

**BEFORE THE  
SURFACE TRANSPORTATION BOARD**

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**ENTERED  
Office of Proceedings  
August 18, 2015  
Part of  
Public Record**

**Finance Docket No. 34797**

**New England Transrail, LLC, d/b/a Wilmington & Woburn Terminal Railway—Petition  
For An Exemption From 49 U.S.C. § 10901 To Acquire, Construct And Operate As A Rail  
Carrier On Tracks and Land in Wilmington and Woburn, Massachusetts**

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**Petitioner's Status Report and Request for Clarification**

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As the Board knows from prior filings, New England Transrail, LLC (NET) is intending to acquire property and construct railroad track on and adjacent to the Olin Chemical Superfund site (Site) located in Wilmington and Woburn, Massachusetts. To do so, NET needs authorization from the Surface Transportation Board (STB), which can only be given after the STB conducts an environmental review. In a June 19, 2012 decision, the STB deferred the initiation of the environmental review, citing to comments made by the U.S. Environmental Protection Agency ((EPA) in September 2011 which requested STB to defer its environmental analysis until characterization of the Site had progressed further.<sup>1</sup>

Since that time, a great deal of investigatory and characterization work has been undertaken at the Site. As a result, on May 15, 2015, EPA provided NET with a “Comfort/Status and Reasonable Steps Letter” (see Attachment A) which stated that, based on the design of the NET project as provided to the Agency by NET personnel:

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<sup>1</sup> Prior to the 2012 deferral, NET filed annual updates with the Board as to the status of environmental conditions at the Site and the response activities undertaken by EPA and the Site owner.

- Any response actions which may be implemented as part of Operable Unit (OU) 1 (remediation of the Olin property) or 2 (remediation of off-property surface water and sediment) appear to be located outside of NET's proposed development;
- NET's proposed development is compatible with the conclusions of the OU1 and OU2 baseline risk assessment and anticipated institutional controls; and
- The NET project will not impede the completion of the OU3 (groundwater) investigation or potential response actions relating to groundwater at the Site.

Of course, these conclusions were premised on the assumption that NET will fulfill its commitment to EPA to cooperate in the installation of a permanent cap, limit development to commercial and industrial use, and incorporate vapor mitigation measures as part of building construction.

Just as importantly, in letters dated July 2 and July 28, 2015, EPA approved the final Remedial Investigation (RI) Report and related documents for OU1 and OU2 (see Attachment B). On July 24, Olin produced the complete RI Report. The Executive Summary for that document is included as Attachment C; the full report, complete with figures, tables, etc., can be accessed at <https://bakerbotts.box.com/STBFiling>.

In light of the years of additional Site work undertaken by Olin and EPA since the 2011 EPA request for deferral, the completion of the RI, and the issuance of the Comfort Letter, we respectfully petition the Board pursuant to 49 C.F.R. § 1117.1 to lift the deferral referenced in the Board's June 19, 2012 decision. It is clear that EPA no longer believes deferral of the environmental review is necessary. Moreover, there is no reason to await the issuance of EPA's Record of Decision (ROD) for the site. EPA has decided to issue a single ROD for all three Operable Units -- given that an RI for the groundwater Operable Unit 3 is still multiple years off,



there will similarly be no ROD for multiple years. EPA's Comfort letter evidences the fact that the NET project will in no way interfere with any of the operable units, including OU3 (see Attachment A at 6), and thus linking the commencement of the environmental review to ROD issuance is no longer advisable.

Finally, we note that the scope of the NET project has not materially changed. The project was initially conceived as a multi-purpose transload facility – now commonly known among transportation planners as a rail freight village – and remains so. The only changes are (1) the abandonment of any plans to build a Solid Waste Transfer Facility and (2) reorienting the planned NET facility (after consultation with EPA) to better accommodate remedial activities which may be required and in furtherance of Agency remediation goals. Nonetheless, NET's plan is to file a Supplemental Petition for Exemption once the deferral of the environmental review is lifted, describing in detailed the current configuration of the project and updating the Board on the why the project will further the transportation policy goals of 49 U.S.C. § 10501.

We thank the Board for its consideration of this Petition and stand ready to answer any questions or provide any additional information that may be required.

