0-1 ft bgs were identified off-Property, east of the Site, near the terminus of the South Ditch, and adjacent to the MBTA railway. Sample locations include: SS-439, SS-443, SS-445, SS-447, SDF-2, and BS040 with arsenic concentrations ranging from 14 mg/kg to 42 mg/kg. Two of the three samples collected off-Property, west of the Site on the former PanAM right-of-way had arsenic concentrations greater than Industrial RSL; sample locations are identified as SS-433 and SS-448 and have arsenic concentrations ranging from 23 mg/kg to 32 mg/kg. All of these elevated arsenic concentrations are located adjacent to, or on, former railways beds. As discussed in Section 4.1-3, arsenic distribution in OU1 is consistent with background conditions. Arsenic is detected off-site at higher concentrations exceeding background conditions; these detections are associated with former railroad activities (arsenic-based preservatives for railroad ties, herbicide usage).

Chromium (trivalent) was detected in almost all off-Property soil samples from 0-1 ft bgs and 1-3 ft bgs; however, the concentrations were below the Industrial RSL.

Hexavalent chromium was detected in 25% of surface soil samples (four locations) in Lower South Ditch off-Property soils at concentrations above the Industrial RSL ranging from 19 mg/kg to 1,100 mg/kg. Hexavalent chromium was also detected in shallow subsurface soil at one location at a concentration less than the Industrial RSL of 5.6 mg/kg.

4.2.3.2. VOCs

TM-2-P was the only VOC detected from an off-Property surface soil location and occurred on the eastern side of the property in SS-445 at a depth of 0-1 ft bgs; at a concentration below the Industrial RSL. TMPs were not detected in subsurface soils in OU2. **Figures 4.1-11** through **4.1-13** summarize off-Property TMP data.

4.2.3.3. SVOCs

Among the approximate 30 SVOCs detected in off-Property surface soil, only benzo(a)pyrene benzo(a)anthracene, BEHP, and NDPrA were detected above an Industrial RSL in surface soil located in the off-Property portion of Lower South Ditch (EA5). The PAHs were detected above RSLs in only one sample, although PAHs were detected in approximately 25% of the samples analyzed. BEHP was detected at a frequency of approximately 78%; however, it was also only detected once at concentrations greater than the corresponding Industrial RSL. Benzaldehyde was also detected in 10 out of 10 samples. NDPA was not detected above the Industrial RSL. Other compounds with a higher frequency of detection included benzaldehyde (100% frequency), 1 and 2-methylnaphalene, (30%), acenapthene (20%), acetophenone (20%) and

biphenyl (20%) and phenol (17%). In shallow subsurface soils, BEHP was detected once in the Lower South Ditch area at a concentration below the Industrial RSL. **Figures 4.1-14** through **4.1-22** summarize these compounds and their distributions off-Property.

4.2.3.4. Specialty Compounds

Acetaldehyde and formaldehyde were detected in each of three samples analyzed, but at concentrations orders of magnitude below RSLs. Hydrazine was detected in one of the off-Property soil sample (SS-448 at 0-1 ft bgs) located along the PanAM right-of-way; however, the concentration was also less than the Industrial RSL. **Figures 4.1-23** through **4.1-25** summarize hydrazine distribution for both off-Property and on-Property soils.

4.2.4 Bounding of Soil Results Exceeding Industrial RSLs

4.2.4.1. Perimeter

The RI data discussed above, and presented in **Figures 4.1-1** through **4.1-28,** indicates levels of arsenic and hexavalent chromium above the Industrial RSL, east and west of the Property. Elevated arsenic and PAHs are associated with PanAM railway west of the Site and arsenic is associated with the MBTA railway east of the Site, and is a function of former railway activities. The elevated hexavalent chromium east of the Site in the Lower South Ditch (EA5) has been delineated to the East Ditch as well as to the north and south. The elevated concentrations of chromium and hexavalent chromium in sample SS-445 were not confirmed by additional delineation sampling and analysis. The off-PWD is located immediately west of the elevated PanAM railway grade and further delineation of soil to the west of those samples is not possible since the railway grade terminates along the ditch.

4.2.4.2. North Pond Soils

As shown in **Attachment D** which contains the North Pond Investigation Memorandum, eight VOCs, six SVOCs, 22 metals, and four inorganics were detected in the 2013 soil borings. The VOCs detected in soil (historic sediments) samples are not chemicals of interest and are not attributable to the OCSS. The SVOCs detected in North Pond soils are PAHs detected at low frequency, and are PAHs commonly detected in sediments in urban/suburban water bodies. As expected, several naturally-occurring metals and inorganics were also detected in soil samples. In particular, the concentrations of chromium are orders of magnitude lower than those reported in sediments at the Site. The concentrations and types of constituents detected do not indicate impact of the historic North Pond sediment from the OCSS.

The summary of detected chemicals for OU1 surface soil (0-1ft), shallow subsurface soil (1-10 ft), and deep subsurface soil (>10ft), presented in **Tables 4.1-1** through **4.1-3**, identify compounds lacking soil RSLs. Several of the compounds lacking soil RSLs had low frequency of detection including: 4-iso-Propyltoluene, sec-Butylbenzene, m&p –xylenes, 4-Bromophenyl phenyl ether, 3 & 4 Methylphenol, 4-Chlorophenyl phenyl ether, acenaphthylene, benzo(ghi)perylene, carbazole, dimethyl phthalate, alpha chlordane, and endosulfan sulfate. Many compounds listed with no Industrial RSLs were also essential nutrients including: calcium, chloride, magnesium, potassium, and sodium. Essential nutrients were eliminated from the COPC selection and were not carried through the BHHRA. Most parameters presented in the soil tables that do not have Industrial RSLs also have no toxicity values available. The lack of toxicity values prevents the calculation of risks for those parameters.

4.2.5 Surface Water

The following subsections discuss the nature and distribution of contaminants by chemical class for off-Property surface water samples collected from two sampling events during the OU2 RI.

The areas associated with off-Property surface water include the off-PWD, East Ditch, Landfill Brook and the Maple Meadow Brook Wetland (including Maple Meadow Brook and Sawmill Brook). The analytical results associated with off-Property surface water sampling have been compiled and summarized. The discussion that follows summarizes the nature and extent of metals and inorganics, VOCs, SVOCs, and specialty compounds in off-Property surface water for current conditions, including discussions about the off-PWD, East Ditch, Landfill Brook and the Maple Meadow Brook Wetland. **Tables 4.2-3** through **4.2.6** identifies those samples and associated sample location identifiers that represent current conditions and which are the focus of the following discussions. **Figure 2.2-3** identifies the locations of surface water samples that are representative of current conditions in OU2.

4.2.5.1. Background Conditions for Surface Water

Background surface water samples were collected to characterize background conditions as described in the FSP. The two background surface water locations (SDBK-001 for the East Ditch and SDBK-004 for MMBW) are referred to as reference locations, and are shown on **Figure 2.5-1**. By agreement with USEPA, samples from SDBK-002 and SDREF-012 are not used as reference locations due their proximity to the Spinazzola Trust Landfill. **Table 2.5-1** summarizes the laboratory analyses conducted on background surface water and sediment samples. **Table 2.5-2** includes a summary of statistics for detected parameters in background surface water samples representative of current OU2 conditions. The detected concentrations for both arsenic and cPAHs in SDBK-001 in the East Ditch are above the AWQC.

4.2.5.2. Off-Property West Ditch

The off-PWD is located off-Property, along the western property boundary (**Figure 2.2-3**). Three surface water samples were collected within this area (OPWD-SW-S, OPWD-1, and OPWD-2). Analytical data from the off-PWD are presented in **Table 4.2-3**.

4.2.5.2.1. Metals and Inorganics

As shown in **Table 4.2-3**, of the 17 metals detected in surface water, the most frequently detected include aluminum barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc. Arsenic and beryllium were less frequently detected. Inorganics detected include chloride, bromide, nitrate/nitrite, ammonia and sulfate. The distributions of concentrations for these analytical parameters are provided in **Figures 4.1-29** through **4.1-34**. The highest concentrations of chloride, ammonia and sulfate are present in OPWD-1 which, is consistent with the direction of groundwater flow approaching the weir. More importantly, the concentrations for these indicator parameters, in addition to calcium and chromium, are lower in surface water in the off-PWD than the Upper South Ditch downstream of the weir. This relationship is apparent by comparing concentration summary data in **Table 4.1-4** (South Ditch surface water) and **Table 4.2-3** (off-PWD surface water), and this is consistent with the understanding of groundwater discharge in this area of the Site. Groundwater discharge has been suppressed, but not eliminated, in the off-PWD by construction and continued operation of the weir. Additional discussion of groundwater and surface water interaction for the off-PWD and Upper South Ditch is presented in Section 5 of this report.

4.2.5.2.2. VOCs

As shown in **Table 4.2-3**, VOCs detected in surface water include low concentrations of TMPs, carbon disulfide, and toluene. The distribution of TMP concentrations is provided in **Figure 4.1-35**.

4.2.5.2.3. SVOCs

Analytical data for surface water samples from the off-PWD are summarized on **Table 4.2-3**. NDMA and benzoic acid were detected frequently (83%) having been detected in five of six surface water samples. The distribution of NDMA is shown on **Figure 4.1-36**. Phenols, including phenol, 3- and 4-methylphenol, and 4-nitrophenol, acenapthene, and di-n-butylphthalate were also detected in surface water samples, but at lower frequencies (from 16-33%). PAHs were detected more frequently. The location where the largest number and highest concentrations of PAHs were detected was at OPWD-2, which is located immediately adjacent to the end of the rail spur behind 8 Jewel Drive. The spur contains numerous deteriorated, creosote-impregnated railroad ties, and several piles of deteriorated ties are located upstream along the elevated railroad grade. The concentrations and frequency of detection of PAHs decrease in downstream samples, and are essentially non-detect by OPWD-SW-S.

4.2.5.2.4. Specialty Compounds

Formaldehyde was the only specialty compound detected and was present at low, estimated concentrations in 75% of the samples. As discussed previously, formaldehyde is not considered a COI even though it was likely used in manufacturing processes. Its' ubiquitous presence at low-level concentrations in all media is consistent with its occurrence as a common anthropogenic pollutant in urban settings.

4.2.5.3. East Ditch (Upper and Lower)

The East Ditch is located between the eastern property boundary and the adjacent MBTA rail line. This section presents a discussion of the analytical results from samples collected throughout this surface water body, starting north of the Facility at surface water sample location EDSD/SW0 (Upper East Ditch) and extending south to where surface water exits a culvert at sample location EDSD/SW7 (Lower East Ditch). A summary of the analytical data from the East Ditch is presented in **Table 4.2-4**.

As described previously in Section 3, shallow groundwater and surface water on the northern portion of the East Ditch (north of Eames Street) flows in a northerly direction within the Ipswich River drainage basin. This portion of East Ditch that flows to the north is termed the Upper East Ditch. Surface water south of Eames Street flows in a southerly direction within the Aberjona River drainage basin, and is identified as Lower East Ditch. When the term downstream is used for the Upper East Ditch, it refers to a direction to the north and northwest. When downstream is used in the Lower East Ditch, it refers to a direction to the south/southeast.

Sample locations EDSD/SW0 and EDSD/SW1 are within the Upper East Ditch. Due to its' distance from the Site, and apparent lack of detection of COIs at EDSD/SW0, reference location sample OC-SW-SDBK-001 was collected in the same area, and is considered the most representative reference location for East Ditch.

4.2.5.3.1. Metals and Inorganics

Of the nineteen metals detected in unfiltered surface water samples collected from the East Ditch, all but four are detected frequently (50% to 100% frequency) as shown in **Table 4.2-4.** These include aluminum barium, calcium, chromium, hexavalent chromium, cobalt, copper, iron, lead. Other metals detected include, barium, copper, iron, magnesium, manganese, nickel, potassium, sodium and zinc. Arsenic was only detected in 2 samples, while silver, thallium and vanadium were each detected once. Vanadium is broadly associated with fossil fuels. Both arsenic and manganese were detected at concentrations above the AWQC. Arsenic is also above the AWQC in the reference location sample.

Data in **Table 4.2-4** indicate chromium and hexavalent chromium are detected at low concentrations in the East Ditch surface water. Chromium was also detected in reference sample location OC-SW-SDBK-001. The locations and distributions of concentrations for these analytical parameters are provided in **Figure 4.1-30** and **4.1-31**. Chromium was not detected in Lower East Ditch above the confluence of South Ditch. Hexavalent chromium was detected twice: once in EDSW/SD-2 (located between Plant B and South Ditch) and then farther downstream at EDSD/SW5. Detections of chromium occur at and south of the confluence with South Ditch. Chromium was only detected once in filtered surface water samples collected from ISCO-3.

As shown in **Table 4.2-4** and on **Figures 4.1-32**, the concentrations of calcium is consistent along the property boundary of the Lower East Ditch as well as downstream in the New Boston Street Drainway.

Frequently detected inorganics include ammonia, chloride, nitrate and sulfate. Bromide was detected at 20% frequency. Ammonia was detected once in the Upper East Ditch at EDSW/SD-1 and was not detected at the reference location OC-SW-BK SW/SD-001. Ammonia was detected at all surface water locations in Lower East Ditch with the highest concentrations detected south of the confluence with South Ditch. The concentrations of ammonia at EDSD/SW5 (located above of the Landfill Brook confluence) are lower than the farthest downstream location EDSD/SW7. Landfill Brook enters the East Ditch between these locations and average ammonia concentrations in Landfill Brook (LB-3) are slightly greater than those detected at EDSD/SW5 in East Ditch. These data indicate Landfill Brook is an important input of ammonia to East Ditch. Halls Brook confluence with East Ditch is further downstream and ammonia present in Hall's Brook Holding Area is well established as a groundwater and surface water contaminant associated with the Industriplex Site. The distribution of ammonia along East Ditch and Landfill Brook is shown in **Figures 4.1-29**. Ammonia was detected at a concentrations greater than the AWQC.

The distribution of sulfate in surface water within East Ditch is shown on **Figure 4.1-33**. Sulfate was detected at all surface water sample locations with the highest concentrations reported in the Lower East Ditch downstream of the confluence of South Ditch. Average concentrations of sulfate then decrease with distance downstream.

As shown on **Figure 4.1-34**, the distribution of chloride concentrations in surface water samples from the East Ditch is reasonably consistent. Highest concentrations were detected during the June 2011 sampling event in the Upper East Ditch at sample location EDSD/SW0, and the background location but these concentrations were only marginally higher than elsewhere in the East Ditch.

4.2.5.3.2. VOCs

VOCs were detected at several locations within the East Ditch (**Table 4.2-4**). VOCs detected include TM-1-P, chlorinated solvents (1,1,1-TCA, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, TCE, and PCE), m,p-xylene, toluene and MTBE as shown on **Figure 4.1-35**, the highest surface water concentration of TMP in East Ditch was detected at location EDSD/SW2. TMP was not detected in the Upper East Ditch (EDSD/SW1 and EDSD/SW0) or Lower East Ditch (EDSD/SW4 and EDSD/SW7) locations. The chlorinated solvents, and fuel compounds toluene, xylene, and MBTE, are not COIs associated with the OCSS. The USEPA investigated the East Ditch decades ago and identified several sources of VOCs that were not attributed to the Site. The chlorinated VOCs are most frequently detected in Upper East Ditch at EDSD/SW1, and Lower East Ditch at EDSD/SW5. The final SIP Report (prepared for USEPA by Ecology and the Environment in 1993) identified E.C. Whitney and Son's (Whitney Barrel) and Raffi and Swanson as two of the sources for these VOCs. The Raffi and Swanson property

located north of Eames Street has been previously investigated under the MCP, and its location is consistent with detections of chlorinated solvents in EDSD/SW1. The detection of chlorinated VOCs in Lower East Ditch are located south of E.C. Whitney and Son's. The chlorinated solvents in East Ditch are not present in South Ditch. The WSL is also a source of chlorinated VOCs that migrate to Landfill Brook which discharges into the East Ditch.

4.2.5.3.3. SVOCs

As shown in **Table 4.2-4**, NDMA, NDPrA, three PAH compounds, BEHP, benzoic acid, and caprolactum were detected in East Ditch surface water samples collected during the two RI sampling rounds. Benzoic acid is also detected at similar concentrations in the reference sample location. NDPrA was detected once at EDSD/SW0. The PAHs are detected where East Ditch runs next the MBTA rail line (EDSD/SW0 - EDSD/SW5) and are not detected as far south as EDSD/SW7 where the ditch and rail line become separated. The cPAHS were detected at concentrations greater than the AWQC. The reference sample location (OC-SW-SDBK-001) also detected cPAHs at concentrations greater than the AWQC.

The distribution of NDMA in surface water is shown on **Figure 4.1-40**. The highest NDMA concentration in the Lower East Ditch was upstream of South Ditch confluence at location EDSD/SW2. NDMA concentrations decrease downstream from the confluence of South Ditch and are detected less consistently (one detect and one non-detect) at sample location EDSD/SW7. NDMA was detected in the Upper East Ditch (north of the divide) at location EDSD/SW1, but decreased to non-detectable concentrations further north at location (EDSD/SW0). Olin and USEPA have discussed the downstream extent of NDMA, chromium, and ammonia, and recognize that East Ditch by Halls Brook is part of another site with chromium and ammonia contamination. The available data for NDMA in surface water samples from the South Ditch and the East Ditch indicate a decreasing concentration gradient from the lower end of South Ditch (upstream) to the lower end of the East Ditch (downstream). NDMA-containing groundwater discharges to the South Ditch surface water. South Ditch surface water then flows into the East Ditch, and NDMA subsequently attenuates (dilution and photo-degradation) as it flows southward towards the Halls Brook Holding Area. The available groundwater analytical data from existing overburden wells near East Ditch indicates that NDMA detected in surface water at EDSD/SW7 is not associated with active groundwater discharge at or near that location.

4.2.5.4. Landfill Brook

Landfill Brook is a surface water body located off-Property south of the WSL. The brook flows in a west to east direction along the south side of the WSL. The brook starts within several small wetland areas surrounded by a residential neighborhood and several large automotive repair and maintenance business, and joins the New Boston Drainway in an industrial/commercial area along New Boston Street. Surface water samples were collected from three locations from upstream to downstream (LB-1, LB-2, and LB-3) prior to Landfill Brook's discharge into the East Ditch (New Boston Street Drainway). A summary of the analytical data from Landfill Brook is presented in **Table 4.2-5**.

Due to the presence of data from other published reports that have been discussed with USEPA in meetings in November 2013, and which support Olin's opinion that the sources of impacts to Landfill Brook sediment and surface water are unrelated to the OCSS, an expanded discussion of Landfill Brook is provided in subsection 4.3.2 at the end of Section 4. This discussion on Landfill Brook is presented separately to avoid disruption of the presentation of the other information in Section 4.

The discussion in Section 4.3.2 draws on other hydrogeologic and geochemical data to discriminate between the CSL and WSL as potential contributors of groundwater to Landfill Brook and its headwaters. Section 4.3.2 follows a discussion of the CSL in Section 4.3.1.

4.2.5.4.1. Surface Water

Surface water quality within Landfill Brook is affected by groundwater discharge from the WSL, and possibly other source areas comprised of the automotive businesses just north of Landfill Brook's headwater, and the former Merrimac Chemical Company facility which was located along the southeastern portion of the WSL. Both geochemical and specific analyte distributions in surface water, sediment, and groundwater indicate the CSL is not a source of impacts measured at the Landfill Brook.

4.2.5.4.2. Metals and Inorganics

As shown in **Table 4.2-5**, of the nineteen metals detected in surface water samples, aluminum, arsenic, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, potassium, sodium and zinc were the most frequently detected. Cobalt, nickel and vanadium were detected at a frequency of 50% but only in samples from LB-1 and LB-2. Cadmium was only detected once at LB-1 and mercury once at LB-1 and LB-3. These data indicate that the least frequently detected metals (cadmium, cobalt and nickel), and aluminum, copper, and lead tend to have highest concentrations closest to the automotive businesses, which includes in excess of 200 junk automobiles stored in a large parking area that borders the headwater wetlands. Arsenic and manganese were detected at concentrations greater than the AWQC in Landfill Brook surface water samples.

Ammonia, sulfate, and chloride were detected in all samples. Nitrate was detected only at LB-2 and LB-3. Both sodium and chloride concentrations are elevated in LB-1, indicating run-off of road salt from the surrounding automotive businesses and roads. The distributions of these inorganics and metals indicate impacts from surface water run-off from the adjacent businesses. The distribution of ammonia, chromium, calcium sulfate and sulfate, and chloride are shown in **Figures 4.1-29** through **4.1-34**. Hexavalent chromium was not detected in Landfill Brook surface water. The concentration of ammonia increases downstream as the brook passes along the side of the WSL. Both the highest and the lowest concentrations of sulfate were reported at sample location LB-1 during different seasons which is closely associated with the small wetland. The higher sulfate concentration at LB-1 is probably associated with reducing conditions in the wetlands. Ammonia is present at concentrations greater than the chronic AWQC.

4.2.5.4.3. VOCs

Analytical data for surface water samples from Landfill Brook are summarized on **Table 4.2-5**. As shown in the table, several VOCs, including fuel compounds and one chlorinated compounds were detected at low concentrations Landfill Brook. These compounds are not Olin COIs. MTBE was detected in all surface water samples at low, estimated concentrations. Toluene, 1,1 DCA, 2-Butanone, and 4-iso-Propyltoluene were all detected at LB-3, closer to the former location of the Merrimac Chemical Company that occupied the Site prior to the WSL.

4.2.5.4.4. SVOCs

Analytical data for surface water samples from Landfill Brook are summarized on **Table 4.2-5**. SVOCs detected primarily include cPAHs, chrysene and benzoic acid. The PAHs and benzoic acid are primarily detected in LB-1, and to a lesser extent LB-2, again suggesting PAH impacts from run-off originating in bordering commercial areas. Both 3- and 4-methylphenol, as well as BEHP, were detected in LB-1. The presence of BEHP is well documented in the northwestern

portion of the WSL, and is not present in groundwater from the CSL. These data are discussed later in Section 4.3.2. The locations of these samples are shown on **Figure 2.2-3**. The cPAHs and chrysene were detected at concentrations greater than the AWQC.

4.2.5.5. Maple Meadow Brook Wetland Area

The Maple Meadow Brook Wetland area is represented by the wetland area located west and northwest of Main Street (west of the Property), and includes Sawmill Brook and Maple Meadow Brook. Under the RI Work Plan, surface water samples were collected from both Maple Meadow Brook and Sawmill Brook in December 2010 and June 2011. The nature and extent of site-related constituents in surface water from this area is discussed in the following subsections. A summary of detected analytes for MMB and Sawmill Brook is provided in **Table 4.2-6**. **Figures 4.1-29** through **4.1-36**, summarize distributions of detected concentrations of ammonia, chromium, hexavalent chromium, calcium, sulfate, chloride, TM-1-P and NDMA, respectively.

4.2.5.5.1. Metals and Inorganics

Of the eighteen metals detected, aluminum, barium, calcium, copper, iron, lead, magnesium, manganese, potassium, sodium and zinc were frequently detected. Cobalt and nickel were detected at a frequency of approximately 20%, while arsenic, cadmium, chromium, thallium and vanadium were detected infrequently (once or twice).

The concentrations of metals in surface waters presented in **Table 4.2-6** are generally consistent with the reference sample concentrations; however, the maximum detected concentrations of aluminum, barium, calcium, copper, iron, lead, magnesium, manganese, nickel, potassium and zinc were greater than the reference location. With the exception of calcium, none of these metals are considered COIs for the OCSS. Chromium, which is a COI, was only detected once at MMB-SW/SD-6 which is immediately adjacent to the Spinazzola Trust landfill. The maximum detected concentrations of arsenic, barium, calcium, cobalt, copper, iron, lead, magnesium, manganese, nickel, and potassium were also detected in June 2011 at that same location. The presence of these metals in MMB surface water are attributable to the Spinazzola Trust Landfill, which has been observed by AMEC to have visible leachate seeps emanating from the toe of slope within the wetlands. Manganese and thallium were detected at concentrations greater than the AWQC.

Inorganic constituents that were detected frequently in MMB and Sawmill Brook surface water include chloride, nitrate, ammonia and sulfate. Bromide was only detected at two locations: MMB-SW/SD-8 and MMB-SW/SD-5 in the middle section of Sawmill Brook. The concentrations of ammonia and sulfate in surface water are typically lower in Sawmill Brook, and higher in MMB where the highest concentrations of both constituents occurs at the upstream location MMB-SW/SD-6 adjacent to the Spinazzola Trust Landfill. With the exception of the location just downstream of the Spinazzola Trust Landfill, ammonia, and sulfate concentrations in surface water are consistent with the reference location. Ammonia was detected at a concentration greater than the AWQC in one sample (MMB-SW/SD-6) by the Spinazzola Trust Landfill.

Based on the concentrations of metals and inorganic constituents detected in surface water compared to the reference location, as well as the distribution of these analytes, MMB and Sawmill Brook do not appear to be impacted by metals or inorganic compounds associated with the OCSS. Elevated concentrations in MMB are associated with the Spinazzola Trust Landfill.

4.2.5.5.2. VOCs

As summarized in **Table 4.2-6**, low level estimated concentrations of several fuel-related and chlorinated VOCs (toluene, MTBE, cis-1,2-DCE, and TCE) were detected at locations MMB-

SD/SW-2, MMB-SW/SD-3 and MMB-SW/SD-6 in MMB downstream of the Spinazzola Trust Landfill. Only toluene was detected at MMB-SW/SD-6. MTBE and 1,2 Cis-DCE were most frequently detected at MMB-SD/SW-2. Based on review of these VOCs and distribution, they are not are associated with the OCSS and are not Olin COIs. They could have originated from either the Spinazzola Trust Landfill or automotive repair businesses located on Main Street near Eames Street.

4.2.5.5.3. SVOCs

As shown in **Table 4.2-6**, the most frequently detected SVOC in surface water during the 2010 and 2011 sampling events was benzoic acid which was detected in 10 of 25 samples or (40% frequency). Benzoic acid is also detected at the reference location at a similar concentration. Phenol, 3- and 4-methylphenol, caprolactam, the highest concentration of benzoic acid and several carcinogenic PAHs (benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene), di-n-butylphthalate and NDPrA were also detected at location MMB-SW/SD-6 adjacent to the Spinazzola Trust Landfill. Di-n-butylphthalate was also detected downstream in MMB at MMB-SW/SD-2, MMB-SW/SD-3 and MMB-SW/SD-1. NDPrA was also detected at low, estimated concentrations below the reporting limit at MMB-SW/SD-11 and MMB-SW/SD-8 in the December 2010 sampling event. In addition benzo(a)pyrene and di-n-butylphthalate was also detected at MMB-SW/SD-9 adjacent to the MBTA rail line. BEHP, a SVOC commonly associated with the OCSS, was not detected Sawmill Brook or MMB surface water. Based on a review of the detected compounds, in the CPAHs are not related to the OCSS. cPAHs were detected at concentrations greater than the AWQC.

NDMA was detected at a low, estimated concentration (0.47 J nanograms per Liter [ng/L]) at location MMB SD/SW-1 during the June 2011 sampling round. Although there were a few elevated detection limits due to sample dilution during analysis, both the upstream and downstream sampling locations (relative to MMB SD/SW-1) were non-detect at 1.9 ng/L. The groundwater sample collected during the May 2011 sampling event from GW-65S detected 2.7 ng/L NDMA. Historical data reported in the FRI indicated several “NJ” qualified detections from 2003 through 2006 may represent false positive results. The 2011 surface water data, in conjunction with corresponding shallow groundwater data, indicates there may be an isolated area where shallow groundwater containing trace levels of NDMA may discharge periodically to surface water. The MMB SD/SW-1 low, estimated concentration of 0.47 J ng/L is 5 to 6 orders of magnitude below ecological screening benchmarks.

4.2.5.5.4. Specialty Compounds

Table 4.2-6 indicates formaldehyde was detected in 11 of the samples collected in 2010 but in none of the samples collected in June 2011. The samples were detected at low, estimated concentrations (below ecological screening levels), and is frequently detected in other media at similar low concentrations. A low, estimated detection of hydrazine was also found at one sample location (MMB-SW/SD-8).

Formaldehyde occurs naturally and is as a common anthropogenic contaminant that is deposited atmospherically. Hydrazine is an unstable compound and is difficult to analyze for due to inferences that can result in false positive detections. For hydrazine to be associated with the OCSS and present in the wetland it would need to be transported in groundwater at significant concentrations from the Site. Hydrazine is detected sporadically at the site but always at low concentrations. There is no documented groundwater pathway from the Site that could explain the detection of hydrazine in only one sample at a low, estimated concentration (e.g. below the reporting limit). When a compound is detected only once from multiple samples and sample rounds and at such low, estimated concentrations it should not be assumed to be present unless there is other data that clearly documents a confirmed migration pathway.

Based on a review of detected specialty compounds and their distribution, formaldehyde and hydrazine in surface water in the MMB wetland are not interpreted to represent Site related impacts.

4.2.5.6. North Pond

A summarized in **Attachment D**, surface water results identify one VOC (acetone - likely a laboratory artifact), 16 SVOCs, 14 metals, and five inorganics detected in at least one or more of the 2013 surface water samples from North Pond. The SVOCs detected include PAHs and several phthalates, including BEHP. The low levels of BEHP and Di-n-butylphthalate detected in surface water samples from North Pond are consistent with the low level detections of BEHP and Di-n-butylphthalate in the duplicate surface water sample (SW/SD-600) collected from the surface water that flows into North Pond from the area of the former Ritter Trucking and other industrial facilities located to the north. Di-n-octylphthalate and BEHP were released to sediment and surface water from the Ritter Trucking Site as reported by USEPA in their 1998 Final Site Inspection and Prioritization Report.

Chromium, ammonia and sulfate were among the constituents detected in surface water in North Pond but they were also detected at concentrations consistent with those found in the sample collected from surface water flowing into the pond from the area of the former Ritter Trucking facility and other industrial properties to the north. The distribution of NDMA, NDPA, BEHP, TMPs, chromium, sulfate and ammonia in groundwater adjacent to, and upgradient from North Pond (i.e., the most recent OU3 sampling events in monitoring well GW-74S/D, GW-80S/D/BR, GW-50S/D, and GW-403D) are discussed in Attachment D. That data indicates that there is not a completed migration pathway for these COIs in groundwater and the surface water/sediment of the pond. NDMA was not detected in surface water samples from North Pond. The North Pond surface water data for these chemicals of interest demonstrate no impact to North Pond from the Site, and are consistent with analytical data associated with surface water entering North Pond from industrialized areas to the north.

4.2.6 Sediment Analytical Results

The following subsections discuss the nature and distribution of contaminants by chemical class for off-Property OU2 sediment. There are several areas associated with off-Property sediment: the off-PWD, East Ditch, Landfill Brook, and the Maple Meadow Brook wetland. The following subsections discuss the nature and distribution of contaminants by area and chemical class for off-Property sediment samples collected during one sampling event during the OU2 RI.

The discussion that follows summarizes the nature and extent of metals and inorganics, VOCs, SVOCs, and specialty compounds in off-Property sediment for current conditions, including discussions about the off-PWD, East Ditch, Landfill Brook and the Maple Meadow Brook area. **Tables 4.2-7** through **4.2-10** identify those samples and associated sample location identifiers that represent current conditions, and which are the focus of the following discussions. **Figure 2.2-4** identifies the locations of sediment samples that are representative of current conditions in OU2.

4.2.6.1. Background Conditions for Sediment

Background sediment samples were collected to characterize background conditions as described in the FSP. The two agreed-upon background sediment sample locations used in this RI are identified as SDBK-001(East Ditch) and SDBK-004 (MMBW), and are shown on **Figure 2.5-1**. As agreed with USEPA, sampling locations SDBK-002 and SDREF-012 are not used as background locations for this RI due their proximity to the Spinazzola Trust Landfill. **Table 2.5-1** summarizes surface water and sediment samples collected and laboratory analysis completed

on each background sample. **Table 2.5-3** includes a summary of statistics for detected parameters in background sediment samples representative of current OU2 conditions. There are no accepted federal or state reference values for sediment; therefore, sediment concentrations are compared to reference locations where available. The significance of sediment concentrations is evaluated in the Baseline Ecological Risk Assessment. These sections focus on describing the nature and extent of contamination, and whether detected constituents are considered to be the result of releases from the OCSS.

4.2.6.2. Off-Property West Ditch Sediments

The off-PWD is located off-Property, along the western property boundary. Three sediment samples were collected from this ditch during the OU2 RI. There is no sediment reference location associated with the off-PWD. The following subsections discuss the sediment analytical results.

4.2.6.2.1. Metals and Inorganics

As shown in **Table 4.2-7**, all nineteen metals detected were detected in every sediment sample including, aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel potassium, silver, sodium, vanadium and zinc. The highest concentrations of calcium, chromium, iron, manganese, sodium, and zinc occurred at OPWD-SD-S, which is the downstream sample location prior to water turning south and flowing under the PanAM railway to South Ditch. The elevated iron and chromium may suggest the presence of small amounts of floc which was noted in one surface water sampling event. In general, floc, if present, is expected to become trapped under the thick layer of leaf litter that covers the stream bottom. Flow in off-PWD is typically stagnant.

Figures 4.1-37 through **4.1-42** summarize distributions of ammonia, chromium, hexavalent chromium, chloride, sulfate, and BEHP.

4.2.6.2.2. VOCs

As shown in **Table 4.2-7**, three sediment sample locations in the off-PWD area were analyzed for VOCs. TMPs, 1,2,4-trichlorobenzene, and 2-butanone were detected at low, estimated concentrations in one of the three off-PWD sediment samples (OPWD-SD-S). The VOC 2-butanone is not present in overburden groundwater, and its presence in surface water and sediment is ascribed to laboratory contamination.

4.2.6.2.3. SVOCs

As shown in **Table 4.2-7**, of the nineteen SVOCs detected in the sediment samples collected in the off-PWD, the majority of compounds were PAHs which is consistent with the location adjacent to the former PanAM rail line and spur on the adjoining 8 Jewel Drive property. As mentioned previously, the area has numerous deteriorated creosote preserved railroad ties. Other SVOCs detected frequently include diphenyl ether, diphenylmethanone, BEHP, NDPhA, and benzoic acid, and are consistent with detection of Site-related SVOCs in groundwater. The highest concentrations of diphenyl ether, diphenylmethanone, and NDPhA occur at OPWD-SD-S. This sample location also has the highest total organic carbon content, and the elevated concentrations of these SVOCs may simply be a matter of increased sorption.

Though present in sediment, the PAHs are considered to be related to the presence of treated railroad ties, and are not considered to be indicative of releases from operations at the former facility on the Olin Property.

4.2.6.2.4. Specialty Compounds

As shown in **Table 4.2-7**, formaldehyde was detected in two sediment samples at low concentrations, and hydrazine in one sample at a low, estimated concentration. The formaldehyde analytical data for sediment samples from the off-PWD was compared to all other formaldehyde analytical data associated with sediment samples collected from the South Ditch (OU1), and separately for OU2 (East Ditch, MMBW). A review of the data indicates similar concentrations of formaldehyde in sediments within South Ditch, East Ditch, and MMBW. The concentrations in the MMBW (furthest from the Site) are actually slightly higher than the other locations. Formaldehyde, due to its ubiquitous low concentration distribution is considered a background condition from anthropogenic sources.

4.2.6.3. East Ditch Area Sediments

The East Ditch area is located to the east of the property boundary along the western border of the MBTA commuter rail line. Sediment was commonly absent in the ditch due to the presence of ballast associated with the railway, making sampling of sediment difficult. Only two of five planned sediment samples were collected (due to a lack of sediment), despite a concerted effort to locate pockets of sediment that could be sampled. Sediment samples were not collected in Upper East Ditch except at the reference location, and a sediment sample could not be collected at EDSD/SW5 in Lower East Ditch. Pre-RI sediment data was presented in the RI/FS Work Plan, but since sediment is no longer present at these locations that data is not considered representative of current conditions. The reader may refer to the RI/FS work if there is interest in reviewing older data.

It should be noted there are multiple sources for impacts to the East Ditch. The USEPA Final Site Inspection Prioritization Report for E.C. Whitney (1993) identifies Raffi and Swanson, US Pigments and Resins, E.C. Whitney Barrel, and WSL as inputs and potential contributors of VOCs and fuel oil compounds into the East Ditch. Another potential source contributor may be the Industriplex Site (located across from the WSL), where sediment removal actions occurred within the New Boston Street Drainway. There are no federal or state regulatory standards or screening values for sediment, sediment data is compared to the East Ditch reference location in Upper East Ditch (BK-SW/SD-001) data shown on **Table 2.5-3**.

4.2.6.3.1. Metals and Inorganics

As shown in **Table 4.2-8**, of the 21 metals detected, all except antimony, arsenic, mercury, silver, thallium, vanadium and zinc, were detected frequently. The maximum concentration of each metal was higher than those in the reference location, except potassium.

Inorganic constituents detected include ammonia, chloride, and sulfate. Although no sediment was identified in the two Upper East Ditch sample locations, sufficient sediment was collected to provide a reference sample from within the Upper East Ditch. The reference location contained the same metals, except mercury. The maximum concentrations of most metals, except aluminum and potassium, are higher in Lower East Ditch than the reference location. The distribution of ammonia, chromium, hexavalent chromium, chloride, and sulfate in sediment samples in the East Ditch are summarized on **Figures 4.1-37** through **4.1-42**. The concentrations of metals and inorganics are highest in South Ditch at ISCO2, prior to the confluence with Lower East Ditch. Due to the absence of sediment at location EDSD/SW5, it is difficult to evaluate changes in sediment concentrations between the confluences of South Ditch and Landfill Brook. Based on existing data, the highest concentrations of chloride and ammonia are above South Ditch, and the highest concentrations of chromium and sulfate are below South Ditch. Landfill Brook contains appreciable sulfate and ammonia in sediment at the downstream

location (LB-3). The concentrations of ammonia in Landfill Brook sediment are higher than those detected in South Ditch.

4.2.6.3.2. VOCs

As shown in **Table 4.2-8**, two sediment samples were collected from two locations in the East Ditch and analyzed for VOCs. Four VOCs, including TM-2-P, 2-butanone, acetone, 1,1,2-trichloro-1,2,2-trifluoroethane, and trichloroethene were each detected once in samples from the East Ditch. Only 2-butanone and acetone were present at the reference location. Acetone and 2-butanone were detected at EDSD/SW2 above the confluence of South Ditch, and the remaining VOCs were detected at EDSD/SW7 below the confluence of Landfill Brook. Also note acetone and 2-butanone are not present in overburden groundwater, and are infrequently detected in surface water samples. The detection of these two VOCs in sediment samples may be an artifact of laboratory analysis.

4.2.6.3.3. SVOCs

As shown in **Table 4.2-8**, SVOCs detected in East Ditch sediment include: 2-methylnaphthalene, acenaphthylene, acenapthene, anthracene, benzoic acid, diphenyl ether, phenol, BEHP, NDPhA, dibenzofuran, naphthalene, and numerous PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene). NDMA was not detected in sediment in the East Ditch. BEHP was the most frequently detected compound along with the PAHs. The distribution of BEHP concentrations is shown on **Figure 4.1-42**. The highest concentration of BEHP occurs upstream of South Ditch. The concentration of BEHP in the downstream sample from Landfill Brook is higher than the downstream concentration in Lower East Ditch. The PAHs and cPAHs are likely associated with railroad operations and nearby industrialized areas.

4.2.6.3.4. Specialty Compounds

As shown in **Table 4.2-8**, formaldehyde, hydrazine, and acetaldehyde were detected in the sediment sample from EDSD/SW7 at low, estimated concentrations.

4.2.6.4. Landfill Brook Sediments

Section 4.3 describes the hydrologic and geochemical setting of Landfill Brook. That assessment concludes that chemicals detected in surface water and sediment at Landfill Brook did not originate from the OCSS, or the Olin property, including the CSL. Sediment samples were collected from three locations, upstream to downstream, (LB-1, LB-2, and LB-3) within Landfill Brook prior to its discharge into the East Ditch (New Boston Street Drainway). The WSL was developed in a former gravel pit and is not a lined secure landfill. All three sample locations are adjacent to the western and southern side of the WSL. A summary of the sediment analytical data from Landfill Brook is presented in **Table 4.2-9**.

4.2.6.4.1. Metals and Inorganics

As shown in **Table 4.2-9**, the metals detected in the three Landfill Brook sediments include aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, silver, sodium, tin, vanadium and zinc. Tin was only detected in LB-3. Mercury was detected in LB-1 and LB-3, with the highest concentration at LB-3. The highest concentrations of most metals occur at LB-3, while at LB-1 concentrations of metals are generally higher than those detected in LB-2. This is particularly true for chromium, cobalt, copper, iron, lead, and nickel which are typical steel alloy metals, or are used in automotive batteries and equipment. These data may indicate the automotive repair business and junk car storage next to the Landfill Brook headwater area as possible sources of

these metals. The distribution of chromium is shown in **Figure 4.1-38** and indicates a progressive increase in downstream chromium concentrations, which would indicate contribution from the WSL.

Inorganic constituents detected include ammonia, chloride, and sulfate. The highest concentrations of these constituents are also detected at LB-3. The distributions of concentrations of ammonia, chloride, and sulfate are shown in **Figures 4.1-37, 4.1-40**, and **4.1-41** respectively. In general, metals and inorganics appear to increase in concentration from upstream to downstream within Landfill Brook, with highest concentrations at location LB-3. Ammonia concentrations are higher in organic-rich sediment, with reducing, anaerobic conditions, which is also consistent with patterns in the background sample locations. Literature on peat deposits indicate peat has a high capacity to fix nitrogen as ammonia (Abbes, et.al 1993, and Vaillancourt, et.al 1999). The ammonia concentrations observed in Landfill Brook sediments are consistent with background from MMB and less than upper ranges indicated by literature.

4.2.6.4.2. VOCs

As shown in **Table 4.2-9**, low concentrations of four VOCs, including chlorinated benzene compounds, were detected in Landfill Brook sediments at the most downstream sample location LB-3. The location of these detections at LB-3, and historical data concerning the WSL presented in Section 4.3 indicates these VOCs are associated with the WSL.

4.2.6.4.3. SVOCs

As shown in **Table 4.2-9**, SVOCs detected in the sediment samples collected from Landfill Brook are primarily PAHs including: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene. BEHP was detected in all three samples, and as indicated on **Figure 4.1-42**, BEHP concentrations increase downgradient with the highest concentration occurring at LB-3. As discussed in Section 4.3, historical data from the WSL indicates the presence of surface water and sediment associated with the WSL as being impacted with BEHP in the northwestern quadrant of the landfill. This is consistent with the detection of BEHP from LB-1 through LB-2 and LB-3. NDPhA was also detected in sediment at LB-3. Historical information regarding the WSL places this sediment sample location in proximity to the former Merrimac Chemical Company, which occupied the site before it was developed as a landfill. NDPhA is a documented chemical in groundwater associated with this portion of the WSL, and is discussed in Section 4.3.

The presence of BEHP, chromium, ammonia, and NDPhA in sediment, while COIs at the OCSS, are not exclusive to Olin. Increases of the concentrations of these constituents downstream along the side of the WSL, as well as the hydrologic and historical geochemical data discussed in Section 4.3, demonstrate that Landfill Brook is impacted by the WSL and automotive businesses along its headwater, and is not impacted by the Olin site or the CSL.

4.2.6.5. Maple Meadow Brook Area Sediments

Sediment samples were collected in December 2010, and are representative of current conditions in the MMB Wetland area. The sediment samples were collected within MMB and SMB over a three-day period. The nature and extent of site-related constituents in sediment for this area is discussed in the following subsections. A summary of detected analytes for MMB and SMB is provided in **Table 4.2-10**.

Figure 4.1-37 through **Figure 4.1-42** presents the distribution of sediment concentrations for ammonia, chromium, hexavalent chromium, chloride, sulfate, and BEHP, respectively.

4.2.6.5.1. Metals and Inorganics

As indicated in **Table 4.2-10**, the sediment in MMB and Sawmill Brook are highly organic and are typically described as fibric to sapric peat and muck, which is further supported by the total organic carbon concentrations. The sediment samples from MMB SW/SD-1 and MMB SW/SD-9 have considerably less organic carbon and a more mineral-rich sediment matrix. The organic sediments have a high retention for ammonia and organic compounds that sorb to organic carbon in the sediments, and may also be prone to having higher cation exchange capacity for some metals.

As indicated in **Table 4.2-10** of the twenty three metals detected in sediment, twenty are also detected in the reference sediment sample at generally comparable concentrations. Selenium, silver, and thallium were not present in the reference sample, and were only detected once in MMBW sediment. Tin and mercury were detected at a frequency of approximately 62%, whereas the other metals were detected in all samples, unless otherwise noted. The maximum concentration of metals in MMBW sediment are higher than the concentrations in reference locations. The average concentration of several metals such a lead, iron. arsenic, zinc, and aluminum are higher in MMB and Sawmill Brook sediments than the background location, but this data set appears to be somewhat skewed by the presence of higher concentrations of these metal at sample locations in proximity to and surrounding the edges of the Spinazzola Trust Landfill (MMB-SW/SD-6, MMB-SW/SD-2, MMB-SW/SD-8, MMB-SW/SD-8A, and MMB-SW/SD-11 [the latter three being located along Sawmill Brook]). The highest concentrations of chromium, copper, lead, cobalt, cadmium, aluminum, arsenic, barium, iron, mercury, silver, and nickel are associated with these locations.

The distribution of chromium in sediment is shown in **Figure 4.1-38** and decrease downstream in both MMB and Sawmill Brook from maximum concentrations near the Spinazzola Trust Landfill. These patterns indicate the landfill as a source of metals within the MMBW complex.

Inorganics detected include chloride, ammonia, and sulfate. The average chloride concentration in sediment is comparable to the reference sample location. Concentrations do not show defined patterns except that sediment low in organic material have lower chloride content (MMB-SW/SD-1 and MMB-SW/SD-9). Both sulfate and ammonia concentrations are also higher in the organic rich sediment, and average concentrations are consistent with the reference sample location. Literature on peat deposits indicate peat has a high capacity to fix nitrogen as ammonia (Abbes, et.al 1993, and Vaillancourt, et.al 1999). The ammonia concentrations observed in MMB and Sawmill Brook sediments are less than upper ranges indicated by literature.

The concentrations and distribution of inorganic parameters and metals in MMB and SMB are consistent with naturally occurring concentrations, and are not indicative of OCSS-related impacts. The presence of elevated concentrations of a twelve metals in sediment appears to be associated with the Spinazzola Trust Landfill based on distribution of the highest concentrations.

Based on results of analyses for metals, the MMBW surface water and sediment is not impacted by releases of metals and inorganic constituents from the OCSS. Analysis of samples for hexavalent chromium was not proposed in the work plan since the historical data reviewed at that time also did not indicate the potential of such impacts. Therefore, a data gap does not exist with respect to the OCSS characterization for hexavalent chromium. Hexavalent chromium was not detected in the shallow groundwater sample from GW-83S near the MMB and the Spinazzola Trust Landfill, nor was it detected in the deeper groundwater samples in that well pair.

4.2.6.5.2. VOCs

Two VOCs, 2-butanone and acetone, were reported at low, estimated concentrations in most of the sediment samples, and were also reported in the background sample. At these concentrations, given that they are not detected in overburden groundwater, these two VOCs are probably artifacts of laboratory analysis, and are clearly not associated with a release from the OCSS.

4.2.6.5.3. SVOCs

Sediment samples representative of current conditions in the Maple Meadow Brook detected twelve PAH compounds at low, estimated concentrations at moderate frequency: two phenols at very low frequency (1 or 2 detections) and BEHP and benzoic acid at the highest frequency. The majority of the PAHs were detected in sediments downstream of the Spinazzola Trust landfill at MMB-SW/SD-6, MMB-SW/SD-5, MMB-SW/SD-8A, and MMB-SW/SD-8. The detected concentrations of BEHP, and benzoic acid are consistent spatially, and were both detected at similar concentrations at the reference location. Eleven PAH compounds were also detected at the reference location. At the low frequency of detection and low, estimated concentrations, the detection of 3- and 4-methylphenol and 4-nitrophenol also do not indicate the presence of an impact attributable to a release from the OCSS.

4.2.6.5.4. Specialty Compounds

Analysis of sediment samples collected in 2010 in the Maple Meadow Brook wetland detected formaldehyde and acetaldehyde at low and low, estimated concentrations. The formaldehyde data for sediment samples in MMBW was compared to the other formaldehyde analytical data associated with sediment samples (South Ditch, East Ditch, off-PWD). A review of the data suggests similar concentrations of formaldehyde in sediments from off-PWD, South Ditch, and East Ditch. As discussed previously, the ubiquitous detection of formaldehyde in the environment is a function of anthropogenic sources. Regarding acetaldehyde, the USEPA Air Toxics website indicates “Acetaldehyde is ubiquitous in the ambient environment. It is an intermediate product of higher plant respiration and formed as a product of incomplete wood combustion in fireplaces and woodstoves, coffee roasting, burning of tobacco, vehicle exhaust fumes, and coal refining and waste processing. Hence, many individuals are exposed to acetaldehyde by breathing ambient air.” Therefore it is likely that the source of acetaldehyde in this case is also anthropogenic.

In summary, sediment data in MMB and Sawmill Brook do not indicate the presence of impacts attributable to releases from the OCSS. Sediment concentrations for metals, inorganics, and SVOCs may be considered background and/or attributed to the Spinazzola Trust Landfill.

4.3 Additional Areas of Investigation

4.3.1 Calcium Sulfate Landfill

The CSL was operated as a mono-fill from 1975 to 1987, receiving fine-grained gypsum sediment removed from the former facility settling ponds. The CSL is approximately 2.5 acres in size with a volume of approximately 37,000 cubic yards (cy). In 1987 the CSL was capped, covered with top soil, and seeded with final closure status requested in 1988. Final closure certification of the CSL and approval of a Post-Closure Monitoring Plan (PCMP) in accordance with the Massachusetts Solid Waste Management Regulations (310 CMR 19.000) was issued by MassDEP on January 9, 2009.

The cap is a vegetated soil cover that is inspected and mowed semi-annually. The PCMP requires Inspection, monitoring and maintenance activities for the CSL that include:

- annual inspections of the cover system, access roads, fences, gates and groundwater monitoring well network;
- semiannual groundwater monitoring which is to be completed in the spring and fall to coincide with periods of high and low groundwater level; and
- biennial monitoring reports

There are no surface water features associated with the CSL that require monitoring. The former bio-cell, which was partially constructed but never operated as a remediation component for on-site treatment of South Ditch sediment is a lined impoundment adjacent to the CSL that impounds water, mostly from run-off.

Access to the CSL is restricted by the Olin perimeter property fence. The gypsum (the same mineral used in sheet rock wallboard) is an inert material composed of calcium and sulfate. There are no routes of exposure to this material, as the landfill is capped, monitored and maintained. The most recent 2013 Biennial monitoring Report is contained in **Attachment C**.

As discussed in Section 1.3.5, the monitoring well network monitors groundwater on the southern side of the CSL adjacent to the WSL (SL-3), along its eastern downgradient side (SL-5, SL-6), along a northern perimeter with locally elevated bedrock (SL-7, SL-8), and along its western side (SL-1D and SL-2) which may receive some component of groundwater flow from the CSL, The current monitoring program includes semi-annual collection of groundwater samples and groundwater elevations from these seven monitoring wells, two of which have consistently been dry (SL-7, SL-8). The CSL analytical parameters include calcium, sulfate, aluminum, chromium, iron, manganese, nickel, sodium, chloride, alkalinity (total, bicarbonate, and carbonate), and total dissolved solids.

Analytical data from for the most recent monitoring period at the CSL is consistent with historical data and show no concentrations of groundwater exceeding State (MMCLs) or Federal (MCLs) water quality standards. Concentrations of aluminum, iron, manganese, sulfate, and TDS each exceeded their respective secondary (SMCLs) guidance values in three or more monitoring wells, and the ORSG standard for sodium was exceeded in two monitoring wells. The concentrations of calcium and sulfate are highest in SL-6, SL-5, and to a lesser degree SL-3 and are consistent with their position on the downgradient sides of the CSL. Concentrations of sulfate are low on the western side (SL-1, SL-2) consistent with the hydrologic understanding that the primary groundwater flow direction is to the east.

Under the OU3 RI Program, additional groundwater samples were collected for analysis of the comprehensive analyte suite. Results of that sampling will be discussed in the OU3 RI Report. Additional description of specific analytes which are, and are not, detected in groundwater at the CSL is provided in Section 4.3.2, which includes discussion of the sources of groundwater contributing to the headwaters of Landfill Brook.

4.3.2 Landfill Brook Headwater Evaluation

The following discussion summarizes the physical, hydrologic, and geochemical aspects of Landfill Brook, all of which are contributing factors to surface water and sediment impacts that have been characterized from its headwaters to its confluence with East Ditch. The CSL, located northwest of the WSL, has no measurable impact on Landfill Brook's water quality when compared to that caused by the WSL and other potential sources. These other sources include automotive businesses in proximity to the Landfill Brook headwaters and the former Merrimac Chemical Company which operated a chemical manufacturing facility that was located in the

southeast portion of the WSL, prior the WSL being developed within a former gravel pit. This evaluation draws upon existing information and reports provided to USEPA including the 1999 report by Geomega titled "Geochemical Discrimination Between Groundwater Emanating from the Calcium Sulfate and WSLs" (Geomega, 1999), and the 2008 report by the Agency for Toxic Substances and Disease Registry (ATSDR) titled "Evaluation of Environmental Concerns and Cancer Incidence, 2000-2003, Related to the WSL in Woburn, Middlesex County, Massachusetts" (ASTDR, 2008). These reports are provided in **Appendix O**. The evaluation cites groundwater results for OU3 that have been provided to USEPA electronically, and which will be further detailed in the OU3 RI report. This assessment references information from both reports and reproduces figures of interest from the Geomega Report.

4.3.2.1. Landfill Brook Physical Setting

Landfill Brook is a small body of water which has its headwater south and west of the CSL and the WSL, respectively. Its headwater is a wetland and small open body of water within the area that is bordered by Main Street to the west, North Maple Street to the south, and North Washington Avenue to the East. Flow from this wetland is eastward, then generally south and southeast as it passes by the western and southern extents of the WSL. A culvert captures flow from Landfill Brook just west of New Boston Street and directs flow towards the south to East Ditch. An automotive body shop and repair facility, and several other automotive businesses including a salvage yard (with in excess of 200 vehicles), are located along and just north of Breed Avenue, approximately 600 feet north of the Landfill Brook headwaters.

4.3.2.1.1. Topography

Surface topography from Breed Ave to the north and Maple Street to the west slopes toward the Landfill Brook headwaters. Several prominent bedrock ridges are present to the north and west, which isolate the Landfill Brook headwaters from other surface water drainage systems in those directions. Other less pronounced topographic highs to the south separate Landfill Brook from Halls Brook.

Aside from these natural features, dominant man made topographic feature is the WSL, located immediately east and north of Landfill Brook. The WSL is approximately 40 acres in size and is composed of accumulated waste disposed of in a former sand and gravel pit. The WSL has been capped and closed. There is potentially a bedrock feature beneath the WSL that may orient groundwater flow from the WSL to the west along the buried channel towards GW-75D (Geomega, 1999, p8). The CSL is a comparatively small feature with a surface area of approximately 2.5 acres. The elevated surface of the CSL is due in part to a bedrock high beneath the landfill. The presence of a bedrock high and outcrops in the vicinity of the CSL also influence the groundwater flow pathways (Geomega, 1999 p8,).

4.3.2.1.2. Hydrogeology

A small groundwater high exists in the north-central portion of the CSL (see **Figure 3.3.-2**). The primary direction of groundwater flow from the CSL is to the northeast and east, although a small component of flow may have a tendency to flow south/ southwest toward the direction of Landfill Brook drainage. Because of the proximity of the WSL to the south, and a groundwater divide to the west, most of the groundwater beneath the CSL flows toward the South Ditch and East Ditch drainage. This is consistent with the detection of high concentrations of sulfate in monitoring well SL-5 and SL-6, and comparatively low concentrations of sulfate and other constituents in SL-1 and SL-2.

Beneath WSL, groundwater along the north and east sides of the landfill flows toward both north and east with groundwater from within the WSL impacting the northern side of the CSL at monitoring well location SL-3. Groundwater along the west-northwest side of the WSL briefly

flows west until it merges with water flowing southeast from the bedrock ridge and groundwater divide located just south of Cook Avenue. Groundwater beneath the landfills coalesces along a common boundary between SL-3 and GW-40D (Geomega, 1999, p10).

The study by Geomega (1999) included wells that no longer exist today. Figure 1 from the Geomega report is reproduced here as **Figure 4.3-1** and illustrates topographic and groundwater flow conditions. Based on that assessment and current groundwater flow conditions as on **Figures 3.2.1** and **3.2.2** in this RI, the area of contribution of flow from the CSL to the headwater area of Landfill brook is small compared to the dominant contribution by the WSL and surrounding areas to the west.

4.3.2.2. Landfill and Groundwater Geochemical Settings

The CSL and WSL geochemical setting is extremely important in understanding the nature of source and impacts to groundwater which in turn contribute to surface water and sediment quality in Landfill Brook. The geochemical setting of the two landfills, and groundwater in the vicinity of the WSL and the CSL, are very different and were studied previously to discriminate between groundwater impacts that could be caused these landfills (Geomega, 1999). The CSL was operated as a mono-fill for gypsum through its operational history. The leachate chemistry of the fill which is essentially pure gypsum and solute transport from the CSL are controlled by simple dissolution and precipitation reactions relating to gypsum.

$$CaSO_4 \leftrightarrow Ca^{2+} + SO_4^{2-} \qquad Ksp = 10^{-4.60}$$

The concentration of calcium and sulfate ions from gypsum dissolution is equal to, and in accordance with, the solubility product. The CSL leachate is essentially chemically inert. Maximum calcium and sulfate concentrations in groundwater at the CSL are consistent with predicted solubility.

In contrast, WSL is a hetero-fill landfill that includes multiple waste streams from commercial, industrial and household wastes. The biological degradation of organic wastes disposed in municipal landfills is complex and changes with burial depth of waste and time. Degradation of organic materials occurs initially under aerobic conditions and becomes progressively anaerobic once available oxygen is consumed from biological respiration. Biological respiration releases carbon dioxide and results in the formation of carbonic acid and bicarbonate alkalinity. Anaerobic conditions result in the reduction of organic nitrate sources to nitrite which is biologically reduced to ammonia. Reduced conditions in municipal landfill leachates also results in mobilization of redox sensitive metal species that undergo oxidation / reduction such as iron and manganese, in addition to generating landfill gas enriched in methane. Landfill leachates which percolate to the groundwater table typically contain elevated ammonia, alkalinity, organic acids, metals, in addition to low levels of VOCs and SVOCs that originate from household and industrial/commercial waste streams.

A conceptual comparison of the two contrasting landfill settings was included by Geomega as Figure 3 from their report (Geomega, 1999), and is reproduced here as **Figure 4.3-2**.

The difference in geochemical signatures of these two landfills is very evident in Piper diagrams Figure 10 from Geomega (Geomega, 1999), reproduced here as **Figure 4.3-3**. The Geomega study was also designed to look at potential geochemical similarities within a subset of residential wells, which are the named locations in this figure, and some of these properties have been sold and have new owners. The piper (tri-linear) diagrams illustrate that geochemistry can be used to evaluate the areal extent of impact on groundwater exerted by the WSL compared to the CSL. The geochemistry of the CSL wells are unique and clearly dissimilar from all other wells indicating its impact is restricted to the immediate vicinity of the

CSL, and extending to the southwest only as far as GW-40D which was located just beyond the only property boundary.

Due to the differences in leachate formation, groundwater impacts from the CSL should have a sulfate dominant signature while WSL should have an alkalinity dominant signature. Also due to the dissolution of gypsum into calcium and sulfate ions, the theoretical calcium: sulfate ratio should be 0.5 based on molecular weight of each ion. The CSL wells have sulfate: alkalinity ratios >5 and calcium sulfate ratios near 0.5 (0.35-0.5). Taken together this information can be used to aid in discriminating between CSL and WSL geochemical signatures in groundwater and where mixing of these water occurs. These data, from Geomega Figure 9 (Geomega, 1999), are reproduced here as **Figure 4.3-4**.

Based on these chemical signatures, evidence of groundwater from CSL and WSL coalescing near GW-40S/D and MW-5 is evident, as the sulfate: alkalinity ratio drops in this area while the calcium:sulfate ratio is only slightly less than 0.5. Outside of this area, the sulfate:alkality ratio drops to less than one and the calcium:sulfate ratio increases to near 1.0. In this regard, CSL well SL-3 is clearly impacted by the WSL. The geochemistry of GW 72D and GW-75D are clearly similar to other wells located within or adjacent to the WSL to the south (MW-3, MW-8D, and MG-2C) Therefore, the western extent of flow from the WSL extends to GW-75D (Geomega, 1999, p10). The extent of geochemical impact to groundwater from the CSL is on the other hand very limited, extending only to GW-40D, beyond which coalescing groundwater from the WSL is dominant geochemically. The extent of the WSL plume is reproduced from Geomega Figure 8 as **Figure 4.3-5**. The area of impact from the WSL covers the entire headwater region of Landfill Brook.

4.3.2.3. Groundwater/Surface Water Chemistry

Surface water and sediment samples were collected from three locations along Landfill Brook. SW-LB-1/SD-LB-1 was collected from a low, wet area approximately 250 feet south of Breed Avenue; SW-LB-2/SD-LB-2 was collected southwest of the WSL approximately 300 feet east of the end of Maple Street; and SW-LB-3/SD-LB-3 was collected from the southeast corner of the WSL approximately 650 feet west of New Boston Street.

Several contaminants and COIs were detected in the sediment and surface water samples (**Tables 4.2-5** and **4.2-9**). These include VOCs, PAHs, BEHP, ammonia, and sulfate. The presence of ammonia and sulfate in WSL wells is well documented in Geomega (1999) report Table 1. The presence of BEHP at the WSL is well documented in ATSDR (2008, p20) and the highest concentrations of BEHP were detected in surface water at sample location SD-3 inside the WSL security fence along the northwestern border of the WSL. BEHP was not detected in any of the OU3 RI groundwater samples from the CSL. Low, estimated concentrations of BEHP were detected in GW40S, however, it has already been shown that the WSL plume begins to coalesce with the CSL groundwater in the vicinity of that well. VOCs were detected at each surface water sampling location, but the concentration of total VOCs was highest at SW-LB-3. Occurrence of VOCs in sediment was limited to the SD-LB-3 location. This location corresponds with the former location of the Merrimac Chemical Company facility that was operated in the southeast portion of what is now the WSL.

4.3.2.3.1. VOCs and SVOCs

Of the specific VOCs detected in surface water (1,1-DCA, 2-Butanone, 4-iso-Propyltoluene, carbon disulfide, MTBE and toluene) and sediments (1,2-DCB, 2-butanone, chlorobenzene and sec-Butylbenzene) within Landfill Brook, only 1,1-DCA was detected within the CSL at very low concentrations ranging from 0.00031 in SL-6, to 0.001 mg/L in SL-3; 1,1-DCA was not detected in GW-40S/D or GW-75D, which is located approximately 300 feet upgradient from the SW-LB-1

location. MTBE was detected in SW-LB-01 as well as in GW-72D and GW-75D. These well locations, along with the Landfill Brook headwater, may have been affected by fuel spills associated with the automotive storage area just upgradient from their locations. The presence of these VOCs in WSL groundwater is well documented (ASTDR, 2008 p14).

BEHP and several PAHs were detected in sediment sample SD-LB-1. BEHP is present in groundwater across the Olin property; however, its occurrence is mostly limited to areas north of the South Ditch, and groundwater flow paths would prohibit its migration form the locations to LFB. BEHP was detected at a very low, estimated concentration GW-40S (0.5Jµg/L), which marks where groundwater flowing south from the CSL and the WSL coalesce. The fact that none of the wells within the CSL contain BEHP indicates that the occurrence at GW-40S is due to the WSL. Leachate seeps have previously been identified leaving the WSL along the southwest face resulting in ponding on the southwest side of the site near the railroad beds and MW-5, which is approximately 75 feet south of GW-40S/D (Geomega, p5, 1999). Surface water samples collected at SW-3, located near MW-5 contained BEHP, pentachlorophenol, and several PAHs (ATSDR, Table 3, 2008). PAHs are generally not mobile in groundwater. Their lack of soluble mobility is supported by the fact that PAHs were not detected in surface water samples; their occurrence in sediment samples is most likely the result of road runoff. The highest concentrations of BEHP and PAHs in sediment were detected at SD-LB-3, which is downgradient from the southeast corner of the WSL. Previous sampling in monitoring well MW-14S/D, which is located in the southeast portion of the WSL, indicated the presence of n-Nitrosodiphenylamine (NDPhA), BEHP, benzene, chloroethane 1,4-DCB and TCE in groundwater (ATSDR, Table 2, 2008). Again, this area corresponds to the location of the former Merrimac Chemical Company facility, and the presence of NDPhA at this location, though also present at the OCSS, is clearly not related to the OCSS.

4.3.2.3.2. Inorganics

Ammonia was detected in all surface water and sediment samples. The WSL is a complex reactive landfill cell that consumes oxygen due to the degradation of organic wastes and produces carbon dioxide and eventually carbonic acid. The reducing conditions of the WSL facilitate reducing conditions that liberate manganese, reduces nitrate to nitrate, which is further reduce via biological processes to produce ammonia. The concentration of ammonia in surface water increases from SW-LB-1 to SW-LB-3 by a factor of five in the winter, and by a factor of 16 in late spring when groundwater flows are greater due to increased precipitation. The increase in concentration in the downstream direction relates directly to the sample's location with respect to the WSL groundwater flow path. As stated previously, GW-75D has been shown to be influenced by groundwater from the WSL (Geomega, p. 10, 1999) and GW-75D is located just upgradient from the Landfill Brook headwater (i.e., SW-LB-1/SD-LB-1). SW-LB-2, which is located off the southwest corner of the WSL had a greater concentration of ammonia and SW-LB-3, located directly down gradient from the WSL had the highest concentration.

Historic ammonia concentrations in wells that are installed within the CSL (e.g., SL-1S/D, SL-2, SL-3, SL-5, SL-6, SL-7, and GW-18D and GW-20), ranged from non-detect to 33 mg/L (Geomega 1999) SL-6 was the only well within the CSL that had an ammonia concentration that was greater than 10 mg/L (i.e., 33 mg/L). Groundwater from SL-6 flows northeast and does not contribute the Landfill Brook. GW-40D, which is located at the southwest corner of the CSL, and is also within the groundwater flow path from the WSL, had an ammonia concentration of 84.8 mg/L in 1998. In contrast, GW-72, MW-3, MW-8D and MG-02-A, located west, southwest, south and south of the WSL, respectively (MG-02-A is located equally south, but further west of MW-8D), have historic ammonia concentrations ranging from 3.7 to 158 mg/L, with the highest concentration detected in MG-02-A (Geomega, Table 1, 1999). Similar to surface water results, the ammonia concentrations in groundwater increase to the south along the west side of the

WSL and to the west along the south side of the WSL. These data are clear evidence that reducing conditions within the WSL produce ammonia, which is not the case for the CLS as shown by the data.

The sulfate concentrations in sediment are lowest (78 mg/kg) at Landfill Brook's headwater (SD-LB-1) and highest (310 mg/kg) at the furthest downstream location SD-LB-3, which is located directly down gradient from the WSL. In surface water along Landfill Brook, sulfate was detected at concentrations ranging from 4.4 to 88 mg/L in the headwater, and 16 to 39 mg/L at the furthest down gradient sample (SW-LB-3). The concentration of sulfate in surface water is consistent with the concentration observed in the surrounding wells, and most likely represents the effect of groundwater discharging to the stream; groundwater geochemically dominated by the WSL, and also a source of sulfate.

Background sulfate concentrations in area groundwater are 24 mg/L (Geomega, Table 2, 1999). The sulfate: calcium ratios in GW-75D, directly upgradient from the Landfill Brook headwater, are consistent with those in the WSL rather than the CSL (Geomega, p13, 1999). Moving south down the west side of the WSL, sulfate in wells varies from 54 mg/L in GW-72D to 36.2 mg/L in MW-3. Moving east across the southern portion of the WSL, sulfate concentrations in groundwater vary from 40 mg/L in MW-8D to 99.9 mg/L in MG-02-C. The sulfate concentrations in these wells represent WSL's sulfate contribution to groundwater.

The concentrations of chloride in groundwater at the CSL are typically two orders of magnitude less than those in surface water location OC SW LB-1 in the headwaters of LF Brook. In addition, the concentration of sodium is typically an order of magnitude less at the CSL compared to OC SW LB-1. Therefore, the CSL cannot be considered to have significant contribution of either sodium or chloride to Landfill Brook. The ratio of sodium to chloride at OC SW LB-1 is closer to what would be expected from road salt, which is probably heavily used in winter at the auto repair and salvage facility located between CSL and OC SW LB-1.

4.3.2.4. Conclusions

Surface water quality within Landfill Brook is affected by groundwater discharge from the WSL, and possibly other source areas comprised of the automotive businesses just north of Landfill Brook's headwater, and the former Merrimac Chemical Company facility which was located along the southeastern portion of the WSL. Both geochemical and specific analyte distributions in surface water, sediment, and groundwater indicate that neither the CSL nor the OCSS are important contributing sources of impacts measured at Landfill Brook.

4.3.3 North Pond

The North Pond is located southeast of the Olin facility on the border of Wilmington and Woburn just south of Presidential Way. The North Pond has been investigated at various times during the years. Surface soil, subsurface soil, and sediment samples were collected during 2003/2004 investigations to assess historical (buried) sediment, and modern sediment and surface water conditions at that time. The data collected did not indicate impacts from the OCSS, but the samples were not analyzed for the extensive list of compounds prescribed by the Remedial Investigation (RI) work plan. The historical sediments were sampled again during the 2013 RI investigation by advancing six soil borings within the historic bounds of North Pond. In June 2013, four surface water and sediment samples were collected by boat from the current North Pond. Details and results of those investigations are presented in a Memorandum contained in **Attachment D**.

As summarized in that attachment, sediment results indicate four VOCs, 14 SVOCs, 24 metals, and four inorganics detected one or more times in the 2013 sediment samples. Most of the SVOC detections were PAHs, consistent with the industrialized setting of the area and storm

water runoff from the industrialized area. Both TM-1-P and BEHP were detected in one of five samples at low, estimated concentrations at different locations whereas chromium, hexavalent chromium, and ammonia, as well as almost other metals were detected in all samples at low concentrations. The ammonia concentration increases with increasing organic content of the sediment indicating the presence of ammonia is related to organic matter in the sediment (and likely related to biological activity). As indicated previously in the discussion of surface water, BEHP was clearly released to North Pond via to the drainage to the north (from Ritter Trucking) and the one detection of BEHP in current sediment was at SW/SD-602 within the portion of North Pond where the outfall of that drainage feature enters North Pond. The source of the one low-level detection of TM-1-P is unknown, although it appears to be present only recently. The fact that it was only detected once, in one media (current sediment), at a low, estimated concentration, indicates that it is not present as a result of impacts from the OCSS. It is also possible that isobutene (a mixture of TM-1-P and TM-2-P) is present as a contaminant in isooctane (a common fuel oxygenate) since it is a potential intermediate used in isooctane production for use in motor fuels. Based on the results of the North Pond investigations, the historic sediment encountered in soil borings are not impacted by releases from the OCSS. There is no current surface water connection or groundwater migration pathway between the OCSS and North Pond. The modern sediments were excavated in the 1984-1986 timeframe in accordance with an Order of Conditions as described in Attachment D. Historical operations at the OCSS could not have impacted current North Pond sediment.

5.0 CONTAMINANT FATE AND TRANSPORT/CONCEPTUAL SITE MODEL

The components of the CSM, (contaminant sources, migration pathways, receptors, contaminant fate and transport) were discussed extensively in the Draft Focused RI Report (MACTEC, 2008). The major components of the CSM with respect to OU1 (on-Property soils, surface waters, and sediment) and OU2 (off-Property surface water and sediment) are provided below. Discussion is also provided regarding how discharge of groundwater (OU3) affects OU1 and OU2. A figure depicting hydrogeologic, contaminant source, and contaminant transport aspects of the CSM relating OU3 groundwater and OU1 surface water in Upper South Ditch is included as **Figure 5.0-1**. This figure depicts the historical importance of waste disposal practices at former Lake Poly that resulted in the subsurface release of a DAPL, and the subsequent movement of DAPL along the sloping bedrock surface to one of its current locations in the Upper DAPL Pool. The figure relates shallow groundwater impacts of organic contaminants sorbed to soil below the water table, and deeper groundwater impacts related to DAPL and Diffuse material above DAPL, to resulting surface water impacts. These groundwater discharge flow paths are also illustrated in **Figure 5.0-1**. Groundwater discharge of COIs to surface water also results in the formation of aluminum and iron-rich hydroxide floc that contains chromium. This material is chemically stable and inert in the surface water environment once formed. Groundwater impacts to surface water are primarily restricted to Off-PWD, South Ditch and East Ditch within the Aberjona watershed **(Figure 1.0-3)**. Groundwater impacts within the Ipswich river watershed are deep and within the buried valley underlying the MMB wetland complex. The aquifer is too thick to result in measurable impacts of any consequence to shallow groundwater and surface water located there. A more thorough discussion of groundwater will be provided at a later date in the OU3 RI/FS.

5.1 Contaminant Sources

Sources of contamination at the Property are related to former manufacturing operations and waste disposal practices. Currently, there are no sources of contaminants in unsaturated soil that are leachable and contribute to, and result in, the formation of a groundwater plume in overburden or bedrock. There are current groundwater impacts associated with former releases of TMP and processing oils at the former Plant B production area and tank farm. There are no areas of surface soil erosion and overland transport of run-off that contribute to impacts to surface water from OU1 soils. The sources of surface water impacts are restricted to discharge of groundwater containing COIs, and historical impacts from waste disposal practices that resulted in contamination of the sediment within the on-Property ditch system. The sources of groundwater impacts are also restricted to historical waste disposal practices, and there are no current ongoing releases from unsaturated OU1 soils. These sources include specific areas of waste disposal and infrastructure at the facility (see **Figure 1.3-1**). The majority of the contaminant sources have been investigated and addressed through response actions under the MCP. These sources and other potential sources of contamination are identified below:

- 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;
- The liquid waste disposal practices resulted in the formation of DAPL pools located within bedrock depressions. These include the Main Street DAPL pool and the Upper

DAPL pool, which is divided into an on-Property and off-Property portion. The on-Property portion is largely within the Containment Area and the off-Property portion lies between the Containment Area and Jewel Drive. The Main Street DAPL pool is farther to the northwest. The DAPL pools are depicted on **Figure 1.0-3**.

- Former manufacturing facilities including the laboratory, Plant A, Plant B, Plant C-1, C-2, C-3, and Plant D and the wastewater treatment plant which was installed in the early 1970s;
- Release of TMPs in vicinity of the Plant B production area and processing oils in vicinity of the Plant B tank farm;
- Former buried debris area;
- Former drum disposal area;
- CSL;
- on-Property Ditch Systems;
- Former fuel oil UST locations;
- Subsurface utilities and septic systems; and
- Former transformer locations.

The list of known chemicals, and chemical compounds, which were documented as having been used during previous manufacturing activities at the Site, but could not be analyzed during the RI process due to the absence of approved analytical methods, is included in **Table 5.0-1.** The list includes raw materials brought onto the Site, products that were manufactured at the Site, and constituents of waste streams. Twenty-two of these raw materials and components of liquid waste streams are inorganic compounds including salts (e.g., sodium chloride, sodium dichromate), acids (e.g., sulfuric acid), and bases (e.g., ammonium hydroxide). Although USEPA-approved analytical methodologies for these specific compounds do not exist, consistent with standard remedial investigation procedures and protocols, environmental media were analyzed for the individual components of these inorganic compounds such as aluminum, sodium, chloride, chromium, sulfate, ammonia, nitrate, nitrite, and zinc.

Other raw materials or potential components of liquid waste streams without USEPA-approved analytical methods include 2-ethylhexanol (an alcohol), 2-ethylhexanoic acid, hexamethylenetetramine, benzonitrile, butyl alcohol, paraformaldehyde (polymer of formaldehyde), and urea. Analysis of environmental media included methods for some components of these compounds (formaldehyde, ammonia, etc). The alcohols likely have reacted in the environment and/or have degraded. Products without USEPA-approved analytical methods include Wytox ADP, Wytox 345/355/436 (polymeric phosphate), Nitropore OT, Wytox 312, Wytox Pap, Actafoam R-3, Nitropore 5PT, and Phenolic and Urea/Formaldehyde Resins. The facility would have focused on the production and shipment of commercial products and minimizing releases (or loss) of revenue-producing product. None-the-less, the lack of analytical methods does introduce some uncertainty in the nature and extent of any releases to environmental media. Reports of specific releases of products to the environment were not found in the records reviewed. The resins that were manufactured did not have any liquid waste streams associated with them. The lack of analytical methods for the resins is unlikely to have substantially underestimated releases of those products.

As discussed in Section 2 of the Draft Focused RI (relevant sections provided as **Appendix A**), and summarized in Section 2.1 of this report, extensive soil removal actions were conducted at the former Lake Poly, the former drum disposal areas, and the former Buried Debris Area. Sediment and/or soil removal actions were also completed within Central Pond, on-PWD, and South Ditch. The on-Property portion of the Upper DAPL Pool and the three Acid Pits and a portion of the former drum disposal areas are contained within the Slurry Wall/Cap. The Plant B

groundwater recovery/treatment system for LNAPL includes groundwater extraction and treatment which remains in operation at Plant B. A large area of TMP-impacted soils (EPH/VPH Area) in the vicinity of the former Plant B production area was remediated by soil vapor extraction. In accordance with the RI/FS Work Plan, additional environmental investigations have now been conducted adjacent to, and under, the former manufacturing building foundations and associated underground utilities, along the property boundary, near the former disposal areas, within surface soils under the Containment Area temporary cap, at UST locations, at all the transformer locations, and all surface water bodies within OU1 and OU2. Note that the Ephemeral Drainage is a Site topographic / drainage feature which contains water intermittently as a result of precipitation and run-off conditions, and is therefore not considered a water body, and therefore not sampled. Surface water bodies that were sampled include off-PWD, South Ditch, the Stormwater Detention Basin, Central Pond, East Ditch, Landfill Brook and MMB and Sawmill Brook.

The CSL was closed in 1987. Final closure certification of the CSL and approval of a Post Closure Monitoring Plan in accordance with the Massachusetts Solid Waste Management Regulations (310 CMR 19.000) was issued by MassDEP on January 9, 2009 (MassDEP, 2009). Groundwater associated with the CSL is discussed with respect to surface water quality in Landfill Brook, and will be considered further under OU3.

The site has been impacted by SVOCs from past releases (principally phthalates, phenols, and nitrosamine compounds), VOCs (principally TMPs), and metals (principally chromium, sodium, and calcium), which are considered to be COIs. In addition, the manufacturing processes included use of inorganic constituents including chloride, sulfate, calcium, and ammonia, which are also considered to be COIs. Many of these COIs also occur naturally in the environment, as elements, and are as common urban or anthropogenic contaminants. For example, inorganic constituents such as chloride and metals such as sodium are used extensively in road salt for de-icing. Nitrate, sulfate, and ammonia are all present in aquatic ecosystems. BEHP is a commonly used plasticizer and is a common anthropogenic contaminant. PAHs are equally common from combustion of fossil fuels, and are also used in railroad tie treatments. These types of constituents are also present in site media, and at certain locations and concentrations are not necessarily believed to be site-related. As described in Section 4, formaldehyde is also a common anthropogenic contaminant, and although it was used at the site, there is no indication of a formaldehyde release. Therefore, the ubiquitous presence of formaldehyde in virtually all media is not considered to be an indication of site-related impacts. It is also well published by USEPA that acetaldehyde is widely distributed in the environment associated with plants and neither is it considered to be in the environment as a consequence of a release from the Site. Arsenic in soil is another example of a naturally occurring transition metal (a background condition) that is also an element used in treatment of railroad ties, and in manufacture of herbicides. While arsenic is present on-Site at background concentrations, concentrations increase off-Site in areas associated with former or current railroad activities. While NDMA was not detected in soil or sediment samples, it was detected in groundwater and surface water. The assessment to determine the significance of NDMA and other COIs detected in site media is provided in the BHHRA and the BERA.

The Site was listed on the NPL based on the site scoring that was limited to the presence of N-nitrosodimethylamine (NDMA) in groundwater within the Maple Meadow Brook aquifer in proximity to the municipal water supply wells. Because this exposure pathway resulted in a score sufficient for listing, other pathways were not scored at that time. However, NDMA has not been identified as a raw material, a manufactured product, or a waste stream constituent in any of the operational history documentation. NDMA has been identified in DAPL, groundwater and surface water samples only. Activities have been conducted previously to identify the

potential source(s) of NDMA detected in groundwater and surface water samples at the Site. These included conducting a detailed review of literature and facility records and evaluation of potential precursors in DAPL and diffuse groundwater. A thorough review of available manufacturing records did not identify any purchase, manufacture, storage, or use of NDMA during manufacturing activities. A literature search was conducted to identify potential mechanisms for the formation of NDMA that might explain the presence of NDMA. Published articles in the literature in 2003 had identified the presence of NDMA in water samples collected from publicly owned wastewater treatment plants and water treatment plants that had been disinfected by chlorination or chloramination. The understanding of NDMA formation mechanisms in literature at that time is consistent with current literature. Articles published include Gerecke, A. C., and Sedlak, D.L., (2003), Precursors of n-Nitrosodimethylamine in Natural Waters, Environ. Sci. Technol., 2003, 37, 1331-1336) and Mitch, W. A., Gerecke, A., Sedlak, D. L., (2003) – A N-nitrosodimethylamine (NDMA) precursor analysis for chlorination of water and wastewater, Wat. Res. 2003, 37 (15): 3733-3741. One potential formation mechanism for NDMA postulated for those treatment plants was a reaction involving NDMA precursor compounds (such as dimethylamine (DMA), dimethyldithiocarbamates, and certain nitrogen-containing cationic polyelectrolytes (used as flocculation aids) and chloramines. The potential formation reaction included an intermediate compound, unsymmetrical dimethylhydrazine (UDMH). The latter article identified an analytical method for determining relative concentrations of potential NDMA “precursor” material in water samples.

In 2004, Olin submitted to MassDEP the “Report for the Initial Testing of the Proposed Test Method for NDMA Precursors, 51 Eames Street Site, Wilmington, MA, DEP RTN 3-0471”. That report summarized a study that evaluated the utility of applying the Mitch et.al. precursor analytical method to dense aqueous phase liquid (DAPL) and diffuse groundwater for the purpose of identifying groundwater locations where NDMA precursors might be present and, if present, to determine relative concentrations of precursors at various locations. As reported in pages 18 and 19 of that report, the study did not confirm, for the DAPL and diffuse groundwater samples, that the precursor analytical method was capable of detecting NDMA precursors such as DMA in those matrices. Therefore, the report recommended that the wide-scale application of the method should not be considered since it could not be confirmed that the method could reliably and consistently detect NDMA precursors in groundwater.

The information discussed above represents the available information concerning the potential formation of NDMA. It is not possible to reconstruct conditions associated with historical manufacturing operations in order to determine definitively if NDMA was formed during operations, in wastewaters, in groundwater, or if there is some other explanation for the presence of NDMA in groundwater and surface water samples collected from the Site. The Conceptual Site Model for the Site includes the nature and extent, fate and transport of NDMA in Site media, but however cannot definitively conclude upon the actual formation mechanism.

Other chemical compounds such as hydrazine, formaldehyde, acetaldehyde, dimethylformamide, diphenylamine, and phthalic acid/phthalic anhydride, and zinc also were evaluated for OU1 and OU2. For OU1 soils these compounds were determined either to not be present, infrequently present, or present but at concentrations well below Industrial RSLs. These constituents will not be considered further in this section.

Transition metals such as arsenic are not considered to be site-related based on a statistical review of the arsenic data. The two distinct outliers (i.e., a large difference in arsenic concentrations for specific samples) were identified in soils located along the PanAM railroad bed, and the OU2 soils in EA5. These two off-Property locations are adjacent to railway lines and have higher arsenic concentrations than any of the on-property exposure areas, the Containment Area, and the background soil sample areas.

As indicated in the MassDEP BMP-Development of Rail Trails; “Railroads are known to have elevated metals, pesticides, (such as lead arsenate), and constituents of oil or fuel (petroleum products). It would not be uncommon to find arsenic (up to ten times natural background levels) present in the soil along a right-of-way from old railroad ties dipped in an arsenic solution, arsenic weed-control sprays, and arsenic laced slag used as the railroad bed fill.”

This information suggests that sources and releases of arsenic should be expected at the two off-Property locations (PanAM railroad bed and EA5) from railroad operations.

Review of the data indicate arsenic concentrations are consistent in OU1 surface soils among all of the exposure areas and represent a single sample population. This would indicate background conditions, and does not indicate a Site-related release of arsenic.

There is no indication from RI sampling that hexavalent chromium is concentrated in any specific area of the site as a consequence of manufacturing processes. Hexavalent chromium (Cr(VI)) is generally present in the vicinity of former disposal areas such as Lake Poly and the East and West Pits under the corresponding warehouses. Hexavalent chromium exceeds Industrial RSLs at several locations and risk contributed to human or ecological receptors is evaluated in the BHHRA and BERA. The speciation of chromium is dependent on the prevailing geochemical environment, and is redox sensitive. In groundwater, the presence of reducing conditions and excess $Fe+^{2}$ results in the rapid reduction of Cr (VI) to Cr(III). Hence Cr(VI) is not expected to be stable in groundwater. In dissolved phase, Cr(VI) is more soluble due to its limited ability to complex and form mineral precipitates. Under oxidizing conditions, such as the presence of atmospheric air, both Cr(III) and Cr(VI) are stable. Cr(VI) is stable at higher pH either as bichromate, ($HCrO_4$), or chromate, CrO_4^{2-} anion, and will have limited sorption to iron oxides surfaces in soil due to competition with other anions such as sulfate. The kinetics of oxidation by atmospheric oxygen is slow. In contrast, rapid oxidation of dissolved Cr(III) by Mn (III, IV) oxides in water has been reported in literature. The ability of this mechanism to be favored is pH-dependent since this reaction mechanism is restricted to dissolved Cr(III) species which decreases significantly with pH; and reactions above pH 4-5 are inhibited by the precipitation of Cr(III) oxyhydroxides on Mn(III, IV) oxide surfaces. In summary, in shallow soil, in the absence of reducing groundwater conditions, Cr(VI) should be stable and exist simultaneously with Cr(III). In reducing groundwater conditions, Cr(III) is favored.

Since chromium occurs naturally in the environment, the presence of Cr(VI) is dependent on pH and redox conditions. The existence of Cr(VI) should not be ascribed as a marker contaminant of either Olin or any site without a careful understanding of its distribution and strong evidence that it is present at high concentrations associated with some operational aspect at a given facility.

5.2 Migration Pathways

During the period of facility operation from 1953 until approximately 1970, liquid waste disposal practices resulted in direct discharge (overflow of pits and Lake Poly) to the on-Property ditch system. The majority of these impacts on-Property have been remediated, reducing the potential for continued migration of contaminated sediment. There is no longer a direct migration pathway from former source areas (disposal features) to surface water or sediment. The OU1 soil investigations did not identify contaminants in surface soil that would pose a risk of a migration pathway by leaching or erosion and transport with surface water run-off.

During the RI, assessment and evaluation of available data indicate there is no evidence of substantial leaching of soil contaminants to groundwater, thus this mechanism is not considered an important migration pathway for OU1. The current CSM is provided as **Figure 5.0-1**. The evaluation of the soil to groundwater leaching pathway is included as **Appendix J**.

A leaching evaluation is presented in **Appendix J** which concludes that no compelling evidence is present that leaching of soils above the water table is impacting OU3 groundwater. Impacts to groundwater are apparent from solubilization of organic contaminants sorbed to soil and located below the water table at Plant B, and TMP impacts at and below the water table associated with the TMP area (EA7). These contaminants also include, to a more limited extent, NDPhA and BEHP at Plant B, and TMP south of former Lake Poly associated with the former buried debris area and drum storage areas. The nature of these groundwater impacts will be discussed in greater detail in the OU3 RI Report. The primary sources in groundwater that contribute to impacts in OU1/OU2 surface water in the Aberjona watershed (off-PWD, South Ditch and East Ditch) are associated with Diffuse Material that results from diffusion from underlying DAPL. The Diffuse Material is transported advectively with groundwater; the dissolved constituents are subject to sorption, diffusion into fine grained soil material, precipitation within the aquifer matrix (aluminum, iron, chromium, and sulfate), and attenuation through dispersion and dilution.

An area of limited LNAPL volume is present behind Plant B, which is contained by the Plant B groundwater recovery/treatment system. As leaching from this LNAPL within the zone of groundwater fluctuation occurs at and below the water table, any migration pathway associated with LNAPL is considered part of OU3.

The area of TMPs located under the parking lot east of the former administration building is also thought to be associated with a former liquid release of di-isobutylene, which is a mixture of 2,2,4-trimethyl-1-pentene and 2,2,4-trimethyl-2-pentene. There is no free-phase liquid present in this area, but the TMPs have adsorbed to soils within the zone of water table fluctuation. The limited solubility of the TMPs suggests that impacts to groundwater are likely not substantial (to be evaluated in the OU3 RI). Groundwater in this portion of the site migrates northward toward East Ditch.

Because the TMPs are highly volatile, these compounds are present in soil vapor and have the potential to migrate (vapor intrusion) into buildings that might be constructed in the future. The investigation of the TMP area in the parking lot confirmed that the soil TMP impacts did not extend beneath the unoccupied office building located immediately west of the parking lot. Residual TMPs are also present in subsurface soil in the EPH/VPH Area where the AS/SVE system previously removed a substantial mass of TMPs from the subsurface. There is potential for vapor intrusion for future buildings associated with the TMPs in that area.

The liquid wastes were disposed of in unlined pits and dense liquids migrated vertically downward to the bedrock surface, where DAPL flowed to and pooled in bedrock depressions. The DAPL pools are immediately overlain by impacted overburden groundwater that has been termed the Diffuse Layer because constituents from DAPL have diffused along concentration gradients into overlying groundwater over time. Dissolved impacts have migrated by groundwater and surface water pathways to on-Property and off-Property locations from Diffuse Layer material and overlying impacted groundwater. Diffuse material was also formed and emplaced in deeper groundwater by convective mixing of DAPL material as it migrated down the Western Bedrock Valley.

Historically, both deeper and shallow overburden groundwater surrounding South Ditch has exhibited chemical characteristics of diffuse groundwater at certain locations (e.g., GW-201S, 79S, GW-55S, GW-202D and GW-55D). In addition, as part of the IRSWP monitoring activities (MACTEC, 2008) a subset of chemical parameters (aluminum, chromium, chloride, sulfate, ammonia, and specific conductance) are monitored quarterly and the results are reported in the Semi-Annual Status Reports. Based on the results of IRSWP and recent RI/FS sampling and analysis results, the solutes present in both deep and shallow groundwater in vicinity of South

Ditch are generally also present in surface water at comparable concentrations. These results are consistent with transport of dissolved contaminants in groundwater and discharge of both deeper and shallow overburden groundwater to surface water along the South Ditch as a function of the surface water and groundwater interaction described in prior paragraphs. The thickness of saturated overburden under the South Ditch and Ephemeral Drainage wetland complex varies from approximately 10 to 18 feet. Based on the discussion above, the primary mechanisms that control the route of migration that impacts OU1 and OU2 surface water is groundwater discharge. The direction of groundwater flow, in terms of both horizontal and vertical components, determines migration pathways from groundwater to surface water. The interconnection of surface water bodies then determines downstream migration in surface water with potential for transport of sediment.

To determine groundwater flow paths relevant to surface water, water level elevation measurements in shallow wells were contoured to create shallow groundwater equipotential surface maps. **Figures 3.3-1** and **3.3-2** depict the interpreted potentiometric surface for May and October of 2011, synoptic groundwater data respectively. An interpreted groundwater divide is shown on both figures. The position of the divide shifts depending on seasonal effects of precipitation (e.g., October having slightly higher groundwater levels than May). The location of the divide determines to which watershed shallow groundwater in the vicinity of the divide will flow. Deep groundwater lateral flow patterns are essentially the same as shallow groundwater.

Groundwater north of the divide is within the Ipswich Watershed, which includes the following surface water features: East Ditch at some point north of Eames Street, MMB and Sawmill Brook. Groundwater south of the divide is within the Aberjona watershed and includes the surface water features: on-PWD, off-PWD, South Ditch, Ephemeral Drainage and East Ditch south of Eames Street. Landfill Brook is also within the Aberjona watershed, but the impacts to Landfill Brook, as presented in Section 4.3.2, are not related to the OCSS.

The surface water systems within the Site are hydraulically connected to shallow groundwater, and most streams receive some inputs from groundwater over at least portions of their reaches. Migration of contaminants to surface water occurs through groundwater discharge. Shallow groundwater in both watersheds will at some point, discharge to the surface water bodies previously mentioned.

Once in the surface water, dissolved contaminants will flow downstream until dilution, oxidation, precipitation, sorption or some other physical and geochemical process alters the constituent concentration to either non-detect or background levels. Recharge of surface water to groundwater in certain stream reaches may occur seasonally, as groundwater levels decline below the stream bottom elevation, and may result in migration of the contaminants in the surface water back into the shallow impacted groundwater within the vicinity of the stream.

5.2.1 Ipswich Watershed Surface Water Bodies

The vertical hydraulic gradients between nested wells within the MMB aquifer were discussed in Section 3.3. The vertical gradient data indicate that shallow groundwater will tend to discharge to surface water features but the mid depth to deep overburden groundwater often shows divergent gradients with downward vertical gradients within some deep portions of the western Bedrock valley. These data suggest the three-dimensional aspect of groundwater flow is predominantly horizontal underlying the MMBW. The aquifer has considerable saturated thickness and impacted groundwater is typically deep. Consistent with data presented in the RI WP (Section 6.1.1 and **Figures 6.2-23** through **6.2-37**), groundwater impacts in MMB remain deep and the shallow groundwater is generally free from site-related impacts. The one exception is the detection of NDMA at one sample location during one event (SW/SD-1) located

downstream of the confluence with Sawmill Brook at a low, estimated concentration below the reporting limit (0.47J ng/L). A surface water sample collected further downstream (SW/SD-9) did not contain NDMA which indicates that NDMA-contaminated shallow groundwater discharges to the MMB wetland in a localized area and at a very low concentration. This is consistent with the only detection of NDMA in shallow groundwater during the same period in GW-65S.

With the exception of NDMA, the site-related constituents that were detected in surface water within the Ipswich watershed (i.e., sulfate, calcium, ammonia, chloride) can be attributed to either naturally occurring sources, or common anthropogenic sources other than from site-related activities. Average ammonia concentrations in background surface water samples range from <0.1 to 0.25 mg/L while average concentrations in MMB were 0.28 mg/L. Elevated ammonia in surface water is only present near the Spinazzola Trust landfill. Average chloride concentrations in background samples range from 77 to 140 mg/L, while the average concentration in MMB is 121 mg/L. Average sulfate concentrations in background samples range from 8.1 to 26 mg/L while the average concentration in MMB is 14.7 mg/L. The low concentrations of these constituents in surface water are indicative of, and consistent with, background conditions.

Impacts to sediment in both MMB and Sawmill Brook (primarily metals and some organic constituents) are clearly associated with sample locations in proximity to the Spinazzola Trust Landfill. Based on distribution in all media, formaldehyde is ubiquitous and is consistent with anthropogenic sources. Acetaldehyde is widely recognized as naturally occurring in the environment as being associated with plant growth cycles. Neither of these two organic compounds are considered to be associated with releases from the Site. Acetone, 2-butanone, and methylene chloride are considered to be laboratory artifacts based on all data collected, and their general lack of detection in groundwater. Based on a preponderance of chemical and hydrogeologic information, the deep groundwater within the MMBA, which is impacted from the Site by virtue of DAPL migration, and the presence of Diffuse Layer material, remains deep and mostly isolated from shallow groundwater; therefore; the deep groundwater is not impacting shallow groundwater and subsequently surface water and sediment in MMBW. The nature and extent of deep groundwater impacts, including the distribution of Diffuse Layer material, will be discussed in the OU3 RI Report. One surface water sample in MMB did detect NDMA at a low, estimated concentration but the significance this isolated NDMA detection is clearly negligible.

In the north-flowing portion of Upper East Ditch (direction change occurring at some point north of Eames Street), NDMA was detected in the surface water sample which was located closest to the site (EDSD/SW1). Like the detection of NDMA in MMB, the next downstream sample (EDSD/SW0) was non-detect. The location, MMB-SW/SD-1 where NDMA was detected once, is a place where the MMB substrate is sandy and where the surface stratigraphy was likely affected by the construction of the Middlesex Canal. With the exception of these very localized low level detections of NDMA, the contaminant migration pathway from groundwater to surface water bodies within the Ipswich watershed via shallow groundwater discharge is largely incomplete and with minimal impact. No other site-related constituents were detected in surface waters within the Ipswich watershed.

5.2.2 Aberjona Watershed Surface Water Bodies

Surface waters within the Aberjona watershed are located both on-Property and off-Property. Unlike the Ipswich watershed, the aquifer saturated thickness is relatively thin in the area of the Site and both horizontal and vertical gradient components are more pronounced. The Diffuse Layer and overlying groundwater associated with the off-PWD DAPL pool become shallower as bedrock rises and groundwater flows around the southwestern corner of the Slurry/Wall

Containment Area. As a result, groundwater in the off-PWD, South Ditch, Stormwater Detention Basin, Central Pond (although not connected by an inlet or outlet to South Ditch), and East Ditch are impacted by site-related constituents from shallow and deeper groundwater discharge. The nature and extent of impact to the Detention Basin and Central Pond are limited to a fewer number of constituents (generally at low concentrations) compared to South Ditch. Diffuse groundwater was present within the area surrounding Upper South Ditch at the time of the installation of the Slurry Wall /Containment Area and contributes to surface water impacts through groundwater discharge.

Diffuse Layer material forms above the DAPL interface in the DAPL pools through the process of diffusion and resides as a layer above the DAPL pools. This Diffuse Layer material is aqueous and can be advectively transported with groundwater away from the DAPL pools and as such has been also been termed Diffuse groundwater in prior reports. During transport, the concentrations of individual constituents are attenuated by a number of processes such as advection, dispersion, sorption and geochemical reactions such as precipitation. In the vicinity of South Ditch, these dissolved constituents in the Diffuse groundwater migrate toward and discharge to surface water along South Ditch. The current distribution of Diffuse groundwater in the vicinity of South Ditch will be described in greater detail in the OU3 RI report, including the distribution of dissolved constituents. Shallow groundwater present in the vicinity of the former Drum Storage Area, and former Buried Debris Area migrates down the western side of the Containment Area and discharges to the Upper South Ditch. This shallow groundwater is also impacted with TMPs and NDPhA. Deeper groundwater situated above the off-Property portion of the Upper DAPL Pool, including Diffuse groundwater, also migrates toward and discharges vertically upward to Upper South Ditch, in particular the region of the ditch just downgradient of the weir. The Containment Area surrounds the on-Property portion of the Upper DAPL Pool and the slurry wall is being evaluated through a program of hydraulic pulse interference testing that will be discussed in a separate report. Therefore, the Containment Area is also considered a potential source. Groundwater under the central and eastern portion of the former facility, not otherwise captured by Plant B, flows to the southeast and ultimately discharges to East Ditch. Additional contributors impacting the East Ditch with VOCs are summarized in the final SIP Report (prepared by Ecology and the Environment in 1993). The report identifies E.C. Whitney and Son's (Whitney Barrel) and other businesses as potential sources. The WSL is also a source of chlorinated VOCs that migrate from Landfill Brook and discharge into the East Ditch.

As described in Section 4.2.5.4, the WSL is considered a source which impacts Landfill Brook that ultimately discharges into the East Ditch. The CSL is a potential source of calcium and sulfate to groundwater from the dissolution of gypsum which was the primary material disposed at the CSL. Groundwater concentrations and groundwater flow directions indicate that the CSL is not an important contributor, if at all, to impacts at Landfill Brook. The primary direction of groundwater flow from the CSL is to the northeast and east. The CSL will be considered further under the OU3 RI report.

As indicated in Section 3.3.1; overburden groundwater gradients between shallow groundwater and surface water indicate South Ditch receives groundwater throughout most of the year. Occasionally, however, the central reach of the ditch may lose water, and go dry seasonally for short periods of time. This will occur even while the upper and lower reaches continue to receive groundwater.

In summary, the on-Property and off-Property migration pathways related to OU1/OU2 within the Aberjona Watershed include:

- Migration of dissolved phase constituents in overburden groundwater from the former Facility portion of the Site, and discharge to surface water in the off-PWD and South Ditch.
- Discharge of shallow, impacted groundwater to South Ditch surface water which is accompanied by precipitation and deposition of Al-Cr-Fe flocculants (floc) within ditch sediments. Two types of floc are present including a "white floc" which contains chromium and aluminum and a "red floc" comprised of iron, aluminum and sulfate. The floc once formed is stable under ambient surface water conditions in South Ditch, and is subject to transport and deposition in the surface water system.
- Leaching of soluble constituents present in LNAPL at and above the water table to groundwater in the vicinity of Plant B. These constituents are currently captured by the Plant B groundwater recovery/treatment system. Treated waters are discharged to on-PWD under a RGP.
- Leaching of soluble VOCs (TMPs) to groundwater under the parking lot located between the former administration building and East Ditch and migration of that groundwater toward East Ditch.
- Discharge of other shallow impacted groundwater to the East Ditch along the eastern property boundary.
- Migration of dissolved phase constituents and floc impacted sediment in South Ditch and East Ditch to downstream areas.

5.3 Receptors

Based on existing OU1/OU2 environmental data the following receptor pathways have been identified for current and/or future land use at OU1/OU2:

- Human (industrial/commercial and trespasser) and ecological exposure to on-Property soils.
- Human (trespasser) and ecological exposure to off-Property soils east of the Site (EA5) and along the PanAM property west of the Site (not Olin COIs).
- Human (trespasser) and ecological (aquatic and semi-aquatic) exposure to surface water and sediment in the South Ditch, Stormwater Detention Basin and Central Pond.
- Human (trespasser) and ecological (semi-aquatic) exposure to sediment in the on-PWD, off-PWD and West Ditch Wetland.
- Human (trespasser) exposure to surface water in East Ditch.

The exposure pathways associated with Site-wide groundwater will be evaluated in the RI/FS for OU3. The potential vapor intrusion migration pathway associated with OU1 soil at the Property has been evaluated and the available information indicates migration of contaminants through the vadose zone into occupied buildings is not currently a complete migration pathway. Vapor intrusion will need to be considered for future development in the TMP Area, Plant B Area and former Lake Poly Area.

5.4 Environmental Fate and Transport

Potential transport mechanisms for constituents in environmental media within OU1 and OU2 are identified and briefly discussed in the following text.

Constituents in Vadose Zone Soil

- Overland flow as a result of erosion and surface water runoff
- Leaching from soil to groundwater via precipitation
- Volatilization into soil vapor, with subsequent advective and diffusive migration (especially by preferential pathways) into buildings and other structures
- Volatilization from surface soil to the atmosphere
- Release of soil-associated constituents (as dust) to ambient air (wind) or during earth-moving activities

Constituents in Saturated Zone Soil

- Dissolution into groundwater
- Accumulation at the water table (LNAPL)

Constituents in Groundwater

- Advective flow of dissolved constituents (with groundwater flow)
- Advective flow of dissolved constituents in groundwater to surface water (groundwater discharge/gaining stream)
- Diffusion of dissolved constituents in groundwater into lower permeability soil matrix
- Sorption of dissolved groundwater constituents to soil matrix (iron oxide surfaces and soil organic carbon)
- Diffusion of volatile organic compounds (as vapor) from groundwater to soil gas at the groundwater/vadose zone interface

Constituents in Surface Water

- Advective flow of dissolved constituents (with surface water flow) in surface water course
- Advective flow of dissolved constituents (with surface water flow) to groundwater (losing stream)
- Sorption of dissolved constituents to organic sediment
- Advective flow of particulate-associated constituents (with surface water flow)
- Deposition of particulate-associated constituents to sediment
- Deposition and sorption of dissolved phase and particulate-associated constituents to soil adjacent to stream (flooding)

Constituents in Sediment

- Sediment transport via scouring due to high surface water flow to downstream water course and subsequent deposition
- Sediment transport via scouring due to high surface water flow to soil adjacent to stream (downstream) with deposition

Potential fate-related mechanisms/processes for constituents in environmental media within OU1 and OU2 are identified and briefly discussed in the following text.

- Biodegradation of constituents in soil, surface water, sediment, and groundwater
- Abiotic degradation of constituents in soil, surface water, sediment, and/or groundwater
- Photolysis (relevant for NDMA in surface water)
- Chemical interaction and transformation in soil, surface water, sediment, and/or groundwater with associated chemical reaction
- Precipitation

- Flocculation
- Complexation
- Phase change (for ammonia, pH dependent)
- Uptake into biota (bioaccumulation/biomagnification)

The following section summarizes the chemical and physical processes that affect fate and transport of specific constituents relevant to the site as well as the physical/chemical/mobility characteristics of Site indicator parameters. At the request of USEPA, the list of metals discussed includes copper, cobalt and manganese, which have been detected in South Ditch surface water. Arsenic is also discussed due to presence in soil and groundwater. The distribution of these metals at the site and in site groundwater does not indicate their presence in the environment is a consequence of former facility operations. The speciation of chromium is dependent on the prevailing geochemical environment, and chromium (Cr+3), whether related to the OCSS or not, can be oxidized and converted to Cr+6 by several mechanisms in the environment depending on redox conditions. Therefore Cr+6 cannot be considered a marker contaminant. Cr+3 is a common element that can also be naturally occurring. The environmental conditions present in groundwater favor the stability of Cr+3 over Cr+6. Hexavalent chromium is rapidly reduced to Cr+3 in the presence of ferrous iron and/or manganese in chemically-reduced or low pH groundwater.

As described earlier in the report, surface waters of the South Ditch, have been impacted by the groundwater including both shallow groundwater and deeper groundwater some of which may have characteristics of Diffuse Layer material (e.g, elevated specific conductance and certain organic chemicals associated with DAPL). **Attachment E** has been included to provide data on specific constituents in groundwater in the vicinity of South Ditch surface water. The CSM (**Figure 5.0-1**) illustrates the relationship between DAPL and diffuse groundwater, as well as groundwater migration of dissolved constituents to surface water in South Ditch. Diffuse layer material and overlying groundwater contain lower concentrations of similar VOCs and SVOCs associated with DAPL. 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. There is a wide range of constituent concentrations in diffuse and overlying groundwater. Note that while acetone and 2-butanone have been detected in DAPL, they are generally detected in groundwater, including that with characteristics of Diffuse Layer material. The OU3 RI report will contain a detailed discussion of dissolved constituents in DAPL, Diffuse Layer material, and overlying groundwater.

Surface water and sediment quality in the Stormwater Detention Basin indicate minimal impacts and that the water and sediment quality is consistent with run-off from the Containment Area with perhaps some input from groundwater. Central Pond surface water and sediment quality is consistent with surrounding groundwater.

The presence of LNAPL at Plant B and former LNAPL now developed as a smear zone in the zone of groundwater fluctuation and below the normal groundwater table as a function of drawdown around the extraction wells contributes dissolved phase constituents to groundwater which are largely captured and treated by the Plant B groundwater extraction and treatment system. The presence of TMPs at the water table and below under the Administrative Building parking lot are associated with the former release from the Plant B production area. While an LNAPL phase is not present, it is possible a thin LNAPL was present long ago and migrated downgradient along the water table prior to being retained largely as sorbed material on the aquifer soil matrix.

The presence of PAHs near the former Boiler House behind Plant C and the laboratory building is consistent with those operations. The elevated metals behind Plant C in surface soil are consistent with atmospheric deposition of fly ash. The PAHs are not soluble and are not a source of impacts to groundwater. PAHs in surface water and sediment associated with off-PWD and East Ditch, are associated with railroad operations, including the presence of creosote treated ties.

The floc that has been observed within the ditch system has been characterized and investigated in order to evaluate the fate and transport of the material. Under ambient surface water conditions this material is chemically stable and will not re-solubilize. The floc is transported with surface water as part of the sediment load and be deposited with other sediment. Floc composition, morphology, and environmental stability were discussed in Section 2.1 and are detailed in Section 2.1.4.1.2.1.2 of the FRI provided in **Appendix A**.

Appendix K contains the USEPA Superfund Chemical Data Matrix (SCDM) data sheets for most of the detected constituents in environmental media for OU1/OU2. Those data sheets present information concerning physical/chemical characteristics, persistence, and mobility of the constituents. Most of the indicator constituents for the site can be characterized as persistent (metals, inorganics, BEHP, NDPA, higher molecular weight PAHs, and TMPs). Most of the indicator inorganics/metals and some SVOCS (calcium, sulfate, chloride, sodium, ammonia, and NDMA) are highly soluble in water and therefore are highly mobile (but not bioaccumulative). NDMA has not been detected in any soil or sediment samples. BEHP and TMPs are less soluble in water (and less mobile in water) and have an affinity for soil and sediments (sorption). The TMPs are the only Site indicator compounds that are considered to be volatile. OU1/OU2 fate and transport information for principal site contaminants includes:

- 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 and remains in isolated DAPL pools in bedrock depressions located both on- and off-Property.
- The 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, including on-Property areas.
- The primary current mechanism for release of these dissolved constituents from the DAPL pools is chemical diffusion, which is a slow and inefficient mass transfer process. DAPL is an on-going source of Diffuse material.
- Several of the DAPL constituents, and in particular chromium, are rapidly attenuated by geochemical reactions which take place as solutes move over a distance of several feet from the low pH environment of the DAPL/ Diffuse Layer interface to the buffered pH conditions of overlying groundwater. Chromium however is still present in diffuse groundwater that discharges to surface water downstream of the weir in Upper South Ditch. Some chromium is incorporated into the white floc.

Metals and Inorganics

- Chromium, aluminum, and iron in surface water typically precipitate as floc including aluminum and chromium hydroxides and iron sulfates. The “white floc” consisted of pure aluminum hydroxide (gibbsite) with between 0.8% and 2% trivalent chromium. The “red floc” (also referred to as “iron floc”) characterization suggested the material was similar to the mineral redingtonite (containing iron, chromium, aluminum, and sulfate) with a chromium content of 5% - 10%.
- In surface water, copper can travel great distances, either suspended on soil particles or as free ions. Most copper compounds will settle and be bound to either water sediment or soil particles. The cupric ion (Cu(II) or Cu2+) is the most important oxidation state of

copper and is the oxidation state generally encountered in water. Adsorption of copper to colloids and particulates occurs and can constitute a major proportion of copper. Adsorption of copper to suspended clays and oxides increased with increasing pH. In freshwater free of organic complexing agents, the solubility of Cu(II) is controlled by malachite below a pH of 7 and by tenorite above a pH of 7. Copper in water is held in solution mainly by complexation with naturally occurring organic ligands. In freshwater, organic ligands are more important in binding copper than inorganic ligands containing sulfur, phosphorus, chloride, nitrogen.

- The transport and partitioning of manganese in water are controlled by the solubility of the specific manganese compound present. In most waters (pH 4-7), Mn (II) predominates and is associated principally with carbonate, which has relatively low solubility. The solubility of Mn (II) can be controlled by manganese oxide equilibria, with manganese being converted to other oxidation states. In extremely reduced water, the fate of manganese tends to be controlled by the formation of the poorly soluble sulfide. In surface with low oxygen levels, Mn (IV) can be reduced both chemically and bacterially to the Mn (II) oxidation state. The tendency of soluble manganese compounds to adsorb to soils and sediments can be highly variable, depending mainly on the cation exchange capacity and the organic composition of the soil.

  The potential for manganese to leach from the vadose zone to the groundwater under normal conditions is low due to its low solubility. The presence of the warehouses and Containment Area cap limit the amount of precipitation which can infiltrate through the vadose zone under current conditions. The historic discharge of acidic liquid wastes to unlined pits and ponds would have temporarily created conditions favorable for the dissolution of manganese minerals (oxides, silicates and or carbonates), and for the mobilization of manganese adsorbed onto iron oxyhydroxides. As the bottom of the pits and ponds were in direct contact with or in close proximity to the water table, the amount of manganese mobilized is likely small. The potential significant mobilization of manganese from the vadose zone ended with the termination of direct discharge of liquid waste in the 1970s.

  In the portions of the saturated zone impacted by DAPL (either as it migrated through or by the continuing presence of a DAPL pool), the low pH would favor soluble Mn (II) over stable solid phases (carbonates or oxides) containing either Mn (II) or Mn (IV). Increasing pH away from the DAPL up into the Diffuse and overlying groundwater zones would tend to favor the formation of solid phases and the co-precipitation of manganese with iron oxyhydroxides, as well as the sorption of manganese onto iron oxyhydroxides. Mixing of impacted groundwater containing dissolved manganese with surface water should result in the precipitation of manganese under normal surface water stream conditions.
- Released in surface water, cobalt may sorb to colloidal particles and settle into sediment or sorb directly to sediment. Complexation of cobalt to dissolved organic substances can reduce sediment sorption. The distribution coefficient of cobalt (i.e. from water to sediment) varies due to pH, redox conditions, ionic strength and dissolved organic matter. Factors affecting the speciation and fate of cobalt in water and sediments include organic ligands such as humic acids, anions, pH and redox potential.
- Arsenic is typically present in the environment in two of its four possible oxidation states: arsenate [As (V)] or arsenite [As (III)]. Arsenate is stable in oxidizing environments, while arsenite is stable in moderately reducing environments. The oxidation state of arsenic has a significant effect on its rate of transport in groundwater. As (V) sorbs to the aquifer matrix to a greater extent than As(III), particularly to iron hydroxides, manganese, and aluminum, at pH values less than neutral, while As (III) sorbs to a

greater extent than As (V) at pH values greater than neutral. Adsorption of arsenic onto iron is also affected by the amount of iron oxide present, as well as concentrations of competing ions (e.g., phosphate, sulfate). Naturally occurring arsenic is commonly found in Massachusetts soil, bedrock, and groundwater. Arsenic occurs primarily as sulfide minerals in bedrock and as a secondary element on, or in, iron oxyhydroxides. In settings where arsenic-bearing sulfide minerals (e.g., pyrite, arsenopyrite, arsenite) are present, oxidation of these minerals can lead to elevated concentrations of arsenic in groundwater. Similarly, reductive dissolution of iron hydroxides (coupled with microbial oxidation of organic matter) and the release of sorbed arsenic can explain much of the observed mobilization of arsenic into groundwater regionally in New England.

Arsenic has been detected in shallow soil; however, the potential for it to leach from the vadose zone to the groundwater under normal conditions is low due to its low solubility. However, the historic discharge of acidic liquid wastes to unlined pits and ponds could have temporarily created conditions favorable for the mobilization of arsenic from unsaturated (vadose zone) soil due to the dissolution of iron hydroxides. As the bottom of the pits and ponds were in direct contact with or in close proximity to the water table, the amount of arsenic mobilized is likely small. The former pits that were not excavated have been covered with buildings (East and West Warehouses) or a cap (containment area), which limits the amount of infiltration of precipitation which can occur in these areas. Therefore, the potential significant mobilization of arsenic from the vadose zone likely ended with the termination of direct discharge of liquid waste in the 1970s.

Because of the higher density of the liquid wastes, they tended to sink through the saturated zone soils until they reached the top of the lower permeability bedrock beneath the site, forming the DAPL pools. The reduction in aquifer pH would lead to the dissolution of iron oxyhydroxide minerals present in the saturated soil, thereby releasing sorbed arsenic. Bedrock underlying the Site does not include rock types which are known to contain elevated arsenic farther west. Dissolved arsenic, predominantly as arsenate, would migrate away from DAPL areas via diffusion and advective flow into areas of the aquifer with higher pH. Arsenate strongly sorbs to iron and manganese oxyhydroxides and aluminum oxyhydroxides (which are known to present in the aquifer matrix) even at less than neutral pH values. Therefore, the lateral migration of arsenic in groundwater should be limited, unless other factors not related to the site create reducing conditions in groundwater (i.e., significant influx of organic carbon) which could promote mobilization of arsenic. These factors, however, are more relevant to OU3, and will be considered further under the OU3 RI. There are two areas of industrial oil release to the subsurface which have resulted in reducing groundwater conditions that may, to a very localized extent, affect arsenic mobility in groundwater; one near Plant B, and one near the East Warehouse. Should groundwater containing dissolved arsenic discharge to surface water, the increase in pH as mixing occurs will likely result in sorption of the arsenic to hydroxides, where it would be stable under normal stream conditions.

- Hexavalent chromium and trivalent chromium were detected in vadose zone soils in both OU1 and OU2. Both Cr (III) and Cr (VI) are expected to be stable under the oxic conditions present above the water table. In OU1, elevated concentrations of hexavalent chromium were generally associated with the former liquid disposal areas. As noted above, under oxic conditions both Cr (III) and Cr (VI) are stable and infiltration of precipitation through the former liquid waste disposal areas is limited by the buildings and Containment Area cap. Therefore, it is unlikely that any significant mobilization of chromium is occurring under current site conditions. As with arsenic and manganese, significant mobilization of site contaminants from the vadose zone ceased with the termination of acidic waste discharge.

In the portions of the saturated zone impacted by DAPL (either as it migrated through soil or by the continuing presence of a DAPL pool), the low pH would favor Cr (III) over Cr (VI). Migration of Cr (VI) in the saturated zone is expected to be limited by two primary reactions: adsorption onto aquifer solids and reduction to Cr (III). These two reactions will strongly limit the extent of hexavalent chromium impacts in groundwater. The extent of trivalent chromium in groundwater is also expected to be limited due to the sorption of Cr (III) onto aquifer solids and precipitation of stable chromium solids in the aquifer. Discharge of shallow, impacted groundwater to surface water is accompanied by precipitation and deposition of within ditch sediments. The "white floc" contains chromium and aluminum, which once formed, is stable under ambient surface water conditions. The deposited floc is then subject to further transport and deposition in the surface water system.

- The analytical data set includes a large body of data for "ammonia". It should be recognized that the analytical method does not distinguish the two major forms of ammonia that might be present in surface water or groundwater (ammonia gas (NH_3) and ammonium ion (NH_4^+). In surface water and groundwater at the Site, ammonium ion is the predominant species of ammonia. In water, there is a pH dependent equilibrium between NH_3 and NH_4^+. At pH below 8.3, (the pKa) the ammonium ion is the predominant form of dissolved ammonia in surface water and sediment. Ammonia gas is not a significant component of the ammonia that has been measured in surface water and groundwater.
- Ammonia in groundwater is not attenuated by geochemical reactions and will not readily sorb to granular aquifer materials. Ammonia is soluble in water, but is not stable in most environments. It is easily transformed to nitrate in waters that contain oxygen and can be transformed to nitrogen gas in waters that are low in oxygen. Ammonia in surface water and sediment is also created by natural biological processes as a function of the nitrogen cycle. Soluble nitrogen in the form of ammonia is present in organic rich wetland deposits. In particular Peat deposits have the ability to fix high concentrations of Ammonia. Ammonia in off-Property South Ditch surface water will interchange nitrogen with aquatic plant and algae, which can convert and fix the nitrogen for growth, eventually recycling the nitrogen back into the atmosphere. Under current hydraulic conditions, volatilization of ammonia or ammonium is not expected to transfer a significant flux of ammonia to the atmosphere where it can be oxidized by sunlight. These mechanisms are not expected to appreciably attenuate ammonia/ ammonium concentrations in surface water. The most important attenuation mechanism is likely to be sorption to organic substrates and dilution by other surface water as the surface water progressively flows downstream
- NDMA is not attenuated by geochemical reactions and will not readily sorb to aquifer materials. Therefore, NDMA is not attenuated to a significant extent in groundwater other than by advection, dispersion and diffusion. NDMA is not volatile but is degraded by photo-oxidation through sunlight exposure. In the presence of sunlight, NDMA is short-lived in surface water. Although the UV oxidation half-life rates are relatively fast, the effectiveness of this destructive mechanism is dependent on time and intensity of sunlight exposure, water turbidity and water depth, which limit light penetration into the surface water. Biological degradation of NDMA in surface water is not expected to be an important attenuation mechanism although it does occur (World Health Organization, 2006).

VOCs

- TMPs are sparingly soluble in water, have been detected in vadose zone soils, particularly at or near the water table, and have been detected at mostly relatively low concentrations in groundwater samples. TMPs will tend to partition from water to air.
- TMPs are highly volatile and because of that characteristic, a large mass of these compounds has previously been removed from the vadose zone via AS/SVE. Also because of their volatility, TMPs in the vadose zone and in shallow groundwater represent a potential for vapor migration into buildings and into ambient air during excavation activities.

SVOCs

- BEHP, and other SVOCs including NDPhA and phenolic compounds sorb strongly to soil and sediment organic content and have relatively low water solubility and low to limited potential to migrate in groundwater at substantial concentrations.
- PAHs, including cPAHS, are extremely insoluble and due to their high distribution coefficient sorb very strongly to soils and have very limited potential for migration in groundwater.

PCBs

- PCBs associated with the transformer site are also highly insoluble and will sorb strongly to soil, rendering them immobile except by physical transport of soil particles.

6.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

The BHHRA has been developed for OU1 and OU2, which Olin and USEPA have agreed to address in this combined RI Report. The BHHRA is contained in **Appendix M** and the sections below are a summary of the BHHRA.

OU1 is defined in the SOW as the approximately 50-acre Olin Property (hereafter, the "Olin Property" or "Property"), including the former facility area, the established conservation area, the on-Property ditch system, the calcium sulfate landfill, and the slurry wall/containment area. The evaluation of OU1 includes soil and On-Property surface water and sediment. OU2 is defined as off-Property surface water and sediment areas, including, at a minimum, the off-Property East Ditch, South Ditch and West Ditch.

The objective of the BHHRA is to characterize health risks to human populations that are assumed to be potentially exposed to COIs associated with historical operations at the Property under the current and foreseeable future uses of the Site, in the absence of any additional remedial measures. COIs are chemicals that have been associated with the former facility (as a raw material, product, or a constituent of waste streams or accidental releases) and that have been released to one or more environmental media. The results of the BHHRA will be considered with other regulatory and technical information, to evaluate the need for remedial action at OU1 and OU2, and if remedial action is required, to develop and evaluate remedial alternatives.

The AOC and SOW were developed per the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The applicable regulatory requirement is the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300.

A complete list of regulation, guidance and policy documents that have been relied upon to complete the BHHRA is included in **Appendix M**. Specifically, the BHHRA is performed using USEPA CERCLA guidance for risk assessment.

The BHHRA is completed using a four-step process, consistent with the framework for risk assessment described in *RAGS* (USEPA, 1989). The four steps include Data Evaluation (sometimes also referred to as Hazard Identification), Exposure Assessment, Toxicity Assessment, and Risk Characterization.

6.1 Human Health Risk Conceptual Site Model

A CSM describes sources of releases to the environment, release mechanisms, the receiving media, the migration pathways through which COIs that were released to the environment have been and may continue to be transported and/or trans-located from source or release areas to other environmental media (secondary receiving media) where possible human and environmental exposure may occur. The physical CSM for OU1 and OU2 (sources, migration pathways, receiving media) is described in detail in Section 5.0 and potential human receptors have also been identified. The potential human receptors and exposure pathways are discussed below in the context of the physical CSM.

For the purposes of this BHHRA, it is assumed the northern portion of the Property will remain in industrial/commercial use, and an institutional control prohibits more sensitive land uses. Some portions of the Property have no active use, and it is expected that in the future, some areas will continue to have no active use. Approximately 20 acres of the Property, located to

the south of the South Ditch, is subject to a conservation restriction. Therefore, no development or active or passive recreational use is allowed for that portion of the Property. Other portions of the Property include resource areas and associated buffer zones at which construction, development, and active uses are not expected (but are none-the-less evaluated). Given that information and working assumptions, the following human receptors are considered for this BHHRA for OU1 and OU2.

- Current and future land use – indoor and outdoor industrial/commercial workers (adults)
- Future land use – construction (including excavation) workers (adults)
- Current and future land use – trespassers (adolescents and adults)

An exposure pathway is the course a chemical takes from its source to the person being contacted. Exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of human exposure. Exposure pathways generally consist of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium, (3) a point of potential human contact with the contaminated medium (known as the exposure point), and (4) an exposure route at the contact point (e.g., ingestion of soil, inhalation of vapors) (USEPA, 1989). For the exposure pathway to be considered potentially complete, all four elements must be present.

An exposure point (also called an exposure area or exposure unit) is a location within which an exposed receptor may reasonably be assumed to move at random and where contact with an environmental medium (e.g., soil) is equally likely at all sub-locations. In addition to the behavior of receptors, the existing pattern of chemical constituents in environmental media is also considered in identifying exposure areas. The identified current and future receptors, the assumption of random exposure within an exposure area, and the nature and extent of contamination have been considered in identifying exposure areas for the BHHRA. Important factors in identifying the exposure areas at OU1 and OU2 include the current and anticipated future uses of the various areas of these operable units. Therefore, the BHHRA exposure areas for OU1 and OU2 reflect current and future receptors and the current and future uses of the various areas (considering resource areas and associated buffer zones as potential determinants of future land use as well as the institutional control that will maintain the northern portion of the Property as an industrial/commercial property).

Environmental media evaluated quantitatively for OU1 and OU2 in this BHHRA (exposure media) include surface soil (and airborne dust), subsurface soil (and airborne dust), surface water and sediment. Potential outdoor air (potential vapors released from soil during future excavation activities) and indoor air (potential vapor intrusion of VOCs in soils) exposures have been evaluated qualitatively.

Exposure routes are the mechanisms by which people are exposed to environmental media. Exposure routes that are typically evaluated in environmental risk assessments include ingestion of the environmental medium, skin (dermal) contact with the environmental medium, and inhalation of outdoor or indoor air.

The exposure pathways associated with Site-wide groundwater will be evaluated in the RI/FS for OU3. There is currently no use of groundwater for any purpose at the Property.

The CSM for the BHHRA is presented graphically in **Figure 6.1-1.** **Table 6.1-1** provides a summary of the receptors and exposure scenarios for OU1 and **Table 6.1-2** provides a

summary of the receptors and exposure scenarios for OU2 evaluated in the BHHRA. **Figure 6.1-2** presented the exposure areas for the BHHRA.

6.2 Hazard Identification

The hazard identification includes the evaluation, selection, and summarization of analytical data for the BHHRA and the selection of Chemicals of Potential Concern (COPCs). These two activities are described below.

6.2.1 Data Evaluation

The entire body of available medium-specific analytical laboratory data for soil, surface water, and sediment for OU1 and OU2 have been evaluated to determine the subsets of data that are appropriate to characterize human health risks for current and foreseeable future land uses and site conditions for OU1 and OU2.

The laboratory analyses associated with historical and RI investigation activities (beginning in 2009), periodic monitoring, and response actions have been conducted using USEPA published and approved laboratory analytical methods (if available). The investigations, monitoring programs, and response action sampling and analysis programs have incorporated Quality Assurance/Quality Control (QA/QC) samples and associated procedures, and the historical analytical data and all of the RI analytical data have undergone data validation as described for historical data in the 2007 Draft Focused RI (MACTEC, 2007) and for RI activities in the 2009 Quality Assurance Project Plan (QAPP) (MACTEC, 2009d), and **Appendix E**. The available analytical data overall are suitable for use in the BHHRA.

Some of the analytical data were not selected for use in the BHHRA. Those data were not selected because they are no longer representative of site conditions (they represent pre-remedial conditions or the medium (soil or sediment) that was sampled has been excavated and is no longer present or because there are elevated reporting limits for non-detects for certain samples that are not suitable for use in the BHHRA. **Appendix M, Attachment 1** documents the selection of data for use in the BHHRA.

Based on the preliminary evaluation of potential human exposure, **Tables 6.1-1** and **6.1-2** (summary of receptors and exposure pathways) and **Figure 6.1-1** (human health risk assessment CSM) provide the framework for evaluating data to be used in the BHHRA and for making decisions about grouping of the analytical data. **Figure 6.1-2** identifies the exposure areas, the soil background area, and other features (such as the Calcium Sulfate Landfill [CSL] which are not evaluated in the BHHRA).

The exposure areas have been identified based on the current and foreseeable future land uses and activities (considering the deed restriction (Notice and Declaration of Restrictive Covenant) for the entire 51 Eames Street Property and the Environmental and Open Space Restriction (Environmental Restriction) for the southern portion of the Property), physical configuration of OU1 and OU2, degree of development, the presence and location of environmental resource areas (wetlands and buffer zones), spatial coverage of environmental sampling, and the distribution of contaminant concentrations in soil.

The exposure areas for OU1 have been identified as EA1, EA2, EA3, EA4, EA6, EA7, the Containment Area, South Ditch, on-PWD, Stormwater Detention Basin, and Central Pond. The exposure areas for OU2 have been identified as EA5, Off-PWD, East Ditch, MMBW, and North Pond. As discussed in Section 4, impact to MMBW surface water and sediment are negligible

but this area is evaluated in the BHHRA. As discussed in Section 4, Landfill Brook is impacted by the WSL. Landfill Brook is not impacted by COIs released from OU1. Therefore, Landfill Brook has been evaluated, at the request of USEPA, only through COPC selection step of the BHHRA.

All of the analytical data selected for use in the BHHRA are included in **Appendix M, Attachment 2**. The analytical data have been grouped and summarized to support the selection of COPCs.

6.2.2 COPC Selection

The chemicals considered to be likely to pose more than a *de minimis* level of risk are identified, and subsequently included in the quantitative BHHRA. The COPCs are selected by reducing the number of chemicals to be considered by applying a concentration/toxicity screen and by eliminating essential nutrients. The procedure used to select COPCs for the BHHRA is summarized as follows, and the risk-based screening step is consistent with *USEPA Region I Risk Update Number 3* (USEPA, 1995).

- Concentration-Toxicity Screening
- Selected as a COPC in soil if the maximum detected concentration is greater than the USEPA RSL (adjusted) for industrial soils (USEPA, 2013a).
- Selected as a COPC in surface water if the maximum detected concentration is greater than the Ambient Water Quality Criteria (AWQC) for consumption of organisms only (USEPA, 2009) or the USEPA RSL (adjusted) for tap water (USEPA, 2013a).
- Selected as a COPC in sediment if the maximum detected concentration is greater than the USEPA RSL (adjusted) for industrial soils (USEPA, 2013a).

Chemicals for which no screening value is available are retained as COPCs unless they are essential nutrients.

The risk assessment dataset derived through the data evaluation process as described in **Appendix M** was utilized to produce subsets of data to be used for selecting COPCs for surface soil (all of OU1 and OU2, excluding the background data), shallow subsurface soil (all of OU1 and OU2), surface water (combined data set including: South Ditch, Central Pond, Detention Basin, East Ditch, Off-PWD, MMBW, and North Pond - Landfill Brook is evaluated separately.), and sediment (combined data set including: On-PWD/West Ditch Wetland, South Ditch, Central Pond, Detention Basin, East Ditch, Off-PWD, MMBW, and North Pond - Landfill Brook is evaluated separately). COPCs were selected Site-wide for surface and subsurface soil because the source of contamination for each exposure area is similar, and the COPC screening is based on the maximum detected concentration of each analyte (using site-wide data is a conservative, health-protective approach). COPCs were selected for Landfill Brook surface water and sediment separately because this area is not impacted by COIs that were released from OU1. Low frequency of detection (less than 5%) is typically used to eliminate COPCs. Low frequency of detection was not used in this BHHRA because COPCs were selected Site-wide, and using that criterion might mask a higher frequency in one portion of the Site.

Table 6.2-1 identifies the selected COPCs for surface soil, subsurface soil, surface water, and sediment.

As shown in **Appendix M**, COPCs selected in Landfill Brook surface water and sediments are not COIs. COPCs selected in surface water and sediment are mostly PAHs and metals which

would appear to be related to storm water runoff from surrounding developed areas. As discussed in Section 4.2.3.4.1, surface water quality within Landfill Brook is affected by groundwater discharge from the WSL and possibly other sources in the area. Since COPCs in surface water and sediment are not COIs and surface water quality is affected by other sources, Landfill Brook is not evaluated any further in the BHHRA.

6.3 Exposure Assessment

For OU1 and OU2, the exposure media evaluated quantitatively in the BHHRA include surface and subsurface soil, surface water, and sediments. The vapor intrusion pathway is addressed qualitatively. In the OU3 RI report, the groundwater-related vapor intrusion pathway will be evaluated quantitatively.

Based on the current and assumed future land uses for the EAs, receptors evaluated include:

Current Land Use – OU1

- Outdoor Worker – Surface Soil at EA1, EA2, EA3, EA6, and EA7
- Trespasser – Surface Soil at EA1, EA2, EA3, EA4, EA6, and EA7
- Trespasser – Surface Water at South Ditch, Central Pond and Stormwater Detention Basin
- Trespasser – Sediment at on-PWD, South Ditch, Central Pond and Stormwater Detention Basin

Current Land Use – OU2

- Trespasser – Surface Soil at EA5
- Trespasser – Surface Water at EA5, Off-PWD, East Ditch, MMBW, and North Pond
- Trespasser – Sediment at EA5, Off-PWD, East Ditch, MMBW and North Pond

Future Land Use – OU1

- Indoor Worker – Surface Soil at EA1,EA3 and EA7
- Indoor Worker – Subsurface Soil at EA1, EA3 and EA7
- Outdoor Worker – Surface Soil at EA1, EA2, EA3, EA6, EA7, and Containment Area
- Outdoor Worker – Subsurface Soil at EA1, EA3, and EA7
- Construction Worker – Surface Soil at EA1, EA2, EA3, EA6, and EA7
- Construction Worker – Subsurface Soil at EA1, EA3, and EA7
- Trespasser – Surface Soil at EA1, EA2, EA3, EA4, EA6, EA7, and Containment Area
- Trespasser – Subsurface Soil at EA1, EA3, and EA7
- Trespasser – Surface Water at South Ditch, Central Pond and Stormwater Detention Basin
- Trespasser – Sediment at on-PWD, South Ditch, Central Pond and Stormwater Detention Basin

Future Land Use – OU2

- Outdoor Worker – Surface Soil at EA5
- Construction Worker – Surface Soil at EA5
- Trespasser – Surface Soil at EA5

- Trespasser – Surface Water at EA5, Off-PWD, East Ditch, Maple Meadow Brook, and North Pond
- Trespasser – Sediment at EA5, Off-PWD, East Ditch, Maple Meadow Brook, and North Pond

The current land use at the Property has been described in detail in Section 1.3. The exposure setting and exposure pathways (including exposure media, receptors, exposure areas, and exposure routes) have previously been identified in **Tables 6.1-1** and **6.1-2**, and in **Figures 6.1-1** and **6.1-2**.

In accordance with USEPA guidance, Reasonable Maximum Exposure (RME) EPCs for surface soil, shallow subsurface soil, surface water, and sediment are based on the lesser of the 95 percent UCL on the arithmetic mean concentration (95% UCL value) or the maximum detected concentration in the data set (USEPA, 2002b).

The 95% UCL values are calculated using the ProUCL software (Version 5.0.00, USEPA, 2013b). The ProUCL software performs a goodness-of-fit test for data sets with or without non-detects to identify the distribution type for the data set (e.g., normal, lognormal, gamma, or non-discernable), and then calculates a conservative and stable 95 percent UCL value in accordance with the framework described in "Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites" (USEPA, 2002b). The software includes numerous algorithms for calculating 95% UCL values, and provides a recommended UCL value based on the algorithm that is most applicable to the statistical nature of the data set.

Exposures (average daily doses or average air concentrations) to COPCs are quantified by using numerical parameters that include ingestion rates, dermal contact areas, body weights, exposure times, exposure frequencies, and exposure durations. These parameters and the sources of their values are documented in **Appendix M**. The specific numerical values for each of these parameters are selected in consideration of the receptor activities and ages that the exposure scenarios are modeling, and are generally selected as the upper-end (generally 95th percentile) values for each quantitative parameter. Using receptor scenarios that are protective for all potentially exposed populations associated with a given land use, with numerical parameters that are generally based on the upper-end distributions, results in exposure scenarios are referred to as the RME. Exposure parameters are developed from USEPA Region I and USEPA national guidance (USEPA, 2002a; 2004; 2011).

6.4 Toxicity Assessment

The objective of the toxicity assessment is to identify potential health impacts of COPCs and to quantify the relationship between the intake, or dose, of COPCs and the likelihood of adverse health effects associated with exposure to the COPCs.

The BHHRA evaluates the potential for both carcinogenic (cancer) and non-carcinogenic health effects. Non-carcinogenic health effects refer to toxicological effects other than cancer, such as toxicity to the liver, skin, or central nervous system. Following USEPA guidance (USEPA, 1989), both non-carcinogenic and carcinogenic are evaluated separately.

Toxicity values used for evaluating health risks include cancer slope factors (CSFs) and UR values for carcinogens; and Reference Doses (RfDs) and Reference Concentrations (RfCs) for non-carcinogens. Because the potential for toxicity and/or carcinogenicity can depend on the route of exposure (i.e., oral or inhalation), unique dose-response values have been developed for the oral, dermal, and inhalation exposure routes.

The following hierarchy of sources for dose-response values for CERCLA sites (USEPA, 2003) has been utilized in identifying dose-response values for this BHHRA.

- Tier 1 – Integrated Risk Information System (http://www.epa.gov/iris/).
- Tier 2 - National Center for Environmental Assessment (NCEA) provisional peer reviewed toxicity values (PPRTVs) **(http://hhpprtv.ornl.gov/)**.
- Tier 3 - Other Toxicity Values:
    - California Environmental Protection Agency (CALEPA) toxicity values (CALEPA, 2009).
    - Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs) (ATSDR, 2009)
    - Toxicity values remaining in current versions of HEAST.
    - For the TMP compounds, toxicity values were not available from the sources identified above. Therefore, an ingestion RfD and an inhalation RfC have been derived for these compounds. The derivation of these values is documented in **Appendix M**.

The toxicity values utilized in the BHHRA are summarized in tabular form in Appendix M and toxicological profiles for each of the COPCs are provided in Appendix M, Attachment 10.

There are numerous detected parameters that were selected as COPCs because there were no RSLs available. For most of those COPCs, there are no readily available published toxicity values from Tier I, II, or III data sources. Those COPCs include, but are not limited to, ammonia, sulfate, bromide (detected in surface water only), chloride, nitrate, urea, nonylphenol (detected in surface water only), diphenylether, and diphenylmethanone (detected in surface water and sediment only). Since the lack of toxicity values prevents calculation of risks the BHHRA underestimates risk for those parameters. However, the underestimation of risk for these parameters is discussed further in Appendix M.

6.5 Risk Characterization

Quantitative estimates of both carcinogenic and non-carcinogenic risks are calculated for each exposure scenario selected for evaluation in the exposure assessment, in accordance with USEPA (1989) guidance.

An estimate of the excess lifetime cancer risk (ELCR) associated with exposure to each COPC in a given medium is calculated by multiplying the exposure route pathway-specific lifetime average daily dose (e.g., dermal exposure to surface soil) or lifetime average exposure concentration (e.g., inhalation of dust) by its exposure route-specific CSF (e.g., oral CSF) or UR.

$$ELCR = \text{Lifetime Average Daily Dose or Exposure (mg/kg/day or } \mu g/m^3) \times CSF\ (mg/kg/day)^{-1} \text{ or } UR\ (\mu g/m^3)^{-1}$$

The ELCR represents an upper bound of the probability of an individual developing cancer over a lifetime as the result of exposure to a COPC. The ELCR is calculated for each carcinogenic COPC for each medium and exposure route combination for each receptor at each exposure area. The ELCR for all COPCs in a given medium are summed to identify a route-specific total ELCR (e.g., soil ingestion) and the ELCR for all exposure routes for a given receptor/medium combination (e.g., soil ingestion and dermal contact) are summed to yield a total medium ELCR (e.g., for surface soil).

The non-cancer hazard quotient (HQ) associated with exposure to each COPC is calculated by dividing the exposure route pathway-specific average daily dose or exposure concentration by its exposure route-specific RfD or RfC.

HQ = Average Daily Dose or Exposure (mg/kg/day or µg/m^3) / RfD (mg/kg/day) or RfC (µg/m^3)

The HQ is calculated for each COPC for each medium and exposure route combination for each receptor at each exposure area. For a given medium/receptor/age group combination (e.g., surface soil and adult outdoor worker), HQs for all COPCs are summed by route (e.g., dermal contact) to identify a medium/route HI, and the HIs for multiple exposure routes (e.g., incidental ingestion and dermal contact) are summed to identify a medium-specific total HI (e.g., for surface soil ingestion and dermal contact). Because HIs are not additive across age groups (applies to the trespasser only in this assessment), the higher HI between the two age groups (adolescent and adult), in this case) is selected as the representative HI for the trespasser. An HI less than 1 indicates that non-carcinogenic toxic effects are unlikely to occur as a result of COPC exposure. HIs greater than 1 may be indicative of a possible non-carcinogenic toxic effect. As the HI increases above 1, so does the likelihood of adverse effects. Risk calculations are documented in **Appendix M.**

The calculated cancer and non-cancer risks are evaluated in the context of risk management criteria established in the NCP and discussed in the preamble to the NCP (USEPA, 1990). The results of the baseline risk assessment are compared to CERCLA risk management criteria. The cancer risk estimates for a site are compared to the cancer risk range of 10^{-6} (one in a million) to 10^{-4} (one in ten-thousand). Risks at or below 10^{-4} do not generally warrant a response action. Risks greater than 10^{-4} generally warrant development and evaluation of remedial alternatives. Non-cancer risks are compared to a HI value of 1, which corresponds to levels of exposure that people (including sensitive individuals) could experience without expected adverse effects.

Cancer and non-cancer risks for current and future exposure scenarios are summarized by exposure area and presented in **Tables 6.5-1** and **6.5-2**.

6.5.1 Risk Characterization for Vapor Intrusion from Soil

As discussed in **Appendix M**, there are chemicals present in shallow subsurface soils (1-10 ft bgs) that have sufficient volatility and toxicity to warrant evaluation of vapor intrusion from soil to indoor air. However, there are no current occupied buildings located in the vicinity of these chemicals in shallow subsurface soils. Therefore, the vapor intrusion pathway is not complete for current site uses.

In the future it is possible for redevelopment of the Property to occur and new industrial/commercial buildings could be constructed. **Appendix M** has identified four areas where there is the potential for future vapor intrusion if buildings were to be constructed. These areas include: EA7 (including the former EPH/VPH area), EA3, the area of the former Lake Poly, and the containment area. There is no foreseeable construction and occupancy of buildings in the containment area. The remaining three areas (EA7, EA3, and the former Lake Poly) have the potential for future buildings to be constructed.

