Phase V Status and Remedial Monitoring Report

RTN 4-3024222
Former Bird Machine Company Site
Walpole, MA

Submitted to:

Baker Hughes Incorporated
Houston, TX

Submitted by:

AMEC Environment & Infrastructure, Inc.
Chelmsford, Massachusetts

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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
cfs	cubic feet per second
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

List of ACRONYMS, continued

ppb	parts per billion (for groundwater, micrograms per liter)
PPE	Personnel Protective Equipment
RAM	Release Abatement Measure
RAP	Remedial Action Plan
RC	Reportable Concentration
RD	Reductive Dechlorination
RMR	Remedial Monitoring Report
ROS	Remedy Operation Status
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 V Status and Remedial Monitoring Report (RMR) for the former Bird Machine Company (BMC) Site located in Walpole, Massachusetts. BHI is submitting this RMR pursuant to 310 CMR 40.0890 of the Massachusetts Contingency Plan (MCP). This RMR documents the operation of a Comprehensive Remedial Action that is expected to be a Permanent Solution for the Site, and that was installed as described in the Phase IV Final Inspection Report (FIR; AMEC 2012). A Permanent Solution will achieve a condition of No Significant Risk (NSR) for current and reasonably foreseeable site uses. As documented in the Class C-2 Response Action Outcome (RAO) Statement submitted to the Massachusetts Department of Environmental Protection (MassDEP) on December 16, 2011, the Site already achieves the requirements of a Temporary Solution (AMEC 2011a).

Release Abatement Measures (RAMs) have been conducted at several locations between 2005 and 2011 to reduce the mass and concentrations of contaminants at the Site. The Phase II Comprehensive Site Assessment (CSA) reports (AMEC 2011b, AMEC 2011c) 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 CSA reports 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 RMR.

Areas of groundwater contamination exceeding MMCLs have been identified for arsenic, chlorinated Volatile Organic Compounds (cVOCs), and 1,4-dichlorobenzene (DCB). A Monitored Natural Attenuation (MNA) remedy consisting of active monitoring of natural processes was selected to achieve cleanup goals, and was installed in accordance with Phase IV of the MCP. MNA is considered an Active Remedial Monitoring Program under the MCP and has been designed and constructed to provide a Permanent Solution that achieves a condition of NSR, as described in the FIR (AMEC 2012).

The August 2013 Phase V Status and Remedial Monitoring Report (RMR; AMEC 2013) coincided with one year of initial process monitoring as described in the FIR (AMEC 2012). At that time, it was determined that initial process monitoring had confirmed that key MNA processes were underway and a transition to long-term performance monitoring was appropriate. Long-term monitoring is designed to confirm that site conditions remain suitable for MNA, and that overall contaminant concentrations and mass are decreasing within a reasonable timeframe.

The long-term monitoring program includes continued quarterly sampling at six locations within the plumes that have had significant fluctuations in recent contaminant concentrations above the MMCLs. Semiannual sampling is performed for 9 other wells within the horizontal and vertical extent of the plume areas where previous quarterly sampling shows little variation in concentrations. Annual sampling is performed for 23 wells along the plume lateral or vertical edges where concentrations are below MMCLs. Analytes for long-term monitoring consists of the contaminants exceeding MMCLs and their primary breakdown products. The current OMM program for long-term monitoring is summarized in **Table 1**.

Wells sampled during the September round included the subset of wells sampled on a quarterly basis. Wells sampled during the December/January round included the subset of wells sampled on a quarterly and semi-annual basis.

Section 1 of this report provides background information for the site. Section 2 describes monitoring procedures, and Section 3 documents any modifications from the plans presented in the FIR. Section 4 of this RMR provides monitoring results and evaluations of MNA effectiveness, and Section 5 includes an updated Conceptual Site Model (CSM) and recommendations for future monitoring. This RMR documents that a remedial monitoring well network to support an Active Remedial Monitoring Program is being operated in accordance with the plans and specifications presented in the FIR.

1.0 SITE BACKGROUND

AMEC completed this Phase V RMR for the former BMC Site located in Walpole, Massachusetts on behalf of BHI. This document is submitted pursuant to 310 CMR 40.0892 of the MCP. This RMR documents operation and implementation of MNA, an Active Remedial Monitoring Program, 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 Environment & Infrastructure, Inc. 271 Mill Road Chelmsford, Massachusetts 01824 Phone: 978-692-9090

A Tier 1B Permit Application was submitted to the MassDEP on January 10, 2008, 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 February 28, 2008, and expired on February 28, 2013. Because Remedy Operation Status (ROS) (AMEC, 2013b) was achieved and a ROS Opinion filed with the MassDEP on February 13, 2013, renewal of the permit was not required under the MCP.