Respectfully submitted,



Steven L. Leifer  
BAKER BOTTS LLP  
1299 Pennsylvania Avenue, N.W.  
Washington, DC 20004  
(202) 639-7723

Attorneys for New England  
Transrail, LLC

Date: August 18, 2015

## Attachment A



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**

**Region 1**

**5 Post Office Square, Suite 100**

**Boston, MA 02109-3912**

May 13, 2015

Robert W. Jones, III  
Managing Principal  
New England Transrail, LLC  
46 Grand Cove, Edgewater, NJ 07020-7245

Re: Comfort/Status and Reasonable Steps Letter  
51 Eames Street, Wilmington, Massachusetts  
Olin Chemical Superfund Site

Dear Mr. Jones:

I am writing in response to your December 18, 2014 request for a Prospective Purchaser Agreement ("PPA") or Comfort/Status Letter ("CSL") regarding the property at 51 Eames Street Wilmington, Massachusetts (the "Property"). My response is based upon the facts presently known to the United States Environmental Protection Agency ("EPA").

Under the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"), commonly referred to as Superfund, EPA's primary mission is to protect human health and the environment from the exposure risks posed by contaminated or potentially contaminated lands. However, in doing so, EPA also recognizes the social and economic benefits of returning contaminated lands to productive use.

As you know, the Property is located within the current study area designated by EPA as the Olin Chemical Superfund Site (the "Site"), and subject to the requirements of an Administrative Settlement Agreement and Order on Consent ("AOC"), EPA Region 1 CERCLA Docket No. 01-2007-0102, with an effective date of July 3, 2007. The AOC requires that American Biltrite, Inc., Olin Corporation ("Olin"), and Stepan Company (collectively, the "Respondents") complete a Remedial Investigation and Feasibility Study ("RI/FS") at the Site consistent with CERCLA.

The AOC also requires that the Respondents shall provide continued access to property owned by Respondents at the Site at all reasonable times, and that Olin, as sole current owner of the Property, provide a Transfer Notice and execute a Transfer Agreement in the event that any change in the ownership interest in the Property is imminent. The Transfer Notice is to be provided to EPA at least 30 days prior to any transfer. The Transfer Agreement is to be executed between Olin and the intended transferee or option holder, which for the purposes of this CSL is New England Transrail, LLC ("NET") (see AOC, Paragraph XII).

EPA understands that NET plans to develop and use the Property as a commodities-based rail transloading terminal facility as shown in Attachment 1. EPA does not support or oppose NET's proposed development, and EPA is not opining as to whether NET's proposed development complies with local or state zoning or land use regulations.

#### History and Status of the Site

The Olin Chemical Superfund Site includes the 53-acre Property located at 51 Eames Street in Wilmington, Massachusetts. The Property was largely forested prior to the 1950s. From 1953 until 1986, numerous entities conducted chemical manufacturing operations at a facility located on the Property. Olin purchased the Property in 1980. Liquid wastes generated at the facility, which included sulfuric acid, sodium chloride, sodium sulfate, ammonium chloride, ammonium sulfate, chromium sulfate and other compounds, were disposed of in unlined pits (commonly referred to as lagoons) on the northern half of the Property, and wastes percolated into the soil or overflowed into natural and man-made drainage ways.

The liquid wastes disposed of at the Site had high concentrations of dissolved inorganic constituents with fluid densities greater than water. These dense liquids migrated vertically to the bedrock surface, forming a brine layer in bedrock depressions within the aquifer commonly referred to in Site study documents as dense aqueous phase liquid ("DAPL") pools. The DAPL pools contain elevated concentrations of several contaminants of interest, most notably n-nitrosodimethylamine ("NDMA"). NDMA is believed to have formed within the aquifer due to the presence of the liquid wastes disposed at the Site.

Numerous environmental investigations and response activities were conducted at the facility prior to inclusion of the Site in EPA's CERCLA program. These investigations and subsequent response actions resulted in the excavation and off-Site disposal of contaminated soil from two drum disposal areas, a buried debris area, and Lake Poly (a former lagoon); as well as impacted sediment from the West Ditch and associated wetland, the South Ditch, and Central Pond. All response actions were conducted in accordance with work plans approved by the Massachusetts Department of Environmental Protection ("MassDEP"). An area of trimethylpentenes in soil and shallow groundwater located near the Plant B groundwater recovery/treatment system were identified and remediated using an air sparge/soil vapor extraction system ("AS/SVE").