There are no USEPA-published soil screening values which are protective of future vapor intrusion exposures. In addition, it is very difficult to quantitatively evaluate risks for future vapor intrusion from soil. Therefore, it is recommended that if future industrial/commercial buildings

are contemplated in the three areas listed above that vapor migration be addressed by additional investigation/risk assessment, or by institutional or engineering controls included in building design. This is discussed in more detail in **Appendix M**.

6.6 Risk Assessment Conclusions

The current and foreseeable future use of the portion of OU1 located north of the South Ditch is industrial/commercial. A deed restriction (Notice and Declaration of Restrictive Covenant) is on file with the Registry of Deeds will maintain that use and prohibit more sensitive land uses. The portion of OU1 at the Property is subject to the Environmental and Open Space Restriction (Environmental Restriction) that maintains the area as a conservation land and prohibits development and passive and active recreational use of that area. The areas within OU2 have also been evaluated in the BHHRA. Consistent with the current and foreseeable future land use, the BHHRA has evaluated potential exposures and risks as documented in **Appendix M**.

A screening evaluation has also been conducted to assess the potential vapor intrusion pathway associated with volatiles in surface soil and shallow subsurface soil for current and future occupied buildings at the Property. This BHHRA for OU1 and OU2 has not evaluated risks associated with direct contact with groundwater nor with any potable or non-potable uses of groundwater. The BHHRA for OU3 will address those potential exposures and risks.

The conclusions of the BHHRA can be summarized as follows:

- The cancer risk estimates for the current and future trespasser, current and future industrial/commercial outdoor worker and indoor worker, and the future construction worker at the OU1 exposure areas (EA1, EA2, EA3, EA4, EA6, EA7, on-PWD, South Ditch, Central Pond, and the Stormwater Detention Basin), are within or below the CERCLA acceptable risk range.
- The non-cancer HI estimates for the current and future trespasser, current and future industrial/commercial outdoor worker and indoor worker, and the future construction worker at the OU1 exposure areas (EA1, EA2, EA3, EA4, EA6, EA7, on-PWD, South Ditch, Central Pond, and the Stormwater Detention Basin), are below a value of 1.
- The cancer risk estimates for the current and future trespasser, current and future industrial/commercial outdoor worker, and the future construction worker at the OU2 soil exposure area (EA5) and for the current and future trespasser at the OU2 surface water/sediment exposure areas (Lower South Ditch, East Ditch, Maple Meadow Brook, and North Pond) are within or below the CERCLA acceptable risk range.
- The non-cancer HI estimates for the current and future trespasser, current and future industrial/commercial outdoor worker, and the future construction worker at the OU2 soil exposure area (EA5) and for the current and future trespasser at the OU2 surface water/sediment exposure areas (East Ditch, Maple Meadow Brook, off-PWD, and North Pond) are below a value of 1.
- The cancer risk estimate for the trespasser exposed to sediment and surface water in the off-PWD is above the CERCLA acceptable risk range. However, the predominant risk contributors are PAH compounds detected in surface water that are unrelated to historical activities or releases at the Property.
- Based on CERCLA criteria, the calculated human health risks associated with potential exposures to surface soil, shallow subsurface soil, surface water, and sediment at OU1 indicate that the northern portion OU1 (EA1, EA2, EA3, EA6, EA7, on-PWD, South

Ditch, Central Pond, and the Stormwater Detention Basin is suitable for current and future industrial/commercial use (more sensitive land uses are not foreseeable per the Notice and Declaration of Restrictive Covenant) and the southern portion of OU1 (EA4) is suitable for use as a conservation area (more sensitive land uses are not foreseeable per the Environmental and Open Space Restriction).

- Based on CERCLA criteria, the calculated human health risks associated with potential trespasser exposures to OU2 surface water and sediment at Lower South Ditch, East Ditch, Maple Meadow Brook, off-PWD, and North Pond do not warrant further investigation nor evaluation in a Feasibility Study.
- Based on CERCLA criteria, the calculated human health risks associated with potential trespasser, industrial/commercial worker, and construction worker exposures to OU2 surface soil at EA5 indicate the area is suitable for industrial/commercial use (more sensitive land uses are not foreseeable given the physical conditions and the close proximity to the commuter rail line).

Based on a qualitative evaluation of potential future conditions, concentrations of VOCs (primarily TMPs) in subsurface soils at EA3, EA7 and at one location in EA1 (former Lake Poly area) indicate that inhalation non-cancer risks potentially associated with vapor intrusion for future buildings (indoor workers) and for future excavation of soils (construction workers) should be controlled via institutional and engineering controls such as the incorporation of vapor mitigation features into building design.

7.0 BASELINE ECOLOGICAL RISK ASSESSMENT

The BERA has been developed for Operable Units 1 and 2, which Olin and USEPA have agreed to address in this combined RI Report. The BERA is contained in **Appendix N** and the sections below are a summary of the BERA.

OU1 is defined in the SOW as the approximately 50-acre Olin Property (hereafter, the "Olin Property" or "Property"), including the former facility area, the established conservation area, the on-Property ditch system, the calcium sulfate landfill, and the slurry wall/containment area. The evaluation of OU1 includes soil and On-Property surface water and sediment. OU2 is defined as off-Property surface water and sediment areas, including, at a minimum, the off-Property East Ditch, South Ditch and West Ditch.

The objective of the BERA is to characterize risk to ecological receptors that are assumed to be potentially exposed to COIs associated with historical operations at the Property, in the absence of any additional remedial measures. COIs are chemicals that have been associated with the former facility (as a raw material, product, or a constituent of waste streams or accidental releases) and that have been released to one or more environmental media. The results of the BERA will be considered with other regulatory and technical information, to evaluate the need for remedial action at OU1 and OU2, and if remedial action is required, to develop and evaluate remedial alternatives. COIs were identified in the executive summary of this RI Report.

The AOC and SOW were developed per the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The applicable regulatory requirement is the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300.

A complete list of regulation, guidance and policy documents that have been relied upon to complete the BERA is included in **Appendix N**. Specifically, the BERA is performed using USEPA CERCLA guidance for risk assessment.

The BERA is completed using an eight-step process, consistent with the framework for risk assessment described in *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997). The BERA consists of a problem formulation, exposure and effects assessment, risk characterization, and conclusions.

7.1 Problem Formulation

The problem formulation provides the framework upon which the risk assessment is organized. The problem formulation is based on the findings of numerous investigations, risk assessments and remedial actions conducted since 1978 to develop an understanding of the nature and extent of environmental impacts at OU1 and OU2.

7.1.1 Exposure Areas

Habitats were identified from observations made during site visits. The BERA evaluated risk to ecological receptors in OU1 in two terrestrial exposure areas (**BERA Figure 3.5-1,** and **Figure ES-5**):

- Exposure Area 2 (EA2); and
- Exposure Area 4 (EA4)

The BERA did not evaluate ecological risk for terrestrial exposure areas EA1 or EA3 as those areas are heavily developed and do not provide significant habitat.

The BERA evaluated ecological risk in OU1 in five aquatic exposure areas (**BERA Figure 3.5-2** and **Figure ES-5**):

- Central Pond;
- Storm Water Detention Basin;
- On-PWD/WDW;
- Upper South Ditch; and
- Lower South Ditch.

The on-Property and off-Property portions of the Lower South Ditch were evaluated together as a single exposure area.

The BERA evaluated ecological risk in OU2 in one terrestrial exposure area:

- Exposure Area 5 (EA5).

The BERA evaluated ecological risk in OU2 in three aquatic exposure areas:

- Off-PWD;
- MMB Wetland;
- North Pond*; and
- Landfill Brook (only through COPEC selection; the nature and extent evaluation in the RI found that Landfill Brook is not impacted by the OCSS);

** North Pond has been evaluated per request from USEPA. There is no current complete exposure pathway between the Property and North Pond. The current sediments in North Pond could not have been impacted by historical activities and releases associated with the Property.*

As decided upon during the March 7, 2013 meeting with the USEPA and MassDEP, the East Ditch is assessed in a separate SLERA. The East Ditch SLERA is contained in **Appendix N** with the BERA.

An on-Property soil background area and an off-Property reference location were also identified for OU1 and OU2 and were incorporated in the risk characterization:

- Terrestrial Background; and
- MMB Wetland Aquatic Background (or Reference) Area.

7.1.2 Ecological Receptors

Ecological receptors were selected by focusing on species and communities that:

- Are indigenous to the area (taking into consideration the habitat types and areas available within the site);
- Are likely to be highly exposed to COPECs due to their habitat preference, behavioral traits, and home range; and
- Are representative of various feeding guilds or trophic levels (e.g., herbivore, invertivore, carnivore);

Terrestrial, aquatic, and semi-aquatic receptors were selected based on their observed or likely presence in OU1 and OU2 and on indicator species previously evaluated in prior ecological risk assessments conducted for the Olin Property.

Terrestrial receptors for OU1 and OU2 consisted of:

- Terrestrial plant community;
- Soil invertebrate community;

- American robin (*Turdus americanus*) populations, representing omnivorous songbirds;
- Red-tailed hawk (*Buteo jamaicensis*) populations, representing carnivorous birds of prey;
- Northern short-tailed shrew (*Blarina brevicauda*) populations, representing omnivorous small mammals; and
- Red fox (*Vulpes vulpes*) populations, representing carnivorous mammals.

Semi-aquatic receptors for OU1 and OU2 consisted of:

- Benthic macroinvertebrate community;
- Green frog (*Rana clamitans*) populations, representing amphibians;
- Marsh wren (*Cistothorus palustris*) populations, representing invertivorous songbirds;
- Green heron (*Butorides virescens*) populations, omnivorous semi-aquatic birds;
- Muskrat (*Ondatra zibethicus*) populations, representing herbivorous mammals; and
- Raccoon (*Procyon lotor*) populations, representing omnivorous mammals.

Fish were not included as receptors because Central Pond, the Storm Water Detention Basin, the on-PWD/WDW, South Ditch, and the off-PWD do not support fish.

Consultation with the USFWS and Massachusetts Natural Heritage and Endangered Species Program indicated that there are no specially protected species and no estimated or priority habitats in the vicinity of OU1 or OU2.

7.1.3 Complete Exposure Pathways

Chemicals may move from environmental media to ecological receptors through several major biological exposure mechanisms:

- Uptake of chemicals from soil through roots (plants);
- Ingestion of chemicals bound to soil (terrestrial invertebrates, birds, mammals);
- Ingestion of chemicals bound to sediment (benthic invertebrates, amphibians, semi-aquatic birds, mammals);
- Ingestion of dissolved and particulate chemicals in surface water (benthic invertebrates, amphibians, semi-aquatic birds, mammals);
- Ingestion of chemicals through consumption of contaminated plants (herbivores, omnivores); and
- Ingestion of chemicals through consumption of contaminated prey (all predators).

Although inhalation and dermal absorption pathways are possibly complete for some receptors, the BERA considered these pathways to be minor compared to dietary ingestion and are not evaluated.

Exposure pathways and receptors, by exposure area, are presented in **BERA Table 3.8-1**.

7.1.4 Assessment and Measurement Endpoints

Assessment endpoints in the BERA define ecological attributes that are to be protected. Measurement endpoints are measurable characteristics of those attributes that can be used to gauge the degree of impact that has occurred or may occur. Measurement endpoints are related to the assessment endpoint and the effects that can be measured or observed (e.g., toxicity in invertebrate bioassays). Measurement endpoints are most often used as surrogates for assessment endpoints since in most cases the assessment endpoint itself cannot be readily measured or observed (Suter, 1993).

The BERA evaluated the following assessment and measurement endpoints:

Assessment Endpoints		Measurement Endpoints		Inference Weight
1	Sustainability (richness, diversity, structure, and function) of terrestrial plant communities in Site exposure areas.	1A	Compare site bulk soil concentrations to soil effects benchmarks and to reference area conditions.	Low
2	Sustainability (richness, diversity, structure, and function) of soil invertebrate communities in Site exposure areas.	2A	Compare site bulk soil concentrations to soil effects benchmarks and to reference area conditions.	Low
3	Sustainability (survival, growth and reproduction) of populations of invertivorous birds in terrestrial Site exposure areas.	3A	Compare estimated daily dose for omnivorous song bird species (American robin) based on ingestion of prey and incidental ingestion of soil in terrestrial Site exposure areas to published avian TRVs and compare to reference area conditions.	Medium / High
4	Sustainability (survival, growth and reproduction) of populations of omnivorous small mammals in terrestrial Site exposure areas.	4A	Compare estimated daily doses for omnivorous small mammal species (short-tailed shrew) based on ingestion of prey and incidental ingestion of soil in terrestrial Site exposure areas to published mammalian TRVs and to reference area conditions.	Medium / High
5	Sustainability (survival, growth and reproduction) of populations of birds of prey in terrestrial Site exposure areas.	5A	Compare estimated daily doses for carnivorous bird species (Red-tailed Hawk) based on ingestion of prey and incidental ingestion of soil in Site exposure areas to published avian TRVs and compare to reference area conditions.	Medium / High
6	Sustainability (survival, growth and reproduction) of populations of carnivorous mammals in terrestrial Site exposure areas.	6A	Compare estimated daily doses for carnivorous mammal species (Red Fox) based on ingestion of prey and incidental ingestion of soil in Site exposure areas to published mammal TRVs and compare to reference area conditions.	Medium / High
7	Sustainability (richness, diversity, structure, function) of benthic invertebrate communities in aquatic Site exposure areas.	7A	Compare site bulk sediment and surface water concentrations to sediment and surface water effects benchmarks.	Low
		7B	Compare sediment toxicity test results for the South Ditch sample to corresponding sediment toxicity test results for reference samples.	Medium / High
8	Sustainability (survival, growth and reproduction) of populations of amphibians in aquatic Site exposure areas.	8A	Compare site bulk sediment and surface water concentrations to sediment and surface water effects benchmarks.	Low

Assessment Endpoints		Measurement Endpoints		Inference Weight
9	Sustainability (survival, growth and reproduction) of populations of semi-aquatic birds in aquatic Site exposure areas.	9A	Compare estimated daily doses for invertivorous bird species (Marsh Wren) based on ingestion of prey and incidental ingestion of sediment and surface water in Site aquatic exposure areas to published avian TRVs.	Medium / High
		9B	Compare estimated daily doses for omnivorous bird species (Green Heron) based on ingestion of prey and incidental ingestion of sediment and surface water in Site aquatic exposure areas to published avian TRVs.	Medium / High
10	Sustainability (survival, growth and reproduction) of populations of semi-aquatic mammals in aquatic Site exposure areas.	10A	Compare estimated daily doses for semi-aquatic herbivorous mammal species (muskrat) based on ingestion of plants and incidental ingestion of sediment and surface water in Site aquatic exposure areas to published mammalian TRVs.	Medium / High
		10B	Compare estimated daily doses for semi-aquatic omnivorous mammal species (raccoon) based on ingestion of prey and incidental ingestion of sediment and surface water in Site aquatic exposure areas to published mammalian TRVs.	Medium / High

Measurement endpoints were assigned inference weights reflecting their relative importance, following the guidance provided by Menzie *et al.* (1997).

7.1.5 Conceptual Site Model

Detailed information pertaining to the transport of contaminants within OU1 and OU2 is presented in Section 5 of the RI Report.

7.1.6 Data Used in the BERA

Data used in the BERA consisted of soil, surface water and sediment chemistry data, and sediment toxicity tests data. Available data were selected for use in the BERA using the criteria established by USEPA in "*Guidance for Data Usability in Risk Assessment*" (USEPA, 1992b). Sample collection and handling, laboratory analyses, and data Quality Assurance/Quality Control (QA/QC) procedures were performed in accordance with USEPA methods, as described in the project Quality Assurance Project Plan (QAPP). Section 2.0 of the RI Report provides a detailed description of the sampling and analytical methods that were used to generate the data for the RI. Data used in the BERA are also summarized in **BERA Table 3.9-2.**

7.1.7 COPEC Selection

Contaminants of potential ecological concern (COPECs) were selected by the comparing maximum detected concentrations to screening benchmarks by exposure area and media. Constituents with maximum detected concentrations greater than their corresponding screening benchmarks were identified as COPECs. COPECs represent chemicals that are present in environmental media at concentrations that could pose more than a negligible risk to ecological receptors and, therefore, are carried through the risk assessment for quantitative evaluation of

potential risks. COPECs identified for further evaluation in the BERA are selected in **BERA Table 3.13-1** through **Table 3.13-19**. Concentrations of chemicals below conservative screening benchmarks are considered to pose negligible risk to ecological receptors.

Depending on exposure area and medium, COPECs identified for further evaluation consisted of VOCs, SVOCs (including PAHs), EPH, pesticides, metals, other inorganics, and miscellaneous specialty compounds (*e.g.* hydrazine).

Ecological screening benchmarks for chemicals detected in surface water, sediment, and soil were obtained from published regulatory sources and peer-reviewed scientific literature using a multi-tiered hierarchy (**BERA Tables 3.12-2** through **Table 3.12-4**) and following USEPA guidance.

7.1.8 Ammonia Screening

Detected concentrations of ammonia in many surface water samples collected from the Site were above their respective screening criterion. Ammonia originates from a variety of man-made point source discharges as well as natural and man-made non-point sources, making it difficult to attribute detected concentrations at the Site to any one particular source. Generally speaking, ammonia in the environment originates from a combination of municipal, agricultural, industrial, and natural processes. Given the large number of point, non-point, and natural sources of ammonia in the aquatic environment, is unlikely that the ammonia detected in surface water at the Site (other than South Ditch) is, in fact, Site-related.

7.2 Exposure and Effects Assessment

The BERA evaluated risk to ecological receptors from exposure to COPECs by:

- Comparison of concentrations in environmental media to effects benchmarks and reference concentrations;
- Sediment toxicity tests (Lower South Ditch only); and
- Food chain modeling and TRV-based risk calculations.

7.2.1 Exposure Point Concentrations (EPCs)

The BERA evaluated risk to ecological receptors using Reasonable Maximum Exposure (RME) and Central Tendency Exposure (CTE) EPCs. The RME EPC provides an upper estimate of exposure concentrations. In accordance with USEPA guidance (USEPA, 2002), RME EPCs used in the BERA are based on the lesser of the 95% Upper Confidence Limit (UCL) on the arithmetic mean concentration or the maximum detected concentration. The 95% UCL values are calculated using the ProUCL software (V. 4.1.00; USEPA, 2011).

The CTE represents the concentration to which a population of receptors would most likely be exposed across an exposure area and over time. CTE EPCs are average (arithmetic mean) concentrations calculated using ½ the SQL for non-detects. If the average concentration of a COPEC in an exposure area is greater than the maximum concentration, as occurs where the frequency and magnitude of detections is minimal, the lesser of the maximum or RME EPC was used as the CTE EPC.

BERA Table 4.1-1 through **Table 4.1-17** demonstrate EPC selection by exposure area and medium.

7.3 Effects Benchmark Comparison Methods

For measurement endpoints 1A, 2A, 7A and 8A, RME and CTE EPCs were compared to effects benchmarks to calculate Hazard Quotients (HQs). Effects benchmarks represent concentrations at or above which adverse effects are likely to occur. Effects benchmarks are typically based on toxicity tests and experimental observations published and summarized in the scientific literature. Effects benchmarks are typically reported based on the degree of measured response observed (*e.g.*, EC50, concentration effecting 50% of the test organisms). Effects benchmarks differ from screening benchmarks that identify concentrations below which adverse effects are not expected to occur.

Ecological effects benchmarks (**BERA Table 4.2-1** through **BERA Table 4.2-3**) for chemicals detected surface water, sediment, and soil (identified for plant and invertebrate) were obtained from published regulatory sources and peer-reviewed scientific literature using a multi-tiered hierarchy. In soil, separate effects benchmarks were identified for terrestrial plant and soil invertebrate receptors.

Hazard quotients (HQs) were calculated by comparing EPCs to effects benchmarks, as shown:

Hazard Quotient = EPC / Benchmark (Equation 7-1)

Where:

EPC = RME EPC or CTE EPC
Benchmark = Effects Benchmark

An RME EPC coupled with a screening benchmark provides a conservative estimate of risk, while a CTE EPC coupled with an effects benchmarks provides a more realistic estimate of risk. Therefore, an HQ less than 1 based on a RME and a screening benchmark indicates that the contaminant alone is unlikely to cause adverse ecological effects, while an HQ greater than 1 based on a CTE and effects benchmark suggests that a COPEC may be present at a concentration at which adverse effects may occur.

The risk characterization also includes an evaluation of incremental risks, which take into account the contribution of reference area concentrations to the overall site risks. Incremental risk was calculated as shown in Equation 3:

Incremental Risk HQ = Site HQ – Reference HQ (Equation 7-2)

For the BERA, reference area data were available for terrestrial exposure areas (EA2, EA4, and EA5) and for the MMB Wetland. No reference data were available for the other aquatic exposure areas evaluated in this BERA.

HQs calculated by comparing RME and CTE EPCs to effects benchmarks are presented in **BERA Table 4.3-1** through **Table 4.3-17.**

7.4 Food Chain Modeling Methods

Exposure of terrestrial and semi-aquatic wildlife (*i.e.*, birds and mammals) to COPECs was estimated using food chain models. Soil, sediment, and surface water EPCs were entered into the food chain model to calculate an estimated daily intake (EDI) to which the receptor may be exposed. EPCs for prey items (tissue) were estimated using literature based bioaccumulation factors (BAFs), except for estimates of chromium concentrations in invertebrate tissue. Chromium is a site-related COI frequently detected in site media. The scientific literature indicates there is no meaningful positive correlation between soil/sediment concentration and invertebrate tissue concentrations (Sample *et al.*, 1998a,b; USEPA, 1999b). Because no defensible soil- or sediment-to-invertebrate chromium BAFs are available in the scientific

literature, a fixed value of 20 mg Cr/kg invertebrate tissue dry weight (equivalent to 4 mg/kg wet weight assuming invertebrates are 80% water) is used instead. The rationale for this approach is discussed in detail in **BERA Section 4.7 (Uncertainty)** and in **BERA in Attachment 5** and **Attachment 8**.

Models incorporate a site foraging frequency (SFF), which accounts for the proportion of a receptor's diet and incidental ingestion of soil or sediment that is obtained from an exposure area. If the exposure area is larger than the receptor's foraging range, it is assumed that the receptor obtained all of its food from within that exposure area. If the exposure area is smaller than the receptor's foraging range, it is assumed to obtain a fraction of its food from the exposure area. That fraction is calculated by dividing the exposure area by the foraging range.

Estimated Daily Intakes (EDIs) for individual COPECs were compared to wildlife TRVs, expressed as milligrams per kilogram (mg/kg) body weight (BW) per day, to evaluate the effect of exposure on representative species. The comparison was quantified using the HQ approach, as shown:

$$\text{Hazard Quotient} = \text{EDI} / \text{TRV} \quad \text{(Equation 7-3)}$$

Where:

EDI = Estimated daily intake calculated from the food chain model (mg/kg BW-day)
TRV = Toxicity Reference Value (mg/kg BW-day)

TRVs were obtained from studies published in primary literature resources or review articles that reported NOAEL and LOAELs with survival, growth, or reproductive endpoints. Chronic studies were generally selected over acute or subchronic studies. USEPA-derived TRVs established to calculate Eco-SSLs were used preferentially when available (USEPA, 2013a). NOAEL and LOAEL TRVs are roughly analogous to screening and effects benchmarks used for other media, except that they represent screening and effects doses, rather than concentrations. Wildlife TRVs used in the food chain model are presented and discussed in greater detail in **BERA Attachment 5**.

The details of the food chain models, including exposure assumptions, BAFs, and TRVs, are provided in **BERA Attachment 5** along with the food chain modeling spreadsheets. Results of the food chain modeling are presented in **BERA Table 4.5-1** through **Table 4.5-11**.

Incremental risks (Equation 7-2) were also calculated for food chain risks.

7.4.1 Sediment Toxicity Test Methods & Results

In 2011, one sediment sample was collected from location ISCO-2 in Lower South Ditch, and from two reference locations (SDBK-002 and MMB-SW/SD-1) for toxicity testing. All three samples were submitted to EnviroSystems, Inc. (ESI) laboratory in Hampton, NH for a 42-day survival, growth and reproduction test using *Hyalella azteca* and following the procedures outlined in:

- Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates (ASTM Method E 1706-05, 2010),
- Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates (US EPA 2000); and
- Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA 1998).

ISCO-2 was selected to represent Lower South Ditch because it had the highest sediment HQs, calculated using ecological screening benchmarks.

Survival was measured on the 28th day of the test. Survival in ISCO-1 (42%) was below the laboratory control (93%) and below both reference samples (96% and 95%), a statistically significant reduction ($p<0.05$). Since a statistically significant reduction in survival was observed, growth and reproduction were not further considered. The full sediment toxicity testing report is provided in the RI **Appendix G** and **BERA Attachment 6**. **BERA Attachment 9** includes the South Ditch Toxicity Test Memorandum previously submitted to USEPA and dated April 29, 2015. The memorandum provides a summary of the sediment samples, the test procedures, and the results of the test. Survival, growth, and reproduction for sample ISCO-2 were significantly lower than both reference samples. These results clearly demonstrate that the sediment sample ISCO2 exhibited significantly greater toxicity to Hyalella azteca than the two reference samples and the laboratory control. A review of the analytical data suggests that toxicity in ISCO2 was likely the result of concentrations of BEHP (480 mg/kg) and chromium (3,000 mg/kg) that were orders of magnitude higher than concentrations in reference samples, where BEHP was not detected in either sample (reporting limit < 0.3 mg/kg) and where chromium concentrations were reported at 5 mg/kg and 11 mg/kg.

7.4.2 Uncertainty Analysis

There is uncertainty associated with estimates of risk in any BERA because the risk estimates are based on a number of assumptions regarding exposure and toxicity. There is uncertainty associated with the exposure and modeling assumptions, toxicological data, and risk characterization (USEPA, 1997). A thorough understanding of the uncertainties associated with risk estimates is critical to understanding predicted risks and placing them into proper perspective. The BERA considered major uncertainties and assumptions, well as steps taken to minimize uncertainty, associated with the following categories:

- Exposure and Modeling Uncertainties
- Data Summary/Exposure Point Concentrations
- Exposure Parameters
- Bioaccumulation Factors and BAFs
- Bioavailability of COPECs
- Inhalation and Dermal Exposure Pathways
- Toxicological Uncertainties
- Literature-Derived TRVs and Benchmarks
- Uncertainty in Risk Characterization

7.5 Risk Characterization

Risk characterization includes three major components: risk estimation, risk description, and uncertainty analysis. Risk estimation consists of integrating the exposure profiles with the effects information. Risk description provides information important for interpreting the risk results. The uncertainty analysis discusses potential sources of uncertainty, and the relative certainty associated with estimates of risk. The BERA reviews each of the assessment endpoints, analyzes results for measurement endpoints, and considers the relationship between assessment and measurement endpoints, including the confidence in the relationships relative to characterizing risk. The BERA used a weight of evidence approach to make conclusions regarding overall risk of harm.

Ideally, risk characterization based on food chain model HQs would be based on a dose-response curve for each COPEC and receptor combination. However, for most ecological receptors, sufficient information to establish dose-response curves is not available in the

published scientific literature. Instead, the likelihood of adverse population level effects was determined using the following Four-Way Interpretative Risk Matrix developed for USEPA Region I that incorporates all four EPC/TRV combinations:

Four-Way Interpretative Risk Matrix					
RME/ NOAEL HQ	**RME/ LOAEL HQ**	**CTE/ NOAEL HQ**	**CTE/ LOAEL HQ**	**Risk Conclusion:** Adverse population-level effects:	**Confidence Level**
≤ 1	≤ 1	≤ 1	≤ 1	Unlikely	High
> 1	≤1	≤ 1	≤ 1	Unlikely	High
> 1	> 1	≤ 1	≤ 1	Unlikely	Moderate
> 1	≤ 1	> 1	≤ 1	Possible	Low
> 1	> 1	> 1	≤ 1	Possible	Moderate
> 1	> 1	> 1	> 1	Possible	High (increases with higher HQs)

When possible, incremental risk HQs from food chain models have been used as the basis for the risk characterization. Incremental risk HQs (Equation 7-2) are the most appropriate HQ for characterizing site-related risk because they account for non-site sources.

HQs calculated for terrestrial plants, soil invertebrates, benthic invertebrates and amphibians were based on effects benchmarks factored with the RME and CTE scenarios, so only two sets of HQ conditions were calculated. In such cases, the Two-Way Interpretative Risk Matrix, also developed for USEPA Region I, was used as a guide to address the range of risk conclusions and confidence levels:

Two-Way Interpretative Risk Matrix			
RME/Effects Benchmark HQ	**CTE/Effects Benchmark HQ**	**Risk Conclusion:** Adverse population-level effects:	**Confidence Level**
≤ 1	≤ 1	Unlikely	High
> 1 and ≤ 10	≤ 1	Unlikely	Moderate
>10	≤ 1	Possible	Low
> 1	> 1	Possible	High (increases with higher HQs)

The Four-Way and Two-Way risk matrices were the first steps to estimate and characterize risk. Then, underlying assumptions and uncertainties and site-specific factors such as robustness of sample size, bioavailability, or confidence in an individual benchmark, were considered to derive final risk conclusions.

The BERA characterized risk by exposure area and assessment/measurement endpoints, beginning with the terrestrial exposure areas and concluding with the semi-aquatic exposure areas, as summarized below:

EA-2. All of the measurement endpoints found that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to EA-2 soil.

EA-4. All of the measurement endpoints found that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to EA-4 soil.

EA-5. Most of the measurement endpoints found that adverse effects may be possible for ecological receptor populations and communities exposed to EA-5 soil. Food chain models for robins and shrews, and plant and invertebrate effects benchmark comparisons all indicated that adverse site-related effects may be possible from chromium in EA-5 soil. Adverse effects from BEHP to robins and shrews may also be possible.

Central Pond. Most of the measurement endpoints found that adverse effects are unlikely for ecological receptor populations and communities exposed to media in Central Pond. The sediment benchmark comparison found that there is low confidence that phenol is a risk to benthic invertebrates and amphibians. However, the sediment benchmark comparison carries a low inference weight. Medium/high weighted measurement endpoints (food chain models) did not identify risks from phenol. Considering the low confidence and the low weight associated with the sediment benchmark comparison, the overall weight-of-evidence indicates that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to Central Pond surface water and sediment.

Storm Water Detention Basin. Most of the measurement endpoints found that adverse effects are unlikely for ecological receptor populations and communities exposed to media in the Storm Water Detention Basin. The sediment benchmark comparison found that there is low confidence that phenol may pose risks to benthic invertebrates and amphibians. However, the sediment benchmark comparison carries a low inference weight. Medium/high weighted measurement endpoints (food chain models) did not identify risks from phenol. Considering the low confidence and the low weight associated with the sediment effects benchmark comparison, the overall weight-of-evidence indicates that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to Strom Water Detention Basin surface water and sediment.

On-PWD/WDW. All of the measurement endpoints found that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to On-PWD sediment.

South Ditch. In the Upper South Ditch, most of the measurement endpoints found that adverse effects are unlikely for ecological receptor populations and communities exposed to sediment there. The sediment benchmark comparison found that site-related risks to benthic invertebrate and amphibian communities from the C11-C22 aromatic EPH fraction are uncertain. The sediment benchmark comparison carries a low inference weight. Other medium/high weighted measurement endpoints (food chain models) found that adverse effects from COPECs in Upper South Ditch were unlikely. The low weight associated with the sediment benchmark comparison, the overall weight-of-evidence indicates that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to Upper South Ditch sediment. This is consistent with the fact that a sediment removal action was conducted in Upper South Ditch. The surface water benchmark comparison indicates that adverse site-related effects or ecological receptors from chromium and ammonia may be possible.

In the Lower South Ditch, most of the measurement endpoints found that adverse effects could occur for ecological receptor populations and communities exposed to surface water and

sediment there. The sediment benchmark comparison found that there could be effects to benthic invertebrate and amphibian communities from chromium and silver; site-related risks from the EPH fraction are uncertain. The sediment benchmark comparison carries a low inference weight. The sediment toxicity test, which carries a medium/high inference weight, indicated that the worst-case conditions in the Lower South Ditch adversely affect the benthic community. The marsh wren food chain model, which also carries a medium/high inference weight, suggested that BEHP may pose a risk. Three other food chain models (green heron, muskrat, raccoon), also carrying a medium/high inference weight found that adverse effects from COPECs in Lower South Ditch are unlikely. The overall weight-of-evidence indicates that adverse site-related effects for ecological receptor populations and communities exposed to Lower South Ditch sediment may be possible from BEHP and chromium. The surface water benchmark comparison indicates that adverse site-related effects or ecological receptors from chromium and ammonia may be possible.

Off-PWD. Most of the measurement endpoints found that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to media in the Off-PWD, including the surface water benchmark comparison and all four food chain models (marsh wren, green heron, muskrat, and raccoon). The sediment benchmark comparison suggested that there may be site-related adverse effects from chromium. However, the sediment benchmarks comparison carries a low inference weight. Medium/high weighted measurement endpoints did not identify risk from chromium. Considering the low confidence and low weight associated with the sediment benchmark comparison, the overall weight-of-evidence indicates that adverse effects are unlikely for populations and communities of ecological receptors exposed to COPECs in Off-PWD surface water and sediment.

Maple Meadow Brook Wetland. All of the measurement endpoints found that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to MMB Wetland surface water and sediment.

North Pond. Most of the measurement endpoints found that adverse site-related effects are unlikely for ecological receptor populations and communities exposed to media in North Pond, including the surface water benchmark comparison and four food chain models (marsh wren, muskrat, heron, and raccoon). The sediment benchmark comparison was inconclusive due to concern that the chromium CTE EPC may severely overestimate exposure. However, the sediment benchmark comparison carries a low inference weight. Medium/high weighted endpoints (food chain models) and another low weighted measurement endpoint (surface water benchmark comparison) did not identify risks from chromium. Considering the low confidence and the low weight associated with the sediment benchmark comparison, the overall weight-of-evidence indicates that adverse site-related effects to populations and communities are unlikely for ecological receptors exposed to chromium in North Pond surface water and sediment.

North Pond has been evaluated per request from USEPA. There is no current complete exposure pathway between the OCSS and North Pond. Given that sediments were reported to have been removed from North Pond prior to development, the current sediments in North Pond would not have been impacted by historical activities and releases associated with the Property. Historic sediments recovered from soil borings were clearly not impacted by former releases from the OCSS.

7.6 Conclusions

This BERA for OU1 and OU2 of the OCSS found that adverse effects associated with releases at or from OU1 and OU2 to ecological receptors is unlikely in the following exposure areas and media:

- EA-2 soil;
- EA-4 soil;
- Central Pond surface water and sediment;
- Storm Water Detention Basic surface water and sediment;
- On-PWD/WDW surface water and sediment;
- Upper South Ditch sediment;
- Off-PWD surface water and sediment;
- Maple Meadow Brook surface water and sediment; and
- North Pond surface water and sediment.

The BERA for OU1 and OU2 of the OCSS also found that adverse effects associated with releases at or from OU1 and OU2 may be possible in the following exposure areas and media:

- EA-5 soil, due to chromium and BEHP;
- Upper and Lower South Ditch surface water, due to chromium and ammonia; and
- Lower South Ditch sediment, due to chromium and BEHP.

Consistent with the findings of the sediment toxicity test remedial alternatives for Lower South Ditch sediments should be evaluated.

8.0 SUMMARY AND CONCLUSIONS

This section provides a summary of the findings of the OU1/OU2 Draft RI and identifies the conclusions with respect to those findings. The summary of findings addresses the historical and RI investigations (conducted to delineate the nature and extent of contamination and to support risk assessment activities), the evaluation of fate and transport of contaminants, and the human health and ecological risk assessments. The conclusions discuss the results in the context of meeting the requirements for completion of the RI for OU1 and OU2.

8.1 Summary

This section provides a summary of the nature and extent of contamination (by medium), the fate and transport of constituents in environmental media, and a summary of the human health and ecological risk assessments.

8.1.1 Nature and Extent of Contamination

Nature and extent of contamination has been characterized/delineated for OU1 and OU2 soil, surface water, and sediment. Data have been collected using USEPA methods, analyzed via USEPA and MassDEP analytical methods, the data have been validated and overall the data are considered usable as reported by the laboratories (with specific data validation actions taken during validation). The collection of soil, surface water, and sediment samples provides very good spatial coverage for both delineation of nature and extent and for risk assessment activities. The analytical suite has included a comprehensive analyte list (more than 300 parameters including standard analytical lists as well as several specialty chemicals associated with historical operations). The following text discusses the completion of the delineation, identifies the primary chemical constituents of potential concern, and discusses the distribution of the contamination. The nature and extent of contamination has been delineated by a combination of criteria:

- (physical limits of the impacted medium (for example, for the South Ditch, the banks of the South Ditch and the boundary between OU1 and OU2);
- identification of non-detects (where possible);
- by comparison of concentrations of detected analytes in environmental media to background concentrations; and
- by comparison of concentrations of detected analytes in environmental media to published human health risk-based concentrations (such as USEPA Regional Screening Levels (RSLs) for industrial land use).

The delineation criteria for soil, surface water, and sediment are discussed in the relevant sections below.

8.1.1.1. OU1 / OU2 Soil

The nature and extent of contamination in soil has been characterized for the three intervals of concern (0–1 ft bgs, 1–10 ft bgs, and >10 ft bgs) that have been investigated. Surface soil evaluation included areas within the property boundary (OU1) and areas immediately to the west along the haul road to the CSL on the former PanAM rail road spur, and the surface soil surrounding South Ditch east of the Property (EA5).

Surface Soil (0-1 ft bgs). For surface soil within OU1, among VOCs, acetone, methylene chloride, and toluene had the highest frequency of detection but no concentrations were greater than Industrial RSLs. For surface soil, among SVOCs, BEHP, several high molecular weight PAHs, and NDPA were most frequently detected. Maximum concentrations of BEHP, NDPA,

and several PAHs were greater than corresponding Industrial RSLs and the maximum concentration of C11-C22 Aromatics was greater than the MassDEP MCP S-2 soil standard (relevant for industrial/commercial land use). Among inorganics and metals, maximum concentrations of arsenic, hexavalent chromium, and vanadium were above Industrial RSLs. Arsenic is not associated with releases from the Site. RSLs are not available for the inorganics and metals ammonia, calcium, chloride, sodium, and sulfate. The maximum detected concentration of Aroclor-1260 was also greater than the corresponding Industrial RSL. Among specialty compounds, formaldehyde had the highest frequency of detection, however there is no indication that the ubiquitous presence of formaldehyde is related to releases from the OCSS and its presence in all media is attributed to natural and anthropogenic sources.

Within OU2, arsenic, hexavalent chromium, B(a)P and BEHP were detected above industrial RSLs within EA5. Only arsenic was detected above Industrial RSLs on the western side of the PanAM property. Arsenic is not associated with releases from the Site. Available information indicates that constituents detected in soil samples include naturally occurring substances and substances associated with historical manufacturing activities.

Shallow Subsurface Soil (1-10 ft bgs). Among VOCs, TMPs had the highest frequency of detection and maximum concentrations of those two compounds were greater than AMEC-calculated Industrial RSLs. Among SVOCs, BEHP, diphenyl ether, and NDPA were most frequently detected and maximum concentrations greater than corresponding Industrial RSLs were reported for BEHP, NDPA, and four PAHs. Among specialty compounds, formaldehyde had the highest frequency of detection, but is not associated with releases at the Site. Additional parameters with maximum concentrations greater than corresponding Industrial RSLs were arsenic, hexavalent chromium, vanadium, and hydrazine. RSLs are not available for the inorganics and metals ammonia, calcium, chloride, sodium, and sulfate. The maximum concentration of C11-C22 Aromatics was also greater than the MassDEP S-2 soil standard. Available information indicates that constituents detected in soil samples include naturally occurring substances and substances associated with historical manufacturing activities.

Deep Subsurface Soil (> 10 ft bgs). Deep subsurface soil is all located below the water table. TMPs were the most frequently detected VOCs and maximum detected concentrations were greater than corresponding RSLs. Among SVOCs, BEHP, diphenyl ether, and NDPA were most frequently detected. The maximum detected concentration of BEHP was greater than the corresponding RSL. Among specialty compounds, formaldehyde had the highest frequency of detection, but as indicated before is not associated with releases from the Site. Among inorganics and metals, maximum concentrations of arsenic and hexavalent chromium were greater than corresponding Industrial RSLs. Arsenic is not associated with releases from the Site. RSLs are not available for the inorganics and metals ammonia, calcium, chloride, sodium, and sulfate. The maximum concentration of C5-C8 Aliphatics and C11-C22 Aromatics was greater than the corresponding MassDEP S-2 soil standard. There were several detected parameters for which RSLs are not available. Available information indicates that constituents detected in soil samples include naturally occurring substances and substances associated with historical manufacturing activities.

Bounding of Soil Contamination. The concentration distributions of chemical parameters have been examined to determine if the locations or areas of impacted soil are bounded (samples with non-detects, with concentrations consistent with background concentrations, or with concentrations below both industrial and residential RSLs bordering those locations or areas, or with physical site features that would contain or prevent migration of contamination). The examination of bounding of soil impacts has been conducted for both the perimeter of the Property and locations or areas within the interior of the Property footprint. The results of the examination are presented below.

The bounding of soil impacts along the perimeter of the Property has been examined in depth. Graphical presentations of chemical concentration distributions in the three soil intervals indicate that horizontal and vertical delineation of contamination has been accomplished along the majority of the property perimeter. Olin and USEPA have concurred that the distribution of hexavalent chromium is sufficiently well understood to allow its evaluation in risk assessments. The extent of impacted soils associated with Plant B LNAPL is also adequately delineated, and the impact is primarily related to TMPs, BEHP, EPH/VPH. Arsenic in OU1 soils was determined to be consistent with background conditions and that two areas of elevated arsenic were identified off-Property associated with the former PanAM railway spur (on the western side of the property) and the eastern extent of EA5, (on the eastern side of the property). In general, the distribution figures indicate that samples located along the property perimeter have non-detects or low concentrations that are below Industrial RSLs, or below published background levels. One off-Property surface soil sample near the South Ditch and east of the Olin property had indicated elevated concentrations of hexavalent chromium, however subsequent resampling in this area did not confirm those results.

Overall, the nature and extent of on-Property soil and off-Property surface soil impacts have been well characterized, and the distribution of contamination is adequately understood. The delineation of soils is adequate to support risk characterization and risk management decisions.

8.1.1.2. OU1 /OU2 Surface Water

South Ditch. The historical data and RI data show a consistent identification of constituents detected in the surface water samples. Among metals and inorganics, the most frequently detected parameters include aluminum, barium, chloride, chromium, cobalt copper, iron, magnesium, manganese, nickel, sodium, potassium, calcium, sulfate, and ammonia. NDMA, NDPA, and NDPrA were also detected in South Ditch surface water samples. Low concentrations of BEHP, 2-nitrophenol, 4-nitrophenol, benzoic acid, diphenyl ether, bromoform and diphenylmethanone were also detected in surface water samples. TMPs were also detected frequently, but at trace levels. The available hydrogeologic information, groundwater data, groundwater elevation measurements in the surrounding well pairs and piezometers, and surface water data indicate that solutes in surface water of the South Ditch are primarily related to solutes present in groundwater with diffuse characteristics underlying the Upper South Ditch and shallow groundwater migrating to the stream.

Stormwater Detention Basin. The Detention Basin was designed to receive storm water flow that is collected from the Containment Area cap and piped to the basin. Detected parameters include metals and inorganics at relatively low concentrations including aluminum, barium, chloride, chromium, hexavalent chromium, copper, iron, lead, manganese, magnesium, sodium, vanadium, zinc potassium, calcium, chloride, sulfate, and ammonia. NDPrA was also detected.

Central Pond. Central Pond has no surface water inlet or outlet and the surface water present is an expression of the overburden groundwater table. The analytes detected in the surface water sample from the pond are restricted to metals and inorganics including aluminum, barium, chloride, chromium, iron, lead, magnesium, manganese, sodium, nickel, potassium, calcium, sulfate, and ammonia at concentrations lower than the South Ditch but higher than the Stormwater Detention Basin

Off-PWD. Metals and inorganics are detected in surface water include ammonia, chromium, hexavalent chromium, calcium, sulfate, and chloride. NDMA was detected in five of six surface water samples collected in the off-PWD. Phenols and benzoic acid were also detected in surface water samples. There were several PAH compounds detected in surface water samples and these PAHs are attributed to the presence of deteriorated creosote preserved railroad ties and storm water runoff from the industrial/commercial area immediately to the west.

East Ditch. Inorganics and metals are detected in surface water samples include, but are not limited to ammonia, chromium, hexavalent chromium, calcium, sulfate, and chloride. Vanadium has also been detected at concentrations above reference sample concentrations, however based on the historic operations and contaminant sources, vanadium is not considered to be a COI. Ammonia concentrations were detected at all surface water locations with the highest concentrations reported at EDSD/SW5 located downstream of South Ditch. The ammonia concentrations in the lower portion of the East Ditch decrease to a concentration equivalent to that detected in Landfill Brook surface water prior to it flowing into the East Ditch.

VOCs detected in surface water samples from East Ditch include TMP and several chlorinated and fuel-related VOCs that are not related to the OCSS. The highest surface water concentration of TMP in East Ditch was detected at location EDSD/SW2 (downstream of the current Plant B treatment building).

Among SVOCs, NDMA, NDPrA, three PAH compounds, and BEHP were detected in East Ditch surface water samples collected during the two RI sampling rounds. NDMA concentrations decrease downstream and NDMA is detected inconsistently at farthest downstream sample location EDSD/SW7.

MMB Wetland. The MMBW area is represented by the wetland area located west and northwest of Main Street (west of the Property) including Sawmill Brook and MMB. For the MMB Wetland, the concentrations of metals (chromium, hexavalent chromium, and calcium) in surface waters are consistent with background sample concentrations. Inorganic constituents including ammonia, chloride, and sulfate in MMB and Sawmill Brook surface water also appear consistent and comparable to background concentrations. Elevated metals and inorganics were detected in samples collected in proximity to the Spinazzola Trust Landfill. VOCs and SVOCs were also detected in these samples.

NDMA was detected in only one surface water sample from MMB wetland, at an estimated concentration of 0.47 ng/L. The 2011 surface water data in conjunction with corresponding shallow groundwater data indicates there may be an isolated area where shallow groundwater containing trace levels of NDMA may discharge to surface water. This low, estimated concentration is more than 6 orders of magnitude below the ecological screening benchmark of 0.117 mg/L (117,000 ng/L) from USEPA EPA Region III July 2006 III BTAG Screening Benchmarks for Freshwater.

Landfill Brook and North Pond are not considered by Olin to be impacted by the OCSS. Olin did agree to characterize risks associated with exposure to North Pond surface water.

Overall, the nature and extent of on-Property and off-Property surface water impacts have been well characterized, and the distribution of contamination is adequately understood to support risk characterization and risk management decisions.

8.1.1.3. OU1 /OU2 Sediment

Sediment sampling and analysis has been conducted historically in the South Ditch, Central Pond, the off-PWD, on-PWD Wetland, East Ditch, MMB, and North Pond. Additional samples were collected under the RI from these areas and Landfill Brook with the exception of the on-PWD. Sediments were previously excavated from the on-Property West ditch, the on-Property west ditch Wetland, Central Pond, and approximately 2/3 of the length of the South Ditch (from upstream of the weir down to and including the delta area). The excavated sediments were disposed off-Site. Because of the historical sediment excavations, recent (post-excavation) sediment data for samples collected from remediated portions of the ditch system and Central Pond indicate far less impact than the data for the lower portion of the South Ditch. The nature of contamination in sediments of the South Ditch, the on-PWD wetland, off-PWD, and the

Central Pond, Detention Basin and East Ditch has been well characterized. MMB sediments have also been well characterized and are not impacted from releases associated with the OCSS. Landfill Brook sediment impacts are also not associated with the OCSS. It is Olin's position that North Pond data do not show evidence of historical impacts associated with releases from the OCSS. Olin has however agreed to characterize risks associated with exposure to North Pond sediment.

South Ditch. The historical data and the 2009 through 2013 RI data, show a consistent identification of constituents found in sediment samples. The most frequently detected parameters include BEHP, TMPs, three Extractable Petroleum Hydrocarbons (EPH) fractions, 3&4-methylphenol, formaldehyde, several metals and inorganics including: aluminum, chromium, iron (which have been associated with floc in the South Ditch), and hexavalent chromium, sulfate and ammonia. The EPH fractions were detected in samples collected from the Lower South Ditch (sample locations SD-1 (OU1) and ISCO-2 (OU2)). The extent of contamination in sediments of the South Ditch is defined by the configuration of the South Ditch. The lateral extent of the sediment impacts is constrained by the banks of the ditch. The limit of the upstream impact on sediments is defined as the location of the constructed weir at the upper end of the South Ditch (but this area has previously been remediated). The downstream impact in sediment of the South Ditch is delineated by the terminus of the South Ditch. The terminus is the confluence of the South Ditch and the East Ditch. The South Ditch terminates at the East Ditch and the East Ditch is essentially a continuation of the South Ditch system

On-PWD Wetland. Constituents detected in sediment samples are similar COIs including: chromium, (and most other metals), BEHP and TMPs (at low frequency).

Stormwater Detention Basin. Detected analytes in sediment include samples include TMPs, BEHP, phenols, NDPhA, and one PAH at low concentrations in addition to metals and inorganic constituents and appear to be consistent with potential impacts from groundwater.

Central Pond. Detected analytes in sediment samples include TMPs, phenols, and four PAHs at low concentrations in addition to metals and inorganic constituents.

East Ditch. Metals and inorganic compounds detected in the East Ditch sediment include, but are not limited to: aluminum, arsenic, barium, calcium, chromium, cobalt, copper, hexavalent chromium, iron, lead, manganese, mercury, nickel, vanadium, zinc, and ammonia. VOCs, detected include TM-2-P, and others not related to the OCSS (2-butanone, acetone, 1,1,2-trichloro-1,2,2-trifluoroethane, and TCE) SVOCs detected include BEHP, 2-methylnaphthalene, phenol, diphenyl ether and other compounds, (mainly PAHs) not associated with releases from the OCSS (acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzoic acid, benzo(k)fluoranthene, , chrysene, dibenz(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene).

MMB Wetland. The concentrations and distribution of inorganic parameters and metals in MMB and Sawmill Brook sediment samples are consistent with naturally occurring concentrations, and are not indicative of impacts associated with the OCSS. The presence of elevated concentrations of a few metals in sediment appears to be associated with the Spinazzola Trust Landfill. The presence of several SVOC and VOCs are consistent with the reference sample location

Landfill Brook and North Pond are not considered by Olin to be impacted by the OCSS. Olin did agree to characterize risks associated with exposure to North Pond sediment.

Overall, the nature and extent of on-Property and off-Property sediment impacts have been well characterized, and the distribution of contamination is adequately understood to support risk characterization and risk management decisions.

8.1.2 Fate and Transport

This section summarizes the general fate and transport considerations for OU1 and OU2. Remaining sources of contamination at the Property related to former manufacturing operations and waste disposal practices have been delineated and the fate and transport of constituents from these sources has been described. The liquid waste disposal practices that resulted in the formation of DAPL and associated Diffuse Layer Material have impacted groundwater that currently migrates and discharges to South Ditch and off-PWD surface water. There is currently no evidence of impact to OU3 groundwater from leaching of OU1 soils and no direct migration of OU1 soils to OU1/OU2 surface water. Therefore OU1 soil is not currently contributing an impact to either OU1 surface water or OU2 surface water or sediment.

The principal constituents associated the processing oil LNAPL, including TMPs, NDPA, BEHP and C11-C22 aromatic compounds, at Plant B Tank Farm (EA3) are present in soil at and below the water table and are subject to solubilization and migration in groundwater (OU3) and discharge to East Ditch (OU2). The migration of soluble constituents leached from soil impacted by LNAPL in the Plant B LNAPL area is currently controlled by the Plant B groundwater extraction and treatment system. A portion of the Plant B area is designated as Zone II groundwater (within the zone of contribution of public water supply wells). These are OU3 migration issues.

Groundwater is also impacted from a release of TMPs to OU1 soil in vicinity of the former office building/Plant B production area (EA7). These TMPs will also volatilize and migrate within soil vapor and represent potential for VI if buildings are considered in this portion of the property in future development plans. The potential for VI concerns is an OU1 issue and the impact to groundwater is an OU3 issue.

OU3 groundwater impacted by SVOCs, metals and inorganic compounds discharges to off-Property West Ditch, South Ditch and East Ditch surface water. This discharge to South Ditch is accompanied by precipitation and deposition of Al-Cr-Fe floc within ditch sediments including a “white floc” which contains chromium and aluminum and a “red floc” comprised of iron, aluminum and sulfate. The floc is stable under ambient surface water conditions in South Ditch, and is subject to transport and deposition in the surface water system. Metals, to a more limited extent, are also subject to exchange and sorption to iron and manganese oxide surfaces. Hexavalent chromium should readily revert to trivalent chromium in groundwater, but may co-exist with trivalent chromium in surface and subsurface soil.

Constituents dissolved in OU1 surface water are subject to transport in surface water to East Ditch and downstream to the New Boston Drainway. The SVOCs in surface water are subject to sorption to sediment and deposition. Most of the SVOCs present (PAHs, BEHP) are relatively persistent in the environment and will only be subject to minor degrees of attenuation due to biological processes in sediment. Most attenuation in surface water is due to partitioning to sediment and dilution. NDMA is highly susceptible to degradation by UV light (sunlight) and once in surface water will not partition to sediment and will degrade in accordance with exposure time to sunlight and the degree of turbidity in the water.

Surface water and sediment in MMB and Sawmill Brook are not impacted by OCSS with the exception of one detection of NDMA in one surface water sample at a low, estimated concentration (0.47J ng/L). There is negligible risk associated with this single detection of NDMA.

8.1.3 Risk Assessment

The following subsections summarize the results of human health and ecological risk assessments completed at the Site.

8.1.3.1. Human Health Risk Assessment

The BHHRA evaluated cancer and non-cancer risks for industrial / commercial worker and construction worker exposures to OU1 surface and subsurface soil and surface soil in OU2 (EA5). The BHHRA also evaluated cancer and non-cancer risks for potential trespasser exposures to OU1 surface soil and OU1 and OU2 surface water and sediment at all areas except Landfill Brook by agreement with USEPA. These evaluations do not indicate cancer risk above the CERCLA acceptable risk range for any receptor evaluated, and no non-cancer HI values greater than 1. The BHHRA calculations indicate based on CERCLA criteria:

- Human health risks associated with potential exposures to surface soil, shallow subsurface soil, surface water, and sediment at OU1 indicate that the northern portion OU1 (EA1, EA2, EA3, EA6, EA7, on-PWD, South Ditch, Central Pond, and the Stormwater Detention Basin is suitable for current and future industrial/commercial use.
- Human health risks associated with potential trespasser, industrial/commercial worker, and construction worker exposures to OU2 surface soil at EA5 indicate the area is suitable for industrial/commercial use
- Human health risks associated with potential trespasser exposures to OU2 surface water and sediment at Lower South Ditch, East Ditch, Maple Meadow Brook, off-PWD, and North Pond indicate no trespasser exposure concerns.

The BHHRA also provided a qualitative evaluation of potential future VI concerns associated with volatile compounds (primarily TMPs) in EA7 and EA3, in addition to one sample identified at the former Lake Poly Area. There are no USEPA-published soil screening values which are protective of future vapor intrusion exposures. In addition, it is very difficult to quantitatively evaluate risks for future vapor intrusion from soil. There are no current occupied buildings located in the vicinity of these areas and there is currently no VI risk. Therefore, the vapor intrusion pathway is not complete for current site uses. In the future it is possible for redevelopment of the Property to occur and new industrial/commercial buildings could be constructed that would need to consider potential VI pathways.

8.1.3.2. Ecological Risk Assessments

The BERA characterized risk by exposure area and assessment/measurement endpoints, beginning with the terrestrial exposure areas and concluding with the semi-aquatic exposure areas. The BERA for OU1 and OU2 of the Olin Superfund Site found that adverse site-related effects to ecological receptors is unlikely in the following exposure areas and media:

- EA-2 soil;
- EA-4 soil;
- Central Pond surface water and sediment;
- Storm Water Detention Basic surface water and sediment;
- On-PWD/WDW surface water and sediment;
- Upper South Ditch sediment; and
- Maple Meadow Brook surface water and sediment; and
- North Pond surface water and sediment.

The BERA for OU1 and OU2 of the Olin Superfund Site also found that adverse site-related effects may be possible in the following exposure areas and media:

- EA-5 soil, due to chromium and BEHP;
- Upper South Ditch surface water, due to chromium and ammonia;
- Lower South Ditch surface water due to chromium and ammonia and sediment due to chromium and BEHP; and

8.2 Conclusions

The nature and extent of contamination for on-Property soil, surface water, and sediment of OU1 and the off-Property surface water and sediment of OU2 has been well characterized and defined. The data are adequate to support risk characterization and risk management decisions. The conclusions of the RI include:

- The human health risk assessment indicates the Property overall is suitable for industrial/commercial use.
- One small area of surface soil has reported concentrations of PCBs which do not pose unacceptable risks to current or future workers.
- The TMPs in soil in the northeast corner of the property associated with EA7 and EA3 and to a lesser extent former Lake Poly area could pose potential vapor intrusion risks for future building construction and occupancy. Therefore this portion of the Site should be evaluated in a Feasibility Study for potential engineering controls and requirements to mitigate potential future VI concerns. There is no current VI issue for existing buildings.
- The ecological risk assessment indicates there are no ecological risk concerns in the portions of the Property available for redevelopment.

The BERA for OU1 and OU2 also found that adverse site-related effects may be possible for Lower South Ditch sediment and EA-5 soil, due to chromium and BEHP. This is consistent with the findings of the sediment toxicity test.

- Therefore, these areas should be evaluated in a Feasibility Study to address chromium and BEHP.
- Surface water in upper and lower South Ditch shows potential adverse effects to ecological receptors primarily due to ammonia and chromium. Therefore, these specific OU1 and OU2 surface water bodies should be evaluated in the OU1/OU2 Feasibility Study.
- The BHHRA and BERA indicated no human health or ecological risk concerns for OU2 surface water and sediment in the MMB wetland, and North Pond and those water bodies do not need to be evaluated in the OU1/OU2 Feasibility Study.

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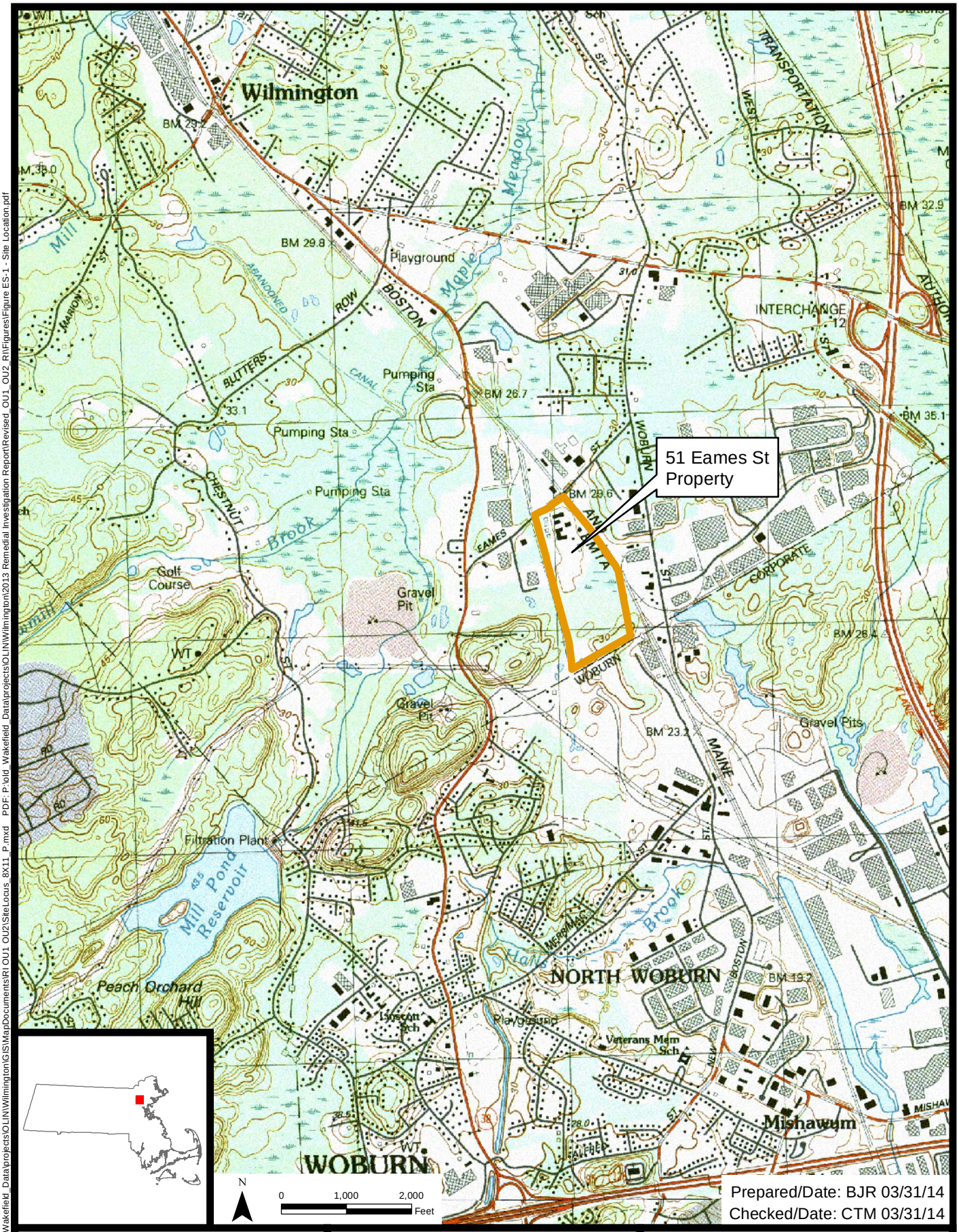
FIGURES



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Checked/Date: CTM 03/31/14

Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Figure ES-1
Site Location

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Butters Row
Butters Row Treatment Plant
Butters Row #2
Town Park
Butters Row #1
Chestnut St #1A/2
Chestnut St
Chestnut St #1
Sawmill Brook
Maple Meadow Brook
Maple Meadow Brook Wetland
Upper East Ditch
Spinazola Landfill
Main St
Eames St
PanAM Railways
MBTA Rail Line
Sanmina Property
Jewel Dr
Off-Property West Ditch
Plant B Discharge
On-PWD
Lower East Ditch
Containment Area
Cook Ave
Delta
South Ditch
Conservation Area
EA5
Off-Property South Ditch
Border Ave
Calcium Sulfate Landfill
Town of Wilmington
City of Woburn
Woburn Landfill
North Pond
New Boston Street Drainway
South Pond
Landfill Brook

Legend

- Operable Unit 1
- 51 Eames St. Property Boundary
- Town Wells
- Town Line
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wooded Areas
- Wetland Boundary
- Culvert

*Operable Unit 2 is portion shown outside of OU1.

AMEC Environment & Infrastructure
271 Mill Rd
Chelmsford, MA 01824

0 340 680 1,360 Feet

Figure ES-2
Site Features
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Former Office Building
Guard Shack
Former Lab
Butler Building
Former Plant B Tank Farm
Pilot Lab
Plant B Production Area
EPH/VPH Area
PanAM Railroad
Plant B Treatment Bldg.
Maintenance Shop
Finished Product Storage
Plant A
Boiler House
Plant C-2
Plant C-1
Plant C-3
Stockroom
Dual Wall Storage Tank
MBTA Rail Line
Plant D Tank Farm
Plant D
Drum Storage Area
Lake Poly
West Pit
East Pit
East Ditch
West Ditch Wetland
East Warehouse
Jewel Drive
West Warehouse
Former Wastewater Treatment Plant
Leak Detection Manhole
Plant B Discharge
Buried Debris Area
Inspection Cleanout Vault
Acid Pits
Drum Area A
Lined Lagoon I
Drum Area B
Inspection Cleanout Vault
Inspection Cleanout Vault
On-Property West Ditch
Central Wetland
Lined Lagoon II
Inspection Cleanout Vault
Central Pond
Enclosure Vault
Delta
Central Pond Drainage Areas
Detention Basin
EA5
South Ditch
Off-Property South Ditch
Weir
Conservation Easement
Ephemeral Drainage
Biocell
Calcium Sulfate Landfill
Town of Wilmington
City of Woburn

Legend

- Town Line
- Drain/Sewer Line
- Fence
- Trail
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Surface Water
- Wetland Boundary
- 51 Eames St Property Boundary
- Containment Structure
- Aboveground Conveyance Piping
- Underground Conveyance Piping

AMEC Environment & Infrastructure
271 Mill Rd
Chelmsford, MA 01824

N

0 100 200 400 Feet

Figure ES-3
Site Features (Current and Historic)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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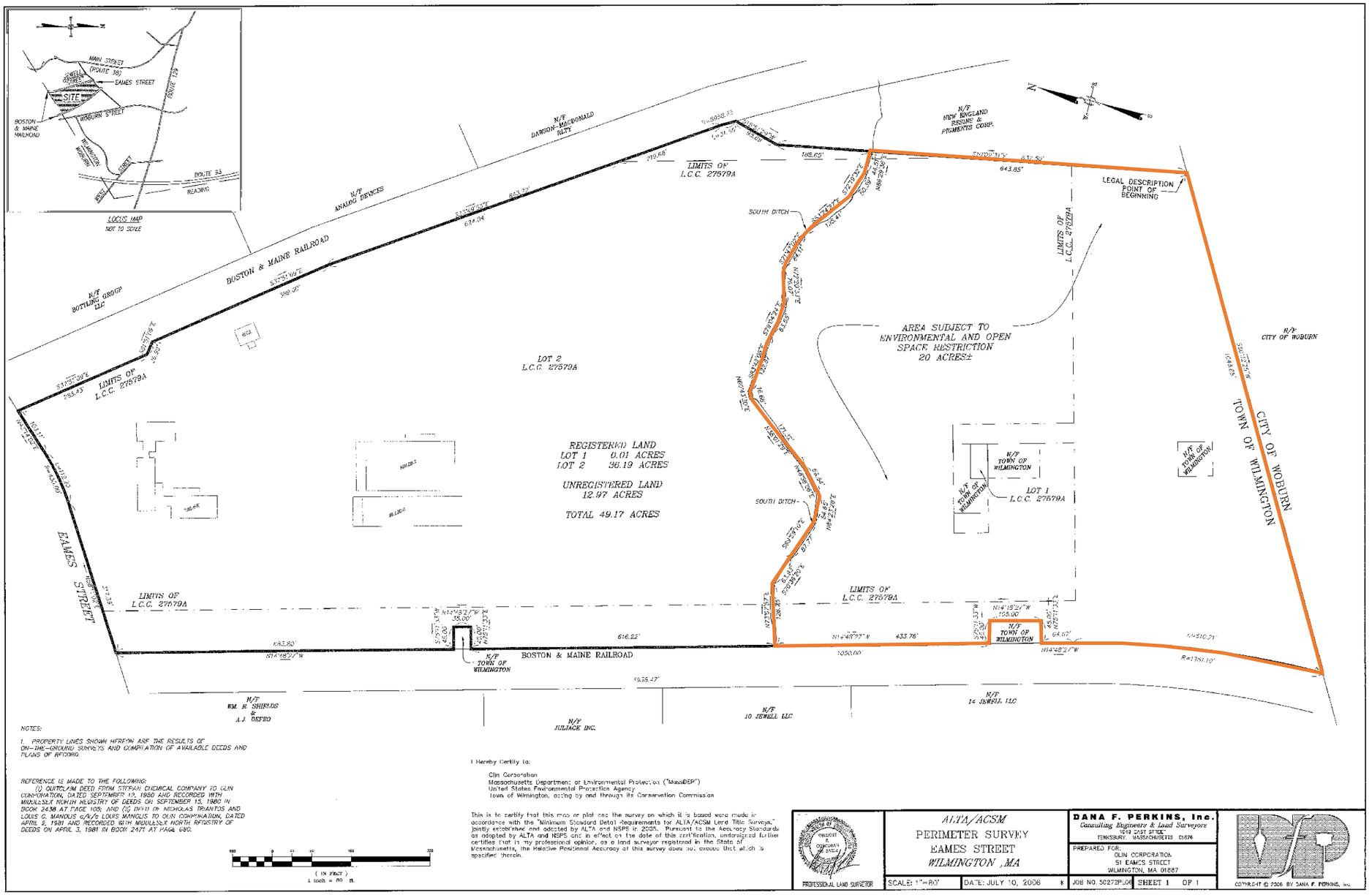

Area Subject to Environmental and Open Space Restriction

amec

Figure ES-4
Area Subject To Environmental and Open Space Restriction
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

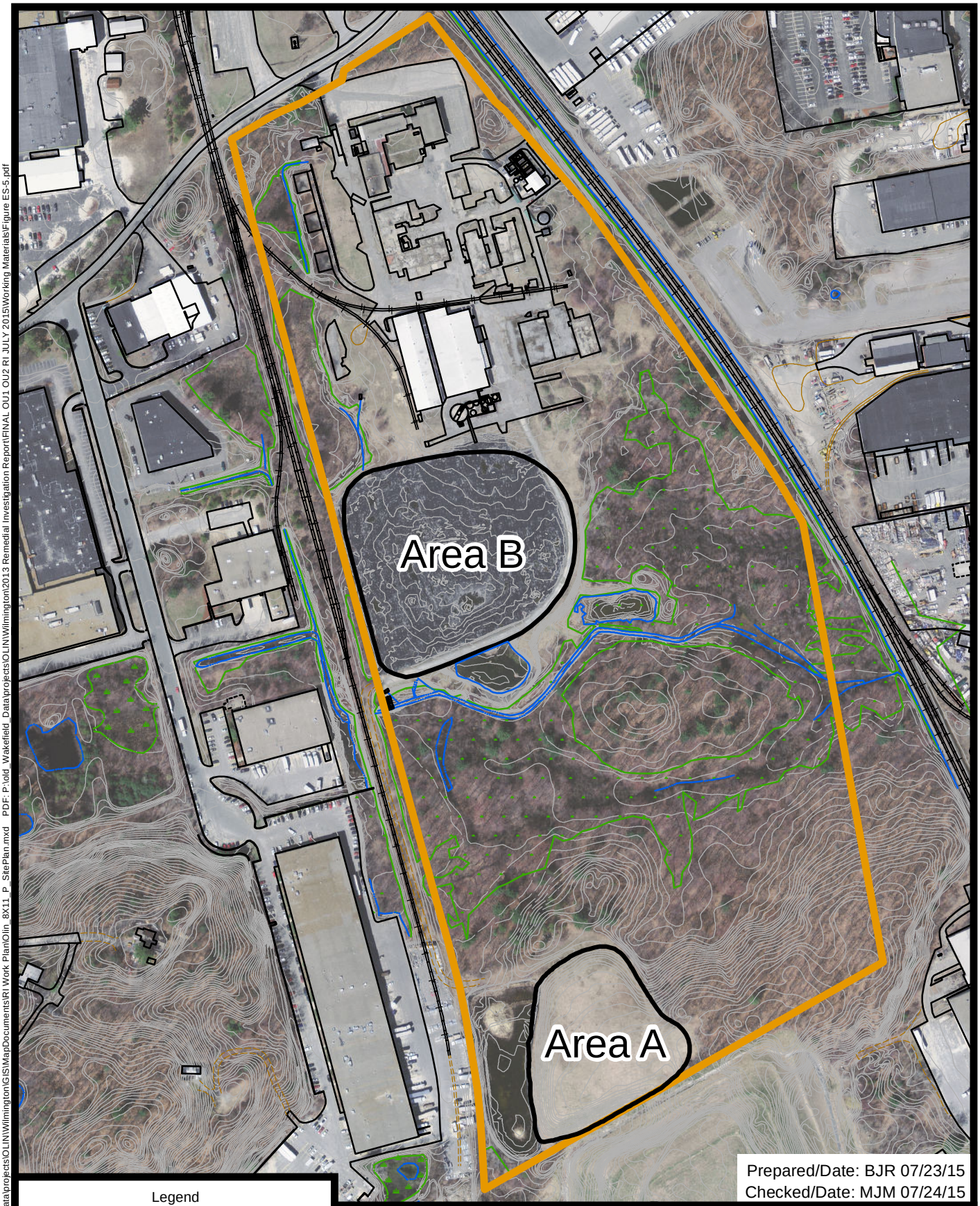

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Figure ES-5
Areas Subject to Notice and Declaration of Restrictive Covenant
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Maple Meadow Brook Wetland
EA2
EA7
EA3
EA1
EA2
Off Property West Ditch
East Ditch
Containment Area
Detention Basin
Central Pond
EA6
South Ditch
EA4
EA5
Soil Background
Calcium Sulfate Landfill
North Pond
Landfill Brook

Legend

- Exposure Area
- Culvert
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 250 500 Feet

Figure ES-6
HHRA Exposure Areas
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Maple Meadow Brook Wetland

EA2

On-PWD

EA3

EA2

EA1

On-PWD

East Ditch

Off-PWD

Containment Area

EA4

Detention Basin

Central Pond

Upper South Ditch

Lower South Ditch

EA5

Soil Background

Calcium Sulfate Landfill

North Pond

Landfill Brook

Legend

- Exposure Area
- Culvert
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

AMEC Environment & Infrastructure
271 Mill Rd
Chelmsford, MA 01824

N

0 250 500 Feet

Figure ES-7
BERA Exposure Areas

Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 07/23/15 | Checked/Date: CTM 07/23/15

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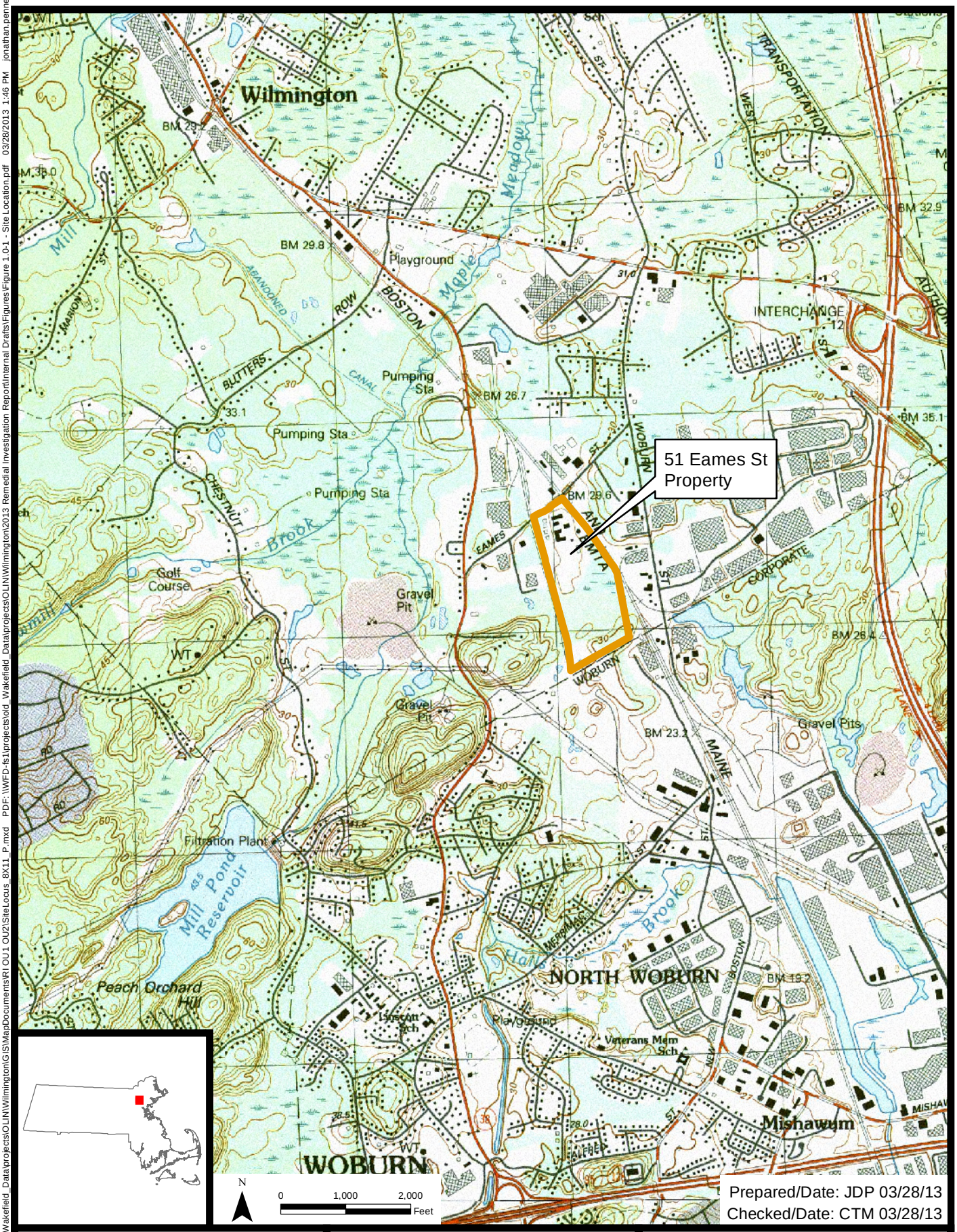

Prepared/Date: JDP 03/28/13
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Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Figure 1.0-1
Site Location

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\SiteLocus_8X11_P.mxd PDF: \\WFD-fs1\projects\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Internal Drafts\Figures\Figure 1.0-1 - Site Location.pdf 03/28/2013 1:46 PM jonathan.penney

Butters Row
Butters Row Treatment Plant
Butters Row #2
Town Park
Butters Row #1
Chestnut St #1A/2
Chestnut St
Chestnut St #1
Sawmill Brook
Maple Meadow Brook
Maple Meadow Brook Wetland
Upper East Ditch
Spinazola Landfill
Main St
Eames St
PanAM Railways
MBTA Rail Line
Sanmina Property
Jewel Dr
Plant B Discharge
On-PWD
Off-Property West Ditch
Lower East Ditch
Containment Area
Cook Ave
Delta
South Ditch
Conservation Area
EA5
Off-Property South Ditch
Border Ave
Calcium Sulfate Landfill
Town of Wilmington
City of Woburn
Woburn Landfill
North Pond
New Boston Street Drainway
South Pond
Landfill Brook

Legend

- Operable Unit 1
- 51 Eames St. Property Boundary
- Town Wells
- Town Line
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wooded Areas
- Wetland Boundary
- Culvert

*Operable Unit 2 is portion shown outside of OU1.

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271 Mill Rd
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0 340 680 1,360 Feet

Figure 1.0-2
Site Features
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 2/17/14 | Checked/Date: CTM 2/17/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\Olin_11X17_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 1.0-2 - Site Features.pdf 2/17/2014 11:44 AM brian.roden

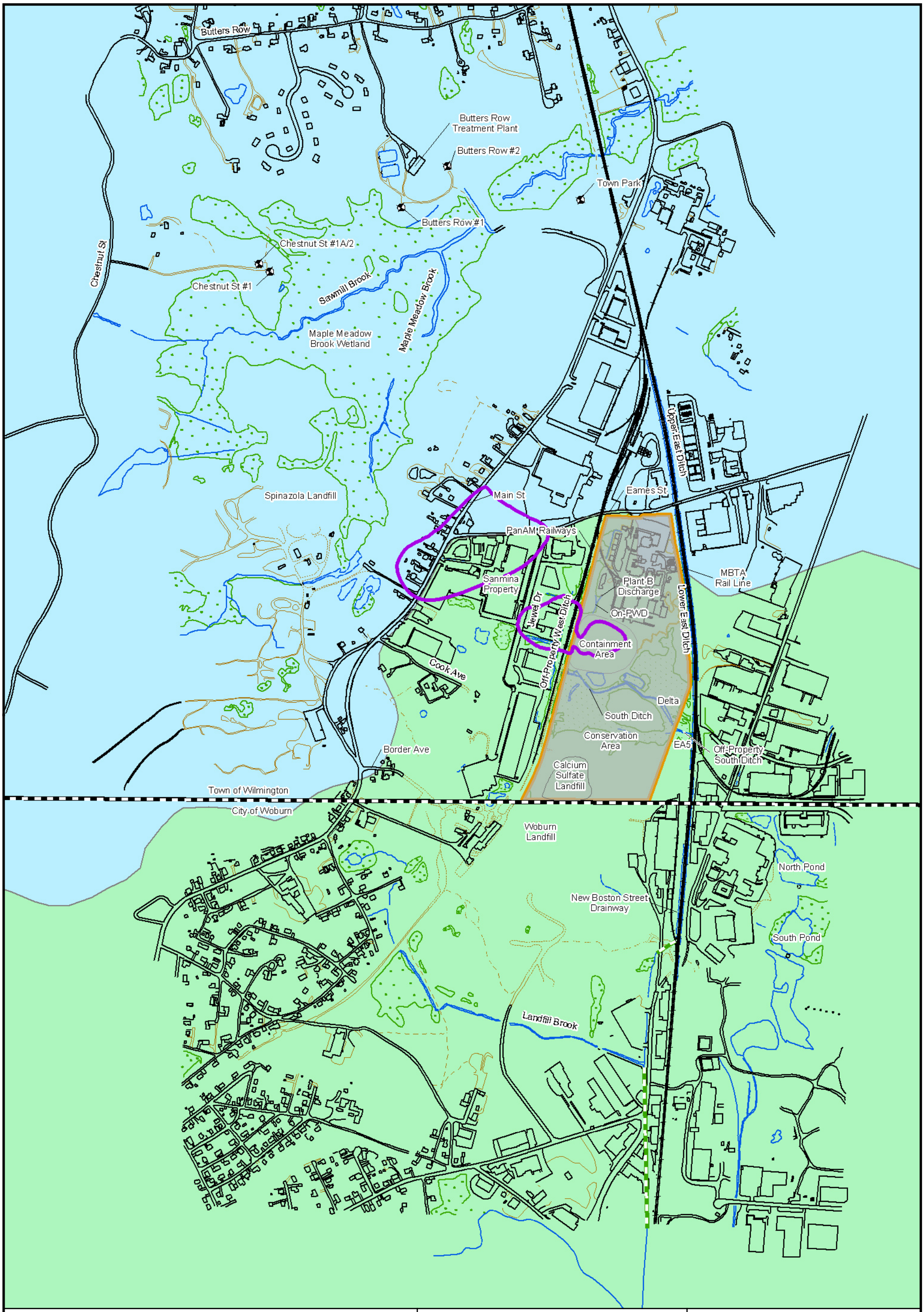

Figure 1.0-3
Watershed and DAPL Site Features
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 3/31/14 | Checked/Date: PHT 3/31/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\Watershed Areas.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 1.0-3 - Watershed and DAPL Features.pdf

Former Office Building
Guard Shack
Former Lab
Butler Building
Former Plant B Tank Farm
Pilot Lab
Plant B Production Area
EPH/VPH Area
PanAM Railroad
Plant B Treatment Bldg.
Maintenance Shop
Finished Product Storage
Plant A
Boiler House
Plant C-1
Plant C-2
Plant C-3
Stockroom
Dual Wall Storage Tank
MBTA Rail Line
Plant D Tank Farm
Plant D
Drum Storage Area
Lake Poly
West Pit
East Pit
East Ditch
West Ditch Wetland
East Warehouse
Jewel Drive
West Warehouse
Former Wastewater Treatment Plant
Leak Detection Manhole
Plant B Discharge
Buried Debris Area
Inspection Cleanout Vault
Acid Pits
Drum Area A
Lined Lagoon I
Drum Area B
Inspection Cleanout Vault
Inspection Cleanout Vault
On-Property West Ditch
Central Wetland
Lined Lagoon II
Inspection Cleanout Vault
Central Pond
Enclosure Vault
Delta
Central Pond Drainage Areas
Detention Basin
EA5
South Ditch
Off-Property South Ditch
Weir
Conservation Easement
Ephemeral Drainage
Biocell
Calcium Sulfate Landfill
Town of Wilmington
City of Woburn

Legend

- Town Line
- Drain/Sewer Line
- Fence
- Trail
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Surface Water
- Wetland Boundary
- 51 Eames St Property Boundary
- Containment Structure
- Aboveground Conveyance Piping
- Underground Conveyance Piping

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N

0 100 200 400 Feet

Figure 1.3-1
Site Features (Current and Historic)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 02/17/14 | Checked/Date: CTM 02/17/14

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Butler Building
Bunker #1
Bunker #2
Bunker #3
Transformer #1
Office/Lab
Office
Leach Field
Pilot Lab
Plant A
17
18
12
11
Plant C1
15
16
14
13
Plant B
Leach Field
8
7
SVE System
1
2
3
4
5
6
RSO-06 Hot Spot Excavation
Plant C2
Plant C3
9
10
Boiler House
Transformer #2
150,000 Gallon Water Tank
#2 Fuel Oil UST
#6 Fuel Oil USTs
Lake Poly Excavation
Drum Storage Area
Lake Poly
West Warehouse
West Pit
East Pit
East Warehouse
Urea Silo
Transformer #3
Transformer #4
Plant D2
Plant D1
Hydrazine Tank
Plant D3
19
20
21
22
23
Transformer #5
Acid Pit
Acid Pit
Acid Pit

Above Ground Storage Tank Description

Tank No.	Contents
1	please see text
2	DPA
3	DOP
4	please see text
5	Diisobutylene
6	#415 Process Oil
7	Ammonia Storage
8	Formaldehyde Storage
9	Hydrazine Day Tank
10	Caustic Storage
11	Wytox Storage
12	Nonylphenol Storage
13	Hydrazine Day Tank
14	Sodium Chlorate Storage
15	Sulfuric Acid Storage
16	Sulfuric Acid Storage
17	Hydrochloric Acid Storage
18	Sodium Nitrite Storage
19	Unknown
20	Chlorosulfonic Acid
21	Hydrazine Day Tank
22	Diphenol Oxide
23	Ammonium Hydroxide

Legend

- 51 Eames St. Property Boundary
- Above Ground Storage Tank
- Underground Storage Tank
- Transformer
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wooded Areas
- Wetland Boundary
- Culvert

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0 40 80 160 Feet

Figure 1.3-2
Facility Storage Tanks,
Leach Fields, and Transformers
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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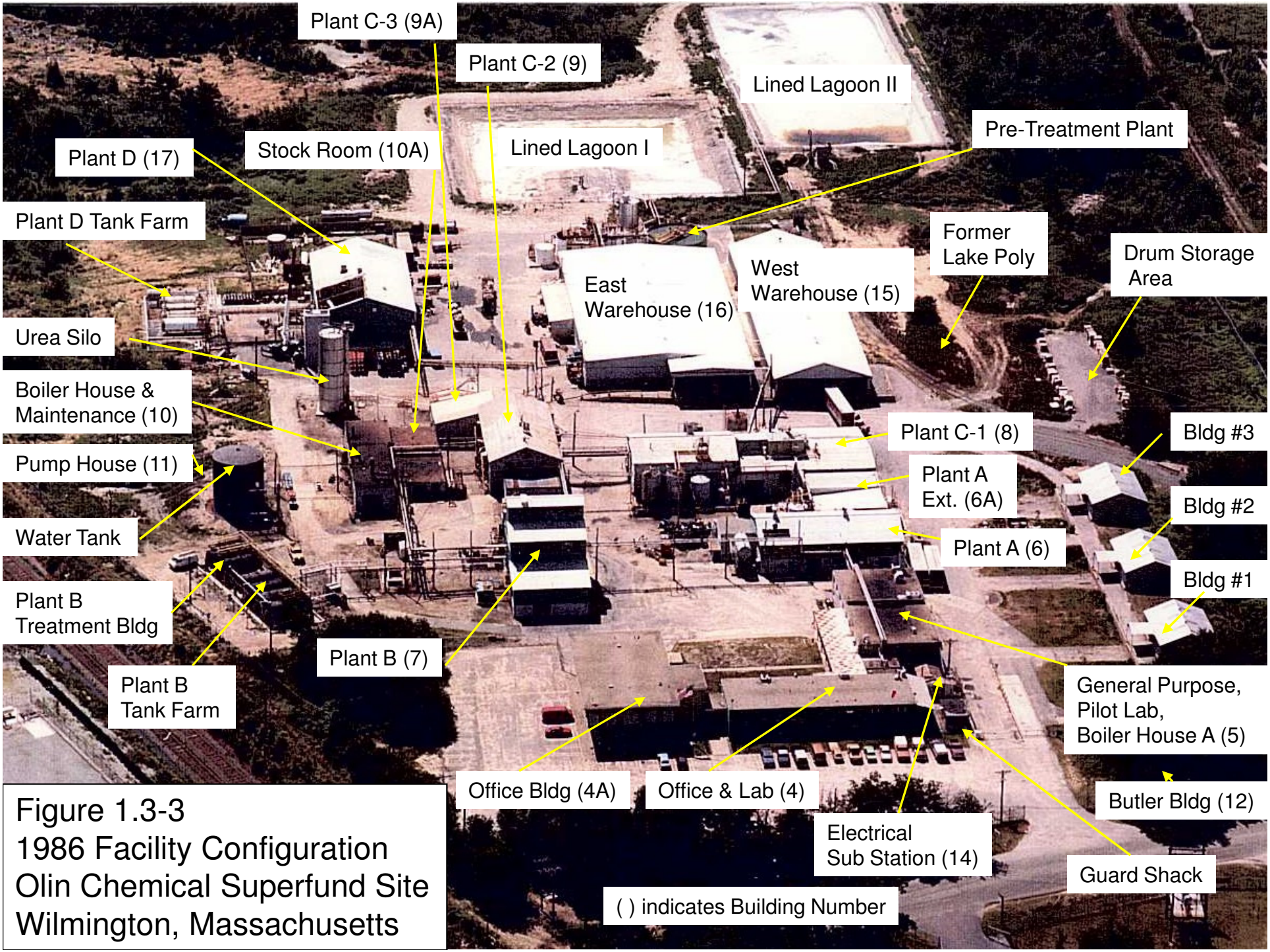
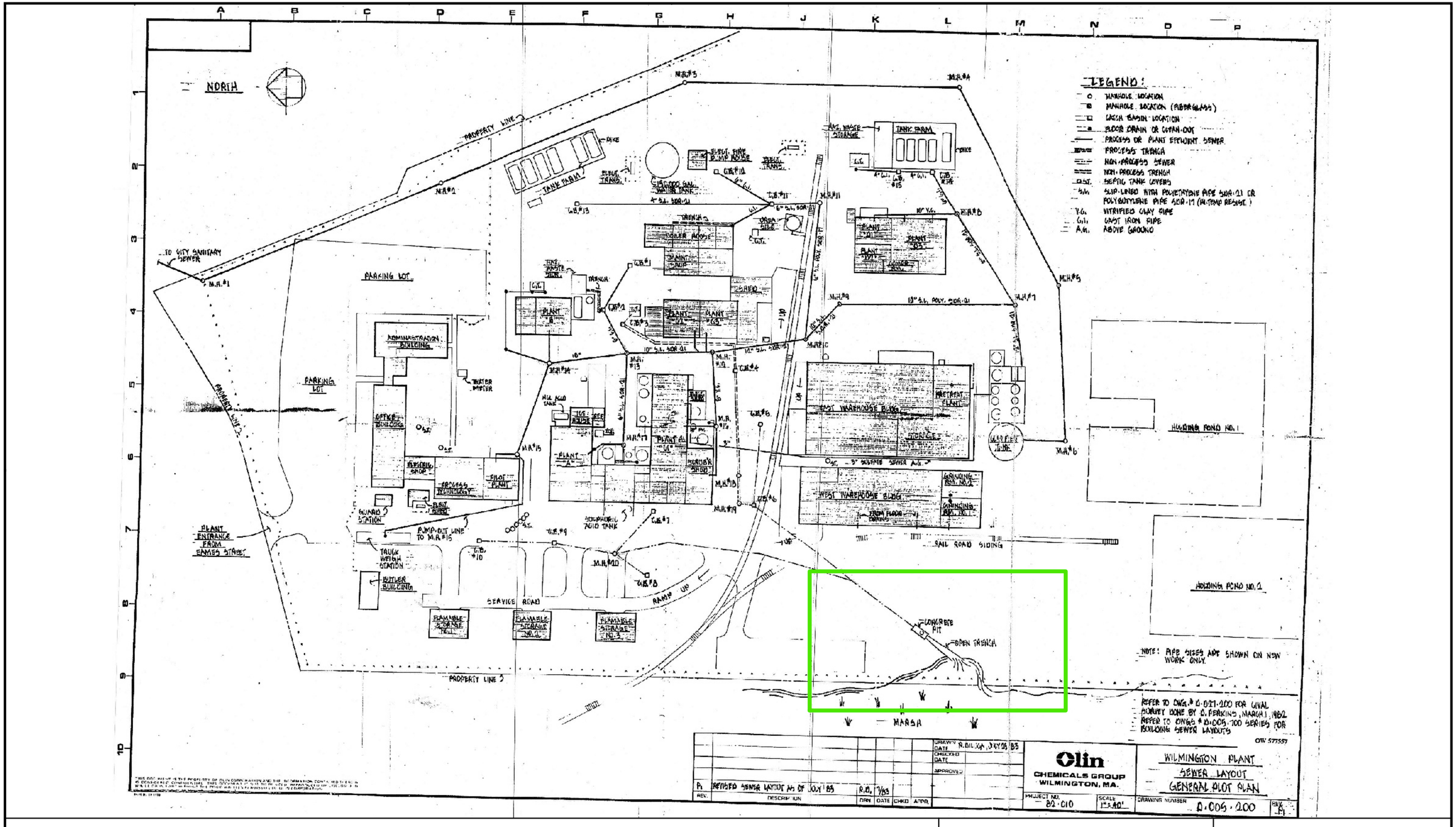


Figure 1.3-3
1986 Facility Configuration
Olin Chemical Superfund Site
Wilmington, Massachusetts



Green box indicates concrete pit and open trench that is the point of discharge to the On-Property West Ditch or On-Property West Ditch wetland

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Figure 1.3-4
1983 Sewer Layout
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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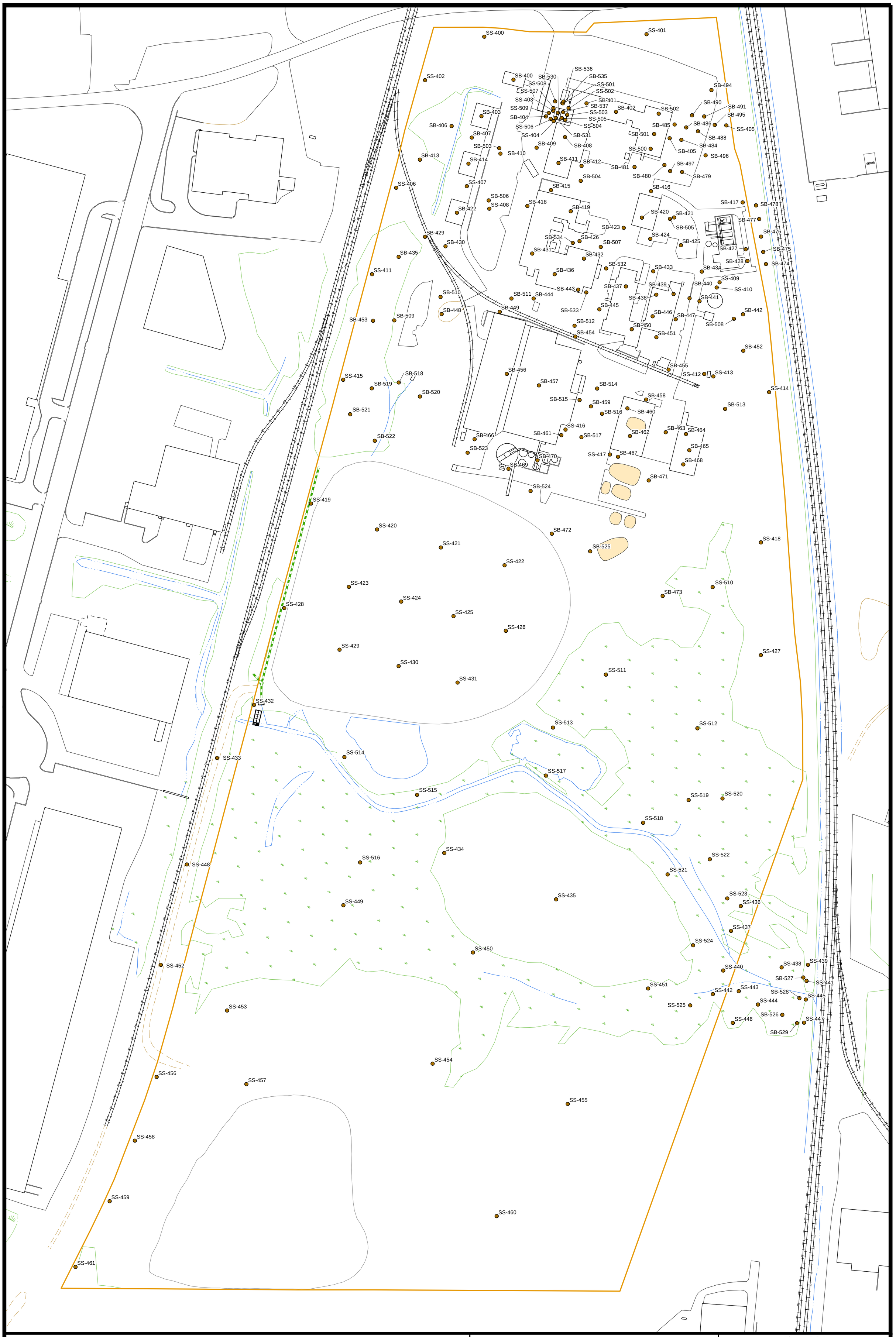

Legend

- RI Soil Sample Locations
- Soil Stockpile
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

Notes:
1. Refer to Figures 1.3-1 and 1.3-2 for Historic Disposal Features.
2. Refer to Figures 4.1-1a, 4.1-1b, and 4.1-1c for historic and current sample locations

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N

0 80 160 Feet

Figure 2.2-1
Remedial Investigation Soil Sample Locations OU1 and OU2
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 12/07/14 | Checked/Date: CTM 12/07/14

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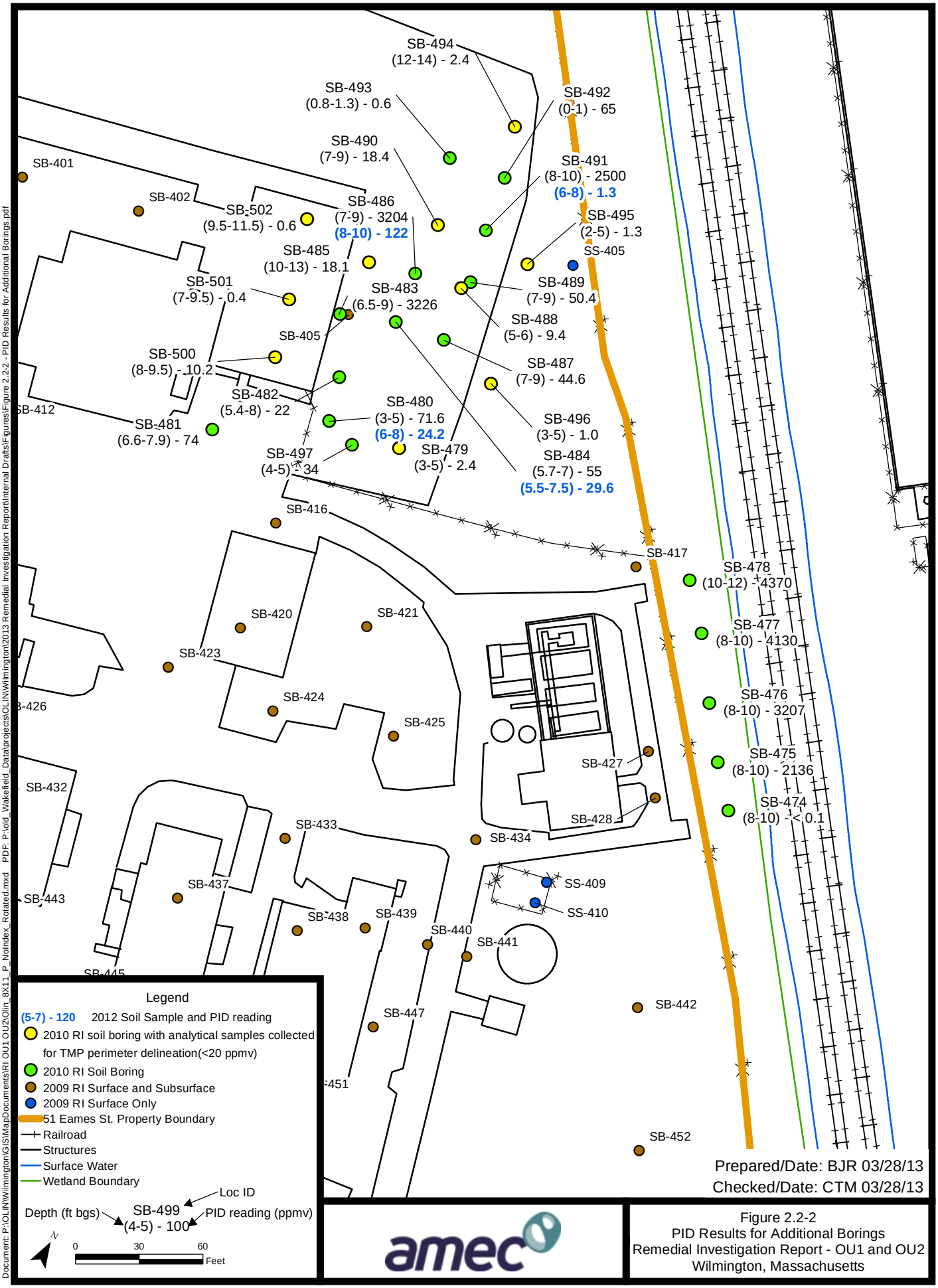
SB-494
(12-14) - 2.4
SB-493
(0.8-1.3) - 0.6
SB-492
(0-1) - 65
SB-490
(7-9) - 18.4
SB-491
(8-10) - 2500
(6-8) - 1.3
SB-401
SB-402
SB-502
(9.5-11.5) - 0.6
SB-486
(7-9) - 3204
(8-10) - 122
SB-495
(2-5) - 1.3
SS-405
SB-485
(10-13) - 18.1
SB-501
(7-9.5) - 0.4
SB-483
(6.5-9) - 3226
SB-489
(7-9) - 50.4
SB-488
(5-6) - 9.4
SB-405
SB-500
(8-9.5) - 10.2
SB-487
(7-9) - 44.6
SB-482
(5.4-8) - 22
SB-412
SB-481
(6.6-7.9) - 74
SB-480
(3-5) - 71.6
(6-8) - 24.2
SB-496
(3-5) - 1.0
SB-497
(4-5) - 34
SB-479
(3-5) - 2.4
SB-484
(5.7-7) - 55
(5.5-7.5) - 29.6
SB-416
SB-417
SB-478
(10-12) - 4370
SB-420
SB-421
SB-477
(8-10) - 4130
SB-423
SB-424
SB-476
(8-10) - 3207
SB-426
SB-425
SB-427
SB-475
(8-10) - 2136
SB-432
SB-428
SB-474
(8-10) - < 0.1
SB-433
SB-434
SB-437
SB-409
SB-443
SB-438
SB-439
SB-410
SB-440
SB-441
SB-445
SB-442
SB-447
SB-451
SB-452
Legend
(5-7) - 120 2012 Soil Sample and PID reading
2010 RI soil boring with analytical samples collected for TMP perimeter delineation(<20 ppmv)
2010 RI Soil Boring
2009 RI Surface and Subsurface
2009 RI Surface Only
51 Eames St. Property Boundary
Railroad
Structures
Surface Water
Wetland Boundary
Loc ID
Depth (ft bgs)
SB-499
(4-5) - 100
PID reading (ppmv)
N
0
30
60
Feet
Prepared/Date: BJR 03/28/13
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Figure 2.2-2
PID Results for Additional Borings
Remedial Investigation Report - OU1 and OU2
Wilmington, Massachusetts
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MMB-SW/SD-9
MMB-SW/SD-1
Outlet
MMB-SW/SD-4
MMB-SW/SD-10
Sawmill Brook
MMB-SW/SD-5
Inlet #1
MMB-SW/SD-8A
MMB-SW/SD-8
MMB-SW/SD-11
MMB-SW/SD-3
Maple Meadow Brook
MMB-SW/SD-2
MMB-SW/SD-6
EDSD/SW0
Upper East Ditch
EDSD/SW1 (EDBS5)
Lower East Ditch
Inlet #2
On-PWD
Off-PWD
EDSD/SW2 (EDBS6)
OPWD-2
OPWD-1
ISCO1
SD-17
SD-503
OPWD-SW-S
SD-501
PZ-18R
PZ-17RR
PZ-16RR
South Ditch
SD-1
ISCO3
ISCO2
LB-1
EDSD/SW5 (EDBS11)
LB-2
Landfill Brook
LB-3
EDSD/SW7

Legend

- Surface Water Flow Direction
- Surface Water Sample Location
- Stream Gauge Location
- Culvert
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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N

0 300 600
Feet

Figure 2.2-3
Surface Water Sample Locations - OU1 and OU2
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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MMB-SW/SD-9
MMB-SW/SD-1
MMB-SW/SD-4
MMB-SW/SD-10
Sawmill Brook
MMB-SW/SD-5
MMB-SW/SD-8A
MMB-SW/SD-11
MMB-SW/SD-8
MMB-SW/SD-3
Maple Meadow Brook
MMB-SW/SD-2
MMB-SW/SD-6
Upper East Ditch
Lower East Ditch
WDW-32
RSD-01
WDW-30
WDW-31
WDW-28
WDW-29
WDW-26
RSD-02
WDW-24
WDW-27
WDW-22
WDW-25
WDW-23
WDW-21A
WDW-21B
WDW-20
WDW-19
SD-SD1
On-PWD
WDW-17
EDSD/SW2 (EDBS6)
WDW-14
WDW-16
Off-PWD
WDW-13
WDW-12
WDW-11
OPWD-2
OPWD-1
SD-504
SD-SD4
SD-502
OPWD-SD-S
SD-501
SD-SD2
SD-503
SDSW-E
South Ditch
SD-SD5
SD-SD3
SD-1
ISCO2
LB-1
LB-2
Landfill Brook
LB-3
EDSD/SW7

Legend

- Sediment Sample Location
- Culvert
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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N

0 300 600 Feet

Figure 2.2-4
Sediment Sample Locations - OU1 and OU2
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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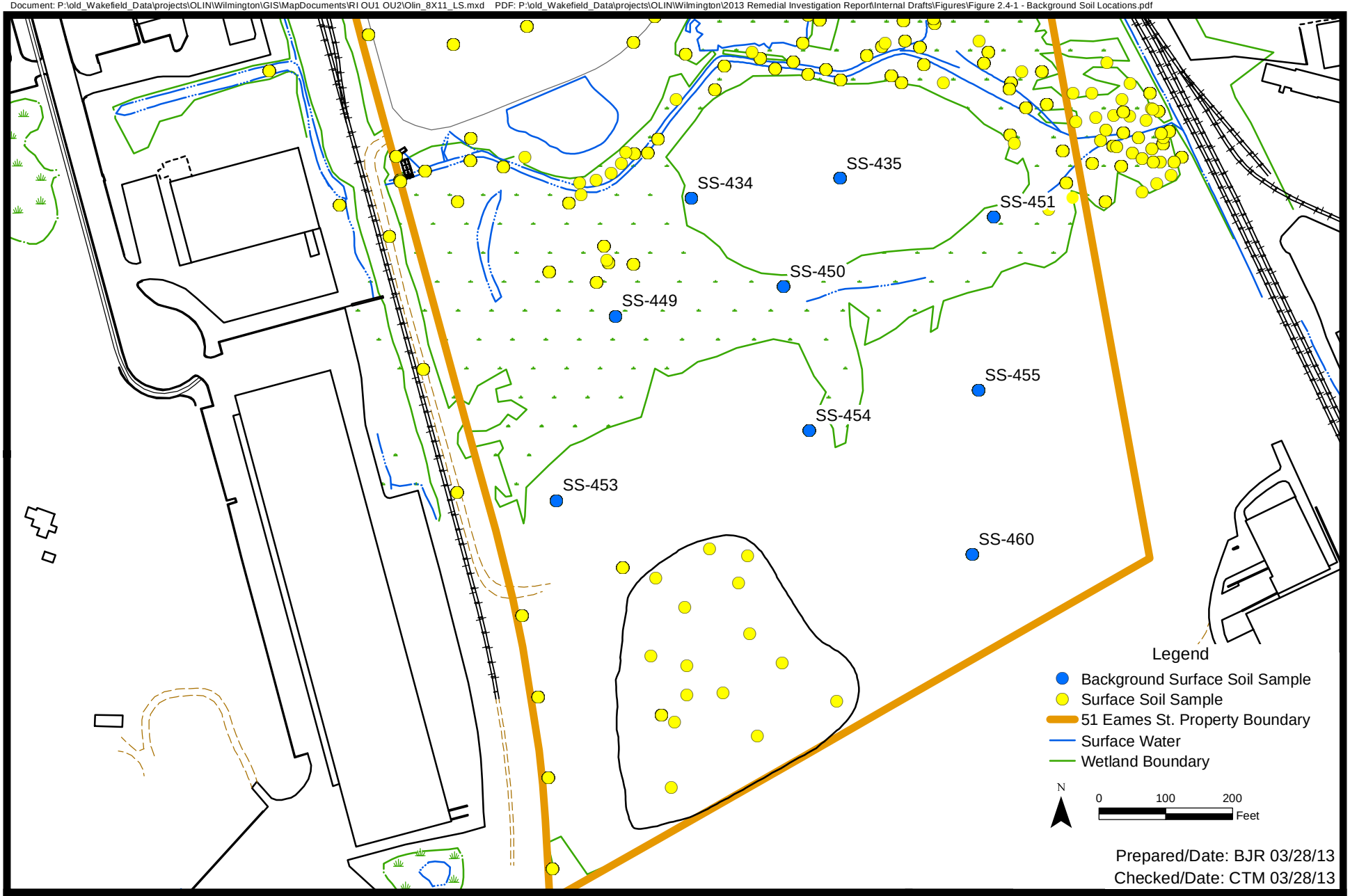

Remedial Investigation - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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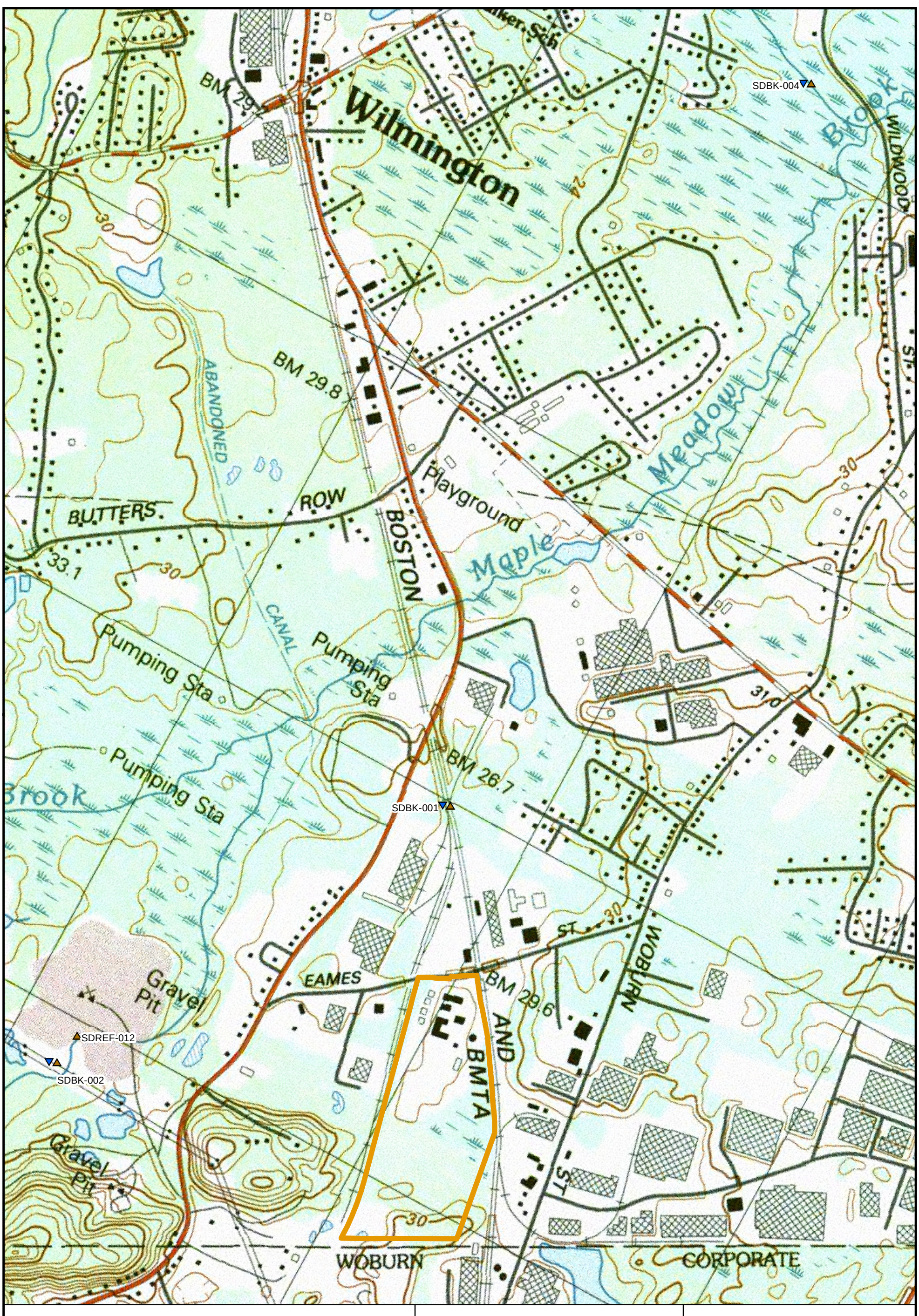
Figure 2.4-1
Background Surface Soil Sample Locations



Legend

- Background Surface Water Sample Location
- Background Sediment Sample Location
- 51 Eames St. Property Boundary

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2 Robbins Rd
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N

0 400 800 1,600 Feet

Figure 2.5-1
Background Surface Water and Sediment Sampling Locations
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Legend

- Elevation Contour (ft)
- 51 Eames St. Property Boundary
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wooded Areas
- Wetland Boundary
- Culvert

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2 Robbins Rd
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0 250 500 1,000 Feet

Figure 3.1-1
Site Topography
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: JDP 3/26/13 | Checked/Date: CTM 3/26/13

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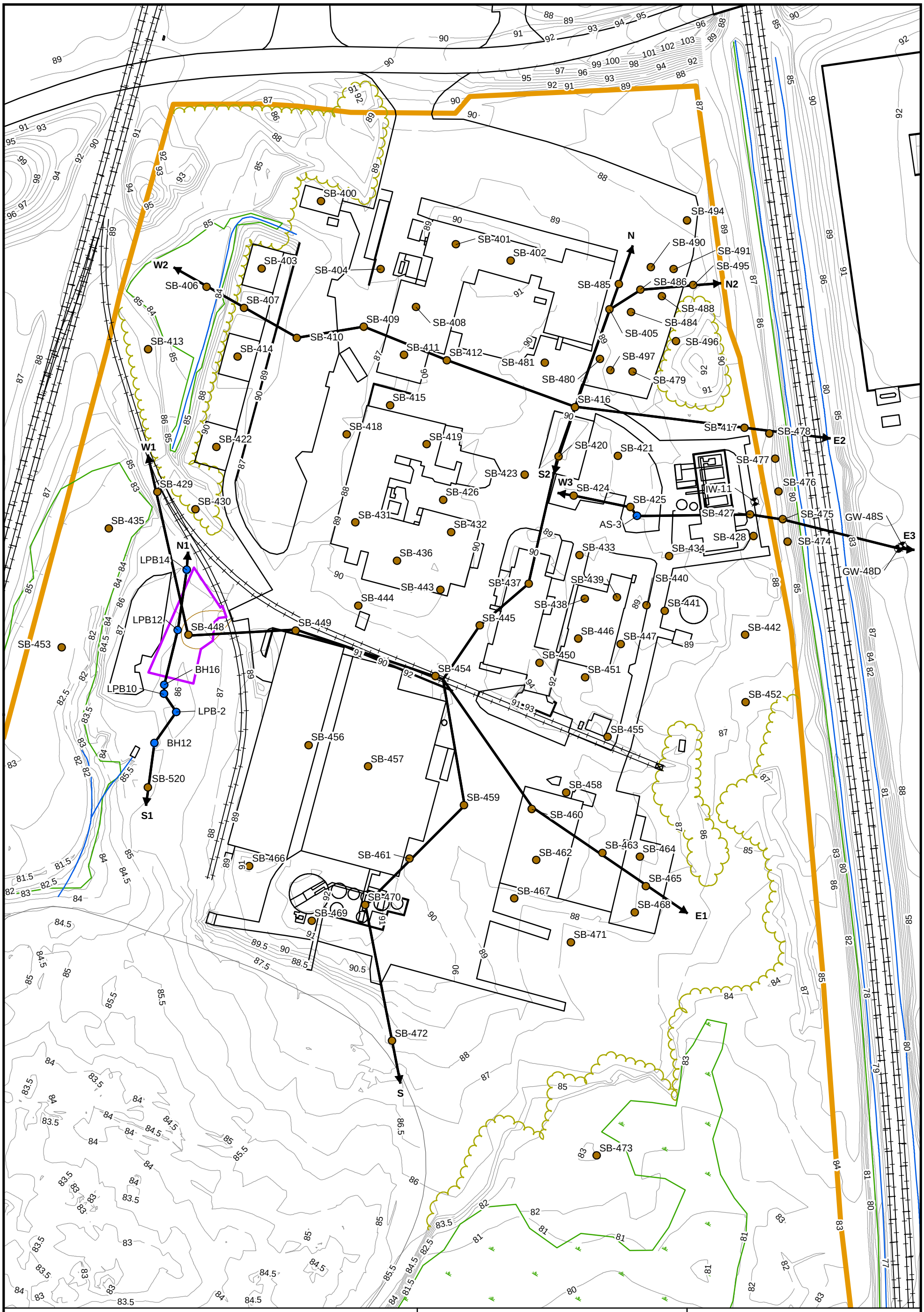

Legend

- 2009-2010 Soil Boring Location
- Historic Soil Boring Location
- Cross Section
- Lake Poly Excavation Limits
- 51 Eames St. Property Boundary
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Wooded Areas
- Culvert
- Elevation Contour (ft)

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N

0 45 90 180 Feet

Figure 3.2-1
Location of Cross Sections

Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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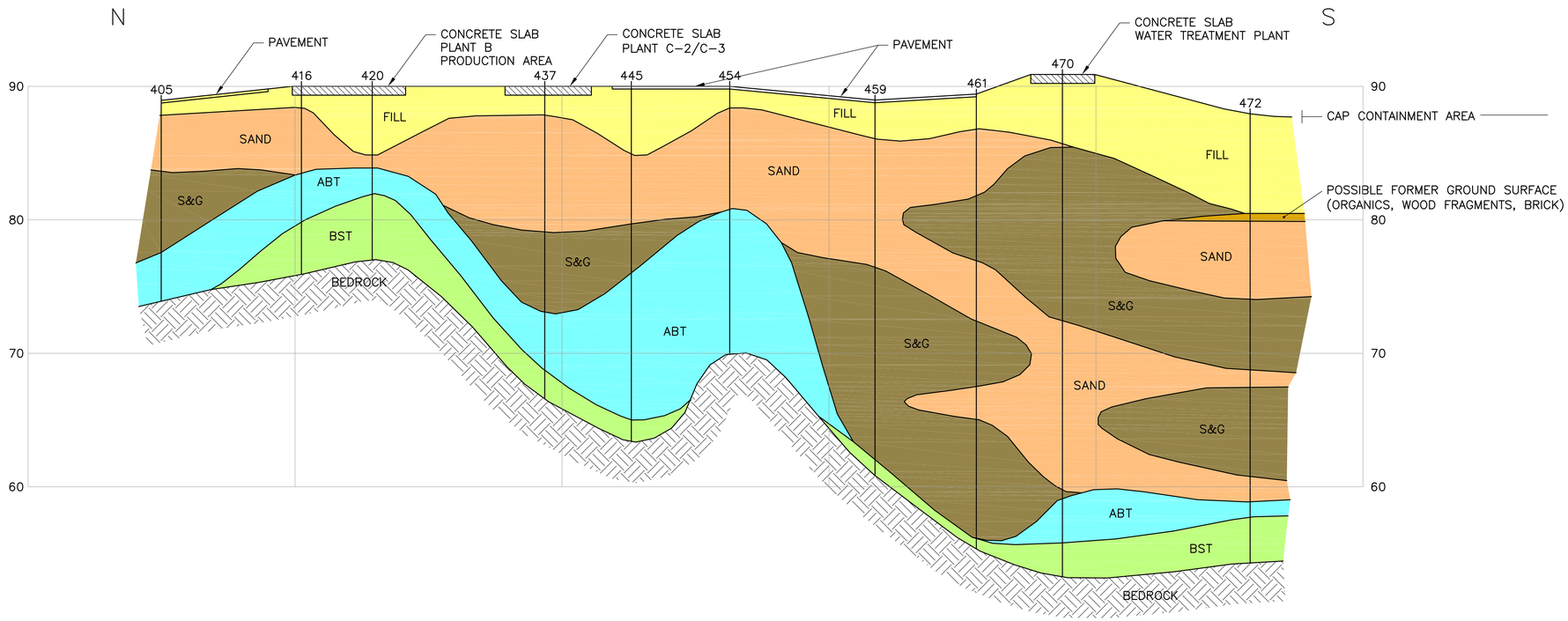


FILL MATERIAL (GENERALLY FINE TO COARSE SAND) WITH TRACES TO SOME GRAVEL

PEAT/ORGANICS

GLACIAL OUTWASH (SAND) UNIFORM FINE TO COARSE SAND

GLACIAL OUTWASH (S&G) SAND AND GRAVEL WITH OCCATIONAL COBBLES

ABLATION TILL (ABT) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND TRACES OF SILT

BASAL TILL (BST) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND SILT

NOTES:

405 = SOIL BORING SB-405

SEE FIGURE 3.2-1 FOR SECTION LINE LOCATION

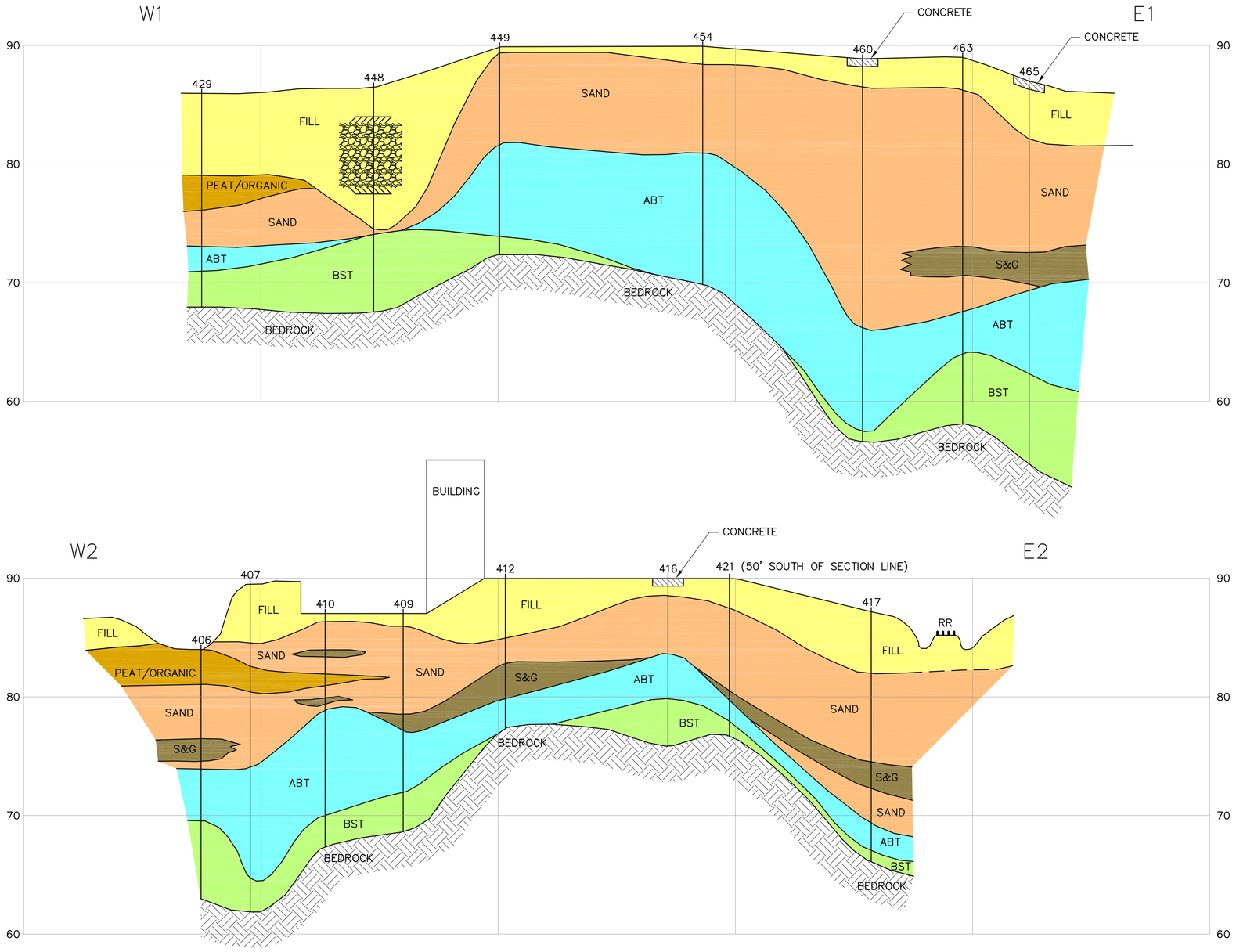
VERTICAL EXAGGERATION IS 10:1

0 25 50 100
SCALE IN FEET

Prepared/Date: RHH 03/27/13
Checked/Date: PHT 03/27/13

REMEDIAL INVESTIGATION REPORT OU1 AND OU2 OLIN CHEMICAL SUPERFUND SITE WILMINGTON, MASSACHUSETTS	amec	INTERPRETED CROSS SECTION N-S Project 6107-14-0016 Figure 3.2-2

Z:\Projects\OLIN-Wilmington\SOILS-C-502.dwg Wed, 27 Mar 2013 - 8:46am richard.holman



FILL MATERIAL (GENERALLY FINE TO COARSE SAND) WITH TRACES TO SOME GRAVEL

PEAT/ORGANICS

GLACIAL OUTWASH (SAND) UNIFORM FINE TO COARSE SAND

GLACIAL OUTWASH (S&G) SAND AND GRAVEL WITH OCCATIONAL COBBLES

ABLATION TILL (ABT) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND TRACES OF SILT

BASAL TILL (BST) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND SILT

NOTES:

429 = SOIL BORING SB-429

GEOFABRIC

LAKE POLY RIPRAP FILL

SEE FIGURE 3.2-1 FOR SECTION LINE LOCATION

VERTICAL EXAGGERATION IS 10:1

0 25 50 100
SCALE IN FEET

Prepared/Date: RHH 03/27/13
Checked/Date: PHT 03/27/13

REMEDIAL INVESTIGATION REPORT
OU1 AND OU2
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSACHUSETTS

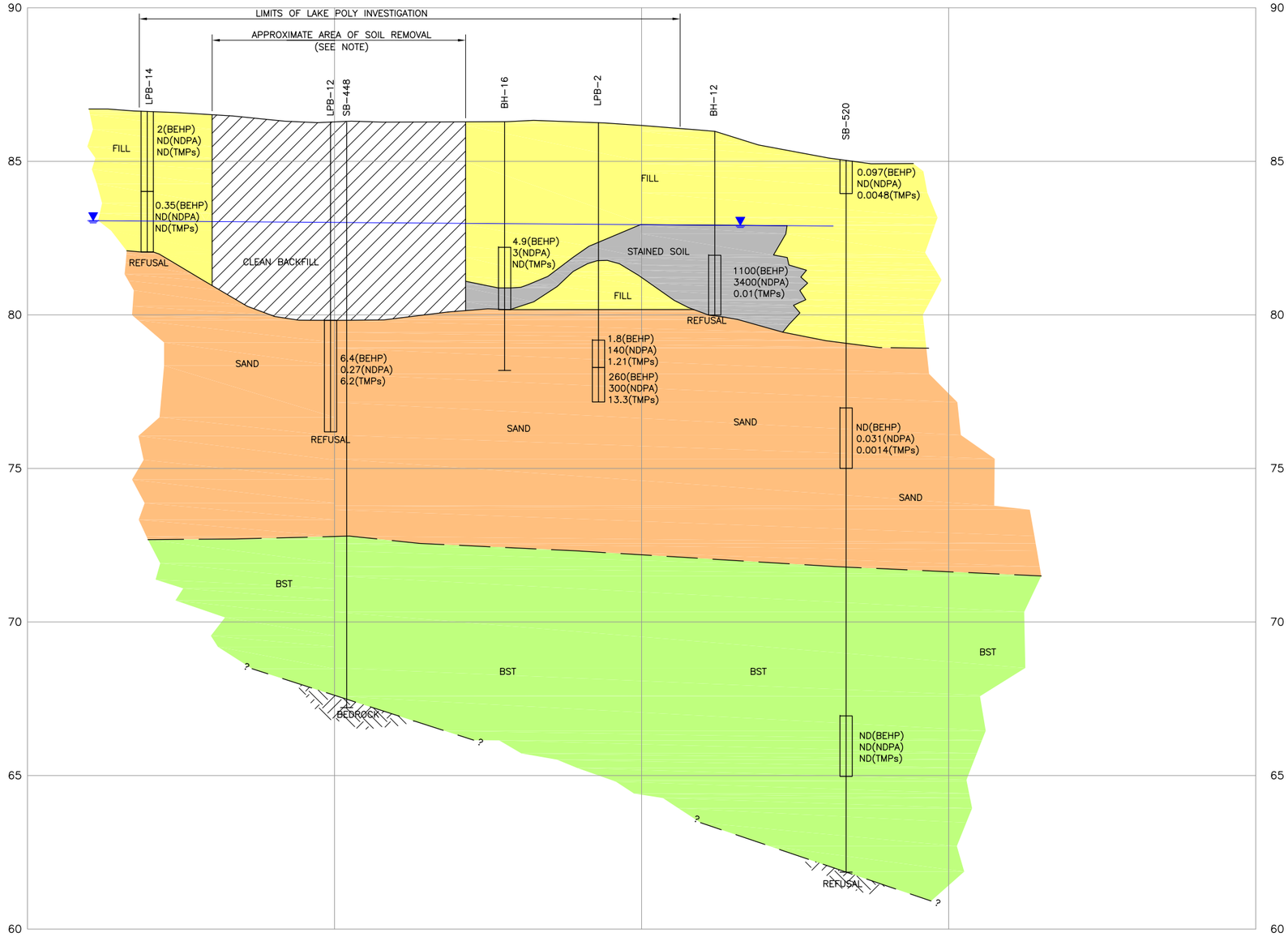
amec

INTERPRETED CROSS SECTIONS
W1-E1 AND W2-E2
Project 6107-14-0016
Figure 3.2-3

Z:\Projects\Olin-Wilmington\SOILS-C-501.dwg Wed, 27 Mar 2013 - 8:47am richard.holman

NORTH
N1

SOUTH
S1



NOTE
SOIL WAS REMOVED FROM THE LAKE POLY AREA IN 2000 AND 2004. THIS CROSS SECTION PASSES THROUGH A PORTION OF THE EXCAVATIED AREA, WHICH MOSTLY LIES TO THE EAST OF THIS SECTION.

NOTES:

SB–405 = EXPLORATION ID

SEE FIGURE 3.2–1 FOR SECTION LINE LOCATION

VERTICAL EXAGGERATION IS 10:1

FILL MATERIAL (GENERALLY FINE TO COARSE SAND) WITH TRACES TO SOME GRAVEL

GLACIAL OUTWASH (SAND) UNIFORM FINE TO COARSE SAND

BASAL TILL (BST) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND SILT

GENERALIZED GROUNDWATER ELEVATION BASED UPON OCTOBER 2011 DATA

0.031(BEHP)
ND(NDPA)
ND(TMPs)
SOIL SAMPLE INTERVAL WITH ANALYTICAL RESULTS FOR:

BEHP (Bis[2–ethylhexyl]phthalate)

NDPA (n–Nitrosodiphenylamine)

TMPs (Trimethylpentenes)(Total)

20 mg/kg TOTAL CONCENTRATION OF COMPOUND DETECTED AT SAMPLE INTERVAL

ND NOT DETECTED

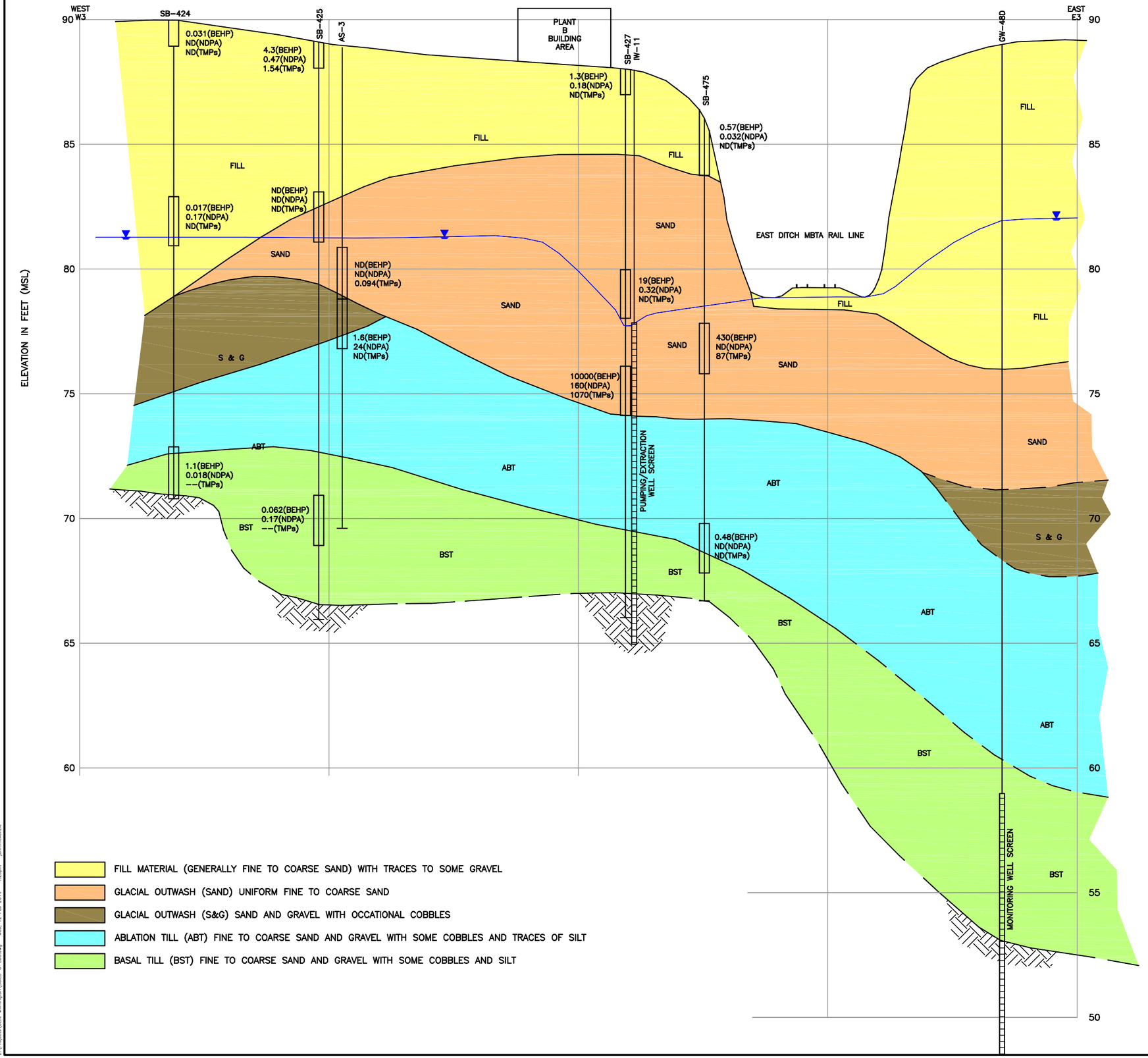
–– NOT ANALYZED

0 10 20 40
SCALE IN FEET

Prepared/Date: JVM 01/31/14
Checked/Date: TDL 01/31/14

REMEDIAL INVESTIGATION REPORT OU1 AND OU2 OLIN CHEMICAL SUPERFUND SITE WILMINGTON, MASSACHUSETTS	amec	INTERPRETED CROSS SECTION N1-S1 LAKE POLY AREA Project 6107-14-0016 Figure 3.2-4

Z:\Projects\GLN-Wilmington\SOILS-C-503.dwg Wed, 12 Feb 2014 – 1:31pm john.mckenzie



GENERALIZED GROUNDWATER ELEVATION BASED UPON AUGUST 2013 DATA

0.031(BEHP) ND(NDPA) ND(TMPs) SOIL SAMPLE INTERVAL WITH ANALYTICAL RESULTS FOR:

BEHP	(Bis[2-ethylhexyl]phthalate)
NDPA	(n-Nitrosodiphenylamine)
TMPs	(Trimethylpentenes)(Total)
20	mg/kg TOTAL CONCENTRATION OF COMPOUND DETECTED AT SAMPLE INTERVAL
ND	NOT DETECTED
--	NOT ANALYZED

NOTES:

SB-405 = EXPLORATION ID

SEE FIGURE 3.2-1 FOR SECTION LINE LOCATION

VERTICAL EXAGGERATION IS 10:1

FILL MATERIAL (GENERALLY FINE TO COARSE SAND) WITH TRACES TO SOME GRAVEL

GLACIAL OUTWASH (SAND) UNIFORM FINE TO COARSE SAND

GLACIAL OUTWASH (S&G) SAND AND GRAVEL WITH OCCATIONAL COBBLES

ABLATION TILL (ABT) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND TRACES OF SILT

BASAL TILL (BST) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND SILT

0 10 20 40
SCALE IN FEET

Prepared/Date: JVM 01/29/14
Checked/Date: TDL 01/30/14

REMEDIAL INVESTIGATION REPORT
OU1 AND OU2
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSACHUSETTS

amec

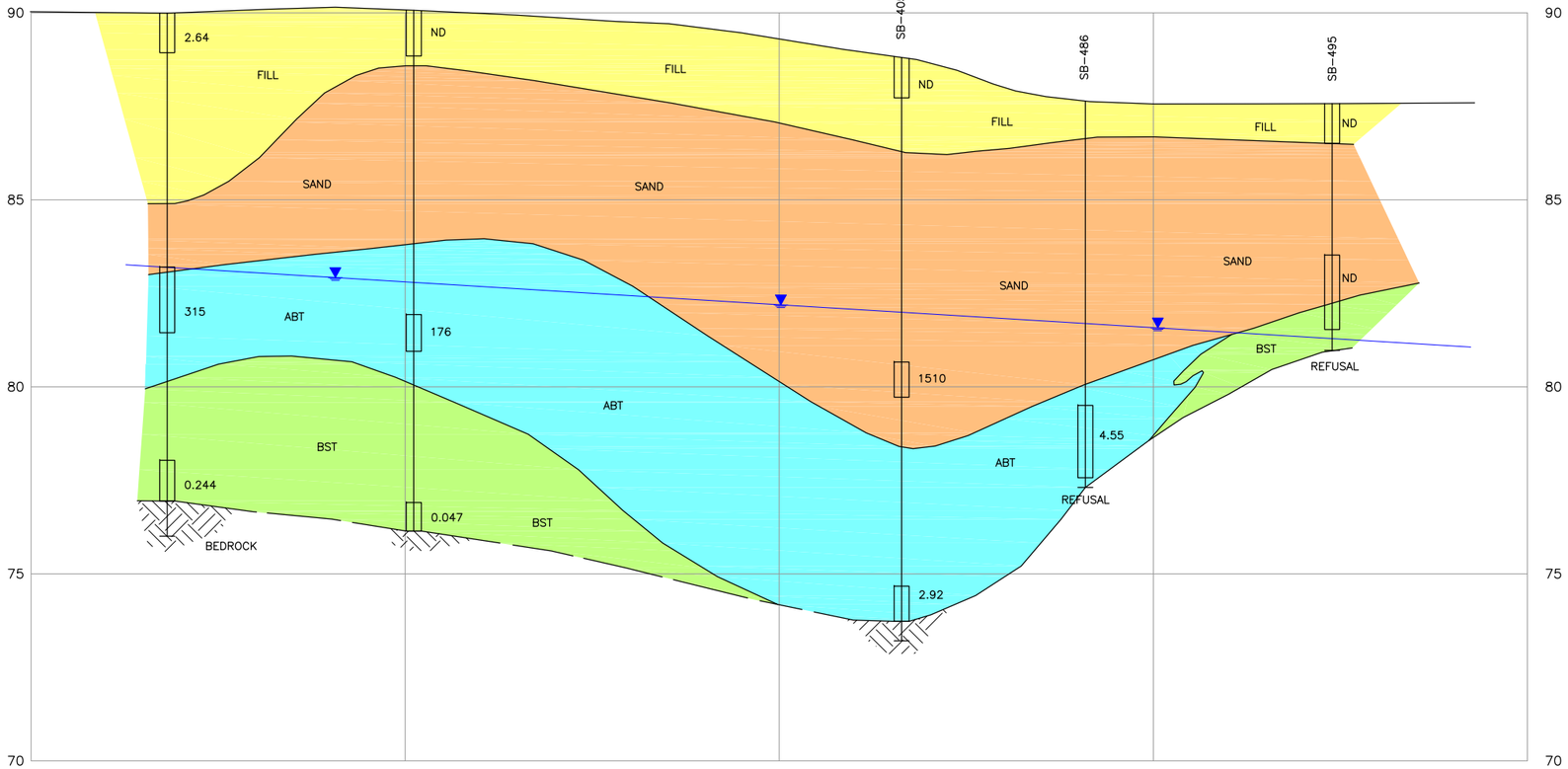
INTERPRETED CROSS SECTION W3-E3
PLANT B AREA
Project 6107-14-0016
Figure 3.2-5

Z:\Projects\OLIN-Wilmington\SOILS-C-505.dwg Wed, 12 Feb 2014 - 1:28pm john.mckenzie

SOUTH
S2

NORTH
N2

ELEVATION IN FEET (MSL)



FILL MATERIAL (GENERALLY FINE TO COARSE SAND) WITH TRACES TO SOME GRAVEL

GLACIAL OUTWASH (SAND) UNIFORM FINE TO COARSE SAND

ABLATION TILL (ABT) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND TRACES OF SILT

BASAL TILL (BST) FINE TO COARSE SAND AND GRAVEL WITH SOME COBBLES AND SILT

GENERALIZED GROUNDWATER ELEVATION BASED UPON OCTOBER 2011 DATA

2.5 SOIL SAMPLE INTERVAL WITH ANALYTICAL RESULTS FOR TMPs (Trimethylpentenes)(Total)

20 mg/kg TOTAL CONCENTRATION OF TRIMETHYLPENTENES DETECTED AT SAMPLE INTERVAL

ND NOT DETECTED

-- NOT ANALYZED

NOTES:

SB-405 = EXPLORATION ID

SEE FIGURE 3.2-1 FOR SECTION LINE LOCATION

VERTICAL EXAGGERATION IS 10:1

0 10 20 40
SCALE IN FEET

Prepared/Date: JVM 01/29/14
Checked/Date: ???

