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Transmittal Memo

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Date:	14 May 2009	

Subject: **Final Remedial Investigation Workplan for AOC 72, Plow Shop Pond, Devens, Massachusetts**
Contract No. GS-10F-0230J, Delivery Order W912WJ-05-F-0037

On behalf of the US Army Corps of Engineers (USACE) New England District and the Army BRAC Office at Devens, AMEC is pleased to submit the enclosed revision pages for the final Remedial Investigation Workplan for Area of Concern (AOC) 72, Plow Shop Pond. Revisions are provided to address comments on the draft final version of the workplan which was submitted 03/09/09. Comments were received from EPA on 04/09/09 and from MassDEP on 04/03/09, and are summarized in an enclosure along with a brief description of the revision or response. Please contact me or Bob Simeone if there are questions regarding the attached.

Sincerely, Marc Grant

Marc Grant, P.E.
Project Manager

Enclosures Response to comments on the March 2009 Draft Final Workplan
Revision pages for the Final RI Workplan for AOC 72

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EPA Comments dated 04/09/09

(From cover letter) In addition, EPA requests that Army submit documentation of the human health and ecological toxicity factors (RfDs, Slope Factors, TRVs, screening level and Tier 3a benchmarks, etc.) that the Army proposes to use in the human health and ecological risk assessments as soon as possible. EPA recommends that the Army begin the process of seeking regulator concurrence on these factors now, so as to resolve these issues concurrently with the field effort. In this way, the BCT can work towards agreement on these factors before the Army begins the risk assessment calculations.

Documentation will be provided within two weeks to allow for discussion and concurrence within the next few months as sampling and analytical activities are completed.

1. In the Army's January 16, 2009 response to EPA follow-up comments (see page 11 of 44 of 020309 response package), Army agreed to investigate the feasibility of running a "dummy beaker" for each of the sediment toxicity stations to be frozen at the end of the test and transported to EPA ORD for analysis. Recent emails from AMEC imply that the Army is willing to include this effort in the AOC72 RI. Please incorporate appropriate text into the workplan to address the addition of this effort.

A footnote describing this procedure has been added to page 8 of 12 in the workplan.

2. Attachment A, Section 4.6: Sweep sampling is discussed here as using "a D-net 'raked' along the bottom, followed by continuous sweeps of the water column to catch additional dislodged organisms." The Army's November 5, 2008 responses (see response to EPA comment 5, page 7 of 44 of 020309 response package) indicated that benthic analysis would "be supported by sweep netting from the detritus layer to the top of the periphyton to collect benthic and epibenthic organisms for diversity analysis." Please clarify that the continuous sweeps of the water column will cover the detritus layer to the top of the periphyton.

The requested change has been made to the text.

3. Attachment A, Appendix A, SOP for Surface Water Sampling: The 2nd bullet should be changed to indicate that the surface water samples will be taken immediately above the surface water-sediment interface, rather than from the upper 6 inches of the water column.

This portion of Appendix A is no longer referenced and can be deleted or crossed out from the Draft Final copy; surface water sampling procedures are described in FSP Section 4.3.

4. Attachment C, Worksheet #9c: This worksheet identifies the sediment toxicity test methods as EPA 100.2/100.4 with footnote 6 identifying these tests as "42-Day Amphipod Survival and Growth (Hyalella)" and "20-Day Midge Larvae Survival and Growth (Chironomus) with ash-free dry weights". EPA Method 100.4 is entitled "Chronic Freshwater Amphipod Sediment Bioassay." This method includes measurement of reproduction. Please include amphipod reproduction in addition to survival and growth in these tests per the EPA test method.

The footnote has been corrected.

5. Attachment C, Worksheet #9d: This worksheet indicates a 40 business day turnaround time for bioassay data packages. Please revise this since the amphipod bioassay test lasts for at least 42 days.

The 40 business days is equivalent to at least 8 weeks (depending on holidays), or 56 calendar days, compared to the 42-calendar day test period. The actual turnaround time may be somewhat longer than this, but should be within the 91 calendar days provided in the schedule in Figure 11 of the workplan.

6. Attachment C, Worksheet #9c: In Attachment E, the 9/29/08 response to EPA's 9/11/08 comments on Attachment C-QAPP indicated that "a separate submittal will be provided for BCT review prior to issuing the draft final workplan, which will include a summary of ESI & SA 71 metals results for sediment samples in the proposed sampling locations. This submittal will include an evaluation of TAL metals for addition to the current list of ROD metals to be analyzed." Although such a submittal has not been received, the workplan includes the ecological and/or human risk drivers from previous studies in Table 1. These include barium, copper, and cadmium, which should be added to the list of inorganic analytes that will be analyzed in sediment and surface water. Please revise Attachment C (QAPP) to include these chemicals (i.e. footnote 10 of Worksheet #9c).

We understand from EPA's email message of 4/30/09 that the Army's position that barium, copper, and cadmium were not found to be risk drivers in the 2005 ESI report – and therefore were not scoped for inclusion in the AOC 72 effort – is accepted.

7. Attachment E, Section 3.2.3: The section entitled "Effects Assessment" on page 14 should include EPA's EcoSSLs as the preferred source of wildlife TRVs because they have been extensively peer reviewed. If EcoSSLs are available for the chemicals to be analyzed, please identify them in the reference list.

The requested change has been made to the text.

8. Attachment E, Section 3.4: The 4th sentence states: "These unidentified factors are however extraneous to the COPCs at hand." EPA disagrees with this statement, because the potential additive or synergistic effects of unidentified stressors may have a crucial but indeterminate effect on the effects of the COPCs. Please clarify or eliminate this sentence.

The sentence has been eliminated.

EPA Comment during 05/04/09 Conference Call on Floc Photos

A reference sample should be added for the three surface water toxicity samples to be collected from Red Cove.

Reference samples for surface water toxicity will be collected at the Northeast Cove locations (#8 and #9) and this has been added to the workplan (p.10) and Attachments (FSP pp.4, 6; QAPP Worksheet 9c).

MassDEP Comments dated 04/03/09

1) The Work Plan limits the number of Contaminants of Potential Concern (COPC) to be examined to arsenic, metals, and ammonia (NH4). MassDEP asked that the WP broaden it's examination of COPCs since earlier studies cited in the WP focused on human stressors and not specifically those in an aquatic environment. The Army's response was that "*Prior studies focused on ecological and human heath identifying COCs for those receptors. Revised text, Section 2 of the WP provides rationale for focusing on 10 metals, PAHs, and ammonia.*" If the

Army cannot establish a causal relationship between the COPCs to the risks identified from the EPA ESI and the new toxicity data then the Army should be prepared to broaden the list of COPCs.

Comment noted.

2) Seasonal impacts to benthic organisms and fish were raised by MassDEP because prior data indicated that there was seasonal hydrologic and biologic variability. The groundwater flow model was developed as a steady state analysis and did not allow for projections on seasonal inputs. MassDEP asked if it was possible to review data and/or duplicate work on a seasonal basis. The Army's response: "*We do not think it is necessary to propose periodic seasonal measurements without first collecting baseline data to establish potential impacts on aquatic communities. No unique seasonal effects have been identified for Plow Shop Pond that would require sampling and observing biota.*" The argument is circular/self-fulfilling in that "no unique seasonal effects have been identified" may be due to the fact that seasonality is not being considered. MassDEP accepts the work outlined in the Work Plan as a base line but requests that a sensitivity analysis be added to identify what additional steps should be taken to evaluate seasonal impacts, such as magnitude of contaminant impacts relating to possible additional ecological risks. The WP should remain open to seasonal measurements after the baseline data is collected.

Comment noted.

3) Risk assessment for this WP must be protective, especially at Red Cove due to landfill plume discharge and visible outbreaks in pond sediments. MassDEP does not believe population risk assessments are sensitive endpoints. Population risk assessments are not considered sufficient to determine a condition of no significant risk. The Army's response: *The proposed approach is not a population "impact" evaluation in the way that the commenter seems to imply, i.e. we are not measuring organism species and abundance and using that information to predict risks.* MassDEP maintains that population risk-based assessment alone is not of sufficient detail and sensitivity to determine ecological risks to Plow Shop Pond. The Army has indicated that both standard risk assessment and a population-based risk assessment will be included in the WP. MassDEP will focus on eco-risk management recommendations for Shepley's Hill Landfill and AOC-72 from the standard risk assessment portion of the WP.

Comment noted.

Remedial Investigation Workplan for AOC 72, Plow Shop Pond

FINAL

Devens, Massachusetts

May 2009

Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by:

AMEC Earth & Environmental, Inc
Westford, Massachusetts
Contract No.: GS-10F-0230J
Delivery Order: W912WJ-05-F-0037

SHL-0125

NOTICE

The United States Department of Defense, Department of the Army, funded wholly or in part the preparation of this document and work described herein under Contract No. GS-10F-0230J and Delivery Order W912WJ-05-F-0037. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Remedial Investigation Workplan for AOC 72, Plow Shop Pond

FINAL

Devens, Massachusetts

May 2009

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Remedial Investigation Workplan for AOC 72, Plow Shop Pond

FINAL

Devens, Massachusetts

May 2009

CERTIFICATION:

I hereby certify that the enclosed Report, shown and marked in this submittal, is that proposed to be incorporated with Contract Number GS-10F-0230J. This Document has been prepared in accordance with USACE Scope of Work and is hereby submitted for Government approval.

Reviewed by:

5/14/09	
AMEC Project Manager	Date
5/14/09	
AMEC Senior Reviewer	Date

Received by:

USACE Project Manager	Date

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Abbreviations, Acronyms, and Symbols

AMEC	AMEC Earth and Environmental, Inc.
AOC	Area of Concern
BCT	BRAC Cleanup Team
BMI	Benthic Macroinvertebrate
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMR	Code of Massachusetts Regulations
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DAP	Data Analysis Plan
DGA	Data Gaps Analysis
DO	Dissolved Oxygen
DQO	Data Quality Objective
ESI	Expanded Site Investigation
FS	Feasibility Study
FSP	Field Sampling Plan
GPR	Ground Penetrating Radar
HERA	Human and Ecological Risk Assessment
MassDEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
NCP	National Contingency Plan
PAH	Polycyclic Aromatic Hydrocarbons
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
RI	Remedial Investigation
SA 71	Study Area 71 (aka Railroad Roundhouse)
SAP	Sampling and Analysis Plan
SHL	Shepley's Hill Landfill
SQT	Sediment Quality Triad
SSHP	Site Safety and Health Plan
USACE-NAE	U.S. Army Corps of Engineers – New England District
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

EXECUTIVE SUMMARY

This Remedial Investigation (RI) Workplan for Area of Concern (AOC) 72 at the former Fort Devens has been prepared by AMEC Earth & Environmental, Inc. (AMEC) on behalf of the United States Army Corps of Engineers, New England District (USACE-NAE). AOC 72 consists of Plow Shop Pond, located on the east of Shepley's Hill Landfill (SHL) at Devens (Figure 1). Plow Shop Pond discharges to Nonacoicus Brook which flows west on the north side of SHL. SHL and surrounding property including Nonacoicus Brook are included in the risk assessments for human and ecological receptors in the draft *Supplemental Groundwater and Landfill Cap Assessment* for SHL, which was issued as a BCT Draft in December 2008. Remediation of the landfill, and RI and Feasibility Study (FS) of AOC 72, is occurring under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, and National Oil and Hazardous Substances Contingency Plan (NCP) requirements, with regulatory coordination of the Massachusetts Department of Environmental Protection (MassDEP) and the United States Environmental Protection Agency (USEPA).

Plow Shop Pond has been the subject of numerous environmental studies. The initial step in this RI was preparation of a Data Gaps Analysis (DGA) Report (AMEC, 2006) in which gaps in existing site characterization data were identified. The available data for AOC 72 and information needed to complete the RI were the subject of subsequent meetings between MassDEP, USEPA, and USACE-NAE, including Base Realignment and Closure (BRAC) Cleanup Team (BCT) meetings on August 21, 2007, May 15, 2008, and June 19, 2008. A draft workplan was submitted for BCT review on August 25, 2008, and was the subject of subsequent BCT meetings (September 18 and 24, 2008) and correspondence during the period from September 2008 to February 2009. This draft final version of the workplan incorporates all changes in responses to comments during that time. A copy of the comments and responses is provided in Attachment F.

This RI Workplan presents an updated Conceptual Site Model (CSM) and DGA along with rationale and procedures for the collection of information required to satisfy the identified data gaps. Subsequent steps in the RI will include execution of this workplan, completion of an RI report which describes relevant site and contaminant conditions and identifies and quantifies potential risks to human health and the environment by site-derived contaminants, and evaluation of remedial actions in an FS, should the assessment identify unacceptable risks to human health and the environment.

This RI Workplan was prepared under contract Number GS-10F-0230J, Delivery Order Number W912WJ-05-F-0037, for the USACE-NAE. Attachments to this RI Workplan include a Sampling and Analysis Plan (SAP) and a Human and Ecological Risk Assessment (HERA) Plan. The SAP further consists of four stand-alone plans: the Field Sampling Plan (FSP), the Data Analysis Plan (DAP), the Quality Assurance Project Plan (QAPP), and the Site Safety and Health Plan (SSHP). The FSP provides a description of the sample design and rationale as well as the sampling and field data-gathering methods to be used on the project. The DAP describes how the data will be evaluated. The QAPP describes the chemical data quality objectives, analytical methods and measurements, Quality Assurance/Quality Control (QA/QC) protocols necessary to achieve the Data Quality Objectives (DQOs), and data assessment procedures for the evaluation and the identification of any data limitations. The SSHP describes health and safety procedures to be implemented during project work. The HERA Plan presents the procedures that will be used to assess the level of risk to human health and to the environment associated with known and anticipated exposures related to releases of site contaminants.

1.0 INTRODUCTION

This RI Workplan serves as the second step to complete an RI for AOC 72. The initial step was preparation of the DGA Report (AMEC, 2006) in which gaps in existing site characterization data were identified. Site characterization has continued since the DGA Report, and the available data for AOC 72 and information needed to complete the RI were the subject of BCT meetings between MassDEP, USEPA, and USACE-NAE on August 21, 2007, May 15, 2008, and June 19, 2008. A draft workplan was submitted for BCT review on August 25, 2008, and was the subject of subsequent BCT meetings (September 18 and 24, 2008) and correspondence during the period from September 2008 to February 2009. This draft final version of the workplan incorporates all changes in responses to comments during that time. A copy of the comments and responses is provided in Attachment F. This document was prepared under contract Number GS-10F-0230J, Delivery Order Number W912WJ-05-F-0037, for the USACE-NAE.

1.1 Site History

Plow Shop Pond is located southwest of the business and residential district in Ayer, Massachusetts. The 30-acre pond basin is bounded on the west and south by former Fort Devens property, to the north by commercial development (Molumco Industrial Park), and to the east by the Guilford Transportation railroad which crosses a causeway between Grove and Plow Shop Ponds (Figure 1). The pond is eutrophic with abundant aquatic plant life. Plow Shop Pond is used by local residents for recreational fishing, and is canoe-accessible at a landing on the northwest side. Signs are reportedly posted for "catch and release" fishing (Gannett Fleming 2006).

The pond is the last in a chain of six ponds in Ayer. Plow Shop Pond is fed by Grove Pond east of the railroad causeway through a culvert connecting the two, and discharges to Nonacoicus Brook through a dam on the west. The six ponds were formed by a series of dams installed in the 1800s. During that time Grove and Plow Shop Ponds were periodically "flowed" or flooded during the winter months to provide a source of ice, and were drained during the spring and summer for grazing of livestock. Prior to the existence of the ponds, the area that is now submerged was occupied by meadows underlain by peat bogs (Gannett Fleming 2006).

Plow Shop Pond and the surrounding ponds and rivers are located within the Squannassit Area of Critical Environmental Concern (ACEC). The ACEC designation by the Massachusetts Secretary of Energy and Environmental Affairs creates a framework for local, regional, and state stewardship of critical natural resources. The Squannassit ACEC encompasses 37,450 acres in portions of nine towns, and for the most part lies along and to the west of the Nashua River, from a section of Route 2 in the Towns of Harvard and Lancaster north to New Hampshire. ACEC resource details are provided at www.mass.gov/dcr/stewardship/acec/acecs/l-squsit.htm.

A former outflow located on the north side of Plow Shop Pond was used for water power at least since the late 1800s. A sawmill was located along the north outflow, which is identified as Saw Mill Brook on some plans. The flowage extended to the north beneath West Main Street and then turned to the west until it re-connected with Nonacoicus Brook. In 1942, the flowage was shown to be connected to a below ground culvert that discharged to a wetland on the north side of West Main Street. This culvert appears to have been blocked by a dike around 1961. The Saw Mill Brook outflow was apparently engineered so that it formed the principal outflow of Plow Shop Pond during its existence, and the Nonacoicus Brook dam was only used as a spillway during periods of high flow (ENSOL 2007).

In 1998, the U.S. Geological Survey (USGS) used a high-frequency acoustic energy fathometer and ground-penetrating radar (GPR) to measure water depth and saturated sediment thickness at Plow Shop Pond (Mercadante et al., 1999). Ground-truth values were obtained manually at several locations by pushing a stick into the sediment until refusal was met. Surface water was deepest (up to 8 feet) along the east side of the pond, and sediment was thickest (up to 16 feet) along the west side (Figure 2). Some sediment may have been emplaced prior to the construction of the dam in 1887 (Mercadante et al., 1999).

The uses of the properties west, south, and east of Plow Shop Pond appear to have changed little over the past century. SHL to the west was reportedly operating by the early 1940s, and evidence from test pits within the landfill suggests earlier usage, possibly as early as the mid-nineteenth century. The landfill contains a variety of waste materials, including incinerator ash, demolition debris, asbestos, sanitary wastes, spent shell casings, glass, and other wastes, and it was capped in 1993. The railroad causeway that bisects Grove and Plow Shop Ponds was constructed in 1848.

Study Area (SA) 71 at the southeast corner of the pond is the former location of a railroad roundhouse operated by the Boston and Maine Railroad from approximately 1900 to 1935. The site consists of a 200- to 300-foot wide strip of land extending south from Plow Shop Pond along the northeast installation boundary for approximately 1,100 feet. Historical features included an array of railroad tracks, a coal trestle, ash pit, water tower, and several buildings. The roundhouse was located at the northern end of this strip, immediately adjacent to the southern shore of Plow Shop Pond. Available maps and aerial photographs indicate that all of the buildings except a brick storeroom and the water tower had been removed by 1942.

The Molumco Industrial Park on the north currently includes a lumberyard, a resin distributor, and a warehouse. A plow manufacturer first located in this area in approximately 1850 and the building burned in 1886. A sawmill was located along Saw Mill Brook north of the Fitchburg Railroad right of way and south of West Main Street from the late 1800s through at least 1921. By 1892, a lumberyard affiliated with the sawmill took over the former location of the plow manufacturer. The area currently occupied by the Moore Lumber yard has been the location of a lumberyard for over 100 years. A number of wooden product manufacturers (furniture, box, and wooden wheels) have been located at the north end of Plow Shop Pond in proximity to the sawmill. From approximately 1892 to 1912, various food-processing (vinegar, cider, preserves) businesses were located immediately to the north of Plow Shop Pond (ENSOL 2007), and Nashoba Mordant & Dye Company operated in this area in the late 1800s (Gannett Fleming 2006).

1.2 Document Organization

Section 2 of this RI Workplan presents an updated CSM and DGA based on the most recent site data, along with rationale for the collection of information required to satisfy the identified data gaps, and proposed sampling locations. Subsequent steps in the RI will include execution of this workplan, completion of an RI report which describes relevant site and contaminant conditions and identifies and quantifies potential risks to human health and the environment by site-derived contaminants, and evaluation of remedial actions in an FS should the assessment identify unacceptable risks to human health and the environment. Section 3 of this RI Workplan presents a proposed schedule for completion of the RI and FS.

This RI Workplan includes a Sampling and Analysis Plan (SAP) and a Human and Ecological Risk Assessment (HERA) Plan. The SAP further consists of four stand-alone plans: the Field Sampling Plan (FSP), the Data Analysis Plan (DAP), the Quality Assurance Project Plan (QAPP), and the Site Safety and Health Plan (SSHP). The 4-part SAP and the HERA Plan are provided as Attachments A-D and E, respectively.

The FSP provides a description of the sampling and field data-gathering methods to be used on the project. The DAP describes how the data will be evaluated. The QAPP describes the chemical data quality objectives, analytical methods and measurements, Quality Assurance/Quality Control (QA/QC) protocols necessary to achieve the Data Quality Objectives (DQOs), and data assessment procedures for the evaluation and the identification of any data limitations. The SSHP describes health and safety procedures to be implemented during project work. The HERA Workplan presents the procedures that will be used to assess the level of risk to human health and to the environment associated with known and anticipated exposures related to releases of site contaminants.

2.0 CONCEPTUAL SITE MODEL & DATA GAPS ANALYSIS

This section of the workplan summarizes the CSM, identifies RI objectives and data gaps for completing the objectives, and presents an overview of the proposed activities to fill these gaps.

2.1 Conceptual Site Model

The primary contaminant relating to SHL and potentially presenting human and ecological risk is arsenic discharging to AOC 72 in groundwater. The transport and discharge of arsenic from groundwater to a pond has been studied in detail at several locations in Massachusetts. USEPA studied arsenic fate and transport in the Red Cove portion of Plow Shop Pond during the period from 2005 to 2007, and portions of this study are continuing (USEPA, 2008). The CSM contaminant transport conclusions that follow are largely based on the USEPA study results, which are consistent with studies at other sites.

Groundwater from SHL carrying dissolved arsenic, iron, and other metals discharges to AOC 72 in the vicinity of Red Cove. Iron oxides precipitate as an orange-red floc or sediment in Red Cove as reduced groundwater discharges to oxygenated surface water. Arsenic is adsorbed by or co-precipitated with the iron floc. Precipitation of metals occurs near and above the sediment surface where oxidizing conditions prevail. The redox boundary near the sediment surface results in decreasing sediment arsenic concentrations with depth below the sediment surface. Mixing of the sediment and surface water may lead to "recycling" of iron and arsenic where the dissolved contaminants from deeper zones are oxidized and precipitate again as sediment. Recycling between sediment and surface water may result in arsenic transport beyond the area of groundwater discharge, depending on the amount of turbulence and surface water flow. However, elevated sediment arsenic concentrations are observed primarily where the highest rates of groundwater from SHL are likely to discharge, closest to shore and south of the "hinge" between groundwater discharge to and recharge from the pond. Plow Shop Pond is a shallow, low-energy environment unfavorable to large-scale sedimentary mixing.

AOC 72 may also be impacted by polycyclic aromatic hydrocarbons (PAH) and/or metals released in the former Railroad Roundhouse (SA 71) area, and by inflow from the west end of Grove Pond. The western area of Grove Pond near the outlet to AOC 72 has been impacted by discharges from the former Hartnett Tannery located at its northwest corner. Sediment chromium concentrations are elevated near the former tannery in Grove Pond and throughout much of AOC 72, with the notable exceptions of Red Cove and the SA 71 area.

2.2 Evaluation of Existing Data

Documents containing site characterization data for AOC 72 are summarized in Table 1. The data developed during or prior to USEPA's 2006 Expanded Site Investigation (ESI) were evaluated for usability in that study. The data determined to be useable for the ESI were provided in an electronic format to USACE-NAE for the current RI Workplan. Subsequent to the ESI, the Army reported new results for SA 71, and these are being combined with the ESI data for the current evaluation. The studies for Plastic Distribution Corporation (PDC) by ENSOL in

2007 did not include any post-ESI sampling within AOC 72, but did include mapping of the ESI metals results for sediment (ENSOL 2007). USEPA's recent Red Cove study included sediment and surface water samples analyzed by non-conventional methods and the results of these samples have not been validated (USEPA, 2008).

Sections 6 and 8.2 of the ESI conclude that human health risk drivers for Grove and Plow Shop Ponds include arsenic, chromium, DDD, DDE, lead, manganese, mercury, PAHs, PCBs, and vanadium. The ESI suggests that vanadium has natural origins, and that DDD, DDE, PAHs, and PCBs are derived from a variety of anthropogenic inputs such as upstream contamination, stormwater runoff, atmospheric deposition, and contributions from the former tannery or SA 71. Sections 7 and 8.3 of the ESI conclude that ecological risk drivers for Grove and Plow Shop Ponds include arsenic, chromium, and PAHs.

Section 6 of the SA 71 study concludes that the principal contributors to human risk are arsenic, chromium, and PAHs. The ecological risk assessment was limited to benthic organisms and found that benzo(a)anthracene (a PAH) and zinc were the only Compounds of Potential Concern (COPCs) which explained variance in benthic toxicity results. No COPCs explained variability of benthic community indices, and it was suggested that stressed conditions observed in the benthic community may be caused by low oxygen conditions associated with eutrophication.

The locations and results of shallow[1] sediment samples tested for arsenic, iron, and chromium are illustrated in Figures 3-5 for Plow Shop Pond and Figures 6-8 for Grove Pond. Approximately 104 sediment and 42 surface water sampling locations are included in the available data for metals in Plow Shop Pond. Approximately 70 of the Plow Shop Pond sediment samples and 15 of the surface water samples also have PAH analyses. Benthic toxicity data collected in the ESI included 11 samples from Plow Shop Pond and 3 samples from Grove Pond, using a 10-day test period. Data for longer-duration (20-day Choronomid and 42-day amphipod) toxicity tests were developed during the SA 71 study for the former Railroad Roundhouse area, and for a reference area on the south side of AOC 72 located between Red Cove and the former roundhouse. The ESI results for other metals are presented in the ENSOL report; note especially Figures 6.2 (aluminum), 6.7 (lead), 6.9 (zinc), 6.11 (mercury), and 6.12 (manganese) for other metals identified in the SHL ROD and risk drivers identified in the ESI or SA 71 reports.

The depictions in Figures 2-8 of elevated arsenic and iron concentrations in the Red Cove area, and elevated chromium concentrations in Grove Pond near the outlet and throughout much of Plow Shop Pond, are consistent with earlier maps from the ESI and from PDC's report, and support key points of the CSM. These figures do not include a few locations from the ESI data nor the USEPA Red Cove data. The exclusions from the electronically-supplied ESI data were made because of missing coordinates and unexplained duplicate results, and additional review of the report and backup data are likely to allow future use of these data for the RI. USEPA has indicated that the Red Cove data can be validated for future use in the RI. The excluded results appear to be consistent with other data points in the sampled areas; therefore they are not expected to be significant for the data gap evaluation that follows.

[1] For the purpose of this initial data gap evaluation, sediment samples were selected where the depth listed in the database is less than 1 foot. Deeper samples will be considered in the RI as appropriate.

2.3 RI Technical Objectives and Data Gaps

The overall objectives of the Army and other project stakeholders for the AOC 72 RI are to complete the investigation of Plow Shop Pond as needed to estimate risks to human health and the environment, and to close all CERCLA-related reporting. Specific technical objectives include the following:

- Evaluate current and potential future contaminant flux from SHL to AOC 72.
- Evaluate other contaminant sources and distribution in AOC 72.
- Evaluate whether the iron floc in Red Cove can act as a physical asphyxiant.
- Evaluate whether the iron floc in Red Cove constitutes "readily apparent harm" as defined under the MCP.
- Evaluate human and ecological risks related to site contaminants in sediment.
- Evaluate human and ecological risks related to site contaminants in surface water.
- Evaluate localized ecological risks related to site contaminants in Red Cove.

Working hypotheses and methods of evaluation are summarized in Table 2, along with the data needed and any apparent data gaps. These evaluations and data gaps are discussed below.

2.3.1 Contaminant Flux from Shepley's Hill Landfill

The ongoing groundwater discharge from Shepley's Hill Landfill to Plow Shop Pond may be expected to result in increasing concentrations and/or volume of contaminants in sediment, as the solid phase metals accumulate in sediment due to precipitation from groundwater. The accumulation rates can be estimated based on current flux rates measured by USEPA in the Red Cove study, chemistry data for sediment and upgradient groundwater, and groundwater modeling. Data are available from existing studies and there are no apparent data gaps for this evaluation.

2.3.2 Other Contaminant Sources and Distribution in AOC 72

Other contaminant sources besides SHL have been identified for AOC 72, including SA 71 (former Railroad Roundhouse) on the south side of Plow Shop Pond and the former Hartnett Tannery located at the west end of Grove Pond where it discharges to Plow Shop Pond. The principal sources of Contaminants of Potential Concern (COPCs) have largely been established by prior studies and risk assessments, i.e. PAHs and zinc contributed by SA 71 and chromium by the former tannery. Site histories, chemistry, and fate/transport data are largely available from existing studies. EPA has requested additional sediment samples north of the existing SA 71 samples to further evaluate the extent of effects from this area.

2.3.3 Iron Floc as an Asphyxiant

The iron floc that appears to be concentrated in Red Cove may not be dense enough to provide benthic habitat, but may impede oxygen transport from surface water to the sediment surface, stressing benthic receptors. The potential for the floc to act as a physical asphyxiant or oxygen barrier will be evaluated by comparison of sediment physical properties and in situ dissolved oxygen (DO) between floc and non-floc areas. (The potential for chemical toxicity will be evaluated through toxicity testing as described further below). Data are not available from existing studies and will be collected for this evaluation, through field measurements of DO and collection of undisturbed sediment cores and testing for density and specific gravity.

2.3.4 Iron Floc as Readily Apparent Harm

Section 40.0995 of the Massachusetts Contingency Plan (MCP) describes conditions that represent readily apparent harm as:

> a. Visual evidence of stressed biota attributable to the release at the disposal site, including, without limitation, fish kills or abiotic conditions.
> b.. The existence of oil and/or hazardous material attributed to the disposal site in concentrations which exceed Massachusetts Surface Water Standards promulgated in 314 CMR 4.00, which include USEPA Ambient Water Quality Criteria applied pursuant to 314 CMR 4.05(5)(e).
> c. Visible presence of oil, tar, or other non-aqueous phase hazardous material in soil within three feet of the ground surface over an area equal to or greater than two acres, or over an area equal to or greater than 1,000 square feet in sediment within one foot of the sediment surface.

MassDEP is of the opinion that the persistent red staining from the iron/arsenic flocculant, viewable from satellite imagery, paired with pond bottom devoid of healthy plant life is sufficient visual evidence of stressed biota and rises to the level of "readily apparent harm" as per 310 CMR 40.0995(3)(b)(1)(a). The conclusion that "readily apparent harm" exists at and around Red Cove is further supported in MassDEP's view by present data and visual observations per 40.0995(3)(b)(1)(b) and 40.0995(3)(b)(1)(c): present sampling data suggests that flocculant and groundwater discharges to Red Cove exceed the Massachusetts Surface Water Quality Standards (314 CMR 4.00) for several constituents and the flocculant impacted area covers an area greater than one thousand square feet within one foot of the sediment surface.

In addition, the USEPA ORD 2008 Report Section 4.2 Sediment Chemistry indicates that there is correlation with stressed biota and iron/arsenic flocculant: "The transition zone from groundwater to surface water in Red Cove is characterized by a sharp transition from reducing to oxidizing condition [and] is visually evidenced by the pervasive precipitation of reddish-orange iron oxides...in locations with minimal growth of aquatic plants."

Visual observations and documentation of floc, vegetation, and biota conditions will be made during RI data collection activities. Data collection activities include benthic community surveys in dredge and sweep samples, toxicity testing, physical testing, and chemistry (including dissolved oxygen and TCLP) testing. These results will be used to evaluate the hazards posed by the iron floc.

2.3.5 Risks Related to Sediment

Human health and ecological risks due to sediment exposure will be estimated in accordance with USEPA guidance, as described in detail in the HERA Workplan (Attachment E). Sediment chemistry data will be used for estimating human and terrestrial ecological receptor risks, and is readily available from previous studies. Sediment toxicity data for benthic macroinvertebrates (BMI) are most widely available for short (10-day) test durations. Longer test periods as are currently preferred by MassDEP were only performed for the SA 71 samples, which include the former Railroad Roundhouse area and a reference area on the south side of AOC 72. Sediment Quality Triad (SQT) tests encompassing chemistry, longer duration toxicity, and community surveys of species diversity will be performed for sediment at other locations within AOC 72 and reference areas.[2]

2.3.6 Risks Related to Surface Water

Human health and ecological risks due to surface water exposure will be estimated in accordance with USEPA guidance, as described in detail in the HERA Workplan. Surface water chemistry data will be used for estimating human and terrestrial ecological receptor risks, and is readily available from previous studies; there are no apparent data gaps for this evaluation. Deep surface water samples representative of groundwater upwelling conditions in Red Cove will be collected as described in Section 2.3.7.

2.3.7 Localized Risk in Red Cove

Localized risks for BMI receptors and aquatic organisms specific to Red Cove may be greater than for AOC 72 in general, due to groundwater upwelling in relatively small portions of the Red Cove area. An evaluation of localized risk will be conducted as described above using sediment and surface water data for upwelling and local reference areas. SQT tests, and surface water chemistry and toxicity tests, will be collected for these types of areas in Red Cove to evaluate sediment and surface water impacts. Deep surface water samples will be collected immediately above the sediment surface using a low-flow sampling procedure.

2.4 Proposed RI Activities

AOC 72 sediment and surface water have been sampled extensively as indicated in the preceding figures and documented in the referenced reports. Data gaps for the RI were identified in Section 2.3 and Table 2, focused on evaluating conditions specific to iron floc and groundwater upwelling areas in Red Cove, and SQT tests for AOC 72 (including SA-71) and reference areas. The following data collection activities are proposed to eliminate these data gaps and allow completion of the RI. Proposed sampling locations for Plow Shop Pond are indicated in Figure 9 and for Grove Pond in Figure 10. SQT chemical analytes beyond the metals having cleanup goals in the SHL ROD (aluminum, arsenic, chromium, iron, lead, manganese, nickel, and sodium will include PAHs, mercury (including methylmercury), and zinc, considering the ESI and SA 71 study results suggesting that one or more PAHs and mercury or zinc are among the potential risk drivers for human and ecological receptors. The following discussion of proposed locations includes a brief summary of existing results for the COPCs in each area of interest. Detailed sampling procedures are provided in the Field Sampling Plan (FSP) in Attachment A. The benthic biota portions of SQT samples will be collected in triplicate from dredge samplers as described in FSP Section 4.4, and by sweep netting as described in FSP Section 4.5.

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[2] As a control on change in contaminant species during the toxicity test, a dummy toxicity test beaker for each sediment sample will be frozen upon test completion and shipped to EPA's laboratory for determination of arsenic species, and comparison with pre-toxicity testing conditions.

2.4.1 Red Cove

Conduct SQT tests for surface sediment (0-6 inches) at six locations in Red Cove providing coverage from the head to the mouth, with a target water depth of 0.25-1.0 m. Sampling locations will include a range of groundwater upwelling conditions and apparent floc thicknesses. These conditions will be determined by field screening prior to selecting final sample locations. The initial proposed area of field screening is depicted in Inset B of Figure 9. This proposed area may be revised based on underwater photography to be conducted over the larger area outlined in Figure 9. Photographic results of the larger area will be discussed with the BCT prior to initiating field screening.

Field screening will be conducted at 15 points near Red Cove and will include underwater photography and measurement of sediment pore water characteristics (ph, DO, ORP, specific conductance) at 0-6 and 6-12 inches below sediment surface using a filtered push-point sampler. Results of these measurements will be presented and discussed with the BCT to select the final SQT sample locations. Additional samples will be collected concurrent with SQT sampling as follows:

1. At the same six locations and prior to SQT sampling, sample deep surface water (0-6 inches above sediment surface) for analysis of metals and water quality parameters including ammonia, and field measurement of pH, DO, ORP, & SC.
2. At three of the six locations, determined based on upwelling conditions and discussed with BCT, also sample deep surface water prior to SQT sampling for analysis of toxicity using Daphnia and Minnow.
3. At three of the six locations, determined based on floc conditions and discussed with BCT, also collect a sediment core prior to SQT sampling for physical testing of the upper 6 inches for density and specific gravity, to evaluate the asphyxiation potential associated with the floc.
4. At the same six locations and after SQT sampling, conduct sweep sampling above the sediment surface for benthic community analysis (BCA).
5. At a total of seven locations within 10 feet of the shoreline of Red Cove, collect surface sediment (0-6 inches) for chemistry analysis only (not benthic toxicity or community analyses). The six SQT sampling locations described above to be selected based on field screening may be among these seven locations; sufficient additional samples will be collected to total seven. The seven sediment chemistry locations will be discussed and determined with BCT at the same time as the six SQT locations.

As indicated in Section 2.1 and 2.2, Red Cove has the highest observed concentrations of arsenic (Figure 9), iron (Figure 4), and manganese (ENSOL Figure 6.12b) for surface sediment in AOC 72. Concentrations of other metal COPCs in this area are relatively low.

2.4.2 Plow Shop Pond Reference Coves

Conduct SQT tests for surface sediment (0-6 inches) at the "Little Cove" west of SA 71 (location #7), at the tip of the Northeast Cove (location #8), and in the vicinity of PSP02 on the west bank of the Northeast Cove (location #9) as indicated in Figure 9. These reference locations were observed from the water during a site reconnaissance on 9/24/08. The Northeast and Little Cove locations appear to have habitat similar to Red Cove, and the PSP02 location appears similar to the SA71 area. Prior to SQT sampling, a deep surface water sample and a sediment core will be collected at locations #8 and #9. After SQT sampling at all three locations, a sweep sample will be collected above the sediment surface for BCA.

Little Cove appears to be hydraulically downgradient of groundwater flowing along the east boundary of Shepley's Hill Landfill, and a portion of the groundwater discharging into the pond in this area may flow beneath SHL. Two historic sediment samples were collected in Little Cove southeast of location #7, SHD-92-02X and SHD-94-01X. Neither of these locations had elevated concentrations of arsenic (Figure 3) or chromium (Figure 5), but SHD-92-02X had an elevated level of iron (Figure 4). Both samples appeared to have relatively high levels of manganese (ENSOL Figure 6.12b), but levels of other metals – including mercury and zinc – did not appear to be elevated. The portion of Little Cove east of proposed location #7 was observed to have a reddish floc during the reconnaissance and this presumed iron floc area will be avoided during sampling.

The Northeast Cove sediment was sampled near proposed location #8 with SE-SHL-09, and proposed location #9 is slightly north of sediment sample PSP02 on the southwest bank of the cove. Like Little Cove, the sediment at SE-SHL-09 appears to have elevated levels of iron (Figure 4) and manganese (ENSOL Figure 6.12b) but not arsenic (Figure 3), and this area seems likely to be a groundwater discharge area considering regional hydrology. Chromium at SE-SHL-09 appears to be elevated compared to Little Cove and much of Plow Shop Pond (ENSOL Figure 6.5b), as is lead (ENSOL Figure 6.7b), but mercury, zinc, and other metals do not appear to be elevated. PSP02 may have elevated levels of zinc (ENSOL Figure 6.9b) and manganese (ENSOL Figure 6.12b), but other metals concentrations appear similar to elsewhere in Plow Shop Pond.

2.4.3 SA 71 (Railroad Roundhouse)

Conduct SQT tests for surface sediment (0-6 inches) at locations #10 and #11 in Figure 9. These two samples are positioned north and east of prior sediment sampling at SA 71, to further evaluate the extent of effects in this area. After SQT sampling, a sweep sample will be collected above the sediment surface for BCA.

Location #10 is northwest of existing sediment sample 71D-05-07X, which had elevated PAHs, a moderately impaired benthic community, and the third highest benthic toxicity of the 2005 SQT samples. Location #10 is also directly north of the highest zinc concentrations in sediment, which were in the area around and shoreward of 71-D-06-18X and 71-D-06-21X. Location #11 is northeast of the existing SA 71 sediment samples, and the nearest samples did not include benthic toxicity or community testing. The nearest samples to location #11 did not coincide with any maxima for the contaminants identified as having been released at SA 71.

2.4.4 Grove Pond

Conduct SQT tests for surface sediment (0-6 inches) at locations #12 to #17 in Figure 10. These samples are positioned near the inlet (#15-17) and outlet (#12-14) of Grove Pond. After SQT sampling, a sweep sample will be collected above the sediment surface for BCA.

The Grove Pond outlet area at proposed locations #12-14 appears to have elevated surface sediment concentrations of chromium (Figure 8), and possibly elevated lead (ENSOL Figure 6.7) and/or mercury (ENSOL Figure 6.12), compared to Plow Shop Pond or other portions of Grove Pond. The Grove Pond inlet area at proposed locations #15-17 may have slightly elevated surface sediment concentrations of zinc (ENSOL Figure 6.9) compared to Plow Shop Pond or other portions of Grove Pond.

Sampling and analysis procedures are described in detail in the SAP provided as Attachments A-D.

3.0 PROJECT SCHEDULE

The proposed schedule of project activities and milestones is presented in Figure 11. As indicated in the schedule, sampling and analysis (line 14) is proposed for late April 2009 when the water and sediment have warmed and the maximum number of benthic species will be in their larval stages. Pond temperatures will be monitored starting in April and the results discussed with the BCT prior to finalizing a sampling date. Completion of the Final RI Report (line 30) is expected in August 2010 based on this sampling schedule. Assuming that a formal FS Workplan (line 31) is prepared, and that workplan preparation is contingent on substantive agreement on the RI Report, completion of the Final FS Report (line 48) is expected by July 2011.

REFERENCES

AMEC. 2006. *Final Data Gaps Analysis Report, Shepley's Landfill, Devens, MA (SHL-0066).* Prepared for USACE-NAE, Concord MA. March.

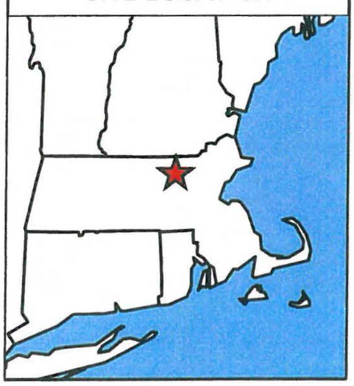
ENSOL, 2007. *Phase II Comprehensive Site Assessment, Area 2 - Grove Pond and Plow Shop Pond.* Prepared for Plastic Distribution Corporation, Ayer MA. July.

Gannett Fleming, 2006. *Expanded Site Investigation. Remedial Oversight of Activities at Fort Devens Plow Shop and Grove Ponds, Draft.* Prepared for USEPA Region 1. May.

Mercadante, A.M., Colman, J.A., Buursink, M.L., 1999. Map Showing Morphometry, Bathymetry, and Soft-Sediment Thickness of Plow Shop and Grove Ponds, Fort Devens, Ayer, Massachusetts. USGS Water-Resources Investigations Report 99-4241.

USEPA, 2008. *Arsenic Fate, Transport and Stability Study, Final Report.* USEPA National Risk Management Research Laboratory. September.

SITE LOCATION



Plow Shop Pond Location

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

LEGEND

Streams
Landfill Boundary

0 750 Feet

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FIGURE 1

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SITE LOCATION

Plow Shop Pond Bathymetry
and Sediment Thickness

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

LEGEND

Bathymetric Contours (meters)

- 2.26 - 2.43 max
- 2.01 - 2.25
- 1.76 - 2.00
- 1.51 - 1.75
- 1.26 - 1.50
- 1.01 - 1.25
- 0.76 - 1.00
- 0.51 - 0.75
- 0.26 - 0.50
- 0.00 - 0.25

Sediment Thickness (meters)

Landfill Boundary

N

0 150 Feet

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FIGURE 2

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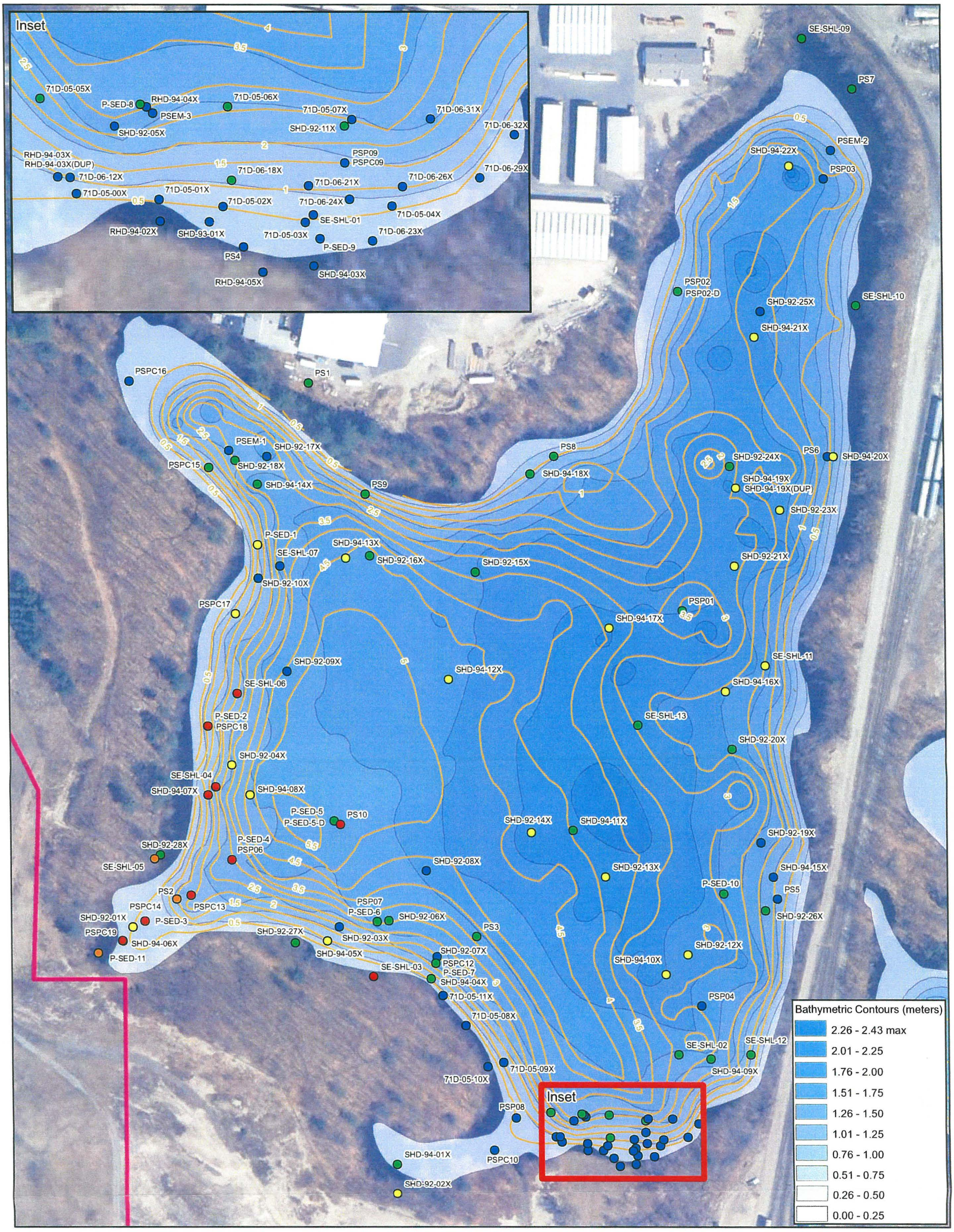

SITE LOCATION

Arsenic in Shallow Sediment of Plow Shop Pond

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

LEGEND

Arsenic (mg/kg) in Surface Sediment (0-1 foot)

- 1,801 - 6,800
- 651 - 1,800
- 321 - 650
- 141 - 320
- 0 - 140

Sediment Thickness (meters)

Landfill Boundary

0 160 Feet

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FIGURE 3

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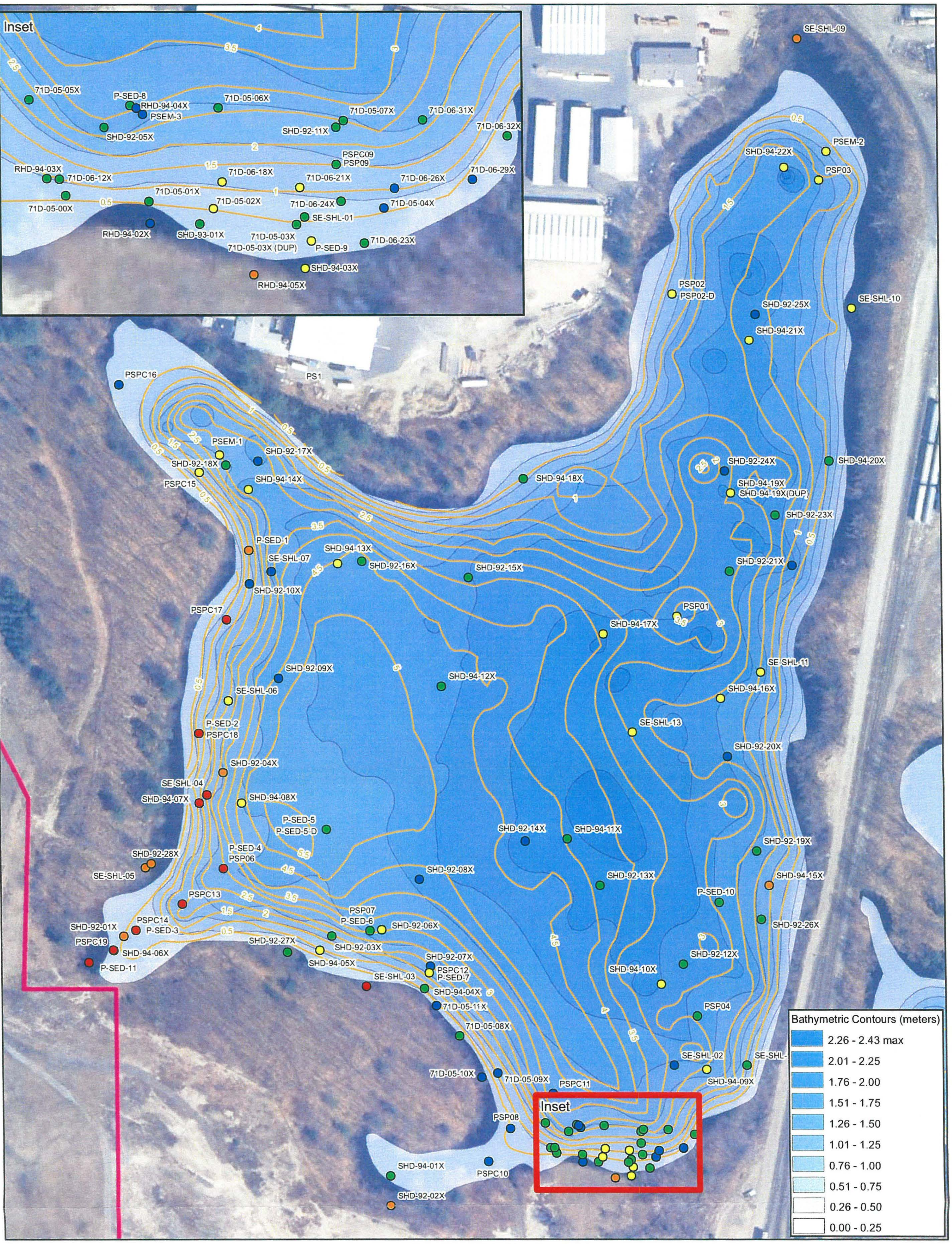

Iron in Shallow Sediment of Plow Shop Pond

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

LEGEND

Iron (mg/kg) in Surface Sediment (0-1 foot)

- 69,701 - 410,000
- 40,301 - 69,700
- 24,701 - 40,300
- 12,301 - 24,700
- 428 - 12,300

Sediment Thickness (meters)

Landfill Boundary

0 160 Feet

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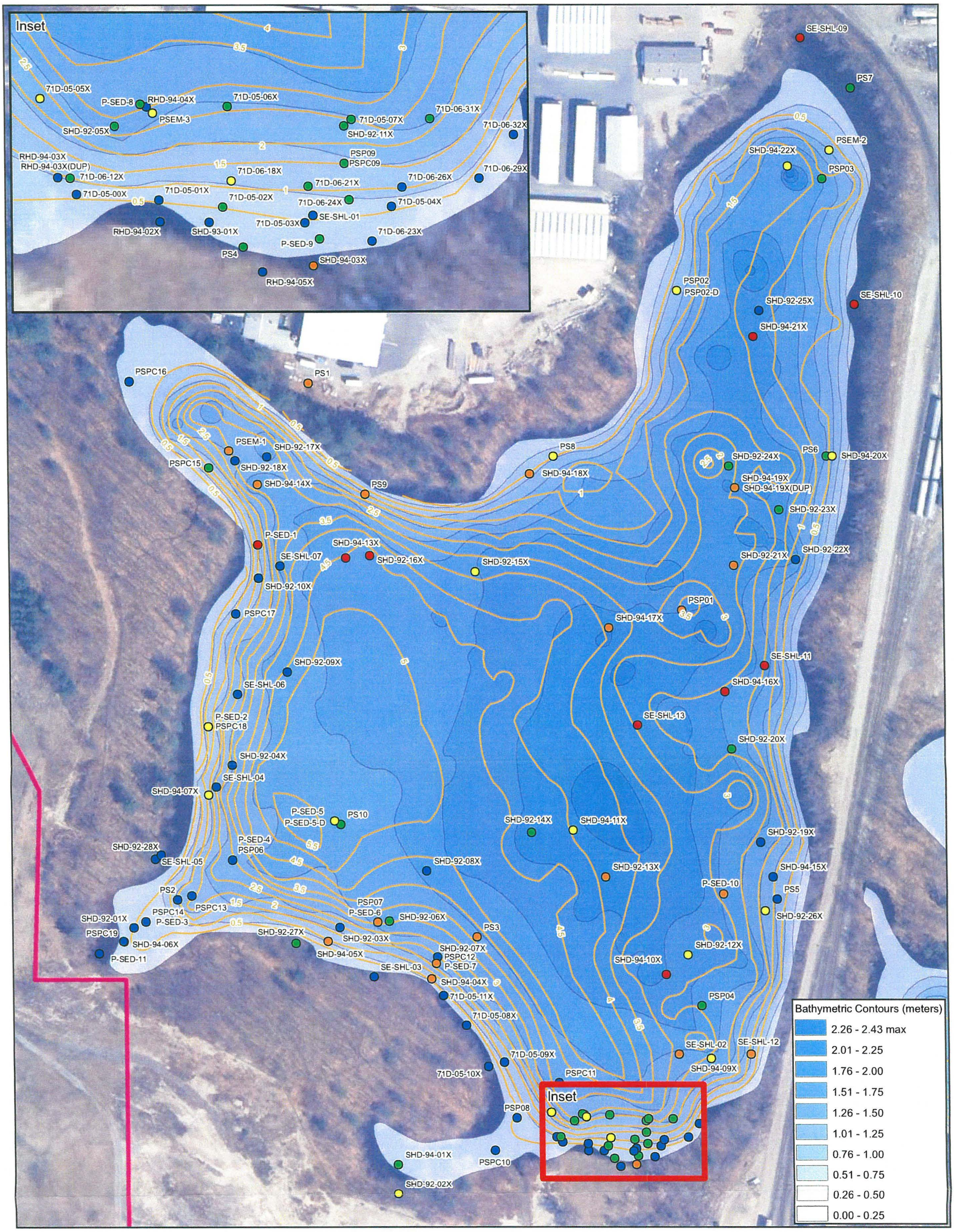
FIGURE 4

H:\ShepleyLandfill\Task21\MXD\Figure4_Iron.mxd H:\ShepleyLandfill\Task21\Export\Figure4_Iron.pdf March 4, 2009 DWN: AP KMP DJK CHKD: KMP



SITE LOCATION

Chromium in Shallow Sediment of Plow Shop Pond

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

LEGEND

Chromium (mg/kg) in Surface Sediment (0-1 foot)

- 5,251 - 10,000
- 3,401 - 5,250
- 1,871 - 3,400
- 651 - 1,870
- 0 - 650
- Sediment Thickness (meters)
- Landfill Boundary

N

0 160 Feet

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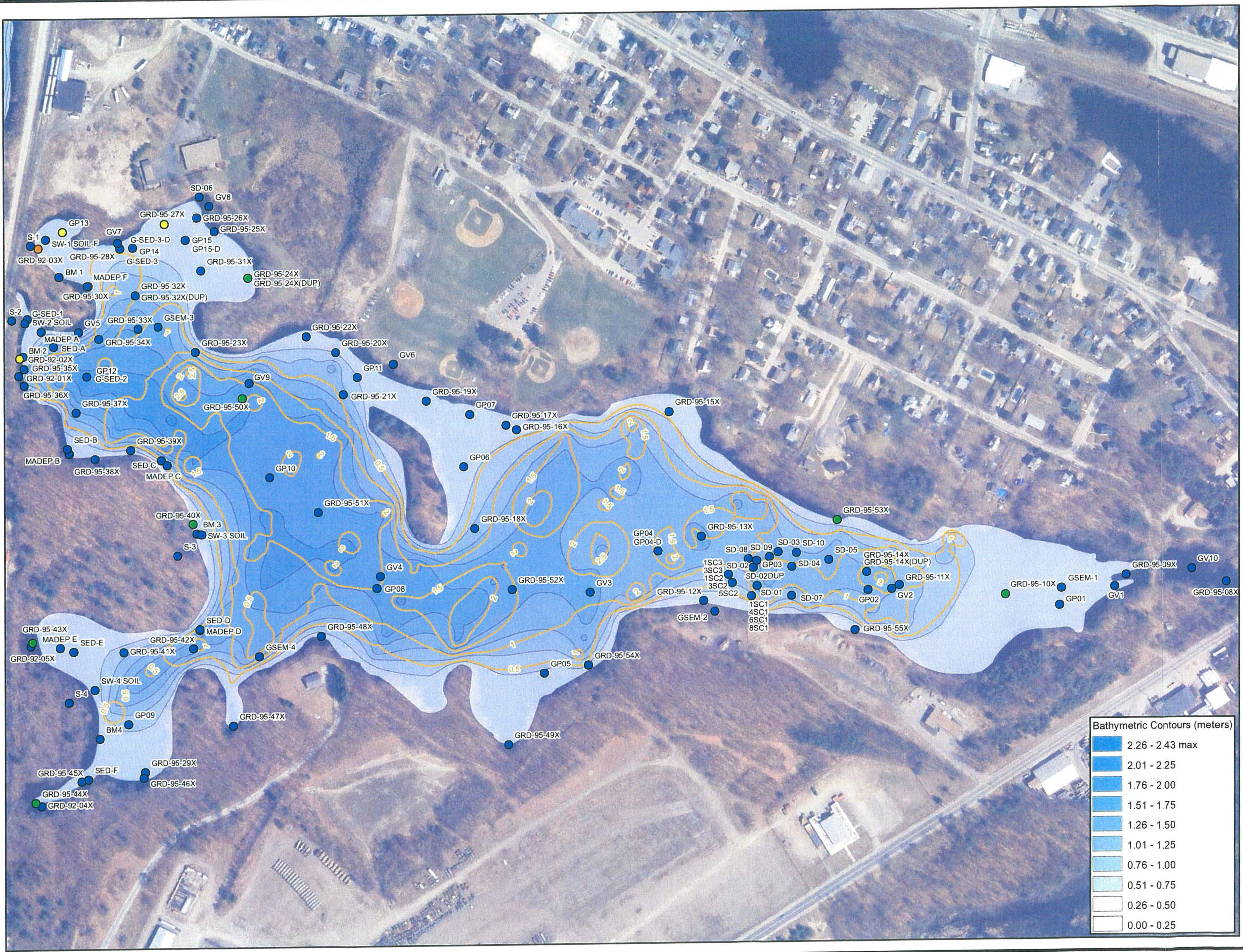
FIGURE 5

H:\ShepleyLandfill\Task21\MXD\Figure5_Chromium.mxd H:\ShepleyLandfill\Task21\Export\Figure5_Chromium.pdf March 4, 2009 DWN: AP KMP DJK CHKD: KMP



Arsenic in Shallow Sediment of Grove Pond

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

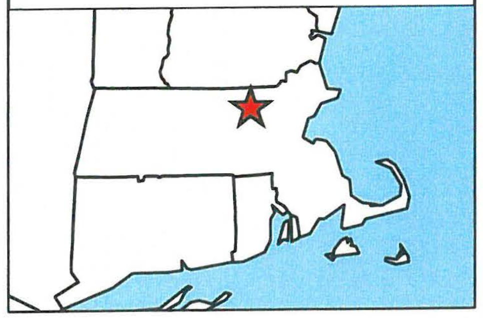
Ayer, Massachusetts

LEGEND

Arsenic (mg/kg) in Surface Sediment (0-1 foot)

- 1,801 - 4,300
- 651 - 1,800
- 321 - 650
- 141 - 320
- ND - 140
- Sediment Thickness (meters)
- Landfill Boundary

SITE LOCATION



NOTES & SOURCES

Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.
Data from MassGIS.

0 400
Feet

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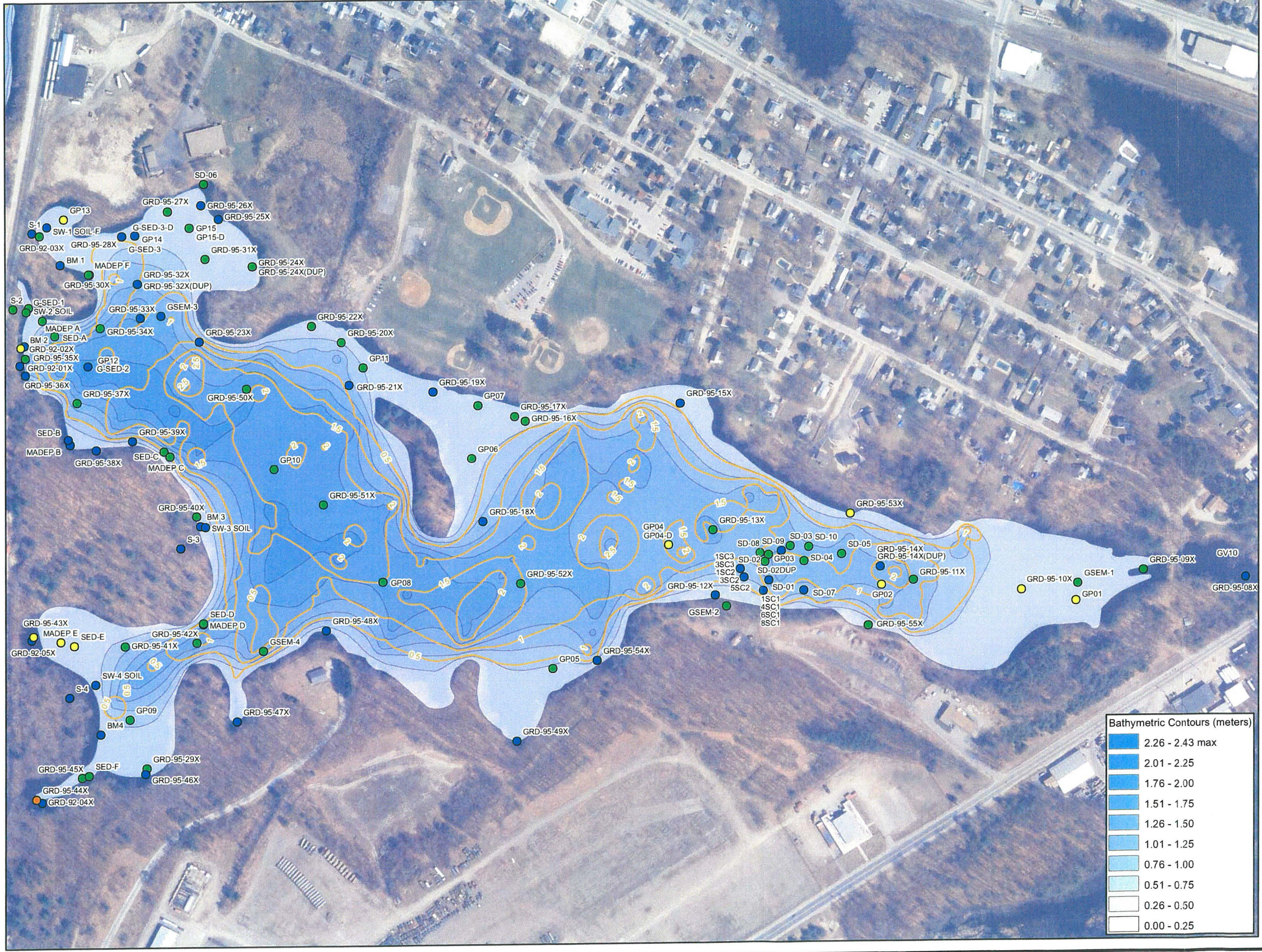
March 4, 2009 DWN: AP DJK CHKD: KMP

FIGURE
6



Iron in Shallow Sediment of Grove Pond

Remedial Investigation Work Plan AOC 72, Plow Shop Pond

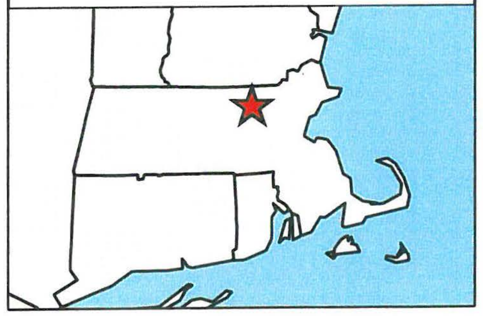
Ayer, Massachusetts

LEGEND

Iron (mg/kg) in Surface Sediment (0-1 foot)

- 69,701 - 410,000
- 40,301 - 69,700
- 24,701 - 40,300
- 12,301 - 24,700
- 93 - 12,300
- Sediment Thickness (meters)
- Landfill Boundary

SITE LOCATION



NOTES & SOURCES

Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.
Data from MassGIS.

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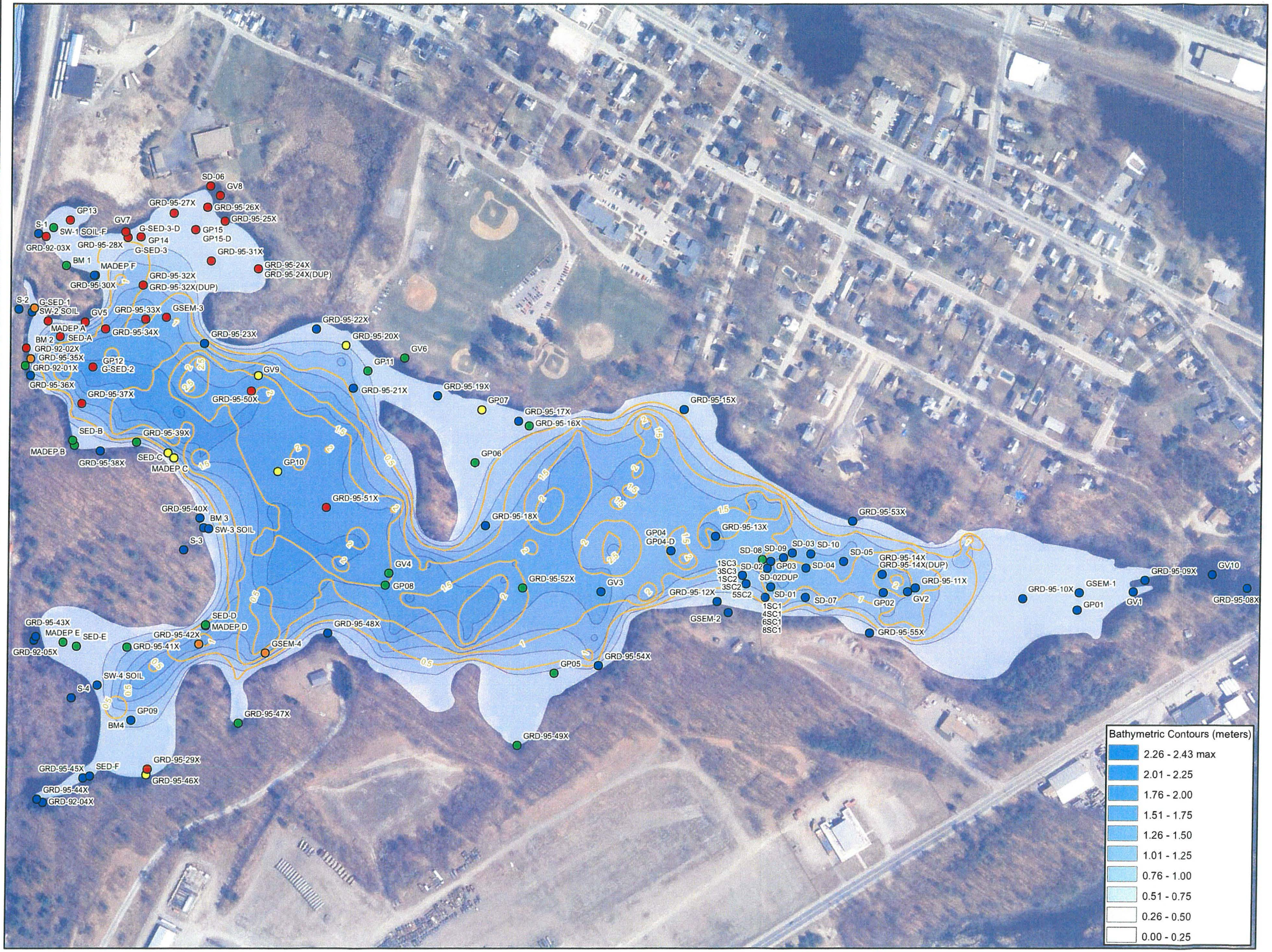
March 4, 2009 DWN: AP DJK CHKD: KMP

FIGURE 7



Chromium in Shallow Sediment of Grove Pond

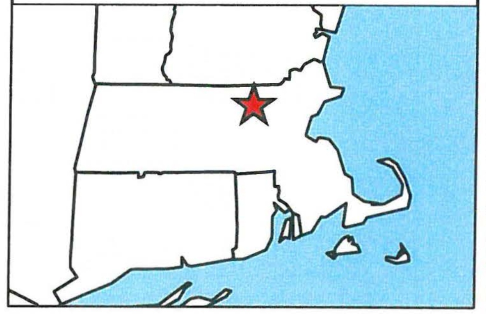
Remedial Investigation Work Plan
AOC 72, Plow Shop Pond
Ayer, Massachusetts

LEGEND

Chromium (mg/kg) in Surface Sediment (0-1 foot)

- 5,251 - 52,000
- 3,401 - 5,250
- 1,871 - 3,400
- 651 - 1,870
- ND - 650
- Sediment Thickness (meters)
- Landfill Boundary

SITE LOCATION



NOTES & SOURCES

Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.
Data from MassGIS.