Since 1989 the Respondents have operated the Plant B groundwater recovery/treatment system. The system was installed in response to seepage of a light non-aqueous phase liquid ("LNAPL") into the East Ditch. The LNAPL is process oil that contains chemicals of interest including bis(2-ethylhexyl)phthalate, n-nitrosodi-n-propylamine, and trimethylpentenes. The system was designed to create a groundwater cone of depression to prevent migration and allow for mechanical removal of the LNAPL. Groundwater extracted during operation of the Plant B system is treated to remove iron and ammonia as well as dissolved organic compounds. The treated groundwater is discharged to surface water in the on-Property upper West Ditch under an EPA-issued Remediation General Permit.

In 2000 Olin constructed a slurry wall/cap containment structure around the on-Property portion of the upper DAPL pool. The intent of this source control action was to eliminate, to the extent

feasible, the on-Property DAPL material as a source of dissolved constituents to groundwater. A significant volume of DAPL remains outside the containment structure. The containment structure is comprised of a 3-foot thick perimeter slurry wall extended to the top of bedrock (about 40 feet below ground surface) and covered with a temporary 5-acre geo-synthetic cap to minimize infiltration of precipitation into the containment area.

The Site was finalized for inclusion on the National Priorities List ("NPL") on April 18, 2006. The NPL is EPA's list of CERCLA-eligible Sites. In June 2007, EPA and the Respondents entered into the AOC which required that the Respondents complete an RI/FS consistent with CERCLA. Due to the extent of previous investigations and recognition of the technically complex nature of cross-media impacts, the RI/FS was divided into three operable units ("OUs") as follows:

- Operable Unit 1 ("OU1"): Defined as the 53-acre Property, including the former facility area, established conservation area, on-Property ditch system, calcium sulfate landfill, and slurry wall/capped area. OU1 was intended to address source control concerns and includes soil, sediment, surface water, and potential vapor issues.
- Operable Unit 2 ("OU2"): Defined as off-Property surface water and sediment areas including, at a minimum, the off-Property East Ditch, South Ditch and Landfill Ditch; Sawmill Brook and Maple Meadow Brook; and North Pond. OU2 was intended to address source control and management of migration concerns, and includes surface water and sediment issues.
- Operable Unit 3 ("OU3"): Defined as all on- and off-Property groundwater areas including the Maple Meadow Brook aquifer, groundwater beneath the Property, and groundwater contamination located south and east of the Property. OU3 was intended to address management of migration concerns and includes groundwater and potential vapor issues.

Field work for OU1 and OU2 was completed from 2009 to 2012. Results were combined into a single Draft Remedial Investigation Report submitted to EPA in April 2013. Following review and comment by EPA, MassDEP, the Town of Wilmington and the Wilmington Environmental Restoration Committee ("WERC"), a Draft Final Remedial Investigation Report was submitted to EPA in April 2014 and is expected to be finalized soon. Field work for OU3 began in 2010 and is expected to be complete in 2015.

On April 14, 2015, EPA issued a letter documenting the decision to combine the operable units into a single proposed plan and Record of Decision.

#### CERCLA's Bona Fide Prospective Purchaser Liability Protection

In January 2002, Congress amended CERCLA to include liability limitations for landowners that acquire contaminated property after the effective date of the amendments (January 11, 2002) if those landowners qualify as "bona fide prospective purchasers" ("BFPP"). To meet the statutory criteria for a BFPP, a landowner must satisfy certain threshold criteria and continuing obligations. Among other threshold criteria, which are not included in full herein, a BFPP must establish that (i) all disposal of hazardous substances at the facility occurred before the purchaser

acquired the facility; (ii) the purchaser performed "all appropriate inquiry" into the previous ownership and uses of the property before acquisition; and (iii) the purchaser is not potentially liable or affiliated with any other person who is potentially liable for response costs at the facility.

In addition to the threshold criteria, a landowner must meet certain continuing obligations in order to qualify as a BFPP. One continuing obligation requires a landowner to provide full cooperation, assistance, and access to persons that are authorized to conduct response actions at the Site. In addition, a BFPP must establish, among other things, that (i) it is in compliance with any land use restrictions established or relied on in connection with the cleanup; and (ii) it does not impede the effectiveness or integrity of any institutional control employed in connection with the cleanup. As provided in EPA's Interim Guidance Regarding Criteria Landowners Must Meet in Order to Qualify for Bona Fide Prospective Purchaser, Continuous Property Owner, or Innocent Landowner Limitations on CERCLA Liability, dated March 6, 2003, landowners must "comply with land use restrictions and implement institutional controls even if the restrictions or institutional controls were not in place at the time the person purchased the property."