This RMR is organized as follows:

- Section 1 – Site Background
- Section 2 – Operation, Maintenance, and Monitoring
- Section 3 – OMM Modifications Since the Preceding Report
- Section 4 – Evaluation of Effectiveness
- Section 5 – Recommendations and Updated CSM
- Section 6 – References

The remainder of Section 1 summarizes site characteristics, release history, and response actions. Section 2 describes monitoring procedures, and Section 3 documents any modifications from the plans presented in the FIR. Section 4 provides monitoring results and evaluations of MNA effectiveness, and Section 5 includes an updated CSM and recommendations for future monitoring. Section 6 provides references for this report.

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.

Existing site features are indicated in **Figure 3** 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 3 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 during building demolitions, and may still exist on either side of the drain in other areas. Figure 3 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 3, and the areas above the structures left in place, have been filled to grade with sandy soil.

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 2011b): 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 2011c): 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 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. These soil concentrations were found to pose No Significant Risk for current and future foreseeable uses of the Site.

Groundwater sampling indicates elevated concentrations of arsenic and 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. The updated extent of these exceedances is provided in Section 4 based on the results of quarterly monitoring. 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 sand and gravel fill in depths of up to 10 feet, generally thickest where the Neponset River was rerouted. Beneath the fill layer, a 5-foot to 10-foot thick silty sand layer is present, which thins to a few feet in the west where bedrock is at a depth of 10 feet or less. The bedrock surface slopes downward to the east and is typically 20 to 30 feet deep near the river. Where bedrock deepens, the silty sand is underlain by a coarser silty sand and gravel in thicknesses of up to 20 feet. Cross sections including the latest contaminant findings are presented in Section 4.

The majority of borings at the Site were not cored into rock, and drilling refusals are generally interpreted as the bedrock surface unless inconsistent with borings that were cored or hammered to confirm rock. A bedrock low of about 45 ft below ground surface (bgs) occurs in the east-center of the Site near monitoring well MW-708. Bedrock cored during the FIR monitoring well installations consisted of two distinct rock types, conglomerate and shale. The interpreted bedrock surface map is provided in **Figure 4**.

Bedrock at MW-702 to the northwest and MW-710 to the east consisted of alternating layers of consolidated to unconsolidated conglomerate containing a mixture of angular to rounded boulders and sand. The layers consisted of approximately 5-foot thick consolidated rock alternating with approximately 3-foot thick unconsolidated boulders and sand. These alternating layers are consistent with highly fractured and weathered conglomerate material having been repeatedly faulted and folded. Bedrock at MW-708, a few hundred feet west of MW-710, consisted of slightly weathered shale in approximately 2-centimeter thick bedding layers. These layers were oriented vertically, suggesting previous faulting and folding in the area.

The water table beneath the Site occurs approximately 3 to 5 ft bgs in either fill or sand. Bedrock is believed to impede vertical flow as it is generally less transmissive than the shallow sand aquifer, depending on competency. Groundwater in the sand aquifer appears to be discharging to the Neponset River or its associated wetlands during much of the year. 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. 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. Mapped shallow and deep piezometric surfaces for the recent quarterly monitoring events are presented in Section 4.

Groundwater flow directions in specific areas of the MBA vary depending on water table conditions. Groundwater elevations were mapped for monitoring events in October 2006, July 2008, and April 2009 in the Remedial Action Plan (RAP; AMEC 2011d), and based on river flow records these three times appear to represent a range of typical median, low, and high water tables, respectively. Significant changes in the water table surface are apparent between the three events, particularly in the southeast portion of the Site. Aside from precipitation and river flow, another difference between the events was that in 2006 the MBA buildings and pavement were still intact; while 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. Lateral groundwater seepage velocities in the sandy soils are estimated to range between 0.1 and 0.9 feet per day in the MBA, based on these three mapped events.

2.0 OPERATION, MAINTENANCE, AND MONITORING [310 CMR 40.0892(2)(A)]

The MNA remedy consists of an Active Remedial Monitoring Program as defined at 310 CMR 40.0006. The type and frequency of Operation, Maintenance, and Monitoring (OMM) under this program is summarized below.