0 400
Feet

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FIGURE 8

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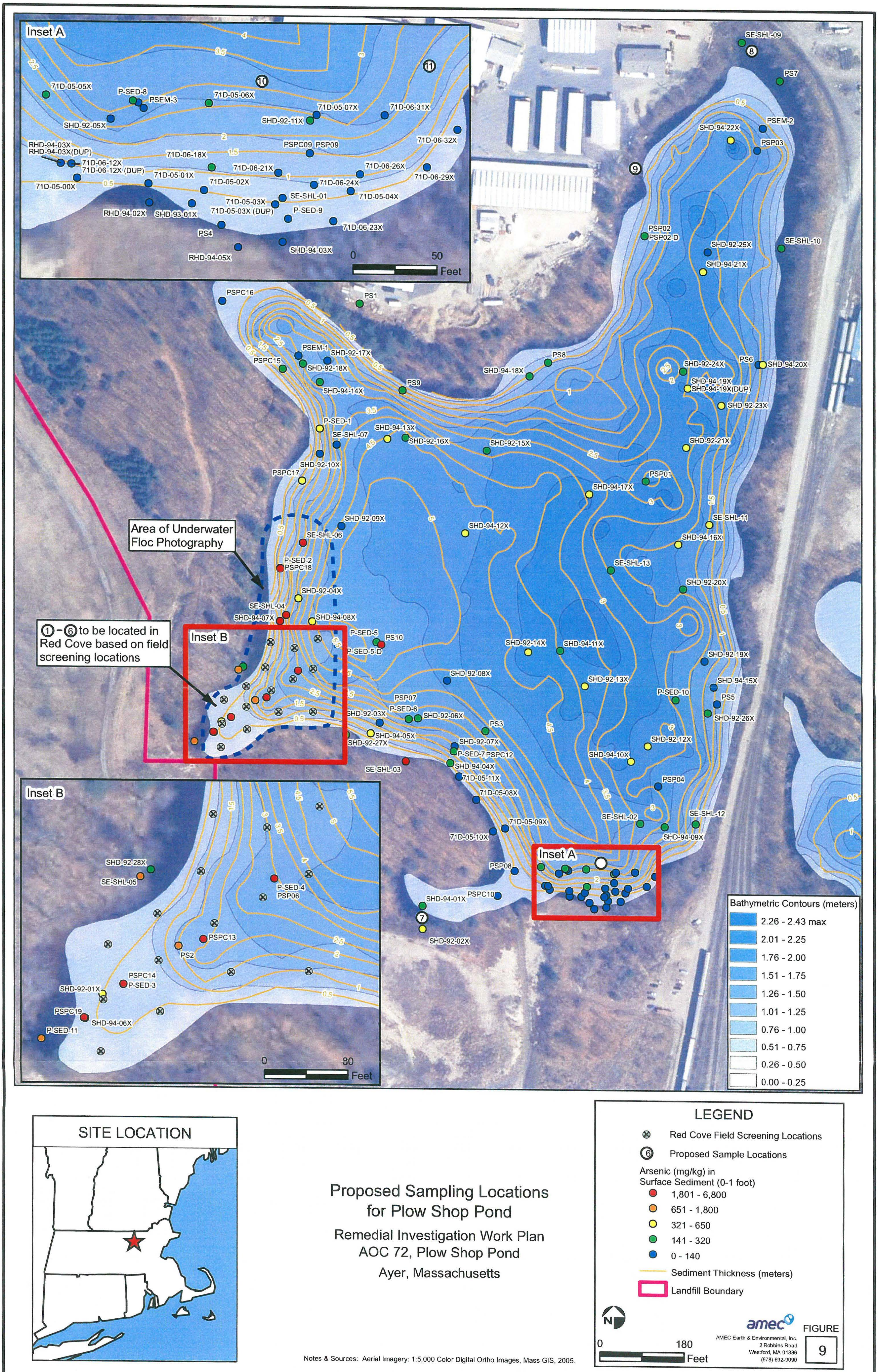
March 4, 2009 DWN: AP DJK CHKD: KMP



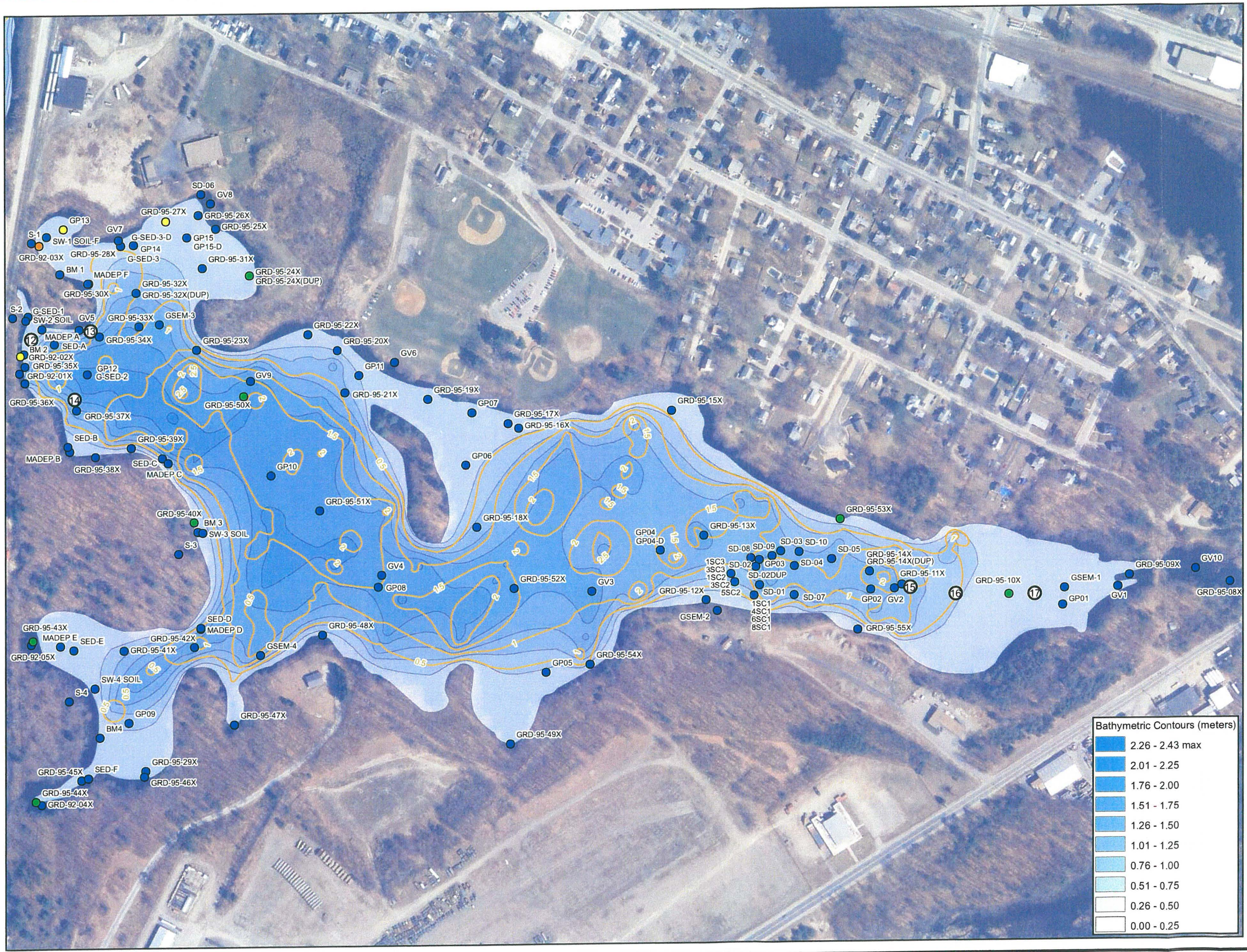
Proposed Sampling Locations for Plow Shop Pond

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond
Ayer, Massachusetts

FIGURE 9

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

H:\ShepleyLandfill\Task19\MXD\Figure 9 Field Screening Locations.mxd H:\ShepleyLandfill\Task19\Export\Figure 9 Field Screening Locations.pdf March 4, 2009 DWN: KMP DJK CHKD: KMP



Proposed Sampling Locations for Grove Pond

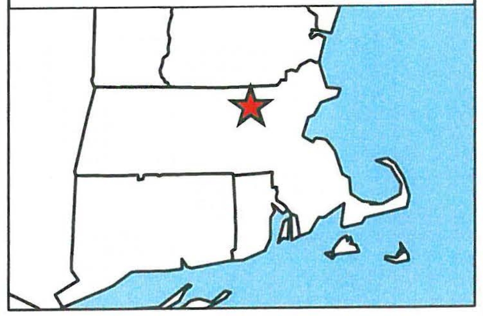
Remedial Investigation Work Plan AOC 72, Plow Shop Pond

Ayer, Massachusetts

LEGEND

- (2) Proposed Sample Locations
- Arsenic (mg/kg) in Surface Sediment (0-1 foot)
  - 1,801 - 4,300
  - 651 - 1,800
  - 321 - 650
  - 141 - 320
  - ND - 140
- Sediment Thickness (meters)
- Landfill Boundary

SITE LOCATION



NOTES & SOURCES

Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.
Data from MassGIS.

0 400
Feet

amec

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FIGURE 10

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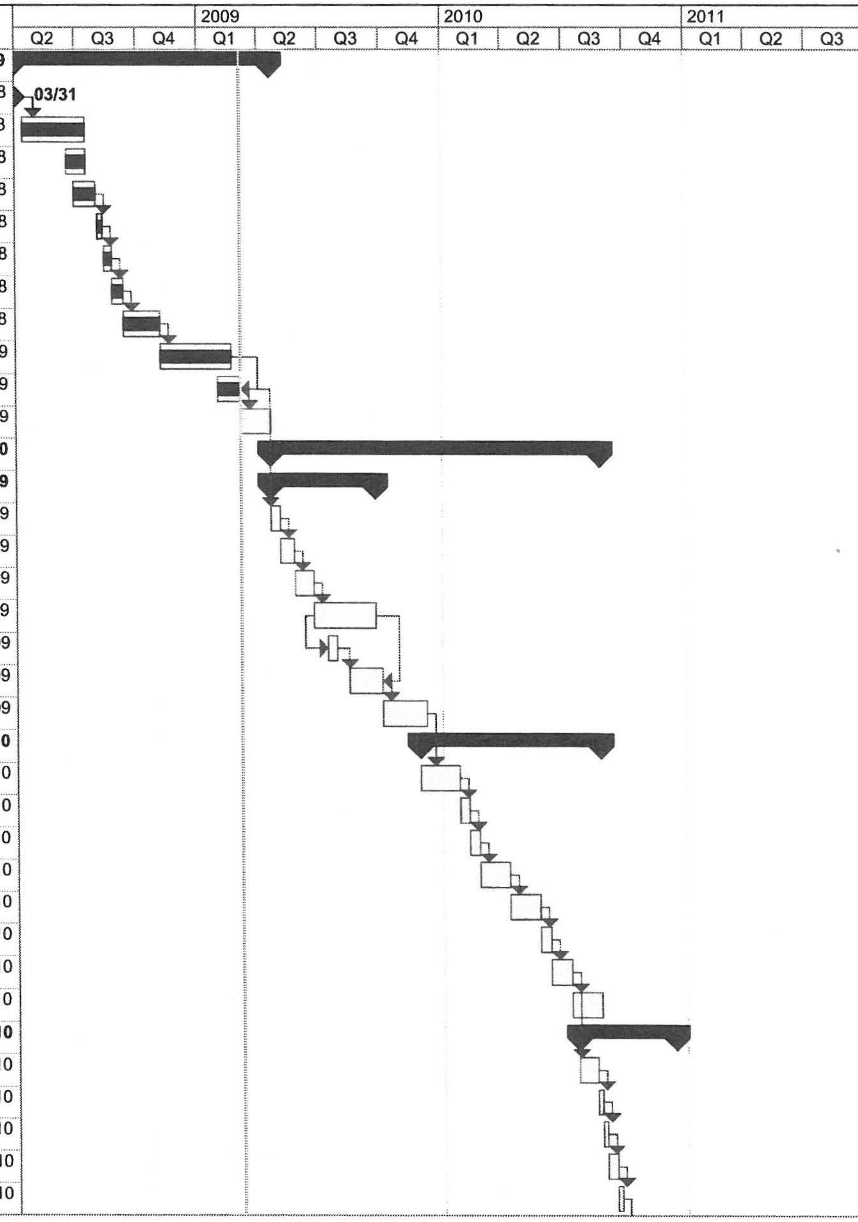
March 4, 2009 DWN: DJK CHKD: KMP

Figure 11. Proposed Project Schedule

ID	% Compl	Task Name	Duration	Start	Finish
1	**87%**	**AOC 72 RI Work Plan**	**317 days**	**Mon 03/31/08**	**Mon 04/20/09**
2	100%	Receive all relevant data	0 days	Mon 03/31/08	Mon 03/31/08
3	100%	Review data for usability and create database	68 days	Mon 04/14/08	Wed 07/16/08
4	100%	Update DGA and CSM	21 days	Thu 06/19/08	Thu 07/17/08
5	100%	Draft Work Plan	25 days	Mon 06/30/08	Fri 08/01/08
6	100%	Army review	6 days	Mon 08/04/08	Mon 08/11/08
7	100%	Preparation of BCT draft, incl. backcheck	8 days	Thu 08/14/08	Mon 08/25/08
8	100%	BCT Review	12 days	Tue 08/26/08	Thu 09/11/08
9	100%	BCT Mtg (9/18) and RCLs	39 days	Fri 09/12/08	Wed 11/05/08
10	100%	BCT Final Comment Review & Resolution	101 days	Thu 11/06/08	Fri 02/20/09
11	100%	Revise document and issue draft final	34 days	Sat 01/31/09	Fri 03/06/09
12	0%	Draft final document becomes final	45 days	Sat 03/07/09	Mon 04/20/09
13	**0%**	**AOC 72 RI Report**	**481 days**	**Mon 04/20/09**	**Wed 08/25/10**
14	**0%**	**Sampling/Analysis**	**154 days**	**Mon 04/20/09**	**Wed 09/23/09**
15	0%	Mobilization & Field Screening	14 days	Mon 04/20/09	Sun 05/03/09
16	0%	BCT review screening results & select RC locations	21 days	Mon 05/04/09	Sun 05/24/09
17	0%	Field investigation	28 days	Tue 05/26/09	Mon 06/22/09
18	0%	Sample analysis	91 days	Tue 06/23/09	Wed 09/23/09
19	0%	Data validation & import to datbase	14 days	Tue 07/14/09	Mon 07/27/09
20	0%	Data Analysis (revising CSM, statistical analysis, modeling)	49 days	Sat 08/15/09	Sat 10/03/09
21	0%	Risk Characterization	63 days	Sun 10/04/09	Tue 12/08/09
22	**0%**	**Report Preparation**	**264 days**	**Sun 11/29/09**	**Wed 08/25/10**
23	0%	Prepare Army draft report	56 days	Sun 11/29/09	Tue 01/26/10
24	0%	Army review	14 days	Wed 01/27/10	Tue 02/09/10
25	0%	Preparation of BCT draft, incl. backcheck	14 days	Wed 02/10/10	Wed 02/24/10
26	0%	BCT Review	45 days	Thu 02/25/10	Sat 04/10/10
27	0%	RCL	45 days	Sun 04/11/10	Tue 05/25/10
28	0%	BCT Review of RCL	15 days	Wed 05/26/10	Thu 06/10/10
29	0%	Revise document and issue draft final	30 days	Fri 06/11/10	Sun 07/11/10
30	0%	Draft final document becomes final	45 days	Mon 07/12/10	Wed 08/25/10
31	**0%**	**AOC 72 FS Work Plan**	**143 days**	**Thu 07/22/10**	**Wed 12/15/10**
32	0%	Prepare Army draft Workplan	28 days	Thu 07/22/10	Wed 08/18/10
33	0%	Army review	7 days	Thu 08/19/10	Wed 08/25/10
34	0%	Preparation of BCT draft, incl. backcheck	7 days	Thu 08/26/10	Wed 09/01/10
35	0%	BCT Review	14 days	Thu 09/02/10	Thu 09/16/10
36	0%	RCL	7 days	Fri 09/17/10	Thu 09/23/10

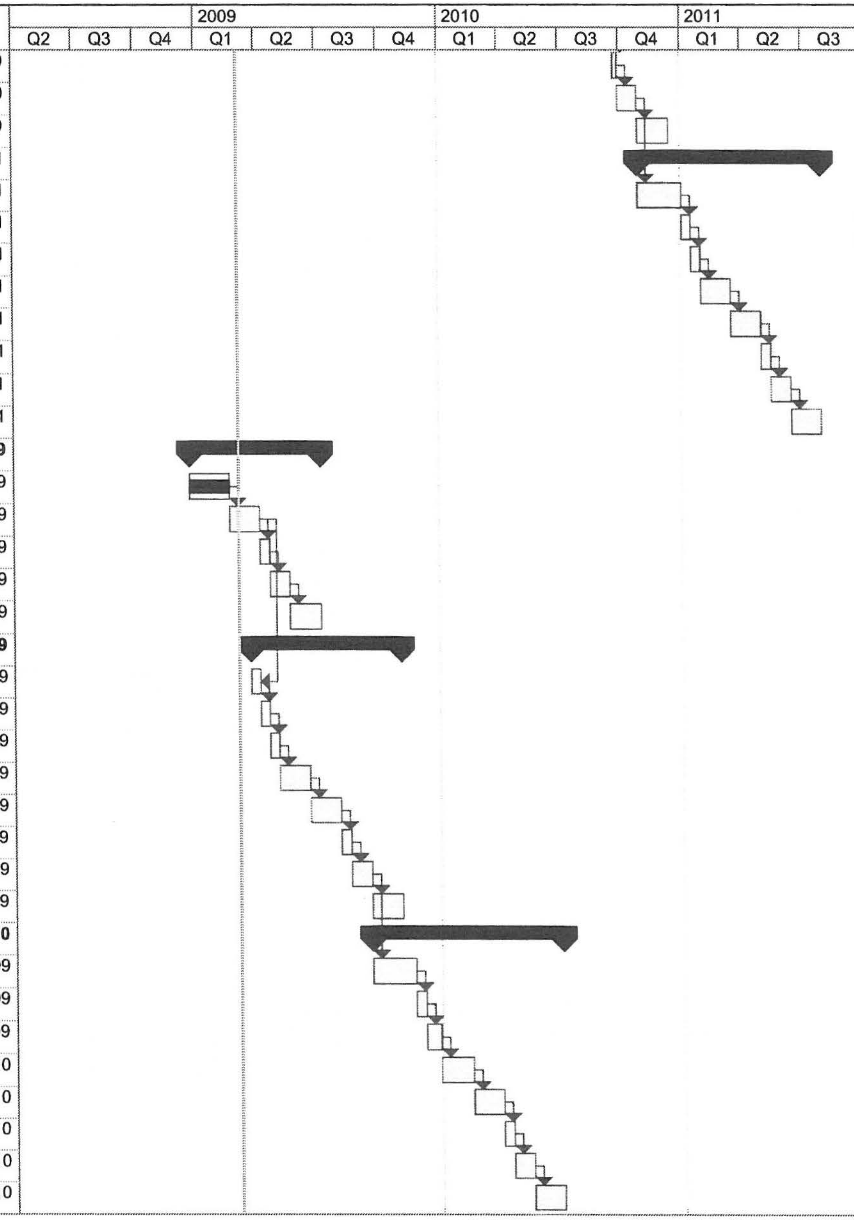


Project: Shepley's Hill Landfill
Date: Thu 03/05/09

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

Figure 11. Proposed Project Schedule

ID	% Compl	Task Name	Duration	Start	Finish
37	0%	BCT Review of RCL	7 days	Fri 09/24/10	Thu 09/30/10
38	0%	Revise document and issue draft final	28 days	Fri 10/01/10	Fri 10/29/10
39	0%	Draft final document becomes final	45 days	Sat 10/30/10	Wed 12/15/10
40	**0%**	**AOC 72 FS Report**	**271 days**	**Sat 10/30/10**	**Sat 07/30/11**
41	0%	Prepare Army draft report	63 days	Sat 10/30/10	Mon 01/03/11
42	0%	Army review	14 days	Tue 01/04/11	Mon 01/17/11
43	0%	Preparation of BCT draft, incl. backcheck	14 days	Tue 01/18/11	Mon 01/31/11
44	0%	BCT Review	45 days	Tue 02/01/11	Thu 03/17/11
45	0%	RCL	45 days	Fri 03/18/11	Sun 05/01/11
46	0%	BCT Review of RCL	15 days	Mon 05/02/11	Mon 05/16/11
47	0%	Revise document and issue draft final	30 days	Tue 05/17/11	Wed 06/15/11
48	0%	Draft final document becomes final	45 days	Thu 06/16/11	Sat 07/30/11
49	**29%**	**SHL SA Report (cont'd from BCT Draft submittal)**	**191 days**	**Tue 12/23/08**	**Tue 07/07/09**
50	100%	BCT Review	56 days	Tue 12/23/08	Fri 02/20/09
51	0%	RCL	45 days	Sat 02/21/09	Mon 04/06/09
52	0%	BCT Review of RCL	15 days	Tue 04/07/09	Tue 04/21/09
53	0%	Revise document and issue draft final	30 days	Wed 04/22/09	Thu 05/21/09
54	0%	Draft final document becomes final	45 days	Fri 05/22/09	Tue 07/07/09
55	**0%**	**SHL FS Work Plan**	**222 days**	**Tue 03/24/09**	**Wed 11/04/09**
56	0%	Prepare Army Draft Work Plan	14 days	Tue 03/24/09	Mon 04/06/09
57	0%	Army Review	14 days	Tue 04/07/09	Mon 04/20/09
58	0%	Prepare BCT Draft Work Plan	14 days	Tue 04/21/09	Mon 05/04/09
59	0%	BCT Review of Draft Work Plan	45 days	Tue 05/05/09	Fri 06/19/09
60	0%	Prepare/Submit Response to Comments Letter (RCL)	45 days	Sat 06/20/09	Tue 08/04/09
61	0%	BCT review of RCL	15 days	Wed 08/05/09	Wed 08/19/09
62	0%	Prepare Draft Final Work Plan	30 days	Thu 08/20/09	Sat 09/19/09
63	0%	Draft final document becomes final	45 days	Sun 09/20/09	Wed 11/04/09
64	**0%**	**SHL FS Report**	**278 days**	**Sun 09/20/09**	**Fri 07/02/10**
65	0%	Perform analysis and prepare Army Draft Report	63 days	Sun 09/20/09	Mon 11/23/09
66	0%	Army Review	14 days	Tue 11/24/09	Tue 12/08/09
67	0%	Prepare BCT Draft Report	21 days	Wed 12/09/09	Wed 12/30/09
68	0%	BCT Review of Draft Report	45 days	Thu 12/31/09	Tue 02/16/10
69	0%	Prepare Response to Comments Letter (RCL)	45 days	Wed 02/17/10	Fri 04/02/10
70	0%	BCT review of RCL	15 days	Sat 04/03/10	Sat 04/17/10
71	0%	Prepare Draft Final Report	30 days	Sun 04/18/10	Mon 05/17/10
72	0%	Draft final document becomes final	45 days	Tue 05/18/10	Fri 07/02/10



Project: Shepley's Hill Landfill
Date: Thu 03/05/09

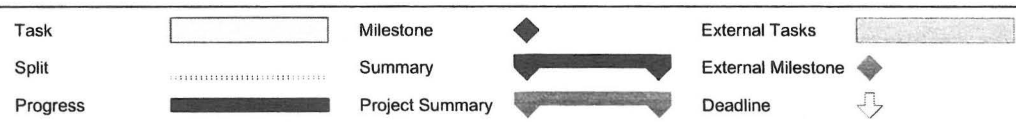


Table 1. Summary of Data Relevant to AOC 72

Report title	Year	Prepared for	Author	Data Collected	AOC 72 Risk Drivers or COPCs
SA 71 Sediment Risk Characterization	2008	Army	MACTEC	SQT results incl 20-d and 42-d toxicity tests	Human: As, Cr Ecolog: PAH, Zn
Final Report; Arsenic Fate, Transport, and Stability Study; Ft. Devens Superfund Site	2008	USEPA	USEPA NRMRL	Hydraulic Conductivities; Thermal Indicators of Discharge Areas; Groundwater Seepage; SED and SW Chemistry	
Phase II CSA, RTN 2-0010138, Area 2 - Grove Pond and Plow Shop Pond	2007	PDC	ENSOL Inc	No new data	
Expanded Site Investigation, Ft. Devens Plow Shop and Grove Ponds	2006	USEPA	Gannett Fleming	SED and SW Chemistry; 10-day SED tox test	Human: As, Cr, Hg, V, PAH, PCB, DDD Ecolog: As, Cr, PAH
Toxicity Testing Results; Grove, Plow Shop, and Flanagan Ponds	2005	USEPA	Lockheed Martin	SED and SW 10-day tox tests	
Grove Pond Arsenic Investigation: Final Report	2002	USEPA	Gannett Fleming	SED and SW Chemistry	
Supplemental Groundwater Investigation	2002	Army	Harding ESE	SED and SW Chemistry	
Benthic Community Survey of Nonacoicus Brook	2001	Army	Harding ESE	Benthic Survey	
Trace Element Exposure in Benthic Invertebrates; Grove Pond, Plow Shop Pond, and Nonacoicus Brook	2000	USEPA	US FWS	Mussel and Crayfish Tissue sample analyses	
Screening Level Ecological Risk Assessment	1999	USEPA	USEPA	SED and SW Chemistry	Ecolog: Ba, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn
Surface Water and Sediment Sampling	1998	USEPA	Lockheed Martin	SED and SW Chemistry	
Evaluation of Health Concerns Associated with Grove Pond and Plow Shop Pond	1998	ATSDR	ATSDR	No new data	
Review of AVS/SEM results for Grove Pond Sediment	1998	MassDEP	TRC	SED Chemistry	
Plow Shop Pond and Grove Pond Sediment Evaluation	1995	Army	ABB	SED and SW Chemistry; 10-day SED tox test; fish tissue	Human: Hg Ecolog: As, Cu
Site Assessment Report, Boston & Maine Railroad Property, Fort Devens	1994	B&M RR	ERM	SED and SW Chemistry	
Grove Pond Field Investigation	1994	MassDEP	M&E	SED Chemistry	

Abbreviations:
SQT = Sediment Quality Triad
SED = Sediment
SW = Surface water

Table 2. Data Gaps & Proposed RI Activities for AOC 72

Objective	Hypothesis	Evaluation	Data Needs	Data Gap
1. Evaluate current and potential future contaminant flux from SHL to AOC 72 via groundwater.	An ongoing groundwater discharge to Plow Shop Pond may result in increasing contaminant concentrations and/or volume in sediment.	Estimate accumulation rates based on current flux rates, groundwater and sediment chemistry, and groundwater modeling.	Flux estimates, groundwater and sediment chemistry data.	None
2. Evaluate other contaminant sources and distribution within AOC 72.	COPCs were released from source areas including Red Cove, SA 71, and the former tannery at Grove Pond.	Relate specific COPCs to specific source areas based on site histories, chemical occurrence, and transport mechanisms.	Site histories and chemistry data.	None
3. Evaluate whether the iron floc in Red Cove can act as a physical asphyxiant.	The density of the floc may not provide a BMI habitat substrate, but may impede oxygen transport to sediment.	Compare bulk density, porosity, and in situ DO between floc and non-floc zones.	In situ DO and physical property analysis for floc and non-floc zones.	In situ DO and physical property analysis for floc and non-floc zones.
4. Evaluate whether the iron floc in Red Cove constitutes "readily apparent harm" under the MCP.	The iron floc could meet the criteria for readily apparent harm at 310 CMR 40.0995(3)(b)(1).	Compare visual observations and chemistry data with the MCP criteria.	Visual observations and chemistry data.	Continue visual observations of vegetation and biota in floc and non-floc areas.
5. Evaluate human and ecological risks related to site contaminants in sediments.	Human health and ecological risks can be estimated based on sediment chemistry data. For BMI receptors, toxicity testing and community surveys are also considered.	Estimate risks in accordance with USEPA guidance based on sediment chemistry data, and for BMI considering toxicity testing and community surveys.	Sediment chemistry data and SQT tests including chemistry, BMI toxicity, and BMI community surveys.	SQT tests in AOC 72 (beyond those available for SA 71) and reference areas.
6. Evaluate human and ecological risks related to site contaminants in surface water.	Human health and ecological risks can be estimated based on surface water chemistry data.	Estimate risks in accordance with USEPA guidance based on surface water chemistry data.	Surface water chemistry data.	None
7. Evaluate localized risks for BMI receptors related to site contaminants in Red Cove.	Highly localized conditions in groundwater upwelling zones may impact BMI communities.	Consider weight of evidence in correlating BMI parameters with site contaminants.	Surface water chemistry data and sediment SQT tests specific to upwelling areas.	Surface water sampling for chemistry and sediment sampling for SQT tests in upwelling areas.

Attachment A

Remedial Investigation Workplan for AOC 72, Plow Shop Pond

Attachment A – Field Sampling Plan

FINAL

Devens, Massachusetts

May 2009

Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by:

AMEC Earth & Environmental, Inc
Westford, Massachusetts
Contract No.: GS-10F-0230J
Delivery Order: W912WJ-05-F-0037

SHL-0125

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Abbreviations, Acronyms, and Symbols

AMEC	AMEC Earth and Environmental, Inc.
AOC	Area of Concern
ASTM	American Society of Testing and Materials
BEC	BRAC Environmental Coordinator
BRAC	Base Realignment and Closure
CFR	Code of Federal Regulations
CO	USACE-NAE Contracting Officer
COR	USACE-NAE Contracting Officer's Representative
CSM	Conceptual Site Model
DAP	Data Analysis Plan
DGA	Data Gaps Analysis
DO	dissolved oxygen
DQO	data quality objective
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FS	Feasibility Study
FSP	Field Sampling Plan
HERA	human and ecological risk assessment
HHRA	Human Health Risk Assessment
IDW	Investigation Derived Waste
MassDEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
NAS	National Academy of Science
ORP	oxidation-reduction potential
pH	potential of Hydrogen
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SHL	Shepley's Hill Landfill
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
TDS	total dissolved solids
TKN	Total Kjeldahl Nitrogen
TSS	total suspended solids
USACE-NAE	U.S. Army Corps of Engineers – New England District
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

1.0 INTRODUCTION

This Field Sampling Plan (FSP) for Area of Concern (AOC) 72 at the former Fort Devens has been prepared by AMEC Earth & Environmental, Inc. (AMEC) on behalf of the United States Army Corps of Engineers, New England District (USACE-NAE). AOC 72 consists of Plow Shop Pond, located on the east of Shepley's Hill Landfill (SHL) at Devens (Figure 1). Remediation of the landfill, and Remedial Investigation (RI) and Feasibility Study (FS) of AOC 72, is occurring under the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act, and National Oil and Hazardous Substances Contingency Plan requirements, with regulatory coordination of the Massachusetts Department of Environmental Protection (MassDEP) and the United States Environmental Protection Agency (USEPA).

Plow Shop Pond is located southwest of the business and residential district in Ayer, Massachusetts. The 30-acre pond basin is bounded on the west and south by former Fort Devens property, to the north by commercial development (Molumco Industrial Park), and to the east by the Guilford Transportation railroad which crosses a causeway between Grove and Plow Shop Ponds. The pond is eutrophic with abundant aquatic plant life. Plow Shop Pond is used by local residents for recreational fishing, and is canoe-accessible at a landing on the northwest side. Signs are reportedly posted for "catch and release" fishing (Gannett Fleming 2006).

Plow Shop Pond and the surrounding ponds and rivers are located within the Squannassit Area of Critical Environmental Concern (ACEC). The ACEC designation by the Massachusetts Secretary of Energy and Environmental Affairs creates a framework for local, regional, and state stewardship of critical natural resources. The Squannassit ACEC encompasses 37,450 acres in portions of nine towns, and for the most part lies along and to the west of the Nashua River, from a section of Route 2 in the Towns of Harvard and Lancaster north to New Hampshire. ACEC resource details are provided at www.mass.gov/dcr/stewardship/acec/acecs/l-squsit.htm.

This FSP is Attachment A of an RI Workplan for AOC 72 that includes an evaluation of existing data and data gaps, proposed investigations, a Sampling and Analysis Plan (SAP; Attachments A-D), and a Human and Ecological Risk Assessment Plan (Attachment E). The SAP includes this FSP, a Data Analysis Plan (DAP; Attachment B to the RI Workplan), a Quality Assurance Project Plan (QAPP; Attachment C), and a Site Safety and Health Plan (SSHP; Attachment D). This FSP describes sampling and field data-gathering methods to be used to complete the RI. Section 2 of this FSP describes project organization and responsibilities during performance of the field activities. Proposed field activities are summarized in Section 3.0, while specific field procedures are presented in Section 4.0. In the terminology of USEPA's *Guidance for Monitoring at Hazardous Waste Sites: Framework for Monitoring Plan Development and Implementation* (USEPA, 2004), Section 3 describes the monitoring boundaries, or the "what, where, and when" aspects of the Monitoring Plan. Section 4 describes the data collection methods in more detail. Section 5.0 summarizes the requirements for project documentation. Corrective action procedures are presented in Section 6.0.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The responsibilities of key project personnel are specified in the Project Management Plan (AMEC, 2006). Specific roles related to this workplan are described below.

2.1 Laboratory Responsibilities

Quality assurance responsibilities of laboratory personnel are presented in the QAPP.

2.2 Field Technical Staff

2.2.1 Field Team Leader

The Field Team Leader, Mike Robinson, will coordinate field mobilization activities and will oversee all phases of work at the Site that generates data, including items as follows:

- Coordinating field related activities with the Project Manager;
- Daily coordination with USACE personnel regarding field activities and logistical issues;
- Provide as appropriate daily or weekly updates to the Project Manager regarding progress and report on any technical or logistical issues that arise;
- Management and supervision of all field personnel, including subcontractors;
- Supervising the collection of the samples and providing and ensuring that field activities are conducted in accordance with approved procedures and methodologies, that QA/QC samples have been collected as required, and that sampling forms, labels, chain-of-custody forms and custody seals have been prepared correctly;
- Communicating with the laboratory for timely delivery of supplies;
- Advising the laboratory of any changes to scheduled sample submittals;
- Directing the packaging and delivering or shipping samples to the laboratory; and
- Adhering to work schedules as established by the Project Manager.

2.2.2 Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) will be responsible for verifying that project personnel adhere to the site safety requirements. Mr. Robinson or his designee will serve as the SHSO. The responsibilities include:

- Conducting the health and safety training for project personnel and subcontractors, as appropriate;
- Modifying health and safety equipment or procedure requirements based on data gathered during the site work;
- Determining and posting locations and routes to medical facilities, including poison control centers, and arranging for emergency transportation to medical facilities;

- Notifying local public emergency officers, i.e., police and fire departments, of the nature of the field operation and posting their telephone numbers;
- Assigning health and safety-related duties to qualified field team individuals;
- Ensuring that before personnel work on site, acceptable medical examinations are current;
- Ensuring the acceptability of health and safety training;
- Observing work party members for symptoms of exposure or stress;
- Providing first aid if necessary on site; and
- Performing site audits to verify adherence to the requirements of the project Health and Safety Plan.

The SHSO has the authority to stop any operation that threatens the health or safety of the team or surrounding populace. The daily health and safety activities may be overseen by the SHSO or his designee.

2.2.3 Additional Field Technical Staff

The Field Team will be composed of technical staff drawn from AMEC's pool of company resources. The technical team staff will be utilized to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competences required to effectively and efficiently perform the required work. Specific individual responsibilities will include:

- Provision of day to day assistance to the Field Team Leader on technical issues in specific areas of expertise;
- Maintaining field logs and transferring data for permanent storage;
- Coordination and oversight of technical efforts of subcontractors assisting the field team;
- Identifying problems at the field team level, resolving difficulties in consultation with the Field Team Leader, implementing and documenting corrective action procedures, and providing communication between team members and upper management; and
- Participating in preparation of the final report.

2.3 Special Training Requirements and Certification

All AMEC and subcontractor field personnel on-site shall have completed OSHA training in accordance with the Code of Federal Regulations (CFR) in 40CFR 1910.120 and will have been trained regarding the requirements stated in the QAPP, and the SSHP. Laboratories that analyze samples for this project will be certified as described in the QAPP.

3.0 FIELD ACTIVITIES

Field activities will consist of sampling and in situ measurements of sediment, biota, and surface water in Plow Shop Pond and Grove Pond. Sampling locations are indicated in Figures 9 and 10, excerpted from the RI Workplan. The extent of field screening near Red Cove will first be confirmed by underwater photography of floc conditions over the area shown in Figure 9, and the results discussed with the BCT. When the extent of field screening is approved, in situ measurements of pH, specific conductance (SC), Oxidation/Reduction Potential (ORP), and dissolved oxygen (DO) in sediment pore water will be performed at 15 locations and the results discussed with the BCT to identify 6 specific sampling locations near Red Cove. Underwater photographic documentation of the condition of vegetation and any other biota observable using a viewing scope or viewing bucket will be recorded at the time of the field screening measurements.

Generally four types of samples will be collected during the final mobilization at Plow Shop and Grove Ponds:

- Deep surface water samples will be collected from the 6 locations to be identified based on the initial field screening in Red Cove. All six locations will include field measurement of pH, SC, ORP, and DO, and all will have samples for metals and water quality parameters including ammonia. Three of the six locations will include toxicity testing for aquatic species, and the same toxicity testing will be conducted for two reference samples (locations #8 & #9).
- Undisturbed sediment cores will be collected from 3 iron floc areas to be identified in Red Cove based on the initial field screening, and 2 non-floc areas outside Red Cove (locations #8 & #9). Cores will undergo physical testing of the upper 6 inches for density and specific gravity.
- Surface dredge samples of sediment and biota will be collected from all 17 proposed sampling locations in Figures 9 and 10 (including the six to be identified in Red Cove) for Sediment Quality Triad (SQT) testing. These tests include chemistry (metals including methylmercury, ammonia, and PAHs) and benthic toxicity tests of sediment, and benthic species identification and enumeration for biota samples. Up to seven additional dredge samples will be collected within 10 feet of the shore of Red Cove for chemistry analysis, based on discussions of field screening results with the BCT.
- Benthic/epibenthic sweep samples will be collected from all 17 proposed sampling locations in Figures 9 and 10. These biota samples collected from the sediment surface will undergo species identification and enumeration.

Underwater photographic documentation of the condition of vegetation and any other biota observable using a viewing scope or viewing bucket will be recorded prior to sampling. Field activities will be undertaken in late April to early May when the water has warmed and the maximum number of benthic species will be in their larval stages.

4.0 FIELD PROCEDURES

Field procedures will generally follow the Standard Operating Procedures (SOPs) included in Appendix A, except as otherwise noted herein.

4.1 Environmental Requirements and Protection of Property

Sample collection from these ponds within the Town of Ayer must comply with federal, state, and local requirements to protect the environment and the town property on which the work is performed. As part of project planning, applicable Federal, State and Local laws and regulations will be identified and work will be performed in accordance with said authorities. This effort will include all permits, licenses, approvals, and/or certificates necessary to accomplish the work specified. All such regulatory requirements will apply to any subcontractor or supplier accessing the property. This list will be updated, as appropriate, as the project progresses.

In the unlikely event of noncompliance, AMEC will immediately bring the incident to the attention of the USACE-NAE Contracting Officer (CO), Army's Contracting Officer's Representative (COR), and Devens Base Realignment and Closure (BRAC) Environmental Coordinator (BEC) by telephone and then by written notice. The Army will independently review Contractor work to ensure compliance with all applicable requirements.

While completing this work, AMEC will have the following responsibilities:

- When the work to be performed requires clearance or permits, AMEC will obtain such clearance or permits with the assistance of the BEC prior to initiation of operations.
- AMEC will comply with all on and off-site Installation or site-specific time and procedural requirements (federal, state, and local) described in the permits obtained.
- AMEC will exercise due diligence to protect all property from damage resulting from the work described herein, and will be responsible for any such damage. Any property of the United States damaged or destroyed by the AMEC team incident to the exercise of the privileges herein granted shall be promptly repaired or replaced by the AMEC team to a condition satisfactory to the COR or make reimbursement in an amount necessary to restore or replace the property to a condition satisfactory to the COR in accordance with Federal Acquisition Regulation Clause 52.245-2.

4.2 Sampling Sediment Pore Water

Sediment pore water measurements for field screening in Red Cove will be collected without mixing the floc with other media, to the extent feasible. The floc is quite thin (<1 cm) and sensitive to movement in the water column. Locations will be accessed by boat operated to minimize disturbance of the water column or sediment. Operations may include securing the boat to shore at sufficient points to result in negligible lateral movement of the sampler, and/or securing the sampler to the pond bottom or to a platform resting on the bottom.

The extent of field screening near Red Cove will first be confirmed by underwater photography of floc conditions over the area shown in Figure 9, and the results discussed with the BCT. When the extent of field screening is approved, in situ sediment pore water measurements will be collected at 15 locations in Red Cove prior to mobilization for surface water (see Section 4.3) and sediment/biota (Sections 4.4-4.6) sampling. The results of these field measurements will be presented to and discussed with the BCT for selection of surface water and sediment sampling locations in Red Cove. Underwater photographic documentation of the condition of vegetation and any other biota observable using a viewing scope or viewing bucket will be recorded prior to and during pore water sampling.

The sediment pore water will be collected using a micro PushPoint sampler with a polypropylene "Screen-Sok". The PushPoint sampler and guard rod along with the Screen-Sok will be inserted into the sediment to a depth of 0 to 6 inches and 6 to 12 inches below the sediment-water interface. The guard rod will then be removed and tubing from a peristaltic pump will be attached to the PushPoint. The peristaltic pump will transfer the pore water from the sampler to the flow through cell. The flow rate for the peristaltic pump will be maintained between 50 and 200 millimeters per minute to minimize the potential for drawing pond water into the sample.

The DO, SC, ORP, and pH readings will be measured using a multi-meter and flow through cell. A peristaltic pump will be used to transfer the water from the sampling locations to the flow through cell. The field readings will be recorded in the log book or sampling sheet once the readings have stabilized. The multi-meter will be calibrated for DO, SC, ORP, and pH in accordance with the Multi-Meter Calibration SOP (Appendix A).

4.3 Sampling Surface Water

Deep surface water measurements in Red Cove will be collected without mixing the floc with other media, to the extent feasible. The floc is quite thin (<1 cm) and sensitive to movement in the water column. Locations will be accessed by boat operated to minimize disturbance of the water column or sediment. Operations may include securing the boat to shore at sufficient points to result in negligible lateral movement of the sampler, and/or securing the sampler to the pond bottom or to a platform resting on the bottom.

Surface water samples will be collected from immediately above the surface water-sediment interface at six locations in Red Cove, to be determined as described in Section 4.2. Surface water samples will be collected prior to collecting any corresponding sediment sample so that any disturbances created by the sediment sampling do not impact the surface water samples.

The surface water samples will be collected using the micro Push Point sampler with a Screen-Sok to reduce the potential for sediment in the sample. The sampler will be lowered to a depth so that the end of the sampler is immediately above the surface water-sediment interface. Once sampler is in position, a peristaltic pump will be used to pump water through a multi-meter flow through cell. The field parameters of pH, DO, SC, and ORP will be recorded. Once the field parameters are recorded, the pump tubing will be disconnected from the flow through cell and samples will be collected for laboratory analysis of metals (including methylmercury), water quality criteria, and ammonia. Three of the six locations in Red Cove will include samples for toxicity testing, and two reference samples for toxicity will be obtained outside Red Cove (locations #8 & #9). After sample collection, the horizontal position of the sample will be obtained using GPS.

4.4 Sampling Sediment Cores

Sediment core samples will be collected in accordance with the procedures outlined below and the Soil and Sediment Sampling SOP included in Appendix A. Access to the sampling location will be via boat operated to minimize any disturbance of the sediment or surface water. Three iron floc areas will be sampled in Red Cove, to be determined as described in Section 4.2, and two reference areas will be sampled outside Red Cove. Sediment core samples will be collected after any corresponding surface water sampling (see 4.3) so that any disturbances created by the sediment sampling do not impact the water samples.

Sediment cores will be collected using a 3-inch OD steel Shelby tube in accordance with ASTM D 1587 to obtain an undisturbed sample or using a 2-inch OD stainless steel hand sediment corer. The sampler will be pushed into the sediments in a continuous and rapid motion, without impact or twisting. The tube will not be pushed further than the length provided for the sample to allow recovery in the coring device. Upon removal from the pond, the ends of the Shelby tube will be capped and sealed to preserve the moisture content. If the sediment corer is used, the plastic liner will be removed from the corer and the ends will be capped to preserve the moisture content. Sample tubes will be kept in a vertical position at all times and will be hand delivered to the laboratory to minimize disturbance. Once the testing laboratory receives the sample tube, they will perform the testing on the top 6-inches of the core. After sample collection, the horizontal position of the sample will be obtained using GPS, and depth of surface water will be measured to the nearest inch.

4.5 Sampling Surface Sediment

Surface dredge sediment and biota samples will be collected at 17 locations in Plow Shop and Grove Ponds as indicated in Figures 9 and 10, including six locations in Red Cove to be determined as described in Section 4.2.1. All 17 surface sediment samples will be analyzed for metals (including methylmercury), ammonia, PAHs, TOC, grain size, benthic community, and toxicity, and one sample will be tested for TCLP metals. Underwater photographic documentation of the condition of vegetation and any other biota observable using a viewing scope or viewing bucket will be recorded prior to sampling at the 17 SQT locations. Up to seven additional surface dredge samples will be collected within 10 ft of the shore of Red Cove, at locations to be determined through discussion of field screening results with the BCT, for analysis of metals (including methylmercury), ammonia, and PAHs.

Sediment surface samples will be collected in accordance with the procedures outlined below and the Soil and Sediment Sampling SOP included in Appendix A. Access to the sampling location will be via boat operated to minimize any disturbance of the sediment or surface water. Sediment samples will be collected after collecting any corresponding surface water sample (see 4.3) or sediment cores (see 4.4) so that any disturbances created by the surface sediment sampling do not impact the other samples.

Surface sediment samples will be collected with an Eckman or Ponar dredge. The target depth for sample collection is 0 to 0.5 feet. At locations where the root mat is particularly dense, or if there are several inches or more of loose organic debris and vegetation covering the pond bottom, samples may be collected from beneath the root mass or loose organic material. The dredge sample will be transferred to the appropriate containers for analysis without compositing in order to avoid oxidation of the sediments. The sample containers will be placed in a cooler on ice immediately after collection. After sample collection, the horizontal position of the sample will be obtained using GPS, and depth of surface water will be measured to the nearest inch.

A split sample will be collected from the sediment grab samples for EPA/ORD speciation analysis. The split sample will be placed in a 4-ounce jar and frozen. The split samples will be shipped to the laboratory with dry ice.

Benthic biota samples will have the sediment transferred directly from the dredge to the sieving bucket. The sieving bucket consists of an approximately 3-gallon bucket with a 500-micron (µm) stainless steel mesh bottom. The sediment will be removed from the bucket by dipping the bucket into the water and/or using gently flowing water from a hose. Once all the sediment is removed from the sieving bucket, the remaining material will be transferred to the sample container. Care will be taken to ensure all the material has been transferred to the sample container using a squirt bottle and/or tweezers. Once all the material is in the container, it will be preserved with ethanol or formalin.

The sediment location having the greatest visible thickness of floc will be sampled and analyzed for TCLP metals.

4.6 Sweep Sampling

Following the collection of benthic samples with the dredge, benthic samples will also be collected by sweep sampling using a 500-µm long-handled D-net "raked" along the bottom, followed by continuous sweeps of the water column from the detritus layer to the top of the periphyton to catch additional dislodged organisms. The amount of raking and the amount of sweep time will be consistent among all of the sampling locations for standardization. Material collected in the D-net will be transferred to a 500-µm mesh sieve bucket and gently washed with pond water to remove extraneous fines. The remaining sample material will be transferred to an appropriate sample container and preserved with ethanol or formalin.

4.7 Field QC Sampling Procedures

Field QC samples that will be prepared and submitted to the laboratory will consist of equipment blanks, duplicate samples, and matrix spike/matrix spike duplicate samples. The frequency and method of collection of field QC samples are described in the QAPP. Benthic samples collected from the dredge will be collected in triplicate at each sample location.

4.8 Decontamination Procedures

All non-dedicated equipment will be decontaminated in accordance with the procedures outlined below and those presented in the Equipment Decontamination SOP presented in Appendix A.

Non-dedicated sediment and surface water sampling equipment shall be decontaminated prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples. Equipment can be decontaminated at the sample location, or at a pre-designated, controlled location. All equipment must be decontaminated before leaving the site.

At a minimum, items will be cleaned following the procedure outlined below:

1) wash with a non-phosphate detergent (Alconox®, Liquinox®, or other suitable detergent) and potable water solution;
2) rinse with potable water;
3) spray with isopropyl alcohol, and
4) rinse with deionized or distilled water.

Where possible, equipment shall be disassembled prior to cleaning. If equipment is heavily soiled, a second wash with an aqueous non-phosphate detergent solution will be added at the beginning of the process. In addition, heavily soiled items may require steam cleaning using a portable, high pressure steam cleaner equipped with a pressure hose and fittings.

4.9 Sample Packaging and Shipping Requirements

Packaging and shipment of all environmental samples collected during the field activities will be conducted in accordance with all appropriate U.S. Department of Transportation regulations (e.g., 49 CFR, Parts 100 199). Sample preservation will be in accordance with the QAPP. The lids of the containers shall not be sealed with duct tape, but may be covered with custody seals or placed directly into self sealing bags. Prior to shipping, glass sample containers should be wrapped on the sides, tops, and bottoms with bubble wrap or other appropriate padding to prevent breakage during transport. Samples will be shipped as soon as possible to allow the laboratory to meet holding times for analyses.

When a cooler or package is ready for shipment to the laboratory, two copies of the chain of custody form shall be placed inside a zip-lock bag and taped to the package (inside if possible). Chain-of-custody seals will be placed on the packages which will then be sealed with strapping tape and labeled "Fragile," "This-End-Up" or other appropriate notices. A letter stating the names and telephone numbers of AMEC and laboratory personnel who can be contacted in the event of problems during shipment will be taped to the outside of the package.

4.10 Investigation-Derived Waste (IDW) Management

Investigation-derived waste (IDW) materials will be generated in association with sample collection, handling, and equipment decontamination. IDW will be containerized and transported to a temporary storage area at Devens RFTA for characterization and disposal in accordance with state and federal requirements.

5.0 FIELD OPERATIONS DOCUMENTATION

5.1 Field Logbook and Field Data Sheets

Field activities will be documented using a field logbook in accordance with the Field Logbook SOP presented in Appendix A. The documentation in the field logbook is designed to contain sufficient information to enable the sampling activity to be reconstructed without relying on the collector's memory.

For certain tasks, information will be recorded on pre-printed field data sheets (e.g., boring logs, well installation/development logs, or drum logs). This information should not be repeated in the field logbook, except in summary form to avoid transcription errors. Examples of field data sheets to be used during the activities described in this work plan are presented in Appendix A.

5.2 Photographic Records

All sampling points will be documented by photograph in order to permit positive identification of the sampling point in the future and to document their validity as a representation of an existing situation. Photographs taken to document sampling points will include two or more reference points to facilitate relocating the point at a later date.

For each photograph taken, the following items should be noted in the field logbook:

- Date and time of photograph,
- Photographer name,
- Name of site,
- Sequential number of the photograph with unique identifier relating to digital file,
- Site sketch indicating location of photographer when picture was taken and the general direction faced, and
- General description of the subject.

Photographic documentation of the condition of vegetation and any other biota observable from above the pond surface will be recorded at and around locations "A" prior to sampling.

5.3 Sample Documentation

5.3.1 Sample Numbering System

Site-specific sample identification numbers will be assigned prior to sample collection. Each sample will be identified in the field notebook and field sampling form by an alpha-numeric code following the identification scheme outline below. The site-specific sample number will consist of the following:

- Sample Matrix Code -- The sample matrix code describes the matrix as follows:
  SD = Sediment sample; and
  SW = Surface water sample.
- Location Code -- The sample location code follows the sample matrix code, and indicates the sample location as follows:
  P08xx = Plow Shop Pond (where "xx "is a sequential sample number);
  G08xx = Grove Pond; and
  F08xx = Flanagan Pond;
- Depth Code -- Sediment samples will indicate the sample depth within the sample ID with "A" representing the shallowest interval sampled and "B", "C", etc. representing any successive intervals. Surface water samples will have a depth code "X";
- Filtered/Unfiltered Code. For surface water samples, the depth code will be followed by an "F" or a "U" to indicate whether the sample is filtered or unfiltered. Sediment samples will all have a filtered/unfiltered code "X"; and
- Sample Type. The last letter of the sample identification will be (A) for regular samples, (B) for duplicates, (C) for MS/MSD and (D) for equipment blanks.

Example of sample identification: SWP0801XUD: surface water sample from location P0801, filtered, duplicate sample

5.3.2 Sample Labels

All samples containers will be identified using a label affixed to the container prior to transportation to the laboratory. Information on sample labels will include:

- the name of the project or site;
- a unique sample identification number (See Section 5.3.1),
- the sampler's name/signature/initials;
- the nature of the chemical preservative, if appropriate,
- the type of analysis requested, and
- the date and time the sample was taken.

5.3.3 Chain-of-Custody Records

All sample handling will be conducted using the appropriate chain-of-custody procedures detailed in the Chain-of-Custody SOP in Appendix A and in the QAPP. Chain-of-Custody procedures provide documentation of the handling of each sample and are implemented so that a record of sample collection, transfer of samples between personnel, sample shipping, and receipt by the laboratory that will analyze the sample is maintained. A sample Chain-of-Custody Record is presented in Appendix B.

6.0 NONCONFORMANCE/CORRECTIVE ACTIONS

Any USACE or AMEC project team member may initiate the field corrective action process. This process consists of identifying a problem, acting to eliminate the problem, documenting the corrective action, monitoring the effectiveness of the corrective action, and verifying that the problem has been eliminated. Although not all inclusive, examples of corrective actions for field measurements may include the following:

- Repetition of a measurement to check the error;
- Check for all proper adjustments for ambient conditions such as temperature;
- Check of batteries;
- Calibration checks;
- Recalibration;
- Replace instruments or measurement devices;
- Stop work (if necessary);
- Revisions to information submitted on chain-of-custody forms; and
- Amendment of sampling procedures or Work Plans.

Technical staff and project personnel will be responsible for reporting all technical or QA non-conformances or suspected deficiencies of any activity or issued document by reporting the situation to the PM and the QA/QC Coordinator on a Nonconformance Report (NCR). The QA/QC Coordinator will be responsible for assessing the suspected deficiency based on the potential for the situation to impact the quality of the data.

The Field Team Leader, or a designee, will be responsible for correcting equipment malfunctions throughout the field sampling effort and resolving situations in the field that may result in nonconformance or noncompliance with the QAPP. All corrective measures will be immediately documented in the field logbook, and sample alteration forms will be completed.

Additional corrective actions, if necessary, will be determined by the Project Manager. The Project Manager has the authority to initiate stop work orders, if necessary, and is responsible for ensuring that a corrective action for a nonconformance is initiated.

If appropriate, the Project Manager will be responsible for ensuring that no additional work that is dependent on the nonconforming activity is performed until the corrective action(s) is completed.

<u>Laboratory</u>
All laboratories are required to comply with the standard operating procedures previously submitted to the Project Chemist. The laboratory project managers will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

The Project Chemist will be notified immediately if any QC sample exceeds the project-specified control limits. The analyst will identify and correct the anomaly before continuing with the sample analysis. The Laboratory Project Manager will document the corrective action taken in a memorandum submitted to the Project Chemist within five days of the initial notification. A narrative describing the anomaly, the steps taken to identify and correct it, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) will be submitted with the data package using a corrective action form. Copies of each laboratory's corrective action forms are found in their Quality Assurance Manuals.

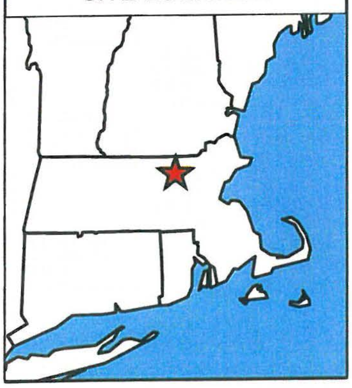
REFERENCES

AMEC. 2006. Project Management Plan. Shepley's Hill Landfill, Devens, MA. SHL-0063. March 2006

Gannett Fleming, 2006. *Expanded Site Investigation. Remedial Oversight of Activities at Fort Devens Plow Shop and Grove Ponds, Draft*. Prepared for USEPA Region 1. May.

USEPA. 2004. Guidance for Monitoring at Hazardous Waste Sites: Framework for Monitoring Plan Development and Implementation. OSWER Directive No. 9355.4-28. January.

SITE LOCATION



Plow Shop Pond Location

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

LEGEND

Streams
Landfill Boundary

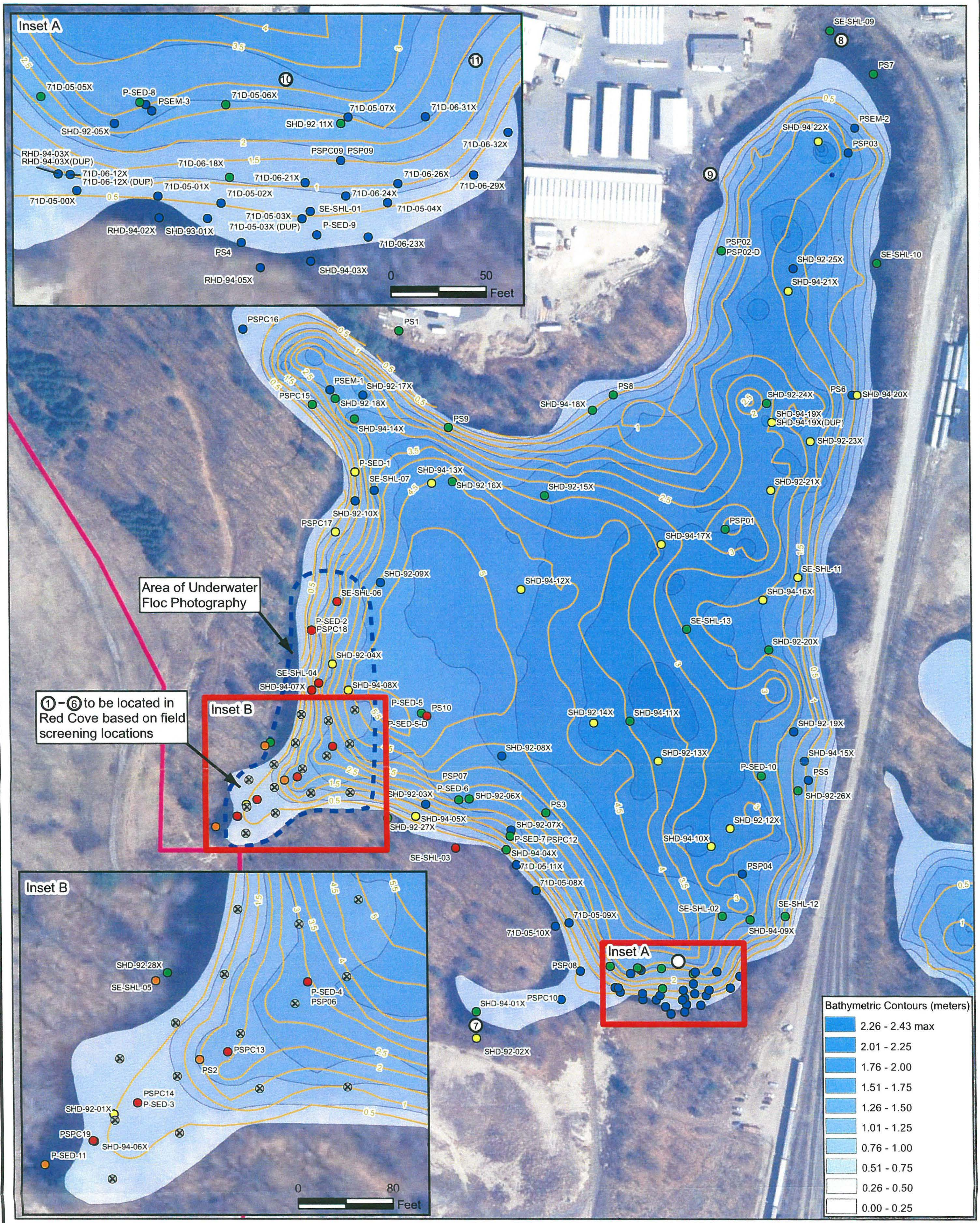
0 750 Feet

N

AMEC Earth & Environmental, Inc.
2 Robbins Road
Westford, MA 01886
(978) 692-9090

FIGURE 1

H:\ShepleyLandfill\Task18\MXD\Figure1.mxd H:\ShepleyLandfill\Task18\Export\Figure1.pdf August 1, 2008 DWN: AP CHKD: KMP



Proposed Sampling Locations for Plow Shop Pond

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond
Ayer, Massachusetts

LEGEND

- Red Cove Field Screening Locations
- Proposed Sample Locations

Arsenic (mg/kg) in Surface Sediment (0-1 foot)

- 1,801 - 6,800
- 651 - 1,800
- 321 - 650
- 141 - 320
- 0 - 140

Sediment Thickness (meters)

Landfill Boundary

0 180 Feet

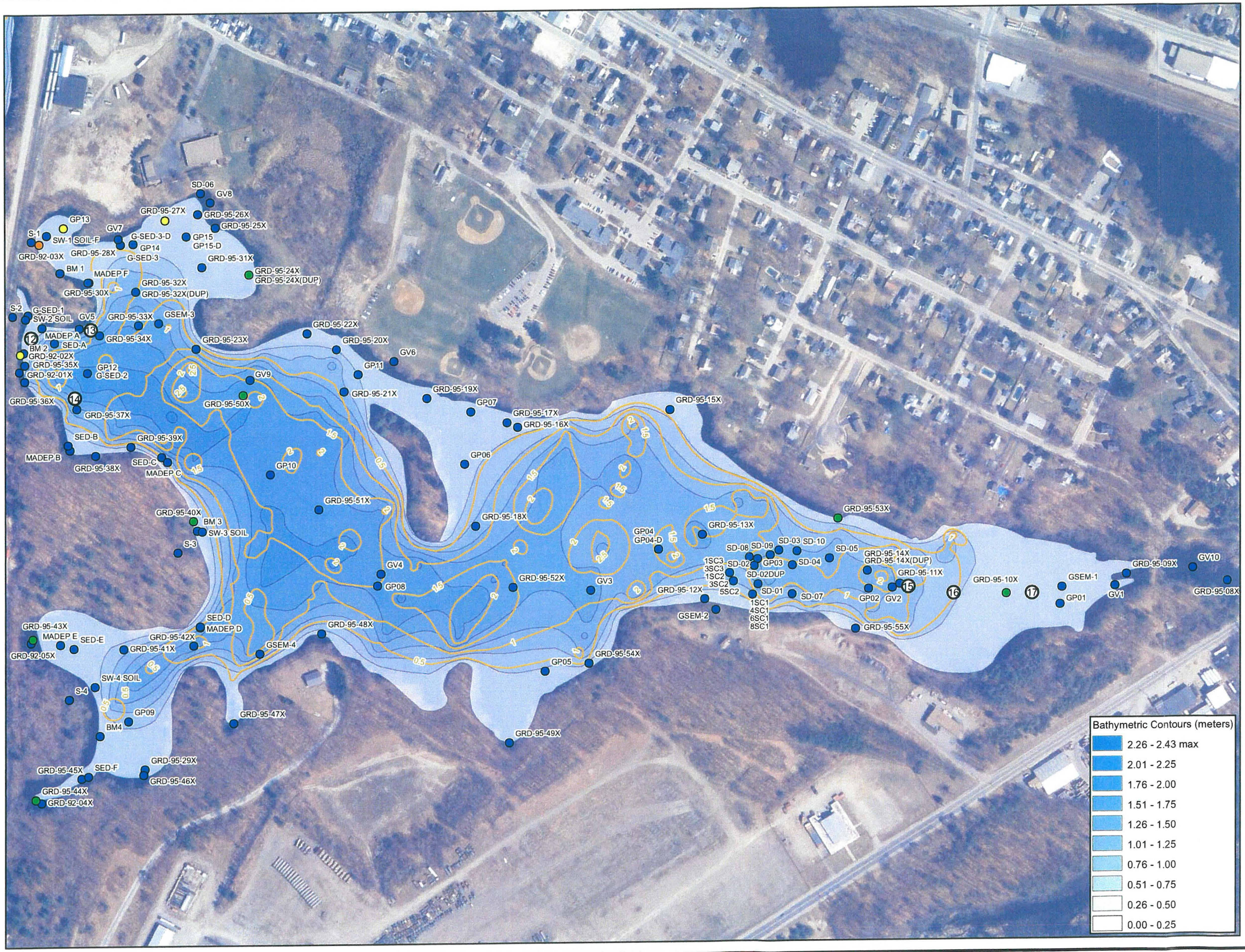
amec

AMEC Earth & Environmental, Inc.
2 Robbins Road
Westford, MA 01886
(978) 692-9090

FIGURE 9

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

H:\ShepleyLandfill\Task19\MXD\Figure 9 Field Screening Locations.mxd H:\ShepleyLandfill\Task19\Export\Figure 9 Field Screening Locations.pdf March 4, 2009 DWN: KMP DJK CHKD: KMP



Proposed Sampling Locations for Grove Pond

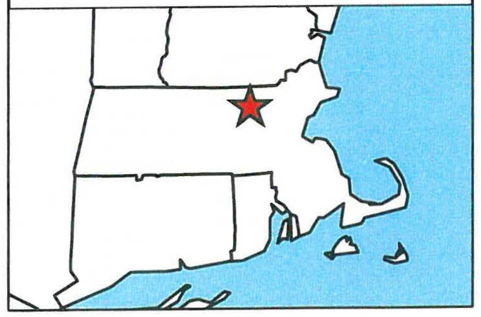
Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

LEGEND

- (2) Proposed Sample Locations
- Arsenic (mg/kg) in Surface Sediment (0-1 foot)
  - 1,801 - 4,300
  - 651 - 1,800
  - 321 - 650
  - 141 - 320
  - ND - 140
- Sediment Thickness (meters)
- Landfill Boundary

SITE LOCATION



NOTES & SOURCES

Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.
Data from MassGIS.

0 400
Feet

AMEC Earth & Environmental, Inc.
2 Robbins Road
Westford, MA 01886
(978) 692-9090

H:\ShepleyLandfill\Task19\MXD\Figure10.mxd
H:\ShepleyLandfill\Task19\Export\Figure10.pdf
March 4, 2009 DWN: DJK CHKD: KMP

FIGURE
10

APPENDIX A

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE

Multi-Meter Calibration

Purpose

To establish standard protocols for all AMEC field personnel to ensure that consistent and acceptable procedures are used to calibrate the multi meter.

pH Calibration

Note: A two point calibration using pH buffers 7 and 4 will be used to cover conditions generally found in the Fort Devens ponds.

1. Connect the sonde to the handheld display and turn the power on.

2. On the display, scroll to the calibration mode and scroll to the 2 point calibration option.

3. If not already done, remove the sponge from the calibration container. Pour 1-2 inches of pH 7 buffer solution into the container. If you have used pH 7 buffer solution saved from your last calibration, you can use it for this rinsing process. Put the sonde in the container, screw the cap on firmly and shake the solution around to rinse the sonde and bottle. Unscrew the bottle and pour out the solution.

4. Fill the calibration container about ½ full with fresh pH 7 buffer solution. Place the sonde in the bottle and screw the cap back on. Gently rotate and/or move the sonde up and down to remove any bubbles from the sensors. Ensure that the pH reference and glass sensor as well as the temperature sensor are completely submerged in solution.

5. Enter 7.00 for the first point. Record the temperature and pH value of the pH Buffer 7 that you entered on the calibration worksheet in the Calibration Standard section.

6. Watch for the pH value and temperature to stabilize. When stable, record the pH meter readings as the pH Buffer 7 Pre-Calibration values on the calibration worksheet. Enter this value into the display as the first calibration point and record the pH readings as the pH Buffer 7 Post-Calibration values on the calibration worksheet.

7. At this time, remove sonde from calibration container and pour out the pH 7 buffer. Prompt the display for the 2nd pH buffer.

8. Enter 4.00 for the 2nd pH. Pre-rinse the calibration bottle and sonde with used and fresh pH 4 buffer as you did for the pH 7 buffer. Watch the pH display to see if it responds and rises quickly to near the pH 4 level, which is an indicator that the pH sensors are in good condition. Discard and then pour enough of the pH 10 buffer into the pre-rinsed calibration cup to cover the pH sensors.

9. Fill the calibration container about ½ full with fresh pH 4 buffer solution. Place the sonde in the bottle and screw the cap back on. Gently rotate and/or move the sonde up and down to remove any bubbles from the sensors. Insure that the pH reference and glass sensor as well as the temperature sensor are completely submerged in solution.

10. Record the temperature and pH value of the pH Buffer 4 that you entered on the calibration worksheet in the Calibration Standard section.

11. Watch for the pH value and temperature to stabilize. When stable, record the pH meter readings as the pH Buffer 4 Pre-Calibration values on the calibration worksheet.

12. Enter this value into the display as the first calibration point and record the pH readings as the pH Buffer 4 Post-Calibration values on the calibration worksheet.

13. Remove sonde from calibration container and pour out pH 4 buffer. Rinse calibration bottle and sonde with tap water and store sonde in bottle with wet sponge or place sonde in wet towel for short-term storage and transport.

Dissolved Oxygen Calibration

Inspect the DO probe anodes, recondition if they are darkened or gray in color. After a membrane change only, run the probe continuously for 3-4 minutes or until good stability is realized. It is recommended to change DO membranes every 30 days. Also inspect O-ring and replace if not providing a tight seal. After installing a new membrane, make sure that it is tightly stretched and wrinkle free. Note: DO membranes will be slightly unstable during the first 3 to 6 hours after they are installed; it is suggested that the final calibration of the DO sensor take place after this time period.

Barometric Pressure (BP) Note: If your meter does not have BP built into it you will need to obtain a local BP reading from a local source

Dissolved Oxygen Calibration procedure:

1. Calibration should occur on-site in the atmospheric conditions which sampling will occur. Carefully remove the sensor guard and inspect the membrane to ensure that no water droplets are on the membrane.as needed, wash off with wash bottle or gently dab with Kimwipe or other lens tissue to absorb the water droplets. Also dry the silver thermistor (temperature sensor) for accurate temperature measurements. Carefully replace the sensor guard and place the sonde in the calibration container with the wet sponge and approximately 1/8 inch of water or you may use the wet towel method if you prefer. Do not allow water to touch the membrane and make sure no water droplets are on the membrane. If using the calibration container, unscrew the cap slightly to relieve pressure, allowing equilibrium to be reached with atmospheric pressure. The sonde must now sit in this saturated environment for at least 10 minutes before

the DO calibration can begin. Both the DO reading and the temperature need to stabilize before starting the calibration sequence.