Another continuing obligation required to qualify as a BFPP is taking "reasonable steps to stop any continuing release; prevent any threatened future release; and prevent or limit human, environmental, or natural resource exposure to any previously released hazardous substance." Section 101(40)(D) of CERCLA, 42 U.S.C. Section 9601(40). Based upon the information that EPA has evaluated to date, including the conceptual design provided by NET to EPA on December 18, 2014, EPA believes that, for an owner of the Property, the following would be appropriate reasonable steps with respect to the hazardous substance contamination found at the Property:

- Entering into the Transfer Agreement with Respondents (as referenced above);
- Complying with the applicable land transfer requirements of Paragraph XII of the AOC;
- Providing access to the Property at all reasonable times and cooperating with EPA for the purpose of conducting monitoring and response actions;
- Complying with any existing deed restrictions or institutional controls;
- Agreeing to record and comply with any additional deed restrictions or institutional controls as deemed necessary pursuant to a Record of Decision to implement or maintain response actions;
- Protecting and maintaining all aspects of the existing groundwater recovery and treatment system designated by Respondents as Plant B during and after redevelopment activities, including the permitted surface water discharge to the Upper West Ditch;
- Protecting and maintaining all aspects of the existing slurry wall containment area and temporary cap, and cooperating fully with the anticipated design and installation of a permanent cap on the containment area;
- Cooperating fully with any future response actions to be determined by EPA through anticipated decision documents such as Records of Decision or Action Memoranda;
- Notifying all contractors, subcontractors, lessees and any other parties operating at the Property of this letter, and ensuring that these parties satisfy the requirements set forth in this letter;

- Installing vapor barriers or incorporating other suitable vapor intrusion mitigation measures in future buildings on the Property as deemed necessary by EPA pursuant to anticipated decision documents such as Records of Decision or Action Memoranda;
- Providing EPA and Respondents with copies of any environmental data collected at the Property;
- Providing EPA and Respondents with weekly progress summaries during active re-development construction, including the identification of anticipated areas of intrusive activities, such as excavation, on the Property;
- Cooperating with EPA's field oversight activities during future response actions; and
- Refraining from using the Property in any manner that would interfere with or adversely affect the implementation, integrity or protectiveness of any past or future response actions performed at the Site.

This letter does not provide a release of CERCLA liability, but only provides information with respect to reasonable steps based on the information that EPA currently has available to it. The reasonable steps suggested by EPA in this letter are based on the nature and extent of contamination known to EPA at this time, and are provided solely for informational purposes. Site investigations are ongoing and final response actions have not yet been determined by EPA. If additional information regarding the nature and extent of hazardous substance contamination at the Site and/or Property becomes available, additional actions may be necessary to satisfy the reasonable steps criterion. You should ensure that you are aware of the condition of the Property so that you are able to take reasonable steps with respect to any hazardous substance contamination. In particular, if new areas of contamination are identified, you should ensure that reasonable steps are undertaken.

Please note that the BFPP provision has a number of conditions in addition to those requiring the property owner to take reasonable steps. Taking reasonable steps, and certain other BFPP conditions, are continuing obligations of a BFPP. You will need to assess whether you satisfy each of the statutory conditions for the BFPP status and will need to ensure that you continue to meet the applicable conditions.

#### Nature of this Comfort/Status and Reasonable Steps Letter

EPA generally issues comfort/status and reasonable steps letters to facilitate the cleanup and reuse of contaminated or formerly contaminated properties where there is no other mechanism available to adequately address a party's concern. This comfort/status and reasonable steps letter is intended to help NET and interested stakeholders make informed decisions by providing information that the EPA has about the Site and by identifying statutory protections, enforcement discretion guidance, resources and tools that may potentially be applicable.

It is important to note that EPA has not yet completed the investigation phase of CERCLA for the Site, issued a proposed cleanup plan for public comment, or selected a remedy for any portion of the Site. Accordingly, EPA's final remedy could affect the reasonable steps described above and the future use of the Site. However, as explained further below, based upon the conceptual design provided by NET to EPA on December 18, 2014 (See Attachment 1) and facts currently known to EPA, it does not appear that NET's proposed development will significantly

impact potential future investigatory or response activities at the Property. If NET's proposed conceptual design for the Property changes, the conclusions in this letter could also change.

