DRAFT Phase IV Remedy Implementation Plan
RTN 4-3024222
Former Bird Machine Company Site
Walpole, MA

Submitted to:

Baker Hughes Incorporated
Houston, TX

Submitted by:

AMEC Environment & Infrastructure, Inc.
Westford, Massachusetts

February 2012

TABLE OF CONTENTS

Section **Page**

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS

AMEC	AMEC Environment & Infrastructure, Inc.
bgs	below ground surface
BHI	Baker Hughes Inc.
BMC	Bird Machine Company
BWSC	Bureau of Waste Site Cleanup
CAM	Compendium of Analytical Methods
CMR	Code of Massachusetts Regulations
COC	Contaminants of Concern
CSA	Comprehensive Site Assessment
cVOC	chlorinated Volatile Organic Compounds
DCB	1,4-dichlorobenzene
DCE	dichloroethene
DDA	Demolition Debris Area
DO	Dissolved Oxygen
EPC	Exposure Point Concentration
EPH	Extractable Petroleum Hydrocarbons
Fe2	Ferrous Iron
FIR	Final Inspection Report (310 CMR 40.0878)
ft	feet
H&S	Health and Safety
HASP	Health and Safety Plan
HSM	Health and Safety Manager
ISCO	In Situ Chemical Oxidation
LRA3	Lead Release Area 3
LSP	Licensed Site Professional
MassDEP	Massachusetts Department of Environmental Protection
MBA	Manufacturing Building Area
MCP	Massachusetts Contingency Plan
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MMCL	Massachusetts Maximum Contaminant Level for drinking water
MNA	Monitored Natural Attenuation
mV	millivolts
NAPL	Non-aqueous phase liquid
ND	Not Detected by laboratory analysis
NSR	No Significant Risk
OHM	Oil or Hazardous Material
OMM	Operation, Maintenance, and Monitoring
ORP	Oxidation-Reduction Potential
OSHA	U.S. Occupational Safety & Health Administration
OSWER	U.S Office of Solid Waste and Emergency Response
P&T	Pump and Treat
PID	Photoionization Detector
ppb	parts per billion (for groundwater, micrograms per liter)
PPE	Personnel Protective Equipment

List of ACRONYMS, continued

RAM	Release Abatement Measure
RAP	Remedial Action Plan
RC	Reportable Concentration
RD	Reductive Dechlorination
RIP	Remedy Implementation Plan
RTN	Release Tracking Number
SRS	South Rail Spur
SSO	Site Safety Officer
SVOC	semivolatile organic compound
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
VC	vinyl chloride
VOC	volatile organic compounds
Weston	Weston Solutions, Inc.

EXECUTIVE SUMMARY

On behalf of Baker Hughes, Inc. (BHI), AMEC Environment & Infrastructure, Inc. (AMEC) completed this Phase IV Remedy Implementation Plan (RIP) for the former Bird Machine Company (BMC) Site located in Walpole, Massachusetts. BHI is submitting this RIP pursuant to 310 CMR 40.0870 of the Massachusetts Contingency Plan (MCP). This RIP documents the plan for a Comprehensive Remedial Action that is expected to be a Permanent Solution for the Site, and that was selected in the Phase III Remedial Action Plan (RAP; AMEC 2011a). A Permanent Solution will achieve a condition of No Significant Risk (NSR) for current and reasonably forseeable site uses. As documented in the Class C-2 Response Action Outcome (RAO) Statement submitted to the Massachusetts Department of Environmental Protection (MassDEP) on 12/16/11, the Site already achieves the requirements of a Temporary Solution (AMEC 2011b).

Release Abatement Measures (RAMs) have been conducted at several locations to reduce the mass and concentrations of contaminants at the Site. The Phase II Comprehensive Site Assessment (CSA) reports (AMEC 2011c, AMEC 2011d) indicate that a condition of NSR exists for all areas of the Site except groundwater, where some monitoring well concentrations exceed drinking water criteria (Massachusetts Maximum Contaminant Levels or MMCLs). It is unlikely that groundwater at the Site will be used for drinking water, but the Site is within a Potential Drinking Water Source Area designated by the Town of Walpole (Walpole 2007). Considering this designation, groundwater at the Site is categorized as GW-1 under the MCP. The CSAs found no current pathway between Site contaminants and the Town's water supply wells to the northeast, but the potential for contaminant movement from a portion of the Site warrants further monitoring. Background information including a description of RAMs and Site characteristics is summarized in Section 1 of this RIP.

Areas of groundwater contamination exceeding MMCLs have been identified for arsenic, chlorinated Volatile Organic Compounds (cVOCs), and 1,4-dichlorobenzene (DCB). Monitored Natural Attenuation (MNA) has been selected for implementation in Phase IV. MNA is expected to provide a Permanent Solution that achieves a condition of NSR. MNA has already produced significant reductions in arsenic and cVOC concentrations at individual wells over the past four years of groundwater monitoring. MNA appears capable of achieving or approaching background for cVOCs -- which are expected to require the greatest reductions in groundwater concentrations -- and for the other contaminants.

An Engineering Design for MNA is provided in Section 2 of this RIP, including goals and objectives, proposed activities, and design and operating parameters. The potential areas of groundwater contamination above MMCLs are illustrated in three dimensions using a plan view and cross-sections. A field monitoring program including sampling methods and locations, analytical parameters, and monitoring frequencies is presented, along with data evaluation methods and reporting requirements. Initially the program is envisioned to include approximately 30 water quality monitoring wells and 40 additional water level monitoring points (wells or surface water benchmarks) measured on a quarterly basis. Methods of determining MNA effectiveness and procedures for changing this program over time are also presented.

Section 2 includes site investigations that will precede installation of the final monitoring well network. This initial Geoprobe investigation of groundwater chemistry, geochemistry, bedrock depths, and hydraulic gradients will provide data to optimize the final monitoring well locations. This investigation is consistent with the Triad approach described by the United States Environmental Protection Agency (USEPA) as a potential early phase of developing a performance monitoring plan for MNA (USEPA 2004). A data collection plan is provided in Section 2 along with the process to incorporate these results in the site conceptual model, and if necessary revise the MNA monitoring program that is presented in this RIP. Results of these investigations will be documented along with the final installed monitoring system in the Final Inspection Report (FIR) that is prepared pursuant to 310 CMR 40.0878.

Section 3 and the remaining portions of the RIP include construction specifications, a Health and Safety Plan, and the remaining requirements under 310 CMR 40.0870 of the MCP. Following presentation to the public and response to public comments, this RIP will be finalized and field work initiated. The field phase, including initial data collection and final well installations, is expected to require three months for completion. An expected schedule is provided in Section 3.2 in which a Draft FIR will be submitted in July 2012, and the MNA monitoring program will begin about one month after that. MNA is expected to require up to 10 years to achieve a Permanent Solution under the MCP, and progress will be reported every six months until completion.

1.0 CONTACTS AND SITE BACKGROUND [310 CMR 40.0874(3)(A)]

AMEC completed this Phase IV RIP for the former BMC Site located in Walpole, Massachusetts on behalf of BHI. This document is submitted pursuant to 310 CMR 40.0870 of the MCP. This RIP provides a plan for implementation of MNA, which is the selected Permanent Solution for the Site. The Site location is indicated in Figure 1, and following is general information pertaining to the MCP status.

Release Tracking Number (RTN):	RTN 4-3024222
Tier Classification:	Tier IB
Site Address:	100 Neponset Street Walpole, Massachusetts 02071-1037
Person Undertaking Response Actions:	Baker Process Inc. 2929 Allen Pkwy Ste 2100 Houston TX 77019-7111 Contact: Mr. Chris Clodfelter Phone: 713-439-8329
Licensed Site Professional:	Kim M. Henry, LSP (License # 7122) AMEC Earth & Environmental 2 Robbins Road Westford, Massachusetts 01886 Phone: 978-692-9090

A Tier 1B Permit Application was submitted to the MassDEP on 1/10/08, including a revised Tier Classification and updated Phase I information combining several linked sites under the subject RTN. Tier 1B permit #W204776 for this RTN was effective on 2/28/08. The permit expires on 2/28/13 and must be renewed in order to continue conducting the remedial monitoring program presented in this RIP.

This RIP is organized as follows:

- Section 1 – Contacts and Site Background
- Section 2 – Engineering Design
- Section 3 – Construction Plans and Specifications
- Section 4 – Operation, Maintenance, and Monitoring
- Section 5 – Health and Safety Plan
- Section 6 – Permits, Licenses, and Approvals
- Section 7 – Property Access Issues
- Section 8 – References

The remainder of Section 1 summarizes site characteristics, release history, and investigations and response actions to date based on earlier MCP submittals, particularly Section 1 of the RAP

(AMEC 2011a) and Section 4 of the CSA (AMEC 2011c). Additional details of site characteristics and contaminants are presented in Section 2, which provides design and operating parameters for an MNA system. Section 3 includes specifications for construction, and Section 4 provides a plan for Operation, Maintenance, and Monitoring (OMM) of the completed MNA system. A worker Health and Safety Plan for construction and OMM phases is presented in Section 5, and the remaining sections address regulatory approvals and property access issues.

1.1 Disposal Site Description

The Site, defined in the MCP as the area where the release "has come to be located," is in the central portion of the 108-acre Property. The approximate universal transverse mercator coordinates for the Site are 4,664,600 North and 312,700 East (World Geodetic System 1984/North American Datum 1983), based on the United States Geological Survey (USGS) Franklin Quadrangle Map, 1987. The Site Location Map, **Figure 1**, shows the regional location of the Site and positions of the nearest municipal water supply wells. Access to the property and Site is obtained via Neponset Street; this road and other Site features are depicted on an aerial photo in **Figure 2**. The Neponset River flows around the Site from the south to the northeast. Ruckaduck Pond is located to the west and was formerly used for water power, with dams maintaining an elevation several feet above the downstream river. An outlet from Ruckaduck Pond (formerly used to power a turbine) traverses the Site through an underground pipe, returning to the river on the east side.

As documented in the Phase II CSA, historical maps [including Sanborn Library, LLC Fire Insurance (Sanborn) Maps] were reviewed to determine the previous owner/operators of the property and the operations history. The Property appears to have been developed by 1832 with a "shingle mill" and two houses south of the Site, and a small pond in the present location of Ruckaduck Pond. A map dated 1852 indicates "Smith's Mill" and three houses in the same area. A map dated 1888 indicates the Walpole Emery Mill in the same area, and Old Colony Railroad in its present location along the western edge of the Site. Sanborn maps from 1918 indicate that a railroad spur and three "factory" buildings had been constructed, and an open channel or “tailrace” had been constructed downstream of one of the factory buildings to convey water used for powering machinery back to the Neponset River. The BMC reportedly started operations at the property in 1919.

The 1927 and 1944 Sanborn Fire Insurance Maps indicate larger industrial buildings at the property, including a machine shop, casting shed, lumber shed, assembling, welding shop, and office. A 1940 USGS Topographic Map contains more detailed topography in the vicinity of the Site, indicates the boundary of the Cedar Swamp, and shows Cedar Swamp Brook. Historical aerial photographs and facility plans from 1931 to 1978 indicate that the Neponset River was rerouted at different times to facilitate the expansion of buildings and the addition of new ones. The open tailrace channel was filled in and replaced with a buried 24-inch concrete pipe in 1966. The industrial buildings on the Property were expanded several times in the 1960s and 1970s.

BMC primarily manufactured and repaired industrial centrifuges on the Property. BHI acquired BMC in 1989. BMC became an operating unit within Baker Process, Inc., a wholly-owned subsidiary of Baker Hughes Incorporated. Baker Hughes Process Systems, Inc. is the present owner of the Property. Manufacturing operations at the Property were discontinued in 2004, and most buildings associated with the former BMC were demolished by 2008. There is typically one worker at the Property, a security guard. Current human receptors at the Site are limited to occasional trespassers. The Property is zoned Limited Manufacturing, which allows a wide range of commercial, institutional, and residential uses. The Property is also grandfathered for industrial use.

The area surrounding the property has a mixture of residential and recreational (undeveloped forests and wetlands) uses. There are 273 residences with an estimated 743 residents located within ½-mile of the Site (Weston, 2005). There are presently no inhabited houses or private water supply wells within 500 feet (ft) of the Site. There are no schools, daycare centers, playgrounds, or parks within 500 ft of the Site. The 1987 USGS Franklin quadrangle map depicts the Boyden School located approximately 0.35 mile southeast of the Property, and 0.5 miles southeast of the Site. The nearest public water supply wells are slightly over 1 mile northeast of the Site as indicated in Figure 1.