2. When DO % saturation and temperature readings are stable, select Calibrate option.

3. Set the meter to read DO % saturation.

4. If your handheld does not have barometric pressure built into it, be sure to enter your local barometric pressure in mm Hg. If your handheld does have barometric pressure built in, it will be displayed. Record the barometric pressure on your calibration worksheet. Monitor the stabilization of the DO % readings. After no changes occur for approximately 30 seconds, record the Pre-Calibration DO% on the calibration worksheet.

5. Confirm the calibration by entering on the meter. Then record the Post-Calibration DO% value and on the calibration worksheet.

6. End of Day Calibration Check: It is recommended that at the end of your sample run to perform a DO calibration check. Carefully remove the sensor guard and inspect the DO membrane to ensure that no water droplets are on the membrane. As needed, wash off with wash bottle or gently dab with lens tissue to absorb the water droplets. Also dry the silver thermistor (temperature sensor). Carefully replace the sensor guard and place the sonde in the calibration bottle with the wet sponge or wrap in the wet towel if using this method. If using the calibration container, unscrew the cap slightly to allow equilibrium to be reached with atmospheric pressure. When readings stabilize, record the DO% on your calibration worksheet as End of Day D.O. calibration check.

STANDARD OPERATING PROCEDURE

Soil and Sediment Sampling

PURPOSE

To establish standard protocols for all AMEC field personnel to collect a representative soil/sediment sample of the location to be tested for chemical analysis.

PROCEDURE

Soil/Sediment samples are recovered using a variety of methods and equipment, depending on the depth of the water, the portion and depth of the soil/sediment profile required, the type of sample required (disturbed vs. undisturbed), and the sediment type. Soil/Sediment is collected either directly, using a hand-held device such as a hand augers or core samplers (slide hammer), or indirectly using a remotely activated device such as a Ponar dredge.

The following procedure will be used for collecting surface soil with a hand auger or core barrel:

- Insert the auger or core barrel into the sediment, to the required depth.
- For hand augers only, rotate to cut a core of material.
- Slowly withdraw the sampling apparatus from the sediment and transfer the sample to a decontaminated stainless steel bowl.
- The sample is to be homogenized before transferring to a laboratory container.

The following procedure will be used for collecting surface sediment with a Ponar dredge:

- Attach a sturdy nylon rope to the hook provided on the top of the dredge.
- Arrange the Ponar dredge sampler in the open position, setting the trip bar so the sampler remains open when lifted from the top.
- Slowly lower the sampler to a point just above the sediment.
- Drop the sampler sharply into the sediment and jerk up on the line, thus releasing the trip bar and closing the dredge.
- Raise the sampler to the surface and decant any free liquid through the screens on top of the dredge.
- Transfer the sediment to a stainless steel bucket. Collect sediment until sufficient material has been gained. Transfer to an appropriate sample container.

Soil/Sediment samples collected for volatile organic compound (VOC) analysis should be placed directly into jars or other sample containers directly from the sampling device (before homogenization) to minimize volatilization of contaminants. Homogenization of soil obtained from the entire sample length should be performed so that analytical results will be representative of the total sample interval.

If required, the soil/sediment lithology should be recorded in the boring log.

STANDARD OPERATING PROCEDURE

Surface Water Sampling

PURPOSE

The objective is to collect a surface water sample representative of a location's surface water to be tested for chemical analysis.

PROCEDURE

- Apply a temporary label to the sampling containers prior to sample collection. Label information must include at a minimum, the sampling location, and should include date, time, sampling personnel, and project number.

- Collect the surface water sample using an appropriate stainless steel or teflon sampling device (e.g., long-handles dipper). Surface water samples will be collected from the upper 6 inches of the water column. If possible, avoid collection of suspended sediments.

- Water samples collected for VOC analysis (if required) will be collected first, followed by other samples requiring preservatives, and then followed by samples not requiring preservation. Samples requiring dissolved constituent analysis will be collected by transferring the collected sample to a decontaminated stainless steel bowl, and then pumping the sample through a properly sized filter (usually a 0.45 μm filter) into the laboratory supplied sample container.

- The sampling device must be cleaned prior to use at the first sampling location and between sampling locations. Cleaning and decontamination procedures should be in accordance with the equipment decontamination SOP.

- Documentation should include securely fixing a legible, permanent label to the sample jars and complying with site-specific paperwork. Sample descriptive information should be entered into a bound notebook and/or field data sheet. Sample information should include: Sample ID, time sampled, sampler name, odor, color, and relative turbidity.

STANDARD OPERATING PROCEDURE

Equipment Decontamination

PURPOSE

To establish standard protocols for all AMEC field personnel to ensure that consistent and acceptable equipment decontamination procedures are followed.

RESPONSIBILITIES

Decontamination of various types of sampling equipment before and between sample collection is necessary to maintain the highest sample integrity possible. A qualified individual shall be responsible for the proper decontamination of sampling equipment. Field personnel shall set up a decontamination area, identify the frequency and equipment to be decontaminated, and determine the cleaning technique and types of cleaning solutions to be used. Pertinent equipment decontamination information shall be recorded in the field logbook.

PROCEDURE

Typical decontamination procedures for various types of equipment are outline below.

- Equipment can be decontaminated at the sample location, or at a pre-designated, controlled location. All equipment must be decontaminated before leaving the site.
- When required the decontamination area shall allow access control, safe residual material handling, clean equipment storage, and access to the area being investigated. The decontamination area shall be upwind from potential source location.
- Decontamination of drilling equipment includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, steel cable, along with pump drop-lines and pumps. These items are typically cleaned, by the subcontractor, with a steam pressure washer.
- Types of equipment requiring decontamination include, but are not limited to, bailers, interface probes, water level meters, trowels, shovels, stainless steel spoons and bowls, and dippers. At a minimum, items are cleaned following the procedure outlined below:

    1) Wash with a non-phosphate detergent (alconox, liquinox, or other suitable detergent) and potable water solution; and
    2) Rinse with potable water.

  Some programs require the following additional steps:

    3) Spray with appropriate solvent depending on site-specific requirements (typically isopropyl alcohol),
    4) Rinse with deionized or distilled water.
    5) If possible, equipment shall be disassembled prior to cleaning. A second wash should be added at the beginning of the process if very soiled equipment is present.

- Submersible pumps, shall be decontaminated by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. The internal surfaces shall be decontaminated by recirculating the appropriate decontamination fluids through the pump while it is operating. This can be done using several large diameter pipes (4-inch or greater) filled with the decontamination fluids. The pump is placed within the closed pipes, and operated while recirculating the fluids. The decontamination sequence shall include:

1) Detergent and potable water wash,
2) Potable water rinse,
3) Appropriate solvent spray into the pump, and
4) Potable water rinse. The decontamination fluids shall be changed after each decontamination cycle.

- Down-hole drilling equipment and monitoring well development and purging equipment shall be decontaminated prior to initial use and between each borehole or well. However, down-hole drilling equipment may require more frequent cleaning to prevent carry over between vertical zones within a single borehole.

- All groundwater, surface water, and unsaturated zone sampling devices shall be decontaminated prior to initial use and between collection of each sample.

- Site decontamination water shall be discharged to the ground on unpaved surfaces unless containment has been predetermined or is necessitated based on field observations.

STANDARD OPERATING PROCEDURE

Field Logbook

PURPOSE

To establish standard protocols for all AMEC field personnel pertaining to the identification, use, and control of logbooks and associated field data records.

RESPONSIBILITIES

The logbook user is responsible for recording pertinent data into the logbook to satisfy project requirements and attesting to the accuracy of the entries by dated signature. Logbooks are intended to be project specific. For new logbooks:

- Enter Project name and project number on the cover
- Inside the cover of the logbook enter project manager, project name, project number, AMEC office address and phone number

PROCEDURE

Logbook pages shall be filed out sequentially from the first page and numbered by the field technician as they are used. Any pages that are inadvertently skipped should have a line drawn through them and dated when the omission is discovered. Pages should not be re-numbered.

- Entries shall be made chronologically and in sufficient detail to allow the writer or a reviewer to reconstruct the applicable events. At the start of each workday logbooks entries should include:
  - Date
  - Site location and description
  - Personnel (AMEC, subcontractor, agency, client, etc.) on-site
  - Weather conditions
- In general an entry should be made into logbooks every 30 minutes. Entries can include field observations and changing site conditions.
- Typical information to be entered includes, but is not limited to the following:
  - Project name and/or project number and date entered at the top of each page
  - Date and time of all on-site activities, including field descriptions, equipment used, telephone conversations, correspondence, or deliverables
  - On-site meeting information
  - Note when individuals arrive and leave from site
  - Field instrumentation calibration records and readings
  - Entries on individual field data sheets shall be referenced in the applicable logbook but should not be duplicated in the logbook.
  - Field work documentation, including photograph references and sample tag or label numbers
  - Field calculations
- All entries should be made in pen or permanent marker. Entry errors are corrected by drawing a single line through the incorrect entry, initialing and dating.
- The bottom of each completed page shall be signed when it is complete. To indicate the end of entries for the day a line shall be drawn across the remaining portion of the last page with an entry recorded on it.
- Logbook entries shall be routinely photocopied and kept on file in the project office.

STANDARD OPERATING PROCEDURE

Chain-of-Custody

PURPOSE

To establish standard protocols for all AMEC field personnel to ensure that proper chain-of-custody procedures are utilized to ensure a traceable chain-of-custody of analytical samples until they are received at the appropriate laboratory.

RESPONSIBILITIES

AMEC field personnel are responsible for logging individual samples onto carbon copy chain-of-custody forms. It is recommended that the chain-of-custody information be recorded in the field logbook.:

PROCEDURE

The header of each Chain-of-Custody form (COCs) shall contain project specific information including:

- Project manager
- Project name
- Project number
- Project location

•Additional specific information may be required for certain projects. This information shall be placed on all COCs and the COCs shall be number sequentially (1 of_ , etc.).

•Samples shall be entered by sample name on separate lines of the COC. COC forms shall include:

- Sample identification numbers
- Matrix
- Date
- Time of collection
- Number of containers,
- Analytical methods to be performed and preservatives added (if any).

•The sampler will also sign the custody form prior to relinquishing custody of the samples. The COC form shall accompany the samples from the field to the laboratory. One copy of the COC form will be retained by the sampler and the remaining copies of the COC form shall be placed inside a zip-lock bag and taped to the inside of the cooler. A unique COC form must be completed for each cooler, however, all of the COCs for a single shipment to a single destination, should be packaged together in one cooler.

•Whenever a transfer of custody takes place, both parties shall sign and date the accompanying carbon copy COC forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy. When possible, record the airbill number as the recipient. The laboratory shall attach a copy of the completed COC forms to the analytical reports.

•Custody seals shall be placed on shipping coolers if the cooler is to be removed from the sampler's custody. Custody seals will be placed in such a manner that they must be broken to open the containers or coolers. The custody seals shall be labeled with the following information:

- Sampler's initials
- Date and time that the sample/cooler was sealed.

APPENDIX B

EXAMPLE FIELD FORMS

GROUND-WATER/SURFACE WATER SAMPLING FORM

Sample Location ____________ Surface Water ☐ Groundwater ☐ Sample Identification ____________
(Use: Well name)
Sampling Personnel ____________ Date ________ Start Time ________ Weather ________

MEASUREMENT SUMMARY:
Measuring Point ________ Depth to Water ________ Depth to Product ________ Product Thickness ________
Total Casing Depth ________ Borehole Diameter ________ Calculated Purge Volume ________ Gallons

SAMPLING SUMMARY:
Sampling Method: Grab ☐ Composite ☐ Grundfos ☐ Bladder Pump ☐ Peristaltic Pump ☐ Bailer ☐
Pump Started ________ Pump Stopped ________ Total Gallons ________ Organic Vapor at Well Head ________

Time (military)	pH S.U.	SC (umhos/cm)	Temp (^oC)	Turb. (NTU)	Flow Rate (ml/min)	DTW (ft)	D.O. (mg/L)	Redox (mV)

Final:

Time	**pH**	**SC**	**Temp**	**Turb.**	**Flow Rate**	**DTW**	**D.O.**	**Redox**

Comments: ____

HYDROLAB: pH Calibration Buffers: 4 ☐ 7 ☐ 10 ☐ Eh Reference Solution ________
SC Reference Solution ________ umhos/cm Turbidity Reference Solution ________ NTUs

Sample Name ____________ Time ________ VOCs ☐ SVOCs ☐ PAHs ☐ TOC ☐
Total Metals ☐ Dissolved Metals ☐ Pesticides ☐ Explosives ☐ Sulfate ☐
Other ☐ List: Metals=RCRA 8 (As, Ba, Ca, Cr, Pb, Hg, Se, Ag) + Al, B, Mo, Cu, Mn.
MS/MSD ________ Blind Dup ________ Blind Dup Name ________ TB ________

amec

GROUND-WATER/SURFACE WATER SAMPLING FORM

Sediment Sample Log

Project Name: Location:

Project Number: Sampled by: Sample Time:

Total Depth: Date Started: Date Finished:

Recovery/Penetration: Water Depth:

Comments:

Description of Sample and/or Sample Location

Depth (feet)	Sample No.	Sample Depth	Sediment Description	PID	Depth (feet)
0					
1					

AMEC Earth & Environmental
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(978) 692-9090

CHAIN OF COUSTODY

DATE: ____________

PAGE: _____ OF _____

Project Manager:	Project Contact:		Disposal Instructions: LAB
Project Name:	Phone Number:		Shipment Method:
Project Number:	Purchase Order No.:		Waybill Number:

Comments: H=Hold Analysis Request X=Analyze

Preservatives and Containers

Sample Information

Methods for Analysis

RUSH

No.	LAB Sample ID	AMEC ID	Date Sampled	Time Sampled	Matrix	QC (MS/MSD)	TOTAL BOTTLES	COMMENTS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Sampler's Signature:	**Date:**	**Time:**
Relinquished By:	**Date:**	**Time:**
Received By:	**Date:**	**Time:**
Relinquished By:	**Date:**	**Time:**
Received By (LAB):	**Date:**	**Time:**

For Lab Use

Does COC match samples:	Y or N
Broken Container:	Y or N
Received within holding time:	Y or N
COC seal intact:	Y or N
Other problems:	Y or N
AMEC contacted:	Y or N
Date contacted:	________
Cooler Temperature at receipt:	______ C
Volatile Cooler Temperature:	C

Matrix	**Preservative**
A- Air	H - HCl
S- Soil	N- HNO3
GW-Groundwater	S- H2SO4
DW- Drinking Water	Na - NaOH
WW- Waste Waster	M - MEOH
O - Other	

NOTES:

Attachment B

Remedial Investigation Workplan for AOC 72, Plow Shop Pond

Attachment B – Data Analysis Plan

FINAL

Devens, Massachusetts

May 2009

Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by:

AMEC Earth & Environmental, Inc
Westford, Massachusetts
Contract No.: GS-10F-0230J
Delivery Order: W912WJ-05-F-0037

SHL-0125

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Abbreviations, Acronyms, and Symbols

AMEC	AMEC Earth and Environmental, Inc.
AOC	Area of Concern
BCT	BRAC Cleanup Team
BMI	Benthic Macroinvertebrate
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMR	Code of Massachusetts Regulations
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DAP	Data Analysis Plan
DGA	Data Gaps Analysis
DO	Dissolved Oxygen
DQO	Data Quality Objective
ESI	Expanded Site Investigation
FS	Feasibility Study
FSP	Field Sampling Plan
GPR	Ground Penetrating Radar
HERA	Human and Ecological Risk Assessment
MassDEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
NCP	National Contingency Plan
PAH	Polycyclic Aromatic Hydrocarbons
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
RI	Remedial Investigation
SA 71	Study Area 71 (aka Railroad Roundhouse)
SAP	Sampling and Analysis Plan
SHL	Shepley's Hill Landfill
SQT	Sediment Quality Triad
SSHP	Site Safety and Health Plan
USACE-NAE	U.S. Army Corps of Engineers – New England District
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

1.0 INTRODUCTION

This Data Analysis Plan (DAP) for Area of Concern (AOC) 72 at the former Fort Devens has been prepared by AMEC Earth & Environmental, Inc. (AMEC) on behalf of the United States Army Corps of Engineers, New England District (USACE-NAE). AOC 72 consists of Plow Shop Pond, located on the east of Shepley's Hill Landfill (SHL) at Devens (Figure 1). Remediation of the landfill, and Remedial Investigation (RI) and Feasibility Study (FS) of AOC 72, is occurring under the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act, and National Oil and Hazardous Substances Contingency Plan requirements, with regulatory coordination of the Massachusetts Department of Environmental Protection (MassDEP) and the United States Environmental Protection Agency (USEPA).

Plow Shop Pond is located southwest of the business and residential district in Ayer, Massachusetts. The 30-acre pond basin is bounded on the west and south by former Fort Devens property, to the north by commercial development (Molumco Industrial Park), and to the east by the Guilford Transportation railroad which crosses a causeway between Grove and Plow Shop Ponds. The pond is eutrophic with abundant aquatic plant life. Plow Shop Pond is used by local residents for recreational fishing, and is canoe-accessible at a landing on the northwest side. Signs are reportedly posted for "catch and release" fishing (Gannett Fleming 2006).

Plow Shop Pond and the surrounding ponds and rivers are located within the Squannassit Area of Critical Environmental Concern (ACEC). The ACEC designation by the Massachusetts Secretary of Energy and Environmental Affairs creates a framework for local, regional, and state stewardship of critical natural resources. The Squannassit ACEC encompasses 37,450 acres in portions of nine towns, and for the most part lies along and to the west of the Nashua River, from a section of Route 2 in the Towns of Harvard and Lancaster north to New Hampshire. ACEC resource details are provided at www.mass.gov/dcr/stewardship/acec/acecs/l-squsit.htm.

Documents containing site characterization data for AOC 72 are summarized in Table 1. The data developed during or prior to USEPA's 2006 Expanded Site Investigation (ESI) were evaluated for usability in that study (Gannett Fleming, 2006). The data determined to be useable for the ESI were provided in an electronic format to USACE-NAE for the current RI Workplan. Subsequent to the ESI, the Army reported new results for SA 71 (MACTEC, 2008), and these are being combined with the ESI data for the current evaluation. The studies for Plastic Distribution Corporation (PDC) in 2007 did not include any post-ESI sampling within AOC 72 (ENSOL, 2007). USEPA's recent Red Cove study included sediment and surface water samples analyzed by non-conventional methods and the results of these samples have not been validated (USEPA, 2008).

This DAP is Attachment B of an RI Workplan for AOC 72 that includes an evaluation of existing data and data gaps, proposed investigations, a Human and Ecological Risk Assessment (HERA) Plan, and a Sampling and Analysis Plan (SAP). The SAP includes a Field Sampling Plan as Attachment A to the RI Workplan, a Quality Assurance Project Plan as Attachment C, and a Site Safety and Health Plan as Attachment D. This DAP summarizes how existing and new data (proposed to be collected per the SAP) will be utilized to complete the RI. Section 2 of this DAP summarizes the Conceptual Site Model (CSM) and RI technical objectives for AOC 72 (see also Section 2 of the RI Workplan). Section 3 summarizes data analysis methods for the RI.

2.0 CSM & RI TECHNICAL OBJECTIVES

This section of the workplan summarizes the CSM and identifies RI technical objectives.

2.1 Conceptual Site Model

The primary contaminant relating to SHL and potentially presenting human and ecological risk is arsenic discharging to AOC 72 in groundwater. The transport and discharge of arsenic from groundwater to a pond has been studied in detail at several locations in Massachusetts. USEPA studied arsenic fate and transport in the Red Cove portion of Plow Shop Pond during the period from 2005 to 2007, and portions of this study are continuing (USEPA, 2008). The CSM contaminant transport conclusions that follow are largely based on the USEPA study results, which are consistent with studies at other sites.

Groundwater from SHL carrying dissolved arsenic, iron, and other metals discharges to AOC 72 in the vicinity of Red Cove. Iron oxides precipitate as an orange-red floc or sediment in Red Cove as reduced groundwater discharges to oxygenated surface water. Arsenic is adsorbed by or co-precipitated with the iron floc. Precipitation of metals occurs near and above the sediment surface where oxidizing conditions prevail. The redox boundary near the sediment surface results in decreasing sediment arsenic concentrations with depth below the sediment surface. Mixing of the sediment and surface water may lead to "recycling" of iron and arsenic where the dissolved contaminants from deeper zones are oxidized and precipitate again as sediment. Recycling between sediment and surface water may result in arsenic transport beyond the area of groundwater discharge, depending on the amount of turbulence and surface water flow. However, elevated sediment arsenic concentrations are observed primarily where the highest rates of groundwater from SHL are likely to discharge, closest to shore and south of the "hinge" between groundwater discharge to and recharge from the pond. Plow Shop Pond is a shallow, low-energy environment unfavorable to large-scale sedimentary mixing.

AOC 72 may also be impacted by polycyclic aromatic hydrocarbons (PAH) and/or metals released in the former Railroad Roundhouse (SA 71) area, and by inflow from the west end of Grove Pond. The western area of Grove Pond near the outlet to AOC 72 has been impacted by discharges from the former Hartnett Tannery located at its northwest corner. Sediment chromium concentrations are elevated near the former tannery in Grove Pond and throughout much of AOC 72, with the notable exceptions of Red Cove and the SA 71 area.

2.2 RI Technical Objectives

The overall objectives of the Army and other project stakeholders for the AOC 72 RI are to complete the investigation of Plow Shop Pond as needed to estimate risks to human health and the environment, and to close all CERCLA-related reporting. Specific technical objectives include the following:

- Evaluate current and potential future contaminant flux from SHL to AOC 72.
- Evaluate other contaminant sources and distribution in AOC 72.

- Evaluate whether the iron floc in Red Cove can act as a physical asphyxiant.
- Evaluate whether the iron floc in Red Cove constitutes "readily apparent harm".
- Evaluate human and ecological risks related to site contaminants in sediment.
- Evaluate human and ecological risks related to site contaminants in surface water.
- Evaluate localized ecological risks related to site contaminants in Red Cove.

Working hypotheses and methods of evaluation are summarized in Table 2, along with the data needed and any apparent data gaps. Investigations to eliminate these data gaps are proposed in the SAP.

3.0 DATA ANALYSIS METHODS

This section of the workplan summarizes data sources and expected methods for evaluation in the RI report.

3.1 Data Sources & Validation

Data collected during the RI will be combined with historical data to refine the CSM, evaluate contaminant sources and flux rates, and support risk assessment. Data collected during the RI will be validated in accordance with USEPA Region I Tier II criteria as described in detail in Attachment C (QAPP) to the RI Workplan. Historical data includes the ESI data collected prior to 2005, the SA 71 data collected in 2005-2006, and USEPA's Red Cove data collected in 2005-2007.

The ESI data were validated by USEPA (Gannett Fleming, 2006), and the SA 71 data were validated by USACE-NAE (MACTEC, 2008). Portions of the ESI data that were supplied electronically to AMEC were excluded from the initial data evaluation in Section 2 of the RI Workplan because of missing coordinates and unexplained duplicate results. AMEC will conduct additional review of the ESI data and if necessary contact USEPA to resolve any discrepancies as needed to allow future use of all of the relevant ESI data for the RI. USEPA has indicated that the Red Cove data can also be validated for future use in the RI.

3.2 Numerical Groundwater Flow Modeling

The existing numerical groundwater flow model for the Shepley's Hill area, developed using the USGS MODFLOW program (MacDonald and Harbaugh, 1988), has been utilized over many years to guide site investigations, interpret the arsenic plume trajectory, and predict the effectiveness of the contingency pump and treat remedy currently in operation. The model was recently updated during preparation of the draft *Supplemental Groundwater and Landfill Cap Assessment for Long-Term Monitoring and Maintenance* report (draft December 2008). Updates included 3 layers, representing shallow and deep portions of the overburden aquifer and bedrock respectively, and recalibration to current water level data. Further adjustments to the groundwater model will be performed during the RI for AOC 72 to ensure consistency with data recently collected by USEPA in the Red Cove area, including hydraulic conductivity values, thermal indicators of the distribution of groundwater discharge, and direct measurements of discharge of arsenic impacted groundwater to the pond.

Specifically, model boundary conditions and hydraulic properties will be adjusted to best match the locations and estimated rates of discharge under current conditions. Along with observations on current contaminant concentrations in groundwater, the model can then be used to predict the contaminant flux to AOC 72, and the potential for seasonal variations can be estimated. Considering properties of the existing sediment, the flux estimates can be used to evaluate rates of metals accumulation. If necessary in an FS, the model can further be used to explore the feasibility and likely effectiveness of a range of hypothetical remedial alternatives (e.g., expansion of the pump and treat system to include an additional extraction well to intercept pond discharge).

As long-term changes are of concern, all models will be run under steady-state conditions. Particle track simulations utilizing MODPATH (Pollock, 1989) will be used to illustrate flow patterns. The results of the flow modeling, in terms of flow patterns, groundwater velocities, discharge rates, and contaminant flux will be used to support the decisions based on the risk assessments.

3.3 Evaluation of Contaminant Conditions and Risks

The nature and extent of contamination for AOC 72 will be described for surface water, sediment, and biota using maps and tables to show spatial and any temporal trends. Comparisons will be made with earlier conclusions in the ESI, SA 71, and PDC reports, and differences will be summarized. The site characteristics, source characteristics, extent of contamination, and numerical estimates of flux will be combined in an evaluation of contaminant fate and transport.

The CSM will be updated and expanded based on the evaluation of contaminant fate and transport. The CSM provides the basis for estimating and interpreting risks in that it helps identify exposure pathways, differentiate between contaminant sources, and estimate future changes in contaminant nature and extent. All validated data will be considered in the RI risk assessments, following the procedures described in Attachment E (HERA Plan) to the RI Workplan.

REFERENCES

ENSOL, 2007. *Phase II Comprehensive Site Assessment, Area 2 - Grove Pond and Plow Shop Pond*. Prepared for Plastic Distribution Corporation, Ayer MA. July.

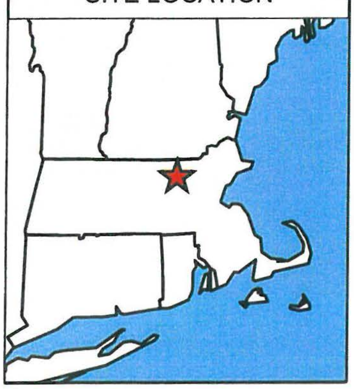
Gannett Fleming, 2006. *Expanded Site Investigation. Remedial Oversight of Activities at Fort Devens Plow Shop and Grove Ponds, Draft*. Prepared for USEPA Region 1. May.

MacDonald, M. G., and A. W. Harbaugh, 1988, A modular three-dimensional finite difference ground-water flow model: U.S. Geological Survey Techniques of Water Resources Investigations, Book 6.

MACTEC, 2008. *Final SA 71 Sediment Risk Characterization, Devens MA.* Prepared for USACE-NAE, Concord MA. May

Pollock, D.W. 1989. Documentation of Computer Programs to Compute and Display Pathlines Using Results from the U.S. Geological Survey Modular Three-Dimensional Finite-Difference Ground-Water Flow Model. USGS Open File Report 89-391.

USEPA, 2008. *Arsenic Fate, Transport and Stability Study, Final Report.* USEPA National Risk Management Research Laboratory. September.



Plow Shop Pond Location

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

LEGEND

Streams
Landfill Boundary

0 750 Feet

AMEC Earth & Environmental, Inc.
2 Robbins Road
Westford, MA 01886
(978) 692-9090

FIGURE 1

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

H:\ShepleyLandfill\Task18\MXD\Figure1.mxd H:\ShepleyLandfill\Task18\Export\Figure1.pdf August 1, 2008 DWN: AP CHKD: KMP

Table 1. Summary of Data Relevant to AOC 72

Report title	Year	Prepared for	Author	Data Collected	AOC 72 Risk Drivers or COPCs
SA 71 Sediment Risk Characterization	2008	Army	MACTEC	SQT results incl 20-d and 42-d toxicity tests	Human: As, Cr Ecolog: PAH, Zn
Final Report; Arsenic Fate, Transport, and Stability Study; Ft. Devens Superfund Site	2008	USEPA	USEPA NRMRL	Hydraulic Conductivities; Thermal Indicators of Discharge Areas; Groundwater Seepage; SED and SW Chemistry	
Phase II CSA, RTN 2-0010138, Area 2 - Grove Pond and Plow Shop Pond	2007	PDC	ENSOL Inc	No new data	
Expanded Site Investigation, Ft. Devens Plow Shop and Grove Ponds	2006	USEPA	Gannett Fleming	SED and SW Chemistry; 10-day SED tox test	Human: As, Cr, Hg, V, PAH, PCB, DDD Ecolog: As, Cr, PAH
Toxicity Testing Results; Grove, Plow Shop, and Flanagan Ponds	2005	USEPA	Lockheed Martin	SED and SW 10-day tox tests	
Grove Pond Arsenic Investigation: Final Report	2002	USEPA	Gannett Fleming	SED and SW Chemistry	
Supplemental Groundwater Investigation	2002	Army	Harding ESE	SED and SW Chemistry	
Benthic Community Survey of Nonacoicus Brook	2001	Army	Harding ESE	Benthic Survey	
Trace Element Exposure in Benthic Invertebrates; Grove Pond, Plow Shop Pond, and Nonacoicus Brook	2000	USEPA	US FWS	Mussel and Crayfish Tissue sample analyses	
Screening Level Ecological Risk Assessment	1999	USEPA	USEPA	SED and SW Chemistry	Ecolog: Ba, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn
Surface Water and Sediment Sampling	1998	USEPA	Lockheed Martin	SED and SW Chemistry	
Evaluation of Health Concerns Associated with Grove Pond and Plow Shop Pond	1998	ATSDR	ATSDR	No new data	
Review of AVS/SEM results for Grove Pond Sediment	1998	MassDEP	TRC	SED Chemistry	
Plow Shop Pond and Grove Pond Sediment Evaluation	1995	Army	ABB	SED and SW Chemistry; 10-day SED tox test; fish tissue	Human: Hg Ecolog: As, Cu
Site Assessment Report, Boston & Maine Railroad Property, Fort Devens	1994	B&M RR	ERM	SED and SW Chemistry	
Grove Pond Field Investigation	1994	MassDEP	M&E	SED Chemistry	

Abbreviations:
SQT = Sediment Quality Triad
SED = Sediment
SW = Surface water

Table 2. Data Gaps & Proposed RI Activities for AOC 72

Objective	Hypothesis	Evaluation	Data Needs	Data Gap
1. Evaluate current and potential future contaminant flux from SHL to AOC 72 via groundwater.	An ongoing groundwater discharge to Plow Shop Pond may result in increasing contaminant concentrations and/or volume in sediment.	Estimate accumulation rates based on current flux rates, groundwater and sediment chemistry, and groundwater modeling.	Flux estimates, groundwater and sediment chemistry data.	None
2. Evaluate other contaminant sources and distribution within AOC 72.	COPCs were released from source areas including Red Cove, SA 71, and the former tannery at Grove Pond.	Relate specific COPCs to specific source areas based on site histories, chemical occurrence, and transport mechanisms.	Site histories and chemistry data.	None
3. Evaluate whether the iron floc in Red Cove can act as a physical asphyxiant.	The density of the floc may not provide a BMI habitat substrate, but may impede oxygen transport to sediment.	Compare bulk density, porosity, and in situ DO between floc and non-floc zones.	In situ DO and physical property analysis for floc and non-floc zones.	In situ DO and physical property analysis for floc and non-floc zones.
4. Evaluate whether the iron floc in Red Cove constitutes "readily apparent harm" under the MCP.	The iron floc could meet the criteria for readily apparent harm at 310 CMR 40.0995(3)(b)(1).	Compare visual observations and chemistry data with the MCP criteria.	Visual observations and chemistry data.	Continue visual observations of vegetation and biota in floc and non-floc areas.
5. Evaluate human and ecological risks related to site contaminants in sediments.	Human health and ecological risks can be estimated based on sediment chemistry data. For BMI receptors, toxicity testing and community surveys are also considered.	Estimate risks in accordance with USEPA guidance based on sediment chemistry data, and for BMI considering toxicity testing and community surveys.	Sediment chemistry data and SQT tests including chemistry, BMI toxicity, and BMI community surveys.	SQT tests in AOC 72 (beyond those available for SA 71) and reference areas.
6. Evaluate human and ecological risks related to site contaminants in surface water.	Human health and ecological risks can be estimated based on surface water chemistry data.	Estimate risks in accordance with USEPA guidance based on surface water chemistry data.	Surface water chemistry data.	None
7. Evaluate localized risks for BMI receptors related to site contaminants in Red Cove.	Highly localized conditions in groundwater upwelling zones may impact BMI communities.	Consider weight of evidence in correlating BMI parameters with site contaminants.	Surface water chemistry data and sediment SQT tests specific to upwelling areas.	Surface water sampling for chemistry and sediment sampling for SQT tests in upwelling areas.

Attachment C

Remedial Investigation Workplan for AOC 72, Plow Shop Pond

Attachment C – Quality Assurance Project Plan

FINAL

Devens, Massachusetts

May 2009

Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by:

AMEC Earth & Environmental, Inc
Westford, Massachusetts
Contract No.: GS-10F-0230J
Delivery Order: W912WJ-05-F-0037

SHL-0125

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ACRONYMS AND ABBREVIATIONS

AEC	Army Environmental Center
AES	Atomic Emission Spectrometry
AMEC	AMEC Earth and Environmental
AOC	Area of Concern
ASTM	American Society for Testing and Materials
AWQC	Ambient Water Quality Criteria
BEC	Base Realignment and Closure Environmental Coordinator
BCT	Base Realignment and Closure Cleanup Team
BRAC	Base Realignment and Closure
CAAA	Corrective Action Alternatives Analysis
CC	Continuing Calibration
CCC	Criterion Continuous Concentration
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMC	Criterion Maximum Concentration
CMR	Code of Massachusetts Regulations
COC	Chain of Custody
COD	Chemical Oxygen Demand
COPC	Chemicals of Potential Concern
COR	Contracting Officer Representative
CRDL	Contract Required Detection Limit
CSA	Comprehensive Site Assessment
DGA	Data Gaps Analysis
DMA	Dimethylated Arsenic
DO	Dissolved Oxygen
DoD	Department of Defense
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EDMS	Electronic Data Management System
EM	Engineer Manual
EPA	Environmental Protection Agency
EPA-NE	USEPA New England (Region I)
ERIS	Environmental Restoration Information System
FSC	Field Sample Custodian
FSMS	Field Sampling Management System
FSP	Field Sampling Plan
GC/MS	Gas Chromatography/Mass Spectrometry
GW	Groundwater
HA	Health Advisory
ICAL	Initial Calibration
ICP	Inductively Coupled Plasma
IDL	Instrument Detection Limit
LCS	Laboratory Control Sample
LEL	Lowest Effect Level
LIMS	Laboratory Information Management System

ACRONYMS AND ABBREVIATIONS CONTINUED

LSC	Laboratory Sample Custodian
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
MDL	Method Detection Limit
MMA	Monomethylated Arsenic
MMCL	Massachusetts Maximum Contaminant Level
MS	Mass Spectrometry
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NOAA	National Oceanic and Atmospheric Administration
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Agency
PAH	Polycyclic Aromatic Hydrocarbons
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, Sensitivity
PDF	Portable Document File
PE	Performance Evaluation
PMP	Project Management Plan
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QL	Quantitation Limit
QSM	Quality Systems Manual
RI	Remedial Investigation
ROD	Record of Decision
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SDG	Sample Delivery Group
SHL	Shepley's Hill Landfill
SMCL	Secondary Maximum Contaminant Level
SOP	Standard Operating Procedures
SOW	Statement of Work
TAL	Target Analyte List
TAT	Turnaround Time
TDS	Total Dissolved Solids
TEL	Threshold Effects Level
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USACE-NAE	United States Army Corps of Engineers – New England District
USAEC	United States Army Environmental Center
USEPA	United Stated Department of Environmental Protection

1.0 TITLE AND APPROVAL PAGE

The Title and Approval page is shown on Worksheet 1 (Appendix A).

2.0 CONTENTS AND DOCUMENTATION FORMAT

2.1 Table of Contents

The Table of Contents shows a summary of the text sections of this Quality Assurance Project Plan (QAPP).

2.2 Documentation Control Format

A controlled document numbering system is not required for small projects and will not be used for this Remedial Investigation (RI) Workplan. Due to the project duration, updates to the plans are not anticipated. The format of this QAPP includes a summary of the QAPP elements followed by USEPA-NE QAPP Worksheets in Appendix A. Other attachments include: Appendix B (Laboratory Standard Operating Procedures and Certifications), Appendix C (Relevant USEPA Guidance), and Appendix D (Personnel Resumes).

2.3 Document Control Numbering Format

This document has been assigned a unique AMEC identification number (SHL-0125). The list of QAPP recipients is shown in Worksheet 3 (Appendix A). Amendments and updates to this QAPP will be sent to the recipients listed in Worksheet 3.

2.4 USEPA-NE QAPP Worksheet #2

USEPA-NE QAPP Worksheet 2 (Appendix A) identifies general project information and the USEPA program under which the current work is performed. USEPA-NE QAPP worksheets, which are not applicable to this project, are highlighted in bold italic print and described in Worksheet 2 – part 2.

This QAPP is a project specific document which defines data quality objectives and describes laboratory operations and analysis activities, including laboratory organization and responsibilities, analytical procedures, measurement performance criteria, analytical procedures, performance and systems audits, corrective actions, data assessment, data verification, and data validation. This QAPP has been generated using the graded approach. Due to the limited scope of work and project duration of field activities, references to other existing project documents are referenced to fulfill the QAPP content requirements. This QAPP is Attachment C to the RI Workplan.

The AMEC Project Management Plan (PMP) (AMEC, 2006) is referenced to address organizational structure, lines of communication, and scheduling aspects of the project. RI objectives, data gaps, and measurement components are described in Section 2 of the RI

Workplan. The FSP provided in Attachment A to the RI Workplan is referenced to address sampling design, rationale, site maps, and field sampling activities.

3.0 DISTRIBUTION LIST AND PROJECT PERSONNEL SIGN-OFF SHEET

Worksheets 3 and 4 (Appendix A) show the QAPP distribution list and project personnel sign-off sheet. The distribution list shows the personnel to which approved copies of the QAPP and revisions will be sent. The project personnel sign-off sheet documents that key project personnel performing work have read the QAPP, understand the intent, and will perform the work as stated in the QAPP. Signed sheets will be maintained in the central project file at AMEC.

4.0 PROJECT ORGANIZATION

4.1 Project Organizational Chart

The RI for Area of Concern (AOC) 72 is being conduced pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and National Oil and Hazardous Substances Contingency Plan (NCP) requirements, with regulatory coordination of the Massachusetts Department of Environmental Protection (MassDEP) and the United States Environmental Protection Agency (USEPA).

The USACE-NAE Contracting Officer (KO) is responsible for the day-to-day monitoring of performance in areas of contract compliance and contract administration; reviewing the Army's Contracting Officer's Representative's (COR) assessment of the Contractor's performance; and resolving all differences between the COR's assessment and the Contractor's assessment of performance. The KO is responsible for providing a final determination of the adequacy of the Contractor's performance.

The Army's Contracting Officer's Representative (COR) for this work is the USACE-NAE. The USACE-NAE is responsible for monitoring, assessing, recording, and reporting on the technical performance of the Contractor on a day-to-day basis. The COR will provide certification and approval of project milestones before authorizing progress payments to the Contractor based on the payment plan. Mr. Randy Godfrey is the USACE-NAE Project Manager. Mr. Peter Hugh is the COR engineering and technical lead for USACE-NAE.

The Base Realignment and Closure (BRAC) Environmental Coordinator (BEC) is the principal field representative for response actions at Fort Devens, Massachusetts. The BEC coordinates the work of installation staff, Army technical support agencies, and the private contractor in the successful accomplishment of the BRAC Environmental Restoration Program (ERP) goals and policies. Mr. Robert Simeone is the BRAC point of contact for this project.

The Federal Facilities Agreement (FFA) establishes the roles and responsibilities for the USEPA and the Army and provides the procedural framework and timetable for all response actions in accordance with CERCLA. The USEPA is the lead regulatory agency. The MassDEP plays a "participatory" role in remediation efforts, according to the FFA. The MassDEP will review deliverables associated with this project.

A project organizational chart is provided in the PMP (AMEC, 2006).

4.2 Communication Pathways

Communication pathways will be established which expedite the flow of information; yet minimize potential misrepresentation and replication of information. Coordination and regulatory communication pathways for this project are detailed in the PMP (AMEC, 2006).

Laboratory contract and analysis issues will be resolved by the AMEC project chemist with input and concurrence from the project team. Data validation issues will be documented and resolved by the AMEC data validation chemist.

4.2.1 Modifications to Approved QAPP

Modifications to the approved QAPP will be made when the project activities originally documented in the QAPP require significant modification to achieve the project goals or are the result of changes and improvements in processes which occur over the project duration. Draft modifications and amendments to the approved QAPP will be submitted by AMEC personnel to the USACE-NAE for approval. Procedural modifications to this document will be documented for agency review prior to implementation. Following approval, significant modifications to the approved QAPP will be incorporated into the final version of the QAPP and maintained by AMEC as part of the official site records.

4.3 Personnel Responsibilities and Qualifications

Primary project personnel, responsibilities, and qualifications are described in Worksheet 6 (Appendix A). Project personnel resumes summarized in Worksheet 6 are included in Appendix D. Personnel who conduct work activities will have the necessary experience and training to satisfactorily complete the assigned tasks.

4.4 Special Training Requirements/Certification

No special training requirements and certifications are required for this project. The FSP (Attachment A to this RI Workplan) specifies the training requirements for field personnel. Chemistry laboratory subcontractors will be National Environmental Laboratory Accreditation Program (NELAP) certified and/or MassDEP approved (and compliant with Department of Defense (DoD) Quality Systems Manual (QSM)), when applicable. For specialized laboratory analyses, such as bioassay and benthic community analysis, laboratory demonstration of performance and standard operating procedures (SOPs) will be reviewed and approved prior to using the laboratory.

5.0 PROJECT PLANNING/PROJECT DEFINITION

5.1 Project Planning Meetings

The scope of work for this project evolved from the initial Performance Work Statement, which the Army developed in consultation with the USEPA and the MassDEP. The scope of the RI for AOC 72 was refined in meetings with the USEPA and the MassDEP during 2007-2008 as summarized in Section 2 of the RI Workplan.

5.2 Problem Definition/Site History and Background

The problem definition, site history, and background are described in Worksheet 8b (Appendix A). Site maps are shown in the FSP.

6.0 PROJECT DESCRIPTION AND SCHEDULE

6.1 Project Overview

A summary of the project elements is shown in Worksheet 9a (Appendix A). Additional details are provided in Section 2 of the RI Workplan.

Analyses to be conducted for this project include metals in sediment and surface water samples. Total and dissolved metals will be analyzed at all surface water locations. Water quality parameters, including chloride, nitrate, sulfate, ammonia, nitrite, sulfide, alkalinity, total dissolved solids (TDS), total suspended solids (TSS), total organic carbon (TOC), chemical oxygen demand (COD), and hardness will also be measured in surface water. A subset of the surface water samples will undergo toxicity testing. Sediment core samples will be tested for density and specific gravity analysis with a calculation for porosity. Sediment samples will be collected for metals, ammonia, polycyclic aromatic hydrocarbons (PAH), TOC, grain size, benthic toxicity (bioassay), benthic community, and one sample for TCLP metals.

Worksheet 9b (Appendix A) lists the analytes which will be investigated at this site. The primary contaminants of concern at this site are those identified in the Record of Decision (ROD) and include aluminum, arsenic, chromium, iron, lead, manganese, nickel, and sodium (USEPA, 1995), with the addition of mercury (including methylmercury), zinc, and PAHs based on other studies of contamination in Plow Shop Pond. To achieve the project objectives, risk-based concentrations are identified for the purposes of identifying the appropriate media-specific Project Quantitation Limits and method of analysis.

For analytes in surface water, the risk-based criteria represent the lower of Ambient Water Quality Criteria (AWQC) protective of human health (i.e., consumption of fish and/or water) and freshwater criteria (i.e., Criterion Maximum Concentration (CMC) and the Criterion Continuous Concentration (CCC)) where they exist (USEPA, 2006). The AWQC are considered applicable or suitably analogous public health and environmental standards. For sediment, the risk-based criteria represent the lower of the MCP Method 2 Direct Contact Soil Concentrations (310 CMR

40.0985(6)) and in order of preference, the MassDEP Sediment Screening Values (MassDEP, 2006); Lowest Effect Levels (LEL) for freshwater organisms (Persaud, D.R., *et.al.* 1993); followed by Threshold Effect Levels (TEL) for freshwater organisms (NOAA, 1999). No applicable or suitably analogous public health or environmental standard for sediment has been identified at this site. Risk-based concentrations that are lower than the achievable laboratory quantitation limit are shown in bold in Worksheet 9b.

According to the USEPA QAPP Guidance (USEPA, 2008), project quantitation limits (QLs) should be at least two to five times lower than project action limits. Attainment of these criteria for all analytes listed in Worksheet 9b is not readily achievable using standard laboratory methodology. Approximate laboratory quantitation limits (QLs) and method detection limits (MDLs) are shown in Worksheet 9b.

Worksheet 9c (Appendix A) summarizes the frequency of field quality control samples that will be collected at this site. Worksheet 9d (Appendix A) will be updated with the list of laboratories to be used for the project once under contract. Backup support laboratories will also be listed in this table.

Sampling tasks are described in the FSP. In general the project includes sampling of surface water and sediment. Sampling Standard Operating Procedure (SOPs) are included in the FSP.

Analytical tasks will include analysis of sediment and/or surface water samples for the parameters shown in Worksheet 9b (Appendix A). Analytical tasks and associated QA/QC samples are further described in Sections 11.0, 12.0, and 13.0 of this QAPP.

Data verification, including internal review processes performed by qualified personnel, for field measurements and laboratory data will be performed by field and laboratory personnel. Data validation of laboratory data will be performed by qualified data validators in accordance with USEPA Region I Tier II guidelines. Further discussion of data verification and validation procedures is included in Sections 18.0 and 19.0 of this QAPP.

Quality assurance assessments will be performed as initial and periodic technical systems audits of field and laboratory operations and periodic performance audits of laboratory methods. Further discussion and details regarding QA assessments is included in Section 16.0 of this QAPP. Data usability will be assessed by determining if compiled data for a given site or task has met the project quality objectives. Data usability is typically assessed by the project manager and/or technical team member (e.g., chemist, data validator). Section 20.0 describes data usability evaluation in more detail.

Project document and records generated as a part of this project will be maintained in secure site files and storage areas. Descriptions of documents and records pertaining to this project are summarized in Sections 14.0, 15.0, and 17.0 and in the PMP (AMEC, 2006).

6.2 Project Schedule

The overall project schedule, including field investigations and document submittals, is included in Section 3 of the RI Workplan.

7.0 PROJECT QUALITY OBJECTIVES AND MEASUREMENT PERFORMANCE CRITERIA

7.1 Project Quality Objectives

This QAPP serves as a project specific plan covering comprehensive sampling, analysis, QA/QC, and data validation efforts. General project quality objectives and decision statements are shown in Worksheet 11a (Appendix A).

Prior to working on project samples, analytical laboratories will be solicited to bid on the project statement of work (SOW). The SOW outlines the anticipated scope and nature of analytical services. The laboratory must satisfactorily fulfill contractual requirements, including providing technical and cost information applicable to contract execution. The laboratories must be National Environmental Laboratory Accreditation Program (NELAP) certified, or have current (un-expired) USACE validation for applicable methods. In addition, the laboratory will be Massachusetts State certified for any applicable analyses. For certain non-standard environmental tests, such as bioassay and benthic community analysis, laboratory certification or validation does not exist. In such cases AMEC will review applicable laboratory supporting information (such as standard operating procedures, demonstration of capability, and/or method detection limit studies) prior to selecting a laboratory for these analyses. Laboratories will comply with all requirements of the DoD Quality Systems Manual, Final Version 3.

The analytical laboratory(ies) may also be required to analyze performance evaluation (PE) or split samples to further ensure consistency and accuracy of results. Measurement performance criteria for all methods are summarized in Worksheets 11b and 24b in Appendix A. Fixed laboratory analytical methods and standard operating procedures (SOPs) are summarized in Worksheet 20 (Appendix A).

The methods which will be used for chemical analysis of site samples are summarized in the following paragraphs:

Metals (method 6010B and 6020A): The ROD list metals include: aluminum, arsenic, chromium, iron, lead, manganese, nickel, and sodium. This list of metals will be used for analysis of sediment and surface water. In addition both surface water and sediment samples will be analyzed for mercury, methyl mercury and zinc; and surface water will be analyzed for calcium and magnesium. Metals will be analyzed by method 6010B (Inductively Coupled Plasma-Atomic Emission Spectrometry) (ICP-AES) in sediment and by method 6020A (Inductively Coupled Plasma-Mass Spectrometry) (ICP-MS) in surface water. Total metals will be analyzed for all samples, dissolved metals will also be analyzed for the surface water sample locations.

PAHs (method 8270 SIM): Sediment samples will be analyzed for PAHs by method 8270 (Gas Chromatography/Mass Spectrometry) (GC/MS). The instrument will be run in Selective Ion Monitoring mode in order to achieve greater sensitivity for the PAH compounds.

The sediments samples will also be analyzed to total organic carbon (TOC) by the Lloyd Kahn method, as well as grain size. One sediment sample will also be analyzed for TCLP RCRA8 metals.

It should be noted that for sediment samples, the percent solids of the sample will be verified to be greater than or equal to 30% prior to analysis. If the percent solid is below 30%, additional dewatering or drying techniques will be performed on the sample to achieve this value prior to analysis.

Water Quality Parameters (various methods): The following water quality parameters will be measured by the stated method: anions (chloride, nitrate, sulfate) by method 300.0, ammonia by Standard Methods (SM) 4500NH_3, nitrite by SM 4500NO_2, sulfide by method SM4500S^{-2} D, alkalinity by method SM2320B, total dissolved solids by method SM2540C, total suspended solids by method SM2540D, total organic carbon by method SM5310C, chemical oxygen demand by method 410.4, and hardness by SM2340B.

Geotechnical tests will be performed on sediment core samples. These tests will be performed by ASTM methods at a qualified geotechnical laboratory, which is on the list of USACE approved laboratories. Bioassay analysis, based on EPA test method 100.2 (USEPA, 2000), for chronic 20-day *Chironomus dilutus* and on EPA test method 100.4 (USEPA, 2000) for chronic 42-day *Hyalella azteca* will be performed on sediment dredge samples. At the end of each toxicity test a replicate sample will be frozen and shipped to EPA ORD for arsenic speciation analysis. Benthic Community Analysis will also be performed on sediment dredge samples; three replicate samples will be collected per sampling location and a 100 organism count per subsample.

Toxicity analysis, based on EPA test method 1002.0 (USEPA, 2002), for chronic 7-day *Ceriodaphnia dubia* and EPA test method 1000.0 (USEPA, 2002) for chronic 7-day *Pimephales promelas*, fathead minnow, will be performed on selected surface water samples.

The components of an USEPA Region I Tier II validation will be performed on chemical analysis results from the sediment and surface water. The USEPA Region I Tiered Organic and Inorganic Data Validation Guidelines, dated July 1, 1993 is included in Appendix C of this QAPP. Should any validation review indicate data deficiencies, an additional portion of the data will be fully reviewed to determine the extent of the deficiencies and the affect on overall usability.

As summarized in Worksheets 29b and 29c (Appendix A), CLP-equivalent analytical data are validated according to the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 2004), USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, 1999), the Region I USEPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses (USEPA, 1996), and method specific requirements. Analyses not covered in the data validation guidelines will use equivalent approaches for other analytical methods (water quality parameters). Geotechnical and bioassay test results will be evaluated by the key data users from an overall usability and representativeness perspective.

Record keeping, field activities, sampling, sample custody, laboratory analyses, data reduction and validation must be of sufficient scope and detail that the resulting data are technically and legally defensible. This QAPP has been prepared to outline the specific requirements for conducting all activities on this project to ensure that those objectives are met.

7.2 Measurement Performance Criteria

The quality assurance objective for all measurement data includes considerations for precision, accuracy, completeness, representativeness, comparability, and sensitivity. For inorganic and organic parameters, the protocols are found in USEPA *SW846 Test Methods for the Evaluating Solid Waste, Physical and Chemical Methods, Update III, 1996* (USEPA, 2000) and USEPA *Methods of Chemical Analysis of Water and Wastes* (USEPA, 1983). Geotechnical analyses will follow the protocols found in ASTM methods. Worksheet 20 (Appendix A) provides method references for all measurements. Measurement performance criteria are summarized in Worksheet 11b (Appendix A).

7.2.1 Precision

Precision is a quantitative measure of the variability between two duplicate samples. Precision is expressed as the relative percent difference (RPD) in concentration between duplicate and original sample analyses, as calculated from the following formula:

$$RPD = \frac{|S - D|}{\frac{1}{2}(S + D)} \times 100$$

Where:

RPD = Relative percent difference (percent);
S = Concentration of analyte in first (original) sample (mg/kg or µg/L); and
D = Concentration of analyte in second (duplicate) sample (mg/kg or µg/L).

The precision of the analytical data is evaluated by calculating RPD values for four types of duplicate samples: field duplicates, MSDs, laboratory duplicates, and blank spike duplicates. The QC criterion is method or laboratory specific QC criterion. Data qualifiers may be applied in the data validation process to certain analytical results where RPD values do not meet the established QC criteria (shown in Worksheet 24b in Appendix A).

7.2.2 Accuracy

Spike sample analyses are conducted by the laboratory to assess the accuracy of specific analytical methods and to provide information on the effect of the sample matrix on the analytical methodology. Spike sample analyses are performed by adding known amounts ("spikes") of representative target compounds to a sample aliquot that is subjected to the entire analytical procedure. The original sample (non-fortified) and the spike sample results are compared. Accuracy is reported as percent recovery (%R) of the spike, as calculated from the following equation:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

Where:

%R = Percent recovery (percent);

SSR = Spike sample result (concentration units);
SR = Original sample result (concentration units); and
SA = Spike added (concentration units).

The accuracy of the analytical data is evaluated by calculating %R values for matrix spike (MS) and laboratory control samples (LCS). MS samples are prepared by spiking actual field samples. LCS samples are prepared by spiking laboratory grade clean water or soil samples. QC acceptance criteria for %R may be method or laboratory specific QC criteria. Data qualifiers may be applied in the data validation process to certain analytical results where the %R values do not meet the established QC criteria (shown in Worksheet 24b in Appendix A).

7.2.3 Representativeness

Representativeness expresses the extent to which the analytical data reflect the actual media at the site. In general, the data should be representative of the site conditions and characteristics. Proper sampling and sample management procedures as documented in Sections 9 and 10 achieve acceptable representativeness. Representativeness will be evaluated with respect to general sample management issues including sample documentation, preservation, handling, and transport as well as a discussion of representativeness with respect to analytical-method specific issues including method deviations, presence of potential laboratory or field artifacts, indications of sample nonhomogeneity, internal standard recovery deficiencies, and surrogate recovery deficiencies.

7.2.4 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability of the sampling and analytical programs is evaluated separately. Sampling comparability will be evaluated based upon the following:

- A consistent approach to sampling was applied throughout the program;
- Samples were consistently preserved; and
- Sampling was performed during the same time of the year and under similar physical conditions.

Analytical comparability will be evaluated based upon the following:

- The investigation consistently utilized the same analytical laboratory, sample preparation, and analytical methods;
- The analytical results for a given analysis are reported with consistent detection limits and consistent units of measure; and
- Soil and sediment sample results are reported on a dry weight basis, allowing for comparison between different samples and with regulatory standards.

7.2.5 Completeness

Completeness is a measure of the amount of usable data resulting from the sampling and analysis program. Completeness of the sampling and analytical programs is evaluated separately. Sampling completeness is generally defined as the number of samples collected divided by the number of samples required to adequately assess site conditions. Analytical completeness is defined as the percentage of acceptable (i.e., not rejected) data points for individual methods and analytes. The overall completeness objective for the sampling and analytical program is 90 percent.

The percent complete (PC) is calculated as follows:

$$PC = \frac{N_A}{N_1} \times 100$$

N_A = actual number of valid analytical results obtained.
N_1 = theoretical number of results obtainable under ideal conditions.

7.2.6 Sensitivity

7.2.6.1 Method Detection Limit

The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDL determinations typically follow the procedures presented in 40 CFR 136, Appendix B, or equivalent statistical approach. The laboratory shall establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project. The laboratory performs MDL studies annually. For metals analysis, the laboratory typically reports down to the MDL, and qualifies data which is below the quantitation limit with a "J" (see section 15.4). MDLs are typically determined as follows:

(1) Estimate the MDL using one of the following:

a) the concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5, or

b) the concentration equivalent of 3 times the standard deviation of replicate measurement of the analyte in reagent water, or

c) the region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).

(2) Prepare (i.e., extract, digest, etc.) and analyze seven samples of a matrix spike (ASTM Type II water for aqueous methods, clean sand for soil methods, etc.) containing the analyte of interest at a concentration three to five times the estimated MDL.

(3) Determine the variance (S^2) for each analyte as follows:

$$S^2 = \frac{1}{n-1}\left[\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2\right]$$

where x_i = the ith measurement of the variable x and $\bar{x}$ = the average value of x

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

(4) Determine the standard deviation (s) for each analyte as follows:

$$s = (S^2)^{1/2}$$

(5) Determine the MDL for each analyte as follows:

$$MDL = 3.14(s)$$

(note: 3.14 is the one-sided t-statistic at the 99 percent confidence level appropriate for determining the MDL using 7 samples)

(6) If the spike level used in step 2 is more than 10 times the calculated MDL, repeat the process using a lower spiking concentration.

7.2.6.2 Instrument Detection Limit (IDL)

The instrument detection limit (IDL) is the minimum concentration of a substance that an instrument can differentiate from noise. IDLs for metals analytes are determined quarterly on samples that have not gone through any preparation steps. It is typically determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day.

7.2.6.3 Quantitation Limit (QL)

The Quantitation Limit (QL) is the lowest concentration that can be reliably reported within quantitative accuracy under routine laboratory operating conditions. The QL is generally 3 to 10 times the MDL. For most analytes the QL is selected as the lowest non-zero standard in the calibration curve. Sample QLs are matrix dependent (upon sample weight, volume, and dilution factors).

8.0 SAMPLING PROCESS DESIGN

Sampling process design and rationale (and site maps) are shown in Section 2 of the RI Workplan.

9.0 SAMPLING PROCEDURES AND REQUIREMENTS

Sampling procedures will follow the Standard Operating Procedures (SOPs) and procedures described in the FSP.

9.1 Cleaning and Decontamination of Equipment/Sample Containers

9.1.1 Equipment Decontamination

Equipment decontamination and SOPs are described in the FSP. Non-dedicated sediment and surface water sampling devices (i.e., stainless steel spoons, bowls, etc.) shall be decontaminated prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples. Equipment can be decontaminated at the sample location, or at a pre-designated, controlled location. All equipment must be decontaminated before leaving the site.

9.1.2 Sample Containers

It is important to use the proper sample containers so that no chemical alteration occurs between the field sampling and transit to the laboratory. The sample bottles will be prepared using USEPA methods, and shipped to the field by the laboratory or commercial supplier. Sample containers, preservatives, and holding times are summarized in Table 9-1.

Sample containers will be selected to ensure compatibility with the sample matrix, storage requirements, and to minimize breakage during transportation. Sample labels will be affixed to each container to identify site name, the sample number, collector's name, date and time of collection, type of sample (grab or composite), matrix (sediment, surface water, groundwater or soil), location of sampling point, preservatives added, and analyses to be performed. Labels are pre-printed with all information except the collector's name and date and time of collection.

9.2 Field Equipment Calibration

Field equipment calibration will follow manufacturer's instructions and AMEC SOPs provided in the FSP.

9.3 Field Equipment Maintenance, Testing, and Inspection Requirements

Field equipment is maintained in good working order by performing maintenance, testing, and inspections. Some spare parts are kept on-site for easy replacement and to reduce delays in field activities due to equipment down time. Field equipment is stored in secure areas when not in use.

9.4 Inspection and Acceptance Requirements for Supplies/Sample Containers

All supplies and sample containers will be inspected by AMEC personnel prior to use. Certificates of compliance accompany sample containers and certify that they are free of contamination. Pre-preserved sample containers will be used. Appropriate preservatives will be verified prior to using containers.

10.0 SAMPLE HANDLING, TRACKING AND CUSTODY REQUIREMENTS

10.1 Sample Collection Documentation

Pertinent information related to sample collection and related field activities will be documented in the form of field logbooks, sample labels, chain-of-custody forms, and field data sheets. The following sections describe the field documentation procedures followed for this project.

10.1.1 Field Notes

Field activities will be documented using a field logbook in accordance with the SOP and description provided in the FSP. The documentation in the field logbook is designed to contain sufficient information to enable the sampling activity to be reconstructed without relying on the collector's memory.

For certain tasks, information will be recorded on pre-printed field data sheets (e.g., boring logs, well installation/development logs, or drum logs). This information should not be repeated in the field logbook, except in summary form to avoid transcription errors.

10.1.2 Field Documentation Management System

Pertinent information related to field activities will be documented in the form of field logbooks, sample labels, chain-of-custody forms, and field data sheets.

Sequentially numbered field logbooks will be used by individual personnel working on-site. At the conclusion of a task or when a logbook has been completed, the logbook will be retained by the document control coordinator. All field forms documenting field activities will be stored in project files maintained at the AMEC office.

10.2 Sample Handling and Tracking System

10.2.1 Field Sample Handling

AMEC personnel will perform sample labeling and identification in a consistent manner to ensure that field samples are properly labeled and traceable. Sample labels will be securely affixed to sample bottles. Sample labels will include project name, Sample ID, type of analysis, preservative, sampler, matrix, number of containers, and date and time of sample collection. The Sample ID system is described in the FSP.

After the sample containers have been filled, they will be placed in a shipping container. Those samples requiring preservation at 4°C will be covered with ice packs or crushed ice in plastic bags and placed in an insulated cooler. Crushed ice or ice packs will be added to the shipping coolers as the samples are collected. Each sample container (cooler) will be sealed using tamper-proof security tape (e.g., signed and dated external custody seals) for shipment to the designated laboratory by overnight express courier. Daily sample collection activities will end in time to allow shipment preparation for overnight delivery.

A completed chain-of-custody (COC) record (see Figure 10-1) will accompany each sample to provide documentation and to trace sample possession. Samples shall be collected and preserved in accordance with Table 9-1. Samples shall be transferred to the laboratory either by courier or express mail system (e.g., Federal Express). The sample handling system is summarized in Worksheet 16 (Appendix A).

10.2.2 Laboratory Sample Handling

Upon sample receipt by the lab, sample coolers are opened and an infrared (IR) temperature gun (or equivalent) is used to record the cooler temperature reading. The sample custodian fills out a "Cooler Receipt Checklist" (see example Figure 10-2) and other forms to document the condition of the samples upon receipt at the laboratory. The sample custodian records the cooler temperature, cooler receipt date/time, custody seal information, and performs an overall check to ensure that all samples on the Chain of Custody (COC) were received and properly preserved. Any discrepancies discovered by the sample custodian are documented and brought to the attention of the project manager at AMEC for resolution.

Samples that require preservation are checked for adequate quantity of preservative through measuring the pH of the sample. If the sample is received outside the proper pH or the incorrect preservative has been added, the AMEC project manager is informed by sample management. The AMEC project manager determines an action to be taken for the sample.

Once the cooler receipt checklist is completed and preservation has been checked, samples are unpacked and each sample is affixed with a pre-printed label containing a unique Lab Sample ID. A Sample Delivery Group (SDG) is assigned to a group of samples of twenty or fewer by the lab project manager. SDGs are assigned based on the turn-around times of the samples along with grouping them with samples containing similar analyses.

When each sample has been assigned a Lab Sample ID and SDG, these samples are then entered into the Lab Information Management System (LIMS). The LIMS tracks samples from quotation through log-in, analysis, and invoicing. The LIMS maintains an electronic record of all samples logged in. The sample is stored under refrigeration until the analyst requests to analyze it.

The storage refrigerators are kept locked and can be accessed by the sample custodians and analysts. The temperature is maintained at 4°C ± 2. Refrigerator temperatures are monitored (at least) daily. If the temperature reading is outside the limits, corrective action (e.g., transfer of samples to adequate storage, repair of refrigerator) will be taken.

The laboratory sample custodian will remove the sample from the refrigerator and issue it to the analyst, when requested. When the analysis is complete, the analyst will return the sample to the sample custodian, or refrigerator. During the extraction and analysis of the sample, the LIMS is updated to record the date/time of each process.

Once the samples have been analyzed for a particular SDG, the LIMS will notify the Data Group that the SDG is complete. The Data Group will then generate an electronic data deliverable

(EDD) in a standard format that AMEC requires. A Portable Document File (PDF) is also generated and sent to AMEC.

10.3 Sample Custody

The sample custody and documentation procedures described in this section will be followed during sample collection. Each person involved with sample handling will be trained in chain-of-custody procedures prior to the implementation of the field program. To reduce the chance for error, the number of personnel handling the samples will be restricted.

A sample is under custody if:

- It is in the actual possession of the responsible party; or
- It is in view of the responsible party, after being in that person's physical possession; or
- It was in physical possession and then locked up to prevent tampering; or
- It is in a designated and identified secure area.

The following procedures will be used to document, establish, and maintain custody of field samples:

- Sample labels will be completed for each sample, using black, waterproof ink, ensuring that the labels are legible and affixed firmly to the sample container.
- All sample-related information will be recorded in the project logbooks.
- The field sample custodian (FSC) will retain the custody of the samples until they are transferred or properly dispatched.
- During the course and at the end of the field work, the Field Team Leader, or designee, will determine whether these procedures have been followed, and if additional samples are required.

In transferring and shipping samples, the following procedures will be used:

- A COC Record (as shown in Figure 10-1) will accompany samples at all times. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents transfer of custody of samples from the sampler to another person, or to the laboratory.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed COC Record enclosed in each sample box or cooler. Sample containers and coolers will be custody-sealed using tamper-proof security tape for shipment to the laboratory by overnight express mail or by courier.

- Whenever samples are split with a facility or government agency, a separate COC Record will be prepared for those samples. Split sample documentation will be recorded in field log books.

- All packaged samples will be accompanied by the COC Record showing identification of the contents. The original COC Record will accompany the shipment, and a copy will be retained by the Field Team Leader.

The laboratory chosen to conduct the analysis of samples will, as a minimum, check all incoming samples for integrity and note any observations on the original COC Record and/or sample receipt checklists (Figures 10-1 and 10-2). The temperature of the cooler will be recorded on the COC Record and appropriate sample receipt checklists. Each sample will be logged into the laboratory system by assigning it a unique laboratory sample number. This number and the field sample identification number will be recorded on the laboratory report. Samples will be stored and analyzed according to specified methods. The original COC Record will be returned to the Project Manager for permanent storage.

The following procedures will be used by the Laboratory Sample Custodian (LSC) in maintaining the chain-of-custody once the samples have arrived at the laboratory:

- The samples received by the laboratory will be cross-checked to verify that the information on the sample labels matches that one the COC Record included with the shipment.

- If all data and samples are correct, and there has been no tampering with the custody seals, the "received by laboratory" box will be assigned and dated. If discrepancies are noted, the AMEC project manager will be notified.

- The samples will be stored in appropriate, secure storage locations. Laboratory personnel are notified of the arrival of samples so that expeditious analysis of the samples can commence.

- Samples are tracked from sample receipt through preparation, analysis, and disposal at the laboratory.

11.0 FIELD ANALYTICAL METHOD REQUIREMENTS

The FSP describes the techniques that will be used to operate equipment used to measure field parameters for sediment and surface water samples. These measurements include dissolved oxygen (DO), specific conductance (SC), Oxidation/Reduction Potential (ORP), and pH.

11.1 Field Analytical Methods and SOPs

Manufacturer's operating manuals and SOPs, as described in the FSP, will be used for field analytical measurements.

11.2 Field Analytical Method/SOP Modifications

The field procedures used for this project have been developed in accordance with federal, state, and local requirements. It is not expected that modifications to these SOPs will be required. However, if modifications become necessary during the course of sampling, the modifications will be documented in project memos, and the associated SOP will be revised.

11.3 Field Analytical Instrument Calibration

Screening field instruments will be calibrated daily prior to use. Calibration criteria are detailed in the FSP and associated SOPs.

11.4 Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Requirements

Field equipment is maintained in good working order by performing maintenance, testing, and inspections. These activities are summarized in the FSP. Some spare parts are kept on-site for easy replacement and to reduce delays in field activities due to instrument down time. In general, field equipment is supplied by an equipment rental company and replaced as needed. Field equipment is stored in secure areas when not in use.

11.5 Field Analytical Inspection and Acceptance Requirements for Supplies

Supplies used in support of field equipment will be available and free of contamination. Supplies are stored in a secure and clean area.

12.0 FIXED LABORATORY ANALYTICAL METHOD REQUIREMENTS

12.1 Fixed Laboratory Analytical Methods and SOPs

Fixed laboratory methods are described in Section 7.1. SOPs and method modifications are summarized in Worksheet 20 (Appendix A). Analytical laboratory SOPs are included in Appendix B. Individual laboratory Quality Assurance or Management Plans are kept on file at AMEC.

12.2 Fixed Laboratory Analytical Method/SOP Modifications

If sample matrix or laboratory conditions warrant modifications of analytical SOPs to meet project quality objectives, the project chemist or data validator will follow the communication pathways identified in section 4.2 to receive approval prior to implementing modification. The laboratory will also summarize changes to SOPs in the data report narrative. When appropriate, modifications to fixed laboratory analytical SOPs will be made.

12.3 Fixed Laboratory Instrument Calibration

Fixed laboratory instruments and equipment used to collect, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's and method specifications.

Calibration of laboratory equipment will be accomplished according to the applicable USEPA method requirements and in accordance with the requirements specified in the QSM (DoD, 2005). Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed. For all instruments, the laboratory will maintain a factory-trained repair staff with in-house spare parts, or maintain service contracts with vendors. A summary of instrument maintenance and calibration is provided in Worksheet 21 (Appendix A).