Based on the conclusions of the baseline human health and ecological risk assessment, which are documented in the Draft Final RI Report for OU1 and OU2, there appear to be no existing or potential future unacceptable human health risks associated with residual contamination for OU1, which includes the Property, assuming that deed restrictions or other institutional controls as required by EPA are placed on the Property to limit development to commercial or industrial use. There also appear to be no unacceptable ecological risks from residual contamination in soil for OU1; however, (i) response actions may be required in the South Ditch to address acute toxicity measured in sediment and to mitigate the effects of the on-going discharge of contaminants in groundwater to surface water in the upper reach, and (ii) there are unacceptable risks which may require response actions associated with OU2 in an area located just east of the Property.

Based on the December 18, 2014 conceptual design provided by NET, the areas where OU1 and OU2 response actions may be required appear to be located outside of NET's proposed development. Additionally, it does not appear that NET's proposed development and use of the Property will interfere with potential response actions for OU1 or OU2. It is important to note that soil within the 5-acre containment area was not included in the remedial investigation process based on the assumption that a permanent cap will be installed. Therefore, the containment area will not be available for reuse until such time that an EPA-approved permanent cap is installed. Any future use of the containment area must be compatible with any permanent cap or other remedy required for the containment area.

OU3 field work is largely complete; however, a remedial investigation and baseline risk assessment are still pending. OU3 is relevant because OU3 includes groundwater beneath the Property, including areas of DAPL. Portions of groundwater or DAPL beneath the Property may require response actions. As such, it is premature for EPA to determine the need, scope or specific location of any response actions for OU3 on the Property, other than the presumption based on OU3 data generated to date that a potential vapor intrusion pathway exists and that vapor barriers or other mitigation methods should be incorporated into new building construction in most areas on the Property.

Based on EPA's understanding of NET's proposed development and use of the Property, as shown in NET's December 18, 2014 conceptual design, and subject to the other caveats described above in this letter, it appears that NET's proposed development is compatible with the conclusions of the OU1 and OU2 baseline risk assessment and anticipated institutional controls, and will not impede the completion of the OU3 investigation or potential response actions relating to groundwater at the Site.

This letter does not limit or affect EPA's authority under CERCLA, or any other law, or provide a release from CERCLA liability. EPA encourages you to consult with legal counsel and the appropriate state, tribal or local environmental protection agency before taking any action to acquire, clean up, or redevelop potentially contaminated property. It is your responsibility to ensure that the proposed redevelopment and use of the Property complies with any federal, state,

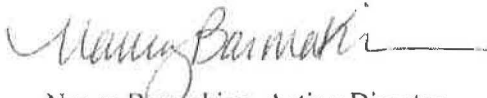


local, and/or tribal laws or requirements that may apply. EPA also recommends that you consult with your own environmental professional to obtain advice on the compatibility of the proposed reuse.

We hope this information is useful to you.

If you have any questions, or wish to discuss this letter, please feel free to call Jim DiLorenzo, Remedial Project Manager, at [dilorenzo.jim@epa.gov](mailto:dilorenzo.jim@epa.gov) or (617) 918-1247, or Kevin Pechulis, Senior Enforcement Counsel, at [pechulis.kevin@epa.gov](mailto:pechulis.kevin@epa.gov) or (617) 918-1612.