1.2 Release History and Response Actions

The Site includes multiple RTNs due to the discovery of various releases at the property during recent investigations. Timing of releases is not well known, and the Site was used for manufacturing from at least 1832 to 2004. The RTNs were linked together to facilitate administrative compliance with MCP requirements. Three exposure areas were identified and evaluated in the October 2011 Phase II CSA Report (AMEC 2011c): the Manufacturing Building Area (MBA), the Lead Release Area 3 (LRA3), and the South Rail Spur (SRS). A separate exposure area was addressed in the December 2011 Phase II CSA Addendum (AMEC 2011d): the Demolition Debris Area (DDA). All four areas are indicated in Figure 2. Release Abatement Measures (RAMs) were conducted at several locations within the DDA, MBA, and LRA3 to reduce the mass and concentrations of contaminants at the Site. The CSAs indicate that a condition of No Significant Risk (NSR) exists for all areas of the Site except groundwater within the MBA, where some monitoring well concentrations exceed drinking water criteria.

The remaining contamination at MBA includes metals (primarily antimony, barium, lead, nickel, and zinc) and Extractable Petroleum Hydrocarbon (EPH) compounds in soil. The concentrations of metals and Semivolatile Organic Compounds (SVOCs) have been reduced significantly by soil excavation RAMs. The remaining elevated concentrations in soil are under and around the former locations of manufacturing buildings. Groundwater sampling indicates elevated concentrations of arsenic and chlorinated Volatile Organic Compounds (cVOCs) in the area adjoining the river downgradient of the manufacturing buildings, and chlorobenzenes in a single well in the North Parking area. Groundwater concentrations in these areas exceed drinking water criteria. A conservative interpretation of the maximum extent of these exceedances is provided in **Figure 3** based on the historic detections and groundwater flow directions, as indicated in the RAP. It is unlikely that groundwater at the Site will be used for drinking water, but the Site is within a Potential Drinking Water Source Area designated by the Town of Walpole (Walpole 2007). Considering this designation, groundwater at the Site is categorized as GW-1 under the MCP.

1.3 Hydrogeological Characteristics

The southeastern portion of the Site includes extensive sand and gravel fill, at depths of up to eight feet where the Neponset River was rerouted. The water table beneath the Site occurs approximately 3 to 5 ft below ground surface (bgs) in either fill or sand. Depth to bedrock is about 26 ft bgs near the eastern edge of the MBA and shallower to the west. The direction of groundwater flow in the shallow aquifer above bedrock is generally east toward the Neponset River or its associated wetlands. The water table in the areas adjacent to the River is less than 1 foot bgs. The horizontal direction of groundwater flow is toward the River from both sides. The vertical direction of flow is upward, discharging to the River, where measurements were available on the west riverbank. Vertical flow in the vicinity of Ruckaduck Pond is expected to be downward since the dam impounds surface water at an elevation above the water table. Lateral groundwater seepage velocities in the sandy soils are estimated to be 0.1 to 0.9 feet per day in the MBA.

There appears to be considerable variation in groundwater flow direction depending on water table conditions in specific areas of the MBA. Groundwater elevations have been mapped for monitoring events in October 2006, July 2008, and April 2009, as shown in **Figures 4-6**. The USGS hydrograph for the Neponset River discharge at the Norwood gauging station (the closest gauge to the Site) is provided in **Figure 7**, with the three dates of water table mapping indicated. The October 26, 2006 event occurred when river flow was near the median long-term daily statistic, therefore, Figure 4 likely represents typical fall seasonal conditions which are intermediate between summer and spring. The July 22-23, 2008 measurement occurred after several months of below-average river flow and immediately prior to a storm event, therefore the water table depicted in Figure 5 likely represents relatively dry low-flow conditions which may be expected during summer months. The April 15, 2009 event occurred after several months of near-average spring flows, therefore Figure 6 likely represents typical spring high-flow conditions. Note the significant changes in the water table surface between the three events, particularly in the southeast portion of the Site. Aside from precipitation and river flow, another difference between the events is that in 2006 the MBA buildings and pavement were still intact; in 2007 the buildings were demolished and some pavement removed resulting in the present Site conditions. Removal of the impervious structures may have affected infiltration patterns.

1.4 Contaminant Extent and Transport

The estimated areas of groundwater contamination exceeding MMCLs or background concentrations are indicated in Figure 3. Arsenic contamination is observed at the water table (3 to 5 ft bgs) while 1,4-dichlorobenzene (DCB) and cVOC contamination is in the deepest part of the sand aquifer (up to 26 ft bgs). Additional details on the vertical extent of contamination are provided in Section 2.4, including cross-sections of the aquifer. The Neponset River appears to be a groundwater discharge area based on measured horizontal and vertical gradients around the Site. Groundwater contaminants shown in Figure 3 have not been identified in monitoring wells east of the river (MB-MW-360 and -361). Sediment and surface water concentrations in the river suggest that the contaminant discharge from groundwater to the river has not resulted in increasing concentrations of contaminants in the river. A CSA completed for the river where it borders the Site found a condition of No Significant Risk for river receptors (Weston 2007).

The CSAs for the Site (AMEC 2011c, AMEC 2011d) found no current pathway between Site contaminants and the Town's water supply wells located 1.2 miles to the northeast (Figure 1), but the potential for movement in this direction warrants further monitoring. The town supply wells draw water from surficial sands and gravel above bedrock, in the High Yield (>300 gpm) aquifer mapped by USGS northeast of the Site. The bedrock surface in the supply well area is 62 to 80 feet bgs, compared to 20 to 30 feet bgs at the Site; bedrock slopes downward to the northeast along the river valley. The potential for contaminant migration to the Town's supply wells appears to be greatest for non-aqueous phase liquid (NAPL) chlorinated organic compounds which are denser than water, but NAPL has not been observed at the Site. The chlorinated organic compounds encountered at the BMC site have been in the dissolved phase rather than NAPL. In this dissolved form the density contrast has no affect on migration, compared to advection, dispersion, and other processes. Depending on the vertical groundwater flow gradients and the concentrations of contaminants, NAPL (if present) could potentially follow the bedrock surface to the northeast and flow under the river discharge area. The key areas for monitoring at the BMC site appear to be: 1) evaluation of vertical groundwater flow gradients which will affect the potential for discharge to surface water versus lateral migration of deeper contamination, and 2) evaluation of the extent of deeper groundwater contamination both within the site and along the expected discharge area, including confirmation that NAPL is not present.

2.0 ENGINEERING DESIGN [310 CMR 40.0874(3)(B)]

This section of the RIP provides an Engineering Design for Monitored Natural Attenuation (MNA) of groundwater contamination. MNA consists of active monitoring of natural processes to ensure attainment of cleanup goals. Areas of groundwater contamination exceeding MMCLs have been identified for arsenic, cVOCs, and DCB as indicated in Figure 3. MNA is expected to provide a Permanent Solution that achieves a condition of No Significant Risk (NSR) at the site within 5 to 10 years of implementation. The Engineering Design in this section of the RIP provides details on how MNA will be designed and operated to achieve the remedial action goals for this site.

2.1 Goals of the Remedial Action

The site remedial objective is to achieve a Permanent Solution in accordance with the MCP, including public involvement activities throughout this process. The requirements for a Permanent Solution include the following:

1. Achieve a condition of NSR for current and reasonably foreseeable future site uses in accordance with 310 CMR 40.0000. NSR has been achieved at the Site except for groundwater which may be a potential source of drinking water, as described above. A condition of NSR for groundwater can be achieved when Exposure Point Concentrations (EPCs) are below GW-1 criteria, or if concentrations achieve any background levels that are above GW-1 criteria.
2. Eliminate or control any source of oil and/or hazardous material which is resulting or is likely to result in an increase in concentrations in an environmental medium, as specified in 310 CMR 40.1003(5).
3. To the extent practicable, reduce levels of site contaminants to those that achieve or approach background.

Achieving these objectives will require elimination of any significant sources of groundwater contaminants. Source control has occurred at the Site through soil excavation RAMs in the areas in and upgradient from arsenic and some cVOC groundwater contamination. The RAM around Building 6/6A, upgradient from arsenic detected in LR-MW-122, included the removal of soil having arsenic above background levels. The RAM around Building 7A/7C and LRA2, upgradient from cVOCs detected in LR-MW-129, included removing soil with metals and oily contamination that was not known to contain cVOCs.

Sources of groundwater contamination have not been specifically identified upgradient from MB-MW-362 and -374, or NP-MW-601. All above-ground structures and below-ground tanks in these areas have been removed as of early 2008, and it is possible that these structures included source materials; also the historic Cart Path area is a potential source of the contaminants identified in NP-MW-601 (AMEC 2011a). MNA for groundwater will include additional investigations to confirm that any source that is likely to result in increasing concentrations of contaminants is controlled or eliminated, as described in the following subsections.

2.2 New Information

There is no new information relating to the areas of groundwater contamination since completion of the Final CSAs and RAP in December 2011.

2.3 Proposed Activities and Existing Site Features

The proposed MNA remedy consists of installing, sampling, evaluating, and reporting data from monitoring wells in the areas of groundwater contamination exceeding MMCLs. A preliminary conceptual design for MNA was presented in the Final RAP and included 14 new well clusters consisting of shallow/deep pairs, 2 new bedrock monitoring wells, and 2 new shallow (unpaired) wells to augment the existing monitoring wells (AMEC 2011a). Groundwater samples were proposed for analysis of contaminants exceeding cleanup goals and their breakdown products if any, and for geochemical or hydrologic parameters indicative of processes affecting MNA. Monitoring was assumed to occur quarterly, at least until sufficient results are available to determine stability of site conditions and the value of specific data for performance monitoring. Data would be evaluated and reported semiannually.

Proposed activities will also include investigations preceding the monitoring well installations, to collect data designed to optimize these well locations. Investigations will largely consist of groundwater sampling with a Geoprobe in the plume areas depicted in Figure 3. This approach is consistent with the Triad approach described by USEPA as a potential early step in developing a performance monitoring plan for MNA (USEPA 2004). USEPA indicates that development of a performance monitoring plan is frequently an iterative process, such that the program will change over time in response to the data collected. This process is described further in Section 2.5, which provides a conceptual plan of activities. A detailed design for these initial investigations and the resulting MNA system is provided in Section 2.6.

Existing site features are indicated in **Figure 8** and include: a fire pump house (building no. 9), garage (19), and guard shack (21); floors and frost walls of demolished buildings 1, 3, 5, 20, 22, and 23; frost walls of demolished buildings 4, 4A, 6A, 7A, 8, 8A, 12, and 15; and pavement around the former buildings except where it was removed for RAM excavations. Figure 8 also shows remaining subsurface drains that lead to outfalls in the Neponset River. These drains were connected to the former buildings (roof drains or sanitary lines) or to surface catch basins, a few of which still remain as indicated in the figure. Note that the drain line connecting the pond and the river was installed within a former masonry-lined tail race; the masonry was observed in place near the southeast wall of former building 1, and may still exist on either side of the drain in other areas. Figure 8 shows several subsurface structures which were left in place following building demolition: a 10,000-gallon concrete wastewater sump that was cleaned and filled with sand; several sections of Transite pipe encased in concrete; a 5,000-gallon steel wastewater tank that was closed in place near former building 4 by filling with concrete; and a reinforced-concrete base for a wastewater pump station adjacent to the 5,000-gallon tank. The RAM excavation areas in Figure 8, and the areas above the structures left in place, have been filled to grade with sandy soil.

2.4 Media to be Treated

2.4.1 Lateral Extent of Contamination

The lateral extent of groundwater contamination indicated in Figure 3 has been conservatively drawn to maximize the areas of exceedance, based on historic data and flow directions as indicated in the RAP (AMEC 2011a). The actual exceedances of MMCLs by EPCs at existing wells include the following:

- arsenic at LR-MW-122 (note the most recent detect is < MMCL)
- cVOCs at LR-MW-129 (the most recent detects are < MMCLs), MB-MW-362, and MB-MW-374

The EPC for DCB in NP-MW-601 was below the MMCL, though recent detects have been slightly above the criterion.