12.4 Fixed Laboratory Instrument/Equipment Maintenance, Testing, and Inspection Requirements

Equipment, instruments, tools, gauges, and other items requiring preventative maintenance will be serviced in accordance with the manufacturer's specified recommendation. Typical maintenance for major instrumentation is provided in Worksheet 21 (Appendix A). A maintenance schedule for specific equipment is maintained at the laboratory. In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

Manufacturer's procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule, and to arrange necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc. will be performed by qualified personnel.

In the event that the USEPA method mandates specific preventive maintenance procedures, which are more frequent than that recommended by the manufacturer, the frequency required in the USEPA method will be followed. Logs will be established to record maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced for laboratory instruments will be reviewed, maintained, and filed by the operators at the laboratories. A list of critical spare parts will be requested from the manufacturer and/or identified by the operator. These spare parts will be acquired and maintained in order to reduce downtime. In some cases, commercial vendor service contracts are used to maintain and service instrumentation.

12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies

The laboratory manager or designee is responsible for tracking laboratory supplies to ensure that a sufficient quantity is available to meet the project/laboratory needs. Supplies that may contribute to common laboratory contamination are checked prior to use at the laboratory. Records are maintained which document inspection and acceptance of laboratory supplies.

Each laboratory SOP contains a list of the supplies and reagents that are required for the method. The majority of supplies come from laboratory supply companies. Chemical reagents, solvents, gases, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Traceability of measurements is assured through a system of documentation, calibration, and analysis of reference standards. Reagent cleanliness is assured by purchasing certified high purity materials and monitored through use of the preparation/method blanks with each sample batch.

13.0 QUALITY CONTROL REQUIREMENTS

13.1 Sampling Quality Control

As a quality assurance and quality control check on field sampling equipment blank samples, and field duplicates will be sent to the laboratory with specified frequencies. The frequency with which these samples will be taken, and the number of such samples, are discussed in this section and summarized in Worksheet 9c (Appendix A). Acceptance limits for results and corrective action measures for field QC samples are summarized in Worksheets 22a and 22b in Appendix A. Performance evaluation (PE) and quality assurance (QA) samples are optional QA/QC elements, which can be used to assess the accuracy of a laboratory. These samples are discussed in sections 13.2.2.6 and 13.2.2.7.

13.1.1 Equipment Blanks

Equipment blanks are used to determine the effectiveness of the field decontamination process. Equipment blanks are defined as deionized water used for decontamination poured over field equipment that has been decontaminated. This rinsate water is then transferred to a sample bottle. Equipment blank samples will be taken every day that decontamination occurs for each type of sampling equipment that is decontaminated. The equipment blank samples will be analyzed for the same analytes as the samples that are collected that day.

13.1.2 Field Duplicates

Field duplicates are used to measure field sample homogeneity and measure precision of the field sampling techniques and laboratory analyses. A field duplicate is defined as two or more samples collected independently at a sampling location during a single act of sampling. The total number of field duplicates for each analysis is equal to 10 percent of the samples collected, rounded to the next whole number, i.e. for 10 samples it would mean 1 duplicate; but for 11 samples, 2 duplicates would be required.

Field duplicates will be indistinguishable by the laboratory from other samples. Therefore, one complete sample set will be identified with a "coded" or false identifier that will be in the same format as other identifier used with this sample matrix. Both the false and true identifiers will be recorded in the field notebook. On the COC Records, the "coded" identifier will be used. The sample identification system is detailed in the FSP.

13.2 Analytical Quality Control

Quality control results will be calculated by the analyst and reviewed by the laboratory supervisor to determine the accuracy and precision of the analytical results. The Laboratory Supervisor or the Laboratory Manager will review all final reports and associated quality control data. Approval will be indicated by signature. Results will be recorded on the QC report. The QC results will also be used to prepare control charts for each test and type of matrix. A systems audit of the laboratory will be conducted to ensure that the quality control systems are in place and functioning in the laboratory. A summary of laboratory QC frequency is shown in Worksheet 9c (Appendix A). Acceptance limits and corrective action measures for laboratory QC samples are summarized in Worksheets 24a and 24b in Appendix A.

13.2.1 Field Analytical QC

Field measurements of water quality parameters (pH, specific conductance (SC), Oxidation/Reduction Potential (ORP), and dissolved oxygen) will be performed for screening purposes. However, there are no applicable QC samples associated with these field measurements.

13.2.2 Fixed Laboratory QC

Quality control data are necessary to determine precision and accuracy of the analyses, and to demonstrate the absence of interferences and contamination of glassware and reagents. Laboratory-generated QC will consist of method blanks, replicates, surrogates, laboratory control samples (LCS), matrix spikes (MS), and matrix spike duplicates (MSD) samples. Performance evaluation samples and Quality Assurance samples are optional QA elements, which can be used to assess the accuracy of a laboratory. The laboratory supervisor will review the results of the analyses. Deviations from the established QC criteria will be noted and reanalysis or other corrective action will be instituted as appropriate for the situation. The number of samples to be analyzed is summarized in Worksheets 9c and 24a in Appendix A.

13.2.2.1 Method Blanks

Method blanks will be run for all appropriate analyses to verify that the procedures used do not introduce contaminants that affect the analytical results. At a minimum, one method blank will be processed for every batch (up to 20) of samples analyzed. Method blanks are prepared for water samples using reagent or deionized water and for soil samples using Ottawa Sand or anhydrous sodium sulfate. The method blank undergoes all of the procedures required for sample preparation. The resultant extract or digestate is analyzed with the field samples prepared under identical conditions.

13.2.2.2 Laboratory Duplicates (or Laboratory Replicates)

Laboratory duplicate (or laboratory replicate) samples are aliquots of a single sample that are split upon arrival at the laboratory or prior to analysis. Laboratory replicates are used to evaluate precision. Significant differences between two replicates that are split in a controlled laboratory environment will result in flagging of the affected analytical results.

13.2.2.3 Laboratory Control Sample

Laboratory control samples (LCS) are used to determine the effectiveness of the extraction and analysis on a clean matrix (laboratory grade water or soil). A known quantity of target analytes is spiked into the sample, which is prepared and analyzed at the laboratory. The recovery of the spiked analytes is calculated as a measure of the accuracy of the laboratory method. An LCS is typically analyzed with each sample batch (up to 20 samples). LCS control limits are shown in Worksheet 24b (Appendix A). Laboratory control sample duplicates (LCSD) may also be analyzed to assess analytical precision and accuracy.

13.2.2.4 Matrix Spike/Matrix Spike Duplicate

Matrix spike/matrix spike duplicate (MS/MSD) samples are used to determine the effect of matrix interference on analytical results. MS/MSD samples are spiked with known concentrations of target analytes. The samples are prepared in the laboratory and receive consistent treatment as field samples throughout the analytical method. Method recommended matrix spiking solutions may be used to determine if matrix affects extraction or analysis efficiency. The percent difference between the percent recovery values of the spike duplicates is taken as a measure of the precision of the analytical method. A matrix spike duplicate sample is prepared in the same manner as the matrix spike sample. The matrix spiking compounds and control limits for percent recovery and RPDs are listed in Worksheet 24b (Appendix A) for each analysis method. Typically, matrix spike analysis and sample duplicate analyses are used for metals and non-metallic inorganic analyses. MS/MSDs (and/or MS/sample duplicate) are analyzed with each sample batch (up to 20 samples).

13.2.2.5 Surrogates

Surrogates are organic compounds that are similar to the target analytes in chemical composition and behavior, but that are not normally found in environmental samples. Surrogates shall be added to environmental samples, controls, and blanks, in accordance with the method requirements in order to evaluate accuracy, method performance, and extraction efficiency. The surrogate recovery criteria are based on laboratory performance and are listed in Worksheet.

13.2.2.6 Internal Standards

Internal standards are measured amounts of certain compounds added after sample preparation or extraction. They are used in an internal standard calibration method to correct sample results for analysis efficiency. Internal standards shall be added to environmental samples, blanks, standards and QC samples, in accordance with method requirements.

13.2.2.7 Performance Evaluation Samples

A performance evaluation (PE) sample contains certified concentrations of the target compounds for a specific method of analysis (preferably, compounds that are anticipated to be identified at the site). PE samples can be purchased from commercial suppliers or obtained from the USEPA. PE samples are also an element of most laboratory certification and validation programs. Additional PE samples can also be used if requested by regulatory agencies or if warranted based on laboratory results or method issues. If PE samples are used, they may be submitted to the laboratory double-blind (the sample will be introduced into the sampling stream in the field and will be analyzed by the laboratory without the laboratory's knowledge of its significance) or single blind (the laboratory is aware that the sample is a PE, but has no knowledge of the concentration or analytes present). The results from the PE sample analysis will be evaluated with respect to proper identification of spiked target compounds and the acceptability of the resulting quantitation based on established acceptance limits for all of the PE sample target analytes. PE samples are not anticipated to be used for this project.

13.2.2.8 Quality Assurance Samples

Quality Assurance (QA) samples are samples, which are homogenized and sent to two laboratories for analysis. The QA laboratory is typically a government designated independent laboratory. A comparison between the results of the primary project laboratory and the QA laboratory is made to determine if consistent or inconsistent results are obtained. If significant differences exist, further investigation is undertaken to determine the source of the inconsistency. The evaluation of acceptability is typically determined by the regulatory agency, which recommends and oversees the collection and analysis of QA samples. The QA laboratory analysis is typically directed and coordinated by an independent government agency.

14.0 DATA ACQUISITION REQUIREMENTS

Data generated by other contractors who have worked on this site will be used for making project decisions. Data sources and evaluation methods are described in the Data Analysis Plan (DAP) provided as Attachment B of this RI Workplan.

15.0 DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

15.1 Project Documentation and Records

This project will require the administration of a central project file. The data and records management protocols will provide controls and retention of all materials related to the project. Record control will include receipt from external sources, transmittals, and transfer to storage and indication of record status. Record retention will include receipt at storage areas, indexing, filing, storage, maintenance, and retrieval. Project repository and administrative record retention is also described in section 7 of the PMP (AMEC, 2006).

15.1.1 Project Documentation and Record Control

Project related documentation is summarized in Worksheet 26 (Appendix A). All incoming materials related to the project including sketches, correspondence, authorization, and logs will be forwarded to the Project Manager or designee. These documents will be placed in the project file as soon as is practical. If correspondence is required for reference by project personnel, a copy will be made rather than retaining the original. All records will be legible and easily identifiable.

Examples of the types of records that will be maintained in the project file are:

- Field documents;
- Correspondences;

- Photographs;
- Laboratory data;
- Reports; and
- Procurement agreements

Outgoing project correspondences and reports must be reviewed and signed by the Project Manager prior to transmittal.

15.1.2 Project Documentation and Record Status

To prevent the inadvertent use of obsolete or superseded project-related procedures, all the personnel of the laboratory and project staffs will be responsible for reporting changes in protocol to the Project Manager and/or the Laboratory manager. The Project Manager and/or Laboratory Manger will then inform the project and laboratory staffs and the Project Quality Assurance Officer of these changes.

Revisions to procedures will be subject to the same level of review and approval as the original document. The revised document will be distributed to all holders of the original document and discussed with project personnel. Outdated procedures will be marked "void." The voided document may be destroyed at the request of the Project Manager with the exception of one copy of the document, which will be maintained in the project file. The reasons for and the date the document was voided will be recorded.

15.1.3 Project Documentation and Record Storage

Project-related information will be maintained by AMEC. Designated personnel will assure that incoming records are legible and in suitable condition for storage. A records index was initiated at the beginning of the project. Each document that is placed into the project file will be logged. The logging of the records will be the responsibility of the Project Manager and/or designee.

Record storage will be performed in two stages:

- Storage during and immediately following the project; and
- Permanent storage of records directly related to the project.

Both phases will use storage facilities that provide a suitable environment to minimize deterioration or damage, and that prevents loss. The facilities will, where possible, have controlled access and provide protection from excess moisture and temperature extremes. Records will be secured in steel file cabinets labeled with the appropriate project identification. The removal of records from all files during both stages will be controlled.

During the course of the project and at the completion of the project, the Project Manager or appointed document custodian will be responsible for inventorying and tracking the project documents. Report discrepancies must be resolved prior to transferring the file to a permanent storage facility. All material from the project files, including drawings, project-related documents, and software program documentation and verification records will be permanently retained. All storage systems will provide for the prompt retrieval of information for reference or use outside the storage areas. Project records will be accessible for a period of five years after completion of this project.

15.1.4 Field Documentation and Record Control

A file, similar to the project central file, will be established and maintained by field personnel under the direction of the Field Team Leader. The field records include: field data sampling sheets, field logbooks, boring and well construction logs, training records and certifications, equipment maintenance and calibration records, and material certifications.

15.2 Field Analysis Data Package Deliverables

Field analysis (surface water and sediment monitoring parameters) will be recorded in logbooks and/or sampling forms. These parameters include dissolved oxygen (DO) and pH. Hard copies of the logbook entries and sampling forms are stored in the project files.

15.3 Fixed Laboratory Data Package Deliverables

The hardcopy data package deliverable will consist of: Case Narrative, Sample Results Forms, Initial Calibration and Continuing Calibration Verification, Blank Results, Laboratory Control Samples, Matrix Spike Samples, Duplicate Results, Serial Dilutions, Preparation Logs, Analysis Run Logs, Surrogate Recoveries, Internal Standard Recoveries, Chain of Custody documentation, and Sample Receipt Checklists.

In addition, the supporting raw data for all samples, such as percent solid calculations, distillation logs, extraction logs, digestion logs, benchsheets, and other correspondence relating to the project samples will be maintained at the laboratory.

15.4 Data Reporting Formats

The following guidelines will be used for reporting and correcting laboratory data:

- Documentation will be completed with permanent black ink;
- All entries will be legible;
- Errors will be corrected by crossing out with a single line, dating, and initialing (when appropriate, the reason for the change will also be included); and
- Laboratory reports will be signed.

The laboratory reports shall consist of the CLP-equivalent forms. Validated data will be submitted into the US Army Environmental Center (AEC) Environmental Restoration Information System (ERIS), in compliance with the Army specified requirements for data validation and submission.

For all laboratory analytical reports, USEPA defined data qualifiers will be required.

The nine USEPA defined data qualifiers for inorganic analyses are:

B - Reported value was obtained from a reading that was less than the QL but greater than or equal to the method detection limit (MDL).
U - Analyte was analyzed for but not detected.
E - The reported value is estimated because of the presence of interference.
M - Duplicate injection precision was not met.
N - Spiked sample recovery was not within control limits.
S - The reported value was determined by method of Standard Addition (MSA).
W - Post-digestion spike recovery for furnace AA analysis is out of control limits while the sample absorbance is less than 50% of the spike absorbance.
* - Duplicate analysis is not within control limits.
+ - Correlation coefficient for method of standard addition (MSA) is less than 0.995

15.5 Data Handling and Management

As well as hard copy data packages, a portable document file (PDF) of the entire hard copy report will be submitted for data validation and archiving purposes. Electronic data deliverables (EDD) will be submitted into the ERIS.

15.6 Data Tracking and Control

All data package deliverables (hardcopy and PDF format) are tracked through assigned SDG numbers and stored at on-site or off-site secure, retrievable locations.

16.0 ASSESSMENTS AND RESPONSE ACTIONS

16.1 Planned Assessments

A qualitative and quantitative assessment of the quality of sediment and water analytical data from the investigation conducted at Shepley's Hill Landfill will be conducted to assess the quality control and data validation procedures. A discussion of project assessments and response actions is included in Worksheet 27a (Appendix A). Other assessments of field and laboratory procedures will be made using external and internal audit processes as described below and summarized in Worksheet 27b (Appendix A). General project assessment plans for field, data, and laboratory audits are shown in Worksheet 27c (Appendix A).

16.1.1 Internal Audits

Technical systems audits will be performed by the Field Team Leader, the Project Chemist, or designee. These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement systems. At times, the auditor may request additional personnel with specific expertise from other project groups to assist in conducting technical systems audits.

16.1.1.1 Systems Audits

Field technical systems audits performed by the Field Team Leader or designee, will encompass evaluation of field components to ascertain their appropriate selection and application. The mobilization stage will be audited before work begins to assure that all procedures, training, and materials are ready to support all items within the FSP, QAPP, and Site Safety and Health Plan (SSHP). Additional audits may be required depending on the results of the initial audits. Field technical systems audits may include review of sample handling and tracking, sample custody, sample storage and preservation, data tracking and control, and field measurement equipment and documentation.

Laboratory systems audits will be conducted prior to award of laboratory subcontracts. Laboratory technical system audits may include review of the laboratory policies, instrumentation, supplies, personnel, training, SOPs, data verification, and reporting procedures. For this project, systems audits will be performed remotely, through the review of laboratory QA Manuals, SOPs, and laboratory certifications.

16.1.1.2 Performance Audits

Performance audits are independent checks of data using certified or standard reference material. Performance audits can be conducted periodically with the use of PE samples through the duration of the project to determine the accuracy and implementation of the project work plans. Performance audits may be implemented by submitting PE samples to a laboratory prior to the initiation of field activities or during the course of the project. In addition to project specific performance audits, the laboratory will also participate in inter-laboratory performance evaluation studies, such as those administered by state agencies and as part of the laboratory NELAP certification program. Performance audits beyond those conducted by NELAP are not anticipated for this project.

QA laboratory split samples may also be used for performance audit purposes. Split samples are analyzed at independent laboratories to evaluate the accuracy and consistency of results between laboratories and/or methods. The use of QA samples adds value by verifying the analytes of concern and quantifying the levels of contamination. This may bolster the credibility and usability of the data generated by the primary laboratories. In general, the QA samples are targeted in locations of known or expected contamination.

16.1.2 External Audits

External audits of laboratories will also be conducted for this project to assure that the laboratory is able to meet the requirements of this QAPP. External audits include NELAP and state auditing procedures.

16.2 Assessment Findings and Corrective Action Responses

All audits and associated corrective actions will be reported in writing to the Project Manager. Laboratories are responsible for reporting results of performance audits and that systems audit reports are responded to and appropriate corrective action measures are implemented and documented. Conditions when corrective actions may be initiated include:

- When predetermined acceptance standards are not attained (objectives for precision, accuracy, completeness, sensitivity);
- When procedures or data compiled are determined to be incorrect or incomplete;
- When equipment or instrumentation is found to be malfunctioning;
- When samples and test results cannot be traced with certainty;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment; or
- As a result of laboratory/inter-laboratory comparison studies.

Following identification of an adverse condition or quality assurance problem, notification of the deficiency will be made to the Project Manager and the senior individual in charge of the activity found to be deficient, along with recommendations for correction. A record of this notification will be attached to the audit report. Following implementation of corrective action, the senior individual in charge will report actions taken and results to the Project Manager. A record of action taken and results will also be attached to the audit report.

Any deviation from project requirements as specified in this document requires proper documentation using a Field Change Request Form. This form will be completed in the field by the Field Team Leader and forwarded to the Contracting Officer Representative (COR) by the most expedient communications means available. Upon receipt, the COR will review and indicate final disposition of the request and return the original document to the originator. A copy of the document should be retained for the project file. Changes that require an immediate response will be initiated by telephone or other telecommunication transmission, and then documented using the procedure described above.

16.3 Additional QAPP Non-Conformances

All project personnel have the responsibility, as part of their normal work duties, to promptly identify and report conditions adverse to quality, and solicit correction. When a significant condition adverse to quality is noted at the project site, laboratory, or subcontractor locations, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented in a Corrective Action Report (CAR) and reported to the Project Manager, Field Team Leader, Project Chemist and/or involved subcontractor management. Implementation of correction action will be verified by documented follow-up action. Documentation of additional QAPP non-conformances may also be included in laboratory data packages, where appropriate.

17.0 QA MANAGEMENT REPORTS

Quality assurance reports to management include verbal status reports and written reports on field sampling activities, laboratory processes, data validation reports, and final project reports, as summarized in Worksheet 28 (Appendix A).

18.0 VERIFICATION AND VALIDATION REQUIREMENTS

Field measurements will be made by qualified field geologists, engineers, environmental scientists, and/or technicians. The results will be reviewed by field and office staff for obvious errors or inconsistencies.

Laboratory verification and validation procedures include internal review processes. Data package review will consist of analyst, supervisor, and/or QA level review prior to release of data.

Data validation procedures are performed by AMEC in accordance with the USEPA Region I Tier II guidelines (see Appendix C for a summary of the Region I Tiered Organic and Inorganic Data Validation Guidelines). Section 19.0 provides further details regarding specific data verification and validation procedures for field and laboratory measurements and analyses.

19.0 VERIFICATION AND VALIDATION PROCEDURES

19.1 Field Analysis/Measurement

Field data will be verified using procedures including:

- Routine checks will be made during the recording and processing of data, e.g., looking for errors in identification codes.
- Internal consistency of a data set will be evaluated. This step may involve plotting the data and testing for outliers.
- Checks for consistency of the data set over time will be performed. This can be accomplished by visually comparing data sets against gross upper limits obtained from historical data sets, or by testing for historical consistency. Anomalous data will be identified.
- Checks may be made for consistency with parallel data sets; i.e., data sets obtained from the same population (for example, from the same region of the aquifer).

The purpose of these verification checks and tests is to identify outliers; i.e., an observation that does not conform to the pattern established by other observations. Outliers may be the result of transcription errors or instrumentation breakdowns. Outliers may also be manifestations of a greater degree of spatial or temporal variability than expected.

After an outlier has been identified, a decision concerning its factual basis must be made. Obvious mistakes in data will be corrected when possible, and the correct values inserted. If the correct values cannot be obtained, the data may be excluded. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it may be excluded, but a note to that effect will be included in the report. Also, an attempt will be made to determine the effect of the outlier with both inclusion and exclusion from the data set.

19.2 Laboratory Analysis

Internal laboratory data verification procedures shall be performed by laboratory personnel. Internal data verification procedures include review of data packages for completion and accuracy. The data verification process for sample collection and laboratory analysis is summarized in Worksheet 29a (Appendix A).

Following receipt of data packages at AMEC, data validation will be performed using the USEPA CLP National Functional Guidelines for Inorganic Data Review (USEPA, 2004), the USEPA CLP National Functional Guidelines for Organic Data Review (USEPA, 1999) and the Region I USEPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses (USEPA, 1996). All samples will be validated in accordance with USEPA Region I Tier II criteria (see Appendix C for definition of Region I USEPA tiered data validation requirements). Data validation for non-CLP parameters such as water quality methods will be based on method requirements and the QSM guidelines (DoD, 2005). Worksheets 29b and 29c in Appendix A summarize data validation processes.

20.0 DATA USABILITY/RECONCILIATION WITH PROJECT QUALITY OBJECTIVES

Data usability will be assessed by determining if data has met the project quality objectives. Data usability is typically assessed by the project manager, with recommendations or input from the project chemist, data validator, or other team member from a general overall project perspective. This includes an evaluation of the impact of any deficiencies in precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS parameters) on interpretation of sample results. An overall assessment of the consistency and comparability of the results from a program perspective is also evaluated. Data usability elements and their impact on data interpretation are summarized in Worksheet 30 (Appendix A).

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Figure 10-1 Chain of Custody Form

CHAIN OF CUSTODY

PAGE OF

ALPHA WOODS HOLE LABS

Westborough, MA TEL: 508-898-9220 FAX: 508-898-9193

Raynham, MA TEL: 508-822-9300 FAX: 508-822-3288

Bedford, NH TEL: 603-232-8247 FAX: 603-628-2241

Client Information

Client:

Address:

Phone:

Fax:

Email:

☐ These samples have been Previously analyzed by Alpha

Project Information

Project Name:

Project Location:

Project #:

Project Manager:

ALPHA Quote #:

Turn-Around Time

☐ Standard ☐ Rush (ONLY IF PRE-APPROVED)

Due Date: Time:

Other Project Specific Requirements/Comments/Detection Limits:

Date Rec'd in Lab:

ALPHA Job #:

Report Information Data Deliverables

☐ FAX ☐ EMAIL

☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State/Fed Program *Criteria*

MCP PRESUMPTIVE CERTAINTY-CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?

☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

ANALYSIS

SAMPLE HANDLING

Filtration

☐ Done

☐ Not Needed

☐ Lab to do

Preservation

☐ Lab to do

(Please specify below)

TOTAL # BOTTLES

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials													Sample Specific Comments	
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
						☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
					Container Type	-	-	-	-	-	-	-	-	-	-	-	-		
					Preservative	-	-	-	-	-	-	-	-	-	-	-	-		

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP *or* CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms.

FORM NO: 01-01 Internal
(rev. 12-April-06)

Figure 10-2 Example Laboratory Sample Receipt Checklist

Alpha Analytical Labs
Sample Delivery Group Form

Laboratory Job No. ____________________ SDG Reviewer ________________________

Client: ______________________________ Date/Time: ________________________

Preliminary Review

1. *Samples Delivered via:*

☐ Alpha Courier ☐ Express Mail
☐ Client ☐ Other__________

2. *Chain of Custody:*

☐ Present
☐ Absent

3. *Custody Seal:*

☐ Absent
☐ Present/Intact
☐ Present/Broken

3. *All Containers Accounted for:*

☐ Yes ☐ No

4. *Samples received:*

☐ Intact ☐ Extra: ______________________________________
☐ Broken Sample IDs : ______________________________________
☐ Leaking Sample IDs : ______________________________________

5. *Temperature Blank:*

☐ Present Temperature (in Celsius): ☐ 2 - 6 Celsius degrees
☐ Other ____________

☐ Absent Is the ice (n blue ice) present? ☐ Yes ☐ No * Cooler Temp:____________

Secondary Review

1. Do the sample(s) labels and Chain of Custody agree?

☐ Yes ☐ No * ______________________________________

2. Are the samples in appropriate containers?

☐ Yes ☐ No * ______________________________________

3. Are the samples properly preserved?

☐ Yes ☐ No * Initial pH=__________Preserved In-House w/______________________

4. Are the samples within holding times?

☐ Yes ☐ No * ______________________________________

* Contact client and attach the phone log

Form No.: 01-02 01/07/2003

Table 9-1

Requirements for Sample Containers, Preservation, Volume, and Holding Time

Name	SOP Number[1]/ Analytical Method Reference	Container Type[2]	Preservative	Sample Container Size[3]	Maximum Holding Time
Sediment Samples					
Metals	L-1/6010B	G	4°C	250 gram	180 days until analysis
Mercury	L-16/7471A	P	4°C	10 gram	28 days until analysis
Ammonia	L-5/SM4500NH_3	G	4°C	100 gram	28 days until analysis
TOC	L-23/Lolyd Kahn	G	4°C	10 gram	14 days until analysis
Bioassay	EPA 100.2 / 100.4	P	4°C	Plastic bucket liners	14 days
Benthic Community Analysis	N/A	P	Formalin or ethanol	1 liter	None
Grain Size	L-22/ASTM D422-63	Plastic Bag	4°C	500 gram	None
Density	L-19/ASTM D2937	Shelby tube or Lexan liner	None	5 pounds	None
Specific Gravity	L-20/ASTM D854	Shelby tube or Lexan liner	None	5 pounds	None
PAHs	L-13/8270C	G	4°C	50 grams	14 days until extraction and then 40 days till analysis
Surface Water Samples					
Metals	L-2/6020A	P	Nitric acid to pH <2	500 mL	180 days until analysis
Mercury	L-3/7470A	P	Nitric acid to pH <2	500 mL	28 days until analysis
Anions (chloride, nitrate, sulfate)	L-4/300.0	P	4°C	250 mL	48 hours until analysis for nitrate, 28 days until analysis for chloride and sulfate
Nitrite	L-12/SM4500NO_2	P	4°C	250 mL	48 hours until analysis
Ammonia	L-5/ SM4500NH_3	P	Sulfuric acid to pH <2, 4°C	500 mL	28 days until analysis
Sulfide	L-6/SM4500S^{-2}D	P or G	Zinc acetate	250 mL	7 days until analysis

Table 9-1

Requirements for Sample Containers, Preservation, Volume, and Holding Time

Name	SOP Number[1]/ Analytical Method Reference	Container Type[2]	Preservative	Sample Container Size[3]	Maximum Holding Time
			and NaOH, no headspace, 4°C		
Alkalinity	L-7/SM2320B	P	4°C	1 liter	14 days until analysis
Total Dissolved Solids (TDS)	L-9/SM2450C	P	4°C	1 liter	7 days until analysis
Total Suspended Solids (TSS)	L-8/SM2540D	P	4°C	1 liter	7 days until analysis
Total Organic Carbon (TOC)	L-10/5310C	G	Sulfuric acid or HCl to pH <2	2 – 40 mL vials	28 days until analysis
Chemical Oxygen Demand (COD)	L-11/410.4	P	Sulfuric acid to pH <2, 4°C	250 mL	28 days until analysis
Hardness	SM2340B	P	Nitric acid to pH <2; 4°C	Combined with metals analysis	180 days until analysis
Toxicity	EPA 1000.2 / 1002.0	P	4°C	Cube	36 hours

1 See Fixed Laboratory Method SOP Reference Table (EPA-NE QAPP Worksheet #20)
2 G = Glass, amber; P = Polyethylene
3 In some cases, multiple sample analyses can be combined into one sample container.

Appendix A

EPA-New England Quality Assurance Project Plan Worksheets

1.0 Title and Approval Page (EPA-NE QAPP Worksheet #1 - Rev. 10/99)

Site Name/Project Name: Shepley's Hill Landfill / RI for AOC 72
Site Location: Devens, Massachusetts

Title: Draft Final QAPP
Revision Number: 0
Revision Date: 03/06/09
Page: 1 of 1

Document Title: Draft Final Site Specific Quality Assurance Project Plan

Lead Organization (Agency, State, Tribe, Federal Facility, PRP, or Grantee): USEPA

Preparer's Name and Organizational Affiliation: Denise Ladebauche, AMEC

Preparer's Address and Telephone Number: AMEC Earth & Environmental, Inc., 2 Robbins Road, Westford, MA 01886 (978)-692-9090

Preparation Date (Day/Month/Year): 03/06/09

Investigative Organization's Project Manager:

Signature/Date

Marc Grant, AMEC Project Manager

Printed Name/Organization

Investigative Organization's Project Chemist:

Signature/Date

Denise Ladebauche, AMEC

Printed Name/Organization

Lead Organization's Project Manager:

Signature/Date

Ellen Iorio, USACE-NAE

Printed Name/Organization

Approval Signature:

Signature/Date

Ginny Lombardo, USEPA Program Manager

USEPA Region 1

Approval Authority

Other Approval Signatures:

Signature/Date

Lynne Welsh, MassDEP Project Manager

Printed Name/Title

Document Control Number: SHL-0125

EPA-NE QAPP Worksheet #2 - Rev. 10/99

Site Name/Project Name: Shepley's Hill Landfill / RI for AOC 72
Site Location: Devens, Massachusetts
Site Number/Code:
Operable Unit:
Contractor Name: AMEC
Contractor Number:
Contract Title:
Work Assignment Number:
Anticipated date of QAPP Implementation: 2009

Title: Draft Final QAPP
Revision Number: 0
Revision Date: 03/06/09

1. Identify Guidance used to prepare QAPP:

Region I, EPA-NE Quality Assurance Project Plan Program Guidance, April 1, 2008

2. Identify EPA Program: CERCLA

3. Identify approval entity: EPA-NE or State: USEPA-NE
or other entity: USACE-NAE

4. Indicate whether the QAPP is a generic program QAPP or a ***project specific QAPP***. (underline one)

5. List dates of scoping meetings that were held: 08/21/07 and 06/19/08

6. List title of QAPP documents and approval dates written for previous site work, if applicable: Not applicable

7. List organizational partners (stakeholders) and connection with EPA and/or State:

USACE-NAE – Supervising Contractor; BEC – Principal field representative for response actions at Devens

8. List data users: USEPA, MassDEP, USACE-NAE, AMEC, other contractors

9. If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable to the project, then circle the omitted QAPP Elements, Worksheets and Required Information on the attached Table. Provide an explanation for their exclusion below:

Worksheet 5a (Organizational Chart) and 5b (Communication Pathways) - The information from Worksheets 5a and 5b are included in the Project Management Plan.
Worksheet 7 (Special Personnel Training Requirements) - No specialized training, beyond that identified in section 4.4 is required, therefore, Worksheet 7 is not included.
Worksheet 10 (Project Schedule Timeline Table) – The project schedule timelines are detailed in the Project Management Plan.

Worksheets 12a (Sampling Design and Rationale) and 12b (Sampling Locations, Sampling and Analysis Method/SOP Requirements Table) - The information from Worksheets 12a and 12b is included in the project Field Sampling Plan (and Table 9-1: Requirements for Sample Containers, Preservation, Volume, and Holding Time).

Worksheets 13 (Project Sampling SOP Reference Table), 14 (Field Sampling Equipment Calibration Table), and 15 (Field Equipment Maintenance, Testing, and Inspection Table) – The information from Worksheets 13, 14, and 15 is included in the Field Sampling Plan.

Worksheets 17 (Field Analytical Method/SOP Reference Table), 18 (Field Analytical Instrument Calibration Table), and 19 (Field Analytical Instrument/Equipment Maintenance, Testing, and Inspection Table) – The information from Worksheets 17, 18, and 19 is included in the Field Sampling Plan.

Worksheets 23a (Field Analytical QC Table) and 23b (Field Analytical Method /SOP Precision and Accuracy Table) - Worksheets 23a and 23b are not included because field analysis for definitive data is not performed for this project.
Worksheet 25 (Non-Direct Measurements Criteria and Limitations Table) - The information from Worksheet 25 is included in the Data Gaps Analysis Report.

EPA-NE QAPP Worksheet #2 (continued)

Worksheets and/or Required Information that are not applicable to the project are highlighted and shown in ***bold italic*** print. An explanation for their omission is contained in EPA-NE QAPP Worksheet #2, Item 9.

REQUIRED EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS	EPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Project Management and Objectives			
A1	1.0 Title and Approval Page	1	- Title and Approval Page
A2	2.0 Table of Contents and Document Format 2.1 Table of Contents 2.2 Document Control Format 2.3 Document Control Numbering System 2.4 EPA-NE QAPP Worksheet #2	2	- Table of Contents - EPA-NE QAPP Worksheet
A3	3.0 Distribution List and Project Personnel Sign-off Sheet	3 4	- Distribution List - Project Personnel Sign-off Sheet
A4, A8	4.0 Project Organization 4.1 Project Organizational Chart 4.2 Communication Pathways 4.2.1 Modifications to Approved QAPP 4.3 Personnel Responsibilities and Qualifications 4.4 Special Training Requirements/ Certification	***5a*** ***5b*** 6 ***7***	- ***Organizational Chart*** - ***Communication Pathways*** - Personnel Responsibilities and Qualifications Table - ***Special Personnel Training Requirements Table***
A5	5.0 Project Planning/Project Definition 5.1 Project Planning Meetings 5.2 Problem Definition/Site History and Background	8a 8b	- Project Scoping Meeting Attendance Sheet with Agenda and other Project Planning Meeting Documentation - Problem Definition/Site History and Background - ***EPA-NE DQO Summary Form*** - ***Site Maps (historical and present)***
A6	6.0 Project Description and Schedule 6.1 Project Overview 6.2 Project Schedule	9a 9b 9c 9d ***10***	- Project Description - Contaminants of Concern and Other Target Analytes Table - Field and Quality Control Sample Summary Table - Analytical Services Table - System Designs - ***Project Schedule Timeline Table***
A7	7.0 Project Quality Objectives and Measurement Performance Criteria 7.1 Project Quality Objectives 7.2 Measurement Performance Criteria	11a 11b	- Project Quality Objectives/Decision Statements - Measurement Performance Criteria Table

EPA-NE QAPP Worksheet #2 (continued)

Measurement/Data Acquisition			
B1	8.0 Sampling Process Design 8.1 Sampling Design Rationale	***12a*** ***12b***	- ***Sampling Design and Rationale*** - ***Sampling Locations, Sampling and Analysis Method/SOP Requirements Table*** - ***Sample Location Map***
B2, B6, B7, B8	9.0 Sampling Procedures and Requirements 9.1 Sampling Procedures 9.2 Sampling SOP Modifications 9.3 Cleaning and Decontamination of Equipment/Sample Containers 9.4 Field Equipment Calibration 9.5 Field Equipment Maintenance, Testing and Inspection Requirements 9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers	***13*** ***12b*** ***14*** ***15***	- ***Sampling SOPs*** - ***Project Sampling SOP Reference Table*** - ***Sampling Container, Volumes and Preservation Table*** - ***Field Sampling Equipment Calibration Table*** - ***Cleaning and Decontamination SOPs*** - ***Field Equipment Maintenance, Testing and Inspection Table***
B3	10.0 Sample Handling, Tracking and Custody Requirements 10.1 Sample Collection Documentation 10.1.1 Field Notes 10.1.2 Field Documentation Management System 10.2 Sample Handling and Tracking System 10.3 Sample Custody	16	- Sample Handling, Tracking and Custody SOPs - Sample Handling Flow Diagram - Sample Container Label (Sample Tag) - Chain-of-Custody Form and Seal
B4, B6, B7, B8	11.0 Field Analytical Method Requirements 11.1 Field Analytical Methods and SOPs 11.2 Field Analytical Method/SOP Modifications 11.3 Field Analytical Instrument Calibration 11.4 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements 11.5 Field Analytical Inspection and Acceptance Requirements for Supplies	***17*** ***18*** ***19***	- ***Field Analytical Methods/SOPs*** - ***Field Analytical Method/SOP Reference Table*** - ***Field Analytical Instrument Calibration Table*** - ***Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Table***
B4, B6, B7, B8	12.0 Fixed Laboratory Analytical Method Requirements 12.1 Fixed Laboratory Analytical Methods and SOPs 12.2 Fixed Laboratory Analytical Method/SOP Modifications 12.3 Fixed Laboratory Instrument Calibration	20 21	- Fixed Laboratory Analytical Methods/SOPs - Fixed Laboratory Analytical Method/SOP Reference Table - Fixed Laboratory Instrument Maintenance and Calibration Table

	12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements 12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies		
B5	13.0 Quality Control Requirements 13.1 Sampling Quality Control 13.2 Analytical Quality Control 13.2.1 Field Analytical QC 13.2.2 Fixed Laboratory QC	22a 22b ***23a*** ***23b*** 24a 24b	**Sampling** - Field Sampling QC Table - Field Sampling QC Table cont. **Analytical** - ***Field Analytical QC Sample Table*** - ***Field Analytical QC Sample Table cont.*** - ***Field Screening/Confirmatory Analysis Decision Tree*** - Fixed Laboratory Analytical QC Sample Table - Fixed Laboratory Analytical QC Sample Table cont.
B9	14.0 Data Acquisition Requirements	***25***	- ***Non-Direct Measurements Criteria and Limitations Table***
A9, B10	15.0 Documentation, Records and Data Management 15.1 Project Documentation and Records 15.2 Field Analysis Data Package Deliverables 15.3 Fixed Laboratory Data Package Deliverables 15.4 Data Reporting Formats 15.5 Data Handling and Management 15.6 Data Tracking and Control	26	- Project Documentation and Records Table - Data Management SOPs
	Assessment/Oversight		
C1	16.0 Assessments and Response Actions 16.1 Planned Assessments 16.2 Assessment Findings and Corrective Action Responses 16.3 Additional QAPP Non-Conformances	27a 27b 27c	- Assessment and Response Actions - Project Assessment Table - Project Assessment Plan - Audit Checklists
C2	17.0 QA Management Reports	28	- QA Management Reports Table

EPA-NE QAPP Worksheet #2 (continued)

Data Validation and Usability			
D1	18.0 Verification and Validation Requirements		- Validation Criteria Documents
D2	19.0 Verification and Validation Procedures	29a 29b 29c	- Data Evaluation Process - Data Validation Summary Table - Data Validation Modifications
D3	20.0 Data Usability/Reconciliation with Project Quality Objectives	30	- Data Usability Assessment

ATTACHMENTS:

A – QAPP Worksheets
B – Analytical Laboratory SOPs and Certifications
C – Relevant EPA Guidance
D – Personnel Resumes

Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Document Control Number
Ginny Lombardo	Project Manager	USEPA	617-918-1754	SHL-0125
Lynne Welsh	Project Manager	MassDEP	508-792-4007	SHL-0125
Robert Simeone	BRAC Environmental Coordinator	Devens Reserve Forces Training Area	978-796-2205	SHL-0125
Ellen Iorio	Program Manager	USACE-NAE	978-318-8717	SHL-0125
Peter Hugh	Technical Lead	USACE-NAE	978-318-8433	SHL-0125
David Lubianez	Project Chemist	USACE-NAE	978-318-8311	SHL-0125
Mark Applebee	Program Manager	AMEC	978-692-9090 x299	SHL-0125
Marc Grant	Project Manager	AMEC	978-692-9090 x240	SHL-0125
Mike Robinson	Field Team Leader	AMEC	978-692-9090 x358	SHL-0125
Denise Ladebauche	Project Chemist	AMEC	978-692-9090 x379	SHL-0125
Mary Davis	Laboratory Project Manager	Alpha Analytical Labs	508-898-9220 x171	SHL-0125

Fixed Laboratory Analytical QC Sample Table cont.

Medium/Matrix	SED
Sampling SOP	See FSP
Analytical Parameter	All
Concentration Level	Low/Medium
Analytical Method/ SOP Reference[1]	L-13
Laboratory Name	Alpha Analytical
No. of Sample Locations	24 SED

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
(ICAL)	samples		Prepare new standards			
Second Source Calibration Verification	Once after ICAL	±25% of expected value	Correct problem; re-run second source verification. If that fails repeat correct problem and repreat ICAL. Re-analyze all samples since last successful ICAL or second source.	Analyst	Accuracy	±25% of expected value
Calibration Verification (CV)	Daily before sample analysis and every 12 hours	Average RF for SPCCs ≥ 0.050 % D ≤ 20%	Correct problem then rerun CV. If that fails repeat ICAL.	Analyst	Accuracy	Average RF for SPCCs ≥ 0.050 % D ≤ 20%
Internal Standards	In all field samples	-50% to +100% of ICAL midpoint Retention time of ±30 seconds from retetion time of midpoint standard of ICAL	Inspect instrument and reanalyze samples	Analyst	Accuracy	-50% to +100% of ICAL midpoint Retention time of ±30 seconds from retetion time of midpoint standard of ICAL

Sampling SOP : See FSP
Analytical Method/SOP [1]: L-1, L-16, L-21, L-5, (Metals in sediment by SW846 method 6010B/7471A, methyl mercury and Ammonia by SM4500NH_3)

Fixed Laboratory Analytical QC Sample Table cont.

Analyte	Approximate Laboratory Sensitivity/ Quantitation Limits (mg/kg)	Analytical Precision	Analytical Accuracy/Bias
Aluminum	4	RPD ≤ 50%	80 – 120
Arsenic	0.4	RPD ≤ 50%	80 – 120
Chromium	0.4	RPD ≤ 50%	80 – 120
Iron	2.0	RPD ≤ 50%	80 – 120
Lead	2.0	RPD ≤ 50%	80 – 120
Manganese	0.4	RPD ≤ 50%	80 – 120
Mercury	0.08	RPD ≤ 50%	80 – 120
Methyl mercury	0.04 (ng/g)	RPD ≤ 50%	80 – 120
Nickel	1.0	RPD ≤ 50%	80 – 120
Sodium	80	RPD ≤ 50%	80 – 120
Zinc	2.0	RPD ≤ 50%	80 – 120
Ammonia	7.5	RPD ≤ 50%	75 – 125

1 See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20)

Project Personnel Sign-Off Sheet

Organization: AMEC

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read	QAPP Acceptable as Written
Mark Applebee	Program Manager	978-692-9090 x299			
Marc Grant	Project Manager	978-692-9090 x240			
Mike Robinson	Field Team Leader	978-692-9090 x358			
Denise Ladebauche	Project Chemist	978-692-9090 x379			

Personnel Responsibilities and Qualifications Table

Name	Organizational Affiliation	Responsibilities	Location of Personnel Resumes, if not included	Education and Experience Qualifications
Mark Applebee	AMEC, Westford, MA	Program Manager	See Attachment D	See Attachment D
Marc Grant	AMEC, Westford, MA	Project Manager	See Attachment D	See Attachment D
Mike Robinson	AMEC, Westford, MA	Field Team Leader	See Attachment D	See Attachment D
Denise Ladebauche	AMEC, Westford, MA	Project Chemist	See Attachment D	See Attachment D

Note: Resumes are included in Attachment D

Project Scoping Session Participants Sheet

Project Name: Shepley's Hill Landfill – AOC 72 **Projected Date(s) of Sampling:** Spring-Summer 2009 **Project Manager:** Marc Grant	**Site Name:** Plow Shop and Grove Ponds **Site Location:** Ayer MA

Date of Session: August 21, 2007
Scoping Session Purpose: Ecological Risk Assessment for AOC 72

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Kate Sellers Chris Mackay	Project Manager Risk Assessor	AMEC	978-692-9090 207-879-4222	Kate.sellers@amec.com Chris.mackay@amec.com	Army Contractor
Mike Penko	Engineering Technical Lead	USACE		Michael.penko@usace.army.mil	Army Technical Support
Greg Braun Warren Kimball Brian Duval		MassDEP		Greg.braun@state.ma.us Warren.kimball@state.ma.us Brian.duval@state.ma.us	Regulatory Oversight
Richard Sugatt		USEPA		Sugatt.rick@epa.gov	Regulatory Oversight
Ken Munney		USFWS		Kenneth_munney@fws.gov	Regulatory Oversight
Todd Finlayson		Gannett Fleming		rtfinlayson@gfnet.com	USEPA Contractor

Comments/Decisions: The components of the conceptual site model (CSM) were discussed, along with a preliminary decision matrix for ecological risk assessment.

Action Items: Data for potential use in the risk assessment will be exchanged.

Consensus Decisions: Conduct a risk assessment in enough depth to determine if remediation is warranted.

Project Scoping Session Participants Sheet

Project Name: Shepley's Hill Landfill – AOC 72 **Projected Date(s) of Sampling:** Spring-Summer 2009 **Project Manager:** Marc Grant	**Site Name:** Plow Shop and Grove Ponds **Site Location:** Ayer MA

Date of Session: May 15, 2008
Scoping Session Purpose: Ecological Risk Assessment for AOC 72

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Marc Grant Chris Abate Chris Mackay	Project Manager Hydrogeologist Risk Assessor	AMEC	978-692-9090 978-692-9090 207-879-4222	marc.grant@amec.com chris.abate@amec.com Chris.mackay@amec.com	Army Contractor
Mike Penko	Engg Technical Lead	USACE		Michael.penko@usace.army.mil	Army Technical Support
Bob Simeone		Army BRAC		Robert.j.simeone@us.army.mil	BRAC Environmental Coordinator
Greg Braun Brian Duval Lynne Welsh Hui Liang		MassDEP		Greg.braun@state.ma.us Brian.duval@state.ma.us Lynne.welsh@state.ma.us Hui.liang@state.ma.us	Regulatory Oversight
Richard Sugatt Ginny Lombardo Bill Brandon		USEPA		Sugatt.rick@epa.gov Lombardo.ginny@epa.gov Brandon.bill@epa.gov	Regulatory Oversight
Dave McTighe		Gannett Fleming		dmmctigue@gfnet.com	USEPA Contractor

Comments/Decisions: Refinements to the CSM (especially based on EPA's ORD report) were discussed.

Action Items: Convene a meeting in June to discuss data gaps / DQOs needed to develop the draft RI workplan.

Consensus Decisions:

Project Scoping Session Participants Sheet

Project Name:	Shepley's Hill Landfill – AOC 72	**Site Name:**	Plow Shop and Grove Ponds
Projected Date(s) of Sampling:	Spring-Summer 2009	**Site Location:**	Ayer MA
Project Manager:	Marc Grant		

Date of Session: June 19, 2008
Scoping Session Purpose: Ecological Risk Assessment for AOC 72

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Marc Grant Chris Mackay	Project Manager Risk Assessor	AMEC	978-692-9090 207-879-4222	Marc.grant@amec.com Chris.mackay@amec.com	Army Contractor
Mike Penko	Engg Technical Lead	USACE		Michael.penko@usace.army.mil	Army Technical Support
Bob Simeone		Army BRAC		Robert.j.simeone@us.army.mil	BRAC Environmental Coordinator
Brian Duval Lynne Welsh		MassDEP		Brian.duval@state.ma.us Lynne.welsh@state.ma.us	Regulatory Oversight
Richard Sugatt Ginny Lombardo Bill Brandon Brian Olson		USEPA		Sugatt.rick@epa.gov Lombardo.ginny@epa.gov Brandon.bill@epa.gov Olson.brian@epa.goc	Regulatory Oversight
Ken Munney		USFWS		Kenneth_munney@fws.gov	Regulatory Oversight
Todd Finlayson		Gannett Fleming		rtfinlayson@gfnet.com	USEPA Contractor

Comments/Decisions: Past and future ERA methods were discussed, including a population-based approach. Potential data gaps and collection efforts were discussed.

Action Items: AMEC will submit additional information on the population-based ERA methods, and provide a revised DGA/CSM for consideration.

Consensus Decisions: A detailed RI Workplan will be developed for review and approval.

Problem Definition/Site History and Background

History and Background:

A Remedial Investigation (RI) Workplan for Area of Concern (AOC) 72 at the former Fort Devens has been prepared by AMEC Earth & Environmental, Inc. (AMEC) on behalf of the United States Army Corps of Engineers, New England District (USACE-NAE). This QAPP is Attachment C of the RI Workplan. AOC 72 consists of Plow Shop Pond, located on the east of Shepley's Hill Landfill (SHL) at Devens (Figure 1 of RI Workplan). Plow Shop Pond discharges to Nonacoicus Brook which flows west on the north side of SHL. SHL and surrounding property including Nonacoicus Brook are included in the risk assessments for human and ecological receptors in the draft Supplemental Groundwater and Landfill Cap Assessment for SHL, which is expected to be completed by September 2008. Remediation of the landfill, and RI and Feasibility Study (FS) of AOC 72, is occurring under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, and National Oil and Hazardous Substances Contingency Plan (NCP) requirements, with regulatory coordination of the Massachusetts Department of Environmental Protection (MassDEP) and the United States Environmental Protection Agency (USEPA).

Plow Shop Pond has been the subject of numerous environmental studies. The initial step in this RI was preparation in 2006 of a Data Gaps Analysis (DGA) in which gaps in existing site characterization data were identified. The available data for AOC 72 and information needed to complete the RI were the subject of subsequent meetings between MassDEP, USEPA, and USACE-NAE, including BRAC Cleanup Team (BCT) meetings on August 21, 2007, May 15, 2008, and June 19, 2008. The RI Workplan presents an updated Conceptual Site Model and DGA along with rationale and procedures for the collection of information required to satisfy the identified data gaps. Subsequent steps in the RI will include execution of this workplan, completion of an RI report which describes relevant site and contaminant conditions and identifies and quantifies potential risks to human health and the environment by site-derived contaminants, and evaluation of remedial actions in an FS, should the assessment identify unacceptable risks to human health and the environment.

Plow Shop Pond is located southwest of the business and residential district in Ayer, Massachusetts. The 30-acre pond basin is bounded on the west and south by former Fort Devens property, to the north by commercial development (Molumco Industrial Park), and to the east by the Guilford Transportation railroad which crosses a causeway between Grove and Plow Shop Ponds (Figure 1). The pond is eutrophic with abundant aquatic plant life. Plow Shop Pond is used by local residents for recreational fishing, and is canoe-accessible at a landing on the northwest side. Signs are posted for "catch and release" fishing.

Objectives:

The overall objectives of the Army and other project stakeholders for the AOC 72 RI are to complete the investigation of Plow Shop Pond as needed to estimate risks to human health and the environment, and to close all CERCLA-related reporting. Specific technical objectives include the following:

- Evaluate current and potential future contaminant flux from SHL to AOC 72.
- Evaluate other contaminant sources and distribution in AOC 72.
- Evaluate whether the iron floc in Red Cove can act as a physical asphyxiant.
- Evaluate whether the iron floc in Red Cove constitutes "readily apparent harm" as defined under the MCP.
- Evaluate human and ecological risks related to site contaminants in sediment.
- Evaluate human and ecological risks related to site contaminants in surface water.
- Evaluate localized ecological risks related to site contaminants in Red Cove.

Working hypotheses and methods of evaluation are summarized in Section 2 and Table 2 of the RI Workplan.

Sampling Tasks:

AOC 72 sediment and surface water have been sampled extensively as indicated in the RI Workplan. Data gaps for the RI were identified in Section 2.3 and Table 2 of the workplan, focused on evaluating conditions specific to iron floc and groundwater upwelling areas in Red Cove, and Sediment Quality Triad tests for AOC 72 and reference areas. Field activities will consist of sampling and in situ measurements of sediment and surface water in Plow Shop Pond, Grove Pond, and Flanagan Pond. Sampling locations are indicated in Figures 9 and 10 of the RI Workplan. Samples will be analyzed for metals and ammonia, polycyclic aromatic hydrocarbons, physical characteristics, and benthic characteristics.

Project Description

Sampling Tasks: Field sampling activities and methods are described in the Field Sampling Plan. In general, sampling includes collection of:

- Sediment and surface water samples from Plow Shop Pond, Grove Pond, and Flanagan Pond

Analysis Tasks: Laboratory analysis includes metals, water quality, polycyclic aromatic hydrocarbons, geotechnical parameters, bioassay testing, and benthic community analysis.

Quality Control Tasks: A set of routine quality control samples accompanies each set of samples sent to the laboratory. The type and frequency of QC is summarized in Worksheet 9c.

Secondary Data: Secondary data are identified in the Data Analysis Plan (Attachment B to the RI Workplan).

Data Management Tasks: Electronic data deliverables (EDD) in the USAEC Environmental Restoration Information System (ERIS) format will be used for this project.

Documentation and Records: Data packages are tracked at the laboratory by assignment of sample delivery group (SDG) numbers. The laboratory sends hard copy and PDF formats of all data packages to AMEC. Data packages are recorded, tracked, and stored at secure on-site and off-site storage locations.

Data Packages: USEPA Level IV (CLP-equivalent) data packages are submitted by the laboratory to AMEC.

Assessment/Audit Tasks: AMEC personnel perform assessments and internal audits of sampling and analysis processes. These audits consist of systems (e.g., field sampling and laboratory inspections) and performance (e.g., analysis of QA split samples) audits. External audits of sampling procedures and laboratory processes by USACE, USEPA, or MassDEP may also be conducted.

Data Verification and Validation Tasks: Data verification by the contract laboratory and data validation by AMEC personnel will be performed on analytical sample results. USEPA Region I Tier II data validation is performed on all chemistry data generated for the project.

Data Usability Assessment Tasks: Data users will perform data usability assessment. Data quality indicators will be evaluated as well as an overview of data consistency and comparability from a project perspective.

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SED
Analytical Parameter: Metals and Ammonia
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP[1]: L-1, L-5, L-16 and L-21

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Risk-based Concentration[2] (mg/kg dry weight)	Analytical Method (mg/kg)		Approximate Achievable Laboratory Limits[3] (mg/kg)	
			IDLs[1]	Method QLs[1]	MDLs[4]	QLs[4]
Ammonia	7664-41-7	N/A	N/A	N/A	N/A	7.5
Aluminum	7429-90-5	25,500	N/A	N/A	0.37	4
Arsenic	7440-38-2	20	N/A	N/A	0.072	0.4
Chromium	7440-47-3	30	N/A	N/A	0.016	0.4
Iron	7439-89-6	9,100	N/A	N/A	0.60	2.0
Lead	7439-92-1	130	N/A	N/A	0.056	2.0
Manganese	7439-96-5	291	N/A	N/A	0.005	0.4
Mercury	7439-97-6	20	N/A	N/A	0.0168	0.08
Methyl mercury	22967-92-6	3	N/A	N/A	0.02 ng/g	0.04 ng/g
Nickel	7440-02-0	20	N/A	N/A	0.088	1.0
Sodium	7440-23-5	N/A	N/A	N/A	16	80
Zinc	7440-66-6	2,500	N/A	N/A	0.036	2.0

N/A = Not available
[1] Method reference is SW846 6010B for metals, SW846 7471A for mercury and SM4500NH_3 for ammonia.
[2] Represents the lower of the MCP Method 2 Direct Contact Soil Concentrations (310 CMR 40.0985(6)) and in order of preference the MassDEP Sediment Screening Values (MassDEP, 2006), the Lowest Effect Levels (LEL) for freshwater organisms (Persaud, D.R., *et.al. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. August, 1993), followed by the Threshold Effect Levels (TEL) for freshwater organisms (NOAA's *Screening Quick Reference Tables*. September 1999).
[3] Approximate laboratory limits are shown for MDLs and QLs, info to be updated when contract laboratory is selected.
[4] MDLs are expected to vary slightly between each MDL study (conducted annually). QLs may be expected to vary slightly based on individual laboratories and on the sample volume or weight used for analysis.

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SED
Analytical Parameter: PAHs
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP[1]: L-13

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Risk-based Concentration[2] (mg/kg dry weight)	Analytical Method (mg/kg)		Approximate Achievable Laboratory Limits[3] (mg/kg)	
			MDLs[1]	Method QLs[1]	MDLs[4]	QLs[4]
Naphthalene	91-20-3	0.18	N/A	N/A	0.001589	0.013
2-Methylnaphthalene	91-57-6	500	N/A	N/A	0.001619	0.013
Acenaphthylene	208-96-8	3000	N/A	N/A	0.001883	0.013
Acenaphthene	83-32-9	3000	N/A	N/A	0.001542	0.013
Fluorene	86-73-7	0.077	N/A	N/A	0.001327	0.013
Phenanthrene	85-01-8	0.2	N/A	N/A	0.001233	0.013
Anthracene	120-12-7	0.057	N/A	N/A	0.001675	0.013
Fluoranthene	206-44-0	0.42	N/A	N/A	0.001422	0.013
Pyrene	129-00-0	0.2	N/A	N/A	0.001560	0.013
Benzo(a)Anthracene	56-55-3	0.1	N/A	N/A	0.001203	0.013
Chrysene	218-01-9	0.17	N/A	N/A	0.001381	0.013
Benzo(b)Fluoranthene	205-99-2	40	N/A	N/A	0.001793	0.013

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SED
Analytical Parameter: PAHs
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP[1]: L-13

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table Continued)

Analyte	CAS Number	Risk-based Concentration[2] (mg/kg dry weight)	Analytical Method (mg/kg)		Approximate Achievable Laboratory Limits (mg/kg)	
			MDLs[1]	Method QLs[1]	MDLs[3]	QLs[3]
Benzo(k)Flouranthene	207-08-9	0.24	N/A	N/A	0.001957	0.013
Benzo(a)Pyrene	50-32-8	0.15	N/A	N/A	0.001534	0.013
Indeno(1,2,3-cd)Pyrene	193-39-5	0.2	N/A	N/A	0.002158	0.013
Dibenzo(a,h)Anthracene	53-70-3	0.033	N/A	N/A	0.001429	0.013
Benzo(g,h,i)Perylene	191-24-2	0.17	N/A	N/A	0.001771	0.013

N/A = Not available.

[1] Method reference is SW846 8270C SIM
[2] Represents the lower of the MCP Method 2 Direct Contact Soil Concentrations (310 CMR 40.0985(6)) and in order of preference the MassDEP Sediment Screening Values (MassDEP, 2006), the Lowest Effect Levels (LEL) for freshwater organisms (Persaud, D.R., *et.al. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. August, 1993), followed by the Threshold Effect Levels (TEL) for freshwater organisms (NOAA's *Screening Quick Reference Tables*. September 1999).
[3] MDLs may be expected to vary slightly between each MDL study (conducted annually). QLs may be expected to vary slightly based on individual laboratories and on the sample volume or weight used for analysis.

Medium/Matrix: Surface Water
Region I Matrix Code (from EPA-NE DQO Summary Form): SW
Analytical Parameter: Metals
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP[1]: L-2, L-3 and L-21

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Risk-based Concentration [2] (ug/L)	Analytical Method (ug/L)		Approximate Achievable Laboratory Limits[3] (ug/L)	
			IDLs[1]	Method QLs[1]	MDLs[4]	QLs[4]
Aluminum	7429-90-5	87	N/A	N/A	1.5	10
Arsenic	7440-38-2	**0.018**	N/A	N/A	0.07	0.5
Calcium	7440-70-2	N/A	N/A	N/A	6.6	100
Chromium	7440-47-3	11 [5]	N/A	N/A	0.07	0.5
Iron	7439-89-6	300	N/A	N/A	8.6	50
Lead	7439-92-1	2.5	N/A	N/A	0.02	0.5
Magnesium	7439-95-4	N/A	N/A	N/A	1.9	100
Manganese	7439-96-5	50	N/A	N/A	0.07	0.5
Mercury	7439-97-6	0.77	N/A	N/A	0.056	0.2
Methyl mercury	22967-92-6		N/A	N/A	10 ng/L	20 ng/L
Nickel	7440-02-0	52	N/A	N/A	0.08	0.5
Sodium	7440-23-5	N/A	N/A	N/A	4.8	100
Zinc	7440-66-6	N/A	N/A	N/A	0.4	5

N/A = Not available.
[1] Method reference is SW846 6020A and SW846 7470A for mercury.
[2] Represents lowest of AWQC among Human Health Consumption criteria and Freshwater Criterion Maximum Concentration (CMC) and the Criterion Continuous Concentration (CCC) where they exist (www.epa.gov/waterscience/criteria/wqcriteria; accessed April 12, 2006). Risk-based concentrations that are less than representative quantitation limits are denoted in **Bold** font. The AWQC of 0.018 ug/l for Arsenic is based on ingestion of both fish and water; the AWQC for fish ingestion alone is 0.14 ug/l and this is more relevant for the ponds.
[3] Approximate laboratory limits are shown for MDLs and QLs, info to be updated when contract laboratory is selected.
[4] MDLs may be expected to vary slightly between each MDL study (conducted annually). QLs may be expected to vary slightly based on individual laboratories and on the sample volume or weight used for analysis.
[5] Represents Chromium (VI).

Medium/Matrix: Water
Region I Matrix Code (from EPA-NE DQO Summary Form): SW
Analytical Parameter: Water Quality methods
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP[1]: L-4 through L-12

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	Method Reference[1]	Risk-based Concentration [2] (ug/L)	Analytical Method (ug/L) [1]		Approximate Achievable Laboratory Limits (ug/L)	
			MDLs	Method QLs	MDLs [3]	QLs [3]
Chloride	300.0	250,000	20	N/A	178	500
Nitrate	300.0	1000	2	N/A	6	50
Sulfate	300.0	250,000	20	N/A	182	1,000
Ammonia, Nitrogen	SM4500NH_3	30,000	N/A	50	8	75
Nitrite	SM4500NO_2	N/A	N/A	10	2	50
Sulfide	SM4500-S^{-2} D	N/A	N/A	1,000	20	100
Alkalinity	SM2320B	N/A	N/A	10,000	400	2,000
Total Dissolved Solids	SM2540C	500,000	N/A	10,000	3360	10,000
Total Suspended Solids	SM2540D	N/A	N/A	4,000	5,000	5,000
Total Organic Carbon	SM5310C	N/A	N/A	1,000	183	500
Chemical Oxygen Demand	410.4	N/A	N/A	3,000	5,320	20,000
Hardness	SM2340B	N/A	N/A	N/A	22.6	1,660

N/A = Not available
[1] Method reference is as shown in "method reference" column.
[2] Represents the lower of MCP Method 1 GW-1 and GW-3 Standards (310 CMR 40.0974(2)). If neither exists for analyte, concentration represents lower of Secondary Maximum Contaminant Levels (SMCL) or Health Advisory (HA) (Massachusetts Drinking Water Standards, Spring 2005). Method 1 standards and SMCL/HAs are used as detection limit benchmarks and are not applicable ARARs across Shepley's Hill Landfill.
[3] MDLs may be expected to vary slightly between each MDL study (conducted annually). QLs may be expected to vary slightly based on individual laboratories and on the sample volume or weight used for analysis.

Field and Quality Control Sample Summary Table

Medium/ Matrix	Analytical Parameter	Conc. Level	Analytical Method/ SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS/MSD pairs	No. of Equip. Blanks[9]	No. of QA split Samples[1]	Total No. of Samples to Lab[2]
			CHEMICAL ANALYSES						
SE	Total Metals[3]	Low	6010B / 7471A	24	3	2	1	TBD	28
SE	Ammonia	Low	SM4500NH_3B	24	3	2	1	TBD	28
SE	PAHs	Low	8270C SIM	24	3	2	1	TBD	28
SE	Methyl mercury	Low	CV-AFS	24	3	2	1	TBD	28
SE	TOC	Low	Lolyd Kahn	24	3	2	1	TBD	28
SE	Grain Size	N/A	ASTM D422-63	24	3	N/A	N/A	TBD	27
SE	TCLP RCRA8 Metals	Low	1311/6010B	1	1	0	0	TBD	2
SW	Total Metals[10]	Low	6020A	6	1	1	1	TBD	8
SW	Dissolved Metals[10]	Low	6020A	6	1	1	1	TBD	8
SW	Methyl mercury	Low	CV-AFS	6	1	1	1	TBD	8
SW	Water Quality	Low	WQ Suite[4]	6	1	1[5]	1	TBD	8
			BIOASSAY TESTS AND BENTHIC ANALYSIS						
SE	Bioassay	N/A	EPA 100.2 / 100.4[6]	17					17
SW	Bioassay	N/A	EPA 1000.2 / 1002.0[11]	5					5
SE	Benthic Community Analysis	N/A	USGS Benthic Macroinverebrate Processing Procedures, B-9135-00[8]	68					68

Field and Quality Control Sample Summary Table

Medium/ Matrix	Analytical Parameter	Conc. Level	Analytical Method/ SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS/MSD pairs	No. of Equip. Blanks[9]	No. of QA split Samples[1]	Total No. of Samples to Lab [2]
			GEOTECHNICAL TESTS						
SE	Density, Specific Gravity, Porosity[7]	N/A	ASTM D2937 ASTM D854	5					5

MS = Matrix spike
MSD = Matrix spike duplicate
SE = Sediment
SW = Surface Water

[1] Quality Assurance (QA) split samples (samples sent to a government designated independent testing laboratory) will be collected if directed by USACE-NAE, USEPA, or MassDEP.

[2] Total number of samples to lab consists of: number of sampling locations + number of field duplicate pairs + number of equipment blanks.

[3] Metals lists includes Record of Decision (ROD) metals = aluminum, arsenic, chromium, iron, lead, manganese, nickel, and sodium plus mercury and zinc.

[4] Water Quality (WQ) suite includes: anions (chloride, nitrate, sulfate) by method 300.0, ammonia by method $SM4500NH_3$, nitrite by method $SM4500NO_2$, sulfide by method $SM4500\text{-}S^{-2}$ D, alkalinity by method SM2320B, total dissolved solids by method SM2540C, total suspended solids by method SM2540D, total organic carbon by method SM5310C, chemical oxygen demand by method 410.4 and hardness by SM2340B.

[5] Matrix spike samples are applicable to all analyses except sulfide, TDS, and TSS.

[6] Bioassay tests include:

42-Day Hyalella azteca - Method 100.4
20-Day Chironomus dilutus with ash-free dry weights - Method 100.5

[7] ASTM Methods for sediment to include:

D2937 –Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
D854 - Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
Porosity is calculated from the density and specific gravity results.

[8] Benthic community analysis based upon *Methods of Analysis by the U.S. Geological Survey National Water Quality Laboratory- Processing, Taxonomy, and Quality Control of Benthic Macroinvertebrate Samples, Open-File Report 00-212, 2000.* Standard Taxonomic Assessment of subsample with 100 organism count.

[9] Equipment blank samples will be taken every day that decontamination occurs for each type of sampling equipment that is decontaminated.

[10] Metals lists includes Record of Decision (ROD) metals = aluminum, arsenic, chromium, iron, lead, manganese, nickel, and sodium plus mercury, calcium, magnesium and zinc.

[11] Bioassay tests will be based on EPA test method 1000.0 and 1002.0.

7-Day FATHEAD MINNOW, *PIMEPHALES PROMELAS*, LARVAL SURVIVAL AND GROWTH TEST
7-Day DAPHNID, *CERIODAPHNIA DUBIA*, SURVIVAL AND REPRODUCTION TEST

Analytical Services Table

Medium/ Matrix	Analytical Parameter	Concentration Level	Analytical Method/SOP[1]	Data Package Turnaround Time	Laboratory/Organization (Name and Address: Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address: Contact Person and Telephone Number)
Water	Metals	Low	L-2, L-3	15 business days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 Mary Davis 508-898-9220 x171	TBD
Water	Water Quality	Low	L-4 through L-12	15 business days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 Mary Davis 508-898-9220 x171	TBD
Water	Methyl mercury	Low	L-21	20 business days	TBD	TBD
Water	Bioassay	N/A	N/A	40 business days	TBD	TBD
Sediment	Metals	Low	L-1, L-16	15 business days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 Mary Davis 508-898-9220 x171	TBD
Sediment	Methyl mercury	Low	L-21	20 business days	TBD	TBD
Sediment	Ammonia	Low	L-4	15 business days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 Mary Davis 508-898-9220 x171	TBD
Sediment	Geotechnical	Low	L-19, L-20	15 business days	GeoTesting Express 1145 Massachusetts Avenue Boxborough, MA 01719 Gary Torosian 978 635 0012	TBD
Sediment	PAHs	Low	L-13	15 business days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 Mary Davis 508-898-9220 x171	TBD
Sediment	TOC	Low	L-23	15 business days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 Mary Davis 508-898-9220 x171	TBD
Sediment	Grain Size	N/A	L-22	15 business days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581	TBD

Analytical Services Table

Medium/ Matrix	Analytical Parameter	Concentration Level	Analytical Method/SOP[1]	Data Package Turnaround Time	Laboratory/Organization (Name and Address: Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address: Contact Person and Telephone Number)
					Mary Davis 508-898-9220 x171	
Sediment	Bioassay	N/A	N/A	40 business days	TBD	TBD
Sediment	Benthic Community Analysis	N/A	N/A	40 business days	TBD	TBD

[1]See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).

Project Quality Objectives/Decision Statements

Project data will be used to determine the nature and extent of contamination, specifically the quality of surface water and sediment in the vicinity of AOC 72.

Project data will be used to support human health and ecological risk assessments. If unacceptable risk exists, project data will be used to evaluate potential remedies and determine if further investigations are warranted.

Data will be evaluated based on adherence to acceptance criteria for precision, accuracy, representativeness, completeness, comparability, and sensitivity, as described in section 7.2 of the QAPP and outlined in Worksheet 11b.

The schedule is defined in the RI Workplan Section 3.

Data will be collected and results generated by field and laboratory personnel. Field and project managers overseeing this work are summarized in Worksheet 6.

Data will be used by personnel including hydrogeologists, environmental engineers, geologists, chemists, project managers, and risk assessors as summarized in Worksheet 6.