REMEDIAL INVESTIGATION REPORT
OU1 AND OU2
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSACHUSETTS

amec

INTERPRETED CROSS SECTION S2-N2
TRIMETHYLPENTENE AREA
Project 6107-14-0016
Figure 3.2-6

Z:\Projects\Olin-Wilmington\SOILS-C-504.dwg Wed, 12 Feb 2014 - 1:29pm john.mckenzie

A'
GW-65BR
GW-65S
GW-65D
GW-86D
GW-86M
GW-86S
GW-87D
B'
GW-103D
GW-103BR
CHESTNUT ST 1
GW-63D
GW-63S
GW-85M
GW-85D
MP-5
GW-84D
GW-84S
GW-84M
GW-61S
GW-61D
GW-61BR
GW-83D
GW-83M
GW-83S
GW-57D
B
GW-62D
GW-62M
GW-62BRD
GW-62S
GW-70S
GW-70D
GW-45D
GW-45S
GW-43D
GW-43S
A

Legend

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

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, Massachusetts 01824

N

0 150 300 600 Feet

Figure 3.2-7
Cross Section Locations -
Maple Meadow Brook Area
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 3/12/14 | Checked/Date: CTM 3/12/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\MMB_Xsections.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 3.2-7 - MMB Cross Sections.pdf

A

A’

GW-43S/D
Jewel Drive
SANMINA
Building
Main Street
GW-45S/D
GW-70S/D
GW-62S/M/D/BR
Maple Meadow Brook
GW-83S/M/D
MP5
GW-85M/D
GW-86S/M/D
Saw Mill Brook
GW-87D
GW-65S/D/BR

Water Table

Upper DAPL Pool

Main Street DAPL Pool

DAPL

Bedrock

Gravel
f. to c. Sand
Gravel, some sand
Sand some gravel
Sand/gravel
Gravel
m. to c. Sand some gravel
F. Sand
m. to c. Sand
Sand and Gravel
m. to c. Sand some gravel
Till
f. to c. Sand
f. to m. Sand
f. to c. Sand, tr. to some gravel
Gravel
Till
DAPL ?
Peat some silt/clay (muck)
f. Sand
f. to m. Sand
Peat (muck)
f. to m. Sand, Tr. Gravel
Sand & Gravel
Silt
Till
Bedrock
Till
Peat
Peat
f. to m. Sand
f. to m. Sand
S. to G
Sand & Gravel
Till
Bedrock
Fill
Peat
f. to m. Sand
f. & m. Sand
f. to c. Sand
Till
Bedrock

Till
Gravel & Cobbles in gray/green clayey/sand matrix

Note
f. = fine
m. = medium
c. = coarse

Elevation, Feet (MSL)

100
80
60
40
20
0
-20
-40
-60

0
500
1000
1500
2000
2500
3000
3500
4000
4500

Feet

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

Remedial Investigation Report – OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Surficial Geology Cross Section A - A’
Maple Meadow Brook Area
Project 6107-14-006
Figure 3.2-8

PORT2014008a.cdr

B

B’

GW-57D

Main Street

Residence

GW-84S/M/D

Maple Meadow Brook

Saw Mill Brook

Chestnut #1

GW-61S/D/BR

GW-85M/D

GW-63S/D

GW-103D/BR

f. to m. Sand, some gravel

Water Table

f. to m. Sand

m. to c. Sand

Silt

f. to m. Sand, some silt, tr. gravel

Gravel

Bedrock

Peat

Some Silt/Clay (muck)

Peat

Some Sand/Silt (muck)

f. to m. Sand, Tr. Gravel

Peat

Peat

f. Sand to Silty fn Sand

f. to m. Sand

S & G

Sand/Gravel

Silt (olive gray)

Basal Till

S & G

M. to C. Sand

Basal Till

Till

Till

Sand

Sandy Gravel

Gravel

Till

Basal Till
Includes Cobbles (gabbo, mylonite) and gravel in silt/clay to clayey sand matrix

Note
f. = fine
m. = medium
c. = coarse

Elevation, Feet (MSL)

100
80
60
40
20
0
-20
-40

0
500
1000
1500
2000
2500
3000
3500
4000
4500

Feet

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

Remedial Investigation Report – OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

amec

Surficial Geology Cross Section B - B’
Maple Meadow Brook Area
Project 6107-14-006
Figure 3.2-9

PORT2014008b.cdr

Legend

- Bedrock Contour (ft)
- Bedrock Boring
- Bedrock Outcrop
- 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 60 120 240 Feet

Figure 3.2-10
Bedrock Contours

Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_11X17_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 3.2-10 - Bedrock Contours.pdf 3/12/2014

GW-47
May 2011 - 8.99
Oct 2011 - 7.67

GW-31S
May 2011 - 8.47
Oct 2011 - 8.56

GW-31D
May 2011 - 8.68
Oct 2011 - 8.53

GW-32D
May 2011 - 6.33
Oct 2011 - 6.17

GW-32S
May 2011 - 5.88
Oct 2011 - 6.1

GW-21D
May 2011 - 0.69
Oct 2011 - 0.64

GW-21S
May 2011 - 6.11
Oct 2011 - 6.04

GW-406BRD
May 2011 - 5.8
Oct 2011 - 5.65

GW-406BRS
May 2011 - 5.88
Oct 2011 - 5.79

GW-406
May 2011 - 3.38
Oct 2011 - 3.24

GW-54S
May 2011 - 2.6
Oct 2011 - 2.36

GW-54D
May 2011 - 2.91
Oct 2011 - 2.64

GW-13
May 2011 - 9.41
Oct 2011 - 9.4

GW-69D
May 2011 - 10.18
Oct 2011 - 9.88

V-45S
011 - 8.83
011 - 8.47

GW-28D
May 2011 - 0.81
Oct 2011 - 0.56

GW-69S
May 2011 - 10.26
Oct 2011 - 9.94

GW-28S
May 2011 - 0.8
Oct 2011 - 0.57

GW-53D
May 2011 - 4.93
Oct 2011 - 4.94

GW-14
May 2011 - 7.2
Oct 2011 - 7.03

GW-48S
May 2011 - 6.89
Oct 2011 -

GW-304
May 2011 - 5.53
Oct 2011 - 5.57

GW-29D
May 2011 - 1.79
Oct 2011 - 1.54

GW-52S
May 2011 - 6.07
Oct 2011 - 5.98

GW-29S
May 2011 - 1.01
Oct 2011 - 0.99

GW-308
May 2011 - 5.15
Oct 2011 - 4.99

GW-34SR
May 2011 - 4.67
Oct 2011 - 4.43

GW-26
May 2011 - 3.81
Oct 2011 - 3.61

GW-10DR
May 2011 - 2.75
Oct 2011 - 2.51

GW-34D
May 2011 - 5.64
Oct 2011 - 5.37

GW-307
May 2011 - 3.49
Oct 2011 - 3.5

GW-76S
May 2011 - 3.65
Oct 2011 - 3.45

GW-10S
May 2011 - 6.62
Oct 2011 - 6.37

GW-42S
May 2011 - 3.57
Oct 2011 - 3.42

GW-3S
May 2011 - 5.74
Oct 2011 - 6.14

GW-6S
May 2011 - 5.84
Oct 2011 - 5.72

GW-6D
May 2011 - 6.49
Oct 2011 - 6.34

GW-40
May 2011 -
Oct 2011 -

GW-42D
May 2011 - 2.66
Oct 2011 - 2.61

GW-24
May 2011 - 1.7
Oct 2011 - 1.42

GW-3D
May 2011 - 4.57
Oct 2011 - 4.67

GW-25
May 2011 - 2.43
Oct 2011 - 2.28

GW-17S
May 2011 - 0.88
Oct 2011 - 0.9

PZ-24
May 2011 - 5.69
Oct 2011 - 5.56

GW-405BRS
May 2011 - 7.51
Oct 2011 - 7.77

PZ-25
May 2011 - 5.19
Oct 2011 - 5.07

GW-17D
May 2011 - 0.89
Oct 2011 - 1.02

GW-68BR
May 2011 - 7.73
Oct 2011 - 7.66

PZ-16RR
May 2011 - 0
Oct 2011 - 0.29

PZ-18R
May 2011 - 1.96
Oct 2011 - 2.05

PZ-17RR
May 2011 - -0.05
Oct 2011 - -1.04

GW-4D
May 2011 - 1.02
Oct 2011 - 0.88

GW-4
May 2011 - 5.8
Oct 2011 - 5.66

GW-405BRM
May 2011 - 8.68
Oct 2011 - 8.53

GW-405BRD
May 2011 - 8.75
Oct 2011 - 8.74

GW-39
May 2011 - 1.45
Oct 2011 - 1.53

PZ-21
May 2011 - -3.02
Oct 2011 - -3.04

PZ-23
May 2011 - 0.05
Oct 2011 - -0.09

GW-55D
May 2011 - 0.07
Oct 2011 - 0.15

GW-55S
May 2011 - 0.05
Oct 2011 - 0.13

GW-50S
May 2011 - 0.96
Oct 2011 - 0.88

GW-5
May 2011 - 4.36
Oct 2011 - 3.27

GW-50D
May 2011 - 1.2
Oct 2011 - 1.17

GW-81BR
May 2011 - 1.49
Oct 2011 - 0.45

SL-7
May 2011 - 9.64
Oct 2011 - 9.3

GW-81D
May 2011 - 3.96
Oct 2011 - 4.78

SL-1S
May 2011 - 2.58
Oct 2011 - 3.2

SL-6
May 2011 - 9.21
Oct 2011 - 10.68

GW-49D
May 2011 - 4.14
Oct 2011 - 3.91

SL-1D
May 2011 - 2.76
Oct 2011 - 3.35

SL-5
May 2011 - 13.25
Oct 2011 - 13.58

GW-80BR
May 2011 - 3.9
Oct 2011 - 3.73

SL-2
May 2011 - 3.42
Oct 2011 - 3.87

GW-80D
May 2011 - 3.94
Oct 2011 - 3.74

SL-3
May 2011 - 10.46
Oct 2011 - 10.93

GW-40S
May 2011 - 5.93
Oct 2011 - 6.42

GW-80ST
May 2011 - 3.96
Oct 2011 - 3.71

Legend

- Estimated Depth to Groundwater Contour (ft)
- 51 Eames St. Property Boundary
- Monitoring Well Location
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Wooded Areas
- Culvert

AMEC Environment and Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 90 180 360 Feet

Figure 3.3-1
Interpreted Depth to
On-Property Groundwater
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 4/3/14 | Checked/Date: PHT 4/3/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\Depth_to_GW.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 3.3-1 - Depth to GW.pdf

Ipswich Watershed

Aberjona Watershed

GW-88S 80.05
GW-61S 80.35
GW-63S 80
GW-64S 80.15
GW-86S 80.05
GW-65S 79.78
MW-203S 80.75
MW-206S 80.76
MW-202S 83.48
MW-204S 81.08
GW-62S 80.91
GW-58S 80.79
GW-46D 82.13
GW-42S 80.93
GW-25 80.67
GW-24 81
PZ-24 80.81
PZ-25 80.61
PZ-18R 80.28
PZ-17RR 78.95
PZ-16RR 77.9
PZ-23 77.15
PZ-21 81.32
GW-39 80.25
GW-55S 79.75
GW-50S 76.04
GW-70S 81.08
GW-45S 81.07
GW-69S 81.01
GW-28S 82.8
GW-29S 82.29
GW-26 81.09
GW-10S 80.48
GW-76S 82.45
GW-34SR 82.73
GW-6S 82.86
GW-3S 79.66
GW-402D 78.31
GW-17S 78.52
GW-4 76.32
GW-403D 77.61
GW-47 82.61
GW-31S 81.63
GW-32S 81.72
GW-21S 83.49
GW-406 83.67
GW-54S 83.8
GW-304 84.37
GW-308 81.95
GW-307 82.01
GW-13 79.19
GW-48S 82.01
GW-14 79.6
GW-52S 79.53
SL-7 83.66
SL-6 80.89
SL-5 79.55
SL-1S 81.42
SL-2 80.08
SL-3 79.74
GW-40S 80.47
GW-80S 75.64
GW-74S 72.4
GW-401D 71.28
GW-75D
GW-72D

80.2
81
82
80
79
78
77
76
75
84
83

Historical data from GW-75D and GW-72D was evaluated to verify interpreted location for the 78 foot contour west of Woburn Sanitary Landfill

Legend

- Shallow Monitoring Well Location
- Interpreted Groundwater Contour (Dashed where inferred)
- Interpreted Groundwater Divide
- Slurry Wall
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

Note: Water levels measured on 5/21/10 and 5/19/10 in GW-72D and GW-75D, respectively (wells not shown on map) were used to verify the shape of the potentiometric surface in the southwestern portion of the map.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 300 600 Feet

Figure 3.3-2
Groundwater Elevations in
Shallow Monitoring Wells - May 2011
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/04/14 | Checked/Date: PHT 04/02/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\Olin_22x34P_GroundwaterContours10_0.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 3.3-2 Groundwater Elevations Shallow Monitoring Wells - May 2011.pdf 4/4/2014 9:51 AM brian.roden

Ipswich Watershed

Aberjona Watershed

GW-64S 80.95
GW-65S 80.84
GW-86S 80.91
GW-63S 80.86
GW-88S 80.91
GW-61S 81
MW-203S 81.04
MW-206S 81.12
MW-202S 83.66
MW-204S 81.45
GW-62S 81.28
GW-58S 81.15
GW-70S 81.42
GW-45S 81.43
GW-69S 81.33
GW-28S 83.03
GW-31S 81.54
GW-47 83.93
GW-32S 81.5
GW-21S 83.56
GW-13 79.2
GW-54S 84.04
GW-14 79.77
GW-304 84.33
GW-52S 79.62
GW-29S 82.31
GW-26 81.29
GW-34SR 82.97
GW-308 82.11
GW-307 82
GW-76S 82.65
GW-10S 80.73
GW-46D 82.14
GW-42S 81.08
GW-6S 82.98
GW-3S 79.26
GW-402D 78.27
GW-25 80.82
GW-24 81.28
PZ-24 80.94
GW-17S 78.5
PZ-17RR 79.94
PZ-16RR 77.61
PZ-18R 80.37
PZ-25 80.73
PZ-23 77.29
GW-4 76.46
GW-39 80.17
PZ-21 81.34
GW-403D 77.31
GW-55S 79.67
GW-50S 76.12
SL-7 84
SL-1S 80.8
SL-6 79.42
SL-2 79.63
SL-5 79.22
GW-80S 75.89
GW-40S 79.98
SL-3 79.27
GW-74S 72.5
GW-75D
GW-72D
GW-401D 71.62

81.2
81
82
83
84
80
79
78
77
76
75

Historical data from GW-75D and GW-72D was evaluated to verify interpreted location for the 78 foot contour west of Woburn Sanitary Landfill

Legend

- Shallow Monitoring Well Location
- Interpreted Groundwater Contour (Dashed where inferred)
- Interpreted Groundwater Divide
- Slurry Wall
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

Note: Water levels measured on 5/21/10 and 5/19/10 in GW-72D and GW-75D, respectively (wells not shown on map) were used to verify the shape of the potentiometric surface in the southwestern portion of the map.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 300 600 Feet

Figure 3.3-3
Groundwater Elevations in
Shallow Monitoring Wells - October 2011
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/04/14 | Checked/Date: PHT 04/02/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\Olin_22x34P_GroundwaterContours10_0.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 3.3-3 Groundwater Elevations Shallow Monitoring Wells - Oct 2011.pdf 4/4/2014 9:37 AM brian.roden

Sawmill Brook

Maple Meadow Brook

Upper East Ditch

Lower East Ditch

Off-PWD

On-PWD

South Ditch

Landfill Brook

Legend

- SurfaceWaterFlowArrows
- Culvert
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

AMEC Environment & Infrastructure
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Chelmsford, MA 01824

N

0 300 600

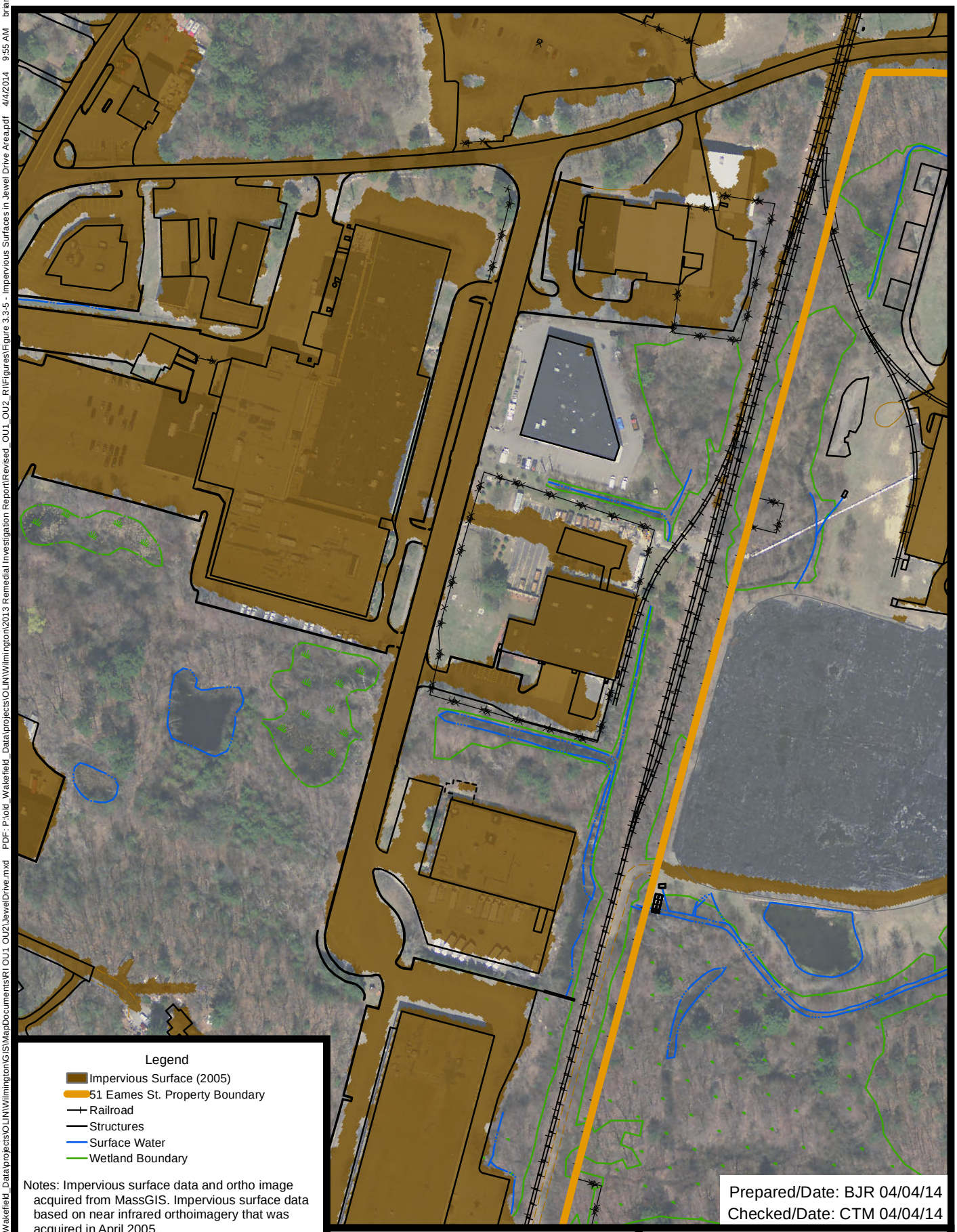
Feet

Figure 3.3-4
Site-Wide Surface Water Flow

Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/04/14 | Checked/Date: CTM 04/04/14

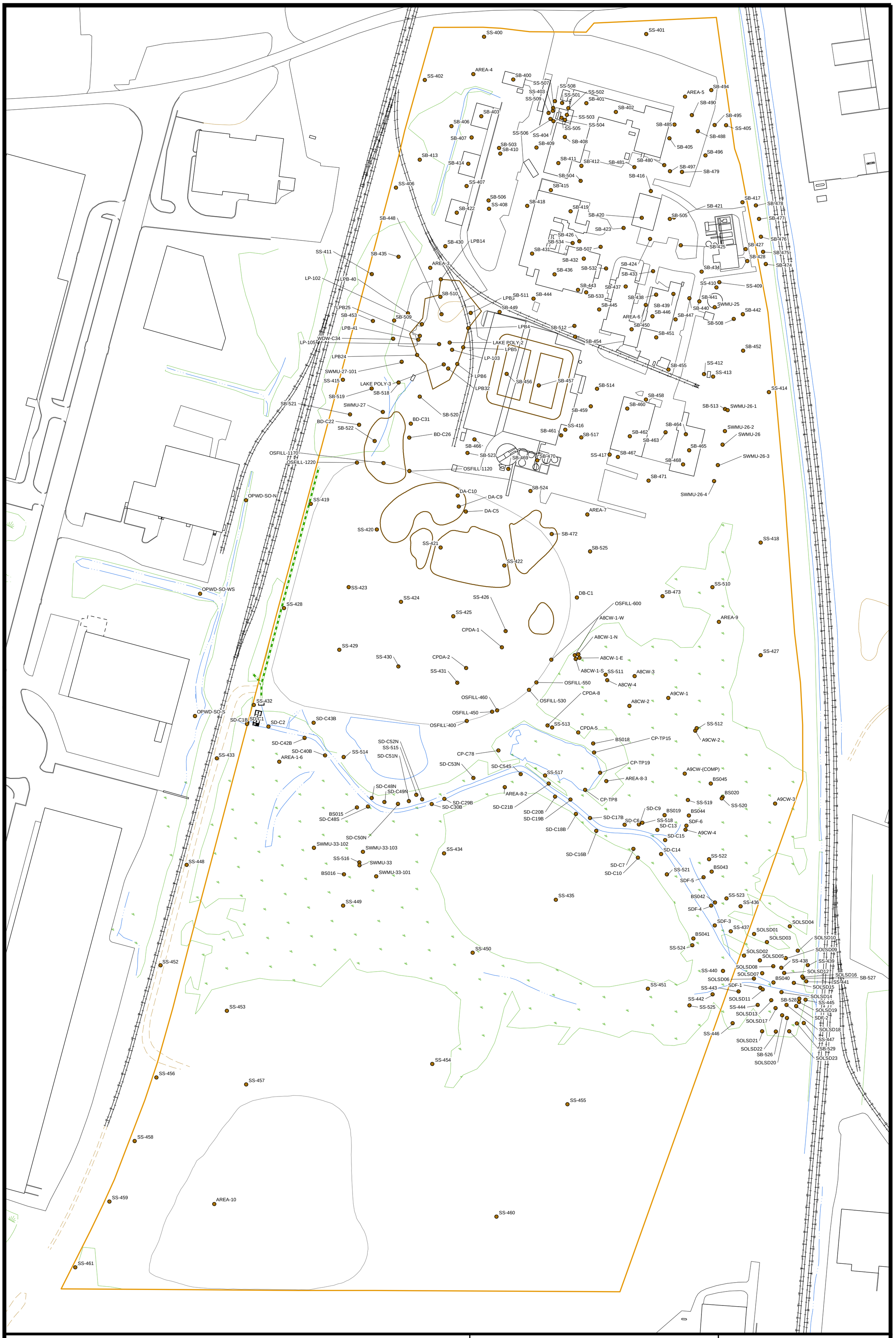
Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\SurfaceFlowDirection.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 3.3-4 - Site-Wide Surface Water Flow.pdf 4/4/2014 9:53 AM brian.roden



amec

Figure 3.3-5
Impervious Surfaces in Jewel Drive Area
Remedial Investigation Report - OU1 and OU2
Wilmington, Massachusetts

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\JewelDrive.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 3.3-5 - Impervious Surfaces in Jewel Drive Area.pdf 4/4/2014 9:55 AM brian.roden



Legend

- Soil Sample Location
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Note:
Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

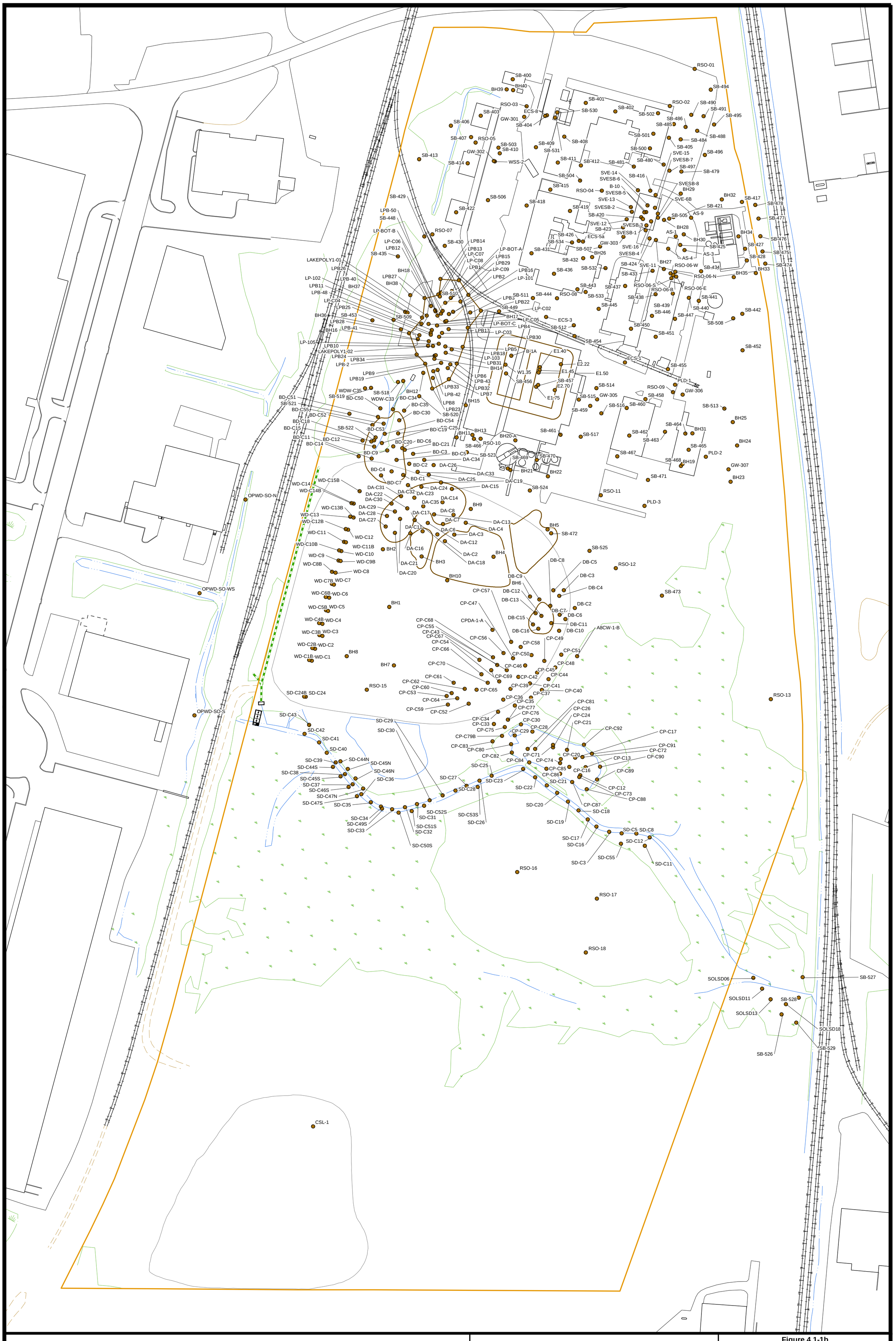
N

0 80 160 Feet

Figure 4.1-1a
Surface Soil (0-1 feet) Sample Locations
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 02/19/14 | Checked/Date: CTM 02/19/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PreliminaryRI_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-1a - Surface Soil (0-1 feet) Sample Locations.pdf 2/19/2014 9:57 PM brian.roden



Legend

- Soil Sample Location
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Note:
Historic Disposal Features are shown in Figure 1.3-1.

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N

0 80 160 Feet

Figure 4.1-1b
Shallow Subsurface Soil (1-10 feet)
Sample Locations
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 02/19/14 | Checked/Date: CTM 02/19/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PreliminaryRI_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-1b - Shallow Subsurface Soil (1-10 feet) Sample Locations.pdf 2/19/2014 9:59 PM brian.roden

SB-400 SB-494 SB-403 SB-406 SB-404 SB-485 SB-407 SB-405 SB-503 SB-410 SB-409 SB-413 SB-414 SB-412 SB-497 SB-416 SVEMW-9 SB-415 SB-429 SB-506 SB-418 SVE-6B AS-8 SB-417 SB-478 SB-422 SB-419 SB-421 SB-448 SB-420 AS-7 SB-477 SB-423 AS-2 AS-1 SB-426 SB-476 SB-430 SB-425 SB-427 SB-435 SB-507 AS-3 SB-475 SB-432 SB-428 SB-424 SB-436 SB-532 SB-433 SB-434 SB-474 LPB-40 ECS-4 LAKE POLY 1-B SB-443 SB-437 SB-511 SB-444 SB-533 SB-438 SB-441 SB-449 SB-445 SB-439 SB-440 SB-442 SB-446 SB-447 SB-508 SB-512 ECS-2 SB-450 SB-451 SB-454 LPB18 B-1A TE2.10 SB-452 B-1B SB-455 B-3A SB-456 SB-457 SB-514 E2.70 SB-519 SB-518 B-2A SB-515 SB-458 SB-521 SB-520 SB-516 SB-460 SB-513 SB-459 ECS-6 SB-522 SB-464 SB-461 SB-462 SB-517 BH11 BH20 SB-463 SB-466 SB-465 SB-523 SB-469 SB-470 SB-467 SB-468 BD-C13 BD-C10 WD-C16 SB-471 WD-C15 SB-524 SB-472 SB-525 SB-473

Legend

- Soil Sample Location
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Note:
Historic Disposal Features are shown in Figure 1.3-1.

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Chelmsford, MA 01824

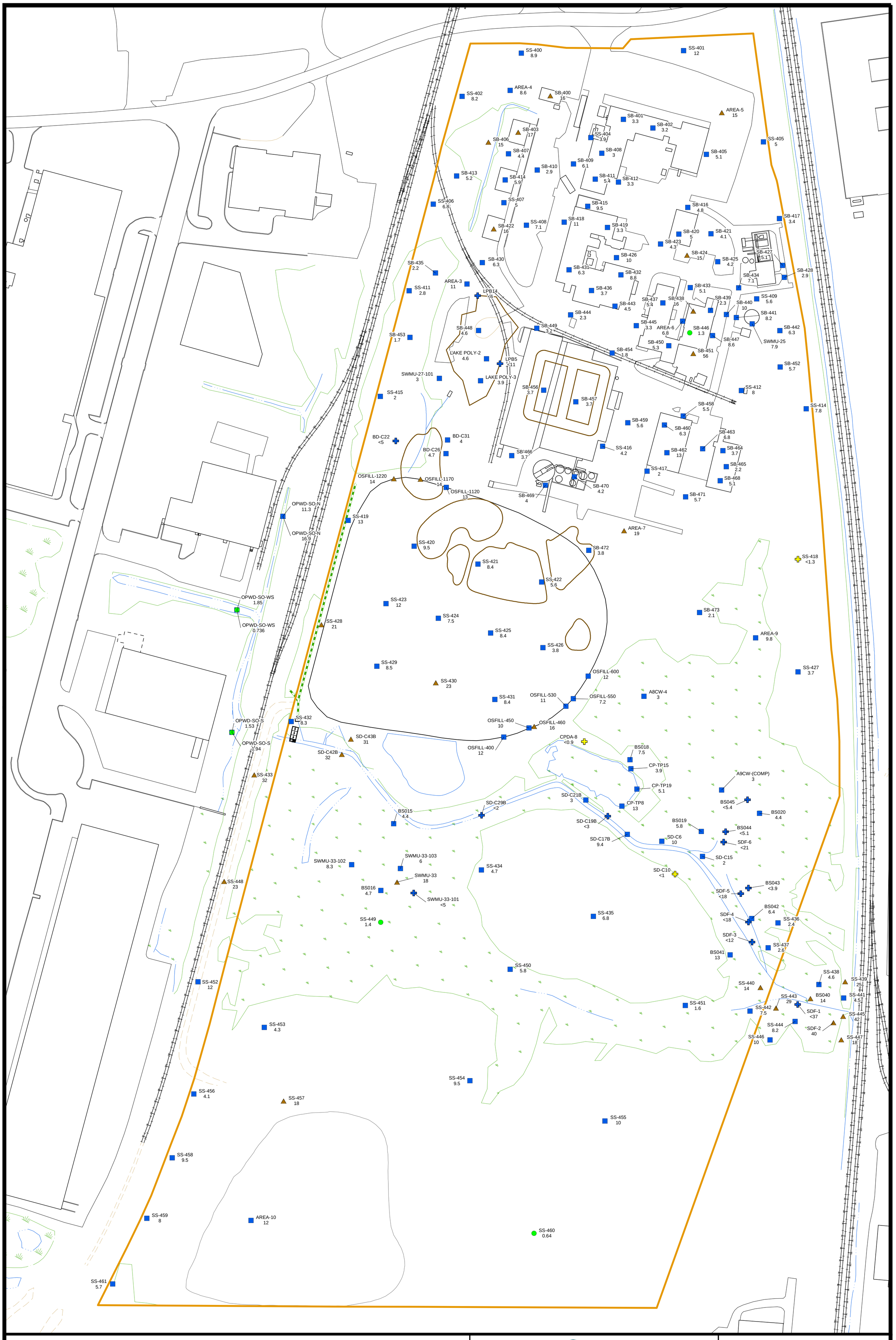
N

0 80 160 Feet

Figure 4.1-1c
Deep Soil (Greater Than 10 feet)
Sample Locations
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 02/19/14 | Checked/Date: CTM 02/19/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PreliminaryRI_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-1c - Deep Soil (Greater Than 10 feet) Sample Locations.pdf 2/19/2014 10:01 PM brian.roden



Legend

- Detected Concentration Below Industrial RSL
- Detected Concentration Greater Than Industrial RSL and Below Site Specific Background
- Detected Concentration Greater Than Site Specific Background
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Arsenic = 1.6 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Site specific background for arsenic = 11.7 mg/kg as show in Table 2.4-2.
4. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
5. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

0 80 160 Feet

Figure 4.1-2
Distribution of Surface Soil Concentrations for Arsenic
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-2 - Distribution of Surface Soil Concentrations for Arsenic.pdf 3/6/2014 2:01 PM brian.roden

SB-400 3.5
BH39 4.3
BH40 2.2
SB-401 3.2
SB-402 3.8
SB-403 4.4
SB-404 1.5
SB-405 4.3
SB-406 2.5
SB-407 1.4
SB-408 3.7
SB-409 3.4
SB-410 1.7
SB-411 3.7
SB-412 3
SB-413 2.6
SB-414 3.6
SB-415 4.6
SB-416 3
BH29 4.7
BH32 4
SB-417 3.4
SB-418 16
SB-419 3.3
SB-420 2.9
SB-421 3.1
BH28 4.2
SB-422 2.7
SB-423 2.4
SB-424 3.4
BH27 7.5
BH30 5.5
BH34 4.2
SB-425 6.9
SB-426 4.4
SB-427 4.1
SB-428 5.2
SB-429 3.7
SB-430 1.7
SB-431 3.8
BH26 0.9
SB-432 0.9
SB-433 3.5
SB-434 4
BH33 3.2
SB-435 2.5
SB-436 1.5
SB-437 4
SB-438 4.2
SB-439 3
BH35 2.7
SB-441 2.9
SB-443 1.7
SB-444 3.1
SB-445 5.2
SB-440 4.6
SB-442 2.6
SB-446 0.5
SB-447 2.8
SB-450 4.1
SB-451 1.3
LPB14 <7
LPB15 <12
SB-448 3.1
LPB16 <12
SB-449 5
BH38 4.4
BH18 <2
BH37 7.1
LPB12 <6
BH17 4.4
SB-453 1.8
BH36 <2.9
LPB28 <12
LPB28 <13
BH16 2.3
LPB10 <12
LPB5 <11
LPB-2 2.5
LPB-2 4
BH14 3.7
BH12 4.2
LPB8 <6
LPB7 12
LPB8 <5
LPB7 <6
SB-454 3.1
SB-452 1
W1.35 1.3
E1.40 <2
W1.35 1.3
E2.22 2.6
E1.45 <2
E1.50 1.3
SB-456 6.9
E1.50 <0.81
SB-457 1.9
E2.70 <1
E1.75 1.4
E1.75 1.9
SB-455 5.3
BH15 5.5
SB-459 3.1
SB-458 4
SB-460 3.6
BD-C34 <1
BD-C35 7.1
BD-C9 <1
BD-C30 <1
BD-C20 <2
BD-C18 <5
BD-C19 3.8
BD-C25 <1
BD-C6 <1
BD-C15 <2
BD-C12 <2
BD-C21 <1
BD-C3 <2
BD-C14 <2
BD-C5 <2
BD-C11 <2
BD-C2 <2
BD-C7 2
BD-C1 <2
BD-C4 <1
WD-C15B <2
BH13 9.2
SB-466 2.3
BH11 12
SB-461 3.1
SB-470 9.9
SB-462 4.7
SB-463 3.2
BH31 5.7
SB-464 3.2
SB-465 2.5
SB-467 3.8
BH19 1.9
SB-468 1
SB-469 16
BH21 9.6
BH22 11
SB-471 4.3
BH23 2.2
OPWD-SO-N 7.53
OPWD-SO-N 8.98
OPWD-SO-N 10.6
OPWD-SO-N 10.4
BH9 13
BH5 9
SB-472 4.3
WD-C11 <2
WD-C11B 1.9
BH2 12
BH3 21
BH4 13
WD-C8B <2
WD-C8 2.2
BH10 1.1
OPWD-SO-WS 1.46
OPWD-SO-WS 0.92
OPWD-SO-WS 0.986
OPWD-SO-WS 1.27
BH6 16
SB-473 2.2
BH1 8
WD-C4B <2
WD-C4 6.8
BH8 4.6
BH7 4.3
CP-C56 4.9
CP-C47 2.8
CP-C49 3.2
CP-C69 89
CP-C60 8.8
CP-C65 6
CP-C39 4.8
CP-C35 6
OPWD-SO-S 1.2
OPWD-SO-S 1
OPWD-SO-S 1.27
OPWD-SO-S 1.38
CP-C28 2.5
CP-C80 6.5
CP-C21 2
CP-C13 2.8
CP-C84 1.6
CP-C16 2.2
CP-C90 11
CP-C87 1.6
SD-C27 <1
SD-C35 3.5
SD-C8 2.1
RSO-16 8.6
RSO-17 5.9
RSO-18 10

Legend

- Detected Concentration Below Industrial RSL
- Detected Concentration Greater Than Industrial RSL and Below Site Specific Background
- Detected Concentration Greater Than Site Specific Background
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Arsenic = 1.6 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Site specific background for arsenic = 11.7 mg/kg as show in Table 2.4-2.
4. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
5. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 60 120
Feet

Figure 4.1-3
Distribution of Soil (1 to 10 ft) Concentrations for Arsenic
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-3 - Distribution of Soil (1-10 ft) Concentrations for Arsenic.pdf 3/6/2014 1:56 PM brian.roden

SB-400 1.8
SB-403 1.2
SB-404 2.2
SB-406 1.3
SB-407 4.2
SB-405 2.6
SB-409 4.7
SB-410 1.8
SB-413 2.2
SB-414 2.2
SB-412 2.1
SB-415 2.2
SB-416 2.2
SB-417 2.4
SB-418 2.8
SB-419 2.1
SB-422 3.7
SB-420 1.6
SB-421 2.3
SB-423 1.8
SB-424 2.3
SB-425 3.3
SB-429 0.99
SB-430 3.2
SB-426 3
SB-427 2
SB-427 3.8
SB-428 4.9
SB-435 1.5
SB-432 2.5
SB-433 3.3
SB-434 5.8
SB-436 2.8
SB-443 4.5
SB-437 3.7
SB-438 2.7
SB-439 3.2
SB-440 2.2
SB-444 6.4
SB-441 3
SB-448 1.5
SB-449 4.6
SB-445 4.9
SB-442 2.6
SB-446 3.6
SB-447 3.9
SB-450 4.5
SB-454 4.4
SB-451 6
SB-452 7.8
TE2.10 3.74
SB-456 3.5
SB-455 2.9
SB-457 4
E2.70 <1
SB-458 3.5
SB-459 3.8
SB-460 3.9
BH11 18
SB-466 2
BH20 4.2
SB-461 4.8
SB-462 2.2
SB-463 3
SB-464 3.2
SB-465 6.6
SB-470 <5
SB-469 2.2
SB-469 1.6
SB-467 4.2
SB-468 3.8
SB-471 3.6
BD-C13 <1
BD-C10 <2
WD-C16 <2
WD-C15 <2
SB-472 4
SB-473 5.3
SB-473 7.5

Legend

- Detected Concentration Below Industrial RSL
- Detected Concentration Greater Than Industrial RSL and Below Site Specific Background
- Detected Concentration Greater Than Site Specific Background
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Arsenic = 1.6 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Site specific background for arsenic = 11.7 mg/kg as show in Table 2.4-2.
4. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
5. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 50 100 Feet

Figure 4.1-4
Distribution of Soil (Greater Than 10 ft) Concentrations for Arsenic
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-4 - Distribution of Soil (Greater Than 10 ft) Concentrations for Arsenic.pdf 3/6/2014 12:14 PM brian.roden

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Chromium = 1,500,000 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

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Chelmsford, MA 01824

N

0 80 160 Feet

Figure 4.1-5
Distribution of Surface Soil Concentrations for Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-5 - Distribution of Surface Soil Concentrations for Chromium.pdf 3/6/2014 2:19 PM brian.roden

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)

- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Chromium = 1,500,000 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

N

0 60 120
Feet

Figure 4.1-6
Distribution of Soil (1 to 10 ft)
Concentrations for Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Internal Drafts\Figures\Figure 4.1-6 - Distribution of Soil (1-10 ft) Concentrations for Chromium.pdf 4/16/2013 10:27 AM brian.roden

SB-400 7.5
SB-403 5.3
SB-404 11
SB-406 27
SB-407 16
SB-405 37
SB-409 22
SB-410 20
SB-413 16
SB-414 18
SB-412 27
SB-415 11
SB-416 39
SB-417 27
SB-418 29
SB-419 150
SB-422 16
SB-420 12
SB-421 38
SB-423 17
SB-429 29
SB-424 88
SB-425 46
SB-426 100
SB-427 7.6
SB-427 8.7
SB-430 22
SB-435 11
SB-432 18
SB-428 21
SB-436 200
SB-433 49
SB-434 40
SB-443 20
SB-437 35
SB-444 130
SB-438 17
SB-439 17
SB-440 13
SB-441 19
SB-448 390
SB-449 160
SB-445 48
SB-446 26
SB-447 12
SB-442 13
LAKE POLY 1-B 3400
SB-450 18
SB-454 250
SB-451 48
LPB18 1200
SB-452 17
B-1A 190
TE2.10 53.5
B-1B 260
SB-455 18
B-3A 200
SB-456 280
B-2A 47
B-3A 160
B-2A 6.2
SB-457 180
E2.70 39.7
SB-458 13
SB-459 460
SB-460 120
BH11 25
SB-466 250
SB-461 230
BH20 230
SB-462 150
SB-463 16
SB-464 53
SB-465 9.2
SB-470 50
SB-467 250
SB-469 33
SB-468 23
SB-469 240
SB-471 21
BD-C13 5
BD-C10 4.8
WD-C16 6
WD-C15 19
SB-472 280
SB-473 230
SB-473 360

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Chromium = 1,500,000 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

N

0 50 100 Feet

Figure 4.1-7
Distribution of Soil (Greater Than 10 ft) Concentrations for Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Internal Drafts\Figures\Figure 4.1-7 - Distribution of Soil (Greater Than 10 ft) Concentrations for Chromium.pdf 4/16/2013 10:31 AM brian.roden

SB-503
<2.9
SB-504
0.29
SB-506
11
SB-505
0.34
SB-507
1.3
SB-510
10
SB-511
0.45
LP-102
1.22
LP-102
2.29
SB-509
<27
SB-512
6.2
SB-508
<3
LP-105
0.42
LP-103
0.41
SB-456
2.1
SB-457
6.8
SB-514
0.54
SB-519
<30
SB-518
<28
SB-513
<0.23
SS-416
7.3
SB-522
<0.25
SB-517
1.2
SB-523
0.39
SB-470
6.8
SB-469
<2.1
SB-524
0.31
SB-525
0.52
SS-510
<2.6
SB-473
<2.4
SS-511
<3.8
SS-513
<3.5
SS-512
<2.9
SS-514
<2.2
SS-517
<2.4
BS045
<95
SS-519
<4
SS-520
<4.7
SS-515
<2.5
BS044
<63
SDF-6
<2.5
SS-518
<3.9
SS-516
<2.4
SS-522
<3.2
BS043
<80
SS-521
<4.9
SDF-5
<1.7
SS-523
<3.5
BS042
<54
SDF-4
<1.7
SS-436
<3
SDF-3
<1.1
SS-437
8.9
BS041
<49
SS-524
<4.4
SS-438
<3.7
SB-527
<2.9
SS-439
<4.2
BS040
<30
SS-441
<3.3
SB-528
19
SDF-1
28
SS-443
<3.5
SS-445
1100
SS-525
<3.0
SS-444
<3.3
SDF-2
26
SOLSD14
<110
SB-526
<3.4
SS-446
<2.8
SS-447
<7.2
SB-529
<3.3

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- *2.5* Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Hexavalent Chromium = 5.6 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 80 160 Feet

Figure 4.1-8
Distribution of Surface Soil Concentrations for Hexavalent Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-5 - Distribution of Surface Soil Concentrations for Chromium.pdf 3/6/2014 2:19 PM brian.roden

SB-503
<2.5

SB-504
<0.26

SB-506
<0.23

SB-505
0.58

SB-507
<0.25

SB-510
6

SB-511
0.5

LP-101
14.5

LP-101
19.9

SB-449
<2.4

SB-509
28

LP-102
12.7

LP-102
2.78

SB-508
1.1

SB-512
0.87

SB-454
5.7

LP-105
0.47

LP-103
1.76

SB-456
3.9

SB-457
4

SB-518
<0.25

SB-519
0.29

SB-514
0.21

SB-459
<2.3

SB-521
0.27

SB-513
1.0

SB-522
1.6

SB-466
<2.1

SB-461
<2.4

SB-517
0.32

SB-523
0.17

SB-470
8.4

SB-469
<2.1

SB-524
0.34

SB-472
<2.4

SB-525
<0.24

SB-473
<2.3

SB-527
<2.9

SB-528
4.0

SB-526
<2.7

SB-529
<2.4

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- *2.5* Detected Analyte Concentration (mg/kg)

- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Hexavalent Chromium = 5.6 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

N

0 60 120
Feet

Figure 4.1-9
Distribution of Soil (1 to 10 ft)
Concentrations for Hexavalent Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

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SB-503
ND

SB-506
ND

SB-507
4.1

SB-511
2.3

SB-508
0.26

SB-512
1.4

SB-454
10

SB-456
9.7

SB-457
11

SB-514
0.88

SB-513
0.47

SB-518
36

SB-519
2.2

SB-521
48

SB-522
0.2

SB-466
16

SB-517
8

SB-523
1.1

SB-470
2.6

SB-524
ND

SB-472
5.3

SB-525
9.7

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Hexavalent Chromium = 5.6 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

N

0 50 100 Feet

Figure 4.1-10
Distribution of Soil (Greater Than 10 ft) Concentrations for Hexavalent Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

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SS-400 <0.0096
SS-401 <0.005
SS-402 <0.01
AREA-4 <0.011
SB-400 <0.0046
SB-494 <0.0046
AREA-5 <0.01
SB-401 <0.0051
SB-402 <0.005
SB-490 <0.0049
SB-495 <0.0065
SS-404 <0.0054
SB-485 <0.0059
SS-405 <0.005
SB-403 <0.0046
SB-406 <0.012
SB-407 <0.006
SB-408 <0.005
SB-405 <0.0047
SB-488 <0.0049
SB-409 <0.005
SB-411 <0.0048
SB-413 <0.0091
SB-410 <0.005
SB-414 <0.0051
SB-480 <0.005
SB-496 <0.0075
SB-412 <0.0054
SB-481 <0.0049
SB-497 <0.27
SB-479 <0.0061
SS-406 <0.0075
SS-407 <0.0074
SB-415 <0.0055
SB-416 <0.0051
SB-422 <0.0044
SS-408 <0.0048
SB-418 <0.0049
SB-417 <0.0044
SB-478 <0.0077
SB-419 <0.0051
SB-420 2.64
SB-421 1.81
SB-423 <0.0052
SB-477 <0.0064
SB-426 <0.0044
SB-424 <0.0057
SB-427 <0.0054
SB-476 <0.0083
SB-430 <0.0054
SB-425 1.54
SB-435 <0.039
AREA-3 <0.014
SB-431 <0.0046
SB-432 <0.32
SB-475 <0.0057
SB-433 <0.0055
SB-434 <0.0047
SS-411 <0.02
LPB14 <0.12
SB-436 <0.0055
SS-409 <0.0049
SB-474 <0.0063
SB-437 <0.0049
SB-438 <0.0054
SB-443 <0.0049
SB-440 <0.0045
SB-441 <0.0049
SB-444 <0.0048
SB-428 <0.0044
AREA-6 <0.01
SWMU-25 <0.01
SB-448 <0.0051
SB-449 <0.0061
SB-445 <0.0049
SB-446 <0.0054
SB-439 <0.0053
SB-442 <0.0052
SB-453 <0.038
LAKE POLY-2 <0.005
SB-450 <0.005
SB-447 <0.006
LPB5 <0.099
SB-454 <0.0055
SB-451 <0.0052
SB-452 <0.0055
SWMU-27-101 <0.009
LAKE POLY-3 <0.005
SB-518 0.036
SB-456 <0.0054
SB-457 <0.005
SS-412 <0.0054
SS-415 <0.016
SB-514 0.046
SB-520 <0.0048
SS-414 <0.0052
SB-458 <0.0052
SB-459 0.61
SB-460 <0.0055
SWMU-26-1 <0.006
BD-C22 <0.49
BD-C31 <0.13
SS-416 <0.0053
BD-C26 <0.13
SB-462 <0.0047
SB-463 <0.0049
SB-464 <0.0052
SWMU-26-2 <0.006
SB-466 <0.0051
SB-517 0.99
SB-465 <0.0054
OSFILL-1220 <0.13
OSFILL-1170 <0.13
SS-417 0.002
SB-470 <0.005
SB-469 <0.005
SB-468 <0.0053
SWMU-26-3 <0.006
OSFILL-1120 <0.13
SB-471 <0.0049
SWMU-26-4 <0.006
DA-C10 <0.13
OPWD-SO-N <0.15
SS-419 <0.0051
DA-C9 <0.12
DA-C5 <0.12
AREA-7 <0.01
SS-420 <0.0046
SB-472 <0.0056
SS-421 <0.006
SS-418 <0.0055
SS-422 <0.0058
OPWD-SO-WS <0.15
SS-423 <0.0048
SB-473 <0.0073
SS-424 <0.0049
SS-428 <0.0049
SS-425 <0.0048
AREA-9 <0.012
SS-426 <0.0048
SS-429 <0.0065
CPDA-1 <0.007
SS-427 <0.0069
CPDA-2 <0.011
OSFILL-600 <0.13
SS-430 <0.006
A8CW-3 <0.006
A8CW-4 0.002
SS-431 <0.0045
OSFILL-550 <0.12
OSFILL-530 <0.14
A9CW-1 <0.01
OPWD-SO-S <0.17
SS-432 <0.0063
OSFILL-450 <0.13
A8CW-2 <0.006
SD-C43B <0.16
OSFILL-460 <0.13
OSFILL-400 <0.13
CPDA-8 <0.007
SD-C42B <0.18
CPDA-5 <0.007
A9CW-2 <0.007
SS-433 <0.0078
AREA-1-6 <0.008
SD-C21B <0.14
AREA-8-3 <0.006
AREA-8-2 <0.006
A9CW-3 <0.007
SD-C52N <0.13
SD-C29B <0.14
SD-C19B <0.13
SD-C17B <0.14
SDF-6 <0.4
SD-C6 <0.34
A9CW-4 <0.007
SD-C15 <0.17
SWMU-33-102 <0.009
SS-434 <0.0061
SD-C10 <0.14
SWMU-33-103 <0.012
SS-448 <0.0057
SWMU-33 <0.033
SDF-5 <0.3
SWMU-33-101 <0.013
SS-435 <0.39
SS-449 <0.0071
SDF-4 <0.79
SS-436 <0.0063
SDF-3 <0.72
SS-437 <0.0068
SS-450 <0.0074
SS-438 <0.01
SS-439 <0.0095
SS-440 <0.0085
SS-443 <0.0086
SS-441 <0.0096
SS-451 <0.0062
SDF-1 <0.47
SS-442 <0.012
SS-445 0.0056
SS-453 <0.0076
SS-444 <0.0095
SDF-2 <0.56
SS-446 <0.008
SS-452 <0.0054
SS-454 <0.0057
SS-456 <0.0064
SS-457 <0.0052
SS-455 <0.0061
SS-458 <0.0072
SS-459 <0.0067
AREA-10 <0.01
SS-460 <0.0064
SS-461 <0.0071

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (calculated) for TotalTMPs = 39 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 80 160 Feet

Figure 4.1-11
Distribution of Surface Soil Concentrations for Total Trimethylpentenes
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

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RSO-01 <0.006
SB-494 <0.0051
SB-400 <0.0049
BH39 0.006
BH40 <0.01
RSO-03 <0.005
SB-401 <0.0044
SB-490 <0.0044
RSO-02 <0.005
SB-403 <0.012
SB-404 <0.0048
SB-402 <0.0057
SB-502 <0.0045
SB-491 <0.0049
SB-406 <0.0045
SB-407 <0.0052
SB-485 <0.0042
SB-486 4.55
SB-495 <0.0045
SB-501 <0.0048
SB-408 <0.0047
SB-488 <0.0049
SB-405 1510
SB-484 0.0016
RSO-05 <0.007
SB-409 <0.0049
SB-500 0.0012
SB-410 <0.0051
SB-480 <0.26
SB-497 <0.0049
SB-496 <0.0052
SB-413 <0.0051
SB-414 <0.0052
SB-481 <0.26
SB-479 <0.0045
SB-411 <0.0054
SB-412 <0.0051
SVE-14 <18
SB-480 <0.0049
SVESB-7 <0.14
SB-416 176
SVESB-6 90
SVESB-8 82
SVESB-5 550
SVESB-5 74
SB-415 <0.0053
RSO-04 <0.005
SVE-15 <1.7
BH29 0.104
SVE-13 <1.6
BH32 0.02
SB-417 <0.24
SB-418 <0.0045
BH28 0.62
SB-478 < 0.19
SB-419 <0.0054
SVESB-2 <0.15
SB-420 315
SB-421 <0.0046
AS-9 <1.6
SB-422 <0.0052
SVE-12 <3
SB-477 194
SVESB-3 0.27
SVE-6B 1.5
BH30 0.043
SB-429 <0.005
RSO-07 <0.006
SB-423 <0.0046
SVESB-1 18.1
BH34 2.42
SB-476 257
SB-430 <0.0043
SB-426 <0.0053
SVESB-4 <0.15
AS-1 2.1
SVE-16 <89
SB-424 <0.0044
AS-4 140
SB-427 <0.0051
SB-475 87
SB-435 <0.0043
SB-431 <0.0043
SB-432 <0.28
BH26 1.36
AS-3 0.94
SB-425 <0.0054
SB-428 <0.0049
BH27 0.007
SB-434 <0.0051
SB-474 <0.0051
LPB14 <0.13
SB-436 <0.0055
SVE-11 <1.7
BH33 <0.011
LPB15 <0.11
SB-433 <0.005
BH35 0.035
BH38 0.249
SB-437 <0.0053
SB-439 <0.0053
SB-443 <0.0051
LAKEPOLY1-01 2.32
BH18 0.114
LPB12 6.2
SB-438 <0.005
SB-441 <0.0047
SB-444 <0.0052
RSO-08 <0.005
SB-440 <0.0054
BH37 0.018
LPB16 <0.12
SB-449 0.0133
SB-445 <0.0048
SB-442 <0.0046
SB-453 0.0047
BH36 0.039
SB-448 <0.004
BH17 1.21
SB-446 <0.0055
SB-447 0.055
LAKEPOLY1-02 142
SB-454 <0.0047
SB-450 <0.0051
SB-451 <0.0052
BH16 <0.011
LPB28 <0.12
LPB10 15.4
LPB28 <0.12
LPB10 146
LPB5 <0.11
LPB-2 13.3
LPB-2 1.21
BH14 0.008
SB-452 <0.0049
SB-455 <0.0065
SB-518 0.00094
BH12 0.01
LPB8 <0.12
LPB7 <0.11
SB-456 <0.0047
SB-457 <0.0045
LPB8 <0.12
RSO-09 0.054
RSO-09 0.235
BD-C9 <0.14
SB-520 0.0014
BD-C35 <0.19
SB-458 <0.0053
BD-C34 <0.17
BH15 6
SB-515 <0.28
SB-459 0.094
BD-C19 1.51
BD-C30 <0.15
SB-460 <0.0058
SB-464 <0.0047
BH25 3.15
BD-C18 23.8
BD-C25 <0.16
SB-516 <0.27
BH13 0.017
BD-C15 <0.16
BD-C6 <0.15
RSO-10 <0.005
SB-463 <0.0046
BH31 0.003
BD-C20 8.9
BD-C21 <0.15
BH11 3.2
SB-461 <0.0049
SB-517 0.078
SB-462 <0.0051
BH24 0.066
BD-C12 <0.17
BD-C3 <0.14
BD-C2 <0.14
SB-466 <0.0047
SB-465 <0.005
BD-C14 <0.17
BD-C5 <0.14
DA-C34 <0.13
SB-467 <0.0053
BD-C11 <0.16
BD-C4 <0.15
DA-C26 <0.13
SB-470 <0.0053
SB-469 <0.005
BH19 0.004
SB-468 <0.005
BD-C7 <0.16
BD-C1 <0.12
DA-C33 2.3
DA-C25 <0.15
BH21 0.026
BH22 0.021
DA-C31 <0.12
DA-C32 <0.13
DA-C19 <0.13
SB-471 <0.0046
BH23 12.1
DA-C22 1.35
DA-C24 <0.15
DA-C15 <0.13
WD-C15B <0.16
DA-C30 0.37
DA-C23 <0.16
RSO-11 <0.005
DA-C29 7.9
DA-C35 9.9
DA-C14 9.7
BH9 4.21
DA-C28 <0.14
DA-C13 95
DA-C8 0.85
DA-C21 0.42
DA-C18 <0.14
DA-C27 <0.13
DA-C12 <0.15
DA-C7 <0.14
DA-C17 0.44
DA-C4 <0.14
BH5 0.001
SB-472 <0.0049
DA-C6 <0.12
WD-C11 <0.14
DA-C3 <0.13
WD-C11B <0.14
DA-C20 <0.13
DA-C16 <0.12
BH2 <0.011
DA-C2 <0.13
BH3 0.003
DA-C11 <0.12
BH4 <0.011
RSO-12 <0.006
WD-C8B <0.12
WD-C8 <0.16
BH10 0.028
OPWD-SO-N <0.15
BH6 <0.011
SB-473 <0.005
DB-C2 0.41
DB-C13 0.55
DB-C6 0.37
OPWD-SO-WS <0.16
BH1 <0.0000013
WD-C4B <0.15
WD-C4 <0.15
BH8 0.051
BH7 <0.011
CP-C56 <0.15
CP-C47 <0.15
CP-C49 <0.14
CP-C69 <0.14
RSO-15 <0.009
CP-C60 <0.2
CP-C65 0.41
CP-C39 <0.12
RSO-13 <0.006
CP-C35 <0.16
OPWD-SO-S <0.15
CP-C28 <0.12
CP-C80 <0.14
CP-C21 0.72
CP-C84 <0.12
CP-C13 0.76
CP-C16 0.76
CP-C90 0.3
CP-C87 <0.12
SD-C27 <0.14
SD-C35 1.73
SD-C52S <0.13
SD-C8 <0.14
RSO-16 <0.006
RSO-17 <0.01
RSO-18 <0.008

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (calculated) for TotalTMPs = 39 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 60 120
Feet

Figure 4.1-12
Distribution of Soil (1 to 10 ft) Concentrations for Total Trimethylpentenes
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/11/14 | Checked/Date: CTM 03/11/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-12 - Distribution of Soil (1-10 ft) Concentrations for Total TMPs.pdf 3/11/2014 11:57 AM brian.roden

SB-494
<0.0047
SB-485
0.016
SB-405
2.92
SB-497
<0.0041
SB-416
0.047
SVEMW-9
0.74
SB-421
5.6
SB-420
0.044
SVE-6B
95
AS-5
6.1
AS-1
200
AS-3
<1.6
SB-478
348
SB-477
443
SB-476
153
SB-427
1070
SB-427
<0.005
SB-475
<0.0052
SB-428
<0.0053
SB-474
<0.0052
SB-435
<0.0047
SB-432
0.25
SB-444
<0.0047
SB-438
<0.0042
SB-440
<0.0044
SB-448
<0.0044
LAKE POLY-1-B
<0.13
SB-447
<0.0047
SB-518
0.0031
SB-520
0.0025
SB-456
<0.0053
SB-457
<0.0041
SB-515
<0.24
SB-459
<0.0047
SB-516
0.029
BH11
0.005
SB-466
<0.0044
BH20
0.047
SB-461
<0.0044
SB-517
0.208
SB-462
<0.0045
SB-465
<0.0053
SB-467
<0.0045
SB-470
<0.0047
SB-469
<0.0047
SB-469
<0.0041
BD-C13
<0.15
BD-C10
<0.15
WD-C16
<0.15
SB-472
<0.004

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (calculated) for TotalTMPs = 39 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

0 50 100 Feet

Figure 4.1-13
Distribution of Soil (Greater Than 10 ft) Concentrations for Total Trimethylpentenes
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

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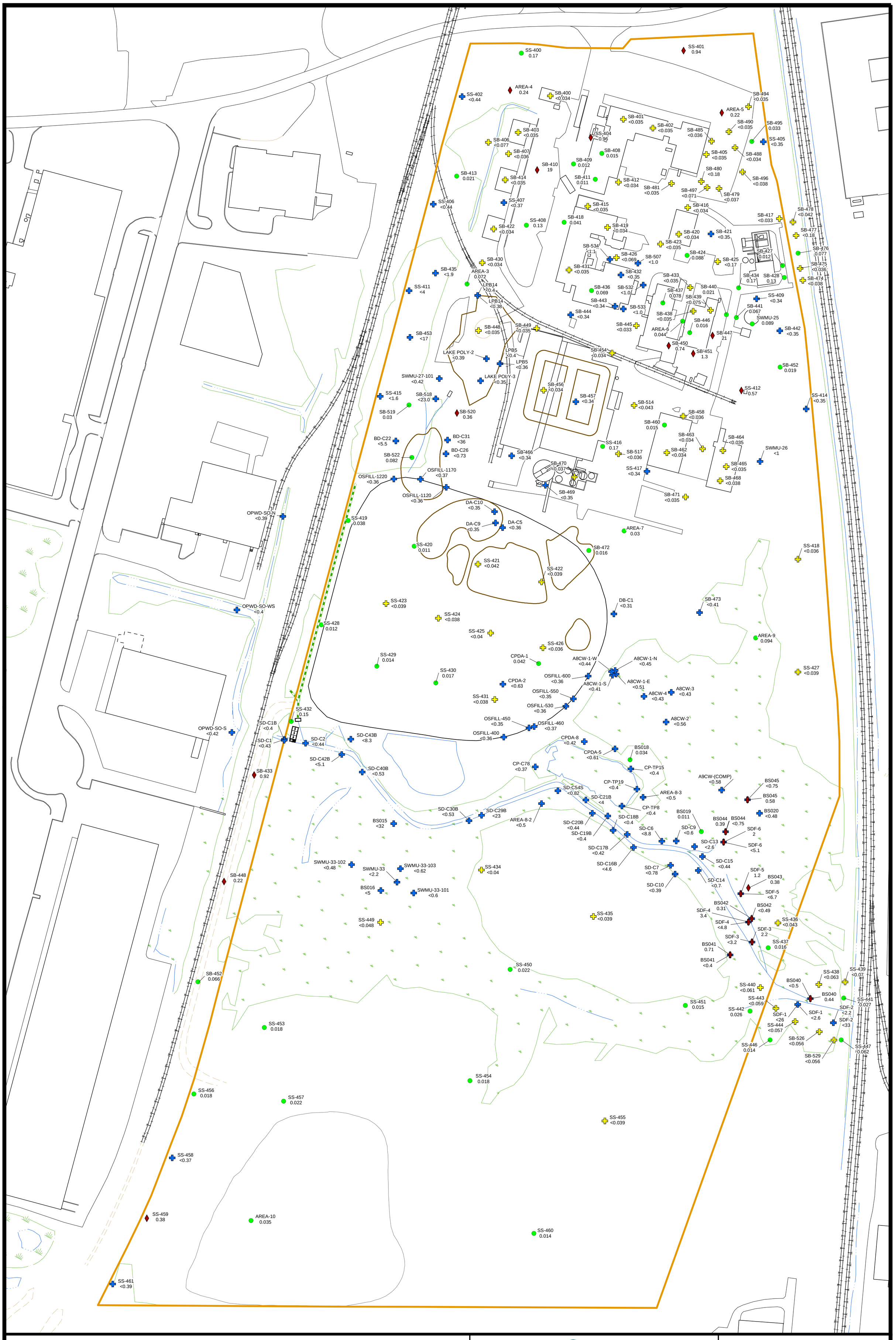

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Bezno(a)Pyrene = 0.21 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

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271 Mill Road
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0 80 160 Feet

Figure 4.1-14
Distribution of Surface Soil Concentrations for Benzo(a)pyrene
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

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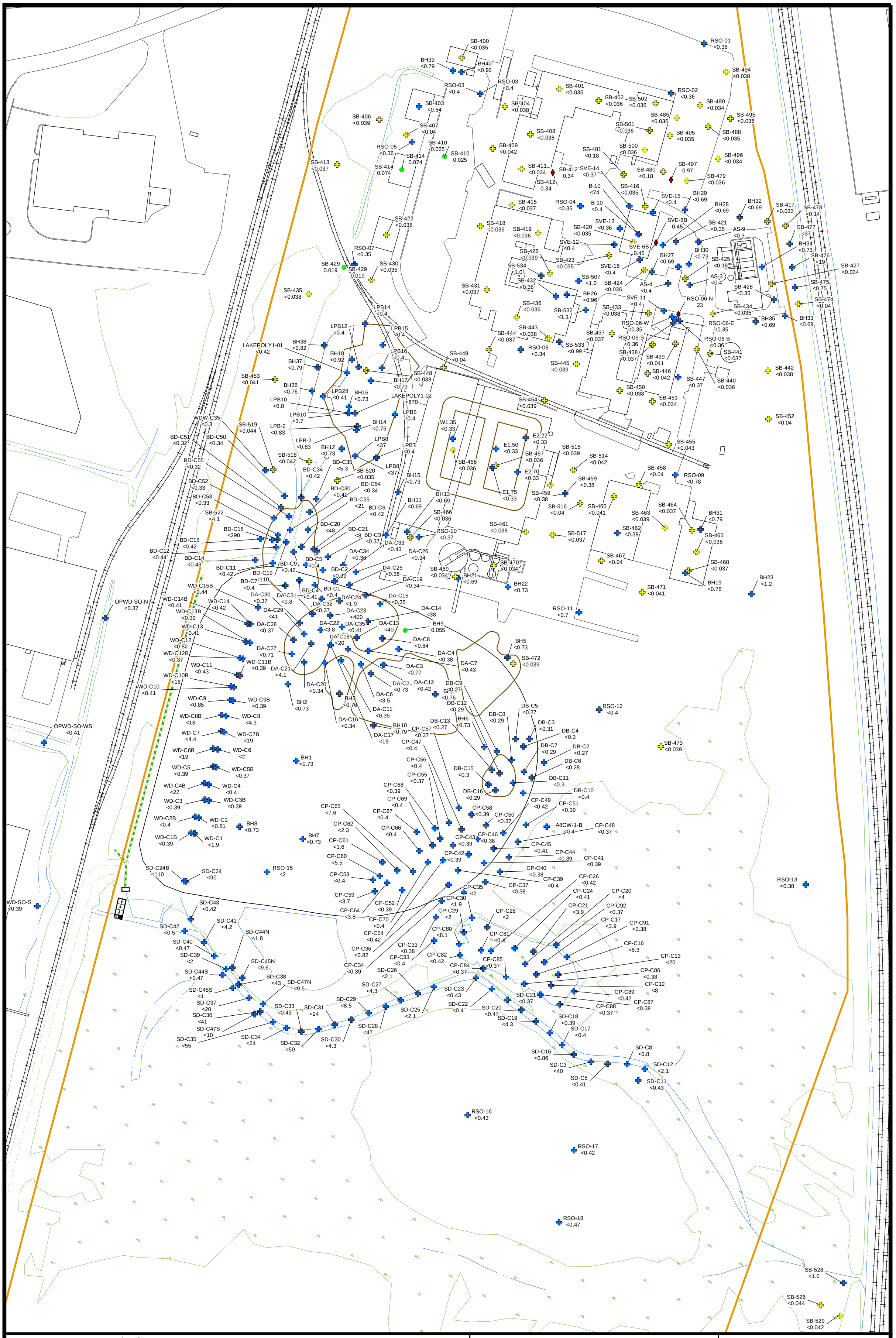

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Bezno(a)Pyrene = 0.21 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

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2 Robbins Rd
Westford, MA 01886

N

0 60 120
Feet

Figure 4.1-15
Distribution of Soil (1 to 10 ft)
Concentrations for Benzo(a)pyrene
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

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SB-400 <0.037
SB-403 <0.042
SB-404 <0.035
SB-406 <0.037
SB-407 0.013
SB-409 <0.037
SB-410 0.012
SB-412 <0.037
SB-413 <0.036
SB-414 <0.036
SB-415 <0.035
SB-416 <0.036
SB-417 <0.041
SB-418 <0.037
SB-419 <0.036
SB-420 <0.036
SB-421 <0.036
SB-422 <0.038
SB-423 <0.035
SB-424 <0.037
SB-425 <0.035
SB-426 <0.038
SB-427 <0.74
SB-428 <0.037
SB-429 <0.036
SB-430 <0.034
SB-432 <0.35
SB-433 <0.036
SB-434 <0.038
SB-435 <0.036
SB-436 <0.034
SB-437 <0.035
SB-438 <0.035
SB-440 <0.036
SB-441 <0.036
SB-442 <0.036
SB-443 <0.036
SB-444 <0.035
SB-445 <0.036
SB-446 <0.036
SB-447 <0.037
SB-448 <0.036
SB-449 <0.037
SB-450 <0.036
SB-451 <0.037
SB-452 <0.036
SB-454 <0.035
SB-455 <0.035
SB-456 <0.036
SB-457 <0.042
SB-458 <0.036
SB-459 <0.037
SB-460 <0.037
SB-461 <0.035
SB-462 <0.036
SB-463 <0.036
SB-464 <0.036
SB-465 <0.037
SB-466 <0.036
SB-467 <0.037
SB-468 <0.036
SB-469 <0.036
SB-470 <0.036
SB-471 <0.036
SB-472 <0.036
SB-473 <0.036
SB-474 <0.04
SB-475 <0.036
SB-476 <7.5
SB-477 <0.96
SB-478 <1.9
SB-485 <0.036
SB-494 <0.036
SB-497 <0.073
SB-502 <0.036
SB-507 <1.1
SB-514 <0.036
SB-515 <0.039
SB-516 <0.042
SB-517 <0.042
SB-518 <0.82
SB-519 <0.042
SB-520 <0.035
SB-522 <0.04
SB-532 <1.3
SB-533 <1.2
TE2.10 <0.396
E2.70 <0.33
AS-1 <0.4
AS-2 <0.4
AS-3 <0.4
AS-5 <0.4
AS-7 <0.4
AS-8 <0.4
SVE-6B <0.4
BH11 <0.73
BH20 <0.69
LAKE POLY 1-B <0.37
BD-C13 <0.42
BD-C10 <0.41
WD-C16 <0.42
WD-C15 <0.42

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Bezno(a)Pyrene = 0.21 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

N

0 50 100 Feet

Figure 4.1-16
Distribution of Soil (Greater Than 10 ft) Concentrations for Benzo(a)pyrene
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

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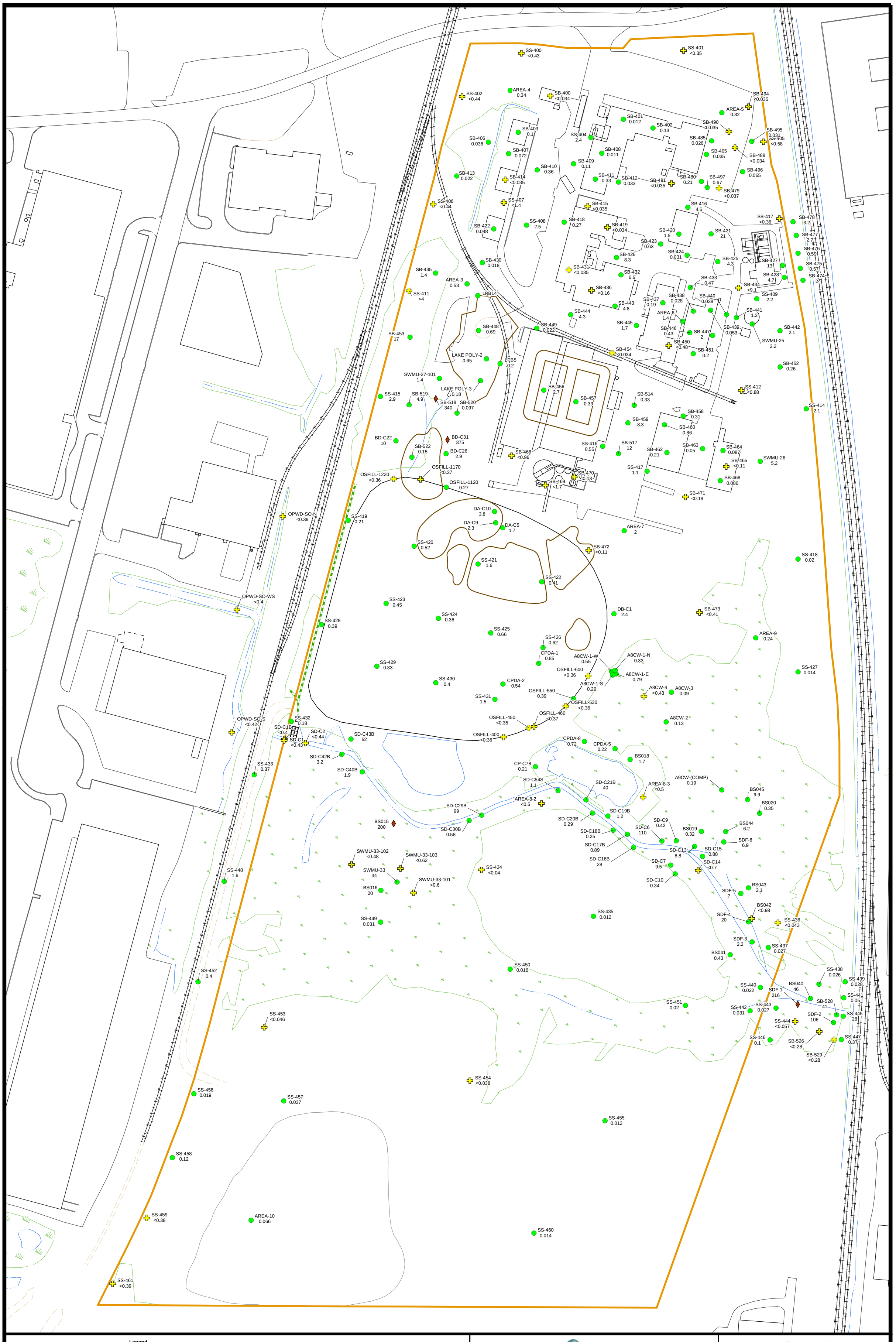

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- *2.5* Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Bis(2-ethylhexyl)phthalate = 120 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

0 80 160 Feet

Figure 4.1-17
Distribution of Surface Soil Concentrations for Bis(2-ethylhexyl)phthalate
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

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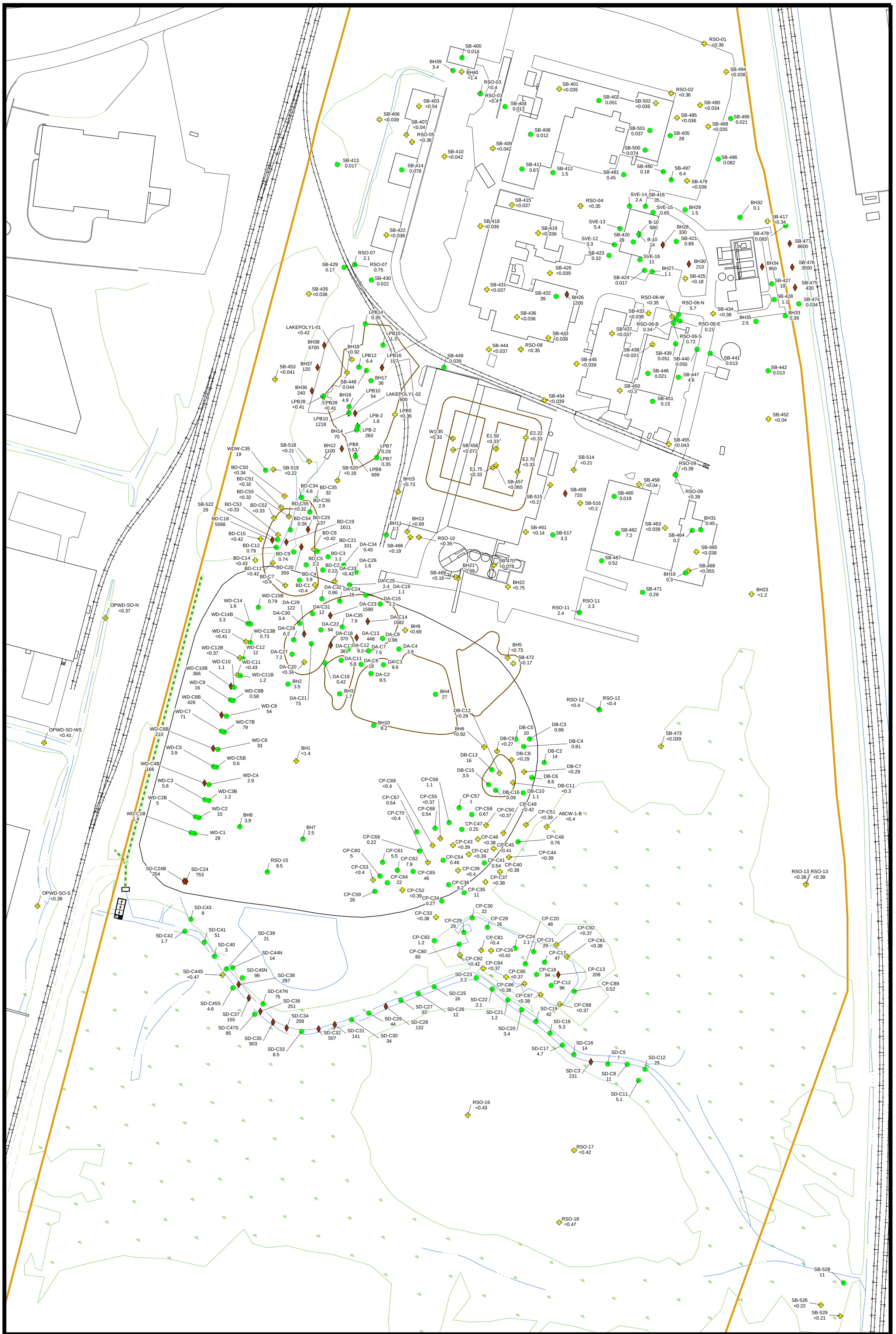

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SB-400 <0.037
SB-494 0.022
SB-403 <0.042
SB-404 <0.035
SB-485 <0.036
SB-406 0.037
SB-407 <0.037
SB-405 0.36
SB-409 <0.037
SB-410 <0.036
SB-413 0.016
SB-414 <0.036
SB-412 0.015
SB-497 0.92
SB-415 <0.035
SB-416 0.053
SB-418 <0.037
SB-419 <0.036
SB-417 <0.39
SB-478 1600
SB-422 <0.038
SB-420 0.074
SB-421 420
AS-7 25
SB-477 28
SB-423 0.11
AS-1 29
SB-424 1.1
SB-426 <0.038
SB-425 0.062
AS-3 1.6
SB-476 1900
SB-429 0.027
SB-427 10000
SB-427 13
SB-430 0.017
SB-475 0.48
SB-435 <0.036
SB-432 600
SB-428 <0.42
SB-474 0.05
SB-434 <0.38
SB-436 <0.034
SB-433 0.044
SB-443 0.034
SB-437 <0.035
SB-438 0.021
SB-440 0.023
SB-441 0.025
SB-444 <0.035
SB-445 0.018
SB-442 <0.036
SB-448 0.029
SB-449 <0.037
LAKE POLY 1-B 1.2
SB-446 0.024
SB-447 0.022
SB-450 <0.34
SB-454 <0.035
SB-451 <0.037
SB-452 0.023
TE2.10 <0.396
SB-455 <0.035
SB-518 12
SB-456 <0.34
SB-514 <0.18
SB-519 <0.21
SB-457 <0.075
E2.70 <0.33
SB-520 <0.18
SB-515 <0.19
SB-458 <0.036
SB-459 <0.11
SB-516 <0.21
SB-460 0.022
SB-517 <0.21
SB-461 <0.14
SB-522 <0.2
BH11 <0.73
SB-466 <0.19
BH20 <0.69
SB-462 <0.11
SB-463 <0.036
SB-464 <0.036
SB-465 <0.041
SB-470 <0.087
SB-467 <0.075
SB-468 <0.036
BD-C13 <0.42
BD-C10 <0.41
SB-469 <0.23
SB-469 <0.23
WD-C16 0.64
WD-C15 <0.42
SB-471 <0.083
SB-472 <0.11
SB-473 <0.036

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Bis(2-ethylhexyl)phthalate = 120 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

N

0 50 100 Feet

Figure 4.1-19
Distribution of Soil (Greater Than 10 ft) Concentrations for Bis(2-ethylhexyl)phthalate
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

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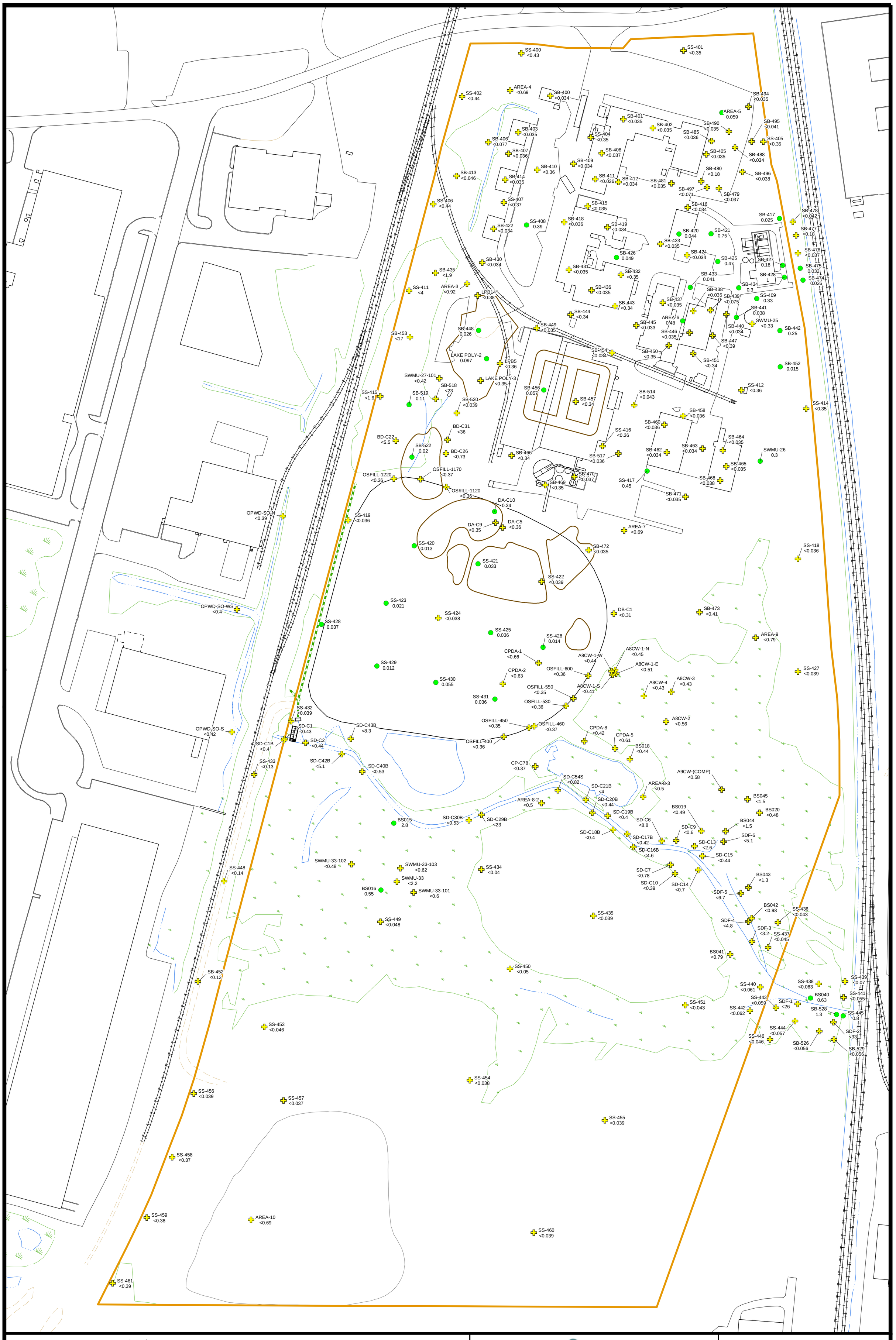

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for N-Nitrosodiphenylamine = 350 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

0 80 160 Feet

Figure 4.1-20
Distribution of Surface Soil Concentrations for N-Nitrosodiphenylamine
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/06/14 | Checked/Date: CTM 03/06/14

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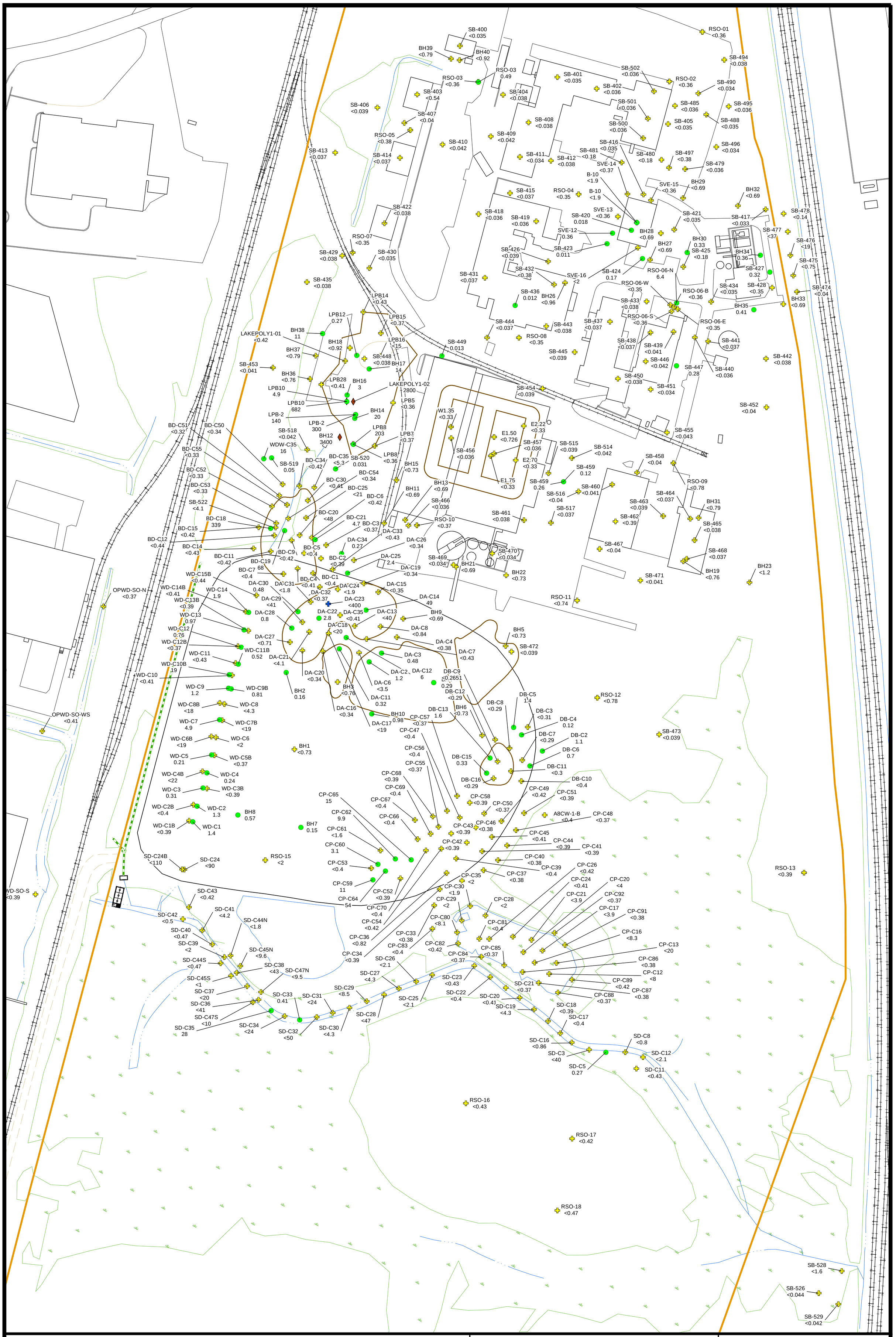

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for N-Nitrosodiphenylamine = 350 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

N

0 60 120 Feet

Figure 4.1-21
Distribution of Soil (1 to 10 ft) Concentrations for N-Nitrosodiphenylamine
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

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SB-400 <0.0185
SB-494 <0.018
SB-403 <0.021
SB-404 <0.0175
SB-485 <0.018
SB-406 <0.0185
SB-405 <0.018
SB-407 <0.0185
SB-409 <0.0185
SB-410 <0.018
SB-413 <0.018
SB-414 <0.018
SB-412 <0.0185
SB-497 <0.0365
SB-415 <0.0175
SB-416 0.045
SB-478 <0.95
SB-417 <0.0205
SB-418 <0.0185
SB-419 <0.018
SB-420 0.013
SB-421 0.67
AS-7 4.6
SB-422 <0.019
SB-423 <0.0175
SB-476 <3.75
SB-477 <0.48
AS-1 46
SB-427 0.15
SB-429 <0.018
SB-424 0.018
SB-427 0.11
SB-426 <0.019
AS-3 24
SB-430 <0.017
SB-425 0.17
SB-427 160
SB-475 <0.018
SB-435 <0.018
SB-432 <0.175
SB-428 <0.0185
SB-436 <0.017
SB-433 <0.018
SB-434 <0.019
SB-474 <0.02
SB-437 <0.0175
SB-440 <0.018
SB-443 <0.018
SB-438 <0.0175
SB-444 0.026
SB-441 <0.018
SB-448 <0.018
SB-445 <0.018
SB-449 <0.0185
SB-442 <0.018
SB-446 <0.018
SB-447 <0.0185
LAKE POLY 1-B <0.185
SB-450 <0.018
SB-454 <0.0175
SB-451 <0.0185
SB-452 <0.018
TE2.10 <0.198
SB-455 <0.0175
SB-518 <0.41
SB-519 <0.021
SB-456 <0.018
SB-514 <0.018
SB-457 <0.021
E2.70 <0.165
SB-520 0.026
SB-459 <0.0185
SB-458 <0.018
SB-515 <0.0195
SB-460 <0.0185
SB-516 <0.021
SB-463 <0.018
SB-522 <0.02
SB-461 <0.0175
SB-464 <0.018
BH11 <0.365
SB-466 <0.018
BH20 <0.345
SB-465 <0.0185
SB-517 <0.021
SB-467 <0.0185
SB-470 <0.018
SB-468 <0.018
BD-C13 <0.21
BD-C10 <0.205
SB-469 <0.0175
SB-469 <0.018
WD-C16 0.6
SB-471 <0.018
WD-C15 <0.21
SB-472 <0.018
SB-473 <0.018

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for N-Nitrosodiphenylamine = 350 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
2 Robbins Rd
Westford, MA 01886

N

0 50 100 Feet

Figure 4.1-22
Distribution of Soil (Greater Than 10 ft) Concentrations for N-Nitrosodiphenylamine
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/13 | Checked/Date: CTM 04/16/13

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SB-400
4.5
SB-494
<3.4
SB-490
<3.5
SB-485
6.6
SB-495
8.4
SB-488
<3.4
SB-480
25
SB-496
4.7
SB-481
<3.4
SB-479
<3.7
SB-497
33
SB-478
10
SB-421
390
SB-477
39
SB-534
31
SB-507
<3.6
SB-427
13
SB-476
9.9
SB-475
14
SB-432
1900
SB-532
28
SB-428
100
SB-474
15
LPB14
210
SB-440
8.1
SB-533
<3.5
SB-441
18
SB-447
190
LPB5
<3.6
SB-514
<4.3
SB-517
<3.6
OSFILL-1220
<3.6
OSFILL-1120
7.1
OSFILL-1170
<3.6
OSFILL-600
<3.6
OSFILL-530
<3.6
OSFILL-550
8.4
OSFILL-450
29
OSFILL-460
<3.7
OSFILL-400
<3.6
CP-TP15
8
CP-TP19
20
CP-TP8
6.8
SDF-6
92
SDF-5
130
SDF-4
81
SDF-3
30
SDF-1
7500
SDF-2
1400

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (MCP S2 Standard) for C11-C22 Aromatics = 3,000 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 80 160
Feet

Figure 4.1-23
Distribution of Surface Soil Concentrations for C11-C22 Aromatics
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\PrelimRI_SoilDistributions_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-23 - Distribution of Surface Soil Concentrations for C11-C22 Aromatics.pdf 3/12/2014 8:15 AM brian.roden

SB-400 <3.5
SB-494 <3.7
SB-502 <3.5
SB-490 <3.3
SB-485 <3.5
SB-495 <3.5
SB-488 <3.5
SB-501 <3.6
SB-500 12
SB-496 3.7
SB-481 140
SB-480 110
SB-497 44
SB-479 <3.6
SVE-14 30
SVE-15 <3.6
B-10 38
B-10 1400
SVE-13 96
SB-421 23
B-10 1700
AS-9 250
SVE-12 65
SVE-6B 640
SVE-16 310
AS-1 980
SB-534 <3.6
SB-507 15
AS-4 300
AS-3 97
SB-427 <17
SB-478 82
SB-477 4500
SB-476 2200
SB-475 1100
SB-428 190
SB-474 <3.9
SB-432 4700
SB-532 <3.9
SVE-11 360
SB-533 120
SB-440 84
SB-441 <3.7
SB-447 360
LPB14 5.2
LPB15 6.1
LPB12 19
LPB16 330
LPB28 14
LPB28 96
LPB10 2100
LPB10 620
LPB5 <3.6
LPB8 17
LPB8 500
LPB7 5.7
LPB7 <3.7
SB-514 <4.2
SB-515 <3.9
SB-459 670
SB-516 <4.0
SB-517 <3.7

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (MCP S2 Standard) for C11-C22 Aromatics = 3,000 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 60 120
Feet

Figure 4.1-24
Distribution of Soil (1 to 10 ft) Concentrations for C11-C22 Aromatics
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

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SB-400
<3.7

SB-494
<3.6

SB-485
<3.6

SB-497
<3.6

AS-8
<3.7

SB-421
88

AS-7
91

SVE-6B
260

AS-7
1500

AS-2
4.6

AS-1
20

AS-5
70

AS-3
13

AS-3
380

SB-478
350

SB-477
41

SB-476
1000

SB-427
890

SB-427
<3.6

SB-475
<3.6

SB-428
5.2

SB-474
<3.9

SB-507
<3.9

SB-432
1700

SB-532
<4.4

SB-533
<4.0

SB-440
<3.6

SB-441
4.7

SB-447
<3.6

SB-514
<3.6

SB-515
<4.0

SB-516
<4.2

SB-517
<4.2

SB-469
<3.6

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (MCP S2 Standard) for C11-C22 Aromatics = 3,000 mg/kg.
2. < - Not Detected, value shown is reporting limit
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 50 100
Feet

Figure 4.1-25
Distribution of Soil (Greater Than 10 ft) Concentrations for C11-C22 Aromatics
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

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SB-403 <0.0021
SB-407 <0.0022
SB-413 <0.0027
SB-410 <0.0022
SB-409 <0.0021
SB-411 <0.0021
SB-412 <0.0021
SB-402 <0.0021
SB-422 <0.0021
SB-416 <0.0021
SB-421 <0.0021
SB-424 <0.0021
SB-426 0.00081
SB-427 <0.0021
SB-430 <0.002
SB-431 <0.0022
SB-432 0.24
SB-434 0.2
SB-435 <0.0104
SB-436 0.0016
SB-443 0.14
SB-437 <0.0022
SB-444 <0.0021
SB-445 <0.002
SB-446 0.0018
SB-442 <0.0021
LPB-40 <0.28
SB-448 0.039
SB-449 <0.0022
SB-453 <0.0104
SB-450 <0.0021
SB-451 <0.002
LPB-41 <0.28
SB-452 <0.0021
SB-456 0.00065
SB-457 <0.0021
SB-458 <0.0022
SB-459 <0.0021
SB-463 <0.0021
SB-464 0.0037
SB-465 0.007
SB-468 0.27
SB-471 0.00098
SS-420 <0.0023
SB-472 <0.0022
SS-422 0.0041
SS-424 0.002
SB-473 <0.0024
SS-429 0.00062
SS-427 <0.0024
SS-431 0.0016
SS-448 0.0017
SS-434 <0.0024
SS-450 <0.0032
SS-440 <0.0035
SS-441 <0.0029
SS-443 <0.0034
SS-453 <0.0028
SS-447 <0.006
SS-456 <0.0024
SS-457 <0.0022
SS-455 <0.0023
SS-459 <0.0023
SS-460 <0.0024

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Hydrazine = 0.95 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 80 160 Feet

Figure 4.1-26
Distribution of Surface Soil Concentrations for Hydrazine
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

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SB-403 <0.0034
GW-301 <0.27
SB-404 <0.0024
SB-402 <0.0021
SB-407 <0.0024
SB-410 <0.0025
SB-409 0.00084
SB-413 <0.0023
GW-302 <0.3
WSS-2 <0.3
SB-411 0.0028
SB-412 0.00071
SB-416 <0.0021
SB-422 <0.0023
SB-419 <0.0021
SB-420 <0.0021
SB-421 0.00058
SB-426 0.00069
SB-430 <0.0022
SB-425 0.0007
SB-435 <0.0022
SB-431 <0.0022
SB-432 0.00076
SB-436 0.0008
SB-434 <0.0022
SB-443 <0.0024
SB-437 <0.0023
SB-444 <0.0023
LPB-50 <0.27
LPB-50 <0.28
LPB-40 <0.3
LPB-50 <0.3
SB-448 0.0013
SB-445 0.00065
SB-446 <0.0025
SB-442 0.0034
SB-453 <0.0024
LPB-48 <0.27
LPB-48 1.9
SB-450 0.00067
SB-451 0.0023
LPB-41 <0.35
LPB-48 <0.28
SB-452 0.0032
LPB-41 <0.27
LPB-43 <0.32
LPB-43 <0.28
LPB-42 <0.28
LPB-43 <0.28
SB-456 0.0027
SB-457 0.052
LPB-42 <0.28
LPB-42 <0.27
PLD-1 <0.3
GW-306 <0.31
SB-459 0.0086
SB-463 0.0045
SB-464 0.0028
SB-466 <0.0022
SB-465 0.21
PLD-2 <0.3
SB-468 0.28
GW-307 <0.31
SB-471 0.0023
PLD-3 <0.3
PLD-3 0.42
SB-472 0.00078
SB-473 <0.0024

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Hydrazine = 0.95 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 60 120
Feet

Figure 4.1-27
Distribution of Soil (1 to 10 ft) Concentrations for Hydrazine
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

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SB-435
<0.0022

SB-432
0.0025

LPB-40
<0.3

SB-448
<0.0021

SB-456
0.00058

SB-457
0.0028

SB-466
0.0012

SB-472
0.0031

Legend

- Chemical Detected Below Industrial RSL
- Chemical Detected Above Industrial RSL
- Analyte not detected - Reporting Limit Below Industrial RSL
- Analyte not detected - Reporting Limit Above Industrial RSL
- 2.5 Detected Analyte Concentration (mg/kg)
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Historic Disposal Feature (see Figure 1.3-1)

Notes:
1. Industrial RSL (USEPA) for Hydrazine = 0.95 mg/kg.
2. < - Not Detected, value shown is reporting limit.
3. Samples collected as part of the RI have IDs SS-4XX, SB-4XX, SS-5XX, or SB-5XXX. All other samples were collected previous to the RI.
4. Historic Disposal Features are shown in Figure 1.3-1.

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 50 100
Feet

Figure 4.1-28
Distribution of Soil (Greater Than 10 ft) Concentrations for Hydrazine
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

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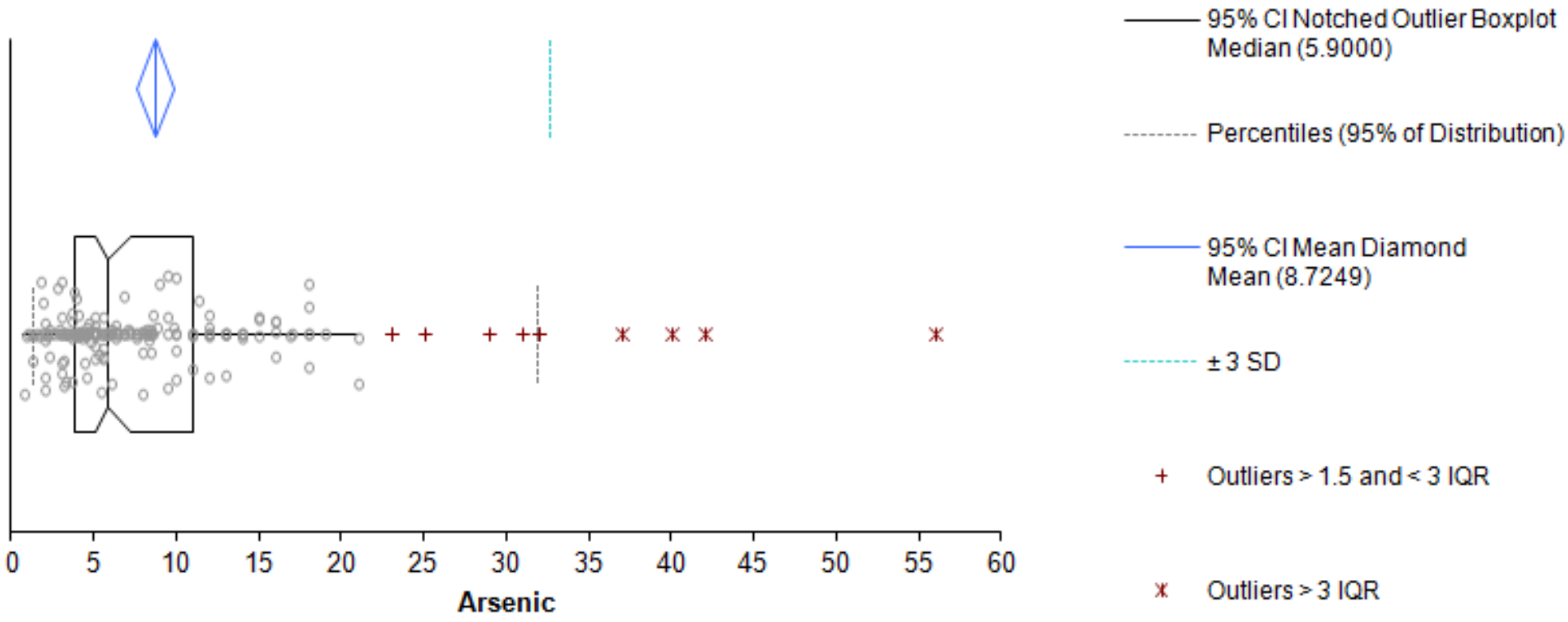
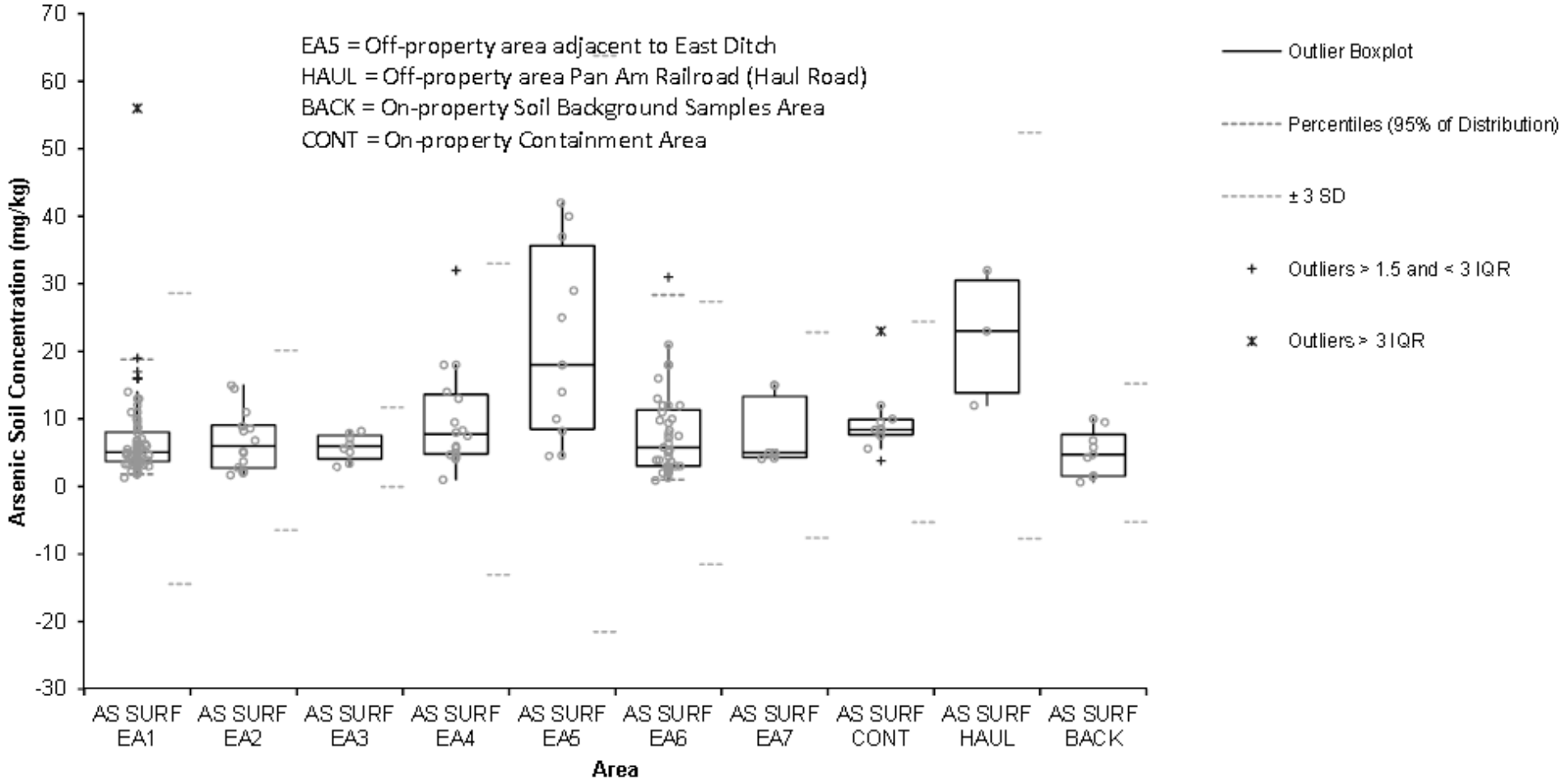


Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

amec

Figure 4.1-29
Box Plot of Raw Arsenic Data for
Outlier Information



Box Plots of Exposure Area Sample groups to Identify Outlier Sample Locations

Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

amec

Figure 4.1-30
Box Plot of Arsenic Surface Soil Data

MMB-SW/SD-9
12/1/10 - 0.23
6/6/11 - <0.1

MMB-SW/SD-1
12/1/10 - 0.18
6/6/11 - <0.1

MMB-SW/SD-4
12/2/10 - 0.16
6/6/11 - <0.1

MMB-SW/SD-10
12/2/10 - 0.23
6/6/11 - <0.1

MMB-SW/SD-8A
12/2/10 - <0.1
6/8/11 - 0.15

MMB-SW/SD-5
12/2/10 - <0.1
6/7/11 - 0.1

MMB-SW/SD-11
12/2/10 - <0.1
6/7/11 - 0.25

MMB-SW/SD-3
12/3/10 - 0.22
6/8/11 - 0.29

MMB-SW/SD-8
12/2/10 - <0.1
6/7/11 - 0.16

EDSD/SW0
12/13/10 - <0.1
6/8/11 - <0.1

MMB-SW/SD-2
12/3/10 - 0.6
6/8/11 - 0.66

EDSD/SW1 (EDBS5)
12/13/10 - 0.11
6/8/11 - <0.1

MMB-SW/SD-6
12/3/10 - 0.48
6/8/11 - 2.5

PZ-17RR
IRSWP - 65
12/10/10 - 96
6/6/11 - 130
12/17/12 - 33

OPWD-2
12/10/10 - 17
6/7/11 - 36

EDSD/SW2 (EDBS6)
12/13/10 - 0.26
6/8/11 - 0.92

PZ-16RR
IRSWP - 66
12/9/10 - 77
6/6/11 - 110

OPWD-1
12/10/10 - 66
6/7/11 - 63

SD-503
12/17/12 - 7.5

SD-1
12/9/10 - 66
6/6/11 - 95
12/17/12 - 21

SD-501
12/17/12 - 28

OPWD-SW-S
12/10/10 - 48
6/7/11 - 37

ISCO2
IRSWP - 60
12/9/10 - 74
6/6/11 - 110

ISCO1
IRSWP - 27.9
12/10/10 - 40
6/6/11 - 31

ISCO3
IRSWP - 2.9

PZ-18R
IRSWP - 29

SD-17
IRSWP - 56

LB-1
12/9/10 - 1.3
6/7/11 - 0.52

EDSD/SW5 (EDBS11)
12/13/10 - 2.2
6/8/11 - 8.7

LB-2
12/9/10 - 4.6
6/7/11 - 3.7

LB-3
12/9/10 - 6.9
6/7/11 - 8.7

EDSD/SW7
6/18/12 - 9
6/18/12 - 10

Notes:
IRSWP - Indicated an arithmetic mean was calculated using
half the detection limit for non detects for data from Oct 2010 to Jan 2013.

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

AMEC Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 340 680 1,360 Feet

Figure 4.1-31
Distribution of Surface Water Concentrations for Ammonia
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

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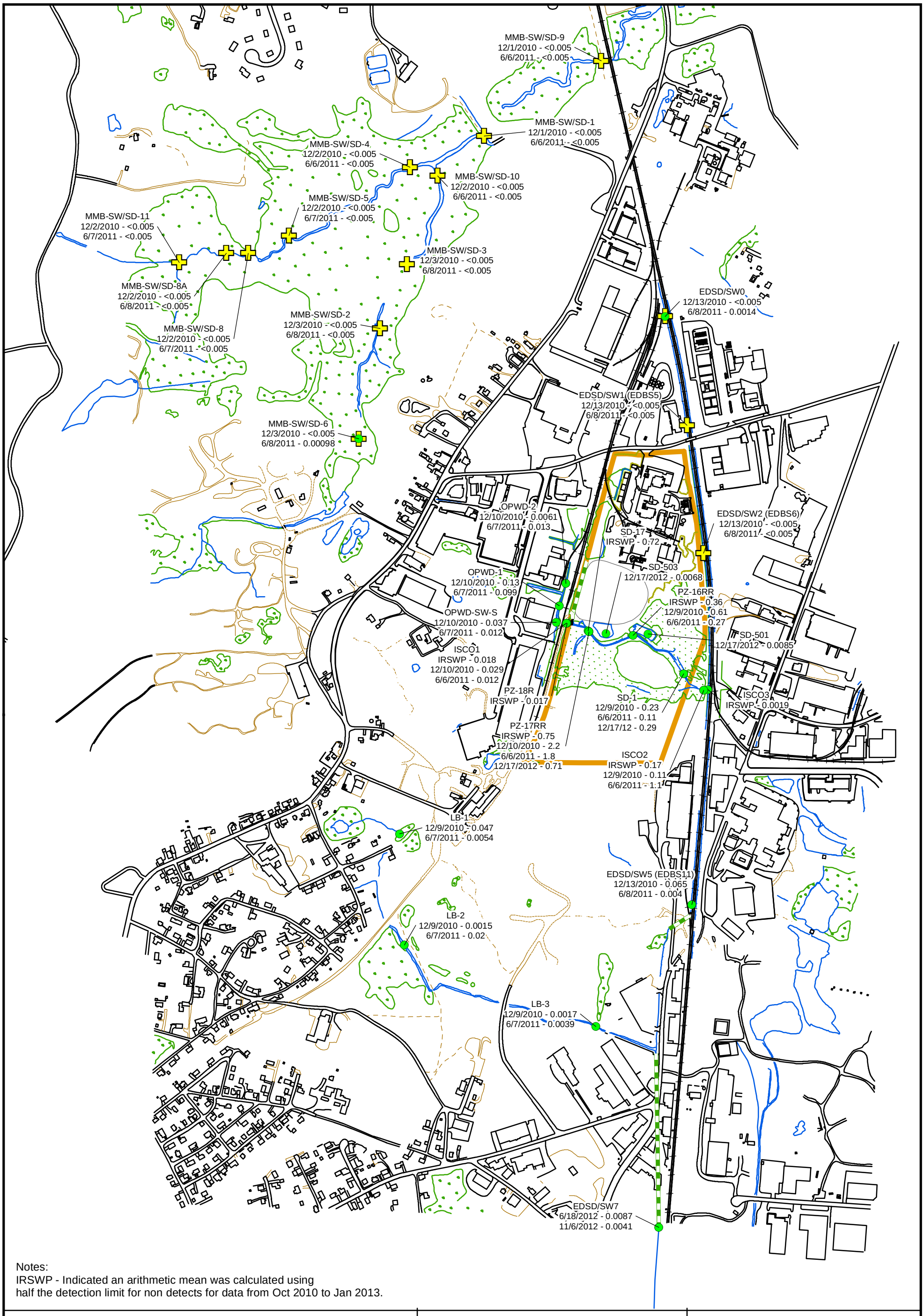

Notes:
IRSWP - Indicated an arithmetic mean was calculated using
half the detection limit for non detects for data from Oct 2010 to Jan 2013.

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 4.1-32
Distribution of Surface Water Concentrations for Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU1OU2SurfaceWaterDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Internal Drafts\Figures\Figure 4.1-32 - SW Chromium.pdf

EDSD/SW2 (EDBS6)
12/13/10 - <0.001
6/8/11 - 0.00056

OPWD-SW-S
12/10/10 - <0.001
6/7/11 - <0.001

SD-503
12/17/12 - 0.01

SD-501
12/17/12 - <0.005

SD-1
12/17/12 - <0.005

ISCO1
6/6/11 - <0.001

PZ-17RR
12/17/12 - <0.005

ISCO2
6/6/11 - <0.001

EDSD/SW5 (EDBS11)
12/13/10 - 0.00086
6/8/11 - <0.001

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 4.1-33
Distribution of Surface Water Concentrations for Hexavalent Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

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MMB-SW/SD-9
12/1/10 - 21
6/6/11 - 24

MMB-SW/SD-1
12/1/10 - 17
6/6/11 - 22

MMB-SW/SD-4
12/2/10 - 18
6/6/11 - 22

MMB-SW/SD-10
12/2/10 - 21
6/6/11 - 30

MMB-SW/SD-8
12/2/10 - 12
6/7/11 - 25

MMB-SW/SD-11
12/2/10 - 12
6/7/11 - 24

MMB-SW/SD-5
12/2/10 - 13
6/7/11 - 22

MMB-SW/SD-3
12/3/10 - 24
6/8/11 - 30

MMB-SW/SD-8A
12/2/10 - 9.7
6/8/11 - 24

EDSD/SW0
12/13/10 - 18
6/8/11 - 46

MMB-SW/SD-2
12/3/10 - 27
6/8/11 - 33

EDSD/SW1 (EDBS5)
12/13/10 - 27
6/8/11 - 45

MMB-SW/SD-6
12/3/10 - 23
6/8/11 - 40

OPWD-2
12/10/10 - 6.1
6/7/11 - 6.8

EDSD/SW2 (EDBS6)
12/13/10 - 22
6/8/11 - 43

PZ-17RR
12/10/10 - 62
6/6/11 - 72
12/17/12 - 26

PZ-16RR
12/9/10 - 57
6/6/11 - 72

OPWD-1
12/10/10 - 21
6/7/11 - 26

SD-501
12/17/12 - 190

SD-1
12/9/10 - 70
6/6/11 - 81
12/17/12 - 23

OPWD-SW-S
12/10/10 - 28
6/7/11 - 24

ISCO2
12/9/10 - 56
6/6/11 - 67

SD-503
12/17/12 - 53

ISCO1
12/10/10 - 27
6/6/11 - 25

LB-1
12/9/10 - 53
6/7/11 - 31

EDSD/SW5 (EDBS11)
12/13/10 - 11
6/8/11 - 46

LB-2
12/9/10 - 25
6/7/11 - 24

LB-3
12/9/10 - 49
6/7/11 - 44

EDSD/SW7
6/18/12 - 38
11/6/2012 - 42

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

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Figure 4.1-34
Distribution of Surface Water Concentrations for Calcium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU1OU2SurfaceWaterDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Internal Drafts\Figures\Figure 4.1-34 - SW Calcium.pdf

MMB-SW/SD-9
12/1/2010 - 0.012
6/6/2011 - <0.1

MMB-SW/SD-1
12/1/2010 - 0.092
6/6/2011 - 0.063

MMB-SW/SD-4
12/2/2010 - 0.017
6/6/2011 - <0.1

MMB-SW/SD-10
12/2/2010 - <0.1
6/6/2011 - <0.1

MMB-SW/SD-5
12/2/2010 - 0.083
6/7/2011 - 0.11

MMB-SW/SD-8A
12/2/2010 - 0.077
6/8/2011 - 0.14

MMB-SW/SD-8
12/2/2010 - 0.04
6/7/2011 - 0.035

MMB-SW/SD-3
12/3/2010 - 0.22
6/8/2011 - 0.12

MMB-SW/SD-11
12/2/2010 - 0.081
6/7/2011 - 0.036

EDSD/SW0
12/13/2010 - 0.071
6/8/2011 - 0.39

MMB-SW/SD-2
12/3/2010 - 0.093
6/8/2011 - 0.026

EDSD/SW1 (EDBS5)
12/13/2010 - 0.039
6/8/2011 - <0.1

MMB-SW/SD-6
12/3/2010 - 1.8
6/8/2011 - 0.48

EDSD/SW2 (EDBS6)
12/13/2010 - 0.068
6/8/2011 - 0.028

OPWD-2
12/10/2010 - 0.96
6/7/2011 - 1.6

PZ-17RR
IRSWP - 3.0
12/10/2010 - 11
6/6/2011 - 9
12/17/2012 - 3.6

OPWD-1
12/10/2010 - 1.1
6/7/2011 - 0.83

SD-501
12/17/2012 - 0.21

OPWD-SW-S
12/10/2010 - 0.33
6/7/2011 - 0.1

PZ-16RR
12/9/2010 - 2.9
6/6/2011 - 0.85

ISCO3
IRSWP - 0.19
12/10/2010 - 0.25
6/6/2011 - 0.1

ISCO3
IRSWP - 0.16

PZ-18R
IRSWP - 0.18

ISCO2
IRSWP - 0.97
12/9/2010 - 0.6
6/6/2011 - 5.4

SD-503
12/17/2012 - 0.9

SD-17
IRSWP - 3.1

SD-1
12/9/2010 - 1.1
6/6/2011 - 0.46
12/17/2012 - 1.8

LB-1
12/9/2010 - 12
6/7/2011 - 1.2

EDSD/SW5 (EDBS11)
12/13/2010 - 0.77
6/8/2011 - 0.13

LB-2
12/9/2010 - <0.1
6/7/2011 - 1

LB-3
12/9/2010 - <0.1
6/7/2011 - 0.035

EDSD/SW7
6/18/2012 - 0.12
11/6/2012 - <0.2

Notes:
IRSWP - Indicated an arithmetic mean was calculated using
half the detection limit for non detects for data from Oct 2010 to Jan 2013.

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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Figure 4.1-35
Distribution of Surface Water Concentrations for Aluminum
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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MMB-SW/SD-9
12/1/2010 - 0.45
6/6/2011 - 2.2

MMB-SW/SD-1
12/1/2010 - 0.53
6/6/2011 - 1.2

MMB-SW/SD-4
12/2/2010 - 0.46
6/6/2011 - 0.88

MMB-SW/SD-10
12/2/2010 - 0.43
6/6/2011 - 1.2

MMB-SW/SD-8A
12/2/2010 - 0.48
6/8/2011 - 3.3

MMB-SW/SD-5
12/2/2010 - 0.49
6/7/2011 - 1.9

MMB-SW/SD-11
12/2/2010 - 0.45
6/7/2011 - 1.3

MMB-SW/SD-8
12/2/2010 - 0.38
6/7/2011 - 2.8

MMB-SW/SD-3
12/3/2010 - 2.3
6/8/2011 - 2.7

EDSD/SW0
12/13/2010 - 0.17
6/8/2011 - 11

MMB-SW/SD-2
12/3/2010 - 1.1
6/8/2011 - 1.6

EDSD/SW1 (EDBS5)
12/13/2010 - 0.87
6/8/2011 - 0.89

MMB-SW/SD-6
12/3/2010 - 20
6/8/2011 - 29

OPWD-2
12/10/2010 - 8.8
6/7/2011 - 30

EDSD/SW2 (EDBS6)
12/13/2010 - 0.73
6/8/2011 - 1

PZ-17RR
12/10/2010 - 10
6/6/2011 - 12
12/17/2012 - 3.7

OPWD-1
12/10/2010 - 17
6/7/2011 - 29

PZ-16RR
12/9/2010 - 5.7
6/6/2011 - 4.8

OPWD-SW-S
12/10/2010 - 8.3
6/7/2011 - 5

SD-501
12/17/2012 - 0.43

SD-503
12/17/2012 - 1.5

ISCO1
12/10/2010 - 8
6/6/2011 - 4.7

SD-1
12/9/2010 - 3.7
6/6/2011 - 2
12/17/2012 - 1.5

ISCO2
12/9/2010 - 2.4
6/6/2011 - 13

LB-1
12/9/2010 - 33
6/7/2011 - 15

EDSD/SW5 (EDBS11)
12/13/2010 - 0.7
6/8/2011 - 0.91

LB-2
12/9/2010 - 1.6
6/7/2011 - 18

LB-3
12/9/2010 - 2.6
6/7/2011 - 12

EDSD/SW7
11/6/2012 - 0.79
6/18/2012 - 1.7

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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Figure 4.1-36
Distribution of Surface Water Concentrations for Iron
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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MMB-SW/SD-9
12/1/10 - 21
6/6/11 - 3.9

MMB-SW/SD-1
12/1/10 - 22
6/6/11 - 5.4

MMB-SW/SD-4
12/2/10 - 19
6/6/11 - 7.1

MMB-SW/SD-10
12/2/10 - 24
6/6/11 - 3.2

MMB-SW/SD-8A
12/2/10 - 12
6/8/11 - 11

MMB-SW/SD-5
12/2/10 - 15
6/7/11 - 5.7

MMB-SW/SD-11
12/2/10 - 15
6/7/11 - 13

MMB-SW/SD-3
12/3/10 - 22
6/8/11 - 8

MMB-SW/SD-8
12/2/10 - 16
6/7/11 - 8.7

EDSD/SW0
12/13/10 - 14
6/8/11 - 19

MMB-SW/SD-2
12/3/10 - 25
6/8/11 - 16

EDSD/SW1 (EDBS5)
12/13/10 - 17
6/8/11 - 20

MMB-SW/SD-6
12/3/10 - 20
6/8/11 - 39

OPWD-2
12/10/10 - 66
6/7/11 - 69

EDSD/SW2 (EDBS6)
12/13/10 - 15
6/8/11 - 19

SD-503
12/17/12 - 96

OPWD-1
12/10/10 - 360
6/7/11 - 320

SD-501
12/17/12 - 460

OPWD-SW-S
12/10/10 - 290
6/7/11 - 160

SD-1
12/9/10 - 590
6/6/11 - 800
12/17/12 - 110

ISCO1
IRSWP - 124
12/10/10 - 240
6/6/11 - 150

PZ-18R
IRSWP - 121

ISCO3
IRSWP - 41

ISCO2
IRSWP - 360
12/9/10 - 560
6/6/11 - 800

PZ-17RR
12/10/10 - 810
6/6/11 - 990
12/17/12 - 150

PZ-16RR
IRSWP - 390
12/9/10 - 660
6/6/11 - 800

SD-17
IRSWP - 343

LB-1
12/9/10 - 88
6/7/11 - 4.4

EDSD/SW5 (EDBS11)
12/13/10 - 36
6/8/11 - 69

LB-2
12/9/10 - 35
6/7/11 - 17

LB-3
12/9/10 - 39
6/7/11 - 16

EDSD/SW7
6/18/12 - 70
11/6/12 - 81

Notes:
IRSWP - Indicated an arithmetic mean was calculated using
half the detection limit for non detects for data from Oct 2010 to Jan 2013.

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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Figure 4.1-37
Distribution of Surface Water Concentrations for Sulfate
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

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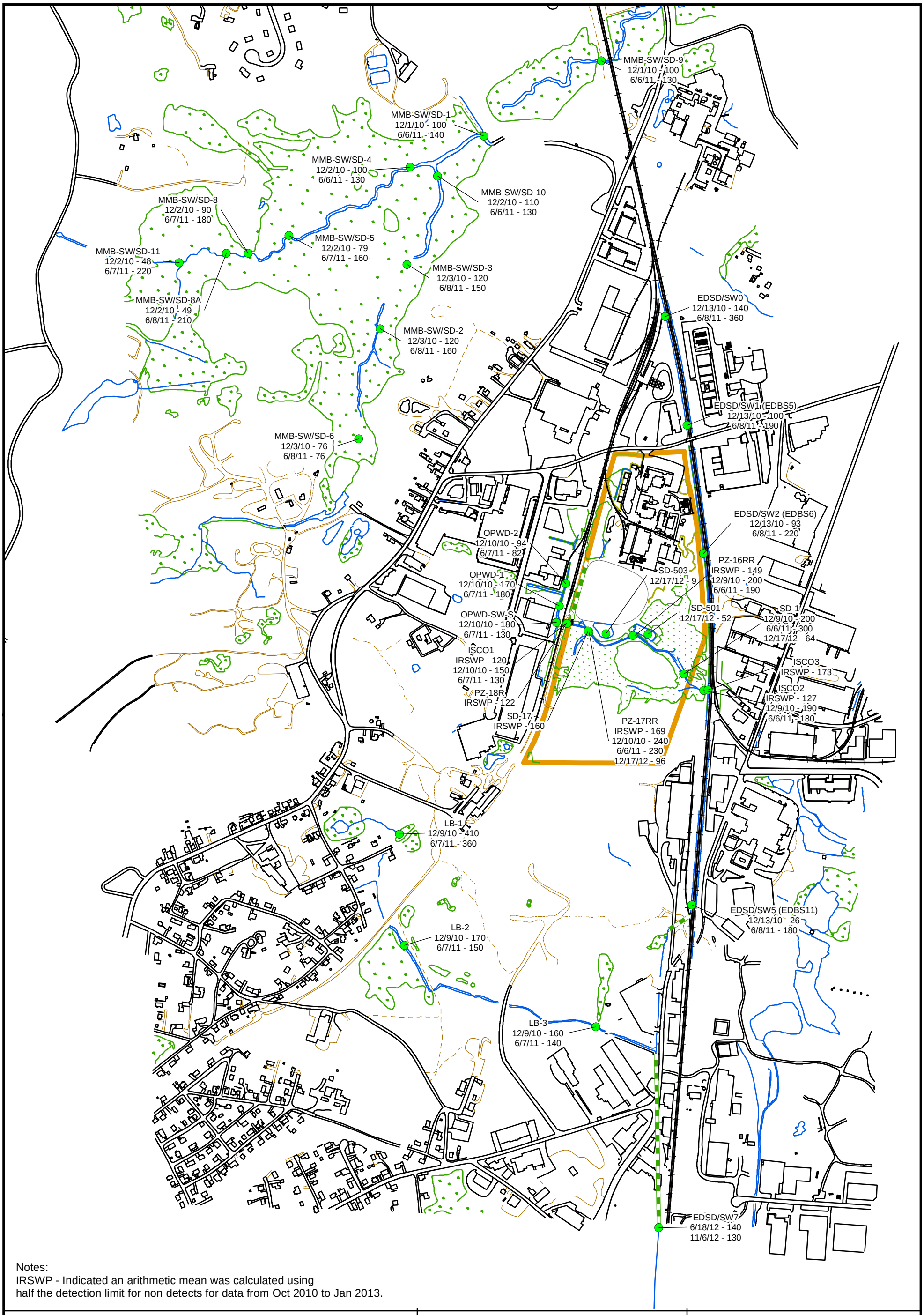

Notes:
IRSWP - Indicated an arithmetic mean was calculated using
half the detection limit for non detects for data from Oct 2010 to Jan 2013.