Additional investigation of cVOC concentrations in the vicinity of MB-MW-374, and DCB concentrations in the vicinity of NP-MW-601, will be conducted to optimize monitoring locations for these relatively wide and long areas, respectively. These investigations will also confirm that no NAPL is present that would serve as a continuing source in either area. The cVOC plume appears to be delineated laterally by deep well MB-MW-364 to the north, and the PCE may have had a source to the west near a historic shallow detection below the MMCL at RA-MW-13 (later removed during building demolition). The DCB exceedance area may extend upgradient as far as historic DCB detections in CP-MW-102 near the pond, with lateral delineation provided by NP-MW-603 and CP-MW-101. Investigations to better map the cVOC and DCB plumes will begin near the existing detections and work outward, utilizing field measurements of target analytes to select sampling locations as described in Sections 2.5 and 2.6.

The lateral extent of arsenic exceedances appears to be limited considering 1) the results for cross-gradient wells adjacent to LR-MW-122, and 2) the groundwater flow directions which are relatively consistent in this area. The area to be treated appears to be less than 50 feet wide, extending west (upgradient) along the water table. The upgradient extent of arsenic in groundwater is not yet established, but potential historic sources in this area include the former tailrace and the former Laboratory Building.

2.4.2 Vertical Extent of Contamination

The vertical extent of groundwater contamination and subsurface geology are indicated in **Figures 9 to 12** using several cross-sections through the site. Bedrock is believed to provide a vertical control on flow as it is less transmissive than the shallow sand aquifer, and groundwater in the sand is expected to be discharging to the Neponset River during much of the year. Regionally bedrock slopes down to the northeast along the river valley. The Dedham Granite formation is expected to vary in competency, where some areas have been affected by brittle deformation resulting in fractures and faulting, and other areas are relatively unfractured. The strength of vertical flow gradients is expected to change depending on the relative levels of the water table and the river, which can vary seasonally and in response to significant storm events. Depending on the competency of the bedrock at the site, it is likely that groundwater in the bedrock is hydraulically connected with groundwater in the overlying sandy soil.

In general, sandy fill comprises the upper 10-feet of overburden material in all cross-sections. Beneath the fill layer, the lithology of the material gradually coarsens from silty sand in the north (cross-section A-A') to silty sand and gravel in the south (cross-section C-C'). This change may be related to deposition along the Neponset River channel, which previously flowed through the southern portion of the Site. Bedrock in the mapped area is approximately 20 to 30 feet bgs and sloping downward to the east. Note that the majority of borings at the Site were not cored into rock; for the purpose of constructing the cross-sections, refusals are interpreted as the bedrock surface. A bedrock low point (about 40 ft bgs) exists near the location of monitoring well MB-MW-364 between cross-sections A-A' and C-C'. This low point is in the vicinity of the Neponset River position circa 1948 before extensive filling in this area, and may reflect a bedrock trough running along the same orientation as the river from west to east.

Existing deep wells are located above bedrock at the bottom of the sand aquifer, as indicated in Figures 10 to 12. DCB and cVOCs are detected in these deep wells west of the river, and arsenic is in the shallow well LR-MW-122 along the river. As indicated in the CSA and RAP, the MNA system must be designed to ensure that groundwater contaminants do not flow beneath the river (in sands or bedrock) and migrate downstream toward the Town's supply wells, which are located 1.2 miles northeast of the affected areas. The key objectives for monitoring at the BMC site appear to be: 1) evaluation of vertical groundwater flow gradients which will affect the potential for discharge to surface water versus lateral migration of deeper contamination, and 2) evaluation of the extent of deeper groundwater contamination, both within the site and along the expected discharge area. These issues will be evaluated by measuring water levels in shallow and deep wells along with surface water levels, groundwater concentrations, and bedrock topography.

2.4.3 Geochemistry

Reductive dechlorination (RD) is expected to be the primary mechanism for biodegradation of cVOCs and DCB at the site. Dissolved oxygen (DO) and Oxidation-Reduction Potential (ORP) measurements during purging for recent groundwater sampling indicate anaerobic conditions at MB-MW-362 and -374, and at NP-MW-601, as indicated in Table 1. Measurements of daughter products are a direct indication of dechlorination reactions, and the detection of trichloroethene (TCE), dichloroethene (DCE), and vinyl chloride (VC) as described in the CSA are indicative of an anaerobic RD process for PCE.

Table 1. Existing Geochemistry Data

Well Location	Sampling Date	DO (mg/L)	ORP/Eh3 (mV)
MB-MW-362	7/22/08	0.26	-77
MB-MW-362	12/7/09	0.54	119
MB-MW-374	12/7/09	1.44	41
NP-MW-601	12/7/09	0.76	137
MB-MW-362	7/26/10	0.10	43
MB-MW-374	7/26/10	0.78	49
NP-MW-601	7/26/10	0.15	101
MB-MW-362	3/17/11	0.95	146
MB-MW-374	3/17/11	0.78	52
NP-MW-601	3/17/11	0.68	114

Future groundwater sampling should include the above methods supplemented with the following indicators of microbial activity:

- metabolic products – ethene, ethane, chloride
- anaerobic activity indicators – methane, ferrous iron (Fe2)
- competing electron acceptors – nitrate, sulfate

These data will be used in conjunction with the results for primary target analytes, to evaluate the types of biodegradation processes underway and how they may be affected by conditions at the Site.

2.5 Conceptual Plan for MNA and Data Collection

2.5.1 MNA Objectives

The MNA systems will include monitoring wells and sampling programs designed to satisfy the eight specific objectives identified by USEPA in OSWER Directive 9200.4-17P (USEPA 1999):

1) Demonstrate that natural attenuation is occurring according to expectations,
2) Detect changes in environmental conditions (e.g., hydrogeologic, geochemical, microbiological, or other changes) that may reduce the efficacy of any of the natural attenuation processes,
3) Identify any potentially toxic and/or mobile transformation products,
4) Verify that the plume is not expanding downgradient, laterally or vertically,
5) Verify that there is no unacceptable impact to downgradient receptors,
6) Detect new releases of contaminants to the environment that could impact the effectiveness of the natural attenuation remedy,
7) Demonstrate the efficacy of institutional controls that were put in place to protect potential receptors, and
8) Verify attainment of remediation objectives.

Achieving objectives 1 through 6 and 8 will require groundwater monitoring in and around the three areas of the Site where contaminants have exceeded drinking water standards. Institutional controls are not required for this Site to achieve a condition of NSR during remedy implementation; therefore objective 7 is not applicable.

2.5.2 Initial Data Collection and Evaluation

This subsection provides a conceptual plan for collection and evaluation of data that will be used to optimize the MNA system design. As indicated in Section 2.3, activities initially will focus on field data collection to refine the monitoring well locations and other details of the monitoring system. Section 2.4 described the media to be treated, and the additional data that would help establish the horizontal and vertical extent of contamination and the geochemistry. These data include chemical concentrations in groundwater near MB-MW-374 and NP-MW-601 and in the expected discharge areas; vertical flow gradients in groundwater in these areas; and bedrock topography. The data will be collected using a Geoprobe to sample groundwater at 5-foot intervals within the aquifer until refusal, and to collect water level measurements. Samples will be analyzed for COCs and geochemical indicators of microbial activity listed in Section 2.4.3.

Data collection locations are planned as indicated in **Figure 13**. For the cVOC and DCB plumes these include sampling along: 1) a transect that follows the plume centerline (the flow path with the highest concentrations); 2) a perpendicular transect in the area of peak centerline concentrations (assumed near NP-MW-601 and between MB-MW-374 and -362, for the purpose of Figure 13); and 3) transects at or downgradient of the edge of the discharge area. Groundwater samples will be analyzed in the field using a mobile laboratory and field test kits to obtain same-day results. Sampling along these transects will be at a nominal spacing of 100 feet, although this may be adjusted based on the field results. Sampling will begin at plume locations closest to MB-MW-374 and NP-MW-601 and move upgradient and downgradient from there. Chemistry, geochemistry, bedrock, and vertical gradients from the field will be mapped to adjust the plume geometry and potential flow pathways, and to evaluate the need for data collection points beyond the transects indicated in Figure 13.

The goal of this data collection is to refine the understanding of contaminant pathways and MNA processes at the Site, such that monitoring locations will be optimized. The conceptual position of the MNA wells, which will be adjusted using these data, is provided in Section 2.5.3. Following the completion of all data collection described above, the entire data set will be evaluated as follows:

- Plan views and cross-sections of the plumes will be updated
- Shallow and deep potentiometric head maps will be prepared
- Geochemical conditions will be summarized in tabular or graphic form

This evaluation, and any revisions to the conceptual locations of the MNA wells indicated below, will be documented in the Final Inspection Report (FIR) that is prepared pursuant to 310 CMR 40.0878.

2.5.3 Monitoring Locations

MNA monitoring wells will be focused along the plume centerlines to collect data on contaminant mass changes and geochemical conditions in the areas of highest mass, and near the discharge area to confirm that the plume does not migrate beyond the Neponset River and its associated wetlands. **Figure 14** shows a potential monitoring well network that would meet these criteria, pending the collection of additional data as described in Section 2.5.2. The well locations in Figure 14 will be adjusted if plume geometries and extents differ significantly from what are shown in the figure. Well locations may be added if a significant center of mass is identified that warrants more intensive monitoring, although this is not expected considering the historic contaminant concentrations. The monitoring wells will be installed during a separate field mobilization that follows the data evaluation described in Section 2.5.2.

The monitoring locations in Figure 14 are assumed to include two-level well clusters in the cVOC- and DCB-affected areas, and single wells in the arsenic-affected area, installed in the shallow sand aquifer. For the cluster locations the shallow well is expected to be screened above the center of mass, and the deep well within it. One bedrock well (screened below the bedrock surface) is also assumed for both the cVOC- and the DCB-affected areas, near the downgradient edge of the plume. Bedrock well locations in Figure 14 may be adjusted based on the initial data collection results for bedrock topography, deep well concentrations, and hydraulic gradients.

2.5.4 Monitoring Parameters and Frequency

Monitoring will initially focus on confirming key MNA processes ("process monitoring") before transitioning to long-term performance monitoring. The transition to long-term monitoring may be based on trends observed in the data, identification of indicators which improve the efficiency of data collection, or other factors. Both the initial process monitoring and the long-term monitoring would be expected to include the primary COCs, geochemical indicators of transformation processes, and hydrogeologic parameters. Long term monitoring would typically involve less overall testing than process monitoring due to reductions in the parameter list, sampling frequency, or sampling locations owing to improved characterization or plume stability. This Phase IV RIP presents a plan for initial process monitoring on a quarterly basis, as described in Section 2.6. Any subsequent adjustments to this monitoring plan will be presented in a semiannual Phase V Status and Remedial Monitoring Report in accordance with 310 CMR 40.0892.

2.5.5 MNA Evaluations and Reporting

Monitoring results will be evaluated to confirm MNA mechanisms, evaluate stability of the plumes, estimate mass loss and remediation times, and determine if any enhancement is needed to achieve cleanup goals. Results of these evaluations will be presented in the semiannual Phase V Status and Remedial Monitoring Reports to be submitted in accordance with 310 CMR 40.0892. Reports will describe recent and cumulative monitoring results, any changes to monitoring since the previous report, progress in achieving cleanup goals, and any measures taken to correct conditions affecting performance. Data evaluation is discussed further in Section 2.6.4.

2.6 Design and Operating Parameters

2.6.1 Data Collection Plan

A series of temporary groundwater monitoring points will be installed and sampled to evaluate existing conditions and optimize locations for MNA monitoring wells, based on the rationale in Section 2.5.2. These points will be focused along the centerlines and several transects of the existing contaminant plume locations as indicated in Figure 13. Daily results of data collection in these areas will be mapped to adjust the plume geometry and potential transport pathways, and to evaluate the need for data collection points that differ from the locations shown in Figure 13.

A truck- or track-mounted vibratory direct-push unit (Geoprobe SP-22 system or equivalent) will be used to advance a temporary groundwater collection screen to the desired depth. Samples will be collected at the groundwater table and at five foot intervals below the water table until bedrock refusal. Based on historical drilling logs from the property, an average of four samples will be collected from each location based on an aquifer thickness of 20 feet. The expected total number of sampling points is 35 to 45, resulting in 140 to 180 groundwater analytical samples.