Data will be reported in accordance with USEPA Level IV (CLP-equivalent) protocols, as described in QAPP section 15.3.

Measurement Performance Criteria Table

Medium/Matrix	Sediment and Surface Water
Analytical Parameter	Methods L-1 through L-18, L-21 and L-23 shown on worksheet #20
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)[3]	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See FSP	L-1 through L-18, L-21, L-23	Accuracy	See worksheet 24b	Matrix Spike/Matrix Spike Duplicates and Laboratory Control Samples	A
		Accuracy/bias - Contamination	No target compounds ≥ QL	Method Blanks	A
		Accuracy/bias	Initial and continuing calibration standards within standards specified by the laboratory SOP and summarized in Worksheet 21	Initial and continuing calibration standards	A
		Precision - Overall	RPD ≤ 30% when detects for both duplicates are ≥ QL for water; RPD ≤ 50% when detects for both duplicates are ≥ QL for sediment	Field Duplicates	S&A
		Precision – Lab	See worksheet 24b	Matrix Spike/Matrix Spike Duplicate	A
		Sensitivity	Initial calibration acceptance limits shown in Worksheet 21	QL set at low level calibration standard concentration or MDL for metals	A

Measurement Performance Criteria Table

Medium/Matrix	Sediment and Surface Water
Analytical Parameter	Methods L-1 through L-18, L-21 and L-23 shown on worksheet #20
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)[3]	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Sensitivity	Method detection limit (MDL) must produce a response at least 3 times greater than the instrument noise level.	MDL studies	A
		Sensitivity	Instrument detection limit (IDL) must be ≤ MDL.	IDL studies	A
		Data Completeness	90% overall	Data completeness check	S&A
		Comparability	Results will be compared to other sample results to verify that the results are consistent and make sense from a broad perspective. Comparability of oversight split sampling data and performance evaluation samples will be made based on the criteria specified for the specific analytes and matrices.	Comparability check	S&A

[1] Reference analytical method/SOP Number from EPA-NE QAPP Worksheet #20.

Sample Handling System

SAMPLE COLLECTION, PACKAGING AND SHIPMENT
Sample Collection: AMEC field personnel
Sample Packing: AMEC field personnel
Coordination of Shipment: AMEC field personnel
Type of Shipment (Courier): Federal Express or courier
SAMPLE RECEIPT AND ANALYSIS
Responsible Organization: Contract laboratories
Sample Receipt: Sample custodian at laboratory
Sample Custody and Storage: Sample custodian at laboratory
Sample Preparation: Sample preparation technician
Sample Determinative Analysis: Analyst
SAMPLE ARCHIVAL
Field Sample Storage (No. of days from sample collection): Sixty days from data reporting, approximately 90 days from sample collection.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Six months from data reporting, approximately 7 months from sample collection.
SAMPLE DISPOSAL
Responsible Organization: Contract laboratories or other arrangements, as necessary (i.e., return to AMEC for disposal)
Responsible Personnel: Waste disposal specialist

Fixed Laboratory Analytical Method/SOP Reference Table

Reference Number [1]	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive or Screening Data	Method Code[2]	Analytical Parameter	Instrument	Modified for Project Work Y or N
L-1	Alpha Analytical	SOP/06-01 Inductively Coupled Plasma – Atomic Emission Spectrometry, Method 6010B,November 7, 2008, Issue No. 9	Definitive	6010	Metals	ICP-AES	N
L-2	Alpha Analytical	SOP/06-10 Inductively Coupled Plasma – Mass Spectrometry, Method 6020A, August 30, 2004, Issue No. 2	Definitive	6020	Metals	ICP-MS	N
L-3	Alpha Analytical	SOP/06-02 Mercury in Liquid Waste (Automated Cold-Vapor Techniques) Method 7470A, August 30, 2004, Issue No. 4	Definitive	7470A	Mercury	CVAA	N
L-4	Alpha Analytical	SOP/07-23 Determination of Inorganic Anions by Ion Chromatography Method 300.0, August 8, 2005, Issue No. 3	Definitive	300.0	Anions (Sulfate, Chloride, Nitrate)	IC	N
L-5	Alpha Analytical	SOP/07-14 Nitrogen, Ammonia Method SM4500NH3-BH, April 30, 2005, Issue No. 2.	Definitive	$4500NH_3$	Ammonia	Titrimetric	N
L-6	Alpha Analytical	SOP/07-30 Total Sulfide, Methylene Blue Method, Method SM4500S^{-2}-AD, February 9, 2003, Issue No. 1	Definitive	4500S/D	Sulfide	Spetrophotometric	N
L-7	Alpha Analytical	SOP/07-22 Alkalinity, Titration Method, Method SM2320B, September 19, 2003, Issue No. 2	Definitive	2320B	Alkalinity	Titrimetric	N
L-8	Alpha Analytical	SOP/07-29 Total Suspended Solids Dried at 103-105°C, Method SM2540D, September 29, 2005, Issue No. 2	Definitive	2540D	Total Suspended Solids	Gravimetric	N
L-9	Alpha Analytical	SOP/07-28 Total Dissolved Solids Dried at 180°C, Method SM 2540C, September 29, 2005, Issue No. 2	Definitive	2540C	Total Dissolved Solids	Gravimetric	N

Fixed Laboratory Analytical Method/SOP Reference Table

Reference Number [1]	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive or Screening Data	Method Code[2]	Analytical Parameter	Instrument	Modified for Project Work Y or N
L-10	Alpha Analytical	SOP/07-24 Total Organic Carbon (TOC) Persulfate – Ultraviolet Oxidation Method, Method SM5310C, May 24, 2003, Issue No. 3	Definitive	5310C	TOC	IR	N
L-11	Alpha Analytical	SOP/07-16 Chemical Oxygen Demand (COD) Closed Reflux, Colorimetric Method (Total and Soluble in Liquid), Method 410.4, June 3, 2006, Issue No. 3	Definitive	410.4	Chemical Oxygen Demand	Colorimetric	N
L-12	Alpha Analytical	SOP/ 07-26 Nitrate, Nitrite and Nitrate/Nitrite Nitrogen Automated Cadmium Reduction Method, Method SM4500NO_2-B	Definitive	4500NO_2-B	Nitrite	Lachat	N
L-13	Alpha Analytical	SOP/03-04 Polynuclear Aromatic Hydrocarbons (PAH) by Selected Ion Monitoring (SIM), Method 8270C (Modified), April 30, 2005, Issue No. 4	Definitive	8270C SIM	PAHs	GC/MS	N
L-14	Alpha Analytical	SOP/02-04 Soxhlet Extraction, Method 3540C, July 10, 2008, Issue No. 7	Definitive – Extraction	3540	PAHs	GC/MS	N
L-15	Alpha Analytical	SOP/05-03 TCLP Extraction Metals and Semi-Volatile Organics, Method 1311, September 28, 2007, Issue No. 4	Definitive – TCLP Extraction	13112007	Metals	TCLP Shaker	N
L-16	Alpha Analytical	SOP/06-03 Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique), Method 7471A, May 3, 2007, Issue No. 5	Definitive	7471A	Mercury	CVAA	N
L-17	Alpha Analytical	SOP/05-05 Hot Block Digestion for Aqueous Samples, August 13, 2006, Issue No. 4	Definitive – Digestion	3005	Metals	ICP	N
L-18	Alpha Analytical	SOP/05-07 Hot Plate Digestion of Sediments, Sludges and Soils, October 20, 2005, Issue No. 2	Definitive – Digestion	3050	Metals	ICP	N

Fixed Laboratory Analytical Method/SOP Reference Table

Reference Number [1]	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive or Screening Data	Method Code[2]	Analytical Parameter	Instrument	Modified for Project Work Y or N
L-19	GeoTesting Express	ASTM D 2937 Standard Test Method for Density of Soil in Place by the Drive Cylinder Method, Revision 3, June 2006 [4]	Definitive	D2937	Density	Gravimetric	N
L-20	GeoTesting Express	ASTM D 854 Standard Test Method for Specific Gravity of Soil Solids by Water Pycnometer, Revision 3, June 2006 [4]	Definitive	D854	Specific Gravity	Gravimetric	N
L-21	TBD		Definitive		Methyl Mercury	CVAA	N
L-22	Alpha Analytical	W-029 Particle Size Analysis of Soils – With / Without Hydrometer and Liquid Limit, Plastic Limit, and Plasticity Index	Definitive	ASTM D422-63	Grain Size	N/A	N
L-23	Alpha Analytical	W-028 Total Organic Carbon in Soil, Sediment and Water	Definitive	Lloyd Kahn	TOC	CHNS/O Analyzer	N
N/A	TBD	Bioassay Test [3]	Definitive	100.2, 100.4, 1000.0, 1002.0	Survival and growth	N/A	N
N/A	TBD	Benthic Community Analysis	Definitive	N/A	N/A	N/A	N

CVAA = Cold Vapor Atomic Absorption
IC = Ion Chromatography
ICP-AES = Inductively Coupled Plasma-Atomic Emission Spectrometry
ICP-MS = Inductively Coupled Plasma- Mass Spectrometry
IR = Infrared
GC/MS = Gas Chromatography/Mass Spectrometry
N/A = Not applicable

[1] Reference number is L-# for chemistry laboratory tests.
[2] NESTS Method Code, where applicable, as described on the EPA-NE DQO Summary Form or equivalent.
[3] Bioassay tests will be based on EPA test method 100.2, 100.4, 1000.0 and 1002.0.
[4] Geotechnical Test for porosity is calculated from the density and specific gravity results.

Fixed Laboratory Instrument Maintenance and Calibration Table

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference[1]
ICP-AES, ICP-MS	Metals	Daily sensitivity and stability checks	Initial: daily; Low level: daily, after initial Continuing: every 10 samples	Initial: r ≥ 0.995; Low level: %D ± 20% Continuing: %D ± 10%	Perform maintenance, Recalibrate, Prepare new standards; Reanalyze impacted samples	Analyst	L-1, L-2
IC	Anions	Daily sensitivity and stability checks	Initial: prior to analyzing samples; Continuing: every 10 samples	Initial: r ≥ 0.995 Continuing: ± 10%	Perform maintenance, Recalibrate, Prepare new standards; Reanalyze impacted samples	Analyst	L-4
CVAA	Mercury	Daily sensitivity and stability checks	Every batch of samples Each analysis batch Every 10 samples	Acceptable accuracy for reference standard Within 10% of true value Within 20% of expected value	Reprepare standards and samples Reprepare and reanalyze samples Reprepare and reanalyze all samples after last successful check	Analyst	L-3, L-16
GC/MS	PAHs	Daily sensitivity and stability checks	Initial: 5 point calibration of all analytes, prior to analyzing samples; Continuing: every 12 hours prior to the analysis of samples	Initial: r ≥ 0.99 Continuing: ± 20%	Perform maintenance, Recalibrate, Prepare new standards; Reanalyze impacted samples	Analyst	L-13

AES = Atomic Emission Spectrometry
CVAA = Cold Vapor Atomic Absorption
IC = Ion Chromatography
ICP = Inductively Coupled Plasma
MS = Mass Spectrometry

[1] See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).

Field Sampling QC Table

Sampling SOP	See FSP
Medium/Matrix	SED, SW
Analytical Parameter	All
Concentration Level	Low
Analytical Method/SOP Reference [1]	L-1 through L-18, L-21, L-23
Sampler's Name	TBD
Field Sampling Organization	AMEC
No. of Sample Locations	24 SED and 6 SW

Field QC:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Equipment Blanks/ Rinsate Blanks	Each day that decontamination is performed per equipment type	No target compounds ≥ QL	Resample and/or qualify data	Field Sampler and Data Validator	Accuracy/bias-Contamination	No target compounds ≥ QL
Cooler Temperature Blanks	Cooler temperature blanks are used. However, if a blank is not present the cooler temperatures are measured using an infrared temperature gun, or equivalent	4^{0}C, ± 2^{0}C, or as stated in Table 9-1	Resample and/or qualify data	Field Sampler and Data Validator	Accuracy/bias-Preservation	4^{0}C, ± 2^{0}C, or as stated in Table 9-1
Field Duplicate Pairs (Duplicate Subsamples)	10%	50% difference for soil; 30% difference for water (See Worksheet 22b)	Resample and/or qualify data	Field Sampler and Data Validator	Precision	50% difference for soil; 30% difference for water
Collocated Samples	10% when duplicates cannot be collected (e.g., surface water)	50% difference for soil; 30% difference for water (See worksheet 22b)	Resample and/or qualify data	Field Sampler and Data Validator	Precision	50% difference for soil; 30% difference for water
Field Splits	As requested by USACE-NAE, USEPA, and/or MassDEP (may be up to 10%)	In accordance with regulatory agency guidelines	Investigate cause of discrepancy between split sample results. Adjust sampling or analysis SOP to attain comparable sample results	Field Sampler or Analyst	Accuracy/bias and Precision	In accordance with regulatory agency guidelines

Field Sampling QC Table

Sampling SOP	See FSP
Medium/Matrix	SED, SW
Analytical Parameter	All
Concentration Level	Low
Analytical Method/SOP Reference [1]	L-1 through L-18, L-21, L-23
Sampler's Name	TBD
Field Sampling Organization	AMEC
No. of Sample Locations	24 SED and 6 SW

Field QC:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
PES sent to Laboratory	As needed, based on AMEC or regulatory request.	In accordance with PE acceptance limits	Investigate cause of non attainment of acceptable results. Adjust analysis SOP to attain accurate results	Analyst	Accuracy/bias	In accordance with PE acceptance limits
Matrix Spike / Matrix Spike Duplicates	1 per 20	In accordance with regulatory agency guidelines	Resample and/or qualify data	Field Sampler and Data Validator	Accuracy and Precision	In accordance with regulatory agency guidelines

[1] See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).

Sampling SOP See FSP
Analytical Method/SOP[1]: L-1 through L-18, L-21, L-23

Field Sampling QC Table cont.

Analyte	Field Precision as Measured by: <u>Duplicate Subsamples</u> or Collocated Samples (underline one)	Field Accuracy/Bias - (Contamination)
Surface water measurements	RPD $\leq$ 30%	< QL
Sediment measurements [2]	RPD $\leq$ 50%	< QL

RPD = Relative percent difference
QL = Quantitation limit

[1] See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).
[2] Sediment samples will be greater than 30% solids prior to analysis.

Fixed Laboratory Analytical QC Sample Table

Medium/Matrix	SED and SW
Sampling SOP	See FSP
Analytical Parameter	All
Concentration Level	Low/Medium
Analytical Method/ SOP Reference[1]	L-1, L-2, L-3, and L-16
Laboratory Name	All contract laboratories
No. of Sample Locations	24 SED, 6 SW

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	1/extraction batch	< QL	Locate source of contamination, correct problem, re-extract and analyze associated samples	Analyst	Accuracy/bias (contamination)	< QL
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the sequence	< QL	Locate source of contamination, correct problem, re-analyze calibration blank and previous ten samples	Analyst	Accuracy/bias (contamination)	< QL
Laboratory Duplicate	1/20 for inorganics	See worksheet 24b	Reanalyze or qualify data	Analyst	Precision	See worksheet 24b
Matrix Spike	1/20	See worksheet 24b	Evaluate sample concentration to verify that spiked amount is greater than 4x sample concentration. Reanalyze if analytical problem. Qualify data.	Analyst	Bias	See worksheet 24b
Matrix Spike Duplicates	1/20 for inorganics	See worksheet 24b	Evaluate sample concentration to verify that spiked amount is greater than 4x sample concentration. Reanalyze if analytical problem. Qualify data.	Analyst	Precision and Bias	See worksheet 24b

Fixed Laboratory Analytical QC Sample Table

Medium/Matrix	SED and SW
Sampling SOP	See FSP
Analytical Parameter	All
Concentration Level	Low/Medium
Analytical Method/ SOP Reference[1]	L-1, L-2, L-3, and L-16
Laboratory Name	All contract laboratories
No. of Sample Locations	24 SED, 6 SW

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Control Sample (LCS)	1/extraction batch	See worksheet 24b	Evaluate exceedance and impact on sample data. Re-extract batch if necessary	Analyst	Accuracy	See worksheet 24b
Method Detection Limit (MDL)	Annually	MDL must produce a response greater than 3 times the instrument noise level; using standard concentration within 3-5 times the anticipated MDL	Check for errors. Repeat MDL study, if necessary	Analyst	Sensitivity	MDL must produce a response greater than 3 times the instrument noise level
Instrument Detection Limit (IDL)	Quarterly	IDL must be ≤MDL	Check for errors. Repeat IDL, if necessary	Analyst	Sensitivity	IDL must be ≤MDL
Performance Evaluation (PE) Samples	As needed or requested	Within acceptance limits of USEPA or commercial vendor criteria	Qualify associated sample data	Data validator	Bias	Within acceptance limits of USEPA or commercial vendor criteria
Initial Calibration	Prior to analyzing	See worksheet 21	Perform maintenance; Re-calibrate;	Analyst		See worksheet 21

Fixed Laboratory Analytical QC Sample Table

Medium/Matrix	SED and SW
Sampling SOP	See FSP
Analytical Parameter	All
Concentration Level	Low/Medium
Analytical Method/ SOP Reference[1]	L-1, L-2, L-3, and L-16
Laboratory Name	All contract laboratories
No. of Sample Locations	24 SED, 6 SW

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
(ICAL)	samples		Prepare new standards		Accuracy	
Continuing Calibration verification (CCV)	After every 10 samples and at the end of an analytical sequence	See worksheet 21	Correct problem; re-run CCV. Repeat ICAL, if necessary. Re-analyze all samples since last successful ICAL or CCV.	Analyst	Accuracy	See worksheet 21
Independent Calibration Check (ICV) standard	Once after each initial calibration; prior to sample analysis	Within ± 10%	Correct problem and verify ICV. If that fails, repeat ICAL.	Analyst	Accuracy	Within ± 10%

[1] See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).

Fixed Laboratory Analytical QC Sample Table cont.

Medium/Matrix	SED
Sampling SOP	See FSP
Analytical Parameter	All
Concentration Level	Low/Medium
Analytical Method/ SOP Reference[1]	L-13
Laboratory Name	Alpha Analytical
No. of Sample Locations	24 SED

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1/extraction batch	< QL	Locate source of contamination, correct problem, re-extract and analyze associated samples	Analyst	Accuracy/bias (contamination)	< QL
Matrix Spike	1/20	See worksheet 24b	Evaluate sample concentration to verify that spiked amount is greater than 4x sample concentration. Reanalyze if analytical problem. Qualify data.	Analyst	Bias	See worksheet 24b
Matrix Spike Duplicates	1/20	See worksheet 24b	Evaluate sample concentration to verify that spiked amount is greater than 4x sample concentration. Reanalyze if analytical problem. Qualify data.	Analyst	Precision and Bias	See worksheet 24b
Laboratory Control Sample (LCS)	1/extraction batch	See worksheet 24b	Evaluate exceedance and impact on sample data. Re-extract batch if necessary	Analyst	Accuracy	See worksheet 24b

Fixed Laboratory Analytical QC Sample Table cont.

Medium/Matrix	SED
Sampling SOP	See FSP
Analytical Parameter	All
Concentration Level	Low/Medium
Analytical Method/ SOP Reference[1]	L-13
Laboratory Name	Alpha Analytical
No. of Sample Locations	24 SED

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Detection Limit (MDL)	Annually	MDL must produce a response greater than 3 times the instrument	Check for errors. Repeat MDL study, if necessary	Analyst	Sensitivity	MDL must produce a response greater than 3 times the
		noise level; using standard concentration within 3-5 times the anticipated MDL				instrument noise level
Surrogates	Added to all field samples and QC prior to extraction	Laboratory's in-house criteria	Correct problem then reprep and reanalyze samples.	Analyst	Accuracy	Laboratory's in-house criteria
Performance Evaluation (PE) Samples	As needed or requested	Within acceptance limits of USEPA or commercial vendor criteria	Qualify associated sample data	Data validator	Bias	Within acceptance limits of USEPA or commercial vendor criteria
Initial Calibration	Prior to analyzing	See worksheet 21	Perform maintenance; Re-calibrate;	Analyst	Accuracy	See worksheet 21

Sampling SOP: See FSP
Analytical Method/SOP [1]: L-2, L-3, L-21 (Metals in water by SW846 methods 6020A/7470A, and methyl mercury)

Fixed Laboratory Analytical QC Sample Table cont.

Analyte	Approximate Laboratory Sensitivity/ Quantitation Limits (ug/L)	Analytical Precision	Analytical Accuracy/Bias
Aluminum	50	RPD ≤ 30%	80 – 120
Arsenic	0.5	RPD ≤ 30%	80 – 120
Calcium	100	RPD ≤ 30%	80 – 120
Chromium	0.5	RPD ≤ 30%	80 – 120
Iron	50	RPD ≤ 30%	80 – 120
Lead	0.5	RPD ≤ 30%	80 – 120
Magnesium	100	RPD ≤ 30%	80 – 120
Manganese	0.5	RPD ≤ 30%	80 – 120
Mercury	0.2	RPD ≤ 30%	80 – 120
Methyl mercury	20 (ng/L)	RPD ≤ 30%	80 – 120
Nickel	0.5	RPD ≤ 30%	80 – 120
Sodium	100	RPD ≤ 30%	80 – 120
Zinc	5	RPD ≤ 30%	80 – 120

1 See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20)

Sampling SOP: See FSP
Analytical Method/SOP [1]: L-4 through L-12 (Water quality parameters in water)

Fixed Laboratory Analytical QC Sample Table cont.

Analyte	Approximate Laboratory Sensitivity/ Quantitation Limits (ug/L)	Analytical Precision	Analytical Accuracy/Bias
Chloride – method 300.0	500	RPD ≤ 30%	75-125
Nitrate – method 300.0	50	RPD ≤ 30%	75-125
Sulfate – method 300.0	1,000	RPD ≤ 30%	75-125
Ammonia, Nitrogen – method SM4500NH_3	75	RPD ≤ 30%	75-125
Nitrite – method SM4500NO_2	100	RPD ≤ 30%	75-125
Sulfide – method SM4500S^{-2}D	100	RPD ≤ 30%	75-125
Alkalinity – SM2320B	2,000	RPD ≤ 30%	75-125
Total Dissolved Solids – method SM2540C	10,000	RPD ≤ 30%	90-110
Total Suspended Solids – method SM2540D	5,000	RPD ≤ 30%	90-110
Total Organic Carbon – method 5310C	500	RPD ≤ 30%	75-125
Chemical Oxygen Demand – method 410.4	20,000	RPD ≤ 30%	75-125
Hardness – method SM2340B	2,000	RPD ≤ 30%	75-125

1 See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20)

Sampling SOP : See FSP
Analytical Method/SOP [1]: L-13 (PAHs in sediment by SW846 method 8270C SIM)

Fixed Laboratory Analytical QC Sample Table cont.

Analyte	Approximate Laboratory Sensitivity/ Quantitation Limits (mg/kg)	Analytical Precision	Analytical Accuracy/Bias
Naphthalene	0.013	RPD ≤ 50%	40-140%
2-Methylnaphthalene	0.013	RPD ≤ 50%	40-140%
Acenaphthylene	0.013	RPD ≤ 50%	40-140%
Acenaphthene	0.013	RPD ≤ 50%	40-140%
Fluorene	0.013	RPD ≤ 50%	40-140%
Phenanthrene	0.013	RPD ≤ 50%	40-140%
Anthracene	0.013	RPD ≤ 50%	40-140%
Fluoranthene	0.013	RPD ≤ 50%	40-140%
Pyrene	0.013	RPD ≤ 50%	40-140%
Benzo(a)Anthracene	0.013	RPD ≤ 50%	40-140%
Chrysene	0.013	RPD ≤ 50%	40-140%
Benzo(b)Fluoranthene	0.013	RPD ≤ 50%	40-140%
Benzo(k)Flouranthene	0.013	RPD ≤ 50%	40-140%
Benzo(a)Pyrene	0.013	RPD ≤ 50%	40-140%
Indeno(1,2,3-cd)Pyrene	0.013	RPD ≤ 50%	40-140%
Dibenzo(a,h)Anthracene	0.013	RPD ≤ 50%	40-140%
Benzo(g,h,i)Perylene	0.013	RPD ≤ 50%	40-140%

1 See Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20)

Project Documentation and Records Table

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records	Other ______
Field Notes	Equipment Calibration Logs	Sample Receipt, Custody, and Tracking Records	Field Sampling Audit Checklists	
COC Records	Equipment Maintenance, Testing, and Inspection Logs	Standard Traceability Logs	Fixed Laboratory Audit Checklists	
Air Bills	Corrective Action Forms	Instrument Calibration Logs	Data Validation Reports	
Sample Labels		Sample Preparation Logs	PE Results (if applicable)	
Custody Seals		Run Logs	QA Results (if applicable)	
Corrective Action Forms		Equipment Maintenance, Testing, and Inspection Logs	Corrective Action Reports	
Photographs		Non-Conformance Forms or Corrective Action Forms		
		Field Sample Results		
		Results for Standards, QC Checks, and QC Samples		
		Instrument Printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples		
		Sample Disposal Records		
		Electronic and/or hard copies of data reports		
		MDL study results		

Project Documentation and Records Table

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records	Other ________
		IDL study results		
		Initial demonstration of capability records		
		Training records		
		PE sample results (if applicable)		

Assessment and Response Actions

Types of assessment and response actions applicable to the project are summarized in the following paragraphs.

An initial systems audit of field procedures will be conducted by AMEC personnel. The purpose of these audits is to evaluate facilities, equipment, and processes to ensure conformance and acceptability to the standards specified in the FSP and QAPP.

Prior to laboratory selection, a systems audit will occur by review of the laboratory QA Manual, SOPs, and certifications, to ensure compliance with project quality objectives.

Laboratories may also analyze performance evaluation samples as part of the NELAP certification program and/or QA split samples. Other types of performance evaluation samples may be utilized on a case-by-case basis to assess the adequacy of a particular laboratory or method. The response actions for non attainment of satisfactory performance audit results are investigated into causes and implementation of corrective actions at the laboratory.

Project Assessment Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) responsible for performing assessment, title and organizational affiliation	Person(s) responsible for responding to assessment findings, title and organizational affiliation	Person (s) responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person (s) responsible for monitoring effectiveness of CA, title and organizational affiliation
Field Sampling Technical Systems Audit	At start of sampling and regularly thereafter	Internal	AMEC	Mike Robinson, AMEC Field Team Leader	AMEC Field Personnel	Mike Robinson, AMEC Field Team Leader	Mike Robinson, AMEC Field Team Leader
Fixed Laboratory Technical Systems Audit	Prior to award of contract	Internal	AMEC	Denise Ladebauche, AMEC Project Chemist	Contract laboratory QA Manager or Technical Operations Manager	Contract laboratory personnel (including QA personnel, analyst, section supervisors, etc.)	Denise Ladebauche, AMEC Project Chemist
NELAP Laboratory Validation Program	PE samples analyzed twice per year; inspection Every 2 years	External	NELAC	Accrediting Authority	Contract laboratory QA Coordinator or Technical Operations Manager	Contract laboratory QA Coordinator or Technical Operations Manager	Contract laboratory QA Coordinator or Technical Operations Manager
QA Split Sampling	Periodically	External	USACE-NAE	USACE-NAE Project Chemist	AMEC Project Chemist	Field or laboratory personnel	AMEC and field or subcontractor laboratory personnel
Performance Evaluation Samples	Periodically	Internal or External	AMEC or government agencies	AMEC or government agencies	Contract laboratory QA Coordinator or Technical Operations Manager	Contract laboratory QA Coordinator or Technical Operations Manager	Denise Ladebauche, AMEC Project Chemist

Project Assessment Plan

QAPP Title:	Draft Final Quality Assurance Project Plan, RI Workplan for AOC 72, Revision 0
Assessed Organization:	AOC 72 Field Program
Location of Assessment:	Devens, MA
Dates of Assessment:	TBD
Assessment Team Members:	Field Team Leader or Designee
Type of Assessment:	Technical Systems Audit
Assessment Scope:	Field activities including: sediment and surface water sampling procedures and associated tasks including equipment decontamination, field forms and logbook documentation, Chain of Custody process, and field monitoring instrument calibration.
Documents to be Reviewed:	Field Logbooks, field data sheets, COC forms
Notification Date(s):	N/A
Proposed Schedule:	See RI Workplan Section 3
Assessment No.:	N/A
Contract No.:	GS-10F-0230J

Project Assessment Plan

QAPP Title:	Draft Final Quality Assurance Project Plan, RI Workplan for AOC 72, Revision 0
Assessed Organization:	Analytical Chemistry Subcontract Laboratories
Location of Assessment:	AMEC, Westford, MA
Dates of Assessment:	Prior to award of contract.
Assessment Team Members:	Denise Ladebauche, Project Chemist
Type of Assessment:	Technical Systems Audit
Assessment Scope:	Review of laboratory capabilities and certifications.
Documents to be Reviewed:	Laboratory Quality Assurance Manual, Laboratory SOPs, NELAP certification records
Notification Date(s):	N/A
Proposed Schedule:	Prior to contract award
Assessment No.:	N/A
Contract No.:	GS-10F-0230J

Project Assessment Plan

QAPP Title:	Draft Final Quality Assurance Project Plan, RI Workplan for AOC 72, Revision 0
Assessed Organization:	Analytical Chemistry, Geotechnical, Bioassay and Benthic Community Analysis Data Validation and Review
Location of Assessment:	AMEC, Westford, MA
Dates of Assessment:	As each laboratory or geotechnical data report is generated and reported.
Assessment Team Members:	Data Validator (Chemistry), Data User (Geotechnical, Bioassay and Benthic Community Analysis)
Type of Assessment:	Chemistry data audit
Assessment Scope:	Data Validation according to USEPA CLP National Functional Guidelines for Inorganic Data Review (USEPA, 2004), USEPA CLP National Functional Guidelines for Organic Data Review (USEPA, 1999), and USEPA -New England Data Validation Functional Guidelines for Evaluating Environmental Analyses (USEPA, 1996). Data review will be reviewed for overall completeness and representativeness.
Documents to be Reviewed:	Analytical chemistry data packages for metals, water quality parameters, geotechnical, bioassay, and benthic survey.
Notification Date(s):	N/A
Proposed Schedule:	TBD
Contract No.:	GS-10F-0230J

QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation, Title and Organizational Affiliation	Report Recipients, Title and Organizational Affiliation
Data Validation Reports	As data is generated and reported	See RI Workplan Section 3 for project schedule	AMEC Data Validator	Marc Grant, AMEC Project Manager or key technical resource lead for study area
Final Project Reports	As data is compiled and interpreted	See RI Workplan Section 3 for project schedule	AMEC Project Manager	USACE-NAE, USEPA, MassDEP

Data Verification Process

Verification Task	Description	I/E	Responsible for Verification (Name, Organization)
Sample collection	The field sampler will verify that chain of custody forms are filled out accurately and completely. Sample identifications will be verified. The designed laboratory and method of analysis will be verified against the task work plan specifications.	I	Field Samplers
Sample receipt	Upon receipt at the laboratory, the sample custodian verifies that sample preservation and volume is satisfactory for the designated analysis. The sample custodian notifies the laboratory project manager if any inconsistencies or deficiencies are noted in the samples upon receipt.	E	Laboratory Sample Custodians
Sample preparation	The sample preparation technician verifies that the sample is in satisfactory condition for extraction/digestion procedures. Notes are taken on unusual color or condition of samples. The laboratory project manager is notified of any significant issues with the sample.	E	Laboratory Sample Preparation Technicians
Sample analysis	The analyst verifies that sample results and QC are satisfactory and consistent. Analysis anomalies are noted in the data package. The section supervisor and/or laboratory project manager are notified of any QC deficiencies.	E	Laboratory Analyst
Data review	Chemistry data review is performed in a three stage process by 1) analyst 2) peer review (analyst or section supervisor) and 3) laboratory project manager (completeness, report narrative review).	I/E	Laboratory Analyst, Peer, Laboratory Project Manager

I = Internal
E = External

Data Validation Summary Table

Medium/ Matrix	Analytical Parameter	Concentra-tion Level	Validation Criteria	Validation Criteria Modified	Data Validation Tier Level	Modified Tier Level Used[1]	Data Validator (Name, title and organizational affiliation)	Responsibility for Data Validations (Name, title and organizational affiliation)
SED/SW	Metals; water quality parameters;	Low	USEPA CLP National Functional Guidelines and USEPA-NE Region 1 Data Validation Functional Guidelines	Y [1]	II	N	Data validator, AMEC, Westford, MA	Senior Chemist, AMEC, Westford, MA
SED	PAHs	Low	USEPA CLP National Functional Guidelines and USEPA-NE Region 1 Data Validation Functional Guidelines	Y [1]	II	N	Data validator, AMEC, Westford, MA	Senior Chemist, AMEC, Westford, MA
SED	Bioassay Tests	N/A	Overall review of laboratory practices in accordance with EPA SOPs and data usability	N/A	N/A	N/A	Risk Assessors, AMEC, Westford, MA	N/A
SW	Toxicity Tests	N/A	Overall review of laboratory practices in accordance with EPA SOPs and data usability	N/A	N/A	N/A	Risk Assessors, AMEC, Westford, MA	N/A
SED	Benthic Community Analysis	N/A	Overall review of good laboratory practices and data usability	N/A	N/A	N/A	Risk Assessors, AMEC, Westford, MA	N/A
SED	Geotechnical measurements	N/A	Overall review of good laboratory practices and data usability	N/A	N/A	N/A	Geologist, AMEC, Westford, MA	N/A

[1]The most recent revision of the USEPA CLP National Functional Guidelines and the Region I, USEPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses will be used to validate project data, as modified to incorporate SW846 (and other non-CLP) methods to incorporate criteria specified in the individual methods.

Data Validation Modifications

Data Validation modifications from the Region I, USEPA-NE Data Validation Functional Guidelines follow:

For SW846 and USEPA water quality methods, data validation criteria will be adjusted to accommodate method and laboratory requirements. QC acceptance limits are summarized in Worksheet 24b.

Data Usability Assessment

Data usability is typically performed by the project manager, with recommendations or input by the project chemist, data validator, or other team member when data are compiled and viewed from an overall project perspective. Typical data usability assessment details follow:

Precision: If poor overall precision of data is observed, it may be an indication of poor sampling technique, field sample non-homogeneity, sample transport problems, or analytical methodology variations. For sample non-homogeneity issues, data must be interpreted accordingly (i.e., more representative concentrations may be obtained from averaging sample concentrations over an appropriately sized area of concern). If poor precision is related to sampling techniques, transport, or methodology phenomena (such as poor sample extraction efficiencies) causes and corrective actions will be taken.

Accuracy/bias: If poor overall accuracy of data is observed, the cause may be related to sampling techniques, sample transport problems, sample matrix, or analytical methodology limitations. Positive or negative biases can be caused by poor sampling techniques such as ineffective decontamination procedures or use of inappropriate sample containers or preservation procedures. Improvements in sampling techniques must be taken to correct these deficiencies. Poor accuracy can also be attributed to matrix effects (evidenced by poor recovery of spiked analytes) or by methodology limitations (e.g., poor extraction efficiency). If this phenomenon is observed, investigations into modifications to improve the accuracy of analytical SOPs will be made.

Representativeness: Lack of representativeness among samples is observed by poor precision of sample duplicates, from samples in close proximity, or from samples collected at various time intervals (e.g., long term groundwater monitoring programs). If field duplicate precision indicates that spatial variability is an issue, additional scoping meetings or subsequent re-sampling may be warranted.

Comparability: Lack of comparability among samples may be attributed to differences in sampling techniques, analytical protocols, or reporting procedures. If different field personnel collect samples, an evaluation of the consistency in protocols will be performed. If samples are analyzed by different analytical methodologies, an evaluation of possible sources of discrepancies will be undertaken. If split samples are collected and analyzed at independent laboratories, an investigation into possible inconsistencies between procedures will be investigated. Reporting procedures will be reviewed to verify that results are reported on the same unit basis (e.g., dry weight basis for soil).

Completeness: Data completeness is determined based on the number of usable data points compared to the number of samples collected for a specific matrix and method. Lack of completeness for samples may be attributed to sample transport issues (i.e., breakage of samples) or laboratory issues (i.e., poor quality control resulting in rejection of data). If data completeness goals (90%; 100% for critical data points) are not met, causes of failure will be determined and corrective action measures will be taken.

Sensitivity (Quantitation Limits (QL), Method Detection Limits (MDLs)): Laboratory sensitivity (quantitation limits) must be adequate to achieve project objectives (comparison to applicable regulatory standards). Laboratory quantitation limits are set at the lowest calibration standard. Method detection limits are performed annually to statistically determine the lowest limit of detection achievable for a specific matrix and methodology. Methods are chosen based on their ability to achieve project sensitivity objections. Laboratory sensitivity may be adversely impacted if sample interferences are present, resulting in sample dilutions which raise the QL. Investigations into the source of interferences and their removal from sample extracts will be undertaken if this situation occurs.

Overall Evaluation: An overall evaluation of the laboratory data will be made to interpret the data from a general perspective. Lack of consistency between data points in an overall evaluation may be attributed to sample collection issues (such as improper preservation, cross contamination, ineffective decontamination) or analytical methodology limitations (ineffective extraction efficiency, cross contamination, presence of interferences, etc.). If outlier data points are apparent from a general overall evaluation, further investigations into causes will be made. Project report narratives will highlight possible anomalous data points, including discussing possible causes and corrective actions.

Appendix B

Laboratory Standard Operating Procedures

(See EPA-NE QAPP Worksheet #20 – Fixed Laboratory Analytical Method/SOP Reference Table for list of SOPs included)

Note: Laboratory Standard Operating Procedures and Certifications will be provided on a compact disk following laboratory selection and contracting.

Appendix C

Relevant EPA Guidance Documents

1. Region I Tiered Organic and Inorganic Data Validation Guidelines, July 1, 1993

REGION I

TIERED ORGANIC AND INORGANIC DATA VALIDATION GUIDELINES

JULY 1, 1993

INTRODUCTION

Historically, Region I has required that analytical data for Superfund sites undergo full validation according to the Region I Laboratory Data Validation Functional Guidelines documents.

Full validation, however, does not always meet the Data Quality Objectives (DQOs) for each site activity, and it can contribute to high costs and missed deadlines. To address this problem, Region I's Environmental Services Division (ESD) has created a tiered approach to data validation which accomplishes the following:

- o enables data users to select the level of validation necessary to meet their DQOs
- o saves time and money
- o promotes consistent evaluation of data quality between Superfund sites

Three tiers have been established and are described in the next section. Tier III is equivalent to the full validation currently performed in Region I, and includes the procedures performed under Tiers I and II.

TIERED APPROACH TO DATA VALIDATION

The inorganic and organic data validation process can be broken down into three distinct levels: Tier I, Tier II, and Tier III.

Tier I: A completeness evidence audit is performed to ensure that all laboratory data and documentation are present. Completeness evidence audits are performed in accordance with procedures contained in the Region I CSF Completeness Evidence

Audit Program, dated 7/3/91. (This document is the currently used procedure as referenced in the memorandum titled "Region I CSF Completeness Evidence Audit Program" from the Region I CLP-TPOs to Region I Contractors, dated 7/7/91.)

Tier II: A Tier I completeness evidence audit is performed, and, in addition, the results of all Quality Control (QC) checks and procedures are evaluated and used to assess and qualify sample results. Tier II data validation is performed primarily from information contained on the tabulated data reporting forms. It has been estimated by ESD that Tier II validation takes 50% of the time required to perform a Tier III validation.

Tier III: A full data validation is performed. Tier III includes Tier I and Tier II procedures plus an in-depth examination of all raw data to check for technical, calculation, analyte identification/analyte quantitation, and transcription errors. Tier III data validation is performed in accordance with the Region I CSF Completeness Evidence Audit Program and the Region I Laboratory Data Validation Functional Guidelines.

At a minimum, all data should be carried through Tiers I or II. Tier I is mandatory, regardless of the immediate intended use of the data, to ensure that all laboratory documents have been obtained for future data validation, potential litigation, and/or to defend site decisions. Validation requirements must always be documented in an approved QAPP prior to sampling. Several examples of when a Tier I or Tier II validation may suffice to meet DQOs are as follows:

- Design run data which are collected during a treatability study. Data used to support the final design parameters, however, should undergo Tier III validation.

- Long-term monitoring data which have only "minimal changes" in constituent concentrations from the previous round. The magnitude of these allowable changes, as well as the procedures to be followed if QAPP requirements are not met, must be documented in an approved QAPP prior to sampling. (If QAPP requirements are not met, a Tier II or Tier III validation should be performed.)

- EPA oversight split data which "compare well" with PRP data. The comparison criteria, as well as procedures to be followed if QAPP requirements are not met, must be documented in an approved QAPP prior to sampling. (If QAPP requirements are not met, a Tier II or Tier III validation should be performed.)

Full validation (Tier III) can always be performed at a later date as long as Tiers I or II have been initially completed. The entire data package (Tier III) or just individual parameters, matrices, sample locations, and/or risk compounds (partial Tier III) could then be specified for full validation. If a subset of the entire data package was targeted for full validation, then a Tier II validation would be performed on the entire data package (if it hadn't already) and a partial Tier III validation would be performed for individual parameters, etc. (whatever was to comprise the subset validation). The <u>first paragraph</u> of the data validation memorandum must explicitly document the level of validation performed, i.e. Tier II plus partial Tier III validation for benzene, Tier II plus partial Tier III validation for sample location MW-100, Tier II plus partial Tier III validation for volatile organics, etc.

In certain circumstances, full validation (Tier III) may be deemed necessary from the start of a project. Several examples of when full validation is needed are as follows:

- Only one set of data for a particular sample location, type and/or parameter is available and a decision of whether to remediate will be based on this sample. An example of this is background data.

- The data will be used to define a critical site boundary.

- The data will be used to determine compliance with clean-up goals.

TIER II DATA VALIDATION PROCEDURE

To perform a Tier II data validation, a Tier I review is completed and the results of all QC checks and procedures are evaluated and used to assess and qualify sample results. During a Tier II review, the raw data for field samples and QC checks are not evaluated (with a few exceptions, i.e. pH check for volatile organics, metals, and cyanide to verify proper sample preservation). The goal is to validate data using information contained mainly on the tabulated data reporting forms and chain-of-custody (COC) forms. Tier II assumes that all results are reported by the laboratory and that all reported results are correct.

Prior to performing a Tier II validation, conduct the Tier I completeness evidence audit according to the requirements contained in the Region I CSF Completeness Evidence Audit Program, dated 7/3/91, and request the missing deliverables from the laboratory. Begin the Tier II validation while waiting for any missing deliverables.

To perform a Tier II inorganic validation, the reviewer must have all data reporting forms for field sample and QC sample results (Forms I through XIV), as well as the COC forms in the data package. Validation is performed according to requirements contained in the attached table (Attachment I) and in conjunction with the Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, dated 6/13/88 (modified 2/89). This guidance is also applicable to inorganic analyses performed in accordance with the ILM01.0, ILM02.0, and ILM03.0 versions of the U.S. EPA CLP Statement of Work (SOW). Tier II reporting and deliverable requirements are the same as those for full validation (Tier III); only the actual validation procedures contained in Section 3 of the Region I Functional Guidelines have been modified to minimize examination of the raw data and to eliminate the recalculation of results.

To perform a Tier II organic validation, the reviewer must have all data reporting forms for field sample and QC sample results (Forms I through X), as well as the COC forms in the data package. Validation is performed according to guidance contained in the attached table (Attachment II) and in conjunction with the Region I Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, dated 2/1/88 (modified 11/1/88). This guidance is also applicable to organics analyses performed in accordance with the OLM01.0 SOW, even though the 11/1/88 Region I Functional Guidelines document has not yet been modified to accomodate pesticide/PCB method changes contained in the OLM01.0 SOW. Tier II reporting and deliverable requirements for data validation are the same as for full validation (Tier III); only the actual validation procedures contained in Sections 3 and 4 of the Region I Functional Guidelines have been modified to minimize examination of the raw data and to eliminate the recalculation of results.

The results for each QC parameter, specified in Attachments I and II, must be evaluated using the data reporting forms provided by the laboratory. The data provided on the forms are not verified with the raw data. Information contained on the forms should be used to verify that QC samples were analyzed with the correct analytes at the proper frequency and concentration, that the QC limits were met, and required corrective actions were taken. The QC parameters of System Performance and Compound Identification for the volatile and semivolatile fractions are not evaluated during the Tier II review as it would require that a substantial review of the raw data be performed.

As a result of the Tier II evaluation, the field sample results may be accepted, qualified as estimated, or rejected. <u>In circumstances where the entire data package or data for multiple samples must be rejected or will be significantly qualified based upon the Tier II results, the reviewer must first consider the impact of rejected results and/or discrepant information on the data needs of the specific project. If the data are critical to the project needs, then examination of the raw data is strongly recommended to prevent faulty site decisions based on technical, transcription, and/or calculation errors. The EPA Remedial Project Manager (RPM) or Site Assessment Manager (SAM) must be contacted to approve a partial or complete Tier III validation prior to its initiation</u>. If the RPM or SAM decides that no further validation is warranted based on the objectives of the sampling event and the nature of the data qualification, then the reviewer should document this decision in the <u>first paragraph</u> of the data validation (DV) memorandum. The nature of the data problem, the extent of data qualification, and the level of validation performed must also be documented in the DV memorandum. It is expected that raw data review might be required more frequently for pesticide/PCB data, since identification and quantitation of pesticides and PCBs is based solely on gas chromatography data with no mass spectral confirmation/quantitation.

The attached tables, Attachment I (Tier II Inorganic Data Validation) and Attachment II (Tier II Organic Data Validation), consist of four columns which identify the specific QC criteria to be checked, the laboratory reporting form(s) to review, the specific sections of the Region I Functional Guidelines to follow, and the adjustments needed for the specific sections of the Region I Functional Guidelines to perform a Tier II validation.

ATTACHMENT I

TIER II INORGANIC DATA VALIDATION

TIER II INORGANIC DATA VALIDATION

QC CRITERIA	DATA REPORTING FORMS TO REVIEW	APPLICABLE SECTIONS IN FUNCTIONAL GUIDELINES[3]	COMMENTS
Data Completeness	! Complete SDG File (CSF) 1. Original Sample Data Package including Cover Page, Forms I through XIV, DC-1, DC-2, raw data 2. Original shipping and receiving documents 3. All original lab records of sample transfer, preparation and analysis, as well as telephone contact logs.	! I., p. 21	! Perform a Tier I completeness evidence audit according to procedures in the Region I CSF Completeness Evidence Audit Program, dated July 3, 1991, to ensure that all laboratory data and documentation are present. Request missing deliverables from the laboratory following appropriate procedures.
Holding Times	! Forms I, XIII, XIV ! Chain-of-Custody/Traffic Report ! Sample Digestion/Distillation Logs	! II. A through D, pp. 21-22	! Examine Chain-of-Custody/Traffic Report Forms to determine if samples were properly preserved in the field. ! To verify sample pH upon laboratory receipt, review sample digestion logs as this information is not included on the forms.
Calibration	! Forms IIA, IIB, XIV	! III. A through B, pp. 22-23 C.1-3, pp. 23-24 C.5 and 6, p. 24 C.8 and 9, p. 24 D.1-3, pp. 24-25 D.5-8, pp. 25-26	! Calibration correlation coefficients for AA, Hg, and CN are not reviewed since this information is not included on the forms.
Blanks	! Forms I, III, X, XIII, XIV ! Chain-of-Custody/Traffic Report	! IV. A through D, pp. 26-28	! Review data reporting forms only. Do not verify with raw data.
ICP Interference Check Sample	! Forms I, IV, X, XI, XIV	! V. A through B, p. 28 C.1 and 2, p. 28 C.4, p. 29 D, pp. 29-31	! Review data reporting forms only. Do not verify with raw data. ! Paragraph C.4: For evidence of results with an absolute value >2xIDL for those analytes which are not present in the ICS A solution, evaluate Form IV. Do not check the raw data.

SEE NOTE ON PAGE 3 OF 3.

[3]REGION I LABORATORY DATA VALIDATION FUNCTIONAL GUIDELINES FOR EVALUATING INORGANICS ANALYSES, 6/13/88, MODIFIED 2/89

TIER II INORGANIC DATA VALIDATION

QC CRITERIA	DATA REPORTING FORMS TO REVIEW	APPLICABLE SECTIONS IN FUNCTIONAL GUIDELINES[3]	COMMENTS
Matrix Spike Sample Analysis	! Forms VA, VB, XIII ! Chain-of-Custody/Traffic Report	! VI. A through B, pp. 31-32 C.1, p. 32 C.3-5, p. 32 D, pp. 32-33	! Review data reporting forms only. Do not verify with raw data. ! Review Chain-of-Custody/Traffic Report Forms to verify that samples identified as field blanks are not used for spiked sample analysis.
Laboratory Duplicate Sample Analysis	! Forms VI, XIII ! Chain-of-Custody/Traffic Report	! VII. A through B, p. 33 C.1, p. 33 C.3 and 4, p. 34 D, p. 34	! Review data reporting forms only. Do not verify with raw data. ! Review Chain-of-Custody/Traffic Report Forms to verify that samples identified as field blanks are not used for duplicate sample analysis.
Field Duplicates	! Form Is ! Chain-of-Custody/Traffic Report	! VIII. A through D, pp. 34-35	! No change from current procedures.
Laboratory Control Sample Analysis (LCS)	! Forms VII, XIII	! IX. A through B, p. 35 C.1, p. 35 C.3, p. 36 D, p. 36	! Review data reporting forms only. Do not verify with raw data.
Furnace Atomic Absorption Analysis	! Forms I, VIII, XIII, XIV	! X. A through B, p. 37 C.1 and 2, p. 37 C.4, p. 37 D, pp. 37-38	! Review data reporting forms only. Do not verify with raw data. ! Review Form Is for the presence/absence of "M" flags indicating the failing/passing of the duplicate injection precision criteria for field samples. ! Do not verify post-digestion spike recoveries reported on Form XIV with the raw data. ! To verify that the Furnace Atomic Absorption Analysis Scheme was followed, evaluate Form XIV for spike recoveries not within 85-115%, initial and reanalyses, and dilution factors. In addition to Form XIV, evaluate Form I for sample concentrations to verify that an MSA analysis was not required for any result quantitated directly from the calibration curve and for which spike recoveries were not within 85-115%.
ICP Serial Dilution Analysis	! Forms IX, X, XIV	! XI. A through B, pp. 38-39 C.1, p. 39 C.3, p. 39 D, p. 39	! Review data reporting forms only. Do not verify with raw data. ! Paragraph C.3: For evidence of negative interference, evaluate Form IX. Do not check the raw data.

SEE NOTE ON PAGE 3 OF 3.

[3]REGION I LABORATORY DATA VALIDATION FUNCTIONAL GUIDELINES FOR EVALUATING INORGANICS ANALYSES, 6/13/88, MODIFIED 2/89

TIER II INORGANIC DATA VALIDATION

QC CRITERIA	DATA REPORTING FORMS TO REVIEW	APPLICABLE SECTIONS IN FUNCTIONAL GUIDELINES[3]	COMMENTS
Detection Limits	! Forms I, X, XIII, XIV	! XII. A through D, pp. 39-40	! Paragraph C.3: To verify that sample weights, volumes, and dilutions are taken into account when reporting sample quantitation limits, evaluate Forms I, X, XIII, and XIV.
Sample Result Verification	! Forms I, XII, XIII, XIV	! XIII. A through B, pp. 40-41 C.3, p. 41 D, p. 41	! Review data reporting forms only. Do not verify with raw data. ! For any result reported on Form I for which the sample result is greater than the linear range for ICP (Form XII) and greater than the calibrated range for non-ICP parameters (Form XIV), verify that the result was reported from a diluted sample analysis (Form XIV) and that the diluted sample result falls within the respective ranges. Dilution and preparation factors are found on Forms XIII and XIV. Do not check the raw data.
Overall Assessment of Data for a Case		! XIV., p. 42	! Limit to the sections evaluated during Tier II review.

NOTE: IN CIRCUMSTANCES WHERE THE ENTIRE DATA PACKAGE OR DATA FOR MULTIPLE SAMPLES MUST BE REJECTED OR WILL BE SIGNIFICANTLY QUALIFIED BASED UPON THE TIER II RESULTS, THE REVIEWER MUST FIRST CONSIDER THE IMPACT OF REJECTED RESULTS AND/OR DISCREPANT INFORMATION ON THE DATA NEEDS OF THE SPECIFIC PROJECT. IF THE DATA ARE CRITICAL TO THE PROJECT NEEDS, THEN EXAMINATION OF THE RAW DATA IS STRONGLY RECOMMENDED TO PREVENT FAULTY SITE DECISIONS BASED ON TECHNICAL, TRANSCRIPTION, AND/OR CALCULATION ERRORS. THE EPA REMEDIAL PROJECT MANAGER (RPM) OR SITE ASSESSMENT MANAGER (SAM) MUST BE CONTACTED TO APPROVE A PARTIAL OR COMPLETE TIER III VALIDATION PRIOR TO ITS INITIATION.

[3]REGION I LABORATORY DATA VALIDATION FUNCTIONAL GUIDELINES FOR EVALUATING INORGANICS ANALYSES, 6/13/88, MODIFIED 2/89

ATTACHMENT II

TIER II ORGANIC DATA VALIDATION

TIER II ORGANIC DATA VALIDATION

QC CRITERIA	DATA REPORTING FORMS TO REVIEW	APPLICABLE SECTIONS IN FUNCTIONAL GUIDELINES[3]	COMMENTS
Data Completeness	! Complete SDG File (CSF) 1. Original Sample Data Package including Cover Page, Forms I through X, DC-1, DC-2, raw data 2. Original shipping and receiving documents 3. All original lab records of sample transfer, preparation and analysis, as well as telephone contact logs.		! Perform a Tier I completeness evidence audit according to procedures in the Region I CSF Completeness Evidence Audit Program, dated July 3, 1991, to ensure that all laboratory data and documentation are present. Request missing deliverables from the laboratory following appropriate procedures.
Holding Times VOA & SVOA	! Form Is ! Chain of Custody / Traffic Report ! SDG Narrative	! I. A through D, pp. 21-22	! Examine Chain-of-Custody/Traffic Report Forms to determine if samples were properly preserved in the field. ! To verify sample pH upon laboratory receipt, review the SDG Narrative as this information is not included on the forms.
Pest/PCB		! I. A through D, p. 48	
GC/MS Tuning VOA & SVOA	! Form Vs	! II. A through B, pp. 22-23 C.3.a and c, p. 23 D, pp. 24-26	! Review data reporting forms only. Do not verify with raw data and do not recalculate reported values.
Calibration VOA & SVOA	! Forms IV, VI, VII	! III. A through B, pp. 26-27 C.1.a.2, p. 27 C.1.b.2, p. 28 C.2.a.1, p. 28 C.2.b.2, p. 29 D, pp. 29-30	! Review data reporting forms only. Do not verify with raw data. Do not recalculate %RSD, RRF or %D values. ! Review Form IV to determine the samples associated with each calibration.
Instrument Performance/Calibration Pest/PCB	! Forms VI, VII, VIII, IX	! II. A, p. 49 B.1-4, pp. 49-51 C through D, pp. 51-54 ! III. A through B, pp. 54-55 C.1.c and e, pp. 55-56 C.2, p. 56 D, p. 56	! Review data reporting forms only. Do not verify with raw data and do not recalculate reported values.

SEE NOTE ON PAGE 3 OF 3.

[3]**REGION I LABORATORY DATA VALIDATION FUNCTIONAL GUIDELINES FOR EVALUATING ORGANICS ANALYSES, 2/1/88, MODIFIED 11/1/88**

TIER II ORGANIC DATA VALIDATION

QC CRITERIA	DATA REPORTING FORMS TO REVIEW	APPLICABLE SECTIONS IN FUNCTIONAL GUIDELINES[3]	COMMENTS
Blanks VOA & SVOA	! Forms I, IV ! Chain of Custody / Traffic Report	! IV. A through B, p. 30 C.2, pp. 30-31 D, pp. 31-33	! Review data reporting forms only. Do not verify with raw data.
Pest/PCB		! IV. A through B, p. 57 C.2 and 3, p. 57 D, pp. 57-59	
Surrogate Recovery VOA & SVOA	! Form IIs	! V. A through B, pp. 33-34 C.2.a-c, p. 34 C.3.a-c, p. 34 D, pp. 34-35	! Review data reporting forms only. Do not verify with raw data.
Pest/PCB		! V. A through B, p. 59 D, pp. 59-60	
Matrix Spike & Matrix Spike Duplicate VOA & SVOA	! Forms I, III	! VI. A through B, pp. 35-36 C.1 and 3, p. 36 D, pp. 36-37	! Review data reporting forms only. Do not verify with raw data.
Pest/PCB		! VI. A through B, p. 60 C.1 and 3, pp. 60-61 D, p. 61	
Field Duplicates VOA & SVOA	! Form Is ! Chain of Custody / Traffic Report	! VII. A through D, pp. 37-38	! No change from current procedures.
Pest/PCB		! VII. A through D, pp. 61-62	
Internal Standards Performance VOA & SVOA	! Form VIIIs	! VIII. A through B, p. 38 C.2 and 3, p. 38 D, pp. 38-39	! Review data reporting forms only. Do not verify with raw data.
Compound Identification VOA & SVOA	—	—	! Not evaluated during Tier II review.
Pest/PCB	! Forms I, X	! VIII. A, B, pp. 62, 63 C, D, pp. 63, 64	! Review data reporting forms only. Do not verify with raw data.

SEE NOTE ON PAGE 3 OF 3.

[3]REGION I LABORATORY DATA VALIDATION FUNCTIONAL GUIDELINES FOR EVALUATING ORGANICS ANALYSES, 2/1/88, MODIFIED 11/1/88

Appendix D

AMEC Earth and Environmental Personnel Resumes

(See EPA-NE QAPP Worksheet #6 – Personnel Responsibilities and Qualifications Table for list of resumes included)

Mark R. Applebee

Senior Project Manager

Professional Summary

Mr. Applebee has 18 years of program, project and technical management experience related to Environmental and Engineering projects. He has managed environmental projects conducted under CERCLA and Federal and State environmental regulations throughout New England. He has developed a broad background in the planning and implementation of site investigations, remedial investigations and feasibility studies, remedial design and remedial action projects. He has planned and executed Emergency Actions, Time-Critical and Non-Time Critical Removal Actions under CERCLA and Immediate Response Actions and Release Abatement Measures under the Massachusetts Contingency Plan. Mr. Applebee has negotiated highly controversial Records of Decision with regulatory agencies and presented the information, conclusions and recommendations of investigations and studies at public meetings. He has worked extensively with Federal Agencies, including the U.S. Army Corps of Engineers, Department of the Army, EPA, Federal Emergency Management Agency, and the U.S. Fish and Wildlife Service.

Professional Qualifications

Engineer in Training, 1987

OSHA 40-Hour and OSHA 8-Hour Supervisor, Hazardous Waste Site Training

CPR and First Aid Training

Education

B.S., Civil Engineering, University of New Hampshire, 1988

Memberships

Society of American Military Engineers (SAME)

Languages

English

Location

Westford, Massachusetts

Summary of Core Skills

Program Management – Federal Projects

Mr. Applebee served as program manager for a $10 million annual environmental restoration program involving projects throughout New England. Responsibilities included establishing program priorities, annual and 5-year budgets, and quarterly reporting of program execution.

Environmental Investigations and Remediation

Mr. Applebee has designed, managed and implemented a wide range of environmental projects from initial investigations to remediation and operation and maintenance activities. The majority of the efforts were federally funded projects conducted under a variety of Federal Programs, including Superfund, Base Realignment and Closure (BRAC), Installation Restoration Program (IRP), and Formerly Used Defense Sites (FUDS). Several of these projects involved utilization of innovative technologies, including soil vapor extraction, asphalt batching, monitored natural attenuation, and *in situ* chemical reduction.

Environmental Management

Mr. Applebee has experience in a wide variety of environmental management projects. He has prepared spill contingency plans and integrated natural resource management plans (INRMP) for the Department of the Army. The INRMP addressed the appropriate management of natural resources in concert with military training within a 5,000-acre impact area and training ranges.

Munitions and Explosives of Concern (MEC)

Mr. Applebee has managed several projects involving MEC identification, avoidance and/or removal. He managed planning efforts for a comprehensive Feasibility Study for MEC encompassing 14,000 acres at the Camp Edwards Impact Area and Training Ranges. Mr. Applebee has implemented projects involving small arms ranges remediation, MEC avoidance activities associated with investigations and remediation, and MEC detection, identification and removal within water bodies. He has completed a USACE sponsored MEC training course.

Employment History

2004 – Pres.:	Program Manager, AMEC Earth & Environmental, Westford, MA
2000 – 2004:	Senior Project Manager, AMEC Earth & Environmental, Westford, MA
1990 – 2000:	Project Manager, U.S. Army Corps of Engineers, New England District, Concord, MA
1989 – 1990:	Structural Engineer, U.S. Army Corps of Engineers, New England District, Concord, MA
1989 – 1992:	Temporary Assignment, Federal Emergency Management Agency. Voluntary deployments to Charleston, SC, AL, and New England to support federal disaster recovery efforts after natural disasters.
1988 – 1989:	Training Program, U.S. Army Corps of Engineers, New England District, Concord, MA
1987 – 1988:	Engineer Technician, Cold Regions Research and Engineering Laboratory, Lyme, NH

Detailed Skills by Representative Project

Comprehensive Site Assessment/Corrective Actions Alternatives Analysis, Shepley's Hill Landfill, USACE New England District, Former Fort Devens, MA. (Ongoing, $550,000, 321060116) Program Manager for Comprehensive Site Assessment/Corrective Actions Alternatives Analysis at an 84-acre solid waste landfill conducted under CERCLA and state solid waste regulations. Work includes landfill cap assessment, groundwater and surface water investigation, human health and ecological risk assessment, and feasibility study.

Operation and Maintenance, Massachusetts Military Reservation, Army Environmental Center and USACE New England District, Camp Edwards, MA. (Ongoing, $750,000, 575240001) Team member to ECC. Technical Manager for the operation and maintenance of two groundwater treatment systems at the Massachusetts Military Reservation. Prepared and submitted monthly and annual reports summarizing the O&M activities and treatment system performance.

Remedial Actions, Massachusetts Military Reservation, USACE and National Guard Bureau, Camp Edwards, MA. (Ongoing, $50M, 276225018) Project manager for Remedial Investigation, Feasibility Study, Remedial Design, Remedial Action and Operation and Maintenance (O&M)

activities at Demolition Area 1 (Demo 1) at the Massachusetts Military Reservation. Mr. Applebee managed the planning and design of interim remedial actions for the soil and groundwater operable units at the former open burn/open detonation (OB/OD) area. The groundwater interim action consisted of extraction, treatment and recharge of groundwater contaminated with explosives (RDX, HMX, TNT) and propellants (Perchlorate and 2,4-DNT). Groundwater treatment systems were constructed to treat 320 gallons per minute at two locations along the longitudinal axis of the two-mile long plume. The systems consist of granular activated carbon (GAC) and ion exchange media to efficiently remove the contaminants. Mr. Applebee managed the development of a System Performance and Environmental Impact Monitoring (SPEIM) and Operation and Maintenance Plans for the groundwater operable unit. The purpose of the SPEIM Plan was to establish performance monitoring objectives relative to the treatment systems and the hydraulic capture of the plume.

Responsible for preparation of comprehensive Feasibility Study Work Plan that provides the foundation, approach and schedule for the subsequent submittals required to complete the Feasibility Study, Remedial Design and Remedial Action components for the AOCs. Project Manager for site characterization efforts at several AOCs and prepared workplans and technical memoranda describing proposed sampling efforts and results of those investigations. Developed site-wide contaminant of concern (COC) identification process for soil and groundwater at Camp Edwards.

Remedial Investigation and Design, Eastland Woolen Mill, USEPA Region I, Corinna, ME. (2000, $5M, N/A) Project/Technical Manager for fast track CERCLA project located in Corinna, Maine. Planned and managed complex source control characterization efforts involving completing explorations adjacent to and within old Mill building located on Main Street and over a river. Managed $2.0 million RI activities that involved soil, sediment, surface water, overburden groundwater and bedrock groundwater planned and executed within 6 months. Completed EE/CA for an early Removal Action to address the remediation of contaminated soils and sediments beneath the Mill and in the river. Managed design efforts for Mill demolition, DNAPL recovery, river and state highway realignment, dam removal, contaminated soil excavation and on-site thermal treatment. Initiated Historic Building Survey in accordance with Section 106 of the National Historic Preservation Act.

BRAC Program, U.S. Army, Fort Devens, MA. (2000, $90M, N/A) Project/Technical Manager for Base Realignment and Closure (BRAC) environmental restoration program. Responsibilities included budgeting, planning and execution of investigations, studies and remediation under CERCLA and Massachusetts Contingency Plan for over 325 Study Areas (SAs) and AOCs.

Landfill Consolidation, MA. Negotiated highly controversial Record of Decision for consolidation of six landfill sites at a new on-site location. Worked closely with the public to complete a landfill siting study and select the best on-site location. Presented information, conclusions and recommendations of investigations and studies at public meetings. Scoped and managed the design of the excavation, characterization and transportation of existing landfill materials and new on-site landfill according to the Massachusetts Solid Waste Regulations.

Monitored Natural Attenuation Assessment, Historic Gas Stations. Scoped and managed Monitored Natural Attenuation Assessment at two sites. Successfully demonstrated to USEPA and MADEP that Natural Attenuation was an appropriate technology for the sites through quarterly sampling, trend analysis, and groundwater modeling (BIOPLUME II). Developed and managed the execution of a Long Term Monitoring Plan for each site.

Remedial Investigation, Emergency Action, and Time-Critical Removal Action; Airfield PCE Plume. Managed Remedial Investigation, Emergency Action, and Time-Critical Removal Action related to PCE contamination associated with historic parachute cleaning operations. Installed, monitored and closed-out Soil Vapor Extraction (SVE) system as part of USEPA mandated

Emergency Action to address vadose zone PCE contamination. Executed a Time-Critical Removal Action to eliminate other sources of contamination. Utilized screened augers and small diameter wells to delineate the nature and extent of the 3,000-ft long groundwater plume. Developed work plan for pilot scale study of In-situ Chemical Reduction.

Design and Construction, Barnum Road Maintenance Yards. Directed the design efforts and oversaw the construction of the $2.2 million remediation of a 9-acre maintenance yard. Design components included excavation and segregation methodology, storm drainage, detention pond, asphalt batching of contaminated soils, and paving. A radiological survey was completed prior to initiation of the construction. The Remedial Action Close-Out Report was completed and accepted by USEPA Region I within a year of ROD signature.

Community Involvement. Managed the development and distribution of quarterly environmental newsletters over a 4-year period. Established and maintained a community document distribution list. Developed and issued several fact sheets and proposed plans. Conducted presentations at monthly Restoration Advisory Board (RAB) and official public meetings. Participated in local community action group meetings.

Long Term Monitoring and Maintenance Plan, Shepley's Hill Landfill, Ft. Devens, MA. Scoped and managed Long Term Monitoring and Maintenance Plan according to the ROD for 84-acre solid waste landfill. Managed the development and negotiated groundwater monitoring performance standards based on reduction of overall site risk. Completed Five-Year Review in accordance with USEPA guidance.

Time-Critical Removal Actions. Managed the preparation of Action Memoranda, design information, remediation, and No Further Action Decision Documents for over 40 Removal Actions. Sites addressed quickly and cost-effectively to allow property to be transferred from the Army to the local redevelopment authority and redeveloped.

Ordnance and Drum Identification and Removal, Mirror Lake. Managed Removal Action to locate metallic objects, dive on the anomalies, identify the anomalies and remove those that posed potential risks. Recovery efforts conducted by licensed divers who also had the appropriate DOD explosives training. A No Further Action Decision Document was achieved as a result of this removal action.

Long Term Monitoring Plan, South Post Impact Area, Fort Devens, MA. Designed and implemented Long Term Monitoring Plan to address explosives and metals contamination in groundwater, surface water and sediment that resulted from military activities at three areas. The monitoring plan included conducting annual sampling, collecting semi-annual water level data, and performing groundwater modeling to evaluate contaminant migration.

Operation and Maintenance Support, U.S. Army, Fort Devens, MA. Project/Technical Manager for several Operation and Maintenance projects for the Fort Devens Environmental Management Office.

Immediate Response Action, JP-4 Fuel Spill. Managed an Immediate Response Action (IRA) under the Massachusetts Contingency Plan in response to a 2,200-gallon release of JP-4 at Moore Army Airfield. Actions included immediate response to assess release, including soil and groundwater sampling, preparation and negotiation of an IRA plan, remediation, and site close-out. The remediation included demolition and removal of pump house and fueling system to provide access to contaminated soils, removal of approximately 5,000 cubic yards of soil, off-site treatment of soil, and site restoration.

Integrated Natural Resources Management Plan (INRMP), Fort Devens, MA. Managed the preparation of the Fort Devens INRMP to address the appropriate management of natural resources in concert with military training on the South Post. Significant coordination required to obtain concurrence from local, state, and federal authorities.

Spill Prevention, Control and Containment Plan (SPCCP), Fort Devens, MA. Prepared SPCCP to address over 20 oil or hazardous waste storage areas located throughout Fort Devens. SPCCP was approved and implemented by Fort Devens.

UST Program, MA. Designed and managed UST assessment, removal and replacement activities over a five-year period. Conducted UST site assessments under the Massachusetts Contingency Plan at over 25 locations where USTs were previously removed by others. Assessments included small diameter sampling probes, soil boring, and monitoring well installation to determine if previous removal actions were adequate. Additional soil removal was required at a few sites and site closure was achieved at all sites. Removed and achieved no further action on over 75 UST/AST sites. Installed replacement storage tanks in compliance with local, state, and federal regulation were needed.

Building Demolition and Asbestos Abatement. Managed the demolition of over 30 former military buildings that were located on property to be transferred to the Federal Bureau of Prisons. Project included abatement of both friable and non-friable asbestos containing materials (ACM).

Fueling Pad Upgrades. Managed the construction of upgrades to existing training area fueling pads to facilitate appropriate and economical management of storm water. The upgrades included concrete pads with appropriate containment and a drainage system with in-line oil/water separator.

Underground Injection Control Program, Fort Devens, MA. Managed the assessment and corrective actions required to comply with the Commonwealth of Massachusetts Underground Injection Systems (UIS) Program at Fort Devens. The program includes the evaluation of over 200 non-residential structures to identify dry wells, sumps or other non-compliant facilities. Corrective measures included removal of contaminated materials, removal of systems where no longer needed, and upgrading of systems to meet the regulations.