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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Figure 4.1-38
Distribution of Surface Water Concentrations for Chloride
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU1OU2SurfaceWaterDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Internal Drafts\Figures\Figure 4.1-38 - SW Chloride.pdf

MMB-SW/SD-9
12/1/10 - <0.001
6/6/11 - <0.001

MMB-SW/SD-1
12/1/10 - <0.001
6/6/11 - <0.001

MMB-SW/SD-4
12/2/10 - <0.001
6/6/11 - <0.001

MMB-SW/SD-10
12/2/10 - <0.001
6/6/11 - <0.001

MMB-SW/SD-8A
12/2/10 - <0.001
6/8/11 - <0.001

MMB-SW/SD-5
12/2/10 - <0.001
6/7/11 - <0.001

MMB-SW/SD-3
12/3/10 - <0.001
6/8/11 - <0.001

MMB-SW/SD-11
12/2/10 - <0.001
6/7/11 - <0.001

MMB-SW/SD-8
12/2/10 - <0.001
6/7/11 - <0.001

EDSD/SW0
12/13/10 - <0.001
6/8/11 - <0.001

MMB-SW/SD-2
12/3/10 - <0.001
6/8/11 - <0.001

EDSD/SW1 (EDBS5)
12/13/10 - <0.001
6/8/11 - <0.001

MMB-SW/SD-6
12/3/10 - <0.001
6/8/11 - <0.001

EDSD/SW2 (EDBS6)
12/13/10 - 0.0044
6/8/11 - 0.0039

OPWD-2
12/10/10 - 0.0025
6/7/11 - 0.0071

ISCO1
12/10/10 - <0.001
6/6/11 - <0.001

PZ-16RR
12/9/10 - 0.0042
6/6/11 - 0.0056

OPWD-1
12/10/10 - <0.001
6/7/11 - <0.001

SD-501
12/17/12 - <0.002

SD-1
12/9/10 - 0.003
6/6/11 - 0.0019
12/17/12 - <0.001

OPWD-SW-S
12/10/10 - 0.00071
6/7/11 - <0.001

PZ-17RR
12/10/10 - 0.0074
6/6/11 - 0.01
12/17/12 - 0.0014

SD-503
12/17/12 - <0.002

ISCO2
12/9/10 - 0.0024
6/6/11 - 0.0019

LB-1
12/9/10 - <0.001
6/7/11 - <0.001

EDSD/SW5 (EDBS11)
12/13/10 - <0.001
6/8/11 - <0.001

LB-2
12/9/10 - <0.001
6/7/11 - <0.001

LB-3
12/9/10 - <0.001
6/7/11 - <0.001

EDSD/SW7
6/18/12 - <0.001
11/6/12 - <0.001

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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Figure 4.1-39
Distribution of Surface Water Concentrations for 2,4,4-Trimethyl-1-pentene
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/12/14 | Checked/Date: CTM 03/12/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU1OU2SurfaceWaterDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Internal Drafts\Figures\Figure 4.1-39 - SW TMP.pdf

MMB-SW/SD-9
12/1/10 - <1.9
6/6/11 - <1.9

MMB-SW/SD-1
12/1/10 - <1.9
6/6/11 - 0.47 J

MMB-SW/SD-4
12/2/10 - <1.9
6/6/11 - <1.9

MMB-SW/SD-10
12/2/10 - <1.9
6/6/11 - <1.9

MMB-SW/SD-8A
12/2/10 - <1.9
6/6/11 - <19

MMB-SW/SD-5
12/2/10 - <1.9
6/7/11 - <19

MMB-SW/SD-11
12/2/10 - <1.9
6/7/11 - <19

MMB-SW/SD-3
12/3/10 - <1.9
6/8/11 - <19

MMB-SW/SD-8
12/2/10 - <1.9
6/7/11 - <19

EDSD/SW0
12/13/10 - <2
6/8/11 - <2

MMB-SW/SD-2
12/3/10 - <2.3
6/8/11 - <20

EDSD/SW1 (EDBS5)
12/13/10 - 3
6/8/11 - <1.9

MMB-SW/SD-6
12/3/10 - <1.9
6/8/11 - <38

EDSD/SW2 (EDBS6)
12/13/10 - 6
6/8/11 - 12

OPWD-2
12/10/10 - 6
6/7/11 - <38

OPWD-1
12/10/10 - 110
6/7/11 - 60

SD-503
12/17/12 - 3

PZ-16RR
12/9/10 - 170
6/6/11 - 170

OPWD-SW-S
12/10/10 - 76
6/7/11 - 23

SD-501
12/17/12 - <2

SD-1
6/6/11 - 48
12/9/10 - 140
12/17/12 - 24

ISCO1
12/10/10 - 61
6/6/11 - 23

PZ-17RR
12/10/10 - 300
6/6/11 - 290
12/17/12 - 45

ISCO2
12/9/10 - 120
6/6/11 - 78

EDSD/SW5 (EDBS11)
12/13/10 - <2
6/8/11 - <20

EDSD/SW7
6/18/12 - 9
11/6/12 - <1.9

Legend

- *MMB-SW/SD-4* Location ID
- *0.05* Analyte Concentration (ng/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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Figure 4.1-40
Distribution of Surface Water Concentrations for N-Nitrosodimethylamine
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 12/03/14 | Checked/Date: CTM 12/03/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU1OU2SurfaceWaterDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\RTC_OU1_OU2_Draft\Figure 4.1-40 - SW NDMA REV.pdf

MMB-SW/SD-9
12/1/2010 - 62

MMB-SW/SD-1
12/1/2010 - 96
2/17/2011 - 130

MMB-SW/SD-4
12/2/2010 - 790

MMB-SW/SD-10
12/2/2010 - 1500

MMB-SW/SD-5
12/2/2010 - 880

MMB-SW/SD-8A
12/2/10 - 620

MMB-SW/SD-8
12/2/2010 - 730

MMB-SW/SD-3
12/3/2010 - 960

MMB-SW/SD-11
12/2/2010 - 490

EDSD/SW0

MMB-SW/SD-2
12/3/2010 - 580

EDSD/SW1 (EDBS5)

MMB-SW/SD-6
12/3/2010 - 530

OPWD-2
12/10/2010 - 130

EDSD/SW2 (EDBS6)
12/13/2010 - 130

SD-504
12/17/2012 - 22

SD-503
12/17/2012 - 14

OPWD-1
12/10/2010 - 93

SD-501
12/17/2012 - 17

OPWD-SD-S
12/10/2010 - 540

SD-1
12/9/2010 - 240

SD-SD2
12/10/2010 - 250

SD-SD3
12/9/2010 - 170

ISCO2
12/9/2010 - 290
2/17/2011 - 170

SD-502
12/17/2012 - 35

SDSW-E
12/9/2010 - 130

LB-1
12/9/2010 - 140

EDSD/SW5 (EDBS11)

LB-2
12/9/2010 - 120

LB-3
12/9/2010 - 580

EDSD/SW7
6/18/2012 - 10
11/6/2012 - 8.5

Legend

- *SDC1* Location ID
- *10* Analyte Concentration (mg/kg)
- Analyte Not Detected (ND)
- No Sediment at Location
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Culvert
- 51 Eames St. Property Boundary

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N

0 340 680 1,360 Feet

Figure 4.1-41
Distribution of Sediment Concentrations for Ammonia
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/11/14 | Checked/Date: CTM 03/11/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU!OU2SedimentDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-41 - SD Ammonia.pdf

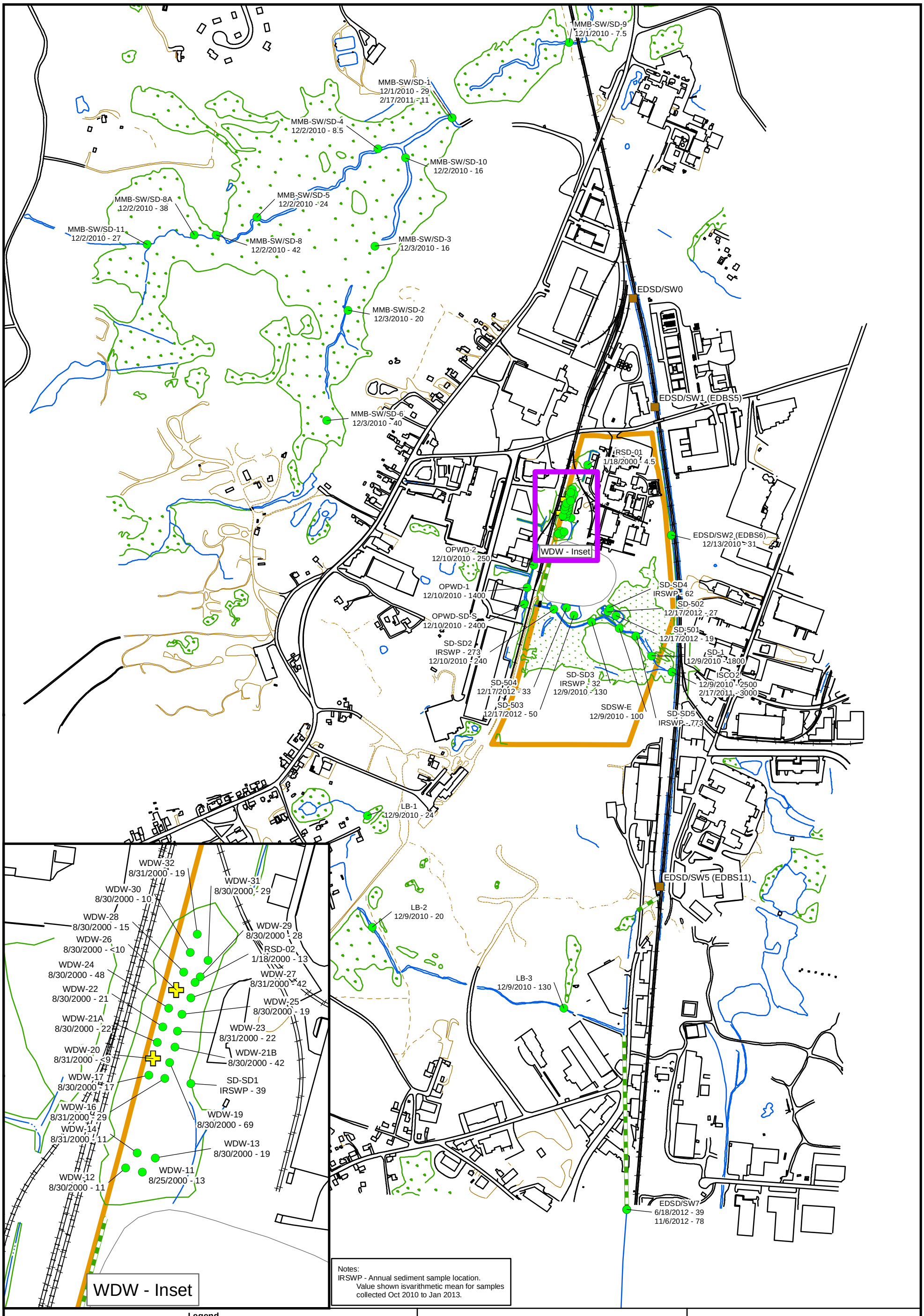

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Figure 4.1-42
Distribution of Sediment Concentrations for Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/11/14 | Checked/Date: CTM 03/11/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU!OU2SedimentDistributions_with_Inset.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-42 - SD Chromium.pdf

EDSD/SW0

EDSD/SW1 (EDBS5)

SD-502
12/17/2012 - 0.27

SD-SD2
12/10/2010 - <3.3

OPWD-SD-S
12/10/2010 - <7.1

SD-504
12/17/2012 - <0.36

SD-503
12/17/2012 - <0.31

SD-SD3
12/9/2010 - <2.6

SD-501
12/17/2012 - 0.21

SDSW-E
12/9/2010 - 2.6

SD-1
12/9/2010 - 25

ISCO2
12/9/2010 - 28

EDSD/SW5 (EDBS11)

Legend

- *SDC1* Location ID
- *10* Analyte Concentration (mg/kg)
- Analyte Not Detected (ND)
- No Sediment at Location
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Culvert
- 51 Eames St. Property Boundary

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N

0 340 680 1,360 Feet

Figure 4.1-43
Distribution of Sediment Concentrations for Hexavalent Chromium
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/11/14 | Checked/Date: CTM 03/11/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU!OU2SedimentDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-43 - SD Hex Chrom.pdf

MMB-SW/SD-9
12/1/2010 - 34

MMB-SW/SD-1
12/1/2010 - 48
2/17/2011 - 210

MMB-SW/SD-4
12/2/2010 - 480

MMB-SW/SD-10
12/2/2010 - 930

MMB-SW/SD-5
12/2/2010 - 860

MMB-SW/SD-11
12/2/2010 - 760

MMB-SW/SD-8
12/2/2010 - 420

MMB-SW/SD-3
12/3/2010 - 1000

MMB-SW/SD-8A
12/2/2010 - 690

EDSD/SW0

MMB-SW/SD-2
12/3/2010 - 630

EDSD/SW1 (EDBS5)

MMB-SW/SD-6
12/3/2010 - 150

EDSD/SW2 (EDBS6)
12/13/2010 - 690

OPWD-2
12/10/2010 - 91

OPWD-1
12/10/2010 - 110

SD-503
12/17/2012 - 6.3

SD-502
12/17/2012 - 18

OPWD-SD-S
12/10/2010 - 240

SD-501
12/17/2012 - 24

SD-SD2
12/10/2010 - 38

SD-1
12/9/2010 - 140

SD-504
12/17/2012 - 13

ISCO2
12/9/2010 - 130
2/17/2011 - 130

SDSW-E
12/9/2010 - 52

SD-SD3
12/9/2010 - 64

LB-1
12/9/2010 - 110

EDSD/SW5 (EDBS11)

LB-2
12/9/2010 - 61

LB-3
12/9/2010 - 150

EDSD/SW7
6/18/2012 - 55
11/6/2012 - 26

Legend

- *SDC1* Location ID
- *10* Analyte Concentration (mg/kg)
- Analyte Not Detected (ND)
- No Sediment at Location
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Culvert
- 51 Eames St. Property Boundary

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N

0 340 680 1,360 Feet

Figure 4.1-44
Distribution of Sediment Concentrations for Chloride
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/11/14 | Checked/Date: CTM 03/11/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU!OU2SedimentDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-44 - SD Chloride.pdf

MMB-SW/SD-9
12/1/2010 - 120

MMB-SW/SD-1
12/1/2010 - <63
2/17/2011 - <75

MMB-SW/SD-4
12/2/2010 - 350

MMB-SW/SD-10
12/2/2010 - 1400

MMB-SW/SD-5
12/2/2010 - 360

MMB-SW/SD-8A
12/2/2010 - 940

MMB-SW/SD-11
12/2/2010 - 980

MMB-SW/SD-8
12/2/2010 - 550

MMB-SW/SD-3
12/3/2010 - 940

EDSD/SW0

MMB-SW/SD-2
12/3/2010 - 1200

EDSD/SW1 (EDBS5)

MMB-SW/SD-6
12/3/2010 - 690

EDSD/SW2 (EDBS6)
12/13/2010 - <160

OPWD-2
12/10/2010 - 280

SD-504
12/17/2012 - 1900

OPWD-1
12/10/2010 - 310

SD-502
12/17/2012 - 1200

OPWD-SD-S
12/10/2010 - 1500

SD-501
12/17/2012 - 510

SD-SD2
12/10/2010 - 700

SD-1
12/9/2010 - 640

SD-503
12/17/2012 - 900

ISCO2
12/9/2010 - 600
2/17/2011 - 830

SD-SD3
12/9/2010 - 360

SDSW-E
12/9/2010 - 210

LB-1
12/9/2010 - 78

EDSD/SW5 (EDBS11)

LB-2
12/9/2010 - 110

LB-3
12/9/2010 - 310

EDSD/SW7
6/18/2012 - <48
11/6/2012 - 71

Legend

- *SDC1* Location ID
- *10* Analyte Concentration (mg/kg)
- Analyte Not Detected (ND)
- No Sediment at Location
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Culvert
- 51 Eames St. Property Boundary

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N

0 300 600 1,200 Feet

Figure 4.1-45
Distribution of Sediment Concentrations for Sulfate
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/11/14 | Checked/Date: CTM 03/11/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU!OU2SedimentDistributions.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-45 - SD Sulfate.pdf

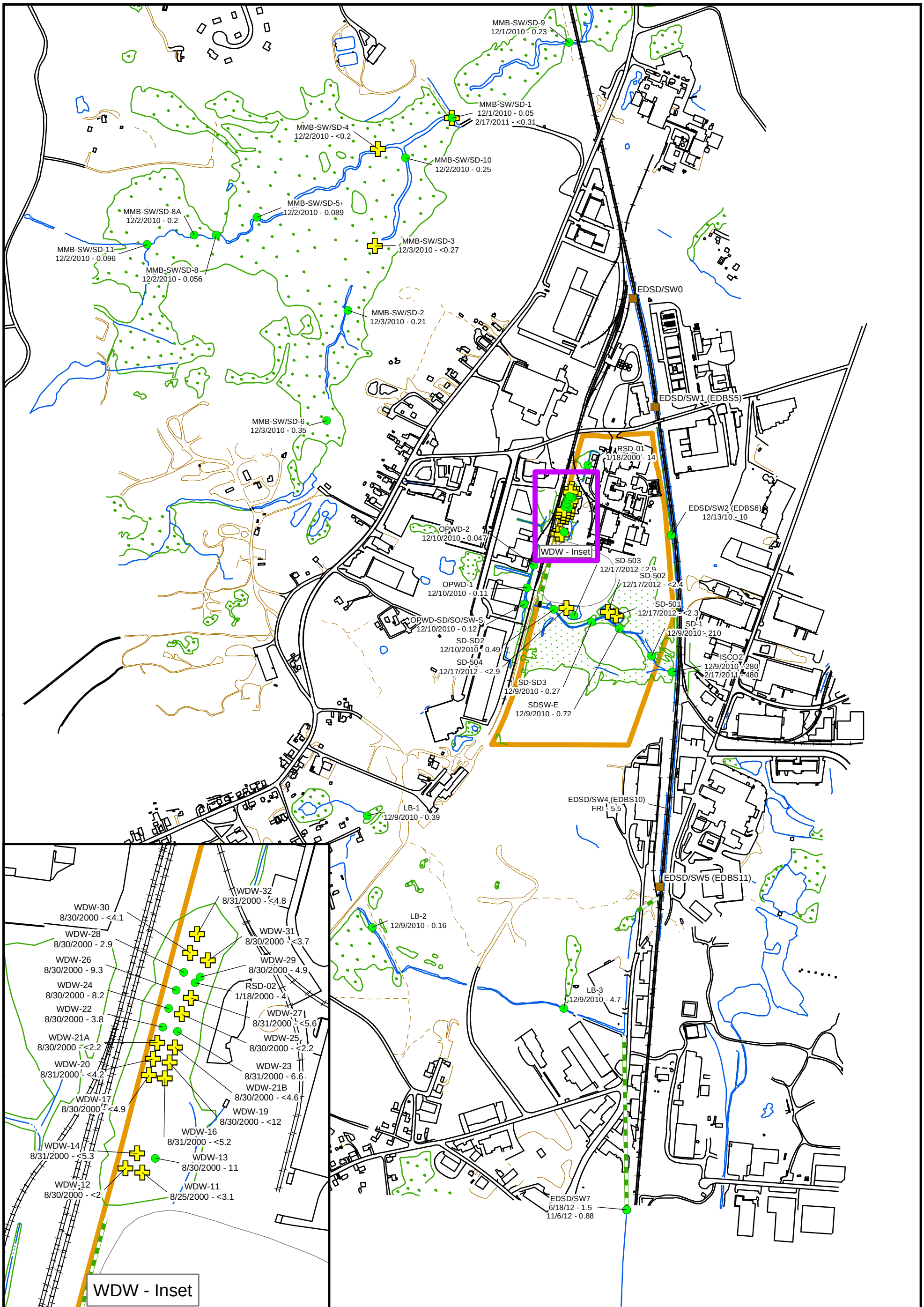

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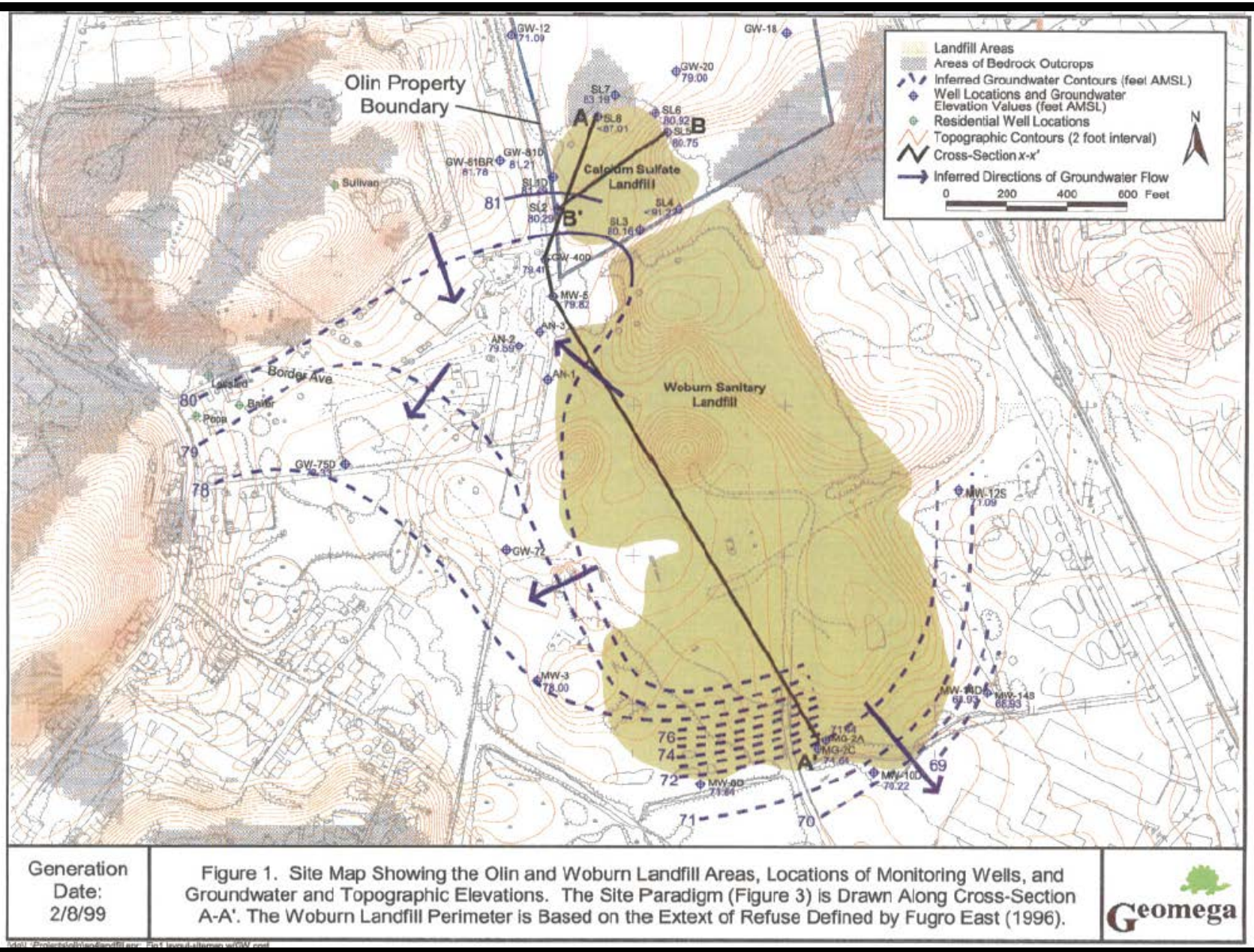
Figure 4.1-46
Distribution of Sediment Concentrations for Bis(2-ethylhexyl)phthalate
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 03/11/14 | Checked/Date: CTM 03/11/14

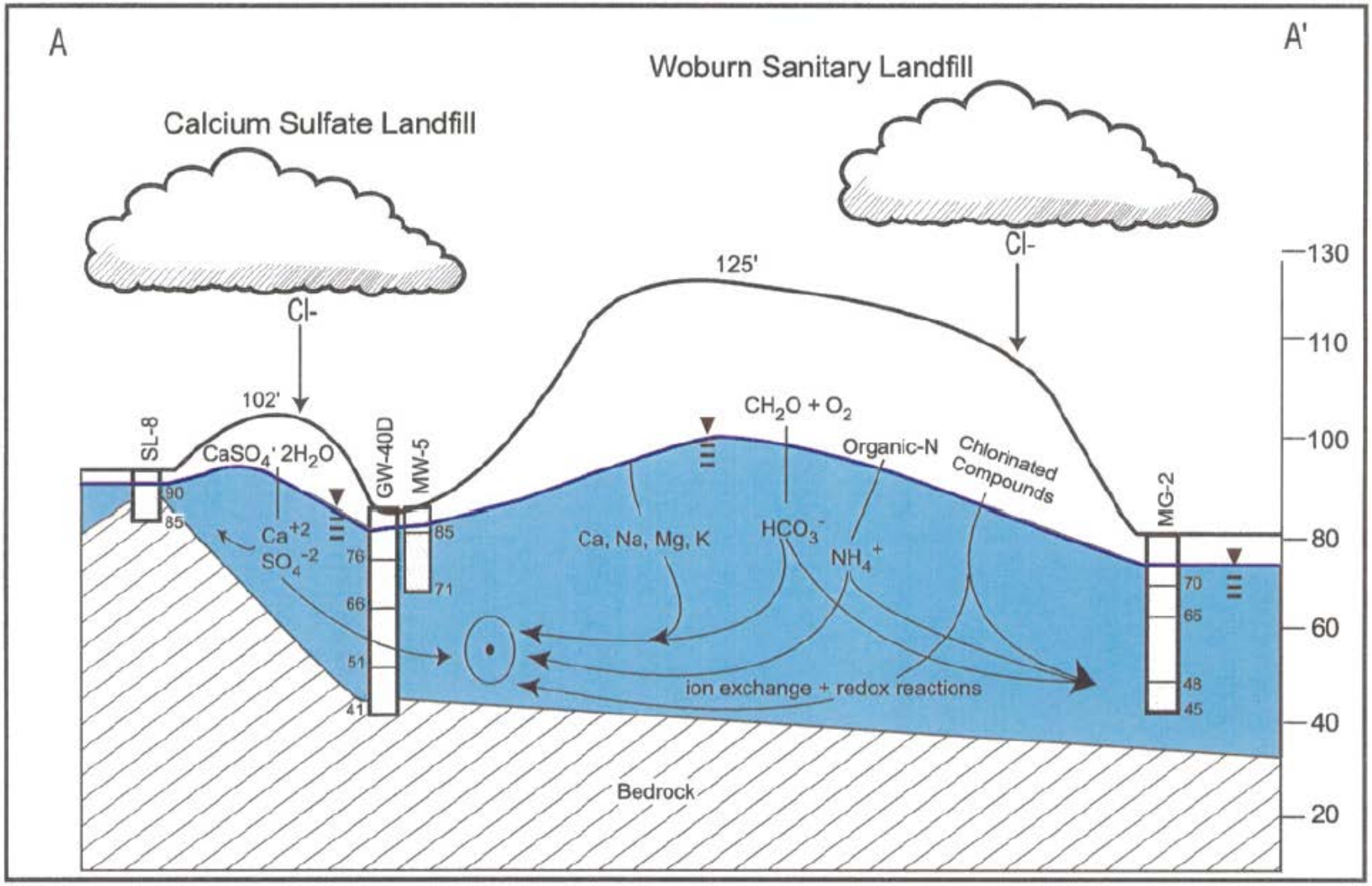
Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI OU1 OU2\OU!OU2SedimentDistributions_with_Inset.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 4.1-46 - SD BEHP.pdf



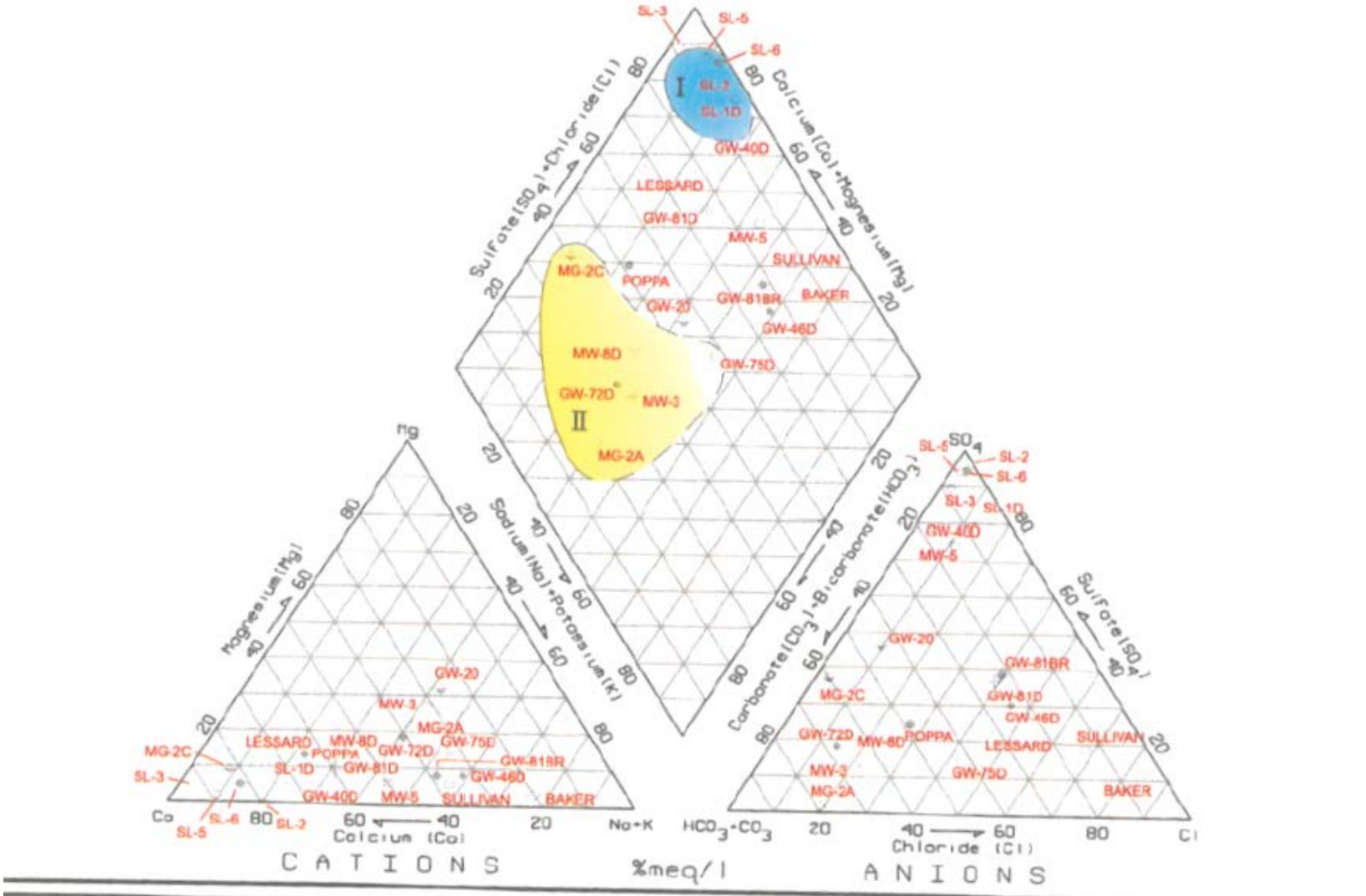
Generation Date: 2/8/99

Figure 1. Site Map Showing the Olin and Woburn Landfill Areas, Locations of Monitoring Wells, and Groundwater and Topographic Elevations. The Site Paradigm (Figure 3) is Drawn Along Cross-Section A-A'. The Woburn Landfill Perimeter is Based on the Extext of Refuse Defined by Fugro East (1996).

Geomega



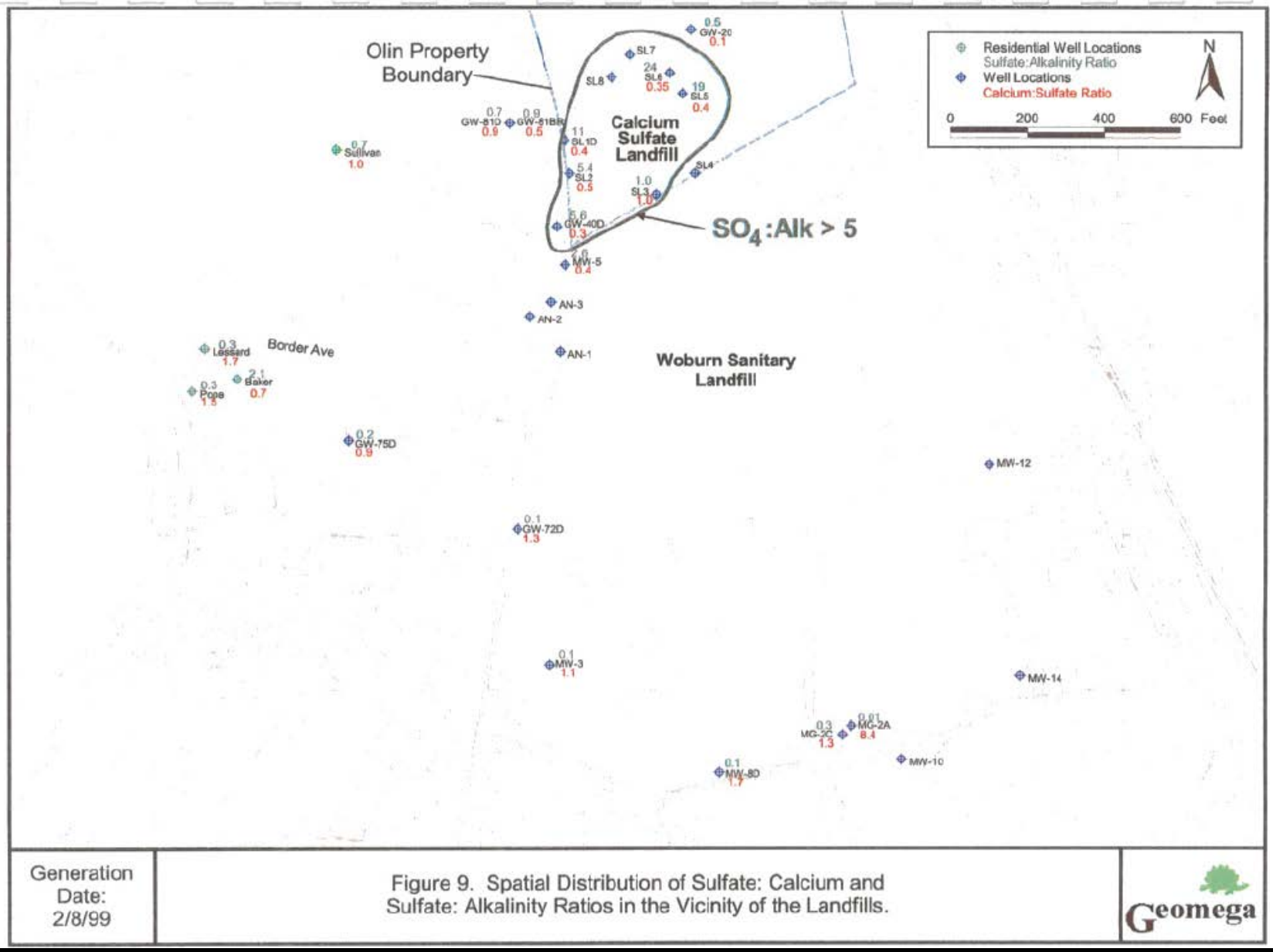
Generation Date: 2/8/99	Figure 3. Conceptual Landfill Geochemical Paradigm Along Transect A - A'. Well completion intervals in feet amsl.	Geomega



Generation Date: 2/8/99

Figure 10. Trilinear Diagram Demonstrating Discrimination Between the Calcium Sulfate/Woburn Sanitary Landfill - Related Groundwaters.

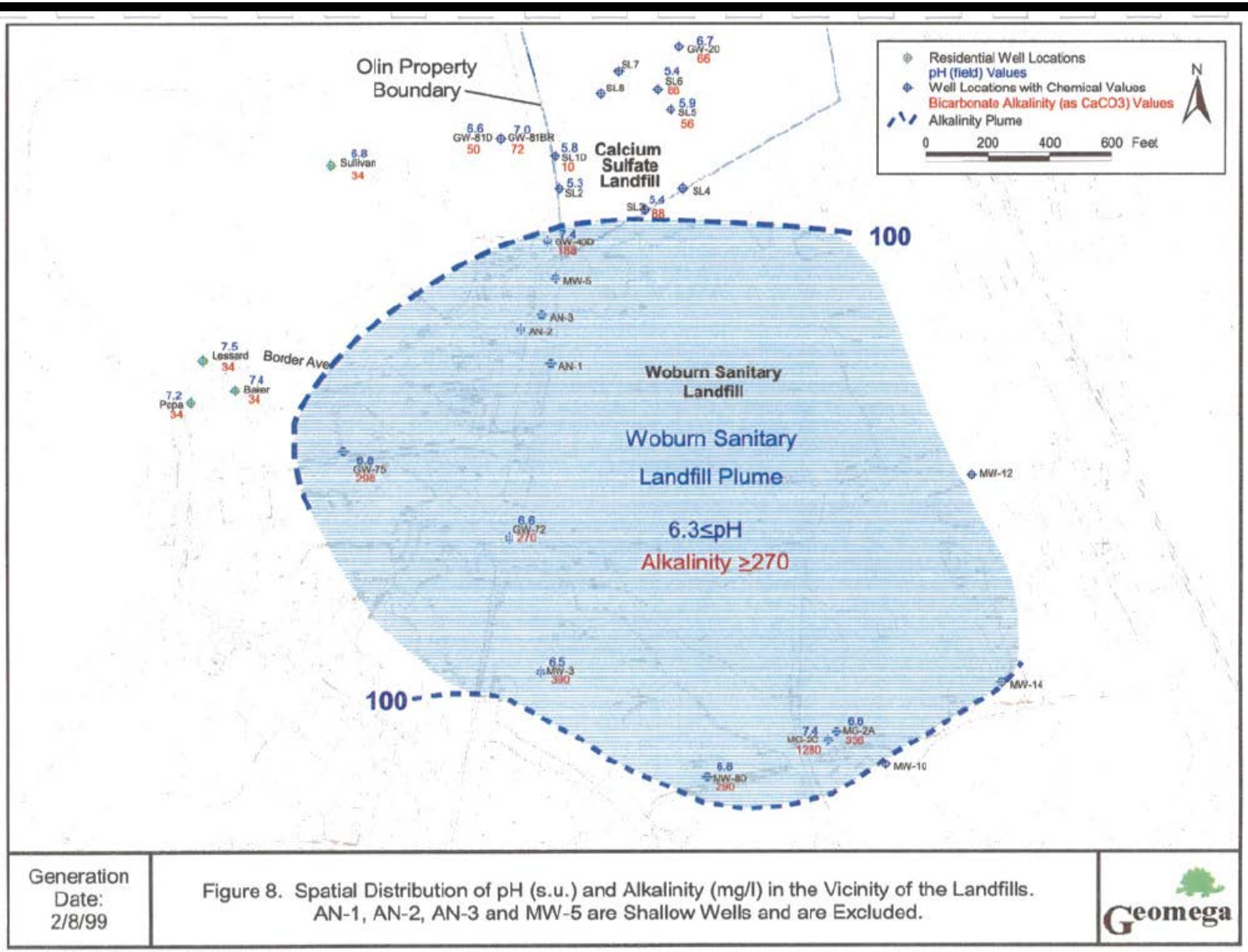
Geomega



Generation Date: 2/8/99

Figure 9. Spatial Distribution of Sulfate: Calcium and Sulfate: Alkalinity Ratios in the Vicinity of the Landfills.

Geomega



Generation Date: 2/8/99

Figure 8. Spatial Distribution of pH (s.u.) and Alkalinity (mg/l) in the Vicinity of the Landfills. AN-1, AN-2, AN-3 and MW-5 are Shallow Wells and are Excluded.

Geomega

North

South

Initial Source of Groundwater Contamination

SB-448

Former Lake Poly (Previously Remediated)

GW-10DR

GW-10S

Former GW-24

GW-408D

GW-408S

GW-202D

GW-202S

South Ditch Overburden Groundwater Discharge (Precipitation of Floc and Discharge of Dissolved Contaminants of Interest)

GW-55D

Approximate Elevation, Feet (MSL)

90

80

70

60

50

40

Outwash Deposits

Basal Till

Bedrock

Vertical percolation of DAPL from Lake Poly

Basal Till

Bedrock

pH 4.5 to 6 (Diffuse Layer)

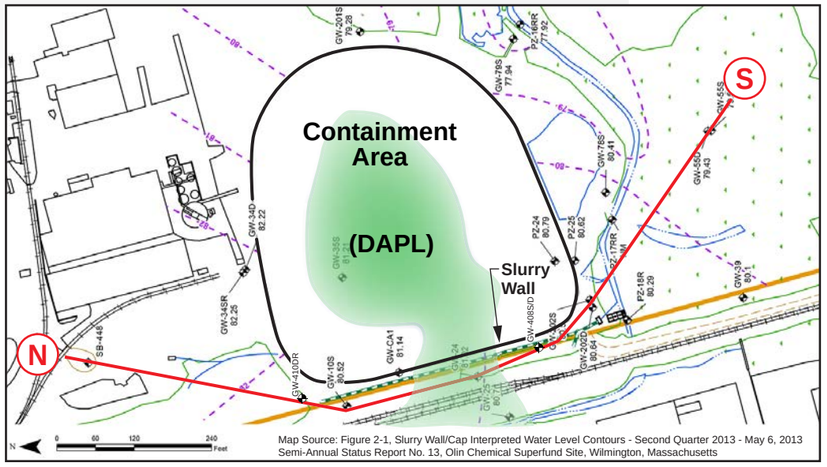
pH 3 to 4.5 (DAPL)

Edge of Off-Property West Ditch
DAPL Pool adjacent to slurry wall

Legend

- Water Table
- Interpreted Groundwater Equipotential Lines
- Interpreted Groundwater Flow Lines
- Schematic/Monitoring Well
- Shallow Groundwater Impacts (for example TMP, NDPL)
- Historical Movement of DAPL Along Basal Till/Bedrock Surface (*No Longer Occurring*)
- Diffuse Layer (specific conductance from 20,600 – 3,000 µS/cm)

Not to Scale



Map Source: Figure 2-1, Slurry Wall/Cap Interpreted Water Level Contours - Second Quarter 2013 - May 6, 2013
Semi-Annual Status Report No. 13, Olin Chemical Superfund Site, Wilmington, Massachusetts

Prepared/Date: TDL 2/18/14
Checked/Date: PHT 2/18/14

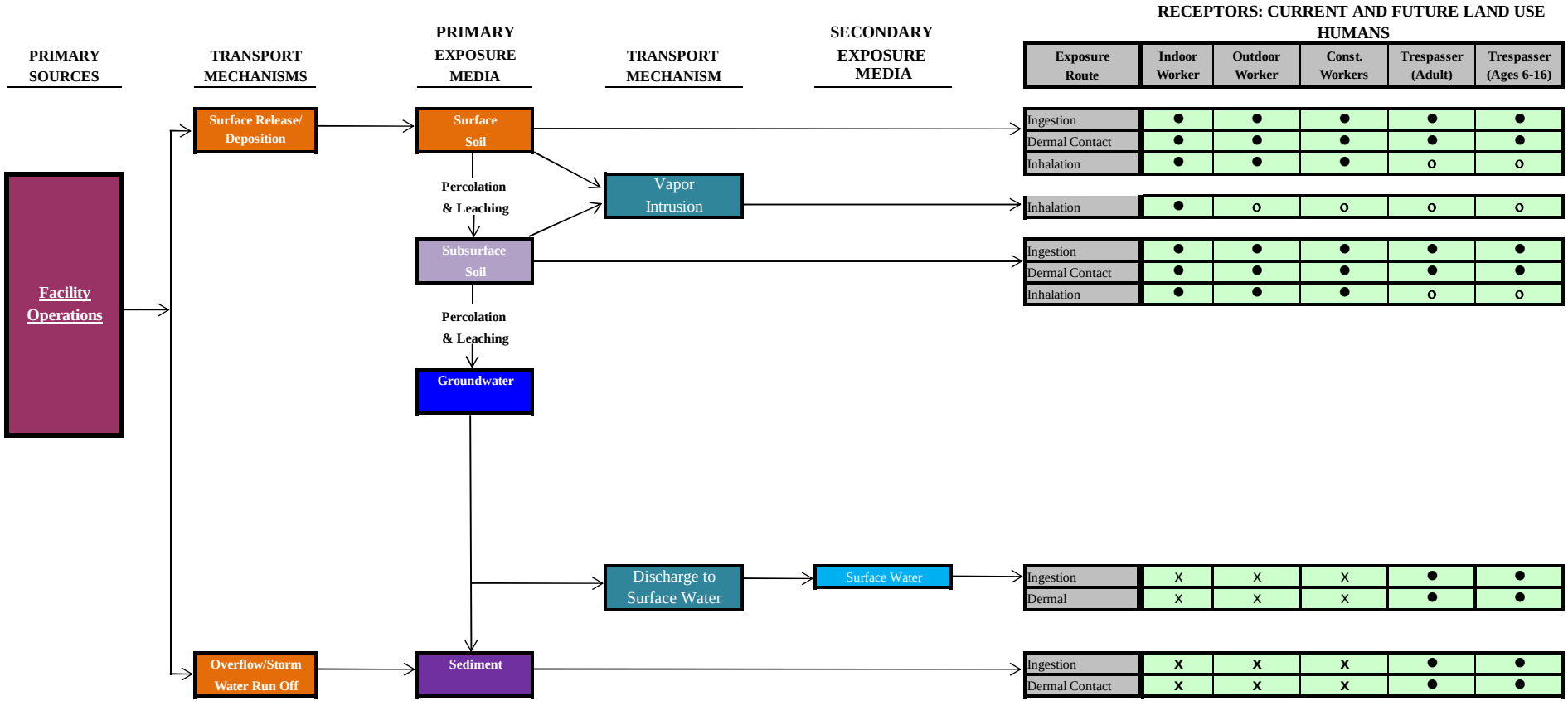
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

amec

Figure 5.0-1
OU1/OU2 Conceptual Site Model

PORT2014009a.ai

Figure 6.1-1
Human Health Risk Assessment Conceptual Site Model - OU1 and OU2
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts



Indicates a potentially complete exposure pathway
Indicates an exposure route that may be complete in the exposure pathway
Indicates an exposure route that may be complete in the exposure pathway but likely to be minimal risk
Indicates an exposure route that would not be complete in the exposure pathway, not evaluated

CSM shows only exposure pathways related to OU1 and OU2. Exposure pathways for OU3 (exposure to groundwater) will be evaluated in the OU3 HHRA.

Prepared by/ Date: LCG 3/12/14
Checked by/ Date: BJR 3/12/14

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HHRA_CSM_OU1_OU2.xlsx, CSM for RI

Original Printed in Color

Maple Meadow Brook Wetland
EA2
EA7
EA3
EA1
EA2
Off Property West Ditch
East Ditch
Containment Area
Detention Basin
Central Pond
EA6
EA4
South Ditch
EA5
Soil Background
Calcium Sulfate Landfill
North Pond
Landfill Brook

Legend

- Exposure Area
- Culvert
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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0 250 500 Feet

Figure 6.1-2
HHRA Exposure Areas

Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

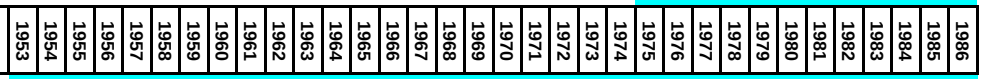
Prepared/Date: BJR 03/31/14 | Checked/Date: MJM 03/31/14

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\HHRA OU1 OU2\HHRA_22X34_P_rotated.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\2013 Remedial Investigation Report\Revised_OU1_OU2_RI\Figures\Figure 6.1-2 - HHRA Exposure Areas.pdf 3/31/2014 2:57 PM brian.roden

TABLES

Table 1.4-1
Chronology of Manufacturing and Waste Disposal Features
Remedial Investigtion Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Waste Disposal Features	
Lake Poly	
East and West Pits	
Acid Pits	
Lined Lagoons	
Pretreatment Plant	
MDC Sewer Connection	
Calcium Sulfate Landfill	
Product	**Plant**
Opex®	A
Kempore® (with sodium dichromate)	C-1
Kempore® (without sodium dichromate)	C-1
Resins	B
Phthalate plasticizers (dioctylphthalate dibutylphthalate)	B
Hydrazine	C-3
Wytox 312	B
Nitropore OBSH	D
Nitropore OT (4,4' oxybisbenzenedisulfonylhydrazide or OBSH)	D
Wiltrol-N (N-nitrosodiphenylamine)	B
Wytox ADP (dioctyldiphenylamine)	B
Expandex 5 PT (5-phenyltetrazole)	Plant D-1/Pilot



Prepared By:	MJM
Checked By:	MH

Table 1.4-2
Major Products, Raw Materials, and Waste Materials at the 51 Eames Street Facility
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Product	Product Type	Chemical Name	Raw Materials	Notes	Waste Materials	Production Years	Plant	Waste Disposal Location
Opex	Nitrogen Blowing Agent	dinitrosopentamethylenetetramine	Hexamethylenetetramine Sodium nitrite Hydrochloric acid Processing oil Ammonia	liquid 30-33% hexamine (pH 9.5 - 11.5) clear yellow liquid, 40 - 45% NaNO2	Sodium chloride Sodium nitrate Formaldehyde Processing oil Ammonium chloride	1953 – 1986	Plant A	Lake Poly 1953 - 1969 Acid Pits 1970 - 1971 Wastewater Treatment Plant and MDC Sewer 1972 - 1986
Kempore	Nitrogen Blowing Agent	azodicarbonamide or azobisformamide	Hydrazine Urea Sulfuric acid Sodium chlorate Sodium Bromide (catalyst level) Sodium dichromate (1956 - 1967)	fuming water white liquid (64%) white prills, free-flowing white crystalline material white crystalline powder or granules	Sodium sulfate Sulfuric acid Urea Sodium chloride Ammonium sulfate Sodium bromide Chrome oxide (1956 - 1967)	1956 – 1986	Plant C-1 (reactor)	Lake Poly 1956 - 1957 East and West Pits 1958 -1965 Acid Pits 1966 -1971 Wastewater Treatment Plant and MDC Sewer 1972 - 1986
Kempore dispersions		Azodicarbonamide and dioctyl phthalate	Azodicarbonamide Dioctyl phthalate	solid liquid	None	1960 – at least 1980	Plant C until 1971 Plant B after 1971	
Hydrazine	Intermediate product for use in Kempore production	Hydrazine and semicarbazide solution	Urea Chlorine Sodium hydroxide Sulfuric acid	white prills, free-flowing	Sodium sulfate Sodium chloride Ammonium sulfate	1963 - 1970	Plant C-3	East and West Pits 1963 - 1965 Acid Pits 1966 -1970
Wytox ADP	Antioxidant/stabilizer	dioctyldiphenylamine	Diphenylamine Diisobutylene Aluminum chloride Sodium hydroxide	liquid	Aluminum hydroxide Sodium hydroxide	1962 - 1971	Plant B	Lake Poly 1961 - 1969 Acid Pits 1970 - 1971
Wytox 345/355/436 (polymeric phosphite)			Nonyl phenol Phosphorus trichloride Paraformaldehyde Oxalic Acid Additive W (from Plant B)	clear liquid clear liquid powder powder	HCl recovered by scrubber	1965 or 1966 (unconfirmed)	Plant C-1 extension	
OBSC/OBSH or Nitropore OT	Nitrogen Blowing Agent	4,4' oxybisbenzenesulfonylchloride(intermediate) or 4,4' oxybisbenzenesulfonylhydrazide	Diphenyl oxide Chlorosulfonic acid Hydrazine Ammonium hydroxide Oil	solid liquid liquid liquid	Chlorosulfonic acid Sulfuric acid Ammonium chloride Hydrochloric acid Sodium chlorosufonate	1970-1975	Plant D	Acid Pits 1970 - 1971 Wastewater Treatment Plant and MDC Sewer 1972 - 1975
Wiltrol-N	Retarder	N-nitrosodiphenylamine	Diphenylamine Sodium nitrite Sulfuric acid	clear yellow liquid, 40 - 45% NaNO2	Sodium nitrite Sodium sulfate	1965 - 1967	Plant B	Lake Poly 1965 - 1967
Wytox 312	Antioxidant/stabilizer	trisnonylphenyl phosphite	Nonyl phenol Phosphorous trichloride	clear liquid clear fuming liquid	None (HCl recovered by scrubber)	1965 – to at least 1980	Plant B	
Wytox Pap	Antioxidant/stabilizer	alkylated phenol	Nonyl phenol Dinonyl phenol Formaldehyde	clear liquid	None	1971 – to at least 1980	Plant B	
Actafoam R-3	blowing agent activator	Unknown (liquid azodicarbonamide activator)	2-ethylhexoic acid Zinc oxide Dioctyl phthalate	clear, colorless liquid	None	1963 – at least 1980	Plant B	
Nitropore 5PT	Nitrogen Blowing Agent	5-phenyltetrazole	Benzonitrile Sodium azide Sodium nitrite Ammonium chloride Dimethyl formamide Hydrochloric acid	clear oily liquid fine, white crystalline powder clear yellow liquid, 40 - 45% NaNO2 colorless liquid liquid	Sodium chloride Sodium nitrate Dimethyl formamide Benzonitrile	1973 – at least 1980 (limited quantities 12 tons per year)	"Pilot Plant" Plant D-1	Wastewater Treatment Plant and MDC Sewer 1973 - 1980
Phenolic and Urea Formaldehyde Resins		Phenolic and Urea Formaldehyde Resins	Phenol Urea Formaldehyde	 liquid (50%)	Phenol Formaldehyde	1961 - 1967	Plant B	
Phthalate plasticizers		Dioctyl phthalate, dibutyl phthalate	Phthalic anhydride 2-ethylhexanol Butyl alcohol	white flakes colorless liquid liquid	None	1955 - 1961		Lake Poly 1955 - 1961

Prepared By: MJM
Checked By: MH

Table 1.4-3
Buildings Associated with the 51 Eames Street Facility
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Building Number	Building Name	Function	Comment
1	Building #1	Finished Product Storage	
2	Building #2	Finished Product Storage	
3	Building #3	Finished Product Storage	
4	Office/Lab	Office/lab	
4A	Office Building	Office/lab	
5	General Purpose Building	Boiler House "A", offices, pilot lab, electrical	
6	Plant A	Manufacturing	Opex, grinding
6A	Plant A extension	Ice house?	
7	Plant B	Manufacturing	Wytox ADP, Wytox PAP, PDA, PAP SE, R-10, Actafoam R-3
8	Plant C-1	Manufacturing	Kempore, grinding
8A	Plant C-1	Manufacturing	Phosphites
8B	Plant C-1 Shed (C-1 Extension)	Manufacturing	Kempore MC, FF, (Diosna) HS, N, F-2 powder
9	Plant C-2	Manufacturing	Kempore 60, 60/125, 150, AF, 200
9A	Plant C-3	Manufacturing	Hydrazine, Wytox Solids, RIA, Kempore Dispersions
10	Maintenance/Boiler Room	Maintenance, heat, steam	
10A	Stock Room	Storage	
11	Pump House	Pump	
12	Butler Building	Storage	
13	No building with this number	NA	
14	Electrical Sub Station	Electrical	
15	West Warehouse	Storage	
15A	West Warehouse (south)	Storage	
16	East Warehouse	Storage	
17	Plant D (D-1, D-2, D-3)	Manufacturing	Nitropore OBSC/OBSH, Expandex 5PT
NA	Guard Shack	Security	
NA	Plant B Treatment Building	Groundwater containment/treatment	

Prepared By: MJM
Checked By: MH

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
AREA-1	AREA 01	08-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-10	AREA 10	09-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-10	AREA 10 DUP	09-Jul-91	FD	0 - 1	36	65		28		23	5							
AREA-2	AREA 02	09-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-3	AREA 03	09-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-4	AREA 04	09-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-5	AREA 05	09-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-6	AREA 06	09-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-7	AREA 07	09-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-8	AREA 08	09-Jul-91	FS	0 - 1	36	65		28		23	5							
AREA-9	AREA 09	09-Jul-91	FS	0 - 1	36	65		28		23	5							
SWMU-27	SWMU-27	30-Jul-91	FS	0 - 1	36	65		28		25	6							
SWMU-30	SWMU-30	30-Jul-91	FS	0 - 1	36	65		28		23	5							
SWMU-33	SWMU-33	30-Jul-91	FS	0 - 1	36	65		28		23	5							
TP-1	TP-1-SN1	02-Oct-91	FS		34	65		28		23	5							
TP-19	TP-19-SN6	07-Oct-91	FS		34	65		28		23	5							
TP-21	TP-21-SN8	08-Oct-91	FS		34	65		28		23	4							
SWMU-27	SWMU-27	22-Apr-93	FS	0 - 0						2	1							
SWMU-25	SWMU-25	07-May-93	FS	0 - 0	36	65		21		23	4							
AREA-1	AREA 1(COMP)	15-Dec-96	FS	0 - 1		65		21		23	3							
AREA-1-1	AREA 1-1	15-Dec-96	FS	0 - 1	36													
AREA-1-2	AREA 1-2	15-Dec-96	FS	0 - 1	36													
AREA-1-3	AREA 1-3	15-Dec-96	FS	0 - 1	36						1							
AREA-1-4	AREA 1-4	15-Dec-96	FS	0 - 1	36						1							
AREA-1-5	AREA 1-5	15-Dec-96	FS	0 - 1	36						1							
AREA-1-6	AREA 1-6	15-Dec-96	FS	0 - 1	36						1							
DRMA-COMP-A	DRMA(COMP A)	15-Dec-96	FS	0 - 1		65		21		23	2							
DRMA-COMP-B	DRMA(COMP B)	15-Dec-96	FS	0 - 1		65		21		23	2							
DRMB-COMP	DRMB-(COMP)	15-Dec-96	FS	0 - 1		65		21		23	2							
G1-DRMB	G1-DRMB	15-Dec-96	FS	0 - 1	36													
G2-DRMB	G2-DRMB	15-Dec-96	FS	0 - 1	36													
G3-DRMB	G3-DRMB	15-Dec-96	FS	0 - 1	36													
G4-DRMB	G4-DRMB	15-Dec-96	FS	0 - 1	36													
GA1-DRMA	GA1-DRMA	15-Dec-96	FS	0 - 1	36													
GA2-DRMA	GA2-DRMA	15-Dec-96	FS	0 - 1	36													
GA3-DRMA	GA3-DRMA	15-Dec-96	FS	0 - 1	36													
GA4-DRMA	GA4-DRMA	15-Dec-96	FS	0 - 1	36													
GB1-DRMA	GB1-DRMA	15-Dec-96	FS	0 - 1	36													
GB2-DRMA	GB2-DRMA	15-Dec-96	FS	0 - 1	36													

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
GB3-DRMA	GB3-DRMA	15-Dec-96	FS	0 - 1	36													
GB4-DRMA	GB4-DRMA	15-Dec-96	FS	0 - 1	36													
LAKE POLY-1	LAKE POLY-1	15-Dec-96	FS	0 - 1	36	65		21		23	2							
LAKE POLY-2	LAKE POLY-2	15-Dec-96	FS	0 - 1	36	65		21		23	2							
LAKE POLY-2	LAKE POLY-2 DUP	15-Dec-96	FD	0 - 1	36	65		21		23	2							
LAKE POLY-3	LAKE POLY-3	15-Dec-96	FS	0 - 1	36	65		21		23	2							
SWMU-26	SWMU26 COMP	15-Dec-96	FS	0 - 1		65		21		1	2							
SWMU-26-1	SWMU26-1	15-Dec-96	FS	0 - 1	36													
SWMU-26-2	SWMU26-2	15-Dec-96	FS	0 - 1	36													
SWMU-26-3	SWMU26-3	15-Dec-96	FS	0 - 1	36						1							
SWMU-26-4	SWMU26-4	15-Dec-96	FS	0 - 1	36													
A8CW-1	A8CW-1	16-Dec-96	FS	0 - 1	36	65		21		1	2							
A8CW-2	A8CW-2	16-Dec-96	FS	0 - 1	36	65		21		1	2							
A8CW-3	A8CW-3	16-Dec-96	FS	0 - 1	36	65		21		1	2							
A8CW-4	A8CW-4	16-Dec-96	FS	0 - 1	36	65		21		23	2							
A9CW-(COMP)	A9CW-(COMP)	16-Dec-96	FS	0 - 1		65		21		23	2							
A9CW-1	A9CW-1	16-Dec-96	FS	0 - 1	36													
A9CW-2	A9CW-2	16-Dec-96	FS	0 - 1	36													
A9CW-3	A9CW-3	16-Dec-96	FS	0 - 1	36													
A9CW-4	A9CW-4	16-Dec-96	FS	0 - 1	36													
AREA-8-1	AREA8-1	16-Dec-96	FS	0 - 1	36	65		21		23	2							
AREA-8-2	AREA8-2	16-Dec-96	FS	0 - 1	36	65		21		1	2							
AREA-8-3	AREA8-3	16-Dec-96	FS	0 - 1	36	65		21		1	2							
AREA-8-4	AREA8-4	16-Dec-96	FS	0 - 1	36	65		21		1	2							
CPDA-1	CPDA-1	16-Dec-96	FS	0 - 1	36	65		21		1	2							
CPDA-2	CPDA-2	16-Dec-96	FS	0 - 1	36	65		21		1	2							
CPDA-3	CPDA-3	16-Dec-96	FS	0 - 1	36	65		21		1	2							
CPDA-4	CPDA-4	16-Dec-96	FS	0 - 1	36	65		21		1	2							
CPDA-5	CPDA-5	16-Dec-96	FS	0 - 1	36	65		21		1	2							
CPDA-6	CPDA-6	16-Dec-96	FS	0 - 1	36	65		21		1	2							
CPDA-7	CPDA-7	16-Dec-96	FS	0 - 1	36	65		21		1	2							
CPDA-8	CPDA-8	16-Dec-96	FS	0 - 1	36	65		21		23	2							
CPDA-9	CPDA-9	16-Dec-96	FS	0 - 1	36	65		21		23	2							
CPDA-9	CPDA-9 DUP	16-Dec-96	FD	0 - 1	36	65		21		1	2							
BS013	BS013WDX	21-Jan-97	FS	0 - 0		65		21		23								
BS014	BS014WDX	21-Jan-97	FS	0 - 0		65		21		23								
BS015	BS015SDX	21-Jan-97	FS	0 - 0		65		21		23								
BS016	BS016SMD	21-Jan-97	FS	0 - 0		65		21		23								
BS017	BS017PND	21-Jan-97	FS	0 - 0		65		21		23								

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
BS018	BS018PND	21-Jan-97	FS	0	-	0		65		21		23								
BS019	BS019WMD	21-Jan-97	FS	0	-	0		65		21		23								
BS020	BS020WMD	21-Jan-97	FS	0	-	0		65		21		23								
SBGR	SBGR	03-Nov-98	FS									23	1							
SWMU-27-101	SS101XX27D DUP	23-Nov-98	FD	0	-	2	66	67				23	4							
SWMU-27-101	SS101XX27X	23-Nov-98	FS	0	-	2	66	67				23	4							
SWMU-27-102	SS102XX27X	23-Nov-98	FS	0	-	2	65	67				23	4							
SWMU-27-103	SS103XX27X	23-Nov-98	FS	0	-	2	65	67				23	4							
SWMU-33-101	SS101XX33X	23-Nov-98	FS	0	-	2	66	67				23	4							
SWMU-33-102	SS102XX33X	23-Nov-98	FS	0	-	2	66	67				23	4							
SWMU-33-103	SS103XX33X	23-Nov-98	FS	0	-	2	66	67				23	4							
LP-102	SS101XXLPX	24-Nov-98	FS	0	-	2						2	4							
LP-102	SS102XXLPX	24-Nov-98	FS	0	-	2						2	4							
LP-103	SS103XXLPD DUP	24-Nov-98	FD	0	-	2						2	4							
LP-103	SS103XXLPX	24-Nov-98	FS	0	-	2						2	4							
LP-104	SS104XXLPX	24-Nov-98	FS	0	-	2						2	4							
LP-105	SS105XXLPX	24-Nov-98	FS	0	-	2						2	4							
LP-101	101A	30-Nov-98	FS	0	-	2						2	1							
LP-102	102A	30-Nov-98	FS	0	-	2						2	1							
LP-104	104A	30-Nov-98	FS	0	-	2						2	1							
SWMU-27-101	SS101XX27X	30-Nov-98	FS	0	-	2	64													
SWMU-27-102	SS102XX27X	30-Nov-98	FS	0	-	2	63													
SWMU-27-103	SS103XX27X	30-Nov-98	FS	0	-	2	63													
SWMU-33-101	SS101XX33X	30-Nov-98	FS	0	-	2	64													
SWMU-33-102	SS102XX33X	30-Nov-98	FS	0	-	2	64													
SWMU-33-103	SS103XX33X	30-Nov-98	FS	0	-	2	64													
CP-1	CP 1 (Central Pond 1)	04-Nov-99	FS							1			1							
CP-2	CP 2 (Central Pond 2)	04-Nov-99	FS							1			1							
LP-1	LP 1 (Lake Poly 1)	04-Nov-99	FS	0	-	0				1			1							
LP-2	Duplicate	04-Nov-99	FD	0	-	0				1			1							
LP-2	LP 2 (Lake Poly 2)	04-Nov-99	FS	0	-	0				1			1							
NW-WAREHOUSE	NW Warehouse	04-Nov-99	FS	0	-	0				1			1							
SE-WAREHOUSE	SE Warehouse	04-Nov-99	FS	0	-	0				1			1							
WD-1	WD 1 (West Ditch 1)	04-Nov-99	FS	0	-	0				1			1							
WD-2	WD 2 (West Ditch 2)	04-Nov-99	FS	0	-	0				1			1							
RSO-14	RSO-14-S1 (0-3 FT)	24-Jan-00	FS	-0.9	-	2.13						22	1							
RSO-14	RSO-14-S1 (0-3)	24-Jan-00	FS	-0.9	-	2.13	40	72												
DB-C1	97598-DB-C1	10-Aug-00	FS	0.7	-	0.7	68	67		22		3	1							
DB-C14	97598-DB-C14	10-Aug-00	FS	-1.3	-	1.7	67	67		22		3	1							

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
BP-1	97598-BP-1	11-Aug-00	FS	0.5	-	0.5		67		22		6	1							
BP-2	97598-BP-2	11-Aug-00	FS	0.5	-	0.5		67		22		6	1							
BP-3	97598-BP-3	11-Aug-00	FS	0.5	-	0.5		67		22		6	1							
BP-4	97598-BP-4	11-Aug-00	FS	0.5	-	0.5		67		22		6	1							
DA-C10	1120-DA-C10	18-Sep-00	FS	-0.2	-	1.8	66	67		19		3	1							
DA-C5	1120-DA-C5	18-Sep-00	FS	0.3	-	2.3	66	67		19		3	1							
DA-C9	1120-DA-C9	18-Sep-00	FS	0.3	-	0.3	66	67		19		3	1							
SD-C1	1140-SD-C1	03-Oct-00	FS	0.5	-	0.5		67				1	1							
SD-C1B	1140-SD-C1B	03-Oct-00	FS	0.5	-	0.5		67				1	1							
SD-C2	1140-SD-C2	03-Oct-00	FS	0.5	-	0.5		67				1	1							
SD-C2B	1140-SD-C2B	03-Oct-00	FS	-0.5	-	-0.5		67				1	1							
CP-C25	1140-CP-C25	05-Oct-00	FS	0.9	-	0.9	65	67		19		8	1							
SD-C10	1140-SD-C10	11-Oct-00	FS	0.46	-	0.46	66	67		19		8	1							
SD-C13	1140-SD-C13	11-Oct-00	FS	0.46	-	0.46		67				1	1							
SD-C14	1140-SD-C14	11-Oct-00	FS	0.54	-	0.54		67				1	1							
SD-C15	1140-SD-C15	11-Oct-00	FS	0.49	-	0.49	66	67		19		8	1							
SD-C3B	1140-SD-C3B	11-Oct-00	FS	-0.2	-	-0.2		67				1	1							
SD-C4	1140-SD-C4	11-Oct-00	FS	-0.4	-	-0.4		67				1	1							
SD-C6	1140-SD-C6	11-Oct-00	FS	0.48	-	0.48	66	67		19		8	1							
SD-C7	1140-SD-C7	11-Oct-00	FS	0.49	-	0.49		67				1	1							
SD-C9	1140-SD-C9	11-Oct-00	FS	0.5	-	0.5		67				1	1							
SD-C16B	1140-SD-C16B	12-Oct-00	FS	0.21	-	0.21		67				1	1							
SD-C17B	1140-SD-C17B	12-Oct-00	FS	0.47	-	0.47	66	67		19		8	2							
SD-C18B	1140-SD-C18B	12-Oct-00	FS	-0	-	-0		67				1	1							
SD-C19B	1140-SD-C19B	12-Oct-00	FS	0.11	-	0.11	66	67		19		8	2							
SD-C20B	1140-SD-C20B	12-Oct-00	FS	0.51	-	0.51		67				1	1							
SD-C21B	1140-SD-C21B	12-Oct-00	FS	0.27	-	0.27	66	67		19		8	2							
SD-C22B	1140-SD-C22B	12-Oct-00	FS	-0.4	-	-0.4		67				1	1							
SD-C23B	1140-SD-C23B	12-Oct-00	FS	-1.2	-	-1.2	65	67		19		8	2							
SD-C23B	1140-SD-C23B-D	12-Oct-00	FD	-1.2	-	-1.2	65	67		19		8	2							
OSFILL-450	1130-OSFILL-450	13-Oct-00	FS	0.5	-	0.5	66	67			7	8	1		5					
OSFILL-550	1130-OSFILL-550	13-Oct-00	FS	0.5	-	0.5	66	67			7	8	1		5					
BD-C22	1120-BD-C22	27-Oct-00	FS	0.6	-	0.6	66	67		19		8	1							
BD-C26	1120-BD-C26	27-Oct-00	FS	0.5	-	0.5	66	67		19		8	1							
BD-C31	1120-BD-C31	27-Oct-00	FS	0.5	-	0.5	66	67		19		8	1							
SD-C25B	1140-SD-C25B	02-Nov-00	FS	-0.9	-	-0.9	65	67		19		8	2							
SD-C26B	1140-SD-C26B	02-Nov-00	FS	-0.4	-	-0.4		67				1	1							
SD-C27B	1140-SD-C27B	02-Nov-00	FS	-0.4	-	-0.4		67				1	1							
SD-C28B	1140-SD-C28B	02-Nov-00	FS	-0.3	-	-0.3		67				1	1							

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SD-C29B	1140-SD-C29B	02-Nov-00	FS	0.48	-	0.48	66	67		19		8	2							
SD-C30B	1140-SD-C30B	02-Nov-00	FS	0.48	-	0.48		67				1	1							
SD-C31B	1140-SD-C31B	02-Nov-00	FS	-0.3	-	-0.3	65	67		19		8	2							
SD-C32B	1140-SD-C32B	02-Nov-00	FS	0.48	-	0.48		67				1	1							
SD-C33B	1140-SD-C33B	02-Nov-00	FS	0.48	-	0.48	65	67		19		8	2							
SD-C33B	1140-SD-C33B-D	02-Nov-00	FD	0.48	-	0.48	65	67		19		8	2							
SD-C34B	1140-SD-C34B	03-Nov-00	FS	0.48	-	0.48		67				1	1							
SD-C35B	1140-SD-C35B	03-Nov-00	FS	0.48	-	0.48		67				1	1							
SD-C36B	1140-SD-C36B	03-Nov-00	FS	0.48	-	0.48		67				1	1							
SD-C37B	1140-SD-C37B	03-Nov-00	FS	0.28	-	0.28	65	67		19		8	2							
SD-C38B	1140-SD-C38B	03-Nov-00	FS	0.08	-	0.08		67				1	1							
SD-C38B	1140-SD-C38B-D	03-Nov-00	FD	0.08	-	0.08		67				1	1							
SD-C39B	1140-SD-C39B	03-Nov-00	FS	0.48	-	0.48	65	67		19		8	2							
SD-C40B	1140-SD-C40B	03-Nov-00	FS	0.48	-	0.48		67				1	1							
SD-C41B	1140-SD-C41B	03-Nov-00	FS	-1.3	-	-1.3		67				1	1							
SD-C42B	1140-SD-C42B	03-Nov-00	FS	0.38	-	0.38	66	67		19		8	2							
SD-C43B	1140-SD-C43B	03-Nov-00	FS	0.65	-	0.65	66	67		19		8	2							
A8CW-1-E	1160-A8CW-1-E	09-Nov-00	FS	0	-	2		67		19		3	1							
A8CW-1-N	1160-A8CW-1-N	09-Nov-00	FS	0	-	2		67		19		3	1							
A8CW-1-S	1160-A8CW-1-S	09-Nov-00	FS	0	-	2		67		19		3	1							
A8CW-1-W	1160-A8CW-1-W	09-Nov-00	FS	0	-	2		67		19		3	1							
OSFILL-1120	1130-OSFILL-1120	15-Nov-00	FS	0.5	-	0.5	66	67			7	8	1		5					
OSFILL-1170	1130-OSFILL-1170	15-Nov-00	FS	0.5	-	0.5	66	67			7	8	1		5					
OSFILL-1220	1130-OSFILL-1220	15-Nov-00	FS	0.5	-	0.5	66	67			7	8	1		5					
OSFILL-1220	1130-OSFILL-1220 D	15-Nov-00	FD	0.5	-	0.5	66	67			7	8	1		5					
OSFILL-400	1130-OSFILL-400	15-Nov-00	FS	0.5	-	0.5	66	67			7	8	1		5					
OSFILL-460	1130-OSFILL-460	15-Nov-00	FS	0.5	-	0.5	66	67			7	8	1		5					
OSFILL-530	1130-OSFILL-530	15-Nov-00	FS	0.5	-	0.5	66	67			7	8	1		5					
OSFILL-600	1130-OSFILL-600	15-Nov-00	FS	0.5	-	0.5	66	67			7	8	1		5					
CP-C78	1140-CP-C78	09-May-01	FS	0.9	-	0.9		66				1	1							
CP-C89 thru CP-C91	1140-CP-8991	10-May-01	FS									8	1	6	22	12				
SD-C48N	1140-SD-C48N	14-May-01	FS	0.26	-	0.76						1	1							
SD-C48S	1140-SD-C48S	14-May-01	FS	0.66	-	1.16						1	1							
SD-C49N	1140-SD-C49N	14-May-01	FS	-0	-	0.46						1	1							
SD-C50N	1140-SD-C50N	14-May-01	FS	0.06	-	0.56						1	1							
SD-C51N	1140-SD-C51N	14-May-01	FS	0.56	-	1.06						1	1							
SD-C52N	1140-SD-C52N	14-May-01	FS	0.56	-	1.06	66					1	1							
SD-C53N	1140-SD-C53N	15-May-01	FS	0.63	-	1.13						1	1							
SD-C54N	1140-SD-C54N	15-May-01	FS	-0.9	-	-0.4		67				1	1							

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SD-C54S	1140-SD-C54S	15-May-01	FS	0.53	-	1.03		67				1	1							
WDW-C34	1140-WDW-C34	16-May-01	FS	-0.6	-	-0.6						1	1							
LPB3	1160-LPB3-S1	09-Jul-01	FS	0	-	2.5						1	1							
LPB4	1160-LPB4-S1	10-Jul-01	FS	0	-	1						1	1							
LPB5	1160-LPB5-S1	10-Jul-01	FS	0	-	2.5	66	67		19		5	3		22	12				
LPB6	1160-LPB6-S1	10-Jul-01	FS	0	-	1						1	1							
LPB14	1160-LPB14-S1	11-Jul-01	FS	0	-	2.5	66	67		19		4	4		22	12				
LPB24	1160-LPB24-S1	11-Jul-01	FS	0	-	2						1	1							
LPB25	1160-LPB25-S1	11-Jul-01	FS	0	-	2.5						1	1							
LPB32	1160-LPB 32-S1	12-Jul-01	FS	0	-	2						1	1							
SDF-3	1010-SED-DUPE1	17-Sep-01	FD	0	-	0.5	66	67				9	4		22					
SDF-3	1010-SED-SDF-3S	17-Sep-01	FS	0	-	0.5	66	67				9	4		22					
SDF-4	1010-SED-SDF-4S	17-Sep-01	FS	0	-	0.5	66	67				9	4		22					
SDF-5	1010-SED-SDF-5S	17-Sep-01	FS	0	-	0.5	66	67				9	4		22					
SDF-6	1010-SED-SDF-6S	17-Sep-01	FS	0	-	0.5	66	67				9	4		22					
CP-TP15	1010-CP-TP15	18-Sep-01	FS	0	-	2.25					7	8	1		22					
CP-TP19	1010-CP-TP19	18-Sep-01	FS	0	-	2.25					7	8	1		22					
CP-TP8	1010-CP-TP8	18-Sep-01	FS	0	-	2.25					7	8	1		22					
CP-EX1	1170-CPEX1-BOT	27-Aug-03	FS									8	1		22					
CP-EX2	1170-CPEX2-BOT	27-Aug-03	FS									8	1		22					
CP-EX3	1170-CPEX3-BOT	27-Aug-03	FS									8	1		22					
CP-EX1	1170-CPEX1-SIDE123	28-Aug-03	FS									8	1		22					
CP-EX1	1170-CPEX1-SIDE4	28-Aug-03	FS									8	1		22					
CP-EX2	1170-CPEX2-SIDE123	28-Aug-03	FS									8	1		22					
CP-EX2	1170-CPEX2-SIDE4	28-Aug-03	FS									8	1		22					
CP-EX3	1170-CPEX3-SIDE123	28-Aug-03	FS									8	1		22					
CP-EX3	1170-CPEX3-SIDE4	28-Aug-03	FS									8	1		22					
CP-EX2	1170-CPEX2-Side1	10-Oct-03	FS										1		22					
CP-EX2	1170-CPEX2-Side2	10-Oct-03	FS										1		22					
CP-EX2	1170-CPEX2-Side3	10-Oct-03	FS										1		22					
LPB-40	LPB-40-OVR	10-Dec-03	FS	0	-	2.9	2	1					1				3			
LPB-41	LPB-41-OVR	10-Dec-03	FS	0	-	1.5	2	1					1				3			
ECS-C-1	ECS-C-1	30-Jan-04	FS					75			9	8	6		21					
ECS-C-2	ECS-C-2	30-Jan-04	FS					75			9	8	6		21					
BIOCELL	1140-BP-DS1	21-Apr-04	FS					69					1	1			3			
BIOCELL	1140-BP-DS2	21-Apr-04	FS					69					1	1			3			
BIOCELL	1140-BP-DS3	21-Apr-04	FS					69					1	1			3			
BIOCELL	1140-BP-DS4	21-Apr-04	FS					69					1	1			3			
BIOCELL	1140-BP-DS5	21-Apr-04	FS					69					1	1			3			

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
BIOCELL	1140-BP-DS1-02	19-May-05	FS			69					2	1			3			
BIOCELL	1140-BP-DS2-02	19-May-05	FS			69					2	1			3			
BIOCELL	1140-BP-DS3-02	19-May-05	FS			69					2	1			3			
BIOCELL	1140-BP-DS4-02	19-May-05	FS			69					2	1			3			
BIOCELL	1140-BP-DS5-02	19-May-05	FS			69					2	1			3			
BS041	BS041LSD	22-Aug-05	FS	0 - 0.5		67	16	19		24	6							
BS041	BS041LSD-DUP	22-Aug-05	FD	0 - 0.5		67	16	19		24	6							
BS042	BS042LSD	22-Aug-05	FS	0 - 0.5		67	16	19		24	6							
BS043	BS043LSD	22-Aug-05	FS	0 - 0.5		67	16	19		24	6							
BS044	BS044LSD	23-Aug-05	FS	0 - 0.5		67	16	19		24	6							
BS045	BS045LSD	23-Aug-05	FS	0 - 0.5		67	16	19		24	6							
CS GPS-1	CS GPS-1	24-Oct-06	FS	0 - 1							2							
CS GPS-11	CS GPS-11	24-Oct-06	FS	0 - 1							2							
CS GPS-13	CS GPS-13	24-Oct-06	FS	0 - 1							2							
CS GPS-15	CS GPS-15	24-Oct-06	FS	0 - 1							2							
CS GPS-17	CS GPS-17	24-Oct-06	FS	0 - 1							2							
CS GPS-19	CS GPS-19	24-Oct-06	FS	0 - 1							2							
CS GPS-21	CS GPS-21	24-Oct-06	FS	0 - 1							2							
CS GPS-21	CS GPS-21DUP	24-Oct-06	FD	0 - 1							2							
CS GPS-23	CS GPS-23	24-Oct-06	FS	0 - 1							2							
CS GPS-25	CS GPS-25	24-Oct-06	FS	0 - 1							2							
CS GPS-27	CS GPS-27	24-Oct-06	FS	0 - 1							2							
CS GPS-29	CS GPS-29	24-Oct-06	FS	0 - 1							2							
CS GPS-3	CS GPS-3	24-Oct-06	FS	0 - 1							2							
CS GPS-5	CS GPS-5	24-Oct-06	FS	0 - 1							2							
CS GPS-7	CS GPS-7	24-Oct-06	FS	0 - 1							2							
CS GPS-9	CS GPS-9	24-Oct-06	FS	0 - 1							2							
SB-405	OC-SB-405-0.0/1.0-XXX	18-Aug-09	FS	0 - 1	78	79			24	5								
SB-412	OC-SB-412-0.0/1.0-XXX	18-Aug-09	FS	0 - 1	78	80			24	6					3	2	1	1
SB-416	OC-SB-416-0.0/1.0-XXX	18-Aug-09	FS	0 - 1	78	80			24	6					3	2	1	1
SB-420	OC-SB-420-0.0/1.0-XXX	18-Aug-09	FS	0 - 1	78	80			24	5						2		1
SB-423	OC-SB-423-0.0/1.0-XXX	18-Aug-09	FS	0 - 1	78	79			24	5						2		
SB-419	OC-SB-419-0.0/1.0-XXX	19-Aug-09	FS	0 - 1	78	80			24	5						2	1	1
SB-421	OC-SB-421-0.0/1.0-XXX	19-Aug-09	FS	0 - 1	78	80			24	7		5	6		3	2	1	1
SB-424	OC-SB-424-0.0/1.0-XXX	19-Aug-09	FS	0 - 1	78	80			24	6					3	2	1	1
SB-425	OC-SB-425-0.0/1.0-XXX	19-Aug-09	FS	0 - 1	78	80			24	5						2		1
SB-426	OC-SB-426-0.0/1.0-XXX	19-Aug-09	FS	0 - 1	78	80			24	7					3	2	1	1
SB-415	OC-SB-415-0.0/1.0-XXX	20-Aug-09	FS	0 - 1	78	79			24	5								
SB-431	OC-SB-431-0.0/1.0-XXX	20-Aug-09	FS	0 - 1	78	79			24	6					3			

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-432	OC-SB-432-0.0/1.0-XXX	20-Aug-09	FS	0 - 1	78	80				24	6		5	6	3	2	1	1
SB-436	OC-SB-436-0.0/1.0-XXX	20-Aug-09	FS	0 - 1	78	79				24	6				3			
SB-443	OC-SB-443-0.0/1.0-XXX	20-Aug-09	FS	0 - 1	78	80				24	6				3		1	1
SB-437	OC-SB-437-0.0/1.0-XXX	21-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-445	OC-SB-445-0.0/1.0-XXX	21-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-433	OC-SB-433-0.0/1.0-XXX	24-Aug-09	FS	0 - 1	78	79				24	5							
SB-438	OC-SB-438-0.0/1.0-XXX	24-Aug-09	FS	0 - 1	78	79				24	5							
SB-439	OC-SB-439-0.0-1.0-XXX	24-Aug-09	FS	0 - 1	78	79				24	5							
SB-440	OC-SB-440-0.0/1.0-XXX	24-Aug-09	FS	0 - 1	78	79				24	5		5	6				
SB-441	OC-SB-441-0.0/1.0-XXX	24-Aug-09	FS	0 - 1	78	79				24	5		5	6				
SB-422	OC-SB-422-0.0/1.0-XXX	25-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-430	OC-SB-430-0.0/1.0-XXX	25-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-446	OC-SB-446-0.0/1.0-XXX	25-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-448	OC-SB-448-0.0/1.0-XXX	25-Aug-09	FS	0 - 1	78	80				24	7				3	2	1	1
SB-400	OC-SB-400-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	79				24	5		5	6				
SB-401	OC-SB-401-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	79				24	5							
SB-402	OC-SB-402-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	80				24	7				3	2	1	1
SB-403	OC-SB-403-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-407	OC-SB-407-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	80				24	7				3	2	1	1
SB-408	OC-SB-408-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	79				24	5							
SB-409	OC-SB-409-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-411	OC-SB-411-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-414	OC-SB-414-0.0/1.0-XXX	26-Aug-09	FS	0 - 1	78	79				24	5							
SB-410	OC-SB-410-0.0/1.0-XXX	27-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-418	OC-SB-418-0.0/1.0-XXX	27-Aug-09	FS	0 - 1	78	79				24	5					2		
SB-444	OC-SB-444-0.0/1.0-XXX	27-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-449	OC-SB-449-0.0/1.0-XXX	27-Aug-09	FS	0 - 1	78	80		9		24	6				3	2	1	1
SB-454	OC-SB-454-0.0/1.0-XXX	27-Aug-09	FS	0 - 1	78	79				24	5							
SB-451	OC-SB-451-0.0/1.0-XXX	28-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-455	OC-SB-455-0.0/1.0-XXX	28-Aug-09	FS	0 - 1							3							
SB-442	OC-SB-442-0.0/1.0-XXX	31-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-447	OC-SB-447-0.0/1.0-XXX	31-Aug-09	FS	0 - 1	78	79				24	6		5	6				
SB-452	OC-SB-452-0.0/1.0-XXX	31-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-458	OC-SB-458-0.0/1.0-XXX	31-Aug-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-460	OC-SB-460-0.0/1.0-XXX	01-Sep-09	FS	0 - 1	78	79				24	5						1	
SB-463	OC-SB-463-0.0/1.0-XXX	01-Sep-09	FS	0 - 1	78	79				24	6				3			
SB-464	OC-SB-464-0.0/1.0-XXX	01-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-465	OC-SB-465-0.0/1.0-XXX	02-Sep-09	FS	0 - 1	78	80				24	7				3	2	1	1
SB-467	OC-SB-467-0.0/1.0-XXX	02-Sep-09	FS	0 - 1				9			2							

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-468	OC-SB-468-0.0/1.0-XXX	02-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-471	OC-SB-471-0.0/1.0-XXX	02-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-459	OC-SB-459-0.0/1.0-XXX	03-Sep-09	FS	0 - 1	78	80		9		24	7				3	2	1	1
SB-461	OC-SB-461-0.0/1.0-XXX	03-Sep-09	FS	0 - 1				9			2							
SB-462	OC-SB-462-0.0/1.0-XXX	03-Sep-09	FS	0 - 1	78	79				24	5							
SB-470	OC-SB-470-0.0/1.0-XXX	04-Sep-09	FS	0 - 1	78	79				25	9							
SB-472	OC-SB-472-0.0/1.0-XXX	04-Sep-09	FS	0 - 1	78	80		9		24	6				3	2	1	1
SB-466	OC-SB-466-0.0/1.0-XXX	08-Sep-09	FS	0 - 1	78	79				24	6							
SB-469	OC-SB-469-0.0/1.0-XXX	08-Sep-09	FS	0 - 1	78	79				25	9							
SB-450	OC-SB-450-0.0/1.0-XXX	09-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-417	OC-SB-417-0.0/1.0-XXX	10-Sep-09	FS	0 - 1	78	79				24	5							
SB-427	OC-SB-427-0.0/1.0-XXX	10-Sep-09	FS	0 - 1	78	80				24	6		5	6	3	2	1	1
SB-428	OC-SB-428-0.0/1.0-XXX	10-Sep-09	FS	0 - 1	78	80				24	5		5	6		2		1
SB-434	OC-SB-434-0.0/1.0-XXX	10-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-456	OC-SB-456-0.0/1.0-XXX	11-Sep-09	FS	0 - 1	78	80				25	10				3	2	1	1
SB-457	OC-SB-457-0.0/1.0-XXX	11-Sep-09	FS	0 - 1	78	80				25	10				3	2	1	1
SS-400	OC-SS-400-0.0/1.0-XXX	14-Sep-09	FS	0 - 1	78	79				24	5							
SS-401	OC-SS-401-0.1/1.0-XXX	14-Sep-09	FS	0 - 1	78	79				24	5							
SS-402	OC-SS-402-0.0/1.0-XXX	14-Sep-09	FS	0 - 1	78	79				24	5							
SS-403	OC-SS-403-0.0/1.0-XXX	14-Sep-09	FS	0 - 1				9			2							
SS-404	OC-SS-404-0.0/1.0-XXX	14-Sep-09	FS	0 - 1	78	79		9		24	5							
SS-405	OC-SS-405-0.0/1.0-XXX	14-Sep-09	FS	0 - 1	78	79				24	5							
SS-406	OC-SS-406-0.0/1.0.-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-407	OC-SS-407-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-408	OC-SS-408-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-409	OC-SS-409-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79		9		24	5							
SS-410	OC-SS-410-0.0/1.0-XXX	15-Sep-09	FS	0 - 1				9			2							
SS-411	OC-SS-411-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-412	OC-SS-412-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79		9		24	5							
SS-413	OC-SS-413-0.0/1.0-XXX	15-Sep-09	FS	0 - 1				9			2							
SS-414	OC-SS-414-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-415	OC-SS-415-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-416	OC-SS-416-0.0/1.0-DUP	15-Sep-09	FD	0 - 1	78	79		9		25	9							
SS-416	OC-SS-416-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79		9		25	9							
SS-417	OC-SS-417-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79		9		24	5							
SS-418	OC-SS-418-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-419	OC-SS-419-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-420	OC-SS-420-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-421	OC-SS-421-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SS-422	OC-SS-422-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-423	OC-SS-423-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-424	OC-SS-424-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	80				24	7				3	2	1	1
SS-425	OC-SS-425-0.0/1.0-XXX	15-Sep-09	FS	0 - 1	78	79				24	5							
SS-426	OC-SS-426-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	79				24	5							
SS-427	OC-SS-427-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-428	OC-SS-428-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	79				24	5							
SS-429	OC-SS-429-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-430	OC-SS-430-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	79				24	5							
SS-431	OC-SS-431-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-432	OC-SS-432-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	79				24	5							
SS-436	OC-SS-436-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	79				25	9							
SS-437	OC-SS-437-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	79				25	9							
SS-440	OC-SS-440-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-442	OC-SS-442-0.0/1.0-XXX	16-Sep-09	FS	0 - 1	78	79				24	5							
SB-406	OC-SB-406-0.0/1.0-XXX	17-Sep-09	FS	0 - 1	78	79				24	5							
SB-413	OC-SB-413-0.0/1.0-XXX	17-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-435	OC-SB-435-0.0/1.0-XXX	17-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SB-453	OC-SB-453-0.0/1.0-XXX	17-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-457	OC-SS-457-0.0/1.0-XXX	17-Sep-09	FS	0 - 1	78	80				24	7				3	2	1	1
SB-473	OC-SB-473-0.0/1.0-XXX	18-Sep-09	FS	0 - 1	78	80				25	11				3	2	1	1
SS-456	OC-SS-456-0.0/1.0-XXX	18-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-458	OC-SS-458-0.0/1.0-XXX	18-Sep-09	FS	0 - 1	78	79				24	5							
SS-459	OC-SS-459-0.0/1.0-XXX	18-Sep-09	FS	0 - 1	78	80				24	6				3	2	1	1
SS-461	OC-SS-461-0.0/1.0-XXX	18-Sep-09	FS	0 - 1	78	79				24	5							
SB-485	OC-SB-485-0.0/1.0-XXX	15-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-488	OC-SB-488-0.0/1.0-XXX	15-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-479	OC-SB-479-0.0/1.0-XXX	16-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-480	OC-SB-480-0.0/1.0-XXX	16-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-490	OC-SB-490-0.0/1.0-XXX	16-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-494	OC-SB-494-0.0/1.0-XXX	16-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-495	OC-SB-495-0.0/1.0-XXX	16-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-496	OC-SB-496-0.0/1.0-XXX	16-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-481	OC-SB-481-0.0/1.0-XXX	17-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-497	OC-SB-497-0.0/1.0-XXX	17-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-474	OC-SB-474-0.0/1.0-XXX	18-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-475	OC-SB-475-0.0/1.0-XXX	18-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-476	OC-SB-476-0.0/1.0-XXX	18-Nov-10	FS	0 - 1	78	79					2		5	6				
SB-477	OC-SB-477-0.0/1.0-XXX	18-Nov-10	FS	0 - 1	78	79					2		5	6				

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-478	OC-SB-478-0.0/1.0-XXX	18-Nov-10	FS	0 - 1	78	79				2			5	6				
SS-433	OC-SS-433-0.0/1.0-XXX	08-Jun-11	FS	0 - 1	77	79			24	7								
SS-448	OC-SS-448-0.0/1.0-DUP	08-Jun-11	FD	0 - 1	77	80			24	8					3	2	1	1
SS-448	OC-SS-448-0.0/1.0-XXX	08-Jun-11	FS	0 - 1	77	80			24	8					3	2	1	1
SS-452	OC-SS-452-0.0/1.0-XXX	08-Jun-11	FS	0 - 1	77	79			24	7								
SS-501	OC-SS-501-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-502	OC-SS-502-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-503	OC-SS-503-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-504	OC-SS-504-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-505	OC-SS-505-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-506	OC-SS-506-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-507	OC-SS-507-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-508	OC-SS-508-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-509	OC-SS-509-0.0-1.0-XXX	20-Nov-12	FS	0 - 1			9			2								
SS-510	OC-SS-510-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-511	OC-SS-511-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-512	OC-SS-512-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-513	OC-SS-513-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-514	OC-SS-514-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-515	OC-SS-515-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-516	OC-SS-516-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-517	OC-SS-517-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-518	OC-SS-518-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-519	OC-SS-519-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-520	OC-SS-520-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-521	OC-DUP-1	04-Dec-12	FD	0 - 1					1	4								
SS-521	OC-SS-521-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-522	OC-SS-522-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-523	OC-SS-523-0.0/1.0-XXX	04-Dec-12	FS	0 - 1					1	4								
SS-524	OC-SS-524-0.0/1.0-XXX	05-Dec-12	FS	0 - 1					1	4								
SS-525	OC-SS-525-0.0/1.0-XXX	05-Dec-12	FS	0 - 1					1	4								
SB-503	OC-SB-503-0.0/1.0-XXX	10-Dec-12	FS	0 - 1					1	4								
SB-506	OC-SB-506-0.0/1.0-XXX	10-Dec-12	FS	0 - 1					1	4								
SB-507	OC-SB-507-0.0/1.0-XXX	10-Dec-12	FS	0 - 1					1	4			21					
SB-511	OC-SB-511-0.0/1.0-XXX	10-Dec-12	FS	0 - 1					1	4								
SB-512	OC-SB-512-0.0/1.0-XXX	10-Dec-12	FS	0 - 1					1	4								
SB-504	OC-SB-504-0.0/1.0-XXX	11-Dec-12	FS	0 - 1					1	4								
SB-505	OC-SB-505-0.0/1.0-XXX	11-Dec-12	FS	0 - 1					1	4								

Table 2.2-1
Summary of Chemical Analyses for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-508	OC-SB-508-0.0/1.0-XXX	11-Dec-12	FS	0	-	1						1	4							
SB-513	OC-SB-513-0.0/1.0-XXX	12-Dec-12	FS	0	-	1						1	4							
SB-514	OC-SB-514-0.0/1.0-XXX	12-Dec-12	FS	0	-	1	2	80				1	4		21					
SB-517	OC-SB-517-0.0/1.0-XXX	12-Dec-12	FS	0	-	1	2	80				1	4		21					
SB-523	OC-SB-523-0.0/1.0-XXX	12-Dec-12	FS	0	-	1						1	4							
SB-524	OC-SB-524-0.0/1.0-XXX	12-Dec-12	FS	0	-	1						1	4							
SB-510	OC-SB-510-0.0/1.0-XXX	13-Dec-12	FS	0	-	1						1	4							
SB-520	OC-SB-520-0.0/1.0-XXX	13-Dec-12	FS	0	-	1	2	80					2							
SB-522	OC-SB-522-0.0/1.0-XXX	13-Dec-12	FS	0	-	1		80				1	4							
SB-525	OC-SB-525-0.0/1.0-XXX	13-Dec-12	FS	0	-	1						1	4							
SB-532	OC-SB-532-0.0/1.0-XXX	13-Dec-12	FS	0	-	1							2		21					
SB-533	OC-SB-533-0.0/1.0-XXX	13-Dec-12	FS	0	-	1							2		21					
SB-534	OC-SB-534-0.0/1.0-XXX	13-Dec-12	FS	0	-	1							2		21					
SB-509	OC-SB-509-0.0/1.0-XXX	14-Dec-12	FS	0	-	1						1	4							
SB-518	OC-SB-518-0.0/1.0-XXX	14-Dec-12	FS	0	-	1	2	80				1	4							
SB-519	OC-SB-519-0.0/1.0-XXX	14-Dec-12	FS	0	-	1		80				1	4							
SB-521	OC-SB-521-0.0/1.0-XXX	14-Dec-12	FS	0	-	1						1	4							
SB-536	OC-SB-536-0.0/1.0-XXX	17-Jun-13	FS	0		1					9		2							
SB-537	OC-DUP	17-Jun-13	FD	0		1					9		2							
SB-537	OC-SB-537-0.0/1.0-XXX	17-Jun-13	FS	0		1					9		2							

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/10/14
Checked by / Date: CTM 03/10/14

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
BH1	BH01	05-Jun-91	FS	4.3 - 6.3	36	65	27		23	6							
BH2	BH02	05-Jun-91	FS	3.5 - 5.5	36	65	27		23	6							
BH3	BH03	05-Jun-91	FS	4.2 - 6.2	36	65	27		23	6							
BH4	BH04	05-Jun-91	FS	6.3 - 8.3	36	65	27		23	6							
BH5	BH05	06-Jun-91	FS	5.9 - 7.9	36	65	27		23	5							
BH6	BH06	06-Jun-91	FS	4.4 - 6.4	36	65	27		23	5							
BH7	BH07	06-Jun-91	FS	3 - 5	36	65	27		23	6							
BH10	BH10	07-Jun-91	FS	3.8 - 5.8	36	65	27		23	5							
BH11	BH11 (4-6 ft)	07-Jun-91	FS	4 - 6	36	65	27		23	5							
BH8	BH08	07-Jun-91	FS	3 - 5	36	65	27		23	5							
BH9	BH09	07-Jun-91	FS	2.6 - 4.6	36	65	27		23	5							
BH12	BH12	10-Jun-91	FS	4 - 6	36	65	27		23	5							
BH13	BH13	10-Jun-91	FS	8 - 10	36	65	27		23	5							
BH14	BH14	10-Jun-91	FS	4 - 6	36	65	27		23	5							
BH15	BH15	10-Jun-91	FS	8 - 10	36	65	27		23	5							
BH16	BH16	10-Jun-91	FS	4 - 6	36	65	27		23	5							
BH17	BH17	10-Jun-91	FS	8 - 10	36	65	27		23	5							
BH18	BH18	10-Jun-91	FS	4 - 6	36	65	27		23	5							
BH21	BH21	10-Jun-91	FS	8 - 10	36	65	27		23	5							
BH22	BH22	10-Jun-91	FS	8 - 10	36	65	27		23	5							
BH23	BH23	10-Jun-91	FS	4 - 6	36	65	27		23	5							
BH24	BH24	10-Jun-91	FS	4 - 6	36					5							
BH25	BH25	10-Jun-91	FS	4 - 6	36					5							
BH19	BH19	11-Jun-91	FS	5 - 7	36	65	27		23	5							
BH26	BH26	11-Jun-91	FS	7 - 9	36	65	27		23	5							
BH27	BH27	11-Jun-91	FS	4 - 6	36	65	27		23	5							
BH28	BH28	11-Jun-91	FS	4 - 6	36	65	27		23	5							
BH28	BH28 DUP	11-Jun-91	FD	4 - 6	36	65	27		23	5							
BH29	BH29	11-Jun-91	FS	4 - 6	36	65	27		23	5							
BH30	BH30	11-Jun-91	FS	8 - 10	36	65	27		23	5							
BH31	BH31	11-Jun-91	FS	3 - 5	36	65	27		23	5							
BH32	BH32	11-Jun-91	FS	4 - 6	36	65	27		23	5							
BH32	BH32 DUP	11-Jun-91	FD	4 - 6	36	65	27		23	5							
BH33	BH33	11-Jun-91	FS	6 - 8	36	65	27		23	5							
BH34	BH34	11-Jun-91	FS	6 - 8	36	65	27		23	5							
BH35	BH35	11-Jun-91	FS	6 - 8	36	65	27		23	5							
TP-1	TP-1-SN1	02-Oct-91	FS		34	65	28		23	5							
TP-19	TP-19-SN6	07-Oct-91	FS		34	65	28		23	5							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
TP-21	TP-21-SN8	08-Oct-91	FS				34	65	28		23	4							
BH36	BH36	06-Feb-92	FS	4	-	6	36	65	27		23	5							
BH37	BH37	06-Feb-92	FS	4	-	6	36	65	27		23	5							
BH38	BH38	06-Feb-92	FS	3	-	5	36	65	27		23	5							
BH39	BH39	06-Feb-92	FS	4	-	6	36	65	27		23	5							
BH40	BH40	06-Feb-92	FS	4	-	6	36	65	27		23	5							
LPB-1	LPB-1(4-6)	18-Jan-95	FS	4	-	6	35	64			23	4							
LPB-1	LPB-1(6-8)	18-Jan-95	FS	6	-	8	36	64			22	4							
LPB-2	LPB-2(7-8)	18-Jan-95	FS	7	-	8	36	64			23	4							
LPB-2	LPB-2(8-9)	18-Jan-95	FS	8	-	9	36	64			23	4							
W1.35	W1.35, 6-7	15-Apr-98	FS	6	-	7	57	67	19		15	3							
W1.35	W1.35, 7.5-8.5	15-Apr-98	FS	7.5	-	8.5	57	67	19		15	3							
E1.40	E1, 40, 3-4	16-Apr-98	FS	3	-	4					23	3							
E1.45	E1, 45, 1.5	16-Apr-98	FS	1.5	-	1.5					23	3							
E1.50	E1.5, 6-7	17-Apr-98	FS	6	-	7	58	66	19		15	3							
E1.50	E1.5, 8-8.5	17-Apr-98	FS	8	-	8.5	57	67	19		15	3							
E1.75	E1.75, 6-7	20-Apr-98	FS	6	-	7	57	67	19		15	3							
E1.75	E1.75,8.5-9.5	20-Apr-98	FS	8.5	-	9.5	58	66	19		15	3							
E2.70	E2.70, 9.2	20-Apr-98	FS	9.2	-	9.2	57	67	19		15	3							
E2.22	E2.22, 7-8	21-Apr-98	FS	7	-	8	57	67	19		15	3							
B-1A	B-1, 8'-10'	12-Aug-98	FS	8	-	10					4	6							
SBGR	SBGR	03-Nov-98	FS								23	1							
LP-101	SB101XXLPX	24-Nov-98	FS	6	-	8					2	4							
LP-102	SB102XXLPX	24-Nov-98	FS	6	-	8					2	4							
LP-103	SB103XXLPX	24-Nov-98	FS	6	-	8					2	4							
LP-104	SB104XXLPX	24-Nov-98	FS	6	-	8					2	4							
LP-105	SB105XXLPX	24-Nov-98	FS	6	-	8					2	4							
LP-101	101B	30-Nov-98	FS	6	-	8					2	1							
LP-102	102B	30-Nov-98	FS	6	-	8					2	1							
LP-104	104B	30-Nov-98	FS	6	-	8					2	1							
CP-1	CP 1 (Central Pond 1)	04-Nov-99	FS						1			1							
CP-2	CP 2 (Central Pond 2)	04-Nov-99	FS						1			1							
BH20-A	BH20-A (3-6 FT)	24-Jan-00	FS	3	-	6					22	1							
CPDA-1-A	CPD-1-A (0-3 FT)	24-Jan-00	FS	2.09	-	5.09					22	1							
RSO-09	RSO-09-S1 (0-3 FT)	24-Jan-00	FS	0	-	3					22	1							
RSO-09	RSO-09-S1 (0-3)	24-Jan-00	FS	0	-	3	37	66											
RSO-09	RSO-09-S2 (3-6 FT)	24-Jan-00	FS	3	-	6					22	1							
RSO-09	RSO-09-S2 (3-6)	24-Jan-00	FS	3	-	6	37	66											

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
RSO-10	RSO-10-S1 (0-3 FT)	24-Jan-00	FS	0 - 3					22	1							
RSO-10	RSO-10-S1 (0-3)	24-Jan-00	FS	0 - 3	37	66											
RSO-10	RSO-10-S2 (3-6 FT)	24-Jan-00	FS	3 - 6					22	1							
RSO-10	RSO-10-S2 (3-6)	24-Jan-00	FS	3 - 6	37	66											
RSO-11	RSO-11-S1 (0-3 FT)	24-Jan-00	FS	0 - 3					22	1							
RSO-11	RSO-11-S1 (0-3)	24-Jan-00	FS	0 - 3	37	66											
RSO-11	RSO-11-S2 (3-6 FT)	24-Jan-00	FS	3 - 6					22	1							
RSO-11	RSO-11-S2 (3-6)	24-Jan-00	FS	3 - 6	37	66											
RSO-12	RSO-12-S1 (0-3 FT)	24-Jan-00	FS	0 - 3					22	1							
RSO-12	RSO-12-S1 (0-3)	24-Jan-00	FS	0 - 3	37	66											
RSO-12	RSO-12-S2 (3-6 FT)	24-Jan-00	FS	3 - 6					22	1							
RSO-12	RSO-12-S2 (3-6)	24-Jan-00	FS	3 - 6	37	66											
RSO-13	RSO-13-S1 (0-3 FT)	24-Jan-00	FS	0 - 3					22	1							
RSO-13	RSO-13-S1 (0-3)	24-Jan-00	FS	0 - 3	37	66											
RSO-13	RSO-13-S2 (3-5.5 FT)	24-Jan-00	FS	3 - 5.5					22	1							
RSO-13	RSO-13-S2 (3-6)	24-Jan-00	FS	3 - 6	37	66											
RSO-15	RSO-15-S1 (0-3 FT)	24-Jan-00	FS	1.52 - 4.52					22	1							
RSO-15	RSO-15-S1 (0-3)	24-Jan-00	FS	1.52 - 4.52	37	66											
RSO-01	RSO-01-S1 (0-3 FT)	25-Jan-00	FS	0 - 3					22	1							
RSO-01	RSO-01-S1 (0-3)	25-Jan-00	FS	0 - 3	37	66											
RSO-01	RSO-01-S2 (3-6 FT)	25-Jan-00	FS	3 - 6					22	1							
RSO-01	RSO-01-S2 (3-6)	25-Jan-00	FS	3 - 6	37	66											
RSO-02	RSO-02-S1 (0-3 FT)	25-Jan-00	FS	0 - 3					22	1							
RSO-02	RSO-02-S1 (0-3)	25-Jan-00	FS	0 - 3	37	66											
RSO-02	RSO-02-S2 (3-6 FT)	25-Jan-00	FS	3 - 6					22	1							
RSO-02	RSO-02-S2 (3-6)	25-Jan-00	FS	3 - 6	37	66											
RSO-03	RSO-03-S1 (0-3 FT)	25-Jan-00	FS	0 - 3					22	1							
RSO-03	RSO-03-S1 (0-3)	25-Jan-00	FS	0 - 3	37	66											
RSO-03	RSO-03-S2 (3-6 FT)	25-Jan-00	FS	3 - 6					22	1							
RSO-03	RSO-03-S2 (3-6)	25-Jan-00	FS	3 - 6	37	66											
RSO-04	RSO-04-S1 (0-3 FT)	25-Jan-00	FS	0 - 3					22	1							
RSO-04	RSO-04-S1 (0-3)	25-Jan-00	FS	0 - 3	37	66											
RSO-04	RSO-04-S2 (3-6 FT)	25-Jan-00	FS	3 - 6					22	1							
RSO-04	RSO-04-S2 (3-6)	25-Jan-00	FS	3 - 6	37	66											
RSO-05	RSO-05-S1 (0-3 FT)	25-Jan-00	FS	0 - 3					22	1							
RSO-05	RSO-05-S1 (0-3)	25-Jan-00	FS	0 - 3	37	66											
RSO-05	RSO-05-S2 (3-6 FT)	25-Jan-00	FS	3 - 6					22	1							
RSO-05	RSO-05-S2 (3-6)	25-Jan-00	FS	3 - 6	37	66											

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
RSO-06	RSO-06-S2 (3-6 FT)	25-Jan-00	FS	0.9 - 3.9					22	1							
RSO-06	RSO-06-S2 (3-6)	25-Jan-00	FS	0.9 - 3.9	40	72											
RSO-06	RSO-06-S1 (0-3 FT)	25-Jan-00	FS	3.9 - 6.9					22	1							
RSO-06	RSO-06-S1 (0-3)	25-Jan-00	FS	3.9 - 6.9	40	72											
RSO-07	RSO-07-S1 (0-3 FT)	25-Jan-00	FS	0 - 3					22	1							
RSO-07	RSO-07-S1 (0-3)	25-Jan-00	FS	0 - 3	37	66											
RSO-07	RSO-07-S2 (3-6 FT)	25-Jan-00	FS	3 - 6					22	1							
RSO-07	RSO-07-S2 (3-6)	25-Jan-00	FS	3 - 6	37	66											
RSO-08	RSO-08-S1 (0-3 FT)	25-Jan-00	FS	0 - 3					22	1							
RSO-08	RSO-08-S1 (0-3)	25-Jan-00	FS	0 - 3	37	66											
RSO-08	RSO-08-S2 (3-6 FT)	25-Jan-00	FS	3 - 6					22	1							
RSO-08	RSO-08-S2 (3-6)	25-Jan-00	FS	3 - 6	37	66											
RSO-16	RSO-16 (0-3)	26-Jan-00	FS	0 - 3	37	66			23	1							
RSO-17	RSO-17 (0-3)	26-Jan-00	FS	0 - 3	37	66			23	1							
RSO-18	RSO-18 (0-3)	26-Jan-00	FS	0 - 3	37	66			23	1							
DB-C10	97598-DB-C10	10-Aug-00	FS	0.8 - 3.8	68	67	22		3	1							
DB-C11	97598-DB-C11	10-Aug-00	FS	6.2 - 6.2	68	67	22		3	1							
DB-C12	97598-DB-C12	10-Aug-00	FS	5.9 - 5.9	68	67	22		3	1							
DB-C13	97598-DB-C13	10-Aug-00	FS	1.9 - 4.9	68	67	22		3	1							
DB-C15	97598-DB-C15	10-Aug-00	FS	1.9 - 4.9	68	67	22		3	1							
DB-C16	97598-DB-C16	10-Aug-00	FS	5.3 - 5.3	68	67	22		3	1							
DB-C2	97598-DB-C2	10-Aug-00	FS	1.1 - 4.1	68	67	22		3	1							
DB-C3	97598-DB-C3	10-Aug-00	FS	1.2 - 4.2	68	67	22		3	1							
DB-C4	97598-DB-C4	10-Aug-00	FS	6.8 - 6.8	68	67	22		3	1							
DB-C5	97598-DB-C5	10-Aug-00	FS	1.4 - 4.4	68	67	22		3	1							
DB-C6	97598-DB-C6	10-Aug-00	FS	1.4 - 4.4	68	67	22		3	1							
DB-C7	97598-DB-C7	10-Aug-00	FS	6 - 6	68	67	22		3	1							
DB-C8	97598-DB-C8	10-Aug-00	FS	5.7 - 5.7	68	67	22		3	1							
DB-C9	97598-DB-C9	10-Aug-00	FS	1.6 - 4.6	68	67	22		3	1							
DA-C11	1120-DA-C11	18-Sep-00	FS	0 - 3	66	67	19		3	1							
DA-C12	1120-DA-C12	18-Sep-00	FS	7 - 7	66	67	19		3	1							
DA-C13	1120-DA-C13	18-Sep-00	FS	7 - 7	66	67	19		3	1							
DA-C14	1120-DA-C14	18-Sep-00	FS	5.9 - 5.9	66	67	19		3	1							
DA-C15	1120-DA-C15	18-Sep-00	FS	1.2 - 4.2	66	67	19		3	1							
DA-C16	1120-DA-C16	18-Sep-00	FS	0.2 - 3.2	66	67	19		3	1							
DA-C17	1120-DA-C17	18-Sep-00	FS	6.2 - 6.2	66	67	19		3	1							
DA-C18	1120-DA-C18	18-Sep-00	FS	6.3 - 6.3	66	67	19		3	1							
DA-C19	1120-DA-C19	18-Sep-00	FS	1.3 - 4.3	66	67	19		3	1							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
DA-C2	1120-DA-C2	18-Sep-00	FS	1.4 - 4.4	66	67	19		3	1							
DA-C20	1120-DA-C20	18-Sep-00	FS	0.3 - 3.3	66	67	19		3	1							
DA-C21	1120-DA-C21	18-Sep-00	FS	6.4 - 6.4	66	67	19		3	1							
DA-C22	1120-DA-C22	18-Sep-00	FS	6 - 6	66	67	19		3	1							
DA-C23	1120-DA-C23	18-Sep-00	FS	6.1 - 6.1	66	67	19		3	1							
DA-C24	1120-DA-C24	18-Sep-00	FS	5.7 - 5.7	66	67	19		3	1							
DA-C3	1120-DA-C3	18-Sep-00	FS	1.6 - 4.6	66	67	19		3	1							
DA-C4	1120-DA-C4	18-Sep-00	FS	1.7 - 4.7	66	67	19		3	1							
DA-C6	1120-DA-C6	18-Sep-00	FS	0.5 - 3.5	66	67	19		3	1							
DA-C7	1120-DA-C7	18-Sep-00	FS	7.2 - 7.2	66	67	19		3	1							
DA-C8	1120-DA-C8	18-Sep-00	FS	6.9 - 6.9	66	67	19		3	1							
WD-C1	1140-WD-C1	19-Sep-00	FS	8.3 - 8.3		67			1	1							
WD-C10	1140-WD-C10	19-Sep-00	FS	6.6 - 6.6		67			1	1							
WD-C11	1140-WD-C11	19-Sep-00	FS	5.6 - 5.6	66	67			8	1							
WD-C11	1140-WD-C11 (156878)	19-Sep-00	FS	5.6 - 5.6			19										
WD-C2	1140-WD-C2	19-Sep-00	FS	8 - 8		67			1	1							
WD-C3	1140-WD-C3	19-Sep-00	FS	7.7 - 7.7		67			1	1							
WD-C4	1140-WD-C4	19-Sep-00	FS	7.6 - 7.6	66	67	19		8	1							
WD-C5	1140-WD-C5	19-Sep-00	FS	7.4 - 7.4		67			1	1							
WD-C6	1140-WD-C6	19-Sep-00	FS	7.1 - 7.1		67			1	1							
WD-C7	1140-WD-C7	19-Sep-00	FS	6.6 - 6.6		67			1	1							
WD-C8	1140-WD-C8	19-Sep-00	FS	6.8 - 6.8	66	67	19		8	1							
WD-C9	1140-WD-C9	19-Sep-00	FS	7 - 7		67			1	1							
WD-C10B	1140-WD-C10B	21-Sep-00	FS	5.6 - 5.6		67			1	1							
WD-C11B	1140-WD-C11B	21-Sep-00	FS	5.6 - 5.6	66	67			8	2							
WD-C11B	1140-WD-C11B (157182)	21-Sep-00	FS	5.6 - 5.6			19										
WD-C1B	1140-WD-C1B	21-Sep-00	FS	7.3 - 7.3		67			1	1							
WD-C2B	1140-WD-C2B	21-Sep-00	FS	7 - 7		67			1	1							
WD-C3B	1140-WD-C3B	21-Sep-00	FS	6.7 - 6.7		67			1	1							
WD-C4B	1140-WD-C4B	21-Sep-00	FS	6.6 - 6.6	66	67	19		8	2							
WD-C5B	1140-WD-C5B	21-Sep-00	FS	6.5 - 6.5		67			1	1							
WD-C6B	1140-WD-C6B	21-Sep-00	FS	6.2 - 6.2		67			1	1							
WD-C7B	1140-WD-C7B	21-Sep-00	FS	5.6 - 5.6		67			1	1							
WD-C8B	1140-WD-C8B	21-Sep-00	FS	5.8 - 5.8	66	67	19		8	2							
WD-C9B	1140-WD-C9B	21-Sep-00	FS	6 - 6		67			1	1							
DA-C25	1120-DA-C25	29-Sep-00	FS	5.8 - 5.8	66	67	19		3	2							
DA-C26	1120-DA-C26	29-Sep-00	FS	0.5 - 3.5	66	67	19		3	2							
DA-C27	1120-DA-C27	29-Sep-00	FS	1.6 - 4.6	66	67	19		3	2							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
DA-C28	1120-DA-C28	29-Sep-00	FS	2.7 - 5.7	66	67	19		3	2							
DA-C29	1120-DA-C29	29-Sep-00	FS	6.2 - 6.2	66	67	19		3	2							
DA-C29	1120-DA-C29-D	29-Sep-00	FD	6.2 - 6.2	66	67				2							
DA-C30	1120-DA-C30	29-Sep-00	FS	6.5 - 9.5	66	67	19		3	2							
DA-C31	1120-DA-C31	29-Sep-00	FS	4.9 - 7.9	66	67	19		3	2							
DA-C32	1120-DA-C32	29-Sep-00	FS	5 - 8	66	67	19		3	2							
DA-C33	1120-DA-C33	29-Sep-00	FS	5.4 - 5.4	66	67	19		3	2							
DA-C34	1120-DA-C34	29-Sep-00	FS	2.3 - 5.3	66	67	19		3	2							
CP-C10	1140-CP-C10	02-Oct-00	FS	1.4 - 1.4		67			1	1							
CP-C11	1140-CP-C11	02-Oct-00	FS	2.3 - 2.3		67			1	1							
CP-C12	1140-CP-C12	02-Oct-00	FS	3.7 - 3.7		67			1	1							
CP-C13	1140-CP-C13	02-Oct-00	FS	3.1 - 3.1	66	67	19		8	1							
CP-C13	1140-CP-C13-D	02-Oct-00	FD	3.1 - 3.1	66	67	19		8	1							
CP-C14	1140-CP-C14	02-Oct-00	FS	2.3 - 2.3		67			1	1							
CP-C15	1140-CP-C15	02-Oct-00	FS	2.9 - 2.9		67			1	1							
CP-C16	1140-CP-C16	02-Oct-00	FS	3.7 - 3.7	66	67	19		8	1							
CP-C17	1140-CP-C17	02-Oct-00	FS	3.4 - 3.4		67			1	1							
CP-C18	1140-CP-C18	02-Oct-00	FS	2.4 - 2.4		67			1	1							
CP-C19	1140-CP-C19	02-Oct-00	FS	3.1 - 3.1		67			1	1							
CP-C20	1140-CP-C20	02-Oct-00	FS	2.8 - 2.8		67			1	1							
CP-C21	1140-CP-C21	02-Oct-00	FS	2.5 - 2.5	66	67	19		8	1							
CP-C22	1140-CP-C22	02-Oct-00	FS	2.2 - 2.2		67			1	1							
CP-C24	1140-CP-C24	02-Oct-00	FS	4.2 - 4.2		67			1	1							
CP-C9	1140-CP-C9	02-Oct-00	FS	2 - 2		67			1	1							
WD-C12	1140-WD-C12	04-Oct-00	FS	6.1 - 6.1		67			1	1							
WD-C12B	1140-WD-C12B	04-Oct-00	FS	5.2 - 5.2		67			1	1							
WD-C13	1140-WD-C13	04-Oct-00	FS	6.1 - 6.1		67			1	1							
WD-C13B	1140-WD-C13B	04-Oct-00	FS	5.2 - 5.2		67			1	1							
WD-C14	1140-WD-C14	04-Oct-00	FS	7.6 - 7.6		67			1	1							
WD-C14B	1140-WD-C14B	04-Oct-00	FS	6.9 - 6.9		67			1	1							
WD-C15B	1140-WD-C15B	04-Oct-00	FS	9.3 - 9.3	66	67	19		8	2							
CP-C26	1140-CP-C26	05-Oct-00	FS	1.9 - 1.9		67			1	1							
CP-C27	1140-CP-C27	05-Oct-00	FS	3.1 - 3.1		67			1	1							
CP-C28	1140-CP-C28	05-Oct-00	FS	3.5 - 3.5	66	67	19		8	1							
CP-C29	1140-CP-C29	05-Oct-00	FS	2.5 - 2.5		67			1	1							
CP-C30	1140-CP-C30	05-Oct-00	FS	1.4 - 1.4		67			1	1							
CP-C31	1140-CP-C31	05-Oct-00	FS	2.3 - 2.3	65	67	19		8	1							
CP-C32	1140-CP-C32	05-Oct-00	FS	4.8 - 4.8		67			1	1							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
CP-C33	1140-CP-C33	05-Oct-00	FS	5.3 - 5.3		67			1	1							
CP-C34	1140-CP-C34	05-Oct-00	FS	6.3 - 6.3		67			1	1							
CP-C35	1140-CP-C35	05-Oct-00	FS	5.7 - 5.7	66	67	19		8	1							
CP-C36	1140-CP-C36	05-Oct-00	FS	5.4 - 5.4		67			1	1							
CP-C37	1140-CP-C37	05-Oct-00	FS	5.4 - 5.4		67			1	1							
CP-C38	1140-CP-C38	05-Oct-00	FS	6.2 - 6.2		67			1	1							
CP-C39	1140-CP-C39	05-Oct-00	FS	6.7 - 6.7	66	67	19		8	1							
CP-C40	1140-CP-C40	05-Oct-00	FS	4.2 - 4.2		67			1	1							
CP-C41	1140-CP-C41	05-Oct-00	FS	6.5 - 6.5		67			1	1							
CP-C42	1140-CP-C42	05-Oct-00	FS	6.3 - 6.3		67			1	1							
CP-C43	1140-CP-C43	05-Oct-00	FS	5 - 5		67			1	1							
CP-C44	1140-CP-C44	05-Oct-00	FS	4.8 - 4.8		67			1	1							
CP-C45	1140-CP-C45	05-Oct-00	FS	6.6 - 6.6		67			1	1							
CP-C46	1140-CP-C46	05-Oct-00	FS	6.1 - 6.1		67			1	1							
CP-C47	1140-CP-C47	05-Oct-00	FS	5.4 - 5.4	66	67	19		8	1							
CP-C48	1140-CP-C48	05-Oct-00	FS	5.8 - 5.8		67			1	1							
CP-C49	1140-CP-C49	05-Oct-00	FS	6.8 - 6.8	66	67	19		8	1							
CP-C50	1140-CP-C50	05-Oct-00	FS	4.8 - 4.8		67			1	1							
CP-C51	1140-CP-C51	05-Oct-00	FS	5.3 - 5.3		67			1	1							
DA-C35	1120-DA-C35	07-Oct-00	FS	7.9 - 7.9	66	67	19		3	2							
CP-C52	1140-CP-C52	09-Oct-00	FS	8.7 - 8.7		67			1	1							
CP-C53	1140-CP-C53	09-Oct-00	FS	8.5 - 8.5		67			1	1							
AS-1	AS-1-8-10	10-Oct-00	FS	8 - 10	37					1		22	12				
BD-C1	1120-BD-C1	10-Oct-00	FS	4.6 - 4.6	66	67	19		8	1							
BD-C2	1120-BD-C2	10-Oct-00	FS	4.8 - 4.8	66	67	19		8	1							
BD-C3	1120-BD-C3	10-Oct-00	FS	1.2 - 3.2	66	67	19		8	1							
BD-C4	1120-BD-C4	10-Oct-00	FS	7.5 - 7.5	66	67	19		8	1							
BD-C5	1120-BD-C5	10-Oct-00	FS	6.9 - 6.9	66	67	19		8	1							
BD-C6	1120-BD-C6	10-Oct-00	FS	1.4 - 3.4	66	67	19		8	1							
CP-C54	1140-CP-C54	10-Oct-00	FS	3.3 - 3.3		67			1	1							
CP-C55	1140-CP-C55	10-Oct-00	FS	4.1 - 4.1		67			1	1							
CP-C56	1140-CP-C56	10-Oct-00	FS	4.1 - 4.1	66	67	19		8	1							
CP-C57	1140-CP-C57	10-Oct-00	FS	4.4 - 4.4		67			1	1							
CP-C58	1140-CP-C58	10-Oct-00	FS	4.5 - 4.5		67			1	1							
AS-3	AS-3 8-10	11-Oct-00	FS	8 - 10	37					1		22	12				
BD-C11	1120-BD-C11	11-Oct-00	FS	9.7 - 9.7	66	67	19		8	1							
BD-C12	1120-BD-C12	11-Oct-00	FS	8.6 - 8.6	66	67	19		8	1							
BD-C14	1120-BD-C14	11-Oct-00	FS	8.6 - 8.6	66	67	19		8	1							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
BD-C14	1120-BD-C14-D	11-Oct-00	FD	8.6	-	8.6	66	67	19		8	1							
BD-C15	1120-BD-C15	11-Oct-00	FS	7.7	-	7.7	66	67	19		8	1							
BD-C8	1120-BD-C8	11-Oct-00	FS	8.5	-	8.5	65	67	19		8	1							
BD-C9	1120-BD-C9	11-Oct-00	FS	8.1	-	8.1	66	67	19		8	1							
SD-C11	1140-SD-C11	11-Oct-00	FS	3.4	-	3.4		67			1	1							
SD-C12	1140-SD-C12	11-Oct-00	FS	2.96	-	2.96		67			1	1							
SD-C3	1140-SD-C3	11-Oct-00	FS	2.15	-	2.15		67			1	1							
SD-C5	1140-SD-C5	11-Oct-00	FS	2.62	-	2.62		67			1	1							
SD-C8	1140-SD-C8	11-Oct-00	FS	2.71	-	2.71	66	67	19		8	1							
SD-C8	1140-SD-C8-D	11-Oct-00	FD	2.71	-	2.71	66	67	19		8	1							
BD-C7	1120-BD-C7	12-Oct-00	FS	7.9	-	7.9	66	67	19		8	2							
SD-C16	1140-SD-C16	12-Oct-00	FS	3.18	-	3.18		67			1	1							
SD-C17	1140-SD-C17	12-Oct-00	FS	2.22	-	2.22		67			1	1							
SD-C18	1140-SD-C18	12-Oct-00	FS	4.83	-	4.83		67			1	1							
SD-C19	1140-SD-C19	12-Oct-00	FS	1.88	-	1.88		67			1	1							
SD-C20	1140-SD-C20	12-Oct-00	FS	2.14	-	2.14		67			1	1							
SD-C21	1140-SD-C21	12-Oct-00	FS	2.76	-	2.76		67			1	1							
SD-C22	1140-SD-C22	12-Oct-00	FS	3.22	-	3.22		67			1	1							
SD-C23	1140-SD-C23	12-Oct-00	FS	2.84	-	2.84		67			1	1							
AS-4	AS-4-8	16-Oct-00	FS	8	-	8	37					1		22	12				
AS-9	AS-9 S-2 7	17-Oct-00	FS	7	-	7	37					1		22	12				
AS-9	AS-9 S-2D 7	17-Oct-00	FD	7	-	7	37					1		22	12				
SVE-6B	SVE-6B S2 8	17-Oct-00	FS	8	-	8	37					1		22	12				
SVE-6B	SVE-6B S2DUP 8	17-Oct-00	FD	8	-	8	37					1		22	12				
SD-C24	1140-SD-C24	18-Oct-00	FS	3	-	3		67			1	1							
SD-C24B	1140-SD-C24B	18-Oct-00	FS	2	-	2		67			1	1							
SD-C24B	1140-SD-C24B-D	18-Oct-00	FD	2	-	2		67			1	1							
CP-C59	1140-CP-C59	20-Oct-00	FS	4.9	-	4.9		67			1	1							
CP-C60	1140-CP-C60	20-Oct-00	FS	5.5	-	5.5	66	67	19		8	1							
CP-C61	1140-CP-C61	20-Oct-00	FS	5.4	-	5.4		67			1	1							
CP-C62	1140-CP-C62	20-Oct-00	FS	3.7	-	3.7		67			1	1							
CP-C64	1140-CP-C64	20-Oct-00	FS	5.2	-	5.2		67			1	1							
CP-C65	1140-CP-C65	20-Oct-00	FS	5.3	-	5.3	66	67	19		8	1							
CP-C66	1140-CP-C66	20-Oct-00	FS	5.1	-	5.1		67			1	1							
CP-C67	1140-CP-C67	20-Oct-00	FS	4.7	-	4.7		67			1	1							
CP-C68	1140-CP-C68	20-Oct-00	FS	4.1	-	4.1		67			1	1							
CP-C69	1140-CP-C69	20-Oct-00	FS	4.3	-	4.3	66	67	19		8	1							
CP-C70	1140-CP-C70	20-Oct-00	FS	4.2	-	4.2		67			1	1							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
B-10	B-10 S-2	25-Oct-00	FS	5 - 6.2	37					2		22	12				
SVE-11	SVE-11 S2 7-9	25-Oct-00	FS	7 - 9	37					1		22	12				
BD-C18	1120-BD-C18	27-Oct-00	FS	2.9 - 2.9	66	67	19		8	1							
BD-C19	1120-BD-C19	27-Oct-00	FS	3.1 - 3.1	66	67	19		8	1							
BD-C20	1120-BD-C20	27-Oct-00	FS	3.8 - 3.8	66	67	19		8	1							
BD-C21	1120-BD-C21	27-Oct-00	FS	1.9 - 1.9	66	67	19		8	1							
BD-C23	1120-BD-C23	27-Oct-00	FS	5.7 - 5.7	65	67	19		8	1							
BD-C24	1120-BD-C24	27-Oct-00	FS	6.6 - 6.6	65	67	19		8	1							
BD-C25	1120-BD-C25	27-Oct-00	FS	6.8 - 6.8	66	67	19		8	1							
BD-C28	1120-BD-C28	27-Oct-00	FS	2.6 - 2.6	65	67	19		8	1							
BD-C29	1120-BD-C29	27-Oct-00	FS	5.4 - 5.4	65	67	19		8	1							
BD-C30	1120-BD-C30	27-Oct-00	FS	6.4 - 6.4	66	67	19		8	1							
BD-C33	1120-BD-C33	27-Oct-00	FS	2 - 2	65	67	19		8	1							
BD-C34	1120-BD-C34	27-Oct-00	FS	5.6 - 5.6	66	67	19		8	1							
BD-C35	1120-BD-C35	27-Oct-00	FS	1.9 - 1.9	66	67	19		8	1							
B-10	TP-1, 6-9`	01-Nov-00	FS	6 - 9	37	67				1		22	12				
B-10	TP-1 S-1 9.5	01-Nov-00	FS	9.5 - 9.5	37	67				1		22	12				
B-10	TP-1 S-1 DUP 9.5	01-Nov-00	FD	9.5 - 9.5	37	67				1		22	12				
CP-C71	1140-CP-C71	02-Nov-00	FS	3.8 - 3.8					1	1							
CP-C72	1140-CP-C72	02-Nov-00	FS	3.2 - 3.2					1	1							
CP-C73	1140-CP-C73	02-Nov-00	FS	3.6 - 3.6					1	1							
CP-C74	1140-CP-C74	02-Nov-00	FS	2.4 - 2.4					1	1							
SD-C25	1140-SD-C25	02-Nov-00	FS	2.8 - 2.8		67			1	1							
SD-C26	1140-SD-C26	02-Nov-00	FS	2.18 - 2.18		67			1	1							
SD-C27	1140-SD-C27	02-Nov-00	FS	2.48 - 2.48	66	67	19		8	1							
SD-C28	1140-SD-C28	02-Nov-00	FS	2.58 - 2.58		67			1	1							
SD-C28	1140-SD-C28-D	02-Nov-00	FD	2.58 - 2.58		67			1	1							
SD-C29	1140-SD-C29	02-Nov-00	FS	2.18 - 2.18		67			1	1							
SD-C30	1140-SD-C30	02-Nov-00	FS	2.48 - 2.48		67			1	1							
SD-C31	1140-SD-C31	02-Nov-00	FS	1.78 - 1.78		67			1	1							
SD-C32	1140-SD-C32	02-Nov-00	FS	2.38 - 2.38		67			1	1							
SD-C33	1140-SD-C33	02-Nov-00	FS	1.68 - 1.68		67			1	1							
SD-C34	1140-SD-C34	03-Nov-00	FS	1.18 - 1.18		67			1	1							
SD-C35	1140-SD-C35	03-Nov-00	FS	1.28 - 1.28	66	67	19		8	1							
SD-C36	1140-SD-C36	03-Nov-00	FS	1.58 - 1.58		67			1	1							
SD-C37	1140-SD-C37	03-Nov-00	FS	1.58 - 1.58		67			1	1							
SD-C38	1140-SD-C38	03-Nov-00	FS	1.68 - 1.68		67			1	1							
SD-C39	1140-SD-C39	03-Nov-00	FS	2.58 - 2.58		67			1	1							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SD-C40	1140-SD-C40	03-Nov-00	FS	2.08	-	2.08		67			1	1							
SD-C41	1140-SD-C41	03-Nov-00	FS	3.48	-	3.48		67			1	1							
SD-C42	1140-SD-C42	03-Nov-00	FS	1.28	-	1.28		67			1	1							
SD-C43	1140-SD-C43	03-Nov-00	FS	5.45	-	5.45		67			1	1							
A8CW-1-B	1160-A8CW-1-B	09-Nov-00	FS	3	-	3		67	19		3	1							
RSO-06-B	1160-RS0-06-B	09-Nov-00	FS	8	-	8		67	19		3	1							
RSO-06-E	1160-RS0-06-E	09-Nov-00	FS	4	-	6		67	19		3	1							
RSO-06-N	1160-RS0-06-N	09-Nov-00	FS	4	-	6		67	19		3	1							
RSO-06-S	1160-RS0-06-S	09-Nov-00	FS	4	-	6		67	19		3	1							
RSO-06-W	1160-RS0-06-W	09-Nov-00	FS	4	-	6		67	19		3	1							
SVE-12	SVE 12-6-8	14-Nov-00	FS	6	-	8	37	67				2		22					
SVE-13	SVE 13-9	14-Nov-00	FS	9	-	9	37	67				2		22					
SVE-14	SVE 14-8-9	15-Nov-00	FS	8	-	9	37	67				2		22	12				
SVE-15	SVE 15-9-9.5	15-Nov-00	FS	9	-	9.5	37	67				2		22	12				
SVE-16	SVE 16-8	15-Nov-00	FS	8	-	8	37	67				2		22	12				
LAKE POLY 1-E	1160-LAKE POLY 1-E	17-Nov-00	FS	6	-	8	65	67	19		3	1							
LAKE POLY 1-N	1160-LAKE POLY 1-N	17-Nov-00	FS	6	-	8	65	67	19		3	1							
LAKE POLY 1-S	1160-LAKE POLY 1-S	17-Nov-00	FS	6	-	8	65	67	19		3	1							
LAKE POLY 1-W	1160-LAKE POLY 1-W	17-Nov-00	FS	6	-	8	65	67	19		3	1							
CP-C75	1140-CP-C75	18-Nov-00	FS	4.3	-	4.3					1	1							
CP-C76	1140-CP-C76	18-Nov-00	FS	6.3	-	6.3					1	1							
CP-C77	1160-CP-C77	01-Dec-00	FS	5.6	-	5.6					1	1							
LAKEPOLY1-01	1160-LAKEPOLY1-01	08-May-01	FS	4.5	-	4.5	66	66			3	3							
LAKEPOLY1-02	1160-LAKEPOLY1-02	08-May-01	FS	4.5	-	4.5	66	66			3	3							
CP-C79	1140-CP-C79	09-May-01	FS	3	-	3		66			1	1							
CP-C80	1140-CP-C80	09-May-01	FS	2.4	-	2.4	66	66			7	1							
CP-C81	1140-CP-C81	09-May-01	FS	2.6	-	2.6		66			1	1							
CP-C82	1140-CP-C82	09-May-01	FS	3	-	3		66			1	1							
CP-C83	1140-CP-C83	09-May-01	FS	1.3	-	1.3		66			1	1							
CP-C84	1140-CP-C84	10-May-01	FS	1.7	-	1.7	66	67			7	1							
CP-C85	1140-CP-C85	10-May-01	FS	1.8	-	1.8		67			1	1							
CP-C86	1140-CP-C86	10-May-01	FS	3.3	-	3.3		67			1	1							
CP-C87	1140-CP-C87	10-May-01	FS	2.9	-	2.9	66	67			7	1							
CP-C88	1140-CP-C88	10-May-01	FS	4.3	-	4.3		67			1	1							
CP-C89	1140-CP-C89	10-May-01	FS	1.4	-	1.4		67			1	1							
CP-C89 thru CP-C91	1140-CP-8991	10-May-01	FS								8	1	6	22	12				
CP-C90	1140-CP-C90	10-May-01	FS	1.6	-	1.6	66				7	1							
CP-C91	1140-CP-C91	10-May-01	FS	2.1	-	2.1		67			1	1							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
CP-C92	1140-CP-C92	10-May-01	FS	2.3 - 2.3		67			1	1							
SD-C44N	1140-SD-C44N	14-May-01	FS	1.58 - 2.08		67			1	1							
SD-C44S	1140-SD-C44S	14-May-01	FS	2.58 - 3.08		67			1	1							
SD-C45N	1140-SD-C45N	14-May-01	FS	2.88 - 3.38		67			1	1							
SD-C45S	1140-SD-C45S	14-May-01	FS	1.98 - 2.48		67			1	1							
SD-C46N	1140-SD-C46N	14-May-01	FS	1.48 - 1.98					1	1							
SD-C46S	1140-SD-C46S	14-May-01	FS	1.68 - 2.18					1	1							
SD-C47N	1140-SD-C47N	14-May-01	FS	3.18 - 3.68		67			1	1							
SD-C47S	1140-SD-C47S	14-May-01	FS	2.28 - 2.78		67			1	1							
SD-C49S	1140-SD-C49S	14-May-01	FS	1.46 - 1.96					1	1							
SD-C50S	1140-SD-C50S	14-May-01	FS	1.26 - 1.76					1	1							
SD-C51S	1140-SD-C51S	14-May-01	FS	1.16 - 1.66					1	1							
SD-C52S	1140-SD-C52S	14-May-01	FS	1.26 - 1.76	66				1	1							
SD-C53S	1140-SD-C53S	15-May-01	FS	1.13 - 1.63					1	1							
WDW-C33	1140-WDW-C33	16-May-01	FS	2.2 - 2.2					1	1							
CP-C79B	1140-CP-C79B	17-May-01	FS	3.7 - 3.7					1	1							
SD-C55	1140-SD-C55	18-May-01	FS	1.45 - 1.95					1	1							
BD-C50	1140-BD-C50	19-May-01	FS	4.6 - 4.6	66	67			1	1							
BD-C51	1140-BD-C51	19-May-01	FS	1.5 - 1.5	66	67			1	1							
BD-C52	1140-BD-C52	19-May-01	FS	7.8 - 7.8	66	67			1	1							
BD-C53	1140-BD-C53	19-May-01	FS	3.8 - 3.8	66	67			1	1							
BD-C54	1140-BD-C54	19-May-01	FS	4.8 - 4.8	66	67			1	1							
BD-C55	1140-BD-C55	19-May-01	FS	4.7 - 4.7	66	67			1	1							
BD-C55	1140-BD-C55D	19-May-01	FS	4.7 - 4.7	66	67			1	1							
WDW-C35	1140-WDW-C35	21-May-01	FS	2.6 - 2.6	66	67			1	1							
LPB11	1160-LPB11-S1	09-Jul-01	FS	0 - 4					1	1							
LPB11	1160-LPB11-S2	09-Jul-01	FS	4 - 6					1	2							
LPB11	1160-LPB11-S3	09-Jul-01	FS	6 - 9					1	1							
LPB13	1160-LPB13-S1	09-Jul-01	FS	0 - 4.5					1	1							
LPB13	1160-LPB13-S2	09-Jul-01	FS	4.5 - 6					1	1							
LPB13	1160-LPB13-S3	09-Jul-01	FS	6 - 7					1	1							
LPB17	1160-LPB17-S1	09-Jul-01	FS	0 - 5.5					1	1							
LPB17	1160-LPB17-S2	09-Jul-01	FS	5.5 - 8.5					1	1							
LPB19	1160-LPB19-S1	09-Jul-01	FS	0 - 3.5					1	1							
LPB19	1160-LPB19-S2	09-Jul-01	FS	3.5 - 4.5					1	1							
LPB19	1160-LPB19-S3	09-Jul-01	FS	6 - 12					1	1							
LPB3	1160-LPB3-S2	09-Jul-01	FS	2.5 - 6					1	1							
LPB3	1160-LPB3-S3	09-Jul-01	FS	6 - 6.5					1	1							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
LPB9	1160-LPB9-S1	09-Jul-01	FS	0 - 4.5					1	1							
LPB9	1160-LPB9-S2	09-Jul-01	FS	4.5 - 6					1	1							
LPB9	1160-LPB9-S3	09-Jul-01	FS	6 - 8					1	1							
LPB10	1160-LPB10-S1	10-Jul-01	FS	0 - 5.5	66	67	19		5	3		22	12				
LPB10	1160-LPB10-S2	10-Jul-01	FS	5.5 - 7.5	66	67	19	7	9	9		22	12				
LPB10	1160-LPB10-S2-D	10-Jul-01	FD	5.5 - 7.5		67	19		3	2		22					
LPB10	1160-LPB10-S3	10-Jul-01	FS	7.5 - 8.5					1	1							
LPB12	1160-LPB12-S1	10-Jul-01	FS	0 - 3.5	65	67	19		4	3		22	12				
LPB12	1160-LPB12-S2	10-Jul-01	FS	3.5 - 6.5	65	67	19	7	9	9		22	12				
LPB12	1160-LPB12-S3	10-Jul-01	FS	6.5 - 10	66	67	19	7	9	9		22	12				
LPB15	1160-LPB15-S1	10-Jul-01	FS	0 - 6.5	65	67	19		5	3		22	12				
LPB15	1160-LPB15-S2	10-Jul-01	FS	6.5 - 8.5					1	1							
LPB15	1160-LPB15-S3	10-Jul-01	FS	8.5 - 11	66	67	19	7	9	8		22	12				
LPB16	1160-LPB16-S1	10-Jul-01	FS	0 - 7.5	65	67	19		4	4		22	12				
LPB16	1160-LPB16-S2	10-Jul-01	FS	7.5 - 8.5	66	67	19	7	9	8		22	12				
LPB18	1160-LPB18-S1	10-Jul-01	FS	0 - 8					1	1							
LPB18	1160-LPB18-S2	10-Jul-01	FS	8 - 10					2	1							
LPB4	1160-LPB4-S2	10-Jul-01	FS	1 - 4					1	1							
LPB4	1160-LPB4-S3	10-Jul-01	FS	4 - 6					1	1							
LPB5	1160-LPB5-S2	10-Jul-01	FS	2.5 - 8	66	67	19	7	9	8		22	12				
LPB6	1160-LPB6-S2	10-Jul-01	FS	1 - 8					2	1							
LPB7	1160-LPB7-S1	10-Jul-01	FS	0 - 3	66	67	19		4	3		22	12				
LPB7	1160-LPB7-S2	10-Jul-01	FS	3 - 8	66				1	3			12				
LPB8	1160-LPB8-S1	10-Jul-01	FS	0 - 5	66	67	19		4	3		22	12				
LPB8	1160-LPB8-S2	10-Jul-01	FS	5 - 7	66	67	19	7	9	9		22	12				
LPB8	1160-LPB8-S3	10-Jul-01	FS	7 - 8					1	1							
LPB1	1160-LPB1-S1	11-Jul-01	FS	0 - 4					1	1							
LPB1	1160-LPB1-S2	11-Jul-01	FS	4 - 8					1	1							
LPB14	1160-LPB14-S2	11-Jul-01	FS	2.5 - 4.5	66	67	19		4	5		22	12				
LPB2	1160-LPB2-S1	11-Jul-01	FS	0 - 6					1	1							
LPB2	1160-LPB2-S2	11-Jul-01	FS	6 - 8					1	1							
LPB22	1160-LPB22-S1	11-Jul-01	FS	0 - 4.2					1	1							
LPB22	1160-LPB22-S2	11-Jul-01	FS	4.2 - 9					1	1							
LPB23	1160-LPB23-S1	11-Jul-01	FS	0 - 3					1	1							
LPB23	1160-LPB23-S2	11-Jul-01	FS	3 - 8					1	1							
LPB24	1160-LPB24-S2	11-Jul-01	FS	2 - 2.5					1	1							
LPB24	1160-LPB24-S3	11-Jul-01	FS	2.5 - 8					1	1							
LPB25	1160-LPB25-S2	11-Jul-01	FS	2.5 - 3					1	2							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
LPB25	1160-LPB25-S3	11-Jul-01	FS	3 - 8					1	1							
LPB26	1160-LPB26-S1	11-Jul-01	FS	0 - 3.5					1	1							
LPB26	1160-LPB26-S2	11-Jul-01	FS	3.5 - 7					1	1							
LPB26	1160-LPB26-S3	11-Jul-01	FS	7 - 8					1	1							
LPB27	1160-LPB27-S1	11-Jul-01	FS	0 - 5					1	1							
LPB27	1160-LPB27-S2	11-Jul-01	FS	5 - 7.5					1	1							
LPB27	1160-LPB27-S3	11-Jul-01	FS	7.5 - 12					1	1							
LPB28	1160-LPB28-S1	11-Jul-01	FS	0 - 5	66	67	19		4	3		22	12				
LPB28	1160-LPB28-S2	11-Jul-01	FS	5 - 9	66	67	19		4	5		22	12				
LPB28	1160-LPB28-S3	11-Jul-01	FS	9 - 10					1	1							
LPB7	1160-LPB7-S2	11-Jul-01	FS	3 - 8		67	19		3	2		22					
LPB29	1160-LPB 29-S1	12-Jul-01	FS	0 - 7					1	1							
LPB29	1160-LPB 29-S2	12-Jul-01	FS	7 - 8					1	2							
LPB29	1160-LPB29-S2	12-Jul-01	FS	7 - 8					1								
LPB29	1160-LPB 29-S3	12-Jul-01	FS	8 - 10.5					1	1							
LPB30	1160-LPB 30-S1	12-Jul-01	FS	0 - 8					1	1							
LPB30	1160-LPB 30-S2	12-Jul-01	FS	8 - 9					1	2							
LPB30	1160-LPB 30-S3	12-Jul-01	FS	9 - 11					1	1							
LPB31	1160-LPB 31-S1	12-Jul-01	FS	0 - 6					1	1							
LPB31	1160-LPB 31-S2	12-Jul-01	FS	6 - 8					1	1							
LPB32	1160-LPB 32-S2	12-Jul-01	FS	2 - 8					1	1							
LPB33	1160-LPB 33-S1	12-Jul-01	FS	0 - 6					1	1							
LPB33	1160-LPB 33-S2	12-Jul-01	FS	6 - 7					1	1							
LPB33	1160-LPB33-S2	12-Jul-01	FS	6 - 7					1								
LPB33	1160-LPB 33-S3	12-Jul-01	FS	7 - 8					1	1							
LPB34	1160-LPB 34-S1	12-Jul-01	FS	0 - 6					1	1							
LPB34	1160-LPB 34-S2	12-Jul-01	FS	6 - 8					1	1							
CP-EX1	1170-CPEX1-BOT	27-Aug-03	FS						8	1		22					
CP-EX2	1170-CPEX2-BOT	27-Aug-03	FS						8	1		22					
CP-EX3	1170-CPEX3-BOT	27-Aug-03	FS						8	1		22					
CP-EX1	1170-CPEX1-SIDE123	28-Aug-03	FS						8	1		22					
CP-EX1	1170-CPEX1-SIDE4	28-Aug-03	FS						8	1		22					
CP-EX2	1170-CPEX2-SIDE123	28-Aug-03	FS						8	1		22					
CP-EX2	1170-CPEX2-SIDE4	28-Aug-03	FS						8	1		22					
CP-EX3	1170-CPEX3-SIDE123	28-Aug-03	FS						8	1		22					
CP-EX3	1170-CPEX3-SIDE4	28-Aug-03	FS						8	1		22					
CP-EX2	1170-CPEX2-Side1	10-Oct-03	FS							1		22					
CP-EX2	1170-CPEX2-Side2	10-Oct-03	FS							1		22					

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
CP-EX2	1170-CPEX2-Side3	10-Oct-03	FS						1			22					
LPB-40	LPB-40-VI	10-Dec-03	FS	5 - 10	2	1			1				3				
LPB-41	LPB-41-VI	10-Dec-03	FS	1.5 - 3.5	2	1			1				3				
LPB-41	LPB-41-BLW	10-Dec-03	FS	5 - 9.5	2	1			1				3				
LPB-42	LPB-42-OVR	10-Dec-03	FS	0 - 3.5	2	1			1				3				
LPB-42	LPB-42-VI	10-Dec-03	FS	3.5 - 5	2	1			1				3				
LPB-42	LPB-42-BLW	10-Dec-03	FS	9 - 10	2	1			1				3				
LPB-43	LPB-43-OVR	10-Dec-03	FS	1 - 3.5	2	1			1				3				
LPB-43	LPB-43-VI	10-Dec-03	FS	3.5 - 5	2	1			1				3				
LPB-43	LPB-43-BLW	10-Dec-03	FS	8.7 - 10	2	1			1				3				
LPB-48	LPB-48-OVR	10-Dec-03	FS	2.5 - 5	2	1			1				3				
LPB-48	LPB-48-VI	10-Dec-03	FS	5 - 8	2	1			1				3				
LPB-50	LPB-50-OVR	10-Dec-03	FS	2.5 - 5	2	1			1				3				
LPB-50	LPB-50-VI	10-Dec-03	FS	7.5 - 8.4	2	1			1				3				
LPB-50	LPB-50-BLW	10-Dec-03	FS	8.4 - 10	2	1			1				3				
ECS-1	ECS-1	29-Jan-04	FS	5 - 7					1			13					
ECS-3	ECS-3	29-Jan-04	FS	5 - 7					1			13					
ECS-5a	ECS-5	29-Jan-04	FS	5 - 7					1			13					
ECS-8	ECS-8	30-Jan-04	FS	5 - 7					1			13					
ECS-C-1	ECS-C-1	30-Jan-04	FS			75	9	8	6		21						
ECS-C-2	ECS-C-2	30-Jan-04	FS			75	9	8	6		21						
CSL-1	CSL1-4-6	08-Mar-04	FS	4 - 6	2	1			1				3				
GW-306	PLD1A-0-4 (GW-306)	08-Mar-04	FS	0 - 4	2	1			1				3				
GW-307	PLD2A-0-4 (GW-307)	08-Mar-04	FS	0 - 4	2	1			1				3				
PLD-1	PLD1-5-8	08-Mar-04	FS	5 - 8	2	1			1				3				
PLD-2	PLD2-5-8	08-Mar-04	FS	5 - 8	2	1			1				3				
PLD-3	PLD3-0-4	08-Mar-04	FS	0 - 4	2	1			1				3				
PLD-3	PLD3-5-8	08-Mar-04	FS	5 - 8	2	1			1				3				
GW-301	WSS1-2-4 (GW-301)	09-Mar-04	FS	2 - 4	2	1			1				3				
GW-302	WSS3-2-4 (GW-302)	09-Mar-04	FS	2 - 4	2	1			1				3				
WSS-2	WSS2-2-4	09-Mar-04	FS	2 - 4	2	1			1				3				
GW-303	WSL1-6-10 (GW-303)	10-Mar-04	FS	6 - 10	2	1			1								
GW-303	WSL1-6-10 DUP (GW-303)	10-Mar-04	FD	6 - 10	2	1			1								
GW-305	WSL3-5-9 (GW-305)	11-Mar-04	FS	5 - 9	2	1			1								
BIOCELL	1140-BP-DS1	21-Apr-04	FS			69			1	1			3				
BIOCELL	1140-BP-DS2	21-Apr-04	FS			69			1	1			3				
BIOCELL	1140-BP-DS3	21-Apr-04	FS			69			1	1			3				
BIOCELL	1140-BP-DS4	21-Apr-04	FS			69			1	1			3				