Samples will be collected from the temporary screen using a peristaltic pump via low flow sampling techniques as described in Section 2.6.2. Water table depths will be measured and prevailing weather conditions will be noted as changes in the local groundwater elevations could occur over the sampling period. A mobile analytical laboratory will be used to analyze the groundwater samples collected from within the DCB and cVOC plumes in accordance with USEPA SW-846 Method 8260B, with detection limits of 2 parts per billion (ppb) or less for target compounds. Data analyzed in this manner will be used for field screening but is not required to be CAM-compliant in accordance with the MCP. It is anticipated that approximately 15 to 20 groundwater samples will be collected and analyzed by the on-site mobile laboratory per day (approximately 4 or 5 monitoring points) including appropriate matrix spike/matrix spike duplicate and field duplicate samples. The expected duration of data collection is 7 to 10 days.

In addition to the mobile lab samples, samples will be collected for testing MNA parameters including ethene, ethane, chloride, methane, ferrous iron, nitrate, and sulfate. Field test methods are summarized in **Table 2** and are based on Hach-branded field test kits or equivalent, except for methane / ethane / ethene. Samples collected from within the arsenic contaminant plume will be analyzed using the Hach arsenic low range test kit as these samples cannot be practically analyzed by a mobile laboratory. Based on the field test qualitative results, a subset of arsenic samples will be sent to a permanent laboratory for quantitative analysis. The fixed-lab data will be used to refine monitoring well locations for the arsenic plume, as described in Section 2.6.2.

Table 2. Test Methods for Field Screening Data

Analyte	**Field test kit**
Arsenic	Hach arsenic low range test kit
Chloride	Hach model 8-P test kit
Ferrous Iron	Hach method 8146 test kit
Sulfate	Hach method 8051 test kit
Nitrate	Hach model NI-14 test kit
Methane. Ethane, Ethene	Laboratory Method SW3810

2.6.2 Monitoring Network Design and Operation

The locations of new and existing monitoring wells are indicated in Figure 14. The new well locations may be adjusted based on initial data collection and evaluation, as described in Section 2.5.2 and 2.6.1, considering any measurements indicative of changes to the conceptual site model. Any changes to the proposed well locations, or the existing wells that are used for initial monitoring, will be documented in the FIR that is prepared pursuant to 310 CMR 40.0878. Wells constructed in the shallow sand aquifer will be installed using an auger drill rig, without retrieval of soil samples. Overburden drilling at bedrock well locations will also be conducted using auger drilling, followed by bedrock coring. Well construction methods are described in Section 3.1. Drill cuttings will be containerized and transported to a temporary storage area onsite for characterization testing prior to disposal. Well construction logs for new and existing wells will be included in the FIR.

Groundwater sampling will initially focus on process monitoring, as described in Section 2.5.4. Analytical parameters are summarized in **Table 3**, and for the cVOC and DCB plumes will include volatile organic compounds (VOCs), geochemical indicators listed in Section 2.4.3 (ethene, ethane, chloride, methane, Fe2, nitrate, sulfate), and water levels in the monitoring wells and river on a quarterly basis. Initial process monitoring for the arsenic plume will be for

Table 3. MNA Sampling Parameters and Container Types

Analytes	Method	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protection)	Maximum Holding Time (preparation/ analysis)
VOCs	SW-846 8260B	40 mL	Glass, 4x 40 ml septum sealed vials	HCl pH <2, Cool to 4°C (<6°C, but not frozen) protect from light, no headspace	14 days from collection
Arsenic	SW-846 6020/6010B	100 mL	500 mL polyethylene container	HNO_3 to pH<2	6 months from collection
Ferrous Iron	Hach method 8146 test kit	35 mL	N/A (onsite field test using kit)		Same day as collection
Chloride	SW-846 9057	250 mL	250 mL polyethylene container	H_2SO_4 pH <2 Cool to 4°C (<6°C, but not frozen)	28 days from collection
Nitrate, Sulfate	IC Method E300	250 mL	250 mL polyethylene container	Cool to 4°C (<6°C, but not frozen)	48 hours for Nitrate and 28 days from collection for Sulfate
Ethene, Ethane. Methane	Kerr Method	40 mL	Glass, 4x 40 ml septum sealed vials	H_2SO_4 pH <2 Cool to 4°C (<6°C, but not frozen)	7 days for extraction and 40 days from extraction till analysis.

arsenic and water levels only. The groundwater flow setting appears to be relatively dynamic considering variability in levels of the adjacent river and pond; therefore additional water level measurements will be collected at two or more intervals following at least one major storm event during the first year of monitoring. Also considering this factor, the quarterly sampling events will be scheduled based on long-term precipitation forecasts to include a range of high and low-flow river conditions to evaluate the hydrogeologic response.

Groundwater sampling at wells and temporary screens will be performed with low-flow sampling techniques using either a bladder pump or a peristaltic pump. The pump will be equipped with dedicated polyethylene tubing. The pump intake will be lowered slowly into the well to the approximate center of the saturated screen section, and will remain at least two feet above the bottom of the well to prevent the disturbance of any sediment which may be present. The water level will be measured and recorded before starting the pump. Sampling records from previously sampled wells will be reviewed in order to determine initial flow rates, or purging will be started at flow rates of approximately 0.2 to 0.5 liters per minute. The flow rate will be adjusted to ensure that little or no drawdown (less than 0.3 feet) occurs in the well. If this level of drawdown cannot be sustained, the pumping rate will be reduced to the minimum capabilities of the pump to avoid pumping the well dry. The level of the water will not be allowed to drop below the intake on the pump to avoid the possible entrainment of air into the sample. If the recharge rate is very low, sampling shall commence as soon as the well has recharged to a sufficient level to purge one system volume (volume of pump and tubing) and then collect the appropriate volume of sample.

During the purging of the well, the field parameters (pH, temperature, conductivity, dissolved oxygen, redox potential and turbidity) will be monitored every 3 to 5 minutes, or as appropriate, using a flow-through cell, until the parameters stabilize. Field parameters will be considered stabilized when, for three consecutive readings, the temperature is within ± 3%, pH is within ± 0.1, dissolved oxygen is within ± 10% or changes less than 0.3 mg/L, redox potential is within ± 10 mV, conductivity is within ± 3%, and turbidity is within ± 10%. An attempt will be made to purge the well until turbidity of the purged water is less than 5 nephelometric turbidity units.

After purging is completed, groundwater samples will be pumped directly into the proper sample containers. All sample containers will be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. Samples requiring dissolved constituent analysis will be collected by pumping water through a new 0.45 µm filter into the appropriate sample container using a peristaltic pump and new silicone tubing. Sample containers, preservatives, volumes, hold times, and shipping requirements are summarized in Table 3. Each sample will be labeled and placed into a cooler with ice for shipment to the laboratory. Sampling activities will be documented using pre-printed field data sheets to record well purging and any field screening results. Purge water will be collected until sampling is complete, and either returned to the monitoring well in accordance with the MCP or transported to a temporary storage area onsite for characterization testing prior to disposal.

2.6.3 Expected Effectiveness

MNA is expected to reduce concentrations of contaminants to below drinking water standards in the shallow sand aquifer at the Site, and to achieve or approach background levels. For the purpose of Presumptive Certainty in achieving or approaching background, in accordance with

MassDEP Policy WSC-04-160, it is assumed that the background level of arsenic is approached at a level of 5 ppb which is one-half of the GW-1 criterion for this contaminant. Similarly for cVOCs and chlorobenzenes background would be approached at one-half of the GW-1 standards: 35 ppb for TCB; 2.5 ppb for PCE, TCE, or DCB; and 1 ppb for VC.

The principal MNA processes are expected to include desorption, dilution, and biodegradation, considering site conditions described in the CSA (AMEC 2011c). The Site has relatively fast groundwater flow with seepage velocities estimated in the range of 37 to 330 ft/yr through sandy material. Neponset River flow is estimated at 200 to 400 times greater than the groundwater discharge, based on estimates in the CSA. Anaerobic conditions and dechlorination products are observed in wells having organic contaminants. Because releases are believed to be at least decades old, plumes of contaminants likely have achieved steady state or declining concentrations. However, source removals in portions of the vadose and saturated zones during 2005 – 2008 may have affected hydrogeology and plume stability in some areas. Therefore, in the absence of any continuing sources, contaminants sorbed to the aquifer matrix are expected to continue desorbing to groundwater, biodegrading (for organics) in the aquifer, and discharging to the river. Plumes appear to be relatively dilute based on low ratios of contaminant maximum concentrations to solubilities (<0.08%), and plume widths are less than 200 feet.

As indicated in the RAP, source removal and MNA appear to have reduced arsenic concentrations in groundwater to around the GW-1 criterion of 10 ppb based on recent measurements. The exposure point concentration for DCB is also around the level of the GW-1 criterion at the location of the highest detections. The cVOC detections in the southeast portion of MBA appear to represent the greatest challenge to achieving NSR based on exceedances of up to eight times the GW-1 standards in the latest sample results. Achieving or approaching background would require reductions in groundwater concentrations of about 50% for arsenic, 50% for DCB, and almost 95% for PCE. A PCE reduction of at least 98% has already been observed in LR-MW-129, where concentrations declined from 100 ppb to non-detect (<2.5 ppb) over four years.

2.6.4 Evaluations of Effectiveness

MNA effectiveness will be demonstrated through declining contaminant concentrations and reduced plume size within a reasonable timeframe, and persistence of site conditions favorable to MNA processes. Data analysis will include graphic or tabular displays of the following measurements for COCs and geochemical indicators:

- plume extent (horizontal & vertical)
- concentrations versus time
- groundwater flow directions
- groundwater and surface water flow rates

Evaluation of progress in achieving cleanup goals can be difficult due to subsurface and/or measurement variability, and seasonal or storm-related variations in groundwater movement. Therefore, multiple lines of evidence will be used to reduce uncertainty in evaluating the overall effectiveness. The conceptual site model will be updated as needed to ensure that it considers all viable hypotheses for explaining the data.

Data analysis will include estimates of mass loss rates and remediation times, and an evaluation of plume stability. The evaluations will be presented in the semiannual Phase V Status and Remedial Monitoring Reports to be submitted in accordance with 310 CMR 40.0892. Reports will describe recent and cumulative monitoring results, any changes to monitoring since the previous report, progress in achieving cleanup goals, and any measures taken to correct conditions affecting performance.

2.6.5 Revisions and Contingency Remedies

The RAP identified several remedial alternatives for contaminated groundwater, and two of these – In Situ Chemical Oxidation (ISCO) and Pump-and-Treat (P&T) – were evaluated in detail along with MNA. In their comments on the Draft RAP, the Town of Walpole indicated a preference for ISCO due to its high rankings for timeliness and reliability. ISCO or P&T could serve as contingent remedies that are implemented if it is determined that MNA will not achieve a Permanent Solution for one or more areas of the Site. Another feasible contingent remedy may consist of enhancing the existing biodegradation of organic contaminants through injection of nutrients or other modification of geochemistry, as was mentioned in the RAP. This subsection describes a decision process for either continuing with MNA as described in this RIP, or modifying the program to achieve a more effective remedy. Modifications may be minor such as by monitoring new areas, or significant in terms of implementing enhanced bioremediation, ISCO, or other options. If a significant revision to the remedy is needed to achieve a Permanent Solution, then supplemental documentation will be submitted in accordance with the MCP, such as additional Phase IV design and construction plans or a RAM plan.

MNA will be continued if evaluations of site data demonstrate that natural attenuation is occurring at rates that will achieve drinking water standards and approach background levels in a reasonable timeframe. In the RAP this timeframe was identified as up to 10 years for MNA, compared to about 4 years for ISCO and 8 years for P&T for organic contaminants. Determination of satisfactory reductions in concentrations will consider multiple lines of evidence including temporal trends in individual wells, estimates of mass reduction, and distribution of contaminants and geochemical conditions. This RIP anticipates a transition from initial process monitoring to long-term performance monitoring as described in Section 2.5.4, and this type of minor change in the monitoring program will be presented in a semiannual Phase V Status and Remedial Monitoring Report in accordance with 310 CMR 40.0892.

MNA could also require minor modifications if monitoring data reflect changing and variable conditions that make interpretation of data from the installed system difficult and effectiveness uncertain. For example, pulses of contaminants could be caused by seasonal hydrogeological or geochemical cycling or changes in MNA processes, and observation of these conditions might suggest the need for a change in monitoring frequency or in the positions of monitoring points. Minor changes to the MNA program such as locations, frequencies, or parameters would be presented in a semiannual Phase V Status Report as described above.