Presentations / Publications

Applebee, M.R., D.J. Deleppo, M.G. Quinlan, P. LaGoy. 1996. Accelerated Remediation of Contaminated Soil Sites for Property Transfer Using Investigation by Remediation Approach. 12th Annual Conference on Contaminated Soils, University of Massachusetts, Amherst, MA, October 21-24.

Hill, D., K. Weeks, M. Warminsky, M. Applebee. 2002. “Innovative Soil Technologies.” The Military Engineer. January/February, No. 615.

Marc Grant, PE

Program Manager

Professional Summary

Mr. Grant has 25+ years of experience in hazardous waste site investigation and remediation; regulatory compliance auditing and training; and waste site permitting. He currently serves as Program Manager for a 10-year, $120M RI/FS project for the US Army Corps of Engineers. Mr. Grant has extensive experience in directing RI/FS at Federal and State Superfund sites. He has performed and managed RCRA permit applications and corrective action plans, RCRA contingency and closure plans, RCRA audits, and RCRA compliance determinations on behalf of industrial clients. Mr. Grant has also performed compliance audits and air emissions evaluations with respect to Clean Air Act requirements.

Professional Qualifications

Professional Engineer (PE), MA, 1997, #39799

Education

B.S., Environmental Engineering, Rensselaer Polytechnic Institute, 1980

Languages

English

Location

Westford, Massachusetts

Summary of Core Skills

RCRA/CERCLA Corrective Actions & Closures

Mr. Grant has managed a wide range of projects involving groundwater and soil investigation and remediation at RCRA (Resource Conservation and Recovery Act) and CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act, aka Superfund) sites. The largest of these is the on-going study of the Massachusetts Military Reservation (MMR) for the National Guard Bureau and US Army Corps of Engineers. The $120M study at MMR began in 1997. Other projects managed include a $1.3M study of the SRS site in Southington, CT; RCRA workplan preparation for BP Oil's refinery at Toledo, OH; over $3M of investigations and remediation at Reilly Industries' chemical plant at Indianapolis, IN; and site investigation at the CITGO oil terminal at Braintree, MA under the Massachusetts Contingency Plan. Mr. Grant also provides senior review of site assessment projects including Base Realignment and Closure (BRAC) work. Core skills include project and program management including scheduling and cost tracking, regulatory negotiations, technical review, and public presentations.

Multimedia Compliance Audits and Training

Mr. Grant has experience in a wide variety of environmental compliance projects, including training of compliance inspectors for regulatory agencies. This experience includes compliance audits against all major U.S. regulations, including RCRA, CERCLA, the Clean Air Act, Safe Drinking Water Act, Clean Water Act, and Toxic Substances Control Act. The range of audited facilities encompasses small manufacturing plants, federal facilities operated by the Army National Guard, and large commercial hazardous waste disposal facilities.

RCRA and Solid Waste Permits

Mr. Grant has authored and managed permit preparation for several hazardous waste and solid waste management facilities. These include a resource recovery (solid waste incineration) facility, a pharmaceutical manufacturer, and four commercial hazardous waste disposal facilities.

Employment History

Program Manager, AMEC Earth & Environmental, 1999 – Present

Project Manager, Ogden Environmental & Energy Services (predecessor to AMEC), 1995 – 1999

Project Manager, ENSR, 1988 – 1995

Engineer, self-employed, 1986 – 1988

Engineer, GCA Technology Division, 1980 – 1986

Presentations / Publications

Grant, M. and B.W. Schwab; Recycling an Urban PAH/TPH Site with Data Evaluation, Risk Characterization, and an AUL; Paper presented at 13th Annual Soils Conference, Amherst, Massachusetts, October 1997.

Detailed Skills by Representative Project

RCRA/CERCLA Corrective Actions & Closures

Remedial Investigation/Feasibility Study for Massachusetts Military Reservation, National Guard Bureau and US Army Corps of Engineers; Camp Edwards, MA (On-going, $120M, 313000560, 276225018). Program Manager for the RI/FS and RD/RA of the Impact Area and Training Range in Camp Edwards, Massachusetts performed under the Safe Drinking Water Act. Oversees all project activities and subcontractors, including unexploded ordnance clearance, monitoring well installation, soil and groundwater sampling, RI and FS reporting, remedial designs, and remedial actions. Other activities have included budget and staff tracking and allocations, schedule preparation and tracking, public meetings, weekly technical meetings with EPA and DEP, and weekly progress reports to EPA and DEP. AMEC prepared engineering plans and specifications for two groundwater extraction and treatment systems to address explosives and perchlorate contamination in groundwater. Engineering design services included preparation of civil, structural, mechanical, and electrical engineering plans and specifications. AMEC implemented a design-build approach for this project, which allowed the Army to meet the accelerated project schedule directed by EPA. AMEC prepared a construction health and safety plan, Construction Quality Assurance Plan, project remediation cost estimates, and O&M and System Performance Monitoring Plans. Construction phase engineering services included submittal review, engineering during construction, and QA/QC.

AMEC also designed and implemented Rapid Response Actions (RRAs), which are similar to time-critical removal actions under CERCLA, at seven areas at MMR. Treatability studies were conducted by AMEC to develop a soil washing treatment approach. Concurrent with soil delineation activities, AMEC developed, designed, and managed the construction of a 1.3-acre bituminous concrete containment pad to support RRA soil remediation operations. The turnkey project involved coordination with the Army to select an appropriate location for remediation activities, completion of a land survey, coordination with remediation technology vendors, preparation of design drawings and technical specifications, and construction quality assurance. Upon excavation of over 800cy of contaminated soil, soil washing reduced the volume of contaminated soils by over 75% by isolating and segregating the fractions of the soil in which the contaminants were located.

AMEC designed and implemented small arms range maintenance operations at MMR as an interim action to mitigate potential impacts to groundwater. AMEC employed a "no net waste pollution prevention strategy," which involved turn-key characterization, excavation, and on-site treatment and reuse of approximately 50,000 tons of berm soil at 16 small arms training ranges. AMEC's support allowed the Army to successfully negotiate a pollution prevention approach to lead removal without requiring costly and time-consuming RCRA permitting.*

Non-Time-Critical Removal Action, SRSNE PRP Group; Southington CT Assistant Project manager for this $1.3 million Non-Time-Critical Removal Action (NTCRA) completed over a period of 6 months. Developed detailed schedule with resource loading and cost tracking. Activities included: Pump tests in the overburden and fractured bedrock aquifers; Geoprobe sampling with field screening of soils to delineate extent of contamination; treatability studies to evaluate metals removal, biodegradation, and enhanced oxidation technologies for groundwater treatment; pilot tests of soil vapor extraction and air sparging treatments for soils; and laboratory scale studies of *in situ* biodegradation of chlorinated organics in soil.

RCRA Facility Investigation Workplan, BP Oil; Toledo, OH. Project Manager and Technical Lead for the RCRA Facility Investigation (RFI) workplan for BP Oil's petroleum refinery at Toledo, OH. The RFI workplan and Description of Current Conditions Report (DOCC) covered 53 SWMUs and 10 AOCs at the 465-acre site. The RFI workplan incorporated extensive sampling data collected by BP during monitoring and closure, and included screening procedures and use of Action Levels.

CERCLA/RCRA Corrective Action Activities, Reilly Industries, Indianapolis, IN. Project Manager and Technical Lead for the CERCLA/RCRA corrective action activities at Reilly Industries' facility at Indianapolis, Indiana. An RI/FS was initiated in 1987 in accordance with a CERCLA Consent Order with EPA. Interim remedial measures at this former coal tar refinery and active chemical production plant included removal of over 100 buried drums, design of a groundwater pump-and-treat system, and design of a temporary landfill cover and runoff control system for a tar pond. As a result of obtaining a final RCRA permit, RCRA Corrective Action requirements were phased in for two additional Operable Units.

Environmental Conditions of Properties Reports, Navy, Multiple Locations. (2006, $804K, 321060117) Senior Reviewer for Environmental Condition of Property (ECP) Reports on behalf of the Navy Base Realignment and Closure (BRAC) Program Management Office (PMO) for its 2005 BRAC Program, for the purpose of providing a comprehensive evaluation of the historical, cultural, and environmental conditions of each installation for eight sites in the Northeast including, Naval Air Station Brunswick, ME, Marine Corps Reserve Center West Trenton, Naval Reserve Center Forest Park, IL, Naval and Marine Corps Reserve Center, Akron, OH, Navy Reserve Center, Cleveland, OH, Navy and Marine Corps Reserve Center, Reading, PA, Navy Reserve Center, Adelphi, MD, and the Naval Air Station Joint Reserve Base, Willow Grove, PA. Prepared ECP Reports for the Navy and Marine Corps installations presenting the information and findings.*

RFI Workplan Revision, Union Camp, Savannah, GA. Project Manager and Technical Lead for revising RFI Workplans for the Savannah, Georgia facility. The original workplan covering four SWMUs was revised to address NODs and an addendum was prepared to cover an additional SWMU discovered after the revisions.

Potential Corrective Measures Evaluation, Union Camp, Dover, OH. Evaluated potential corrective measures based on the draft Risk Assessment and RFI Report for the Dover, Ohio facility. This information was used by the client to develop a strategy for responding to Agency comments on the RFI Report and for proceeding with a Corrective Measures Study.

Remedial Investigation, Stanley Works, Multiple Locations in MA. Project Manager for the remedial investigation at several manufacturing facilities in Massachusetts. This work included preparation and implementation of remedial investigations in accordance with Massachusetts

Contingency Plan (MCP) requirements. Corollary work included preparation of site classification and waiver application forms.

Remedial Investigations, CITGO, Braintree, MA. Project Manager for remedial investigations of CITGO's Braintree, Massachusetts facility, in support of CITGO's litigation with OXY USA, the former site owner. These were performed in accordance with MCP Phase 2 requirements for site investigations. Work included soil, sediment, and groundwater sampling/analysis, optimization of an existing free product recovery system, removal of contaminated soil during tank replacements, removal and onsite asphalt batching of contaminated soils and sludges, and feasibility studies to determine treatment requirements and options for the facility stormwater system.

Contaminated Materials Management Plan, Everett Energy, MA. Developed and negotiated a plan for managing potentially contaminated soils and other debris during construction at an MCP site. Prepared specifications for soil monitoring, testing, segregation, and disposal in accordance with Massachusetts DEP policy for virgin oil-contaminated soils.

RCRA Waste Removal and Closure, Reilly Industries, Multiple Locations in IL. Project Manager and Technical Lead for RCRA waste removal and closure activities at three locations in Illinois. Innovative statistical analysis was used to demonstrate that portions of the wastes are not characteristically hazardous. Work included arrangements for staging, transportation, and disposal of wastes.

CERCLA Landfill Closure, MO. Project Manager for EPA subcontractor oversight of remediation at a commercial hazardous waste landfill in Missouri. Prepared a specification testing program for final cover installation. Managed oversight inspections and reporting under EPA Technical Enforcement Support contract.

CERCLA Landfill Closure, RI. Conducted oversight inspections and provided technical enforcement support to EPA Region 1 during closure of a hazardous waste landfill in Rhode Island. Conducted and coordinated analyses of groundwater monitoring, cover installation, and financial requirements for post-closure care.

Multimedia Compliance Audits & Training

Compliance Audit, Alcoa, Massena, NY. Audited compliance with RCRA generator requirements at Alcoa's aluminum manufacturing facility in Massena, New York. Reviewed administrative plans and waste handling methods and developed revised plans and handling procedures to enhance compliance with NYSDEC requirements.

RCRA Compliance Inspections, Aristech Chemical, Various Facilities, KY and OH. Conducted RCRA compliance inspections of chemical manufacturing operations at Aristech facilities in Kentucky and Ohio. Developed recommendations to improve compliance status and minimize waste generation.

Asbestos NESHAP Training Seminars. Developed and performed training seminars for EPA inspectors involved in asbestos NESHAP enforcement. Performed more than 30 seminars in all 10 EPA regions to train federal, state, and local inspectors on NESHAP enforcement procedures. Seminars included 2- and 3-day classroom instruction, sample inspections, and safety procedures.

Compliance Audit, Compact Disc Manufacturer. Audited compliance with RCRA generator requirements for a compact disc manufacturer handling waste solvents and metal-contaminated filters. Reviewed administrative plans and waste handling methods and developed recommendations to improve compliance with RCRA requirements.

Treatment, Storage, and Disposal Facilities Audits, Confidential Client. Performed audits of RCRA-permitted commercial Treatment, Storage, and Disposal Facilities (TSDFs) for a confidential client consisting of a consortium of hazardous waste generators. These audits were designed to assess TSDF compliance with RCRA/CWA/CAA requirements and status with respect to significant liability issues, such as soil and groundwater contamination. The audits included a site visit, interviews with facility environmental and health/safety personnel, and extensive review of facility permits, plans, and inspection records. The audit results were reviewed with the TSDF and documented in a final report for the client group.

ECAS, National Guard Bureau, Various States. (1995-1998, $1M, 313000031, 313000071, 313000079, 313000089, 313000127) Conducted Environmental Compliance Assessment System (ECAS) multimedia audits of Army National Guard facilities in New Jersey, Massachusetts, Louisiana, Texas, Pennsylvania, Washington, and Utah. These audits were designed to identify pollution prevention opportunities and compliance issues with respect to State and Federal requirements under RCRA, CERCLA, CAA, SDWA, CWA, FIFRA, and TSCA. Facilities included Organizational Maintenance Shops, Armories, and Combined Support & Maintenance Shops. Audit findings were summarized daily and downloaded to the client using computerized tracking forms.*

RCRA Compliance Procedure Review, Sandoz Pharmaceuticals Corp., NJ. Reviewed RCRA compliance procedures for this New Jersey pharmaceuticals manufacturer and developed a Compliance Manual to streamline recordkeeping and other administrative requirements. This manual was designed to improve RCRA compliance demonstrations internally and for EPA/NJDEP inspections.

Used Oil Recycling Facility Audits. Conducted RCRA compliance audits of used oil handlers and recyclers in EPA Region X in support of EPA enforcement strategy development. Documented sampling and analysis procedures, processing techniques, and waste manifest/transport procedures.

RCRA and Solid Waste Permits

Solid Waste Permit Application, American Ref-Fuel. Contributing author for the solid waste permit application to retrofit the American Ref-Fuel Niagara Resource Recovery Facility with mass burn MSW furnaces, boilers, and associated equipment. Prepared the permit sections describing the process equipment and MSW characteristics using specifications and other information supplied by the client.

Part B Permit Applications, Bristol-Meyers Squibb, NJ. Co-author for the Part B permit applications for two mixed waste storage facilities in New Jersey. These two facilities are designed to store radioactive hazardous waste in containers until suitable disposal facilities can be identified.

Part B Permit Renewal/Permit Modification, Dow Chemical, Torrance, CA. RCRA Technical Lead for the Part B permit renewal/permit modification for Dow Chemical's Torrance, California facility. This application package for tank and container storage areas included a SWMU Questionnaire, California Environmental Quality Act evaluation form, and health risk assessment. Major changes from the existing Part B included demonstrating compliance with seismic requirements, updating the Waste Analysis Plan for over 40 waste streams, updating other administrative plans, and modifications pursuant to EPA's 1991 Boiler and Industrial Furnace (BIF) regulations. The project also included tank integrity inspections and certifications, and design modifications to the Container Storage Area containment system. Prepared permit documents and responses to EPA Region IX and DTSC comments.

Part B Permit Application, DuPont, Deepwater, NJ. RCRA Technical Lead for the Part B permit application for proposed incineration and landfill facilities at Deepwater, NJ. The proposed facilities included a new commercial rotary kiln incinerator, storage of 240,000 gallons in tanks and 260,000 gallons in containers, and a landfill capacity of 1.8 million cubic yards. Principal author for the technical sections on tank storage, container storage, the landfill, and closure requirements.

Contributing author for facility management plans. Worked with DuPont and the landfill and incinerator design contractors to identify technical approach and data needs. Evaluated civil and process engineering documents for completeness and adequacy. Prepared permit documents and responses to EPA Region II and NJDEP comments.

Part B Permit Application, Reilly Industries, Indianapolis, IN. Project Manager and RCRA Technical Lead for the Part B permit application for the Reilly Industries facility at Indianapolis, IN. This facility included 1.1 million gallons of tank treatment and storage capacity, and 124,000 gallons of container storage capacity. Principal author for all permit sections. Worked with Reilly to identify specifications for existing storage facilities and incorporate these specs in the permit application. Modified existing procedures and structures as needed to satisfy requirements for permitted facilities. Prepared permit documents and responses to EPA Region V and IDEM comments.

Part B Permit Application, ThermalKEM, NC. Co-author for the Part B permit application for a new state-of-the-art commercial hazardous waste incinerator in North Carolina. The facility design and permit application package were developed simultaneously through close coordination with ThermalKEM and their design engineers, in order to meet the state's aggressive schedule for permitting and construction. Prepared permit documents and responses to EPA Region IV and DEHNR comments.

* Projects performed through AMEC Earth and Environmental, Inc.

Michael Robinson

Environmental Scientist/Project Manager

Professional Summary

Mr. Robinson has over 10 years of experience in the environmental industry including field and engineering task management projects with both investigative and remediation components. Mr. Robinson has managed and coordinated multi-disciplinary field activities in the context of several regulatory environments, including CERCLA, RCRA, the Massachusetts Contingency Plan (MCP), California, New Jersey and Rhode Island state regulations, and ASTM Environmental Due Diligence protocols. Over the past four years, Mr. Robinson has been a task manager and technical contributor on the Massachusetts Military Reservation project and more recently has project and task manager roles on a variety of projects for commercial clients.

Mr. Robinson's technical work has focused on site investigations to determine the nature and extent of contamination, site hydrogeologic characterization, and soil and groundwater remediation. His experience includes sites contaminated with chlorinated hydrocarbons, petroleum hydrocarbons, arsenic, MGP/coal tar, explosives and perchlorate.

Professional Qualifications

OSHA 40-hr HAZWOPR with up to date 8-hr refresher course

Education

MA, Environmental Studies, Boston University, Graduate School of Arts and Sciences, January 1995

BA, Biochemistry, Cornell University, College of Arts and Sciences, Ithaca NY, May 1990

Summary of core skills

Site Investigation

The primary focus of Mr. Robinson's work experience has been the investigation and characterization of soil and groundwater hazardous waste sites in accordance with federal, state, and local regulatory programs. Mr. Robinson has implemented and managed both soil and groundwater sampling program tasks. His responsibilities have included planning (i.e. scope of work and work plan development, budgeting, contractor procurement), coordination (i.e. contractor oversight, cost tracking, technical oversight, health and safety plan implementation), data analysis and interpretation, report preparation and strategy development. Mr. Robinson has co-authored work plans, investigation reports, remediation plans and closure reports for approval by various federal, state, and local agencies regulatory bodies, including US EPA, Massachusetts Dept. of Environmental Protection (MA DEP), Rhode Island Dept. of Environmental Management (RIDEM), California Regional Water Quality Control Boards (RWQCB), Santa Clara Valley Water Quality District (SCVWD). Mr. Robinson has analysed site specific results in order to characterize the nature and extent of subsurface contamination and to develop and refine site conceptual models with the goal of developing and evaluating sampling and remediation strategies.

Mr. Robinson is familiar with many subsurface investigation techniques including test pit excavation, overburden and bedrock drilling (including direct-push, hollow-stem auger and air rotary techniques), soil logging, monitoring well and piezometer installation and development, and passive soil gas survey. Mr. Robinson is proficient in soil, sediment, surface water, and groundwater sampling techniques as well as several field analytical methods for petroleum and PCBs.

Remediation

Mr. Robinson has task management experience with respect to remediation projects. Mr. Robinson's remediation experience includes soil and UST/AST removal oversight, groundwater extraction and treatment, soil vapor extraction and treatment, and monitored natural attenuation (MNA).

Laboratory/Field Analytical

Mr. Robinson has experience with several field analytical test procedures including those produced by Hach and Chemetrics to evaluate the concentration of metals, dissolved oxygen and other parameters in water and wastewater samples. Mr. Robinson is also familiar with several immunoassay procedures for the determination of PCB and petroleum concentrations in soil.

In addition to the field analytical techniques described above, Mr. Robinson also has experience with several laboratory analytical techniques. Mr. Robinson's laboratory analytical experience includes the use of high-performance liquid chromatography (HPLC), peptide synthesis and protein sequencing. Much of this work was conducted in support of various research, QA/QC, and manufacturing projects at a biotech facility.

Employment History

July 2002- present, Environmental Scientist/Project Manager, AMEC Earth & Environmental, Westford, MA

January 2000 - May 2002, Project Geologist, IT Corporation, Concord CA

July 1995 - December 1999, Project Specialist, ENSR Consulting and Engineering, Acton MA and Alameda, CA

April 1995 - July 1995, Field Technician, Environmental Sampling Technology, Needham MA

March 1994 - May 1995, Graduate Student Intern, Massachusetts Water Resources Authority, Sewerage Division, Toxics Reduction and Control Department, Charlestown MA

June 1990 – August 1993, Research Associate, Repligen Corporation, Cambridge MA

Presentations/Publications (Seminars and Training)

"Annual Fireworks Displays as a Potential Source of Perchlorate in Groundwater," J.K. Harriz, M.J. Robinson, C. Abate and P. Gwinn. Presentation at the Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compound.

Conducted training seminars on proper environmental sampling techniques and on PCB field analytical test kits for personnel at a major utility. (ENSR Consulting and Engineering, Acton MA)

Conducted in-house training on EPA Region 1 "Low-flow" groundwater sampling protocol. (ENSR Consulting and Engineering, Acton MA)

Details by Representative Project

Massachusetts Military Reservation Impact Area, National Guard Bureau, Groundwater Study Program, Cape Cod, MA - Remedial Investigation. (ongoing, $49,765,945, 276225018) Mr. Robinson served as a task manager and technical contributor to remedial investigation activities at three operable units (Southeast Ranges, Central Impact Area, and the Northwest Corner) at the Massachusetts Military Reservation. In addition to specific technical tasks described below, Mr. Robinson's responsibilities include providing general technical support to client representatives, participating in weekly project team conference calls, and interacting with regulatory agencies on behalf of the client. In conjunction with the Southeast Ranges Operable Unit, Mr. Robinson evaluated existing analytical and geophysical data, aerial photographs and historical records to develop a soil sampling and remediation strategy at two former training ranges with the objective of delineating site contaminants which consisted primarily of explosives, perchlorate, and metals. The proposed implementation of these strategies was presented in two site work plans authored by Mr. Robinson and negotiated with the regulatory agencies. Mr. Robinson also developed a strategy to excavate source areas at two former training ranges and prepared two remediation plans specifying excavation procedures.

Mr. Robinson served as the task manager for the Central Impact Area Groundwater Operable Unit. Responsibilities included regular review of groundwater monitoring data and concentration trends, developing 2D and 3D groundwater plume depictions, and evaluation of contaminant fate and transport. Mr. Robinson was often required to present data to client representatives and regulators at meetings and was the primary author of the site Remedial Investigation Report. Mr. Robinson designed a Post-Screening Investigation to evaluate the distribution of UXO within the Impact Area as well as refine the delineation of source areas within the Central Impact Area for the purposes of remedial design.

For the Northwest Corner Operable Unit, Mr. Robinson has provided general technical support for a soil and groundwater investigation to evaluate the nature and extent of perchlorate and explosives in soil and groundwater. Mr. Robinson was the primary author of the site Remedial Investigation Report in which the site contamination was primarily attributed to an annual fireworks display rather than military sources.

Massachusetts Military Reservation, Cape Cod, MA. (2006, approx. $200,000, 276225018 Phase 009I) Mr. Robinson managed an investigation and remediation program designed to address potential explosives and perchlorate releases to the subsurface as a result of the planned detonation of unexploded ordnance (UXO). When encountered, UXO at MMR are detonated or "blown-in-place" (BIP) by EOD personnel to ensure worker safety. Mr. Robinson supervised a sampling program designed to evaluate whether these detonations resulted in releases to the subsurface and if so, the extent of the resulting contamination. Responsibilities included coordinating sampling and soil removal activities with field and base personnel, evaluating analytical data to determine the extent of excavation at each detonation location, and preparing an excavation plan. In addition, Mr. Robinson prepared quarterly summary reports and monthly analytical results summaries for submittal to the regulatory agencies.

U.S. Army Corps of Engineers, Shepley's Hill Landfill, Devens, MA – Site Investigation. (ongoing, $550,000, 321060116) Mr. Robinson is currently managing field activities for a Comprehensive Site Assessment at a landfill where elevated levels of arsenic are present in groundwater. Mr. Robinson coordinated and provided oversight for the initial field activities: test pit excavations conducted to expose the PVC liner capping the landfill and an evaluation of the condition of the liner. In addition to field management activities, Mr. Robinson developed an investigative strategy and prepared a CSA Work Plan to implement recommendations made in the site Data Gaps

Analysis Report. Preparation of this Work Plan required coordinating a multi-disciplinary project team in order to generate a cohesive document. Ongoing work includes implementation of the remaining activities proposed in the CSA work plan, data evaluation and preparation of a Comprehensive Site Assessment Report for the landfill.

U.S. Navy, Alameda Point, CA – Soil and Groundwater Remediation. Mr. Robinson designed a soil and groundwater sampling program to delineate the nature and extent of petroleum contamination exceeding groundwater standards at four sites at a former military installation. Upon client and regulatory approval, he supervised the implementation of this program and evaluated analytical results and other site data to identify the nature and extent of impacted soil and groundwater. Based on the results of the investigations, Mr. Robinson prepared technical justification for modifying the remediation technologies originally selected by the remedial contractor at two of the four sites. Mr. Robinson also played a significant role in the design and construction of remedial systems at the four sites. He conducted pilot tests to collect site-specific data for the design of biosparge systems and dual-phase vacuum extraction systems at each of the sites. In addition, Mr. Robinson prepared air quality permits (Bay Area Air Quality District [BAAQMD]) and wastewater discharge permits (East Bay Municipal Utility District [EBMUD]) for the operation of dual-phase vacuum extraction systems at two of the sites. He subsequently administered permits during the operation of the treatment systems which including coordinating permit-required monitoring activities and preparing periodic monitoring reports.

Petroleum Distribution Facility, Fortuna, CA -Soil Remediation. Mr. Robinson coordinated the excavation of over 1,000 cubic yards of soil impacted by diesel fuel at a former bulk terminal and supervised the construction of a passive soil biodegradation pile. Based on soil sampling data, he estimated degradation rates and developed cost estimates for system operation.

Retail Petroleum Distribution Company, Several sites in CA. Mr. Robinson coordinated the investigation, remediation and/or closure of a portfolio of thirty to forty retail petroleum sites. Mr. Robinson was responsible for developing, evaluating, and implementing site sampling and remediation strategies in conjunction with several local governing agencies.

Confidential Client, Cumberland, RI, - Superfund Site Investigation. Mr. Robinson managed quarterly groundwater monitoring program (one of the first programs to require the use of low-flow groundwater sampling techniques) at an industrial facility impacted by chlorinated solvents and arsenic. Mr. Robinson evaluated current and historical analytical results to develop technical justification for proposed reductions in sampling frequency and parameter list at specified wells. Mr. Robinson also designed and conducted site investigation to collect additional data for to refine the site conceptual model with respect to fate and transport of contaminants and to support a natural attenuation evaluation.

Confidential Client, Cumberland, RI, - Remedial System Evaluation. Mr. Robinson managed a monthly groundwater sampling program designed to evaluate the performance of a groundwater remediation system. The system relied on innovative technologies to hyper-oxygenate water and subsequently, inject this hyper-oxygenated water into the subsurface in order to mitigate the highly reducing conditions present in the aquifer. The reducing conditions were caused by the degradation of organic matter released to the subsurface at the facility via a leachfield and resulted in the presence of arsenic in concentrations significantly greater than the MCL. In addition to ensuring appropriate data quality, Mr. Robinson was also responsible for evaluated trends in analytical parameters to assess the effectiveness of the system.

Confidential Client, Dighton MA - RCRA Voluntary Corrective Action. Mr. Robinson served as a task manager for a multi-disciplinary sampling program conducted at a former chemical manufacturing facility in support of a Human Health Risk Assessment. Responsibilities included implementing the sampling program in accordance with the work plan and associated QA/QC protocols. Mr. Robinson planned, coordinated and supervised soil sampling, installation and development of overburden and bedrock monitoring wells, and surface water and sediment sampling. In addition, he conducted a groundwater sampling program consisting of sampling over forty monitoring wells using EPA Region 1 Low-Flow Procedures.

US Navy, Quonset Point, RI – PCB Investigation. Mr. Robinson implemented a soil sampling program designed to delineate the extent of PCB contamination in surface soil in support of a soil removal action. The field program consisted of collecting soil samples and using field screening test kits to determine PCB concentrations. Subsequent to his evaluation of the field screening results, Mr. Robinson evaluated the reliability of field screening results through a statistical evaluation of confirmatory laboratory samples and concluded that the field screening results were appropriate for use in determining the amount and extent of soil requiring removal.

Chemical Manufacturing Facility, Fitchburg MA – Site Investigation and Remediation. Mr. Robinson designed and implemented a MCP Phase I Investigation to delineate soil and groundwater contamination beneath building located within an industrial complex. The sampling program included sampling soil beneath building floor drains using direct-push techniques in order to delineate the nature and extent of subsurface contamination by non-halogenated organic solvents. Site data demonstrated that the high soil density beneath the building limited the vertical migration of contaminants. In order to accelerate site closure, Mr. Robinson developed a Release Abatement Measure (RAM) Plan for the removal of over 100 cubic yards of impacted soil. Vacuum excavation rather than conventional soil excavation techniques were used due to the restricted access to the disposal area. Mr. Robinson coordinated RAM activities with facility personnel so that the remedial action could be completed during a scheduled plant shutdown. The RAM Plan included the real-time analysis of samples using a field GC in order to reduce remedial time frame. Mr. Robinson supervised implementation of the RAM and prepared RAM Report to document remedial activities and to support site closure.

Railroad, Framingham MA – Site Investigation and Remediation. Mr. Robinson conducted MCP Phase II Investigation at an active railroad yard in order to delineate the nature and extent of petroleum hydrocarbon impacts to soil and groundwater. Responsibilities included oversight of the installation of overburden monitoring wells and the collection of soil and groundwater samples. Mr. Robinson also performed slug tests and analysed the resulting data to evaluate aquifer hydraulic conductivity at the site. The site data collected and evaluated by Mr. Robinson was later used in a MCP Method 3 Risk Assessment to support site closure.

Denise Ladebauche

Environmental Chemist

Professional Summary

Ms. Ladebauche started her environmental career in 2000 working at a full service environmental testing laboratory. She has spent much of her career in the laboratory, working in a number of different roles, specifically sample management, custody, sample login, hazardous waste over-site and project management. She has provided laboratory project management for clients on numerous projects involving the Massachusetts Contingency Plan (MCP), Connecticut Reasonable Confidence Protocols (RCP), Department of Defense (DoD) Quality Systems Manual (QSM), National Pollutant Discharge Elimination System (NPDES), Massachusetts Water Resource Authority (MWRA), and hazardous waste characterization.

Professional Qualifications

Hazardous Waste Management (RCRA) Certification, 2006

Education

B.A., Environmental Science, Biology Minor, Clark University, MA, 2000

Languages

English

Location

Westford, Massachusetts

Summary of Core Skills

Project Management

Ms. Ladebauche has acted as a liaison between clients and the laboratory: ordering sampling containers, checking COCs, shipping samples or arranging for sample pickup, tracking data and deliverables, and contacting the clients when necessary to discuss problems with the data or deliverables.

Laboratory QAPP and SAP Preparation

Ms. Ladebauche has assisted clients with analytical method selection, outlined data deliverable capabilities, and prepared tables of laboratory detection limits and QC for project-specific Quality Assurance Project Plans (QAPPs) and Sampling Analysis Plans (SAPs).

Data Review

Ms. Ladebauche has reviewed sample data prior to delivery to clients to ensure the project and or QAPP requirements were achieved. She has worked with the laboratory to correct any deficiencies in the data.

Employment History

2006 – Pres.: Environmental Chemist, AMEC Earth & Environmental, Inc., Westford, MA

2005 – 2006: Client Service Representative, Alpha Analytical Inc, Westborough, MA

2002 – 2005: Login Manager, Alpha Analytical Inc, Westborough, MA

2001 – 2002: Client Service Representative, Alpha Analytical Inc, Westborough, MA

2001 – 2001: Login Technician, Alpha Analytical Inc, Westborough, MA

Detailed Skills by Representative Project

Sample Management and Laboratory Coordination

Sample Management and Laboratory Coordination, NLON, New London, Connecticut. Ms. Ladebauche coordinated with client to set up sampling events at a former Naval Base in New London, CT. She arranged delivery and pick up of sampling containers from the laboratory and site and tracked the sample's analytical status and data deliverables.

Data Review

Data Review, Massachusetts Military Reservation, Camp Edward, Massachusetts. Ms. Ladebauche performed data quality review on analyses of soils and waters for perchlorate, explosives and metals in accordance with DoD QSM and project-specific criteria.

Data Review, SSC Natick, Massachusetts. Ms. Ladebauche performed a data quality review of laboratory data generated as part of a DoD site clean up of the Soldiers Systems Command Army Base in Natick, Massachusetts. The project involved results for water samples that were analyzed for a broad suite of organic and inorganic parameters, as well as air samples for volatile organic compounds.

QAPP and SAP Preparation

Ms. Ladebauche revised sections of QAPP and SAP concerning laboratory protocols, data quality objectives and laboratory detection limits.

* Projects performed through AMEC Earth and Environmental, Inc.

Attachment D

Remedial Investigation Workplan for AOC 72, Plow Shop Pond

Attachment D – Site Safety & Health Plan

FINAL

Devens, Massachusetts

May 2009

Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by:

AMEC Earth & Environmental, Inc
Westford, Massachusetts
Contract No.: GS-10F-0230J
Delivery Order: W912WJ-05-F-0037

SHL-0125

The following text is an addendum to AMEC's Final Site Safety and Health Plan dated July 2007 for the Shepley's Hill Landfill Scope of Work.

3.2.9 Working on Water from a Boat

The boat used for the collection of surface water and sediment samples must be adequate for the sampling being conducted and the water body conditions. The boat should be of sufficient size for the number of personnel on the boat. The boat should never have more personnel or weight than what it is rated for. Flat bottom boats provide good stability when working over the site in addition to allowing access to shallow water. Although rubber rafts typically have flat bottoms and are easy to transport, they can be difficult to change position within the boat, and therefore should be avoided if possible. Canoes should never be used for sampling because of their instability when working over the side.

AMEC sampling personnel will conform to United States Coast Guard (USCG) regulations when working on water. When working from a boat, personal floatation devices (PFD) shall be worn at all times. Space blankets will be available at the Site to reduce heat loss in case of cold stress. All boats will conform to USCG regulations, including, but not limited to a ring buoy with at least 90 feet of rope attached, a first aid kit, and a fire extinguisher (if boat is powered by gasoline or diesel). Distance between ring buoys shall not exceed 200 feet. Two personnel will work as a team when on a boat, with a site person on shore in view of the sampling operation. On shore person must maintain a communication device, i.e. cell phone, and a ring buoy with at least 90 feet of rope.

Hazards related to working on open water include injuries as a result of falls on slippery surfaces, hypothermia, and drowning. Workers should employ the following practices:

1) When working around docks, lagoons or dams, there are often railings for protection. Check first to see that these railings are in good condition. If not, bring it to the attention of whoever is responsible for their maintenance and take extra precautions (as listed below) before commencing work.

2) Water conducts heat away from the body much more quickly than air. It is therefore necessary to take precautions to avoid hypothermia. Wear protective clothing such as waterproof rubber boots or waders that are leak proof. Alternatively, wear foam neoprene boots and suits that provide thermal protection as well as buoyancy.

3) The potential for drowning should be considered in any situation where there is little or no current and water depths greater than waist level, or in any water with appreciable current that is at least knee deep. In these instances take the following precautions:

- Ensure there is a second standby person at all times in sight that is capable of offering assistance;

• Wear a life jacket or ensure that the standby person has a life preserver ring attached to a rope; and

• If fallen into cold water, remain calm and call for help. If possible, wait for help to come to you. Flailing around increases the potential for hypothermia.

Attachment E

Remedial Investigation Workplan for AOC 72, Plow Shop Pond

Attachment E – Human and Ecological Risk Assessment Plan

FINAL

Devens, Massachusetts

May 2009

Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by:

AMEC Earth & Environmental, Inc
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SHL-0125

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ACRONYMS AND ABBREVIATIONS

ADD	Average Daily Dose
AMEC	AMEC Earth & Environmental, Inc.
AWQC	Ambient Water Quality Criteria
BCF	Bioconcentration Factor
BW	Body Weight
CMR	Code of Massachusetts Regulations
COC	Compound of Concern
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DRI	Dietary Reference Intake
DSWM	Division of Solid Waste Management
EcoSSLs	Ecological Soil Screening Levels
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
FDA	Food and Drug Administration
FS	Feasibility Study
HERA	Human and Ecological Risk Assessment
HERD	Human and Ecological Risk Division
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IR	Ingestion Rate
IRIS	Integrated Risk Information System
LD_{50}	Lethal Dose for 50 percent of a study population
LOAEL	Lowest Observed Adverse Effect Level
MassDEP	Massachusetts Department of Environmental Protection
MCL	Federal Maximum Contaminant Level
MMCL	Massachusetts Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
NAS	National Academy of Sciences
NCP	National Contingency Plan
ND	Not Detected
NOAEL	No Observed Adverse Effect Level
NRC	National Research Council
RAGS	Risk Assessment Guidance for Superfund
RDI	Recommended Daily Intake
RL	Reporting Limit
RME	Reasonable Maximum Exposure
TEC	Threshold Effects Concentration
TRV	Toxicity Reference Value
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

This Human and Ecological Risk Assessment (HERA) Plan for Area of Concern (AOC) 72 at the former Fort Devens has been prepared by AMEC Earth & Environmental, Inc. (AMEC) on behalf of the United States Army Corps of Engineers, New England District (USACE-NAE). AOC 72 consists of Plow Shop Pond, located on the east of Shepley's Hill Landfill (SHL) at Devens (Figure 1). Plow Shop Pond discharges to Nonacoicus Brook which flows west on the north side of SHL. SHL and surrounding property including Nonacoicus Brook are included in the risk assessments for human and ecological receptors in the draft *Supplemental Groundwater and Landfill Cap Assessment* for SHL, which was issued as a BCT Draft in December 2008. Remediation of the landfill, and RI and Feasibility Study (FS) of AOC 72, is occurring under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, and National Oil and Hazardous Substances Contingency Plan (NCP) requirements, with regulatory coordination of the Massachusetts Department of Environmental Protection (MassDEP) and the United States Environmental Protection Agency (USEPA)..

A HERA will be conducted as part of the RI for AOC 72, in accordance with the technical risk assessment approaches in CERCLA guidance. The purpose of this HERA Plan is to document the approach for conducting the risk assessment at AOC 72. This HERA Plan specifies methods to identify contaminants of concern (COCs), which are contaminants that contribute to an excess risk of harm to potential human and environmental receptors. If site conditions present an unacceptable risk, an FS will be performed to evaluate remedies. This HERA Plan is Attachment E of an RI Workplan for AOC 72 that includes an evaluation of existing data and data gaps, proposed investigations, and a Sampling and Analysis Plan (Attachments A-D). The risk assessment approach for humans is provided in Section 2 of this HERA Plan, and the approach for ecological receptors is provided in Section 3.

Plow Shop Pond is located southwest of the business and residential district in Ayer, Massachusetts. The 30-acre pond basin is bounded on the west and south by former Fort Devens property, to the north by commercial development (Molumco Industrial Park), and to the east by the Guilford Transportation railroad which crosses a causeway between Grove and Plow Shop Ponds. The pond is eutrophic with abundant aquatic plant life. Plow Shop Pond is used by local residents for recreational fishing, and is canoe-accessible at a landing on the northwest side. Signs are posted for "catch and release" fishing.

Plow Shop Pond and the surrounding ponds and rivers are located within the Squannassit Area of Critical Environmental Concern (ACEC). The ACEC designation by the Massachusetts Secretary of Energy and Environmental Affairs creates a framework for local, regional, and state stewardship of critical natural resources. The Squannassit ACEC encompasses 37,450 acres in portions of nine towns, and for the most part lies along and to the west of the Nashua River, from a section of Route 2 in the Towns of Harvard and Lancaster north to New Hampshire. ACEC resource details are provided at www.mass.gov/dcr/stewardship/acec/acecs/l-squsit.htm.

Study Area (SA) 71 at the southeast corner of the pond is the former location of a railroad roundhouse operated by the Boston and Maine Railroad from approximately 1900 to 1935. The site consists of a 200- to 300-foot wide strip of land extending south from Plow Shop Pond along the northeast installation boundary for approximately 1,100 feet. Historical features included an array of railroad tracks, a coal trestle, ash pit, water tower, and several buildings. The roundhouse was located at the northern end of this strip, immediately adjacent to the southern shore of Plow Shop Pond. Available maps and aerial photographs indicate that all of the buildings except a brick storeroom and the water tower had been removed by 1942. A final Sediment Risk Characterization for SA 71 was completed in 2008 based on investigations up to 2006 (MACTEC, 2008). An earlier Expanded Site Investigation (ESI) by USEPA included risk assessments for data collected by numerous investigators up to 2005 (Gannett Fleming, 2006).

2.0 HUMAN HEALTH RISK ASSESSMENT APPROACH

This section of the HERA Plan documents the approach to be used to evaluate human exposures at Plow Shop Pond (AOC 72) as they relate to SHL and SA 71. The Human Health Risk Assessment (HHRA) will be conducted in accordance with the following guidance:

- USEPA Risk Assessment Guidance for Superfund (RAGS) Volume I, *Part A Human Health Evaluation Manual* (USEPA, 1989a);
- RAGS Volume 1, *Part D Standardized Planning, Reporting and Review of Superfund Risk Assessments* (USEPA, 2002a);
- RAGS Volume I, *Part E, Dermal Risk Assessment Interim Guidance* (USEPA, 2004);
- *Calculating Upper Confidence Limits for Exposure point Concentrations at Hazardous Waste Sites* (USEPA, 2002b);
- *Standard Default Exposure Factors* (USEPA, 1991)
- *Exposure Factors Handbook.* Volumes I-III (USEPA, 1997a); and
- MassDEP *Guidance for Disposal Site Risk Characterization* (MassDEP, 1995) and technical updates.

The quantitative HHRA will follow the four-step process of hazard identification, toxicity assessment, exposure assessment, and risk characterization defined by the National Academy of Sciences (NAS, 1983), the USEPA (1989a), and MassDEP (1995). A qualitative uncertainty analysis discussion will also be included.

2.1 Hazard Identification

The hazard identification section will summarize the relevant data by media (surface water or sediment) that exist for AOC 72 and background/reference areas. This includes validated data from existing studies and data to be collected as described elsewhere in this RI Workplan. All data will be summarized in data tables by environmental sample type and will include frequency of detection, range of laboratory reporting limits, range of detected concentrations, and arithmetic average concentration.

In accordance with USEPA guidance (USEPA, 1989a), an evaluation of the frequency of detection of the site data will be conducted. Compounds that are infrequently detected (e.g., in less than 5% of the samples) at low concentrations in one or two media may be excluded from further evaluation in the risk assessment (USEPA, 1989a). Compounds that were analyzed for, but not detected, will be qualitatively evaluated to determine if further evaluation is warranted. Compounds noted as "estimated" by the laboratory will be included as detected values. An evaluation of the data usability in the risk characterization will be provided, where possible, including evaluations of analytical data quality (i.e., method blank contamination), field sampling, and data quality objectives. All compounds that are omitted from the risk assessment will be identified with the reasons clearly stated.

Compounds of Potential Concern (COPCs) are defined as the analytes that are carried through the quantitative risk characterization step. An analyte is not considered a COPC and is excluded from the risk characterization if it is detected at low frequencies and concentrations. In addition, analytes whose detected concentrations are below relevant risk-based concentrations (e.g. USEPA Regional Screening Levels [http://epp-prgs.ornl.gov] based on an adjusted noncancer hazard index limit of 0.1 and cancer risk limits of 1x10-6) are not considered COPCs. Background/reference concentrations will be identified during the Hazard Identification in accordance with USEPA policy and guidance (USEPA 2002c; 1989), but no compound will be eliminated from the risk characterization if found to be less than background/reference concentrations in accordance with USEPA Region I guidance (USEPA, 1995b). Background/reference concentrations are presented for information purposes only for possible use in the RI/FS. All COPCs are carried through the quantitative risk characterization. Based on current understanding of the site, reference surface water and sediment concentrations for Plow Shop Pond will include data from Grove Pond and from reaches of Plow Shop Pond unaffected by SHL or SA 71 (see Section 2 of the RI Workplan).

2.2 Toxicity Assessment

The toxicity assessment section will summarize the available toxicity data for the COPCs identified at AOC 72. The toxicity data will be obtained from approved USEPA sources (e.g., Integrated Risk Information System (IRIS) (USEPA, 2008), or other sources such as MassDEP, the National Center for Environmental Assessment [NCEA], or the Agency for Toxic Substances and Disease Registry [ATSDR]). For compounds that have no toxicity information, toxicologists at USEPA Region I will be consulted regarding approaches for evaluating potential human health impacts.

2.3 Exposure Assessment

The exposure assessment will provide a discussion of the type and magnitude of exposures to COPCs in the environmental media at AOC 72. The exposure assessment will consist of the following elements: an identification of the potential receptors, including sensitive subgroups; an evaluation and description of the complete exposure pathways; and an estimate of the pathway specific exposure for each potential receptor.

2.3.1 Exposure Scenarios

Previous HHRAs conducted for AOC 72 and surrounding areas have included:

1) *Final SA 71 Sediment Risk Characterization* (MACTEC, 2008)

2) *Expanded Site Investigation* (Gannett Fleming, 2006)

3) *Revised Draft Shepley's Hill Landfill Supplemental Groundwater Investigation* (Harding ESE, 2002)

4) *Evaluation of Health Concerns Associated with Grove Pond and Plow Shop Pond* (ATSDR, 1998)

A Conceptual Site Model for human exposures was developed based on the information presented in these reports. This exposure model, presented in Figure 2, indicates that a complete exposure pathway exists for recreational users of Plow Shop Pond potentially exposed to contaminants via ingestion and dermal absorption of media, and ingestion of fish.

The recreational user will include a pre-adolescent to adolescent age group (ages 6 to 16) and adult (age 17 to 30). It is noted that "catch and release" signs have been posted at Plow Shop Pond since the mid-1990s indicating that fish caught from the pond should not be eaten (Gannett Fleming, 2006). The HHRA evaluation will take into account the previous risk or hazard evaluations of Plow Shop Pond as they relate to SHL and SA 71. The use of measured and estimated concentrations of COPC in fish will be consistent with the data and methods used for the ecological risk assessment, as described in Section 3.2.4.

2.3.2 Estimating Exposure

Consistent with USEPA guidance, Reasonable Maximum Exposure (RME) scenarios will be evaluated in the HHRA for all relevant exposure pathways. Conservative exposure assumptions are used to construct a RME scenario (USEPA, 1999a). Most individuals will not be subject to all the conditions that comprise the RME scenario. Individuals who do not meet all conditions in the RME scenario have lower potential exposures to constituents and, therefore, lower potential risks associated with those exposures.

For each complete exposure pathway and receptor, the Average Daily Dose (ADD) will be calculated to estimate a potential receptor's daily intake from exposure to COPCs. According to USEPA (1989a), the exposure dose should be calculated by averaging over the period of time for which the potential receptor is assumed to be exposed. For compounds with potential carcinogenic effects, the lifetime dose is averaged over the course of a lifetime (70 years) (USEPA, 1989a). The ADD equations for sediment and surface water exposures will be consistent with equations presented by USEPA (1989b) and MassDEP (1995).

Exposure points, the location of potential contact between a receptor and a COPC, will be defined within each site based on the media-specific data relevant for potential exposure(s) and typical behavior patterns for that receptor type. Furthermore, an evaluation of potential "hot spot" areas with elevated concentrations will occur, and any such areas and concentrations will be clearly identified. For each relevant medium, exposure points may be defined as the entire site and/or a smaller area based on whether the medium-specific sampling data indicate a smaller exposure point is relevant for that exposure, or if exposure patterns dictate a smaller area is more relevant. A "near shore" sediment data grouping (samples within 10 feet of the shoreline) will be included for evaluating a recreational wader exposure.

The exposure point concentration for each exposure area will be calculated using USEPA-approved methodology (USEPA, 2002b) such as 95% upper confidence limits of the means or a spatial-weighting approach (e.g., developed using kriging or thiessen polygons) of the data representing the exposure area. In cases where the calculated 95% upper confidence limit exceeds the maximum detected value[1], the maximum detected value will be used in the calculation of risk. For the purposes of developing exposure point concentrations in the risk assessment, analytical values reported as "Not Detected" (ND) will be assigned a value of one-half the reporting limit for initial review of the results. In those cases where the chemical may be a risk- or remediation-driver, an uncertainty evaluation using the alternative non-detect substitution schemes from the ProUCL software program will be performed.

[1] The calculated 95% upper confidence limit can exceed the maximum media-specific concentration when datasets are small (typically less than 7 samples).

The bioavailability of metals in sediment samples will be considered, specifically arsenic concentrations based on collocated concentrations of iron and other factors such as organic carbon, pH, and redox conditions.

2.4 Risk Characterization

The goal of the risk characterization is to provide stakeholders with sufficient information to make informed decisions about COCs, media, and areas impacted by SHL or SA 71 that may need to have remedies evaluated through an FS. The risk characterization step will include the following evaluations.

First, the risk characterization will combine the toxicity data from the toxicity assessment section and the exposure data from the exposure assessment section to estimate potential upper-bound (conservative) cancer risks and noncancer hazards for all identified receptors with potentially complete exposure pathways. For COPCs considered by USEPA to be carcinogenic in humans, estimated total lifetime cancer risks from all exposure pathways for a potential receptor will be compared to the NCP cancer-risk limit range of one in ten thousand (1×10^{-4}) to one in one million (1×10^{-6}) (USEPA, 1990). If estimated total lifetime cancer risks exceed this risk limit range, the compounds that are the primary drivers of excess risk will be identified as COCs for further evaluation. For non-cancer endpoints, the estimated total Hazard Index (HI) from multiple exposure pathways for a potential receptor will be compared to a HI limit of 1. If the total HI exceeds 1, COPCs will be segregated by critical effects. All COPCs that contribute to an endpoint-specific HI that exceeds 1 will be identified as COCs for further evaluation in an FS.

The risk characterization will also include the following items:

- An evaluation of all applicable or suitably analogous public health standards (e.g., Massachusetts Surface Water Quality Standards [314 CMR 4.00]);
- A discussion of the uncertainty regarding the data and assumptions used in deriving the risk estimates.

3.0 ECOLOGICAL RISK ASSESSMENT APPROACH

The ecological risk assessment (ERA) at AOC 72 will be performed using USEPA ERA guidance (USEPA, 1989b; 1992; 1997b; 1998, 1999b, and 2001c) and MassDEP's ERA guidance and associated sediment screening values for assessing the risk of harm to the benthic macroinvertebrate community (MassDEP Interim Technical Updates, 2006a-d). The ERA also will be conducted in a manner consistent with the MCP (310CMR 40.0000) and the associated environmental risk characterization guidance (MassDEP, 1996). The purpose of the ERA will be to determine whether there is a risk of adverse impact posed to potential ecological receptors within Plow Shop Pond from the SHL and the Railroad Roundhouse (SA 71) area. Because of the complexity associated with AOC 72 due to the size, type and multiple potential sources of contaminants, the ecological risk assessment will be evaluated on a weight of evidence approach. Findings will be combined with the spatial distribution analyses in a manner that will permit the identification of overall ecological significance as well as the identification of additional objectives related to the magnitude, responsible agents, and locations of any identified potential impacts.

Risks for those areas of Plow Shop Pond located adjacent to SHL and SA 71 sources of contamination will be compared to those for the reference habitat of reaches of Plow Shop Pond and Grove Pond that are beyond the influence of source areas, to assess contributions to total risk. Landfill and SA 71 risk increments will be assessed by comparisons of existing and supplemental data for the identified sources to appropriate subsets of the existing sediment and surface water chemistry and toxicity data from USEPA's baseline ERA for Plow Shop Pond (Gannett Fleming, 2006).

The ERA will consist of two phases: ecological screening and subsequent baseline ecological risk characterization, each of which is discussed in the following sections. If current or potential future exposures to contaminants in any media are deemed having a potential for risk by ecological screening, an ecological risk characterization will be conducted. Ecological risk characterization is consistent with a baseline ERA and involves Problem Formulation, Analysis, and Risk Characterization, as outlined below.

3.1 Ecological Screening

The ecological component of the ecological risk assessment will not include a screening assessment *per se*. Rather, the identification of potential complete exposure pathways and potential wildlife populations at risk will be based on the Expanded Site Investigation (ESI) developed by USEPA (Gannett Fleming, 2006). The ESI report identified the following findings for Contaminants of Potential Concern (COPCs):

- No unacceptable risk detected to pelagic invertebrates as the result of COPCs associated with SHL or SA 71 based on comparisons of maximum exposure point concentrations to benchmarks as well as direct toxicity testing.
- No unacceptable risk detected to fish communities as the result of COPCs associated with SHL or SA 71 based on comparisons of maximum exposure point concentrations to benchmarks as well as direct toxicity testing.

- No unacceptable risk detected to piscivorous aves as the result of COPCs associated with SHL or SA 71 based on comparisons of maximum exposure rates.
- No unacceptable risk detected risk to insectivorous aves as the result of COPCs associated with SHL or SA 71 based on comparisons of maximum exposure rates.
- Potential risk to benthic macroinvertebrates (BMI) as indicated by exceedance of applicable sediment benchmarks for arsenic and PAHs. The ESI also found potential for unacceptable risk based on benthic toxicity test results, attributed to PAHs in SA 71 but not attributable to a specific COPC in other areas. Comparison of tissue residue levels against literature values suggested a low risk to BMI.
- Potential risk to omnivorous mammals as indicated by exceedance of applicable exposure benchmarks for arsenic and PAHs via ingestion for the raccoon.
- Potential risk to piscivorous mammals as indicated by exceedance of applicable exposure benchmarks for arsenic and PAHs via ingestion for the mink.
- Potential risk to omnivorous aves as indicated by exceedance of applicable exposure benchmarks for chromium via ingestion for the black crown night heron.

Based upon these findings, the baseline risk assessment will focus on impacts to benthic macroinvertebrates, omnivorous and piscivorous mammals, and omnivorous aves.

3.2 Baseline Ecological Risk Assessment

The baseline ecological risk assessment combines an exposure assessment component with an effects assessment component in order to determine the potential impact to wildlife receptor populations exposed to AOC 72. The assessment will be structured in compliance with OSWER guidance directive 9285.7-28 P and specifically the following:

> "Except at a few very large sites, Superfund ERAs typically do not address effects on entire ecosystems, but rather normally gather effects data on individuals in order to predict or postulate potential effects on local wildlife, fish, invertebrate, and plant populations and communities that occur or that could occur in specific habitats at sites (e.g. wetland, floodplain, stream, estuary, grassland, etc.). Ecological risk assessments incorporate a wide range of tests and studies to either directly estimate community effects (e.g. benthic species diversity) or indirectly predict local population-level effects (e.g. toxicity tests on individual species), both of which can contribute to estimating ecological risk. Superfund remedial actions generally should not be designed to protect organisms on an individual basis (the exception being designated protected status resources, such as listed or candidate threatened and endangered species or treaty-protected species that could be exposed to site releases), but to protect local populations and communities of biota. Levels that are expected to protect local populations and communities can be estimated by extrapolating from effects on individuals and groups of individuals using a lines-of-evidence approach".

As such, the risk assessment will be structured to evaluate potential for impact on the collected individuals within the exposed population, based on individuals' risks, in order to quantitatively express the potential risk for effects on the subpopulations and communities as will occur in the specific habitats related to AOC 72. This is in keeping with Principal 1 and Principal 4 of the above guidance expressed as follows:

Principle No. 1 -Superfund's goal is to reduce ecological risks to levels that will result in the recovery and maintenance of healthy local populations and communities of biota. The goal of the Superfund program is to select a response action that will result in the recovery and/or maintenance of healthy local populations/communities of ecological receptors that are or should be present at or near the site. Superfund risk managers and risk assessors should select assessment endpoints and measures (as defined in the 1997 ERAGS) that: 1) are ecologically relevant to the site; i.e., important to sustaining the ecological structure and function of the local populations, communities and habitats present at or near the site, and 2) include species that are exposed to and sensitive to site-related contaminants.

Principle No. 4 - Characterize site risks. When evaluating ecological risks and the potential for response alternatives to achieve acceptable levels of protection, Superfund risk managers should characterize site risks in terms of: 1) magnitude; i.e., the degree of the observed or predicted responses of receptors to the range of contaminant levels, 2) severity; (i.e., how many and to what extent the receptors may be affected), 3) distribution; i.e., areal extent and duration over which the effects may occur, and 4) the potential for recovery of the affected receptors. It is important to recognize, however, that a small area of effect is not necessarily associated with low risk; the ecological function of that area may be more important than its size.

Therefore, in keeping with these and the others of the six guiding principals and the results of the ESI (Gannett Fleming, 2006), the baseline ecological risk assessment will be structured to address the following assessment endpoints:

1. Risk of adverse effects within the subpopulations of BMI and epibenthic macroinvertebrates (eBMI) as the result of exposure to COPCs related to the SHL and SA 71 that would manifest significant changes to the abundance or diversity of the BMI communities,
2. Risk of adverse effects within the subpopulations of BMI and eBMI as the result of the presence of the iron floc potentially acting as an asphyxiant in Red Cove and thereby manifesting significant changes to the abundance or diversity of the BMI communities,
3. Risk of adverse effects within the subpopulations of BMI, pelagic macroinvertebrates (PMI), and fish (pisces) as the result of the presence of the ammonia effluxes specific to groundwater upwelling locations in Red Cove and manifesting significant changes to the abundance or diversity of these communities,
4. Risk of any adverse effect to any individual terrestrial aves omnivores as the result of exposure to COPCs related to the SHL and SA 71,
5. Risk of any adverse effect to any individual terrestrial mammalian omnivores as the result of exposure to COPCs related to the SHL and SA 71,
6. Risk of any adverse effect to any individual terrestrial mammalian piscivores as the result of exposure to COPCs related to the SHL and SA 71,
7. Risk of adverse effects within subpopulations of terrestrial aves omnivores as the result of exposure to COPCs related to the SHL and SA 71 that would manifest as an inability to maintain healthy local populations,

8. Risk of adverse effects within subpopulations of terrestrial mammalian omnivores as the result of exposure to COPCs related to the SHL and SA 71 that would manifest as an inability to maintain healthy local populations, and
9. Risk of adverse effects within subpopulations of terrestrial mammalian piscivores as the result of exposure to COPCs related to the SHL and SA 71 that would manifest as an inability to maintain healthy local populations.

These assessment endpoints and the associated measurement endpoints are discussed in the following subsections.

3.2.1 Risk to BMI and eBMI from COPCs (Assessment Endpoint 1)

Evaluation of risk to BMI from the presence of COPCs in the sediments will be performed based on a Sediment Quality Triad (SQT) approach. In this case, measured sediment concentrations of SHL and SA 71 COPCs will be correlated with sediment toxicity and significant variability in benthic community structure. Current data related to sediment chemistry and the SA 71 BMI test results (MACTEC 2008) will be supplemented with additional 20-day (Choronomid) and 42-day (amphipod) sediment toxicity tests as well as co-located sediment benthic community surveys. The specific measurement endpoint will be the exceedance of site-specific Threshold Effects Concentrations (TECs). The development of the TECs and subsequent analysis of risk will follow standard USEPA proposed guidance as follows:

- Indication of adverse benthic impact will be deemed as statistically significant reductions in either growth or survival between samples taken within AOC 72 relative to the reference areas.
- Indications of adverse benthic impact will be deemed as a statistically significant reduction in abundance, biodiversity or productivity (as defined as reduction in potential reproduction based on any observed reproductive effects) based on analysis of variance and orthogonal contrasts between the sites analyzed in AOC 72 relative to the reference areas.
- Co-located chemistry data will be ranked based on magnitude of response to either toxicity or benthic community data in order to determine TECs as suggested by MassDEP based on the chemical availability of the specific COPCs.
- Combining all available chemistry data, AOC 72 will be subdivided using minimum area integration (i.e. Thiessen polygon analysis) to indicate the areas of potential benthic impact based upon comparisons to site-specific TECs.
- The TEC will be determined as the geometric mean of the no-effect concentration and the lowest effect concentration as defined by McDonald (2000).

Sediment regions found to exceed the COPC-specific TECs will be deemed to be at potential risk in accordance with the measurement endpoint.

Along with the sediment toxicity endpoints, the test sites will be compared with regard to variability in the benthic and epibenthic community structures. BMI and eBMI will be co-collected from the same sampling locations as those used in the sediment chemistry and toxicity analyses. Communities will be analyzed to at least the genus level, and to the species level to the extent possible considering organism maturity and condition, and compared to in-lake and reference areas by analysis of variance and orthogonal contrast. Significant differences in the biology (e.g. macroinvertebrate communities) between the potentially impacted sites and the defined reference locations will be correlated with the defined TEC to determine the degree of impact using a weight of evidence approach.

3.2.2 Risk to BMI from Physical Smothering (Assessment Endpoint 2)

The potential for the iron floc observed in Red Cove to act as a physical stressor (assessment endpoint 2) to BMI will be examined in a different analysis. The measurement endpoints here will be A) the detection of reduced DO coincidental with the presence of the floc, and B) the presence of physical attributes to the floc that would permit it to behave as a smothering agent. Sediments in the presence and absence of the floc will be tested in situ for DO content and for density, grain size and specific gravity with a calculation for porosity. If it is found that the DO and physical properties of the sediments are significantly impacted by the presence of the floc, then it can be concluded that the floc does pose a potential risk as a sediment smothering agent in AOC 72. A literature review will also be conducted to evaluate the potential smothering effects of similar flocs on aquatic biota at other sites. Results of this causative analysis will then be compared to concurrent BMI and eBMI community analyses in order to determine whether the perceived changes in oxygen exchange are manifest in significant adverse impacts to the respective habitats.

3.2.3 Risk to BMI/PMI and Pisces from Ammonia (Assessment Endpoint 3)

In response to a presumption of potential risk recognized since the completion of the EPA risk assessment (Gannett Fleming, 2006), a separate assessment endpoint was formulated to address the potential of impacts associated with potentially elevated ammonia concentrations immediate to the locations of groundwater upwelling in Red Cove.

Surface water samples will be collected immediate to the regions of upwelling and tested for dissolved oxygen, pH, and ammonia content. This will be compared to local ambient conditions in Red Cove as well as current Criterion Continuous Concentration (CCC) defined in the national water quality criteria (USEPA 2002e) as follows:

$$CCC = \frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}} \cdot MIN\left(2.85, 1.45\times 10^{0.028(25-T)}\right)$$

Where T is the absolute temperature. The extent of impact will be defined as the region where the ammonia content (in mg N per l) exceeds the CCC.

3.2.4 Individual Risk to Terrestrial Wildlife (Assessment Endpoints 4-6)

Risk to terrestrial wildlife will be assessed in order to address assessment endpoints 4 through 6. Based upon the impacts with regard to population sustainability in accordance with principal 4, the measurement endpoint will be the cumulative impacts to individuals composing the exposed population that will result in an effective loss in the ability of inherently maintaining themselves. The individual impacts will be evaluated based on their exposure rates relative to a class-specific toxicity reference value (TRV) derived for the specific COPC of exposure. The sentinel populations that are to be evaluated are inclusive to those that demonstrated risk in the ESI (Gannett Fleming, 2006) and are as follows:

- Raccoon (*Procyon lotor*) as the most sensitive sentinel for indigenous omnivorous mammals,
- Mink (*Mustela vison* aka *Neovison vison*) as the most sensitive sentinel for indigenous piscivorous mammals, and
- Black crown night heron (*Nycticorax nycticorax*) as the most sensitive sentinel for indigenous piscivorous aves.

Food chain exposures of the raccoon, mink, and black crowned night heron will be evaluated for both Plow Shop Pond and Grove Pond based on food chain models that estimate exposures to COPCs in relevant environmental media for three separate pathways: (1) ingestion of COPCs in food (consumption of prey items), (2) incidental ingestion of COPCs in associated physical media, and (3) imbibition of drinking water from assessed water bodies. The wildlife exposure models will include prediction of whole body tissue concentrations of COPCs in representative prey/food species for the respective wildlife receptors that consume each plant or prey item. The distribution function of the daily dosages (*f*(DD))will be based on the integration across the population on size N based on the spatial distribution of the COPCs within the defined habitat and the natural history of the respective receptor as follows:

$$f(DD) = \int_{n=1}^{N} \frac{f(\text{food})_n + f(\text{water})_n + f(\text{sediment})_n}{BW_n} dn$$

$$Where:$$

$$f(\text{food})_n = IR(food)_n \cdot \int_{m=1}^{M} [CoPC]_m \, p_m dp$$

$$f(\text{water})_n = IR(water)_n \cdot \int_{l=1}^{L} [CoPC]_l \, p_l dp$$

$$f(\text{sediment})_n = IR(Sed)_n \cdot \int_{k=1}^{K} [CoPC]_k \, p_k dp$$

Where:

N	: Exposed sentinel receptor population of individuals n
BW_n	: Body weight in receptor individual n (kg).
$IR(food)_n$	: Food Ingestion rate for individual n (kg/day)
$IR(water)_n$	: Water Ingestion rate for individual n (l/day)
$IR(Sed)_n$	: Sediment Ingestion rate for individual n (kg/day)
M	: Aggregate of all potential m food sources
$[COPC]_m$	: COPC concentration in food source m (mg/kg)
p_m	: Probability of exposure to food source m
L	: Aggregate of all potential l water sources
$[COPC]_l$	: COPC concentration in drinking water source l (mg/kg)
p_l	: Probability of exposure to drinking water source l
K	: Aggregate of all potential k sediment sources
$[COPC]_k$	: COPC concentration in sediment source k (mg/kg)
p_k	: Probability of exposure to sediment source k

The probability functions will be determined as the product of the probability that an individual will be on site (based on foraging area and seasonal use; see below) and the probability that the given individual will be exposed to a specific type of prey item (based on natural history), water source (based on relative surface areas of the water source) and location in the sediment (based on the area of the sediment projected in the above Thiessen polygon analysis). All potential results (minimum exposure to maximum exposure) will by aggregated and weighted based on their probability of occurring as determined by the proportion of the exposure point as a proportion of the entire habitat. For example, if a site represents 100 percent of the receptors foraging range, and the exposure concentrations in 50 percent of the area is 1 and 50 percent of the area is 2, then the probability function will be 0.5 times 1 and 0.5 times 2. If the site represents 75 percent of the habitat, and the background concentration is 0.5, then the probability function will be 0.25 time 0.5, 0.38 times 1, and 0.38 times 2. The integration of the various functions for exposure to food sources, water sources, and incidentally ingested sediment sources provides the distribution of the exposure for all individuals within the population that will be applied in the individual effects assessment below.

Dietary Intake Rate and Body Weight

The distribution of the dietary composition of the wildlife receptor will be estimated or assumed using life history data summarized in the USEPA Wildlife Exposure Factors Handbook (1993b).

COPC Concentration in Diet

Bio-uptake of COPCs from applicable environmental media (e.g., surface water, sediment) will be modeled into tissues of dietary items (e.g., plants, macroinvertebrates, insects, amphibians, and fish) for each of the wildlife indicator species. Bioconcentration factors (BCFs) are typically used to predict COPC concentrations in aquatic and wetland biota, based on bioavailable COPC concentrations in sediment and/or surface water. Bioavailable concentrations will be determined based on the solubility of inorganic COPC salts present, except that for arsenic a BCF of 1 will be used. For organic COPCs, the available fraction will be assumed to be the total concentration in the appropriate medium of exposure.

To conform to CERCLA guidance for ERA, it is preferable to incorporate site-specific empirical data on actual body burden concentrations of COPCs, or to apply BCFs derived from such site-specific data for samples of biota and associated physical media, rather than rely on published BCFs or theoretical models of COPC bio-uptake.

To estimate the concentration of COPCs in aquatic or wetland plants consumed by omnivorous indicator species, the following BCFs will be used, listed in order of preference:

1. COPC BCFs for uptake in plant tissues, if measured from previous field sampling efforts at this site, will be used first whenever appropriate.
2. Metal COPC concentrations in wetland plant tissues will be estimated using factors provided in sources such as Baes et al. (1984), USEPA (2005) EcoSSL Guidance, and Sample et al. (1997; 1998).
3. For COPCs lacking specific information on the BCF, a default value of 1 will be used.

To estimate the concentration of COPCs in benthic macroinvertebrates, insects, amphibians, fish, and bird eggs consumed by one or more of the omnivorous and piscivorous bird or mammal indicator species, the BCFs to be used, listed in order of preference, are:

1. COPC BCFs for uptake into benthic macroinvertebrate tissues measured in previous field sampling efforts at SHL, such as those for the Plow Shop Pond ERA (e.g., Gannett

Fleming, 2006) or biota sampling and tissue analyses for Nonacoicus Brook, will be used first whenever appropriate.

2. COPC-specific, media-to-prey BCFs for aquatic and wetland macroinvertebrates and other prey will be obtained from the previous ESI (Gannett Fleming, 2006) and supplemented by USEPA (1999b) and other sources, as needed.
3. For COPCs lacking specific information on the BCF or relevant information from the literature, a default value of 1 will be used.

Exposure Point Concentrations will be calculated for all major dietary/prey items, based on pertinent physical media of concern, for each of the indicator species representing the wildlife receptor groups of concern.

COPC Concentration in Drinking Water

Concentrations of COPCs in drinking water will be determined based on the fitted distribution of all measured concentrations in either AOC 72 or Grove Pond.

Area and Seasonal Use

For those receptors with large foraging ranges, only a fraction of the receptor's feeding range is actually made up of habitat within the site. The area use is factored into the probability of exposure based on areal proportion relative to the total foraging area. For example, if AOC 72 comprises 75 percent of a receptor's foraging habitat, then the probability of intersecting an AOC 72 exposure source is 0.75. For the remaining probability (0.25), the individual is assumed to be intersecting exposure sources at background concentrations. Probability of area use will be adapted, as appropriate, from those used in the Plow Shop Pond baseline ERA (Gannett Fleming, 2006), with modifications based on realistic foraging behaviors expected for each wildlife indicator species in the aquatic and wetland habitats of these two study areas.

Because of the variability in toxicity study duration and lack of standardization in the time to manifestation verses period of exposure, seasonal use is assumed to have a conservative probability of 1.0 for the general environs of AOC 72.