Sincerely,

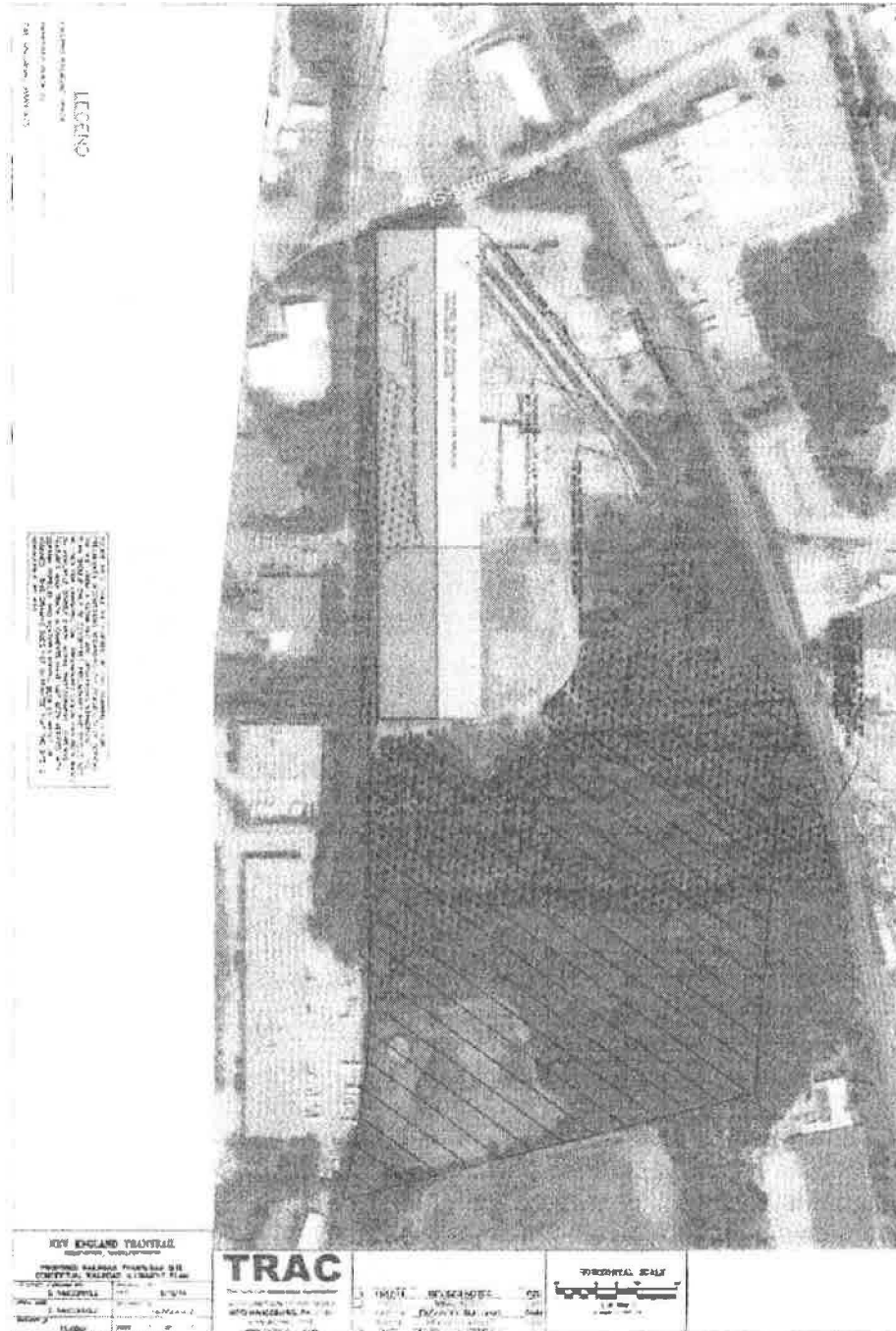
A handwritten signature in cursive script, appearing to read "Nancy Barmakian", followed by a horizontal line.

Nancy Barmakian, Acting Director  
Office of Site Remediation and Restoration

Enclosure

cc: Bob Cianciarulo, EPA  
Kevin Pechulis, EPA  
Jim DiLorenzo, EPA  
Joe Coyne, MassDEP  
James Cashwell, Olin  
Jeff Hull, Town of Wilmington  
Martha Stevenson, WERC

# ATTACHMENT 1



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## Attachment B



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**

**NEW ENGLAND – REGION 1**

5 Post Office Square, Suite 100

Mail Code OSRR07-4

Boston, MA 02109-3912

July 2, 2015

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

Subject: Review and Conditional Approval  
Draft Final Remedial Investigation and Risk Assessment Report,  
Operable Units 1 and 2, MACTEC, April 10, 2014 and Related  
Documents.

Dear Mr. Cashwell:

In accordance with Paragraph 40 of the Administrative Settlement Agreement and Order on Consent ("AOC"), Region I of the United States Environmental Protection Agency ("EPA") has completed a review of the Draft Final Remedial Investigation Report for OU1 and OU2, and companion reports for the Human Health and Ecological Risk Assessments dated April 10, 2014 (the "Report"); and a related Response to Comment letter dated December 12, 2014, a Chromium Bioaccumulation Memorandum dated March 26, 2015, and a South Ditch Toxicity Test Memorandum dated April 29, 2015; collectively prepared by Olin/AMEC (the "Documents").

The Report and Documents are the culmination of more than four years of field investigations and more than two years of active review efforts. During the review cycles, numerous comment and response letters were exchanged resulting in supplemental text, tables, and figures. Collectively these Documents must be integrated into the Final Remedial Investigation and Risk Assessment Report for Operable Units 1 and 2.