2.1 Monitoring Network Design and Operation

The locations of monitoring wells are indicated in **Figure 5**. Initial process monitoring was conducted in the first year of OMM (August 2012 – August 2013) through quarterly sampling and measurements of water levels in the monitoring wells and river. Analytical parameters for the current reporting period are summarized in **Table 2**. 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. The storm monitoring events, originally proposed to be completed during the first year of monitoring, have not been completed to date. An effort will be made to conduct the measurements during the second year of monitoring to evaluate whether such storms have temporal affects on flow direction or rate that are not apparent in the quarterly sampling events. 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.

Groundwater sampling at wells and temporary screens is performed with low-flow sampling techniques using a peristaltic pump. The pump is equipped with dedicated polyethylene tubing. The pump intake is lowered slowly into the well to the approximate center of the saturated screen section, and remains at least two feet above the bottom of the well to prevent the disturbance of any sediment which may be present. The water level is measured and recorded before starting the pump. Sampling records from previously sampled wells are 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 is 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 is reduced to the minimum capabilities of the pump to avoid pumping the well dry. The level of the water is not 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 commences as soon as the well has recharged to a sufficient level to purge one system volume (volume of pump and tubing) and then the appropriate volume of sample is collected.

During the purging of the well, the field parameters (pH, temperature, conductivity, dissolved oxygen, redox potential and turbidity) are monitored every 3 to 5 minutes, or as appropriate, using a flow-through cell, until the parameters stabilize. Field parameters are 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 is made to purge the well until turbidity of the purged water is less than 5 nephelometric turbidity units (ntu).

After purging is completed, groundwater samples are pumped directly into the proper sample containers. All sample containers are filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. Samples requiring dissolved constituent analysis are 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 2**. Each sample is labeled and placed into a cooler with ice for shipment to the laboratory. Sampling activities are documented using pre-printed field data sheets to record well purging and any field screening results. Purge water is collected until sampling is complete, then returned to the monitoring well in accordance with the MCP.

2.2 Control of OHM Spills and Accidents

Site activities consist of groundwater sampling and analysis and water table measurements. Limited amounts of Oil or Hazardous Material (OHM) are associated with these activities, mainly consisting of petroleum or lubricants in vehicles or generators. Equipment containing OHM is operated in paved areas to the extent possible. Safe engineering and construction practices are implemented during for all phases of work, as described in the Health and Safety Plan in the FIR.

Spills of OHM will be reported and addressed in accordance with the MCP. Any impacted material resulting from a spill of 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 2.3. No spills of OHM occurred during the current reporting period.

2.3 Waste Management

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

2.4 Measures to Avoid Adverse Impacts

Field crews periodically traverse and work within wooded and wetland areas east of the Neponset River to sample four monitoring well locations. Work within wetland and riverfront areas complies with an Order of Conditions from the Walpole Conservation Commission, which specifies best management practices to minimize adverse impacts to these sensitive areas.

2.5 Permits, Licenses, and Approvals

No federal permits or approvals are required to implement OMM activities. The work is 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. The public notification letter for this report is provided in **Appendix A**. The BWSC Transmittal Form required under the MCP will be provided in **Appendix B** in the paper copy of this RMR, following final eDEP submittal.

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 and will comply with their Order of Conditions. All waste materials generated during response actions that cannot be reused are transported to appropriately licensed disposal facilities, in accordance with state and federal regulations.

3.0 OMM MODIFICATIONS SINCE THE PRECEDING REPORT [310 CMR 40.0892(2)(B)]

The August 2013 Phase V Status and Remedial Monitoring Report (RMR; AMEC 2013) coincided with one year of initial process monitoring as described in the FIR (AMEC 2012). At that time, it was determined that initial process monitoring had confirmed that key MNA processes were underway and a transition to long-term performance monitoring was appropriate. Long-term monitoring is designed to confirm that site conditions remain suitable for MNA, and that overall contaminant concentrations and mass are decreasing within a reasonable timeframe.

The long-term monitoring program includes continued quarterly sampling at 6 locations within the plumes that have had significant fluctuations in recent contaminant concentrations above the MMCLs. Semiannual sampling is performed for 9 other wells within the horizontal and vertical extent of the plume areas where previous quarterly sampling shows little variation in concentrations. Annual sampling is performed for 23 wells along the plume lateral or vertical edges where concentrations are below MMCLs. Analytes for long-term monitoring consist of the contaminants exceeding MMCLs and their primary breakdown products. The current OMM program for long-term monitoring is summarized in **Table 1**. This semi-annual report documents the first two rounds of sampling since the implementation of OMM modifications presented in the August 2013 RMR.