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
BIOCELL	1140-BP-DS5	21-Apr-04	FS			69				1	1			3			
LP-BOT-A	LP-BOT-A	09-Jun-04	FS	7.5 - 9					1	2							
LP-BOT-B	LP-BOT-B	09-Jun-04	FS	7 - 9					1	2							
LP-BOT-C	LP-BOT-C	09-Jun-04	FS	5 - 9					1	2							
LP-C01	LP-C01	09-Jun-04	FS	5.5 - 7.5					1	2							
LP-C02	LP-C02	09-Jun-04	FS	5 - 6.5					1	2							
LP-C03	LP-C03	09-Jun-04	FS	5 - 7					1	2							
LP-C04	LP-C04	09-Jun-04	FS	5 - 7					1	2							
LP-C05	LP-C05	09-Jun-04	FS	4.5 - 5.5					1	2							
LP-C06	LP-C06	09-Jun-04	FS	4 - 6					1	2							
LP-C07	LP-C07	09-Jun-04	FS	4.5 - 6.5					1	2							
LP-C07	LP-C07D DUP	09-Jun-04	FD	4.5 - 6.5					1	2							
LP-C08	LP-C08	09-Jun-04	FS	5 - 7					1	2							
LP-C09	LP-C09	15-Jun-04	FS	5.5 - 7.5					1	2							
SVESB-1	SVESB1-8-10	16-Jul-04	FS	8 - 10	2					1			14				
SVESB-2	SVESB2-6-8	16-Jul-04	FS	6 - 8	2					1			14				
SVESB-3	SVESB-3-6-8	16-Jul-04	FS	6 - 8	2					1			14				
SVESB-4	SVESB4-4-6.5	16-Jul-04	FS	4 - 6.5	2					1			14				
SVESB-5	SVESB-5-6-8	16-Jul-04	FS	6 - 8	2					1			14				
SVESB-5	SVESB-5-8-11	16-Jul-04	FS	8 - 11	2					1			14				
SVESB-6	SVESB-6-8-10	16-Jul-04	FS	8 - 10	2					1			14				
SVESB-7	SVESB7-8-10	16-Jul-04	FS	8 - 10	2					1			14				
SVESB-8	SVESB-8-8-10	16-Jul-04	FS	8 - 10	2					1			14				
BIOCELL	1140-BP-DS1-02	19-May-05	FS			69				2	1			3			
BIOCELL	1140-BP-DS2-02	19-May-05	FS			69				2	1			3			
BIOCELL	1140-BP-DS3-02	19-May-05	FS			69				2	1			3			
BIOCELL	1140-BP-DS4-02	19-May-05	FS			69				2	1			3			
BIOCELL	1140-BP-DS5-02	19-May-05	FS			69				2	1			3			
SB-405	OC-SB-405-8.0/9.0-XXX	18-Aug-09	FS	8 - 9	78	79		24	5								
SB-412	OC-SB-412-6.0/7.0-XXX	18-Aug-09	FS	6 - 7	78	80		24	6					3	2	1	1
SB-416	OC-SB-416-8.0/9.0-XXX	18-Aug-09	FS	8 - 9	78	80		24	6					3	2	1	1
SB-420	OC-SB-420-6.5/8.5-XXX	18-Aug-09	FS	6.5 - 8.5	78	80		24	6					3	2	1	1
SB-423	OC-SB-423-5.0/6.0-XXX	18-Aug-09	FS	5 - 6	78	79		24	5								
SB-419	OC-SB-419-3.0/5.0-XXX	19-Aug-09	FS	3 - 5	78	80		24	6					3	2	1	1
SB-421	OC-SB-421-8.0/10-XXX	19-Aug-09	FS	8 - 10	78	80		24	7		5	6	3	2	1	1	
SB-424	OC-SB-424-7.0/9.0-XXX	19-Aug-09	FS	7 - 9	78	80		24	5					2		1	
SB-425	OC-SB-425-6.0/8.0-XXX	19-Aug-09	FS	6 - 8	78	80		24	6				3	2	1	1	
SB-426	OC-SB-426-5.0/7.0-DUP	19-Aug-09	FD	5 - 7	78	80		24	7				3		1	1	

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-426	OC-SB-426-5.0/7.0-XXX	19-Aug-09	FS	5 - 7	78	80			24	7				3		1	1
SB-415	OC-SB-415-5.0/7.0-XXX	20-Aug-09	FS	5 - 7	78	79			24	5							
SB-431	OC-SB-431-7.0/9.0-XXX	20-Aug-09	FS	7 - 9	78	79			24	6				3			
SB-432	OC-SB-432-5.0/7.0-XXX	20-Aug-09	FS	5 - 7	78	80			24	6		5	6	3	2	1	1
SB-436	OC-SB-436-6.0/8.0-XXX	20-Aug-09	FS	6 - 8	78	79			24	6				3			
SB-443	OC-SB-443-6.0/8.0-XXX	20-Aug-09	FS	6 - 8	78	80			24	6				3	2	1	1
SB-437	OC-SB-437-5.0/7.0-XXX	21-Aug-09	FS	5 - 7	78	80			24	6				3	2	1	1
SB-445	OC-SB-445-8.0/10-XXX	21-Aug-09	FS	8 - 10	78	80			24	6				3	2	1	1
SB-433	OC-SB-433-5.0/7.0-DUP	24-Aug-09	FD	5 - 7	78	79			24	5							
SB-433	OC-SB-433-5.0/7.0-XXX	24-Aug-09	FS	5 - 7	78	79			24	5							
SB-438	OC-SB-438-5.0/7.0-XXX	24-Aug-09	FS	5 - 7	78	79			24	5							
SB-439	OC-SB-439-8.0/10-XXX	24-Aug-09	FS	8 - 10	78	79			24	5							
SB-440	OC-SB-440-6.0/8.0-XXX	24-Aug-09	FS	6 - 8	78	79			24	5		5	6				
SB-441	OC-SB-441-8.0/10-XXX	24-Aug-09	FS	8 - 10	78	79			24	5		5	6				
SB-422	OC-SB-422-6.0/8.0-XXX	25-Aug-09	FS	6 - 8	78	80			24	6				3	2	1	1
SB-429	OC-SB-429-6.0/8.0-XXX	25-Aug-09	FS	6 - 8	78	79			24	5							
SB-430	OC-SB-430-8.0/10-DUP	25-Aug-09	FD	8 - 10	78	80			24	6				3	2	1	1
SB-430	OC-SB-430-8.0/10-XXX	25-Aug-09	FS	8 - 10	78	80			24	6				3	2	1	1
SB-446	OC-SB-446-5.0/7.0-DUP	25-Aug-09	FD	5 - 7	78	80			24	6				3	2	1	1
SB-446	OC-SB-446-5.0/7.0-XXX	25-Aug-09	FS	5 - 7	78	80			24	6				3	2	1	1
SB-448	OC-SB-448-8.0/10-XXX	25-Aug-09	FS	8 - 10	78	80			24	7				3	2	1	1
SB-400	OC-SB-400-5.0/7.0-XXX	26-Aug-09	FS	5 - 7	78	79			24	5		5	6				
SB-401	OC-SB-401-7.5/9.5-XXX	26-Aug-09	FS	7.5 - 9.5	78	79			24	5							
SB-402	OC-SB-402-7.5/9.5-XXX	26-Aug-09	FS	7.5 - 9.5	78	80			24	7				3	2	1	1
SB-403	OC-SB-403-6.0/8.0-XXX	26-Aug-09	FS	6 - 8	78	80			24	6				3	2	1	1
SB-404	OC-SB-404-5.0/7.0-XXX	26-Aug-09	FS	5 - 7	78	80			24	6				3	2	1	1
SB-407	OC-SB-407-8.0/10-XXX	26-Aug-09	FS	8 - 10	78	80			24	7				3	2	1	1
SB-408	OC-SB-408-7.0/9.0-XXX	26-Aug-09	FS	7 - 9	78	79			24	5							
SB-409	OC-SB-409-6.0/8.0-XXX	26-Aug-09	FS	6 - 8	78	80			24	6				3	2	1	1
SB-411	OC-SB-411-4.7/6.7-XXX	26-Aug-09	FS	4.7 - 6.7	78	80			24	6				3	2	1	1
SB-414	OC-SB-414-6.0/8.0-XXX	26-Aug-09	FS	6 - 8	78	79			24	5							
SB-410	OC-SB-410-6.0/8.0-DUP	27-Aug-09	FD	6 - 8	78	80			24	6				3	2	1	1
SB-410	OC-SB-410-6.0/8.0-XXX	27-Aug-09	FS	6 - 8	78	80			24	6				3	2	1	1
SB-418	OC-SB-418-8/10-XXX	27-Aug-09	FS	8 - 10	78	79			24	5					2		
SB-444	OC-SB-444-5.0/7.0-XXX	27-Aug-09	FS	5 - 7	78	80			24	6				3	2	1	1
SB-449	OC-SB-449-6.0/8.0-XXX	27-Aug-09	FS	6 - 8	78	79			25	9							
SB-454	OC-SB-454-6.0/8.0-XXX	27-Aug-09	FS	6 - 8	78	79			25	9							
SB-451	OC-SB-451-2.5/4.5-DUP	28-Aug-09	FD	2.5 - 4.5	78	80			24	6				3	2	1	1

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-451	OC-SB-451-2.5/4.5-XXX	28-Aug-09	FS	2.5 - 4.5	78	80			24	6				3	2	1	1
SB-455	OC-SB-455-6.0/8.0-DUP	28-Aug-09	FD	6 - 8	78	79			24	5							
SB-455	OC-SB-455-6.0/8.0-XXX	28-Aug-09	FS	6 - 8	78	79			24	5							
SB-442	OC-SB-442-8.0/10-DUP	31-Aug-09	FD	8 - 10	78	80			24	6				3	2	1	1
SB-442	OC-SB-442-8.0/10-XXX	31-Aug-09	FS	8 - 10	78	80			24	6				3	2	1	1
SB-447	OC-SB-447-3.0/5.0-XXX	31-Aug-09	FS	3 - 5	78	79			24	6		5	6				
SB-452	OC-SB-452-5.0/7.0-XXX	31-Aug-09	FS	5 - 7	78	80			24	6				3	2	1	1
SB-458	OC-SB-458-5.0/7.0-XXX	31-Aug-09	FS	5 - 7	78	80			24	5					2		1
SB-460	OC-SB-460-5.5/7.5-XXX	01-Sep-09	FS	5.5 - 7.5	78	79			24	5						1	
SB-463	OC-SB-463-6.0/8.0-XXX	01-Sep-09	FS	6 - 8	78	79			24	6				3			
SB-464	OC-SB-464-5.0/7.0-XXX	01-Sep-09	FS	5 - 7	78	80			24	6				3	2	1	1
SB-465	OC-SB-465-8.0/10-DUP	02-Sep-09	FD	8 - 10	78	80			24	7				3	2	1	1
SB-465	OC-SB-465-8.0/10-XXX	02-Sep-09	FS	8 - 10	78	80			24	7				3	2	1	1
SB-467	OC-SB-467-6.0/8.0-DUP	02-Sep-09	FD	6 - 8	78	79	9		24	5							
SB-467	OC-SB-467-6.0/8.0-XXX	02-Sep-09	FS	6 - 8	78	79	9		24	5							
SB-468	OC-SB-468-8.0/10-XXX	02-Sep-09	FS	8 - 10	78	80			24	6				3	2	1	1
SB-471	OC-SB-471-3.0/5.0-XXX	02-Sep-09	FS	3 - 5	78	80			24	6				3	2	1	1
SB-459	OC-SB-459-6.0/8.0-DUP	03-Sep-09	FD	6 - 8	78	80			25	11		5	6	3	2	1	1
SB-459	OC-SB-459-6.0/8.0-XXX	03-Sep-09	FS	6 - 8	78	80			25	11		5	6	3	2	1	1
SB-461	OC-SB-461-5.0/7.0-XXX	03-Sep-09	FS	5 - 7	78	79			25	9							
SB-462	OC-SB-462-4.0/6.0-XXX	03-Sep-09	FS	4 - 6	78	79			24	5							
SB-470	OC-SB-470-7.0/9.0-XXX	04-Sep-09	FS	7 - 9	78	79			25	9							
SB-472	OC-SB-472-8.0/10-XXX	04-Sep-09	FS	8 - 10	78	80	9		25	10				3	2	1	1
SB-466	OC-SB-466-6.0/8.0-XXX	08-Sep-09	FS	6 - 8	78	80			25	11				3	2	1	1
SB-450	OC-SB-450-8.0/10-XXX	09-Sep-09	FS	8 - 10	78	80			24	6				3	2	1	1
SB-469	OC-SB-469-7.0/9.0-XXX	09-Sep-09	FS	7 - 9	78	79			25	9							
SB-417	OC-SB-417-8.0/10-XXX	10-Sep-09	FS	8 - 10	78	79			24	5							
SB-427	OC-SB-427-8.0/10-DUP	10-Sep-09	FD	8 - 10	78	80			24	5		5	6		2		1
SB-427	OC-SB-427-8.0/10-XXX	10-Sep-09	FS	8 - 10	78	80			24	5		5	6		2		1
SB-428	OC-SB-428-8.0/10-DUP	10-Sep-09	FD	8 - 10						2		5	6				
SB-428	OC-SB-428-8.0/10-XXX	10-Sep-09	FS	8 - 10	78	80			24	5		5	6		2		1
SB-434	OC-SB-434-7.0/9.0-XXX	10-Sep-09	FS	7 - 9	78	80			24	6				3	2	1	1
SB-456	OC-SB-456-7.0/9.0-DUP	11-Sep-09	FD	7 - 9	78	80			25	10				3	2	1	1
SB-456	OC-SB-456-7.0/9.0-XXX	11-Sep-09	FS	7 - 9	78	80			25	10				3	2	1	1
SB-457	OC-SB-457-8.0/10-XXX	11-Sep-09	FS	8 - 10	78	80			25	10				3	2	1	1
SB-406	OC-SB-406-8.0/10-XXX	17-Sep-09	FS	8 - 10	78	79			24	5							
SB-413	OC-SB-413-1.0/5.0-XXX	17-Sep-09	FS	1 - 5	78	80			24	6				3	2	1	1
SB-435	OC-SB-435-6.0/10-XXX	17-Sep-09	FS	6 - 10	78	80			24	6				3	2	1	1

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-453	OC-SB-453-1.0/6.0-XXX	17-Sep-09	FS	1 - 6	78	80			24	6				3	2	1	1
SB-473	OC-SB-473-4.0/6.0-XXX	18-Sep-09	FS	4 - 6	78	80			25	11				3	2	1	1
SB-485	OC-SB-485-6.0/8.0-XXX	15-Nov-10	FS	6 - 8	78	79				2		5	6				
SB-488	OC-SB-488-7.0/9.0-XXX	15-Nov-10	FS	7 - 9	78	79				2		5	6				
SB-479	OC-SB-479-8.0/10-XXX	16-Nov-10	FS	8 - 10	78	79				2		5	6				
SB-480	OC-SB-480-6.0/8.0-DUP	16-Nov-10	FD	6 - 8	78	79				2		5	6				
SB-480	OC-SB-480-6.0/8.0-XXX	16-Nov-10	FS	6 - 8	78	79				2		5	6				
SB-490	OC-SB-490-7.0/9.0-XXX	16-Nov-10	FS	7 - 9	78	79				2		5	6				
SB-494	OC-SB-494-6.0/8.0-XXX	16-Nov-10	FS	6 - 8	78	79				2		5	6				
SB-495	OC-SB-495-4.0/6.0-XXX	16-Nov-10	FS	4 - 6	78	79				2		5	6				
SB-496	OC-SB-496-5.0/6.5-XXX	16-Nov-10	FS	5 - 6.5	78	79				2		5	6				
SB-481	OC-SB-481-7.0/9.0-XXX	17-Nov-10	FS	7 - 9	78	79				2		5	6				
SB-497	OC-SB-497-6.0/8.0-XXX	17-Nov-10	FS	6 - 8	78	79				2		5	6				
SB-500	OC-SB-500-0.5/3.0-XXX	17-Nov-10	FS	0.5 - 3	78	79				2		5	6				
SB-501	OC-SB-501-0.5/3.0-XXX	17-Nov-10	FS	0.5 - 3	78	79				2		5	6				
SB-502	OC-SB-502-3.0/5.0-XXX	17-Nov-10	FS	3 - 5	78	79				2		5	6				
SB-474	OC-SB-474-8.0/10-XXX	18-Nov-10	FS	8 - 10	78	79				2		5	6				
SB-475	OC-SB-475-8.0/10-DUP	18-Nov-10	FD	8 - 10	78	79				2		5	6				
SB-475	OC-SB-475-8.0/10-XXX	18-Nov-10	FS	8 - 10	78	79				2		5	6				
SB-476	OC-SB-476-8.0/10-XXX	18-Nov-10	FS	8 - 10	78	79				2		5	6				
SB-477	OC-SB-477-8.0/10-XXX	18-Nov-10	FS	8 - 10	78	79				2		5	6				
SB-478	OC-SB-478-8.0/10-XXX	18-Nov-10	FS	8 - 10	78	79				2		5	6				
SB-530	OC-SB-530-1.0-3.0-XXX	20-Nov-12	FS	1 - 3			9			2							
SB-531	OC-SB-531-1.0-3.0-XXX	20-Nov-12	FS	1 - 3			9			2							
SB-503	OC-SB-503-6.0/8.0-XXX	10-Dec-12	FS	6 - 8					1	4							
SB-506	OC-SB-506-6.0/8.0-XXX	10-Dec-12	FS	6 - 8					1	4							
SB-507	OC-SB-507-6.0/8.0-XXX	10-Dec-12	FS	6 - 8					1	4		21					
SB-511	OC-SB-511-6.0/8.0-XXX	10-Dec-12	FS	6 - 8					1	4							
SB-512	OC-SB-512-6.0/8.0-XXX	10-Dec-12	FS	6 - 8					1	4							
SB-480	OC-SB-480-6.0/8.0-XXX	11-Dec-12	FS	6 - 8	2					2							
SB-484	OC-SB-484-5.5/7.5-XXX	11-Dec-12	FS	5.5 - 7.5	2					2							
SB-486	OC-SB-486-8.0/10-XXX	11-Dec-12	FS	8 - 10	2					2							
SB-491	OC-DUP-3	11-Dec-12	FD	6 - 8	2					2							
SB-491	OC-SB-491-6.0/8.0-XXX	11-Dec-12	FS	6 - 8	2					2							
SB-504	OC-SB-504-7.5/9.5-XXX	11-Dec-12	FS	7.5 - 9.5					1	4							
SB-505	OC-SB-505-5.0/7.0-XXX	11-Dec-12	FS	5 - 7					1	4							
SB-508	OC-SB-508-8.0/10-XXX	11-Dec-12	FS	8 - 10					1	4							
SB-513	OC-SB-513-7.0/9.0-XXX	12-Dec-12	FS	7 - 9					1	4							

Table 2.2-2
Summary of Chemical Analyses for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	Pesticides	PCBs	Metals	Inorganics/Physical	TPH	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-514	OC-SB-514-7.0/9.0-XXX	12-Dec-12	FS	7 - 9		80			1	4		21					
SB-515	OC-SB-515-6.0/8.0-XXX	12-Dec-12	FS	6 - 8	2	80				2		21					
SB-516	OC-SB-516-6.0/8.0-XXX	12-Dec-12	FS	6 - 8	2	80				2		21					
SB-517	OC-SB-517-6.0/8.0-XXX	12-Dec-12	FS	6 - 8	2	80			1	4		21					
SB-523	OC-SB-523-6.0/8.0-XXX	12-Dec-12	FS	6 - 8					1	4							
SB-524	OC-SB-524-8.0/10-XXX	12-Dec-12	FS	8 - 10					1	4							
SB-509	OC-SB-509-1.0/3.0-XXX	13-Dec-12	FS	1 - 3					1	4							
SB-510	OC-SB-510-7.0/9.0-XXX	13-Dec-12	FS	7 - 9					1	4							
SB-520	OC-SB-520-8.0/10-XXX	13-Dec-12	FS	8 - 10	2	80				2							
SB-522	OC-SB-522-8.0/10-XXX	13-Dec-12	FS	8 - 10		80			1	4							
SB-525	OC-SB-525-3.0/5.0-XXX	13-Dec-12	FS	3 - 5					1	4							
SB-532	OC-SB-532-6.0/8.0-XXX	13-Dec-12	FS	6 - 8						2		21					
SB-533	OC-SB-533-6.0/8.0-XXX	13-Dec-12	FS	6 - 8		17				2		4					
SB-534	OC-SB-534-7.0/9.0-XXX	13-Dec-12	FS	7 - 9						2		21					
SB-518	OC-SB-518-8.0/10-XXX	14-Dec-12	FS	8 - 10	2	80			1	4							
SB-519	OC-SB-519-8.0/10-XXX	14-Dec-12	FS	8 - 10		80			1	4							
SB-521	OC-SB-521-8.0/10-XXX	14-Dec-12	FS	8 - 10					1	4							
SB-530	OC-SB-530 3.5/4.0-XXX	17-Jun-13	FS	3.5 - 4				9		2							
SB-535	OC-SB-535-2.5/3.0-XXX	17-Jun-13	FS	2.5 - 3				9		2							
SB-536	OC-SB-536-2.5/3.0-XXX	17-Jun-13	FS	2.5 - 3				9		2							
SB-537	OC-SB-537-2.5/3.0-XXX	17-Jun-13	FS	2.5 - 3				9		2							
SB-537	OC-SB-537-3.5/4.0-XXX	17-Jun-13	FS	3.5 - 4				9		2							

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/06/14
Checked by / Date: CTM 03/10/14

Table 2.2-3
Summary of Chemical Analyses for OU1 Deep Subsurface Soil Samples (> 10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	Metals	Inorganics/Physical	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
BH11	BH11 (10-12 ft)	07-Jun-91	FS	10	-	12	36	65	27	23	5						
BH20	BH20	10-Jun-91	FS	10	-	12	36	65	27	23	5						
TE2.10	TE2.10.11-12	14-Apr-98	FS	11	-	12	57	67	19	15	3						
E2.70	E2.70, 10	20-Apr-98	FS	10	-	10	57	67	19	15	3						
B-1A	B-1, 16'-17.3'	12-Aug-98	FS	16	-	17.3				4	6						
B-2A	B-2, 16'-18'	13-Aug-98	FS	16	-	18				4	6						
B-2A	B-2, 22'-24'	13-Aug-98	FS	22	-	24				4	6						
B-1B	B-1B, 19.0'-19.6'	14-Aug-98	FS	19	-	19.6				4	6						
B-3A	B-3, 12'-14'	14-Aug-98	FS	12	-	14				4	6						
B-3A	B-3, 18'-20'	14-Aug-98	FS	18	-	20				4	6						
WD-C15	1140-WD-C15	04-Oct-00	FS	10	-	10		67	19	8	1						
AS-1	AS-1 12-13	10-Oct-00	FS	12	-	13	37	67			1	22	12				
AS-3	AS-3 10-12	11-Oct-00	FS	10	-	12	37	67			1	22	12				
AS-3	AS-3 15-16	11-Oct-00	FS	15	-	16					1	22					
AS-2	AS-2-15	12-Oct-00	FS	15	-	15					1	22					
AS-7	AS-7-10-12	12-Oct-00	FS	10	-	12	37	67			1	22	12				
AS-7	AS-7-8-10	12-Oct-00	FS	10	-	10	37				1	22	12				
BD-C10	1120-BD-C10	12-Oct-00	FS	10.3	-	10.3	66	67	19	8	2						
BD-C13	1120-BD-C13	12-Oct-00	FS	10.1	-	10.1	66	67	19	8	2						
AS-5	AS-5-10	13-Oct-00	FS	10	-	10	37				1	22	12				
WD-C16	1140-WD-C16	13-Oct-00	FS	10.1	-	10.1	66	67	19	8	1						
AS-8	AS-8-15	16-Oct-00	FS	15	-	15					1	22					
SVE-6B	SVE-6B S3 10	17-Oct-00	FS	10	-	10	37				1	22	12				
LAKE POLY 1-B	1160-LAKE POLY 1-B	17-Nov-00	FS	10	-	10	66	67	19	3	1						
LPB18	1160-LPB18-S3	10-Jul-01	FS	10	-	10.5				1	1						
LPB-40	LPB-40-BLW	10-Dec-03	FS	10	-	11	2	1			1			3			
LPB-48	LPB-48-BLW	10-Dec-03	FS	8	-	20	2	1			1			3			
ECS-2	ECS-2	29-Jan-04	FS	10	-	12					1		13				
ECS-4	ECS-4	30-Jan-04	FS	10	-	12					1		13				
ECS-6	ECS-6	30-Jan-04	FS	10	-	12					1		13				
SVEMW-9	SVESB-9-10-12	16-Jul-04	FS	10	-	12	2				1		14				
SB-405	OC-SB-405-14/15-XXX	18-Aug-09	FS	14	-	15	78	79		23	5						
SB-412	OC-SB-412-12/13-XXX	18-Aug-09	FS	12	-	13		79		23	5				2		
SB-416	OC-SB-416-13/14-XXX	18-Aug-09	FS	13	-	14	78	79		23	5				2		
SB-420	OC-SB-420-12/14-XXX	18-Aug-09	FS	12	-	14	78	79		23	5				2		
SB-423	OC-SB-423-13/14-XXX	18-Aug-09	FS	13	-	14		79		23	5						
SB-419	OC-SB-419-17/19-XXX	19-Aug-09	FS	17	-	19		79		23	5				2		
SB-421	OC-SB-421-10.5/12.5-XXX	19-Aug-09	FS	10.5	-	12.5	78	79		23	6	5	6		2		
SB-424	OC-SB-424-17/19-XXX	19-Aug-09	FS	17	-	19		79		23	5				2		

Table 2.2-3
Summary of Chemical Analyses for OU1 Deep Subsurface Soil Samples (> 10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	Metals	Inorganics/Physical	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-425	OC-SB-425-18/20-XXX	19-Aug-09	FS	18	-	20		79		23	5				2		
SB-426	OC-SB-426-13/15-XXX	19-Aug-09	FS	13	-	15		79		23	6						
SB-415	OC-SB-415-16/18-XXX	20-Aug-09	FS	16	-	18		79		23	5						
SB-432	OC-SB-432-14/16-XXX	20-Aug-09	FS	14	-	16	78	80		24	6	5	6	3	2		1
SB-436	OC-SB-436-13/15-XXX	20-Aug-09	FS	13	-	15		79		23	5						
SB-443	OC-SB-443-18/20-XXX	20-Aug-09	FS	18	-	20		79		23	5				2		
SB-437	OC-SB-437-21/23-XXX	21-Aug-09	FS	21	-	23		79		23	5				2		
SB-445	OC-SB-445-25/27-XXX	21-Aug-09	FS	25	-	27		79		23	5				2		
SB-433	OC-SB-433-20/22-XXX	24-Aug-09	FS	20	-	22		79		23	5						
SB-438	OC-SB-438-20/22-XXX	24-Aug-09	FS	20	-	22	78	79		23	5						
SB-439	OC-SB-439-16/18-XXX	24-Aug-09	FS	16	-	18				23	5						
SB-440	OC-SB-440-23/25-XXX	24-Aug-09	FS	23	-	25	78	79		23	5	5	6				
SB-441	OC-SB-441-17/19-XXX	24-Aug-09	FS	17	-	19		79		23	5	5	6				
SB-422	OC-SB-422-13/15-XXX	25-Aug-09	FS	13	-	15		79		23	5				2		
SB-429	OC-SB-429-16/18-XXX	25-Aug-09	FS	16	-	18		79		23	5						
SB-430	OC-SB-430-19/21-XXX	25-Aug-09	FS	18	-	21		79		23	5				2		
SB-446	OC-SB-446-15/17-XXX	25-Aug-09	FS	15	-	17		79		23	5				2		
SB-448	OC-SB-448-17/19-XXX	25-Aug-09	FS	17	-	19	78	80		24	7			3	2	1	1
SB-403	OC-SB-403-13/15-XXX	26-Aug-09	FS	13	-	15		79		23	5				2		
SB-404	OC-SB-404-13/15-XXX	26-Aug-09	FS	13	-	15		79		23	5				2		
SB-407	OC-SB-407-26/28-XXX	26-Aug-09	FS	26	-	28		79		23	6				2		
SB-409	OC-SB-409-15/17-XXX	26-Aug-09	FS	15	-	17		79		23	5				2		
SB-414	OC-SB-414-20/22-XXX	26-Aug-09	FS	20	-	22		79		23	5						
SB-410	OC-SB-410-17/19-XXX	27-Aug-09	FS	17	-	19		79		23	5				2		
SB-418	OC-SB-418-15/17-XXX	27-Aug-09	FS	15	-	17		79		23	5				2		
SB-444	OC-SB-444-12/14-XXX	27-Aug-09	FS	12	-	14	78	79		23	5				2		
SB-449	OC-SB-449-11/13-XXX	27-Aug-09	FS	11	-	13		79		23	7						
SB-454	OC-SB-454-18/20-XXX	27-Aug-09	FS	18	-	20		79		24	9						
SB-451	OC-SB-451-18/20-XXX	28-Aug-09	FS	18	-	20		79		23	5				2		
SB-455	OC-SB-455-28/30-XXX	28-Aug-09	FS	28	-	30		79		23	5						
SB-442	OC-SB-442-20/22-XXX	31-Aug-09	FS	20	-	22		79		23	5				2		
SB-447	OC-SB-447-18/20-XXX	31-Aug-09	FS	18	-	20	78	79		24	6	5	6				
SB-452	OC-SB-452-13/15-XXX	31-Aug-09	FS	13	-	15		79		23	5				2		
SB-458	OC-SB-458-22/24-XXX	31-Aug-09	FS	22	-	24		79		23	5				2		
SB-460	OC-SB-460-30/32-XXX	01-Sep-09	FS	30	-	32		79		23	5						
SB-463	OC-SB-463-28/30-XXX	01-Sep-09	FS	28	-	30		79		23	5						
SB-464	OC-SB-464-26/28-XXX	01-Sep-09	FS	26	-	28		79		23	5				2		
SB-465	OC-SB-465-16/18-XXX	02-Sep-09	FS	16	-	18	78	79		23	6				2		
SB-467	OC-SB-467-30/32-XXX	02-Sep-09	FS	30	-	32	78	79	9	23	5						

Table 2.2-3
Summary of Chemical Analyses for OU1 Deep Subsurface Soil Samples (> 10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	Metals	Inorganics/Physical	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-468	OC-SB-468-31/33-XXX	02-Sep-09	FS	31	-	33		79		23	5				2		
SB-471	OC-SB-471-26/28-XXX	02-Sep-09	FS	26	-	28		79		23	5				2		
SB-459	OC-SB-459-26/28-XXX	03-Sep-09	FS	26	-	28	78	79		23	8				2		
SB-461	OC-SB-461-28/30-XXX	03-Sep-09	FS	28	-	30	78	79		23	5						
SB-462	OC-SB-462-31/33-XXX	03-Sep-09	FS	31	-	33	78	79		23	5						
SB-470	OC-SB-470-31/33-XXX	04-Sep-09	FS	31	-	33	78	79		24	9						
SB-472	OC-SB-472-30/32-XXX	04-Sep-09	FS	30	-	32	78	80	9	25	10			3	2	1	1
SB-466	OC-SB-466-30/32-XXX	08-Sep-09	FS	30	-	32	78	80		25	11			3	2	1	1
SB-450	OC-SB-450-33/35-XXX	09-Sep-09	FS	33	-	35		79		23	5				2		
SB-469	OC-SB-469-28/30-XXX	09-Sep-09	FS	28	-	30	78	79		23	6						
SB-469	OC-SB-469-36/37-XXX	09-Sep-09	FS	36	-	37	78	79		24	5	5	6				
SB-417	OC-SB-417-20/22-XXX	10-Sep-09	FS	20	-	22		79		23	5						
SB-427	OC-SB-427-12/14-XXX	10-Sep-09	FS	12	-	14	78	80		24	5	5	6		2		1
SB-427	OC-SB-427-17/19-XXX	10-Sep-09	FS	17	-	19	78	80		23	5	5	6		2		
SB-428	OC-SB-428-23/25-XXX	10-Sep-09	FS	23	-	25	78	79		23	5	5	6		2		
SB-434	OC-SB-434-15/16-XXX	10-Sep-09	FS	15	-	16		79		23	5				2		
SB-456	OC-SB-456-16/18-XXX	11-Sep-09	FS	16	-	18	78	80		25	10			3	2	1	1
SB-457	OC-SB-457-28/30-XXX	14-Sep-09	FS	28	-	30	78	80		25	10			3	2	1	1
SB-406	OC-SB-406-13/15-XXX	17-Sep-09	FS	13	-	15		79		23	5						
SB-413	OC-SB-413-10/12-XXX	17-Sep-09	FS	10	-	12		79		23	5				2		
SB-435	OC-SB-435-11/15-XXX	17-Sep-09	FS	11	-	15	78	80		24	6			3	2	1	1
SB-400	OC-SB-400-17/19-XXX	18-Sep-09	FS	17	-	19		79		23	5	5	6				
SB-473	OC-SB-473-13/15-XXX	18-Sep-09	FS	13	-	15		79		23	6				2		
SB-485	OC-SB-485-11/13-XXX	15-Nov-10	FS	11	-	13	78	79			2	5	6				
SB-494	OC-SB-494-12/14-XXX	16-Nov-10	FS	12	-	14	78	79			2	5	6				
SB-497	OC-SB-497-11/13-XXX	17-Nov-10	FS	11	-	13	78	79			2	5	6				
SB-474	OC-SB-474-10.5/12.5-XXX	18-Nov-10	FS	10.5	-	12.5	78	79			2	5	6				
SB-475	OC-SB-475-16/18-XXX	18-Nov-10	FS	16	-	18	78	79			2	5	6				
SB-476	OC-SB-476-13/15-XXX	18-Nov-10	FS	13	-	15	78	79			2	5	6				
SB-477	OC-SB-477-10/12-XXX	18-Nov-10	FS	10	-	12	78	79			2	5	6				
SB-478	OC-SB-478-10/12-XXX	18-Nov-10	FS	10	-	12	78	79			2	5	6				
SB-503	OC-SB-503-13/15-XXX	10-Dec-12	FS	13	-	15				1	4						
SB-506	OC-SB-506-10/12-XXX	10-Dec-12	FS	10	-	12				1	4						
SB-507	OC-SB-507-13/15-XXX	10-Dec-12	FS	13	-	15				1	4	21					
SB-511	OC-SB-511-11/13-XXX	10-Dec-12	FS	11	-	13				1	4						
SB-512	OC-SB-512-13/15-XXX	10-Dec-12	FS	13	-	15				1	4						
SB-508	OC-SB-508-12/14-XXX	11-Dec-12	FS	12	-	14				1	4						
SB-513	OC-SB-513-10/12-XXX	12-Dec-12	FS	10	-	12				1	4						
SB-514	OC-DUP-4	12-Dec-12	FD	15	-	17				1	4	21					

Table 2.2-3
Summary of Chemical Analyses for OU1 Deep Subsurface Soil Samples (> 10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	Metals	Inorganics/Physical	EPH	VPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SB-514	OC-SB-514-15/17-XXX	12-Dec-12	FS	15	-	17		80		1	4	21					
SB-515	OC-SB-515-13/15-XXX	12-Dec-12	FS	13	-	15	2	80			2	21					
SB-516	OC-SB-516-15/17-XXX	12-Dec-12	FS	15	-	17	2	80			2	21					
SB-517	OC-SB-517-18/20-XXX	12-Dec-12	FS	18	-	20	2	80		1	4	21					
SB-523	OC-SB-523-22/24-XXX	12-Dec-12	FS	22	-	24				1	4						
SB-524	OC-SB-524-27/29-XXX	12-Dec-12	FS	27	-	29				1	4						
SB-520	OC-SB-520-18/20-XXX	13-Dec-12	FS	18	-	20	2	80			2						
SB-522	OC-SB-522-13/15-XXX	13-Dec-12	FS	13	-	15		80		1	4						
SB-525	OC-SB-525-18/20-XXX	13-Dec-12	FS	18	-	20				1	4						
SB-532	OC-SB-532-11/13-XXX	13-Dec-12	FS	11	-	13					2	21					
SB-533	OC-SB-533-13/15-XXX	13-Dec-12	FS	13	-	15					2	21					
SB-518	OC-SB-518-13/15-XXX	14-Dec-12	FS	13	-	15	2	80		1	4						
SB-519	OC-SB-519-12/14-XXX	14-Dec-12	FS	12	-	14		80		1	4						
SB-521	OC-SB-521-16/18-XXX	14-Dec-12	FS	16	-	18				1	4						

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/27/13
Checked by / Date: CTM 03/28/13

Table 2.2-4
Soil Headspace Screening Summary for Soil Samples
Olin Chemical Superfund Site
Wilmington, Massachusetts

Date	Boring ID	Collected Sample Depth (feet)	Soil Screening PID (ppmv)	Total Depth (feet)	Visual/ Olfactory Observations
8/26/2009	SB-400	0-1	<0.1	11	N/A
	SB-400	5-7	<0.1		N/A
9/18/2009	SB-400	17-19	1.3	20	Possible very faint organic odor
8/26/2009	SB-401	0-1	<0.1		N/A
	SB-401	7.5-9.5	<0.1	9.5	N/A
	SB-401	No Deep		refusal	N/A
8/26/2009	SB-402	0-1	<0.1		N/A
	SB-402	7.5-9.5	<0.1	9.5	N/A
	SB-402	No Deep		refusal	N/A
8/26/2009	SB-403	0-1	1.8		N/A
	SB-403	6-8	0.9	29	N/A
	SB-403	13-15	0.8		N/A
8/26/2009	SB-404	5-7	2.7		N/A
	SB-404	13-15	0.4	18	N/A
	SB-404	No surface			N/A
8/18/2009	SB-405	0-1	0.5		N/A
	SB-405	8-9	3000.0	15.5	Faint, sweet organic odor
	SB-405	14-15	560.0		Faint, sweet organic odor
9/17/2009	SB-406	0-1	<0.1		N/A
	SB-406	8-10	0.7	15	Slight boggy/sulfur odor
	SB-406	13-15	0.2		N/A
8/26/2009	SB-407	0-1	0.7		N/A
	SB-407	8-10	0.9	29	N/A
	SB-407	26-28	20.6		N/A
8/26/2009	SB-408	0-1	<0.1		N/A
	SB-408	7-9	<0.1	9	N/A
	SB-408	No Deep		refusal	N/A
8/26/2009	SB-409	0-1	1.7		N/A
	SB-409	6-8	3.3	20	N/A
	SB-409	15-17	0.5		N/A
8/27/2009	SB-410	0-1	0.1		N/A
	SB-410	6-8	0.2	20	N/A
	SB-410	17-19	0.2		N/A
8/26/2009	SB-411	0-1	<0.1		N/A
	SB-411	4.7-6.7	<0.1	8	N/A
	SB-411	No Deep			N/A
8/18/2009	SB-412	0-1	1.0		N/A
	SB-412	6-7	0.9	13	N/A
	SB-412	12-13	1.7		N/A
9/17/2009	SB-413	0-1	<0.1		N/A
	SB-413	1-5	<0.1	12	N/A
	SB-413	10-12	0.1		N/A
8/26/2009	SB-414	0-1	0.6		N/A
	SB-414	6-8	0.3	23	N/A
	SB-414	20-22	0.4		N/A
8/20/2009	SB-415	0-1	0.4		N/A
	SB-415	5-7	33.0	19	N/A
	SB-415	16-18	1.1		N/A
8/18/2009	SB-416	0-1	3.4		N/A
	SB-416	8-9	3000.0	14.5	Faint, sweet organic odor
	SB-416	13-14	81.0		N/A
9/10/2009	SB-417	0-1	0.1		N/A
	SB-417	8-10	17.0	22.5	N/A
	SB-417	20-22	0.3		N/A

Table 2.2-4
Soil Headspace Screening Summary for Soil Samples
Olin Chemical Superfund Site
Wilmington, Massachusetts

Date	Boring ID	Collected Sample Depth (feet)	Soil Screening PID (ppmv)	Total Depth (feet)	Visual/ Olfactory Observations
8/27/2009	SB-418	0-1	0.1		N/A
	SB-418	8-10	0.6	18	N/A
	SB-418	15-17	0.1		N/A
8/19/2009	SB-419	0-1	3.2		N/A
	SB-419	3-5	3.7	21	N/A
	SB-419	17-19	0.2		N/A
8/18/2009	SB-420	0-1	60.0		N/A
	SB-420	6.5-8.5	2700.0	14	Sweet organic odor
	SB-420	12-14	0.3		N/A
8/19/2009	SB-421	0-1	10.6		N/A
	SB-421	9-10	76.0	13	Slight sweet, organic odor
	SB-421	10.5-12.5	1050.0		Slight sweet organic odor
8/25/2009	SB-422	0-1	<0.1		N/A
	SB-422	6-8	<0.1	23	N/A
	SB-422	13-15	<0.1		N/A
8/18/2009	SB-423	0-1	15.8		N/A
	SB-423	5-6	184.0	15	N/A
	SB-423	13-14	0.4		N/A
8/19/2009	SB-424	0-1	1.7		N/A
	SB-424	7-9	37.0	19	N/A
	SB-424	17-19	8.4	refusal	N/A
8/19/2009	SB-425	0-1	0.9		N/A
	SB-425	6-8	52.0	23	N/A
	SB-425	18-20	5.4		N/A
8/19/2009	SB-426	0-1	0.6		N/A
	SB-426	5-7	1.3	16.5	N/A
	SB-426	13-15	0.2		N/A
9/10/2009	SB-427	0-1	0.3		N/A
	SB-427	8-10	18		N/A
	SB-427	12-14	4010	22	Strong organic odor
	SB-427	17-19	8.4		Slight organic odor
9/10/2009	SB-428	0-1	0.3		N/A
	SB-428	8-10	3.4	25	N/A
	SB-428	23-25	0.6		N/A
8/25/2009	SB-429	1 No sample collected			N/A
	SB-429	6 - 8	17	19	N/A
	SB-429	16 - 18	<0.1		N/A
8/25/2009	SB-430	0-1	<0.1		N/A
	SB-430	8-10	<0.1	22	N/A
	SB-430	19-21	<0.1		N/A
8/20/2009	SB-431	0-1	6.1		N/A
	SB-431	7-9	1.1	12.5 refusal	N/A
	SB-431	refusal			N/A
8/20/2009	SB-432	0-1	18.6		N/A
	SB-432	5-7	110	17	Sweet organic odor
	SB-432	14-16	3.1		N/A
8/24/2009	SB-433	0-1	0.3		N/A
	SB-433	5-7	0.5	23	N/A
	SB-433	20-22	2.4		N/A
9/10/2009	SB-434	0-1	0.4		N/A
	SB-434	7-9	0.6	16	N/A
	SB-434	15-16	0.2		N/A

Table 2.2-4
Soil Headspace Screening Summary for Soil Samples
Olin Chemical Superfund Site
Wilmington, Massachusetts

Date	Boring ID	Collected Sample Depth (feet)	Soil Screening PID (ppmv)	Total Depth (feet)	Visual/ Olfactory Observations
9/17/2009	SB-435	0-1	<0.1		N/A
	SB-435	6-10	<0.1		N/A
	SB-435	11-15	0.1	15	N/A
8/20/2009	SB-436	0-1	0.8		N/A
	SB-436	6-8	0.8	16.5	N/A
	SB-436	13-15	0.8		Slight metallic odor
8/21/2009	SB-437	0-1	1.2		N/A
	SB-437	5-7	1.5	25	N/A
	SB-437	21-23	1.4		N/A
8/24/2009	SB-438	0-1	48		N/A
	SB-438	5-7	33	22.5	N/A
	SB-438	20-22	36		N/A
	SB-438	2-2.5	46		N/A
8/24/2009	SB-439	0-1	<0.1		N/A
	SB-439	8-10	0.2	24	N/A
	SB-439	16-18	4.3		N/A
8/24/2009	SB-440	0-1	1.7		N/A
	SB-440	6-8	<0.1	27	Orange stained layers
	SB-440	23-25	8.6		N/A
8/24/2009	SB-441	0-1	1.7		N/A
	SB-441	8-10	<0.1	23	N/A
	SB-441	17-19	4.0		N/A
8/31/2009	SB-442	0-1	0.1		N/A
	SB-442	8-10	<0.1	24	N/A
	SB-442	20-22	<0.1		N/A
8/20/2009	SB-443	0-1	0.5		N/A
	SB-443	6-8	0.7	23	N/A
	SB-443	18-20	0.3		N/A
8/24/2009	SB-444	0-1	0.2		N/A
	SB-444	5-7	1.2	20.5	N/A
	SB-444	12-14	0.2		N/A
8/21/2009	SB-445	0-1	0.4		N/A
	SB-445	8-10	1.2	28	N/A
	SB-445	25-27	1.0		N/A
8/25/2009	SB-446	0-1	<0.1		N/A
	SB-446	5-7	<0.1	30	N/A
	SB-446	15-17	<0.1		N/A
8/31/2009	SB-447	0-1	0.1		N/A
	SB-447	3-5	2.8	21	N/A
	SB-447	18-20	4.9		N/A
8/25/2009	SB-448	0-1	14.8		N/A
	SB-448	8-10	34	20	N/A
	SB-448	17-19	5.0		N/A
8/25/2009	SB-449	0-1	0.2		N/A
	SB-449	6-8	16.8	18.5	Slight metallic odor
	SB-449	11-13	180		Slight odor
9/9/2009	SB-450	0-1	0.9		N/A
	SB-450	8-10	<0.1	37.5	N/A
	SB-450	33-35	3.2		N/A
8/28/2009	SB-451	0-1	<0.1		N/A
	SB-451	2.5-4.5	<0.1	26	N/A
	SB-451	18-20	0.2		N/A
8/31/2009	SB-452	0-1	0.1		N/A
	SB-452	5-7	<0.1	16	N/A
	SB-452	13-15	0.7		N/A

Table 2.2-4
Soil Headspace Screening Summary for Soil Samples
Olin Chemical Superfund Site
Wilmington, Massachusetts

Date	Boring ID	Collected Sample Depth (feet)	Soil Screening PID (ppmv)	Total Depth (feet)	Visual/ Olfactory Observations
9/17/2009	SB-453	0-1	<0.1		N/A
	SB-453	1-6	<0.1	6	N/A
	SB-453	Refusal			N/A
8/27/2009	SB-454	0-1	0.5		N/A
	SB-454	6-8	0.3	21	N/A
	SB-454	18-20	2.0		N/A
8/28/2009	SB-455	0-1	<0.1		N/A
	SB-455	6-8	0.2	39	N/A
	SB-455	28-30	1.4		N/A
9/11/2009	SB-456	0-1	0.5		N/A
	SB-456	7-9	0.5	20.5	N/A
	SB-456	16-18	0.5		Slight odor
9/11/2009	SB-457	0-1	0.3		N/A
	SB-457	8-10	0.4	30	N/A
	SB-457	28-30	0.2		N/A
8/31/2009	SB-458	0-1	0.2		N/A
	SB-458	5-7	0.2	26	N/A
	SB-458	22-24	0.1		N/A
9/3/2009	SB-459	0-1	590		Organic odor
	SB-459	6-8	170	30	Organic odor
	SB-459	26-28	0.4		N/A
9/1/2009	SB-460	0-1	<0.1		N/A
	SB-460	5.5-7.5	0.2	33.5	N/A
	SB-460	30-32	0.2		N/A
9/3/2009	SB-461	0-1	0.1		N/A
	SB-461	5-7	0.1	35	N/A
	SB-461	28-30	0.3		N/A
9/3/2009	SB-462	0-1	0.2		N/A
	SB-462	4-6	25.5	35	N/A
	SB-462	31-33	0.4		N/A
9/1/2009	SB-463	0-1	0.2		N/A
	SB-463	6-8	0.3	32.5	Slight metallic odor
	SB-463	28-30	0.4		N/A
9/1/2009	SB-464	0-1	0.5		N/A
	SB-464	5-7	0.2	32	N/A
	SB-464	26-28	5.2		N/A
9/2/2009	SB-465	0-1	<0.1		N/A
	SB-465	8-10	0.8	34	N/A
	SB-465	16-18	0.1		N/A
9/8/2009	SB-466	0-1	0.5		N/A
	SB-466	6-8	120	33	N/A
	SB-466	30-32	0.8		N/A
9/2/2009	SB-467	0-1	0.1		N/A
	SB-467	6-8	0.1	32	N/A
	SB-467	30-32	0.7		N/A
9/1/2009	SB-468	0-1	0.8		N/A
	SB-468	8-10	1.5	34	N/A
	SB-468	31-33	0.3		N/A
9/9/2009	SB-469	0-1	1.0		N/A
	SB-469	7-9	1.2	38	N/A
	SB-469	28-30	2.1		N/A
	SB-469	36-37	140		Sweet odor
9/4/2009	SB-470	0-1	0.2		N/A
	SB-470	7-9	0.5	41	N/A
	SB-470	31-33	0.1		N/A

Table 2.2-4
Soil Headspace Screening Summary for Soil Samples
Olin Chemical Superfund Site
Wilmington, Massachusetts

Date	Boring ID	Collected Sample Depth (feet)	Soil Screening PID (ppmv)	Total Depth (feet)	Visual/ Olfactory Observations
9/2/2009	SB-471	0-1	0.9		N/A
	SB-471	3-5	0.4	34	N/A
	SB-471	26-28	0.2		N/A
9/4/2009	SB-472	0-1	0.3		N/A
	SB-472	8-10	0.4	35	N/A
	SB-472	30-32	0.9		N/A
9/18/2009	SB-473	0-1	0.6		N/A
	SB-473	4-6	0.1	15	N/A
	SB-473	13-15	0.1		N/A
11/18/2010	SB-474	0-1	<0.1		N/A
	SB-474	8-10	<0.1	12.5	N/A
	SB-474	10.5-12.5	<0.1		N/A
11/18/2010	SB-475	0-1.0	<0.1		N/A
	SB-475	8-10	2136	18	Strong petroleum odor
	SB-475	16-18	30.2		Slight petroleum odor
11/18/2010	SB-476	0-1	<0.1		N/A
	SB-476	8-10	1918	15	Strong petroleum odor
	SB-476	13-15	3207		Strong petroleum odor
11/18/2010	SB-477	0-1	<0.1		N/A
	SB-477	8-10	4130	12.5	Strong petroleum odor, dark staining
	SB-477	10.5-12.5	1900		Strong petroleum odor, some staining
11/18/2010	SB-478	0-1	<0.1		N/A
	SB-478	8-10	<0.1	12	N/A
	SB-478	10-12	4370		Strong petroleum odor
11/16/2010	SB-479	5-5.6	0.9	10	N/A
11/16/2010	SB-480	5-6.7	34	8	N/A
11/17/2010	SB-481	6.6-7.9	74	10	N/A
11/15/2010	SB-482	5.4-8	22	8	N/A
11/15/2010	SB-483	6.5-9	3226	13	Sweet organic odor
11/15/2010	SB-484	5.7-7	55	7	N/A
11/15/2010	SB-485	0-1	0.7		N/A
	SB-485	6-8	4.0	13.9	N/A
	SB-485	11-13	18.1		N/A
11/15/2010	SB-486	7-9	2614	12.7	Sweet organic odor
11/15/2010	SB-487	7-9	44.6	9.2	N/A
11/15/2010	SB-488	0-1	6.3	9.0	N/A
	SB-488	5-6.1	9.4		N/A
11/15/2010	SB-489	7-9	50.4	12.5	N/A
11/15/2010	SB-490	0-1	8.8	10.0	N/A
	SB-490	7-9	18.4		N/A
11/16/2010	SB-491	8-10	2500	10	Sweet, organic odor
11/16/2010	SB-492	1.2-2	25.8	7	N/A
11/16/2010	SB-493	0.8-1.3	0.6	6.5	N/A
11/16/2010	SB-494	0-1	0.9		N/A
	SB-494	6-8	1.5	14	N/A
	SB-494	12-14	2.4		N/A
11/16/2010	SB-495	0-1	0.1	6.5	N/A
	SB-495	4-6	1.7		N/A
11/16/2010	SB-496	0-1	1.0	6.5	N/A
	SB-496	5-6.5	0.9		N/A

Table 2.2-4
Soil Headspace Screening Summary for Soil Samples
Olin Chemical Superfund Site
Wilmington, Massachusetts

Date	Boring ID	Collected Sample Depth (feet)	Soil Screening PID (ppmv)	Total Depth (feet)	Visual/ Olfactory Observations
11/17/2010	SB-497	6-8	3.5	13.0	N/A
	SB-497	11-13	5.8		N/A
11/17/2010	SB-500	0.5-3	0.9	9.5	N/A
11/17/2010	SB-501	0.5-3	0.4	9.5	N/A
11/17/2010	SB-502	3-5	0.6	11.5	N/A
12/11/2012	SB-480	6-8	24.2	9.8	N/A
12/11/2012	SB-484	5.5-7.5	29.6	7.5	N/A
12/11/2012	SB-486	8-10	122	10.2	N/A
12/11/2012	SB-491	6-8	1.3	8	N/A
12/10/2012	SB-503	0-1	1.9		N/A
	SB-503	6-8	7.0	15	N/A
	SB-503	13-15	22.1		N/A
12/11/2012	SB-504	0-1	38	9.8	N/A
	SB-504	7.5-9.5	102		N/A
12/11/2012	SB-505	0-1	30.2	7	N/A
	SB-505	5-7	62		N/A
12/10/2012	SB-506	0-1	1.3		N/A
	SB-506	6-8	6.2	14	Some odor
	SB-506	10-12	10.5		Some odor
12/10/2012	SB-507	0-1	<0.1		N/A
	SB-507	6-8	<0.1	17	N/A
	SB-507	13-15	<0.1		N/A
12/11/2012	SB-508	0-1	4.2		N/A
	SB-508	8-10	6.7	14	N/A
	SB-508	12-14	1.8		N/A
12/13/2012	SB-509	0-1	2.7	5	N/A
	SB-509	1-3	2.7		N/A
12/13/2012	SB-510	0-1	<0.1	9	N/A
	SB-510	7-9	<0.1		N/A
12/10/2012	SB-511	0-1	<0.1		N/A
	SB-511	6-8	<0.1	15	N/A
	SB-511	11-13	<0.1		N/A
12/10/2012	SB-512	0-1	<0.1		N/A
	SB-512	6-8	<0.1	15	N/A
	SB-512	13-15	<0.1		N/A
12/12/2012	SB-513	0-1	2.8		N/A
	SB-513	7-9	2.6	12	N/A
	SB-513	10-12	2.4		N/A
12/12/2012	SB-514	0-1	1.1		N/A
	SB-514	7-9	1.6	20.5	N/A
	SB-514	15-17	1.3		N/A
12/12/2012	SB-515	0-1	0.2		N/A
	SB-515	6-8	0.4	19	N/A
	SB-515	13-15	0.4		N/A
12/12/2012	SB-516	0-1	3.1		N/A
	SB-516	6-8	1.3	20	N/A
	SB-516	15-17	1.3		N/A
12/12/2012	SB-517	0-1	18.2		N/A
	SB-517	6-8	0.8	24	N/A
	SB-517	18-20	1.5		N/A
12/14/2012	SB-518	0-1	0.2		N/A
	SB-518	8-10	0.4	15	N/A
	SB-518	13-15	0.4		N/A

Table 2.2-4
Soil Headspace Screening Summary for Soil Samples
Olin Chemical Superfund Site
Wilmington, Massachusetts

Date	Boring ID	Collected Sample Depth (feet)	Soil Screening PID (ppmv)	Total Depth (feet)	Visual/ Olfactory Observations
12/14/2012	SB-519	0-1	1.6		N/A
	SB-519	8-10	12.5	15	N/A
	SB-519	12-14	1.2		N/A
12/13/2012	SB-520	0-1	0.3		N/A
	SB-520	8-10	0.3	23	N/A
	SB-520	18-20	0.9		N/A
12/14/2012	SB-521	0-1	0.4		N/A
	SB-521	8-10	6.4	18	N/A
	SB-521	16-18	0.8		N/A
12/13/2012	SB-522	0-1	0.3		N/A
	SB-522	8-10	1.5	17	N/A
	SB-522	13-15	0.3		N/A
12/12/2012	SB-523	0-1	1.2		N/A
	SB-523	6-8	0.7	24	N/A
	SB-523	22-24	1.9		N/A
12/12/2012	SB-524	0-1	0.7		N/A
	SB-524	8-10	0.9	29	N/A
	SB-524	27-29	0.7		N/A
12/13/2012	SB-525	0-1	2.0		N/A
	SB-525	3-5	2.0	20	N/A
	SB-525	18-20	2.0		N/A
12/13/2012	SB-532	0-1	2.4		N/A
	SB-532	6-8	1.9	13	N/A
	SB-532	11-13	1.4		N/A
12/13/2013	SB-532	0-1	2.5		N/A
	SB-533	6-8	2.0	15	N/A
	SB-533	13-15	1.1		N/A
12/13/2013	SB-534	0-1	1.6	9	N/A
	SB-534	7-9	1.3		N/A

All soils screened using a MiniRae 10.6eV lamp PID. Completed By: BDL/ DLC

N/A - Nothing observed Checked By: CTM

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
Surface Water																								
SS-12	SS-12	08-Dec-77	FS										5											
SS-5	SS-05	08-Dec-77	FS										5											
SS-12	SS-12	19-Jan-78	FS										5											
SS-5	SS-05	19-Jan-78	FS										5											
SS-12	SS-12	21-Feb-78	FS										5											
SS-12	SS-12	15-Mar-78	FS										5											
SS-5	SS-05	15-Mar-78	FS										5											
SS-12	SS-12	10-Apr-78	FS										5											
SS-5	SS-05	10-Apr-78	FS										5											
SS-12	SS-12	01-Mar-81	FS								1		3											
SS-5	SS-05	01-Mar-81	FS								1		3											
SS-12	SS-12	01-Apr-81	FS								1		3											
SS-5	SS-05	01-Apr-81	FS								1		3											
SS-12	SS-12	01-May-81	FS								1		3											
SS-5	SS-05	01-May-81	FS								1		3											
SS-12	SS-12	01-Jun-81	FS								1		3											
SS-5	SS-05	01-Jun-81	FS								1		3											
SS-12	SS-12	01-Aug-81	FS								1		3											
SS-5	SS-05	01-Aug-81	FS								1		3											
SS-12	SS-12	01-Dec-81	FS								1		3											
SS-5	SS-05	01-Dec-81	FS										3											
SS-12	SS-12	01-Oct-82	FS										4											
SS-5	SS-05	01-Oct-82	FS				2				1		4											
SS-12	SS-12	01-Jun-83	FS										4											
SS-5	SS-05	01-Jun-83	FS				2				1		4											
SS-12	SS-12	01-Oct-83	FS										4											
SS-5	SS-05	01-Oct-83	FS				2				1		4											
SS-12	SS-12	01-Jul-84	FS										4											
SS-5	SS-05	01-Jul-84	FS				2						4											
SS-12	SS-12	01-Dec-84	FS										4											
SS-5	SS-05	01-Dec-84	FS				2				1		4											
SS-12	SS-12	01-May-85	FS								1													
SS-5	SS-05	01-May-85	FS								1													
SS-12	SS-12	01-Dec-85	FS								1		4											
SS-5	SS-05	01-Dec-85	FS								1		4											
SS-12	SS-12	01-Jul-86	FS								1		3											
SS-5	SS-05	01-Jul-86	FS								1		3											
SS-12	SS-12	01-Dec-86	FS								1		3											
SS-5	SS-05	01-Dec-86	FS								1		3											
SS-12	SS-12	01-Jun-87	FS								1		3											
SS-5	SS-05	01-Jun-87	FS								1		3											
SS-12	SS-12	01-Dec-87	FS								1		3											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
SS-5	SS-05	01-Dec-87	FS								1		3											
SDITCH	SDITCH	14-May-90	FS												1									
SW-6	SW-06	31-Aug-92	FS		36	65		21			23		3											
SW-10	SW-10	01-Sep-92	FS		36	65		21			23		3											
SW-11	SW-11	01-Sep-92	FS		36	65		21			23		3											
SW-14	SW-14	01-Sep-92	FS		36	65		21			23		3											
SW-7	SW-07	01-Sep-92	FS		36	65		21			23		3											
SW-9	SW-09	01-Sep-92	FS		36	65		21			23		3											
SW-10	SW-10	01-Dec-92	FS		36	65		21			23		3											
SW-11	SW-11	01-Dec-92	FS		36	65		21			23		3											
SW-14	SW-14	01-Dec-92	FS		36	65		21			23		3											
SW-6	SW-06	01-Dec-92	FS		36	65		21			24		5											
SW-6	SW-06 DUP	01-Dec-92	FD		36	65		21			24		5											
SW-7	SW-07	01-Dec-92	FS		36	65		21			23		3											
SW-9	SW-09	01-Dec-92	FS		36	65		21			23		3											
GSW-15	SW-15	02-Feb-95	FS								14	14	13	14										
GSW-17	SW-17	02-Feb-95	FS								14	14	13	14										
GSW-15	SW-15	03-May-95	FS								14	14	14	15										
GSW-17	SW-17	03-May-95	FS								14	14	14	15										
GSW-17	SW-17	19-Jul-95	FS								14	14	14	14										
GSW-1	SOUTH DITCH #1	18-Apr-96	FS									24		3										
GSW-2	SOUTH DITCH #2	18-Apr-96	FS									1												
GSW-3	SOUTH DITCH #3	18-Apr-96	FS									1												
SW-6	SOUTH DITCH #4	18-Apr-96	FS									1												
GSW-2	SOUTH DITCH #2	19-Apr-96	FS									23		3										
GSW-3	SOUTH DITCH #3	19-Apr-96	FS									23		3										
SW-6	SOUTH DITCH #4	19-Apr-96	FS									23		3										
NP-1	NP-1C	20-Jul-00	FS		66	65		30	7	7	26		23		6	22	12							
NP-2	NP-2C	20-Jul-00	FS		66	65		30	7	7	26		23		6	22	12							
NP-2	NP-2T	20-Jul-00	FS		66	65		30	7	7	26	25	23		6	22	12							
NP-1	1140-SD-SW1	20-Sep-00	FS			65	17				1		1											
NP-1	1140-SD-SW2	21-Sep-00	FS			65	17				1		1											
NP-1	1140-SD-SW3	22-Sep-00	FS			65	17				1		1											
NP-1	1140-SD-SW4	23-Sep-00	FS			65	17				1		1											
NP-1	1140-SD-SW5	25-Sep-00	FS			65	17				1		1											
NP-1	1140-SD-SW6	26-Sep-00	FS			65	17				1		1											
NP-1	1140-SD-SW7	27-Sep-00	FS				17				1		1											
NP-1	1140-SD-SW8	28-Sep-00	FS			65	17				1		1											
NP-1	1140-SD-SW9	29-Sep-00	FS			65	17				1		1											
NP-1	1140-SD-SW10	02-Oct-00	FS			65	17				1		1											
NP-1	1140-SD-SW11	04-Oct-00	FS			65	17				1		1											
NP-1	1150-SD-SW11D	05-Oct-00	FS		6	65	17				6	1			5									
SW11A	1150-SD-SW11A	05-Oct-00	FS		6	65	17				6	1			5									

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
SW11B	1150-SD-SW11B	05-Oct-00	FS		6	65	17				6	1			5									
SW11C	1150-SD-SW11C	05-Oct-00	FS		6	65	17				6	1			5									
SW11E	1150-SD-SW11E	05-Oct-00	FS		6	65	17				6	1			5									
NP-1	97598-SWLOC-14	06-Oct-00	FS								1	1	1											
SW11B	97598-SWLOC-10	06-Oct-00	FS								1	1	1											
SW11C	97598-SWLOC-11	06-Oct-00	FS								1	1	1											
SW11E	97598-SWLOC-16	06-Oct-00	FS								1	1	1											
SWLOC-12	97598-SWLOC-12	06-Oct-00	FS								1	1	1											
SWLOC-9	97598-SWLOC-9	06-Oct-00	FS								1	1	1											
NP-1	1150-SD-SWA1	07-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA2	09-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA3	10-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA4	11-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA5	12-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA6	18-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA7	19-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA8	20-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA9	21-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWA10	23-Oct-00	FS			65	16				1	1	1											
NP-1	1150-SD-SWB1	24-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWB2	25-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC1	26-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC2	27-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC3	30-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC4	31-Oct-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC5	01-Nov-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC6	02-Nov-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC7	03-Nov-00	FS			132	17				1	1	1											
NP-1	1150-SD-SWC8	04-Nov-00	FS			132	17				1	1	1											
NP-1	1150-SD-SWC9	06-Nov-00	FS			132	17				1	1	1											
NP-1	1150-SD-SWC10	07-Nov-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC11	08-Nov-00	FS			65	17				1	1	1											
NP-1	1150-SD-SWC12	09-Nov-00	FS			132	17				1	1	1											
NP-1	1150-SD-SWC13	10-Nov-00	FS			132	17				1	1	1											
NP-1	1150-SD-SWC14	12-Nov-00	FS				17				1	1	1											
NP-1	1150-SD-SWC15	13-Nov-00	FS				17				1	1	1											
NP-1	1150-SD-SWC16	14-Nov-00	FS				17				1	1	1											
ISCO1	1150-OPWD-SWC17	15-Nov-00	FS										1											
NP-1	1150-SD-SWC17	15-Nov-00	FS				17				1	1	1											
ISCO1	1150-OPWD-SWC18	16-Nov-00	FS										1											
NP-1	1150-SD-SWC18	16-Nov-00	FS				17				1	1	1											
ISCO1	1150-OPWD-SWC19	17-Nov-00	FS										1											
NP-1	1150-SD-SWC19	17-Nov-00	FS				17				1	1	1											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
ISCO1	1150-OPWD-SWC20	18-Nov-00	FS											1										
NP-1	1150-SD-SWC20	18-Nov-00	FS				17					1	1	1										
ISCO1	1150-OPWD-SWC21	19-Nov-00	FS											1										
NP-1	1150-SD-SWC21	19-Nov-00	FS				17					1	1	1										
ISCO1	1150-OPWD-SWC22	20-Nov-00	FS											1										
NP-1	1150-SD-SWC22	20-Nov-00	FS				17					1	1	1										
ISCO1	1150-OPWD-SWC23	21-Nov-00	FS											1										
NP-1	1150-SD-SWC23	21-Nov-00	FS				17					1	1	1										
ISCO1	1150-OPWD-SWC24	22-Nov-00	FS											1										
NP-1	1150-SD-SWC24	22-Nov-00	FS				17					1	1	1										
ISCO1	1150-OPWD-SWC25	27-Nov-00	FS											1										
ISCO1	1150-OPWD-SWC26	27-Nov-00	FS											1										
NP-1	1150-SD-SWC25	27-Nov-00	FS		67	17						1	1	1										
NP-1	1150-SD-SWC26	28-Nov-00	FS			17						1	1	1										
ISCO1	1150-OPWD-SWC27	29-Nov-00	FS											1										
NP-1	1150-SD-SWC27	29-Nov-00	FS			17						1	1	1										
ISCO1	1150-OPWD-SWC28	30-Nov-00	FS									3	3	1										
NP-1	1150-SD-SWC28	30-Nov-00	FS			17						3	3	1										
ISCO1	1150-OPWD-SWC29	01-Dec-00	FS											1										
NP-1	1150-SD-SWC29	01-Dec-00	FS		65	17						1	1	1										
ISCO1	1150-OPWD-SWC30	03-Dec-00	FS											1										
NP-1	1150-SD-SWC30	03-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWC31	04-Dec-00	FS											1										
NP-1	1150-SD-SWC31	04-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWC32	05-Dec-00	FS											1										
NP-1	1150-SD-SWC32	05-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWC33	06-Dec-00	FS											1										
NP-1	1150-SD-SWC33	06-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWC34	07-Dec-00	FS											1										
NP-1	1150-SD-SWC34	07-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWC35	08-Dec-00	FS											1										
NP-1	1150-SD-SWC35	08-Dec-00	FS		65							1	1	1										
NP-1	1150-SD-SWC36	09-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWC37	11-Dec-00	FS											1										
NP-1	1150-SD-SWC37	11-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWC38	12-Dec-00	FS											1										
NP-1	1150-SD-SWC38	12-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWC39	13-Dec-00	FS											1										
NP-1	1150-SD-SWC39	13-Dec-00	FS		65							1	1	1										
ISCO1	1150-OPWD-SWD1	21-Dec-00	FS									1	1	1										
NP-1	1150-SD-SWD1	21-Dec-00	FS									1	1	1										
ISCO1	1150-OPWD-SWD2	29-Dec-00	FS									1	1	1										
NP-1	1150-SD-SWD2	29-Dec-00	FS									1	1	1										

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
ISCO1	1150-OPWD-SWD3	04-Jan-01	FS									1	1	1										
NP-1	1150-SD-SWD3	04-Jan-01	FS									1	1	1										
ISCO1	1150-OPWD-SWD4	11-Jan-01	FS									1	1	1										
NP-1	1150-SD-SWD4	11-Jan-01	FS									1	1	1										
ISCO1	1150-OPWD-SWD5	18-Jan-01	FS									1	1	1										
NP-1	1150-SD-SWD5	18-Jan-01	FS									1	1	1										
ISCO1	1150-OPWD-SWD6	25-Jan-01	FS									1	1	1										
NP-1	1150-SD-SWD6	25-Jan-01	FS									1	1	1										
ISCO1	1150-OPWD-SWD7	02-Feb-01	FS									1	1	1										
NP-1	1150-SD-SWD7	02-Feb-01	FS									1	1	1										
ISCO1	1170-ISCO1-1	09-Feb-01	FS									1	1	1										
ISCO2	1170-ISCO2-1	09-Feb-01	FS									1	1	1										
NP-1	1170-NP1-1	09-Feb-01	FS									1	1	1										
ISCO1	1170-ISCO1-2	15-Feb-01	FS									1	1	1										
ISCO2	1170-ISCO2-2	15-Feb-01	FS									1	1	1										
NP-1	1170-NP1-2	15-Feb-01	FS									1	1	1										
ISCO1	1170-ISCO1-3	23-Feb-01	FS									1	1	2										
ISCO2	1170-ISCO2-3	23-Feb-01	FS									1	1	2										
NP-1	1170-NP1-3	23-Feb-01	FS									1	1	2										
ISCO1	1170-ISCO1-4	01-Mar-01	FS									1	1	2										
ISCO2	1170-ISCO2-4	01-Mar-01	FS									1	1	2										
ISCO1	1170-ISCO1-5	09-Mar-01	FS									1	1	2										
ISCO2	1170-ISCO2-5	09-Mar-01	FS									1	1	2										
ISCO1	1170-ISCO1-6	16-Mar-01	FS									1	2	4										
ISCO2	1170-ISCO2-6	16-Mar-01	FS									1	2	4										
ISCO1	1170 ISCO1-7	23-Mar-01	FS									1	2	4										
ISCO2	1170 ISCO2-7	23-Mar-01	FS									1	2	4										
ISCO1	1170 ISCO1-8	26-Mar-01	FS									1	2	4										
ISCO2	1170 ISCO2-8	26-Mar-01	FS									1	2	4										
ISCO1	1170-ISCO1-9	02-Apr-01	FS									1	2	4										
ISCO2	1170-ISCO2-9	02-Apr-01	FS									1	2	4										
ISCO1	1170-ISCO1-10	09-Apr-01	FS									1	2	4										
ISCO2	1170-ISCO2-10	09-Apr-01	FS									1	2	4										
ISCO1	1170-ISCO1-11	16-Apr-01	FS									1	2	4										
ISCO2	1170-ISCO2-11	16-Apr-01	FS									1	2	4										
ISCO1	1170-ISCO1-12	23-Apr-01	FS									1	2	4										
ISCO2	1170-ISCO2-12	23-Apr-01	FS									1	2	4										
ISCO1	1170-ISCO1-13	30-Apr-01	FS									1	2	4										
ISCO2	1170-ISCO2-13	30-Apr-01	FS									1	2	4										
ISCO1	1170-ISCO1-14	07-May-01	FS									1	2	4										
ISCO2	1170-ISCO2-14	07-May-01	FS									1	2	4										
ISCO1	1170-ISCO1-15	14-May-01	FS									1	2	4										
ISCO2	1170-ISCO2-15	14-May-01	FS		67							1	2	4										

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
ISCO2	1170-ISCO2-16	15-May-01	FS		67						1	1												
ISCO2	1170-ISCO2-17	16-May-01	FS		67						1	1												
ISCO2	1170-ISCO2-18	17-May-01	FS		67						1	1												
ISCO2	1170-ISCO2-19	18-May-01	FS		67						1	1												
ISCO1	1170-ISCO1-20	21-May-01	FS								1	1	4											
ISCO2	1170-ISCO2-20	21-May-01	FS								1	1	4											
ISCO2	1170-ISCO2-21	23-May-01	FS		65						1	1												
ISCO2	1170-ISCO2-22	24-May-01	FS		65						1	1												
ISCO2	1170-ISCO2-23	29-May-01	FS								1	1												
ISCO2	1170-ISCO2-24	30-May-01	FS								1	1												
ISCO1	1170-ISCO1-25	04-Jun-01	FS								1	2	4											
ISCO2	1170-ISCO2-25	04-Jun-01	FS								1	2	4											
ISCO1	1170-SD26-1	05-Jun-01	FS								1	1	1											
ISCO2	1170-SD26-4	05-Jun-01	FS								1	1	1											
SD26-2	1170-SD26-2	05-Jun-01	FS								1	1	1											
SW11C	1170-SD26-3	05-Jun-01	FS								1	1	1											
ISCO2	1170-ISCO2-27	06-Jun-01	FS								1	1												
ISCO2	1170-ISCO2-28	07-Jun-01	FS								1	1												
NP-1	1170-SD-29	09-Jun-01	FS								1	1												
ISCO2	1170-ISCO2-30	11-Jun-01	FS								1	2	4											
ISCO1	1170-ISCO1-31	18-Jun-01	FS								1	2	4											
ISCO2	1170-ISCO2-31	18-Jun-01	FS								1	2	4											
ISCO1	1170-ISCO1-32	25-Jun-01	FS								1	2	4											
ISCO2	1170-ISCO2-32	25-Jun-01	FS								1	2	4											
ISCO2	1170-ISCO2-33	02-Jul-01	FS								1	2	4											
ISCO1	1170-ISCO1-34	09-Jul-01	FS								1	2	4											
ISCO2	1170-ISCO2-34	09-Jul-01	FS								1	2	4											
ISCO2	1170-ISCO2-35	16-Jul-01	FS								1	1	4											
ISCO1	1170-ISCO1-36	23-Jul-01	FS								1	2	4											
ISCO1	1170-ISCO1-37	30-Jul-01	FS								1	2	4											
TD1	1170-TD1-37	30-Jul-01	FS								1	2												
TD2	1170-TD2-37	30-Jul-01	FS								1	2												
TD3	1170-TD3-37	30-Jul-01	FS								1	2												
ISCO1	1170-ISCO1-38	06-Aug-01	FS								1	2	4											
ISCO2	1170-ISCO2-38	06-Aug-01	FS								1	2	4											
ISCO1	1170-ISCO1-39	13-Aug-01	FS								1	2	4											
ISCO2	1170-ISCO2-39	13-Aug-01	FS								1	2	4											
ISCO1	1170-ISCO1-40	20-Aug-01	FS								1	2	4											
ISCO2	1170-ISCO2-40	20-Aug-01	FS								1	2	4											
ISCO1	1170-ISCO1-41	27-Aug-01	FS								1	2	4											
ISCO2	1170-ISCO2-41	27-Aug-01	FS								1	2	4											
ISCO1	1170-ISCO1-42	04-Sep-01	FS								1	2	4											
ISCO1	1170-ISCO1-44	12-Nov-01	FS								1	2	4											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
ISCO2	1170-ISCO2-44	12-Nov-01	FS									1	2	4										
PZ-16R	1170-PZ16-44	12-Nov-01	FS									1	2	4										
SD-17	1170-PZ17-44	12-Nov-01	FS									1	2	4										
ISCO1	1170-ISCO1-45	03-Dec-01	FS									1	2	4										
ISCO2	1170-ISCO2-45	03-Dec-01	FS									1	2	4										
ISCO1	1170-ISCO1-46	10-Dec-01	FS									1	2	4										
ISCO2	1170-ISCO2-46	10-Dec-01	FS									1	2	4										
PZ-16R	1170-PZ16-46	10-Dec-01	FS									1	2	4										
SD-17	1170-PZ17-46	10-Dec-01	FS									1	2	4										
ISCO1	1170-ISCO1-47	17-Dec-01	FS									1	2	4										
ISCO2	1170-ISCO2-47	17-Dec-01	FS									1	2	4										
ISCO1	1170-ISCO1-48	26-Dec-01	FS									1	2	4										
ISCO2	1170-ISCO2-48	26-Dec-01	FS									1	2	4										
ISCO1	1170-ISCO1-49	31-Dec-01	FS									1	2	4										
ISCO2	1170-ISCO2-49	31-Dec-01	FS									1	2	4										
ISCO2	1170-ISCO2-50	07-Jan-02	FS									1	2	8										
PZ-16R	1170-PZ16-50	07-Jan-02	FS									1	2	8										
SD-17	1170-PZ17-50	07-Jan-02	FS									1	2	8										
ISCO2	1170-ISCO2-51	04-Feb-02	FS									1	2	8										
PZ-16R	1170-PZ16-51	04-Feb-02	FS									1	2	8										
SD-17	1170-PZ17-51	04-Feb-02	FS									1	2	8										
ISCO2	1170-ISCO2-52	25-Feb-02	FS									1	2	8										
PZ-16R	1170-PZ16-52	25-Feb-02	FS									1	2	8										
SD-17	1170-PZ17-52	25-Feb-02	FS									1	2	8										
ISCO2	1170-ISCO2-53	25-Mar-02	FS									1	2	9										
PZ-16R	1170-PZ16-53	25-Mar-02	FS									1	2	9										
SD-17	1170-PZ17-53	25-Mar-02	FS									1	2	9										
ISCO2	1170-ISCO2-54	22-Apr-02	FS									1	2	8										
PZ-16R	1170-PZ16-54	22-Apr-02	FS									1	2	8										
SD-17	1170-PZ17-54	22-Apr-02	FS									1	2	8										
ISCO1	1170-ISCO1-55	20-May-02	FS									1	2	6										
ISCO2	1170-ISCO2-55	20-May-02	FS									1	2	6										
SD-17	1170-PZ17-55	20-May-02	FS									1	2	6										
ISCO1	1170-ISCO1-56	24-Jun-02	FS									1	2	6										
ISCO2	1170-ISCO2-56	24-Jun-02	FS									1	2	6										
SD-17	1170-PZ17-56	24-Jun-02	FS									1	2	6										
ISCO1	1170-ISCO1-57	22-Jul-02	FS									1	2	6										
SD-17	1170-PZ17-57	22-Jul-02	FS									1	2	6										
ISCO1	1170-ISCO1-58	12-Aug-02	FS									1	2	6										
SD-17	1170-PZ17-58	12-Aug-02	FS									1	2	6										
ISCO1	1170-ISCO1-59	09-Sep-02	FS									1	2	6										
SD-17	1170-PZ17-59	09-Sep-02	FS									1	2	6										
ISCO1	1170-ISCO1-60	07-Oct-02	FS									1	2	6										

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
SD-17	1170-PZ17-60	07-Oct-02	FS									1	2	6										
ISCO1	1170-ISCO1-61	04-Nov-02	FS									1	2	6										
ISCO2	1170-ISCO2-61	04-Nov-02	FS									1	2	6										
SD-17	1170-PZ17-61	04-Nov-02	FS									1	2	6										
ISCO1	1170-ISCO1-62	09-Dec-02	FS									1	2	6										
ISCO2	1170-ISCO2-62	09-Dec-02	FS									1	2	6										
SD-17	1170-PZ17-62	09-Dec-02	FS									1	2	6										
ISCO1	1170-ISCO1-63	03-Feb-03	FS									1	2	4										
ISCO2	1170-ISCO2-63	03-Feb-03	FS									1	2	4										
SD-17	1170-PZ-17-63	03-Feb-03	FS									1	2	4										
ISCO1	1170-ISCO1-63	06-Feb-03	FS											2										
ISCO2	1170-ISCO2-63	06-Feb-03	FS											2										
SD-17	1170-PZ-17-63	06-Feb-03	FS											2										
ISCO1	1170-ISCO1-64	05-May-03	FS									1	2	4										
ISCO2	1170-ISCO2-64	05-May-03	FS									1	2	4										
SD-17	1170-PZ-17-64	05-May-03	FS									1	2	4										
ISCO1	1170-ISCO1-64	19-May-03	FS											2										
ISCO1	1170-ISCO1-AC	19-May-03	FS									1		1										
ISCO2	1170-ISCO2-64	19-May-03	FS											2										
SD-17	1170-PZ-17-64	19-May-03	FS											2										
ISCO1	1170-ISCO1-AG	23-May-03	FS									1		1										
ISCO1	1170-ISCO1-AJ	26-May-03	FS									1		1										
ISCO1	1170-ISCO1-AK	26-May-03	FS									1		1										
ISCO1	1170-ISCO1-AL	26-May-03	FS									1		1										
ISCO1	1170-ISCO1-AM	27-May-03	FS									1		1										
ISCO1	1170-ISCO1-AN	27-May-03	FS									1		1										
ISCO1	1170-ISCO1-AO	27-May-03	FS									1		1										
ISCO1	1170-ISCO1-AP	28-May-03	FS									1		1										
ISCO1	1170-ISCO1-AR	30-May-03	FS									3		3										
ISCO1	1170-ISCO1-AT	01-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-AU	01-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-AV	01-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-AX	01-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-BD	07-Jun-03	FS									3		3										
ISCO2	1170-ISCO2-AA	07-Jun-03	FS									3		3										
ISCO2	1170-ISCO2-AB	08-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-BG	12-Jun-03	FS									3		3										
ISCO2	1170-ISCO2-AF	12-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-BI	14-Jun-03	FS									3		3										
ISCO2	1170-ISCO2-AH	14-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-BR	22-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-BU	22-Jun-03	FS									3		3										
ISCO1	1170-ISCO1-BV	22-Jun-03	FS									3		3										

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
ISCO1	1170-ISCO1-BW	22-Jun-03	FS								3		3											
ISCO2	1170-ISCO2-AP	22-Jun-03	FS								3		3											
ISCO2	1170-ISCO2-AQ	22-Jun-03	FS								3		3											
ISCO2	1170-ISCO2-AR	22-Jun-03	FS								3		3											
ISCO1	1170-ISCO1-BX	23-Jun-03	FS								3		3											
ISCO2	1170-ISCO2-AS	23-Jun-03	FS								3		3											
ISCO2	1170-ISCO2-AT	23-Jun-03	FS								3		3											
ISCO1	1170-ISCO1-BZ	25-Jun-03	FS								3		3											
ISCO2	1170-ISCO2-AV	25-Jun-03	FS								3		3											
ISCO1	1170-ISCO1-64	10-Jul-03	FS				1																	
ISCO2	1170-ISCO2-64	10-Jul-03	FS				1																	
SD-17	1170-P217R-64	10-Jul-03	FS				1																	
ISCO1	1170-ISCO1-65	11-Aug-03	FS								1	2	6											
ISCO2	1170-ISCO2-65	11-Aug-03	FS								1	2	6											
SD-17	1170-PZ-17-65	11-Aug-03	FS								1	2	6											
WHITE FLOC	Whitefloc-2003	08-Sep-03	FS								6		2											
WHITE FLOC	WhiteflocSW-2003	08-Sep-03	FS									6	1											
ISCO1	1170-ISCO1-66	17-Nov-03	FS								1	2	6											
ISCO2	1170-ISCO2-66	17-Nov-03	FS								1	2	6											
SD-17	1170-PZ17-66	17-Nov-03	FS								1	2	6											
ISCO1	1170-ISCO1-67	02-Feb-04	FS								1	2	6											
SD-17	1170-PZ-17-67	02-Feb-04	FS								1	2	6											
ISCO1	1170-ISCO1-68	10-May-04	FS								1	2	6											
ISCO1	1170-ISCO1-68 DUPLICATE	10-May-04	FD								1	2	6											
ISCO2	1170-ISCO2-68	10-May-04	FS								1	2	6											
SD-17	1170-PZ-17-68	10-May-04	FS								1	2	6											
ISCO1	1170-ISCO1-69	09-Aug-04	FS								1	2	6											
ISCO2	1170-ISCO2-69	09-Aug-04	FS								1	2	6											
SD-17	1170-PZ-17-69	09-Aug-04	FS								1	2	6											
ISCO1	1170-ISCO1-70	01-Nov-04	FS								1	2	6											
ISCO2	1170-ISCO2-70	01-Nov-04	FS								1	2	6											
SD-17	1170-PZ-17-70	01-Nov-04	FS								1	2	6											
ISCO1	1170-ISCO1-71	31-Jan-05	FS								1	2	6											
ISCO2	1170-ISCO2-71	31-Jan-05	FS								1	2	6											
SD-17	1170-PZ-17-71	31-Jan-05	FS								1	2	6											
ISCO1	1170-ISCO1-72	09-May-05	FS								1	2	6											
ISCO1	1170-ISCO1-72 DUPLICATE	09-May-05	FD								1	2	6											
ISCO2	1170-ISCO2-72	09-May-05	FS								1	2	6											
SD-17	1170-PZ-17-72	09-May-05	FS								1	2	6											
SDSW-A	SDSW-A-01	09-May-05	FS								1	2	6											
SDSW-B	SDSW-B-01	09-May-05	FS								1	2	6											
SDSW-C	SDSW-C-01	09-May-05	FS								1	2	6											
SDSW-D	SDSW-D-01	09-May-05	FS								1	2	6											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
SDSW-E	SDSW-E-01	09-May-05	FS								1	2	6											
SDSW-F	SDSW-F-01	09-May-05	FS								1	2	6											
SDSW-G	SDSW-G-01	09-May-05	FS								1	2	6											
SDSW-H	SDSW-H-01	09-May-05	FS								1	2	6											
SDSW-I	SDSW-I-01	09-May-05	FS								1	2	6											
ISCO1	1170-ISCO1-73	02-Aug-05	FS								1	2	6											
ISCO1	1170-ISCO1-73 DUPLICATE	02-Aug-05	FD								1	2	6											
SD-17	1170-PZ-17-73	02-Aug-05	FS								1	2	6											
SD-17	1170-PZ-17-73 DUPLICATE	02-Aug-05	FD								1	2	6											
SDSW-A	SD-SW-A-02	02-Aug-05	FS								3	3	6											
SDSW-C	SD-SW-C-02	02-Aug-05	FS								3	3	6											
SDSW-D	SD-SW-D-02	02-Aug-05	FS								3	3	6											
SDSW-D	SD-SW-D-02 DUPLICATE	02-Aug-05	FD								3	3	6											
ISCO1	1170-ISCO1-74	21-Nov-05	FS								1	2	6											
ISCO1	1170-ISCO1-74 DUPLICATE	21-Nov-05	FD								1	2	6											
ISCO2	1170-ISCO2-74	21-Nov-05	FS								1	2	6											
SD-17	1170-PZ-17-74	21-Nov-05	FS								1	2	6											
SDSW-A	SD-SW-A-03	21-Nov-05	FS								3	3	6											
SDSW-B	SD-SW-B-03	21-Nov-05	FS								3	3	6											
SDSW-C	SD-SW-C-03	21-Nov-05	FS								3	3	6											
SDSW-D	SD-SW-D-03	21-Nov-05	FS								3	3	6											
SDSW-D	SD-SW-D-03 DUPLICATE	21-Nov-05	FD								3	3	6											
SDSW-E	SD-SW-E-03	21-Nov-05	FS								3	3	6											
SDSW-F	SD-SW-F-03	21-Nov-05	FS								3	3	6											
SDSW-G	SD-SW-G-03	21-Nov-05	FS								3	3	6											
SDSW-H	SD-SW-H-03	21-Nov-05	FS								3	3	6											
SDSW-J	SD-SW-J-03	21-Nov-05	FS								3	3	6											
ISCO1	1170-ISCO1-75	20-Feb-06	FS										3											
ISCO1	1170-ISCO1-75 DUPLICATE	20-Feb-06	FD										4											
ISCO2	1170-ISCO2-75	20-Feb-06	FS										4											
SD-17	1170-PZ-17-75	20-Feb-06	FS										4											
SDSW-A	SDSW-A-03	20-Feb-06	FS										4											
SDSW-B	SDSW-B-03	20-Feb-06	FS										4											
SDSW-C	SDSW-C-03	20-Feb-06	FS										4											
SDSW-D	SDSW-D-03	20-Feb-06	FS										4											
SDSW-D	SDSW-D-03 Duplicate	20-Feb-06	FD										4											
SDSW-E	SDSW-E-03	20-Feb-06	FS										4											
SDSW-F	SDSW-F-03	20-Feb-06	FS										4											
SDSW-G	SDSW-G-03	20-Feb-06	FS										4											
SDSW-H	SDSW-H-03	20-Feb-06	FS										4											
SDSW-J	SDSW-J-03	20-Feb-06	FS										2											
ISCO1	ISCO-1	22-Aug-07	FS								3	3	6											
ISCO1	ISCO-1 DUP	22-Aug-07	FD								3	3	6											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
ISCO2	ISCO-2	22-Aug-07	FS									3	3	6										
PZ-16RR	PZ-16R SW	22-Aug-07	FS									3	3	6										
PZ-17RR	PZ-17RR	22-Aug-07	FS									3	3	6										
SD-17	SD-17	22-Aug-07	FS									3	3	6										
PZ-18R	PZ18R	23-Aug-07	FS									3	3	6										
ISCO1	OC-ISCO-1	12-Nov-07	FS									3	3	6										
ISCO2	OC-ISCO-2	12-Nov-07	FS									3	3	6										
PZ-16RR	OC-PZ-16RSW	12-Nov-07	FS									3	3	4										
PZ-17RR	OC-PZ-17RR	12-Nov-07	FS									3	3	4										
PZ-17RR	OC-DUPLICATE-PZ17RR	12-Nov-07	FD									3	3	4										
PZ-18R	OC-PZ-18R	12-Nov-07	FS									3	3	6										
SD-17	OC-SD-17	12-Nov-07	FS									3	3	6										
ISCO1	OC-ISCO-1	06-Mar-08	FS									3	3	6										
ISCO2	OC-ISCO-2	06-Mar-08	FS									3	3	6										
PZ-16RR	OC-PZ-16RR	06-Mar-08	FS									3	3	6										
PZ-17RR	OC-PZ-17RR	06-Mar-08	FS									3	3	6										
PZ-18R	OC-PZ-18R	06-Mar-08	FS									3	3	6										
SD-17	OC-SD-17	06-Mar-08	FS									3	3	6										
SD-17	OC-SD-17 DUP	06-Mar-08	FD									3	3	6										
ISCO1	OC-ISCO-1	22-May-08	FS									3	3	6										
ISCO2	OC-ISCO-2	22-May-08	FS									3	3	6										
PZ-16RR	OC-PZ-16RR	22-May-08	FS									3	3	6										
PZ-16RR	OC-PZ-16RR DUP	22-May-08	FD									3	3	6										
PZ-17RR	OC-PZ-17RR	22-May-08	FS									3	3	6										
PZ-18R	OC-PZ-18R	22-May-08	FS									3	3	6										
SD-17	OC-SD-17	22-May-08	FS									3	3	6										
ISCO1	OC-ISCO-1	27-Aug-08	FS									3	3	6										
ISCO2	OC-ISCO-2	27-Aug-08	FS									3	3	6										
PZ-16RR	OC-PZ-16RR	27-Aug-08	FS									3	3	6										
PZ-17RR	OC-PZ-17RR	27-Aug-08	FS									3	3	6										
PZ-18R	OC-PZ-18R	27-Aug-08	FS									3	3	6										
PZ-18R	OC-PZ-18R-DUP	27-Aug-08	FD									3	3	6										
SD-17	OC-SD-17	27-Aug-08	FS									3	3	6										
ISCO1	OC-ISCO-1	18-Nov-08	FS									3	3	6										
ISCO2	OC-ISCO-2	18-Nov-08	FS									3	3	6										
PZ-16RR	OC-PZ-16RR	18-Nov-08	FS									3	3	6										
PZ-17RR	OC-PZ-17RR	18-Nov-08	FS									3	3	6										
PZ-18R	OC-PZ-18R	18-Nov-08	FS									3	3	6										
SD-17	OC-SD-17	18-Nov-08	FS									3	3	6										
ISCO1	OC-ISCO-1	24-Feb-09	FS									3	3	6										
ISCO2	OC-ISCO-2	24-Feb-09	FS									3	3	6										
PZ-16RR	OC-PZ-16RRSW	24-Feb-09	FS									3	3	6										
PZ-17RR	OC-PZ-17RRSW	24-Feb-09	FS									3	3	6										

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
PZ-18R	OC-PZ-18RSW	24-Feb-09	FS											3	3	6										
SD-17	OC-SD-17	24-Feb-09	FS											3	3	6										
ISCO1	OC-ISCO-1	12-May-09	FS											3	3	6										
ISCO2	OC-ISCO-2	12-May-09	FS											3	3	6										
PZ-16RR	OC-PZ16RRSW	12-May-09	FS											3	3	6										
PZ-17RR	OC-PZ17RRSW	12-May-09	FS											3	3	6										
PZ-18R	OC-PZ18RSW	12-May-09	FS											3	3	6										
SD-17	OC-SD17	12-May-09	FS											3	3	6										
ISCO1	OC-ISCO-1	12-Aug-09	FS											3	3	6										
ISCO2	OC-ISCO-2	12-Aug-09	FS											3	3	6										
PZ-16RR	OC-PZ-16RR	12-Aug-09	FS											3	3	6										
PZ-17RR	OC-PZ-17RR	12-Aug-09	FS											3	3	6										
PZ-18R	OC-PZ-18R	12-Aug-09	FS											3	3	6										
PZ-18R	OC-PZ-18R DUP	12-Aug-09	FD											3	3	6										
SD-17	OC-SD-17	12-Aug-09	FS											3	3	6										
ISCO1	OC-SW-ISCO1	12-Nov-09	FS											3	3	6										
ISCO2	OC-SW-ISCO2	12-Nov-09	FS											3	3	6										
PZ-16RR	OC-SW-PZ16RR	12-Nov-09	FS											3	3	6										
PZ-17RR	OC-SW-PZ17RR	12-Nov-09	FS											3	3	6										
PZ-18R	OC-SW-18R	12-Nov-09	FS											3	3	6										
PZ-18R	OC-SW-18R-DUP	12-Nov-09	FD											3	3	6										
SD-17	OC-SW-SD17	12-Nov-09	FS											3	3	6										
ISCO1	OC-SW-ISCO-1-0.2	18-Feb-10	FS	0.2	-	0.2								3	3	6										
ISCO2	OC-SW-ISCO-2-0.2	18-Feb-10	FS	0.2	-	0.2								3	3	6										
PZ-16RR	OC-SW-PZ-16RR-0.2	18-Feb-10	FS	0.2	-	0.2								3	3	6										
PZ-16RR	OC-SW-PZ-16RR-0.2-DUP	18-Feb-10	FD	0.2	-	0.2								3	3	6										
PZ-17RR	OC-SW-PZ-17RR-0.2	18-Feb-10	FS	0.2	-	0.2								3	3	6										
PZ-18R	OC-SW-PZ-18R-0.2	18-Feb-10	FS	0.2	-	0.2								3	3	6										
SD-17	OC-SW-SD-17-0.2	18-Feb-10	FS	0.2	-	0.2								3	3	6										
ISCO1	OC-SW-ISCO1	09-Jun-10	FS											3	3	6										
ISCO2	OC-SW-ISCO2	09-Jun-10	FS											3	3	6										
PZ-16RR	OC-SW-PZ-16RR	09-Jun-10	FS											3	3	6										
PZ-17RR	OC-SW-PZ-17RR	09-Jun-10	FS											3	3	6										
PZ-18R	OC-SW-PZ-18R	09-Jun-10	FS											3	3	6										
SD-17	OC-SW-SD-17	09-Jun-10	FS											3	3	6										
ISCO1	OC-ISCO 1	01-Sep-10	FS											3	3	6										
ISCO2	OC-ISCO 2	01-Sep-10	FS											3	3	6										
PZ-16RR	OC-PZ 16 RR SW	01-Sep-10	FS											3	3	6										
PZ-17RR	OC-PZ 17 RR SW	01-Sep-10	FS											3	3	6										
PZ-18R	OC-PZ 18 R SW	01-Sep-10	FS											3	3	6										
SD-17	OC-SD17SW	09-Sep-10	FS											3	3	6										
ISCO1	OC-SW-ISCO1	15-Nov-10	FS											3	3	6										
ISCO2	OC-SW-ISCO2	15-Nov-10	FS											3	3	6										

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
PZ-16RR	OC-SW-PZ-16RR	15-Nov-10	FS								3	3	6											
PZ-17RR	OC-SW-PZ-17RR	15-Nov-10	FS								3	3	6											
PZ-18R	OC-SW-PZ-18R	15-Nov-10	FS								3	3	6											
PZ-18R	OC-SW-PZ18R-DUP	15-Nov-10	FD								3	3	6											
SD-17	OC-SW-SD-17	15-Nov-10	FS								3	3	6											
ISCO2	OC-SW-ISCO-2-XXX	09-Dec-10	FS		77	72		2			24		10			22	11	3	2	2	1	1	4
PZ-16RR	OC-SW-PZ-16RR-XXX	09-Dec-10	FS		77	72		2			24		10			22	11	3	2	2	1	1	4
SD-1	OC-SW-SD-1-XXX	09-Dec-10	FS		77	72		2			24		10			22	11	3	2	2	1	1	4
ISCO1	OC-SW-ISCO-1-XXX	10-Dec-10	FS		77	72		2			24		10			22	11	3	2	2	1	1	4
ISCO1	OC-SW-ISCO-1-DUP	10-Dec-10	FD		77	72		2			24		10			22	11	3	2	2	1	1	4
PZ-17RR	OC-SW-PZ-17RR-XXX	10-Dec-10	FS		77	72		2			24		10			22	11	3	2	2	1		4
ISCO1	OC-SW-ISCO1	22-Mar-11	FS								3	3	6											
ISCO2	OC-SW-ISCO2	22-Mar-11	FS								3	3	6											
PZ-16RR	OC-SW-PZ-16RRSW	22-Mar-11	FS								3	3	6											
PZ-17RR	OC-SW-PZ-17RRSW	22-Mar-11	FS								3	3	6											
PZ-18R	OC-SW-PZ-18RSW	22-Mar-11	FS								3	3	6											
SD-17	OC-SW-SD-17	22-Mar-11	FS								3	3	6											
ISCO1	OC-SW-ISCO1	16-May-11	FS								3	3	6											
ISCO2	OC-SW-ISCO2	16-May-11	FS								3	3	6											
PZ-16RR	OC-SW-PZ-16RRSW	16-May-11	FS								3	3	6											
PZ-17RR	OC-SW-PZ-17RRSW	16-May-11	FS								3	3	6											
PZ-18R	OC-SW-PZ-18RSW	16-May-11	FS								3	3	6											
PZ-18R	OC-DUP	16-May-11	FD								3	3	6											
SD-17	OC-SW-SD-17	16-May-11	FS								3	3	6											
ISCO1	OC-SW-ISCO-1-XXX	06-Jun-11	FS		77	72		2			25		9			22	11	3	2	2	1	1	4
ISCO1	OC-SW-ISCO-1-DUP	06-Jun-11	FD		77	72		2			26		9			22	11	3	2	2	1	1	4
ISCO2	OC-SW-ISCO-2-XXX	06-Jun-11	FS		77	72		2			25		9			22	11	3	2	2	1	1	4
PZ-16RR	OC-SW-PZ-16RR-XXX	06-Jun-11	FS		77	72		2			24		9			22	11	3	2	2	1	1	4
PZ-17RR	OC-SW-PZ-17RR-XXX	06-Jun-11	FS		77	72		2			24		9			22	11	3	2	2	1	1	4
SD-1	OC-SW-SD-1-XXX	06-Jun-11	FS		77	72		2			24		9			22	11	3	2	2	1	1	
ISCO1	OC-SW-ISCO1	23-Aug-11	FS								3	3	6											
ISCO2	OC-SW-ISCO2	23-Aug-11	FS								3	3	6											
PZ-16RR	OC-SW-PZ-16RRSW	23-Aug-11	FS								3	3	6											
PZ-17RR	OC-SW-PZ-17RRSW	23-Aug-11	FS								3	3	6											
PZ-18R	OC-SW-PZ-18RSW	23-Aug-11	FS								3	3	6											
SD-17	OC-SW-SD-17	23-Aug-11	FS								3	3	6											
ISCO1	OC-SW-ISCO1	08-Nov-11	FS								3	3	6											
ISCO2	OC-SW-ISCO2	08-Nov-11	FS								3	3	6											
PZ-16RR	OC-SW-PZ16RR	08-Nov-11	FS								3	3	6											
PZ-17RR	OC-SW-PZ17RR	08-Nov-11	FS								3	3	6											
PZ-18R	OC-SW-PZ18R	08-Nov-11	FS								3	3	6											
PZ-18R	OC-SW-PZ18R-DUP	08-Nov-11	FD								3	3	6											
SD-17	OC-SW-SD17	08-Nov-11	FS								3	3	6											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
ISCO1	OC-ISCO1-SW	23-Feb-12	FS								3	3	6											
ISCO2	OC-ISCO2-SW	23-Feb-12	FS								3	3	6											
PZ-16RR	OC-SW-PZ16RR-SW	23-Feb-12	FS								3	3	6											
PZ-17RR	OC-SW-PZ-17RR-SW	23-Feb-12	FS								3	3	6											
PZ-18R	OC-PZ18R-SW	23-Feb-12	FS								3	3	6											
SD-17	OC-SD-17-SW	23-Feb-12	FS								3	3	6											
ISCO1	OC-SW-ISCO1	07-Jun-12	FS								3	3	6											
ISCO2	OC-SW-ISCO2	07-Jun-12	FS								3	3	6											
PZ-16RR	OC-SW-PZ-16RRSW	07-Jun-12	FS								3	3	6											
PZ-17RR	OC-SW-PZ-17RRSW	07-Jun-12	FS								3	3	6											
PZ-18R	OC-SW-PZ-18RSW	07-Jun-12	FS								3	3	6											
PZ-18R	OC-SW-PZ-18RSW DUP	07-Jun-12	FD								3	3	6											
SD-17	OC-SW-SD-17	07-Jun-12	FS								3	3	6											
ISCO1	OC-SW-ISCO1	23-Aug-12	FS								3	3	6											
ISCO2	OC-SW-ISCO2	23-Aug-12	FS								3	3	6											
PZ-16RR	OC-SW-PZ-16RRSW	23-Aug-12	FS								3	3	6											
PZ-17RR	OC-SW-PZ-17RRSW	23-Aug-12	FS								3	3	6											
PZ-18R	OC-SW-PZ-18RSW	23-Aug-12	FS								3	3	6											
SD-17	OC-SW-SD-17	23-Aug-12	FS								3	3	6											
ISCO1	OC-SW-ISCO1	16-Nov-12	FS								3	3	6											
ISCO2	OC-SW-ISCO2	16-Nov-12	FS								3	3	6											
PZ-16RR	OC-SW-PZ-16RRSW	16-Nov-12	FS								3	3	6											
PZ-17RR	OC-SW-PZ-17RRSW	16-Nov-12	FS								3	3	6											
PZ-18R	OC-SW-PZ-18RSW	16-Nov-12	FS								3	3	6											
SD-17	OC-SW-SD-17	16-Nov-12	FS								3	3	6											
SD-17	OC-SW-SD-17-DUP	16-Nov-12	FD								3	3	6											
PZ-17RR	OC-SW-PZ-17RR-XXX	17-Dec-12	FS		77	74		2			25		9											
SD-1	OC-SW-SD-1-XXX	17-Dec-12	FS		77	74		2			25		9											
ISCO1	OC-ISCO1	21-Mar-13	FS								3	3	6											
ISCO2	OC-ISCO2	21-Mar-13	FS								3	3	6											
PZ-16RR	OC-PZ-16RRSW	21-Mar-13	FS								3	3	6											
PZ-17RR	OC-PZ-17RRSW	21-Mar-13	FS								3	3	6											
PZ-18R	OC-PZ-18RSW	21-Mar-13	FS								3	3	6											
SD-17	OC-SD-17 SW	21-Mar-13	FS								3	3	6											
PZ-18R	OC-DUP SW	13-May-13	FD								3	3	6											
ISCO1	OC-ISCO1	13-May-13	FS								3	3	6											
ISCO2	OC-ISCO2	13-May-13	FS								3	3	6											
PZ-16RR	OC-PZ-16RRSW	13-May-13	FS								3	3	6											
PZ-17RR	OC-PZ-17RRSW	13-May-13	FS								3	3	6											
PZ-18R	OC-PZ-18RSW	13-May-13	FS								3	3	6											
SD-17	OC-SD-17	13-May-13	FS								3	3	6											
ISCO1	OC-ISCO1	22-Aug-13	FS								3	3	6											
ISCO2	OC-ISCO2	22-Aug-13	FS								3	3	6											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
PZ-16RR	OC-PZ-16RRSW	22-Aug-13	FS								3	3	6											
PZ-17RRR	OC-PZ-17RRRSW	22-Aug-13	FS								3	3	6											
PZ-18R	OC-PZ-18RSW	22-Aug-13	FS								3	3	6											
SD-17	OC-SD-17	22-Aug-13	FS								3	3	6											
ISCO1	OC-ISCO1	21-Nov-13	FS								3	3	6											
ISCO2	OC-ISCO2	21-Nov-13	FS								3	3	6											
PZ-16RR	OC-PZ-16RRSW	21-Nov-13	FS								3	3	6											
PZ-17RR	OC-PZ-17RRSW	21-Nov-13	FS								3	3	6											
PZ-18R	OC-PZ-18RSW	21-Nov-13	FS								3	3	6											
PZ-18R	OC-PZ-18RSWDUP	21-Nov-13	FD								3	3	6											
SD-17	OC-SD-17	21-Nov-13	FS								3	3	6											
Sediment																								
S-3 SED	S-3 SED	14-May-90	FS										1		1									
S-4 SED	S-4 SED	14-May-90	FS		30	46							1		1									
SW-1 SED	SW-1 SED	14-May-90	FS								3		1											
SW-6	SW-06	31-Aug-92	FS	0 - 0.5	36	65			21			23		4										
SW-10	SW-10	01-Sep-92	FS		36	65			21			23		4										
SW-11	SW-11	01-Sep-92	FS		36	65			21			23		4										
SW-14	SW-14	01-Sep-92	FS		36	65			21			23		4										
SW-7	SW-07	01-Sep-92	FS		36	65			21			23		4										
SW-9	SW-09	01-Sep-92	FS		36	65			21			23		4										
SW-10	SW-10	01-Dec-92	FS		36	65			21			23		4										
SW-11	SW-11	01-Dec-92	FS		36	65			21			23		4										
SW-14	SW-14	01-Dec-92	FS		36	65			21			23		4										
SW-6	SW-06	01-Dec-92	FS		36	65			21			24		6										
SW-6	SW-06 DUP	01-Dec-92	FD		36	65			21			24		6										

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
SW-7	SW-07	01-Dec-92	FS				36	65			21			23	4											
SW-9	SW-09	01-Dec-92	FS				36	65			21			23	4											
SED-17	SED-17,11"	02-Feb-95	FS											12	5											
SED-17	SED-17,11" DUP	02-Feb-95	FD												1											
BS004	BS004WMDXX	11-Oct-96	FS								28			23												
BS008	BS008SD	20-Jan-97	FS					65			21			23	1											
BS011	BS011WMD	20-Jan-97	FS					65			21			23	1											
BS008	BS008SD	23-Jan-97	FS					65			19			23												
BS011	BS011WMD	23-Jan-97	FS					65			19			23												
RSD-06	RSD-06	18-Jan-00	FS				37	66				7		22	1											
RSD-07	RSD-07	18-Jan-00	FS				37	66				7		22	1											
RSD-29	RSD-29	23-May-00	FS	0.75	-	0.75								1	1											
RSD-30	RSD-30	23-May-00	FS	0.5	-	0.5								1	1											
RSD-31	RSD-31	23-May-00	FS	0.17	-	0.17								1	1											
RSD-32	RSD-32	23-May-00	FS	0.5	-	0.5								1	1											
RSD-33	RSD-33	23-May-00	FS	2.1	-	2.1								1	1											
RSD-34	RSD-34	23-May-00	FS	0.33	-	0.33								1	1											
RSD-35	RSD-35	23-May-00	FS	0.5	-	0.5								1	1											
SDC-1	1010-SED-SDC-1S	17-Sep-01	FS	0	-	0.5	65	67						9	4			22								
SDC-1	1010-SED-SDC-1D	17-Sep-01	FS	0.5	-	1.3	65	67						9	5			22								
SDC-2	1010-SED-SDC-2S	17-Sep-01	FS	0	-	0.5	65	67						9	4			22								
SDC-3	1010-SED-SDC-3S	17-Sep-01	FS	0	-	0.5	65	67						9	4			22								
SDC-3	1010-SED-SDC-3D	17-Sep-01	FS	0.5	-	1.3	65	67						9	5			22								
SDC-4	1010-SED-SDC-4S	17-Sep-01	FS	0	-	0.5	65	67						9	4			22								
SDC-4	1010-SED-SDC-4D	17-Sep-01	FS	0.5	-	1.8	65	67						9	4			22								
SDC-5	1010-SED-SDC-5S	17-Sep-01	FS	0	-	0.5	65	67						9	4			22								
SDC-5	1010-SED-SDC-5D	17-Sep-01	FS	0.5	-	2	65	67						9	4			22								
SDC-6	1010-SED-SDC-6S	17-Sep-01	FS	0	-	0.5	65	67						9	4			22								
SDC-6	1010-SED-SDC-6D	17-Sep-01	FS	0.5	-	1.4	65	67						9	4			22								
SDC-7	1010-SED-SDC-7S	17-Sep-01	FS	0	-	0.5	65	67						9	4			22								
SDC-7	1010-SED-SDC-7D	17-Sep-01	FS	0.5	-	1.1	65	67						9	4			22								
SDC-8	1010-SED-SDC-8S	17-Sep-01	FS	0	-	0.5	65	67						9	4			22								
SDC-8	1010-SED-SDC-8D	17-Sep-01	FS	0.5	-	1.1	65	67						9	5			22								
SD-SD2	SD-SD2-03-01	17-Jun-03	FS	0	-	0.25		1						15	1											
SD-SD2	SD-SD2-15-01	17-Jun-03	FS	0.25	-	1.25		1						15	1											
SD-SD3	SD-SD3-03-01	17-Jun-03	FS	0	-	0.25		1						15	1											
SD-SD3	SD-SD3-15-01	17-Jun-03	FS	0.25	-	1.25		1						15	1											
SD-SD5	SD-SD5-03-01	17-Jun-03	FS	0	-	0.25		1						15	1											
SD-SD5	SD-SD5-13-01	17-Jun-03	FS	0.25	-	1.08		1						15	1											
SD-SD2	SD-SD2-03-02	10-Aug-04	FS	0	-	0.25								3	2											
SD-SD2	SD-SD2-12-02	10-Aug-04	FS	0.25	-	1								3	2											
SD-SD3	SD-SD3-03-02	10-Aug-04	FS	0	-	0.25								3	2											
SD-SD3	SD-SD3-12-02	10-Aug-04	FS	0.25	-	1								3	2											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
SD-SD5	SD-SD5-03-02	10-Aug-04	FS	0	-	0.25							3		2											
SD-SD5	SD-SD5-15-02	10-Aug-04	FS	0.25	-	1.25							3		2											
SD-SD2	SD-SD2-03-03	19-May-05	FS	0	-	0.25							3		1											
SD-SD2	SD-SD2-(12)-03	19-May-05	FS	0.25	-	1							3		1											
SD-SD3	SD-SD3-03-03	19-May-05	FS	0	-	0.25							3		1											
SD-SD3	SD-SD3-(15)-03	19-May-05	FS	0.25	-	1.25							3		1											
SD-SD5	SD-SD5-03-03	19-May-05	FS	0	-	0.25							3		1											
SD-SD5	SD-SD5-(15)-03	19-May-05	FS	0.25	-	1.25							3		1											
BS030	BS030LSD-02	22-Aug-05	FS	0	-	0.5		67	16		19			24		6										
BS031	BS031LSD-02	22-Aug-05	FS	0	-	0.5		67	16		19			24		5										
BS032	BS032LSD-02	22-Aug-05	FS	0	-	0.5		67	16		19			24		6										
BS030	BS030ELSD-02	13-Sep-05	FS						16		19			24		12										
BS030	BS030ELSD-02 Initial	13-Sep-05	FS					68																		
BS032	BS032ELSD-02	14-Sep-05	FS						16		19			24		12										
BS032	BS032ELSD-02 Initial	14-Sep-05	FS					68																		
BS031	BS031ELSD-02	15-Sep-05	FS						16		19			24		12										
BS031	BS031ELSD-02 Initial	15-Sep-05	FS					68																		
SD-SD2	OC-SD-SD2	16-Nov-07	FS										3		2											
SD-SD3	OC-SD-SD3	16-Nov-07	FS										3		2											
SD-SD5	OC-SD-SD5	16-Nov-07	FS										3		2											
SD-SD2	OC-SD-SD2	19-Nov-08	FS	0	-	0.4							3		2											
SD-SD3	OC-SD-SD3	19-Nov-08	FS	0	-	0.4							3		2											
SD-SD5	OC-SD-SD5	19-Nov-08	FS	0	-	0.4							3		2											
SD-SD2	OC-SD-SD-SD2-0.0/0.5	11-Nov-09	FS	0	-	0.5							3		2											
SD-SD3	OC-SD-SD-SD3-0.0/0.5	11-Nov-09	FS	0	-	0.5							3		2											
SD-SD5	OC-SD-SD-SD5-0.0/0.5	11-Nov-09	FS	0	-	0.5							3		2											
SD-SD2	OC-SD-SD2-0.0/0.5	15-Nov-10	FS	0	-	0.5							3		2											
SD-SD2	OC-SD-SD2-0.0/0.5 DUP	15-Nov-10	FD	0	-	0.5							3		2											
SD-SD3	OC-SD-SD3-0.0/0.5	15-Nov-10	FS	0	-	0.5							3		2											
SD-SD5	OC-SD-SD5-0.0/0.5	15-Nov-10	FS	0	-	0.5							3		2											
ISCO2	OC-SD-ISCO-2-XXX	09-Dec-10	FS	0	-	0.5	77	80					25		11			5	6	3	2		1	1		
SD-1	OC-SD-SD-1-XXX	09-Dec-10	FS	0	-	0.5	77	80					25		11			5	6	3	2		1	1		
SD-SD3	OC-SD-SD-SD3-XXX	09-Dec-10	FS	0	-	0.5	77	80					25		11			5	6	3	2		1	1		
SDSW-E	OC-SD-SDSW-E-XXX	09-Dec-10	FS	0	-	0.5	77	80					25		11			5	6	3	2		1	1		
SD-SD2	OC-SD-SD-SD2-XXX	10-Dec-10	FS	0	-	0.5	77	80					25		13			5	6	3	2		1	1		
SD-SD2	OC-SD-SD-SD2-DUP	10-Dec-10	FD	0	-	0.5	77	80					25		11			5	6	3	2		1	1		
ISCO2	OC-SD-ISCO-2-XXX	17-Feb-11	FS				77	79					24		22											
SD-SD2	OC-SD-SD2-0.0/0.5	11-Nov-11	FS	0	-	0.5							3		2											
SD-SD3	OC-SD-SD3-0.0/0.5	11-Nov-11	FS	0	-	0.5							3		2											
SD-SD3	OC-SD-SD3 DUP-0.0/0.5	11-Nov-11	FD	0	-	0.5							3		2											
SD-SD5	OC-SD-SD5-0.0/0.5	11-Nov-11	FS	0	-	0.5							3		2											
SD-SD2	OC-SD-SD2	16-Nov-12	FS	0	-	0.5							3		2											
SD-SD3	OC-SD-SD3	16-Nov-12	FS	0	-	0.5							3		2											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
SD-SD5	OC-SD-SD5	16-Nov-12	FS	0	-	0.5								3		2											
SD-SD5	OC-SD-SD5-DUP	16-Nov-12	FD	0	-	0.5								3		2											
SD-SD2	OC-SD-SD2	21-Nov-13	FS	0	-	0.5								3		2											

Table 2.2-5
Summary of Chemical Analyses for OU1 and OU2 Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH	EPH	VPH	Hydrazine	Formaldehyde	Opex/Kempore	Dimethylformamide	Phthalic Anhydride	Alkylphenols
SD-SD3	OC-SD-SD3	21-Nov-13	FS	0 - 0.5								3		2										
SD-SD5	OC-SD-SD5	21-Nov-13	FS	0 - 0.5								3		2										
Tissue																								
	CF005STDXX	10-Oct-96	FS					28			23		1											
	CF006STDXX	10-Oct-96	FS			61		28			23		1											
	CF007STDXX	10-Oct-96	FS			61		28			23		1											
	CF008STDXX	10-Oct-96	FS					28			23		1											
	FR003STDXX	10-Oct-96	FS					21			23		1											
	SM005STDXX	10-Oct-96	FS					21			23		1											
	SM006STDXX	11-Oct-96	FS			61		21			23		1											
	SM007STDXX	11-Oct-96	FS					21			23		1											
	SM011STDXX	11-Oct-96	FS					21			23		1											
BS015	BS015SDXX	19-Mar-97	FS			66		21			23													
BS018	BS018PNDX	19-Mar-97	FS			66		21			23													
SSREF-021	BS021WMDX	19-Mar-97	FS			66		21			23													
BS040	BS040EWLSD	04-Nov-05	FS			64		22			23		2											
BS040	BS040EWLSD DUP	04-Nov-05	FD										1											
BS043	BS043EWLSD	04-Nov-05	FS			64		22			23		2											
BS045	BS045EWLSD	04-Nov-05	FS			64		22			23		2											

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/06/14
Checked by / Date: CTM 03/10/14

Table 2.2-6
Summary of Chemical Analyses for OU1 Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Dissolved	Inorganics/Physical	TPH	EPH	VPH
Surface Water																		
SS-11	SS-11	08-Dec-77	FS												5			
SS-11	SS-11	19-Jan-78	FS												5			
SS-11	SS-11	21-Feb-78	FS												5			
SS-11	SS-11	15-Mar-78	FS												5			
SS-11	SS-11	10-Apr-78	FS												5			
SS-11	SS-11	01-May-85	FS										1					
SS-C	SS-C	01-Oct-86	FS										1		3			
SS-C	SS-C	01-Dec-86	FS												2			
SS-C	SS-C	01-Jun-87	FS										1		3			
SS-C	SS-C	01-Dec-87	FS										1		3			
SW-12	SW-12	02-Sep-92	FS				36	65		21			23		3			
SW-13	SW-13	02-Sep-92	FS				36	65		21			23		3			
SW-12	SW-12	01-Dec-92	FS				36	65		21			23		3			
SW-13	SW-13	01-Dec-92	FS				36	65		21			24		5			
NP-3	NP-3C	20-Jul-00	FS				66	65		30	7	7	26		23	6	22	12
NP-3	NP-3T	20-Jul-00	FS				66	65		30	7	7	26	25	23	6	22	12
On-Property West Ditch	1150-WD-1	27-Sep-00	FS				6		17				6			5		
On-Property West Ditch Wetland	1150-WDW-SWA1	24-Oct-00	FS				6	65	17				8	1		5		
BURIED DEBRIS AREA	1150-BD-SWC18	16-Nov-00	FS						17				1	1				
On-Property West Ditch Wetland	1150-WDW-SWC33	06-Dec-00	FS					65					1	1	1			
BURIED DEBRIS AREA	1150-BD-PH1	08-May-01	FS											4				
BURIED DEBRIS AREA	1150-BD-PH2	08-May-01	FS											4				
Sediment																		
W-1 SED	W-1 SED	14-May-90	FS				30	46					3		4			
W-2 SED	W-2 SED	14-May-90	FS				30	46					3		4			
SW-12	SW-12	02-Sep-92	FS				36	65		21			23		4			
SW-13	SW-13	02-Sep-92	FS				36	65		21			23		4			
SW-12	SW-12	01-Dec-92	FS				36	65		21			23		4			
SW-13	SW-13	01-Dec-92	FS				36	65		21			24		6			
BS001	BS001WDXXX	11-Oct-96	FS							28			23					
BS002	BS002WDXXX	11-Oct-96	FS							28			23					
BS005	BS005WDX	20-Jan-97	FS					65		21			23		1			
BS006	BS006WDX	20-Jan-97	FS					65		21			23		1			
BS005	BS005WD	23-Jan-97	FS					65		19			23					
BS006	BS006WD	23-Jan-97	FS					65		19			23					
RAM-1	RAM-1	04-Aug-99	FS	2	-	2		67										
RAM-10	RAM-10	04-Aug-99	FS	2	-	2		67										

Table 2.2-6
Summary of Chemical Analyses for OU1 Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Dissolved	Inorganics/Physical	TPH	EPH	VPH
RAM-10	RAM-10 ENCORE	04-Aug-99	FS	2 - 2	65											
RAM-11	RAM-11	04-Aug-99	FS	2 - 2		67										
RAM-12	RAM-12	04-Aug-99	FS	2 - 2		67										
RAM-13	RAM-13	04-Aug-99	FS	2 - 2		67										
RAM-13	RAM-13 ENCORE	04-Aug-99	FS	2 - 2	65											
RAM-14	RAM-14	04-Aug-99	FS	2 - 2		67										
RAM-14	RAM-14 ENCORE	04-Aug-99	FS	2 - 2	65											
RAM-15	RAM-15	04-Aug-99	FS	2 - 2		67										
RAM-15	RAM-15 ENCORE	04-Aug-99	FS	2 - 2	65											
RAM-2	RAM-2	04-Aug-99	FS	2 - 2		67										
RAM-2	RAM-2 ENCORE	04-Aug-99	FS	2 - 2	65											
RAM-3	RAM-3	04-Aug-99	FS	2 - 2		67										
RAM-4	RAM-4	04-Aug-99	FS	2 - 2		67										
RAM-5	RAM-5	04-Aug-99	FS	2 - 2		67										
RAM-6	RAM-6	04-Aug-99	FS	2 - 2		67										
RAM-7	RAM-7	04-Aug-99	FS	2 - 2		67										
RAM-7	RAM-7 ENCORE	04-Aug-99	FS	2 - 2	65											
RAM-8	RAM-8	04-Aug-99	FS	2 - 2		67										
RAM-9	RAM-9	04-Aug-99	FS	2 - 2		67										
RSD-01	RSD-01	18-Jan-00	FS		37	66					22		1			
RSD-02	RSD-02	18-Jan-00	FS		37	66					22		1			
RSD-03	RSD-03	18-Jan-00	FS		37	66			7		22		1			
RSD-04	RSD-04	18-Jan-00	FS		37	66					22		1			
RSD-05	RSD-05	18-Jan-00	FS		37	66			7		23		1			
RAM-1	RAM #1	22-May-00	FS			67							1			
RAM-10	RAM #10	22-May-00	FS			67							1			
RAM-11	RAM #11	22-May-00	FS			67							1			
RAM-12	RAM #12	22-May-00	FS			67							1			
RAM-12	DUP	22-May-00	FD			67							1			
RAM-2	RAM #2	22-May-00	FS			67							1			
RAM-3	RAM #3	22-May-00	FS			67							1			
RAM-4	RAM #4	22-May-00	FS			67							1			
RAM-5	RAM #5	22-May-00	FS			67							1			
RAM-6	RAM #6	22-May-00	FS			67							1			
RAM-7	RAM #7	22-May-00	FS			67							1			
RAM-8	RAM #8	22-May-00	FS			67							1			
RAM-9	RAM #9	22-May-00	FS			67							1			
RSD-16	RSD-16	23-May-00	FS	1.5 - 1.5						1			1			

Table 2.2-6
Summary of Chemical Analyses for OU1 Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Dissolved	Inorganics/Physical	TPH	EPH	VPH
RSD-17	RSD-17	23-May-00	FS	1.3 - 1.3							1		1			
RSD-18	RSD-18	23-May-00	FS	1.4 - 1.4							1		1			
RSD-19	RSD-19	23-May-00	FS	1.3 - 1.3							1		1			
RSD-20	RSD-20	23-May-00	FS	3.6 - 3.6							1		1			
RSD-21	RSD-21	23-May-00	FS	5.3 - 5.3							1		1			
RSD-22	RSD-22	23-May-00	FS	1.2 - 1.2							1		1			
RSD-23	RSD-23	23-May-00	FS	0.5 - 0.5							1		1			
WDW-1	1140-WDW-1S	25-Aug-00	FS	2.1 - 2.6		67					1		1			
WDW-1	1140-WDW-1D	25-Aug-00	FS	2.6 - 4.2		67					1		1			
WDW-11	1140-WDW-11S	25-Aug-00	FS	0 - 0.5		67					1		1			
WDW-11	1140-WDW-11D	25-Aug-00	FS	0.5 - 2.1		67					1		1			
WDW-2	1140-WDW-2S	25-Aug-00	FS	2.1 - 2.6		67					1		1			
WDW-2	1140-WDW-2D	25-Aug-00	FS	2.6 - 4.2		67					1		1			
WDW-4	1140-WDW-4S	25-Aug-00	FS	2.5 - 3		67					1		1			
WDW-4	1140-WDW-4D	25-Aug-00	FS	3 - 4.1		67					1		1			
WDW-5	1140-WDW-5S	25-Aug-00	FS	1.6 - 2.1		67					1		1			
WDW-5	1140-WDW-5D	25-Aug-00	FS	2.1 - 3.2		67					1		1			
WDW-7	1140-WDW-7S	25-Aug-00	FS	-0.8 - -0.3		67					1		1			
WDW-7	1140-WDW-7D	25-Aug-00	FS	-0.3 - 0.6		67					1		1			
WDW-9	1140-WDW-9S	25-Aug-00	FS	-0.7 - -0.2		67					1		1			
WDW-9	1140-WDW-9D	25-Aug-00	FS	-0.2 - 0.8		67					1		1			
WDW-12	1120-WDW-12S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-12	1120-WDW-12D (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-13	1120-WDW-13S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-13	1120-WDW-13D (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-15	1120-WDW-15S (0-6)	30-Aug-00	FS	0.6 - 1.1		67					1		1			
WDW-15	1120-WDW-15D (6-30)	30-Aug-00	FS	1.1 - 3.1		67					1		1			
WDW-17	1120-WDW-17S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-17	1120-WDW-17D (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-18	1120-WDW-18S (0-6)	30-Aug-00	FS	-0.7 - -0.2		67					1		1			
WDW-18	1120-WDW-18D (6-30)	30-Aug-00	FS	-0.2 - 1.8		67					1		1			
WDW-19	1120-WDW-19S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-19	1120-WDW-19D (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-21A	1120-WDW-21AS (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-21A	1120-WDW-21AD (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-21B	1120-WDW-21BS (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-21B	1120-WDW-21BD (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-21C	1120-WDW-21CS (0-6)	30-Aug-00	FS	0 - 0.5		67					8		1			

Table 2.2-6
Summary of Chemical Analyses for OU1 Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Dissolved	Inorganics/Physical	TPH	EPH	VPH
WDW-21C	1120-WDW-21CD (6-30)	30-Aug-00	FS	0.5 - 2.5		67					8		1			
WDW-22	1120-WDW-22S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-22	1120-WDW-22D (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-24	1120-WDW-24S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-24	1120-WDW-24D (6-24)	30-Aug-00	FS	0.5 - 2		67					1		1			
WDW-25	1120-WDW-25S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-25	1120-WDW-25D (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-26	1120-WDW-26S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-26	1120-WDW-26D (6-24)	30-Aug-00	FS	0.5 - 2		67					1		1			
WDW-28	1120-WDW-28S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-28	1120-WDW-28D (6-24)	30-Aug-00	FS	0.5 - 2		67					1		1			
WDW-29	1120-WDW-29S (0-6)	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-29	1120-WDW-29D (6-30)	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-30	1120-WDW-30S	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-30	1120-WDW-30D	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-31	1120-WDW-31S	30-Aug-00	FS	0 - 0.5		67					1		1			
WDW-31	1120-WDW-31D	30-Aug-00	FS	0.5 - 2.5		67					1		1			
WDW-10	1120-WDW-10S (0-6)	31-Aug-00	FS	0.4 - 0.9		67					8		1			
WDW-10	1120-WDW-10D (6-30)	31-Aug-00	FS	0.9 - 2.9		67					8		1			
WDW-14	1120-WDW-14S (0-6)	31-Aug-00	FS	0 - 0.5	63	67					8		1			
WDW-14	1120-WDW-14D (6-30)	31-Aug-00	FS	0.5 - 2.5	63	67					8		1			
WDW-16	1120-WDW-16S (0-6)	31-Aug-00	FS	0 - 0.5	63	67					8		1			
WDW-16	1120-WDW-16D (6-30)	31-Aug-00	FS	0.5 - 2.5	63	67					8		1			
WDW-20	1120-WDW-20S (0-6)	31-Aug-00	FS	0 - 0.5	63	67					8		1			
WDW-20	1120-WDW-20D (6-30)	31-Aug-00	FS	0.5 - 2.5	63	67					8		1			
WDW-23	1120-WDW-23S (0-6)	31-Aug-00	FS	0 - 0.5	63	67					8		1			
WDW-23	1120-WDW-23D (6-30)	31-Aug-00	FS	0.5 - 2.5	63	67					8		1			
WDW-27	1120-WDW-27S (0-6)	31-Aug-00	FS	0 - 0.5	63	67					8		1			
WDW-27	1120-WDW-27D (6-30)	31-Aug-00	FS	0.5 - 2.5	63	67					8		1			
WDW-3	1120-WDW-3S (0-6)	31-Aug-00	FS	2.3 - 2.8	63	67					8		1			
WDW-3	1120-WDW-3D (6-30)	31-Aug-00	FS	2.8 - 4.8	63	67					8		1			
WDW-32	1120-WDW-32S (0-6)	31-Aug-00	FS	0 - 0.5	63	67					8		1			
WDW-32	1120-WDW-32D (6-30)	31-Aug-00	FS	0.5 - 2.5	63	67					8		1			
WDW-8	1120-WDW-8S (0-6)	31-Aug-00	FS	-1.1 - -0.6	63	67					8		1			
WDW-8	1120-WDW-8D (6-30)	31-Aug-00	FS	-0.6 - 1.4	63	67					8		1			
WDW-C12	1140-WDW-C12	11-Oct-00	FS	2.1 - 2.1		67					1		1			
WDW-C15	1140-WDW-C15	11-Oct-00	FS	1.5 - 1.5		67					1		1			
WDW-C3	1140-WDW-C3	11-Oct-00	FS	2.5 - 2.5		67					1		1			

Table 2.2-6
Summary of Chemical Analyses for OU1 Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Dissolved	Inorganics/Physical	TPH	EPH	VPH
WDW-C6	1140-WDW-C6	11-Oct-00	FS	2.5 - 2.5		67					1		1			
WDW-C9	1140-WDW-C9	11-Oct-00	FS	3.5 - 3.5		67					1		1			
WDW-C1	1140-WDW-C1	18-Oct-00	FS	0.5 - 0.5		67					1		1			
WDW-C10	1140-WDW-C10	18-Oct-00	FS	0.5 - 0.5	65	67		19			8		1			
WDW-C11	1140-WDW-C11	18-Oct-00	FS	2.2 - 2.2	65	67		19			8		1			
WDW-C13	1140-WDW-C13	18-Oct-00	FS	0.5 - 0.5		67					1		1			
WDW-C14	1140-WDW-C14	18-Oct-00	FS	0.5 - 0.5		67					1		1			
WDW-C16	1140-WDW-C16	18-Oct-00	FS	0.5 - 0.5		67					1		1			
WDW-C2	1140-WDW-C2	18-Oct-00	FS	0.5 - 0.5		67					1		1			
WDW-C4	1140-WDW-C4	18-Oct-00	FS	0.4 - 0.4	65	67		19			8		1			
WDW-C5	1140-WDW-C5	18-Oct-00	FS	0.7 - 0.7	65	67		19			8		1			
WDW-C7	1140-WDW-C7	18-Oct-00	FS	2.7 - 2.7		67					1		1			
WDW-C8	1140-WDW-C8	18-Oct-00	FS	0.2 - 0.2		67					1		1			
BD-C17	1120-BD-C17	27-Oct-00	FS	0.2 - 0.2	65	67		19			8		1			
BD-C27	1120-BD-C27	27-Oct-00	FS	0.5 - 0.5	65	67		19			8		1			
BD-C32	1120-BD-C32	27-Oct-00	FS	0.6 - 0.6	65	67		19			8		1			
WDW-C17	1140-WDW-C17	01-Nov-00	FS	0.5 - 0.5		67					1		1			
WDW-C19	1140-WDW-C19	01-Nov-00	FS	0.5 - 0.5		67					1		1			
WDW-C19	1140-WDW-C19-D	01-Nov-00	FD	0.5 - 0.5		67					1		1			
WDW-C21	1140-WDW-C21	01-Nov-00	FS	0.5 - 0.5		67					1		1			
WDW-C22	1140-WDW-C22	01-Nov-00	FS	-0.6 - -0.6		67					1		1			
WDW-C25	1140-WDW-C25	01-Nov-00	FS	-0.1 - -0.1		67					1		1			
WDW-C18	1140-WDW-C18	02-Nov-00	FS	2.7 - 2.7	65	67		19			8		1			
WDW-C20	1140-WDW-C20	02-Nov-00	FS	3.1 - 3.1	65	67		19			8		1			
WDW-C23	1140-WDW-C23	02-Nov-00	FS	3 - 3		67					1		1			
WDW-C24	1140-WDW-C24	02-Nov-00	FS	1.5 - 1.5		67					1		1			
SD-SD1	SD-SD1-03-01	17-Jun-03	FS	0 - 0.25		1					15		1			
SD-SD1	SD-SD1-15-01	17-Jun-03	FS	0.25 - 1.25		1					15		1			
SD-SD1	SD-SD1-03-02	10-Aug-04	FS	0 - 0.25							3		2			
SD-SD1	SD-SD1-15-02	10-Aug-04	FS	0.25 - 1.25							3		2			
SD-SD1	SD-SD1-03-03	19-May-05	FS	0 - 0.25							3		1			
SD-SD1	SD-SD1-(15)-03	19-May-05	FS	0.25 - 1.25							3		1			
SD-SD1	OC-SD-SD1	16-Nov-07	FS	0 - 0.25							3		2			
SD-SD1	OC-SD-SD1-DUP	16-Nov-07	FD	0 - 0.25							3		2			
SD-SD1	OC-SD-SD1	19-Nov-08	FS	0 - 0.3							3		2			
SD-SD1	OC-SD-SD-SD1-0.0/0.5	11-Nov-09	FS	0 - 0.5							3		2			
SD-SD1	OC-SD-SD-SD1-0.0/0.5 DUP	11-Nov-09	FD	0 - 0.5							3		2			
SD-SD1	OC-SD-SD1-0.0/0.5	15-Nov-10	FS	0 - 0.5							3		2			

Table 2.2-6
Summary of Chemical Analyses for OU1 Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Dissolved	Inorganics/Physical	TPH	EPH	VPH
SD-SD1	OC-SD-SD1-0.0/0.5	11-Nov-11	FS	0 - 0.5							3		2			
SD-SD1	OC-SD-SD1	16-Nov-12	FS	0 - 0.5							3		2			
SD-SD1	OC-SD-DUP	21-Nov-13	FD	0 - 0.5							3		2			
SD-SD1	OC-SD-SD1	21-Nov-13	FS	0 - 0.5							3		2			
Tissue																
	CF001WDXXX	10-Oct-96	FS			61		28			23		1			
	CF002WDXXX	10-Oct-96	FS					28			23		1			
	CF003WDXXX	10-Oct-96	FS			61		28			23		1			
	CF004WDXXX	10-Oct-96	FS					28			24		1			
	FR004WDXXX	11-Oct-96	FS					28			23		1			
	FR007WDXXX	11-Oct-96	FS			61		21			23		1			
	SM002WDXXX	10-Oct-96	FS			61		21			23		1			

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/06/14
Checked by / Date: CTM 03/10/14

Table 2.2-7
Summary of Chemical Analyses for OU1 Samples - Central Pond
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH
Surface Water																	
SW-8	SW-08	01-Sep-92	FS				36	65			21		23		3		
SW-8	SW-08	01-Dec-92	FS				36	65			21		24		5		
GSW-16	SW-16	02-Feb-95	FS										14	14	13	14	
GSW-16	SW-16	03-May-95	FS										14	14	14	15	
GSW-16	SW-16	19-Jul-95	FS										14	14	14	14	
GSW-16	SW-16	18-Oct-95	FS										14	14	13	15	
GSW-P	SOUTH DITCH POND #1	18-Apr-96	FS											1			
GSW-P	SO. DITCH POND-F	19-Apr-96	FS											23			
GSW-P	SO. DITCH POND-U	19-Apr-96	FS										23		3		
Central Pond	1150-CP-SW1	09-Oct-00	FS				6		17				6	1			5
Central Pond	1150-CP-SWC18	16-Nov-00	FS										1	1			
Central Pond	1150-CP-E1	10-Apr-01	FS				6		17				6	1			1
SD-501	OC-SW-SD-501-XXX	17-Dec-12	FS				77	74		2			25		9		
Sediment																	
SW-8	SW-08	01-Sep-92	FS				36	65			21		23		4		
SW-8	SW-08	01-Dec-92	FS				36	65			21		24		6		
POND	POND	13-Sep-95	FS				36	64			28		23		1		
BS009	BS009PND	20-Jan-97	FS					65			21		23		1		
BS010	BS010PND	20-Jan-97	FS					65			21		23		1		
BS009	BS009PND	23-Jan-97	FS					65			19		23				
BS010	BS010PND	23-Jan-97	FS					65			19		23				
RSD-08	RSD-08	18-Jan-00	FS				37	66				7	22		1		
RSD-24	RSD-24	23-May-00	FS	0.5	-	0.5							1		1		
RSD-25	RSD-25	23-May-00	FS	1.2	-	1.2							1		1		
RSD-26	RSD-26	23-May-00	FS	0.75	-	0.75							1		1		
SD-SD4	SD-SD4-03-01	17-Jun-03	FS	0	-	0.25		1					15		1		
SD-SD4	SD-SD4-12-01	17-Jun-03	FS	0.25	-	1		1					15		1		
SD-SD4	SD-SD4-03-02	10-Aug-04	FS	0	-	0.25							3		2		
SD-SD4	SD-SD4-12-02	10-Aug-04	FS	0.25	-	1							3		2		
SD-SD4	SD-SD4-03-03	19-May-05	FS	0	-	0.25							3		1		
SD-SD4	SD-SD4-(10)-03	19-May-05	FS	0.25	-	0.83							3		1		
SD-SD4	OC-SD-SD4	16-Nov-07	FS										3		2		
SD-SD4	OC-SD-SD4	19-Nov-08	FS	0	-	0.5							3		2		
SD-SD4	OC-SD-SD-SD4-0.0/0.5	11-Nov-09	FS	0	-	0.5							3		2		
SD-SD4	OC-SD-SD4-0.0/0.5	15-Nov-10	FS	0	-	0.5							3		2		
SD-SD4	OC-SD-SD4-0.0/0.5	11-Nov-11	FS	0	-	0.5							3		2		
SD-SD4	OC-SD-SD4	16-Nov-12	FS	0	-	0.5							3		2		

Table 2.2-7
Summary of Chemical Analyses for OU1 Samples - Central Pond
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	NDMA	Pesticides	PCBs	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics, Filtered	TPH
SD-501	OC-SD-SD-501-XXX	17-Dec-12	FS	0 - 0.5	77	80		1			25		8		
SD-502	OC-SD-SD-502-XXX	17-Dec-12	FS	0 - 0.5	77	80		1			25		8		
SD-SD4	OC-SD-SD4	21-Nov-13	FS	0 - 0.5							3		2		
Tissue															
	FR001PNDXX	10-Oct-96	FS			61			28		23		1		
	FR002PNDXX	10-Oct-96	FS						21		23		1		
	FR005PNDXX	11-Oct-96	FS			61			21		23		1		
	FR006PNDXX	11-Oct-96	FS			61			21		23		1		
	SM012PNDXX	10-Oct-96	FS			61			21		23		1		

FS = Field Sample

Prepared by / Date: KJC 03/06/14
Checked by / Date: CTM 03/10/14

Table 2.2-8
Summary of Chemical Analyses for OU1 Samples - Detention Basin
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	NDMA	Metals	Inorganics/Physical
Surface Water											
SD-503	OC-SW-SD-503-XXX	17-Dec-12	FS				77	74	2	25	9
Sediment											
SD-503	OC-SD-SD-503-XXX	17-Dec-12	FS	0	-	0.5	77	80	1	25	8
SD-504	OC-SD-SD-504-XXX	17-Dec-12	FS	0	-	0.5	77	80	1	25	8

FS = Field Sample

Prepared by / Date: KJC 03/27/13
Checked by / Date: CTM 03/28/13

Table 2.3-1
Summary of Chemical Analyses for OU2 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	PAHs	Pesticides	Herbicides	Metals	Inorganics/Physical	EPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride	Organotins
BGS-1	BGS-1	02-Nov-92	FS					50				23	2						
GW-85D	GW-85-D	07-Oct-96	FS				12	12				23	3						
MB-1	MB-1	07-Oct-96	FS				12	12				23	3						
GW-83D	GW-83-D	08-Oct-96	FS				12	12				23	3						
MB-2	MB-2	08-Oct-96	FS				12	12				23	3						
SSBK-015	SS015XXBKX	22-Apr-96	FS	0	-	0.66		17				3	4						
SSBK-016	SS016XXBKX	22-Apr-96	FS	0	-	0.5		17				3	4						
SSBK-017	SS017XXBKD DUP	22-Apr-96	FD	0	-	0.5		17				3	4						
SSBK-017	SS017XXBKX	22-Apr-96	FS	0	-	0.5		17				3	4						
SSBK-018	SS018XXBKX	22-Apr-96	FS	0	-	0.5		17				3	4						
SSBK-019	SS019XXBKX	22-Apr-96	FS	0	-	0.5		17				3	4						
SSREF-021	BS021REF	21-Jan-97	FS	0	-	0		65		21		23							
SDF-1	1010-SED-SDF-1S	17-Sep-01	FS	0	-	0.5	66	67				9	5	22					
SDF-2	1010-SED-SDF-2S	17-Sep-01	FS	0	-	0.5	66	67				9	5	22					
OPWD-SO-N	OPWD-SO-N-06-01	17-Jun-03	FS	0	-	0.5						22	3						
OPWD-SO-N	OPWD-SO-N-C12-01	17-Jun-03	FS	0	-	1	69	66					1						
OPWD-SO-N	OPWD-SO-N-12-01	17-Jun-03	FS	0.5	-	1						22	3						
OPWD-SO-S	OPWD-SO-S-06-01	17-Jun-03	FS	0	-	0.5						22	3						
OPWD-SO-S	OPWD-SO-S-C12-01	17-Jun-03	FS	0	-	1	69	66					1						
OPWD-SO-S	OPWD-SO-S-12-01	17-Jun-03	FS	0.5	-	1						22	3						
OPWD-SO-WS	OPWD-SO-WS-06-01	17-Jun-03	FS	0	-	0.5						22	3						
OPWD-SO-WS	OPWD-SO-WS-C12-01	17-Jun-03	FS	0	-	1	69	66					2						
OPWD-SO-WS	OPWD-SO-WS-12-01	17-Jun-03	FS	0.5	-	1						22	3						
NPSB1	NPSB1-Fill1	20-Nov-03	FS	0	-	2						8	2						
NPSB4	NPSB4-Fill	08-Sep-04	FS	0	-	2	76	69		21	11	7	5						
BS021-02	BS021REF-02 ( )	22-Aug-05	FS	0	-	0.5		67	16	19		24	6						
BS021-03	BS021REF-03 ( )	22-Aug-05	FS	0	-	0.5		67	16	19		24	6						
BS021-04	BS021REF-04 ( )	22-Aug-05	FS	0	-	0.5		67	16	19		24	6						
BS040	BS040LSD	22-Aug-05	FS	0	-	0.5		67	16	19		24	6						
SOLSD17	SOLSD-17-0-6	20-Sep-05	FS	0	-	0.5						1	1						
SOLSD17	SOLSD-17-6-12	20-Sep-05	FS	0.5	-	1						1	1						
SOLSD18	SOLSD-18-0-6	20-Sep-05	FS	0	-	0.5						1	1						
SOLSD18	SOLSD-18-6-12	20-Sep-05	FS	0.5	-	1						1	1						
SOLSD19	SOLSD-19-0-6	20-Sep-05	FS	0	-	0.5						1	1						
SOLSD19	SOLSD-19-6-12	20-Sep-05	FS	0.5	-	1						1	1						
SOLSD20	SOLSD-20-0-6	20-Sep-05	FS	0	-	0.5						1	1						
SOLSD20	SOLSD-20-6-12	20-Sep-05	FS	0.5	-	1						1	1						
SOLSD21	SOLSD-21-0-6	20-Sep-05	FS	0	-	0.5						1	1						
SOLSD22	SOLSD-22-0-6	20-Sep-05	FS	0	-	0.5						1	1						