If MNA measurements suggest that some portions of the Site will not achieve a Permanent Solution, then supplemental MCP documents for design and construction of contingent remedies will be prepared. The following types of measurements will be considered as evidence of the need for contingent remedies:

- Contaminant concentrations exhibit an increasing trend not expected based on monitoring to date,
- Near-source wells exhibit large concentration increases indicative of a new or renewed release,
- Contaminants are identified in monitoring wells located outside the original plume boundary or other specified compliance boundary,
- Contaminant concentrations are not decreasing at the rate previously determined to be necessary to meet the remediation objectives,
- Changes in land and/or ground-water use will adversely affect the protectiveness of the MNA remedy, and
- Contaminants are identified in locations posing unacceptable risk to human or ecological receptors.

Multiple lines of evidence will be used to determine the need for contingent remedies, to account for the uncertainty associated with variability in subsurface conditions. The evaluations of these types of measurements will be conducted in accordance with USEPA guidance for performance monitoring of MNA (EPA 2004).

2.7 Control of OHM Spills and Accidents

Planned activities consist of groundwater sampling and analysis, and installation of new monitoring wells. Limited amounts of Oil or Hazardous Material (OHM) are expected to be associated with these activities, mainly consisting of petroleum or lubricants in vehicles, drilling equipment, or generators. Equipment containing OHM will be operated in paved areas to the extent possible. Safe engineering and construction practices will be implemented during for all phases of work. These practices can be found in the Health and Safety Plan located in Section 5.0.

Spills of OHM will be reported and addressed in accordance with the MCP. Any impacted material resulting from a spill of contaminated groundwater, machine oil, or other hazardous substances will be placed in 55-gallon waste disposal drums or other approved containers for waste characterization, off-site transportation, and disposal. Equipment that comes in contact with contaminant residuals in soil or groundwater will be decontaminated before leaving the Site. Any wash water used will be managed as described in Section 2.8.

2.8 Waste Management

It is anticipated that minimal soil and water waste will be generated during field activities at the site. Excess groundwater collected during sampling will be poured back into the boring or well from which it was obtained as required by MassDEP. During construction, excess soil cuttings or development water that cannot be returned to the boring or well, and all decontamination water and spill wastes will be containerized and characterized for disposal at a licensed offsite waste facility. Waste characterization and disposal will be conducted within 90 days of waste generation.

2.9 Site Characteristics to be Affected

MNA construction and implementation is not expected to alter site drainage. Soil and groundwater characteristics would not be affected in the short-term, although long-term contaminant reductions are expected. There are no active human uses of the Site which would be affected by MNA. Installation and sampling of additional wells could have a slight impact on natural resource areas along the east side of the Neponset River. Precautions to prevent adverse impacts in this area are described in Section 2.10.

2.10 Measures to Avoid Adverse Impacts

Approximately five temporary groundwater sampling points and three permanent monitoring wells will be installed on the eastern side of the Neponset River as indicated in Figures 13 and 14, respectively. The Geoprobe and auger drill rigs will traverse wooded and wetland areas in order to access these locations during initial construction, which is expected to require a few days for each type of equipment. Field crews will have to traverse the same areas for 1-2 days of sampling the monitoring wells about quarterly for as long as ten years. Work within wetland and riverfront areas will comply with an Order of Conditions from the Walpole Conservation Commission, which will specify best management practices to minimize adverse impacts to these sensitive areas.

2.11 Construction Inspection and Monitoring

Monitoring well construction will be observed and documented to ensure that materials and procedures conform to the construction plans in Section 3. Any deviations from these plans will be described in the FIR. Performance monitoring for MNA is described in Section 2.6 and includes periodic groundwater sampling and analysis, data evaluation, and reporting.

3.0 CONSTRUCTION PLANS AND SPECIFICATIONS [310 CMR 40.0874(3)(C)]

3.1 Construction Materials and Procedures

Monitoring wells will be constructed of 2-inch diameter threaded Schedule 40 polyvinyl chloride casing. It is anticipated the wells will be constructed using a well screen with a slot size of 0.010 inches and a screen length of 5-10 feet. The screen length and slot size may be modified based on field conditions with any modifications noted in the field logbook. Screen intervals will be selected based on the results of the vertical profile sampling with the objective of monitoring zones of contamination. Any wells to be installed at the water table will be installed such that the water table intersects the well screen taking into account temporal variations in groundwater elevation, while ensuring that sufficient screened interval below the water is present to allow installation of bladder pumps for groundwater sampling. A locking waterproof cap will be installed on each well casing prior to placement of filter pack materials to prevent any of these materials from entering the well.

After placement of the well materials in the borehole, a sand filter pack will be placed in the boring to a depth of 2 feet above the top of the screen. The field geologist will select appropriate filter sand based on observations of the local stratigraphy, and experience in similar geologic settings. After placement of the filter pack, a minimum 2-foot thick layer of bentonite chips will then be placed above the filter pack. If the bentonite layer is above the water table, bentonite powder may be used instead of bentonite chips and the bentonite will be hydrated with clean, potable water from the local municipal water source in order to ensure that a proper seal is created. The remaining annular space in the boring will be filled with bentonite grout to a depth of 1 foot bgs. As the annular space is being filled, the steel casing will be gradually withdrawn from the borehole being careful not to remove the casing to a depth where the bottom of the casing is above the top of the fill material. A protective steel casing with a locking cap will be cemented in place over each new completed well.

Bedrock borings will be advanced using a core barrel until competent bedrock is reached. Competent bedrock is defined as having a Rock Quality Determination of greater than 75%. Rock cores will be visually logged in accordance with ASTM D-5434-03, with particular attention on the identification of water-bearing fractures. For bedrock wells the screens will be placed such that the entire screen is situated and sealed within competent bedrock. As further protection against the borehole acting as a conduit between the overburden and bedrock aquifers, the bentonite seal will be at least six feet thick and will straddle the bedrock-to-overburden interface.

Each new monitoring well will be developed no sooner than 24 hours after installation. Well development will be performed using surging and pumping. A surge block may be used to mechanically surge water back and forth between the well and the formation in order to remove fines from the filter pack and enhance the connection between the well and the aquifer. After surging, a submersible pump will be lowered into the well to pump out water and the associated fines. Surging and pumping cycles will continue as needed to reduce the amount of fines entering the well.

As development proceeds, water quality parameters (conductivity, pH, and temperature) will be measured and turbidity will be measured or described (e.g., low, moderate, high is acceptable) at approximately even fluid withdrawal increments during the course of development.

Development will continue until at least three well volumes have been removed. If three successive measurements of parameters have stabilized (values within ten percent of each other) and turbidity is low, well development can cease. If stabilization has not been attained or if turbidity remains high, development will continue until a maximum of ten well volumes has been removed.

All non-dedicated equipment will be decontaminated in accordance with the procedures outlined below. All down-hole drilling equipment will be decontaminated prior to initial use and between each borehole. Non-dedicated sampling devices will 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.

Decontamination of drilling equipment includes drill bits, auger sections, drill-string tools, drill rods, tremie pipes, clamps, hand tools, steel cable, along with pump drop lines and pumps. These items are typically cleaned with a steam pressure washer. Types of sampling equipment requiring decontamination include, but are not limited to, water level meters, sampling tubing, and pumps. 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) rinse with isopropyl alcohol, and
4) rinse with deionized or distilled water (for pumps, this step will consist of a potable water rinse).

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. Decontamination fluids and purge water generated during well development will be containerized and transported to a temporary storage area onsite for characterization testing prior to disposal.

The horizontal and vertical position of newly installed wells will be surveyed by a licensed and Massachusetts-registered surveyor to a horizontal accuracy of 0.1 ft and a vertical accuracy of 0.01 ft. These positions will be tied to a permanent benchmark located near the site (e.g., U.S. Coast and Geodetic Survey, USGS, or USACE benchmark), and the marker will be tied to the National Geodetic Vertical Datum (NGVD) Mean Sea Level. The water level measuring point (notch) on the riser pipe and the ground surface elevations will be surveyed at each monitoring well location.

Well construction and development activities will be documented using a field logbook to contain sufficient information to enable the activity to be reconstructed without relying on the memory of field personnel. Well construction logs for new and existing wells will be included in the FIR.

3.2 Construction Schedule

The Final RIP will be prepared following a public presentation and response to any comments on the Draft RIP. The Final RIP will be implemented no less than three days after providing notice in accordance with the Public Involvement Plan (PIP) that field activities will begin. An expected schedule for these activities is listed below.

- 02/27/12 submit Draft Phase IV RIP and public comment period begins
- 03/14/12 conduct public meeting for the Draft Phase IV RIP
- 03/19/12 public comment period ends for the Draft Phase IV RIP
- 03/27/12 submit Final Phase IV RIP and begin remedy construction after >3 days advance notice
- 07/16/12 complete remedy construction and submit Draft Final Inspection Report (FIR); public comment period begins
- 07/31/12 conduct public meeting for the Draft Phase IV FIR
- 08/06/12 public comment period ends for the Draft Phase IV FIR
- 08/14/12 submit final Phase IV FIR & Completion Statement; begin Phase V Operation, Maintenance, and Monitoring (OMM)

4.0 OPERATION, MAINTENANCE, AND MONITORING [310 CMR 40.0874(3)(D)]

The MNA remedy consists of an Active Remedial Monitoring Program as defined at 310 CMR 40.0006. As such, the results of performance monitoring conducted through groundwater sampling and data evaluation will be presented in semiannual Remedial Monitoring Reports. In addition to active remedial monitoring, well road boxes and protective covers will be inspected and maintained as needed during sampling events. Monitoring wells will be redeveloped if needed based on observations during purging and sampling.

5.0 HEALTH AND SAFETY PLAN [310 CMR 40.0874(3)(E)]

5.1 General Information

5.1.1 Introduction

This Health and Safety Plan (HASP) addresses those activities associated with the scope of work stated in Section 5.2 and will be implemented by the Site Safety Officer (SSO) during site work. **Compliance with this HASP or a HASP which is at least as stringent as this one is required of all persons and third parties who enter this site**. Assistance in implementing this plan can be obtained from the Site Safety Officer and Project Manager, and/or the Health and Safety Manager (HSM). The names of key project personnel will be provided in Sections 5.1.3 and 5.6.5 prior to the initiation of site work. The content of this HASP may change or undergo revision based upon additional information made available to health and safety (H&S) personnel, monitoring results, or changes in the scope of work. Any changes proposed must be reviewed by H&S staff and are subject to approval by the HSM and Project Manager.

This site-specific HASP has been prepared for the use of AMEC and its employees and supplements the Health and Safety training that each AMEC employee receives. The health and safety guidelines in this HASP were prepared specifically for this site and encompass known hazards. If additional hazards are encountered, the level of personal protection will be evaluated and the HASP will be modified as necessary.

This HASP is not intended to be used as the sole HASP by any other contractor or personnel of any such contractor. Contractors must adhere to their own HASP, which is at least as protective as this one. This Plan may not address the specific health and safety needs or requirements of any other such contractor and its employees. Neither this Plan nor any part of it should be used on any other site.

5.1.2 General Site Responsibilities

The general responsibilities for onsite personnel are listed in **Table 4**.

5.1.3 Site-Specific Duties

Any site-specific responsibilities beyond those listed in Table 4 will be documented below, before this plan is finalized:

	Name	Duties
Project Manager (PM):		
Site Safety Officer (SSO):		
Health & Safety Mgr (HSM):		
Field Supervisor:		
Field Personnel:		
Subcontractors:		

Table 4. General Site Responsibilities

Title	General Description	Specific Responsibilities	Required Training
Project Manager	Reports to upper-level management Has authority to direct response operations Assumes total control over site activities	Prepares and organizes the background review of the job at hand, the workplan, the health and safety plan, and the field team. Obtains permission for site access and coordinates activities w/appropriate officials. Ensures that the workplan is completed and on schedule. Briefs field team(s) on specific assignments. Coordinates w/site safety officer to ensure health and safety requirements are met. Prepares final report and support files on response activities. Serves as liaison w/client and public officials.	40-hour HAZWOPER training w/annual 8-hour training (29 CFR 1910.120) 8-hour Supervisor training medical surveillance participant
Field Supervisor	Responsible for field team operations and safety	Manages field operations. Executes workplan and schedule. Enforces safety procedures. Coordinates w/SSO to determine protection level. Documents field activities and sample collection. Serves as liaison w/client and public officials.	40-hour HAZWOPER training w/annual 8-hour training (29 CFR 1910.120) 8-hour Supervisor training medical surveillance participant
Site Safety Officer	Coordinates w/Field Supervisor on all aspects of health and safety Recommends work stoppage if operations threaten health of workers/public	Coordinates safety and health program activities. Conducts tailgate safety meetings and completes all documentation forms required by the HASP. Monitors site personnel for signs of stress, such as weather exposure and fatigue. Maintains PPE/health and safety equipment. Knows emergency procedures, evacuation routes, and telephone numbers of emergency responders.	40-hour HAZWOPER training w/annual 8-hour training (29 CFR 1910.120) 8-hour Supervisor training medical surveillance participant

5.1.4 Site-Specific Personnel - Medical Monitoring

AMEC personnel are enrolled in a medical monitoring program that is in compliance with 29 CFR 1910.120 (f)(2) *et seq*.