**Conditions**

1. Final Remedial Investigation Report. This approval is made with the understanding that Olin will prepare a final RI Report for OU1/OU2 (print and electronic copies), along with new and revised Appendices and Attachments as necessary, which incorporates the comment/responses and supplemental information contained in the Documents. EPA also

requests that the main text of the final RI Report be provided to EPA only in a Microsoft Word file to aid in the development of an anticipated Proposed Plan and Record of Decision. EPA may request source files for specific tables at a later date.

2. Draft Feasibility Study. Consistent with a letter issued by EPA on April 14, 2015, the three operable units shall be combined into a single Feasibility Study to be submitted following approval of the anticipated OU3 Remedial Investigation Report.

Please submit the Final Remedial Investigation Report for OU1/OU2 within 90 days.

Sincerely,



James M. DiLorenzo  
Remedial Project Manager  
USEPA Region 1 - New England

Enclosures:

Cc: Heather Ford, Nobis  
Rick Sugatt, EPA  
Joe Coyne, MassDEP  
Jeffrey Hull, Town of Wilmington  
Martha Stevenson, WERC



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**

**NEW ENGLAND – REGION 1**

5 Post Office Square, Suite 100

Mail Code OSRR07-4

Boston, MA 02109-3912

July 28, 2015

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

Subject: Confirmation of Receipt  
Final Remedial Investigation and Risk Assessment Reports,  
Operable Units 1 and 2, July 24, 2015

Dear Mr. Cashwell:

This letter confirms that EPA has received the Final Remedial Investigation Report for OU1 and OU2, Baseline Human Health Risk Assessment for OU1 and OU2, and Baseline Ecological Risk Assessment for OU1 and OU2 (2 paper and 7 electronic copies); prepared by AMEC and dated July 24, 2015.

These reports are the culmination of more than four years of field investigations and two years of active review efforts. During the review cycles, numerous comment and response letters were exchanged resulting in supplemental text, tables, and figures.

EPA understands that these reports incorporate the resolution of comments and supplemental information as conditioned in EPA's approval letter dated July 2, 2015 and considers these reports to be final.

EPA appreciates the effort put forth by Olin to bring closure to the OU1 and OU2 remedial investigation process, and looks forward to working with Olin to complete the remedial investigation for OU3.

Sincerely,

A handwritten signature in black ink, appearing to read "James M. DiLorenzo".

James M. DiLorenzo  
Remedial Project Manager  
USEPA Region 1 - New England

## Attachment C

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

RECEIVED - OLIN CORP  
JUL 27 2015  
CORPORATE SERVICES / ERG



**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)

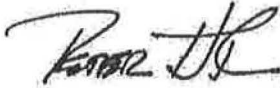


Mr. James M. DiLorenzo  
July 24, 2015  
Page 2

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

**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**

**July 24, 2015**

**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

July 24, 2015

A handwritten signature in black ink, appearing to read "Peter Thompson".

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Peter Thompson  
Project Manager

A handwritten signature in black ink, appearing to read "Michael J. Murphy".

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Michael J. Murphy  
Project Principal

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## LIST OF ACRONYMS

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|                |                                                                       |
|----------------|-----------------------------------------------------------------------|
| 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 <sub>2</sub> | 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 25<sup>th</sup> 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® (dinitrosopentamethylenetetramine) 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  $1 \times 10^{-6}$ ). 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  $1 \times 10^{-6}$  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 hazardous 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  $\frac{1}{2}$  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:

$$\text{Hazard Quotient} = \text{EPC} / \text{Benchmark}$$

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 benchmark 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:

$$\text{Hazard Quotient} = \text{EDI} / \text{TRV}$$

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 28<sup>th</sup> 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.
-

## **CERTIFICATE OF SERVICE**

I hereby certify that on the 18<sup>th</sup> day of August, 2015, a copy of the foregoing was sent by U.S. Mail to the following:

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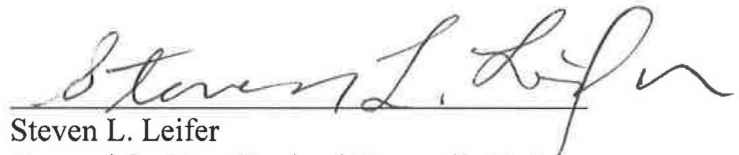
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