Wells sampled during the September round included the subset of wells sampled on a quarterly basis. Wells sampled during the December round included the subset of wells sampled on a semi-annual basis. It was intended that the December round would consist of sample collection from the subset of wells to be sampled on a quarterly and semi-annual basis; however due to an error, only the semi-annual wells were sampled. Upon realization of the error, a field team returned to the site in January to collect samples from the six quarterly wells. Therefore, the completion of the December quarterly sampling over a 1-month period represents a slight deviation from the OMM.

Although not an OMM modification, it is noted that water table measurements following a major storm event were not conducted during the six-month period covered in this report. This storm event monitoring will be conducted during the next six-month period, weather permitting.

Recommendations for any future modifications, based on the results in Section 4, are provided in Section 5 of this report.

4.0 EVALUATION OF EFFECTIVENESS [310 CMR 40.0892(2)(C)]

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 MMCL criterion for this contaminant. Similarly for cVOCs and chlorobenzenes background would be approached at one-half of the MMCL 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 generally less than 200 feet.

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 includes graphic or tabular displays of the following measurements for COCs and geochemical indicators:

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

Data analysis includes evaluation of plume stability and loss of contaminant mass, and where possible estimates of remediation times. 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. Following the evaluations in this section, the CSM will be updated in Section 5 as needed to ensure that it considers all viable hypotheses for explaining the data.

4.1 Flow Rates and Storm Effects

Water table measurements were collected at shallow and deep (above bedrock) wells at the beginning of each monitoring event, on September 12 and December 10, 2013. Shallow and deep water level contours were prepared for these two dates and are provided in **Figures 6 and**

7. Neponset River flows at the nearest stream gauge in Norwood MA are indicated in the right panel of **Figure 8**, and averaged 13 cubic feet per second (cfs) on September 12, 2013 and 40 cfs on December 10, 2013. During these two water table measurements, river flows were near the long-term median values and typical of seasonal conditions; on September 12, 2013 water levels in the Neponset River were 1 cfs below average, and on December 10, 2013 water levels were 9 cfs below average. Seasonal fluctuations in river flow vary from as low as 2 cfs to a high of 1,000 cfs.

The water table elevations measured in September averaged one to two feet lower in elevation than in December, which correlates with a downward trend in river flows during September and a upward trend in December. The long-term median data in **Figure 8** suggest that by September the river flow is typically starting to rise from the annual low point, and by the end of the year the river flow has increased to about half of the annual maximum; however as shown on the left panel of the figure, annual river flows in 2013 were lowest in November. The dates of earlier water table maps, which appear in the FIR or RAP, are indicated in the left panel of **Figure 8** along with the river flow at each event.

Similar to historic conditions, the latest results (particularly for December) show an inflection of the shallow water table downward at MW-714S, and a slight mounding of the shallow water table in the area between MB-MW-365 and MW-712S. The slight downward inflection historically observed at MB-MW-367 was not apparent during the two most recent groundwater gauging events. An upward vertical gradient has been observed at MW-714 since measurements began at this location in September 2012. The shallow water table contours in this area may reflect varying degrees of infiltration through surficial fill due to variations in fill material and degree of compaction, or greater infiltration in low areas where runoff ponds. The latter possibility seems a likely explanation for water table mounding around MB-MW-365, since a small pond was visible at that location in one of the historic aerial photos.

Lateral hydraulic gradients were calculated for the area between MW-711 and MW-709, which is near the center of the cVOC plume where it discharges to the river. Lateral gradients for shallow wells across the top of the aquifer were 0.003 ft/ft in September and 0.019 ft/ft in December. Lateral gradients for deep wells across the bottom of the aquifer were 0.002 ft/ft in September and 0.002 ft/ft in December. As shown on Figure 6b, the water table elevation measured during the September round was 185.46 ft. at MW-709D. Based on the surrounding well data, this value is likely the result of a measurement error; and therefore was not used in determination of groundwater elevation contours. Note that the water table elevation at two nearby monitoring wells (LR-MW-129 and MW-710D) which are typically hydraulically cross-gradient from MW-709D, are on average 0.79 feet lower in elevation. If the elevated water table elevation at MW-709D were used, a negative hydraulic gradient would be apparent between this well and MW-711D, indicating that groundwater is flowing away from the river at this location only.