5.1.5 Acknowledgement

I acknowledge having reviewed this Health & Safety Plan, understand its contents and agree to abide by it. Additionally, I am current in the training and medical surveillance requirements specified in 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response.

NAME *(Please Print)*	SIGNATURE	COMPANY AFFILIATION	DATE

5.2 Project Information

5.2.1 Site Description and Background Information

A detailed description of the Site is provided in Section 1. The CSA indicates that a condition of No Significant Risk (NSR) exists for all areas of the Site except groundwater, where some monitoring well concentrations exceed drinking water criteria. The remaining contamination in soil includes metals (primarily antimony, barium, lead, nickel, and zinc) and EPH compounds in soil. Groundwater sampling indicates elevated concentrations of arsenic and chlorinated Volatile Organic Compounds (cVOCs) in the area adjoining the river downgradient of the manufacturing buildings, and chlorobenzenes in a single well in the North Parking area. Most of the former manufacturing buildings at the Site have been demolished. Existing site features are indicated in Figure 8.

5.2.2 Purpose of Site Work

The purpose of site work is to install wells and sample groundwater as part of a Monitored Natural Attenuation (MNA) remedy for groundwater contamination. MNA consists of active monitoring of natural processes to ensure attainment of cleanup goals. Initial investigations and well installations are expected to be completed in a few months, while groundwater monitoring continues for up to 10 years.

5.2.3 Summary of Scope of Work

The proposed MNA remedy consists of installing, sampling, evaluating, and reporting data from monitoring wells in the areas of groundwater contamination. Proposed field activities will also include investigations preceding the monitoring well installations, to collect data designed to optimize these well locations. Activities are described in Section 2.5, and can be summarized as three main field tasks:

- **Task 1: Groundwater Profile Sample Collection**. A direct-push drill rig will be used to advance a discrete groundwater sampler at multiple locations. At several vertical intervals groundwater will be collected, and analyzed at an onsite laboratory.
- **Task 2: Installation of Permanent Monitoring Wells**. A drill rig will be used to install monitoring wells, based on data collected during Task 1. Monitoring wells will be appropriately developed as part of this task.
- **Task 3: Groundwater Monitoring**. This task consists of long-term monitoring of designated monitoring wells. Samples will be collected according to EPA low-flow procedures, and water levels will be measured in wells and at surface water locations.

5.2.4 Utility Clearance

Gas, electricity, and water supply to the Site will be shut off prior to the start of work. The Project Manager will confirm shut-offs with the utility companies and provide written notice to the Field Supervisor and Site Safety Officer when completed. Work involving ground disturbance will be performed in accordance with AMEC Ground Disturbance Policy to minimize the potential for personal injury, environmental impact, and damage to existing infrastructure at the Site.

5.2.5 Potential Chemical Hazards

Contaminants of concern that may be present at the Site are summarized in Table 5 based on the CSA (AMEC 2011c).

Table 5. Site Chemical Hazard Concentrations

CONTAMINANT	SOURCE OF CONTAMINATION	MEDIA (soil/water/air)	RANGE OF CONCENTRATION ug/L – Groundwater mg/kg - Soil
Arsenic	Industrial Residuals	Groundwater	0.47 – 75
Acenaphthene	Industrial Residuals	Groundwater	1.1 – 41
Phenanthrene	Industrial Residuals	Groundwater	0.43 – 49
C11-C22 Aromatics	Industrial Residuals	Groundwater	80 – 1025
1,2,4-Trichlorobenzene	Industrial Residuals	Groundwater	1.4 – 78.5
Tetrachloroethylene (PCE)	Industrial Residuals	Groundwater	0.25 – 120
Trichloroethylene (TCE)	Industrial Residuals	Groundwater	0.91 – 75.5
Vinyl Chloride	Industrial Residuals	Groundwater	0.2 – 11.5
1,4-Dichlorobenzene	Industrial Residuals	Groundwater	0.41 – 6.4
Arsenic	Industrial Residuals	Soil	0.59 – 51
Lead	Industrial Residuals	Soil	2.7 – 2600
Benzene	Industrial Residuals	Soil	0.00087 – 0.2425
Vinyl Chloride	Industrial Residuals	Soil	0.006
Trichloroethylene (TCE)	Industrial Residuals	Soil	0.0026 – 0.1900
Tetrachloroethylene (PCE)	Industrial Residuals	Soil	0.0036 – 0.3300
1-2 Dichloroethane	Industrial Residuals	Soil	0.00098 – 0.001

5.3 Task-Specific Health & Safety Risk Analysis

Table 6 summarizes potential hazards associated with each of the three types of tasks to be performed at the Site.

Table 6. Hazard Analysis

HAZARDS	Task 1 Direct-Push, On-site GW Lab	Task 2 Permanent MW Installation	Task 3 GW Sampling
Physical			
Confined Space			
Engulfment			
Drowning			
Nuisance dust			
Noise	X	X	
Slips/trips/falls	X	X	X
Fire/Explosion			
Lifting	X	X	X
Falling objects	X	X	
Struck by (traffic, machinery, etc.)	X	X	X
Punctures/abrasions/compressions	X	X	X
Electrical shock			
Heat stress/Cold stress	X	X	X
Other (be specific):			
Biological			
Bloodborne pathogens			
Ticks (Lyme's disease)	X	X	X
Chiggers			
Spiders	X	X	X
Wasps/bees	X	X	X
Snakes			
TB (dirty respirators)			
Bird/bat droppings			
Mosquitoes/gnats, etc.	X	X	X
Vegetation (poison ivy, stinging nettle, etc.)	X	X	X
Hanta virus (mice droppings)			
Other (be specific):			
Radiological			
Sunburn	X	X	X
Radon			
Other (be specific)			

5.4 Chemical Hazards

Table 7 provides chemical properties and exposure assessment data for chemicals that may be encountered at the Site.

Table 7. Chemical Hazards and Health Effects

Chemical Name[a] (or class)	Action Level	PEL	IDLH	Relevant Potential Exposure Pathways (b)	Dermal Health Effects	Inhalation Health Effects	First Aid
Benzene	1 ppm	1 ppm	500 ppm	Ingestion, inhalation, dermal contact	Irritation eyes, skin, nose, dermatitis	respiratory system; giddiness; headache, nausea, staggered gait; fatigue, anorexia, lassitude (weakness, exhaustion)	**Ingestion** – Rinse mouth **Eyes** – Rinse with water then call Dr. **Skin** – wash with soap and water **Inhalation** – Fresh air and rest, call Dr.
Arsenic	0.005 mg/m^3	0.010 mg/m^3	5 mg/m^3	Ingestion, inhalation, dermal contact	Eye and skin irritation, hyperpigmentation of skin,	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation	**Ingestion** – Rinse mouth, medical attention **Eyes** – Rinse with water then call Dr. **Skin** – wash with soap and water **Inhalation** – Fresh air and rest, call Dr.

Chemical Name[a] (or class)	Action Level	PEL	IDLH	Relevant Potential Exposure Pathways (b)	Dermal Health Effects	Inhalation Health Effects	First Aid
Lead	0.025 mg/m^3	0.050 mg/m^3	100 mg/m^3	Ingestion, inhalation, dermal contact	Eye and skin irritation	lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; hypertension	**Ingestion** – Rinse mouth, medical attention **Eyes** – Rinse with water then call Dr. **Skin** – wash with soap and water **Inhalation** – Fresh air and rest, call Dr.
Vinyl Chloride	1 ppm	1 ppm	ND	Ingestion, inhalation, dermal contact	Eye and skin irritation, Frostbite (if liquid)	lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite	**Ingestion** – Rinse mouth, medical attention **Eyes** – Rinse with water then call Dr. **Skin** – wash with soap and water **Inhalation** – Fresh air and rest, call Dr.

Chemical Name[a] (or class)	Action Level	PEL	IDLH	Relevant Potential Exposure Pathways (b)	Dermal Health Effects	Inhalation Health Effects	First Aid
Trichloroethylene	50 ppm	100 ppm	1000 ppm	Ingestion, inhalation, dermal contact	Eye and skin irritation	Headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; cardiac arrhythmias, paresthesia; liver injury	**Ingestion** – Rinse mouth, medical attention **Eyes** – Rinse with water then call Dr. **Skin** – wash with soap and water **Inhalation** – Fresh air and rest, call Dr.
Tetrachloroethylene	50 ppm	100 ppm	150 ppm	Ingestion, inhalation, dermal contact	Eye and skin irritation	Irritation nose, throat, respiratory system; nausea; flush face, neck; dizziness, loss of coordination; headache, drowsiness; liver damage;	**Ingestion** – Rinse mouth, medical attention **Eyes** – Rinse with water then call Dr. **Skin** – wash with soap and water **Inhalation** – Fresh air and rest, call Dr.
1-2-Dichloroethane	25 ppm	50 ppm	50 ppm	Ingestion, inhalation, dermal contact	Eye and skin irritation	Corneal opacity; central nervous system depression; nausea, vomiting; liver, kidney, cardiovascular system damage	**Ingestion** – Rinse mouth, medical attention **Eyes** – Rinse with water then call Dr. **Skin** – wash with soap and water **Inhalation** – Fresh air and rest, call Dr.

Chemical Name[a] (or class)	Action Level	PEL	IDLH	Relevant Potential Exposure Pathways (b)	Dermal Health Effects	Inhalation Health Effects	First Aid

[a]PEL = OSHA Permissible Exposure Limit; represents the maximum allowable 8-hr. time weighted average (TWA) exposure concentration.
(b) = ingestion should not be a relevant exposure pathway
TLV = ACGIH Threshold Limit Value; represents the maximum recommended 8-hr. TWA exposure concentration.
IDLH = Immediately Dangerous to Life and Health; represents the concentration at which one could be exposed for 30 minutes without experiencing escape-impairing or irreversible health effects.
REL = NIOSH Recommended Exposure Limit, based on a 10-hour TWA exposure

5.4.1 Personal Protective Equipment (PPE) Requirements

PPE requirements in Table 8 may be upgraded or downgraded by the site industrial hygienist, HSM, or qualified Site Safety Officer based upon site conditions and air monitoring results.

Table 8. Personal Protective Equipment Requirements

PPE	Task 1 Direct-Push, Onsite GW Lab	Task 2 Permanent MW Installation	Task 3 GW Sampling
Level of Protection (A,B,C,D)	D	D	D
Body (Tyvek, Saranex, etc.)			
Gloves	Nitrile	Nitrile	Nitrile
Feet			
Head	Hardhat	Hardhat	Hardhat
Eye (a)	Safety Glasses	Safety Glasses	Safety Glasses
Ear	Hearing Protection	Hearing Protection	Hearing Protection
Other (e.g., PFD, waders, etc.)(b)			
Respirator			
Cartridge			
Cartridge Change-out Schedule (attach OSHA sheet)			
Weather:			
Temperature			
Humidity			

(a) - optional equipment in accordance with 29 CFR 1910.120 Appendix B

5.4.2 Work Limitations

All work will be conducted during daylight hours unless proper lighting is provided in accordance with OSHA regulations.

5.4.3 Monitoring Equipment Requirements

The Site Safety Officer or designee will conduct air monitoring utilizing a photoionization detector (PID). The SSO will conduct the initial contaminant source monitoring and breathing zone monitoring. Monitoring readings will be logged in the field notebook as specified in the following table. Direct reading instrumentation shall be calibrated in accordance with manufacturing requirements, *e.g.*, at least daily, and results of the calibration shall be documented in the field notebook.

5.4.4 Monitoring worker safety

During subsurface investigations (Task 1 and Task 2) AMEC will monitor the breathable ambient air for worker safety using a PID. Benzene has the lowest action level of all compounds of concern at the site at 1 ppm. If an ambient air level of 1 ppm is exceeded all work will stop until ambient levels return to safe conditions, and/or chemical-specific monitoring will be conducted to evaluate the actual chemical hazard. If action levels indicated in Table 9 are exceeded engineering controls and/or respirators will be utilized to continue work. If compound specific action levels are not exceeded, work can resume.