Table 2.3-1
Summary of Chemical Analyses for OU2 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	PAHs	Pesticides	Herbicides	Metals	Inorganics/Physical	EPH	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride	Organotins
SOLSD23	SOLSD-23-0-6	20-Sep-05	FS	0 - 0.5						1	1						
SOLSD01	SOLSD-1-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD02	SOLSD-2-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD03	SOLSD-3-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD04	SOLSD-4-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD05	SOLSD-5-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD06	SOLSD-6-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD06	SOLSD-6-6-12	21-Sep-05	FS	0.5 - 1						1	1						
SOLSD07	SOLSD-7-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD07	SOLSD-7-6-12	21-Sep-05	FS	0.5 - 1						1	1						
SOLSD08	SOLSD-8-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD09	SOLSD-9-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD10	SOLSD-10-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD11	SOLSD-11-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD11	SOLSD-11-6-12	21-Sep-05	FS	0.5 - 1						1	1						
SOLSD11	SOLSD-11-6-12-D DUP	21-Sep-05	FD	0.5 - 1						1	1						
SOLSD12	SOLSD-12-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD12	SOLSD-12-0-6-D DUP	21-Sep-05	FD	0 - 0.5						1	1						
SOLSD13	SOLSD-13-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD13	SOLSD-13-6-12	21-Sep-05	FS	0.5 - 1						1	1						
SOLSD14	SOLSD-14-0-6	21-Sep-05	FS	0 - 0.5						2	1						
SOLSD14	SOLSD-14-6-12	21-Sep-05	FS	0.5 - 1						1	1						
SOLSD15	SOLSD-15-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SOLSD16	SOLSD-16-0-6	21-Sep-05	FS	0 - 0.5						1	1						
SS-438	OC-SS-438-0.0/1.0-XXX	03-Jun-10	FS	0 - 1	78	79				25	10						
SS-439	OC-SS-439-0.0/1.0-XXX	03-Jun-10	FS	0 - 1	78	79				25	9						
SS-441	OC-SS-441-0.0/1.0-XXX	03-Jun-10	FS	0 - 1	78	80				25	11		3	2	1	1	
SS-443	OC-SS-443-0.0/1.0-XXX	03-Jun-10	FS	0 - 1	78	80				25	10		3	2	1	1	
SS-444	OC-SS-444-0.0/1.0-XXX	03-Jun-10	FS	0 - 1	78	79				25	9						
SS-445	OC-SS-445-0.0/1.0-XXX	03-Jun-10	FS	0 - 1	78	79				25	9						
SS-446	OC-SS-446-0.0/1.0-XXX	03-Jun-10	FS	0 - 1	78	79				25	9						
SS-447	OC-SS-447-0.0/1.0-XXX	03-Jun-10	FS	0 - 1	78	80				25	10		3	2	1	1	
SB-526	OC-SB-526-0.0/1.0-XXX	05-Dec-12	FS	0 - 1		80				1	4						
SB-527	OC-SB-527-0.0/1.0-XXX	05-Dec-12	FS	0 - 1						1	4						
SB-528	OC-SB-528-0.0/1.0-XXX	05-Dec-12	FS	0 - 1		80				2	4						1
SB-529	OC-SB-529-0.0/1.0-XXX	05-Dec-12	FS	0 - 1		80				1	4						

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/27/13
Checked by / Date: CTM 03/28/13

Table 2.3-2
Summary of Chemical Analyses for OU2 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	Herbicides	Metals	Inorganics/Physical	Organotins
SSBK-101	SS101XXBKX	23-Nov-98	FS	0	-	3					1	1	
SSBK-103	SS103XXBKX	23-Nov-98	FS	0	-	3					1	1	
SSBK-104	SS104XXBKX	23-Nov-98	FS	0	-	3					1	1	
SSBK-105	SS105XXBKX	23-Nov-98	FS	0	-	3					1	1	
SSBK-102	SS102XXBKX	01-Dec-98	FS	0	-	3					1	1	
OPWD-SO-N	OPWD-SO-N-24-01	17-Jun-03	FS	1.5	-	2					22	3	
OPWD-SO-N	OPWD-SO-N-30-01	17-Jun-03	FS	2	-	2.5					22	3	
OPWD-SO-N	OPWD-SO-N-36-01	17-Jun-03	FS	2.5	-	3					22	3	
OPWD-SO-S	OPWD-SO-S-24-01	17-Jun-03	FS	1.5	-	2					22	3	
OPWD-SO-S	OPWD-SO-S-30-01	17-Jun-03	FS	2	-	2.5					22	3	
OPWD-SO-S	OPWD-SO-S-36-01	17-Jun-03	FS	2.5	-	3					22	3	
OPWD-SO-WS	OPWD-SO-WS-24-01	17-Jun-03	FS	1.5	-	2					22	3	
OPWD-SO-WS	OPWD-SO-WS-30-01	17-Jun-03	FS	2	-	2.5					22	3	
OPWD-SO-WS	OPWD-SO-WS-36-01	17-Jun-03	FS	2.5	-	3					22	3	
NPSB1	NPSB1-SED1	20-Nov-03	FS	6	-	7.5	76	69	19	11	8	6	
NPSB1	NPSB1-SOIL1	20-Nov-03	FS	9	-	11	76					6	
NPSB2	NPSB2-Fill1	20-Nov-03	FS	2	-	3					8	2	
NPSB3	NPSB3-Fill1	20-Nov-03	FS	2	-	4					8	2	
NPSB3	NPSB3-SED1	20-Nov-03	FS	9.4	-	10.4	76	69	19		8	6	
NPSB4	NPSB4-Sed	08-Sep-04	FS	5	-	7	76	69	21	11	7	5	
SB-526	OC-SB-526-1.0/3.0-XXX	05-Dec-12	FS	1		3		80			1	4	
SB-527	OC-SB-527-1.0/3.0-XXX	05-Dec-12	FS	1		3					1	4	
SB-528	OC-DUP-2	05-Dec-12	FD	1		3					1	2	1
SB-528	OC-SB-528-1.0/3.0-XXX	05-Dec-12	FS	1		3		80			2	4	1
SB-529	OC-SB-529-1.0/3.0-XXX	05-Dec-12	FS	1		3		80			1	4	

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/27/13
Checked by / Date: CTM 03/28/13

Table 2.3-3
Piezometer Water Level Measurements
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

			December 2010 OU-2 Sampling		May 2011 Synoptic Round	Spring 2011 OU-2 Sampling			Fall 2011 Synoptic Round
		Date	12/2/2010	12/3/2011	5/10/2011	6/6/2011	6/7/2011	6/8/2011	10/10/2011
Confluence MMB & SMB	Piezometer #1	PZ-SW-1 in	3.87	-	3.65	3.83	-	-	2.75
		PZ-SW-1 out	3.88	-	3.71	3.85	-	-	2.82
Sawmill Brook (SMB)	Piezometer #2	PZ-SW-5 in	6.03	-	2.15	-	2.40	-	1.28
		PZ-SW-5 out	2.35	-	2.30	-	2.42	-	1.43
Maple Meadow Brook (MMB)	Piezometer #3	PZ-SW-3 in	-	5.94	-	-	-	4.27	3.19
		PZ-SW-3 out	-	4.25	-	-	-	4.29	3.28

Created by: CHL

Checked by: CTM

Table 2.3-4
Summary of Chemical Analyses for OU2 Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics/Physical Filte	Hydrazine	Formaldehyde	Opex / Kempore
Surface Water																	
SS-D	SS-D	01-Oct-86	FS							1		3					
SS-D	SS-D	01-Dec-86	FS									2					
SS-D	SS-D	01-Jun-87	FS							1		3					
SS-D	SS-D	01-Dec-87	FS							1		3					
SW-17	SW-17	01-Sep-92	FS				36	65	21	24		3					
SW-17	SW-17 DUP	01-Sep-92	FD				36	65	21	24		3					
SW-15	SW-15	02-Sep-92	FS				36	65	21	23		3					
SW-16	SW-16	02-Sep-92	FS				36	65	21	23		3					
SW-18	SW-18	02-Sep-92	FS				36	65	21	23		3					
SW-15	SW-15	02-Dec-92	FS				36	65	21	23		3					
SW-16	SW-16	02-Dec-92	FS				36	65	21	24		5					
SW-17	SW-17	02-Dec-92	FS				36	65	21	24		5					
SW-17	SW-17 DUP	02-Dec-92	FD				36	65	21	24		6					
SW-18	SW-18	02-Dec-92	FS				36	65	21	23		3					
GSW-11	SW-11	02-Feb-95	FS							14	14	13	14				
GSW-12	SW-12	02-Feb-95	FS							14	14	13	14				
GSW-14	SW-14	02-Feb-95	FS							14	14	13	14				
GSW-14	SW-14 DUP	02-Feb-95	FD							12	12	13	14				
GSW-11	SW-11	03-May-95	FS							14	14	14	15				
GSW-12	SW-12	03-May-95	FS							14	14	14	15				
GSW-14	SW-14	03-May-95	FS							14	14	14	15				
GSW-14	SW-14 DUP	03-May-95	FD							14	14	14	14				
GSW-12	SW-12	19-Jul-95	FS							14	14	14	14				
GSW-14	SW-14	19-Jul-95	FS							28	28	28	28				
GSW-11	SW-17	18-Oct-95	FS							14	14	13	15				
GSW-11	SW-17 DUP	18-Oct-95	FD							14	14	13	15				
GSW-12	SW-12	18-Oct-95	FS							14	14	13	16				
GSW-14	SW-14	18-Oct-95	FS							14	14	13	15				
OPWD-SW-N	OPWD-SW-N	14-Nov-02	FS							17	15	8					
OPWD-SW-S	OPWD-SW-S	14-Nov-02	FS							17	15	8					
OPWD-SW-SDW	OPWD-SW-SDW	14-Nov-02	FS							17	15	8					
OPWD-SW-WS	OPWD-SW-WS	14-Nov-02	FS							17	15	8					
OPWD-SW-N	OPWD-SW-N	09-Dec-02	FS					1	1								
OPWD-SW-S	OPWD-SW-S	09-Dec-02	FS					1	1								
OPWD-SW-SDW	OPWD-SW-SDW	09-Dec-02	FS					1	1								
OPWD-SW-WS	OPWD-SW-WS	09-Dec-02	FS					1	1								
OPWD-SW-S	OPWD-SW-S	12-Feb-03	FS					1	1	17	15	6					

Table 2.3-4
Summary of Chemical Analyses for OU2 Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics/Physical Filte	Hydrazine	Formaldehyde	Opex / Kempore
OPWD-SW-SDW	OPWD-SW-SDW	12-Feb-03	FS			1		1	17	15	6				
OPWD-SW-WS	OPWD-SW-WS	12-Feb-03	FS			1		1	17	15	6				
OPWD-SW-N	OPWD-SW-N	21-May-03	FS			1	1	1	17	15	7				
OPWD-SW-S	OPWD-SW-S	21-May-03	FS			1	1	1	17	15	7				
OPWD-SW-SDW	OPWD-SW-SDW	21-May-03	FS			1	1	1	17	15	7				
OPWD-SW-WS	OPWD-SW-WS	21-May-03	FS			1	1	1	17	15	7				
REDFLOC	REDFLOC-2003	25-Jun-03	FS						6		2				
REDFLOC	REDFLOCSW-2003	25-Jun-03	FS							6	1				
OPWD-SW-N	OPWD-SW-N	20-Aug-03	FS			1		1	17	15	7				
OPWD-SW-S	OPWD-SW-S	20-Aug-03	FS			1		1	17	15	7				
OPWD-SW-SDW	OPWD-SW-SDW	20-Aug-03	FS			1		1	17	15	7				
OPWD-SW-WS	OPWD-SW-WS	20-Aug-03	FS			1		1	17	15	7				
OPWD-1	OC-SW-OPWD-1-XXX	10-Dec-10	FS		77	71	2		24		10		3	2	2
OPWD-2	OC-SW-OPWD-2-XXX	10-Dec-10	FS		77	71	2		24		10		3	2	2
OPWD-SW-S	OC-SW-OPWD-SD/SO/SW-S-XXX	10-Dec-10	FS		77	71	2		25		10				2
OPWD-1	OC-SW-OPWD-1-XXX	07-Jun-11	FS		77	71	2		24		9		3	2	2
OPWD-2	OC-SW-OPWD-2-XXX	07-Jun-11	FS		77	71	2		24		9		3	2	2
OPWD-SW-S	OC-SW-OPWD-SD/SO/SW-S-XXX	07-Jun-11	FS		77	71	2		25		9				2
Sediment															
SW-17	SW-17	01-Sep-92	FS		36	65		21	24		4				
SW-17	SW-17 DUP	01-Sep-92	FD		36	65		21	24		3				
SW-15	SW-15	02-Sep-92	FS		36	65		21	23		4				
SW-16	SW-16	02-Sep-92	FS		36	65		21	23		4				
SW-18	SW-18	02-Sep-92	FS		36	65		21	23		4				
SW-15	SW-15	02-Dec-92	FS		36	65		21	23		4				
SW-16	SW-16	02-Dec-92	FS		36	65		21	24		6				
SW-17	SW-17	02-Dec-92	FS		36	65		21	24		6				
SW-17	SW-17 DUP	02-Dec-92	FD		36	65		21	24		5				
SW-18	SW-18	02-Dec-92	FS		36	65		21	23		4				
BS007	BS007WDO	20-Jan-97	FS			65		21	23		1				
BS007	BS007WDO	23-Jan-97	FS			65		19	23						
OPWD-SD-N	OPWD-SD-N-01	17-Jun-03	FS		68	66			22		2				
OPWD-SD-S	OPWD-SD-S-01	17-Jun-03	FS		68	66			22		2				
OPWD-SD-WS	OPWD-SD-WS-01	17-Jun-03	FS		68	66			22		2				
OPWD-1	OC-SD-OPWD-1-XXX	10-Dec-10	FS	0 - 0.5	77	79			24		9		3	2	
OPWD-2	OC-SD-OPWD-2-XXX	10-Dec-10	FS	0 - 0.5	77	79			24		9		3	2	
OPWD-SD-S	OC-SD-OPWD-SD/SO/SW-S-XXX	10-Dec-10	FS	0 - 0.5	77	79			25		10				

Table 2.3-4
Summary of Chemical Analyses for OU2 Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Inorganics/Physical Filte	Hydrazine	Formaldehyde	Opex / Kempore
Tissue															
	SM001WDOXX	10-Oct-96	FS				21	23		1					
	SM003WDOXX	10-Oct-96	FS				21	23		1					
	SM004WDOXX	10-Oct-96	FS				21	23		1					

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/27/13
Checked by / Date: CTM 03/28/13

Table 2.3-5
Summary of Chemical Analyses for OU2 Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Semivolatiles	Volatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride	Opex/Kempore
Surface Water																			
SS-1	SS-01	08-Dec-77	FS										5						
SS-2	SS-02	08-Dec-77	FS										5						
SS-1	SS-01	19-Jan-78	FS										5						
SS-2	SS-02	19-Jan-78	FS										5						
SS-1	SS-01	21-Feb-78	FS										5						
SS-2	SS-02	21-Feb-78	FS										5						
SS-1	SS-01	15-Mar-78	FS										5						
SS-16	SS-16	15-Mar-78	FS										5						
SS-1	SS-01	10-Apr-78	FS										5						
SS-16	SS-16	10-Apr-78	FS										5						
SS-1	SS-01	01-Oct-82	FS			2							4						
SS-16	SS-16	01-Oct-82	FS			2							4						
SS-1	SS-01	01-Jun-83	FS			2							4						
SS-16	SS-16	01-Jun-83	FS			2							4						
SS-1	SS-01	01-Oct-83	FS			2							4						
SS-16	SS-16	01-Oct-83	FS			2							4						
SS-1	SS-01	01-Jul-84	FS			2							4						
SS-16	SS-16	01-Jul-84	FS			2							4						
SS-1	SS-01	01-Dec-84	FS			2							4						
SS-16	SS-16	01-Dec-84	FS			2							4						
SS-1	SS-01	01-May-85	FS								1								
SS-16	SS-16	01-May-85	FS								1								
SS-2	SS-02	01-May-85	FS								1								
SS-16	SS-16	01-Dec-85	FS								1		4						
SS-16	SS-16	27-Jun-86	FS								1		4						
SS-B	SS-B	01-Oct-86	FS								1		3						
SS-1	SS-01	01-Dec-86	FS										2						
SS-16	SS-16	01-Dec-86	FS										3						
SS-B	SS-B	01-Dec-86	FS										3						
SS-1	SS-01	01-Jun-87	FS								1		3						
SS-16	SS-16	01-Jun-87	FS								1		3						
SS-1	SS-01	01-Dec-87	FS								1		3						
SS-16	SS-16	01-Dec-87	FS								1		3						
SS-B	SS-B	01-Dec-87	FS								1		3						
SS-E	SS-E	01-Dec-87	FS								1		3						
SW-1	SW-01	10-Dec-91	FS		36	65			28		23		4						
SW-2	SW-02	10-Dec-91	FS		36	65			28		23		4						
SW-1	SW-01	31-Aug-92	FS		36	65			21		23		3						
SW-2	SW-02	31-Aug-92	FS		36	65			21		23		3						
SW-3	SW-03	31-Aug-92	FS		36	65			21		23		3						

Table 2.3-5
Summary of Chemical Analyses for OU2 Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Semivolatiles	Volatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride	Opex/Kempore
SW-4	SW-04	31-Aug-92	FS		36	65			21			23		3					
SW-5	SW-05	31-Aug-92	FS		36	65			21			23		3					
SW-1	SW-01	30-Nov-92	FS		36	65			21			23		3					
SW-2	SW-02	30-Nov-92	FS		36	65			21			23		3					
SW-3	SW-03	30-Nov-92	FS		36	65			21			23		3					
SW-4	SW-04	30-Nov-92	FS		36	65			21			23		3					
SW-5	SW-05	30-Nov-92	FS		36	65			21			23		3					
SW-23	SW-23	02-Dec-92	FS		36	65			21			24		5					
SW-24	SW-24	07-Jan-93	FS		36	65			21			24		4					
SW-25	SW-25	25-Mar-93	FS		36	65			21			26		4					
SW-26	SW-26	25-Mar-93	FS		36	65			21			30		4					
SW-27	SW-27	25-Mar-93	FS		36	65			21			24		4					
SW-28	SW-28	25-Mar-93	FS		36	65			21			24		4					
SW-29	SW-29	25-Mar-93	FS		36	65			21			26		4					
SW-30	SW-30	20-Apr-93	FS		38	65			21			24		4					
EDB	EDB1 WATER	13-Jan-98	FS									28		4					
EDC	EDC2 WATER	13-Jan-98	FS									28		4					
EDS	EDS3 WATER	13-Jan-98	FS									28		4					
ISCO3	1170-ISCO3-1	09-Feb-01	FS									1	1	1					
ISCO3	1170-ISCO3-5	09-Mar-01	FS									1	1	2					
ISCO3	1170-ISCO3-9	02-Apr-01	FS									1	2	4					
ISCO3	1170-ISCO3-13	30-Apr-01	FS									1	2	4					
ISCO3	1170-ISCO3-25	04-Jun-01	FS									1	2	4					
ISCO3	1170-ISCO3-33	02-Jul-01	FS									1	2	4					
ISCO3	1170-ISCO3-38	06-Aug-01	FS									1	2	4					
ISCO3	1170-ISCO3-42	04-Sep-01	FS									1	2	4					
ISCO3	1170-ISCO3-43	08-Oct-01	FS									1	2	4					
ISCO3	1170-ISCO3-44	12-Nov-01	FS									1	2	4					
ISCO3	1170-ISCO3-46	10-Dec-01	FS									1	2	4					
ISCO3	1170-ISCO3-50	07-Jan-02	FS									1	2	8					
ISCO3	1170-ISCO3-51	04-Feb-02	FS									1	2	8					
ISCO3	1170-ISCO3-52	25-Feb-02	FS									1	2	8					
ISCO3	1170-ISCO3-53	25-Mar-02	FS									1	2	9					
ISCO3	1170-ISCO3-54	22-Apr-02	FS									1	2	8					
ISCO3	1170-ISCO3-55	20-May-02	FS									1	2	6					
ISCO3	1170-ISCO3-56	24-Jun-02	FS									1	2	6					
ISCO3	1170-ISCO3-57	22-Jul-02	FS									1	2	6					
ISCO3	1170-ISCO3-61	04-Nov-02	FS									1	2	6					
ISCO3	1170-ISCO3-62	09-Dec-02	FS									1	2	6					
ISCO3	1170-ISCO3-63	03-Feb-03	FS									1	2	4					
ISCO3	1170-ISCO3-63	06-Feb-03	FS											2					
ISCO3	1170-ISCO3-64	05-May-03	FS									1	2	4					

Table 2.3-5
Summary of Chemical Analyses for OU2 Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Semivolatiles	Volatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride	Opex/Kempore
ISCO3	1170-ISCO3-64	19-May-03	FS												2						
EDSD/SW6	EDSW6-01	18-Jun-03	FS				68	65	16	1	20	9		24	23	16					
BACKFLOC	BACKFLOC-2003	19-Jun-03	FS											6		2					
BACKFLOC	BACKFLOCSW-2003	19-Jun-03	FS												6	1					
EDSD/SW1 (EDBS5)	EDSW1-01	19-Jun-03	FS				68	65	16	1	22	9	18	24	23	16					
EDSD/SW2 (EDBS6)	EDSW2-01	19-Jun-03	FS				68	65	16	1	22	9	18	24	23	16					
EDSD/SW3 (EDBS8)	EDSW3-01	19-Jun-03	FS				68	65	16	1	22	9	18	24	23	16					
EDSD/SW4 (EDBS10)	EDSW4-01	19-Jun-03	FS				68	65	16	1	22	9	18	24	23	16					
EDSD/SW4 (EDBS10)	EDSW4 DUP-01	19-Jun-03	FD							1											
EDSD/SW4 (EDBS10)	EDSW4DUP-01	19-Jun-03	FD				68	65	16		22	9	18	24	23	16					
EDSD/SW5 (EDBS11)	EDSW5-01	19-Jun-03	FS				68	65	16	1	22	9	18	24	23	16					
EDSD/SW6	EDSW6-01	19-Jun-03	FS								2		18								
SOEAST	SOEASTSW-2003	25-Jun-03	FS												6	1					
ISCO3	1170-ISCO3-64	10-Jul-03	FS							1											
ISCO3	1170-ISCO3-65	11-Aug-03	FS											1	2	6					
EDSD/SW1 (EDBS5)	EDSW1-02	23-Sep-03	FS				74	68	18	1	21	9	11	24	23	16					
EDSD/SW2 (EDBS6)	EDSW2-02	23-Sep-03	FS				74	68	18	1	21	9	11	24	23	16					
EDSD/SW3 (EDBS8)	EDSW3-02	23-Sep-03	FS				74	68	18	1	21	9	11	24	23	16					
EDSD/SW4 (EDBS10)	EDSW4-02	23-Sep-03	FS				74	68	18	1	21	9	11	24	23	16					
EDSD/SW4 (EDBS10)	EDSW4DUP-02	23-Sep-03	FD				74	68	18	1	21	9	11	24	23	16					
EDSD/SW5 (EDBS11)	EDSW5-02	23-Sep-03	FS				74	68	18	1	21	9	11	24	23	16					
EDSD/SW6	EDSW6-02	23-Sep-03	FS				74	68	18	1	21	9	11	24	23	16					
ISCO3	1170-ISCO3-66	17-Nov-03	FS											1	2	6					
ISCO3	1170-ISCO3-67	02-Feb-04	FS											1	2	6					
EDSD/SW5 (EDBS11)	EDSW5-03	28-Apr-04	FS				75	68		1	21	7		25	23	16					
EDSD/SW6	EDSW6-03	28-Apr-04	FS				75	68		1	21	7		25	23	16					
EDSD/SW7	EDSW7-01	28-Apr-04	FS				75	68		1	21	7		25	23	16					
EDSD/SW8	EDSW8-01	28-Apr-04	FS				75	68		1	21	7		25	23	16					
EDSD/SW0	EDSW0-01	29-Apr-04	FS				75	68		1	19	7		25	23	16					
EDSD/SW0	EDSW0-03	29-Apr-04	FS								2										
EDSD/SW1 (EDBS5)	EDSW1-03	29-Apr-04	FS				75	68		1	21	7		25	23	16					
EDSD/SW2 (EDBS6)	EDSW2-03	29-Apr-04	FS				75	68		1	21	7		25	23	16					
EDSD/SW3 (EDBS8)	EDSW3-03	29-Apr-04	FS				75	68		1	21	7		25	23	16					
EDSD/SW4 (EDBS10)	EDSW4-03	29-Apr-04	FS				75	68		1	21	7		25	23	16					
EDSD/SW4 (EDBS10)	EDSW4 DUP-03	29-Apr-04	FD				75	68		1	21	7		25	23	16					
ISCO3	1170-ISCO3-68	10-May-04	FS											1	2	6					
ISCO3	1170-ISCO3-69	09-Aug-04	FS											1	2	6					
EDLBSW1	EDLBSW1-01	05-Oct-04	FS				77	68	18	1	21	7	11	25	23	15	3				
EDSD/SW7	EDSW7-02	05-Oct-04	FS				77	68	18	1	21	7	11	25	23	15	3				
EDSD/SW8	EDSW8-02	05-Oct-04	FS				77	68	18	1	21	7	11	25	23	15	3				
EDSD/SW8	EDSW8-02 DUP	05-Oct-04	FD								2										
EDSD/SW8	EDSW8DUP-02	05-Oct-04	FD				77	68	18	1	19	7	11	25	23	15	3				

Table 2.3-5
Summary of Chemical Analyses for OU2 Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Semivolatiles	Volatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride	Opex/Kempore
ISCO3	1170-ISCO3-70	01-Nov-04	FS											1	2	6					
ISCO3	1170-ISCO3-71	31-Jan-05	FS											1	2	1					
ISCO3	1170-ISCO3-71	01-Feb-05	FS													5					
EDLBSW1	EDLBSW1-02	15-Feb-05	FS				77	68	18	1	21	7	10	25	23	15	3				
EDSD/SW7	EDSW7-03	15-Feb-05	FS				77	68	18	1	21	7	10	25	23	15	3				
EDSD/SW8	EDSW8-03	15-Feb-05	FS				77	68	18	1	21	7	10	25	23	15	3				
EDSD/SW8	EDSW8 DUP-03	15-Feb-05	FD							1											
EDSD/SW8	EDSW8DUP-03	15-Feb-05	FD				77	68	18		21	7	10	25	23	15	3				
ISCO3	1170-ISCO3-72	09-May-05	FS											1	2	6					
ISCO3	1170-ISCO3-74	21-Nov-05	FS											1	2	6					
ISCO3	1170-ISCO3-75	20-Feb-06	FS													4					
ISCO3	ISCO-3	22-Aug-07	FS											3	3	6					
ISCO3	OC-ISCO-3	12-Nov-07	FS											3	3	6					
ISCO3	OC-ISCO-3	06-Mar-08	FS											3	3	6					
ISCO3	OC-ISCO-3	22-May-08	FS											3	3	6					
ISCO3	OC-ISCO-3	27-Aug-08	FS											3	3	7					
ISCO3	OC-ISCO-3	18-Nov-08	FS											3	3	6					
ISCO3	OC-ISCO-3	24-Feb-09	FS											3	3	6					
ISCO3	OC-ISCO-3	12-May-09	FS											3	3	6					
ISCO3	OC-ISCO-3	12-Aug-09	FS											3	3	6					
ISCO3	OC-SW-ISCO3	12-Nov-09	FS											3	3	6					
ISCO3	OC-SW-ISCO-3-0.2	18-Feb-10	FS	0.2	-	0.2								3	3	6					
ISCO3	OC-SW-ISCO3	09-Jun-10	FS											3	3	6					
ISCO3	OC-ISCO 3	01-Sep-10	FS											3	3	6					
ISCO3	OC-SW-ISCO3	15-Nov-10	FS											3	3	6					
EDSD/SW0	OC-SW-EDSD/SW0-XXX	13-Dec-10	FS				77	71		2				24		9					2
EDSD/SW1 (EDBS5)	OC-SW-EDSD/SW1 (EDBS5)-XXX	13-Dec-10	FS				77	71		2				24		9					2
EDSD/SW2 (EDBS6)	OC-SW-EDSD/SW2 (EDBS6)-XXX	13-Dec-10	FS				77	71		2				25		9					2
EDSD/SW5 (EDBS11)	OC-SW-EDSD/SW5 (EDBS11)-XXX	13-Dec-10	FS				77	71		2				25		9					2
ISCO3	OC-SW-ISCO3	22-Mar-11	FS											3	3	6					
ISCO3	OC-SW-ISCO3	16-May-11	FS											3	3	6					
EDSD/SW0	OC-SW-EDSD/SW0-XXX	08-Jun-11	FS																		2
EDSD/SW0	OC-SW-SD-EDSD/SW0-XXX	08-Jun-11	FS				77	71		2				24		9					
EDSD/SW1 (EDBS5)	OC-SW-EDSD/SW1(EDBS5)-XXX	08-Jun-11	FS				77	71		2				24		9					2
EDSD/SW2 (EDBS6)	OC-SW-EDSD/SW2(EDBS6)-XXX	08-Jun-11	FS				77	71		2				25		9					2
EDSD/SW5 (EDBS11)	OC-SW-EDSD/SW5(EDBS11)-XXX	08-Jun-11	FS				77	71		2				25		9					2
ISCO3	OC-SW-ISCO3	23-Aug-11	FS											3	3	6					
ISCO3	OC-SW-ISCO3	08-Nov-11	FS											3	3	6					
ISCO3	OC-ISCO3-SW	23-Feb-12	FS											3	3	6					
ISCO3	OC-SW-ISCO3	07-Jun-12	FS											3	3	6					
EDSD/SW7	OC-SW-EDSD/SW7-XXX	18-Jun-12	FS				77	71		2				24		9					2
ISCO3	OC-SW-ISCO3	23-Aug-12	FS											3	3	6					

Table 2.3-5
Summary of Chemical Analyses for OU2 Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Semivolatiles	Volatiles	PAHs	NDMA	Pesticides	PCBs	Herbicides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride	Opex/Kempore
EDSD/SW7	OC-SW-EDSD/SW7-XXX	06-Nov-12	FS				77	73		2				24		9					2
ISCO3	OC-SW-ISCO3	16-Nov-12	FS											3	3	6					
ISCO3	OC-ISCO3	21-Mar-13	FS											3	3	6					
ISCO3	OC-ISCO3	13-May-13	FS											3	3	6					
ISCO3	OC-ISCO3	22-Aug-13	FS											3	3	6					
ISCO3	OC-ISCO3	21-Nov-13	FS											3	3	6					
Sediment																					
SW-1	SW-01	31-Aug-92	FS				65	36			21			23		4					
SW-2	SW-02	31-Aug-92	FS				65	36			21			23		4					
SW-3	SW-03	31-Aug-92	FS				65	36			21			23		4					
SW-4	SW-04	31-Aug-92	FS				65	36			21			23		4					
SW-5	SW-05	31-Aug-92	FS				65	36			21			23		4					
SW-1	SW-01	30-Nov-92	FS				65	36			21			23		4					
SW-2	SW-02	30-Nov-92	FS				65	36			21			23		4					
SW-3	SW-03	30-Nov-92	FS				65	36			21			23		4					
SW-4	SW-04	30-Nov-92	FS				65	36			21			23		4					
SW-5	SW-05	30-Nov-92	FS				65	36			21			23		4					
SW-23	SW-23	02-Dec-92	FS				65	36			21			24		6					
SW-24	SW-24	07-Jan-93	FS				65	36			21			23		4					
SW-25	SW-25	25-Mar-93	FS				65	36			21			23		4					
SW-26	SW-26	25-Mar-93	FS				65	36			21			23		4					
SW-27	SW-27	25-Mar-93	FS				65	36			21			23		4					
SW-29	SW-29	20-Apr-93	FS				65	36			21			23		4					
SW-30	SW-30	20-Apr-93	FS				65	36			21			23		4					
EDSD/SW6	EDSD6-01	18-Jun-03	FS				67	68	16		20	9	18	24		9					
EDSD/SW1 (EDBS5)	EDSD1-01	19-Jun-03	FS				67	68	16		20	9	18	24		9					
EDSD/SW2 (EDBS6)	EDSD2-01	19-Jun-03	FS				67	68	16		20	9	18	24		9					
EDSD/SW2 (EDBS6)	EDSD2-DUP-01	19-Jun-03	FD				67	68	16		20	9	18	24		9					
EDSD/SW3 (EDBS8)	EDSD3-01	19-Jun-03	FS				67	68	16		20	9	18	24		9					
EDSD/SW4 (EDBS10)	EDSD4-01	19-Jun-03	FS				67	68	16		20	9	18	24		9					
EDSD/SW5 (EDBS11)	EDSD5-01	19-Jun-03	FS				67	68	16		20	9	18	24		9					
EDSD/SW7	EDSD7-01	28-Apr-04	FS				69	75			19	9		25		15					
EDSD/SW8	EDSD8-01	28-Apr-04	FS				69	75			19	9		25		15					
EDSD/SW0	EDSD0-01	29-Apr-04	FS				69	75			19	9		25		15					
EDSD/SW0	EDSD0DUP-01	29-Apr-04	FD				69	75			19	9		25		15					
EDSD/SW2 (EDBS6)	OC-SD-EDSD/SW2 (EDBS6)-XXX	13-Dec-10	FS	0	-	0.33	79	77						24		8					
EDSD/SW7	OC-SD-EDSD/SW7-XXX	18-Jun-12	FS	0	-	0.5	80	77						24		10	3	2	1	1	
EDSD/SW7	OC-SD-EDSD/SW7-XXX	06-Nov-12	FS				77	77		1				23		9	3	2	1	1	

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/27/13
Checked by / Date: CTM 03/28/13

Table 2.3-6
Summary of Chemical Analyses for OU2 Samples - Landfill Brook
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Metals, Total	Inorganics/Physical
Surface Water										
LB-1	OC-SW-LB-1-XXX	09-Dec-10	FS				77	72	24	9
LB-2	OC-SW-LB-S2-XXX	09-Dec-10	FS				77	72	24	9
LB-3	OC-SW-LB-3-XXX	09-Dec-10	FS				77	72	24	9
LB-1	OC-SW-LB-1-XXX	07-Jun-11	FS				77	72	24	9
LB-2	OC-SW-LB-2-XXX	07-Jun-11	FS				77	72	24	9
LB-3	OC-SW-LB-3-XXX	07-Jun-11	FS				77	72	24	9
Sediment										
LB-1	OC-SD-LB-1-XXX	09-Dec-10	FS	0	-	0.5	77	79	24	8
LB-2	OC-SD-LB-2-XXX	09-Dec-10	FS	0	-	0.5	77	79	24	8
LB-3	OC-SD-LB-3-XXX	09-Dec-10	FS	0	-	0.5	77	79	24	8

FS = Field Sample

Prepared by / Date: KJC 03/27/13
Checked by / Date: CTM 03/28/13

Table 2.3-7
Summary of Chemical Analyses for OU2 Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Opex/Kempore
Surface Water																
SDREF-012	BS012REF	23-Jan-97	FS					65		19	23					
MMB-SW/SD-1	MMB-SW1 D DUP	17-Oct-01	FD								5	5	3			
MMB-SW/SD-2	MMB-SW2	17-Oct-01	FS								6	5	3			
MMB-SW/SD-3	MMB-SW3	17-Oct-01	FS								6	5	3			
MMB-SW/SD-6	MMB-SW6	17-Oct-01	FS								6	5	3			
MMB-SW/SD-7	MMB-SW7	17-Oct-01	FS								6	5	3			
MMB-SW/SD-4	MMB-SW4	18-Oct-01	FS								5	6	3			
MMB-SW/SD-5	MMB-SW5	18-Oct-01	FS								5	5	3			
MMB-SW/SD-8A	MMB-SW8A	18-Oct-01	FS								6	5	3			
MMB-SW/SD-1	MMBSW1-02	12-Jun-02	FS								5	5	3			
MMB-SW/SD-2	MMBSW2-02	12-Jun-02	FS								5	5	3			
MMB-SW/SD-3	MMBSW3-02	12-Jun-02	FS								5	5	3			
MMB-SW/SD-6	MMBSW6-02	12-Jun-02	FS								5	5	3			
MMB-SW/SD-7	MMBSW7-02	12-Jun-02	FS								5	5	3			
MMB-SW/SD-4	MMB-SW4-02	13-Jun-02	FS								5	5	3			
MMB-SW/SD-4	MMB-SW4-02D DUP	13-Jun-02	FD								5	5	3			
MMB-SW/SD-5	MMB-SW5-02	13-Jun-02	FS								5	5	3			
MMB-SW/SD-8A	MMB-SW8A-02	13-Jun-02	FS								5	5	3			
MMB-SW/SD-3	MMB-SW3-03	03-Jun-03	FS						1							
MMB-SW/SD-4	MMB-SW4-03	03-Jun-03	FS						1							
MMB-SW/SD-6	MMB-SW6-03	03-Jun-03	FS						1							
MMB-SW/SD-8	MMB-SW8-03	03-Jun-03	FS						1							
MMB-SW/SD-9	MMB-SW9-03	03-Jun-03	FS						1							
MMB-SW/SD-2	MMB-SW-2	10-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-6	MMB-SW-6	10-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-3	MMB-SW-3	11-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-1	MMB-SW-1	12-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-10	MMB-SW-10	12-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-4	MMB-SW-4	12-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-11	MMB-SW-11	13-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-5	MMB-SW-5	13-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-8	MMB-SW-8	13-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-8A	MMB-SW-8A	13-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-9	MMB-SW-9	13-Nov-03	FS				2		1		1	19	10			
MMB-SW/SD-11	MMB-SW-11	03-Feb-04	FS						1			19	9			
MMB-SW/SD-2	MMB-SW-2	03-Feb-04	FS						1			19	9			
MMB-SW/SD-3	MMB-SW-3	03-Feb-04	FS						1			19	9			

Table 2.3-7
Summary of Chemical Analyses for OU2 Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Opex/Kempore
MMB-SW/SD-5	MMB-SW-5	03-Feb-04	FS				1		19	9				
MMB-SW/SD-8	MMB-SW-8	03-Feb-04	FS				1		19	9				
MMB-SW/SD-8A	MMB-SW-8A	03-Feb-04	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9	03-Feb-04	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1	04-Feb-04	FS				1		19	9				
MMB-SW/SD-10	MMB-SW-10	04-Feb-04	FS				1		19	9				
MMB-SW/SD-4	MMB-SW-4	04-Feb-04	FS				1		19	9				
MMB-SW/SD-11	MMB-SW-11	11-May-04	FS				1		19	9				
MMB-SW/SD-2	MMB-SW-2	11-May-04	FS				1		19	9				
MMB-SW/SD-5	MMB-SW-5	11-May-04	FS				1		19	9				
MMB-SW/SD-8	MMB-SW-8	11-May-04	FS				1		19	9				
MMB-SW/SD-8A	MMB-SW-8A	11-May-04	FS				1		19	9				
MMB-SW/SD-3	MMB-SW-3	12-May-04	FS				1		19	9				
MMB-SW/SD-6	MMB-SW-6	12-May-04	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9	12-May-04	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1	13-May-04	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1 DUP	13-May-04	FD				1							
MMB-SW/SD-1	MMB-SW-1 DUPLICATE	13-May-04	FD						19	9				
MMB-SW/SD-10	MMB-SW-10	13-May-04	FS				1		19	9				
MMB-SW/SD-4	MMB-SW-4	13-May-04	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9	11-Aug-04	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1	12-Aug-04	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1 DUPLICATE	12-Aug-04	FD						19	9				
MMB-SW/SD-1	MMB-SW-1-DUP	12-Aug-04	FD				1							
MMB-SW/SD-8	MMB-SW-8	12-Aug-04	FS				1		19	9				
MMB-SW/SD-10	MMB-SW-10	17-Aug-04	FS				1		19	9				
MMB-SW/SD-11	MMB-SW-11	17-Aug-04	FS				1		19	9				
MMB-SW/SD-2	MMB-SW-2	17-Aug-04	FS				1		19	9				
MMB-SW/SD-3	MMB-SW-3	17-Aug-04	FS				1		19	9				
MMB-SW/SD-4	MMB-SW-4	17-Aug-04	FS				1		19	9				
MMB-SW/SD-5	MMB-SW-5	17-Aug-04	FS				1		19	9				
MMB-SW/SD-6	MMB-SW-6	17-Aug-04	FS				1		19	9				
MMB-SW/SD-8A	MMB-SW-8A	17-Aug-04	FS				1		19	9				
MMB-SW/SD-11	MMB-SW11	15-Nov-04	FS				1							
MMB-SW/SD-11	MMB-SW-11	15-Nov-04	FS						19	9				
MMB-SW/SD-5	MMB-SW5	15-Nov-04	FS				1							
MMB-SW/SD-5	MMB-SW-5	15-Nov-04	FS						19	9				
MMB-SW/SD-6	MMB-SW6	15-Nov-04	FS				1							

Table 2.3-7
Summary of Chemical Analyses for OU2 Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Opex/Kempore
MMB-SW/SD-6	MMB-SW-6	15-Nov-04	FS						19	9				
MMB-SW/SD-8A	MMB-SW8A	15-Nov-04	FS				1							
MMB-SW/SD-8A	MMB-SW-8A	15-Nov-04	FS						19	9				
MMB-SW/SD-2	MMB-SW2	16-Nov-04	FS				1							
MMB-SW/SD-2	MMB-SW-2	16-Nov-04	FS						19	9				
MMB-SW/SD-3	MMB-SW3	16-Nov-04	FS				1							
MMB-SW/SD-3	MMB-SW-3	16-Nov-04	FS						19	9				
MMB-SW/SD-10	MMB-SW10	17-Nov-04	FS				1							
MMB-SW/SD-10	MMB-SW-10	17-Nov-04	FS						19	9				
MMB-SW/SD-4	MMB-SW4	17-Nov-04	FS				1							
MMB-SW/SD-4	MMB-SW-4	17-Nov-04	FS						19	9				
MMB-SW/SD-1	MMB-SW1	18-Nov-04	FS				1							
MMB-SW/SD-1	MMB-SW-1	18-Nov-04	FS						19	9				
MMB-SW/SD-1	MMB-SW-1 Duplicate	18-Nov-04	FD						19	9				
MMB-SW/SD-1	MMB-SW1DUP	18-Nov-04	FD				1							
MMB-SW/SD-8	MMB-SW8	18-Nov-04	FS				1							
MMB-SW/SD-8	MMB-SW-8	18-Nov-04	FS						19	9				
MMB-SW/SD-9	MMB-SW9	18-Nov-04	FS				1							
MMB-SW/SD-9	MMB-SW-9	18-Nov-04	FS						19	9				
MMB-SW/SD-2	MMB-SW-2	10-May-05	FS				1		19	9				
MMB-SW/SD-11	MMB-SW-11	11-May-05	FS				1		19	9				
MMB-SW/SD-3	MMB-SW-3	11-May-05	FS				1		19	9				
MMB-SW/SD-5	MMB-SW-5	11-May-05	FS				1		19	9				
MMB-SW/SD-8	MMB-SW-8	11-May-05	FS				1		19	9				
MMB-SW/SD-8A	MMB-SW-8A	11-May-05	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1	12-May-05	FS				1			9				
MMB-SW/SD-1	MMB-SW-1 DUP	12-May-05	FD				1							
MMB-SW/SD-1	MMB-SW-1 DUPLICATE	12-May-05	FD							9				
MMB-SW/SD-10	MMB-SW-10	12-May-05	FS				1		19	9				
MMB-SW/SD-4	MMB-SW-4	12-May-05	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9	12-May-05	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9 DUP	12-May-05	FD				1							
MMB-SW/SD-9	MMB-SW-9 DUPLICATE	12-May-05	FD						19	9				
MMB-SW/SD-1	MMB-SW-1	13-May-05	FS						19					
MMB-SW/SD-1	MMB-SW-1 DUPLICATE	13-May-05	FD						19					
MMB-SW/SD-6	MMB-SW-6	13-May-05	FS				1		19	9				
MMB-SW/SD-2	MMB-SW-2	26-Jul-05	FS				1		19	9				
MMB-SW/SD-3	MMB-SW-3	26-Jul-05	FS				1		19	9				

Table 2.3-7
Summary of Chemical Analyses for OU2 Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)	Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Opex/Kempore
MMB-SW/SD-1	MMB-SW-1	28-Jul-05	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1 DUP	28-Jul-05	FD				1							
MMB-SW/SD-1	MMB-SW-1 DUPLICATE	28-Jul-05	FD						19	9				
MMB-SW/SD-11	MMB-SW-11	28-Jul-05	FS				1		19	9				
MMB-SW/SD-5	MMB-SW-5	28-Jul-05	FS				1		19	9				
MMB-SW/SD-6	MMB-SW-6	28-Jul-05	FS				1		19	9				
MMB-SW/SD-8	MMB-SW-8	28-Jul-05	FS				1		19	9				
MMB-SW/SD-8A	MMB-SW-8A	28-Jul-05	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9	28-Jul-05	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9 DUPLICATE	28-Jul-05	FD						19	9				
MMB-SW/SD-10	MMB-SW-10	29-Jul-05	FS						19	9				
MMB-SW/SD-4	MMB-SW-4	29-Jul-05	FS				1		19	9				
MMB-SW/SD-11	MMB-SW-11	08-Nov-05	FS				1		19	9				
MMB-SW/SD-2	MMB-SW-2	08-Nov-05	FS				1		19	9				
MMB-SW/SD-3	MMB-SW-3	08-Nov-05	FS				1		19	9				
MMB-SW/SD-5	MMB-SW-5	08-Nov-05	FS				1		19	9				
MMB-SW/SD-8	MMB-SW-8	08-Nov-05	FS				1		19	9				
MMB-SW/SD-8A	MMB-SW-8A	08-Nov-05	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1	09-Nov-05	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1 DUPLICATE	09-Nov-05	FD						19	9				
MMB-SW/SD-1	MMB-SW-1-DUP	09-Nov-05	FD				1							
MMB-SW/SD-4	MMB-SW-4	09-Nov-05	FS				1		19	9				
MMB-SW/SD-6	MMB-SW-6	09-Nov-05	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9	09-Nov-05	FS				1		19	9				
MMB-SW/SD-9	MMB-SW-9 DUPLICATE	09-Nov-05	FD						19	9				
MMB-SW/SD-9	MMB-SW-9-DUP	09-Nov-05	FD				1							
MMB-SW/SD-10	MMB-SW-10	17-Nov-05	FS				1		19	9				
MMB-SW/SD-1	MMB-SW-1	25-May-06	FS				1		22	9				
MMB-SW/SD-1	MMB-SW-1 DUP	25-May-06	FD				1							
MMB-SW/SD-1	MMB-SW-1 Duplicate	25-May-06	FD						22	9				
MMB-SW/SD-10	MMB-SW-10	25-May-06	FS				1		22	9				
MMB-SW/SD-11	MMB-SW11	25-May-06	FS						22	9				
MMB-SW/SD-11	MMB-SW-11	25-May-06	FS				1							
MMB-SW/SD-2	MMB-SW2	25-May-06	FS						22	9				
MMB-SW/SD-2	MMB-SW-2	25-May-06	FS				1							
MMB-SW/SD-3	MMB-SW3	25-May-06	FS						22	9				
MMB-SW/SD-3	MMB-SW-3	25-May-06	FS				1							
MMB-SW/SD-4	MMB-SW-4	25-May-06	FS				1		22	9				

Table 2.3-7
Summary of Chemical Analyses for OU2 Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Opex/Kempore
MMB-SW/SD-5	MMB-SW-5	25-May-06	FS						1			22	9			
MMB-SW/SD-6	MMB-SW6	25-May-06	FS									22	9			
MMB-SW/SD-6	MMB-SW-6	25-May-06	FS						1							
MMB-SW/SD-8	MMB-SW-8	25-May-06	FS						1			22	9			
MMB-SW/SD-8A	MMB-SW8A	25-May-06	FS									22	9			
MMB-SW/SD-8A	MMB-SW-8A	25-May-06	FS						1							
MMB-SW/SD-9	MMB-SW-9	25-May-06	FS						1			22	9			
MMB-SW/SD-9	MMB-SW-9 DUP	25-May-06	FD						1							
MMB-SW/SD-9	MMB-SW-9 Duplicate	25-May-06	FD									22	9			
MMB-SW/SD-1	OC-SW-MMB-SW/SD-1-XXX	01-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-9	OC-SW-MMB-SW/SD-9-XXX	01-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-10	OC-SW-MMB-SW/SD-10-XXX	02-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-11	OC-SW-MMB-SW/SD-11-XXX	02-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-4	OC-SW-MMB-SW/SD-4-XXX	02-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-5	OC-SW-MMB-SW/SD-5-XXX	02-Dec-10	FS				77	72	2		24		9	3	2	2
MMB-SW/SD-8	OC-SW-MMB-SW/SD-8-XXX	02-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-8	OC-SW-MMB-SW/SD-8-DUP	02-Dec-10	FD				77	72	2		24		9	3	2	
MMB-SW/SD-8A	OC-SW-MMB-SW/SD-8A-XXX	02-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-2	OC-SW-MMB-SW/SD-2-XXX	03-Dec-10	FS				77	72	2		24		9	3	2	2
MMB-SW/SD-3	OC-SW-MMB-SW/SD-3-XXX	03-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-6	OC-SW-MMB-SW/SD-6-XXX	03-Dec-10	FS				77	72	2		24		9	3	2	
MMB-SW/SD-1	OC-SW-MMB-SW/SD-1-XXX	06-Jun-11	FS				77	72	2		24		9	3	2	
MMB-SW/SD-1	OC-SW-MMB-SW/SD-1-DUP	06-Jun-11	FD				77	72	2		24		9	3	2	
MMB-SW/SD-10	OC-SW-MMB-SW/SD-10-XXX	06-Jun-11	FS				77	72	2		24		9	3	2	
MMB-SW/SD-4	OC-SW-MMB-SW/SD-4-XXX	06-Jun-11	FS				77	72	2		24		9	3	2	
MMB-SW/SD-9	OC-SW-MMB-SW/SD-9-XXX	06-Jun-11	FS				77	72	2		24		9	3	2	
MMB-SW/SD-11	OC-SW-MMB-SW/SD-11-XXX	07-Jun-11	FS				77	72	2		24		9	3	2	
MMB-SW/SD-5	OC-SW-MMB-SW/SD-5-XXX	07-Jun-11	FS				77	72	2		24		9	3	2	2
MMB-SW/SD-8	OC-SW-MMB-SW/SD-8-XXX	07-Jun-11	FS				77	72	2		24		9	3	2	
MMB-SW/SD-8A	OC-SW-MMB-SW/SD-8A-XXX	07-Jun-11	FS								3			3		
MMB-SW/SD-2	OC-SW-MMB-SW/SD-2-XXX	08-Jun-11	FS				77	72	2		24		9	3	2	2
MMB-SW/SD-3	OC-SW-MMB-SW/SD-3-XXX	08-Jun-11	FS				77	72	2		24		9	3	2	
MMB-SW/SD-6	OC-SW-MMB-SW/SD-6-XXX	08-Jun-11	FS				77	72	2		24		9	3	2	
MMB-SW/SD-8A	OC-SW-MMB-SW/SD-8A-XXX	08-Jun-11	FS				77	72	2		21		9		2	
Sediment																
SDREF-012	BS012REF	20-Jan-97	FS					65		21	23		1			
MMB-SW/SD-1	MMB-SD1 D DUP	17-Oct-01	FD										3			
MMB-SW/SD-2	MMB-SD2	17-Oct-01	FS										3			

Table 2.3-7
Summary of Chemical Analyses for OU2 Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	NDMA	Pesticides	Metals, Total	Metals, Filtered	Inorganics/Physical	Hydrazine	Formaldehyde	Opex/Kempore
MMB-SW/SD-3	MMB-SD3	17-Oct-01	FS										3			
MMB-SW/SD-6	MMB-SD6	17-Oct-01	FS										3			
MMB-SW/SD-7	MMB-SD7	17-Oct-01	FS										3			
MMB-SW/SD-4	MMB-SD4	18-Oct-01	FS										3			
MMB-SW/SD-5	MMB-SD5	18-Oct-01	FS										3			
MMB-SW/SD-8A	MMB-SD8A	18-Oct-01	FS										3			
MMB-SW/SD-1	MMBSD1-02	12-Jun-02	FS										3			
MMB-SW/SD-2	MMBSD2-02	12-Jun-02	FS										3			
MMB-SW/SD-3	MMBSD3-02	12-Jun-02	FS										3			
MMB-SW/SD-6	MMBSD6-02	12-Jun-02	FS										3			
MMB-SW/SD-7	MMBSD7-02	12-Jun-02	FS										3			
MMB-SW/SD-4	MMB-SD04-02	13-Jun-02	FS										3			
MMB-SW/SD-4	MMB-SD04-02D DUP	13-Jun-02	FD										2			
MMB-SW/SD-5	MMB-SD05-02	13-Jun-02	FS										3			
MMB-SW/SD-8A	MMB-SD8A-02	13-Jun-02	FS										3			
MMB-SW/SD-1	OC-SD-MMB-SW/SD-1-XXX	01-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-9	OC-SD-MMB-SW/SD-9-XXX	01-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-10	OC-SD-MMB-SW/SD-10-XXX	02-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-11	OC-SD-MMB-SW/SD-11-XXX	02-Dec-10	FS	0	-	0.5	77	79			24		9	3	2	
MMB-SW/SD-4	OC-SD-MMB-SW/SD-4-XXX	02-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-5	OC-SD-MMB-SW/SD-5-XXX	02-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-8	OC-SD-MMB-SW/SD-8-XXX	02-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-8	OC-SD-MMB-SW/SD-8-DUP	02-Dec-10	FD	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-8A	OC-SD-MMB-SW/SD-8A-XXX	02-Dec-10	FS	0	-	0.5	77	79			24		9	3	2	
MMB-SW/SD-2	OC-SD-MMB-SW/SD-2-XXX	03-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-3	OC-SD-MMB-SW/SD-3-XXX	03-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
MMB-SW/SD-6	OC-SD-MMB-SW/SD-6-XXX	03-Dec-10	FS	0	-	0.5	77	79			24		8	3	2	
SDREF-012	OC-SD-SDREF-012-XXX	03-Dec-10	FS	0	-	0.5	77	79			24		8			
MMB-SW/SD-1	OC-SD-MMB-SW/SD-1-XXX	17-Feb-11	FS				77	79			24		22			
Tissue																
BS021-02	BS021EWREF-02	04-Nov-05	FS					64		22	23		2			
BS021-03	BS021EWREF-03	04-Nov-05	FS					64		22	23		2			
BS021-04	BS021EWREF-04	04-Nov-05	FS					64		22	23		2			

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/05/13
Checked by / Date: CTM 03/28/13

Table 2.3-8
Stream Flow Measurements
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

	Date Measured:	4/15/11	5/13/11	6/14/11	7/13/11	8/17/11	9/13/11	10/31/11	11/30/2011	12/21/2011	1/25/2012	2/27/12	3/22/2012
Outlet													
Maple Meadow Brook Outlet-Canal	Q (out) ft^3/sec =	19.5	22.4	22.9	0.7	17.4	11.0	32.0	29.6	11.6	8.8	6.7	5.0
Inflow #1													
Sawmill Brook	Q 1 ft^3/sec =	6.1	6.6	3.4	0.4	1.9	5.2	6.0	13.9	5.4	3.6	2.2	1.8
Inflow #2													
Maple Meadow Brook	Q 2 ft^3/sec =	3.1	3.3	1.9	0.5	11.4	2.6	3.6	14.5	2.8	2.3	1.5	1.2
	Q (1,2) =	9.2	9.9	5.3	0.9	13.3	7.7	9.6	28.4	8.2	5.9	3.7	3.1
	Q(out) - Q (1,2) =	10.3	17.6	17.6	-0.2	4.1	3.3	22.4	1.3	3.4	2.9	2.9	1.9

Created by: CHL

Checked by: CTM

Table 2.4-1
Summary of Chemical Analyses for Background Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Metals	Inorganics/Physical	Hydrazine	Formaldehyde	Dimethylformamide	Phthalic Anhydride
SS-434	OC-SS-434-0.0/1.0-XXX	16-Sep-09	FS	0	-	1	78	80	24	7	3	2	1	1
SS-435	OC-SS-435-0.0/1.0-XXX	16-Sep-09	FS	0	-	1	78	79	24	5				
SS-449	OC-SS-449-0.0/1.0-XXX	16-Sep-09	FS	0	-	1	78	79	24	5				
SS-450	OC-SS-450-0.0/1.0-XXX	16-Sep-09	FS	0	-	1	78	80	24	6	3	2	1	1
SS-451	OC-SS-451-0.0/1.0-XXX	16-Sep-09	FS	0	-	1	78	79	24	5				
SS-455	OC-SS-455-0.0/1.0-XXX	16-Sep-09	FS	0	-	1	78	80	24	7	3	2	1	1
SS-460	OC-SS-460-0.0/1.0-XXX	16-Sep-09	FS	0	-	1	78	80	24	6	3	2	1	1
SS-453	OC-SS-453-0.0/1.0-XXX	17-Sep-09	FS	0	-	1	78	80	24	6	3	2	1	1
SS-454	OC-SS-454-0.0/1.0-XXX	17-Sep-09	FS	0	-	1	78	79	24	5				

FS = Field Sample

Prepared by / Date: KJC 03/27/13
Checked by / Date: CTM 03/28/13

Table 2.4-2
Summary of Detected Chemicals for Background Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	95% UPL (1)	OC-SS-434-0.0/1.0-XXX SS-434 9/16/2009 0-1 ft	OC-SS-435-0.0/1.0-XXX SS-435 9/16/2009 0-1 ft	OC-SS-449-0.0/1.0-XXX SS-449 9/16/2009 0-1 ft	OC-SS-450-0.0/1.0-XXX SS-450 9/16/2009 0-1 ft
Volatile Organics (mg/Kg)									
Acetone	3 / 9	0.29 : 19	0.034 - 0.035	1.158	0.037	0.0031 U	0.19 U	0.0035 U	0.0037 U
Semivolatile Organics (mg/Kg)									
Benzo(a)anthracene	4 / 9	0.039 : 0.048	0.012 - 0.017	0.018	0.019	0.04 U	0.039 U	0.048 U	0.017 J
Benzo(a)pyrene	5 / 9	0.039 : 0.048	0.014 - 0.022	0.019	0.023	0.04 U	0.039 U	0.048 U	0.022 J
Benzo(b)fluoranthene	5 / 9	0.039 : 0.048	0.018 - 0.029	0.021	0.053	0.04 U	0.039 U	0.048 U	0.019 J
Benzo(ghi)perylene	2 / 9	0.039 : 0.048	0.015 - 0.021	0.020	0.024	0.04 U	0.039 U	0.048 U	0.021 J
Benzaldehyde	9 / 9		0.036 - 0.098	0.063	0.102	0.051	0.036 J	0.058	0.085
Bis(2-Ethylhexyl)phthalate	6 / 9	0.038 : 0.046	0.012 - 0.031	0.019	0.031	0.04 U	0.012 JEB	0.031 JEB	0.016 JEB
Chrysene	6 / 9	0.039 : 0.048	0.015 - 0.027	0.021	0.028	0.04 U	0.015 J	0.048 U	0.027 J
Fluoranthene	8 / 9	0.04 : 0.04	0.015 - 0.043	0.026	0.044	0.04 U	0.022 J	0.019 J	0.043 J
Indeno(1,2,3-cd)pyrene	8 / 9	0.04 : 0.04	0.015 - 0.03	0.021	0.033	0.04 UJ	0.015 J	0.017 J	0.03 J
Phenanthrene	6 / 9	0.047 : 0.057	0.014 - 0.035	0.022	0.036	0.048 U	0.014 J	0.057 U	0.035 J
Pyrene	8 / 9	0.04 : 0.04	0.016 - 0.049	0.028	0.050	0.04 U	0.02 J	0.017 J	0.049 J
Inorganics (mg/Kg)									
Aluminum	9 / 9		1400 - 13000	7378	16279	13000	11000	1900	5800
Arsenic	9 / 9		0.64 - 10	5.0	11.7	4.7	6.8	1.4 J	5.8
Barium	9 / 9		3.5 - 15	10.2	17.7	12	15	3.5	13
Beryllium	9 / 9		0.042 - 0.32	0.21	0.40	0.3	0.29 J	0.087 J	0.18 J
Cadmium	9 / 9		0.037 - 0.26	0.15	0.32	0.22 J	0.26 J	0.053 J	0.12 J
Calcium	9 / 9		86 - 590	368	680	480	590	86	330
Chromium	9 / 9		1.5 - 10	6.2	12.8	8.8	9.1	1.5	6
Cobalt	9 / 9		0.45 - 2.9	1.6	3.41	2.3	2.3	0.56 J	2
Copper	9 / 9		1.7 - 5.8	4.1	6.70	3.6	5.8	3.1	4.1
Iron	9 / 9		610 - 12000	6314	15564	10000	12000	610	5200
Lead	9 / 9		7.8 - 26	15.6	27.7	9.8	14	18	26
Magnesium	9 / 9		24 - 1100	452	1215	520	600	33	740
Manganese	9 / 9		3.4 - 69	28	75.3	32	69	3.8	25
Mercury	7 / 9	0.21 : 0.21	0.048 - 0.11	0.077	0.12	0.074 J	0.11 J	0.21 U	0.048 J
Nickel	9 / 9		1.3 - 7.3	4.0	8.4	5.8	5.8	1.5 J	3.9
Potassium	9 / 9		51 - 580	351	682	400	440	210 J	430
Selenium	2 / 9	0.61 : 0.9	0.39 - 0.6	0.41	0.70	0.39 J	0.6 J	0.9 U	0.86 U
Sodium	4 / 9	120 : 170	33 - 48	57	50.0	150 U	150 U	39 J	48 J
Tin	9 / 9		0.71 - 3.5	2.3	4.44	3.2 J	3.2 J	0.71 J	2.2 J
Vanadium	9 / 9		3.6 - 21	11.9	24.8	15	21	5	13
Zinc	9 / 9		1.9 - 18	8.5	19.6	13	14	1.9 J	6.1
Sulfate	1 / 9	38 : 52	63 - 63	28	NC	46 U	48 U	51 U	63
Total Organic Carbon	2 / 2		29000 - 32000	30500	NC	32000			
Speciality Compound (mg/Kg)									
Formaldehyde	5 / 5		0.11 - 0.35	0.24	0.46	0.11 J			0.35

(1) 95% UPL is calculated using ProUCL software (V. 4.1.00); calculations presented in Appendix I.
Background soil from SS-434, SS-435, SS-449, SS-450, SS-451, SS-453, SS-454, SS-455, and SS-460.
mg/Kg = milligram per kilogram
NC = Not calculated, too few detections
U = not detected, value is the detection limit
J = value is estimated

Table 2.4-2
Summary of Detected Chemicals for Background Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SS-451-0.0/1.0-XXX SS-451 9/16/2009 0-1 ft	OC-SS-453-0.0/1.0-XXX SS-453 9/17/2009 0-1 ft	OC-SS-454-0.0/1.0-XXX SS-454 9/17/2009 0-1 ft	OC-SS-455-0.0/1.0-XXX SS-455 9/16/2009 0-1 ft	OC-SS-460-0.0/1.0-XXX SS-460 9/16/2009 0-1 ft
Volatile Organics (mg/Kg)					
Acetone	0.0031 U	0.0038 U	0.0029 U	0.003 U	0.0032 U
Semivolatile Organics (mg/Kg)					
Benzo(a)anthracene	0.043 U	0.017 J	0.013 J	0.039 U	0.012 J
Benzo(a)pyrene	0.015 J	0.018 J	0.018 J	0.039 U	0.014 J
Benzo(b)fluoranthene	0.018 J	0.029 J	0.019 J	0.039 U	0.02 J
Benzo(ghi)perylene	0.043 U	0.046 U	0.015 J	0.039 U	0.039 U
Benzaldehyde	0.051	0.075	0.067	0.045	0.098
Bis(2-Ethylhexyl)phthalate	0.02 JEB	0.046 U	0.038 U	0.012 JEB	0.014 JEB
Chrysene	0.018 J	0.024 J	0.02 J	0.039 U	0.018 J
Fluoranthene	0.029 J	0.038 J	0.023 J	0.015 J	0.025 J
Indeno(1,2,3-cd)pyrene	0.021 J	0.03 J	0.017 J	0.017 J	0.021 J
Phenanthrene	0.018 J	0.027 J	0.014 J	0.047 U	0.014 J
Pyrene	0.033 J	0.043 J	0.027 J	0.016 J	0.029 J
Inorganics (mg/Kg)					
Aluminum	1400	7100	11000	12000	3200
Arsenic	1.6 J	4.3	9.5	10	0.64 J
Barium	5.5	9.2	12	8.5	13
Beryllium	0.042 J	0.18 J	0.32	0.28	0.19 J
Cadmium	0.037 J	0.16 J	0.22 J	0.23 J	0.057 J
Calcium	180	320	480	390	460
Chromium	1.7	4.7	10	9.7	4
Cobalt	0.45 J	0.91	2.9	2.1	0.51 J
Copper	1.7 J	4.1	5.3	4	5.6
Iron	760	6600	10000	11000	660
Lead	12	20	22	11	7.8
Magnesium	48	220	1100	780	24
Manganese	7.5	13	60	38	3.4
Mercury	0.055 J	0.083 J	0.064 J	0.048 J	0.21 U
Nickel	1.3 J	2.8	7.3	5.8	1.7
Potassium	210 J	320 J	520	580	51 J
Selenium	0.84 U	0.83 U	0.61 U	0.65 U	0.7 U
Sodium	37 J	170 U	120 U	130 U	33 J
Tin	0.78 J	1.6 J	3.5 J	3.4 J	1.7 J
Vanadium	3.6	11	16	19	3.8
Zinc	2.2 J	5.6	18	11	5
Sulfate	52 U	51 U	38 U	45 U	45 U
Total Organic Carbon				29000	
Speciality Compound (mg/Kg)					
Formaldehyde		0.31		0.22	0.22

(1) 95% UPL is calculated using ProUCL software (V. 4.1.00); calculations presented in Appendix I.
Background soil from SS-434, SS-435, SS-449, SS-450, SS-451, SS-453, SS-454, SS-455, and SS-460.
mg/Kg = milligram per kilogram
NC = Not calculated, too few detections
U = not detected, value is the detection limit
J = value is estimated

Prepared by / Date: RRD 04/10/13
Checked by / Date: CTM 04/10/13

Table 2.5-1
Summary of Chemical Analyses for Background Surface Water and Sediment Samples
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	Metals, Total	Inorganics/Physical
Surface Water											
SDBK-001	OC-SW-BK-SW/SD-001-XXX	13-Dec-10	FS				77	72		24	9
SDBK-001	OC-SW-SDBK-001-XXX	08-Jun-11	FS				77	72		24	9
SDBK-001	SW001XXBKX	01-Apr-96	FS				36	64	21	24	5
SDBK-002	OC-SW-BK-SW/SD-002-XXX	03-Dec-10	FS				77	72		24	9
SDBK-002	OC-SW-SDBK-002-XXX	07-Jun-11	FS				77	72		24	9
SDBK-002	SW002XXBKX	01-Apr-96	FS				36	64	21	24	5
SDBK-003	SW003XXBKX	03-Apr-96	FS				36	64	21	24	5
SDBK-004	OC-SW-BK-SW/SD-004-XXX	03-Dec-10	FS				77	72		24	9
SDBK-004	OC-SW-SDBK-004-XXX	08-Jun-11	FS				77	72		24	9
SDBK-004	SW004XXBKX	03-Apr-96	FS				36	64	21	24	5
SDBK-005	SW005XXBKX	02-Apr-96	FS						21		
SDBK-006	SW006XXBKX	02-Apr-96	FS						21		
SDBK-007	SW007XXBKX	02-Apr-96	FS						21		
SDBK-008	SW008XXBKX	03-Apr-96	FS						21		
SDBK-009	SW009XXBKX	03-Apr-96	FS						21		
SDBK-010	SW010XXBKX	04-Apr-96	FS						21		
SDBK-011	SW011XXBKX	04-Apr-96	FS						21		
SDBK-012	SW012XXBKX	04-Apr-96	FS						21		
SDBK-013	SW013XXBKX	02-Apr-96	FS						21		
SDBK-014	SW014XXBKD DUP	04-Apr-96	FD				36	64	21	24	1
SDBK-014	SW014XXBKX	04-Apr-96	FS				36	64	21	24	1
Sediment											
SDBK-001	SD001XXBKX	01-Apr-96	FS	0	-	0.3	36	64		24	2
SDBK-002	SD002XXBKX	01-Apr-96	FS	0	-	0.3	36	64	21	24	2
SDBK-005	SD005XXBKX	02-Apr-96	FS	0	-	0.3			21		2
SDBK-006	SD006XXBKX	02-Apr-96	FS	0.25	-	0.3			21		2
SDBK-007	SD007XXBKX	02-Apr-96	FS	0.25	-	0.3			21		2
SDBK-013	SD013XXBKX	02-Apr-96	FS	0	-	0.25			21		2
SDBK-003	SD003XXBKX	03-Apr-96	FS	0.25	-	0.3	36	64	21	24	2
SDBK-004	SD004XXBKX	03-Apr-96	FS	0.25	-	0.3	36	64	21	24	2
SDBK-008	SD008XXBKX	03-Apr-96	FS	0.25	-	0.3			21		2
SDBK-009	SD009XXBKX	03-Apr-96	FS	0	-	0.3			21		2
SDBK-010	SD010XXBKX	04-Apr-96	FS	0	-	0.3			21		2
SDBK-011	SD011XXBKX	04-Apr-96	FS	0	-	0.5			21		2
SDBK-012	SD012XXBKX	04-Apr-96	FS	0	-	0.3			21		2
SDBK-014	SD014XXBKX	04-Apr-96	FS	0	-	0.5	36	64	21	24	2
SDBK-014	SD014XXBKD DUP	04-Apr-96	FD	0	-	0.5	36	64	21	24	2

Table 2.5-1
Summary of Chemical Analyses for Background Surface Water and Sediment Samples
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth (ft)			Volatiles	Semivolatiles	Pesticides	Metals, Total	Inorganics/Physical
SDBK-001	SD001XXBKR	21-May-96	FS	0	-	0.3			21		2
SDBK-002	OC-SD-BK-SW/SD-002-XXX	03-Dec-10	FS	0	-	0.5	77	79		24	8
SDBK-004	OC-SD-BK-SW/SD-004-XXX	03-Dec-10	FS	0	-	0.5	77	79		24	8
SDBK-001	OC-SD-BK-SW/SD-001-XXX	13-Dec-10	FS	0	-	0.5	77	79		24	8
SDBK-002	OC-SD-SDBK-002-XXX	17-Feb-11	FS				77	79		24	22

FS = Field Sample
FD = Field Duplicate

Prepared by / Date: KJC 03/05/13
Checked by / Date: CTM 03/28/13

Table 2.5-2a
Summary of Detected Chemicals for Background Surface Water Samples - SDBK-001
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SW-BK-SW/SD-001-XXX SDBK-001 12/13/2010	OC-SW-SDBK-001-XXX SDBK-001 6/8/2011
Volatile Organics (mg/L)						
Carbon disulfide	1 / 2	0.01 : 0.01	0.0004 - 0.0004	0.0027	0.01 U	0.0004 J
Toluene	1 / 2	0.001 : 0.001	0.0013 - 0.0013	0.00090	0.001 U	0.0013
Semivolatile Organics (mg/L)						
Acenaphthene	1 / 2	0.001 : 0.001	0.00011 - 0.00011	0.00031	0.00011 J	0.001 U
Benzo(a)pyrene	1 / 2	0.0002 : 0.0002	0.000094 - 0.000094	0.000097	0.000094 J	0.0002 U
Benzo(ghi)perylene	1 / 2	0.0005 : 0.0005	0.00014 - 0.00014	0.00020	0.00014 J	0.0005 U
Benzoic Acid	1 / 1		0.0021 - 0.0021	0.0021	R	0.0021 J
Bis(2-Ethylhexyl)phthalate	1 / 2	0.002 : 0.002	0.00046 - 0.00046	0.00073	0.00046 J	0.002 U
Dibenz(a,h)anthracene	1 / 2	0.0005 : 0.0005	0.00014 - 0.00014	0.00020	0.00014 J	0.0005 U
Indeno(1,2,3-cd)pyrene	1 / 2	0.0005 : 0.0005	0.00016 - 0.00016	0.00021	0.00016 J	0.0005 U
Metals, Total (mg/L)						
Aluminum	2 / 2		0.042 - 1.1	0.57	0.042 J	1.1
Arsenic	1 / 2	0.01 : 0.01	0.0036 - 0.0036	0.0043	0.01 U	0.0036 J
Barium	2 / 2		0.044 - 0.2	0.122	0.044	0.2
Cadmium	1 / 2	0.001 : 0.001	0.0011 - 0.0011	0.00080	0.001 U	0.0011 J
Calcium	2 / 2		28 - 79	54	28	79
Chromium	1 / 2	0.005 : 0.005	0.0022 - 0.0022	0.0024	0.005 U	0.0022 J
Cobalt	1 / 2	0.01 : 0.01	0.003 - 0.003	0.0040	0.01 U	0.003 J
Copper	2 / 2		0.0067 - 0.027	0.0169	0.0067 NJ	0.027
Iron	2 / 2		0.12 - 6.7	3.4	0.12	6.7
Lead	1 / 2	0.001 : 0.001	0.014 - 0.014	0.0073	0.001 U	0.014
Magnesium	2 / 2		2.5 - 7.7	5.1	2.5	7.7
Manganese	2 / 2		0.042 - 3.4	1.7	0.042	3.4
Nickel	1 / 2	0.01 : 0.01	0.0037 - 0.0037	0.0044	0.01 U	0.0037 J
Potassium	2 / 2		2.5 - 9.6	6.1	2.5 J	9.6
Sodium	2 / 2		120 - 450	285	120	450
Vanadium	1 / 2	0.01 : 0.01	0.0022 - 0.0022	0.0036	0.01 UJ	0.0022 J
Zinc	2 / 2		0.022 - 0.023	0.023	0.022 J	0.023 J
Inorganics (mg/L)						
Bromide	1 / 2	0.1 : 0.1	0.13 - 0.13	0.090	0.1 U	0.13
Chloride	2 / 2		230 - 930	580	230	930
Hardness	2 / 2		74 - 230	152	74	230
Nitrate as N	2 / 2		0.47 - 1.9	1.19	1.9	0.47 J
Nitrogen, as Ammonia	1 / 2	0.1 : 0.1	0.4 - 0.4	0.23	0.1 U	0.4
Sulfate	2 / 2		12 - 16	14.0	16	12
Total Organic Carbon	2 / 2		3.35 - 12	7.7	3.35	12
Total Suspended Solids	1 / 2	3.3 : 3.3	82 - 82	42	3.3 U	82

mg/L = milligram per liter
U = not detected, value is the reporting limit
J = value is estimated
N = presumptively present
R = value is rejected

Prepared by / Date: KJC 02/25/14
Checked by / Date: CTM 03/10/14

Table 2.5-2b
Summary of Detected Chemicals for Background Surface Water Samples - SDBK-004
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SW-BK-SW/SD-004-XXX SDBK-004 12/3/2010	OC-SW-SDBK-004-XXX SDBK-004 6/8/2011
Semivolatile Organics (mg/L)						
Benzoic Acid	2 / 2		0.0021 - 0.0021	0.0021	0.0021 J	0.0021 J
Caprolactam	1 / 2	0.0045 : 0.0045	0.00056 - 0.00056	0.0014	0.0045 UJ	0.00056 J
Metals, Total (mg/L)						
Aluminum	2 / 2		0.046 - 0.44	0.24	0.046 J	0.44
Barium	2 / 2		0.025 - 0.05	0.038	0.025	0.05
Calcium	2 / 2		12 - 18	15	12	18
Chromium	1 / 2	0.005 : 0.005	0.00077 - 0.00077	0.0016	0.005 U	0.00077 J
Copper	2 / 2		0.0012 - 0.0039	0.0026	0.0039 NJ	0.0012
Iron	2 / 2		0.28 - 2	1.1	0.28	2
Lead	2 / 2		0.00091 - 0.0013	0.0011	0.00091 J	0.0013 J
Magnesium	2 / 2		2.6 - 3.4	3.0	2.6	3.4
Manganese	2 / 2		0.038 - 0.59	0.3	0.038	0.59
Nickel	1 / 2	0.01 : 0.01	0.0021 - 0.0021	0.0036	0.01 U	0.0021 J
Potassium	2 / 2		2.1 - 2.7	2.4	2.1 J	2.7 J
Sodium	2 / 2		38 - 65	52	38	65
Vanadium	1 / 2	0.01 : 0.01	0.0015 - 0.0015	0.0033	0.01 UJ	0.0015 J
Zinc	2 / 2		0.011 - 0.024	0.018	0.011 J	0.024 J
Inorganics (mg/L)						
Chloride	2 / 2		77 - 140	109	77	140
Hardness	2 / 2		42 - 60	51	42	60
Nitrate as N	2 / 2		0.2 - 0.49	0.35	0.2	0.49 J
Nitrogen, as Ammonia	1 / 2	0.1 : 0.1	0.25 - 0.25	0.15	0.1 U	0.25
Sulfate	2 / 2		8.1 - 26	17.1	26	8.1
Total Organic Carbon	2 / 2		6.7 - 8.9	7.8	6.7	8.9
Total Suspended Solids	1 / 2	5 : 5	2 - 2	2	2	5 U

mg/L = milligram per liter
U = not detected, value is the reporting limit
J = value is estimated
N = presumptively present

Prepared by / Date: KJC 02/25/14
Checked by / Date: CTM 03/10/14

Table 2.5-3a
Summary of Detected Chemicals for Background Sediment Samples - SDBK-001
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	Frequency of Detection			Range of Reporting Limits for Non Detects			Range of Detected Concentrations			Average of All Samples	OC-SD-BK-SW/SD-001-XXX SDBK-001 12/13/2010 0-0.5 ft
Semivolatile Organics (mg/Kg)											
Benzo(a)anthracene	1	/	1				0.032	-	0.032	0.032	0.032 J
Benzo(a)pyrene	1	/	1				0.035	-	0.035	0.035	0.035 J
Benzo(b)fluoranthene	1	/	1				0.063	-	0.063	0.063	0.063
Benzo(ghi)perylene	1	/	1				0.032	-	0.032	0.032	0.032 J
Benzo(k)fluoranthene	1	/	1				0.069	-	0.069	0.069	0.069
Benzoic Acid	1	/	1				0.12	-	0.12	0.12	0.12 J
Chrysene	1	/	1				0.06	-	0.06	0.060	0.06
Dibenz(a,h)anthracene	1	/	1				0.022	-	0.022	0.022	0.022 J
Fluoranthene	1	/	1				0.096	-	0.096	0.10	0.096
Indeno(1,2,3-cd)pyrene	1	/	1				0.038	-	0.038	0.038	0.038 J
Phenanthrene	1	/	1				0.036	-	0.036	0.036	0.036 J
Pyrene	1	/	1				0.077	-	0.077	0.08	0.077
Inorganics (mg/Kg)											
Aluminum	1	/	1				6800	-	6800	6800	6800
Arsenic	1	/	1				11	-	11	11.0	11
Barium	1	/	1				27	-	27	27	27
Beryllium	1	/	1				0.24	-	0.24	0.24	0.24 J
Cadmium	1	/	1				0.24	-	0.24	0.24	0.24 J
Calcium	1	/	1				860	-	860	860	860
Chromium	1	/	1				9.8	-	9.8	9.8	9.8
Cobalt	1	/	1				3.3	-	3.3	3.3	3.3
Copper	1	/	1				14	-	14	14.0	14
Iron	1	/	1				13000	-	13000	13000	13000
Lead	1	/	1				5.3	-	5.3	5.3	5.3
Magnesium	1	/	1				2000	-	2000	2000	2000
Manganese	1	/	1				140	-	140	140	140 J
Nickel	1	/	1				7.7	-	7.7	7.7	7.7
Potassium	1	/	1				980	-	980	980	980
Sodium	1	/	1				170	-	170	170	170
Vanadium	1	/	1				12	-	12	12.0	12
Zinc	1	/	1				75	-	75	75	75
Chloride	1	/	1				150	-	150	150	150
Nitrogen, as Ammonia	1	/	1				26	-	26	26	26
Total Organic Carbon	1	/	1				8400	-	8400	8400	8400

mg/Kg = milligram per kilogram
J = value is estimated

Prepared by / Date: KJC 02/25/14
Checked by / Date: CTM 03/10/14

Table 2.5-3b
Summary of Detected Chemicals for Background Sediment Samples - SDBK-004
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	Frequency of Detection			Range of Reporting Limits for Non Detects			Range of Detected Concentrations			Average of All Samples	OC-SD-BK-SW/SD-004-XXX SDBK-004 12/3/2010 0-0.5 ft
Volatile Organics (mg/Kg)											
2-Butanone	1	/	1				0.61	-	0.61	0.61	0.61 J
Acetone	1	/	1				2	-	2	2	2 J
Semivolatile Organics (mg/Kg)											
Benzaldehyde	1	/	1				0.33	-	0.33	0.33	0.33 J
Benzo(a)anthracene	1	/	1				0.081	-	0.081	0.081	0.081 J
Benzo(a)pyrene	1	/	1				0.096	-	0.096	0.096	0.096 J
Benzo(ghi)perylene	1	/	1				0.087	-	0.087	0.087	0.087 J
Benzoic Acid	1	/	1				0.54	-	0.54	0.54	0.54 J
Bis(2-Ethylhexyl)phthalate	1	/	1				0.26	-	0.26	0.26	0.26 J
Chrysene	1	/	1				0.14	-	0.14	0.14	0.14 J
Dibenzofuran	1	/	1				0.12	-	0.12	0.12	0.12 J
Fluoranthene	1	/	1				0.22	-	0.22	0.22	0.22 J
Indeno(1,2,3-cd)pyrene	1	/	1				0.085	-	0.085	0.085	0.085 J
Phenanthrene	1	/	1				0.14	-	0.14	0.14	0.14 J
Pyrene	1	/	1				0.28	-	0.28	0.28	0.28 J
Inorganics (mg/Kg)											
Aluminum	1	/	1				5500	-	5500	5500	5500 J
Arsenic	1	/	1				6.6	-	6.6	6.6	6.6 J
Barium	1	/	1				84	-	84	84	84 J
Beryllium	1	/	1				0.7	-	0.7	0.7	0.7 J
Cadmium	1	/	1				0.9	-	0.9	0.9	0.9 J
Calcium	1	/	1				9400	-	9400	9400	9400 J
Chromium	1	/	1				7.3	-	7.3	7.3	7.3 J
Cobalt	1	/	1				4.2	-	4.2	4.2	4.2 J
Copper	1	/	1				15	-	15	15	15 J
Iron	1	/	1				7500	-	7500	7500	7500 J
Lead	1	/	1				46	-	46	46	46 J
Magnesium	1	/	1				930	-	930	930	930 J
Manganese	1	/	1				500	-	500	500	500 J
Nickel	1	/	1				6.1	-	6.1	6.1	6.1 J
Potassium	1	/	1				640	-	640	640	640 J
Sodium	1	/	1				430	-	430	430	430 J
Tin	1	/	1				7.3	-	7.3	7.3	7.3 J
Vanadium	1	/	1				11	-	11	11	11 J
Zinc	1	/	1				73	-	73	73	73 J
Chloride	1	/	1				420	-	420	420	420
Nitrogen, as Ammonia	1	/	1				830	-	830	830	830 J
Sulfate	1	/	1				420	-	420	420	420 J
Total Organic Carbon	1	/	1				370000	-	370000	370000	370000 J

mg/Kg = milligram per kilogram
J = value is estimated

Prepared by / Date: KJC 02/25/14
Checked by / Date: CTM 03/10/14

Table 2.6-1
Summary of Chemical Analysis Modifications for Soil Investigation
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Proposed Sample Location	Date Collected	Time	Location ID	Field Sample ID	Area	VOCs	SVOCs, Metals, Ammonia, Anions*	NDMA	EPH VPH	DMF	Phthalic anhydride	Acetaldehyde/ Formaldehyde	Hydrazine	Diphenylamine	PCBs	Cr+6	Ammonia	TOC
A6-Prop3	8/26/09	13:25	SB-400	OC-SB-400-0.0/1.0-XXX	Butler Building	1	1		X									
A6-Prop3	8/26/09	13:30	SB-400	OC-SB-400-5.0/7.0-XXX	Butler Building	1	1		X									
A8-Prop8	9/10/09	14:35	SB-427	OC-SB-427-17/19-XXX	Behind Plant B Treatment Building	1	1	1	1		1	1	X	1				
A8-Prop8	9/10/09	14:35	SB-427	OC-SB-427-12/14-XXX	Behind Plant B Treatment Building	X	X	X	X		X	X		X				
A5-Prop6	8/20/09	14:35	SB-432	OC-SB-432-0.0/1.0-XXX	Plant C-1	1	1	1	X	1	1	1	1	1				
A5-Prop6	8/20/09	14:40	SB-432	OC-SB-432-5.0/7.0-XXX	Plant C-1	1	1	1	X	1	1	1	1	1				
A5-Prop6	8/20/09	15:15	SB-432	OC-SB-432-14/16-XXX	Plant C-1	1	1	1	X	1	1	1	1	1				
A2-Prop5	9/3/09	11:30	SB-459	OC-SB-459-6.0/8.0-XXX	East of East Warehouse	1	1	1	X	1	1	1	1	1		1		1
A2-Prop10	9/9/09	10:40	SB-469	OC-SB-469-36/37-XXX	Former Wastewater Treatment Plant	X	X		X							1		

Notes:
1 - indicates the analysis was proposed in the work plan and collected.
X - indicates the analysis was added during the drilling/sample collection.

Prepared by: TLC
Checked by: MJM

Table 3.3-1
Synoptic Groundwater Elevation Measurements
Olin Chemical Superfund Site
Wilmington, Massachusetts

Well ID	Measuring Point Elevation (ft.)	Depth to Water (ft.) (5/10/2011)	Depth to Water (ft.) (10/10/2011)	Water Elevation (ft.) (5/10/11)	Water Elevation (ft.) (10/10/11)	Top Screen Elevation (ft.)	Bottom Screen Elevation (ft.)
GW-103BR	81.20	3.76	2.91	77.44	78.29	-0.8	-25.1
GW-103D	81.60	4.33	3.48	77.27	78.12	31.6	21.6
GW-10DR	86.25	5.10	4.86	81.15	81.39	69.71	59.71
GW-10S	89.10	8.62	8.37	80.48	80.73	82.3	77.3
GW-13	90.57	11.38	11.37	79.19	79.20	75.5	70.5
GW-14	88.70	9.10	8.93	79.60	79.77	79.9	74.9
GW-17D	81.42	2.91	3.04	78.51	78.38	72.6	67.6
GW-17S	82.07	3.55	3.57	78.52	78.50	76.7	71.7
GW-21D	86.09	2.88	2.83	83.21	83.26	74.6	69.6
GW-21S	90.89	7.40	7.33	83.49	83.56	80.2	70.2
GW-24	83.43	2.43	2.15	81.00	81.28	76.54	71.54
GW-25	85.97	5.30	5.15	80.67	80.82	80.68	75.68
GW-26	84.93	3.84	3.64	81.09	81.29	82.98	77.98
GW-28D	84.81	2.02	1.77	82.79	83.04	79.2	69.2
GW-28S	85.56	2.76	2.53	82.80	83.03	81.9	71.9
GW-29D	85.16	3.15	2.90	82.01	82.26	64.8	54.8
GW-29S	84.31	2.02	2.00	82.29	82.31	79.9	69.9
GW-304	92.24	7.87	7.91	84.37	84.33	81.9	71.9
GW-307	87.83	5.82	5.83	82.01	82.00	75.5	65.5
GW-308	87.58	5.63	5.47	81.95	82.11	85.1	75.1
GW-31D	91.67	10.25	10.10	81.42	81.57	78.1	68.1
GW-31S	91.40	9.77	9.86	81.63	81.54	84.1	74.1
GW-32D	89.18	7.91	7.75	81.27	81.43	65.7	55.7
GW-32S	89.18	7.46	7.68	81.72	81.50	82.6	72.6
GW-34D	90.36	7.70	7.43	82.66	82.93	65.3	55.3
GW-34SR	89.13	6.40	6.16	82.73	82.97	82.9	72.9
GW-39	83.64	3.39	3.47	80.25	80.17	78.6	68.6
GW-3D	85.28	5.75	5.85	79.53	79.43	71.2	61.2
GW-3S	86.40	6.74	7.14	79.66	79.26	75.4	70.4
GW-4	82.19	5.87	5.73	76.32	76.46	71.8	66.8
GW-401D	76.64	5.36	5.02	71.28	71.62	66.54	56.54
GW-402D	88.67	10.36	10.40	78.31	78.27	81.28	71.28
GW-403D	80.17	2.56	2.86	77.61	77.31	69.57	59.57
GW-405BRD	91.04	8.55	8.54	82.49	82.50	-143.96	-153.96
GW-405BRM	91.02	8.46	8.31	82.56	82.71	-37.88	-47.88
GW-405BRS	91.02	7.29	7.55	83.73	83.47	45.32	35.32
GW-406	86.66	2.99	2.85	83.67	83.81	77.44	67.44
GW-406BRD	86.72	5.35	5.20	81.37	81.52	-46.44	-56.44
GW-406BRS	86.74	5.45	5.36	81.29	81.38	16.23	6.23
GW-407BRD	87.99	7.75	6.99	80.24	81.00	-47.53	-57.53
GW-407BRS	88.03	7.80	7.02	80.23	81.01	-3.81	-13.81
GW-40S	88.48	8.01	8.50	80.47	79.98	76.4	66.4
GW-42D	84.07	2.33	2.28	81.74	81.79	50.4	40.4
GW-42S	84.18	3.25	3.10	80.93	81.08	76	66
GW-45D	89.40	8.37	8.04	81.03	81.36	37.3	27.3
GW-45S	89.47	8.40	8.04	81.07	81.43	77.9	67.9
GW-46D	85.87	3.74	3.73	82.13	82.14	76.2	66.2
GW-47	93.17	10.56	9.24	82.61	83.93	87.6	77.6
GW-48S	91.16	9.15	NA	82.01	NA	76.9	66.9
GW-49D	81.37	6.31	6.08	75.06	75.29	71.2	61.2
GW-4D	79.29	2.81	2.67	76.48	76.62	68.5	58.5
GW-5	78.61	3.51	2.42	75.10	76.19	71.3	66.3
GW-50D	80.11	3.91	3.88	76.20	76.23	47.4	37.4
GW-50S	79.70	3.66	3.58	76.04	76.12	72	62
GW-52S	87.95	8.42	8.33	79.53	79.62	80.6	75.6
GW-53D	90.72	6.35	6.36	84.37	84.36	77.8	67.8
GW-54D	89.15	5.46	5.19	83.69	83.96	76.6	66.6

Table 3.3-1
Synoptic Groundwater Elevation Measurements
Olin Chemical Superfund Site
Wilmington, Massachusetts

Well ID	Measuring Point Elevation (ft.)	Depth to Water (ft.) (5/10/2011)	Depth to Water (ft.) (10/10/2011)	Water Elevation (ft.) (5/10/11)	Water Elevation (ft.) (10/10/11)	Top Screen Elevation (ft.)	Bottom Screen Elevation (ft.)
GW-54S	88.85	5.05	4.81	83.80	84.04	81.4	76.4
GW-55D	81.95	2.32	2.40	79.63	79.55	69.7	59.7
GW-55S	81.70	1.95	2.03	79.75	79.67	74.8	69.8
GW-58D	98.20	17.30	16.95	80.90	81.25	26.1	16.1
GW-58S	98.21	17.42	17.06	80.79	81.15	78	68
GW-61BR	83.63	2.80	2.43	80.83	81.20	9.6	-10.4
GW-61D	83.62	3.02	2.47	80.60	81.15	40.7	30.7
GW-61S	83.46	3.11	2.46	80.35	81.00	71.7	61.7
GW-62BR	83.66	2.92	2.57	80.74	81.09	1.6	-23.4
GW-62BRD	83.64	3.00	2.67	80.64	80.97	-23	-63
GW-62D	83.81	2.88	2.51	80.93	81.30	21.4	11.4
GW-62M	84.36	3.42	3.06	80.94	81.30	52.4	42.4
GW-62S	84.57	3.66	3.29	80.91	81.28	77.3	67.3
GW-63D	83.32	3.31	2.45	80.01	80.87	57.1	47.1
GW-63S	82.82	2.82	1.96	80.00	80.86	73.1	63.1
GW-64D	85.96	5.85	5.03	80.11	80.93	28.1	18.1
GW-64S	86.70	6.55	5.75	80.15	80.95	74.1	64.1
GW-65BR	84.77	4.82	3.92	79.95	80.85	-27.2	-57.2
GW-65BRDD	84.98	5.07	4.16	79.91	80.82	-66.38	-86.38
GW-65BRDS	84.99	5.02	4.17	79.97	80.82	-47.5	-57.5
GW-65D	84.19	4.17	3.28	80.02	80.91	-0.9	-15.9
GW-65S	84.14	4.36	3.30	79.78	80.84	74.4	64.4
GW-68BR	89.82	7.35	7.28	82.47	82.54	59.2	14.2
GW-69D	91.19	10.00	9.70	81.19	81.49	55.1	45.1
GW-69S	91.11	10.10	9.78	81.01	81.33	77.9	67.9
GW-6D	90.06	8.15	8.00	81.91	82.06	70.5	60.5
GW-6S	90.98	8.12	8.00	82.86	82.98	79	74
GW-70D	92.09	11.02	10.70	81.07	81.39	40.3	30.3
GW-70S	91.98	10.90	10.56	81.08	81.42	78.2	68.2
GW-74D	77.20	4.58	4.47	72.62	72.73	57.7	47.7
GW-74S	77.41	5.01	4.91	72.40	72.50	69.7	57.7
GW-76S	88.45	6.00	5.80	82.45	82.65	82.9	72.9
GW-80BR	78.91	3.51	3.34	75.40	75.57	49.3	9.3
GW-80D	79.06	3.60	3.40	75.46	75.66	69.4	59.4
GW-80S	79.17	3.53	3.28	75.64	75.89	75.6	70.6
GW-81BR	86.46	1.75	0.71	84.71	85.75	65.2	36.2
GW-81D	86.31	4.17	4.99	82.14	81.32	81	71
GW-83D	87.30	7.77	7.15	79.53	80.15	-30.77	-40.77
GW-83M	88.37	7.88	7.30	80.49	81.07	15.9	-4.1
GW-83S	88.25	7.77	7.15	80.48	81.10	40.9	30.9
GW-84M	88.17	7.88	7.06	80.29	81.11	19.4	4.4
GW-84S	87.94	7.80	6.97	80.14	80.97	44.4	34.4
GW-86D	86.77	6.75	5.89	80.02	80.88	-2.1	-12.1
GW-86M	87.17	7.10	6.23	80.07	80.94	30.9	15.9
GW-86S	87.22	7.17	6.31	80.05	80.91	63.4	53.4
GW-88D	88.72	8.69	7.83	80.03	80.89	30.87	20.87
GW-88M	89.34	9.30	8.44	80.04	80.90	46.09	36.09
GW-88S	88.97	8.92	8.06	80.05	80.91	57.57	47.57
MW-202S	87.79	4.31	4.13	83.48	83.66	76.66	71.66
MW-203BR	86.84	6.13	5.82	80.71	81.02	44.84	20.93
MW-203D	86.64	5.82	5.52	80.82	81.12	58.88	48.88
MW-203S	85.98	5.23	4.94	80.75	81.04	73.44	63.44
MW-204BR	83.04	1.97	3.55	81.07	79.49	5.54	-17.48
MW-204D	83.27	2.25	1.90	81.02	81.37	19.49	9.49
MW-204M	83.00	1.79	1.39	81.21	81.61	44.52	34.52
MW-204S	83.50	2.42	2.05	81.08	81.45	62.46	57.46
MW-206BR	88.76	8.11	7.67	80.65	81.09	28.76	4.99

Table 3.3-1
Synoptic Groundwater Elevation Measurements
Olin Chemical Superfund Site
Wilmington, Massachusetts

Well ID	Measuring Point Elevation (ft.)	Depth to Water (ft.) (5/10/2011)	Depth to Water (ft.) (10/10/2011)	Water Elevation (ft.) (5/10/11)	Water Elevation (ft.) (10/10/11)	Top Screen Elevation (ft.)	Bottom Screen Elevation (ft.)
MW-206D	88.69	7.90	7.52	80.79	81.17	47.28	32.28
MW-206S	89.35	8.59	8.23	80.76	81.12	73.61	63.61
PZ-16RR	81.00	3.10	3.39	77.90	77.61	75.9	74.9
PZ-17RR	82.43	3.48	2.49	78.95	79.94	76.9	75.9
PZ-18R	82.42	2.14	2.05	80.28	80.37	77.97	76.37
PZ-21	82.94	1.62	1.60	81.32	81.34	76.5	75.5
PZ-23	80.95	3.80	3.66	77.15	77.29	75.2	74.2
PZ-24	89.43	8.62	8.49	80.81	80.94	81.5	71.5
PZ-25	88.90	8.29	8.17	80.61	80.73	80.8	70.8
SL-1D	86.36	5.02	5.61	81.34	80.75	79.7	69.7
SL-1S	86.45	5.03	5.65	81.42	80.80	79.95	69.95
SL-2	85.74	5.66	6.11	80.08	79.63	78.5	68.5
SL-3	92.64	12.90	13.37	79.74	79.27	79.5	69.5
SL-5	94.42	14.87	15.20	79.55	79.22	87.6	77.6
SL-6	92.68	11.79	13.26	80.89	79.42	79.1	69.1
SL-7	95.25	11.59	11.25	83.66	84.00	88.3	83.3

Notes:
NA - Not measured

Created By: BJR
Checked By: CTM

Table 3.3-2
Hydraulic Conductivity Aquifer Tests
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Source Name	Report	Publication Date	Type of Test	Analysis Method	Material	Location	Storage Coefficient (S)	Specific Yield (Sy)	Hydraulic Conductivity (K), ft/d
Smith	Supplemental Phase II	Jun-97	48-hr Two-well Pumping Test	Neuman	Surficial	CS-1A/2 & 1o (48-hr test)	8.50E-04	0.5	80.0
Smith	Supplemental Phase II	Jun-97	24-hr Pumping Test	Neuman	Surficial	CS-1A/2 & 2 (24-hr test)	3.00E-03	0.26	230.0
Smith	Supplemental Phase II	Jun-97	48-hr Two-well Pumping Test	Neuman	Surficial	CS-1A/2 & 2 (48-hr test)	2.60E-04	0.5	210.0
Smith	Supplemental Phase II	Jun-97	24-hr Pumping Test	Neuman	Surficial	CS-1A/2 & 3 (24-hr test)	3.10E-03	0.18	190.0
Smith	Supplemental Phase II	Jun-97	48-hr Two-well Pumping Test	Neuman	Surficial	CS-1A/2 & 3 (48-hr test)	1.40E-02	0.3	210.0
Smith	Supplemental Phase II	Jun-97	24-hr Pumping Test	Neuman	Surficial	CS-1A/2 & 4/C (24-hr test)	3.00E-03	0.14	250.0
Smith	Supplemental Phase II	Jun-97	48-hr Two-well Pumping Test	Neuman	Surficial	CS-1A/2 & 4/C (48-hr test)	5.60E-02	0.33	200.0
Smith	Supplemental Phase II	Jun-97	24-hr Pumping Test	Neuman	Surficial	CS-1A/2 & 5/B (24-hr test)	1.60E-04	0.06	250.0
Smith	Supplemental Phase II	Jun-97	48-hr Two-well Pumping Test	Neuman	Surficial	CS-1A/2 & 5/B (48-hr test)	2.30E-02	0.06	23.0
Smith	Supplemental Phase II	Jun-97	24-hr Pumping Test	Neuman	Surficial	CS-1A/2 avg (24-hr test)	2.30E-03	0.16	230.0
Smith	Supplemental Phase II	Jun-97	48-hr Two-well Pumping Test	Neuman	Surficial	CS-1A/2 avg (48-hr test)	1.90E-02	0.34	140.0
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		till	GW-01			56.7
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		sand & till	GW-02			25.5
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		sand & till	GW-03			0.6
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		till	GW-04			1.4
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		till	GW-05			17.0
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		sand & till	GW-06			0.3
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		till	GW-07			0.6
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		till, little sand	GW-08			56.7
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		sand & till	GW-10			28.3
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		sand	GW-11			1.4
Malcolm-Pirnie	Hydrogeologic Investigation	Feb-82	Laboratory (?)		sand, little till	GW-12			11.3
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP silt & sand, sand & gravel	GW-19D.1			76.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP silt & sand, sand & gravel	GW-19D.2			120.0
CRA	Olin CSA Phase II	Jun-93	Slug Test Falling		Surficial	GW-40D			28.3
CRA	Olin CSA Phase II	Jun-93	Slug Test Falling		Surficial	GW-42D			28.3
CRA	Olin CSA Phase II	Jun-93	Slug Test Falling		Surficial	GW-43D			28.3
CRA	Olin CSA Phase II	Jun-93	Slug Test Rising		Surficial	GW-43D			25.5
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW silty gravely sand, ice contact	GW-48D.1			43.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW silty gravely sand, ice contact	GW-48D.2			32.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SC fill, SW silty sand, GP sand & gravel	GW-48S.1			13.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SC fill, SW silty sand, GP sand & gravel	GW-48S.2			13.0
CRA	Olin CSA Phase II	Jun-93	Slug Test Falling		Surficial	GW-50D			28.3
CRA	Olin CSA Phase II	Jun-93	Slug Test Rising		Surficial	GW-51D			2.7
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GC sandy gravel, ice contact	GW-51D.1			4140.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GC sandy gravel, ice contact	GW-51D.2			650.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW gravely sand, outwash	GW-51S.1			15.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW gravely sand, outwash	GW-51S.2			6.4
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP-GW Silty gravel, ice contact	GW-53D.1			94.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP-GW Silty gravel, ice contact	GW-53D.2			130.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP-GW Silty gravel, ice contact	GW-53D.3			96.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW Crs. Sand, outwash	GW-53S.1			1.9
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW Crs. Sand, outwash	GW-53S.2			2.9
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW Crs. Sand, outwash	GW-53S.3			1.7
CRA	Olin CSA Phase II	Jun-93	Slug Test Falling		Surficial	GW-54D			15.0
CRA	Olin CSA Phase II	Jun-93	Slug Test Rising		Surficial	GW-54D			9.6
CRA	Olin CSA Phase II	Jun-93	Slug Test Falling		Surficial	GW-55D			12.2
CRA	Olin CSA Phase II	Jun-93	Slug Test Rising		Surficial	GW-55D			31.2
CRA	Olin CSA Phase II	Jun-93	Slug Test Falling		Surficial	GW-56D			218.3
CRA	Olin CSA Phase II	Jun-93	Slug Test Rising		Surficial	GW-56D			59.5
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GM Sandy silty gravel	GW-61D.1			69.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GM Sandy silty gravel	GW-61D.2			44.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW sand, ML silt	GW-61S.1			29.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW sand, ML silt	GW-61S.2			31.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW, clayey sand, till	GW-63D.1			130.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW, clayey sand, till	GW-63D.2			83.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW, med. sand	GW-63S.1			410.0

Table 3.3-2
Hydraulic Conductivity Aquifer Tests
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Source Name	Report	Publication Date	Type of Test	Analysis Method	Material	Location	Storage Coefficient (S)	Specific Yield (Sy)	Hydraulic Conductivity (K), ft/d
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW, med. sand	GW-63S.2			140.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	ML sandy silt, SP silty sand	GW-64D.1			160.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	ML sandy silt, SP silty sand	GW-64D.2			110.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW sand	GW-64S.1			200.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW sand	GW-64S.2			250.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SP sand	GW73D.1			79.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SP sand	GW73D.2			67.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW sand	GW73S.1			280.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP sand & gravel	GW-78S.1			13.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP sand & gravel	GW-78S.2			4.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW sand	GW-79S.1			6.6
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	SW sand	GW-79S.2			0.6
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP sand, gravel & cobbles	GW-85D.1			150.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Bouwer & Rice	GP sand, gravel & cobbles	GW-85D.2			100.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Conv. Hvorslev	Surficial	MW-201S			1.3
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Conv. Hvorslev	Surficial	MW-201S			2.9
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Conv. Hvorslev	Surficial	MW-202S			56.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Conv. Hvorslev	Surficial	MW-202S			33.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Conv. Hvorslev	Surficial	MW-203D			102.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Conv. Hvorslev	Surficial	MW-203D			49.4
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Oscillating Kipp	Surficial	MW-203S			540.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Oscillating Kipp	Surficial	MW-204D			455.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Oscillating Kipp	Surficial	MW-204D			96.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Oscillating Kipp	Surficial	MW-204M			546.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Oscillating Kipp	Surficial	MW-204M			116.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Conv. Hvorslev	Surficial	MW-204S			79.2
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Conv. Hvorslev	Surficial	MW-204S			51.1
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Oscillating Kipp	Surficial	MW-205S			1272.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Oscillating Kipp	Surficial	MW-205S			191.0
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Conv. Hvorslev	Surficial	MW-206D			57.6
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Conv. Hvorslev	Surficial	MW-206D			76.9
Smith	Supplemental Phase II	Jun-97	Pumping Test	Neuman	Surficial	TP-1A	1.80E-04	0.63	160.0
Smith	Supplemental Phase II	Jun-97	Pumping Test	Neuman	Surficial	TP-1B	1.50E-05	0.87	110.0
Smith	Supplemental Phase II	Jun-97	Pumping Test	Neuman	Surficial	TP-2,3,13	3.70E-03	0.09	75.0
Smith	Supplemental Phase II	Jun-97	Pumping Test	Neuman	Surficial	TP-8	3.80E-04	0.16	53.0
Smith	Supplemental Phase II	Jun-97	Pumping Test	Neuman	Surficial	TP-9	1.50E-03	0.14	45.0
Smith	Supplemental Phase II	Jun-97	Pumping Test	Neuman	Surficial	TP-avg	1.20E-03	0.38	89.0
Smith	Supplemental Phase II	Jun-97	Slug Test	Cooper 1967	Bedrock	GW-61BR	0.01		
CRA	Olin CSA Phase II	Jun-93	Recovery	Cooper-Jacob	Bedrock	GW-62BR			0.060
CRA	Olin CSA Phase II	Jun-93	Drawdown	Theis	Bedrock	GW-62BR			0.034
CRA	Olin CSA Phase II	Jun-93	Drawdown	Cooper-Jacob	Bedrock	GW-62BR			0.064
Smith	Supplemental Phase II	Jun-97	Slug Test	Cooper 1967	Bedrock	GW-62BR	0.00013		
CRA	Olin CSA Phase II	Jun-93	Recovery	Cooper-Jacob	Bedrock	GW-62BRD			0.036
Smith	Supplemental Phase II	Jun-97	Slug Test	Cooper 1967	Bedrock	GW-68BR	0.0047		
CDM	Maple Meadow Landfill Final CSA	Mar-03	Packer		Bedrock	MW-202 BR			5.99E-03
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Rising	Conv. Hvorslev	Bedrock	MW-202BR			1.320
CDM	Maple Meadow Landfill Final CSA	Mar-03	Slug Test Falling	Conv. Hvorslev	Bedrock	MW-202BR			5.540E-02
CDM	Maple Meadow Landfill Final CSA	Mar-03	Packer		Bedrock	MW-203 BR			2.920E-03
CDM	Maple Meadow Landfill Final CSA	Mar-03	Packer		Bedrock	MW-204 BR			3.220E-04
CDM	Maple Meadow Landfill Final CSA	Mar-03	Packer		Bedrock	MW-206 BR			3.850E-03

Table 3.3-3
Horizontal Gradient
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Wells ID	Elevation Change May 2011 DTW (ft.)	Elevation Change October 2011 DTW (ft.)	Distance (ft.)	Avg. Horizontal Gradient	Direction
GW-62S GW-86S	0.86	0.37	2000	**MMBW** 0.000308	northerly
GW-45S GW-55S	1.32	1.76	1300	**Jewel Dr.** 0.001185	southeasterly
GW-308 GW-50S	5.91	5.99	800	**South of Plant B** 0.007438	southeasterly

Created By: CTM
Checked By: PHT

Table 3.3-4
Vertical Gradient
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Location Name	Top of Casing Elevation (ft)	Top of Screen (elevation) (ft)	Bottom of Screen (elevation) (ft)	DTW (ft) (5/10/11)	GW Elevation (ft)	Mid-Screen Elevation (ft)		Vertical Gradient
Ipswich Watershed								
MW-206D	88.69	47.28	32.28	7.9	80.79	39.78		
MW-206S	89.35	73.61	63.61	8.59	80.76	68.61	S to D	0.001041
GW-84D	87.61	-10.6	-25.6	NA	NA	-18.1	S to D	NA
GW-84M	88.17	19.4	4.4	7.88	80.29	11.9	M to D	NA
GW-84S	87.94	44.4	34.4	7.8	80.14	39.4	S to M	0.005455
GW-63D	83.32	57.1	47.1	3.31	80.01	52.1		
GW-63S	82.82	73.1	63.1	2.82	80.00	68.1	S to D	0.000625
GW-86D	86.77	-2.1	-12.1	6.75	80.02	-7.1	S to D	-0.00046
GW-86M	87.17	30.9	15.9	7.1	80.07	23.4	M to D	-0.00164
GW-86S	87.22	63.4	53.4	7.17	80.05	58.4	S to M	0.000571
GW-62D	83.84	21.4	11.4	2.88	80.96	16.4	S to D	0.000179
GW-62M	84.36	52.4	42.4	3.42	80.94	47.4	M to D	0.000645
GW-62S	84.61	77.3	67.3	3.66	80.95	72.3	S to M	-0.0004
GW-58D	98.19	26.1	16.1	17.3	80.89	21.1		
GW-58S	98.21	78	68	17.42	80.79	73	S to D	0.001927
Aberjona Watershed								
GW-42D	84.16	50.4	40.4	2.33	81.83	45.4		
GW-42S	84.16	76	66	3.25	80.91	71	S to D	-0.03594
GW-45D	89.36	37.3	27.3	8.37	80.99	32.3		
GW-45S	89.43	77.9	67.9	8.4	81.03	72.9	S to D	0.000985
GW-3D	85.23	71.2	61.2	5.75	79.48	66.2		
GW-3S	86.69	75.4	70.4	6.74	79.95	72.9	S to D	-0.07015
GW-6D	90.34	70.5	60.5	8.15	82.19	65.5		
GW-6S	91.24	79	74	8.12	83.12	76.5	S to D	-0.08455
GW-17D	81.42	72.6	67.6	2.91	78.51	70.1		
GW-17S	82.07	76.7	71.7	3.55	78.52	74.2	S to D	-0.00244
GW-28D	84.81	79.2	69.2	2.02	82.79	74.2		
GW-28S	85.56	81.9	71.9	2.76	82.8	76.9	S to D	-0.0037
GW-29D	85.34	64.8	54.8	3.15	82.19	59.8		
GW-29S	84.35	79.9	69.9	2.02	82.33	74.9	S to D	-0.00927
GW-50D	80.11	47.4	37.4	3.91	76.2	42.4		
GW-50S	79.71	72	62	3.66	76.05	67	S to D	0.006098
GW-55D	81.73	69.7	59.7	2.32	79.41	64.7		
GW-55S	81.44	74.8	69.8	1.95	79.49	72.3	S to D	-0.01053

Notes:
Negative value (-) indicates a downward gradient
Positive value indicates an upward gradient

Created By: CTM
Checked By: PHT

Table 3.3-5
Piezometer Water Level Measurements - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Date	11/4/2002	2/3/2003	5/5/2003	8/11/2003	11/17/2003	2/2/2004	5/10/2004	8/9/2004	11/1/2004	2/1/2005	5/16/2005	8/8/2005
ID	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
PZ-16RR in	0.99	0.32	---	---	---	---	---	---	---	---	---	---
PZ-16RR out	1.21	0.71	---	1.02	---	---	---	---	---	---	---	---
PZ-17RR in	0.76	0.40	0.41	0.54	0.53	0.31	---	1.01	---	---	---	---
PZ-17RR out	DRY	1.15	1.43	1.40	1.29	1.10	---	DRY	---	---	---	---
PZ-18R in	2.4	1.69	1.85	2.01	1.88	1.70	1.99	2.34	1.90	1.87	1.91	2.58
PZ-18R out	DRY	1.71	1.98	1.78	1.91	1.75	1.90	2.29	1.90	---	1.92	2.70

Date	10/26/2005	11/21/2005	12/5/2005	2/25/2007	5/25/2007	8/20/2007	11/9/2007	3/4/2008	5/16/2008	8/25/2008	11/18/2008	2/23/2009
ID	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
PZ-16RR in	2.60	2.78	2.66	---	---	3.81	2.93	2.44	3.26	3.19	2.98	NG
PZ-16RR out	DRY	DRY	DRY	---	---	2.81	2.94	2.48	DRY	3.05	2.86	2.82
PZ-17RR in	2.40	2.08	2.03	---	---	2.81	2.04	1.91	2.64	2.31	2.41	1.94
PZ-17RR out	DRY	DRY	DRY	---	---	2.59	3.36	3.22	3.47	3.45	2.32	3.31
PZ-18R in	1.88	2.16	---	---	---	2.59	1.99	1.91	2.02	1.99	2.28	2.00
PZ-18R out	DRY	DRY	---	---	---	DRY	1.90	1.9	1.88	1.91	1.89	1.87

Date	5/11/2009	8/10/2009	11/9/2009	2/15/2010	6/8/2010	8/23/2010	11/15/2010	3/21/2011	5/16/2011	8/22/2011	11/8/2011	2/23/2012
ID	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
PZ-16RR in	2.91	3.23	2.80	NG	3.20	4.31	1.90	2.75	2.74	3.35	3.31	3.03
PZ-16RR out	3.08	3.16	2.90	3.35	3.30	DRY	2.80	3.70	3.10	DRY	3.10	DRY
PZ-17RR in	2.45	2.20	2.30	2.74	3.34	2.96	2.17	1.87	3.44	2.44	1.96	2.25
PZ-17RR out	3.45	3.48	3.41	3.50	3.52	3.55	3.10	3.43	3.45	2.45	3.44	3.25
PZ-18R in	2.02	2.04	1.95	NG	1.95	2.73	2.12	2.06	2.06	1.90	1.85	1.90
PZ-18R out	1.91	1.89	1.89	NG	1.91	2.52	1.55	1.87	1.88	1.91	1.88	1.73

Date	5/23/2012	8/20/2012	11/13/2012	3/21/2013	5/6/2013	8/22/2013	12/3/2013
ID	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
PZ-16RR in	3.22	3.59	3.06	2.85	3.08	3.68	2.95
PZ-16RR out	DRY	DRY	DRY	DRY	DRY	DRY	2.97
PZ-17RR in	2.19	3.51	3.50	---	---	2.34	2.17
PZ-17RR out	3.22	3.53	3.49	---	---	3.61	3.48
PZ-18R in	1.84	1.98	1.90	1.86	2.13	2.31	1.86
PZ-18R out	1.90	1.88	1.91	1.86	1.91	1.93	1.85

Notes

1) PZ-16R was replaced (PZ-16RR) in August, 2005

2) PZ-17RR was replaced (PZ-17RRR) on 8/21/13

Created by: DLC

Checked by: CTM

Table 4.1-1
Summary of Detected Chemicals for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection			Range of Reporting Limits for Non Detects			Range of Detected Concentrations			Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Volatile Organics (mg/Kg)															
1,1,1-Trichloroethane	8	/	173	0.0022	:	1	0.003	-	0.071	0.031	--	38000	ns	2.6	0.07
1,1-Dichloroethane	1	/	173	0.0022	:	1	0.001	-	0.001	0.031	--	17	c	0.00068	
1,2,4-Trichlorobenzene	1	/	147	0.0022	:	1	0.098	-	0.098	0.036	--	99	c**	0.0029	0.2
1,2,4-Trimethylbenzene	2	/	147	0.0022	:	1	0.025	-	0.21	0.037	--	260	ns	0.021	
1,2-Dichlorobenzene	1	/	147	0.0022	:	1	0.073	-	0.073	0.036	--	9800	ns	0.27	0.58
1,2-Dichloroethane	1	/	173	0.0022	:	1	0.001	-	0.001	0.031	--	2.2	c*	0.000042	0.0014
1,3,5-Trimethylbenzene	1	/	147	0.0022	:	1	0.13	-	0.13	0.036	--	10000	ns	0.12	
2,4,4-Trimethyl-1-pentene	9	/	172	0.0044	:	0.79	0.002	-	2.1	0.054	--	39	n		
2,4,4-Trimethyl-2-pentene	6	/	172	0.0044	:	0.79	0.017	-	0.61	0.035	--	39	n		
2-Butanone	1	/	173	0.011	:	20	0.004	-	0.004	0.57	--	200000	nms	1	
Acetic acid, methyl ester	1	/	111	0.044	:	2.9	7.2	-	7.2	0.16	--	1000000	nms	3.2	
Acetone	13	/	173	0.006	:	20	0.011	-	0.081	0.87	--	630000	nms	2.4	
Benzene	1	/	173	0.0022	:	1	0.001	-	0.001	0.031	--	5.4	c*	0.0002	0.0026
Formaldehyde	1	/	2	0.12	:	0.12	0.14	-	0.14	0.10	0.459	120000	nm	0.62	
Methylene chloride	6	/	173	0.004	:	2	0.002	-	0.44	0.062	--	960	c**	0.0025	0.0013
Naphthalene	1	/	147	0.022	:	10	0.16	-	0.16	0.35	--	18	c*	0.00047	
Styrene	2	/	173	0.0022	:	1	0.001	-	0.31	0.032	--	36000	ns	1.2	0.11
Tetrachloroethene	4	/	173	0.0022	:	1	0.001	-	0.015	0.031	--	110	c**	0.0044	0.0023
Tetrahydrofuran	3	/	111	0.022	:	1.6	0.007	-	0.009	0.053	--	95000	n	0.71	
Toluene	8	/	173	0.0022	:	1	0.0009	-	0.038	0.031	--	45000	ns	0.59	0.69
Trichloroethene	1	/	173	0.0022	:	1	0.007	-	0.007	0.031	--	6.4	c**	0.00016	0.0018
Xylenes (m&p)	1	/	147	0.0044	:	1	0.011	-	0.011	0.040	--				
Xylenes, Total	2	/	173	0.0044	:	1	0.002	-	0.011	0.034	--	2700	ns	0.19	9.8
Semivolatile Organics (mg/Kg)															
1-Methylnaphthalene	4	/	116	0.033	:	23	0.023	-	0.62	0.27	--	53	c	0.0051	
2,4-Dimethylphenol	1	/	194	0.033	:	36	0.61	-	0.61	0.66	--	12000	n	0.32	
2,4-Dinitrophenol	1	/	176	0.033	:	160	0.016	-	0.016	1.3	--	1200	n	0.034	
2-Methylnaphthalene	8	/	194	0.033	:	36	0.007	-	0.71	0.65	--	2200	n	0.14	
2-Methylphenol	2	/	194	0.033	:	36	0.02	-	3.1	0.67	--	31000	n	0.58	
3 & 4 Methylphenol	1	/	164	0.033	:	36	1.5	-	1.5	0.62	--				
Acenaphthene	6	/	194	0.033	:	36	0.1	-	4.8	0.68	--	33000	n	4.1	
Acenaphthylene	8	/	194	0.033	:	36	0.008	-	0.21	0.64	--				
Acetophenone	13	/	121	0.033	:	23	0.011	-	0.16	0.28	--	100000	nms	0.45	
Aniline	4	/	167	0.033	:	180	0.016	-	0.69	2.3	--	300	c*	0.0039	
Anthracene	16	/	194	0.033	:	36	0.005	-	9.1	0.70	--	170000	nm	42	
Benzaldehyde	32	/	116	0.033	:	23	0.012	-	1.9	0.31	0.102	100000	nms	0.33	
Benzo(a)anthracene	44	/	194	0.033	:	36	0.008	-	28	0.94	0.0192	2.1	c	0.01	
Benzo(a)pyrene	47	/	193	0.033	:	36	0.011	-	21	0.87	0.0229	0.21	c	0.0035	0.24
Benzo(b)fluoranthene	52	/	194	0.033	:	36	0.013	-	29	0.93	0.0528	2.1	c	0.035	

Table 4.1-1
Summary of Detected Chemicals for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Benzo(ghi)perylene	33 / 193	0.033 : 36	0.014 - 16	0.78	0.0239				
Benzo(k)fluoranthene	31 / 193	0.033 : 36	0.011 - 12	0.77	--	21	c	0.35	
Benzoic Acid	29 / 167	0.17 : 180	0.025 - 34	3.6	--	2500000	nm	14	
Benzyl alcohol	1 / 190	0.066 : 72	0.34 - 0.34	1.2	--	62000	n	0.37	
Biphenyl	9 / 116	0.033 : 23	0.023 - 0.57	0.28	--	210	n	0.0087	
Bis(2-Ethylhexyl)phthalate	145 / 195	0.034 : 9.1	0.011 - 375	8	0.0305	120	c	1.1	1.4
Butylbenzylphthalate	7 / 194	0.033 : 36	0.029 - 0.36	0.65	--	910	c	0.2	
Carbazole	7 / 118	0.033 : 23	0.02 - 5.4	0.33	--				
Chrysene	59 / 194	0.033 : 36	0.011 - 26	0.93	0.0282	210	c	1.1	
Dibenz(a,h)anthracene	16 / 193	0.033 : 36	0.015 - 4.8	0.70	--	0.21	c	0.011	
Dibenzofuran	6 / 194	0.033 : 36	0.016 - 1.7	0.66	--	1000	n	0.11	
Diethylphthalate	7 / 194	0.021 : 36	0.013 - 0.085	0.63	--	490000	nm	4.7	
Dimethylphthalate	2 / 194	0.033 : 36	0.064 - 0.11	0.65	--				
Di-n-butylphthalate	17 / 193	0.033 : 110	0.009 - 3	0.77	--	62000	n	1.7	
Di-n-octylphthalate	3 / 193	0.033 : 36	0.012 - 0.053	0.65	--	6200	n	44	
Diphenyl ether	16 / 116	0.033 : 23	0.011 - 1.7	0.31	--				
Diphenylamine	15 / 48	0.033 : 17	0.0023 - 5	0.37	--	15000	n	0.44	
Fluoranthene	75 / 194	0.033 : 36	0.01 - 73	1.3	0.0436	22000	n	70	
Fluorene	9 / 194	0.033 : 36	0.008 - 3.5	0.67	--	22000	n	4	
Hexachlorobenzene	1 / 189	0.033 : 36	0.018 - 0.018	0.66	--	1.1	c	0.00053	0.013
Indeno(1,2,3-cd)pyrene	41 / 193	0.033 : 36	0.011 - 14	0.77	0.033	2.1	c	0.2	
Naphthalene	14 / 194	0.036 : 41	0.008 - 0.96	0.78	--	18	c*	0.00047	
N-Nitrosodiphenylamine	27 / 194	0.033 : 36	0.015 - 2.8	0.59	--	350	c	0.057	
Pentachlorophenol	2 / 190	0.033 : 180	0.032 - 0.045	2.6	--	2.7	c	0.00036	0.01
Phenanthrene	55 / 194	0.036 : 36	0.011 - 35	0.94	0.036				
Phenol	8 / 194	0.033 : 36	0.014 - 32	0.82	--	180000	nm	2.6	
Pyrene	75 / 193	0.033 : 36	0.011 - 29	0.85	0.0501	17000	n	9.5	
PAHs (mg/Kg)									
Acenaphthylene	3 / 5	0.97 : 1	0.65 - 3.9	1.6	--				
Anthracene	5 / 5		0.045 - 0.073	0.057	--	170000	nm	42	
Benzo(a)anthracene	5 / 5		0.32 - 1.1	0.51	0.0192	2.1	c	0.01	
Benzo(a)pyrene	5 / 5		0.31 - 0.71	0.47	0.0229	0.21	c	0.0035	0.24
Benzo(b)fluoranthene	5 / 5		0.49 - 1.2	0.69	0.0528	2.1	c	0.035	
Benzo(ghi)perylene	5 / 5		0.36 - 0.79	0.51	0.0239				
Benzo(k)fluoranthene	5 / 5		0.23 - 0.34	0.28	--	21	c	0.35	
Chrysene	5 / 5		0.54 - 0.97	0.71	0.0282	210	c	1.1	
Dibenz(a,h)anthracene	2 / 5	0.3 : 0.41	0.066 - 0.14	0.14	--	0.21	c	0.011	
Fluoranthene	5 / 5		1.2 - 2	1.6	0.0436	22000	n	70	
Indeno(1,2,3-cd)pyrene	5 / 5		0.33 - 0.8	0.46	0.033	2.1	c	0.2	
Phenanthrene	5 / 5		0.43 - 0.69	0.57	0.036				

Table 4.1-1
Summary of Detected Chemicals for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection			Range of Reporting Limits for Non Detects			Range of Detected Concentrations			Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Pyrene	5	/	5				0.9	-	1.5	1.1	0.0501	17000	n	9.5	
Pesticides/PCBs (mg/Kg)															
4,4'-DDD	8	/	48	0.0033	:	0.21	0.00012	-	0.16	0.021	--	7.2	c	0.0064	
4,4'-DDE	13	/	48	0.0033	:	0.21	0.00053	-	0.049	0.018	--	5.1	c	0.046	
4,4'-DDT	23	/	48	0.0033	:	0.21	0.0014	-	0.68	0.038	--	7	c*	0.067	
Aldrin	3	/	48	0.0017	:	0.21	0.000098	-	0.003	0.015	--	0.1	c	0.00065	
Alpha-BHC	3	/	48	0.0017	:	0.21	0.0002	-	0.0058	0.015	--	0.27	c	0.000036	
Alpha-Chlordane	3	/	25	0.0017	:	0.24	0.00034	-	0.0034	0.026	--				
Beta-BHC	1	/	48	0.0017	:	0.33	0.00013	-	0.00013	0.022	--	0.96	c	0.00013	
Chlordane (technical)	4	/	25	0.0017	:	0.24	0.00028	-	0.036	0.027	--	6.5	c*	0.013	0.14
Delta-BHC	2	/	48	0.0017	:	0.21	0.0015	-	0.031	0.015	--				
Dieldrin	8	/	48	0.0033	:	0.68	0.00055	-	0.0025	0.024	--	0.11	c	0.000061	
Endosulfan I	3	/	48	0.0017	:	0.21	0.0021	-	0.034	0.015	--				
Endrin	2	/	48	0.0033	:	0.21	0.0004	-	0.0072	0.017	--	180	n	0.068	0.081
Endrin ketone	1	/	30	0.0033	:	0.065	0.0014	-	0.0014	0.011	--				
Gamma-BHC/Lindane	7	/	48	0.0017	:	0.21	0.00011	-	0.14	0.021	--	2.1	c	0.00021	0.0012
Heptachlor epoxide	2	/	48	0.0017	:	0.21	0.000078	-	0.00041	0.015	--	0.19	c*	0.000068	0.0041
Aroclor-1016	1	/	42	0.000094	:	1	0.98	-	0.98	0.10	--	21	c**	0.092	
Aroclor-1260	12	/	42	0.1	:	1	0.024	-	13	0.60	--	0.74	c	0.024	
Inorganics (mg/Kg)															
Aluminum	135	/	135				640	-	59000	6565	16279	990000	nm	23000	
Antimony	6	/	123	0.53	:	20	0.28	-	79	1.8	--	410	n	0.27	0.27
Arsenic	136	/	152	0.9	:	21	1.3	-	56	7.1	11.66	2.4	cR	0.0013	0.29
Barium	138	/	138				3.4	-	120	21	17.66	190000	nm	120	82
Beryllium	99	/	123	0.18	:	1.5	0.029	-	4	0.31	0.4	2000	n	13	3.2
Cadmium	102	/	157	0.18	:	4	0.026	-	5.8	0.36	0.321	800	n	0.52	0.38
Calcium	123	/	123				68	-	28000	2397	679.9				
Chromium	194	/	195	5	:	5	1.1	-	5000	143	12.79	1500000	nm		180000
Chromium, Hexavalent	21	/	56	0.23	:	95	0.29	-	11	5.7	--	5.6	c	0.00059	
Cobalt	120	/	123	0.24	:	5.4	0.16	-	45	3.9	3.41	300	n	0.21	
Copper	123	/	123				0.94	-	150	13.8	6.698	41000	n	22	46
Iron	135	/	135				81	-	100000	9196	15564	720000	nm	270	
Lead	153	/	157	5	:	11	1.1	-	210	21	27.73	800	L		14
Magnesium	123	/	123				24	-	6000	1406	1215				
Manganese	123	/	123				2.8	-	970	86	75.31	23000	n	21	
Mercury	55	/	150	0.04	:	0.76	0.01	-	0.83	0.11	0.115	43	ns	0.033	0.1
Nickel	122	/	123	5	:	5	0.66	-	76	10.4	8.42	20000	n	20	
Potassium	118	/	123	620	:	2100	46.3	-	3400	730	682.3				
Selenium	6	/	149	0.5	:	20	0.93	-	3.6	0.80	0.701	5100	n	0.4	0.26
Silver	43	/	135	0.2	:	21	0.064	-	15	0.90	--	5100	n	0.6	

Table 4.1-1
Summary of Detected Chemicals for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Sodium	77 / 123	110 : 1100	15 - 2300	136	50.02				
Thallium	6 / 123	0.35 : 6.5	0.09 - 2.2	0.78	--	10	n	0.011	0.14
Tin	87 / 96	5.4 : 6.8	1 - 400	15.4	4.44	610000	nm	2300	
Vanadium	123 / 123		3.6 - 240	18.7	24.78	5100	n	63	
Zinc	118 / 123	11 : 27	1.2 - 650	41	19.64	310000	nm	290	
Chloride	17 / 108	16 : 48	25 - 560	29	--				
Cyanide, Available	1 / 5	2 : 4.1	3.8 - 3.8	1.9	--				
Cyanide, Total	6 / 12	2 : 2	3.7 - 9.7	3.9	--	140	n	0.014	2
Eh **(mV)**	3 / 3		298 - 322	313	--				
Nitrogen, as Ammonia	115 / 127	5.7 : 8	6.8 - 2100	140	--				
Oxidation Reduction Potential **(mV)**	48 / 48		7 - 560	131	--				
pH **(pH units)**	51 / 51		3.36 - 8.16	5.3	--				
Sulfate	42 / 119	31 : 210	4.2 - 23900	486	--				
Total Organic Carbon	14 / 14		1100 - 35000	12113	--				
Total Organic Carbon **(%)**	5 / 5		11 - 11	11.0	--				
VPH (mg/Kg)									
C9-C10 Aromatics	1 / 25	2 : 4	3.4 - 3.4	1.4	--	500			
Volatile Petroleum Hydrocarbons, Total	1 / 25	2 : 4	3.4 - 3.4	1.4	--				
EPH (mg/Kg)									
Benzo(a)pyrene	4 / 15	0.4 : 1.3	1.2 - 3.4	0.87	0.0229	0.21	c	0.0035	0.24
Benzo(ghi)perylene	2 / 15	0.4 : 1.3	3.9 - 8.4	1.2	0.0239				
C11-C22 Aromatics	30 / 46	3.4 : 4.3	4.5 - 1900	75	--	3000			
C11-C22 Aromatics (unadj.)	30 / 46	3.4 : 13	4.5 - 13000	363	--	3000			
C19-C36 Aliphatics	24 / 46	3.4 : 350	3.6 - 190	24	--	5000			
C9-C18 Aliphatics	7 / 46	3.3 : 350	3.6 - 17	8.5	--	3000			
Extractable Petroleum Hydrocarbons, Total	28 / 40	3.4 : 3.7	4.7 - 2000	109	--				
Specialty Compounds (mg/Kg)									
Hydrazine	12 / 50	0.002 : 0.28	0.00065 - 0.27	0.025	--	0.95	c		
Acetaldehyde	14 / 50	0.2 : 1.1	0.032 - 0.2	0.10	--	52	c**	0.00045	
Formaldehyde	49 / 50	0.1 : 0.1	0.1 - 1.3	0.29	0.459	120000	nm	0.62	
Phthalic Acid/Phthalic anhydride	10 / 49	0.096 : 0.56	0.022 - 29	0.71	--	1200000	nm	5.3	

Table 4.1-1
Summary of Detected Chemicals for OU1 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)	Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)

(1) Values are the Industrial Soil Regional Screening Levels (RSLs).
United States Environmental Protection Agency Regions 3, 6, and 9. November 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentrations_table/index.htm
RSL for 2,4,4-Trimethyl-1-pentene and 2,4,4-Trimethyl-2-pentene calculated consistent with RSL Guidance.
RSL for Chromium (III) used for chromium.
MCP Method 1 Soil category S-2 Standards were used for screening EPH/VPH.
c - RSL is based on an excess lifetime cancer risk of 1 in 1 million.
c* - where n RSL < 100X c RSL.
c** - where n RSL < 10X c RSL.
n - RSL is based on a non-cancer hazard quotient.
nm - RSL is based on a non-cancer hazard quotient; concentration may exceed ceiling limit.
nms - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat and the ceiling limit.
ns - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat.
(2) Values are the Risk- and MCL-based Soil Screening Levels (SSLs) as presented in the RSLs.

mg/Kg = milligram per kilogram
mg/L = milligram per liter
mV = millivolts

U = not detected, value is the reporting limit
J = value is estimated
JEB = value is estimated, analyte detected in the blank
G = value is estimated due to duplicate precision outside of control limits
R = value is rejected
A = value is estimated due to exceedance of holding times
B = analyte was detected in both the sample and its associated laboratory blank
C = value is estimated due to surrogate recovery outside of control limits
E = value is estimated due to interference
G = value is estimated due to duplicate precision outside of control limits
K = value is estimated due to blank spike compound recovery outside the control limits
N = presumptively present
T = value is estimated and may be biased high due to oxidation of Cr+3 to Cr+6

BOLD outlined cells indicate a concentration greater than the Industrial RSL (Appendix F-1)
Shaded cells indicate a concentration greater than the risk-based or MCL-based SSL (Appendix F-1)

Prepared by / Date: KJC 03/06/14
Checked by / Date: CTM 03/10/14

Table 4.1-2
Summary of Detected Chemicals for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Volatile Organics (mg/Kg)									
1,2,3-Trichlorobenzene	2 / 154	0.002 : 11	0.24 - 0.44	0.079	--	490	n	0.015	
1,2,4-Trichlorobenzene	2 / 154	0.002 : 11	0.0016 - 1.2	0.083	--	99	c**	0.0029	0.2
1,2,4-Trimethylbenzene	3 / 154	0.002 : 11	0.39 - 3	0.098	--	260	ns	0.021	
1,2-Dichlorobenzene	1 / 154	0.002 : 11	0.16 - 0.16	0.076	--	9800	ns	0.27	0.58
1,2-Dichloroethane	2 / 227	0.002 : 1600	0.002 - 0.035	4.7	--	2.2	c*	0.000042	0.0014
1,3,5-Trimethylbenzene	2 / 154	0.002 : 11	0.11 - 2.1	0.089	--	10000	ns	0.12	
1,4-Dichlorobenzene	2 / 154	0.002 : 11	0.054 - 0.27	0.077	--	12	c	0.0004	0.072
2,4,4-Trimethyl-1-pentene	67 / 229	0.004 : 89	0.0016 - 6400	47	--	39	n		
2,4,4-Trimethyl-2-pentene	58 / 228	0.004 : 89	0.00094 - 3700	27	--	39	n		
2-Butanone	15 / 227	0.01 : 1600	0.0006 - 0.084	5.3	--	200000	nms	1	
2-Hexanone	10 / 227	0.01 : 1600	0.001 - 3.8	5.1	--	1400	n	0.0079	
4-iso-Propyltoluene	7 / 154	0.002 : 11	0.12 - 5.2	0.15	--				
4-Methyl-2-pentanone	3 / 227	0.01 : 1600	0.005 - 0.027	5.1	--	53000	ns	0.23	
Acetone	19 / 227	0.01 : 1600	0.016 - 180	8.4	--	630000	nms	2.4	
Benzene	5 / 227	0.002 : 1600	0.0005 - 0.024	4.7	--	5.4	c*	0.0002	0.0026
Carbon disulfide	7 / 182	0.0021 : 1600	0.001 - 0.013	5.8	--	3700	ns	0.21	
Carbon tetrachloride	1 / 227	0.002 : 1600	0.009 - 0.009	4.7	--	3	c	0.00015	0.0019
Chlorobenzene	1 / 227	0.002 : 1600	0.017 - 0.017	4.7	--	1400	ns	0.049	0.068
Chloroform	3 / 227	0.002 : 1600	0.001 - 0.007	4.7	--	1.5	c	0.000053	0.022
Chloromethane	1 / 227	0.004 : 1600	0.28 - 0.28	4.8	--	500	n	0.049	
Ethyl benzene	11 / 227	0.002 : 1600	0.002 - 6.7	4.8	--	27	c	0.0015	0.78
Formaldehyde	16 / 26	0.11 : 0.13	0.13 - 1.2	0.24	0.459	120000	nm	0.62	
Isopropylbenzene	1 / 154	0.002 : 11	0.39 - 0.39	0.078	--	11000	ns	0.64	
Methylene chloride	6 / 227	0.005 : 1600	0.002 - 0.42	4.8	--	960	c**	0.0025	0.0013
Naphthalene	1 / 154	0.02 : 110	0.051 - 0.051	0.74	--	18	c*	0.00047	
Propylbenzene	1 / 154	0.002 : 11	0.34 - 0.34	0.077	--	21000	ns	0.99	
sec-Butylbenzene	1 / 154	0.002 : 11	0.14 - 0.14	0.076	--			4.6	
Styrene	7 / 227	0.002 : 1600	0.0005 - 3.3	4.7	--	36000	ns	1.2	0.11
Tetrachloroethene	6 / 227	0.002 : 1600	0.0008 - 0.014	4.7	--	110	c**	0.0044	0.0023
Tetrahydrofuran	3 / 92	0.02 : 110	0.007 - 0.0078	0.83	--	95000	n	0.71	
Toluene	27 / 227	0.002 : 1600	0.0006 - 4.8	4.7	--	45000	ns	0.59	0.69
Trichloroethene	3 / 227	0.002 : 1600	0.007 - 0.022	4.7	--	6.4	c**	0.00016	0.0018
Trichlorofluoromethane	1 / 154	0.004 : 23	0.17 - 0.17	0.13	--	3400	ns	0.69	
Xylene, o	2 / 146	0.002 : 11	0.15 - 0.31	0.082	--	3000	ns	0.19	
Xylenes (m&p)	4 / 146	0.004 : 23	0.00094 - 0.5	0.14	--				
Xylenes, Total	8 / 227	0.004 : 1600	0.00094 - 0.65	4.7	--	2700	ns	0.19	9.8

Table 4.1-2
Summary of Detected Chemicals for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Semivolatile Organics (mg/Kg)									
1,2,4-Trichlorobenzene	2 / 281	0.033 : 670	0.088 - 0.9	3.4	--	99	c**	0.0029	0.2
1,2-Dichlorobenzene	1 / 281	0.033 : 670	0.17 - 0.17	3.4	--	9800	ns	0.27	0.58
1,4-Dichlorobenzene	1 / 281	0.033 : 670	0.23 - 0.23	3.4	--	12	c	0.0004	0.072
1-Methylnaphthalene	1 / 100	0.033 : 37	0.031 - 0.031	0.34	--	53	c	0.0051	
2,4-Dimethylphenol	1 / 281	0.033 : 670	1.8 - 1.8	3.4	--	12000	n	0.32	
2-Methylnaphthalene	2 / 282	0.033 : 670	0.049 - 0.063	3.4	--	2200	n	0.14	
3 & 4 Methylphenol	1 / 202	0.033 : 290	0.13 - 0.13	3.0	--				
4-Chlorophenyl phenyl ether	1 / 281	0.033 : 670	0.17 - 0.17	3.4	--				
Acenaphthene	2 / 282	0.033 : 670	0.014 - 0.015	3.4	--	33000	n	4.1	
Acenaphthylene	1 / 282	0.033 : 670	0.014 - 0.014	3.4	--				
Acetophenone	3 / 100	0.033 : 37	0.034 - 1.5	0.35	--	100000	nms	0.45	
Aniline	1 / 210	0.033 : 1400	0.086 - 0.086	13.7	--	300	c*	0.0039	
Anthracene	4 / 282	0.033 : 670	0.012 - 7.6	3.4	--	170000	nm	42	
Benzaldehyde	1 / 100	0.033 : 37	0.014 - 0.014	0.34	--	100000	nms	0.33	
Benzo(a)anthracene	8 / 282	0.033 : 670	0.02 - 18	3.5	0.019	2.1	c	0.01	
Benzo(a)pyrene	6 / 282	0.033 : 670	0.019 - 23	3.5	0.023	0.21	c	0.0035	0.24
Benzo(b)fluoranthene	10 / 281	0.033 : 670	0.029 - 17	3.5	0.053	2.1	c	0.035	
Benzo(ghi)perylene	3 / 282	0.033 : 670	0.049 - 9.5	3.4	0.024				
Benzo(k)fluoranthene	4 / 281	0.033 : 670	0.013 - 21	3.5	--	21	c	0.35	
Benzoic Acid	13 / 246	0.17 : 1400	0.022 - 2.1	12.5	--	2500000	nm	14	
Biphenyl	5 / 100	0.033 : 37	0.017 - 0.77	0.35	--	210	n	0.0087	
Bis(2-Ethylhexyl)phthalate	164 / 281	0.034 : 1.4	0.012 - 8600	141	0.031	120	c	1.1	1.4
Butylbenzylphthalate	13 / 281	0.033 : 670	0.014 - 4.5	3.5	--	910	c	0.2	
Carbazole	1 / 143	0.033 : 670	0.017 - 0.017	2.7	--				
Chrysene	9 / 282	0.033 : 670	0.012 - 18	3.5	0.028	210	c	1.1	
Dibenz(a,h)anthracene	1 / 282	0.033 : 670	0.15 - 0.15	3.4	--	0.21	c	0.011	
Dibenzofuran	3 / 281	0.033 : 670	0.022 - 0.11	3.4	--	1000	n	0.11	
Diethylphthalate	2 / 281	0.033 : 670	0.046 - 0.057	3.4	--	490000	nm	4.7	
Di-n-butylphthalate	16 / 281	0.033 : 670	0.032 - 507	5.1	--	62000	n	1.7	
Di-n-octylphthalate	15 / 281	0.033 : 670	0.021 - 12	3.5	--	6200	n	44	
Diphenyl ether	8 / 100	0.033 : 37	0.03 - 3.8	0.42	--				
Diphenylamine	6 / 45	0.034 : 0.54	0.022 - 0.25	0.044	--	15000	n	0.44	
Fluoranthene	13 / 282	0.033 : 670	0.015 - 37	3.5	0.044	22000	n	70	
Fluorene	2 / 282	0.033 : 670	0.012 - 0.016	3.4	--	22000	n	4	
Indeno(1,2,3-cd)pyrene	8 / 282	0.033 : 670	0.012 - 10	3.5	0.033	2.1	c	0.2	
Naphthalene	6 / 282	0.035 : 670	0.012 - 0.16	3.6	--	18	c*	0.00047	
N-Nitrosodiphenylamine	39 / 281	0.033 : 50	0.011 - 3400	30	--	350	c	0.057	
Phenanthrene	15 / 282	0.035 : 670	0.015 - 33	3.6	0.036				
Phenol	7 / 281	0.033 : 670	0.055 - 6.6	3.5	--	180000	nm	2.6	
Pyrene	19 / 282	0.033 : 670	0.015 - 35	3.5	0.050	17000	n	9.5	
Pesticides/PCBs (mg/Kg)									
4,4'-DDD	1 / 81	0.0099 : 0.21	0.04 - 0.04	0.014	--	7.2	c	0.0064	