The lateral seepage velocity was calculated for the bottom of the aquifer in this same area near the center of the cVOC plume, which is the depth where the majority of contaminants are present. The bottom of the aquifer in this area consists of silty sand and gravel, which is comparable to the aquifer material at DD-MW-201 where hydraulic conductivity was measured during the DDA Phase II investigations (Weston 2007a). Based on the above lateral gradients, and the measured hydraulic conductivity of 13 ft/day for silty sand & gravel at DD-MW-201, and assuming an effective porosity of 0.23, the lateral seepage velocity at the bottom of the aquifer in this area is estimated to average 0.19 ft/day for the monitoring period.

Comparison of shallow and deep elevations for the same date suggests the following vertical gradients:

- flat or slight upward gradients in the northern part of the site where the aquifer is thinner;
- generally downward gradients in the central area, except at MW-714 and MW-713; and
- generally flat or upward gradients in the east near the Neponset river.

Figures 6a-b and **7a-b** show the gradient direction at well pairs using up and down arrows, or "=" for a flat gradient (a difference of 0.04 feet or less).

Bedrock well measurements at three locations on Figures 6b and 7b indicate upward vertical gradients between bedrock and the overlying sand aquifer in the northern portion of the site, flat to upward vertical gradients in the central portion, and slight upward vertical gradients in the eastern portion of the Site. Bedrock water levels were measured at MW-702B in the north, MW-708B in the central area, and MW-710D near the river. Upward gradients of 0.47 ft and 0.57 ft were observed between the bedrock and deep aquifer screens at MW-702 during the September and December 2013 synoptic gauging events respectively. Upward gradients between MW-708B and the nearby deep well MB-MW-364 ranged from 0.10 ft in September to 0.03 ft in December. Upward gradients between MW-710D and the deep sand aquifer at MW-710M ranged from 0.18 ft in September to 0.20 ft in December. A downward vertical gradient was observed in both sampling rounds between the upper and lower bedrock screens at MW-710.

As noted in Section 3, the water table measurements that were proposed in the FIR to follow a major storm event were not conducted during the six-month period ending in December 2013. This monitoring will be scheduled during the next year, weather permitting.

4.2 Contaminant Extent

This section of the RMR documents the latest findings regarding the extent of groundwater contamination. Sampling logs are provided in **Appendix C**, and complete laboratory results (including non-detects) are provided in tabular form in **Appendix D**. Summaries of detections are provided for COCs in **Table 3**. Table 3 includes recent historic results (since installation of new wells in June 2012) for comparison to the latest results; older results are in grey font in these tables. Horizontal extents are illustrated in **Figure 9**, and vertical extents are shown in **Figures 10 to 13**.

Evaluations of contaminant concentration trends over time and distance are presented in Section 4.3. The concentrations listed parenthetically in the following text are for the most recent (December/January) sampling round unless otherwise specified.

4.2.1 Horizontal Extent of Contamination

Samples collected during the current reporting period were obtained exclusively from wells within the contaminant plumes, and therefore no changes in the estimated horizontal contaminant extent are proposed at this time. An assessment of plume extent will be conducted following the June 2014 Annual sampling event, which includes all wells in the monitoring program. The discussion of recent results in this section is followed by a detailed comparison to historic results at the same wells in Section 4.3

Monitoring wells contained within the DCB plume that were sampled during the current reporting period includes deep well NP-MW-601 and downgradient bedrock well MW-702B, both of which had concentrations above the 5 ppb MMCL. DCB concentrations at MW-702B were 6.3 ppb in September and 5.9 ppb in January; at NP-MW-601 the DCB concentrations were 6.3 ppb in September and 7.0 ppb in January. The concentration of TCB exceeded the 70 ppb MMCL in deep well NP-MW-601 during the September round (73 ppb) and during the December/January round (83 ppb). The TCB results observed are comparable to recent concentrations, and do not show significant concentration increases or decreases. The concentration of TCB observed in bedrock at well MW-702B was equal to the MMCL in September (70 ppb), and dropped slightly by the December/January round to just below the MMCL (67 ppb).

Two monitoring wells within the arsenic plume were sampled during the current reporting period, MW-706S and LR-MW-122. The concentration observed in well LR-MW-122 (10.9 ppb) was generally consistent with historic trends, and remains slightly above the 10 ppb MMCL. The arsenic concentration observed at MW-706S dropped below the MMCL for the first time during the September round (7.6/7.4 ppb), and remained below the MMCL during the December/January round (7.2 ppb).