Effects Assessment

The food chain exposure effects assessment entails reviewing the ecotoxicology of the COPCs and then developing TRVs for the selected ecological receptors for each COPC. EPA EcoSSLs will be employed when available. TRVs may also be derived using No Observed Adverse Effect Level (NOAEL) values from literature sources, such as Schafer *et al.* (1983), USEPA (1999b), Sample *et al.* (1996), Human and Ecological Risk Division (HERD, 2000), and IRIS (USEPA, 2008). When NOAELs are not available, one will be derived from the Lowest Observed Adverse Effect Levels (LOAELs) as outlined below. If no toxicity values are available for a particular compound, appropriate surrogate chemical chronic NOAELs will be used to develop TRVs. Surrogate chemicals will be selected based on structural chemistry, specifically, the active moiety/functional group of the chemical. TRVs will be selected using material developed by the U.S. Army Center for Health Promotion and Preventive Medicine (e.g., Johnson and McAtee, 2000; USACHPPM, 2001) along with all other available sources including those mentioned above.

Effects considered ecologically relevant are growth, reproduction, and mortality. The relevancy of the route of administration will be considered secondary to the effect. The highest NOAEL that is lower than the lowest LOAEL will be used when available. For chemicals without chronic dose-response-based NOAELs, but for which other toxicity values are available, uncertainty factors will be applied to extrapolate these other toxicity values to chronic NOAELs. These other toxicity values include less than chronic NOAELs (e.g., subchronic NOAELs, LOAELs, and the lethal dose for 50 percent of a study population [LD_{50}]). Specifically, an uncertainty factor of 10 (as cited in Sample *et al.*, 1996) will be used to adjust LOAEL TRVs to NOAEL TRVs, and an uncertainty factor of 10 (as cited in Sample *et al.*, 1996) will be used to adjust TRVs derived from subchronic studies to chronic TRVs. An uncertainty factor of 1000 will also be used to adjust LD_{50} values to chronic NOAEL equivalent values. If a NOAEL is derived by application of a 10-fold uncertainty factor to a LOAEL (to adjust for endpoint) and the derived NOAEL TRV value is lower than an actual measured NOAEL, the measured NOAEL is used.

The final step in the effects assessment involves the determination of the probability of adverse ecological effects to the individual ecological constituents within the exposed receptor populations. Since the TRV is considered to be an absolute threshold whose exceedance, by definition, will result in an unacceptable risk of and adverse response, the proportion of that population whose exposure is equal to or exceeds the formulated TRV are therefore those individuals whose situation is such as to be at risk of manifesting said toxic response ($p_{risk} = p(HQ \geq 1 | f(DD))$). This is identical to the typical hazard quotient approach but rather than testing for whether an arbitrary statistic upon the exposure concentration exceeds the TRV, it tests for what proportion of the population would be expected to have an exposure equal to or in excess of the TRV. Results will be reported using TRVs based upon both the LOAELS and the NOAELS for each of the COPCs assessed.

The specific toxic response (increased mortality, reduced growth, reduced fecundity, etc.) is dictated by the observations in the toxicological study. However, within the context of this ERA, the magnitude of the response for that proportion whose exposure meets or exceeds the TRV will be 100 percent of the specific toxicological endpoint. The result of this proportion of the population manifesting the toxicological endpoint is thus evaluated within the context of assessment endpoints 4 thru 6 and will be the basis for their evaluation in the ecological risk characterization. Furthermore, positive results will automatically activate the assessment endpoints 7 thru 9 to evaluate the magnitude and significance of the projected impacts.

3.2.5 Characterization of Ecological Significance (Assessment Endpoints 7-9)

In the risk characterization, the risks associated with estimated exposures to COPCs are characterized for each potential individual for each assessment endpoint. This will be characterized as the proportion probability of exposure over the entire site based on habitat use. As a simplified example, if 50 percent of the possible exposure area has a concentration equivalent to an exposure of 1, 25 percent at 2, and 25 percent at 3, then the exposure distribution will be 0.5 for 1, 0.25 for 2, and 0.25 for 3. If the TRV for reproduction is 1.1, then 0.5 of the population will manifest no impact on reproduction, while 0.5 will manifest a default 100 percent reproductive failure.

The maintenance of a healthy population encompasses one that is not reliant upon recruitment to maintain carrying capacity. Carrying capacity (Kp) is defined as the number of individuals a defined area can support and is almost always limited by availability of food or habitat. The actual value of Kp is irrelevant in this analysis since it impacts only the rate at which a population can be expected to change and not on the actual direction (i.e increasing or decreasing local population). Hence, the value of the recruitment rate (e) will be evaluated on a per female basis (Kp =1). Proposed values are as follows:

Receptor	Fecundity (r per annum)	Mortality (M per annum)	e no stress (per breeding female per anum)
Raccoon (*Procyon lotor*)	1.7-1.9	0.38-0.56	-0.358
Mink (*Neovison vison*)	2-5	0.33-0.5	-1.63
Black crown night heron (*Nycticorax nycticorax*)	0.5-.97	0.39-0.69	-0.136

The inherent ability of a population to maintain carrying capacity is a function of the collective individuals' rate of fecundity (rp) relative to their rate of mortality (Mp). As follows:

$$e = Kp - \left(P_{1(t-1)} \cdot (1 - M_{P_1}) \cdot \left(1 + r_{P_1} \cdot (1 - M_{f_2})\right)\right)$$

If the population is healthy and can sustain itself at the carrying capacity, then e will be equal to or less than zero. If the population is unhealthy in that it is dependent upon recruitment or is destined to reach extinction, then e will be greater than zero. Hence, the fitness of the population, based on the exposures and responses of the individuals making up the exposure population can be evaluated based on the probability of e being less than zero as follows:

$$e = Kp - \left(\frac{P_{1(t-1)}}{M_{P_1}} \cdot \left(1 + \frac{r_{P_1}}{M_{f_2}}\right)\right) \quad \begin{Bmatrix} e \le 0 & Sustainable \\ e > 0 & Unsustainable \end{Bmatrix}$$

$$M = M_{nat}\left(1 + p_{risk}\right) \quad r = r_{nat}\left(1 - p_{risk}\right)$$

The objective of this approach is to provide a context for the evaluation of projected potential impacts. By substituting the above-determined proportional risk based on toxicological endpoints of mortality and/or reproductive failure, a determination upon the measurement endpoint of sustainability can be made based on whether the local population is independently sustainable (no impact) or non-sustainable (potentially at risk). For example. the interplay between mortality and reproductive impact for the raccoon suggests that: 1) with no change in reproductive rate, the population will become unstable at an mortality rate of 63 percent or 13 percent above natural mortality rate, and 2) with mortality rate held constant, the population will become unstable at an r rate of 1.06, which is equivalent to 41 percent of the female population manifesting 100 reproductive failure.

3.3 Result Evaluation

The quantitative results of the ecological risk assessment are intended to provide a measure of impact as related to the presence of specifically identified COPCs. The relevance of the respective measures will be evaluated within a weight of evidence context to provide a conclusion of the magnitude of impact within the context of the system's conditions. The intent is to provide risk managers with an accurate and concise analysis upon which decisions on the necessity of remediation and restorations can be made. This analysis will be based on extent of identified impacts and severity with regards to ultimate outcome if left unaddressed. This analysis will be presented as a narrative within the results sections and will provide the basis for the assessment conclusions.

3.4 Uncertainty Evaluation

For the ERA, conservative assumptions and models will be used to estimate potential ecological risks. If no risks are estimated using these models, then the occurrence of adverse effects to ecological receptors is unlikely. The exception is the potential additive effects of unidentified stressors that may act synergistically to increase both the toxicological efficacy of the exposure, as well as the magnitude of impact on the population's sustainability. Risks may be overestimated using these assumptions and models because of their inherently conservative nature in both the exposure parameters as well as the assumption of total toxicological response (assumed complete mortality/reproductive failure at the LOAEL). For those combinations of COPCs, exposure pathways, and receptors estimated to pose potential risks, the report will identify further investigations that may be necessary to better characterize potential exposures. These may include additional field investigations to refine modeled estimates of chemical concentrations of COPCs in environmental samples or in prey species. Site-specific sampling of prey species for higher-level trophic receptors could include co-located sediment COPC samples with plant, macroinvertebrate, or small mammal COPC concentrations.

Additionally, toxicity information may not be available for all COPCs and all ecological receptors. For the ecological risk characterization, the use of surrogate data for TRV development may result in the estimation of potential risks that are a result of the selected surrogate. Additional data may be necessary to refine toxicity estimates, especially for avian receptors. This task could range from additional efforts to gather toxicity information for COPCs to replacing data from surrogates with site-specific toxicity testing for specific receptors (e.g., birds, small mammals).

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SITE LOCATION

Plow Shop Pond Location

Remedial Investigation Work Plan
AOC 72, Plow Shop Pond

Ayer, Massachusetts

Notes & Sources: Aerial Imagery: 1:5,000 Color Digital Ortho Images, Mass GIS, 2005.

LEGEND

Streams
Landfill Boundary

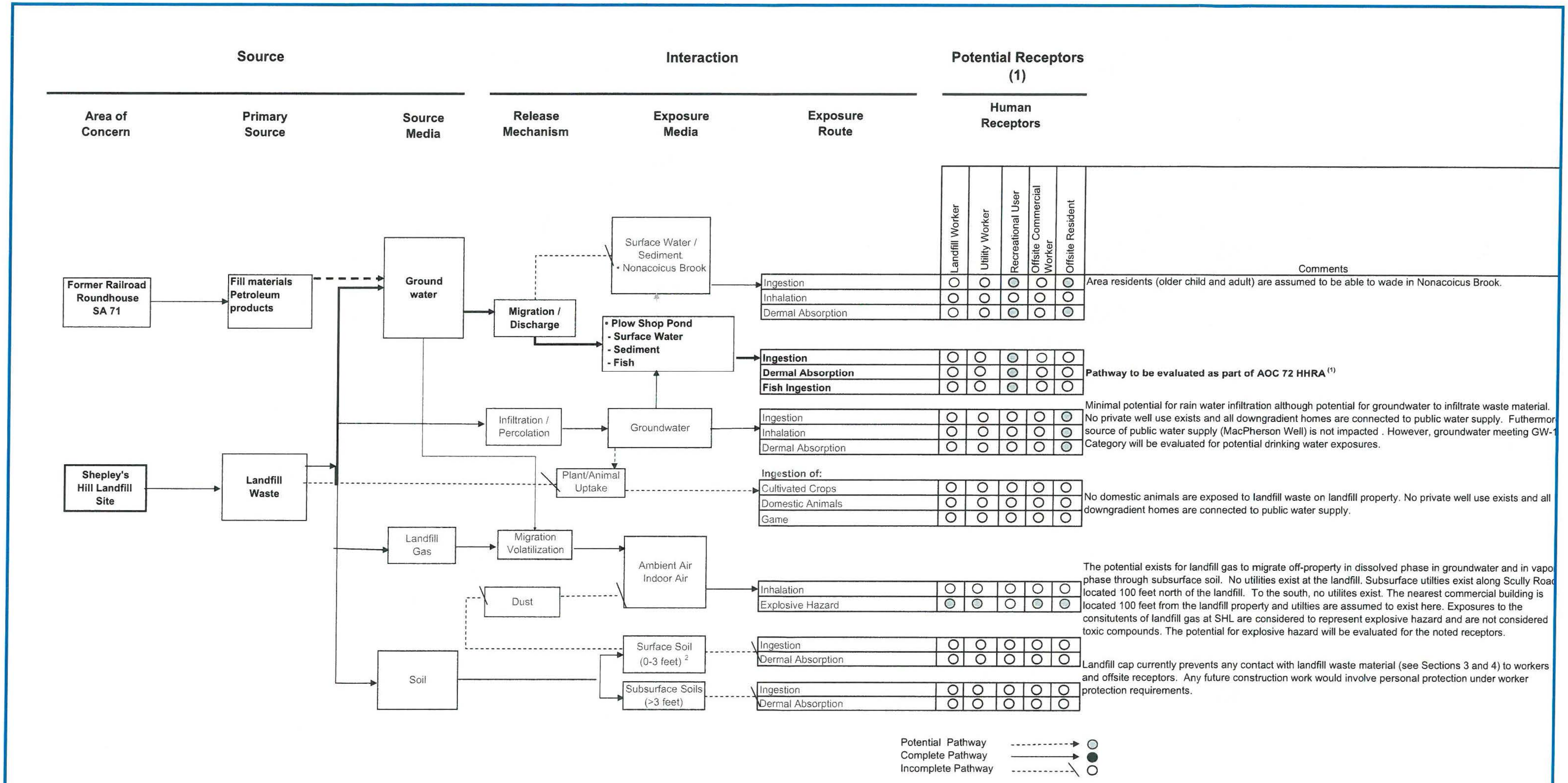
0 750 Feet

amec
AMEC Earth & Environmental, Inc.
2 Robbins Road
Westford, MA 01886
(978) 692-9090

FIGURE 1

H:\ShepleyLandfill\Task18\MXD\Figure1.mxd H:\ShepleyLandfill\Task18\Export\Figure1.pdf August 1, 2008 DWN: AP CHKD: KMP

Figure 2. Conceptual Site Model for Human Exposures for AOC 72

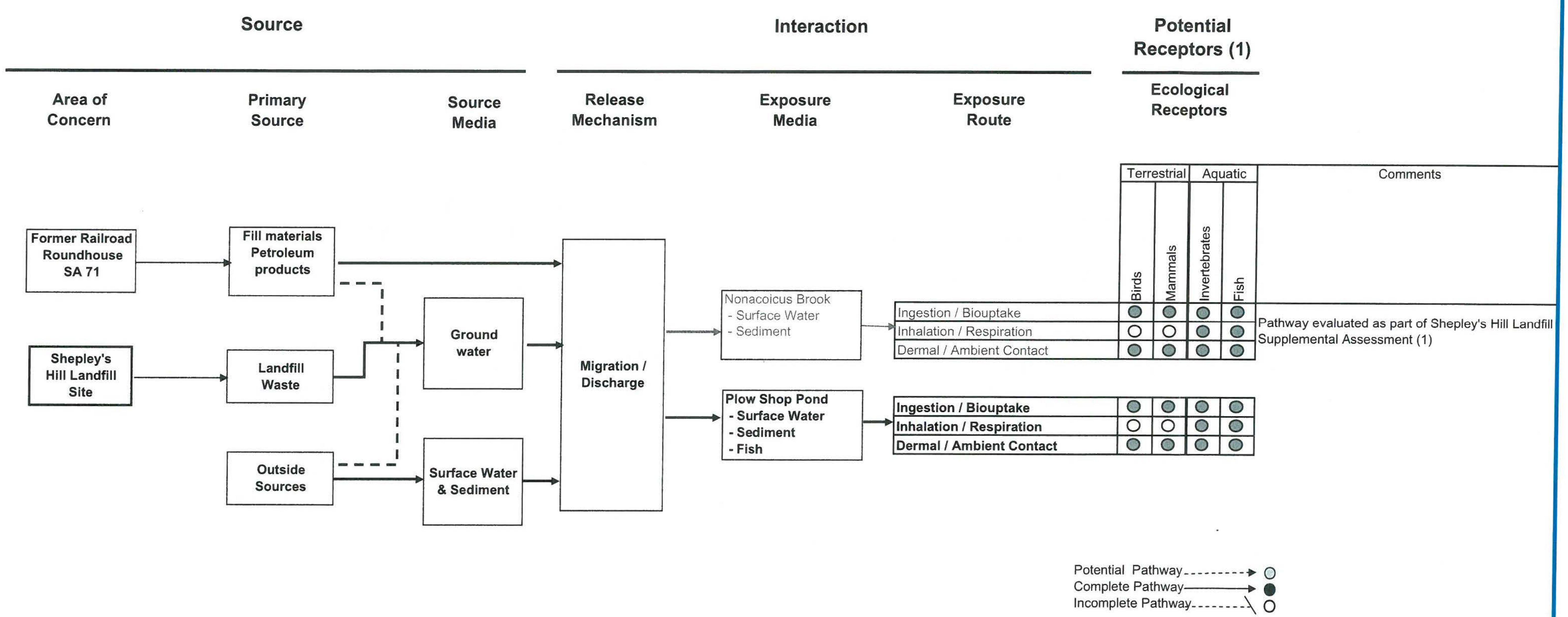


Notes:

(1) Risk Assessment for AOC 72 addresses exposures to Plow Shop Pond. Other exposures at Shepley Hill Landfill are addressed in the Supplemental Assessment Report, draft submitted December 2008.

(2) Surface soil consists of clean fill 0 to 1.5 feet below ground surface over PVC barrier across entire landfill. Landfill materials are expected to be at depths greater than 1.5 feet below grade. Landfill soil is not to be evaluated as exposures are not considered likely to exist.

Figure 3. Conceptual Site Model for Ecological Exposures for AOC 72



Notes:

(1) Risk Assessment for AOC 72 addresses exposures to Plow Shop Pond. Other exposures at Shepley Hill Landfill are addressed in the Supplemental Assessment Report, draft submitted December 2008.

Attachment F

USEPA Comments

Comments and follow-up comments on the August 2008 BCT Draft Workplan were received from USEPA on 9/11/08, 10/3/08, 10/16/08, 12/2/08, and 2/12/09. The comments are provided below with responses in italics following each comment. The comments and responses from the various dates have been combined to keep comment threads together in chronological order, for ease of navigation, using dates to denote comments after the initial 9/11/08 set.

EPA Comment on 10/3/08: A number of [9/29/08] responses indicate that the suggested changes will be made in the final version of the workplan or attachments to the workplan. EPA concurrence is subject to confirmation that these changes are made.

General Comments (9/11/08 unless otherwise indicated):

1. One of the overall RI Technical Objectives identified in this Workplan is to evaluate 'current and potential future contaminant flux from SHL [Shepley's Hill Landfill] to AOC 72' (first bullet under Section 2.3; further defined in Section 2.3.1). The Workplan concludes that sufficient data are available to estimate accumulation rates, based on EPA's current investigation in the Red Cove area and results from previous sediment and groundwater studies. Independent estimates of arsenic flux to Red Cove (EPA, 2008; Gannett Fleming, 2005) show good agreement; however, it must be noted that both sets of computations necessarily include varying degrees of uncertainty. In developing revised accumulation rates for the AOC 72 RI, uncertainty associated with all parameters should be provided along with the rationale used to estimate the magnitudes of each. Also, it should be kept in mind that characterization of groundwater chemistry throughout the saturated overburden beneath the landfill is incomplete, and contributions from bedrock groundwater are presently unknown.

Response (9/29/08 unless otherwise indicated): We agree that there will be uncertainty with respect to estimated arsenic flux and accumulation rates. The sources, magnitude, and potential impacts of this uncertainty on the RI conclusions will be discussed in the report.

2. It is stated in Section 2.3 that the overall objectives for the AOC 72 RI are to complete the investigation of Plow Shop Pond as needed to estimate the risks to human health and the environment, and to close all CERCLA-related reporting. EPA has commented that the extent of adverse effects in sediment at SA 71 has not been adequately delineated. The extent of toxicity and macroinvertebrate community impacts beyond the area of ash must be delineated in order for Army to rebut EPA's evidence-based presumption that the adverse effects are linked to SA 71. In order to do this, Army should conduct the same types of Sediment Quality Triad (SQT) tests further into the pond from the Railroad Roundhouse. Since SQT studies are proposed for AOC 72, and the objectives are to integrate the human health and ecological risk assessments for all areas of Plow Shop Pond, it is important that the SQT tests and human health risk assessment assumptions are comparable in methodology for both Red Cove and Railroad Roundhouse. Therefore, the SQT tests proposed in this Workplan should use the same methods and human health exposure assumptions, notably including 42-day amphipod tests, rather than 28-day tests as proposed.

SQT testing will be conducted for additional samples east of SA 71 (Railroad Roundhouse) as described in the response to EPA General Comment 3 below, and all tests will include a 42-day toxicity test duration.

3. Although EPA agrees with the general approach for SQT and physicochemical sampling, all three types of sampling (A, B, C) should be conducted in the same locations to improve the ability to attribute the presence or absence of biological effects to physicochemical parameters or reference condition. The co-located tests should be conducted in areas of upwelling (C samples) as well as areas of floc deposition. Since the primary purpose of SQT testing in Red Cove is to determine whether there are biological effects caused by landfill-related stressors (arsenic chemical toxicity, ammonia toxicity, dissolved oxygen depletion, and floc habitat alteration and asphyxiation), it is important to have SQT measurements along a gradient of these parameters in Red Cove. The level of effort to delineate impacts in Red Cove should be comparable to that for AOC 71, because these are the two Army-related point sources in Plow Shop Pond and they are comparable in shallow habitat biology and area. Since AOC 71 utilized SQT studies at 12 reference and site locations, at least 12 locations should be subjected to SQT evaluation to determine whether there are adverse effects in Red Cove. At least 8 of these locations should be within Red Cove itself along a transect from the head of the cove, to the middle of the cove, to the mouth of the cove where EPA ORD has shown that arsenic changes valence state to a more toxic pentavalent state. EPA suggests that a transect be placed from the head of the cove to the mouth of the cove, with two sample locations placed near the head of the cove, two sample locations placed in the middle of the transect, and two sample locations placed at the end of the transect at the mouth of the cove. These and two additional locations should be placed so as to have at least two locations in areas of upwelling and two locations in areas of floc deposition, for a total of 8 locations. The other four locations should be designed to evaluate local reference conditions within Plow Shop Pond (i.e. two samples along the shoreline north of Red Cove). These would serve as local reference SQT samples in addition to the reference locations used for the AOC 71 studies. To evaluate the extent of effects from AOC 71 and the potential effects due to the transport of contaminants from the former tannery on Grove Pond, EPA suggests that six additional locations in Plow Shop Pond be tested. These could include the two proposed B locations to the north, two locations near where water enters from Grove Pond and two locations further towards the center of the pond from AOC 71. EPA looks forward to further discussion concerning the number and location of SQT samples needed to finalize the risk assessments for Plow Shop Pond.

The proposed sampling locations are being modified based on discussion at the 9/18/08 BCT meeting and a reconnaissance of Plow Shop Pond on 9/24/08. The modifications include adding locations near SA 71, revising locations in Red Cove, revising and supplementing the northern cove/reference locations, and relocating the Flanagan Pond samples to the east end of Grove Pond. The resulting proposed locations will include:

- *6-8 SQT sampling locations in Red Cove providing coverage from the head to the mouth, with a target water depth of 0.25-1.0 m. The northern and southern sides of the cove are described as having markedly different sediment characteristics – muddy on the north and sandy on the south – and at least one sample will be located on each side. Sampling locations will include a range of groundwater upwelling conditions and apparent floc* *thicknesses. These conditions will be determined by field screening prior to selecting final sample locations. Field screening will be conducted at 15 points in the cove and will include underwater photography and measurement of sediment pore water characteristics (ph, DO, ORP, specific conductance) at 0-6 and 6-12 inches below sediment surface (see also the response to EPA Specific Comment 5). Results of these measurements will be presented and discussed with the BCT to select the final SQT sample locations.*

- *Three of the SQT sample locations in Red Cove will have adjacent surface water samples collected for analysis of metals and water quality parameters including ammonia, and field measurement of pH, DO, ORP, & SC. At each of these three locations, water will be sampled immediately above the sediment surface (see also the responses to EPA comments on Attachment A).*

- *Three of the SQT sample locations in Red Cove will have adjacent sediment core samples collected for analysis of physical properties.*

- o *4 SQT sampling locations in Plow Shop Pond reference locations, including the northern cove which formerly had an outlet to Sawmill Brook, and the southern cove that is west of SA 71.*

  - *Two of the PSP reference locations will have adjacent surface water samples collected for analysis of metals and water quality parameters including ammonia, and field measurement of pH, DO, ORP, & SC. At each of these locations, water will be sampled immediately above the sediment surface.*

  - *Two of the PSP reference locations will have adjacent sediment core samples collected for analysis of physical properties.*

- o *3 SQT sampling locations in the west end of Grove Pond (same as original proposal)*

- o *3 SQT sampling locations in the east end of Grove Pond*

- o *2 SQT sampling locations east and north of SA 71.*

All of the sediment chemistry samples will be split with EPA/ORD for an arsenic speciation analysis. Section 2.4 (including Figures 9 and 10) of the draft workplan and Sections 4.2-4.4 of Attachment A will be revised to present the modified sampling locations and procedures in a separate submittal for BCT review prior to issuing the draft final workplan. This submittal will include a summary of ESI & SA 71 metals results for sediment samples near the proposed sampling locations, as well as evaluation of additional metals analytes for response to EPA's comment on Attachment C regarding TAL metals.

10/3/08: Army proposes a reference SQT site at the northern cove, which formerly had an outlet to Sawmill Brook. This location had obvious anthropogenic impacts, so should be replaced by the shallow shoreline area to the south of this location (near the tree with red leaves). This replacement location had similar habitat as Red Cove, but no obvious anthropogenic impacts.

10/9/08: AMEC did not map the proposed Northeast Cove reference site, for which EPA provides this follow-up comment, in the 9/29/08 RTC [Response to Comments]. The proposed location was mapped in the revised figures provided on 10/6/08 after this follow-up comment. The proposed location (#8 on Figure 9) appears to have the habitat most similar to Red Cove of the areas viewed in the Northeast Cove, and was not observed to have any obvious anthropogenic impacts during the reconnaissance on 9/24/08. We disagree that there is any habitat in the Northeast Cove more similar to Red Cove than the proposed location. If this location is not acceptable, we respectfully request additional discussion of the rationale so that a suitable replacement can be located.

10/16/08: EPA disagrees that the northeast cove near the former outlet to Sawmill Brook is a better reference site than along the west bank of the northeast cove. Although the former had habitat more similar to Red Cove, there was trash and other solid waste in the banks at that location. The latter site seemed to have water depth, vegetation and soft bottom similar to Red Cove. EPA asked AMEC to map the latter location during the field trip, mentioning that it was near the tree with red leaves. This location could be mapped during the field screening.

11/05/08: We were not aware of any unusual solid waste impacts for the proposed location #8. Based on the reconnaissance, the amount of solid waste on the bank did not seem significantly greater than the amount of trash along the rest of the bank. The "red tree" site proposed by EPA appeared to have a larger grain sediment with a lower amount of benthic detritus. While EPA's proposed site would be appropriate as reference for the Railroad Roundhouse Cove, it is of concern that comparisons to the more eutrophic Red Cove will make the analysis more difficult.

10/16/08: The reference location in the "Little Cove" should be as far away as possible from the area of red floc breakout, therefore, the location should be on the southern side of the "Little Cove", rather than the most westerly location.

11/05/08: The requested change for sampling location #7 in Figure 9 will be made.

12/02/08: EPA agrees that the "red tree" site may be better as a reference site for Railroad Roundhouse; therefore, EPA requests that both locations ("red tree" site and former outlet to Sawmill Brook) be included as reference stations for Railroad Roundhouse and Red Cove, respectively.

02/03/09: Both locations will be included as requested.

4. EPA agrees that 3 SQT locations in Flanagan Pond would be useful in interpreting whether effects at Red Cove and/or Railroad Roundhouse are actionable; EPA believes that these samples alone will not be adequate to demonstrate that Flanagan Pond is adequate as a reference location with similar habitat, eutrophic condition and biota as Plow Shop Pond. Therefore, EPA believes that these samples will be less valid as reference conditions than local reference samples within Plow Shop Pond.

The proposed Flanagan Pond sampling locations are being relocated to the east end of Grove

Pond as indicated in the response to EPA General Comment 3. Grove Pond has been studied in detail as indicated in the ESI, and appears to provide habitat similar to Plow Shop Pond.

5. The human health risk assessment should include an assessment of exposure by an adolescent wader to sediments along the shoreline of Red Cove. The exposure point concentration for this "hotspot" evaluation should include only shallow sediment samples along Red Cove. It may be necessary to identify additional sampling needed to provide at least 10 samples of sediments along the shoreline of Red Cove.

This comment is understood to apply to SA 71, in addition to Red Cove, based on the discussion at the 9/18/08 BCT meeting. The relevant receptor group for potential exposures at Plow Shop Pond is a recreational user as identified in Section 2.3.1 of the HERA Work Plan (Attachment E of the RI Work Plan). The recreational user will include a pre-adolescent to adolescent age group (ages 6 to 16) and adult (age 17 to 30). An evaluation of potential exposures by a recreational user of Plow Shop Pond to near-shore sediment samples (defined as sediment sampling locations within 75 feet of the shoreline) was conducted in the ESI (Gannett Fleming, 2006). Sediment samples were identified in the ESI dataset as representing near-shore locations within Red Cove, along the shoreline area immediately to the north of Red Cove and adjacent to SHL, and at locations representing near-shore area adjacent to SA 71. These sediment data will be supplemented with the proposed sediment samples to be collected in Red Cove and near SA-71 as indicated in the response to EPA General Comment 3, yielding well over 10 unique sediment samples within each of these specific areas of interest.

12/02/08 on the 11/5/08 version: Section 2.3.2, page 5 of 20: It is stated that a "near shore" data grouping (samples within 75 feet of the shoreline) will be included for consistency with the ESI. EPA requested previously that samples be collected along the immediate shoreline of Red Cove and evaluated separately for human health risk to a wader. Please revise to include sample collection, analysis and risk evaluation of sediment samples taken within 10 feet of the shoreline of Red Cove.

02/03/09: Considering the shallow depth of Red Cove – the bathymetric map indicates that water depth is less than 0.5 meters (1.6 feet) for the entire area within the mouth of Red Cove representing a total distance of up to 60 feet from shore – we believe that any recreational wader in Red Cove would not be limited to a distance of 10 feet from shore. Water (and/or benthic detritus) depth would be a greater limiting factor for wading activity than simply distance from the shoreline. Furthermore, the three existing samples within 10 feet of shore do not indicate higher contaminant concentrations exist at near-shore samples, nor does any data exist suggesting that arsenic-bearing groundwater discharges preferentially at a distance of less than 10 feet from shore. Therefore, as there is no potential for increased exposure frequency and no information suggesting higher concentrations within 10 feet of the shore, there does not appear to be a 10-foot 'hotspot' for evaluation. The 75-foot distance was chosen for consistency with earlier approved methods performed by EPA's contractor.

The risk evaluation will consider any recreational wading activity whether at 10 feet or 75 feet *of the shoreline in Red Cove and Plow Shop Pond. The EPCs will be based on the historic sediment samples and the results from the proposed sediment samples. AMEC is proposing to collect six sediment samples within the Red Cove area at locations defined from field screening results where conditions indicate a higher potential for groundwater discharge. At least half of the 15 proposed field screening locations will be within 50 feet of shore. Final locations for the six Red Cove sediment samples will be discussed with the BCT prior to collection.*

02/12/09 EPA contends that 10 samples within 10 feet of the shoreline are still necessary for an adequate evaluation of human health risk to a recreational wader. During the field trip with EPA, DEP and AMEC representatives, we saw areas deeper than 3 feet in the main part of the cove. It is certain that no one would get out of a boat in waders in the middle of the cove because they would sink below their waders. It is also certain that the most likely wader will be someone who walks into the cove from the shoreline and that they won't go far due to the deep muck. Since there is abundant floc right near the shoreline, this area represents worst case for the exposure pathway, not the worst case for floc in the entire cove or some area of upwelling further out into the cove. EPA will evaluate the proposed sample locations in the Draft Final document to determine if the locations meet the needs of both the human health and eco risk assessment.

03/06/09 We note that there are there are three existing surface sediment samples nominally within 10 ft of shore (SE-SHL-05, SHD-92-28X, PSED-11). Up to seven additional surface sediment samples will be collected within 10 ft of shore and analyzed for the target chemicals. Some of these seven samples may be among the six Red Cove SQT samples to be located based on discussion of field screening results, and all of the Red Cove samples will be discussed and determined with the BCT at the same time.

Specific Comments (9/11/08 unless otherwise indicated):

12/02/08 on the 11/5/08 version: <u>Section 2.2, page 5 of 12</u>: The second full new paragraph discusses the conclusions of the SA 71 study. There has been no resolution to EPA comments that dispute Army's conclusions; therefore, EPA does not necessarily agree with all of the conclusions stated in this paragraph. Army should add a footnote to this effect, similar to the footnote on page 8 of 20 in Attachment E.

02/03/09: The Army does not believe that footnotes regarding the acceptance status of earlier documents are needed in the workplan text. This workplan provides a consensus technical approach for RI data collection. Prior agreements (or lack thereof) on data interpretation are part of the administrative record and will be considered in preparing the RI. See also the revised response to EPA Comment 5 on Attachment E.

1. Page 6, Section 2.3.2: The text states that the primary sources of other contaminants of potential concern, as well as the fate/transport of these COPCs, have

been established by previous studies and no additional data are needed. The example COPCs cited in this section are PAHs from SA 71 (the former Railroad Roundhouse) and chromium from the former Hartnett Tannery. In the Final RI Workplan, please consider listing (e.g., in a table or other summary format, similar to that shown in Table 1) all contaminants of interest, the rationale for their identification as COPCs, and a pointer to the documents in which the relevant data can be found. For example, the risk evaluations presented in the ESI (Gannett Fleming, 2006) identified mercury and PCBs as risk drivers. Please ensure that these, and any other constituents either presently or formerly considered as contaminants of interest, are considered in the revised Workplan.

Response (9/29/08 unless otherwise indicated): A column listing contaminants of interest will be added to Table 1.

2. Page 6, Section 2.3.4: The text here notes that "[n]o stressed biota or other conditions that satisfy" the definition of 'readily apparent harm' have been identified, particularly in association with iron floc. Indicators of 'readily apparent harm' also include abiotic zones. If areas devoid of vegetation occur in areas of upwelling groundwater, and the SQT testing indicates that there are no benthic organisms in this area, then those areas would qualify as showing readily apparent harm. It seems that the Workplan acknowledges this possibility in the first bullet of page 7, Section 2.4; perhaps this should be stated explicitly in the previous section (e.g., in Section 2.3.7, Localized Risk in Red Cove).

The text describing Readily Apparent Harm is being revised in accordance with MassDEP Specific Comment #3 and the response to that comment.

3. Page 7, Section 2.4: The first bullet indicates that undisturbed sediment cores will be collected from floc and non-floc areas in Red Cove and Plow Shop and Grove Ponds, and these cores will be tested for "...density and specific gravity, with a calculation of porosity." Please clarify why this is important to an evaluation of the potential for 'readily apparent harm'?

The first bullet will be clarified to indicate that the tests of floc physical properties are part of the evaluation of the asphyxiation potential identified in Section 2.3.3.

4. Page 7, Section 2.4: The first bullet indicates that sediment cores will be collected in three floc areas in Red Cove and two non-floc reference areas in Grove and Plow Shop Ponds. Figure 9 shows two "A" samples within Red Cove, two "A" samples outside Red Cove in Plow Shop Pond, and one "A" sample in Grove Pond. Please make corrections.

The "A" location immediately north of Red Cove was intended to be within a floc area, but will be relocated in accordance with the response to EPA General Comment 3.

5. Page 7, Section 2.4: The first bullet indicates that condition of "vegetation and any other observable biota" will be documented for floc and adjacent areas in Red Cove, and for non-floc reference areas, to evaluate the potential for "readily apparent harm". Section 4.2.1 of

Attachment A-Field Sampling Plan indicates that the method of documentation of condition will be visual observation and photography from the surface of the water. Since it will be difficult, if not impossible, to see the bottom due to turbidity in the water column over floc areas, obscuration by vegetation, and reflection from the surface, the sediment should be assessed for abiotic conditions by qualitative sweep net sampling in areas of upwelling and floc deposition. If benthic organisms are not collectable in such areas, then they would be considered to have an abiotic condition. Alternatively, the sediment surface could be photographed by an underwater camera or observed and photographed through a glass-bottomed bucket submersed into the water, as is used for shallow reef observation by tourists.

Section 2.4 summarizing the sampling approach will be revised in a separate submittal as indicated in the response to EPA General Comment 3. Revised procedures will include field screening at 15 points in Red Cove to select 6-8 sampling locations, and this screening will include underwater observations and photographs, and sampling sediment pore water at multiple depths. Sections 4.2-4.4 of Attachment A will be revised accordingly and included in the submittal for BCT review.

We agree with USEPA that sweep-netting would be a practical method for the collection of epibenthic organisms. Further, after close examination of the habitat associated with Red Cove and the rest of Plow Shop Pond, it may be the only method to collect non-pelagic organisms associated with the sediment environments. Eutrophication of Plow Shop Pond has resulted in significant periphyton occlusion and detritus matting. These physical conditions may render the collection of sufficient biomass for community analysis impossible without significant and far-ranging disruptions to the sample areas. We propose that the benthic analysis, along with the sediment toxicity and chemistry analysis, be supported by sweep netting from the detritus layer to the top of the periphyton to collect benthic and epibenthic organisms for diversity analysis.

12/02/08 on the 11/5/08 version: <u>Section 2.4, page 8-10 of 12:</u> This section should describe that triplicate benthic macroinvertebrate dredge samples will be collected as part of SQT sampling in Red Cove, Plow Shop Pond Reference Coves, SA 71, and Grove Pond, as described in detail in Section 4.4 of the Field Sampling Plan. Currently only sweep samples are identified.

02/03/09: The requested clarification will be made.

12/02/08 on the 11/5/08 version: <u>Section 2.4.2, page 9 of 12:</u> Based on previous comments, the northeast cove (location #8) was to serve as a reference for Red Cove due to habitat similarity, and EPA's proposed reference location near sample PSP02 on Figure 9 was to serve as a reference for the additional two SA 71 locations, also based on habitat similarity. Please revise.

02/03/09: The requested clarification will be made.

10/16/08: An email from Bob Nuzzo, of MassDEP, indicates that it is too late in the season to collect representative epibenthic sweep samples from vegetation due to senescence that begins in August. If BMI sampling must occur this fall, then EPA proposes that Army collect only cores for triad samples. The vegetation probably makes it impractical to use Ponar grabs. It is probable that Army could collect enough sediment cores in both vegetated and non-vegetated areas to provide sufficient sediment for macroinvertebrates, chemistry and toxicity testing. Army could return in the spring for sweep samples since they will be recording GPS coordinates. Alternatively, the sweep sampling can be eliminated. This issue should be discussed by Army, EPA and MassDEP prior to finalization of the Workplan and the text of the Workplan will need to be revised to address this.

11/05/08: Although earlier studies have included biota sampling in the late summer or autumn, we agree that this timing may not be optimal. Towards the end of fall, the abundance of BMI tend to decline with an increase in patchiness as adequate habitats are reduced by lower temperatures. Furthermore, there is a significant short-term increase in carbon loading as the result of terrestrial leaf-fall. It is feared that the combination of these extraneous impacts will result in high variability that will hinder the ability to detect site-specific effects. To maximize the probability of being able to isolate site-specific effects, AMEC recommends that the sampling be undertaken in late April to early May when the water has warmed and the maximum number of benthic species will be in their larval stages.

6. Table 2: The Workplan makes the assumption that measurement of surface water chemistry will be sufficient to determine whether surface water has an ecological risk. EPA asserts that exceedance of water quality criteria is evidence of an adverse ecological risk to aquatic organisms, unless rebutted by chronic aquatic toxicity testing with two freshwater species (at least one fish and one invertebrate species, e.g. Ceriodaphnia and fathead minnow larvae). It should be noted in Objective 6 and text that exceedance of water quality criteria will be sufficient evidence for an adverse ecological risk to aquatic organisms unless rebutted by chronic toxicity tests with two freshwater species (fish and invertebrates). EPA recognizes that testing summarized in the ESI indicates that surface water samples obtained in the water column of the pond did not exceed water quality criteria and was not toxic; however, this finding does not pertain to surface water in the immediate vicinity of upwelling groundwater. The EPA ORD report found exceedance of water quality criteria for arsenic and ammonia in upwelling groundwater, collected prior to dilution by overlying surface water. Therefore, there is a potential concern about benthic infauna and fish larvae hatching from eggs deposited in sediment where groundwater emerges.

The text in Section 2.3.7 will be modified to recognize EPA's concern regarding aquatic organisms indicated above. The surface water sampling depth will be changed to occur immediately above the sediment surface using the sampling technique identified in Section 4.2.1 of Attachment A, with analysis of the samples for metals and ammonia, and field measurement of pH, DO, ORP, & SC.

The RI will compare regions of upwelling and non-upwelling for arsenic and ammonia concentrations within the epibenthic zone. If concentrations in the upwelling are significantly greater than the non-upwelling, then this may be indicative of a groundwater source. However, if they are not significantly different and in excess of ambient water quality criteria, this may be indicative of ammonia generation resulting from factors not associated *with the groundwater such as oxygen depletion resulting from hyper-eutrophication.*

7. Figure 3, Arsenic in Shallow Sediment of Plow Shop Pond (also Figure 4, Iron, and Figure 5, Chromium). These figures do not appear to show the EPA's shallow sediment data, collected in 2004. Please check and revise as necessary.

As indicated in Section 2.2, the initial data gap evaluation was based on sediment data having a depth of zero in the database, although deeper samples will be considered in the RI as appropriate. The 2004 samples were collected from a range of depths greater than zero. The 2004 samples with depths of 0.25 and 0.5 feet will be added to the workplan figures showing shallow sediment results, along with a note describing the data depth range.

Attachment A – Field Sampling Plan (comments 9/11/08 unless otherwise indicated)

1. Section 1.0: Where are the "catch and release" fishing postings located and are they maintained?

Response (9/29/08 unless otherwise indicated): This information is based on the ESI and on ATSDR's "Evaluation of Health Concerns Associated with Grove Pond and Plow Shop Pond, Fort Devens, Ayer, Middlesex County, MA" (ATSDR, 2000, 1998) and was not independently verified. A reference will be added to the workplan denoting these sources. Posting locations can be verified if needed during the RI.

2. Section 4.2 and Appendix A, SOP for Surface Water Sampling: The procedure states that surface water will be pumped into a stainless-steel container prior to filtration and transfer to the sample container. Due to low oxygen content and high ferrous iron concentration in deep surface water and sediment pore water, this approach must be avoided. Instead, water samples should be retrieved in a manner typically used for groundwater sampling, where an in-line filter is used and the sample is pumped directly into the sample container. This approach minimizes air exposure prior to filtration, which avoids the problem of ferrous iron oxidation-precipitation and adsorption of arsenic onto the resultant iron floc. Precipitates that form during storage in the stainless steel container will be lost to filtration, resulting in concentrations of As, Fe and other adsorbed constituents biased low.

The proposed surface water samples were originally from the upper 6 inches of the water column and were not expected to have unusually low oxygen content. However, the sampling approach is being modified as indicated in the response to EPA Specific Comment 6, such that surface water will be sampled immediately above the sediment surface using a procedure similar to groundwater sampling.

3. Section 4.2.1: Push-point sampling for sediment pore water: The plan states that sediment pore water will be collected using a push-point sampler (mini-piezometer) from within a depth within 6-inches below the sediment surface. At this depth, the sediment is soft with high organic matter content and will likely have a clayey or silty texture, resulting in solids passing through the screen slots on the push-point sampler. It is recommended that a polypropylene "Screen-Sok" be used with the push-point sampler as available from M.H.E.

Products (http://www.mheproducts.com/downloads.html) and shown at http://www.mheproducts.com/sm-screen-sok+text.jpg.

A filter material will be used to exclude solids as recommended.

4. Section 4.2.1, In-situ water quality measurements: In addition to in-situ measurement of pH and dissolved oxygen, it is recommended that specific conductance and oxidation-reduction potential (ORP) also be measured. The flow-cell can be instrumented in a manner similar to typical procedures for groundwater sampling.

The workplan will be revised to include the recommended measurements, which will be used as part of the identification of groundwater upwelling locations as indicated in the response to EPA General Comment 3.

5. Section 4.4 and Appendix A, SOP Soil and Sediment Sampling: The procedure states that recovered sediment sample will be homogenized in a stainless-steel bowl prior to transfer to the sample container. This approach is adequate if total concentrations of non-volatile chemical constituents are to be analyzed. However, for analysis of volatile constituents or toxicity testing, manipulation of sediments prior to enclosure in the sample container should be avoided (e.g., see attached file "r8-src_eh-02.pdf'; Section 3.0, second paragraph). This is acknowledged in the SOP in Appendix A. Note also that for toxicity testing, exposure to air needs to be avoided or minimized prior to the test in order to prevent changes in contaminant speciation [e.g., As(III) oxidation to As(V)] and/or sediment mineralogy (e.g., oxidation of iron monosulfides to iron oxyhydroxides;http://www.epa.gov/ada/download/issue/600R06112.pdf). Oxidation of sediments will likely result in lower observed toxicity due to increased partitioning of arsenic to sediment solids. It is also recommended that samples for toxicity testing be placed in a cooler on ice immediately.

The workplan will be revised to specify minimal sample manipulation and exposure to air; see also USFWS Comment #2 and the response.

12/4/08 via email: EPA has an additional request related to the sediment toxicity testing to be done under the AOC72 RI WP. Robert Ford, of EPA/ORD, expressed a concern that there may be changes in contaminant bioavailability during the course of toxicity tests that may influence the outcome from this line of evidence. As such, EPA/ORD would like to provide some constraint to interpretation of these results with follow-up characterization of the sediment samples, highlighting those samples that displayed the greatest changes in contaminant speciation or sediment characteristics. We have spoken with co-workers at the EPA Regional Lab who routinely conduct sediment toxicity testing about this concern and asked for their input. They suggested that the lab running the toxicity testing could set up a "dummy beaker" for each sediment toxicity station prepared (included test organisms) and treated in the same manner as the toxicity testing beakers, but not analyzed. At the end for the test, the beaker could be placed in a freezer to "lock" the sediments into the physical condition at test end and they could be shipped frozen to EPA/ORD for analysis. Freezing the entire beaker at test end would give EPA/ORD the most flexibility in allowing them to sample from physically distinct layers that may have developed during the course of the test. All of the analysis results would be provided to the Army and AMEC for consideration in the interpretation of the toxicity test results.

EPA requests that Army/AMEC explore this with the lab that will be conducting the toxicity testing to determine if the lab agrees that this is workable and to determine what additional costs this would add, so that we can discuss this further. As soon as you have information from your lab on this, we would like to have a conference call to discuss. Hopefully, we could concur on an approach on this and incorporate this into the Draft Final RI WP.

Army/AMEC has already agreed to provide split samples of sediment for EPA/ORD to conduct contaminant speciation analysis. As I have previously mentioned, EPA/ORD folks would like to talk with Army/AMEC before field work begins to ensure that everyone is on the same page related to the collection of samples for the splits that EPA/ORD will be analyzing. Robert Ford, of EPA/ORD, plans to conduct some field work at Red Cove in mid-late-February. I expect that we should have the Draft Final RI WP in hand by this time. We suggest that once Robert's plans are finalized, we schedule a face-to-face meeting for that time to both discuss the collection and transmission of the split sediment samples and the request for the transmission of the end-of-toxicity-test sediment samples.

1/16/09: The Army will investigate the feasibility of adding this option to the lab test scope and discuss any problems or coordination issues with the BCT prior to sampling.

10/15/08: Section 4.4, Sampling Surface Sediment [revised 10/9/08]: EPA offers the following information regarding conducting TCLP for the floc layer at select sediment sampling locations. The Toxicity Characteristic Leaching Procedure (TCLP) has been demonstrated to provide unreliable results for assessing the stability of arsenic associated with an iron oxides such as the solid phase that is the primary component of the floc (see attached file; A. Ghosh, M. Mukiibi, W.P. Ela, (2004) TCLP underestimates leaching of arsenic from solid residuals under landfill conditions, Environ. Sci. Technol. 38:4677-4682). The TCLP procedure is not appropriate for representing conditions where microbial iron reduction is active, i.e., the condition that exists in the shallow Red Cove sediment layer. EPA recommends that this procedure not be used, since it will likely confound interpretation of other exposure/toxicity tests that will be conducted. It would be valuable to measure the total concentration of metals in these floc materials (e.g., TAL metals) following extraction using a method such as EPA Method 3051 (acid-extractable). EPA/ORD will use a similar procedure on sample splits (see attached RSKSOP180v3) that we receive, but we recommend that the Army conduct similar analyses via a contract laboratory if these data are to be used as part of the risk assessment.

11/05/08: The TCLP procedure is not proposed as part of an exposure or toxicity assessment. It is proposed to address MassDEP's request to evaluate the potential for "readily apparent harm" as defined under the MCP. Please also see MassDEP's Specific Comments 3 and 4 and the responses. Metals analysis for sediment samples will include acid extraction by EPA Method 3050.

Attachment B – Data Analysis Plan (comment 9/11/08)

Page 4, Section 3.2: Refinement of the numerical groundwater flow model is welcome, and the applications outlined here are well motivated. Please clarify the role of the model in estimation of contaminant fluxes to the pond. In particular, the EPA/ORD Red Cove study provides a rather detailed flux estimate for arsenic based on direct field observations of hydraulic gradients, hydraulic conductivity, and arsenic concentrations at numerous points surrounding the cove. It seems unlikely that the numerical model will offer an improvement in this estimate, at least for arsenic local to Red Cove. The model may, however, offer an opportunity to expand this type of assessment to areas outside of the ORD study area.

Response 9/29/08: In its latest report EPA/ORD provided an estimate of arsenic flux based on measurements from three seepage meters installed in the central portion of Red Cove. These three point wise values were extrapolated over the rest of the Red Cove area to calculate a cumulative flux. The numerical groundwater model serves to integrate data on Red Cove hydraulics with that of the larger flow system, including pumping stresses from the operating extraction wells, and also allows for hypothetical hydraulic containment remedies to be evaluated for effectiveness. Calibration of the model to the EPA/ORD data and other observations will provide for a more robust analysis of the groundwater budget over Red Cove and other areas of interaction with Plow Shop Pond.

Attachment C – QAPP (comments 9/11/08)

The sediment and surface water should be analyzed for all of the TAL metals (notably mercury), because the ESI study found that many metals in addition to aluminum, arsenic, chromium, iron, lead, manganese, and nickel were contaminants of potential concern, and analysis of all the metals is needed to adequately evaluate the potential cause(s) of sediment toxicity, as well as evaluate the likelihood of surface water toxicity related to exceedance of water quality criteria. The detection limits should be lower than the water quality criteria and sediment benchmarks which serve as PALs. The QAPP should also be revised to indicate that the SQT tests will include 42-day amphipod tests. Please revise.

Response 9/29/08: As indicated in the response to EPA General Comment 3, a separate submittal will be provided for BCT review prior to issuing the draft final workplan, which will include a summary of ESI & SA 71 metals results for sediment samples in the proposed sampling locations. This submittal will include an evaluation of TAL metals for addition to the current list of ROD metals to be analyzed.

The detection limit presented in the QAPP for arsenic in surface water (Worksheet 9B) represents the lowest risk-based concentration (EPA's Ambient Water Quality Criterion (0.018 ppb) for ingestion of both fish and water. This value, while the lowest published surface water standard, is not achievable by commercial analytical laboratories, and may not represent a realistic and scientifically defensible AWQC based upon the current *knowledge of arsenic (i.e., the arsenic MCL (10 ppb) was recently adopted based on the latest understanding of possible health risks; EPA has adopted new methodology for deriving human health water quality criteria [65 FR 66444; November 3, 2000]). While the achievable detection limits for arsenic exceed this low criterion, the use of this criterion in the worksheet provides that the lowest possible analytical detection will be employed for characterizing arsenic in surface water samples. It is also noted that this AWQC is not applicable to Plow Shop Pond, but the AWQC for fish ingestion alone (0.14 ppb) is relevant for this pond as a Class B surface water body with recreational users. The pond is not considered a source of potable water without pretreatment (314 CMR 4.00). This issue will be clarified in a footnote to the worksheet.*

The sediment toxicity test duration has been modified as indicated in the response to EPA General Comment 2.

Appendix B - As indicated in this draft document, please include copies of the laboratory SOPs in the final version of this document.

Laboratory SOPs will be included in the final version of the workplan.

Attachment E – Human and Ecological Risk Assessment Plan (comments 9/11/08 unless otherwise indicated)

12/02/08 on the 11/5/08 version: <u>Section 2.1, page 4 of 20:</u> The text states that an analyte is not considered to be a COPC and is excluded from the risk characterization if a determination is made that the compound's presence is unrelated to SHL or SA 71. EPA disagrees because it is standard practice to include as COPCs all chemicals found to be higher than risk-screening levels, regardless of source. This will allow the total risk to be calculated. The risk related to chemicals unrelated to Army sources can be factored out in the uncertainty analysis. Please revise.

02/03/09: The second sentence in the 3rd paragraph of Section 2.1 will be modified as follows:

> *An analyte is not considered a COPC and is excluded from the risk characterization if it is detected at low frequencies and concentrations. In addition, analytes whose detected concentrations are below relevant risk-based concentrations (e.g. USEPA Regional Screening Levels [http://epp-prgs.ornl.gov] based on an adjusted noncancer hazard index limit of 0.1 and cancer risk limits of $1x10^{-6}$) are not considered COPCs.*

10/3/08: The comment (#1) sought clarity on various parameters used in the exposure and population models. These have been addressed with exceptions noted below. It should be noted that the items listed in the comment, which have been specifically addressed in these responses, are only examples. EPA looks forward to further review of the specifics regarding the various model parameters/assumptions. EPA also looks forward to reviewing the enhanced clarification of how the risk calculations are incorporated into the carrying capacity models.

1. The ecological risk assessment in the ESI (EPA 2006) identified potential unacceptable risk

to the following Plow Shop Pond ecological receptor groups: benthic invertebrates, omnivorous mammals, and carnivorous birds. For benthic invertebrates, unacceptable risk was attributed to PAHs in the vicinity of the Railroad Roundhouse. In other areas (e.g., the western shore), a COC driving toxicity could not be identified with confidence. Risk to omnivorous mammals was attributed primarily to the incidental ingestion of arsenic in sediment. Risk to carnivorous birds was attributed primarily to the incidental ingestion of chromium in sediment. While risk to omnivorous mammals and carnivorous birds was found to be unacceptable, there is significant uncertainty associated with risk determination for both receptor groups. This is primarily because of the uncertainty associated with the amount of sediment that the representative species were assumed to ingest.

The Workplan provides additional evaluation of benthic invertebrates and the wildlife receptors identified as possibly at risk in the ESI. The evaluation of benthic macroinvertebrate risk is an important follow-up to the ESI results. In addition, the basic concepts of the proposed food chain modeling approach seem appropriate, as it provides a methodology for further evaluating risk identified in the ESI for the raccoon and the black-crowned night heron, and to a lesser extent, the mink. There is a lack of specificity, however, as to how some of the parameters will be derived to run the models. Parameters need clearer definitions and clearer explanations as to how they will be selected/derived/measured. For example:

> How is the exposed sentinel receptor population of individuals determined?

Response (9/29/08 unless otherwise indicated): It is not necessary to determine the actual population density. This is because the ultimate stability, which is the endpoint of the assessment, is independent and can evaluated on a "per mating pair basis". If the recruitment is positive for a mating pair, then the population is unstable regardless of the number of individuals. A determination of population density is only necessary if the actual rate of extinction were to be determined. This is not necessary in this case.

> How will the probability of exposure to a food source m, 1, and k be determined? Will pond-specific dietary preferences, prey item abundances, and prey item population demographics be measured to determine similar probabilities that were determined for great blue heron in Mackay *et. al.* (2002)? Please provide more specific information as to what data will be used to derive the probabilities that will be used to modify the risk picture.

Probabilities of exposure will be based on the geographical distribution of the contamination relative to the habitat use in and around Plow Shop Pond. An improved description will be provided.

> How will the "solubility of inorganic COPC salts present" as noted on Page 12 of 18 be measured/determined in order to derive BCFs?

BCFs by definition are the ratios of the concentration of a COPC within an organism relative to its water soluble concentration. Water concentrations are a function of the solubility of the

COPC (k_{sp}). Therefore, for a given COPC, the BCF derived from a sediment concentration ($[COPC]_s$) will be determined as follows:

$$BCF = \frac{[COPC]_{organism}}{k_{sp} \cdot [COPC]_s}$$

> 10/3/08: Regarding the "solubility of inorganic COPC salts," the response states that BCFs will be modeled using the solubility (K_{sp}) of COPC in sediment. For several reasons, this approach does not seem geochemically supportable. First of all, the K_{sp} is a solubility product of the separate ionic concentrations brought into solution. It is unclear how this number can be multiplied by a sediment concentration to obtain a water concentration on which to define a BCF. Further, and perhaps more importantly, it does not seem possible to come up with a simple K_{sp} (a value which can vary by an order of magnitude or more depending on site conditions) that would reflect the diverse site conditions and valence states or solid phase states of the COPC in question. For arsenic, for example, there is no obvious solid phase upon which to base a K_{sp}. There is no simple form of arsenic controlling solubility. Arsenic solubility is probably controlled as much by sorption to iron floc as anything and there isn't an iron floc K_{sp} in the literature. Even if there were, it wouldn't say anything about arsenic going into solution without knowledge of how much arsenic is sorbed onto floc. The uncertainties about what controls solubility of COPC probably preclude this approach to deriving a BCF. Please clarify the proposed methodology.

10/9/08: The K_{sp} is a molar constant and therefore the variable mass is not an issue and the stochiometry of the products and reactants are implicit to the equilibrium ratio. One would not expect arsenic to bind strongly to the precipitated ferric oxide since the partial charge of this species, like arsenate and arsenite, is anionic. Therefore, the principal equilibria between soluble and insoluble arsenic forms will be 1) anionic binding capacity (which is negligible) and 2) complex with available cations to form insoluble salts. The salts most likely to form based on the cation abundance and low K_{sp} would be the iron (III) arsenate or arsenite, and solubility of these are relatively well understood, in part considering the use of iron for removal of arsenic from drinking water.

10/16/08: As discussed previously, K_{sp} values can vary considerably, even if the arsenic occurred in a single phase such as scorodite ($FeAsO_4$) and its aqueous concentration would therefore be controlled by a K_{sp} for scorodite. However, the EPA/ORD results from Red Cove indicate that the As in Plow Shop Pond appears to be sorbed to ferrihydrite. In that case, the mass (based on the As:Fe ratio) is very much an issue, as the arsenic in solution via dissolution of the ferrihydrite will be proportional to the solubility of the ferrihydrite.

11/05/08: We propose to use molar binding ratios of 0.60 for arsenite and 0.25 for arsenate (mol As / mol Fe) in the evaluation of arsenic availability, based on the ferrihydrite adsorption study by Raven et al (Environ. Sci. Technol. 32:344).

12/02/08: Modeling arsenic bioavailability and subsequent bioaccumulation or bioconcentration based on estimation of soluble arsenic needs to address the different conditions present within the water column (oxidizing) and sediment-water interface (reducing) within Red Cove and Plow Shop Pond. Adequate parameterization of this model will require, at a minimum, the determination of the chemical speciation of soluble arsenic in contact with solids and the mass content of iron oxyhydroxide either in suspended solids or sediments. Procedures for the determination of these required data inputs were not documented within the Draft AOC 72 RI Work Plan, so it is not clear how these calculations can be conducted. In addition, the sorption capacity of arsenate and arsenite on iron oxyhydroxide is dependent on pH, competing anions (dissolved organic carbon, silicate, phosphate, carbonate), and relative arsenic surface loading. These variables are not adequately represented by the fixed molar binding ratios proposed for estimating aqueous concentrations of arsenite or arsenate in contact with sediments or suspended solids within Red Cove or Plow Shop Pond, at large. Development of a sorption model that can adequately estimate dissolved arsenic concentrations within an acceptable level of uncertainty will entail additional developmental costs, including requirements to verify and validate model performance. Since the estimation of arsenic sorption is the initial step that will influence subsequent estimates of bioavailability, this represents a critical issue to address. It is not clear what benefit will be derived from this activity, given the current draft study design that provides for the direct assessment of dissolved arsenic concentrations throughout the study area and the extent of biological uptake of this contaminant.

02/03/09: The preceding responses were made as part of an attempt to estimate the bioavailability for arsenic, for modeling into tissues of dietary items. This is especially important for macroinvertebrates as there are no direct measures of uptake for this item. Based on the comments to date, we no longer think it will be possible to agree on a method for this estimate. The text in "COPC Concentration in Diet" will be revised to indicate that a BCF of 1 will be used for arsenic.

10/16/08: What is meant by "…the partial charge of this species"? The main As(V) species are $HAsO_4^{-2}$ or $HAsO_4$- both of which are anionic; however, arsenite, As(III), will be present as $H_3AsO_3^0$ with no charge (not anionic). All of these species have an affinity for ferric oxyhydroxides.

11/05/08: Please refer to the work of Raven et al. which showed arsenate and arsenite binding exceed the binding site concentration indicating the formation of As-Fe(III)

12/02/08: Subsequent research addressing the chemical speciation of arsenic sorption to natural iron oxyhydroxides has demonstrated that the extent of sorption is highly dependent on the conditions under which sorption occurs. For example, sorption of arsenic onto existing iron oxyhydroxides versus uptake during precipitation of iron oxyhydroxides exerts significant influence on sorption capacity and the chemical speciation of sorbed arsenic. The referenced study (Raven et al., 1998) does not provide adequate representation of the chemical conditions existing with Red Cove and Plow Shop Pond, and, therefore, should not be used as a point of reference for projecting controls on arsenic sorption within the study area.

02/03/09: Please see the response to the preceding comment (we are no longer proposing this method to assess bioavailability).

10/16/08: There is no evidence for the precipitation of any As salts in the Plow Shop Pond system, either from the recent EPA/ORD work at Red Cove, or from geochemical modeling based on data from EPA work at Red Cove and Shepley's Hill Landfill. The primary mechanism controlling As in solution appears to be adsorption onto ferric oxyhydroxide (ferrihydrite), not precipitation of a discrete As-Fe(III) phase.

11/05/08: Please refer to the work of Nicholas et al (Biodegradation 14:123). In conditions as would be found at the day-lighting of anoxic reducing groundwater to an aerobic environment, the co-precipitation of iron arsenates and arseno-pyrites is very common. However, to be conservative, bioavailability will be modeled based on molar adsorption maxima of 0.6 and 0.25 based on the results of Raven et al, as indicated above.

12/02/08: It should be noted that formation of arsenopyrite was excluded as a solid species forming in Red Cove sediments, even at locations with the highest concentrations of arsenic observed in sediments. In addition, the implication that 0.6 mol As/mol Fe and 0.25 mol As/mol Fe represent maximum adsorption capacities for arsenate and arsenite in the study area, respectively, would need to be verified through acquisition of site-specific data. As stated above, a single partitioning coefficient will not be representative of the variable sorption capacity within the study area due to variability in aqueous chemistry and As:Fe ratios throughout Red Cove and Plow Shop Pond. As previously stated, it is not clear what benefit will be derived from a modeling study in addition to the planned acquisition of site-specific data on dissolved arsenic concentrations and biological arsenic burdens within the study area.

02/03/09: Please see the response to the preceding comment (we are no longer proposing this method to assess bioavailability).

10/16/08: EPA is willing to review AMEC's derivation of BCFs but does not agree that it will be determinative because EPA believes there are too many variables in Red Cove to accurately model bioaccumulation and or bioconcentration. EPA will consider AMEC's derivation provided that it can be shown that the approach used has been accepted in the peer reviewed literature.

References: Ford, R.G., Scheckel, K.G., Acree, S., Ross, R., Lien, B., Luxton, T., and Clark, P., 2008. Final Report, Arsenic Fate, Transport, and Stability Study, Groundwater, Surface Water, Soil, and Sediment Investigation, Fort Devens Superfund Site, Devens, Massachusetts. September 30, 2008.

11/05/08: The model for bioavailability will be based principally on the work of Nikolaidis et al (Environ. Pollut. 129:479).

12/02/08: The modeling approach documented in Nikolaidis et al. (2003) for projecting soluble arsenic concentration for water in contact with arsenic-contaminated sediment is applicable only for oxidizing conditions in which Fe(III)-reduction does not occur. Therefore, this approach does not apply for a majority of the sediment-water interface within Red Cove in which iron-reducing conditions have been demonstrated. As documented in the EPA/ORD Final Report (2008), the formation of iron oxyhydroxides occurs primarily within the water column at a height over one foot above the sediment layer in Red Cove; not at the sediment-water interface. Modeling the potential for benthos exposure and uptake within shallow sediments, as well as the potential for bioaccumulation or bioconcentration within the food chain, would thus need to consider the impact of reductive dissolution of the arsenic-laden iron oxyhydroxides that are deposited onto sediments within Red Cove. As a point of reference for the effect of iron-reduction on arsenic release, please see the following reference: A. R. Keimowitz, H. J. Simpson, M. Stute, S. Datta, S. N. Chillrud, J. Ross, and M. Tsang (2005) Naturally occurring arsenic: Mobilization at a landfill in Maine and implications for remediation. Applied Geochemistry, 20:1985-2002. The development of a model that accurately represents the conditions for arsenic release at the sediment-water interface in Red Cove would be anticipated to add significant development time and cost to the application of this analysis approach. In addition, the characterization of the distribution of iron-reducing conditions throughout Plow Shop Pond (outside the limits of the area characterized under the EPA/ORD study), would require the collection of additional site-specific data that is not fully captured in the existing draft work plan.

02/03/09: Please see the response to the preceding comment (we are no longer proposing this method to assess bioavailability).

The description of the Characterization of Ecological Significance (Assessment Endpoints 7-9) is a little confusing. It would be helpful if the Work Plan included some text explaining how the risk calculations are incorporated into the carrying capacity models to modify the derivation of e, the excess reproductive capacity of a population. The connection between the Characterization of Ecological Significance (Section 3.2.5) and the Individual Risk (Section 3.2.4) needs a clearer explanation, perhaps in more lay-person language, or with a specific example.

Suggested clarifications to the workplan will be provided in a redline-strikeout version of the relevant text.

2. Page 4, Section 2.3.2: This section states that non-detected values will be assigned a value of one-half the reporting limit. Please avoid replacement of non-detects with surrogate values by using the latest version of ProUCL to calculate exposure point concentrations for both human health and ecological risk assessments. This software enables the user to calculate the EPC with and without replacement of non-detects with surrogate values.

We agree that the selection of surrogate values for non-detect results can result in biases in the exposure point concentrations (EPCs), particularly when there are low detection frequencies or where the detection limits are greater than the observed positive results. EPA's guidance on data quality assessment (EPA QA/G-9; EPA, 2000) provides guidance on methods to address non-detects when calculating a representative mean value. Although this guidance has been superseded by QA/G-9R and QA/G-9s (USEPA, 2006a, 2006b), the same *approaches to derive an estimate of the mean value when there are non-detect results are retained in the latter two documents. None of these three guidance documents discuss whether such methods are appropriate for the calculation of the upper concentration limits (UCLs) for the mean values. EPA's UCL Guidance (USEPA, 2002) provides guidance on deriving EPCs based upon the UCL values and includes the use of half the detection limit (DL) for non-detect results.*

The half-DL (or similar) substitution schemes provide a rapid estimate of the potential mean and UCL values for datasets with a large number of chemicals and samples. Prior to the latest version (4.00.02) of ProUCL, the users were required to adjust for non-detects prior to using this software, and often the half-DL scheme was used pursuant to USEPA (2002; 1989). As noted in the comment, ProUCL version 4 can accommodate non-detect results for the calculation of EPCs and was designed to be companion software package for the UCL Guidance (USEPA, 2002). This program, which has not been externally peer-reviewed, offers several alternatives concerning the use of appropriate surrogate values, including the use of half-DL substitution. The ProUCL Technical Guidance (USEPA, 2007) acknowledges that the half DL substitution scheme is the current default use but suggests that alternative methods be considered. To provide an illustration of the treatment of the DL within ProUCL, a large soil dataset for mercury that had a detection frequency of 33% was evaluated. This dataset had an ND range of 0.1 to 0.166 mg/Kg and a detected range from 0.06 to 30 mg/kg. ProUCL recommended against the use of half-DL for this dataset (the basis for this decision was not specified) and treated all of the results that were less than the largest non-detect value as a non-detect, including detected values. Therefore, despite have an actual detection frequency of 93/280, ProUCL derived a UCL value "assuming" a detection frequency of 82/280. Such a discrepancy may be more critical than using a simple substitution scheme.

It is not uncommon to have positive results less than the reported detection limits, particularly for trace organics. Therefore, to avoid the potential for misrepresenting the detection frequency in the development of EPCs, we propose the following:

- *For initial review of the results, the half-DL substitution scheme will be used to derive the UCL. This should yield a conservative estimate of the EPC.*

- *In those cases where the chemical may be a risk- or remediation-driver, an uncertainty evaluation using the alternative non-detect substitution schemes from ProUCL will be performed.*

3. Page 4, Section 2.3.2: The text should point out that the human health risk assessment for the wading scenario around Red Cove will include an exposure point concentration derived from measurement of contaminants in sediment samples only along the shoreline of Red Cove. This evaluation reflects the realistic assumption that an adolescent wader would wade in Red Cove along the shore during exploration or fishing. Army may wish to also calculate risks on an AOC-72-wide basis.

Please see the response to EPA General Comment 5.

4. Page 6, Section 3.1: The bullets summarizing the ESI report note that for several receptor groups "no risk" was identified. While the ESI does refer to "no risk" in several instances, the more appropriate qualifier "no unacceptable risk" is used more often. Please summarize the ESI results as "no unacceptable risk," as appropriate.

The text will be revised as requested.

5. Page 7, Section 3.1: The bullet for "benthic macroinvertebrates (BMI)" states that potential risk was identified based on sediment benchmark exceedances. This bullet should also note that potential unacceptable risk was also supported by the toxicity test results.

The stated benchmarks will be derived based upon the sediment toxicity tests. This will be clarified in the final draft.

10/3/08: The comment referred to text summarizing the results of the ESI report, not proposed methodology of the upcoming risk assessment. A review of the ESI results should recognize the toxicity test results.

10/9/08: To our knowledge, the toxicity results presented in the ESI did not correlate with any known COPC(s), and the ESI findings with respect to COPCs are the subject of the cited text. The text can be revised to add the ESI finding of an adverse effect without attribution to a COPC. Our objective in this study is to establish causes of any long term benthic toxicity or other adverse impacts.

10/16/08: EPA agrees that the objective of this study is to establish causes of any long term benthic toxicity or other adverse impacts. However, EPA asserts that the occurrence of adverse impacts in Red Cove (and near Railroad Roundhouse) are evidence of impacts by Army operations, based on being adjacent to documented sources of pollution, regardless of whether the impacts can be attributed to one or more COPC.

11/05/08: Comment noted, and EPA's position will be stated in the revised text.

02/03/09: The footnote text insertion is being removed, as the Army believes that EPA's positions regarding prior documents are best represented by the Administrative Record for those documents. See also the response to EPA's first Specific Comment (unnumbered) listed in this response to comments.