Table 9. Action Levels for Changes in Levels of Protection

Hazard Monitored	Tasks	Action Level	Response/Level of Protection
Organic/Inorganic gases and vapors (known contaminants)		Chemical dependent according to PEL/TLV/REL	Consult standard references to toxicity data. Action level usually set at 50% of PEL/TLV/REL. When multiple chemicals are present, use lowest published exposure limit.
Organic/Inorganic gases and vapors (unknown contaminants) (Use PEL/TLV/REL criteria on Table 1 if contaminants are known)		Background < 0.5 ppm 0.5-50 ppm in ambient air 50-500 ppm in ambient air >500 ppm above background	Level D Level C: Personnel will use full-face air-purifying respirator with GME-H cartridges. LEVEL B: Personnel will exit the site if Level B respiratory equipment is required. Level A: Personnel will exit the site if Level A respiratory equipment is required.

5.5 Decontamination Procedures

Depending on the specific job task, decontamination may include personnel themselves, sampling equipment, and/or heavy equipment. Heavy equipment will always require decontamination to prevent cross-contamination of samples and/or facilities. The following sections summarize general decontamination protocols.

5.5.1 Heavy Equipment

Heavy equipment will be decontaminated prior to personnel decontamination. Decontamination areas/pads will be set-up for collection of decon fluids and materials. Berms and wind barriers will be set up, if appropriate.

Drill rigs or other construction vehicles that become contaminated with suspect soil will be cleaned prior to leaving the site. The wheel wells, tires, sides of vehicles, etc. will be high-pressure washed at a location to be determined by the SSO. **At no time are personal vehicles allowed in the work (hot) zone.**

5.5.2 Personnel

Use steps and procedures outlined below as guidelines for personnel decontamination:

- Brush loose soil from body;
- Boot removal (where appropriate);
- Suit removal (where appropriate);
- Respirator/hard hat removal (where appropriate);
- Respirator wash (where appropriate);
- Outer glove change (if returning to sampling),
- Glove removal;
- Field wash hands

5.5.2.1 Samples and Sampling Equipment

The same decontamination line will be used for sampling equipment decon as is used for personnel decon. At a minimum the following is performed:

- Refer to work plan for specific equipment decontamination policies and procedures;
- Hand augers and sampling equipment will be washed in Alconox solution or equivalent and rinsed in distilled water;
- Samples will be dry-wiped prior to packaging.

5.5.2.2 Decon Wastes

- Spent decon solutions will be drummed for analytical testing and subsequently properly disposed
- Decontamination shall be performed in a manner that minimizes the amount of waste generated.

5.6 Site Operating Procedures

5.6.1 Initial Site Entry Procedures

- Prior to working on-site, conduct an inspection for physical, chemical, and biological hazards. Gas, electricity, and water supply to the Site will be shut off prior to the start of work. The Project Manager will confirm shut-offs with the utility companies and provide written notice to the Field Supervisor and Site Safety Officer when completed.
- Confirm phone numbers and availability of phones for all site personnel.
- Note any specialized protocols particular to work tasks associated with the project.

5.6.2 Daily Operating Procedures

- Hold Tailgate Safety Meetings prior to work start or changes in task or type of activity.
- Establish daily work, decon, and support zones, as necessary.
  - Employees will not enter the work zone unless proper PPE is used.
- Employees will avoid unnecessary contact with contaminated materials. Do not sit down, kneel, or lay equipment on contaminated surfaces.
- Use monitoring instruments and follow designated protocol and contaminant action levels.
- Use personal protective equipment (PPE) as specified.
  - The 8-hour PEL for noise is 90 dbA. Use hearing protection when noise levels exceed 8-hour PEL.
- Remain upwind of operations and airborne contaminants, if possible.
- Establish a work/rest regime appropriate for ambient temperatures.
- Do not use smoke, chew gum or tobacco, or consume food in contaminated areas.
- Refer to Site Safety Officer (SSO) for specific safety concerns for each individual site task.
- Be alert to your own physical condition.
- **All accidents and near misses, no matter how minor**, must be reported immediately to the SSO and the Health and Safety Manager.

5.6.3 Confined Space Entry Procedures

Site workers shall not enter permit-required confined spaces. Contact the HSM if a confined space is encountered.

5.6.4 Buddy System

Work will be conducted using the buddy system such that a line of sight will be maintained while in the work zone.

5.6.5 Communications

Site personnel will carry cell phones as listed in Table 10 (complete for final HASP version)

Table 10. Phone Numbers for Personnel Working On Site

Name	Affiliation	Cell Phone

5.7 Emergency Response Procedures

5.7.1 Emergency Incident Procedures

The nature of work at contaminated or potentially contaminated work sites makes emergencies a continual possibility. Although emergencies are unlikely and occur infrequently, a contingency plan is required to assure timely and appropriate response actions. The contingency plan is reviewed at tailgate safety meetings.

5.7.1.1 Emergency Incident Procedures

If an emergency incident occurs, take the following action:

Step 1: Size-up the situation based on the available information.
Step 2: Notify the Site Safety Officer, Health and Safety Manager, and/or Field Supervisor.
Step 3: Only respond to an emergency if personnel are sufficiently trained and properly equipped.
Step 4: As appropriate, evacuate site personnel and notify emergency response agencies, e.g., police, fire, etc.
Step 5: Consult the posted emergency phone list and contact key project personnel (see **Attachment 1**)
Step 6: As necessary, request assistance from outside sources and/or allocate personnel and equipment resources for response.
Step 7: Prepare an incident report. Forward incident report to Project Manager and HSM within 24 hours.

5.7.1.2 Medical Emergencies

If a medical emergency occurs, take the following action:

Step 1: Assess the severity of the injury to stabilize the injured person. Follow universal precautions to protect against exposure to blood borne pathogens.
Step 2: Get medical attention for the injured person immediately. Call 911 or consult the Emergency Contacts list which must be posted at the site (see **Attachment 1**).
Step 3: Notify the Site Safety Officer and Field Supervisor immediately. The Site Safety Officer will assume charge during a medical emergency.
Step 4: Depending on the type and severity of the injury, transport the injured employee to the nearest hospital emergency room. If the injury is not serious, then transport the injured employee to a nearby medical clinic. Notify the Health & Safety Manager.
Step 6: Prepare an accident report. The Site Safety Officer is responsible for its preparation and submittal to the Health and Safety Manager (HSM) and Corporate Health and Safety Administrator within 24 hours. CHSA fax number is (858) 458-9044.

5.7.2 Emergency Routes

Route to Hospital Map and Directions are provided as **Attachment 2**.

5.7.2.1 Site Specific Requirements in Event of an Emergency:

5.7.3 Facility Notifications

Env / Safety:	Chris Clodfelter, BHI	713-439-8329
Security:	On-site Security Guard	Tel/Cell # TBD

5.7.3.1 Locate Shut-Offs

Gas, electricity, and water supply to the Site will be shut off prior to the start of work.

5.7.3.2 Evacuation Route

If evacuation is required, the Field Supervisor/SSO shall:

- Step 1: Activate the communication system to alert site workers of evacuation. Personnel shall be advised to remain upwind of contaminants, if possible, and proceed to the designated assembly area.
- Step 2: Account for all personnel at the assembly area.
- Step 3: Notify the client of the need to initiate evacuation procedures for other site personnel.
- Step 4: Notify the Fire and Police Departments and request their assistance for evacuating the surrounding area and residences.

5.7.3.3 Spill Containment Plan

If a spill of hazardous material occurs, the following steps shall be taken to mitigate the incident:

- Step 1: Notify the Field Supervisor, and he/she shall assess the extent of the spill to determine if it can be safely mitigated with the personnel and protective equipment available at the site.
- Step 2: If the release is beyond the field team's capabilities, the Field Supervisor shall evacuate the site personnel to a safe location upwind of the release, and notify the Project Manager and Fire Department.
- Step 3: The Project Manager shall notify the client, Health and Safety Manager, Corporate Health and Safety Director, and regulatory agencies, if necessary.
- Step 4: Takes steps to secure the area and to prevent unauthorized persons from entering the area.
- Step 5: If the spill can be safely mitigated using defensive actions, first don the appropriate PPE. Initially, Level C PPE should be worn until air monitoring indicates a downgrade in PPE is appropriate.
- Step 6: Takes steps to contain the spill and to prevent it from reaching sewers, storm ditches, etc.
- Step 7: Clean up the spill with absorbent, neutralizers, soil removal as appropriate. Place waste in sealed, labeled containers for disposal.

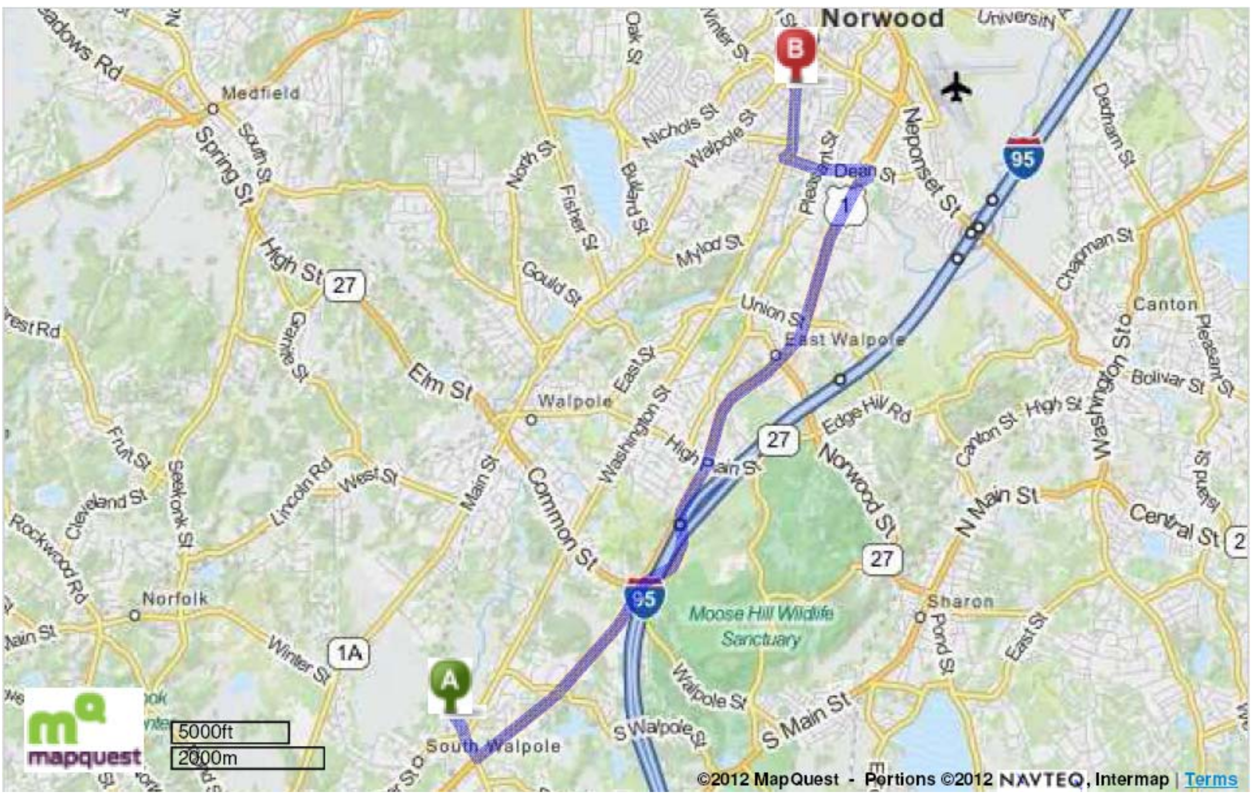
Attachment 1. Emergency Contacts
(To be Posted)

TITLE	NAME	PHONE NUMBER
EMERGENCY		
Police	Walpole PD	**911** / 508-668-1095
Fire	Walpole FD	**911** / 508-668-0260
Local Hospital	Norwood Hospital	781-769-4000
Local Ambulance/Rescue	Walpole FD	**911**
Poison Control Center	Regional Center for Poison Control and Prevention	1-800-222-1222
Haz. Waste Natl. Response Center	HAZMAT	(800) 424-8802
PROJECT/BUSINESS		
Project Manager		Office:978-692-9090 Cell:
Health & Safety Manager		Office:732-302-9500 Cell:
Corporate Health & Safety Administrator		610-828-8100
Field Supervisor		Office:978-692-9090 Cell:
Site Safety Officer		Office:978-692-9090 Cell:
Client Contact	Chris Clodfelter	713-439-8329
Subcontractor		