Concentrations within the cVOC plume were generally consistent with historic trends. On average, concentrations of VOCs are stable or slightly decreasing in concentration with time. The exceptions to this statement are wells MB-MW-374, MW-709S, and MW-714S, all of which had average to below average concentrations of cVOCs during the September round, but showed an increase in concentration during the December/January round. At MB-MW-374, the measured PCE concentration of 72 ppb during the December/January round was the highest ever for this well, though similar to results from the same period one year ago; TCE at this location remained at an average concentration of 11 ppb. Similar to MB-MW-374, PCE at well MW-709S was measured at a historic high of 120 ppb during the December/January round.

No changes were made to the estimated horizontal plume boundaries in this RMR based on the data collected during the current reporting period.

4.2.2 Vertical Extent of Contamination

The vertical extent of groundwater contamination is indicated in Figure 10 for DCB, and in Figures 11 to 13 for cVOCs, using cross-sections along the lines indicated in Figure 9. Arsenic extent above the MMCL has been identified as a shallow plume based on monitoring wells and Geoprobe results, as described in the FIR.

The vertical extent of DCB indicated in Figure 10 is unchanged from the previous RMR depiction. The concentration of DCB observed at MW-702B dropped below the MMCL value for the first time during the June 2013 sampling event, at that time it was determined that the well would continue to be included within the delineated boundary of the DCB area until long term trends warranted removal. Concentrations of DCB at MW-702B increased since the June 2013 round to levels above the MMCL value. Based on the data collected during the current reporting period, MW-702B will remain within the DCB plume.

The DCB results suggest that chlorobenzene contamination above MMCLs in this area is present within the relatively thin (12-foot thick) sand aquifer and shallow bedrock.

Upward vertical gradients of 0.47 ft and 0.63 ft from shallow bedrock to the sand aquifer were observed at MW-702B/D/S during the September and December synoptic gauging events respectively.

The vertical extents of PCE and other cVOCs are indicated in Figures 11 to 13. The estimated area of cVOCs depicted on the figures remains unchanged from the last RMR. Note the horizontal scales differ on these cross-sections but the vertical scales are the same. Extent of contamination is drawn to include all well screens where September or December/January samples had contaminants exceeding the MMCLs. Extent of contamination also includes all April 2012 Geoprobe samples exceeding the MMCLs. Compared to the depiction in the FIR, the vertical extent is similar in terms of the majority of contamination above MMCLs occurring 10 or more feet below the water table within the site, and surfacing along the eastern edge in the area of the river. The water table elevation has been updated to represent conditions observed during the latest (December 2013) synoptic gauging round.

4.3 Concentrations over Time

Plots of contaminant concentrations over time at monitoring wells with current or historic MMCL exceedances are presented in **Figures 14 and 15** for DCB/TCB; **Figures 16 and 17** for arsenic; and **Figures 18 to 28** for cVOCs. Note that results for new monitoring wells cover only an eighteen-month duration, therefore limited conclusions regarding trends are possible for these new wells. Additional sampling data will be added to the plots in future semiannual reports. Results are discussed by contaminant type in the following paragraphs.

DCB/TCB results include over seven years of measurements at NP-MW-601. In general concentrations of TCB at this well have remained relatively consistent at levels slightly above to slightly below the MMCL of 5 ppb. Long term trends of TCB at NP-MW-601 show an overall increase in concentrations since 2006. Concentrations of both TCB and DCB remained above their respective MMCLs (70ppb and 5 ppb) during both the September and December/January monitoring rounds for NP-MW-601.

Chlorobenzenes observed at MW-702B showed little variation in 2012 with concentrations ranging between 58-63 ppb for TCB, and 5.5-6.1 ppb for DCB. During the March 2013 round TCB and DCB peaked at 72 ppb and 7 ppb respectively for MW-702B; however by May, concentrations of both compounds dropped to lows of 38 ppb and 4.2 ppb respectively. The concentrations observed during the current reporting period were consistent with earlier measurements for TCB, and remained at the MMCL in September (70 ppb), and slightly below the MMCL in January (67 ppb). Similar results were observed for DCB at MW-702B, with concentrations slightly above the 5 ppb MMCL; 6.3 ppb in September and 5.9 ppb in January.