6. Page 7, Section 3.1: The bullet for "omnivorous aves" states that potential risk was identified for the black-crowned night heron from ingestion of arsenic and PAHs. Potential unacceptable risk to the back-crowned night heron was actually identified for ingestion of chromium, not arsenic and PAHs. Please correct this summary item.

The text will be revised as requested.

7. Page 9, Section 3.2.1: Please explain the meaning of "orthogonal contrasts".

The orthogonal contrast technique is a simple and efficient way of analyzing experimental data *to obtain the main effects, interaction effects, and nested effects for comparisons between groups of analytes given a specific toxicological response. It is extremely useful in sediment triad analysis where the results have no pre-defined structure. In general an orthogonal contrast takes the form as follows.*

$$Y = \sum_{i=1}^{I} C_i \mu_i$$
$$Such\ That:$$
$$\sum_{i=1}^{I} C_i = 0$$
$$Given\ That:$$
$$Y_i = \mu + t_i + \varepsilon$$
$$Therefore:$$
$$Y = \sum_{i=1}^{I} C_i t_i$$

The evaluation of a response/concentration matrix therefore tests the contrasts of changes in overall toxicological response (Y) relative to the summed concentrations on COPCs in the sediment (t_i). If a COPC produces a significant change in Y, then it can be ranked as an effecting factor. If it does not provide a significant difference, then the response Y is deemed insensitive to COPC t_i.

10/3/08: This response, describing the orthogonal contrasts is still unclear, in part, because the variables Y, C, μ, and ε were not defined. Please provide references in which the orthogonal approach has been used to evaluate toxicological and/or ecotoxicological data. EPA agrees to evaluate this approach, but does not necessarily agree that the results will be determinative.

10/9/08: The toxicological response Y is determined from the means (μ), coefficients of the means (C), and experimental error (ε). References include:

Cristina, M. and S. Nogueira. 2004. Orthogonal contrasts; Definition and concepts. Sci Agric 61:118-24.

Susan E. Gresens, Belt, K.T., Tang, J.A., Gwinn, D.C and Banks, P.A. 2006. Temporal and spatial responses of Chironomidae (Diptera) and other benthic invertebrates to urban stormwater runoff. Hydrobiologia. 575:173-190.

Michael D. Painel, Chapman, P.M., Allard, P.J., Murdoch, M.H. and Minifie, D. 1996 Limited bioavailability of sediment pah near an aluminum smelter: contamination does not equal effects. Environ Toxicol Chem 15:2003-18.

8. Page 9, Section 3.2.1: Please change "...and 28-day (amphipod) sediment toxicity tests..." to "...and 42-day (amphipod) sediment toxicity tests..."

The text will be revised as requested.

9. Page 9, Section 3.2.1: The first and second bullets state: "Indication of positive benthic impact will be deemed as statistically significant reductions in either growth or survival [or abundance, biodiversity, or productivity] between samples taken within AOC 72 or Grove Pond and those collected from the reference area." First of all, while the use of the word "positive" is understandable, as in a positive diagnosis, it may be more appropriate to use the word "negative" in this case to more clearly define the assessment endpoint. Secondly, it is unclear how the Grove Pond will be used to assess the significance of Plow Shop Pond toxic effects. Please clarify.

A "positive" response will be replaced with a "negative" response. Grove Pond represents an upstream control for a number of COPCs, including chromium and mercury. Negative impacts in Grove Pond can be used as controls for the evaluation of toxicological responses in Plow Shop Pond. This will permit the easier statistical assessment of risks associated with COPCs attributable to the Shepley's Hill Landfill.

10/3/08: The response states: "Negative impacts in Grove Pond can be used as controls for the evaluation of toxicological responses in Plow Shop Pond." This is understood but it should also be recognized that reference sampling in the area is inherently risky. The chemical data for any reference sample in the area will need to be scrutinized for true applicability as a reference location. Given the history of site use and given the results of previous samples, any sample could, by chance, have a high hit of a chemical that might cause toxicity and lessen the usefulness of the sample as a true control.

10/9/08: These potential impacts will be considered within the assessment.

12/02/08 on the 11/5/08 version: <u>Section 3.2.1, page 10 of 20:</u> Please define what is meant by "productivity" in the second bulleted paragraph, or delete.

02/03/09: The text will be clarified to refer to observable reproductive effects.

12/02/08 on the 11/5/08 version: <u>Section 3.2.1, page 10 of 20:</u> Please revise or explain the phrase "...in AOC 72 or Grove Pond and those collected from the reference area" in the first two bulleted paragraphs. This language infers that Grove Pond is not a reference area; however, it was decided previously that the reference areas would be in two (or three) locations within Plow Shop Pond and in Grove Pond. Please clarify.

02/03/09: The text will be clarified to eliminate the reference to Grove Pond.

12/02/08 on the 11/5/08 version: <u>Section 3.2.1, page 10 of 20:</u> The 3rd bulleted paragraph refers to a method to determine TECs as suggested by MassDEP. Please explain this approach in greater detail because EPA is unaware of the MassDEP suggestions.

02/03/09: The following text will be added:

- *The TEC will be determined as the geometric mean of the no-effect concentration and the lowest effect concentration as defined by McDonald (2000).*

12/02/08 on the 11/5/08 version: Section 3.2.1, page 11 of 20: The last sentence of this section infers that confirmation of the presence of a potential impact depends on: 1) "significant differences between the potentially impacted site and reference locations", and 2) correlation between these differences and "toxicity test results". This language should be revised because a conclusion of impact can be made if there are significant differences in either macroinvertebrate community (BMI, eBMI) or toxicity results. Please replace this sentence with language equivalent to: "Significant differences in biology (e.g. macroinvertebrate community, toxicity) between the potentially impacted sites and reference locations will be correlated with concentrations of contaminants of potential concern to evaluate, using a weight of evidence approach, whether there is an adverse impact caused by the site(s)."

02/03/09: The text will be revised as requested.

10. Page 9, Section 3.2.2: The description of Assessment Endpoint 2, the evaluation of potential physical smothering, notes that dissolved oxygen (DO) will be measured in areas where floc is present and absent. As suggested in the EPA (2008) (ECO Update/ Ground Water Forum Issue Paper. Evaluating Ground-Water/Surface-Water Transition Zones in Ecological Risk Assessments. July 2008), the transition zone is not simply at the sediment/surface water interface. The DO profile should, therefore, be measured at various depths in detritus/sediment. On a similar note, detailed field notes will be needed to sufficiently describe what is considered sediment and what is considered overlying detritus, where macroinvertebrates also live.

Section 4.2.1 in Attachment A will be revised to specify measurements of sediment DO at the top and bottom of the upper 10 cm that constitutes the vadose zone for BMI. See also the response to EPA Specific Comment 5.

10/3/08: The comment, referring to Page 9, Section 3.2.2, recommended that, to enhance the evaluation of physical smothering of benthos in floc areas, dissolved oxygen (DO) be measured at various depths in detritus/sediment. The comment also noted that detailed field notes will be needed to sufficiently describe what is considered sediment and what is considered overlying detritus, where macroinvertebrates also live. The response proposes "measurements of sediment DO at the top and bottom of the upper 10 cm that constitutes the vadose zone for BMI." As suggested in the latter part of this comment, regarding the ability to determine where sediment begins and overlying detritus ends, it may be premature to define the vadose zone (this should be biologically active zone, not vadose zone) for BMI as a 10 cm interval. Please clarify why this interval is presumed.

10/9/08: After physical examination of the site and reference areas within Plow Shop Pond, it is *recognized that defining the actual biologically active zone may be problematic. Measurements of DO and other field screening parameters are proposed to be collected at 0-6 and 6-12 inches below the surface of the visible sediment in Red Cove. The results of these measurements and visual observations will be presented to and discussed with the BCT for selection of final sampling locations in this area.*

11. Page 10, Section 3.2.3: The CCC for ammonia is listed as: CCC = ((0.0858/(1 + 107.688-pH)) + (3.7/(1+10pH-7.688))). Appendix C in the NAWQC (EPA 2002), however lists a different equation for waters where fish early life stages are present: CCC = ((0.0577/(1 + 107.688-pH)) + (2.487/(1+10pH-7.688))) x MIN (2.85, 1.45x100.028(25-T)).

The methods of standardization were different between the two examples. For clarity, the following definition will be used:

$$CCC = \frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}} \cdot MIN\left(2.85, 1.45 \times 10^{0.028(25-T)}\right)$$

where N is expressed as mg nitrogen per liter.

12. Page 14, Section 3.2.5: EPA believes that the term "entrainment" mentioned twice in this section should be replaced by "recruitment". EPA agrees that the proposed population sustainability approach will be useful to provide a context for the evaluation of projected potential impacts; however, EPA requests an explanation of how Army will translate exceedance of modeled NOAEL- or LOAEL-Hazard Quotients to a probability-based increase in the mortality rate, M.

The text will be revised as requested.

10/3/08: The response indicates that the text will be revised as requested; however, EPA had requested an explanation of how Army will translate exceedance of modeled NOAEL-based or LOAEL-based Hazard Quotients to a probability-based increase in the mortality rate, M. Thus, EPA assumes that the final work plan will provide this explanation. EPA would prefer to get this explanation prior to its appearance in the final workplan, so that it can evaluate the suitability of this procedure.

10/9/08: An explanation was included in the RLSO that was forwarded to EPA on 10/06/08.

10/15/08: Section 3.2.1 [revised 10/6/08]: Taxonomic identification should be to species, at least for midges, rather than to genus only as specified in the last paragraph of Section 3.2.1.

11/05/08: The text in this section will be revised to state "...to at least the genus level, and to the species level to the extent possible considering organism maturity and condition, and compared...".

10/15/08: Section 3.2.5 [revised 10/6/08]: The second sentence is incomplete. Please revise.

11/05/08: The second sentence will be deleted.

12/02/08 on the 11/5/08 version: Section 3.2.5, page 15-16 of 20: EPA still does not fully understand the language in this section. EPA cannot agree with the proposed "e no stress" values until it understands how they were derived. Also, please provide an electronic spreadsheet with the equations and example values for the variables with the formulae visible so that EPA can understand the approach. EPA will not consider this approach to be determinative until it understands and agrees with its components.

02/03/09: An Excel spreadsheet is attached as requested. The no-stress value of entrainment (e) (aka recruitment) was determined directly from the provided equation using the values listed in the table. In a no-stress situation, it is assumed that every breeding pair must be replicable by reproduction and that the probability of impact (p_{risk}) is zero. Hence

$$M = M_{nat} \quad r = r_{nat}$$

Any deficit in the ability to replace losses through mortality will eventually require recruitment in order to avoid a local extinction. This is expressed as the entrainment/recruitment (e) which represents the number of individuals who would need to immigrate to the site to stabilize the local population. Since the time to extinction is not important, (e) can be determined per breeding female. The assumption is that if the reproduction exceeds the mortality, then no immigration will be necessary. This is indicated by a value of (e) less than or equal to zero.

Consider for example the following for the raccoon:

A female raccoon has an average litter of 3.4 to 3.8 individuals per breeding pair (Wildlife Exposure Factors Handbook). This equates to a yield of 1.7 to 1.9 females per breeding female (fecundity "r"). The annual probability of mortality is 38 to 56 percent. This yields a survivorship of 44 to 62 percent. This value is assumed to be the same for both males and females. For every female at the initial time (t-1), the number that survive to reproduce is as follows:

$$\begin{aligned} P_1 &= \left(P_{1(t-1)} \cdot (1 - M_{P_1})\right) \\ &= \left(1 \cdot (\{0.44 ... 0.62\}\right) \\ &= \{0.44 ... 0.62\} \end{aligned}$$

At the end of the reproductive cycle, the number of breeding females (P2) are those that survived (P1) plus the new ones entering into the population via reproduction (f2). This can be expressed as follows:

$$
\begin{aligned}
&P_2 = P_1 + P_1 \cdot r_{P_1}\\
&or\\
&P_2 = P_1 \cdot (1 + \cdot r_{P_1})\\
&Hence:\\
&P_2 = \{0.44...0.62\} \cdot (1 + \cdot\{1.7...1.9\})
\end{aligned}
$$

The survivability of the new ones (f2) is taken as 1.0 since their annual mortality in subsequent breeding years will be accounted for in the P1 mortality. This is a simplification that results from the fact that the mortality rates are equal and that the time to reproductive maturity is 1 year.

If we assume that the local population was at carrying capacity (Kp) in the absence of the stress, then the population can be maintained so long as each breeding female produces at least one breeding female to survive to the next breeding cycle. Therefore Kp = P1(t-1) =1 per breeding female. A positive value for entrainment/recruitment (e) would indicate that P2 is less than P1(t-1) and that the population would decline without immigration from non-exposed populations. A negative value would be indicative of a surplus productivity and a need for individuals to leave the local population to maintain the carrying capacity. Entrainment (e) would therefore only be necessary if P2 were less than P1(t-1). Hence:

$$
\begin{aligned}
&Kp = P_{1(t-1)} = 1\,(breeding\ \ female)\\
&e = Kp - P_2\\
&= Kp - \left(P_{1(t-1)} \cdot (1 - P(M_{P_1})) \cdot \left(1 + r_{P_1} \cdot (1 - P(M_{f_2}))\right)\right) \quad \begin{Bmatrix} e \le 0 & Sustainable \\ e > 0 & Unsustainable \end{Bmatrix}
\end{aligned}
$$

Assuming natural mortality and reproduction, it is possible to derive a baseline value for entrainment (no stress) by solving the equation on a per breeding female basis as follows:

$$
\begin{aligned}
&e = Kp - \left(P_{1(t-1)} \cdot (1 - P(M_{P_1})) \cdot \left(1 + r_{P_1} \cdot (1 - P(M_{f_2}))\right)\right)\\
&Kp = P_{1(t-1)} = 1\,(breeding\ \ female\,)\\
&r_{P_1} = \{1.7...1.9\}\ female\ \ pups\ \ per\ \ female\\
&M_{P_1} = M_{nat} = \{0.38...0.56\}\\
&M_{f_{21}} = 0\\
&r = r_{nat}\\
&Therefore\ :\\
&e = 1 - \left(1 \cdot (1 - \{0.38...0.56\}) \cdot \left(1 + \{1.8...1.9\} \cdot (1 - 0)\right)\right)\\
&= 1 - \left(\{0.44...0.62\} \cdot \{2.8...2.9\}\right)\\
&= 1 - \left(\{1.23...1.80\}\right)\\
&= \{-0.80... - 0.23\}
\end{aligned}
$$

The distribution about e has an arithmetic mean of -0.515 and a geometric mean of -0.358. Put another way: for every 2.79 breeding females in a no stress environment, there is 1 female produced over and above the carrying capacity of the local environment.

02/12/09 EPA accepts the proposed approach provisionally and recommends that Army/AMEC move forward with the Draft Final document. EPA is pursing technical support from someone with expertise in this type of modeling for a review of the proposed approach in the Draft Final report.

03/06/09 Agreed.

MassDEP Comments

Comments and follow-up comments on the August 2008 BCT Draft Workplan were received from MassDEP on 9/11/08, 10/15/08, 12/9/08, and 2/26/09. The comments are provided below with responses in italics following each comment. The comments and responses from the various dates have been combined to keep comment threads together in chronological order using dates to denote comments after the initial 9/11/08 set, except that the final comment set (received as DRAFT) and responses are provided at the end of all previous comments.

Comment (9/11/08 unless otherwise indicated): The Massachusetts Department of Environmental Protection (MassDEP) Federal Facilities Section has reviewed the above referenced document. This draft RI Work Plan (RI WP) presents updates to the Data Gaps Analysis and Conceptual Site Model, Sampling and Analysis Plan (field data, QAPP, safety-health) and HERA Plan. The RI WP identifies arsenic as the primary contaminant with elevated levels of lead, chromium, and PAHs also identified. While much assessment has occurred in the Red Cove, Railroad Roundhouse and Plow Shop Pond Areas, the RI should not limit the COCs to these. The RI should also characterize other possible toxic and conventional pollutants to ensure that impacts from Shepley's Hill Landfill and SA 71 are addressed.

Response (9/29/08 unless otherwise indicated): The RI risk assessments and identification of Contaminants of Concern (COCs) will be conducted in accordance with CERCLA. This workplan is designed to collect sufficient data to complete the RI; for some contaminants these data already exist from earlier studies.

10/15/08: Page 1, Para 1: The Army's first RTC basically restricts COCs to arsenic, other metals and ammonia in the R1WP. MassDEP had originally requested that the RI not be limited to considering limited Contaminants of Concern (COCs) from previous assessment at Shepley's Hill Landfill (SHL) or Railroad Roundhouse. This is requested because stressors to an aquatic environment are not the same as stressors to human health. The Shepley's Hill Landfill assessments focused primarily on human health pathways and stressors. For completeness MassDEP requests that the results of the SHL RI results be evaluated for other contaminants that were identified to determine if any of them would be considered stressors in an aquatic environment.

11/05/08: The prior studies on which the RI Workplan is based (including EPA's ESI and the Army's SA 71 study) included extensive testing of many chemical parameters. These studies focused on ecological and human heath impacts and identified the chemicals of greatest concern for those receptors. The revised text for Section 2 of the workplan, provided on 10/6/08, provides the rationale for focusing on 10 metals, PAHs, and ammonia as chemicals of potential concern.

10/15/08: Given the accelerated timeframe for response to the Army's comments on the draft Work Plan, MassDEP again requests that there be given adequate time to review a revised draft final Work Plan before it is implemented.

12/9/08: As stated in earlier letters, given the accelerated timeframe for response on the draft Work Plan, MassDEP requests that there be given adequate time to review, and/or discuss with the BCT, the final Work Plan before it is implemented.

02/03/09: The Army expects that adequate review time will be available before the final workplan is implemented.

Given the accelerated time frame for review of this draft, MassDEP provides these preliminary comments and looks forward to discussing refinements to the AOC 72 RI WP at next BCT/Technical meetings. The following are our comments:

General Comments (9/11/08 unless otherwise indicated):

1. Focus Areas: The main Contaminants of Concern identified in the Work Plan are arsenic laden leachate from Shepley's Landfill, iron forming a precipitate with arsenic, PAHs from the former railroad round house, and chromium in Grove Pond from the Hartnett tannery. Arsenic, PAHs and chromium are non-volatile, accumulative and persistent in the environment. A good deal of information is available on sediment concentrations of these chemicals in the Ponds from previous Army, USEPA and State investigations. New information from the USEPA ORD 2008 Red Cove study and the Shepley's Hill Landfill 2007 Annual Report – Capture Zone Analysis identify multiple locations of groundwater discharge into Red Cove and also along the western shore of Plow Shop Pond. The USEPA Expanded Site Investigation (ESI) identified higher levels of arsenic contaminated sediment in that area and assessment of these areas should be included in the RI WP.

Response (9/29/08 unless otherwise indicated): The focus areas for additional investigations include the areas identified in the comment.

2. Applicable or Relevant and Appropriate Requirements (ARAR)s: As part of its Superfund responsibilities, MassDEP has previously identified ARARs for the whole of the former Ft. Devens Super fund site and is additionally identifying the following regulations as ARARs for this AOC 72 Remedial Investigation The RI WP may need to be modified to ensure that the appropriate data is collected to address the ARARs In addition, MassDEP requests a chart indicating the data that will be collected to address individual ARARs MassDEP published the "Guide to the Regulation of Toxic Chemicals in Massachusetts Waters" Dec. 1990, that also may be helpful in identifying other site-specific requirements, but the following need to be addressed in AOC 72 RI WP:

Surface Water:

a. Benthic - Action/Location Specific – MA Surface Water Quality Standards (MASWQS) require surface waters "shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the *physical or chemical nature of the bottom,* interfere with the propagation of fish or shellfish, or adversely affect population of non-mobile or sessile benthic organisms" [314 CMR 4.05(5) (b)] USEPA requires aesthetic criteria not be developed with quantifying definitions but determined that they [narrative standards] are essential properties to protect the nation's waterways. The USEPA requires states to have aesthetic criteria in their surface water quality standards because they are considered essential for the protection of waters even though quantifying definitions cannot be developed. To address this requirement, additional data should be gathered that will help determine if the bottom provides proper substrate for benthic organisms.
b. Readily Apparent Harm – Action/Location Specific - MCP would look towards the MASWQS criteria to evaluate 'readily apparent harm' per the MCP.. The Surface Water Program has identified the iron/arsenic flocculant that forms at Red Cove as "objectionable deposits, objectionable color, and adversely affecting the physical and/or chemical nature of the bottom". Additional data should be collected that will define a typical cove bottom including turbidity and opacity, in addition to oxygen levels
c. The RI WP should determine if iron/arsenic flocculant indirectly affects toxicity by creating anaerobic micro-environments at the surface water/sediment interface, away from the discharge of SHL leachate/groundwater plume as identified by USEPA ORD
d. AOC 72 / Plow Shop Pond is within the Squannassit Area of Critical Environmental Concern (ACEC) and is therefore subject to the jurisdiction of the Commonwealth of Massachusetts Water Pollution Control Regulations 314 CMR 4 05(5) - Additional Minimum Criteria Applicable to All Surface Waters state that: "All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life "
e. Please note that both Plow Shop Pond and Grove Pond are impaired water bodies due to contamination, in part from the subject Army BRAC sites, so it is imperative that, as required by the USEPA, more specificity be included where appropriate, to quantify these impacts.

The MassDEP identification of ARARs will be considered in the RI and FS as appropriate.

10/15/08: Page 1 and 2, Response to General Comment 2: The question of ARAR identification is important at the RI stage. CERCLA §121(d)(2)(A) requires States to identify ARARs "in a timely manner." MassDEP has identified additional potential ARARs that are more stringent or are from a delegated program. While MA Surface Water Quality Standard benthic standard, 314 CMR 4.05(5) (b) relies on narrative criteria, "...shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the *physical or chemical nature of the bottom,* interfere with the propagation of fish or shellfish, or adversely affect population of non-mobile or sessile benthic organism", we have supported the standard as required by 40 CFR section 131 11(a)(2) with specific methods for identifying, analyzing, and defining sources of impact to the benthic environment in our original comments. Technical Objectives emanate from ARARs. A Technical Objective should be added for the MSWQ [benthic] Standard, where the evaluation of flocculant as a physical asphyxiant and readily apparent harm are criteria to meet the objective.

11/05/08: The RI Workplan proposes methods for identifying, analyzing, and defining sources of impact to the benthic environment. Technical Objectives relating to the asphyxiation potential and "readily apparent harm" were included in the original draft workplan on page 5 under the third and fourth bullets, and methods to meet these objectives were presented in Sections 2.3.3 and 2.3.4 (please also see MassDEP's Specific Comment 3 and the response).

12/9/08 on the 11/5/08 version of the workplan: As previously commented, The Technical Objectives (TO) do not adequately address the benthic environment. MassDEP requests that either the TO be modified or an additional one added to fully address the MA SWQS identified criteria. MassDEP originally commented that MA SWQS should be considered ARARs and that `readily apparent harm' objective in the MCP was a factor in determining if MA SWQS were violated. The Army added this as a TO. The RI WP had included data collection activities including benthic community surveys, chemistry (including dissolved oxygen and TCLP), toxicity, and physical testing, which should be used to determine whether benthic impacted conditions exist and/or meet a specific MA SWQS TO.

02/03/09: The MassDEP has not identified a specific TO or data need to be addressed. Contrary to this comment, the Army has not revised the original TOs, which we believe do address the stated concerns and data gaps.

10/15/08: MassDEP would like to see some specific acknowledgement of the Squannassit ACEC in this RI WP, to date - this does not appear to have been done.

11/05/08: Information regarding the Squannassit ACEC will be added to Section 1.1 in the workplan and will be included in the RI report.

RI Technical Objectives and Data Gaps (9/11/08 unless otherwise indicated): The technical objectives of this RI WP should address:

1. Sampling methodologies – They should be suited to the issue and area to be evaluated. As an example, bulk sediment sampling to evaluate the reactive zone of aerating groundwater discharge from the aquifer into the pond sediments is too coarse a methodology to achieve its objective. MassDEP is concerned that the sediment sampling methodology presented in the RIWP is not sensitive enough to evaluate the fate and transport mechanisms identified in

earlier studies or assess impacts to non-mobile or sessile benthic organisms within and around Red Cove.

Response (9/29/08 unless otherwise indicated): The sampling methodologies proposed in the workplan conform to standard practices and EPA guidance for sampling benthic habitat; see also the response to EPA comment 10 on Attachment E.

10/15/08: Regarding sampling methods for benthic habitat and BMI please refer to the ESI report so that the results incorporate the toxicity test results. To better evaluate the effect of physical smothering of benthic organisms in the floc-effected sediments, dissolved oxygen (DO) should be measured at various discrete depths. It is proposed that measurements of sediment DO at the top and bottom of the upper 10cm, constitute a zone of interest for BMI.

11/05/08: Regarding sampling methods for benthic habitat and BMI, we are not aware of any procedures described in the ESI report that have not been considered in the RI Workplan. We also note that the toxicity test results in the ESI report have been deemed unacceptable by MassDEP due to the short test duration (please also see MassDEP's Technical Objective Comment 3 and the response). Dissolved oxygen will be measured in sediment pore water in the area potentially impacted by floc, at depths of 0-6 and 6-12 inches as indicated in the response to EPA's General Comment 3.

12/9/08 on the 11/5/08 version of the workplan: MassDEP does not consider ESI toxicity test results to be "unacceptable." Nor has MassDEP rejected the ESI toxicity information. MassDEP would prefer toxicity testing to encompass the reproductive endpoint and encourage the use of 42-day toxicity tests to measure the reproductive endpoint. This is expressed in the MassDEP guidance for freshwater sediment toxicity tests found at: http://www.mass.govidep/water/laws/ecotufws.doc. Toxicity tests less than 42-days do have value and help make determinations about sediment toxicity, but tests less than 42-days generally do not address the reproductive endpoint.

02/03/09: We apologize for the misstatement of MassDEP's position in the comment response language. Please note that this language does not occur in the workplan.

10/15/08: MassDEP would like to reach a consensus on a suitable benthic sampling protocol. Suitable sampling methods are going to be very dependent on the purpose, to evaluate the 'health' of the aquatic system in the pond, protocols designed for wetlands may be appropriate. Additionally, numerous replicates will be needed since benthos populations can be clumped in their distribution across PSP. While Massachusetts does not have wetland assessment protocols, Maine and Minnesota have some that may be useful.

11/05/08: Specific comments on sampling methods have been offered by EPA, MassDEP, and USFWS, and responses to these comments have been provided herein and in the revised workplan text provided on 10/9/08. Any remaining issues should be identified as soon as possible.

10/15/08: With respect to using sweep nets for the collection of macroinvertebrates. We would like see wording in the appropriate field sampling section that macroinvertebrate community samples will be properly separated. We want to ensure that epiphytic species are not mixed with benthic species.

11/05/08: The macroinvertebrate survey samples from sweep netting will be collected separately from those in sediment, as indicated in the revised sampling text provided on 10/9/08.

2. Fish data sources - It is not clear if the data sources cited in the HERA for edible fish tissue will be re-evaluated to determine their adequacy since it was not presented in detail. Other site contaminants may accumulate in fish tissue from either Pond and may be ingested by humans or animals. These should be considered in the HERA. The Catch and Release advisory imposed by the Town of Ayer is for mercury only.

The source of the fish data for the contaminants of interest to be evaluated in the human health risk assessment will be fish filet data presented in the ESI (Gannett Fleming, 2006), as well as estimated fish concentrations from sediment samples using bioaccumulation factors. The comment regarding the reason for the fish advisory is noted.

10/15/08: Fish data – it is not clear how the estimated (edible tissue assumed) fish concentrations will be extrapolated from the sediment sample data; only that bioaccumulation factors will be used. Please provide a reference. In the report, please provide a fair comparison of these data in visual graphic-like (charts, etc) format.

11/05/08: Estimation of contaminant concentrations in fish and other dietary items is described in Attachment E Section 3.2.4. The Human Health and Ecological risk assessments will be consistent in their consideration of the measured and estimated fish concentrations.

3. Toxicity in Red Cove and at SA 71 - The ESI toxicity results indicated chronic toxicity impacts in both the Red Cove area and SA 71. The cause of the toxicity needs to be determined but is not included as a Technical Objective to substantiate the CSM supposition that "The primary contaminant relating to SHL and potentially presenting human and ecological risk is arsenic".

The results of the ESI sediment toxicity tests were rejected for use in the RI by MassDEP, based on the short duration of testing. SQT tests proposed in this workplan include toxicity testing for the duration preferred by MassDEP and chemistry tests which will be used to evaluate the cause of any toxicity measured.

4. USEPA ORD *Final Report Arsenic Fate, Transport and Stability Study Groundwater, Surface Water, Soil and Sediment Investigation for Ft Devens Superfund Site, Devens, March 26, 2008* – This report identified mechanisms, depth-discrete chemical reaction zones, arsenic speciation and locations of arsenic and other contaminant accumulation in Red Cove. However, the Technical Objectives do not reflect how those results will be used to determine impacts to human health and the environments.

The EPA/ORD results have been considered in the Conceptual Site Model (CSM) and evaluation of Data Gaps; this will be clarified with the addition of references in Section 2. The ORD study results will also be used for calibration of the numerical groundwater flow model and in updating the CSM as indicated in the Data Analysis Plan (see also the response to EPA's comment on Attachment B).

5. Background or reference sites – These sites need to be selected so they are not influenced by the known industrial sources at either Plow Shop or Grove Ponds. The locations chosen are problematic for those reasons.

The selection of background and reference sites has been modified based on discussion at the 9/18/08 BCT meeting and a reconnaissance of Plow Shop Pond on 9/24/08, as indicated in the response to EPA General Comment 3.

10/15/08: Figure 9 – Location 8 is a poor choice since it is located at the former discharge of the Pond. This area has high potential for dumping as noted during a site visit in what appeared to be remnants of a former discharge culvert/arch. Also, the vegetation appeared stressed. Location 8 would be better placed at or near PSPO2. Location 7 should be moved closer to SHD-94-01x as presented in the revised Figure 9. Additionally, there is already some data collected at this location.

11/05/08: Please see the responses to EPA General Comment 3.

12/9/08 on the 11/5/08 version of the workplan: As indicated in earlier comments, the northern cove (location #8) reference site is near the historic discharge of Plow Shop Pond which raises the issue of reference suitability. After reading AMEC's response and reasoning to keep location #8 as a reference site, MassDEP does not agree with the argument to keep this location.

Location #8 is a poor choice as it is located at the former discharge of the pond. Our concerns regarding proposed location #8 are three-fold;

1) The area has debris and a high potential for historic and current dumping as noted during a 09/24/08 site visit. Remnants of a discharge culvert/arch concrete channel overpass were observed,

2) The vegetation in the area appears stressed. MassDEP observed stressed vegetation in this area during the 9/24/08 site reconnaissance

3) It is unclear if the pond exit was historically a free flowing channel or a damned weir. If damning occurred, it may have been a depositional area for many of the contaminants historically found in the pond and thus could be heavily impacted. EPA ESI indicated that several metals, i.e. chromium and mercury, were elevated relative to Red Cove which also could distort the area's value as a reference site.

EPA reported observing obvious anthropogenic impacts in this location and on 10/3/08 and 10/16/08 commented it be replaced by the shallow shoreline area to the south "near the tree with red leaves." This replacement location has similar habitat to Red Cove but no obvious anthropogenic impacts.

On 11/05/08, AMEC stated it was open to changing the location of #8 "if this location is not acceptable, we respectfully request additional discussion so that a suitable replacement can be located." MassDEP does not agree with location #8 as a reference area and would like to discuss the use of an alternative to the Saw Mill Creek discharge location. One possibility is southwest of Location #8 (near ESI PSP02).

02/03/09: Please see the responses to EPA General Comment 3; both locations (red tree and location #8) will be sampled as requested by EPA.

10/15/08: On "new" figure 9 - all figure 9s for that matter... Please increase the study area (Inset B) to include the shoreline area north up to sample point SE SHL-06, at least. This is an area that we have observed red-orange staining (discharge) and has higher arsenic hits according to your maps.

11/05/08: Inset B in Figure 9 was not intended to establish limits of a study area, and is not labeled or discussed as such. Inset B was intended to provide a close-up of the area where field screening is proposed. It is not clear from the comment whether MassDEP asks to extend field screening beyond this area.

12/9/08: The Army states (11/5/08) that it is not clear whether MassDEP is asking for an extension of the field screening area – the answer is "yes " This issue was discussed at the October 16th 2008 BCT meeting which AMEC was not present. MassDEP has observed red-orange pond sediments to the north, beyond what appears to be the outline of Inset B. Inset B provides a close-up of the area where field screening is proposed.. Please ensure and confirm that no orange-flocculent/sediments are beyond this field screening area.

02/03/09: The intent of the field screening is to identify a range of groundwater upwelling and apparent floc conditions as described in workplan section 2.4.1, but not necessarily to cover the entire extent of where upwelling and floc occurs. We believe that representative sampling areas can be selected from the indicated screening area around Red Cove. However, the Army agrees to extend visual screening and photography to the northern area up to SE-SHL-06, and to include this area in the field screening if any conditions are observed that appear to be unique and not represented by the field screening locations to the south around Red Cove.

12/9/08: Limited flocculent was observed in the so-called little cove during the site survey on 9/24/08. While this area represents the habitat that most closely approximates Red Cove, its use should be undertaken with the understanding that samples should be collected from the shoreline opposite of the flocculent/staining break out.. This reference location is conditionally suitable, i e samples should be collected from the southern shoreline in the immediate vicinity of SHD-94-01X as seen on Figure 9 of the AOC 72 RI Work Plan.. This issue is addressed in response to EPA question #3 – see page 4 of'33 of the RTC..

02/03/09: The Army agrees as indicated in the cited response.

6. Analytical methods – Methods should be selected so that the detection levels will be below comparative standards. The achievable laboratory quantification limit for arsenic is above the risk-based concentration identified is noted but no strategy is presented to address the issue.

Please see the response to EPA's comment on Attachment C, the QAPP.

7. Seasonal variations - Groundwater flux into Plow Shop Pond and sediment concentrations should be identified and evaluated for possible seasonal impacts to benthic and fish communities mating or larval stages.

Seasonal variations in groundwater flux will be estimated using the groundwater flow model and available water table measurements.

12/9/08: The answer provided by the Army is geotechnical in nature, i .e seasonal variations in groundwater flux will be estimated using the groundwater flow model. Our original question had more to do with evaluation of aquatic communities. Please revise your answer and consider our request to address how seasonal groundwater flux might impact BMI, fish, and other living aquatic communities.

The western shore north of Red Cove and the staining breakout area in Little Cove are likely areas of seasonal hydrologic, and thus biologic, variability. The groundwater flow model will not provide precise data for seasonal groundwater flux since the models are steady state.. Is it possible to review data or duplicate some of this work on a seasonal basis? We ask this since we would like to see if' seasonal fluctuation may be tied to the landfill plume.

02/03/09: The RI will include a discussion of possible seasonal variations based on the available data and, if appropriate, recommendations to measure these variations. We do not think it is necessary to propose periodic seasonal measurements without first collecting baseline data to establish potential impacts on aquatic communities.

Specific Comments (9/11/08 unless otherwise indicated):

1. MassDEP does not believe population risk assessments are sensitive endpoints. Population risk assessments are not considered sufficient to determine if a condition of no significant risk exists.. MassDEP would not be able to concur with HERA results where assessment endpoints for environmental risk characterizations are not sensitive enough to detect an actual effect.. Significant adverse impacts may occur in a population or habitat befbre a notable change in population may be detected.

   Please note that for MassDEP, four criteria must be met to achieve a condition of no significant risk, (per 310 CMR 40 0995) and that biologically significant harm may mean an adverse effect at "any level of biological organization including organism, population, community, and ecosystem level effects" (Guidance for Disposal Site Risk Characterization).. Thus, the term "biologically significant harm" applies to the organisms and groups of organisms that are components of an ecosystem as well as to the ecosystem as a whole.. Although ecosystem level effects are often an underlying concern of environmental protection laws and regulations, they are not always measurable or predictable, and they often do not, in and of themselves, provide sufficiently sensitive indicate MassDEP of environmental harm or risk posed by individual sites. This position is more clearly expressed in the Interim Technical Update: Assessing Risk of Harm to Benthic Invertebrates at: http://www.mass.govidep/water/laws/ecotuben.pdf. Please note, technical updates supersede the Guidance for Disposal Site Risk Characterization and this update specifically mentions the preference for organism-level effects over community-level effects.

Response (9/29/08 unless otherwise indicated): Comment noted.

2. MassDEP does not support the use of' site-specific Probable Effects Concentrations (PECs) to screen sediments for environmental risk characterization.. MassDEP prefers the use of published Probable Effects Concentrations (PECs) or the Threshold Effects Concentrations (TECs) as comparisons to sediment concentrations to screen sediments for ecological risk in the Stage One environmental screening process. Please see the Revised Sediment Screening Values Interim Technical Update for details (http://www.mass.gov/dep/water/laws/ecoturss.pdf).

TECs will be used in the derivation of site-specific sediment toxicity benchmarks.

3. "Readily apparent harm" does not exclusively rely on visual evidence of stressed biota. Page 6, states that "no stressed biota has been identified to date." MassDEP disagrees with the determination in section 2.3.4 of the draft RIWP "regarding readily apparent harm." Section 40.0995 of the Massachusetts Contingency Plan (MCP) describes conditions that represent readily apparent harm as:

   a. Visual evidence of stressed biota attributable to the release at the disposal site, including, without limitation, fish kills or abiotic conditions;
   b.. The existence of oil and/or hazardous material attributed to the disposal site in concentrations which exceed Massachusetts Surface Water Standards promulgated in 314 CMR 4.00, which include USEPA Ambient Water Quality Criteria applied pursuant to 314 CMR 4. 05(5)(e) .
   c. Visible presence of oil, tar; or other non-aqueous phase hazardous material in soil within three feet of the ground surface over an area equal to or greater than two acres, or over an area equal to or greater than 1,000 square feet in sediment within one foot of the sediment surface..

MassDEP is of the opinion that the persistent red staining from the iron/arsenic flocculant, viewable from satellite imagery, paired with pond bottom devoid of healthy plant life is sufficient visual evidence of stressed biota and rises to the level of "readily apparent harm" as per 310 CMR 40 0995(3)(b)(1)(a) and has stated such in previous Technical Meetings.

The conclusion that "readily apparent harm" exists at and around Red Cove is further supported by present data and visual observations per 40 0995(3)(b)(1)(b) and 40 0995(3)(b)(1)(c). Present sampling data suggests that flocculant and groundwater discharges to Red Cove exceed the Massachusetts Surface Water Quality Standards (314 CMR 4 00) for several constituents and the flocculant impacted area covers an area greater than one thousand square feet within one foot of the sediment surface.

In addition, the USEPA ORD 2008 Report Section 4.2 Sediment Chemistry indicates that there is correlation with stressed biota and iron/arsenic flocculant; "The transition zone from groundwater to surface water in Red Cove is characterized by a sharp transition from reducing to oxidizing condition [and] is visually evidence by the pervasive precipitation of reddish-orange iron oxides...in locations with minimal growth of aquatic plants."

The RI workplan proposes testing and documenting sediment conditions to better establish the relationships between biota and locations of floc formation and/or groundwater upwelling. The text of Section 2.3.4 will be revised to reflect MassDEP's conclusions listed above.

4. The flocculant may also be a hazardous material as set forth in 310 CMR 40.0342 & 40.0006 because the flocculant, independent of the sediment and surface water it exists between, presumably exceeds the standard for arsenic in waste materials set forth in 310 CMR 30.000 (EPA D004 waste >5.0 mg/L)

The workplan will be modified to propose testing sediment that contains floc for the toxicity characteristic to determine if it is a hazardous material. The sediment having the greatest visible thickness of floc during the SQT sampling will be re-sampled as described in Section 4.4 of Attachment A, with analysis for TCLP metals.

12/9/08 on the 11/5/08 version of the workplan: At several points in the text there is mention of TCLP testing to be performed. Please be aware that MassDEP has rescinded our earlier request for TCLP analysis. In an e-mail dated 11/18/2008, MassDEP acknowledged that Toxicity Characteristic Leaching Procedure (TCLP) would not be a good fit for the RI WP at Plow Shop Pond. Thus, MassDEP no longer requests TCLP for this RI WP.

02/03/09: The proposed TCLP test still appears to be appropriate for the purpose of regulatory classification, as indicated in the original comment and response.

5. The RIWP cites the OSWER Directive 9285.7-28P as a guide to structure the baseline ecological risk assessment. The RIWP specifically mentions Principle numbers 1 and 4. MassDEP would like to emphasize Principle number 6 of this memorandum. This principle states that if ecological impacts are apparent (e g., no vegetation will grow on contaminated areas) then there is unacceptable risk. Red Cove has persistent flocculant coverage correlating to areas of minimal growth of aquatic plants; therefore the harm is readily apparent. Principle number 6 further asserts that unacceptable ecological risk should be remediated or eliminated.

The RI workplan includes testing and observations to determine ecological impacts and levels of contamination. If it is found that contaminants are detrimental to plant or BMI growth, this will be stated as a conclusive finding of the risk study.

6. MassDEP would like Table 2 to include evaluation of the following results of the studies conducted thus far including but not limited to the Expanded Site Investigation by Gannet Fleming and the studies conducted by ORD Some significant findings presented by ORD are:

   a. Groundwater with elevated concentrations of arsenic currently discharges into Red Cove

   b. Arsenic concentrations observed in Red Cove sediments appear consistent with groundwater discharge as a source of arsenic contamination

   c. Figure 63 shows that DO is very low (approaching zero) at the sediment surface interface for areas within Red Cove

   d. The existing groundwater extraction system does not prevent arsenic plume discharge into the cove

   e. Remediation of existing contaminated sediments within Red Cove will have limited long term effectiveness if conducted without remediation of the groundwater plume discharging into the cove.

The ORD report makes several recommendations which do not appear in this draft including:

   f. Further delineation of the spatial extent of the arsenic plume discharging into Red Cove in order to support design of a better targeted and cost-efficient remedial system to minimize or eliminate contaminated groundwater discharge into the cove;

   g. Continued assessment of the influence of the existing groundwater extraction system on-flow gradients adjacent to Red Cove and discharge patterns into Red Cove;

   h. Evaluation of existing data and determination of supplemental sampling locations needed to design an exposure assessment study that targets locations within the cove that will assist in assessing the separate contributions of contaminants derived horn groundwater discharge versus existing contaminated sediments; and,

   i. Acquisition of additional depth-resolved surface water data to better map the spatial distribution of' redox conditions and dissolved contaminants in the water column.

The importance of action on these issues is reinforced by the fact that the ESI prepared by Gannett & Fleming (2006) found that arsenic in sediment and surface water was identified as a potential contributor to unacceptable risk in Plow Shop Pond.

Table 2 of the RI workplan is a summary of data gaps and proposed RI activities discussed in

Section 2, based on the CSM and existing site data. Items a-d listed in the comment are findings considered in the CSM; therefore the summary in Table 2 does consider these findings. Items e-f are issues for evaluation in the FS if the RI concludes there is unacceptable risk. Item g will be evaluated with the numerical groundwater model, and items h-i are addressed in the sampling proposed in the workplan.

7. As stated earlier by MassDEP at BCT and Technical meetings, benthic invertebrate toxicity studies should include sediment toxicity testing with a reproductive endpoint (42-days) as expressed in the Technical Update for Freshwater Sediment Toxicity Tests. Also, it is not clear why Chironomid tests should be a 20-day test and the proposed period for Hyalella is 28-days.

The amphipod toxicity test duration has been revised to 42 days as indicated in the response to EPA General Comment 2. The 20-day duration for midge larvae is the standard test duration and was used in the previous work at SA 71.

8. Measurement techniques proposed for objective #3 appear to be inappropriate. The sample depth for making this comparison is crude. MassDEP feels that the proposed sediment depth interval in objective #3 is too crude to discern impacts from flocculant that are likely present on the surface of sediment only. The flocculant layer is usually quite thin (<1 cm) and sensitive to movement in the water column. The floc layer is sensitive to movement in the water column. The sampling method should not mix the flocculant with other media and disturb the micro-zone to the extent feasible. Consider using a fine redox microprobe to measure oxidation-reduction changes at the water/floc/sediment interface. Direct measures of D.0., direct measures of flocculant and perhaps invertebrate biomass, diversity, and reproducibility assessments seem to be more appropriate metrics of impact to this habitat.

The DO measurement method will not mix the floc with other media to the extent feasible. The micro PushPoint sampler described in Section 4.2.1 of Attachment A will be mounted on a sediment-supported base so that the 4-cm screen is stationary for sampling above and below the sediment interface. The sampling process will be documented using underwater photography (see also the response to EPA Specific Comment 6). The revised sampling approach will be provided for BCT review as indicated in the responses to EPA General Comment 3 and EPA Specific Comment 5.

11/05/08: The attached RLSO version of Attachment A clarifies that several different methods may be used to immobilize the sampling equipment, including securing the boat at multiple points along the shore.

9. MassDEP proposes an alternative metric of the impacts posed by flocculant in Red Cove. MASSDEP would like the flocculant collected and analyzed for Toxicity Characteristic Leaching Procedure (TCLP) or an equivalent method. If the concentration of arsenic is above 5.0 milligrams per liter then the flocculant is a USEPA D004 hazardous waste and must be treated as such for purposes of remediation.

Please see the response to MassDEP comment 3 on the RI Technical Objectives.

10/15/08: Please explain in more detail the Army's position on the use of Toxicity Characteristic Leaching Procedure (TCLP) for the collected floc. The answer given for this comment refers to an earlier response (Comment #3) regarding chronic toxicity. The two comments differ with regard to concentration vs duration times – there is no connection with the common answer provided. Is the Army willing or opposed to performing TCLP on collected floc? Please answer MassDEP comment #9 directly without referring to an earlier question and answer.

11/05/08: Our apology that the initial response gave an incorrect reference to an earlier answer. TCLP testing of sediment is being added to the workplan as indicated in the original response to MassDEP Specific Comment 4.

10. In the micro-zone lamina could there be valence state changes (like hexavalent Cr) – that result in more toxic chemical species that may exist at this interface? Mixing and recycling of arsenic may be occurring as well as transport of arsenic beyond the area Of groundwater recharge.. EST Figure 5-4 for sediment 0 -1 foot depth and Figure 5-5 for sediment > 1 ft depth show arsenic distribution beyond Red Cove could be due to drift or direct groundwater discharge.

These potential effects can be evaluated in the RI. The SQT testing is designed to provide the information needed to evaluate any sources of toxicity.

11. In Table 2, one objective mentions iron flocculant as "a physical asphyxiant". Additionally, arsenic (the primary contaminant at AOC 72) is co-precipitated with the iron floc – this would make it a toxicant as well. MassDEP considers the flocculant to pose readily apparent harm in Red Cove.

SQT test results will be used to evaluate the toxicity of the floc (see also the response to MassDEP Specific Comment 3).

12. Include sediment toxicity testing with a reproductive endpoint; SQT (sediment quality triad) will be done for sediment. NH_3 (ammonia) risk to fish BMI/PMI. Is this consistent with the Triad methodology?

Please see the response to MassDEP Specific Comment 7 and EPA General Comment 2.

13. Please expand/detail the SOP section for surface water sample collection – Appendix A It does not include; container type (glass or plastic), dip or syringe, filters (if used), duplicates, lab/field blanks, matrix spikes, some in QAPP.

As the commenter suggests, information on container type and QA samples is provided in the QAPP (Attachment C). Surface water sampling is being modified to allow collection of samples immediately above the sediment interface, as indicated in the responses to EPA Specific Comment 6 and EPA's comment 2 on Attachment A.

14. Numerical Groundwater flow model has been used to design and evaluate the Shepley's Hill Landfill Contingency Remedy but because sufficient empirical data is available from both the SHL 2007 Annual Report and USEPA ORD 2008 Report, the Army should use that data to evaluate groundwater flow and contaminant flux. The empirical data includes seasonal information that will greatly enhance this evaluation.

The available data will be used for calibrating the numerical groundwater model, as indicated in the responses to EPA's comment on Attachment B, and MassDEP's General Comment 7.

12/9/08 on the 11/5/08 version of the workplan: MassDEP supports the refinement of the numerical groundwater flow model as it's application has been used in other studies at Shepley's Hill Landfill. One specific issue MassDEP has raised is the seasonal or episodic events that may be important for remedial purposes but cannot be addressed by the steady state model. However, for portions of Red Cove and Plow Shop Pond where empirical data exist, MassDEP is likely to base decisions or conclusions on empirical data over modeled data unless there are compelling reasons to consider the latter.

02/03/09: Comment noted (see also the response to EPA's comment on Attachment B).

15. In this review, the RIWP did not adequately address the potential of seasonal impacts. Please include a section or paragraph in the CSM that considers and plans for seasonal effects as they pertain to sampling the biota of Plow Shop Pond; fish activity and in stream migration, spawning and reproduction, macroinvertebrate stages, larval forms of aquatic life, aquatic macrophyte and vegetation, algal blooms, other physical and biological considerations that may have seasonal dynamic effects on the proposed work plan.

The environmental setting and ecological Conceptual Site Model (CSM) have been covered in detail in earlier studies (ESI, SA 71 study) and relevant information will be included in the RI. No unique seasonal effects have been identified for Plow Shop Pond that would require consideration for sampling and observing biota.

12/9/08: Please allow MassDEP to clarify the original question. We did not intend for strictly "unique" seasonal aspects to be considered. Rather, we would like this RI WP to consider "typical" seasonal effects. The answer provided, does not address the concern raised, i.e. how seasonal effects pertain to sampling biota such as in-stream migration of' fish, spawning, BMI lifecycle (instar) stages, or larval and adult amphibians. Seasonal considerations were taken into account in the revision of this RI WP with regard to moving the BMI sampling times – which leads to the next question ...

10/15/08: In the RI WP Section .3.0 - Field Activities, it states that benthic community surveys, samples and benthic toxicity testing will be collected after ice-out in the spring when late-stage larval forms are present or in late fall after most species have mated. MassDEP is of the opinion these proposed sampling timeframes are not optimal. Sampling for BMI community surveys in PSP is optimal in the late spring –summer period. This is due to the seasonal vegetative senesce in the littoral zone of the pond. Being shallow, plant die-off in PSP would affect qualitative and quantitative macroinvertebrate results. Much of the macroinvertebrate activity in PSP is associated with the plant life in lakes and ponds. Since aquatic plants are senescing by autumn, we expect late spring to summer to be more optimal. Please explain how the Army will compensate for this limitation.

11/05/08: Although earlier studies have included biota sampling in the late summer or autumn, we agree that this timing may not be optimal. Reduced BMI abundance and an increase in patchiness from lower temperatures and terrestrial leaf-fall will result in high variability that will hinder the ability to statistically detect site-specific effects. To maximize the probability of being able to isolate site-specific effects, AMEC recommends that the sampling be undertaken in late April to early May when the water has warmed and the maximum number of benthic species will be in their larval stages.

12/9/08: In our comments from 10/15/08, MassDEP asked that the benthic community surveys be moved to late spring to early summer. While BMI sampling has been moved from the late fall, AMEC recommends that the sampling occur in late April to early May. However, this is too early. Optimal results would not be obtained until May to June for collecting the maximum number of benthic species in their larval stages.

02/03/09: We agree that the optimal timing depends on the rate and degree of warming. The Army can check shallow sediment temperature starting in April and discuss with the BCT prior to finalizing the sampling date.

16. Moving forward: At AOC 72 Red Cove – previous ORD 2008 Report has indicated that contaminated leachate continues to discharge to Red Cove. Additionally, they have estimated the flux of the arsenic discharge to Red Cove and have groundwater results that indicate an area north of Red Cove is also discharging to the Pond. Mass DEP analysis of the 2007 Annual Report section on the Pump and Treat Capture Evaluation also indicates that there is lack of control of groundwater along the western edge of Plow Shop Pond.

The USEPA has indicated that containment of plumes should be addressed as part of the Shepley's Hill Landfill Operable Unit outlined in the 1995 ROD and is currently evaluating the effectiveness of the Pump and Treat Contingency Remedy and studying the residual plume along Nonacoicus Brook. Recently, the Army has expressed a willingness to evaluate additional remedial actions that would comprehensively address both Plow Shop Pond discharges and the groundwater north of SHL. Given the long term costs of the Pump and Treat Remedy and the likely need to address leachate contaminated groundwater discharging into Plow Shop Pond and Red Cove, the Army should evaluate not only optimizing the Pump and Treat system to obtain full containment, but also evaluate comprehensive remedial solutions. With better containment and isolation of the waste, long-term active groundwater remediation at SHL might not be necessary, MassDEP would support this strategy.

Comment noted.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Central Regional Office, 627 Main Street, Worcester, MA 01608

February 26, 2009

Robert Simeone - BRAC Environmental Coordinator
DOA - Devens Reserve Forces Training Area
30 Quebec Street; PO Box 30
Devens, MA 01443

RE: Follow-up to Army's response to BCT comments (received Feb 3, 2009) for the draft final Remedial Investigation Work Plan, AOC 72, Plow Shop Pond, Devens, MA, AMEC Inc.

DRAFT

Dear Mr. Simeone,

The Massachusetts Department of Environmental Protection (MassDEP) Federal Facilities Section has reviewed the above referenced comments and provides the following response (please see attached).

This draft RI Work Plan presents a strategy to collect data for the remediation of Plow Show Pond. A series of independent environmental investigations have documented the continued release of landfill leachate into Plow Shop Pond and have demonstrated ecological impacts. There is the potential for significant biological harm at PSP, especially in Red Cove due to ongoing landfill plume discharge. The ecological risk assessment must meet strong protective criteria. MassDEP maintains that a population risk-based assessment is not of sufficient detail and sensitivity to determine ecological risks to Plow Shop pond.

Under section 4.2.2 of EPA Ecological Risk Assessment Guidance for Superfund, June 1997, Population/Community Evaluations EPA Ecological Risk Assessment for Superfund it states: "Since population/community evaluations are "impact" evaluations, they typically are <u>not predictive</u>. The release of the contaminant must already have occurred and exerted an effect in order for the population/community evaluation to be an effective tool for a risk assessment." Section 4.2.2 highlights limitations with using population studies, specifically with determining the number of species and abundance of organisms in an ecosystem.

In section 3.0 of the Work Plan it states that the Ecological Risk Assessment (ERA) will be performed using MassDEP as well as EPA guidance for assessing the risk of harm to the benthic macroinvertebrate community. Therefore, we expect that the Army will not proceed with the population-based ecological risk assessment option since MassDEP may not be able to accept the results if they are not sensitive enough or according to the Commonwealth's standards.

The other major concern MassDEP has with the RI WP is the use of Apparent Effects Thresholds (EATs) which are a crude metric for assessing ecological risk since they use concentrations where adverse effects are known to occur. The EATs proposed in this WP represent contaminant concentrations above which harmful biological effects always occur. MassDEP prefers the use of the Probable Effects Concentrations (PECs) or the Threshold Effects Concentrations (TECs) as comparisons to sediment concentrations identified in the *Revised Sediment Screening Values* Interim Technical Update, for details (http://www.mass.gov/dep/water/laws/ecoturss.pdf).

This Work Plan must show that the path forward will be protective of receptors and species that are most sensitive to contamination. MassDEP maintains that the benthic sampling methodology presented in the RI WP is not adequately sensitive. The Army's response is that the methods proposed in the WP conform to EPA guidance and standards. Please expand the risk assessment to ensure the inclusion of receptors that are most impacted, and potentially avoid the need for any further study, i.e. Stage II risk assessment.

Under CERCLA guidance and requirements, the ecological risk assessment must meet strong protective criteria. MassDEP is concerned that if the assessment is not detailed enough, we will not be able to draw this conclusion. MassDEP would like to request a meeting to resolve these issues with the BCT. If you have any questions or require additional information please contact me at the address below or call (508) 849-4051. Thank you.

Sincerely,

Brian Duval
Regional Planner - Devens Redevelopment Coordinator
MA Dept of Environmental Protection
627 Main Street, 1st Floor
Worcester, MA 01608

W:Devens/fn correspondence/AOC 72 RI WP response cover to RtC 022609
cc: Fort Devens Mailing List

AOC 72 RI WP RTC comments Feb 26 2009

General Comments:

1. Population risk assessments are not sufficient to determine if a condition of no significant risk exist at a site under the MCP. Chapter 9 of the Guidance for Disposal Site Risk Characterization indicates that assessment endpoints for environmental risk characterizations should be sensitive enough to detect an actual effect. We do not believe population risk assessments are sensitive endpoints. Significant adverse impacts may occur in a population or habitat before a notable change in population may be detected.

2. Populations located close to each other can be affected independently, i.e. one might crash while another is peaking. Physical characteristics of a site can isolate populations so that one population level is not a good indicator of another, for example, a raceway (between the ponds) can be a barrier to populations on either side and populations can fluctuate independently. Erroneous conclusions can result.

3. In the RI WP it states (Attachment E): "The goal of the Superfund program is to select a response action that will result in the recovery and/or maintenance of healthy local populations of ecological receptors that are or should be present at or near the site. Superfund risk managers and risk assessors should select assessment endpoints and measures (as defined in the 1997 ERAGS) that: 1) are ecologically relevant to the site; i.e., important to sustaining the ecological structure and function of the local populations, communities and habitats present at or near the site, and 2) include species that are exposed to and sensitive to site-related contaminants.

4. From EPA guidance: "It may not be practical or technically possible to document existing ecological impacts, either due to limited technique resolution, the localized nature of the actual impact, or limitations resulting from the biological or ecological constraints of the field measurements (e.g., measurement endpoints, exposure point evaluation). Actually demonstrating existing impacts confirms that a "risk" exists. Evaluating a gradient of existing impacts along a gradient of contamination can provide a stressor-response assessment to identify cleanup levels."

5. Under section 4.2.2 of EPA Ecological Risk Assessment Guidance for Superfund, June 1997, Population/Community Evaluations EPA Ecological Risk Assessment for Superfund it states: "Since population/community evaluations are "impact" evaluations, they typically are <u>not predictive</u>. The release of the contaminant must already have occurred and exerted an effect in order for the population/community evaluation to be an effective tool for a risk assessment.

6. Section 4.2.2 (EPA Ecological Risk Assessment Guidance for Superfund, June 1997) highlights several problems with using population studies and points to several limitations, i.e. determining number of species and abundance of organisms in an ecosystem can be difficult with some species difficult to evaluate. It is difficult to detect changes in top predator populations affected by bioaccumulation of substances in their food chain due to the mobility of predators. Some species, most notably insects, can develop a tolerance to contaminants; in these cases a population/community survey would be <u>ineffective</u> for evaluating existing impacts. The section goes on to mention difficulties in accounting for natural variability.

7. On page 4-11 of the above referenced EPA guidance it states "Although population- and community-level studies can be valuable, several factors can confound the interpretation of the results. For example, many fish and small mammal populations normally cycle in relation to population density, food availability, and other factors." It is important that the "noise of the system" be evaluated so that the impacts attributed to chemical contamination at the site are not actually the result of different "natural" factors.

8. Population models have a number of shortcomings. One weakness is that they are models meant to incorporate a vast number of variables. Population models generally have a high degree of uncertainty. Also, population models will show no impacts in habitats where a localized population sink, or dead zone, will be overlooked because reproduction rates in other parts of the habitat range can offset mortality in the dead zone. Based on the large number of uncertainties and shortcomings associated with population risk models, this approach does not appear to be a suitable metric for assessing ecological impacts in PSP.

9. MassDEP emphasizes that ARAR identification is a necessary component of this RI WP. CERCLA requires Massachusetts to identify ARARs, e.g. the Surface Water Quality benthic standard, 314 CMR 4.05(5) (b) relies on narrative criteria, "...shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the *physical or chemical nature of the bottom,* interfere with the propagation of fish or shellfish, or adversely affect population of non-mobile or sessile benthic organism." MassDEP supports the standard under 40 CFR section 131 11(a)(2) with specific methods for identifying, analyzing, and defining sources of impact to the benthic environment. Please ensure that all ARARs previously identified have corresponding Technical Objectives (TOs) to meet their respective objectives.

<u>Specific Comments:</u>

1. On page 27 (of 44) of the RTC, the Army has a general resistance to expanding the study beyond the 10 metals, PAHs, and ammonia as COCs. MassDEP has asked that the RI characterize other possible toxic and conventional pollutants including those that may be emanating from SHL or SA 71 Railroad Roundhouse. The work plan adheres to CERCLA standards and presents the following in section 2.3.2: "Other contaminant

sources besides SHL have been identified for AOC 72, including SA 71 (former Railroad Roundhouse) on the south side of Plow Shop Pond and the former Hartnett Tannery located at the west end of Grove Pond where it discharges to Plow Shop Pond. The principal sources of Contaminants of Potential Concern (COPCs) have largely been established by prior studies and risk assessments, i.e. PAHs and zinc contributed by SA 71 and chromium by the former tannery. Site histories, chemistry, and fate/transport data are largely available from existing studies."

MassDEP accepts the Army's explanation that the WP will collect sufficient data to complete the RI, but contends that "the more information the better" with regard to the final assessment of stressors and ecological and human health risk. Also, one of the Technical Objectives listed in this WP in section 2.2, calls for the evaluation of "other contaminant sources and distribution in AOC 72." Additionally, it is important to determine the origin of the toxicity identified in the 2006 ESI at both Red Cove and SA 71 so that a connection is demonstrated.

2. Page 30 of the RTC: In section 2.2 Technical Objectives (TOs) are given:

- Evaluate current and potential future contaminant flux from SHL to AOC 72.
- Evaluate other contaminant sources and distribution in AOC 72.
- Evaluate whether the iron floc in Red Cove can act as a physical asphyxiant.
- Evaluate whether the iron floc in Red Cove constitutes "readily apparent harm".
- Evaluate human and ecological risks related to site contaminants in sediment.
- Evaluate human/ecological risks related to site contaminants in surface water.
- Evaluate localized ecological risks related to site contaminants in Red Cove.

Our earlier concern that the TOs do not adequately attend to the benthic environment were based on the fact that none of the objectives listed above contain the word "benthic" nor do they fully address the Mass SWQS criteria. However, if close attention is paid to the "physical asphyxiant" – "contaminants in sediment" – and "localized ecological risks related to site contaminants" in Red Cove… the benthic community should be covered.

3. Page 30 (of 44) RTC: – Concern that benthic sampling methodology presented in the RI WP is not sensitive enough. Army Response – that the methods proposed in the WP conform to EPA guidance and standards. MassDEP would like to request a meeting to resolve these issues.

4. Page 32 (of 44) RTC: It states that "Estimation of contaminant concentrations in fish and other dietary items is described in Attachment E section 3.2.4." However, this section appears to be for Terrestrial Wildlife. Unless this has been changed, fish ammonia is covered in section 3.2.3.

On page 104 of the WP, regarding dietary COPC concentrations, it states that bio-uptake from surface water and sediment will be modeled into tissues of plants, macroinvertebrates, insects, amphibians, and fish, for each of the wildlife indicator species. If an extrapolation is to be made between fauna, i.e. birds/mammals vs. fish based on food chain models and exposure, please provide a reference. A reviewable scientific reference was asked for in earlier comments, but has not been provided.

5. Page 34 (or 44) of the RTC: MassDEP asked to extend the area of field screening beyond the area outlined in Insert B. The Army has agreed to extend visual screening and photography to the northern end up to SE-SHL-06, and to provide field screening if conditions appear suspicious of contamination. However, there is chemical and physical data, both temperature and groundwater flow data that indicate high levels of arsenic in this location. If the Army is going to focus on arsenic as a SHL contaminant and assess the risk then we need to focus on the extent of that contaminant.

6. Page 34 (or 44) RTC: If lab reporting limits are above regulatory standard, MassDEP guidance on data usability states: "The Analytical Data Usability Assessment should evaluate whether the Reporting Limits for the analyses are sensitive enough to support the RAO. For example, if the analysis is conducted to determine an Exposure Point Concentration (EPC) and compare the EPC to a Method 1 standard, the Reporting Limit must be at or below the standard." We understand that the AWQC for arsenic (MCL 10 ppb) is close to the detection limit of the instrumentation. Please continue to use the best possible analytical detection methods for arsenic given and that the AWQC for fish ingestion (0.14 ppb) is relevant to Plow Shop Pond as a Class B water body.

7. Page 37 of 44 in RTC: Army states: "TCLP testing appears appropriate for regulatory classification." Please recall that in an e-mail dated 11/18/2008, MassDEP stated that Toxicity Characteristic Leaching Procedure (TCLP) would not be a good fit for the RI WP at Plow Shop Pond. MassDEP does not advise TCLP for this RI WP unless the Army plans to use TCLP in evaluating costs for dredging, i.e. TCLP will be of little use for eco-risk assessment.

Page 37-38 of the RTC: MassDEP requested inclusion of (9) one-sentence bullet items, significant ORD findings in Table 2, to present a clearer picture to a reviewer of this WP. The response states that these items "were considered" in the CSM, will be addressed later if needed, or were already considered in the sampling proposed in the WP. While this may be true, it is easier to view these quick bullet items in a table, rather than sifting through the text.

8. MassDEP understands that shallow sediment temperatures will be checked starting in (late) April and that the Army will discuss with the BCT when to proceed with sampling. MassDEP concurs and maintains that if sampling starts too early, optimal results will not be obtained for determining types and numbers of benthic macroinvertebrate species.

Responses to DRAFT comments of 2/26/09:

General Comments 1-8 -- Comments noted; however the proposed approach is not a population "impact" evaluation in the way that the commenter seems to imply, i.e. we are not measuring organism species and abundance and using that information to predict risks.

General Comment 9 -- Agreed.

Specific Comment 1 -- The Army does not have a "general resistance" to expanding the study for specific chemicals that are suspected to be present based on the extensive site histories and prior studies, but the commenter has not identified any such chemical.

Specific Comment 2-3 -- Agreed.

Specific Comment 4 -- A reference will be provided.

Specific Comment 5 -- The extent of arsenic in sediment is already well characterized; further evaluation is focusing on impacts rather than extent, as indicated in the technical objectives.

Specific Comment 6-7 -- Agreed.

Specific Comment (Not numbered) -- Comment noted; however we believe the current format for Table 2 is more consistent with the technical objectives.

Specific Comment 8 -- Agreed; although the temperature monitoring and other field screening may begin before late April, the pond conditions will be discussed with the BCT prior to the initiation of benthic sampling.

USFWS Comments

Comments on the August 2008 BCT Draft Workplan were received from USFWS through USEPA on 9/16/08. The comments are provided below with responses in italics following each comment.

WP; 2.4: It is unclear if a sufficient number or gradient of contamination samples have been selected in Red Cove or throughout the pond. Currently SQT testing is only proposed for areas associated with Red Cove (and 2 reference locations); however, it appears that all of PSP is supposed to be evaluated to fulfill remedial objectives in Section 2.3. This would infer that additional locations throughout PSP should also be included in SQT testing and that additional COCs should be added to the analytical list (PAHS, etc.). Statistical rigor in the sampling design is not apparent and sampling as stated may not lead to conclusions with high confidence. Further clarification on this is needed.

Response (9/29/08): Revisions to the proposed sampling locations and analytes were discussed at the 9/18/08 BCT meeting, and are being implemented as described in the responses to EPA General Comments 2-4 and the EPA comment on Attachment C.

It would be best if chemistry, tox test and benthic samples were all collected at the same time - this would give the most representative spatial and temporal evaluation - with potential for chemistry flux at this site, timing may be a key issue. Typically, the most representative method is to collect bulk surface seds, homogenize (unless contra-indicated by AVS or other oxidation sensitive analysis parameters) and take split samples for the three tests. If this cannot be conducted, paired sed chemistry and tox testing are the most important, benthic community sampling should be conducted as close as possible in space and time to those. We would favor fall benthic sampling and MA may have established protocols for this or have a standard method and timing for their lake/pond surveys. It would be appropriate to follow their protocols unless they significantly handicap the RI schedule. Since they are trying to capture a range of COC concentrations it might be beneficial to validate contaminant concentrations before chronic tox tests are run.

SQT samples will be collected at the same time, though homogenizing the samples will not be possible considering the oxidation potential (see EPA comment 5 on Attachment A). Sampling is proposed for the fall 2008.

2.4: We are unsure how the sediment core data will be incorporated in the risk assessment. This needs clarification.

Please see the response to EPA Specific Comment 3.

Attachment A - FSP:

4.3: They need to state how deep sed cores are going to be and how they will be processed - i.e. sectioned, etc.

The text will be clarified to indicate that the cores will be sufficiently deep to allow recovery in the coring device, but that the testing laboratory will only test the "upper" (sediment surface) 6-inch end of the core.

4.4: They do not outline how samples will be collected or processed for tox tests or the benthic community.

Information on field preparation of samples is being added to Attachment A.

Attachment C-QAPP: 7.1: They need to describe what type of geotechnical tests will be performed on the sed cores. It is unclear how that data will be integrated into the assessment, as stated previously.

ASTM test methods are D2937 and D854 as indicated in QAPP Appendix A worksheet 9c; please also see the response to EPA Specific Comment 3.

Traditionally, TAL metals analysis is conducted and provides a more robust reporting of site conditions. TAL metals and potentially other COCs analysis, as mentioned previously, would be beneficial for evaluation of sed tox test results. Also, as standard practice, sed chemistry should include TOC and grain size analysis. Benthic Community Analysis (BCA) should indicate identification to species. BCA data analysis statistics could also be outlined.

Please see the response to EPA's comment on Attachment C regarding the TAL metals. BCA will include identification to species to the extent possible considering organism maturity and condition.

Attachment E-HH/ERA: 3.2.4: BCF determination using bioavailability/solubility should be compared to site-specific fish tissue data. This approach also warrants further discussion. Nonacoicus Brook COC uptake dynamics may be very different than PSP for use in site-specific BCFs, unless it can be shown that COC concentrations, TOC content, etc. are similar.

The results of the BCF approach to calculating COPC concentrations will be compared to the available fish tissue data.

We are unsure of how the indicator species will be evaluated differently than was done in the GF ESI. There is no detailed description of how they are going to handle the site data (new and old meshed?) for comparison to TRVs, relative to EPCs, RMEs, 95% UCLs. It would be good if they included both RMEs and UCLs for EPCs and compared to NOAELs/LOAELs/PECs for calculation of Hazard Quotients.

The RI will consider the ESI and SA 71 chemistry data and the additional data proposed to be collected in 2008, as a single combined data set. The RI will also consider the SA 71 SQT test results which were not available for the ESI.

3.2.5: We have reservations about how they are going to conduct the individual to population risk assessment - its not clear how its going to translate from traditional ERA parameters to their carrying capacity calculations. We are willing to see it attempted but may not agree with the methods or validity of the end product.

Comment noted.