Table 4.1-2
Summary of Detected Chemicals for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Aldrin	1 / 81	0.0084 : 0.21	0.032 - 0.032	0.011	--	0.1	c	0.00065	
Alpha-BHC	1 / 81	0.0084 : 0.21	0.024 - 0.024	0.010	--	0.27	c	0.000036	
Alpha-Chlordane	1 / 29	0.16 : 0.23	0.078 - 0.078	0.091	--				
Beta-BHC	1 / 81	0.0099 : 0.21	0.32 - 0.32	0.015	--	0.96	c	0.00013	
Chlordane (technical)	1 / 29	0.16 : 0.23	0.031 - 0.031	0.090	--	6.5	c*	0.013	0.14
Endosulfan sulfate	1 / 81	0.0099 : 0.21	0.15 - 0.15	0.015	--				
Endrin	1 / 81	0.0099 : 0.21	0.089 - 0.089	0.014	--	180	n	0.068	0.081
Gamma-BHC/Lindane	1 / 81	0.0099 : 0.21	1.6 - 1.6	0.030	--	2.1	c	0.00021	0.0012
Aroclor-1260	5 / 43	0.0001 : 0.59	0.019 - 10	0.46	--	0.74	c	0.024	
Inorganics (mg/Kg)									
Aluminum	168 / 168		200 - 15000	4913	16279.000	990000	nm	23000	
Antimony	12 / 142	0.5 : 20	0.26 - 41	2.7	--	410	n	0.27	0.27
Arsenic	121 / 155	0.81 : 13	0.5 - 16	3.7	11.660	2.4	cR	0.0013	0.29
Barium	137 / 140	11 : 40	2.2 - 75	14.6	17.660	190000	nm	120	82
Beryllium	93 / 142	0.06 : 1.5	0.037 - 0.47	0.29	0.400	2000	n	13	3.2
Cadmium	87 / 193	0.1 : 3	0.019 - 2.5	0.29	0.321	800	n	0.52	0.38
Calcium	133 / 134	1000 : 1000	150 - 32000	1379	679.900				
Chromium	331 / 333	1 : 11	1.8 - 7900	357	12.790	1500000	nm		180000
Chromium, Hexavalent	24 / 37	0.23 : 2.5	0.17 - 28	3.4	--	5.6	c	0.00059	
Cobalt	124 / 134	1.5 : 10	0.29 - 14	2.7	3.410	300	n	0.21	
Copper	120 / 142	2 : 20	0.46 - 45	6.7	6.698	41000	n	22	46
Iron	160 / 160		160 - 26000	6062	15564.000	720000	nm	270	
Lead	146 / 193	1 : 13	0.73 - 50	5.1	27.730	800	L		14
Magnesium	132 / 134	1000 : 1000	63 - 6700	1468	1215.000				
Manganese	134 / 134		5.8 - 340	61	75.310	23000	n	21	
Mercury	22 / 173	0.04 : 0.22	0.047 - 7	0.11	0.115	43	ns	0.033	0.1
Nickel	128 / 142	1.4 : 8	0.93 - 52	6.2	8.420	20000	n	20	
Potassium	132 / 134	1000 : 1000	130 - 2700	669	682.300				
Selenium	1 / 169	0.5 : 13	0.73 - 0.73	0.58	0.701	5100	n	0.4	0.26
Silver	23 / 148	0.5 : 13	0.06 - 24	0.94	--	5100	n	0.6	
Sodium	90 / 143	54 : 290	12 - 25600	706	50.020				
Thallium	2 / 142	0.33 : 3	0.15 - 0.15	0.54	--	10	n	0.011	0.14
Tin	54 / 74	5.8 : 7.3	2.1 - 620	18.0	4.440	610000	nm	2300	
Vanadium	130 / 134	1 : 10	0.89 - 190	11.7	24.780	5100	n	63	
Zinc	141 / 142	0.6 : 0.6	2.9 - 61	15.6	19.640	310000	nm	290	
Chloride	23 / 117	17 : 40	1.03 - 170	22	--				
Cyanide, Total	3 / 28	2 : 2	2.3 - 5.4	1.3	--	140	n	0.014	2
Eh **(mV)**	4 / 4		56.2 - 221	170	--				
Flash Point **(°F)**	6 / 6		200 - 200	200	--				
Lab Specific Conductance **(mS/cm)**	6 / 6		0.016 - 0.033	0.027	--				
Nitrate as N	2 / 2		14 - 24	19.0	--	1600000	nm		
Nitrogen, as Ammonia	110 / 150	5.4 : 8.3	3.6 - 4700	149	--				
Oxidation Reduction Potential **(mV)**	31 / 31		2 - 510	165	--				

Table 4.1-2
Summary of Detected Chemicals for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection			Range of Reporting Limits for Non Detects			Range of Detected Concentrations			Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
pH **(pH units)**	46	/	46				4.7	-	9.06	6.4	--				
Sulfate	38	/	116	20	:	80	22	-	285000	4109	--				
Sulfate **(mg/L)**	1	/	1				148	-	148	148	--				
Total Organic Carbon	9	/	14	1000	:	1000	1200	-	42000	6079	--				
Urea	2	/	5	20	:	20	220	-	350	120	--				
TCLP Metals (mg/L)															
Chromium	9	/	10	0.05	:	0.05	0.063	-	0.84	0.31	12.790				
VPH (mg/Kg)															
Ethyl benzene	7	/	38	0.0681	:	13	0.55	-	5.5	0.86	--	27	c	0.0015	0.78
Toluene	3	/	38	0.0681	:	0.8	6	-	57	2.3	--	45000	ns	0.59	0.69
Xylenes, Total	5	/	38	0.136	:	0.48	0.24	-	25	0.98	--	2700	ns	0.19	9.8
C5-C8 Aliphatics	23	/	65	1.02	:	28	3	-	3900	130	--	500			
C5-C8 Aliphatics (unadj.)	23	/	65	1.02	:	28	3	-	4000	134	--	500			
C9-C10 Aromatics	21	/	65	0.34	:	130	3	-	110	9.8	--	500			
C9-C12 Aliphatics	12	/	65	0.34	:	28	2.7	-	140	5.9	--	3000			
C9-C12 Aliphatics (unadj.)	26	/	65	0.34	:	19	2.7	-	170	13.5	--	3000			
Volatile Petroleum Hydrocarbons, Total	29	/	61	1.8	:	19	3	-	4100	155	--				
EPH (mg/Kg)															
Acenaphthene	1	/	34	0.3	:	1.2	6.2	-	6.2	0.45	--	33000	n	4.1	
Acenaphthylene	2	/	34	0.3	:	1.2	0.86	-	0.88	0.31	--				
Benzo(a)anthracene	4	/	34	0.3	:	1.2	1.2	-	5.9	0.55	0.019	2.1	c	0.01	
Benzo(a)pyrene	1	/	34	0.3	:	1.2	0.45	-	0.45	0.28	0.023	0.21	c	0.0035	0.24
Benzo(ghi)perylene	5	/	34	0.3	:	1.2	0.5	-	0.85	0.34	0.024				
Fluoranthene	2	/	34	0.3	:	1.2	0.51	-	5.7	0.45	0.044	22000	n	70	
Fluorene	2	/	34	0.3	:	1.2	1.7	-	2.7	0.39	--	22000	n	4	
Indeno(1,2,3-cd)pyrene	3	/	34	0.3	:	1.2	0.38	-	10	0.59	0.033	2.1	c	0.2	
Naphthalene	1	/	34	0.3	:	1.2	0.77	-	0.77	0.29	--	18	c*	0.00047	
C11-C22 Aromatics	41	/	62	3.3	:	17	3.7	-	4700	393	--	3000			
C11-C22 Aromatics (unadj.)	42	/	62	3.3	:	12	3.7	-	4700	457	--	3000			
C19-C36 Aliphatics	26	/	62	3.3	:	36	5.1	-	2900	125	--	5000			
C9-C18 Aliphatics	31	/	62	3.3	:	36	5.3	-	380	43	--	3000			
Extractable Petroleum Hydrocarbons, Total	41	/	54	3.3	:	3.9	3.7	-	4900	647	--				

Table 4.1-2
Summary of Detected Chemicals for OU1 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Specialty Compounds (mg/Kg)									
Hydrazine	25 / 68	0.0021 : 0.35	0.00058 - 1.9	0.090	--	0.95	c		
Acetaldehyde	11 / 45	0.2 : 0.32	0.034 - 0.1	0.096	--	52	c**	0.00045	
Formaldehyde	43 / 45	0.11 : 0.11	0.087 - 2.1	0.33	0.459	120000	nm	0.62	
Phthalic Acid/Phthalic anhydride	1 / 45	0.1 : 0.16	0.041 - 0.041	0.056	--	1200000	nm	5.3	

(1) Values are the Industrial Soil Regional Screening Levels (RSLs).
United States Environmental Protection Agency Regions 3, 6, and 9. November 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentrations_table/index.htm
RSL for 2,4,4-Trimethyl-1-pentene and 2,4,4-Trimethyl-2-pentene calculated consistent with RSL Guidance.
RSL for Chromium (III) used for chromium.
MCP Method 1 Soil category S-2 Standards were used for screening EPH/VPH.
c - RSL is based on an excess lifetime cancer risk of 1 in 1 million.
c* - where n RSL < 100X c RSL.
c** - where n RSL < 10X c RSL.
n - RSL is based on a non-cancer hazard quotient.
nm - RSL is based on a non-cancer hazard quotient; concentration may exceed ceiling limit.
nms - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat and the ceiling limit.
ns - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat.
(2) Values are the Risk- and MCL-based Soil Screening Levels (SSLs) as presented in the RSLs.

mg/Kg = milligram per kilogram
mg/L = milligram per liter
mV = millivolts
mS/cm = milliSiemen per centimeter

J = value is estimated.
U = not detected, value is reporting limit
R = value is rejected
A = value is estimated due to exceedance of holding times
B = value is estimated, parameter found in both the associated blank and the sample
C = value is estimated due to surrogate recovery outside of control limits
E = value is elevated due to a matrix effect
F = value is estimated due to matrix spike recovery outside of control limits
G = value is estimated due to duplicate precision outside of control limits
H = holding time exceeded
K = value is estimated due to blank spike compound recovery outside the control limits
Q = elevated reporting limit due to high analyte levels
T = value is estimated and may be biased high due to oxidation of Cr+3 to Cr+6
> =value exceeded the maximum reportable value of the instrument

BOLD outlined cells indicate a concentration greater than the Industrial RSL (Appendix F-2)
Shaded cells indicate a concentration greater than the risk-based or MCL-based SSL (Appendix F-2)

Prepared by / Date: KJC 03/06/14
Checked by / Date: CTM 03/10/14

Table 4.1-3
Summary of Detected Chemicals for OU1 Deep Subsurface Soil Samples (>10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Volatile Organics (mg/Kg)								(mg/Kg)	
1,2,3-Trichlorobenzene	1 / 36	0.002 : 1.3	0.078 - 0.078	0.033	--	490	n	0.015	
1,2,4-Trimethylbenzene	1 / 36	0.002 : 1.3	0.15 - 0.15	0.035	--	260	ns	0.021	
1,2-Dichlorobenzene	1 / 36	0.002 : 1.3	0.12 - 0.12	0.034	--	9800	ns	0.27	0.58
1,3,5-Trimethylbenzene	1 / 36	0.002 : 1.3	0.057 - 0.057	0.033	--	10000	ns	0.12	
2,4,4-Trimethyl-1-pentene	21 / 48	0.004 : 1.6	0.0014 - 890	57	--	39	n		
2,4,4-Trimethyl-2-pentene	17 / 48	0.004 : 190	0.0011 - 180	10.0	--	39	n		
2-Butanone	2 / 44	0.016 : 190	0.0079 - 0.065	3.6	--	200000	nms	1	
2-Hexanone	1 / 44	0.016 : 190	1.5 - 1.5	3.6	--	1400	n	0.0079	
4-iso-Propyltoluene	2 / 36	0.002 : 1.3	0.085 - 0.34	0.041	--				
Acetone	6 / 44	0.016 : 190	0.22 - 61	6.1	--	630000	nms	2.4	
Carbon disulfide	5 / 43	0.002 : 190	0.0014 - 0.52	3.4	--	3700	ns	0.21	
Chloromethane	1 / 44	0.0039 : 190	0.0004 - 0.0004	3.4	--	500	n	0.049	
Dibromomethane	1 / 34	0.002 : 1.3	0.0017 - 0.0017	0.034	--	110	n	0.0019	
Ethyl benzene	2 / 44	0.002 : 190	3.3 - 4.3	3.5	--	27	c	0.0015	0.78
Naphthalene	2 / 36	0.02 : 13	0.077 - 0.12	0.30	--	18	c*	0.00047	
Styrene	1 / 44	0.002 : 190	0.0008 - 0.0008	3.3	--	36000	ns	1.2	0.11
Tetrahydrofuran	1 / 33	0.02 : 13	0.027 - 0.027	0.33	--	95000	n	0.71	
Toluene	2 / 44	0.002 : 190	0.003 - 0.91	3.4	--	45000	ns	0.59	0.69
Trichloroethene	1 / 44	0.002 : 190	0.057 - 0.057	3.3	--	6.4	c**	0.00016	0.0018
Xylene, o	1 / 34	0.002 : 1.3	2.6 - 2.6	0.11	--	3000	ns	0.19	
Xylenes (m&p)	1 / 34	0.0039 : 2.7	10 - 10	0.36	--				
Xylenes, Total	1 / 44	0.0039 : 190	12.6 - 12.6	3.6	--	2700	ns	0.19	9.8
Semivolatile Organics (mg/Kg)									
1-Methylnaphthalene	2 / 84	0.034 : 7.5	0.043 - 0.058	0.091	--	53	c	0.0051	
2,4-Dimethylphenol	1 / 92	0.034 : 7.5	0.035 - 0.035	0.14	--	12000	n	0.32	
2-Methylnaphthalene	1 / 92	0.034 : 7.5	0.064 - 0.064	0.14	--	2200	n	0.14	
2-Methylphenol	1 / 92	0.034 : 7.5	0.015 - 0.015	0.14	--	31000	n	0.58	
4-Bromophenyl phenyl ether	2 / 92	0.034 : 7.5	0.011 - 0.017	0.14	--				
4-Chlorophenyl phenyl ether	1 / 92	0.034 : 7.5	0.017 - 0.017	0.14	--				
Acenaphthene	1 / 92	0.034 : 7.5	0.022 - 0.022	0.14	--	33000	n	4.1	
Acetophenone	7 / 84	0.034 : 7.5	0.0041 - 0.053	0.090	--	100000	nms	0.45	
Benzo(a)anthracene	2 / 92	0.034 : 7.5	0.009 - 0.0091	0.14	0.0192	2.1	c	0.01	
Benzo(a)pyrene	2 / 92	0.034 : 7.5	0.012 - 0.013	0.14	0.0229	0.21	c	0.0035	0.24
Benzo(b)fluoranthene	2 / 92	0.034 : 7.5	0.01 - 0.012	0.14	0.0528	2.1	c	0.035	
Benzo(ghi)perylene	1 / 92	0.034 : 7.5	0.0072 - 0.0072	0.14	0.0239				
Benzoic Acid	5 / 75	0.065 : 37	0.05 - 0.14	0.80	--	2500000	nm	14	
Biphenyl	9 / 84	0.034 : 7.5	0.018 - 11	0.24	--	210	n	0.0087	
Bis(2-Ethylhexyl)phthalate	38 / 92	0.034 : 0.73	0.015 - 10000	159	0.0305	120	c	1.1	1.4
Butylbenzylphthalate	3 / 92	0.034 : 7.5	0.031 - 0.11	0.14	--	910	c	0.2	
Chrysene	2 / 92	0.034 : 7.5	0.0081 - 0.0089	0.14	0.0282	210	c	1.1	
Dibenzofuran	2 / 92	0.034 : 7.5	0.029 - 0.038	0.14	--	1000	n	0.11	
Di-n-butylphthalate	3 / 92	0.034 : 7.5	0.021 - 1.4	0.17	--	62000	n	1.7	

Table 4.1-3
Summary of Detected Chemicals for OU1 Deep Subsurface Soil Samples (>10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection			Range of Reporting Limits for Non Detects			Range of Detected Concentrations			Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2)	MCL-Based SSL (2) (mg/Kg)
Di-n-octylphthalate	2	/	92	0.034	:	7.5	0.02	-	0.036	0.14	--	6200	n	44	
Diphenyl ether	17	/	84	0.034	:	7.5	0.014	-	74	1.1	--				
Diphenylamine	3	/	9	0.036	:	0.35	0.0076	-	340	38	--	15000	n	0.44	
Diphenylmethanone	1	/	84	0.034	:	7.5	0.0035	-	0.0035	0.090	--				
Fluorene	1	/	92	0.034	:	7.5	0.025	-	0.025	0.14	--	22000	n	4	
Naphthalene	3	/	92	0.035	:	18	0.015	-	0.13	0.24	--	18	c*	0.00047	
N-Nitrosodiphenylamine	12	/	92	0.034	:	7.5	0.013	-	160	2.7	--	350	c	0.057	
Phenanthrene	2	/	92	0.035	:	9	0.074	-	0.38	0.15	0.036				
Phenol	5	/	92	0.034	:	7.5	0.013	-	0.21	0.14	--	180000	nm	2.6	
Pyrene	3	/	92	0.034	:	7.5	0.015	-	0.043	0.13	0.0501	17000	n	9.5	
Inorganics (mg/Kg)															
Aluminum	79	/	79				570	-	21000	8123	16279	990000	nm	23000	
Antimony	4	/	73	0.53	:	20	0.24	-	0.46	0.65	--	410	n	0.27	0.27
Arsenic	72	/	73	1	:	1	0.99	-	18	3.5	11.66	2.4	cR	0.0013	0.29
Barium	71	/	71				7.5	-	200	43	17.66	190000	nm	120	82
Beryllium	69	/	73	0.4	:	1.5	0.046	-	0.47	0.24	0.4	2000	n	13	3.2
Cadmium	70	/	74	0.3	:	1	0.049	-	1.3	0.28	0.321	800	n	0.52	0.38
Calcium	71	/	71				550	-	13000	3012	679.9				
Chromium	81	/	81				5.3	-	3400	136	12.79	1500000	nm		180000
Chromium, Hexavalent	19	/	22	0.23	:	2.3	0.2	-	48	7.8	--	5.6	c	0.00059	
Cobalt	70	/	71	1.5	:	1.5	1.6	-	26	8.7	3.41	300	n	0.21	
Copper	72	/	73	2	:	2	4	-	66	23	6.698	41000	n	22	46
Iron	77	/	77				840	-	87000	16906	15564	720000	nm	270	
Lead	68	/	74	0.63	:	10	0.52	-	11	2.3	27.73	800	L		14
Magnesium	71	/	71				280	-	15000	5077	1215				
Manganese	71	/	71				32	-	460	144	75.31	23000	n	21	
Nickel	72	/	73	3	:	3	3.2	-	41	14.4	8.42	20000	n	20	
Potassium	71	/	71				320	-	12000	2193	682.3				
Silver	37	/	73	0.53	:	3.1	0.055	-	8.4	1.3	--	5100	n	0.6	
Sodium	72	/	79	110	:	150	22	-	1000	214	50.02				
Thallium	3	/	73	0.5	:	6.3	0.2	-	0.54	0.70	--	10	n	0.011	0.14
Tin	68	/	69	13	:	13	1.8	-	190	30	4.44	610000	nm	2300	
Vanadium	71	/	71				2.8	-	71	27	24.78	5100	n	63	
Zinc	73	/	73				4.4	-	66	23	19.64	310000	nm	290	
Chloride	14	/	79	15	:	40	12.2	-	62.8	14.4	--				
Nitrogen, as Ammonia	72	/	79	4.7	:	7.9	7	-	510	121	--				
Oxidation Reduction Potential **(mV)**	23	/	23				5	-	430	122	--				
pH **(pH units)**	28	/	28				4.29	-	8.13	6.6	--				
Sulfate	31	/	78	33	:	49	8.12	-	13400	316	--				
Sulfate **(mg/L)**	1	/	1				188	-	188	188	--				
VPH (mg/Kg)															
Ethyl benzene	2	/	10	0.0724	:	0.3	0.62	-	1.7	0.32	--	27	c	0.0015	0.78
Toluene	1	/	10	0.0724	:	0.3	1.4	-	1.4	0.24	--	45000	ns	0.59	0.69

Table 4.1-3
Summary of Detected Chemicals for OU1 Deep Subsurface Soil Samples (>10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection			Range of Reporting Limits for Non Detects			Range of Detected Concentrations			Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2)	MCL-Based SSL (2) (mg/Kg)
Xylenes, Total	1	/	10	0.145	:	0.3	0.48	-	0.48	0.16	--	2700	ns	0.19	9.8
C5-C8 Aliphatics	11	/	27	1.09	:	23	3.3	-	1400	125	--	500			
C5-C8 Aliphatics (unadj.)	11	/	27	1.09	:	23	3.3	-	1400	125	--	500			
C9-C10 Aromatics	8	/	27	0.362	:	24	3.1	-	61	7.2	--	500			
C9-C12 Aliphatics	4	/	27	0.362	:	27	3.5	-	21	4.0	--	3000			
C9-C12 Aliphatics (unadj.)	8	/	27	0.362	:	27	3.5	-	75	9.2	--	3000			
Volatile Petroleum Hydrocarbons, Total	12	/	24	2	:	3	3.3	-	1400	147	--				
EPH (mg/Kg)															
Benzo(a)anthracene	1	/	16	0.4	:	1.3	0.44	-	0.44	0.38	0.0192	2.1	c	0.01	
Benzo(ghi)perylene	2	/	16	0.4	:	1.3	0.47	-	2.6	0.54	0.0239				
C11-C22 Aromatics	16	/	33	3.6	:	4.4	4.6	-	1700	195	--	3000			
C11-C22 Aromatics (unadj.)	17	/	33	3.6	:	13	4.6	-	7200	395	--	3000			
C19-C36 Aliphatics	12	/	33	3.4	:	13	4	-	3200	106	--	5000			
C9-C18 Aliphatics	10	/	33	3.4	:	72	4.5	-	520	27	--	3000			
Extractable Petroleum Hydrocarbons, Total	17	/	26	3.6	:	3.9	4	-	4600	407	--				
Specialty Compounds (mg/Kg)															
Hydrazine	5	/	9	0.0021	:	0.3	0.00058	-	0.0031	0.034	--	0.95	c		
Acetaldehyde	15	/	43	0.2	:	0.25	0.033	-	0.16	0.090	--	52	c**	0.00045	
Formaldehyde	43	/	43				0.093	-	1	0.35	0.459	120000	nm	0.62	
Phthalic Acid/Phthalic anhydride	2	/	8	0.11	:	0.13	0.034	-	0.048	0.053	--	1200000	nm	5.3	

(1) Values are the Industrial Soil Regional Screening Levels (RSLs).
United States Environmental Protection Agency Regions 3, 6, and 9. November 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentrations_table/index.htm
RSL for 2,4,4-Trimethyl-1-pentene and 2,4,4-Trimethyl-2-pentene calculated consistent with RSL Guidance.
RSL for Chromium (III) used for chromium.
MCP Method 1 Soil category S-2 Standards were used for screening EPH/VPH.
c - RSL is based on an excess lifetime cancer risk of 1 in 1 million.
c* - where n RSL < 100X c RSL.
c** - where n RSL < 10X c RSL.
n - RSL is based on a non-cancer hazard quotient.
nm - RSL is based on a non-cancer hazard quotient; concentration may exceed ceiling limit.
nms - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat and the ceiling limit.
ns - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat.
(2) Values are the Risk- and MCL-based Soil Screening Levels (SSLs) as presented in the RSLs.

mg/Kg = milligram per kilogram
mg/L = milligram per liter
mV = millivolts

Prepared by / Date: KJC 03/02/14
Checked by / Date: CTM 03/10/14

BOLD outlined cells indicate a concentration greater than the Industrial RSL (Appendix F-3)
Shaded cells indicate a concentration greater than the risk-based or MCL-based SSL (Appendix F-3)

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	AWQC (1) (mg/L)	OC-SW-ISCO1 ISCO1 11/15/2010	OC-SW-ISCO-1-XXX ISCO1 12/10/2010	OC-SW-ISCO1 ISCO1 3/22/2011	OC-SW-ISCO1 ISCO1 5/16/2011	OC-SW-ISCO-1-XXX ISCO1 6/6/2011	OC-SW-ISCO1 ISCO1 8/23/2011	OC-SW-ISCO1 ISCO1 11/8/2011
Volatile Organics (mg/L)												
1,3-Dichlorobenzene	2 / 12	0.001 : 0.001	0.0003 - 0.00057	0.000489167	0.96		0.001 U			0.001 U		
2,4,4-Trimethyl-1-pentene	9 / 12	0.001 : 0.001	0.0014 - 0.01	0.003275			0.001 U			0.001 UJ		
2,4,4-Trimethyl-2-pentene	5 / 12	0.001 : 0.001	0.00044 - 0.002	0.000690833			0.001 U			0.001 U		
2-Butanone	2 / 12	0.01 : 0.01	0.0071 - 0.025	0.006841667			0.01 U			0.01 U		
Acetone	2 / 12	0.05 : 0.05	0.0084 - 0.012	0.022533333			0.05 U			0.05 U		
Bromodichloromethane	3 / 12	0.0005 : 0.001	0.00021 - 0.00051	0.000360833	0.017		0.001 U			0.0005 U		
Bromoform	8 / 12	0.001 : 0.001	0.00067 - 0.0034	0.0012825	0.14		0.001 UJ			0.001 UJ		
Carbon disulfide	3 / 12	0.01 : 0.01	0.00021 - 0.00067	0.003871667			0.00067 J			0.00021 J		
Chlorodibromomethane	6 / 12	0.0005 : 0.0005	0.00048 - 0.0038	0.001431667	0.013		0.0005 U			0.0005 U		
Chloroform	6 / 12	0.001 : 0.001	0.00027 - 0.0012	0.0005675	0.47		0.001 U			0.001 U		
Dibromomethane	6 / 12	0.001 : 0.001	0.00032 - 0.0011	0.000576667			0.001 U			0.001 U		
Toluene	2 / 12	0.001 : 0.001	0.00046 - 0.00048	0.000495	15		0.001 U			0.001 U		
Semivolatile Organics (mg/L)												
2-Nitrophenol	7 / 12	0.00096 : 0.0045	0.00057 - 0.0018	0.001224583			0.0045 U			0.0045 U		
4-Nitrophenol	4 / 12	0.0045 : 0.005	0.00072 - 0.0021	0.0020725			0.0045 UJ			0.0045 U		
Azobenzene	2 / 12	0.00096 : 0.005	0.00046 - 0.00053	0.001684583			0.0045 U			0.0045 U		
Benzo(a)pyrene	1 / 12	0.00018 : 0.00099	0.00015 - 0.00015	0.000162083	0.000018		0.00018 U			0.00018 U		
Benzoic Acid	7 / 10	0.0045 : 0.0045	0.0018 - 0.0021	0.002045			0.0019 J			0.0019 J		
Bis(2-Ethylhexyl)phthalate	2 / 11	0.0018 : 0.0089	0.0018 - 0.0061	0.002440909	0.0022		R			0.0018 U		
Diphenyl ether	4 / 12	0.00096 : 0.005	0.00056 - 0.0011	0.001480417			0.0045 U			0.0045 U		
Diphenylmethanone	4 / 12	0.00096 : 0.005	0.00052 - 0.0012	0.001509583			0.0045 U			0.0045 U		
N-Nitrosodimethylamine	12 / 12		0.000023 - 0.0003	0.000122417	0.003		0.000061			0.000023		
N-Nitrosodi-n-propylamine	2 / 12	1.9E-06 : 0.000021	0.0000049 - 0.0000093	3.50833E-06	0.00051		0.0000019 U			0.0000019 U		
N-Nitrosodiphenylamine	2 / 12	0.00096 : 0.005	0.00047 - 0.00064	0.001694583	0.006		0.0045 U			0.0045 U		
Metals, Total (mg/L)												
Aluminum	89 / 90	0.2 : 0.2	0.076 - 26	1.999266667		0.3	0.25	0.26	0.18	0.1	0.15	0.33
Antimony	1 / 12	0.006 : 0.006	0.0037 - 0.0037	0.003058333	0.64		0.0037 J			0.006 U		
Arsenic	2 / 12	0.01 : 0.01	0.0031 - 0.0035	0.004716667	0.00014		0.01 U			0.01 U		
Barium	12 / 12		0.013 - 0.032	0.02425			0.032			0.028		
Beryllium	5 / 12	0.001 : 0.001	0.0003 - 0.0011	0.000608333			0.001 U			0.001 U		
Calcium	12 / 12		23 - 81	53.16666667			27			25		
Chromium	90 / 90		0.0085 - 5.7	0.442966667		0.027	0.029	0.016	0.012	0.012	0.016	0.03
Cobalt	12 / 12		0.0054 - 0.05	0.028583333			0.014			0.0054 J		
Copper	12 / 12		0.00021 - 0.026	0.008583333			0.0043 J			0.00049 J		
Iron	12 / 12		1.5 - 13	5.958333333			8			4.7		
Lead	10 / 12	0.0001 : 0.001	0.0003 - 0.0021	0.000605			0.00045 J			0.00032 J		
Magnesium	12 / 12		3.3 - 17	10.925			4.4			4.4		

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	AWQC (1) (mg/L)	OC-SW-ISCO1 ISCO1 11/15/2010	OC-SW-ISCO-1-XXX ISCO1 12/10/2010	OC-SW-ISCO1 ISCO1 3/22/2011	OC-SW-ISCO1 ISCO1 5/16/2011	OC-SW-ISCO-1-XXX ISCO1 6/6/2011	OC-SW-ISCO1 ISCO1 8/23/2011	OC-SW-ISCO1 ISCO1 11/8/2011
Manganese	12 / 12		0.5 - 2.2	1.496666667	0.1		1.1			0.81		
Mercury	1 / 12	0.0002 : 0.0002	0.00029 - 0.00029	0.000115833			0.0002 U			0.0002 U		
Nickel	12 / 12		0.0042 - 0.057	0.030933333	4.6		0.012			0.0042 J		
Potassium	12 / 12		1.3 - 3.4	2.291666667			1.5 J			2.2 J		
Silver	1 / 12	0.0001 : 0.001	0.000017 - 0.000017	0.00027225			0.001 UJ			0.0001 U		
Sodium	90 / 90		52 - 320	127.3777778		79 J	96	88	63	98	73 J	89
Thallium	1 / 12	0.01 : 0.01	0.0031 - 0.0031	0.004841667	0.00047		0.0031 J			0.01 U		
Vanadium	1 / 12	0.01 : 0.01	0.0022 - 0.0022	0.004766667			0.01 UJ			0.01 U		
Zinc	12 / 12		0.02 - 0.097	0.056	26		0.02 J			0.021 J		
Metals, Filtered (mg/L)												
Aluminum	75 / 78	0.2 : 0.2	0.036 - 22	0.833564103		0.19		0.17	0.074 J		0.04 J	0.15
Chromium	78 / 78		0.0049 - 5	0.237105128		0.019		0.013	0.0058		0.0086	0.013
Sodium	78 / 78		63 - 330	132.2435897		87 J		94	74		90 J	98
Inorganics (mg/L)												
Bromide	10 / 12	0.2 : 0.2	0.14 - 0.48	0.315833333			0.17			0.14		
Chloride	90 / 90		64 - 320	161.5222222		130	150	140	110 J	130	110	120
Hardness	12 / 12		80 - 270	177.0833333			85			80		
Lab Specific Conductance **(mS/cm)**	78 / 78		0.6 - 3.7	1.297820513		0.87		0.7	0.63		0.79	0.76
Nitrate as N	89 / 90	0.05 : 0.05	0.078 - 6	0.8737		0.38	0.11	0.36	0.14 J	0.05 U	0.08	0.2
Nitrite as N	12 / 84	0.01 : 0.1	0.01 - 0.043	0.031464286		0.01 U	0.01 U	0.1 U	0.01 UJ	0.01 U	0.1 U	0.01 U
Nitrogen, as Ammonia	90 / 90		14 - 180	56.44444444	*	38	40	14	18 J	31 J	37	25
Sulfate	90 / 90		63 - 1300	357.1666667		220	240	68	89 J	150	130	110
Total Organic Carbon	12 / 12		4.5 - 24	11.40833333			7.6			6.1		
Total Suspended Solids	12 / 12		2 - 240	40.48333333			18			6 J		
Specialty Compounds (mg/L)												
Hydrazine	2 / 10	0.0001 : 0.0001	0.000076 - 0.00008	0.0000556			0.0001 U			0.0001 U		
Formaldehyde	5 / 10	0.03 : 0.03	0.015 - 0.021	0.0164			0.015 J			0.03 U		
4,4'-Isopropylidenediphenol	3 / 9	0.00094 : 0.00098	0.00065 - 0.00096	0.000593333			0.00094 U			0.00095 U		
4-Nonylphenol (Tech.)	7 / 9	0.0047 : 0.0048	0.0056 - 0.018	0.009805556	0.0066		0.0047 U			0.0048 U		
Kempore (Azodicarbonamide)	3 / 10	1 : 1.1	1.1 - 1.4	0.725			1 U			1 U		

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter
mS/cm = milliSiemen per centimeter
U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-ISCO1-SW ISCO1 2/23/2012	OC-SW-ISCO1 ISCO1 6/7/2012	OC-SW-ISCO1 ISCO1 8/23/2012	OC-SW-ISCO1 ISCO1 11/16/2012	OC-ISCO1 ISCO1 3/21/2013	OC-ISCO1 ISCO1 5/13/2013	OC-ISCO1 ISCO1 8/22/2013	OC-ISCO1 ISCO1 11/21/2013	OC-SW-ISCO2 ISCO2 11/15/2010	OC-SW-ISCO-2-XXX ISCO2 12/9/2010	OC-SW-ISCO2 ISCO2 3/22/2011	OC-SW-ISCO2 ISCO2 5/16/2011	OC-SW-ISCO-2-XXX ISCO2 6/6/2011	OC-SW-ISCO2 ISCO2 8/23/2011	OC-SW-ISCO2 ISCO2 11/8/2011
Volatile Organics (mg/L)															
1,3-Dichlorobenzene										0.001 U			0.001 U		
2,4,4-Trimethyl-1-pentene										0.0024			0.0019 J		
2,4,4-Trimethyl-2-pentene										0.001 U			0.00045 J		
2-Butanone										0.01 U			0.01 U		
Acetone										0.05 U			0.05 U		
Bromodichloromethane										0.001 U			0.0005 U		
Bromoform										0.001 J			0.00067 J		
Carbon disulfide										0.01 U			0.01 U		
Chlorodibromomethane										0.0034			0.0005 U		
Chloroform										0.00027 J			0.001 U		
Dibromomethane										0.00032 J			0.001 U		
Toluene										0.001 U			0.001 U		
Semivolatile Organics (mg/L)															
2-Nitrophenol										0.00057 J			0.00091 J		
4-Nitrophenol										0.0045 UJ			0.0045 U		
Azobenzene										0.0045 U			0.0045 U		
Benzo(a)pyrene										0.00018 U			0.00015 J		
Benzoic Acid										0.0045 UJ			0.0019 J		
Bis(2-Ethylhexyl)phthalate										0.0065 U			0.0061		
Diphenyl ether										0.0045 U			0.0045 U		
Diphenylmethanone										0.0045 U			0.00067 J		
N-Nitrosodimethylamine										0.00012			0.000078		
N-Nitrosodi-n-propylamine										0.000002 U			0.000002 U		
N-Nitrosodiphenylamine										0.0045 U			0.0045 U		
Metals, Total (mg/L)															
Aluminum	0.085 J	0.088 J	0.08 J	0.2	0.17 J	0.15 J	0.076 J	0.12 J	0.51	0.6 J	1.7	0.6	5.4	0.23	4
Antimony										0.006 U			0.006 U		
Arsenic										0.0031 J			0.01 U		
Barium										0.025			0.027		
Beryllium										0.001 U			0.00074 J		
Calcium										56 J			67		
Chromium	0.015	0.0096	0.013	0.019	0.013	0.011	0.0089 B	0.012	0.047	0.11 J	0.26	0.065	1.1	0.051	0.75
Cobalt										0.025			0.032		
Copper										0.0042 J			0.0078		
Iron										2.4 J			13		
Lead										0.001 U			0.0021		
Magnesium										9.9			14		

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-ISCO1-SW ISCO1 2/23/2012	OC-SW-ISCO1 ISCO1 6/7/2012	OC-SW-ISCO1 ISCO1 8/23/2012	OC-SW-ISCO1 ISCO1 11/16/2012	OC-ISCO1 ISCO1 3/21/2013	OC-ISCO1 ISCO1 5/13/2013	OC-ISCO1 ISCO1 8/22/2013	OC-ISCO1 ISCO1 11/21/2013	OC-SW-ISCO2 ISCO2 11/15/2010	OC-SW-ISCO-2-XXX ISCO2 12/9/2010	OC-SW-ISCO2 ISCO2 3/22/2011	OC-SW-ISCO2 ISCO2 5/16/2011	OC-SW-ISCO-2-XXX ISCO2 6/6/2011	OC-SW-ISCO2 ISCO2 8/23/2011	OC-SW-ISCO2 ISCO2 11/8/2011
Manganese										1.4			1.7		
Mercury										0.0002 U			0.0002 U		
Nickel										0.026			0.034		
Potassium										2.2 J			2.2 J		
Silver										0.001 UJ			0.0001 U		
Sodium	100 J	58 J	69	76	120	98	110	64	120	120 J	73	56	170	150 J	84 J
Thallium										0.01 U			0.01 U		
Vanadium										0.01 U			0.01 U		
Zinc										0.057			0.059		
Metals, Filtered (mg/L)															
Aluminum	0.1 J	0.1	0.043 J	0.17 J	0.16 J	0.063 J	0.2 U	0.069 J	0.29		0.36	0.15		0.036 J	0.13
Chromium	0.015	0.011	0.0096	0.017	0.011	0.0062	0.0061	0.0073	0.027		0.049	0.016		0.013	0.027
Sodium	120 J	64	69	81	130	97	100	66	120		76	66		190 J	100 J
Inorganics (mg/L)															
Bromide										0.33			0.43		
Chloride	140	100	120	110	190	150	180	110	140	190	90	70 J	180	170	97
Hardness										180 J			220		
Lab Specific Conductance **(mS/cm)**	0.97	0.64	0.68	0.72	0.87	0.82	1	0.6	1.4		0.72	0.74		2.2	0.86
Nitrate as N	0.27	0.27	0.12	0.34 J	0.49	0.21	0.4	0.16	2.8	2.8	1	0.57 J	0.57	0.79	1.1
Nitrite as N	0.1 U	0.1 U	0.1 U	R	0.05 U	0.021 J	0.05 U	0.05 U	0.017	0.1 U	0.1 U	0.01 UJ	0.1 U	0.1 U	0.01 U
Nitrogen, as Ammonia	44	23	29	23	14	28	31	20	61	74	19	28 J	110	98	33
Sulfate	170	98	120	110	63	110	130	74	470	560	130	190 J	800	580	180
Total Organic Carbon										9.7			9.4		
Total Suspended Solids										2			240 J		
Specialty Compounds (mg/L)															
Hydrazine										0.0001 U			0.00008 J		
Formaldehyde										0.019 J			0.03 U		
4,4'-Isopropylidenediphenol										0.00094 U			0.00065 J		
4-Nonylphenol (Tech.)										0.0062			0.0056		
Kempore (Azodicarbonamide)										1 U			1.2 N		

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter
mS/cm = milliSiemen per centimeter
U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-ISCO2-SW ISCO2 2/23/2012	OC-SW-ISCO2 ISCO2 6/7/2012	OC-SW-ISCO2 ISCO2 8/23/2012	OC-SW-ISCO2 ISCO2 11/16/2012	OC-ISCO2 ISCO2 3/21/2013	OC-ISCO2 ISCO2 5/13/2013	OC-ISCO2 ISCO2 8/22/2013	OC-ISCO2 ISCO2 11/21/2013	OC-SW-PZ-16RR PZ-16RR 11/15/2010	OC-SW-PZ-16RR-XXX PZ-16RR 12/9/2010	OC-SW-PZ-16RRSW PZ-16RR 3/22/2011	OC-SW-PZ-16RRSW PZ-16RR 5/16/2011	OC-SW-PZ-16RR-XXX PZ-16RR 6/6/2011	OC-SW-PZ-16RRSW PZ-16RR 8/23/2011	OC-SW-PZ16RR PZ-16RR 11/8/2011
Volatile Organics (mg/L)															
1,3-Dichlorobenzene										0.001 U			0.0003 J		
2,4,4-Trimethyl-1-pentene										0.0042			0.0056 J		
2,4,4-Trimethyl-2-pentene										0.001 U			0.0012		
2-Butanone										0.01 U			0.01 U		
Acetone										0.05 U			0.05 U		
Bromodichloromethane										0.001 U			0.00021 J		
Bromoform										0.0017 J			0.0018		
Carbon disulfide										0.01 U			0.01 U		
Chlorodibromomethane										0.0036			0.00048 J		
Chloroform										0.0005 J			0.00049 J		
Dibromomethane										0.00055 J			0.00057 J		
Toluene										0.001 U			0.001 U		
Semivolatile Organics (mg/L)															
2-Nitrophenol										0.001 J			0.0013 J		
4-Nitrophenol										0.00072 J			0.0018 J		
Azobenzene										0.0045 U			0.00046 J		
Benzo(a)pyrene										0.00018 UJ			0.00018 U		
Benzoic Acid										0.0018 J			0.002 J		
Bis(2-Ethylhexyl)phthalate										0.0038 U			0.0018 U		
Diphenyl ether										0.00056 J			0.00062 J		
Diphenylmethanone										0.0045 U			0.001 J		
N-Nitrosodimethylamine										0.00017			0.00017 J		
N-Nitrosodi-n-propylamine										0.000004 U			0.0000095 UJ		
N-Nitrosodiphenylamine										0.0045 U			0.0045 U		
Metals, Total (mg/L)															
Aluminum	0.14	0.8	0.16	0.55	0.96	0.38	1.6	1	1.9	2.9	1.8	0.99	0.85	1.9	1.8
Antimony										0.006 U			0.006 U		
Arsenic										0.0035 J			0.01 U		
Barium										0.023			0.023		
Beryllium										0.001 U			0.0003 J		
Calcium										57			72		
Chromium	0.073	0.17	0.03	0.074	0.13	0.064	0.34 B	0.18	0.39	0.61	0.38	0.19	0.27	0.56	0.38
Cobalt										0.035			0.041		
Copper										0.0091 J			0.0064		
Iron										5.7			4.8		
Lead										0.00039 J			0.0001 U		
Magnesium										12			16		

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-ISCO2-SW ISCO2 2/23/2012	OC-SW-ISCO2 ISCO2 6/7/2012	OC-SW-ISCO2 ISCO2 8/23/2012	OC-SW-ISCO2 ISCO2 11/16/2012	OC-ISCO2 ISCO2 3/21/2013	OC-ISCO2 ISCO2 5/13/2013	OC-ISCO2 ISCO2 8/22/2013	OC-ISCO2 ISCO2 11/21/2013	OC-SW-PZ-16RR PZ-16RR 11/15/2010	OC-SW-PZ-16RR-XXX PZ-16RR 12/9/2010	OC-SW-PZ-16RRSW PZ-16RR 3/22/2011	OC-SW-PZ-16RRSW PZ-16RR 5/16/2011	OC-SW-PZ-16RR-XXX PZ-16RR 6/6/2011	OC-SW-PZ-16RRSW PZ-16RR 8/23/2011	OC-SW-PZ16RR PZ-16RR 11/8/2011
Manganese										1.6			1.9		
Mercury										0.0002 U			0.00029		
Nickel										0.039			0.047		
Potassium										2.5 J			2.2 J		
Silver										0.001 UJ			0.0001 U		
Sodium	140	84 J	190	120	100	120	160	170	120	150	85 J	69	200	160 J	110 J
Thallium										0.01 U			0.01 U		
Vanadium										0.01 U			0.01 U		
Zinc										0.066			0.075		
Metals, Filtered (mg/L)															
Aluminum	0.15	0.12	0.058 J	0.14 J	0.43	0.13 J	0.31	0.2 U	0.86		0.46	0.18		1.5	0.069 J
Chromium	0.074	0.037	0.013	0.031	0.068	0.024	0.073	0.019	0.25		0.12	0.062		0.49	0.023
Sodium	150	83	200	120	100	110	160	180	130		100 J	80		200 J	130 J
Inorganics (mg/L)															
Bromide										0.36			0.43		
Chloride	130	100	210	140	150	140	160	210	160	200	130	90 J	190	190	120
Hardness										190			240		
Lab Specific Conductance **(mS/cm)**	1.5	1	2.1	1.3	0.85	1.2	1.5	1.8	1.5		0.82	0.84		2.3	0.95
Nitrate as N	1.2	0.55	2.1	2 J	1.1	0.71	1.5	1.1	2	1.9	1.4	0.47 J	0.26	0.39	1.8
Nitrite as N	0.1 U	0.1 U	0.1 U	R	0.05 U	0.023 J	0.036 J	0.026 J	0.017	0.1 U	0.1 U	0.01 UJ	0.01 U	0.1 U	0.1 U
Nitrogen, as Ammonia	92	46	110	50	19	37	55	71	66	77	19	24 J	110	110	31
Sulfate	420	250	690	330	150	290	360	490	520	660	120	200 J	800	620	160
Total Organic Carbon										13			10		
Total Suspended Solids										13			14 J		
Specialty Compounds (mg/L)															
Hydrazine										0.0001 U			0.0001 U		
Formaldehyde										0.021 J			0.03 U		
4,4'-Isopropylidenediphenol										0.00098 U			0.00096		
4-Nonylphenol (Tech.)										0.015			0.017		
Kempore (Azodicarbonamide)										1 U			1.1 U		

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter
mS/cm = milliSiemen per centimeter
U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-SW-PZ16RR-SW PZ-16RR 2/23/2012	OC-SW-PZ-16RRSW PZ-16RR 6/7/2012	OC-SW-PZ-16RRSW PZ-16RR 8/23/2012	OC-SW-PZ-16RRSW PZ-16RR 11/16/2012	OC-PZ-16RRSW PZ-16RR 3/21/2013	OC-PZ-16RRSW PZ-16RR 5/13/2013	OC-PZ-16RRSW PZ-16RR 8/22/2013	OC-PZ-16RRSW PZ-16RR 11/21/2013	OC-SW-PZ-17RR PZ-17RR 11/15/2010	OC-SW-PZ-17RR-XXX PZ-17RR 12/10/2010	OC-SW-PZ-17RRSW PZ-17RR 3/22/2011	OC-SW-PZ-17RRSW PZ-17RR 5/16/2011	OC-SW-PZ-17RR-XXX PZ-17RR 6/6/2011	OC-SW-PZ-17RRSW PZ-17RR 8/23/2011	OC-SW-PZ17RR PZ-17RR 11/8/2011
Volatile Organics (mg/L)															
1,3-Dichlorobenzene										0.001 U			0.00057 J		
2,4,4-Trimethyl-1-pentene										0.0074			0.01 J		
2,4,4-Trimethyl-2-pentene										0.0007 J			0.002		
2-Butanone										0.01 U			0.01 U		
Acetone										0.05 U			0.05 U		
Bromodichloromethane										0.00036 J			0.00051		
Bromoform										0.0029 J			0.0034		
Carbon disulfide										0.00058 J			0.01 U		
Chlorodibromomethane										0.0038			0.001		
Chloroform										0.00098 J			0.0012		
Dibromomethane										0.001			0.0011		
Toluene										0.00046 J			0.00048 J		
Semivolatile Organics (mg/L)															
2-Nitrophenol										0.0045 U			0.0018 J		
4-Nitrophenol										0.0016 J			0.0021 J		
Azobenzene										0.0045 U			0.00053 J		
Benzo(a)pyrene										0.00018 U			0.00018 U		
Benzoic Acid										0.0045 UJ			0.0021 J		
Bis(2-Ethylhexyl)phthalate										0.0089 U			0.0018 U		
Diphenyl ether										0.00076 J			0.0011 J		
Diphenylmethanone										0.00052 J			0.0012 J		
N-Nitrosodimethylamine										0.0003			0.00029 J		
N-Nitrosodi-n-propylamine										0.0000095 U			0.000021 UJ		
N-Nitrosodiphenylamine										0.00047 J			0.00064 J		
Metals, Total (mg/L)															
Aluminum	0.64 J	0.31	0.99	2.3	1.8	1.6	2.3	0.19 J	3.4	11	1.3	1.5	9	5.7	2
Antimony										0.006 U			0.006 U		
Arsenic										0.01 U			0.01 U		
Barium										0.025			0.021		
Beryllium										0.0011			0.0011		
Calcium										62			72		
Chromium	0.34	0.14 J	0.37	0.53	0.37	0.34	0.67 B	0.041	0.79	2.2	0.3	0.36	1.8	1.3	0.47
Cobalt										0.047			0.05		
Copper										0.026 J			0.021		
Iron										10			12		
Lead										0.0012			0.00042 J		
Magnesium										15			17		

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-SW-PZ16RR-SW PZ-16RR 2/23/2012	OC-SW-PZ-16RRSW PZ-16RR 6/7/2012	OC-SW-PZ-16RRSW PZ-16RR 8/23/2012	OC-SW-PZ-16RRSW PZ-16RR 11/16/2012	OC-PZ-16RRSW PZ-16RR 3/21/2013	OC-PZ-16RRSW PZ-16RR 5/13/2013	OC-PZ-16RRSW PZ-16RR 8/22/2013	OC-PZ-16RRSW PZ-16RR 11/21/2013	OC-SW-PZ-17RR PZ-17RR 11/15/2010	OC-SW-PZ-17RR-XXX PZ-17RR 12/10/2010	OC-SW-PZ-17RRSW PZ-17RR 3/22/2011	OC-SW-PZ-17RRSW PZ-17RR 5/16/2011	OC-SW-PZ-17RR-XXX PZ-17RR 6/6/2011	OC-SW-PZ-17RRSW PZ-17RR 8/23/2011	OC-SW-PZ17RR PZ-17RR 11/8/2011
Manganese										2.1			2.2		
Mercury										0.0002 U			0.0002 U		
Nickel										0.052			0.057		
Potassium										2.5 J			3.4 J		
Silver										0.001 UJ			0.0001 U		
Sodium	150 J	88 J	210	130	130	130	290	230	130	180	98 J	81	220	160 J	120 J
Thallium										0.01 U			0.01 U		
Vanadium										0.01 UJ			0.01 U		
Zinc										0.083			0.097		
Metals, Filtered (mg/L)															
Aluminum	0.76 J	0.36	0.14	1.1	0.53	0.3	1.1	0.12 J	1.6		0.39	0.29		1.4	0.11
Chromium	0.36	0.16 J	0.17	0.3	0.17	0.13	0.38	0.028	0.49		0.12	0.16		0.6	0.055
Sodium	170 J	95	220	130	120	130	280	230	140		110 J	97		190 J	140 J
Inorganics (mg/L)															
Bromide										0.45			0.48		
Chloride	160	120	230	140	190	160	280	250	160	240	160	120 J	230	190	130
Hardness										220			250		
Lab Specific Conductance **(mS/cm)**	1.6	1.1	2.4	1.4	0.99	1.2	3.4	2.6	1.5		0.9	0.98		2.2	1
Nitrate as N	1.1	0.44	0.7	1.3 J	0.6	0.56	0.72	0.87	0.53	0.69	1.9	0.35 J	1.8	0.18	1.8
Nitrite as N	0.1 U	0.1 U	0.1 U	R	0.05 U	0.023 J	0.05 U	0.05 U	0.01 U	0.01 U	0.1 U	0.01 UJ	0.1 U	0.1 U	0.1 U
Nitrogen, as Ammonia	100	48	140	52	23	40	160	120	66	96	17	30 J	130	110	33
Sulfate	470	270	830	320	170	310	1100	800	530	810	120	230 J	990	600	180
Total Organic Carbon										20			14		
Total Suspended Solids										76			70 J		
Specialty Compounds (mg/L)															
Hydrazine										0.0001 U			0.0001 U		
Formaldehyde										0.016 J			0.03 U		
4,4'-Isopropylidenediphenol										0.00094 U			0.00087 J		
4-Nonylphenol (Tech.)										0.014			0.018 J		
Kempore (Azodicarbonamide)										1 U			1.1 NJ		

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter
mS/cm = milliSiemen per centimeter
U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-SW-PZ-17RR-SW PZ-17RR 2/23/2012	OC-SW-PZ-17RRSW PZ-17RR 6/7/2012	OC-SW-PZ-17RRSW PZ-17RR 8/23/2012	OC-SW-PZ-17RRSW PZ-17RR 11/16/2012	OC-PZ-16RRSW PZ-16RR 3/21/2013	OC-PZ-16RRSW PZ-16RR 5/13/2013	OC-PZ-16RRSW PZ-16RR 8/22/2013	OC-PZ-16RRSW PZ-16RR 11/21/2013	OC-SW-PZ-17RR-XXX PZ-17RR 12/17/2012	OC-SW-PZ-18R PZ-18R 11/15/2010	OC-SW-PZ-18RSW PZ-18R 3/22/2011	OC-SW-PZ-18RSW PZ-18R 5/16/2011	OC-SW-PZ-18RSW PZ-18R 8/23/2011	OC-SW-PZ18R PZ-18R 11/8/2011	OC-PZ18R-SW PZ-18R 2/23/2012
Volatile Organics (mg/L)															
1,3-Dichlorobenzene									0.001 U						
2,4,4-Trimethyl-1-pentene									0.0014						
2,4,4-Trimethyl-2-pentene									0.001 U						
2-Butanone									0.0071 J						
Acetone									0.0084 J						
Bromodichloromethane									0.0005 U						
Bromoform									0.001 U						
Carbon disulfide									0.01 U						
Chlorodibromomethane									0.0005 U						
Chloroform									0.001 U						
Dibromomethane									0.001 U						
Toluene									0.001 U						
Semivolatile Organics (mg/L)															
2-Nitrophenol									0.00096 U						
4-Nitrophenol									0.0048 UJ						
Azobenzene									0.00096 U						
Benzo(a)pyrene									0.00096 U						
Benzoic Acid									R						
Bis(2-Ethylhexyl)phthalate									0.0048 U						
Diphenyl ether									0.00096 U						
Diphenylmethanone									0.00096 U						
N-Nitrosodimethylamine									0.000045 J						
N-Nitrosodi-n-propylamine									0.0000093						
N-Nitrosodiphenylamine									0.00096 U						
Metals, Total (mg/L)															
Aluminum	1 J	0.54	7.6	3.8	1.8	1.6	2.3	0.19 J	3.6	0.24 J	0.25	0.18	0.14	0.27	0.082 J
Antimony									0.006 U						
Arsenic									0.01 U						
Barium									0.021						
Beryllium									0.00056 J						
Calcium									26						
Chromium	0.51	0.26	1.8	0.92	0.37	0.34	0.67 B	0.041	0.71	0.024	0.016	0.012	0.015	0.022	0.014
Cobalt									0.013						
Copper									0.0096 J						
Iron									3.7						
Lead									0.00056 J						
Magnesium									5.1						

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-SW-PZ-17RR-SW PZ-17RR 2/23/2012	OC-SW-PZ-17RRSW PZ-17RR 6/7/2012	OC-SW-PZ-17RRSW PZ-17RR 8/23/2012	OC-SW-PZ-17RRSW PZ-17RR 11/16/2012	OC-PZ-16RRSW PZ-16RR 3/21/2013	OC-PZ-16RRSW PZ-16RR 5/13/2013	OC-PZ-16RRSW PZ-16RR 8/22/2013	OC-PZ-16RRSW PZ-16RR 11/21/2013	OC-SW-PZ-17RR-XXX PZ-17RR 12/17/2012	OC-SW-PZ-18R PZ-18R 11/15/2010	OC-SW-PZ-18RSW PZ-18R 3/22/2011	OC-SW-PZ-18RSW PZ-18R 5/16/2011	OC-SW-PZ-18RSW PZ-18R 8/23/2011	OC-SW-PZ18R PZ-18R 11/8/2011	OC-PZ18R-SW PZ-18R 2/23/2012
Manganese									0.85						
Mercury									0.0002 U						
Nickel									0.014						
Potassium									1.7						
Silver									0.001 UJ						
Sodium	190 J	110 J	240	140	130	130	290	230	88	71 J	86	66	67 J	88	98 J
Thallium									0.01 U						
Vanadium									0.0022 J						
Zinc									0.038 J						
Metals, Filtered (mg/L)															
Aluminum	1.2 J	0.53	1.9	0.93	0.53	0.3	1.1	0.12 J		0.15 J	0.17	0.1	0.036 J	0.17	0.092 J
Chromium	0.54	0.26	0.83	0.36	0.17	0.13	0.38	0.028		0.016	0.013	0.0073	0.0082	0.014	0.014
Sodium	220 J	99	240	140	120	130	280	230		81 J	92	73	89 J	96	120 J
Inorganics (mg/L)															
Bromide									0.2 U						
Chloride	220	130	250	160	190	160	280	250	96	120	150	140 J	110	120	140
Hardness									80						
Lab Specific Conductance **(mS/cm)**	2	1.1	2.4	1.4	0.99	1.2	3.4	2.6		0.79	0.69	0.64	0.79	0.78	1
Nitrate as N	3.4	0.35	0.36	0.69 J	0.6	0.56	0.72	0.87	0.62 J	0.25	0.43	0.14 J	0.078	0.2	0.34
Nitrite as N	0.1 U	0.1 U	0.1 U	R	0.05 U	0.023 J	0.05 U	0.05 U	0.022 J	0.01 U	0.1 U	0.01 UJ	0.01 U	0.01 U	0.1 U
Nitrogen, as Ammonia	89	49	130	58	23	40	160	120	33	36	14	18 J	33	30	51
Sulfate	550	280	850	350	170	310	1100	800	150	190 J	75	89 J	130	120	180
Total Organic Carbon									7.6						
Total Suspended Solids									19						
Specialty Compounds (mg/L)															
Hydrazine															
Formaldehyde															
4,4'-Isopropylidenediphenol															
4-Nonylphenol (Tech.)															
Kempore (Azodicarbonamide)															

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter
mS/cm = milliSiemen per centimeter
U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-SW-PZ-18RSW PZ-18R 6/7/2012	OC-SW-PZ-18RSW PZ-18R 8/23/2012	OC-SW-PZ-18RSW PZ-18R 11/16/2012	OC-PZ-18RSW PZ-18R 3/21/2013	OC-PZ-18RSW PZ-18R 5/13/2013	OC-PZ-18RSW PZ-18R 8/22/2013	OC-PZ-18RSW PZ-18R 11/21/2013	OC-SW-SD-17 SD-17 11/15/2010	OC-SW-SD-17 SD-17 3/22/2011
Volatile Organics (mg/L)									
1,3-Dichlorobenzene									
2,4,4-Trimethyl-1-pentene									
2,4,4-Trimethyl-2-pentene									
2-Butanone									
Acetone									
Bromodichloromethane									
Bromoform									
Carbon disulfide									
Chlorodibromomethane									
Chloroform									
Dibromomethane									
Toluene									
Semivolatile Organics (mg/L)									
2-Nitrophenol									
4-Nitrophenol									
Azobenzene									
Benzo(a)pyrene									
Benzoic Acid									
Bis(2-Ethylhexyl)phthalate									
Diphenyl ether									
Diphenylmethanone									
N-Nitrosodimethylamine									
N-Nitrosodi-n-propylamine									
N-Nitrosodiphenylamine									
Metals, Total (mg/L)									
Aluminum	0.17	0.093 J	0.21	0.18 J	0.16 J	0.2 U	0.14 J	3.6	1.3
Antimony									
Arsenic									
Barium									
Beryllium									
Calcium									
Chromium	0.018	0.013	0.02	0.012	0.012	0.0085 B	0.012	0.85	0.3
Cobalt									
Copper									
Iron									
Lead									
Magnesium									

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-SW-PZ-18RSW PZ-18R 6/7/2012	OC-SW-PZ-18RSW PZ-18R 8/23/2012	OC-SW-PZ-18RSW PZ-18R 11/16/2012	OC-PZ-18RSW PZ-18R 3/21/2013	OC-PZ-18RSW PZ-18R 5/13/2013	OC-PZ-18RSW PZ-18R 8/22/2013	OC-PZ-18RSW PZ-18R 11/21/2013	OC-SW-SD-17 SD-17 11/15/2010	OC-SW-SD-17 SD-17 3/22/2011
Manganese									
Mercury									
Nickel									
Potassium									
Silver									
Sodium	65 J	64	78	130	99	100	65	140	100 J
Thallium									
Vanadium									
Zinc									
Metals, Filtered (mg/L)									
Aluminum	0.16	0.064 J	0.12 J	0.15 J	0.078 J	0.2 U	0.066 J	1.7	0.11
Chromium	0.015	0.011	0.015	0.013	0.0071	0.0049 J	0.0061	0.5	0.058
Sodium	63	64	79	120	100	100	66	140	120 J
Inorganics (mg/L)									
Bromide									
Chloride	110	100	110	210	160	170	110	170	170
Hardness									
Lab Specific Conductance **(mS/cm)**	0.64	0.63	0.73	0.87	0.81	0.98	0.61	1.6	0.94
Nitrate as N	0.27	0.14	0.35 J	0.5	0.22	0.37	0.16	0.52	2.3
Nitrite as N	0.1 U	0.1 U	R	0.05 U	0.02 J	0.05 U	0.05 U	0.01	0.1 U
Nitrogen, as Ammonia	28	27	24	14	28	33	18 J	71	18
Sulfate	97	97	110	73	110	130	72	540	130
Total Organic Carbon									
Total Suspended Solids									
Specialty Compounds (mg/L)									
Hydrazine									
Formaldehyde									
4,4'-Isopropylidenediphenol									
4-Nonylphenol (Tech.)									
Kempore (Azodicarbonamide)									

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter
mS/cm = milliSiemen per centimeter
U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-SW-SD-17 SD-17 5/16/2011	OC-SW-SD-17 SD-17 8/23/2011	OC-SW-SD17 SD-17 11/8/2011	OC-SD-17-SW SD-17 2/23/2012	OC-SW-SD-17 SD-17 6/7/2012	OC-SW-SD-17 SD-17 8/23/2012	OC-SW-SD-17 SD-17 11/16/2012	OC-SD-17 SW SD-17 3/21/2013	OC-SD-17 SD-17 5/13/2013	OC-SD-17 SD-17 8/22/2013	OC-SD-17 SD-17 11/21/2013	OC-SW-SD-1-XXX SD-1 12/9/2010	OC-SW-SD-1-XXX SD-1 6/6/2011	OC-SW-SD-1-XXX SD-1 12/17/2012
Volatile Organics (mg/L)														
1,3-Dichlorobenzene												0.001 U	0.001 U	0.001 U
2,4,4-Trimethyl-1-pentene												0.003	0.0019 J	0.001 U
2,4,4-Trimethyl-2-pentene												0.001 U	0.00044 J	0.001 U
2-Butanone												0.01 U	0.01 U	0.025 J
Acetone												0.05 U	0.05 U	0.012 J
Bromodichloromethane												0.001 U	0.0005 U	0.0005 U
Bromoform												0.0012 J	0.00072 J	0.001 U
Carbon disulfide												0.01 U	0.01 U	0.01 U
Chlorodibromomethane												0.0034	0.0005 U	0.0005 U
Chloroform												0.00037 J	0.001 U	0.001 U
Dibromomethane												0.00038 J	0.001 U	0.001 U
Toluene												0.001 U	0.001 U	0.001 U
Semivolatile Organics (mg/L)														
2-Nitrophenol												0.00072 J	0.00067 J	0.00099 U
4-Nitrophenol												0.0045 UJ	0.005 U	0.005 UJ
Azobenzene												0.0045 U	0.005 U	0.00099 U
Benzo(a)pyrene												0.00018 UJ	0.0002 U	0.00099 U
Benzoic Acid												0.0045 UJ	0.0021 J	R
Bis(2-Ethylhexyl)phthalate												0.0035 U	0.0018 J	0.005 U
Diphenyl ether												0.0045 U	0.005 U	0.00099 U
Diphenylmethanone												0.0045 U	0.005 U	0.00099 U
N-Nitrosodimethylamine												0.00014	0.000048	0.000024 J
N-Nitrosodi-n-propylamine												0.000002 U	0.000002 U	0.0000049
N-Nitrosodiphenylamine												0.0045 U	0.005 U	0.00099 U
Metals, Total (mg/L)														
Aluminum	1.4	1.2	2.1	0.78 J	2.9	11	3.4	1.5	2.1	26	6.3	1.1	0.46	1.8
Antimony												0.006 U	0.006 U	0.006 U
Arsenic												0.01 U	0.01 U	0.01 U
Barium												0.027	0.026	0.013
Beryllium												0.001 U	0.001 U	0.001 U
Calcium												70	81	23
Chromium	0.33	0.28	0.47	0.37 J	0.68	2.4	0.84	0.36	0.5	5.7 B	1.3	0.23	0.11	0.29
Cobalt												0.034	0.039	0.0076
Copper												0.0095 J	0.00021 J	0.0044 J
Iron												3.7	2	1.5
Lead												0.00054 J	0.0003 J	0.00043 J
Magnesium												13	17	3.3

Table 4.1-4
Summary of Detected Chemicals for Surface Water Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	OC-SW-SD-17 SD-17 5/16/2011	OC-SW-SD-17 SD-17 8/23/2011	OC-SW-SD17 SD-17 11/8/2011	OC-SD-17-SW SD-17 2/23/2012	OC-SW-SD-17 SD-17 6/7/2012	OC-SW-SD-17 SD-17 8/23/2012	OC-SW-SD-17 SD-17 11/16/2012	OC-SD-17 SW SD-17 3/21/2013	OC-SD-17 SD-17 5/13/2013	OC-SD-17 SD-17 8/22/2013	OC-SD-17 SD-17 11/21/2013	OC-SW-SD-1-XXX SD-1 12/9/2010	OC-SW-SD-1-XXX SD-1 6/6/2011	OC-SW-SD-1-XXX SD-1 12/17/2012
Manganese												1.8	2	0.5
Mercury												0.0002 U	0.0002 U	0.0002 U
Nickel												0.036	0.041	0.009 J
Potassium												3.2 J	2.6 J	1.3
Silver												0.001 UJ	0.0001 U	0.000017 J
Sodium	82	96 J	120 J	180 J	110 J	190	130	110	140	320	260	160	220	52
Thallium												0.01 U	0.01 U	0.01 U
Vanadium												0.01 U	0.01 U	0.01 U
Zinc												0.076	0.055	0.025 J
Metals, Filtered (mg/L)														
Aluminum	0.34	0.92	1.9	0.89 J	2.9	1	0.95	0.25	0.7	22	2.5			
Chromium	0.16	0.28	0.37	0.41 J	0.66	0.52	0.36	0.12	0.28	5	0.59			
Sodium	97	140 J	140 J	210 J	99	200	140	110	140	320	260			
Inorganics (mg/L)														
Bromide												0.34	0.46	0.2 U
Chloride	120 J	130	130	210	130	210	170	160	180	320	300	200	300	64
Hardness												230	270	80
Lab Specific Conductance **(mS/cm)**	0.98	1.1	1	1.8	1.1	2	1.5	0.89	1.3	3.7	2.8			
Nitrate as N	0.42 J	0.16	1.7	3.7	0.44	0.6	0.6 J	0.71	0.44	0.41	0.63	2.8	6	0.96 J
Nitrite as N	0.01 UJ	0.1 U	0.01 U	0.1 U	0.1 U	0.1 U	R	0.05 U	0.05 U	0.05 U	0.05 U	0.1 U	0.1 U	0.043 J
Nitrogen, as Ammonia	32 J	41	32	77	60	110	61	20	47	180	130	66	95	21
Sulfate	230 J	240	190	460	280	670	350	140	310	1300	900	590	800	110
Total Organic Carbon												11	24	4.5
Total Suspended Solids												2.8	19 J	6
Specialty Compounds (mg/L)														
Hydrazine												0.0001 U	0.000076 J	
Formaldehyde												0.018 J	0.03 U	
4,4'-Isopropylidenediphenol												0.00097 U		
4-Nonylphenol (Tech.)												0.0077		
Kempore (Azodicarbonamide)												1 U	1.4 N	

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter
mS/cm = milliSiemen per centimeter
U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Prepared by / Date: KJC 03/03/14
Checked by / Date: CTM 03/10/14

Table 4.1-5
Summary of Detected Chemicals for Surface Water Samples - Central Pond
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection			Range of Detected Concentrations			Average of All Samples	AWQC (1) (mg/L)	OC-SW-SD-501-XXX SD-501 12/17/2012
Metals, Total (mg/L)									
Aluminum	1	/	1	0.21	-	0.21	0.21		0.21
Barium	1	/	1	0.049	-	0.049	0.049		0.049
Calcium	1	/	1	190	-	190	190		190
Chromium	1	/	1	0.0085	-	0.0085	0.0085		0.0085
Cobalt	1	/	1	0.0012	-	0.0012	0.0012		0.0012 J
Copper	1	/	1	0.0018	-	0.0018	0.0018		0.0018 J
Iron	1	/	1	0.43	-	0.43	0.43		0.43
Lead	1	/	1	0.0009	-	0.0009	0.0009		0.0009 J
Magnesium	1	/	1	13	-	13	13		13
Manganese	1	/	1	0.7	-	0.7	0.7	0.1	0.7
Nickel	1	/	1	0.0053	-	0.0053	0.0053	4.6	0.0053 J
Potassium	1	/	1	7.6	-	7.6	7.6		7.6
Silver	1	/	1	0.000015	-	0.000015	0.000015		0.000015 J
Sodium	1	/	1	68	-	68	68		68
Zinc	1	/	1	0.04	-	0.04	0.04	26	0.04 J
Inorganics (mg/L)									
Bromide	1	/	1	0.13	-	0.13	0.13		0.13 J
Chloride	1	/	1	52	-	52	52		52
Hardness	1	/	1	460	-	460	460		460
Nitrate as N	1	/	1	3.6	-	3.6	3.6		3.6 J
Nitrite as N	1	/	1	0.075	-	0.075	0.075		0.075 J
Nitrogen, as Ammonia	1	/	1	28	-	28	28	(*)	28
Sulfate	1	/	1	460	-	460	460		460
Total Organic Carbon	1	/	1	11	-	11	11		11

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

J = value is estimated

Prepared by / Date: KJC 03/03/14
Checked by / Date: CTM 03/10/14

Table 4.1-6
Summary of Detected Chemicals for Surface Water Samples - Detention Basin
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection			Range of Detected Concentrations			Average of All Samples	AWQC (1) (mg/L)	OC-SW-SD-503-XXX SD-503 12/17/2012
Semivolatile Organics (mg/L)									
N-Nitrosodimethylamine	1	/	1	0.0000032	-	0.0000032	0.0000032	0.003	0.0000032 J
N-Nitrosodi-n-propylamine	1	/	1	0.0000074	-	0.0000074	0.0000074	0.00051	0.0000074
Metals, Total (mg/L)									
Aluminum	1	/	1	0.9	-	0.9	0.9		0.9
Barium	1	/	1	0.026	-	0.026	0.026		0.026
Calcium	1	/	1	53	-	53	53		53
Chromium	1	/	1	0.0068	-	0.0068	0.0068		0.0068 J
Chromium, Hexavalent	1	/	1	0.01	-	0.01	0.01		0.01
Copper	1	/	1	0.0027	-	0.0027	0.0027		0.0027 J
Iron	1	/	1	1.5	-	1.5	1.5		1.5
Lead	1	/	1	0.003	-	0.003	0.003		0.003 J
Magnesium	1	/	1	2.4	-	2.4	2.4		2.4
Manganese	1	/	1	0.12	-	0.12	0.12	0.1	0.12
Nickel	1	/	1	0.0014	-	0.0014	0.0014	4.6	0.0014 J
Potassium	1	/	1	4	-	4	4		4
Silver	1	/	1	0.000056	-	0.000056	0.000056		0.000056 J
Sodium	1	/	1	18	-	18	18		18
Vanadium	1	/	1	0.002	-	0.002	0.002		0.002 J
Zinc	1	/	1	0.01	-	0.01	0.01	26	0.01 J
Inorganics (mg/L)									
Chloride	1	/	1	9	-	9	9		9
Hardness	1	/	1	120	-	120	120		120
Nitrate as N	1	/	1	0.084	-	0.084	0.084		0.084 J
Nitrite as N	1	/	1	0.026	-	0.026	0.026		0.026 J
Nitrogen, as Ammonia	1	/	1	7.5	-	7.5	7.5	(*)	7.5
Sulfate	1	/	1	96	-	96	96		96
Total Organic Carbon	1	/	1	11	-	11	11		11
Total Suspended Solids	1	/	1	38	-	38	38		38

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

J = value is estimated

Prepared by / Date: KJC 03/03/14
Checked by / Date: CTM 03/10/14

Table 4.1-7
Summary of Detected Chemicals for Sediment Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-ISCO-2-XXX ISCO2 12/9/2010 0-0.5 ft	OC-SD-ISCO-2-XXX ISCO2 2/17/2011	OC-SD-SD-1-XXX SD-1 12/9/2010 0-0.5 ft	OC-SD-SD2-0.0/0.5 SD-SD2 11/11/2011 0-0.5 ft	OC-SD-SD2 SD-SD2 11/16/2012 0-0.5 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene	3 / 6	0.0046 : 0.0075	0.0096 - 0.037	0.013	0.0096	0.02	0.0075 U		
2,4,4-Trimethyl-2-pentene	2 / 6	0.0046 : 0.0078	0.0028 - 0.0035	0.0033	0.0035 J	0.0078 U	0.0075 U		
2-Butanone	3 / 6	0.023 : 0.037	0.02 - 0.038	0.023	0.032 J	0.038 J	0.037 U		
4-iso-Propyltoluene	1 / 6	0.0023 : 0.004	0.0026 - 0.0026	0.0019	0.004 U	0.0039 U	0.0037 U		
Acetone	1 / 6	0.23 : 0.4	0.12 - 0.12	0.16	0.4 UJ	0.12 J *	0.37 UJ		
Cis-1,2-Dichloroethene	1 / 6	0.0023 : 0.0039	0.0024 - 0.0024	0.0018	0.0024 J	0.0039 U	0.0037 U		
trans-1,2-Dichloroethene	1 / 6	0.0023 : 0.0039	0.0045 - 0.0045	0.0021	0.0045	0.0039 U	0.0037 U		
Semivolatile Organics (mg/Kg)									
1,3-Dichlorobenzene	1 / 5	0.21 : 0.31	0.039 - 0.039	0.11	0.31 U	5.4 U	0.29 U		
3 & 4 Methylphenol	3 / 6	0.29 : 5.4	0.61 - 3	1.4	0.31 U	5.4 U	0.29 U		
Acetophenone	1 / 6	0.21 : 5.4	0.09 - 0.09	0.55	0.31 U	5.4 U	0.29 U		
Aniline	1 / 6	0.055 : 5.4	0.23 - 0.23	0.55	0.23 J	5.4 U *	0.29 U		
Anthracene	1 / 6	0.21 : 5.4	0.018 - 0.018	0.54	0.31 U	5.4 U	0.29 U		
Benzaldehyde	4 / 6	0.29 : 5.4	0.12 - 0.62	0.71	0.12 J	5.4 U	0.29 U		
Benzo(a)anthracene	2 / 6	0.21 : 5.4	0.06 - 0.12	0.55	0.31 U	5.4 U	0.29 U		
Benzo(a)pyrene	3 / 6	0.29 : 5.4	0.046 - 0.13	0.55	0.31 U	5.4 U	0.29 U		
Benzo(b)fluoranthene	3 / 6	0.29 : 5.4	0.075 - 0.16	0.55	0.31 U	5.4 U	0.29 U		
Benzo(ghi)perylene	3 / 6	0.29 : 5.4	0.054 - 0.096	0.54	0.31 U	5.4 U	0.29 U		
Benzo(k)fluoranthene	2 / 6	0.21 : 5.4	0.083 - 0.087	0.55	0.31 U	5.4 U	0.29 U		
Benzoic Acid	3 / 6	1.1 : 27	0.047 - 0.43	2.6	0.43 J	27 U	1.4 U		
Benzyl alcohol	1 / 6	0.43 : 11	0.071 - 0.071	1.1	0.62 U	11 U	0.58 U		
Biphenyl	2 / 6	0.21 : 5.4	0.016 - 0.32	0.57	0.32	5.4 U	0.29 U		
Bis(2-Ethylhexyl)phthalate	6 / 6		0.27 - 480	162	280	480	210		
Caprolactam	1 / 5	0.21 : 0.31	0.053 - 0.053	0.11	0.31 UJ	5.4 U	0.29 UJ		
Chrysene	3 / 6	0.29 : 5.4	0.06 - 0.14	0.54	0.31 U	5.4 U	0.29 U		
Dibenz(a,h)anthracene	1 / 6	0.21 : 5.4	0.031 - 0.031	0.54	0.31 U	5.4 U	0.29 U		
Di-n-octylphthalate	1 / 6	0.055 : 5.4	0.15 - 0.15	0.54	0.31 U	5.4 U	0.15 J		
Diphenyl ether	3 / 6	0.21 : 5.4	0.19 - 2.6	0.99	2.6	5.4 U	0.22 J		
Diphenylamine	1 / 5	0.055 : 0.22	0.095 - 0.095	0.073	0.095		0.058 U		
Diphenylmethanone	1 / 6	0.21 : 5.4	0.03 - 0.03	0.54	0.31 U	5.4 U	0.29 U		
Fluoranthene	3 / 6	0.29 : 5.4	0.11 - 0.3	0.59	0.31 U	5.4 U	0.29 U		
Indeno(1,2,3-cd)pyrene	3 / 6	0.29 : 5.4	0.059 - 0.087	0.54	0.31 U	5.4 U	0.29 U		
N-Nitrosodiphenylamine	3 / 6	0.21 : 5.4	0.065 - 1.6	0.81	1.6	5.4 U	0.065		
Phenanthrene	2 / 6	0.25 : 6.4	0.071 - 0.16	0.65	0.37 U	6.4 U	0.35 U		
Phenol	4 / 6	0.29 : 5.4	0.13 - 1.1	0.87	0.13 J	5.4 U	0.29 U		
Pyrene	3 / 6	0.29 : 5.4	0.11 - 0.25	0.58	0.31 U	5.4 U	0.29 U		

Table 4.1-7
Summary of Detected Chemicals for Sediment Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-ISCO-2-XXX ISCO2 12/9/2010 0-0.5 ft	OC-SD-ISCO-2-XXX ISCO2 2/17/2011	OC-SD-SD-1-XXX SD-1 12/9/2010 0-0.5 ft	OC-SD-SD2-0.0/0.5 SD-SD2 11/11/2011 0-0.5 ft	OC-SD-SD2 SD-SD2 11/16/2012 0-0.5 ft
Inorganics (mg/Kg)									
Aluminum	15 / 15		4500 - 11000	8853	10000	8100	7900	11000 J	5100 J
Arsenic	6 / 6		3.2 - 11	6.2	6.2	6.7	5		
Barium	6 / 6		11 - 45	22	11 J	14	12 J		
Beryllium	6 / 6		0.21 - 1.3	0.66	1.3	0.77	1		
Cadmium	6 / 6		0.16 - 1.2	0.47	1.2	0.58	0.32 J		
Calcium	6 / 6		820 - 4700	1875	1300	1100 B	820 J		
Chromium	15 / 15		29 - 3000	610	2500	3000	1800	130	430
Chromium, Hexavalent	3 / 5	2.6 : 3.3	2.6 - 28	11.7	28		25		
Cobalt	6 / 6		3.9 - 21	9.4	21	17	4.7		
Copper	6 / 6		17 - 24	20	21	20	17		
Iron	15 / 15		4300 - 17000	10680	4700	4300 B	4400	14000 J	6200
Lead	6 / 6		9.4 - 35	19.6	11	11	9.4		
Magnesium	6 / 6		410 - 2700	1193	480 J	410 B	470 J		
Manganese	6 / 6		38 - 280	127	67 J	49 B	38 J		
Mercury	2 / 6	0.1 : 0.12	0.22 - 0.24	0.11	0.24	0.22 B	0.12 U		
Nickel	6 / 6		8.4 - 24	13.5	24	17	11		
Potassium	6 / 6		680 - 1700	1198	1700	1500	1400		
Selenium	1 / 6	0.68 : 0.91	0.72 - 0.72	0.46	0.72 J	0.89 U	0.91 U		
Silver	6 / 6		1.6 - 62	26	51	62 ^	35		
Sodium	6 / 6		65 - 160	102	95 J	110 J	160 J		
Vanadium	6 / 6		8 - 20	11.7	9.4	8	8.5		
Zinc	6 / 6		30 - 65	45	45 J	30	33 J		
Chloride	6 / 6		38 - 140	92	130	130	140		
Nitrogen, as Ammonia	6 / 6		130 - 290	208	290 J	170	240 J		
Oxidation Reduction Potential **(mV)**	6 / 6		97 - 360	198	200		360		
pH **(pH units)**	6 / 6		5.83 - 7.66	7.1	6.88 HF		5.83 HF		
Sulfate	6 / 6		210 - 830	557	600	830	640		
Total Organic Carbon	6 / 6		7500 - 52000	35250	52000	44000	48000		
EPH (mg/Kg)									
C11-C22 Aromatics	5 / 5		11 - 9400	2110	9400		1100		
C11-C22 Aromatics (unadj.)	5 / 5		11 - 9400	2110	9400		1100		
C19-C36 Aliphatics	5 / 5		14 - 6400	1435	6400		690		
C9-C18 Aliphatics	2 / 5	4.2 : 5.4	96 - 770	175	770		96		
Extractable Petroleum Hydrocarbons, Total	5 / 5		25 - 17000	3808	17000		1900		

Table 4.1-7
Summary of Detected Chemicals for Sediment Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-ISCO-2-XXX ISCO2 12/9/2010 0-0.5 ft	OC-SD-ISCO-2-XXX ISCO2 2/17/2011	OC-SD-SD-1-XXX SD-1 12/9/2010 0-0.5 ft	OC-SD-SD2-0.0/0.5 SD-SD2 11/11/2011 0-0.5 ft	OC-SD-SD2 SD-SD2 11/16/2012 0-0.5 ft
Specialty Compounds (mg/Kg)									
Hydrazine	3 / 5	0.0029 : 0.0029	0.00091 - 0.0024	0.0015	0.0024 J		0.0013 J		
Acetaldehyde	3 / 5	0.26 : 0.33	0.052 - 0.076	0.097	0.063 J		0.33 U		
Formaldehyde	5 / 5		0.27 - 0.98	0.55	0.6		0.27		
Dimethylformamide	1 / 5	0.11 : 0.18	0.3 - 0.3	0.12	0.14 U		0.18 U		

mg/Kg = milligram per kilogram
mV = millivolts

U = not detected,
value is the reporting limit
J = value is estimated
JEB = value is estimated, analyte detected in an equipment blank
B = compound was found in the blank and sample

* = LCS or LCSD exceeds the control limits
^ = ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA, DLCK or MRL standard: Instrument related QC exceeds the control limits.
HF = holding time exceeded

Table 4.1-7
Summary of Detected Chemicals for Sediment Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	OC-SD-SD2 SD-SD2 11/21/2013 0-0.5 ft	OC-SD-SD3-0.0/0.5 SD-SD3 11/11/2011 0-0.5 ft	OC-SD-SD3 SD-SD3 11/16/2012 0-0.5 ft	OC-SD-SD3 SD-SD3 11/21/2013 0-0.5 ft	OC-SD-SD5-0.0/0.5 SD-SD5 11/11/2011 0-0.5 ft	OC-SD-SD5 SD-SD5 11/16/2012 0-0.5 ft	OC-SD-SD5 SD-SD5 11/21/2013 0-0.5 ft	OC-SD-SD-SD2-XXX SD-SD2 12/10/2010 0-0.5 ft	OC-SD-SD-SD3-XXX SD-SD3 12/9/2010 0-0.5 ft	OC-SD-SDSW-E-XXX SDSW-E 12/9/2010 0-0.5 ft
Volatile Organics (mg/Kg)										
2,4,4-Trimethyl-1-pentene								0.037 J	0.0066 U	0.0046 U
2,4,4-Trimethyl-2-pentene								0.0028 J	0.0066 U	0.0046 U
2-Butanone								0.02 J	0.033 U	0.023 U
4-iso-Propyltoluene								0.0034 UJ	0.0026 J	0.0023 U
Acetone								0.34 UJ	0.33 UJ	0.23 UJ
Cis-1,2-Dichloroethene								0.0034 UJ	0.0033 U	0.0023 U
trans-1,2-Dichloroethene								0.0034 UJ	0.0033 U	0.0023 U
Semivolatile Organics (mg/Kg)										
1,3-Dichlorobenzene								0.039 J	0.22 U	0.21 U
3 & 4 Methylphenol								2	3	0.61
Acetophenone								0.09	0.22 U	0.21 U
Aniline								0.055 UJ	0.22 U	0.21 U
Anthracene								0.018 J	0.22 U	0.21 U
Benzaldehyde								0.48	0.62	0.2 J
Benzo(a)anthracene								0.06	0.12 J	0.21 U
Benzo(a)pyrene								0.046 J	0.13 J	0.11 J
Benzo(b)fluoranthene								0.075	0.16 J	0.093 J
Benzo(ghi)perylene								0.054 J	0.096 J	0.073 J
Benzo(k)fluoranthene								0.083	0.087 J	0.21 U
Benzoic Acid								0.047 J	0.22 J	1.1 U
Benzyl alcohol								0.071 J	0.44 U	0.43 U
Biphenyl								0.016 J	0.22 U	0.21 U
Bis(2-Ethylhexyl)phthalate								0.49 J	0.27	0.72
Caprolactam								0.053 J	0.22 UJ	0.21 UJ
Chrysene								0.06	0.14 J	0.068 J
Dibenz(a,h)anthracene								0.031 J	0.22 U	0.21 U
Di-n-octylphthalate								0.055 U	0.22 U	0.21 U
Diphenyl ether								0.19	0.22 U	0.21 U
Diphenylamine								0.055 U	0.22 U	0.21 U
Diphenylmethanone								0.03 J	0.22 U	0.21 U
Fluoranthene								0.11	0.3	0.12 J
Indeno(1,2,3-cd)pyrene								0.059	0.087 J	0.077 J
N-Nitrosodiphenylamine								0.28	0.22 U	0.21 U
Phenanthrene								0.071	0.16 J	0.25 U
Phenol								1.1 J	0.92	0.22
Pyrene								0.11	0.25	0.12 J

Table 4.1-7
Summary of Detected Chemicals for Sediment Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	OC-SD-SD2 SD-SD2 11/21/2013 0-0.5 ft	OC-SD-SD3-0.0/0.5 SD-SD3 11/11/2011 0-0.5 ft	OC-SD-SD3 SD-SD3 11/16/2012 0-0.5 ft	OC-SD-SD3 SD-SD3 11/21/2013 0-0.5 ft	OC-SD-SD5-0.0/0.5 SD-SD5 11/11/2011 0-0.5 ft	OC-SD-SD5 SD-SD5 11/16/2012 0-0.5 ft	OC-SD-SD5 SD-SD5 11/21/2013 0-0.5 ft	OC-SD-SD-SD2-XXX SD-SD2 12/10/2010 0-0.5 ft	OC-SD-SD-SD3-XXX SD-SD3 12/9/2010 0-0.5 ft	OC-SD-SDSW-E-XXX SDSW-E 12/9/2010 0-0.5 ft
Inorganics (mg/Kg)										
Aluminum	9700	9700 J	6600 J	11000	11000 J	11000 J	8600	11000	7600	4500
Arsenic								11	5.3	3.2
Barium								45 J	33 J	14 J
Beryllium								0.36	0.3	0.21 J
Cadmium								0.31 J	0.25 J	0.16 J
Calcium								4700 J	2400 J	930 J
Chromium	94	35	41	29	59	460	99	240	130	100
Chromium, Hexavalent								3.3 U	2.6 U	2.6
Cobalt								5.3	3.9	4.4
Copper								24	21	19
Iron	12000	14000 J	9600	17000	15000 J	14000	11000	16000	11000	7000
Lead								35	31	20
Magnesium								2700 J	1900 J	1200 J
Manganese								280 J	250 J	80 J
Mercury								0.1 U	0.11 U	0.11 U
Nickel								11	9.3	8.4
Potassium								1000	910	680
Selenium								0.91 U	0.69 U	0.68 U
Silver								4.1	2	1.6
Sodium								100 J	82 J	65 J
Vanadium								20	15	9.2
Zinc								65 J	60 J	35 J
Chloride								38	64	52
Nitrogen, as Ammonia								250 J	170 J	130 J
Oxidation Reduction Potential **(mV)**								100	150	280
pH **(pH units)**								7.66 HF	7.51 HF	6.82 HF
Sulfate								700	360	210
Total Organic Carbon								30000	30000	7500
EPH (mg/Kg)										
C11-C22 Aromatics								17	24	11
C11-C22 Aromatics (unadj.)								17	24	11
C19-C36 Aliphatics								29	43	14
C9-C18 Aliphatics								5.4 U	4.4 U	4.2 U
Extractable Petroleum Hydrocarbons, Total								46	67	25

Table 4.1-7
Summary of Detected Chemicals for Sediment Samples - South Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	OC-SD-SD2 SD-SD2 11/21/2013 0-0.5 ft	OC-SD-SD3-0.0/0.5 SD-SD3 11/11/2011 0-0.5 ft	OC-SD-SD3 SD-SD3 11/16/2012 0-0.5 ft	OC-SD-SD3 SD-SD3 11/21/2013 0-0.5 ft	OC-SD-SD5-0.0/0.5 SD-SD5 11/11/2011 0-0.5 ft	OC-SD-SD5 SD-SD5 11/16/2012 0-0.5 ft	OC-SD-SD5 SD-SD5 11/21/2013 0-0.5 ft	OC-SD-SD-SD2-XXX SD-SD2 12/10/2010 0-0.5 ft	OC-SD-SD-SD3-XXX SD-SD3 12/9/2010 0-0.5 ft	OC-SD-SDSW-E-XXX SDSW-E 12/9/2010 0-0.5 ft
Specialty Compounds (mg/Kg)										
Hydrazine								0.00091 J	0.0029 U	0.0029 U
Acetaldehyde								0.076 J	0.052 J	0.26 U
Formaldehyde								0.98 J	0.58	0.33
Dimethylformamide								0.3 J	0.11 U	0.12 U

mg/Kg = milligram per kilogram
mV = millivolts

U = not detected,
value is the reporting limit
J = value is estimated
JEB = value is estimated, analyte detected in an equipment blank
B = compound was found in the blank and sample

* = LCS or LCSD exceeds the control limits
^ = ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA, DLCK or MRL standard: Instrument related QC exceeds the control limits.
HF = holding time exceeded

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	1120-BD-C17 BD-C17 10/27/2000 0.2-0.2 ft	1120-BD-C27 BD-C27 10/27/2000 0.5-0.5 ft	1120-BD-C32 BD-C32 10/27/2000 0.6-0.6 ft	1120-WDW-10D (6-30) WDW-10 8/31/2000 0.9-2.9 ft
Volatile Organics (mg/Kg)								
2,4,4-Trimethyl-1-pentene	2 / 10	0.018 : 0.98	1.3 - 5.4	0.91	0.98 U	0.88 U	0.77 U	
2,4,4-Trimethyl-2-pentene	2 / 10	0.018 : 0.98	0.59 - 2.3	0.53	0.98 U	0.88 U	0.77 U	
Acetone	2 / 22	2.9 : 38	0.095 - 0.34	8.5	20 U	18 U	15 U	
Benzene	1 / 22	0.018 : 1.9	4.4 - 4.4	0.62	0.98 U	0.88 U	0.77 U	
Chlorobenzene	1 / 22	0.018 : 1.9	0.11 - 0.11	0.43	0.98 U	0.88 U	0.77 U	
Ethyl benzene	1 / 22	0.018 : 1.9	0.54 - 0.54	0.45	0.98 U	0.88 U	0.77 U	
Methylene chloride	3 / 22	0.018 : 1.9	0.66 - 1.1	0.54	0.98 U	1.8 U	1.5 U	
Xylenes (m&p)	1 / 20	0.14 : 1.9	0.58 - 0.58	0.49	0.98 UK	0.88 U	0.77 U	
Semivolatile Organics (mg/Kg)								
Benzo(b)fluoranthene	1 / 70	0.36 : 440	3 - 3	6.6	21 U	12 U	10 U	0.36 U
Bis(2-Ethylhexyl)phthalate	37 / 70	1.1 : 54	1.1 - 871	27	244	8.9 J	12	1.2 B
Di-n-butylphthalate	4 / 70	0.36 : 54	0.45 - 263	7.3	21 U	12 U	10 U	0.36 U
Fluoranthene	1 / 70	0.36 : 440	6.1 - 6.1	6.7	21 U	12 U	10 U	0.36 U
N-Nitrosodiphenylamine	1 / 70	0.36 : 440	2.6 - 2.6	6.6	21 U	12 U	10 U	0.36 U
Phenanthrene	1 / 70	0.36 : 440	3.2 - 3.2	6.6	21 U	12 U	10 U	0.36 U
Pyrene	1 / 70	0.36 : 440	4.2 - 4.2	6.6	21 U	12 U	10 U	0.36 U
Inorganics (mg/Kg)								
Aluminum	37 / 37		1100 - 14000	5460	1400 F	1200	1100	4200
Arsenic	3 / 24	2 : 9	3.9 - 7.77	3.2	7 U	8 U	7 U	4 U
Barium	4 / 4		3.4 - 41.1	24				
Beryllium	1 / 4	0.1 : 0.164	0.61 - 0.61	0.20				
Cadmium	5 / 26	0.2 : 2	0.229 - 1.2	0.53	1 U	2 U	1 U	0.8 U
Calcium	2 / 2		200 - 900	550				
Chromium	68 / 87	6 : 19	4.5 - 430	40	36	8 U	7 U	5.2
Copper	2 / 2		2.1 - 17	9.6				
Iron	37 / 37		270 - 17000	6006	840 F	430	600	1100
Lead	19 / 26	4 : 9	2.5 - 110	24	7 U	8 U	7 U	10
Magnesium	2 / 2		88 - 180	134				
Manganese	2 / 2		4 - 22	13.0				
Mercury	5 / 24	0.06 : 0.3	0.23 - 0.44	0.14	0.3 U	0.3 U	0.3 U	0.1 U
Nickel	3 / 4	2 : 2	6.7 - 11.4	7.1				
Sodium	1 / 2	99 : 99	3200 - 3200	1625				
Vanadium	4 / 4		3 - 27	16.9				
Zinc	4 / 4		5.2 - 47.4	28				
Total Organic Carbon	2 / 2		1.6 - 2	1.8				

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	1120-WDW-10S (0-6) WDW-10 8/31/2000 0.4-0.9 ft	1120-WDW-12D (6-30) WDW-12 8/30/2000 0.5-2.5 ft	1120-WDW-12S (0-6) WDW-12 8/30/2000 0-0.5 ft	1120-WDW-13D (6-30) WDW-13 8/30/2000 0.5-2.5 ft	1120-WDW-13S (0-6) WDW-13 8/30/2000 0-0.5 ft	1120-WDW-14D (6-30) WDW-14 8/31/2000 0.5-2.5 ft	1120-WDW-14S (0-6) WDW-14 8/31/2000 0-0.5 ft	1120-WDW-16D (6-30) WDW-16 8/31/2000 0.5-2.5 ft	1120-WDW-16S (0-6) WDW-16 8/31/2000 0-0.5 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene									
2,4,4-Trimethyl-2-pentene									
Acetone						38 U	15 U	36 U	16 U
Benzene						1.9 U	0.73 U	1.8 U	0.8 U
Chlorobenzene						1.9 U	0.73 U	1.8 U	0.8 U
Ethyl benzene						1.9 U	0.73 U	1.8 U	0.8 U
Methylene chloride						1.9 U	0.73 U	1.8 U	0.8 U
Xylenes (m&p)						1.9 U	0.73 U	1.8 U	0.8 U
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	6.3 U	4.5 U	2 U	4.8 U	11 U	4.2 U	5.3 U	5.8 U	5.2 U
Bis(2-Ethylhexyl)phthalate	6.3 U	4.5 U	2 U	4.8 U	11 J	4.2 U	5.3 U	5.8 U	5.2 U
Di-n-butylphthalate	6.3 U	4.5 U	2 U	4.8 U	11 U	4.2 U	5.3 U	5.8 U	5.2 U
Fluoranthene	6.3 U	4.5 U	2 U	4.8 U	11 U	4.2 U	5.3 U	5.8 U	5.2 U
N-Nitrosodiphenylamine	6.3 U	4.5 U	2 U	4.8 U	11 U	4.2 U	5.3 U	5.8 U	5.2 U
Phenanthrene	6.3 U	4.5 U	2 U	4.8 U	11 U	4.2 U	5.3 U	5.8 U	5.2 U
Pyrene	6.3 U	4.5 U	2 U	4.8 U	11 U	4.2 U	5.3 U	5.8 U	5.2 U
Inorganics (mg/Kg)									
Aluminum	3700					1600	4100	1600	3700
Arsenic	7 U					8 U	4 U	8 U	4 U
Barium									
Beryllium									
Cadmium	1 U					2 U	0.9 U	2 U	0.87
Calcium									
Chromium	7 U	9 U	11	10 U	19	8 U	11	8 U	29
Copper									
Iron	3600					1700	6600	1400	8000
Lead	22					8.2	82	8.7	110
Magnesium									
Manganese									
Mercury	0.2 U					0.3 U	0.28	0.2 U	0.37
Nickel									
Sodium									
Vanadium									
Zinc									
Total Organic Carbon									

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	1120-WDW-17D (6-30) WDW-17 8/30/2000 0.5-2.5 ft	1120-WDW-17S (0-6) WDW-17 8/30/2000 0-0.5 ft	1120-WDW-19D (6-30) WDW-19 8/30/2000 0.5-2.5 ft	1120-WDW-19S (0-6) WDW-19 8/30/2000 0-0.5 ft	1120-WDW-20D (6-30) WDW-20 8/31/2000 0.5-2.5 ft	1120-WDW-20S (0-6) WDW-20 8/31/2000 0-0.5 ft	1120-WDW-21AD (6-30) WDW-21A 8/30/2000 0.5-2.5 ft	1120-WDW-21AS (0-6) WDW-21A 8/30/2000 0-0.5 ft	1120-WDW-21BD (6-30) WDW-21B 8/30/2000 0.5-2.5 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene									
2,4,4-Trimethyl-2-pentene									
Acetone					29 U	31 U			
Benzene					1.4 U	1.5 U			
Chlorobenzene					1.4 U	1.5 U			
Ethyl benzene					1.4 U	1.5 U			
Methylene chloride					1.4 U	1.5 U			
Xylenes (m&p)					1.4 U	1.5 U			
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	8.9 U	4.9 U	3.7 U	12 U	3.4 U	4.2 U	3.6 U	2.2 U	1.9 U
Bis(2-Ethylhexyl)phthalate	8.9 U	4.9 U	3.7 U	12 UB	3.4 U	4.2 UB	4	2.2 U	1.9 U
Di-n-butylphthalate	8.9 U	4.9 U	3.7 U	12 U	3.4 U	4.2 U	3.6 U	2.2 U	1.9 U
Fluoranthene	8.9 U	4.9 U	3.7 U	12 U	3.4 U	4.2 U	3.6 U	2.2 U	1.9 U
N-Nitrosodiphenylamine	8.9 U	4.9 U	3.7 U	12 U	3.4 U	4.2 U	3.6 U	2.2 U	1.9 U
Phenanthrene	8.9 U	4.9 U	3.7 U	12 U	3.4 U	4.2 U	3.6 U	2.2 U	1.9 U
Pyrene	8.9 U	4.9 U	3.7 U	12 U	3.4 U	4.2 U	3.6 U	2.2 U	1.9 U
Inorganics (mg/Kg)									
Aluminum					3200	3100			
Arsenic					7 U	9 U			
Barium									
Beryllium									
Cadmium					1 U	2 U			
Calcium									
Chromium	7 U	17	22	69	8.8	9 U	8.9	22	7 U
Copper									
Iron					4600	1300 F			
Lead					15	9 U			
Magnesium									
Manganese									
Mercury					0.2 U	0.3 U			
Nickel									
Sodium									
Vanadium									
Zinc									
Total Organic Carbon									

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	1120-WDW-21BS (0-6) WDW-21B 8/30/2000 0-0.5 ft	1120-WDW-22D (6-30) WDW-22 8/30/2000 0.5-2.5 ft	1120-WDW-22S (0-6) WDW-22 8/30/2000 0-0.5 ft	1120-WDW-23D (6-30) WDW-23 8/31/2000 0.5-2.5 ft	1120-WDW-23S (0-6) WDW-23 8/31/2000 0-0.5 ft	1120-WDW-24D (6-24) WDW-24 8/30/2000 0.5-2 ft	1120-WDW-24S (0-6) WDW-24 8/30/2000 0-0.5 ft	1120-WDW-25D (6-30) WDW-25 8/30/2000 0.5-2.5 ft	1120-WDW-25S (0-6) WDW-25 8/30/2000 0-0.5 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene									
2,4,4-Trimethyl-2-pentene									
Acetone				20 U	17 U				
Benzene				1 U	0.84 U				
Chlorobenzene				1 U	0.84 U				
Ethyl benzene				1 U	0.84 U				
Methylene chloride				1 U	0.84 U				
Xylenes (m&p)				1 U	0.84 U				
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	4.6 UC	3.9 U	2.9 U	4.9 U	3.4 U	6.8 U	3.7 U	2.3 U	2.2 U
Bis(2-Ethylhexyl)phthalate	4.6 UC	3.9 U	3.8	4.9 U	6.6	8	8.2	13	2.2 U
Di-n-butylphthalate	4.6 UC	3.9 U	2.9 U	4.9 U	3.4 U	6.8 U	3.7 U	2.3 U	2.2 U
Fluoranthene	4.6 UC	3.9 U	2.9 U	4.9 U	3.4 U	6.8 U	3.7 U	2.3 U	2.2 U
N-Nitrosodiphenylamine	4.6 UC	3.9 U	2.9 U	4.9 U	3.4 U	6.8 U	3.7 U	2.3 U	2.2 U
Phenanthrene	4.6 UC	3.9 U	2.9 U	4.9 U	3.4 U	6.8 U	3.7 U	2.3 U	2.2 U
Pyrene	4.6 UC	3.9 U	2.9 U	4.9 U	3.4 U	6.8 U	3.7 U	2.3 U	2.2 U
Inorganics (mg/Kg)									
Aluminum				2000	2800				
Arsenic				4 U	5 U				
Barium									
Beryllium									
Cadmium				0.8 U	1 U				
Calcium									
Chromium	42	6.4	21	4.8	22	12 U	48	11 U	19
Copper									
Iron				1300	5100				
Lead				4 U	44				
Magnesium									
Manganese									
Mercury				0.2 U	0.23				
Nickel									
Sodium									
Vanadium									
Zinc									
Total Organic Carbon									

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	1120-WDW-26D (6-24) WDW-26 8/30/2000 0.5-2 ft	1120-WDW-26S (0-6) WDW-26 8/30/2000 0-0.5 ft	1120-WDW-27D (6-30) WDW-27 8/31/2000 0.5-2.5 ft	1120-WDW-27S (0-6) WDW-27 8/31/2000 0-0.5 ft	1120-WDW-28D (6-24) WDW-28 8/30/2000 0.5-2 ft	1120-WDW-28S (0-6) WDW-28 8/30/2000 0-0.5 ft	1120-WDW-29D (6-30) WDW-29 8/30/2000 0.5-2.5 ft	1120-WDW-29S (0-6) WDW-29 8/30/2000 0-0.5 ft	1120-WDW-30D WDW-30 8/30/2000 0.5-2.5 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene									
2,4,4-Trimethyl-2-pentene									
Acetone			23 U	25 U					
Benzene			1.2 U	1.3 U					
Chlorobenzene			1.2 U	1.3 U					
Ethyl benzene			1.2 U	1.3 U					
Methylene chloride			1.2 U	1.3 U					
Xylenes (m&p)			1.2 U	1.3 U					
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	2.7 U	2.1 U	7.7 U	3 JC	1.2 U	2.2 U	7.4 U	4.6 U	1.8 U
Bis(2-Ethylhexyl)phthalate	4.8	9.3	7.7 U	5.6 UC	1.2 U	2.9	11	4.9	1.8 U
Di-n-butylphthalate	2.7 U	2.1 U	7.7 U	5.6 UC	1.2 U	2.2 U	7.4 U	4.6 U	1.8 U
Fluoranthene	2.7 U	2.1 U	7.7 U	6.1 C	1.2 U	2.2 U	7.4 U	4.6 U	1.8 U
N-Nitrosodiphenylamine	2.7 U	2.1 U	7.7 U	5.6 UC	1.2 U	2.2 U	7.4 U	4.6 U	1.8 U
Phenanthrene	2.7 U	2.1 U	7.7 U	3.2 JC	1.2 U	2.2 U	7.4 U	4.6 U	1.8 U
Pyrene	2.7 U	2.1 U	7.7 U	4.2 JC	1.2 U	2.2 U	7.4 U	4.6 U	1.8 U
Inorganics (mg/Kg)									
Aluminum			3300	3800					
Arsenic			6 U	5 U					
Barium									
Beryllium									
Cadmium			1 U	1.2					
Calcium									
Chromium	14 U	10 U	7.1	42	6 U	15	19 U	28	6 U
Copper									
Iron			1700	5000					
Lead			6 U	66					
Magnesium									
Manganese									
Mercury			0.08 U	0.44					
Nickel									
Sodium									
Vanadium									
Zinc									
Total Organic Carbon									

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	1120-WDW-30S WDW-30 8/30/2000 0-0.5 ft	1120-WDW-31D WDW-31 8/30/2000 0.5-2.5 ft	1120-WDW-31S WDW-31 8/30/2000 0-0.5 ft	1120-WDW-32D (6-30) WDW-32 8/31/2000 0.5-2.5 ft	1120-WDW-32S (0-6) WDW-32 8/31/2000 0-0.5 ft	1140-WDW-11D WDW-11 8/25/2000 0.5-2.1 ft	1140-WDW-11S WDW-11 8/25/2000 0-0.5 ft	1140-WDW-C1 WDW-C1 10/18/2000 0.5-0.5 ft	1140-WDW-C11 WDW-C11 10/18/2000 2.2-2.2 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene									0.66 U
2,4,4-Trimethyl-2-pentene									0.66 U
Acetone				7.1 U	17 U				13 U
Benzene				0.36 U	0.87 U				0.66 U
Chlorobenzene				0.36 U	0.87 U				0.66 U
Ethyl benzene				0.36 U	0.87 U				0.66 U
Methylene chloride				0.36 U	0.87 U				0.66 JB
Xylenes (m&p)				0.36 U	0.87 U				0.66 U
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	4.1 U	2.6 U	3.7 U	1.1 U	4.8 U	8.1 U	3.1 U	8.2 U	1.8 U
Bis(2-Ethylhexyl)phthalate	4.1 U	4.7	3.7 U	1.1 U	4.8 UB	8.1 UB	3.1 UB	8.2 U	1.5 J
Di-n-butylphthalate	4.1 U	2.6 U	3.7 U	1.1 U	4.8 U	8.1 U	3.1 U	8.2 U	1.8 U
Fluoranthene	4.1 U	2.6 U	3.7 U	1.1 U	4.8 U	8.1 U	3.1 U	8.2 U	1.8 U
N-Nitrosodiphenylamine	4.1 U	2.6 U	3.7 U	1.1 U	4.8 U	8.1 U	3.1 U	8.2 U	1.8 U
Phenanthrene	4.1 U	2.6 U	3.7 U	1.1 U	4.8 U	8.1 U	3.1 U	8.2 U	1.8 U
Pyrene	4.1 U	2.6 U	3.7 U	1.1 U	4.8 U	8.1 U	3.1 U	8.2 U	1.8 U
Inorganics (mg/Kg)									
Aluminum				5000	7300				1400
Arsenic				2 U	4 U				6 U
Barium									
Beryllium									
Cadmium				0.4 U	0.7 U				1 U
Calcium									
Chromium	10	40	29	6.3	19	8 U	13	19	10
Copper									
Iron				910	2800				4200
Lead				12	100				6 U
Magnesium									
Manganese									
Mercury				0.07 U	0.25				0.2 U
Nickel									
Sodium									
Vanadium									
Zinc									
Total Organic Carbon									

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	1140-WDW-C12 WDW-C12 10/11/2000 2.1-2.1 ft	1140-WDW-C13 WDW-C13 10/18/2000 0.5-0.5 ft	1140-WDW-C14 WDW-C14 10/18/2000 0.5-0.5 ft	1140-WDW-C15 WDW-C15 10/11/2000 1.5-1.5 ft	1140-WDW-C16 WDW-C16 10/18/2000 0.5-0.5 ft	1140-WDW-C17 WDW-C17 11/1/2000 0.5-0.5 ft	1140-WDW-C18 WDW-C18 11/2/2000 2.7-2.7 ft	1140-WDW-C19 WDW-C19 11/1/2000 0.5-0.5 ft	1140-WDW-C2 WDW-C2 10/18/2000 0.5-0.5 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene							5.4		
2,4,4-Trimethyl-2-pentene							2.3		
Acetone							3.6 U		
Benzene							0.18 U		
Chlorobenzene							0.18 U		
Ethyl benzene							0.54		
Methylene chloride							0.18 U		
Xylenes (m&p)							0.58		
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	3 U	0.8 U	3.3 U	2.9 U	2 U	54 UC	53 UC	4.1 UC	5.1 U
Bis(2-Ethylhexyl)phthalate	2.6 J	2.3	3.3 U	14	6	54 UC	116 C	6.4 C	13
Di-n-butylphthalate	3 U	0.45 J	3.3 U	2.9 U	2 U	54 UC	53 UC	4.1 UC	5.1 U
Fluoranthene	3 U	0.8 U	3.3 U	2.9 U	2 U	54 UC	53 UC	4.1 UC	5.1 U
N-Nitrosodiphenylamine	3 U	0.8 U	3.3 U	2.9 U	2 U	54 UC	53 UC	2.6 JC	5.1 U
Phenanthrene	3 U	0.8 U	3.3 U	2.9 U	2 U	54 UC	53 UC	4.1 UC	5.1 U
Pyrene	3 U	0.8 U	3.3 U	2.9 U	2 U	54 UC	53 UC	4.1 UC	5.1 U
Inorganics (mg/Kg)									
Aluminum							2300		
Arsenic							2 U		
Barium									
Beryllium									
Cadmium							0.3 U		
Calcium									
Chromium	19	260	12	11 U	350	16	68	20	21
Copper									
Iron							630		
Lead							2.5		
Magnesium									
Manganese									
Mercury							0.07 U		
Nickel									
Sodium									
Vanadium									
Zinc									
Total Organic Carbon									

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	1140-WDW-C20 WDW-C20 11/2/2000 3.1-3.1 ft	1140-WDW-C23 WDW-C23 11/2/2000 3-3 ft	1140-WDW-C24 WDW-C24 11/2/2000 1.5-1.5 ft	1140-WDW-C3 WDW-C3 10/11/2000 2.5-2.5 ft	1140-WDW-C4 WDW-C4 10/18/2000 0.4-0.4 ft	1140-WDW-C5 WDW-C5 10/18/2000 0.7-0.7 ft	1140-WDW-C6 WDW-C6 10/11/2000 2.5-2.5 ft	1140-WDW-C7 WDW-C7 10/18/2000 2.7-2.7 ft	1140-WDW-C8 WDW-C8 10/18/2000 0.2-0.2 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene	1.3				0.65 U	0.72 U			
2,4,4-Trimethyl-2-pentene	0.59				0.65 U	0.72 U			
Acetone	2.9 U				13 U	14 U			
Benzene	0.14 U				0.65 U	0.72 U			
Chlorobenzene	0.14 U				0.65 U	0.72 U			
Ethyl benzene	0.14 U				0.65 U	0.72 U			
Methylene chloride	0.14 U				0.87 B	1.1 B			
Xylenes (m&p)	0.14 U				0.65 U	0.72 U			
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	41 UC	440 UC	46 UC	0.99 U	1.5 U	5.5 U	0.46 U	4.6 U	6.2 U
Bis(2-Ethylhexyl)phthalate	147 C	871 C	208 C	1.1	1.8	3.2 J	2.8	6.7	3.5 J
Di-n-butylphthalate	41 UC	263 JC	26 JC	0.99 U	1.5 U	5.5 U	0.46 U	4.6 U	4.1 J
Fluoranthene	41 UC	440 UC	46 UC	0.99 U	1.5 U	5.5 U	0.46 U	4.6 U	6.2 U
N-Nitrosodiphenylamine	41 UC	440 UC	46 UC	0.99 U	1.5 U	5.5 U	0.46 U	4.6 U	6.2 U
Phenanthrene	41 UC	440 UC	46 UC	0.99 U	1.5 U	5.5 U	0.46 U	4.6 U	6.2 U
Pyrene	41 UC	440 UC	46 UC	0.99 U	1.5 U	5.5 U	0.46 U	4.6 U	6.2 U
Inorganics (mg/Kg)									
Aluminum	6600				3000	3000			
Arsenic	3.9				6 U	5 U			
Barium									
Beryllium									
Cadmium	0.3 U				1 U	1 U			
Calcium									
Chromium	41	410	110	170	24	37	31	64	31
Copper									
Iron	6900				3700	7800			
Lead	4				13	31			
Magnesium									
Manganese									
Mercury	0.06 U				0.2 U	0.2 U			
Nickel									
Sodium									
Vanadium									
Zinc									
Total Organic Carbon									

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	1140-WDW-C9 WDW-C9 10/11/2000 3.5-3.5 ft	OC-SD-SD1 SD-SD1 11/16/2007 0-0.25 ft	OC-SD-SD1 SD-SD1 11/19/2008 0-0.3 ft	OC-SD-SD-SD1-0.0/0.5 SD-SD1 11/11/2009 0-0.5 ft	OC-SD-SD1-0.0/0.5 SD-SD1 11/15/2010 0-0.5 ft	OC-SD-SD1-0.0/0.5 SD-SD1 11/11/2011 0-0.5 ft	OC-SD-SD1 SD-SD1 11/16/2012 0-0.5 ft	OC-SD-SD1 SD-SD1 11/21/2013 0-0.5 ft	RSD-01 RSD-01 1/18/2000
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene									0.018 U
2,4,4-Trimethyl-2-pentene									0.018 U
Acetone									0.095
Benzene									0.018 U
Chlorobenzene									0.018 UJ
Ethyl benzene									0.018 U
Methylene chloride									0.018 U
Xylenes (m&p)									
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	2.5 U								2.3 U
Bis(2-Ethylhexyl)phthalate	2.4 J								14
Di-n-butylphthalate	2.5 U								2.3 U
Fluoranthene	2.5 U								2.3 U
N-Nitrosodiphenylamine	2.5 U								2.3 U
Phenanthrene	2.5 U								2.3 U
Pyrene	2.5 U								2.3 U
Inorganics (mg/Kg)									
Aluminum		8500	11000	9200	9300	11000 J	7100 J	9800 J	3600
Arsenic									
Barium									3.4
Beryllium									0.1 U
Cadmium									0.2 U
Calcium									200
Chromium	180	20	29 J	21	21	30	67	24	4.5
Copper									2.1
Iron		10000	14000	11000	11000	13000 J	9000	12000	270
Lead									4.6
Magnesium									88
Manganese									4
Mercury									0.06 U
Nickel									2 U
Sodium									99 U
Vanadium									3
Zinc									5.2
Total Organic Carbon									

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	RSD-02 RSD-02 1/18/2000	RSD-16 RSD-16 5/23/2000 1.5-1.5 ft	RSD-17 RSD-17 5/23/2000 1.3-1.3 ft	RSD-18 RSD-18 5/23/2000 1.4-1.4 ft	RSD-19 RSD-19 5/23/2000 1.3-1.3 ft	SD-SD1-(15)-03 SD-SD1 5/19/2005 0.25-1.25 ft	SD-SD1-03-01 SD-SD1 6/17/2003 0-0.25 ft	SD-SD1-03-02 SD-SD1 8/10/2004 0-0.25 ft	SD-SD1-03-03 SD-SD1 5/19/2005 0-0.25 ft
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene	0.043 U								
2,4,4-Trimethyl-2-pentene	0.043 U								
Acetone	0.34								
Benzene	4.4 J								
Chlorobenzene	0.11 J								
Ethyl benzene	0.043 U								
Methylene chloride	0.043 U								
Xylenes (m&p)									
Semivolatile Organics (mg/Kg)									
Benzo(b)fluoranthene	1.6 U								
Bis(2-Ethylhexyl)phthalate	4								
Di-n-butylphthalate	1.6 U								
Fluoranthene	1.6 U								
N-Nitrosodiphenylamine	1.6 U								
Phenanthrene	1.6 U								
Pyrene	1.6 U								
Inorganics (mg/Kg)									
Aluminum	14000					7700	9750	6200	11000
Arsenic							7.77		
Barium	13						37.6		
Beryllium	0.61						0.164 U		
Cadmium	0.47						0.229		
Calcium	900								
Chromium	13	430 J	12	33	16	17	17.9	19	39
Copper	17								
Iron	2100					9600	12200	12000	17000
Lead	7.3						28.8		
Magnesium	180								
Manganese	22								
Mercury	0.2 U								
Nickel	6.7						9.31		
Sodium	3200								
Vanadium	27						17		
Zinc	14						47.4		
Total Organic Carbon								1.6	

Table 4.1-8
Summary of Detected Chemicals for Sediment Samples - On-Property West Ditch and West Ditch Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param.name	SD-SD1-15-01 SD-SD1 6/17/2003 0.25-1.25 ft	SD-SD1-15-02 SD-SD1 8/10/2004 0.25-1.25 ft
Volatile Organics (mg/Kg)		
2,4,4-Trimethyl-1-pentene		
2,4,4-Trimethyl-2-pentene		
Acetone		
Benzene		
Chlorobenzene		
Ethyl benzene		
Methylene chloride		
Xylenes (m&p)		
Semivolatile Organics (mg/Kg)		
Benzo(b)fluoranthene		
Bis(2-Ethylhexyl)phthalate		
Di-n-butylphthalate		
Fluoranthene		
N-Nitrosodiphenylamine		
Phenanthrene		
Pyrene		
Inorganics (mg/Kg)		
Aluminum	7360	7100
Arsenic	6.82	
Barium	41.1	
Beryllium	0.146 U	
Cadmium	0.261	
Calcium		
Chromium	23.9	15
Copper		
Iron	8840	10000
Lead	25.8	
Magnesium		
Manganese		
Mercury		
Nickel	11.4	
Sodium		
Vanadium	20.5	
Zinc	46.8	
Total Organic Carbon		2

mg/Kg = milligram per kilogram

U = not detected, value is the reporting limit
J = value is estimated
B = analyte was detected in the sample and its associated blank
C = value is estimated, surrogate recovery outside of control limits
F = value is estimated, matrix spike recovery outside of control limits
K = value is estimated, blank spike compound recovery outside the control limits

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

Table 4.1-9
Summary of Detected Chemicals for Sediment Samples - Central Pond
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-SD4-0.0/0.5 SD-SD4 11/11/2011 0-0.5 ft	OC-SD-SD4 SD-SD4 11/16/2012 0-0.5 ft	OC-SD-SD4 SD-SD4 11/21/2013 0-0.5 ft	OC-SD-SD-501-XXX SD-501 12/17/2012	OC-SD-SD-502-XXX SD-502 12/17/2012
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-1-pentene	1 / 2	0.0051 : 0.0051	0.011 - 0.011	0.0068				0.0051 U	0.011
2,4,4-Trimethyl-2-pentene	1 / 2	0.0051 : 0.0051	0.0088 - 0.0088	0.0057				0.0051 U	0.0088
2-Butanone	2 / 2		0.025 - 0.027	0.026				0.027	0.025 J
Acetone	2 / 2		0.11 - 0.12	0.12				0.12 J	0.11 J
Methyl Tertbutyl Ether	1 / 2	0.0029 : 0.0029	0.0017 - 0.0017	0.0016				0.0017 J	0.0029 U
Toluene	1 / 2	0.0029 : 0.0029	0.00098 - 0.00098	0.0012				0.00098 J	0.0029 U
Semivolatile Organics (mg/Kg)									
3 & 4 Methylphenol	2 / 2		4.3 - 6.1	5.2				4.3	6.1
Acetophenone	2 / 2		0.15 - 0.26	0.21				0.15 J	0.26 J
Benzaldehyde	2 / 2		1.4 - 1.9	1.7				1.4	1.9
Benzo(b)fluoranthene	1 / 2	0.46 : 0.46	0.14 - 0.14	0.19				0.46 U	0.14 J
Fluoranthene	2 / 2		0.21 - 0.29	0.25				0.21 J	0.29 J
Phenanthrene	1 / 2	0.46 : 0.46	0.21 - 0.21	0.22				0.46 U	0.21 J
Phenol	2 / 2		1.7 - 2.2	2.0				1.7	2.2
Pyrene	2 / 2		0.18 - 0.23	0.21				0.18 J	0.23 J
Inorganics (mg/Kg)									
Aluminum	5 / 5		6500 - 9900	7580	9900 J	7700 J	7300	6500 J	6500 J
Arsenic	2 / 2		6.2 - 8.1	7.2				6.2	8.1
Barium	2 / 2		45 - 46	46				45	46
Beryllium	2 / 2		0.09 - 0.094	0.092				0.094 J	0.09 J
Cadmium	2 / 2		0.21 - 0.26	0.24				0.21 J	0.26 J
Calcium	2 / 2		3800 - 3900	3850				3900	3800
Chromium	5 / 5		15 - 140	45	140	24	15	19	27
Chromium, Hexavalent	2 / 2		0.21 - 0.27	0.24				0.21 J	0.27 J
Cobalt	2 / 2		3.9 - 4	4.0				4	3.9
Copper	2 / 2		21 - 21	21				21	21
Iron	5 / 5		9200 - 17000	10980	17000 J	9900	9300	9500 J	9200 J
Lead	2 / 2		50 - 51	51				51	50
Magnesium	2 / 2		1800 - 2000	1900				2000	1800
Manganese	2 / 2		440 - 590	515				590	440
Mercury	2 / 2		0.057 - 0.07	0.064				0.07 J	0.057 J
Nickel	2 / 2		8.7 - 8.7	8.7				8.7	8.7
Potassium	2 / 2		730 - 790	760				790	730
Selenium	1 / 2	0.72 : 0.72	0.7 - 0.7	0.53				0.7 J	0.72 UJ
Sodium	2 / 2		140 - 150	145				140 J	150 J
Tin	2 / 2		2.1 - 2.2	2.2				2.1 J	2.2 J
Vanadium	2 / 2		16 - 17	16.5				17	16
Zinc	2 / 2		65 - 65	65				65	65
Chloride	2 / 2		18 - 24	21				24	18
Nitrogen, as Ammonia	2 / 2		17 - 35	26				17	35

Table 4.1-9
Summary of Detected Chemicals for Sediment Samples - Central Pond
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

param_name	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-SD4-0.0/0.5 SD-SD4 11/11/2011 0-0.5 ft	OC-SD-SD4 SD-SD4 11/16/2012 0-0.5 ft	OC-SD-SD4 SD-SD4 11/21/2013 0-0.5 ft	OC-SD-SD-501-XXX SD-501 12/17/2012	OC-SD-SD-502-XXX SD-502 12/17/2012
Oxidation Reduction Potential **(mV)**	2 / 2		-32 - -31	-31.5				-31	-32
pH **(pH units)**	2 / 2		7.23 - 7.32	7.3				7.32	7.23
Sulfate	2 / 2		510 - 1200	855				510	1200
Total Organic Carbon	2 / 2		80 - 90	85				90	80

mg/Kg = milligram per kilogram
mV = millivolts
U = not detected,
value is the reporting limit
J = value is estimated

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

Table 4.1-10
Summary of Detected Chemicals for Sediment Samples - Detention Basin
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-SD-503-XXX SD-503 12/17/2012	OC-SD-SD-504-XXX SD-504 12/17/2012
Volatile Organics (mg/Kg)						
2,4,4-Trimethyl-1-pentene	2 / 2		0.0024 - 0.0078	0.0051	0.0024 J	0.0078
2,4,4-Trimethyl-2-pentene	2 / 2		0.0014 - 0.0039	0.0027	0.0014 J	0.0039 J
2-Butanone	2 / 2		0.033 - 0.035	0.034	0.035	0.033 J
Acetone	2 / 2		0.13 - 0.15	0.14	0.15 J	0.13 J
Semivolatile Organics (mg/Kg)						
3 & 4 Methylphenol	2 / 2		1.8 - 4	2.9	4	1.8
Acetophenone	1 / 2	0.58 : 0.58	0.16 - 0.16	0.23	0.16 J	0.58 U
Benzaldehyde	2 / 2		0.62 - 1.3	0.96	1.3	0.62
Benzo(a)pyrene	1 / 2	0.52 : 0.52	0.22 - 0.22	0.24	0.52 U	0.22 J
Bis(2-Ethylhexyl)phthalate	1 / 2	2.9 : 2.9	3.1 - 3.1	2.3	3.1	2.9 U
N-Nitrosodiphenylamine	1 / 2	0.58 : 0.58	0.33 - 0.33	0.31	0.33 J	0.58 U
Phenol	2 / 2		1.4 - 1.9	1.7	1.9	1.4
Inorganics (mg/Kg)						
Aluminum	2 / 2		7800 - 9100	8450	9100 J	7800 J
Arsenic	2 / 2		9.4 - 12	10.7	12	9.4
Barium	2 / 2		48 - 51	50	48	51
Beryllium	2 / 2		0.089 - 0.12	0.10	0.12 J	0.089 J
Cadmium	2 / 2		0.55 - 0.56	0.56	0.55	0.56
Calcium	2 / 2		4700 - 4800	4750	4700	4800
Chromium	2 / 2		33 - 50	42	50	33
Cobalt	2 / 2		4.5 - 4.8	4.7	4.8	4.5
Copper	2 / 2		19 - 25	22	19	25
Iron	2 / 2		11000 - 12000	11500	12000 J	11000 J
Lead	2 / 2		23 - 26	25	26	23
Magnesium	2 / 2		2000 - 2300	2150	2300	2000
Manganese	2 / 2		400 - 440	420	400	440
Mercury	2 / 2		0.062 - 0.075	0.069	0.075 J	0.062 J
Nickel	2 / 2		9.9 - 11	10.5	11	9.9
Potassium	2 / 2		740 - 1100	920	1100	740
Sodium	2 / 2		110 - 150	130	110 J	150 J
Tin	2 / 2		2.2 - 2.3	2.3	2.2 J	2.3 J
Vanadium	2 / 2		19 - 22	21	22	19
Zinc	2 / 2		55 - 73	64	55	73
Chloride	2 / 2		6.3 - 13	9.7	6.3 J	13
Nitrogen, as Ammonia	2 / 2		14 - 22	18	14	22

Table 4.1-10
Summary of Detected Chemicals for Sediment Samples - Detention Basin
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-SD-503-XXX SD-503 12/17/2012	OC-SD-SD-504-XXX SD-504 12/17/2012
Oxidation Reduction Potential **(mV)**	2 / 2		-32 - -31	-32	-32	-31
pH **(pH units)**	2 / 2		6.98 - 6.99	7.0	6.98	6.99
Sulfate	2 / 2		900 - 1900	1400	900	1900
Total Organic Carbon	2 / 2		60 - 110	85	110	60

mg/Kg = milligram per kilogram
mV = millivolts
U = not detected,
value is the reporting limit
J = value is estimated

Prepared by / Date: KJC 03/28/13
Checked by / Date: CTM 03/28/13

Table 4.2-1
Summary of Detected Chemicals for OU2 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Volatile Organics (mg/Kg)									
2,4,4-Trimethyl-2-pentene	1 / 9	0.008 : 0.56	0.0056 - 0.0056	0.061	--	39	n		
Semivolatile Organics (mg/Kg)									
1,2-Dichlorobenzene	1 / 11	0.046 : 33	0.21 - 0.21	2.8	--	9800	ns	0.27	0.58
1,4-Dichlorobenzene	1 / 11	0.046 : 33	0.053 - 0.053	2.7	--	12	c	0.0004	0.072
1-Methylnaphthalene	4 / 10	0.046 : 0.063	0.023 - 0.062	0.034	--	53	c	0.0051	
2-Methylnaphthalene	4 / 13	0.046 : 33	0.026 - 0.075	2.3	--	2200	n	0.14	
3-Nitroaniline	1 / 10	0.28 : 170	0.073 - 0.073	15.3	--				
Acenaphthylene	2 / 13	0.046 : 33	0.058 - 0.063	2.3	--				
Acetophenone	2 / 10	0.046 : 0.99	0.018 - 0.17	0.089	--	100000	nms	0.45	
Aniline	1 / 12	0.046 : 170	0.12 - 0.12	12.7	--	300	c*	0.0039	
Anthracene	1 / 12	0.046 : 33	0.044 - 0.044	2.5	--	170000	nm	42	
Benzaldehyde	10 / 10		0.029 - 0.33	0.12	--	100000	nms	0.33	
Benzo(a)anthracene	1 / 12	0.046 : 33	0.069 - 0.069	2.5	0.0192	2.1	c	0.01	
Benzo(a)pyrene	3 / 12	0.056 : 33	0.014 - 0.062	2.5	0.0229	0.21	c	0.0035	0.24
Benzo(b)fluoranthene	3 / 12	0.046 : 33	0.025 - 0.31	2.5	0.0528	2.1	c	0.035	
Benzo(ghi)perylene	2 / 12	0.046 : 33	0.023 - 0.041	2.5	0.0239				
Benzo(k)fluoranthene	3 / 12	0.046 : 33	0.022 - 0.15	2.5	--	21	c	0.35	
Biphenyl	2 / 10	0.046 : 0.07	0.86 - 0.93	0.20	--	210	n	0.0087	
Bis(2-Ethylhexyl)phthalate	11 / 14	0.057 : 0.28	0.026 - 216	31	0.0305	120	c	1.1	1.4
Carbazole	2 / 10	0.046 : 0.07	0.039 - 0.086	0.036	--				
Chrysene	3 / 12	0.046 : 33	0.029 - 0.25	2.5	0.0282	210	c	1.1	
Dibenzofuran	6 / 12	0.056 : 33	0.022 - 1.2	2.6	--	1000	n	0.11	
Di-n-butylphthalate	1 / 12	0.046 : 33	0.98 - 0.98	2.6	--	62000	n	1.7	
Diphenyl ether	2 / 10	0.046 : 0.07	1.6 - 1.9	0.37	--				
Fluoranthene	8 / 13	0.056 : 33	0.018 - 0.34	2.3	0.0436	22000	n	70	
Indeno(1,2,3-cd)pyrene	1 / 11	0.046 : 33	0.027 - 0.027	2.7	0.033	2.1	c	0.2	
Naphthalene	5 / 13	0.056 : 33	0.021 - 0.082	2.3	--	18	c*	0.00047	
N-Nitrosodi-n-propylamine	1 / 12	0.046 : 33	0.26 - 0.26	2.5	--	0.25	c	0.000007	
N-Nitrosodiphenylamine	3 / 13	0.046 : 33	0.63 - 1.3	2.5	--	350	c	0.057	
Phenanthrene	8 / 13	0.056 : 33	0.023 - 0.19	2.3	0.036				
Phenol	2 / 12	0.046 : 33	0.024 - 0.24	2.5	--	180000	nm	2.6	
Pyrene	7 / 13	0.056 : 33	0.024 - 0.79	2.4	0.0501	17000	n	9.5	
PAHs (mg/Kg)									
Benzo(a)anthracene	1 / 1		2.3 - 2.3	2.3	0.0192	2.1	c	0.01	
Benzo(a)pyrene	1 / 1		0.44 - 0.44	0.44	0.0229	0.21	c	0.0035	0.24
Benzo(b)fluoranthene	1 / 1		0.6 - 0.6	0.60	0.0528	2.1	c	0.035	
Benzo(ghi)perylene	1 / 1		0.51 - 0.51	0.51	0.0239				
Benzo(k)fluoranthene	1 / 1		0.24 - 0.24	0.24	--	21	c	0.35	
Chrysene	1 / 1		0.56 - 0.56	0.56	0.0282	210	c	1.1	

Table 4.2-1
Summary of Detected Chemicals for OU2 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Fluoranthene	1 / 1		1.3 - 1.3	1.3	0.0436	22000	n	70	
Phenanthrene	1 / 1		0.41 - 0.41	0.41	0.036				
Pyrene	1 / 1		0.73 - 0.73	0.73	0.0501	17000	n	9.5	
Pesticides (mg/Kg)									
4,4'-DDT	1 / 1		0.045 - 0.045	0.045	--	7	c*	0.067	
Hexachlorobenzene	1 / 1		0.029 - 0.029	0.029	--	1.1	c	0.00053	0.013
Inorganics (mg/Kg)									
Aluminum	9 / 9		2500 - 43000	10789	16279	990000	nm	23000	
Antimony	2 / 7	0.92 : 6.9	0.29 - 0.34	0.88	--	410	n	0.27	0.27
Arsenic	10 / 11	37 : 37	4.5 - 42	19.4	11.66	2.4	cR	0.0013	0.29
Barium	11 / 11		5.5 - 130	31	17.66	190000	nm	120	82
Beryllium	8 / 8		0.061 - 2.8	0.59	0.4	2000	n	13	3.2
Cadmium	6 / 10	0.36 : 4	0.093 - 0.52	0.65	0.321	800	n	0.52	0.38
Calcium	9 / 9		190 - 1100	496	679.9				
Chromium	42 / 43	10 : 10	7.2 - 62000	6649	12.79	1500000	nm		180000
Chromium, Hexavalent	4 / 16	2.8 : 110	19 - 1100	79	--	5.6	c	0.00059	
Cobalt	9 / 9		0.91 - 10	3.2	3.41	300	n	0.21	
Copper	9 / 9		3.8 - 190	38	6.698	41000	n	22	46
Iron	9 / 9		3700 - 31000	14067	15564	720000	nm	270	
Lead	11 / 11		27 - 150	71	27.73	800	L		14
Magnesium	9 / 9		82 - 1000	538	1215				
Manganese	9 / 9		9 - 170	49	75.31	23000	n	21	
Mercury	10 / 11	0.16 : 0.16	0.047 - 3.1	0.64	0.115	43	ns	0.033	0.1
Nickel	9 / 9		2.1 - 16	8.4	8.42	20000	n	20	
Potassium	8 / 9	1400 : 1400	240 - 2200	669	682.3				
Silver	2 / 11	0.75 : 19	10 - 1100	103	--	5100	n	0.6	
Thallium	1 / 8	1.5 : 3.5	7.4 - 7.4	1.9	--	10	n	0.011	0.14
Tin	8 / 9	7.5 : 7.5	4.5 - 26000	2924	4.44	610000	nm	2300	
Vanadium	9 / 9		12 - 150	39	24.78	5100	n	63	
Zinc	9 / 9		3.4 - 47	17.0	19.64	310000	nm	290	
Cyanide, Total	1 / 1		6.5 - 6.5	6.5	--	140	n	0.014	2
Nitrogen, as Ammonia	9 / 9		150 - 1100	406	--				
Oxidation Reduction Potential **(mV)**	14 / 15	0.01 : 0.01	49 - 570	359	--				
pH **(pH units)**	14 / 14		3.73 - 6.02	4.4	--				
Sulfate	2 / 8	56 : 150	120 - 230	74	--				
Total Organic Carbon	1 / 1		55000 - 55000	55000	--				
Total Organic Carbon **(%)**	1 / 1		11 - 11	11.0	--				
EPH (mg/Kg)									
Benzo(ghi)perylene	1 / 2	2.6 : 2.6	2.3 - 2.3	1.8	0.0239				
Fluoranthene	1 / 2	2.2 : 2.2	2.6 - 2.6	1.9	0.0436	22000	n	70	

Table 4.2-1
Summary of Detected Chemicals for OU2 Surface Soil Samples (0-1 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)	Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Indeno(1,2,3-cd)pyrene	1 / 2	2.2 : 2.2	13 - 13	7.1	0.033	2.1 c	0.2	
C11-C22 Aromatics	2 / 2		1400 - 7500	4450	--	3000		
C11-C22 Aromatics (unadj.)	2 / 2		1400 - 7500	4450	--	3000		
C19-C36 Aliphatics	2 / 2		1800 - 4900	3350	--	5000		
C9-C18 Aliphatics	2 / 2		200 - 780	490	--	3000		
Extractable Petroleum Hydrocarbons, Total	2 / 2		3400 - 13000	8200	--			
Specialty Compounds (mg/Kg)								
Acetaldehyde	3 / 3		0.048 - 0.13	0.082	--	52 c**	0.00045	
Formaldehyde	3 / 3		0.47 - 1.1	0.69	0.459	120000 nm	0.62	

Notes:
(1) Values are the Industrial Soil Regional Screening Levels (RSLs)
United States Environmental Protection Agency Regions 3, 6, and 9. November 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentrations_table/index.htm
RSL for 2,4,4-Trimethyl-2-pentene calculated consistent with RSL Guidance.
RSL for Chromium (III) used for chromium.
MCP Method 1 Soil category S-2 Standards were used for screening EPH/VPH.
c - RSL is based on an excess lifetime cancer risk of 1 in 1 million.
c* - where n RSL < 100X c RSL.
c** - where n RSL < 10X c RSL.
L - lead
n - RSL is based on a non-cancer hazard quotient.
nm - RSL is based on a non-cancer hazard quotient; concentration may exceed ceiling limit.
nms - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat and the ceiling limit.
ns - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat.
(2) Values are the Risk- and MCL-based Soil Screening Levels (SSLs) as presented in the RSLs

mg/Kg = milligram per kilogram
mV = millivolts

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

BOLD outlined cells indicate a concentration greater than the Industrial RSL (Appendix F-4)
Shaded cells indicate a concentration greater than the risk-based or MCL-based SSL (Appendix F-4)

Table 4.2-2
Summary of Detected Chemicals for OU2 Shallow Subsurface Soil Samples (1-10 ft)
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Site Specific Background	Industrial Soil RSL (1) (mg/Kg)		Risk-Based SSL (2) (mg/Kg)	MCL-Based SSL (2) (mg/Kg)
Semivolatile Organics (mg/Kg)									
Bis(2-Ethylhexyl)phthalate	1 / 3	0.21 : 0.22	11 - 11	3.7	0.0305	120	c	1.1	1.4
Diphenyl ether	1 / 3	0.042 : 0.044	0.82 - 0.82	0.29	--				
Inorganics (mg/Kg)									
Chromium	4 / 4		120 - 2500	1580	12.79	1500000	nm		180000
Chromium, Hexavalent	1 / 4	2.4 : 2.9	4 - 4	2.0	--	5.6	c	0.00059	
Tin	1 / 1		2.4 - 2.4	2.4	4.44	610000	nm	2300	
Oxidation Reduction Potential **(mV)**	3 / 4	0.01 : 0.01	34 - 82	47	--				
pH **(pH units)**	4 / 4		3.85 - 6.15	4.6	--				

Notes:
SSL = soil screening levels
(1) Values are the Industrial Soil Regional Screening Levels (RSLs)
United States Environmental Protection Agency Regions 3, 6, and 9. November 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentrations_table/index.htm
RSL for Chromium (III) used for chromium.
c - RSL is based on an excess lifetime cancer risk of 1 in 1 million.
c* - where n RSL < 100X c RSL.
c** - where n RSL < 10X c RSL.
n - RSL is based on a non-cancer hazard quotient.
nm - RSL is based on a non-cancer hazard quotient; concentration may exceed ceiling limit.
nms - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat and the ceiling limit.
ns - RSL is based on a non-cancer hazard quotient; concentration may exceed Csat.
(2) Values are the Risk- and MCL-based Soil Screening Levels as presented in the RSLs

mg/Kg = milligram per kilogram
mV = millivolts

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

BOLD outlined cells indicate a concentration greater than the Industrial RSL (Appendix F-5)
Shaded cells indicate a concentration greater than the risk-based or MCL-based SSL (Appendix F-5)

Table 4.2-3
Summary of Detected Chemicals for Surface Water Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	AWQC (1) (mg/L)	OC-SW-OPWD-1-XXX OPWD-1 12/10/2010	OC-SW-OPWD-1-XXX OPWD-1 6/7/2011	OC-SW-OPWD-2-XXX OPWD-2 12/10/2010	OC-SW-OPWD-2-XXX OPWD-2 6/7/2011
Volatile Organics (mg/L)									
2,4,4-Trimethyl-1-pentene	3 / 6	0.001 : 0.001	0.00071 - 0.0071	0.0020		0.001 U	0.001 UJ	0.0025	0.0071 J
2,4,4-Trimethyl-2-pentene	1 / 6	0.001 : 0.001	0.0019 - 0.0019	0.00073		0.001 U	0.001 U	0.001 U	0.0019
Carbon disulfide	3 / 6	0.01 : 0.01	0.001 - 0.0025	0.0033		0.001 J	0.01 UJ	0.01 U	0.0025 J
Toluene	1 / 6	0.001 : 0.001	0.0005 - 0.0005	0.00050	15	0.001 U	0.001 U	0.001 U	0.0005 J
Semivolatile Organics (mg/L)									
3 & 4 Methylphenol	2 / 6	0.0045 : 0.005	0.00073 - 0.00076	0.0018		0.00073 J	0.0045 U	0.0045 U	0.00076 J
4-Nitrophenol	1 / 6	0.0045 : 0.005	0.00075 - 0.00075	0.0020		0.0045 UJ	0.0045 U	0.0045 UJ	0.0045 U
Acenaphthene	1 / 6	0.00091 : 0.001	0.000047 - 0.000047	0.00039	0.99	0.00091 U	0.00091 U	0.000047 J	0.00091 U
Benzo(a)anthracene	2 / 6	0.00027 : 0.0003	0.00024 - 0.002	0.00047	0.000018	0.00027 U	0.00027 U	0.002 J	0.00024 J
Benzo(a)pyrene	4 / 6	0.00018 : 0.0002	0.00012 - 0.0042	0.00089	0.000018	0.00012 J	0.00022	0.0042 J	0.00059
Benzo(b)fluoranthene	4 / 6	0.00027 : 0.0003	0.00019 - 0.0077	0.0016	0.000018	0.00019 J	0.00029	0.0077 J	0.0011
Benzo(ghi)perylene	3 / 6	0.00045 : 0.0005	0.00011 - 0.0046	0.00099		0.00011 J	0.00045 U	0.0046 J	0.00054
Benzo(k)fluoranthene	2 / 6	0.00027 : 0.0003	0.0005 - 0.0026	0.00061	0.000018	0.00027 U	0.00027 U	0.0026 J	0.0005
Benzoic Acid	5 / 6	0.0045 : 0.0045	0.0019 - 0.0042	0.0024		0.0021 J	0.0019 J	0.0042 J	0.0021 J
Chrysene	4 / 6	0.00091 : 0.001	0.00018 - 0.0053	0.0012	0.000018	0.00018 J	0.00018 J	0.0053 J	0.00067 J
Dibenz(a,h)anthracene	1 / 6	0.00045 : 0.0005	0.0012 - 0.0012	0.00039	0.000018	0.00045 U	0.00045 U	0.0012 J	0.00045 U
Di-n-octylphthalate	2 / 6	0.0045 : 0.005	0.00081 - 0.00087	0.0018		0.00087 J	0.0045 U	0.00081 J	0.0045 U
Fluoranthene	4 / 6	0.00091 : 0.001	0.00023 - 0.0051	0.0012	0.14	0.00023 J	0.00024 J	0.0051	0.00092
Fluorene	1 / 6	0.00091 : 0.001	0.000056 - 0.000056	0.00040	5.3	0.00091 U	0.00091 U	0.000056 J	0.00091 U
Indeno(1,2,3-cd)pyrene	3 / 6	0.00045 : 0.0005	0.000098 - 0.004	0.00088	0.000018	0.000098 J	0.00045 U	0.004 J	0.00049
N-Nitrosodimethylamine	5 / 6	0.000038 : 0.000038	5.6E-06 - 0.00011	0.000049	0.003	0.00011	0.00006	0.0000056	0.000038 UJ
Phenanthrene	4 / 6	0.00018 : 0.0002	0.000081 - 0.0025	0.00053		0.000081 J	0.0001 J	0.0025	0.00032
Phenol	1 / 6	0.0045 : 0.005	0.00051 - 0.00051	0.0020	1700	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.00051 J
Pyrene	4 / 6	0.0045 : 0.005	0.00022 - 0.012	0.0031	4	0.00022 J	0.00028 J	0.012 J	0.0011 J
Metals, Total (mg/L)									
Aluminum	6 / 6		0.1 - 1.6	0.82		1.1	0.83	0.96	1.6
Arsenic	2 / 6	0.01 : 0.01	0.0038 - 0.012	0.0060	0.00014	0.01 U	0.0038 J	0.01 U	0.012
Barium	6 / 6		0.026 - 0.046	0.035		0.032	0.042	0.026	0.046
Beryllium	3 / 6	0.001 : 0.001	0.00017 - 0.00026	0.00035		0.00026 J	0.00019 J	0.001 U	0.00017 J
Calcium	6 / 6		6.1 - 28	18.7		21	26	6.1	6.8
Chromium	6 / 6		0.0061 - 0.13	0.050		0.13	0.099	0.0061	0.013
Cobalt	6 / 6		0.0033 - 0.018	0.0097		0.018	0.017	0.0034 J	0.0033 J
Copper	6 / 6		0.00079 - 0.0061	0.0040		0.0058 J	0.0034	0.0061 J	0.0039
Iron	6 / 6		5 - 30	16.4		17	29	8.8	30
Lead	6 / 6		0.00082 - 0.0058	0.0027		0.0025	0.002	0.0058	0.0041
Magnesium	6 / 6		1.2 - 5.4	3.5		4.7	5.4	1.2	1.2
Manganese	6 / 6		0.27 - 1.5	0.85	0.1	1.3	1.5	0.27	0.27

Table 4.2-3
Summary of Detected Chemicals for Surface Water Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	AWQC (1) (mg/L)	OC-SW-OPWD-1-XXX OPWD-1 12/10/2010	OC-SW-OPWD-1-XXX OPWD-1 6/7/2011	OC-SW-OPWD-2-XXX OPWD-2 12/10/2010	OC-SW-OPWD-2-XXX OPWD-2 6/7/2011
Nickel	6 / 6		0.0041 - 0.018	0.0090	4.6	0.018	0.012	0.005 J	0.0051 J
Potassium	4 / 6	4 : 4	1.6 - 2.3	2.0		1.6 J	2.3 J	4 U	4 U
Sodium	6 / 6		41 - 120	81		100	120	41	42
Vanadium	4 / 6	0.01 : 0.01	0.0026 - 0.012	0.0057		0.0026 J	0.0031 J	0.0062 J	0.012
Zinc	6 / 6		0.009 - 0.12	0.038	26	0.019 J	0.019 J	0.04 J	0.12
Inorganics (mg/L)									
Bromide	5 / 6	0.1 : 0.1	0.1 - 0.21	0.15		0.21	0.2	0.1 U	0.1
Chloride	6 / 6		82 - 180	139		170	180	94	82
Hardness	6 / 6		20 - 87	61		72	87	20	22
Nitrate as N	1 / 6	0.05 : 0.05	0.069 - 0.069	0.032		0.05 U	0.05 U	0.05 U	0.05 U
Nitrite as N	1 / 6	0.01 : 0.1	0.02 - 0.02	0.023		0.01 U	0.1 U	0.02	0.01 U
Nitrogen, as Ammonia	6 / 6		17 - 66	45	(*)	66	63	17	36
Sulfate	6 / 6		66 - 360	211		360	320	66	69
Total Organic Carbon	6 / 6		5 - 17	10.2		11	5.9	13	17
Total Suspended Solids	6 / 6		11 - 250	103		62	77	190	250
Specialty Compounds (mg/L)									
Formaldehyde	3 / 4	0.03 : 0.03	0.0064 - 0.02	0.013		0.02 J	0.03 U	0.0099 J	0.0064 J

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).