Arsenic results include over seven years of measurements at LR-MW-122. During this period arsenic has been detected in the range of 1.4-16 ppb except for August 2006 and July 2010 (34 ppb and 75 ppb, respectively). Arsenic concentrations preceding and succeeding these two dates were near the 10 ppb MMCL standard. Arsenic concentrations at MW-706S dropped below the 10 ppb MMCL for the first time in September (7.6/7.4 ppb) and remained low during the January 2014 round (7.2 ppb). Overall long term trends at both locations show a general decrease in concentration with respect to time.

cVOC measurements are available for a period of over six years for LR-MW-129, over five years for MB-MW-362, and approximately five years for MB-MW-374. Trends of individual cVOC analytes (PCE, TCE, and VC) were generally consistent for a given well, and are plotted on Figures 18-20. Concentrations of cVOCs in LR-MW-129 declined rapidly over the initial year (2007-2008); and all analytes were not detectible at the laboratory reporting limit for the past several years. LR-MW-129 was not sampled during the most recent reporting period. Concentrations at MB-MW-362 show a sharp increase between late 2009 and mid 2010, and then a decline to the recent concentrations of 15 ppb PCE (a historic low) and 9 ppb TCE (near the historic low) in January 2014. Concentrations at MB-MW-374 were near MMCL criteria until mid-2010, then generally increased between mid-2010 and late 2012. Concentrations at this well decreased over the period of February to September 2013; however concentrations of PCE, TCE, and VC all rebounded during the January 2014 sampling round. The PCE concentration of 72 ppb in January 2014 at MB-MW-374 was a historic high for this well.

Concentrations of cVOCs at the new wells with MMCL exceedances generally showed the following trends over the eighteen months of measurements to date, as indicated in Figures 21-28:

- Flat with concentrations near MMCL criteria at MW-704S;
- Fluctuating concentrations above MMCL criteria at MW-709S. PCE was at an all time high for this well of 120 ppb in January 2014;
- Flat with concentrations near MMCL criteria at MW-709D;
- Flat with concentrations slightly above MMCL criteria at MW-710S;
- Flat with concentrations slightly above MMCL criteria at MW-710M;
- Slightly increasing then decreasing with concentrations above MMCL criteria at MW-711D. PCE and TCE rebounded slightly during the most recent sampling round;
- Flat with concentrations near MMCL criteria at MW-713D; and
- Generally increasing concentrations above the MMCL at MW-714S through mid-2013; PCE and TCE dropped significantly in September 2013, then rebounded by the end of the reporting period.

Average concentrations of cVOCs were plotted along two potential groundwater flow paths for the recent measurements at new wells. The first flow path is from MW-711D to MW-709 to MW-704, a distance of 290 feet. The results for shallow and deep screens at the latter two locations were averaged; the resulting PCE, TCE, and VC concentrations are presented in **Figures 29, 30, and 31** respectively. Several of the wells in this flow path were not sampled in September 2013, and the December 2013 line is the only new line on these figures since the previous RMR.

Over the length of the entire MW-711-709-704 flow path, PCE, TCE and VC generally decline in concentration. Upgradient (MW-711) PCE concentrations have been lowest in the last two rounds (June and December 2013) as indicated in Figure 29. PCE in these last two rounds increased between the upgradient and the midpoint location (MW-709) to levels similar to or slightly above the concentrations measured in previous rounds. TCE concentrations in Figure 30 for the December 2013 flow path were similar to earlier rounds, with the highest concentrations at the midpoint location. VC concentrations in Figure 31 vary only slightly over the flow path and little difference is apparent between the sampling rounds. Results for cVOCs over this flow path suggest declining upgradient concentrations, continued presence near the midpoint near where groundwater discharges to the river, and possibly transformation from PCE to TCE over the flow path.

The second flow path is from MB-MW-374 to MW-713D, a distance of 151 feet; the PCE, TCE, and VC concentrations are presented in **Figures 32, 33, and 34** respectively. PCE concentrations show the sharpest decline over this path. TCE and VC concentrations increased slightly along this path for the June 2012 event, but decrease along this path in each subsequent monitoring event. Concentrations of all three analytes are near the MMCL at the downgradient well for each event.

4.4 Estimates of Mass Loss & Plume Stability

MNA is expected to reduce concentrations of contaminants at this site principally by the processes of desorption, dilution, and biodegradation. These processes are expected to be interrelated, for example increased precipitation may speed both desorption of contaminants from the aquifer matrix to groundwater, and dilution due to greater groundwater discharge to the river and increased surface water flow. Note that an increase in the rate of desorption of contaminants may increase groundwater concentrations in some areas in the short term, as greater mass is being removed from the solid aquifer matrix. Fluctuations in desorption may result from changes in water table elevation or gradient, including preferential flow paths along infrastructure or geologic anomalies below the water table.