Attachment 2
HOSPITAL ROUTE

Norwood Hospital
800 Washington Street
Norwood, MA 02062
(781)769-4000
6.9 miles / 17 minutes

HOSPITAL MAP (written directions next page)



Norwood Hospital
800 Washington Street
Norwood, MA 02062
(781)769-4000
6.9 miles / 17 minutes

HOSPITAL DIRECTIONS

100 Neponset St, South Walpole, MA 02071-1037

1. Start out going **south** on **Neponset St** toward **Willow St**. Map	**0.3 Mi** *0.3 Mi Total*
2. **Neponset St** becomes **Water St**. Map	**0.2 Mi** *0.4 Mi Total*
3. **Water St** becomes **North St**. Map	**0.05 Mi** *0.5 Mi Total*
NORTH 1	4. Turn **left** onto **Washington St** / **US-1**. Continue to follow **US-1 N**. Map *Papa Gino's is on the left* *If you reach Meadowview Rd you've gone about 0.1 miles too far*	**6.5 Mi** *7.0 Mi Total*
5. Turn **slight right**. Map *0.1 miles past River Ridge Dr* *If you are on Boston Providence Turnpike and reach E Cross St you've gone about 0.6 miles too far*	**0.2 Mi** *7.1 Mi Total*
6. Turn **left** onto **Dean St**. Map	**0.8 Mi** *7.9 Mi Total*
7. Turn **right** onto **Washington St**. Map *Domino's Pizza is on the corner*	**0.7 Mi** *8.6 Mi Total*
8. **800 WASHINGTON ST** is on the **right**. Map *Your destination is just past Winter St* *If you reach Central St you've gone a little too far*	

800 Washington St, Norwood, MA 02062-3487

6.0 PERMITS, LICENSES, AND APPROVALS [310 CMR 40.0874(3)(F)]

No federal permits or approvals are required to implement this RIP. The work will be conducted under the direction of a Licensed Site Professional under the MCP as indicated in Section 1, and is subject to the Public Involvement requirements of the MCP. Dig Safe will be notified in advance of subsurface drilling as required by Massachusetts General Law Chapter 82, Section 40. Site activities within 100-foot wetland buffers and 200-foot Riverfront Area buffers are subject to the wetland protection requirements of the Walpole Conservation Commission. BHI has inquired with the Commission whether such work should proceed under an existing Order of Conditions due to expire on 5/17/12, or under an amended order, and a determination on this requirement is expected shortly. All waste materials generated during this RAM that cannot be reused will be transported to appropriately licensed disposal facilities, in accordance with state and federal regulations.

7.0 PROPERTY ACCESS ISSUES [310 CMR 40.0874(3)(G)]

The work proposed in this RIP will be conducted solely on property owned by BHI, therefore no property access issues exist.

8.0 REFERENCES

AMEC 2011a. Phase III Remedial Action Plan for RTN 4-3024222, Former Bird Machine Company Site. Prepared by AMEC Earth & Environmental Inc. for Baker Hughes Inc. Final, December 2011.

AMEC 2011b. Response Action Outcome Statement for RTN 4-3024222, Former Bird Machine Company Site. Prepared by AMEC Earth & Environmental Inc. for Baker Hughes Inc. Final, December 2011.

AMEC 2011c. Phase II Comprehensive Site Assessment Report for RTN 4-3024222, Former Bird Machine Company Site. Prepared by AMEC Earth & Environmental Inc. for Baker Hughes Inc. Final, October 2011.

AMEC 2011d. Phase II Comprehensive Site Assessment Addendum for RTN 4-3024222, Former Bird Machine Company Site. Prepared by AMEC Earth & Environmental Inc. for Baker Hughes Inc. Final, December 2011.

USEPA 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water. EPA/600/R-98/128. September 1998.

USEPA 1999. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. OSWER Directive 9200.4-17P. April 21, 1999.

USEPA 2004. Performance Monitoring of MNA Remedies for VOCs in Ground Water. EPA /600/R-04/027. April 2004.

Walpole 2007. Letter from John Spillane, Chairman, Town of Walpole Board of Water & Sewer Commissioners, to Dina Kuykendall, BHI. October 25, 2007.

Weston 2005. Phase I Initial Site Investigation Report for RTN 3-0024222, Bird Machine Company Manufacturing Building Area. Prepared by Weston Solutions Inc. for Baker Process Inc. September 14, 2005.

Weston 2007. Phase II Comprehensive Site Assessment for Release of Hydrocarbons to the Neponset River Site, RTN 4-3023575. Prepared by Weston Solutions Inc. for Baker Process Inc. January 25, 2007.

Appendix A – Public Notification Letters

1. Draft RIP Transmittal Letter dated 2/24/12 including PIP Mailing List Notice of Document Availability, Public Comment Period, and date of upcoming Public Meeting
2. Final RIP Transmittal Letter including PIP Mailing List Notice of Document Availability (to be included in final document)

February 24, 2012

Mr. Gerard Martin
Massachusetts Department of Environmental Protection
Southeast Regional Office
Bureau of Waste Site Cleanup
20 Riverside Drive, Lakeville, Massachusetts 02347

Dear Mr. Martin:

Re: Public Comment Draft
Phase IV Remedy Implementation Plan
100 Neponset Street
Walpole, Massachusetts
RTN 4-3024222

On behalf of Baker Hughes, Inc. (BHI), AMEC Environment and Infrastructure (AMEC) is providing this Public Comment Draft of the Phase IV Remedy Implementation Plan (RIP) for the Bird Machine Company Site at 100 Neponset Street in Walpole, Massachusetts. BHI is submitting this RIP pursuant to 310 CMR 40.0870 of the Massachusetts Contingency Plan (MCP). The Site is listed as Release Tracking Number (RTN) 4-3024222 under the MCP.

This Draft RIP documents the plan for a Comprehensive Remedial Action that is expected to be a Permanent Solution for the Site. The selected remedial action is Monitored Natural Attenuation, as documented in the Final Phase III Remedial Action Plan submitted to the Massachusetts Department of Environmental Protection (MassDEP) on 12/14/11. As documented in the Class C-2 Response Action Outcome Statement submitted to MassDEP on 12/16/11, the Site already achieves the requirements of a Temporary Solution under the MCP.

The public comment period for the Draft RIP will begin on February 27, 2012 and will extend through March 19, 2012. Comments can be submitted to Chris Clodfelter of Baker Hughes at the following address:

Chris Clodfelter
Senior HS&E Specialist
Baker Hughes Incorporated
2929 Allen Parkway
Suite 2100
Houston, Texas 77019-2118
Office: 713.439.8329 | Fax: 713.439.8383

Copies of the Draft RIP are being provided to the MassDEP Southeast Regional Office (File Review Telephone Number: 508-946-2718) and at the Walpole Public Library (Telephone Number: 508-660-7341) in accordance with the Public Involvement Plan (PIP). The library is moving to a new building at 143 School Street and is expected to be open at that location by February 29, 2012. The Draft RIP is also being provided today to the Town of Walpole for upload to their website for this property: http://walpole-ma.gov/BirdMachine.htm. A copy of the executive summary of the Draft RIP, which summarizes the findings and conclusions presented in the document, is attached to this letter. A copy of this letter including the executive summary is being sent via US Mail to the PIP Mailing List for the Site.

Baker Hughes will present a summary of the Draft RIP and be available to answer questions at a public meeting scheduled for Wednesday March 14, 2012 at 7pm, at the Walpole Town Hall. Please contact me if you have any questions regarding the Public Involvement process for this document.

Sincerely,

Kim M. Henry
LSP No. 7122

cc:

Mr. Michael Boynton, Walpole Town Administrator
Ms. Robin Chapell, Walpole Health Agent
Ms. Landis Hershey, Walpole Conservation Agent
Ms. Deborah Burke, Key Petitioner
Public Involvement Plan Mailing List

Enclosure:

Draft Phase IV RIP Executive Summary

COPY OF DRAFT PHASE IV RIP - EXECUTIVE SUMMARY

On behalf of Baker Hughes, Inc. (BHI), AMEC Environment & Infrastructure, Inc. (AMEC) completed this Phase IV Remedy Implementation Plan (RIP) for the former Bird Machine Company (BMC) Site located in Walpole, Massachusetts. BHI is submitting this RIP pursuant to 310 CMR 40.0870 of the Massachusetts Contingency Plan (MCP). This RIP documents the plan for a Comprehensive Remedial Action that is expected to be a Permanent Solution for the Site, and that was selected in the Phase III Remedial Action Plan (RAP; AMEC 2011a). A Permanent Solution will achieve a condition of No Significant Risk (NSR) for current and reasonably forseeable site uses. As documented in the Class C-2 Response Action Outcome (RAO) Statement submitted to the Massachusetts Department of Environmental Protection (MassDEP) on 12/16/11, the Site already achieves the requirements of a Temporary Solution (AMEC 2011b).

Release Abatement Measures (RAMs) have been conducted at several locations to reduce the mass and concentrations of contaminants at the Site. The Phase II Comprehensive Site Assessment (CSA) reports (AMEC 2011c, AMEC 2011d) indicate that a condition of NSR exists for all areas of the Site except groundwater, where some monitoring well concentrations exceed drinking water criteria (Massachusetts Maximum Contaminant Levels or MMCLs). It is unlikely that groundwater at the Site will be used for drinking water, but the Site is within a Potential Drinking Water Source Area designated by the Town of Walpole (Walpole 2007). Considering this designation, groundwater at the Site is categorized as GW-1 under the MCP. The CSAs found no current pathway between Site contaminants and the Town’s water supply wells to the northeast, but the potential for contaminant movement from a portion of the Site warrants further monitoring. Background information including a description of RAMs and Site characteristics is summarized in Section 1 of this RIP.

Areas of groundwater contamination exceeding MMCLs have been identified for arsenic, chlorinated Volatile Organic Compounds (cVOCs), and 1,4-dichlorobenzene (DCB). Monitored Natural Attenuation (MNA) has been selected for implementation in Phase IV. MNA is expected to provide a Permanent Solution that achieves a condition of NSR. MNA has already produced significant reductions in arsenic and cVOC concentrations at individual wells over the past four years of groundwater monitoring. MNA appears capable of achieving or approaching background for cVOCs -- which are expected to require the greatest reductions in groundwater concentrations -- and for the other contaminants.

An Engineering Design for MNA is provided in Section 2 of this RIP, including goals and objectives, proposed activities, and design and operating parameters. The potential areas of groundwater contamination above MMCLs are illustrated in three dimensions using a plan view and cross-sections. A field monitoring program including sampling methods and locations, analytical parameters, and monitoring frequencies is presented, along with data evaluation methods and reporting requirements. Initially the program is envisioned to include approximately 30 water quality monitoring wells and 40 additional water level monitoring points (wells or surface water benchmarks) measured on a quarterly basis. Methods of determining MNA effectiveness and procedures for changing this program over time are also presented.

Section 2 includes site investigations that will precede installation of the final monitoring well network. This initial Geoprobe investigation of contaminant distribution, geochemistry, bedrock depths, and hydraulic gradients will provide data to optimize the final monitoring well locations. This investigation is consistent with the Triad approach described by the United States Environmental Protection Agency (USEPA) as a potential early phase of developing a performance monitoring plan for MNA (USEPA 2004). A data collection plan is provided in Section 2 along with the process to incorporate these results in the site conceptual model, and if necessary revise the MNA monitoring program that is presented in this RIP. Results of these investigations will be documented along with the final installed monitoring system in the Final Inspection Report (FIR) that is prepared pursuant to 310 CMR 40.0878.

Section 3 and the remaining portions of the RIP include construction specifications, a Health and Safety Plan, and the remaining requirements under 310 CMR 40.0870 of the MCP. Following presentation to the public and response to public comments, this RIP will be finalized and field work initiated. The field phase, including initial data collection and final well installations, is expected to require three months for completion. An expected schedule is provided in Section 3.2 in which a Draft FIR will be submitted in July 2012, and the MNA monitoring program will begin about one month after that. MNA is expected to require up to 10 years to achieve a Permanent Solution under the MCP, and progress will be reported every six months until completion.

Appendix B – BWSC Transmittal Form
(to be included in paper copy following eDEP submittal)

Appendix C – Responses to Public Comments
(to be included in final version)