(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

U = not detected, value is the reporting limit
J = value is estimated

Table 4.2-3
Summary of Detected Chemicals for Surface Water Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-OPWD-SD/SO/SW-S-XXX OPWD-SW-S 12/10/2010	OC-SW-OPWD-SD/SO/SW-S-XXX OPWD-SW-S 6/7/2011
Volatile Organics (mg/L)		
2,4,4-Trimethyl-1-pentene	0.00071 J	0.001 UJ
2,4,4-Trimethyl-2-pentene	0.001 U	0.001 U
Carbon disulfide	0.0011 J	0.01 UJ
Toluene	0.001 U	0.001 U
Semivolatile Organics (mg/L)		
3 & 4 Methylphenol	0.0045 U	0.005 U
4-Nitrophenol	0.00075 J	0.005 U
Acenaphthene	0.00091 U	0.001 U
Benzo(a)anthracene	0.00027 U	0.0003 U
Benzo(a)pyrene	0.00018 U	0.0002 U
Benzo(b)fluoranthene	0.00027 U	0.0003 U
Benzo(ghi)perylene	0.00045 U	0.0005 U
Benzo(k)fluoranthene	0.00027 U	0.0003 U
Benzoic Acid	0.0045 UJ	0.0021 J
Chrysene	0.00091 U	0.001 U
Dibenz(a,h)anthracene	0.00045 U	0.0005 U
Di-n-octylphthalate	0.0045 U	0.005 U
Fluoranthene	0.00091 U	0.001 U
Fluorene	0.00091 U	0.001 U
Indeno(1,2,3-cd)pyrene	0.00045 U	0.0005 U
N-Nitrosodimethylamine	0.000076	0.000023
Phenanthrene	0.00018 U	0.0002 U
Phenol	0.0045 UJ	0.005 UJ
Pyrene	0.0045 U	0.005 U
Metals, Total (mg/L)		
Aluminum	0.33	0.1
Arsenic	0.01 U	0.01 U
Barium	0.033	0.028
Beryllium	0.001 U	0.001 U
Calcium	28	24
Chromium	0.037	0.012
Cobalt	0.011	0.0056 J
Copper	0.0041 J	0.00079
Iron	8.3	5
Lead	0.00083 J	0.00082 J
Magnesium	4.2	4.2
Manganese	0.98	0.8

Table 4.2-3
Summary of Detected Chemicals for Surface Water Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-OPWD-SD/SO/SW-S-XXX OPWD-SW-S 12/10/2010	OC-SW-OPWD-SD/SO/SW-S-XXX OPWD-SW-S 6/7/2011
Nickel	0.0096 J	0.0041 J
Potassium	2.1 J	2.2 J
Sodium	89	94
Vanadium	0.01 UJ	0.01 U
Zinc	0.018 J	0.009 J
Inorganics (mg/L)		
Bromide	0.19	0.14
Chloride	180	130
Hardness	87	77
Nitrate as N	0.069	0.05 U
Nitrite as N	0.01 U	0.1 U
Nitrogen, as Ammonia	48	37
Sulfate	290	160
Total Organic Carbon	9.3	5
Total Suspended Solids	28	11
Specialty Compounds (mg/L)		
Formaldehyde		

(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).

(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

U = not detected,
value is the reporting limit
J = value is estimated

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

Table 4.2-4
Summary of Detected Chemicals for Surface Water Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	East Ditch Background (mg/L)		AWQC (mg/L)	OC-SW-EDSD/SW0-XXX EDSD/SW0 12/13/2010	OC-SW-EDSD/SW0-XXX EDSD/SW0 6/8/2011	OC-SW-EDSD/SW1 (EDBS5)-XXX EDSD/SW1 (EDBS5) 12/13/2010
Volatile Organics (mg/L)										
1,1,1-Trichloroethane	2 / 10	0.001 : 0.001	0.001 - 0.0018	0.00068				0.001 U		0.001
1,1,2-Trichloro-1,2,2-Trifluoroethane	5 / 10	0.001 : 0.001	0.0011 - 0.0031	0.0011				0.001 U		0.0013
1,1-Dichloroethane	1 / 10	0.001 : 0.001	0.00033 - 0.00033	0.00048				0.001 U		0.001 U
1,1-Dichloroethene	1 / 10	0.001 : 0.001	0.00078 - 0.00078	0.00053			7.1	0.001 U		0.001 U
2,4,4-Trimethyl-1-pentene	2 / 10	0.001 : 0.001	0.0039 - 0.0044	0.0012				0.001 U		0.001 U
2,4,4-Trimethyl-2-pentene	1 / 10	0.001 : 0.001	0.00057 - 0.00057	0.00051				0.001 U		0.001 U
2-Butanone	2 / 10	0.01 : 0.01	0.0013 - 0.0029	0.0044				0.01 U		0.01 U
Acetone	1 / 10	0.05 : 0.05	0.0039 - 0.0039	0.023				0.05 UJ		0.05 UJ
Chloroethane	2 / 10	0.002 : 0.002	0.00044 - 0.0026	0.0011				0.002 U		0.002 U
Cis-1,2-Dichloroethene	4 / 10	0.001 : 0.001	0.0011 - 0.0061	0.0015				0.001 U		0.001 U
Methyl Tertbutyl Ether	1 / 10	0.001 : 0.001	0.00022 - 0.00022	0.00047				0.001 U		0.001 U
Tetrachloroethene	1 / 10	0.001 : 0.001	0.00026 - 0.00026	0.00048			0.0033	0.001 U		0.001 U
Toluene	5 / 10	0.001 : 0.001	0.00067 - 0.0085	0.0016	0.0013		15	0.001 U		0.0085
Trichloroethene	4 / 10	0.001 : 0.0021	0.00047 - 0.0034	0.0011			0.03	0.001 U		0.00047 J
Vinyl chloride	1 / 10	0.0005 : 0.0005	0.00052 - 0.00052	0.00028			0.0024	0.0005 U		0.0005 U
Xylene, o	1 / 10	0.001 : 0.001	0.00024 - 0.00024	0.00047				0.001 U		0.001 U
Xylenes (m&p)	1 / 10	0.002 : 0.002	0.00052 - 0.00052	0.00095				0.002 U		0.002 U
Semivolatile Organics (mg/L)										
Benzo(ghi)perylene	4 / 10	0.00047 : 0.00053	0.000088 - 0.00018	0.00020	0.00014	J		0.00012 J		0.00018 J
Benzoic Acid	3 / 5	0.0047 : 0.0053	0.0019 - 0.0021	0.0022	0.0021	J		R		R
Bis(2-Ethylhexyl)phthalate	2 / 10	0.0018 : 0.0021	0.0012 - 0.0015	0.0010	0.00046	J	0.0022	0.0018 U		0.0018 U
Caprolactam	1 / 6	0.0047 : 0.0053	0.00073 - 0.00073	0.0022				R		R
Dibenz(a,h)anthracene	4 / 10	0.00047 : 0.00053	0.000081 - 0.00018	0.00020	0.00014	J	0.000018	0.00013 J		0.00018 J
Indeno(1,2,3-cd)pyrene	4 / 10	0.00047 : 0.00053	0.00009 - 0.00017	0.00020	0.00016	J	0.000018	0.00013 J		0.00017 J
N-Nitrosodimethylamine	4 / 10	1.9E-06 : 0.00002	3.3E-06 - 0.000012	0.0000045			0.003	0.000002 U		0.0000033
N-Nitrosodi-n-propylamine	1 / 10	1.9E-06 : 0.00002	3.3E-06 - 3.3E-06	0.0000021			0.00051	0.000002 U		0.000002 U
Metals, Total (mg/L)										
Aluminum	19 / 22	0.1 : 0.2	0.028 - 0.77	0.16	1.1			0.071 J		0.039 J
Arsenic	2 / 10	0.01 : 0.01	0.005 - 0.0078	0.0053	0.0036	J	0.00014	0.01 U		0.01 U
Barium	10 / 10		0.013 - 0.1	0.042	0.2			0.028		0.032
Calcium	10 / 10		11 - 46	34	79			18		27
Chromium	11 / 22	0.005 : 0.005	0.00068 - 0.065	0.0054991	0.0022	J		0.005 U		0.005 U
Chromium, Hexavalent	2 / 4	0.001 : 0.001	0.00056 - 0.00086	0.000605						
Cobalt	5 / 10	0.01 : 0.01	0.0016 - 0.0024	0.0036	0.003	J		0.01 U		0.01 U
Copper	10 / 10		0.00072 - 0.0055	0.0026	0.027			0.0055 NJ		0.0034 NJ

Table 4.2-4
Summary of Detected Chemicals for Surface Water Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	East Ditch Background (mg/L)		AWQC (mg/L)	OC-SW-EDSD/SW0-XXX EDSD/SW0 12/13/2010	OC-SW-EDSD/SW0-XXX EDSD/SW0 6/8/2011	OC-SW-EDSD/SW1 (EDBS5)-XXX EDSD/SW1 (EDBS5) 12/13/2010
Iron	10 / 10		0.17 - 11	1.9	6.7			0.17		0.87
Lead	6 / 10	0.0001 : 0.001	0.00035 - 0.0015	0.0005055	0.014			0.00035 J		0.001 U
Magnesium	10 / 10		1.4 - 6.9	4.8	7.7			1.8		3.6
Manganese	10 / 10		0.016 - 0.91	0.41	3.4		0.1	0.016		0.17
Nickel	5 / 10	0.01 : 0.01	0.0017 - 0.0039	0.0040	0.0037	J	4.6	0.01 U		0.01 U
Potassium	9 / 10	4 : 4	1.6 - 6.1	3.2	9.6			1.6 J		2 J
Silver	1 / 10	0.0001 : 0.001	0.00014 - 0.00014	0.000284				0.001 U		0.001 U
Sodium	22 / 22		17 - 190	82	450			76		55
Thallium	1 / 10	0.01 : 0.01	0.0052 - 0.0052	0.0050			0.00047	0.01 U		0.01 U
Vanadium	1 / 10	0.01 : 0.01	0.0025 - 0.0025	0.0048	0.0022	J		0.01 UJ		0.01 UJ
Zinc	8 / 10	0.05 : 0.05	0.0088 - 0.053	0.028	0.023	J	26	0.053		0.025 J
Metals, Filtered (mg/L)										
Aluminum	8 / 12	0.1 : 0.2	0.023 - 0.074	0.057						
Chromium	1 / 12	0.005 : 0.005	0.00068 - 0.00068	0.0023						
Sodium	12 / 12		71 - 120	92						
Inorganics (mg/L)										
Bromide	2 / 10	0.1 : 0.1	0.11 - 0.18	0.069	0.13			0.1 U		0.1 U
Chloride	22 / 22		26 - 360	170	930			140		100
Hardness	10 / 10		34 - 140	106	230			52		83
Lab Specific Conductance **(mS/cm)**	12 / 12		0.67 - 0.92	0.77						
Nitrate as N	22 / 22		0.68 - 2.6	1.0	1.9			1.8		1
Nitrogen, as Ammonia	19 / 22	0.1 : 0.1	0.11 - 10	2.7	0.4		(*)	0.1 U		0.11
Sulfate	22 / 22		14 - 99	36	16			14		17
Total Organic Carbon	10 / 10		1.2 - 5.1	2.9	12			3		2.9
Total Suspended Solids	5 / 10	2 : 5	2 - 14	4.8	82			2 U		2 U
Specialty Compounds (mg/L)										
Kempore (Azodicarbonamide)	2 / 10	1 : 3	1.2 - 4.1	1.0				1 U	3 U	1 U

Table 4.2-4
Summary of Detected Chemicals for Surface Water Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-EDSD/SW1(EDBS5)-XXX EDSD/SW1 (EDBS5) 6/8/2011	OC-SW-EDSD/SW2 (EDBS6)-XXX EDSD/SW2 (EDBS6) 12/13/2010	OC-SW-EDSD/SW2(EDBS6)-XXX EDSD/SW2 (EDBS6) 6/8/2011	OC-SW-EDSD/SW5 (EDBS11)-XXX EDSD/SW5 (EDBS11) 12/13/2010	OC-SW-EDSD/SW5(EDBS11)-XXX EDSD/SW5 (EDBS11) 6/8/2011	OC-SW-EDSD/SW7-XXX EDSD/SW7 11/6/2012	OC-SW-EDSD/SW7-XXX EDSD/SW7 6/18/2012	OC-SW-SD-EDSD/SW0-XXX EDSD/SW0 6/8/2011	OC-SW-ISCO3 ISCO3 3/22/2011	OC-SW-ISCO3 ISCO3 5/16/2011
Volatile Organics (mg/L)										
1,1,1-Trichloroethane	0.0018	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		
1,1,2-Trichloro-1,2,2-Trifluoroethane	0.0011	0.001 U	0.001 U	0.0015	0.0031	0.0013	0.001 U	0.001 U		
1,1-Dichloroethane	0.00033 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		
1,1-Dichloroethene	0.00078 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		
2,4,4-Trimethyl-1-pentene	0.001 UJ	0.0044	0.0039 J	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 UJ		
2,4,4-Trimethyl-2-pentene	0.001 U	0.001 U	0.00057 J	0.001 U	0.001 U	0.001 UJ	0.001 U	0.001 U		
2-Butanone	0.0029 J	0.01 U	0.01 U	0.01 U	0.0013 J	0.01 U	0.01 U	0.01 U		
Acetone	0.05 U	0.05 UJ	0.05 U	0.05 UJ	0.05 U	0.0039 J	0.05 U	0.05 U		
Chloroethane	0.0026	0.002 U	0.00044 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		
Cis-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.0019	0.0061	0.0031	0.0011	0.001 U		
Methyl Tertbutyl Ether	0.00022 J	0.001 U	0.001 UJ	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 UJ		
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.00026 J	0.001 U	0.001 U	0.001 U		
Toluene	0.001	0.0021	0.001 U	0.00067 J	0.00074 J	0.001 U	0.001 U	0.001 U		
Trichloroethene	0.00048 J	0.001 U	0.001 U	0.0027	0.0034	0.0021 U	0.001 U	0.001 U		
Vinyl chloride	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.00052	0.0005 U	0.0005 U	0.0005 U		
Xylene, o	0.00024 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		
Xylenes (m&p)	0.00052 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		
Semivolatile Organics (mg/L)										
Benzo(ghi)perylene	0.00048 U	0.00015 J	0.0005 U	0.000088 J	0.00053 U	0.00049 U	0.00047 U	0.0005 U		
Benzoic Acid	0.0019 J	R	0.0021 J	R	0.0053 U	R	0.0047 U	0.0021 J		
Bis(2-Ethylhexyl)phthalate	0.0019 U	0.0015 J	0.002 U	0.0012 J	0.0021 U	0.0019 U	0.0019 U	0.002 U		
Caprolactam	0.0048 UJ	R	0.005 UJ	R	0.0053 UJ	0.0049 UJ	0.0047 UJ	0.00073 J		
Dibenz(a,h)anthracene	0.00048 U	0.00013 J	0.0005 U	0.000081 J	0.00053 U	0.00049 U	0.00047 U	0.0005 U		
Indeno(1,2,3-cd)pyrene	0.00048 U	0.00016 J	0.0005 U	0.00009 J	0.00053 U	0.00049 U	0.00047 U	0.0005 U		
N-Nitrosodimethylamine	0.0000019 U	0.0000063	0.000012	0.000002 U	0.00002 U	0.0000019 UJ	0.0000086	0.000002 U		
N-Nitrosodi-n-propylamine	0.0000019 U	0.0000022 U	0.000002 U	0.000002 U	0.00002 U	0.0000019 U	0.000002 U	0.0000033		
Metals, Total (mg/L)										
Aluminum	0.1 U	0.068 J	0.028 J	0.77	0.13	0.2 U	0.12	0.39	0.23	0.18
Arsenic	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0078 J	0.005 J		
Barium	0.057	0.026	0.057	0.013	0.033	0.036	0.04	0.1		
Calcium	45	22	43	11	46	42	38	46		
Chromium	0.005 U	0.005 U	0.005 U	0.065	0.004 J	0.0041 J	0.0087	0.0014 J	0.0013 J	0.005 U
Chromium, Hexavalent		0.001 UJ	0.00056 J	0.00086 J	0.001 UJ					
Cobalt	0.01 U	0.01 U	0.0016 J	0.002 J	0.0024 J	0.0024 J	0.0022 J	0.01 U		
Copper	0.00072	0.0033 NJ	0.0014	0.003 NJ	0.00084	0.0029	0.0019	0.0032		

Table 4.2-4
Summary of Detected Chemicals for Surface Water Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-EDSD/SW1(EDBS5)-XXX EDSD/SW1 (EDBS5) 6/8/2011	OC-SW-EDSD/SW2 (EDBS6)-XXX EDSD/SW2 (EDBS6) 12/13/2010	OC-SW-EDSD/SW2(EDBS6)-XXX EDSD/SW2 (EDBS6) 6/8/2011	OC-SW-EDSD/SW5 (EDBS11)-XXX EDSD/SW5 (EDBS11) 12/13/2010	OC-SW-EDSD/SW5(EDBS11)-XXX EDSD/SW5 (EDBS11) 6/8/2011	OC-SW-EDSD/SW7-XXX EDSD/SW7 11/6/2012	OC-SW-EDSD/SW7-XXX EDSD/SW7 6/18/2012	OC-SW-SD-EDSD/SW0-XXX EDSD/SW0 6/8/2011	OC-SW-ISCO3 ISCO3 3/22/2011	OC-SW-ISCO3 ISCO3 5/16/2011
Iron	0.89	0.73	1	0.7	0.91	0.79	1.7	11		
Lead	0.0001 U	0.00067 J	0.00013 U	0.00086 J	0.0001 U	0.0005 J	0.0015	0.00051 J		
Magnesium	6.6	3	6.5	1.4	6.9	6.5	6.1	5.2		
Manganese	0.27	0.25	0.77	0.22	0.71	0.66	0.91	0.09		
Nickel	0.01 U	0.01 U	0.0017 J	0.0029 J	0.0025 J	0.0039 J	0.0037 J	0.01 U		
Potassium	2.7 J	1.7 J	2.8 J	4 U	3.6 J	6.1	5.4	3.7 J		
Silver	0.0001 U	0.001 U	0.0001 U	0.001 U	0.0001 U	0.001 U	0.00014	0.0001 U		
Sodium	78	46	88	17	81	78	82	190	100 J	87
Thallium	0.0052 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U		
Vanadium	0.01 U	0.01 UJ	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.0025 J		
Zinc	0.05 U	0.016 J	0.0088 J	0.026 J	0.05 U	0.023 J	0.021 J	0.053		
Metals, Filtered (mg/L)										
Aluminum									0.045 J	0.039 J
Chromium									0.005 U	0.005 U
Sodium									120 J	100
Inorganics (mg/L)										
Bromide	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.18 J	0.11	0.1 U		
Chloride	190	93	220	26	180	130	140	360	210	190 J
Hardness	140	68	140	34	140	140	120	140		
Lab Specific Conductance **(mS/cm)**									0.91	0.92
Nitrate as N	0.68	0.73	0.81	0.87	0.93	1.6	1.1	2.6 J	0.93	1.1 J
Nitrogen, as Ammonia	0.1 U	0.26	0.92	2.2	8.7	9	10	0.1 U	5.3	8.2 J
Sulfate	20	15	19	36	69	81	70	19	53	99 J
Total Organic Carbon	2.1	2.6	1.2	5.1	1.5	4.4	4.3	2.3		
Total Suspended Solids	5 U	2	5	5.5	5 U	4 U	12	14		
Specialty Compounds (mg/L)										
Kempore (Azodicarbonamide)	1 U	1 U	4.1 N	1 U	1.2 N	1 UJ	1 U			

Table 4.2-4
Summary of Detected Chemicals for Surface Water Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-ISCO3 ISCO3 8/23/2011	OC-SW-ISCO3 ISCO3 11/8/2011	OC-ISCO3-SW ISCO3 2/23/2012	OC-SW-ISCO3 ISCO3 6/7/2012	OC-SW-ISCO3 ISCO3 8/23/2012	OC-SW-ISCO3 ISCO3 11/16/2012	OC-ISCO3 ISCO3 3/21/2013	OC-ISCO3 ISCO3 5/13/2013	OC-ISCO3 ISCO3 8/22/2013	OC-ISCO3 ISCO3 11/21/2013
Volatile Organics (mg/L)										
1,1,1-Trichloroethane										
1,1,2-Trichloro-1,2,2-Trifluoroethane										
1,1-Dichloroethane										
1,1-Dichloroethene										
2,4,4-Trimethyl-1-pentene										
2,4,4-Trimethyl-2-pentene										
2-Butanone										
Acetone										
Chloroethane										
Cis-1,2-Dichloroethene										
Methyl Tertbutyl Ether										
Tetrachloroethene										
Toluene										
Trichloroethene										
Vinyl chloride										
Xylene, o										
Xylenes (m&p)										
Semivolatile Organics (mg/L)										
Benzo(ghi)perylene										
Benzoic Acid										
Bis(2-Ethylhexyl)phthalate										
Caprolactam										
Dibenz(a,h)anthracene										
Indeno(1,2,3-cd)pyrene										
N-Nitrosodimethylamine										
N-Nitrosodi-n-propylamine										
Metals, Total (mg/L)										
Aluminum	0.053 J	0.2	0.039 J	0.028 J	0.54	0.14 J	0.084 J	0.093 J	0.2 U	0.062 J
Arsenic										
Barium										
Calcium										
Chromium	0.0012 J	0.002 J	0.00068 J	0.005 U	0.0035 J	0.005 U	0.005 U	0.005 U	0.005 U	0.0016 J
Chromium, Hexavalent										
Cobalt										
Copper										

Table 4.2-4
Summary of Detected Chemicals for Surface Water Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-ISCO3 ISCO3 8/23/2011	OC-SW-ISCO3 ISCO3 11/8/2011	OC-ISCO3-SW ISCO3 2/23/2012	OC-SW-ISCO3 ISCO3 6/7/2012	OC-SW-ISCO3 ISCO3 8/23/2012	OC-SW-ISCO3 ISCO3 11/16/2012	OC-ISCO3 ISCO3 3/21/2013	OC-ISCO3 ISCO3 5/13/2013	OC-ISCO3 ISCO3 8/22/2013	OC-ISCO3 ISCO3 11/21/2013
Iron										
Lead										
Magnesium										
Manganese										
Nickel										
Potassium										
Silver										
Sodium	82 J	93	77 J	71 J	74 J	78	85	90	96	86
Thallium										
Vanadium										
Zinc										
Metals, Filtered (mg/L)										
Aluminum	0.1 U	0.028 J	0.036 J	0.025 J	0.023 J	0.2 U	0.074 J	0.2 U	0.2 U	0.062 J
Chromium	0.005 U	0.005 U	0.005 U	0.005 U	0.00068 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sodium	99 J	100	88 J	71	89 J	78	87	88	96	90
Inorganics (mg/L)										
Bromide										
Chloride	200	170	140	160	180	150	170	180	210	190
Hardness										
Lab Specific Conductance **(mS/cm)**	0.8	0.74	0.67	0.68	0.72	0.68	0.7	0.75	0.87	0.77
Nitrate as N	0.7	1	0.94	0.71	0.72	1 J	0.87	0.85	1	0.78
Nitrogen, as Ammonia	1.7	1.7	2.4	1.8	1.7	1.1	1.2	1.4	0.19	0.27
Sulfate	22	33	36	34	26	29	35	29	25	21
Total Organic Carbon										
Total Suspended Solids										
Specialty Compounds (mg/L)										
Kempore (Azodicarbonamide)										

Table 4.2-4
Summary of Detected Chemicals for Surface Water Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	East Ditch Background (mg/L)	AWQC (mg/L)	OC-SW-EDSD/SW0-XXX EDSD/SW0 12/13/2010	OC-SW-EDSD/SW0-XXX EDSD/SW0 6/8/2011	OC-SW-EDSD/SW1 (EDBS5)-XXX EDSD/SW1 (EDBS5) 12/13/2010

Notes:
(1) Background location identified for the East Ditch is located at SDBK-001.
(2) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter
mS/cm = milliSiemen per centimeter

U = not detected, value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

Table 4.2-5
Summary of Detected Chemicals for Surface Water Samples - Landfill Brook
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	AWQC (mg/L)	OC-SW-LB-1-XXX LB-1 12/9/2010	OC-SW-LB-1-XXX LB-1 6/7/2011	OC-SW-LB-2-XXX LB-2 6/7/2011	OC-SW-LB-3-XXX LB-3 12/9/2010	OC-SW-LB-3-XXX LB-3 6/7/2011	OC-SW-LB-S2-XXX LB-2 12/9/2010
Volatile Organics (mg/L)											
1,1-Dichloroethane	1 / 6	0.001 : 0.001	0.00028 - 0.00028	0.00046		0.001 U	0.001 U	0.001 U	0.00028 J	0.001 U	0.001 U
2-Butanone	1 / 6	0.01 : 0.01	0.0014 - 0.0014	0.0044		0.01 U	0.01 U	0.01 U	0.01 U	0.0014 J	0.01 U
4-iso-Propyltoluene	1 / 6	0.001 : 0.001	0.00025 - 0.00025	0.00046		0.001 U	0.001 U	0.001 U	0.001 U	0.00025 J	0.001 U
Carbon disulfide	1 / 6	0.01 : 0.01	0.00043 - 0.00043	0.0042		0.01 U	0.00043 J	0.01 UJ	0.01 U	0.01 UJ	0.01 U
Methyl Tertbutyl Ether	6 / 6		0.0002 - 0.00056	0.00039		0.00056 J	0.0002 J	0.00047 J	0.00028 J	0.00035 J	0.00049 J
Toluene	3 / 6	0.001 : 0.001	0.00036 - 0.0046	0.0012	15	0.001 U	0.00036 J	0.001 U	0.00044 J	0.0046	0.001 U
Semivolatile Organics (mg/L)											
3 & 4 Methylphenol	1 / 6	0.0045 : 0.0045	0.0018 - 0.0018	0.0022		0.0018 J	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.0045 U
Benzo(a)anthracene	1 / 6	0.00027 : 0.00027	0.00052 - 0.00052	0.00020	0.000018	0.00052	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U
Benzo(a)pyrene	2 / 6	0.00018 : 0.00018	0.00017 - 0.001	0.00026	0.000018	0.001	0.00018 U	0.00017 J	0.00018 UJ	0.00018 U	0.00018 U
Benzo(b)fluoranthene	2 / 6	0.00027 : 0.00027	0.00013 - 0.0015	0.00036	0.000018	0.0015	0.00027 UJ	0.00013 J	0.00027 UJ	0.00027 UJ	0.00027 U
Benzo(ghi)perylene	1 / 6	0.00045 : 0.00045	0.0016 - 0.0016	0.00045		0.0016	0.00045 U	0.00045 U	0.00045 UJ	0.00045 U	0.00045 U
Benzo(k)fluoranthene	2 / 6	0.00027 : 0.00027	0.00015 - 0.00061	0.00022	0.000018	0.00061	0.00027 U	0.00015 J	0.00027 UJ	0.00027 U	0.00027 U
Benzoic Acid	4 / 6	0.0045 : 0.0045	0.0019 - 0.0043	0.0024		0.0043 J	0.002 J	0.0019 J	0.0045 UJ	0.0019 J	0.0045 UJ
Benzyl alcohol	1 / 6	0.0091 : 0.0091	0.00076 - 0.00076	0.0039		0.00076 J	0.0091 U	0.0091 U	0.0091 U	0.0091 U	0.0091 U
Bis(2-Ethylhexyl)phthalate	1 / 6	0.0018 : 0.027	0.00074 - 0.00074	0.0033	0.0022	0.027 UJ	0.00074 J	0.0018 U	0.0045 U	0.0018 U	0.0032 U
Chrysene	1 / 6	0.00091 : 0.00091	0.001 - 0.001	0.00055	0.000018	0.001	0.00091 U	0.00091 U	0.00091 U	0.00091 U	0.00091 U
Fluoranthene	1 / 6	0.00091 : 0.00091	0.001 - 0.001	0.00055	0.14	0.001	0.00091 U	0.00091 U	0.00091 U	0.00091 U	0.00091 U
Indeno(1,2,3-cd)pyrene	2 / 6	0.00045 : 0.00045	0.0002 - 0.0012	0.00038	0.000018	0.0012	0.00045 U	0.0002 J	0.00045 UJ	0.00045 U	0.00045 U
Phenanthrene	1 / 6	0.00018 : 0.00018	0.00041 - 0.00041	0.00014		0.00041	0.00018 U	0.00018 U	0.00018 U	0.00018 U	0.00018 U
Pyrene	1 / 6	0.0045 : 0.0045	0.0014 - 0.0014	0.0021	4	0.0014 J	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.0045 U
Metals, Total (mg/L)											
Aluminum	4 / 6	0.1 : 0.1	0.035 - 12	2.4		12	1.2	1	0.1 U	0.035 J	0.1 U
Arsenic	6 / 6		0.0048 - 0.047	0.022	0.00014	0.03	0.011	0.034	0.007 J	0.047	0.0048 J
Barium	6 / 6		0.039 - 0.26	0.091		0.26	0.095	0.053	0.04	0.056	0.039
Cadmium	1 / 6	0.001 : 0.001	0.0028 - 0.0028	0.00088		0.0028	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Calcium	6 / 6		24 - 53	38		53	31	24	49	44	25
Chromium	6 / 6		0.0015 - 0.047	0.013		0.047	0.0054	0.02	0.0017 J	0.0039 J	0.0015 J
Cobalt	3 / 6	0.01 : 0.01	0.0014 - 0.01	0.0048		0.01	0.0026 J	0.0014 J	0.01 U	0.01 U	0.01 U
Copper	6 / 6		0.0036 - 0.051	0.016		0.051 J	0.012	0.0087	0.01 J	0.0087	0.0036 J
Iron	6 / 6		1.6 - 33	13.7		33	15	18	2.6	12	1.6
Lead	5 / 6	0.001 : 0.001	0.00042 - 0.24	0.049		0.24	0.027	0.022	0.001 U	0.00042 J	0.0015
Magnesium	6 / 6		3.3 - 8.1	5.3		8.1	3.3	3.6	6.6	6.1	4
Manganese	6 / 6		0.54 - 2.2	1.2	0.1	1.6	0.54	0.99	1.4	2.2	0.76
Mercury	2 / 6	0.0002 : 0.0002	0.00027 - 0.00055	0.00020		0.00055	0.0002 U	0.0002 U	0.0002 U	0.00027	0.0002 U
Nickel	3 / 6	0.01 : 0.01	0.0023 - 0.019	0.0068	4.6	0.019	0.0046 J	0.0023 J	0.01 U	0.01 U	0.01 U
Potassium	6 / 6		1.4 - 8	5.2		6.9	1.4 J	4.1	8	5.7	4.8
Sodium	6 / 6		81 - 190	119		190	180	83	87	94	81

Table 4.2-5
Summary of Detected Chemicals for Surface Water Samples - Landfill Brook
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	AWQC (mg/L)	OC-SW-LB-1-XXX LB-1 12/9/2010	OC-SW-LB-1-XXX LB-1 6/7/2011	OC-SW-LB-2-XXX LB-2 6/7/2011	OC-SW-LB-3-XXX LB-3 12/9/2010	OC-SW-LB-3-XXX LB-3 6/7/2011	OC-SW-LB-S2-XXX LB-2 12/9/2010
Tin	1 / 6	0.05 : 0.05	0.007 - 0.007	0.022		0.007 J	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Vanadium	3 / 6	0.01 : 0.01	0.0047 - 0.038	0.011		0.038	0.007 J	0.0047 J	0.01 U	0.01 U	0.01 U
Zinc	5 / 6	0.05 : 0.05	0.0073 - 0.5	0.12	26	0.5	0.11	0.038 J	0.0073 J	0.05 U	0.023 J
Inorganics (mg/L)											
Chloride	6 / 6		140 - 410	232		410	360	150	160	140	170
Hardness	6 / 6		74 - 170	117		170	90	74	150	140	79
Nitrate as N	4 / 6	0.05 : 0.05	0.13 - 0.94	0.48		0.05 U	0.05 UJ	0.91	0.87	0.13	0.94
Nitrogen, as Ammonia	6 / 6		0.52 - 8.7	4.3	(*)	1.3	0.52	3.7	6.9	8.7	4.6
Sulfate	6 / 6		4.4 - 88	33		88	4.4	17	39	16	35
Total Organic Carbon	6 / 6		3.4 - 30	10.7		30	13	3.4	7.3	5.8	4.9
Total Suspended Solids	6 / 6		5 - 1100	211		1100	32	94	5	26	7

Notes:
(1) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).
(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

U = not detected, value is the reporting limit
J = value is estimated

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

Table 4.2-6
Summary of Detected Chemicals for Surface Water Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection			Range of Reporting Limits for Non Detects			Range of Detected Concentrations			Average of All Samples	Maple Meadow Brook Wetland Background (1)		AWQC (2) (mg/L)	OC-SW-MMB-SW/SD-10-XXX MMB-SW/SD-10 12/2/2010	OC-SW-MMB-SW/SD-10-XXX MMB-SW/SD-10 6/6/2011
Volatile Organics (mg/L)															
Carbon disulfide	3	/	22	0.01	:	0.01	0.00027	-	0.00029	0.0044				0.01 U	0.01 UJ
Cis-1,2-Dichloroethene	2	/	22	0.001	:	0.001	0.0002	-	0.00062	0.00049				0.001 U	0.001 U
Methyl Tertbutyl Ether	4	/	22	0.001	:	0.001	0.0002	-	0.00033	0.00046				0.001 U	0.001 UJ
Toluene	3	/	22	0.001	:	0.001	0.00034	-	0.00075	0.00050			15	0.001 U	0.001 U
Trichloroethene	1	/	22	0.001	:	0.001	0.0004	-	0.0004	0.00050			0.03	0.001 U	0.001 U
Semivolatile Organics (mg/L)															
3 & 4 Methylphenol	1	/	22	0.0045	:	0.005	0.00074	-	0.00074	0.0022				0.0045 U	0.0045 U
Benzo(a)pyrene	2	/	22	0.00018	:	0.0002	0.000096	-	0.00013	0.000094			0.000018	0.00018 U	0.00018 U
Benzo(b)fluoranthene	1	/	22	0.00027	:	0.0003	0.00013	-	0.00013	0.00014			0.000018	0.00027 U	0.00027 UJ
Benzo(ghi)perylene	1	/	22	0.00045	:	0.0005	0.000089	-	0.000089	0.00022				0.00045 U	0.00045 U
Benzoic Acid	9	/	20	0.0045	:	0.0045	0.0019	-	0.0024	0.0022	0.0021	J		0.0045 UJ	0.0045 U
Caprolactam	2	/	22	0.0045	:	0.005	0.00066	-	0.00066	0.0021	0.00056	J		0.0045 UJ	0.0045 UJ
Di-n-butylphthalate	5	/	22	0.0045	:	0.005	0.00056	-	0.00098	0.0019			4.5	0.0045 U	0.0045 U
N-Nitrosodimethylamine	1	/	22	1.9E-06	:	0.000038	4.7E-07	-	4.7E-07	0.0000041			0.003	0.0000019 U	0.0000019 U
N-Nitrosodi-n-propylamine	3	/	22	1.9E-06	:	0.000038	4.4E-07	-	7.8E-07	0.0000041			0.00051	0.0000019 U	0.0000019 U
Phenol	1	/	22	0.0045	:	0.005	0.00083	-	0.00083	0.0022			1700	0.0045 UJ	0.0045 UJ
Metals, Total (mg/L)															
Aluminum	18	/	22	0.1	:	0.1	0.012	-	1.8	0.17	0.44			0.1 U	0.1 U
Arsenic	2	/	22	0.01	:	0.01	0.0045	-	0.0048	0.0050			0.00014	0.01 U	0.01 U
Barium	22	/	22				0.015	-	0.15	0.037	0.05			0.027	0.034
Cadmium	1	/	22	0.001	:	0.001	0.00025	-	0.00025	0.00049				0.001 U	0.001 U
Calcium	22	/	22				9.7	-	40	22	18			21	30
Chromium	1	/	22	0.005	:	0.005	0.00098	-	0.00098	0.0024	0.00077	J		0.005 U	0.005 U
Cobalt	5	/	22	0.01	:	0.01	0.0016	-	0.0077	0.0046				0.01 U	0.01 U
Copper	18	/	22	0.0005	:	0.01	0.00077	-	0.054	0.0048	0.0039	NJ		0.0038 NJ	0.0005 U
Iron	22	/	22				0.38	-	29	3.4	2			0.43	1.2
Lead	18	/	22	0.0001	:	0.001	0.00016	-	0.11	0.0065	0.0013	J		0.00016 J	0.0001 U
Magnesium	22	/	22				2	-	5.9	3.9	3.4			3.3	4.4
Manganese	22	/	22				0.03	-	9.3	0.91	0.59		0.1	0.16	0.3
Nickel	5	/	22	0.01	:	0.01	0.0012	-	0.0072	0.0046	0.0021	J	4.6	0.01 U	0.01 U
Potassium	22	/	22				1.2	-	3.6	2.4	2.7	J		2.8 J	1.8 J
Sodium	22	/	22				29	-	110	65	65			44	70
Thallium	1	/	22	0.01	:	0.01	0.0066	-	0.0066	0.0051			0.00047	0.01 U	0.01 U
Vanadium	2	/	22	0.01	:	0.01	0.0015	-	0.0037	0.0047818	0.0015	J		0.01 UJ	0.01 U
Zinc	10	/	22	0.05	:	0.05	0.0071	-	0.069	0.022	0.024	J	26	0.05 U	0.05 U

Table 4.2-6
Summary of Detected Chemicals for Surface Water Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Maple Meadow Brook Wetland Background (1)		AWQC (2) (mg/L)	OC-SW-MMB-SW/SD-10-XXX MMB-SW/SD-10 12/2/2010	OC-SW-MMB-SW/SD-10-XXX MMB-SW/SD-10 6/6/2011
Inorganics (mg/L)									
Bromide	2 / 22	0.1 : 0.1	0.1 - 0.12	0.0554545				0.1 U	0.1 U
Chloride	22 / 22		48 - 220	122	140			110	130
Hardness	22 / 22		32 - 120	72	60			66	92
Nitrate as N	15 / 22	0.05 : 0.05	0.097 - 0.6	0.19	0.49	J		0.39	0.05 U
Nitrogen, as Ammonia	14 / 22	0.1 : 0.1	0.1 - 2.5	0.30	0.25		(*)	0.23	0.1 U
Sulfate	22 / 22		3.2 - 39	15.1	26			24	3.2
Total Organic Carbon	22 / 22		1.7 - 7.5	4.4	8.9			5.3	4.5
Total Suspended Solids	11 / 22	2 : 5	2 - 1000	93	2			2 U	5 U
Specialty Compounds (mg/L)									
Hydrazine	1 / 22	0.0001 : 0.0001	0.00006 - 0.00006	0.000050				0.0001 U	0.0001 U
Formaldehyde	10 / 22	0.03 : 0.03	0.005 - 0.01	0.012				0.03 U	0.03 UJ
Kempore (Azodicarbonamide)	1 / 4	1 : 1	0.71 - 0.71	0.55					

Notes:
(1) Background location identified for the Maple Meadow Brook Wetland is located at SDBK-004.
(2) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).

(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

U = not detected, value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.2-6
Summary of Detected Chemicals for Surface Water Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-MMB-SW/SD-11-XXX MMB-SW/SD-11 12/2/2010	OC-SW-MMB-SW/SD-11-XXX MMB-SW/SD-11 6/7/2011	OC-SW-MMB-SW/SD-1-XXX MMB-SW/SD-1 12/1/2010	OC-SW-MMB-SW/SD-1-XXX MMB-SW/SD-1 6/6/2011	OC-SW-MMB-SW/SD-2-XXX MMB-SW/SD-2 12/3/2010	OC-SW-MMB-SW/SD-2-XXX MMB-SW/SD-2 6/8/2011	OC-SW-MMB-SW/SD-3-XXX MMB-SW/SD-3 12/3/2010	OC-SW-MMB-SW/SD-3-XXX MMB-SW/SD-3 6/8/2011
Volatile Organics (mg/L)								
Carbon disulfide	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.00027 J
Cis-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.00062 J	0.0002 J	0.001 U	0.001 U
Methyl Tertbutyl Ether	0.001 U	0.001 UJ	0.001 U	0.001 UJ	0.00033 J	0.0002 J	0.00029 J	0.0002 J
Toluene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00075 J
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.0004 J	0.001 U	0.001 U	0.001 U
Semivolatile Organics (mg/L)								
3 & 4 Methylphenol	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.005 U	0.0045 U	0.005 U
Benzo(a)pyrene	0.00018 UJ	0.00018 U	0.00018 U	0.00018 U	0.00018 U	0.0002 U	0.00018 UJ	0.0002 U
Benzo(b)fluoranthene	0.00027 UJ	0.00027 U	0.00027 U	0.00027 UJ	0.00027 U	0.0003 U	0.00027 UJ	0.0003 U
Benzo(ghi)perylene	0.00045 UJ	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.0005 U	0.00045 UJ	0.0005 U
Benzoic Acid	0.0045 UJ	0.0019 J	R	0.0045 U	0.0045 U	0.0022 J	0.0045 U	0.0021 J
Caprolactam	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.005 UJ	0.0045 UJ	0.00066 J
Di-n-butylphthalate	0.0045 U	0.0045 U	0.00098 J	0.0045 U	0.00059 J	0.005 U	0.00056 J	0.005 U
N-Nitrosodimethylamine	0.0000019 U	0.000019 U	0.0000019 U	0.00000047 J	0.0000023 U	0.00002 U	0.0000019 U	0.000019 U
N-Nitrosodi-n-propylamine	0.00000044 J	0.000019 U	0.00000078 J	0.0000019 U	0.0000019 U	0.00002 U	0.0000019 U	0.000019 U
Phenol	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.005 UJ	0.0045 UJ	0.005 UJ
Metals, Total (mg/L)								
Aluminum	0.081 J	0.036 J	0.092 J	0.063 J	0.093 J	0.026 J	0.22	0.12
Arsenic	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Barium	0.018	0.032	0.026	0.027	0.035	0.049	0.032	0.042
Cadmium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Calcium	12	24	17	22	27	33	24	30
Chromium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Cobalt	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Copper	0.0034 NJ	0.0015	0.0024 NJ	0.0027	0.0029 NJ	0.00077	0.0045 NJ	0.0026
Iron	0.45	1.3	0.53	1.2	1.1	1.6	2.3	2.7
Lead	0.0014	0.00064 J	0.00054 J	0.00023 J	0.0012	0.00044 J	0.0032	0.0016 J
Magnesium	2.3	4.6	3.4	3.9	4.3	5.1	4.1	5
Manganese	0.066	0.2	0.16	0.21	0.95	1.5	0.52	2.1
Nickel	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0012 J	0.0072 J
Potassium	1.4 J	2.8 J	2.9 J	2 J	3.1 J	3.3 J	3.5 J	1.4 J
Sodium	29	110	48	79	58	85	56	65
Thallium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Vanadium	0.01 UJ	0.01 U	0.01 UJ	0.01 U	0.01 UJ	0.01 U	0.01 UJ	0.01 U
Zinc	0.019 J	0.05 U	0.0071 J	0.05 U	0.0085 J	0.05 U	0.012 J	0.021 J

Table 4.2-6
Summary of Detected Chemicals for Surface Water Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-MMB-SW/SD-11-XXX MMB-SW/SD-11 12/2/2010	OC-SW-MMB-SW/SD-11-XXX MMB-SW/SD-11 6/7/2011	OC-SW-MMB-SW/SD-1-XXX MMB-SW/SD-1 12/1/2010	OC-SW-MMB-SW/SD-1-XXX MMB-SW/SD-1 6/6/2011	OC-SW-MMB-SW/SD-2-XXX MMB-SW/SD-2 12/3/2010	OC-SW-MMB-SW/SD-2-XXX MMB-SW/SD-2 6/8/2011	OC-SW-MMB-SW/SD-3-XXX MMB-SW/SD-3 12/3/2010	OC-SW-MMB-SW/SD-3-XXX MMB-SW/SD-3 6/8/2011
Inorganics (mg/L)								
Bromide	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Chloride	48	220	100	140	120	160	120	150
Hardness	38	78	57	70	84	100	76	95
Nitrate as N	0.36	0.31 J	0.12	0.05 U	0.6	0.55 J	0.21	0.05 U
Nitrogen, as Ammonia	0.1 U	0.25	0.18	0.1 U	0.6	0.66	0.22	0.29
Sulfate	15	13	22	5.4	25 J	16	22	8
Total Organic Carbon	4.7	2.3	4.8	4.1	3.8	1.7	6.9	3.4
Total Suspended Solids	2	5 U	4	5 UJ	6.4	5 U	18	5 U
Specialty Compounds (mg/L)								
Hydrazine	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Formaldehyde	0.0088 J	0.03 U	0.0068 J	0.03 UJ	0.005 J	0.03 U	0.0056 J	0.03 U
Kempore (Azodicarbonamide)					1 U	0.71 NJ		

Notes:
(1) Background location identified for the Maple Meadow Brook Wetland is located at SDBK-004.
(2) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).

(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

U = not detected, value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.2-6
Summary of Detected Chemicals for Surface Water Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-MMB-SW/SD-4-XXX MMB-SW/SD-4 12/2/2010	OC-SW-MMB-SW/SD-4-XXX MMB-SW/SD-4 6/6/2011	OC-SW-MMB-SW/SD-5-XXX MMB-SW/SD-5 12/2/2010	OC-SW-MMB-SW/SD-5-XXX MMB-SW/SD-5 6/7/2011	OC-SW-MMB-SW/SD-6-XXX MMB-SW/SD-6 12/3/2010	OC-SW-MMB-SW/SD-6-XXX MMB-SW/SD-6 6/8/2011	OC-SW-MMB-SW/SD-8A-XXX MMB-SW/SD-8A 12/2/2010
Volatile Organics (mg/L)							
Carbon disulfide	0.01 U	0.01 UJ	0.01 U	0.01 UJ	0.01 U	0.00029 J	0.01 U
Cis-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Methyl Tertbutyl Ether	0.001 U	0.001 UJ	0.001 U	0.001 UJ	0.001 U	0.001 UJ	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0004 J	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Semivolatile Organics (mg/L)							
3 & 4 Methylphenol	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.00074 J	0.0045 U
Benzo(a)pyrene	0.00018 U	0.00018 U	0.00018 U	0.00018 U	0.000096 J	0.0002 U	0.00018 U
Benzo(b)fluoranthene	0.00027 U	0.00027 UJ	0.00027 U	0.00027 UJ	0.00013 J	0.0003 U	0.00027 U
Benzo(ghi)perylene	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.000089 J	0.0005 U	0.00045 U
Benzoic Acid	0.0045 UJ	0.0019 J	0.0045 UJ	0.002 J	0.0045 U	0.0024 J	0.0045 UJ
Caprolactam	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.005 UJ	0.0045 UJ
Di-n-butylphthalate	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.00057 J	0.005 U	0.0045 U
N-Nitrosodimethylamine	0.0000019 U	0.0000019 U	0.0000019 U	0.000019 U	0.0000019 U	0.000038 U	0.0000019 U
N-Nitrosodi-n-propylamine	0.0000019 U	0.0000019 U	0.000002 U	0.000019 U	0.0000019 U	0.000038 U	0.00000066 J
Phenol	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.00083 J	0.0045 UJ
Metals, Total (mg/L)							
Aluminum	0.017 J	0.1 U	0.083 J	0.11	1.8	0.48	0.077 J
Arsenic	0.01 U	0.01 U	0.01 U	0.01 U	0.0045 J	0.0048 J	0.01 U
Barium	0.022	0.025	0.018	0.04	0.065	0.15	0.015
Cadmium	0.001 U	0.001 U	0.001 U	0.001 U	0.00025 J	0.001 U	0.001 U
Calcium	18	22	13	22	23	40	9.7
Chromium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.00098 J	0.005 U
Cobalt	0.01 U	0.01 U	0.01 U	0.0022 J	0.0023 J	0.0077 J	0.01 U
Copper	0.0031 NJ	0.0005 U	0.0024 NJ	0.0018	0.0083 NJ	0.054	0.01 U
Iron	0.46	0.88	0.49	1.9	20	29	0.48
Lead	0.00058 J	0.0001 U	0.0014	0.0014 J	0.014	0.11	0.0016
Magnesium	3.5	3.9	2.6	4.2	3.6	5.9	2
Manganese	0.13	0.14	0.034	1.2	1.2	9.3	0.03
Nickel	0.01 U	0.01 U	0.01 U	0.0013 J	0.0032 J	0.0043 J	0.01 U
Potassium	2.6 J	2.3 J	2.2 J	2.1 J	2 J	3.6 J	1.2 J
Sodium	53	80	44	93	37	45	30
Thallium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0066 J	0.01 U
Vanadium	0.01 UJ	0.01 U	0.01 UJ	0.01 U	0.0037 J	0.0015 J	0.01 UJ
Zinc	0.05 U	0.05 U	0.011 J	0.05 U	0.069	0.027 J	0.0093 J

Table 4.2-6
Summary of Detected Chemicals for Surface Water Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-MMB-SW/SD-4-XXX MMB-SW/SD-4 12/2/2010	OC-SW-MMB-SW/SD-4-XXX MMB-SW/SD-4 6/6/2011	OC-SW-MMB-SW/SD-5-XXX MMB-SW/SD-5 12/2/2010	OC-SW-MMB-SW/SD-5-XXX MMB-SW/SD-5 6/7/2011	OC-SW-MMB-SW/SD-6-XXX MMB-SW/SD-6 12/3/2010	OC-SW-MMB-SW/SD-6-XXX MMB-SW/SD-6 6/8/2011	OC-SW-MMB-SW/SD-8A-XXX MMB-SW/SD-8A 12/2/2010
Inorganics (mg/L)							
Bromide	0.1 U	0.1 U	0.1 U	0.1	0.1 U	0.1 U	0.1 U
Chloride	100	130	79	160	76	76	49
Hardness	59	70	43	72	73	120	32
Nitrate as N	0.11	0.05 U	0.24	0.05 U	0.24	0.05 UJ	0.31
Nitrogen, as Ammonia	0.16	0.1 U	0.1 U	0.1	0.48	2.5	0.1 U
Sulfate	19	7.1	15	5.7	20	39	12
Total Organic Carbon	4.5	4.8	3.6	3.7	6.7	7.5	4.9
Total Suspended Solids	2 U	6	4	10	930	1000	2 U
Specialty Compounds (mg/L)							
Hydrazine	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Formaldehyde	0.01 J	0.03 U	0.0084 J	0.03 U	0.0051 J	0.03 U	0.0071 J
Kempore (Azodicarbonamide)			1 U	1 U			

Notes:
(1) Background location identified for the Maple Meadow Brook Wetland is located at SDBK-004.
(2) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).

(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Table 4.2-6
Summary of Detected Chemicals for Surface Water Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-MMB-SW/SD-8A-XXX MMB-SW/SD-8A 6/7/2011	OC-SW-MMB-SW/SD-8A-XXX MMB-SW/SD-8A 6/8/2011	OC-SW-MMB-SW/SD-8-XXX MMB-SW/SD-8 12/2/2010	OC-SW-MMB-SW/SD-8-XXX MMB-SW/SD-8 6/7/2011	OC-SW-MMB-SW/SD-9-XXX MMB-SW/SD-9 12/1/2010	OC-SW-MMB-SW/SD-9-XXX MMB-SW/SD-9 6/6/2011
Volatile Organics (mg/L)						
Carbon disulfide		0.00028 J	0.01 U	0.01 UJ	0.01 U	0.01 U
Cis-1,2-Dichloroethene		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Methyl Tertbutyl Ether		0.001 UJ	0.001 U	0.001 UJ	0.001 U	0.001 UJ
Toluene		0.00034 J	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Semivolatile Organics (mg/L)						
3 & 4 Methylphenol		0.005 U	0.0045 U	0.0045 U	0.0045 U	0.0045 U
Benzo(a)pyrene		0.0002 U	0.00018 U	0.00018 U	0.00018 U	0.00013 J
Benzo(b)fluoranthene		0.0003 U	0.00027 U	0.00027 U	0.00027 U	0.00027 UJ
Benzo(ghi)perylene		0.0005 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U
Benzoic Acid		0.0021 J	0.0045 UJ	0.0019 J	R	0.0019 J
Caprolactam		0.00066 J	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ
Di-n-butylphthalate		0.005 U	0.0045 U	0.0045 U	0.00078 J	0.0045 U
N-Nitrosodimethylamine		0.000019 U	0.0000019 U	0.000019 U	0.0000019 U	0.0000019 U
N-Nitrosodi-n-propylamine		0.000019 U	0.0000019 U	0.000019 U	0.0000019 U	0.0000019 UJ
Phenol		0.005 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ	0.0045 UJ
Metals, Total (mg/L)						
Aluminum		0.14	0.04 J	0.035 J	0.012 J	0.1 U
Arsenic		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Barium		0.042	0.02	0.044	0.025	0.022
Cadmium		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Calcium		24	12	25	21	24
Chromium		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Cobalt		0.0016 J	0.01 U	0.0021 J	0.01 U	0.01 U
Copper	0.0012		0.0025 NJ	0.00083	0.0016 NJ	0.0005 U
Iron		3.3	0.38	2.8	0.45	2.2
Lead	0.0015 J		0.0017	0.00042 J	0.001 U	0.0001 U
Magnesium		4.7	2.5	4.8	3.7	4.1
Manganese		0.57	0.046	0.83	0.16	0.17
Nickel		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Potassium		2.5 J	1.8 J	2.6 J	3.1 J	1.9 J
Sodium		110	44	110	54	76
Thallium		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Vanadium		0.01 U	0.01 UJ	0.01 U	0.01 UJ	0.01 U
Zinc		0.05 U	0.011 J	0.05 U	0.05 U	0.05 U

Table 4.2-6
Summary of Detected Chemicals for Surface Water Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SW-MMB-SW/SD-8A-XXX MMB-SW/SD-8A 6/7/2011	OC-SW-MMB-SW/SD-8A-XXX MMB-SW/SD-8A 6/8/2011	OC-SW-MMB-SW/SD-8-XXX MMB-SW/SD-8 12/2/2010	OC-SW-MMB-SW/SD-8-XXX MMB-SW/SD-8 6/7/2011	OC-SW-MMB-SW/SD-9-XXX MMB-SW/SD-9 12/1/2010	OC-SW-MMB-SW/SD-9-XXX MMB-SW/SD-9 6/6/2011
Inorganics (mg/L)						
Bromide		0.1 U	0.1 U	0.12	0.1 U	0.1 U
Chloride		210	90	180	100	130
Hardness		80	41	83	67	77
Nitrate as N		0.15 J	0.22	0.097	0.12	0.05 U
Nitrogen, as Ammonia		0.15	0.1 U	0.16	0.23	0.1 U
Sulfate		11	16	8.7	21	3.9
Total Organic Carbon		2.9	4.3	2.7	4.5	5.1
Total Suspended Solids		40	2.5 U	6	2 U	5 UJ
Specialty Compounds (mg/L)						
Hydrazine	0.0001 U		0.0001 U	0.00006 J	0.0001 U	0.0001 U
Formaldehyde		0.03 U	0.0091 J	0.03 U	0.0093 J	0.03 U
Kempore (Azodicarbonamide)						

Notes:
(1) Background location identified for the Maple Meadow Brook Wetland is located at SDBK-004.
(2) USEPA, Freshwater Ambient Water Quality Criteria (AWQC) (USEPA, 2013).

(*) - Freshwater criteria are pH, temperature, and life-stage dependent.
mg/L = milligram per liter

U = not detected, value is the reporting limit
J = value is estimated
R = value is rejected
N = presumptively present

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

Table 4.2-7
Summary of Detected Chemicals for Sediment Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-OPWD-1-XXX OPWD-1 12/10/2010 0-0.5 ft	OC-SD-OPWD-2-XXX OPWD-2 12/10/2010 0-0.5 ft	OC-SD-OPWD-SD/SO/SW-S-XXX OPWD-SD-S 12/10/2010 0-0.5 ft
Volatile Organics (mg/Kg)							
1,2,4-Trichlorobenzene	1 / 3	0.0035 : 0.0067	0.0038 - 0.0038	0.0030	0.0035 U	0.0067 U	0.0038 J
2,4,4-Trimethyl-1-pentene	1 / 3	0.007 : 0.013	0.06 - 0.06	0.023	0.007 U	0.013 U	0.06 J
2,4,4-Trimethyl-2-pentene	1 / 3	0.007 : 0.013	0.008 - 0.008	0.0060	0.007 U	0.013 U	0.008 J
2-Butanone	1 / 3	0.035 : 0.067	0.043 - 0.043	0.031	0.035 U	0.067 U	0.043 J
Semivolatile Organics (mg/Kg)							
1,2,4-Trichlorobenzene	2 / 3	0.056 : 0.056	0.027 - 0.066	0.040	0.056 U	0.027 J	0.066 J
4-Chlorophenyl phenyl ether	1 / 3	0.056 : 0.087	0.061 - 0.061	0.044	0.056 U	0.087 U	0.061 J
Benzo(a)anthracene	3 / 3		0.098 - 0.17	0.14	0.17	0.14	0.098 J
Benzo(a)pyrene	3 / 3		0.14 - 0.2	0.17	0.2	0.18	0.14 J
Benzo(b)fluoranthene	2 / 2		0.3 - 0.31	0.31	0.3	0.31	R
Benzo(ghi)perylene	3 / 3		0.12 - 0.15	0.14	0.12	0.15	0.14 J
Benzo(k)fluoranthene	2 / 2		0.16 - 0.18	0.17	0.18	0.16	R
Benzoic Acid	3 / 3		0.054 - 0.42	0.24	0.054 J	0.26 J	0.42 J
Bis(2-Ethylhexyl)phthalate	3 / 3		0.047 - 0.12	0.092	0.11	0.047 J	0.12 J
Carbazole	3 / 3		0.039 - 0.051	0.045	0.039 J	0.051 J	0.044 J
Chrysene	3 / 3		0.21 - 0.28	0.25	0.25	0.28	0.21 J
Dibenz(a,h)anthracene	2 / 2		0.035 - 0.061	0.048	0.035 J	0.061 J	R
Diphenyl ether	2 / 3	0.087 : 0.087	0.094 - 0.86	0.33	0.094	0.087 U	0.86 J
Diphenylmethanone	2 / 3	0.087 : 0.087	0.028 - 0.2	0.091	0.028 J	0.087 U	0.2 J
Fluoranthene	3 / 3		0.34 - 0.59	0.46	0.44	0.59	0.34 J
Indeno(1,2,3-cd)pyrene	3 / 3		0.12 - 0.14	0.13	0.12	0.14	0.14 J
N-Nitrosodiphenylamine	2 / 3	0.087 : 0.087	0.098 - 0.8	0.31	0.098	0.087 U	0.8 J
Phenanthrene	3 / 3		0.1 - 0.18	0.13	0.12	0.18	0.1 J
Pyrene	3 / 3		0.35 - 0.44	0.40	0.42	0.44	0.35 J
Inorganics (mg/Kg)							
Aluminum	3 / 3		13000 - 24000	17000	13000	24000	14000 J
Arsenic	3 / 3		6.7 - 14	10.0	14	9.3	6.7 J
Barium	3 / 3		9.1 - 16	11.7	9.1 J	16 J	10 J
Beryllium	3 / 3		1.1 - 1.4	1.2	1.1	1.4	1.1 J
Cadmium	3 / 3		0.099 - 0.62	0.35	0.33 J	0.099 J	0.62 J
Calcium	3 / 3		480 - 2000	1110	480 J	850	2000 J
Chromium	3 / 3		250 - 2400	1350	1400	250	2400 J
Cobalt	3 / 3		3.2 - 15	7.5	4.4	3.2	15 J
Copper	3 / 3		16 - 39	25	16	19	39 J
Iron	3 / 3		6300 - 13000	9233	8400	6300	13000 J
Lead	3 / 3		8 - 14	12.0	8	14	14 J
Magnesium	3 / 3		830 - 1100	977	830 J	1100 J	1000 J

Table 4.2-7
Summary of Detected Chemicals for Sediment Samples - Off-Property West Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-OPWD-1-XXX OPWD-1 12/10/2010 0-0.5 ft	OC-SD-OPWD-2-XXX OPWD-2 12/10/2010 0-0.5 ft	OC-SD-OPWD-SD/SO/SW-S-XXX OPWD-SD-S 12/10/2010 0-0.5 ft
Manganese	3 / 3		40 - 160	85	40 J	55 J	160 J
Nickel	3 / 3		10 - 15	12.3	12	10	15 J
Potassium	3 / 3		1200 - 1900	1500	1900	1200	1400 J
Silver	3 / 3		3.7 - 41	24	26	3.7	41 J
Sodium	3 / 3		74 - 360	174	74 J	88 J	360 J
Vanadium	3 / 3		9.2 - 15	11.7	9.2	15	11 J
Zinc	3 / 3		23 - 100	49	23 J	24 J	100 J
Chloride	3 / 3		91 - 240	147	110	91	240
Nitrogen, as Ammonia	3 / 3		93 - 540	254	93 J	130 J	540 J
Oxidation Reduction Potential **(mV)**	1 / 1		150 - 150	150			150
pH **(pH units)**	1 / 1		7.19 - 7.19	7.2			7.19 HF
Sulfate	3 / 3		280 - 1500	697	310	280	1500
Total Organic Carbon	3 / 3		13000 - 34000	25000	13000	28000	34000
Specialty Compounds (mg/Kg)							
Hydrazine	1 / 2	0.0041 : 0.0041	0.0013 - 0.0013	0.0017	0.0013 J	0.0041 U	
Formaldehyde	2 / 2		0.4 - 0.61	0.51	0.4	0.61	

mg/Kg = milligram per kilogram
mV = millivolts

U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
HF = holding time exceeded

Prepared by / Date: KJC 03/28/13
Checked by / Date: CTM 03/28/13

Table 4.2-8
Summary of Detected Chemicals for Sediment Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	East Ditch Background (1) (mg/Kg)	OC-SD-EDSD/SW2 (EDBS6)-XXX EDSD/SW2 (EDBS6) 12/13/2010 0-0.33 ft	OC-SD-EDSD/SW7-XXX EDSD/SW7 11/6/2012 0-0.5 ft	OC-SD-EDSD/SW7-XXX EDSD/SW7 6/18/2012 0-0.5 ft
Volatile Organics (mg/Kg)								
1,1,2-Trichloro-1,2,2-Trifluoroethane	1 / 3	0.013 : 0.05	0.0041 - 0.0041	0.012		0.05 UJ	0.0041	0.013 U
2,4,4-Trimethyl-2-pentene	1 / 3	0.005 : 0.02	0.0016 - 0.0016	0.0047		0.02 UJ	0.0016 J	0.005 U
2-Butanone	1 / 3	0.025 : 0.029	0.097 - 0.097	0.041		0.097 J	0.029 U	0.025 U
Acetone	1 / 3	0.25 : 0.29	0.43 - 0.43	0.23		0.43 J	0.29 U	0.25 UJ
Trichloroethene	1 / 3	0.0025 : 0.0099	0.0017 - 0.0017	0.0026		0.0099 UJ	0.0017 J	0.0025 U
Semivolatile Organics (mg/Kg)								
2-Methylnaphthalene	1 / 3	0.042 : 0.6	0.078 - 0.078	0.13		0.078 J	0.042 U	0.6 U
Acenaphthene	2 / 3	0.6 : 0.6	0.019 - 0.14	0.15	0.00011 J	0.14 J	0.019 J	0.6 U
Anthracene	2 / 3	0.6 : 0.6	0.04 - 0.27	0.20		0.27 J	0.04 J	0.6 U
Benzo(a)anthracene	3 / 3		0.25 - 0.77	0.55		0.77 J	0.25	0.63 J
Benzo(a)pyrene	3 / 3		0.24 - 0.94	0.62	0.000094 J	0.94 J	0.24	0.67
Benzo(b)fluoranthene	3 / 3		0.43 - 1.6	1.0		1.6 J	0.43	1 J
Benzo(ghi)perylene	3 / 3		0.11 - 0.56	0.40	0.00014 J	0.56 J	0.11	0.54 J
Benzo(k)fluoranthene	3 / 3		0.17 - 0.53	0.38		0.53 J	0.17	0.45 J
Benzoic Acid	2 / 3	3 : 3	0.16 - 0.49	0.72	0.0021 J	0.49 J	0.16 J	3 U
Bis(2-Ethylhexyl)phthalate	3 / 3		0.96 - 10	4.2	0.00046 J	10 J	0.96 J	1.5
Carbazole	2 / 3	0.6 : 0.6	0.063 - 0.24	0.20		0.24 J	0.063	0.6 U
Chrysene	3 / 3		0.38 - 1.3	0.89		1.3 J	0.38	1
Dibenz(a,h)anthracene	1 / 3	0.2 : 0.6	0.037 - 0.037	0.15	0.00014 J	0.2 UJ	0.037 J	0.6 U
Dibenzofuran	1 / 3	0.042 : 0.6	0.15 - 0.15	0.16		0.15 J	0.042 U	0.6 U
Diphenyl ether	1 / 3	0.042 : 0.6	0.28 - 0.28	0.20		0.28 J	0.042 U	0.6 U
Fluoranthene	3 / 3		0.64 - 2.7	1.7		2.7 J	0.64	1.8 J
Fluorene	2 / 3	0.6 : 0.6	0.02 - 0.23	0.18		0.23 J	0.02 J	0.6 U
Indeno(1,2,3-cd)pyrene	3 / 3		0.11 - 0.53	0.37	0.00016 J	0.53 J	0.11	0.48 J
Naphthalene	1 / 2	0.6 : 0.6	0.11 - 0.11	0.21		0.11 J		0.6 U
N-Nitrosodiphenylamine	1 / 3	0.042 : 0.6	0.21 - 0.21	0.18		0.21 J	0.042 UJ	0.6 U
Phenanthrene	3 / 3		0.31 - 1.3	0.75		1.3 J	0.31	0.64
Phenol	1 / 3	0.2 : 0.6	0.026 - 0.026	0.14		0.2 UJ	0.026 J	0.6 U
Pyrene	3 / 3		0.43 - 2.3	1.3		2.3 J	0.43	1.1
Inorganics (mg/Kg)								
Aluminum	3 / 3		3800 - 6400	5367	1.1	6400 J	3800 J	5900
Antimony	2 / 3	3.4 : 3.4	0.89 - 4	2.2		3.4 UJ	0.89	4
Arsenic	3 / 3		26 - 450	178	0.0036 J	450 J	26	57
Barium	3 / 3		42 - 150	111	0.2	150 J	42 J	140
Beryllium	2 / 3	1.4 : 1.4	0.2 - 1.6	0.83		1.4 UJ	1.6	0.2 J

Table 4.2-8
Summary of Detected Chemicals for Sediment Samples - East Ditch
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	East Ditch Background (1) (mg/Kg)	OC-SD-EDSD/SW2 (EDBS6)-XXX EDSD/SW2 (EDBS6) 12/13/2010 0-0.33 ft	OC-SD-EDSD/SW7-XXX EDSD/SW7 11/6/2012 0-0.5 ft	OC-SD-EDSD/SW7-XXX EDSD/SW7 6/18/2012 0-0.5 ft
Cadmium	3 / 3		0.84 - 3.7	2.2	0.0011 J	2.2 J	3.7	0.84
Calcium	3 / 3		1500 - 7900	3767	79	7900 J	1900	1500
Chromium	3 / 3		31 - 78	49	0.0022 J	31 J	78 J	39
Cobalt	3 / 3		7.2 - 30	16.7	0.003 J	30 J	13	7.2
Copper	3 / 3		110 - 270	170	0.027	110 J	130 J	270
Iron	3 / 3		21000 - 210000	90667	6.7	210000 J	21000	41000
Lead	3 / 3		25 - 340	168	0.014	25 J	140 J	340
Magnesium	3 / 3		1400 - 3300	2233	7.7	1400 J	2000 J	3300
Manganese	3 / 3		230 - 3200	1343	3.4	3200 J	600	230
Mercury	2 / 3	0.33 : 0.33	0.026 - 0.04	0.077		0.33 UJ	0.026 J	0.04 J
Nickel	3 / 3		19 - 29	23	0.0037 J	21 J	29 J	19
Potassium	2 / 3	1400 : 1400	290 - 620	537	9.6	1400 UJ	620 J	290 J
Silver	2 / 3	3.4 : 3.4	0.27 - 2.6	1.5		3.4 UJ	0.27 J	2.6
Sodium	3 / 3		160 - 340	227	450	340 J	160	180 J
Tin	1 / 2	12 : 12	8.6 - 8.6	7.3		8.6 J		12 U
Vanadium	3 / 3		15 - 120	50	0.0022 J	120 J	15	16
Zinc	3 / 3		450 - 1900	967	0.023 J	550 J	1900	450
Chloride	3 / 3		26 - 690	257	930	690	26	55
Nitrogen, as Ammonia	3 / 3		8.5 - 130	50	0.4	130	8.5	10
Sulfate	1 / 3	48 : 160	71 - 71	58	16	160 U	71	48 U
Total Organic Carbon	3 / 3		28 - 86000	31609	12	86000	28	8800
Specialty Compounds (mg/Kg)								
Hydrazine	1 / 2	0.0026 : 0.0026	0.0014 - 0.0014	0.0014			0.0026 U	0.0014 J
Acetaldehyde	1 / 2	0.24 : 0.24	0.055 - 0.055	0.088			0.055 J	0.24 UJ
Formaldehyde	2 / 2		0.72 - 1.1	0.91			1.1 J	0.72

Notes:
(1) Background location identified for the East Ditch is located at SDBK-001.

mg/Kg = milligram per kilogram

U = not detected,
value is the reporting limit
J = value is estimated

Prepared by / Date: KJC 03/04/14
Checked by / Date: CTM 03/10/14

Table 4.2-9
Summary of Detected Chemicals for Sediment Samples - Landfill Brook
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-LB-1-XXX LB-1 12/9/2010 0-0.5 ft	OC-SD-LB-2-XXX LB-2 12/9/2010 0-0.5 ft	OC-SD-LB-3-XXX LB-3 12/9/2010 0-0.5 ft
Volatile Organics (mg/Kg)							
1,2-Dichlorobenzene	1 / 3	0.0044 : 0.005	0.031 - 0.031	0.012	0.0044 U	0.005 U	0.031
2-Butanone	1 / 3	0.044 : 0.05	0.069 - 0.069	0.039	0.044 U	0.05 U	0.069
Chlorobenzene	1 / 3	0.0044 : 0.005	0.059 - 0.059	0.021	0.0044 U	0.005 U	0.059
sec-Butylbenzene	1 / 3	0.0044 : 0.005	0.0046 - 0.0046	0.0031	0.0044 U	0.005 U	0.0046 J
Semivolatile Organics (mg/Kg)							
Benzo(a)anthracene	1 / 3	0.29 : 0.32	1.4 - 1.4	0.57	0.29 U	0.32 U	1.4 J
Benzo(a)pyrene	1 / 3	0.29 : 0.32	1.5 - 1.5	0.60	0.29 U	0.32 U	1.5 J
Benzo(b)fluoranthene	2 / 3	0.32 : 0.32	0.11 - 2	0.76	0.11 J	0.32 U	2 J
Benzo(ghi)perylene	2 / 3	0.32 : 0.32	0.096 - 1.6	0.62	0.096 J	0.32 U	1.6 J
Bis(2-Ethylhexyl)phthalate	3 / 3		0.16 - 4.7	1.8	0.39	0.16 J	4.7
Chrysene	1 / 3	0.29 : 0.32	1.8 - 1.8	0.70	0.29 U	0.32 U	1.8 J
Fluoranthene	3 / 3		0.095 - 3.5	1.2	0.095 J	0.11 J	3.5 J
Indeno(1,2,3-cd)pyrene	1 / 3	0.29 : 0.32	1.4 - 1.4	0.57	0.29 U	0.32 U	1.4 J
N-Nitrosodiphenylamine	1 / 3	0.29 : 0.32	2 - 2	0.77	0.29 U	0.32 U	2 J
Phenanthrene	1 / 3	0.35 : 0.39	1.1 - 1.1	0.49	0.35 U	0.39 U	1.1 J
Pyrene	2 / 3	0.32 : 0.32	0.12 - 2.9	1.1	0.12 J	0.32 U	2.9 J
Inorganics (mg/Kg)							
Aluminum	3 / 3		3800 - 12000	8200	8800	3800	12000
Arsenic	3 / 3		5.5 - 35	15.5	5.9	5.5	35
Barium	3 / 3		9.4 - 94	46	35 J	9.4 J	94 J
Beryllium	3 / 3		0.11 - 0.3	0.22	0.25 J	0.11 J	0.3 J
Cadmium	3 / 3		0.15 - 1	0.64	0.76	0.15 J	1
Calcium	3 / 3		1000 - 4700	2433	1600 J	1000 J	4700 J
Chromium	3 / 3		20 - 130	58	24	20	130
Cobalt	3 / 3		0.65 - 7.2	3.3	2.1	0.65 J	7.2
Copper	3 / 3		4.9 - 61	30	24	4.9	61
Iron	3 / 3		3100 - 25000	12167	8400	3100	25000
Lead	3 / 3		19 - 260	133	260	19	120
Magnesium	3 / 3		330 - 3700	1943	1800 J	330 J	3700 J
Manganese	3 / 3		75 - 380	184	75 J	96 J	380 J
Mercury	2 / 3	0.12 : 0.12	0.14 - 1.2	0.47	0.14	0.12 U	1.2
Nickel	3 / 3		1.8 - 19	10.0	9.3	1.8 J	19
Potassium	3 / 3		240 - 1900	943	690	240 J	1900
Silver	3 / 3		0.2 - 1.6	0.68	0.2 J	0.23 J	1.6
Sodium	3 / 3		45 - 220	132	220	45 J	130 J
Tin	1 / 3	10 : 11	6.8 - 6.8	5.8	11 U	10 U	6.8 J
Vanadium	3 / 3		5.5 - 29	18.8	22	5.5	29
Zinc	3 / 3		22 - 190	107	110 J	22 J	190 J

Table 4.2-9
Summary of Detected Chemicals for Sediment Samples - Landfill Brook
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	OC-SD-LB-1-XXX LB-1 12/9/2010 0-0.5 ft	OC-SD-LB-2-XXX LB-2 12/9/2010 0-0.5 ft	OC-SD-LB-3-XXX LB-3 12/9/2010 0-0.5 ft
Chloride	3 / 3		61 - 150	107	110	61	150
Nitrogen, as Ammonia	3 / 3		120 - 580	280	140 J	120 J	580 J
Sulfate	3 / 3		78 - 310	166	78	110	310
Total Organic Carbon	3 / 3		33000 - 51000	41667	33000	41000	51000

mg/Kg = milligram per kilogram
U = not detected,
value is the reporting limit
J = value is estimated

Prepared by / Date: KJC 03/28/13
Checked by / Date: CTM 03/28/13

Table 4.2-10
Summary of Detected Chemicals for Sediment Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Maple Meadow Brook Wetland Background (1) (mg/Kg)	OC-SD-MMB-SW/SD-10-XXX MMB-SW/SD-10 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-11-XXX MMB-SW/SD-11 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-1-XXX MMB-SW/SD-1 12/1/2010 0-0.5 ft
Volatile Organics (mg/Kg)								
2-Butanone	12 / 13	0.028 : 0.028	0.021 - 0.5	0.22	0.61 J	0.29 J	0.44 J	0.021 J
Acetone	13 / 13		0.035 - 1.7	0.73	2 J	0.92 J	1.3 J	0.075 J
Semivolatile Organics (mg/Kg)								
3 & 4 Methylphenol	2 / 13	0.045 : 0.31	0.2 - 0.32	0.12		0.24 UJ	0.23 UJ	0.32
4-Nitrophenol	1 / 13	0.22 : 1.6	0.091 - 0.091	0.43		1.2 UJ	1.2 UJ	0.26 U
Anthracene	1 / 13	0.045 : 0.31	0.082 - 0.082	0.093		0.24 UJ	0.23 UJ	0.053 U
Benzaldehyde	4 / 13	0.045 : 0.31	0.056 - 0.3	0.11	0.33 J	0.3 J	0.23 UJ	0.053 U
Benzo(a)anthracene	3 / 13	0.045 : 0.31	0.082 - 0.4	0.13	0.081 J	0.24 UJ	0.23 UJ	0.053 U
Benzo(a)pyrene	6 / 13	0.045 : 0.31	0.052 - 0.4	0.12	0.096 J	0.24 UJ	0.23 UJ	0.053 U
Benzo(b)fluoranthene	6 / 13	0.045 : 0.31	0.067 - 0.56	0.16		0.24 UJ	0.23 UJ	0.053 U
Benzo(ghi)perylene	6 / 13	0.045 : 0.27	0.081 - 0.32	0.11	0.087 J	0.24 UJ	0.23 UJ	0.053 U
Benzo(k)fluoranthene	4 / 13	0.045 : 0.31	0.071 - 0.21	0.11		0.24 UJ	0.23 UJ	0.053 U
Benzoic Acid	13 / 13		0.21 - 1.4	0.58	0.54 J	0.52 J	0.83 J	0.3
Benzyl alcohol	1 / 13	0.089 : 0.62	0.35 - 0.35	0.20		0.48 UJ	0.47 UJ	0.11 U
Bis(2-Ethylhexyl)phthalate	10 / 13	0.2 : 0.31	0.05 - 0.35	0.15	0.26 J	0.25 J	0.096 J	0.05 J
Caprolactam	1 / 9	0.045 : 0.31	0.088 - 0.088	0.078		R	0.23 UJ	0.053 U
Carbazole	2 / 13	0.045 : 0.31	0.025 - 0.097	0.093		0.24 UJ	0.23 UJ	0.053 U
Chrysene	7 / 13	0.045 : 0.31	0.073 - 0.48	0.13	0.14 J	0.24 UJ	0.086 J	0.053 U
Dibenz(a,h)anthracene	4 / 13	0.045 : 0.31	0.041 - 0.15	0.094		0.24 UJ	0.23 UJ	0.053 U
Fluoranthene	9 / 13	0.045 : 0.31	0.079 - 0.88	0.20	0.22 J	0.1 J	0.13 J	0.053 U
Indeno(1,2,3-cd)pyrene	6 / 13	0.045 : 0.27	0.095 - 0.34	0.12	0.085 J	0.24 UJ	0.23 UJ	0.053 U
Naphthalene	1 / 13	0.11 : 0.75	0.12 - 0.12	0.22		0.57 UJ	0.56 UJ	0.13 U
Phenanthrene	6 / 13	0.054 : 0.37	0.069 - 0.45	0.14	0.14 J	0.29 UJ	0.28 UJ	0.063 U
Pyrene	9 / 13	0.045 : 0.31	0.071 - 0.85	0.21	0.28 J	0.11 J	0.13 J	0.053 U
Inorganics (mg/Kg)								
Aluminum	13 / 13		5400 - 28000	13162	5500 J	6700 J	14000 J	8200
Arsenic	13 / 13		3.5 - 52	17.3	6.6 J	15 J	22 J	4.5
Barium	13 / 13		22 - 190	103	84 J	140 J	120 J	33
Beryllium	13 / 13		0.17 - 2.7	0.99	0.7 J	0.34 J	1.5 J	0.17 J
Cadmium	13 / 13		0.082 - 4.9	2.1	0.9 J	1.9 J	4.6 J	0.11 J
Calcium	13 / 13		930 - 10000	6187	9400 J	8800 J	10000 J	1200
Chromium	13 / 13		7.5 - 42	22	7.3 J	16 J	27 J	29 J
Cobalt	13 / 13		2.3 - 35	12.8	4.2 J	10 J	19 J	2.8
Copper	13 / 13		7.4 - 90	39	15 J	45 J	53 J	7.8
Iron	13 / 13		6400 - 95000	25662	7500 J	20000 J	36000 J	12000
Lead	13 / 13		7.2 - 470	142	46 J	150 J	160 J	7.2
Magnesium	13 / 13		940 - 4500	2126	930 J	940 J	2400 J	4500

Table 4.2-10
Summary of Detected Chemicals for Sediment Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	Frequency of Detection	Range of Reporting Limits for Non Detects	Range of Detected Concentrations	Average of All Samples	Maple Meadow Brook Wetland Background (1) (mg/Kg)		OC-SD-MMB-SW/SD-10-XXX MMB-SW/SD-10 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-11-XXX MMB-SW/SD-11 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-1-XXX MMB-SW/SD-1 12/1/2010 0-0.5 ft
Manganese	13 / 13		110 - 2100	790	500	J	890 J	1400 J	130
Mercury	8 / 13	0.095 : 0.47	0.027 - 0.51	0.26			0.45 J	0.44 UJ	0.095 U
Nickel	13 / 13		5.4 - 45	18.8	6.1	J	15 J	24 J	16 J
Potassium	13 / 13		410 - 2900	1108	640	J	410 J	1100 J	1900
Selenium	1 / 13	0.75 : 4.3	1.2 - 1.2	1.4			4 UJ	4.1 UJ	0.94 U
Silver	1 / 13	0.75 : 4.3	0.74 - 0.74	1.4			4 UJ	4.1 UJ	0.94 U
Sodium	13 / 13		51 - 940	509	430	J	800 J	840 J	69 J
Thallium	1 / 13	1.5 : 8.6	1.4 - 1.4	2.6			8 UJ	8.2 UJ	1.9 U
Tin	9 / 13	7.5 : 34	0.85 - 16	8.2	7.3	J	10 J	7.4 J	9.4 U
Vanadium	13 / 13		8.9 - 61	32	11	J	44 J	44 J	17
Zinc	13 / 13		22 - 500	211	73	J	190 J	320 J	34
Chloride	13 / 13		34 - 1000	486	420		930	760	48
Nitrogen, as Ammonia	13 / 13		62 - 1500	576	830	J	1500 J	490 J	96 J
Sulfate	11 / 13	63 : 75	120 - 1400	600	420	J	1400 J	980 J	63 UJ
Total Organic Carbon	13 / 13		10000 - 310000	174308	370000	J	270000 J	270000 J	10000 J
Specialty Compounds (mg/Kg)									
Acetaldehyde	6 / 11	0.27 : 1.5	0.22 - 0.42	0.36			0.22 J	1.5 U	0.32 UJ
Formaldehyde	11 / 11		0.31 - 4	2.2			2.6	2.4 J	0.34 J

Notes:
(1) Background location identified for the Maple Meadow Brook Wetland is located at SDBK-004.

mg/Kg = milligram per kilogram

U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
B = compound was found in the blank and sample
* = LCS or LCSD exceeds the control limits

Table 4.2-10
Summary of Detected Chemicals for Sediment Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SD-MMB-SW/SD-1-XXX MMB-SW/SD-1 2/17/2011 0-0.5 ft	OC-SD-MMB-SW/SD-2-XXX MMB-SW/SD-2 12/3/2010 0-0.5 ft	OC-SD-MMB-SW/SD-3-XXX MMB-SW/SD-3 12/3/2010 0-0.5 ft	OC-SD-MMB-SW/SD-4-XXX MMB-SW/SD-4 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-5-XXX MMB-SW/SD-5 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-6-XXX MMB-SW/SD-6 12/3/2010 0-0.5 ft	OC-SD-MMB-SW/SD-8A-XXX MMB-SW/SD-8A 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-8-XXX MMB-SW/SD-8 12/2/2010 0-0.5 ft
Volatile Organics (mg/Kg)								
2-Butanone	0.086	0.34 J	0.2 J	0.5 J	0.25 J	0.14 J	0.2 J	0.29 J
Acetone	0.24 J*	1.1 J	0.73 J	1.7 J	0.83 J	0.49 J	0.66 J	1 J
Semivolatile Organics (mg/Kg)								
3 & 4 Methylphenol	0.31 U	0.23 UJ	0.27 UJ	0.2 J	0.23 UJ	0.16 UJ	0.21 UJ	0.16 UJ
4-Nitrophenol	1.6 U	1.2 UJ	1.3 UJ	1 UJ	0.091 J	0.78 UJ	1.1 UJ	0.82 UJ
Anthracene	0.31 U	0.23 UJ	0.27 UJ	0.2 UJ	0.23 UJ	0.082 J	0.21 UJ	0.16 UJ
Benzaldehyde	0.31 U	0.23 UJ	0.27 UJ	0.2 UJ	0.13 J	0.16 UJ	0.21 UJ	0.14 J
Benzo(a)anthracene	0.31 U	0.23 UJ	0.27 UJ	0.2 UJ	0.23 UJ	0.4 J	0.17 J	0.16 UJ
Benzo(a)pyrene	0.31 U	0.23 UJ	0.084 J	0.2 UJ	0.08 J	0.4 J	0.22 J	0.052 J
Benzo(b)fluoranthene	0.31 U	0.23 UJ	0.11 J	0.2 UJ	0.14 J	0.56 J	0.37 J	0.067 J
Benzo(ghi)perylene	0.1 JB	0.23 UJ	0.27 UJ	0.2 UJ	0.093 J	0.32 J	0.16 J	0.081 J
Benzo(k)fluoranthene	0.31 U	0.23 UJ	0.27 UJ	0.2 UJ	0.15 J	0.21 J	0.15 J	0.16 UJ
Benzoic Acid	1.4 J	0.27 J	0.34 J	0.97 J	0.74 J	0.6 J	0.28 J	0.76 J
Benzyl alcohol	0.62 U	0.46 UJ	0.53 UJ	0.4 UJ	0.47 UJ	0.35 J	0.42 UJ	0.33 UJ
Bis(2-Ethylhexyl)phthalate	0.31 U	0.21 J	0.27 UJ	0.2 UJ	0.089 J	0.35 J	0.2 J	0.056 J
Caprolactam	0.31 U	R	R	0.2 UJ	0.088 J	0.16 UJ	R	0.16 UJ
Carbazole	0.31 U	0.23 UJ	0.27 UJ	0.2 UJ	0.23 UJ	0.097 J	0.21 UJ	0.16 UJ
Chrysene	0.31 U	0.23 UJ	0.094 J	0.2 UJ	0.085 J	0.48 J	0.26 J	0.073 J
Dibenz(a,h)anthracene	0.31 U	0.23 UJ	0.27 UJ	0.2 UJ	0.083 J	0.15 J	0.21 UJ	0.059 J
Fluoranthene	0.31 U	0.079 J	0.19 J	0.2 UJ	0.13 J	0.88 J	0.42 J	0.11 J
Indeno(1,2,3-cd)pyrene	0.095 JB	0.23 UJ	0.27 UJ	0.2 UJ	0.13 J	0.34 J	0.16 J	0.095 J
Naphthalene	0.75 U	0.55 UJ	0.64 UJ	0.48 UJ	0.56 UJ	0.12 J	0.5 UJ	0.39 UJ
Phenanthrene	0.37 U	0.28 UJ	0.11 J	0.24 UJ	0.079 J	0.45 J	0.17 J	0.069 J
Pyrene	0.31 U	0.071 J	0.2 J	0.2 UJ	0.15 J	0.85 J	0.49 J	0.15 J
Inorganics (mg/Kg)								
Aluminum	6000	14000 J	8300 J	8500 J	17000 J	28000 J	20000 J	28000 J
Arsenic	3.5	20 J	14 J	8.2 J	20 J	52 J	30 J	25 J
Barium	26	130 J	96 J	68 J	150 J	190 J	150 J	170 J
Beryllium	0.23 J	0.72 J	0.6 J	1 J	2.1 J	0.72 J	2.4 J	2.7 J
Cadmium	0.31 J	1.5 J	2.4 J	0.87 J	2.8 J	2.3 J	4.6 J	4.9 J
Calcium	1500 B	8700 J	9700 J	9800 J	8100 J	8200 J	5300 J	6100 J
Chromium	11	20 J	16 J	8.5 J	24 J	40 J	38 J	42 J
Cobalt	2.3	9.2 J	4.3 J	8.1 J	17 J	19 J	34 J	35 J
Copper	8.1	27 J	34 J	13 J	50 J	84 J	90 J	74 J
Iron	7200 B	39000 J	10000 J	15000 J	18000 J	95000 J	35000 J	24000 J
Lead	28	64 J	120 J	31 J	280 J	170 J	330 J	470 J
Magnesium	1700 B	1200 J	1100 J	1000 J	2200 J	3300 J	3000 J	4000 J

Table 4.2-10
Summary of Detected Chemicals for Sediment Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SD-MMB-SW/SD-1-XXX MMB-SW/SD-1 2/17/2011 0-0.5 ft	OC-SD-MMB-SW/SD-2-XXX MMB-SW/SD-2 12/3/2010 0-0.5 ft	OC-SD-MMB-SW/SD-3-XXX MMB-SW/SD-3 12/3/2010 0-0.5 ft	OC-SD-MMB-SW/SD-4-XXX MMB-SW/SD-4 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-5-XXX MMB-SW/SD-5 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-6-XXX MMB-SW/SD-6 12/3/2010 0-0.5 ft	OC-SD-MMB-SW/SD-8A-XXX MMB-SW/SD-8A 12/2/2010 0-0.5 ft	OC-SD-MMB-SW/SD-8-XXX MMB-SW/SD-8 12/2/2010 0-0.5 ft
Manganese	110 B	2100 J	520 J	650 J	610 J	1900 J	690 J	600 J
Mercury	0.027 JB	0.22 J	0.38 J	0.47 UJ	0.26 J	0.51 J	0.45 J	0.43 J
Nickel	8.5	11 J	12 J	6.4 J	22 J	28 J	44 J	45 J
Potassium	730	470 J	770 J	470 J	1400 J	1500 J	1700 J	2900 J
Selenium	1.1 U	3.6 UJ	4.2 UJ	3.4 UJ	4.3 UJ	2.4 UJ	3.4 UJ	1.2 J
Silver	1.1 U	3.6 UJ	4.2 UJ	3.4 UJ	4.3 UJ	0.74 J	3.4 UJ	2.9 UJ
Sodium	180 J	580 J	720 J	570 J	940 J	280 J	800 J	720 J
Thallium	2.2 U	1.4 J	8.3 UJ	6.7 UJ	8.6 UJ	4.7 UJ	6.8 UJ	5.7 UJ
Tin	0.85 JB	7.6 J	16 J	34 UJ	7.1 J	11 J	7.7 J	7.9 J
Vanadium	12	21 J	29 J	18 J	48 J	50 J	54 J	61 J
Zinc	36	160 J	190 J	59 J	240 J	500 J	430 J	460 J
Chloride	210	630	1000	480	860	150	690	420
Nitrogen, as Ammonia	130	580 J	960 J	790 J	880 J	530 J	620 J	730 J
Sulfate	75 U	1200 J	940 J	350 J	360 J	690 J	940 J	550 J
Total Organic Carbon	65000	260000 J	290000 J	310000 J	220000 J	140000 J	180000 J	150000 J
Specialty Compounds (mg/Kg)								
Acetaldehyde		0.4 J	0.27 J	1.2 U	0.22 J	0.42 J	0.23 J	1 UJ
Formaldehyde		4	2.3	1.7	2.2	3.2	2.9	2 J

Notes:
(1) Background location identified for the Maple Meadow Brook Wetland is located at SDBK-004.

mg/Kg = milligram per kilogram

U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
B = compound was found in the blank and sample
* = LCS or LCSD exceeds the control limits

Table 4.2-10
Summary of Detected Chemicals for Sediment Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SD-MMB-SW/SD-9-XXX MMB-SW/SD-9 12/1/2010 0-0.5 ft	OC-SD-SDREF-012-XXX SDREF-012 12/3/2010 0-0.5 ft
Volatile Organics (mg/Kg)		
2-Butanone	0.028 U	0.12
Acetone	0.035 J	0.41 J
Semivolatile Organics (mg/Kg)		
3 & 4 Methylphenol	0.045 U	0.067 U
4-Nitrophenol	0.22 U	0.33 U
Anthracene	0.045 U	0.067 U
Benzaldehyde	0.045 U	0.056 J
Benzo(a)anthracene	0.045 U	0.082
Benzo(a)pyrene	0.045 U	0.1
Benzo(b)fluoranthene	0.045 U	0.15
Benzo(ghi)perylene	0.045 U	0.092
Benzo(k)fluoranthene	0.045 U	0.071
Benzoic Acid	0.21 J	0.29 J
Benzyl alcohol	0.089 U	0.13 U
Bis(2-Ethylhexyl)phthalate	0.23	0.083
Caprolactam	0.045 U	0.067 U
Carbazole	0.045 U	0.025 J
Chrysene	0.045 U	0.13
Dibenz(a,h)anthracene	0.045 U	0.041 J
Fluoranthene	0.045 U	0.24
Indeno(1,2,3-cd)pyrene	0.045 U	0.1
Naphthalene	0.11 U	0.16 U
Phenanthrene	0.054 U	0.13
Pyrene	0.045 U	0.21
Inorganics (mg/Kg)		
Aluminum	5400	7000
Arsenic	3.9	7.2
Barium	22	43
Beryllium	0.18 J	0.25 J
Cadmium	0.082 J	0.45 J
Calcium	930	2100
Chromium	7.5 J	11 J
Cobalt	2.5	3.8
Copper	7.4	18
Iron	6400	16000
Lead	7.2	35
Magnesium	1100	1200

Table 4.2-10
Summary of Detected Chemicals for Sediment Samples - Maple Meadow Brook Wetland
Remedial Investigation Report - OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter	OC-SD-MMB-SW/SD-9-XXX MMB-SW/SD-9 12/1/2010 0-0.5 ft	OC-SD-SDREF-012-XXX SDREF-012 12/3/2010 0-0.5 ft
Manganese	110	560
Mercury	0.11 U	0.13 U
Nickel	5.4 J	7.2 J
Potassium	540	520
Selenium	0.75 U	1.2 U
Silver	0.75 U	1.2 U
Sodium	51 J	69 J
Thallium	1.5 U	2.3 U
Tin	7.5 U	12 U
Vanadium	8.9	13
Zinc	22	96
Chloride	34	110
Nitrogen, as Ammonia	62 J	120 J
Sulfate	120 J	200 J
Total Organic Carbon	13000 J	88000 J
Specialty Compounds (mg/Kg)		
Acetaldehyde	0.27 UJ	
Formaldehyde	0.31 J	

Notes:
(1) Background location identified for the Maple Meadow Brook Wetland is located at SDBK-004.

mg/Kg = milligram per kilogram

U = not detected,
value is the reporting limit
J = value is estimated
R = value is rejected
B = compound was found in the blank and sample
* = LCS or LCSD exceeds the control limits

Prepared by / Date: KJC 03/28/13
Checked by / Date: CTM 03/28/13

Table 5.0-1
Chemicals Associated With Former Facility Operations Without Approved Analytical Methods
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Product	Chemical Name	Analytical Method?	Comments
Hydrazine	Hydrazine and semicarbazide solution	No	Analysis for Components - Hydrazine
Wytox ADP	dioctyldiphenylamine	No	
Wytox 345/355/436 (polymeric phosphite)	polymeric phosphite		
OBSC/OBSH or Nitropore OT	4,4' oxybisbenzenesulfonylchloride(intermediate) or 4,4' oxybisbenzenesulfonylhydrazide	No	
Wytox 312	trisnonylphenyl phosphite	No	Analysis for Components - Nonylphenol
Wytox Pap	alkylated phenol	No	Analysis for specific alylated phenols (i.e methylphenols, nonylphenols, propyl phenols)
Actafoam R-3	Unknown (liquid azodicarbonamide activator)	No	Unknown substance
Nitropore 5PT	5-phenyltetrazole	No	
Phenolic and Urea Formaldehyde Resins	Phenolic and Urea Formaldehyde Resins	No	Analysis for Components - Phenol and Formaldehyde
	2-ethylhexanol	No	
	2-ethylhexoic acid	No	
	Additive W (from Plant B)	No	Unknown substance
	Aluminum chloride	No	Analysis for Components - Aluminum and Chloride
	Aluminum hydroxide	No	Analysis for Components - Aluminum
	Ammonium chloride	No	Analysis for Components - Ammonia and Chloride
	Ammonium hydroxide	No	Analysis for Components - Ammonia
	Ammonium sulfate	No	Analysis for Components - Ammonia and Sulfate
	Benzonitrile	No	
	Butyl alcohol	No	
	Chlorine	No	Analysis for Components - Chloride
	Chlorosulfonic acid	No	Analysis for Components - Chloride
	Chrome oxide (1956 - 1967)	No	Analysis for Components - Chromium
	HCl recovered by scrubber (Hydrochloric acid)	No	Analysis for Components - Chloride
	Hexamethylenetetramine	No	
	Hydrochloric acid	No	Analysis for Components - Chloride
	Oxalic Acid	No	
	Paraformaldehyde	No	Analysis for Components - Formaldehyde
	Phosphorous trichloride	No	Analysis for Components - Phosphorus and Chloride
	Sodium azide	No	Analysis for Components - Sodium
	Sodium bromide	No	Analysis for Components - Sodium
	Sodium chlorate	No	Analysis for Components - Sodium and Chloride
	Sodium chloride	No	Analysis for Components - Sodium and Chloride
	Sodium chlorosufonate	No	Analysis for Components - Sodium, Chloride, and Sulfate
	Sodium dichromate (1956 - 1967)	No	Analysis for Components -Sodiuem, Chromium and Hexavalent Chromium
	Sodium hydroxide	No	Analysis for Components - Sodium
	Sodium nitrate	No	Analysis for Components - Sodium and Nitrate
	Sodium nitrite	No	Analysis for Components - Sodium and Sitrite
	Sodium sulfate	No	Analysis for Components - Sodium and Sulfate
	Sulfuric acid	No	Analysis for Components - Sulfate
	Urea	No	
	Zinc oxide	No	Analysis for Components - Zinc

Prepared by: LCG 12/5/2014
Checked by: MJM 12/5/2014

Table 6.1-1
Selection of Exposure Pathways - OU1
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	**Soil**	**Surface Soil**	EA1	Indoor Worker	Adult	None	None	No current indoor workers.
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	None	None	No current construction activities.
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA2	Indoor Worker	Adult	None	None	No current indoor workers.
				Outdoor Worker	Adult	Dermal/Ingestion	Quantitative	
				Construction Worker	Adult	None	None	No current construction activities.
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA3	Indoor Worker	Adult	None	None	No current indoor workers
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	None	None	No current construction activities.
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA4	Indoor Worker	Adult	None	None	No workers present in conservation area.
				Outdoor Worker	Adult	None	None	No workers present in conservation area.
				Construction Worker	Adult	None	None	No workers present in conservation area.
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA6	Indoor Worker	Adult	None	None	No current indoor workers.
				Outdoor Worker	Adult	Dermal/Ingestion	Quantitative	
				Construction Worker	Adult	None	None	No current construction activities.
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA7	Indoor Worker	Adult	None	None	No current indoor workers.
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	None	None	No current construction activities.
				Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			Containment Area	None	None	None	None	No current exposure to soil because area is capped.

Table 6.1-1
Selection of Exposure Pathways - OU1
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
		Subsurface Soil	EA1	None	None	None	None	No current exposure to subsurface soil.
			EA2	None	None	None	None	No current exposure to subsurface soil.
			EA3	None	None	None	None	No current exposure to subsurface soil.
			EA4	None	None	None	None	No current exposure to subsurface soil.
			EA6	None	None	None	None	No current exposure to subsurface soil.
			EA7	None	None	None	None	No current exposure to subsurface soil.
			Containment Area	None	None	None	None	No current exposure to soil because area is capped.
	Water	**Surface Water**	EA1	None	None	None	None	No surface water present.
			EA2	None	None	None	None	No surface water present.
			EA3	None	None	None	None	No surface water present.
			EA3	None	None	None	None	No surface water present.
			EA4	None	None	None	None	No surface water present.
			EA6	Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA7	None	None	None	None	No surface water present.
Current cont.	**Sediment**	**Sediment**	EA1	None	None	None	None	No sediment present.
			EA2	Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA3	None	None	None	None	No sediment present.
			EA3	None	None	None	None	No sediment present.
			EA4	None	None	None	None	No sediment present.
			EA6	Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA7	None	None	None	None	No sediment present.
Future	**Soil**	**Surface Soil**	EA1	Indoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Qualitative	
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	

Table 6.1-1
Selection of Exposure Pathways - OU1
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	**Soil (cont.)**	**Surface Soil**	EA2	Indoor Worker	Adult	None	None	No VOCs in soil therefore no vapor intrusion.
				Outdoor Worker	Adult	Dermal/Ingestion	Quantitative	
				Construction Worker	Adult	Dermal/Ingestion	Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA3	Indoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Qualitative	
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA4	Indoor Worker	Adult	None	None	Conservation restriction prohibits any developmen
				Outdoor Worker	Adult	None	None	Conservation restriction prohibits any developmen
				Construction Worker	Adult	None	None	Conservation restriction prohibits any developmen
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA6	Indoor Worker	Adult	None	None	No VOCs in soil therefore no vapor intrusion.
				Outdoor Worker	Adult	Dermal/Ingestion	Quantitative	
				Construction Worker	Adult	Dermal/Ingestion	Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA7	Indoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Qualitative	
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			Containment Area	Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
				Outdoor Worker		Dermal/Ingestion Inhalation	Quantitative Quantitative	

Table 6.1-1
Selection of Exposure Pathways - OU1
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future cont.	**Soil cont.**	**Subsurface Soil**	EA1	Indoor Worker	Adult	None	None	No VOCs in soil therefore no vapor intrusion.
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA2	None	None	None	None	Redevelopment of EA2 will require filing of wetlands therefore no exposure to subsurface soil.
			EA3	Indoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			EA4	None	None	None	None	Conservation restriction prohibits any development.
			EA6	None	None	None	None	Redevelopment of EA6 will require filing of wetlands therefore no exposure to subsurface soil.
			EA7	Indoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Outdoor Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Construction Worker	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative Quantitative	
					Adolescent	Inhalation Dermal/Ingestion	Quantitative Quantitative	
	Water	**Surface Water**	EA1	None	None	None	None	No surface water present.
			EA2	None	None	None	None	No surface water present.
			EA3	None	None	None	None	No surface water present.
			EA3	None	None	None	None	No surface water present.
			EA4	None	None	None	None	No surface water present.
			EA6	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			EA7	None	None	None	None	No surface water present.

Table 6.1-1
Selection of Exposure Pathways - OU1
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Sediment	**Sediment**	EA1	None	None	None	None	No sediment present.
			EA2	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			EA3	None	None	None	None	No sediment present.
			EA3	None	None	None	None	No sediment present.
			EA4	None	None	None	None	No sediment present.
			EA6	Trespasser	Adult	Dermal/Ingestion	Quantitative	
						Inhalation	None	
					Adolescent	Inhalation	None	
						Dermal/Ingestion	Quantitative	
			EA7	None	None	None	None	No sediment present.

Prepared/Date: LCG 3/4/2014
Checked/Date: BJR 3/4/2014

Table 6.1-2
Selection of Exposure Pathways - OU2
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	**Soil**	**Surface Soil**	EA5	Indoor Worker	Adult	None	None	No current workers.
				Outdoor Worker	Adult	None	None	No current workers.
				Construction Worker	Adult	None	None	No current workers.
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Dermal/Ingestion Inhalation	Quantitative None	
		Subsurface Soil	EA5	None	None	None	None	
	Water	**Surface Water**	EA5	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			Off-Property West Ditch	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Older Child	Dermal/Ingestion	Quantitative	
			East Ditch	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			Mapple Meadow Brook Wetland	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			North Pond	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
	Sediment	**Sediment**	EA5	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			Off-Property West Ditch	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			East Ditch	Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
			Mapple Meadow Brook Wetland	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			North Pond	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
Future	**Soil**	**Surface Soil**	EA5	Indoor Worker	Adult	None	None	No VOCs in soil therefore no vapor intrusion.
				Outdoor Worker	Adult	Dermal/Ingestion	Quantitative	
				Construction Worker	Adult	Dermal/Ingestion	Quantitative	
				Trespasser	Adult	Dermal/Ingestion Inhalation	Quantitative None	
					Adolescent	Inhalation Dermal/Ingestion	None Quantitative	
		Subsurface Soil	EA5	None	None	None	None	Redevelopment of EA5 will require filing of wetlands therefore no exposure to subsurface soil.
	Water	**Surface Water**	EA5	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			Off-Property West Ditch	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			East Ditch	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			Mapple Meadow Brook Wetland	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			North Pond	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	

Table 6.1-2
Selection of Exposure Pathways - OU2
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (cont)	**Sediment**	**Sediment**	EA5	Trespasser	Adult	Dermal/Ingestion	Quantitative	
						Inhalation	None	
					Adolescent	Inhalation	None	
						Dermal/Ingestion	Quantitative	
			Off-Property West Ditch	Trespasser	Adult	Dermal/Ingestion	Quantitative	
						Inhalation	None	
					Adolescent	Inhalation	None	
						Dermal/Ingestion	Quantitative	
			East Ditch	Trespasser	Adult	Dermal/Ingestion	Quantitative	
						Inhalation	None	
					Adolescent	Inhalation	None	
						Dermal/Ingestion	Quantitative	
			Mapple Meadow Brook Wetland	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	
			North Pond	Trespasser	Adult	Dermal/Ingestion	Quantitative	
					Adolescent	Dermal/Ingestion	Quantitative	

Prepared/Date: LCG 3/4/2014
Checked/Date: BJR 3/4/2014

Table 6.2-1
Summary of Chemicals of Potential Concern by Media
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameters	Surface Soil	Subsurface Soil	Surface Water	Surface Water - Landfill Brook	Sediment	Sediment - Landfill Brook
Volatile Organics						
1,3- Dichlorobenzene			X			
2,4,4-Trimethyl-1-pentene		X				
2,4,4-Trimethyl-2-Pentene		X				
4-iso-Propyltoluene		X		X	X	
Bromodichloromethane			X			
Chlorodibromomethane			X			
Chloroform			X			
Cis-1,2-Dichloroethene			X			
Dibromomethane			X			
Trichloroethene			X			
Vinyl chloride			X			
Semivolatile Organics						
2-Nitrophenol			X			
3 & 4 Methylphenol			X			
4-Chlorophenyl phenyl ether		X			X	
4-Nitrophenol			X		X	
Azobenzene			X			
Benzo(a)anthracene	X	X	X	X	X	
Benzo(a)pyrene	X	X	X	X	X	X
Benzo(b)fluoranthene	X	X	X	X	X	
Benzo(k)fluoranthene		X	X	X		
Bis(2-Ethylhexyl)phthalate	X	X	X		X	
Carbazole	X	X			X	
Chrysene			X			
Dibenz(a,h)anthracene	X		X		X	
Dimethylphthalate	X					
Diphenyl ether	X	X	X		X	
Diphenylmethanone			X		X	
Indeno(1,2,3-cd)pyrene	X	X	X	X		
N-Nitrosodimethylamine			X			
N-Nitrosodiphenylamine		X				
N-Nitrosodi-n-propylamine	X		X			
Phenanthrene						
Pyrene			X			
Pesticides						
Aroclor-1260	X	X				
Delta-BHC	X					
Inorganics						
Aluminum			X	X		
Antimony	X	X	X			
Arsenic	X	X	X	X	X	X
Cadmium				X		
Chromium			X			
Chromium, Hexavalent	X	X	X		X	
Cobalt	X		X	X	X	
Lead			X	X		
Manganese			X	X	X	
Mercury			X	X		
Nickel			X			
Silver	X					
Thallium	X		X		X	
Vanadium			X	X		
Zinc				X		
Bromide			X			
Chloride	X	X	X	X	X	X
Nitrate as N			X			
Nitrogen, as Ammonia	X	X	X	X	X	X
Sulfate	X	X	X	X	X	X
Urea		X				

Table 6.2-1
Summary of Chemicals of Potential Concern by Media
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameters	Surface Soil	Subsurface Soil	Surface Water	Surface Water - Landfill Brook	Sediment	Sediment - Landfill Brook
Metals, Filtered						
Aluminum			X			
Chromium			X			
EPH						
C11-C22 Aromatics	X	X			X	
C19-C36 Aliphatics					X	
Specialty Compounds						
4-Nonylphenol			X			
Hydrazine		X	X			
Kempore (Azodicarbonamide)			X			

X = indicates the chemical was selected as a chemical of potential concern for the associated media

Prepared by/ Date: LCG 2/24/14
Checked by/ Date: BJR 2/25/14

Table 6.5-1
Risk Summary Table - Current Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Exposure Area 1 (EA1)				
Surface Soil	Outdoor Worker	Incidental Ingestion	1.E-05	0.2
		Dermal Contact	1.E-05	0.09
		Dust Inhalation	1.E-08	0.0002
		Total Receptor Surface Soil Risk:	**2.E-05**	**0.3**
Surface Soil	Adult Trespasser	Incidental Ingestion	3.E-06	0.06
		Dermal Contact	1.E-06	0.02
	Adolescent Trespasser	Incidental Ingestion	7.E-06	0.10
		Dermal Contact	6.E-06	0.05
		Total Receptor Surface Soil Risk:	**2.E-05**	**0.1**
		Cumulative Receptor Risk:	**2.E-05**	**0.1**
Exposure Area 2 (EA2)				
Surface Soil	Outdoor Worker	Incidental Ingestion	4.E-06	0.03
		Dermal Contact	2.E-06	0.008
		Total Receptor Surface Soil Risk:	**6.E-06**	**0.04**
Surface Soil	Adult Trespasser	Incidental Ingestion	7.E-07	0.01
		Dermal Contact	2.E-07	0.001
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.02
		Dermal Contact	8.E-07	0.004
		Total Receptor Surface Soil Risk:	**3.E-06**	**0.02**
		Cumulative Receptor Risk:	**3.E-06**	**0.02**
Exposure Area 3 (EA3)				
Surface Soil	Outdoor Worker	Incidental Ingestion	3.E-06	0.04
		Dermal Contact	1.E-06	0.01
		Dust Inhalation	6.E-09	0.0002
		Total Receptor Surface Soil Risk:	**4.E-06**	**0.05**
Surface Soil	Adult Trespasser	Incidental Ingestion	6.E-07	0.01
		Dermal Contact	2.E-07	0.002
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.02
		Dermal Contact	6.E-07	0.006
		Total Receptor Surface Soil Risk:	**2.E-06**	**0.03**
		Cumulative Receptor Risk:	**2.E-06**	**0.03**

Table 6.5-1
Risk Summary Table - Current Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Exposure Area 4 (EA4)				
Surface Soil	Adult Trespasser	Incidental Ingestion	1.E-06	0.1
		Dermal Contact	3.E-07	0.002
	Adolescent Trespasser	Incidental Ingestion	2.E-06	0.2
		Dermal Contact	1.E-06	0.005
		Total Receptor Surface Soil Risk:	**4.E-06**	**0.2**
		Cumulative Receptor Risk:	**4.E-06**	**0.2**
Exposure Area 5 (EA5)				
Surface Soil	Adult Trespasser	Incidental Ingestion	2.E-06	0.4
		Dermal Contact	6.E-07	0.03
	Adolescent Trespasser	Incidental Ingestion	4.E-06	0.7
		Dermal Contact	3.E-06	0.08
		Total Receptor Surface Soil Risk:	**1.E-05**	**0.7**
		Cumulative Receptor Risk:	**1.E-05**	**0.7**
Exposure Area 6 (EA6)				
Surface Soil	Outdoor Worker	Incidental Ingestion	4.E-06	0.1
		Dermal Contact	2.E-06	0.007
		Total Receptor Surface Soil Risk:	**5.E-06**	**0.1**
Surface Soil	Adult Trespasser	Incidental Ingestion	7.E-07	0.04
		Dermal Contact	2.E-07	0.001
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.06
		Dermal Contact	8.E-07	0.004
		Total Receptor Surface Soil Risk:	**3.E-06**	**0.06**
		Cumulative Receptor Risk:	**3.E-06**	**0.06**
Exposure Area 7 (EA7)				
Surface Soil	Outdoor Worker	Incidental Ingestion	4.E-06	0.05
		Dermal Contact	1.E-06	0.01
		Dust Inhalation	6.E-09	0.0003
		Total Receptor Surface Soil Risk:	**6.E-06**	**0.06**
Surface Soil	Adult Trespasser	Incidental Ingestion	8.E-07	0.02
		Dermal Contact	2.E-07	0.002
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.03
		Dermal Contact	4.E-07	0.006
		Total Receptor Surface Soil Risk:	**2.E-06**	**0.03**
		Cumulative Receptor Risk:	**2.E-06**	**0.03**

Table 6.5-1
Risk Summary Table - Current Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Central Pond				
Sediment	Adult Trespasser	Incidental Ingestion	2.E-07	0.007
		Dermal Contact	3.E-08	0.0003
	Adolescent Trespasser	Incidental Ingestion	3.E-07	0.01
		Dermal Contact	9.E-08	0.001
		Total Receptor Sediment Soil Risk:	**7.E-07**	**0.01**
Surface water	Adult Trespasser	Incidental Ingestion	--	0.004
		Dermal Contact	--	0.008
	Adolescent Trespasser	Incidental Ingestion	--	0.006
		Dermal Contact	--	0.008
		Total Receptor Surface water Risk:	**0.E+00**	**0.01**
		Cumulative Receptor Risk:	**7.E-07**	**0.03**
Detention Basin				
Sediment	Adult Trespasser	Incidental Ingestion	4.E-07	0.008
		Dermal Contact	5.E-08	0.0005
	Adolescent Trespasser	Incidental Ingestion	5.E-07	0.01
		Dermal Contact	3.E-07	0.002
		Total Receptor Sediment Soil Risk:	**1.E-06**	**0.01**
Surface water	Adult Trespasser	Incidental Ingestion	4.E-09	0.004
		Dermal Contact	5.E-10	0.02
	Adolescent Trespasser	Incidental Ingestion	1.E-08	0.006
		Dermal Contact	5.E-10	0.02
		Total Receptor Surface water Risk:	**2.E-08**	**0.02**
		Cumulative Receptor Risk:	**1.E-06**	**0.04**
East Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	1.E-05	0.2
		Dermal Contact	2.E-06	0.02
	Adolescent Trespasser	Incidental Ingestion	2.E-05	0.3
		Dermal Contact	5.E-06	0.07
		Total Receptor Sediment Soil Risk:	**4.E-05**	**0.4**
Surface water	Adult Trespasser	Incidental Ingestion	3.E-07	0.06
		Dermal Contact	1.E-05	0.03
	Adolescent Trespasser	Incidental Ingestion	4.E-07	0.1
		Dermal Contact	2.E-05	0.03
		Total Receptor Surface water Risk:	**3.E-05**	**0.1**
		Cumulative Receptor Risk:	**7.E-05**	**0.5**

Table 6.5-1
Risk Summary Table - Current Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Maple Meadow Brook				
Sediment	Adult Trespasser	Incidental Ingestion	8.E-07	0.03
		Dermal Contact	1.E-07	0.001
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.05
		Dermal Contact	4.E-07	0.004
		Total Receptor Sediment Soil Risk:	**2.E-06**	**0.06**
Surface water	Adult Trespasser	Incidental Ingestion	2.E-07	0.09
		Dermal Contact	6.E-06	0.06
	Adolescent Trespasser	Incidental Ingestion	3.E-07	0.1
		Dermal Contact	1.E-05	0.06
		Total Receptor Surface water Risk:	**2.E-05**	**0.2**
		Cumulative Receptor Risk:	**2.E-05**	**0.3**
North Pond				
Sediment	Adult Trespasser	Incidental Ingestion	5.E-07	0.02
		Dermal Contact	1.E-07	0.0006
	Adolescent Trespasser	Incidental Ingestion	9.E-07	0.03
		Dermal Contact	7.E-07	0.002
		Total Receptor Sediment Soil Risk:	**2.E-06**	**0.03**
Surface water	Adult Trespasser	Incidental Ingestion	3.E-08	0.002
		Dermal Contact	7.E-06	0.006
	Adolescent Trespasser	Incidental Ingestion	1.E-07	0.003
		Dermal Contact	2.E-05	0.006
		Total Receptor Surface water Risk:	**2.E-05**	**0.009**
		Cumulative Receptor Risk:	**2.E-05**	**0.04**
On Property West Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	3.E-07	0.003
		Dermal Contact	5.E-08	0.0003
	Adolescent Trespasser	Incidental Ingestion	4.E-07	0.005
		Dermal Contact	3.E-07	0.001
		Total Receptor Sediment Soil Risk:	**1.E-06**	**0.006**
		Cumulative Receptor Risk:	**1.E-06**	**0.006**

Table 6.5-1
Risk Summary Table - Current Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Off Property West Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	5.E-07	0.02
		Dermal Contact	8.E-08	0.0006
	Adolescent Trespasser	Incidental Ingestion	6.E-07	0.03
		Dermal Contact	3.E-07	0.002
		Total Receptor Sediment Soil Risk:	**2.E-06**	**0.03**
Surface water	Adult Trespasser	Incidental Ingestion	1.E-06	0.03
		Dermal Contact	2.E-04	0.08
	Adolescent Trespasser	Incidental Ingestion	3.E-06	0.04
		Dermal Contact	4.E-04	0.08
		Total Receptor Surface water Risk:	**5.E-04**	**0.1**
		Cumulative Receptor Risk:	**5.E-04**	**0.2**
Lower South Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	6.E-07	0.06
		Dermal Contact	2.E-07	0.01
	Adolescent Trespasser	Incidental Ingestion	9.E-07	0.1
		Dermal Contact	8.E-07	0.05
		Total Receptor Sediment Soil Risk:	**2.E-06**	**0.2**
Surface water	Adult Trespasser	Incidental Ingestion	2.E-07	0.02
		Dermal Contact	5.E-06	0.03
	Adolescent Trespasser	Incidental Ingestion	6.E-07	0.04
		Dermal Contact	1.E-05	0.03
		Total Receptor Surface water Risk:	**2.E-05**	**0.06**
		Cumulative Receptor Risk:	**2.E-05**	**0.22**
Upper South Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	3.E-07	0.01
		Dermal Contact	7.E-08	0.002
	Adolescent Trespasser	Incidental Ingestion	5.E-07	0.02
		Dermal Contact	3.E-07	0.007
		Total Receptor Sediment Soil Risk:	**1.E-06**	**0.02**
Surface water	Adult Trespasser	Incidental Ingestion	3.E-07	0.07
		Dermal Contact	3.E-08	0.1
	Adolescent Trespasser	Incidental Ingestion	8.E-07	0.1
		Dermal Contact	3.E-08	0.1
		Total Receptor Surface water Risk:	**1.E-06**	**0.2**
		Cumulative Receptor Risk:	**2.E-06**	**0.2**
			Prepared by:	LCG 2/24/2014
			Checked by:	BJR 3/4/2014

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Exposure Area 1 (EA1)				
Surface Soil	Indoor Worker	Incidental Ingestion	8.E-06	0.1
		Dermal Contact	4.E-06	0.03
		Total Receptor Surface Soil Risk:	**1.E-05**	**0.1**
Surface Soil	Outdoor Worker	Incidental Ingestion	1.E-05	0.2
		Dermal Contact	1.E-05	0.09
		Dust Inhalation	1.E-08	0.0002
		Total Receptor Surface Soil Risk:	**2.E-05**	**0.3**
Surface Soil	Construction Worker	Incidental Ingestion	2.E-06	0.3
		Dermal Contact	7.E-07	0.09
		Dust Inhalation	4.E-09	0.001
		Total Receptor Surface Soil Risk:	**3.E-06**	**0.4**
Surface Soil	Adult Trespasser	Incidental Ingestion	3.E-06	0.06
		Dermal Contact	1.E-06	0.02
	Adolescent Trespasser	Incidental Ingestion	7.E-06	0.1
		Dermal Contact	6.E-06	0.05
		Total Receptor Surface Soil Risk:	**2.E-05**	**0.1**
		Cumulative Receptor Risk:	**2.E-05**	**0.1**
Subsurface Soil	Indoor Worker	Incidental Ingestion	2.E-06	0.05
		Dermal Contact	6.E-07	0.02
		Total Receptor Surface Soil Risk:	**3.E-06**	**0.07**
Subsurface Soil	Outdoor Worker	Incidental Ingestion	3.E-06	0.09
		Dermal Contact	2.E-06	0.06
		Dust Inhalation	4.E-09	0.00005
		Total Receptor Surface Soil Risk:	**5.E-06**	**0.1**
Subsurface Soil	Construction Worker	Incidental Ingestion	5.E-07	0.2
		Dermal Contact	1.E-07	0.05
		Dust Inhalation	2.E-09	0.0004
		Total Receptor Subsurface Soil Risk:	**6.E-07**	**0.2**
Subsurface Soil	Adult Trespasser	Incidental Ingestion	7.E-07	0.03
		Dermal Contact	2.E-07	0.01
	Adolescent Trespasser	Incidental Ingestion	8.E-07	0.05
		Dermal Contact	4.E-07	0.03
		Total Receptor Subsurface Soil Risk:	**2.E-06**	**0.08**
		Cumulative Receptor Risk:	**2.E-06**	**0.08**

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Exposure Area 2 (EA2)				
Surface Soil	Outdoor Worker	Incidental Ingestion	4.E-06	0.03
		Dermal Contact	2.E-06	0.008
		Total Receptor Surface Soil Risk:	**6.E-06**	**0.04**
Surface Soil	Construction Worker	Incidental Ingestion	6.E-07	0.06
		Dermal Contact	1.E-07	0.009
		Total Receptor Surface Soil Risk:	**7.E-07**	**0.07**
Surface Soil	Adult Trespasser	Incidental Ingestion	7.E-07	0.01
		Dermal Contact	2.E-07	0.001
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.02
		Dermal Contact	8.E-07	0.004
		Total Receptor Surface Soil Risk:	**3.E-06**	**0.02**
		Cumulative Receptor Risk:	**3.E-06**	**0.02**

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Exposure Area 3 (EA3)				
Surface Soil	Indoor Worker	Incidental Ingestion	2.E-06	0.02
		Dermal Contact	6.E-07	0.004
		Total Receptor Surface Soil Risk:	**2.E-06**	**0.03**
Surface Soil	Outdoor Worker	Incidental Ingestion	3.E-06	0.04
		Dermal Contact	1.E-06	0.01
		Dust Inhalation	6.E-09	0.0002
		Total Receptor Surface Soil Risk:	**4.E-06**	**0.05**
Surface Soil	Construction Worker	Incidental Ingestion	4.E-07	0.07
		Dermal Contact	9.E-08	0.01
		Dust Inhalation	2.E-09	0.001
		Total Receptor Surface Soil Risk:	**5.E-07**	**0.08**
Surface Soil	Adult Trespasser	Incidental Ingestion	6.E-07	0.01
		Dermal Contact	2.E-07	0.002
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.02
		Dermal Contact	6.E-07	0.006
		Total Receptor Surface Soil Risk:	**2.E-06**	**0.03**
		Cumulative Receptor Risk:	**2.E-06**	**0.03**
Subsurface Soil	Indoor Worker	Incidental Ingestion	9.E-06	0.1
		Dermal Contact	4.E-06	0.05
		Total Receptor Subsurface Soil Risk:	**1.E-05**	**0.2**
Subsurface Soil	Outdoor Worker	Incidental Ingestion	2.E-05	0.2
		Dermal Contact	1.E-05	0.1
		Dust Inhalation	2.E-09	0.00005
		Total Receptor Subsurface Soil Risk:	**3.E-05**	**0.4**
Subsurface Soil	Construction Worker	Incidental Ingestion	2.E-06	0.2
		Dermal Contact	7.E-07	0.04
		Dust Inhalation	7.E-10	0.0004
		Total Receptor Subsurface Soil Risk:	**3.E-06**	**0.2**
Subsurface Soil	Adult Trespasser	Incidental Ingestion	3.E-06	0.08
		Dermal Contact	1.E-06	0.03
	Adolescent Trespasser	Incidental Ingestion	4.E-06	0.1
		Dermal Contact	2.E-06	0.08
		Total Receptor Subsurface Soil Risk:	**1.E-05**	**0.2**
		Cumulative Receptor Risk:	**1.E-05**	**0.2**

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Exposure Area 4 (EA4)				
Surface Soil	Adult Trespasser	Incidental Ingestion	1.E-06	0.1
		Dermal Contact	3.E-07	0.002
	Adolescent Trespasser	Incidental Ingestion	2.E-06	0.2
		Dermal Contact	1.E-06	0.005
		Total Receptor Surface Soil Risk:	**4.E-06**	**0.2**
		Cumulative Receptor Risk:	**4.E-06**	**0.2**
Exposure Area 5 (EA5)				
Surface Soil	Outdoor Worker	Incidental Ingestion	1.E-05	1
		Dermal Contact	6.E-06	0.2
		Total Receptor Surface Soil Risk:	**2.E-05**	**1**
Surface Soil	Construction Worker	Incidental Ingestion	2.E-06	1
		Dermal Contact	4.E-07	0.05
		Total Receptor Surface Soil Risk:	**2.E-06**	**1**
Surface Soil	Adult Trespasser	Incidental Ingestion	2.E-06	0.4
		Dermal Contact	6.E-07	0.03
	Adolescent Trespasser	Incidental Ingestion	4.E-06	0.7
		Dermal Contact	3.E-06	0.08
		Total Receptor Surface Soil Risk:	**1.E-05**	**0.7**
		Cumulative Receptor Risk:	**1.E-05**	**0.7**
Exposure Area 6 (EA6)				
Surface Soil	Outdoor Worker	Incidental Ingestion	4.E-06	0.1
		Dermal Contact	2.E-06	0.01
		Total Receptor Surface Soil Risk:	**5.E-06**	**0.1**
Surface Soil	Construction Worker	Incidental Ingestion	5.E-07	0.06
		Dermal Contact	1.E-07	0.008
		Total Receptor Surface Soil Risk:	**6.E-07**	**0.07**
Surface Soil	Adult Trespasser	Incidental Ingestion	7.E-07	0.04
		Dermal Contact	2.E-07	0.001
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.06
		Dermal Contact	8.E-07	0.004
		Total Receptor Surface Soil Risk:	**3.E-06**	**0.06**
		Cumulative Receptor Risk:	**3.E-06**	**0.06**

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Exposure Area 7 (EA7)				
Surface Soil	Indoor Worker	Incidental Ingestion	2.E-06	0.03
		Dermal Contact	6.E-07	0.004
		Total Receptor Surface Soil Risk:	**3.E-06**	**0.03**
Surface Soil	Outdoor Worker	Incidental Ingestion	4.E-06	0.05
		Dermal Contact	1.E-06	0.01
		Dust Inhalation	6.E-09	0.0003
		Total Receptor Surface Soil Risk:	**6.E-06**	**0.06**
Surface Soil	Construction Worker	Incidental Ingestion	6.E-07	0.09
		Dermal Contact	1.E-07	0.01
		Dust Inhalation	2.E-09	0.002
		Total Receptor Surface Soil Risk:	**7.E-07**	**0.1**
Surface Soil	Adult Trespasser	Incidental Ingestion	8.E-07	0.02
		Dermal Contact	2.E-07	0.002
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.03
		Dermal Contact	4.E-07	0.006
		Total Receptor Surface Soil Risk:	**2.E-06**	**0.03**
		Cumulative Receptor Risk:	**2.E-06**	**0.03**
Subsurface Soil	Indoor Worker	Incidental Ingestion	1.E-06	0.02
		Dermal Contact	4.E-07	0.007
		Total Receptor Subsurface Soil Risk:	**2.E-06**	**0.03**
Subsurface Soil	Outdoor Worker	Incidental Ingestion	1.E-05	0.04
		Dermal Contact	8.E-06	0.02
		Dust Inhalation	2.E-09	0.00006
		Total Receptor Subsurface Soil Risk:	**2.E-05**	**0.06**
Subsurface Soil	Construction Worker	Incidental Ingestion	2.E-06	0.05
		Dermal Contact	6.E-07	0.008
		Dust Inhalation	8.E-10	0.0005
		Total Receptor Subsurface Soil Risk:	**2.E-06**	**0.06**
Subsurface Soil	Adult Trespasser	Incidental Ingestion	2.E-06	0.01
		Dermal Contact	9.E-07	0.003
	Adolescent Trespasser	Incidental Ingestion	6.E-06	0.02
		Dermal Contact	5.E-06	0.009
		Total Receptor Subsurface Soil Risk:	**1.E-05**	**0.03**
		Cumulative Receptor Risk:	**1.E-05**	**0.03**

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Containment Area				
Surface Soil	Outdoor Worker	Incidental Ingestion	4.E-06	0.04
		Dermal Contact	1.E-06	0.01
		Dust Inhalation	8.E-09	0.0003
		Total Receptor Surface Soil Risk:	**5.E-06**	**0.05**
Surface Soil	Adult Trespasser	Incidental Ingestion	8.E-07	0.01
		Dermal Contact	1.E-07	0.002
	Adolescent Trespasser	Incidental Ingestion	9.E-07	0.02
		Dermal Contact	3.E-07	0.004
		Total Receptor Surface Soil Risk:	**2.E-06**	**0.03**
		Cumulative Receptor Risk:	**2.E-06**	**0.03**
Central Pond				
Sediment	Adult Trespasser	Incidental Ingestion	2.E-07	0.007
		Dermal Contact	3.E-08	0.0003
	Adolescent Trespasser	Incidental Ingestion	3.E-07	0.01
		Dermal Contact	9.E-08	0.001
		Total Receptor Sediment Risk:	**7.E-07**	**0.01**
Surface water	Adult Trespasser	Incidental Ingestion	--	0.004
		Dermal Contact	--	0.008
	Adolescent Trespasser	Incidental Ingestion	--	0.006
		Dermal Contact	--	0.008
		Total Receptor Surface water Risk:	**0.E+00**	**0.01**
		Cumulative Receptor Risk:	**7.E-07**	**0.03**
Detention Basin				
Sediment	Adult Trespasser	Incidental Ingestion	4.E-07	0.008
		Dermal Contact	5.E-08	0.0005
	Adolescent Trespasser	Incidental Ingestion	5.E-07	0.01
		Dermal Contact	3.E-07	0.002
		Total Receptor Sediment Risk:	**1.E-06**	**0.01**
Surface water	Adult Trespasser	Incidental Ingestion	4.E-09	0.004
		Dermal Contact	5.E-10	0.02
	Adolescent Trespasser	Incidental Ingestion	1.E-08	0.006
		Dermal Contact	5.E-10	0.02
		Total Receptor Surface water Risk:	**2.E-08**	**0.02**
		Cumulative Receptor Risk:	**1.E-06**	**0.04**

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
East Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	1.E-05	0.2
		Dermal Contact	2.E-06	0.02
	Adolescent Trespasser	Incidental Ingestion	2.E-05	0.3
		Dermal Contact	5.E-06	0.07
		Total Receptor Sediment Risk:	**4.E-05**	**0.4**
Surface water	Adult Trespasser	Incidental Ingestion	3.E-07	0.06
		Dermal Contact	1.E-05	0.03
	Adolescent Trespasser	Incidental Ingestion	4.E-07	0.1
		Dermal Contact	2.E-05	0.03
		Total Receptor Surface water Risk:	**3.E-05**	**0.1**
		Cumulative Receptor Risk:	**7.E-05**	**0.5**
Maple Meadow Brook				
Sediment	Adult Trespasser	Incidental Ingestion	8.E-07	0.03
		Dermal Contact	1.E-07	0.001
	Adolescent Trespasser	Incidental Ingestion	1.E-06	0.05
		Dermal Contact	4.E-07	0.004
		Total Receptor Sediment Risk:	**2.E-06**	**0.06**
Surface water	Adult Trespasser	Incidental Ingestion	2.E-07	0.09
		Dermal Contact	6.E-06	0.06
	Adolescent Trespasser	Incidental Ingestion	3.E-07	0.1
		Dermal Contact	1.E-05	0.06
		Total Receptor Surface water Risk:	**2.E-05**	**0.2**
		Cumulative Receptor Risk:	**2.E-05**	**0.26**
North Pond				
Sediment	Adult Trespasser	Incidental Ingestion	5.E-07	0.02
		Dermal Contact	1.E-07	0.0006
	Adolescent Trespasser	Incidental Ingestion	9.E-07	0.03
		Dermal Contact	7.E-07	0.002
		Total Receptor Sediment Risk:	**2.E-06**	**0.03**
Surface water	Adult Trespasser	Incidental Ingestion	3.E-08	0.002
		Dermal Contact	7.E-06	0.006
	Adolescent Trespasser	Incidental Ingestion	1.E-07	0.003
		Dermal Contact	2.E-05	0.006
		Total Receptor Surface water Risk:	**2.E-05**	**0.009**
		Cumulative Receptor Risk:	**2.E-05**	**0.04**

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
On Property West Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	3.E-07	0.003
		Dermal Contact	5.E-08	0.0003
	Adolescent Trespasser	Incidental Ingestion	4.E-07	0.005
		Dermal Contact	3.E-07	0.001
		Total Receptor Sediment Risk:	**1.E-06**	**0.006**
		Cumulative Receptor Risk:	**1.E-06**	**0.006**
Off Property West Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	5.E-07	0.02
		Dermal Contact	8.E-08	0.0006
	Adolescent Trespasser	Incidental Ingestion	6.E-07	0.03
		Dermal Contact	3.E-07	0.002
		Total Receptor Sediment Risk:	**2.E-06**	**0.03**
Surface water	Adult Trespasser	Incidental Ingestion	1.E-06	0.03
		Dermal Contact	2.E-04	0.08
	Adolescent Trespasser	Incidental Ingestion	3.E-06	0.04
		Dermal Contact	4.E-04	0.08
		Total Receptor Surface water Risk:	**5.E-04**	**0.1**
		Cumulative Receptor Risk:	**5.E-04**	**0.2**
Lower South Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	6.E-07	0.06
		Dermal Contact	2.E-07	0.01
	Adolescent Trespasser	Incidental Ingestion	9.E-07	0.1
		Dermal Contact	8.E-07	0.05
		Total Receptor Sediment Risk:	**2.E-06**	**0.2**
Surface water	Adult Trespasser	Incidental Ingestion	2.E-07	0.02
		Dermal Contact	5.E-06	0.03
	Adolescent Trespasser	Incidental Ingestion	6.E-07	0.04
		Dermal Contact	1.E-05	0.03
		Total Receptor Surface water Risk:	**2.E-05**	**0.06**
		Cumulative Receptor Risk:	**2.E-05**	**0.2**

Table 6.5-2
Risk Summary Table - Future Land Use
Remedial Investigation Report OU1 and OU2
Olin Chemical Superfund Site
Wilmington, Massachusetts

Exposure Area / Medium	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Upper South Ditch				
Sediment	Adult Trespasser	Incidental Ingestion	3.E-07	0.01
		Dermal Contact	7.E-08	0.002
	Adolescent Trespasser	Incidental Ingestion	5.E-07	0.02
		Dermal Contact	3.E-07	0.007
		Total Receptor Sediment Risk:	**1.E-06**	**0.02**
Surface water	Adult Trespasser	Incidental Ingestion	3.E-07	0.07
		Dermal Contact	3.E-08	0.1
	Adolescent Trespasser	Incidental Ingestion	8.E-07	0.1
		Dermal Contact	3.E-08	0.1
		Total Receptor Surface water Risk:	**1.E-06**	**0.2**
		Cumulative Receptor Risk:	**2.E-06**	**0.2**

Prepared by: LCG 2/24/2014
Checked by: BJR 3/4/2014

APPENDICES

(Provided on CD ROM)

Appendix A	Historic Study Area Investigations Summary Report
Appendix B	Soil Boring Logs
Appendix C	Surface Soil Field Data Records
Appendix D	Surface Water and Sediment Field Data Records
Appendix E	Validated Soil, Surface Water, and Sediment Data
Appendix F	OU1 and OU2 Soil Data Summary Tables
Appendix G	42-Day Hyalella Azteca Sediment Toxicity Test
Appendix H	Temperature Profile Trip Report/ Piezometer Data
Appendix I	Site Specific Background Soil Memorandum
Appendix J	Soil Leaching Documentation
Appendix K	Fate and Transport – Chemical Data Matrix
Appendix L	Response to Comments Checklist Table (PRI) and Draft RI/ BHHRA/ BERA
Appendix M	Human Health Risk Assessment
Appendix N	Ecological Risk Assessment/ Food Chain Modeling
Appendix O	Supplemental Reference Documents

ATTACHMENTS

(Provided on CD ROM)

A	Remediation General Permit
B	Deed Restrictions
C	Calcium Sulfate Landfill Biennial Post Closure Monitoring Report
D	North Pond Memorandum
E	Groundwater Summary Table and Location Figure