Evaluation of contaminant mass loss and plume stability considers the above evaluations of COC extent in Section 4.2 and changes in concentrations over time discussed in Section 4.3. These evaluations also consider the groundwater flow conditions described in Section 4.1, and are presented below by analyte type. Any changes to the Conceptual Site Model (CSM) and MNA program based on this evaluation are indicated below, and summarized in Section 5.

The DCB/TCB plume at NP-MW-601 and MW-702B shows evidence of mass loss based on the presence of daughter products. DCB is an anaerobic degradation intermediate of TCB, and the maxima for both compounds have coincided in time. DO and ORP results have historically been low at these two wells, indicating continuing anaerobic conditions. Recent concentrations of parent and daughter COCs are increasing, suggesting decreased desorption in the short term. Plume shape appears to be stable and is oriented around two wells about 60 feet apart, in line with groundwater flow. No significant changes in groundwater flow conditions were noted for this area. With TCB results recently fluctuating above the MMCL criteria at NP-MW-601, at a level similar to 2007 and 2012 events, the expected remediation time remains difficult to estimate. Pending further results to evaluate this trend, the CSM at this location does not warrant changes.

Evaluation of the arsenic plume surrounding MW-706S suffers from a relatively short (18 month) duration of measurements, but results at this plume center well are consistent with the long-term trends for downgradient well LR-MW-122. Results at both wells indicate that arsenic concentrations may fluctuate from about 80 ppb to levels around the 10 ppb MMCL criterion, but recently have been around the MMCL. Mass loss is expected as groundwater in the plume area discharges into surface waters of the Neponset River and associated wetlands. Plume shape appears to be stable or thinning and is oriented around two wells about 100 feet apart, in line with groundwater flow. No significant changes in groundwater flow conditions were noted for this area. Remediation times of at least five years are expected based on the short-term and long-term fluctuations in concentrations observed at MW-706S and LR-MW-122, respectively. There are no significant changes to the CSM at this location.

The cVOC plume shape is unchanged from the previous reporting period. Concentrations of PCE and daughter products have increased at some interior monitoring points (i.e. MB-MW-374) and decreased at others (i.e. MB-MW-362) compared to the previous period, and appear to be relatively unchanged over much of the plume. A trend of increasing PCE concentration at upgradient well MW-714S that started in late 2012 was interrupted by a significant drop during the September 2013 sampling round, but rebounded during the December 2013/January 2014 round. The most recent concentration of PCE at MW-714S (40 ppb) is approximately one half the historic high (84 ppb) observed in June 2013. cVOC concentrations for the deep well (MW-714D) at this location have generally remained below the MMCL criteria.

Additional mass loss is expected as groundwater in the plume area discharges into surface waters of the Neponset River and associated wetlands. Groundwater flow conditions are similar to previous observations, including an apparent downward inflection of the water table near MW-714. An upward vertical gradient has been observed at MW-714 since measurements began at this location in September 2012. In the previous RMR, it was hypothesized that increasing cVOC concentrations at this location may reflect increased infiltration through surficial fill in the area. This theory is still valid, and the low concentrations of PCE observed during the September 2013 round may be the result of a lowered water table, which indicates reduced infiltration. Over the past year, PCE concentrations remain high when the water table is elevated, and are consequently reduced with low water table elevations.

5.0 RECOMMENDATIONS AND CSM [310 CMR 40.0892(2)(D)]

5.1 Conceptual Site Model

Groundwater data collected during the current reporting period are generally consistent with historic conditions, and do not warrant changes to the Conceptual Site Model. The current CSM for the site is discussed below.

The estimated areas of groundwater contamination exceeding MMCLs or background concentrations are indicated in **Figures 9** and **10-13**. Arsenic contamination is observed at the water table, DCB contamination is near the bottom of a thin (12-foot thick) sand aquifer and in the underlying shallow bedrock, and PCE contamination is in the deepest part of the sand aquifer (up to 35 ft bgs). The Neponset River appears to be a groundwater discharge area based on measured horizontal and vertical gradients around the Site. PCE and TCE have been identified at one monitoring location east of the river, at higher concentrations in the shallow compared to the deep screen, and appear to be discharging to surface water in this area. Sediment and surface water concentrations in the river suggest that the contaminant discharge from groundwater to the river has not resulted in measureable 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 2007b).

The CSAs for the Site (AMEC 2011b, AMEC 2011c) 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 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 10 to 40 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 would appear 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 effect on migration, compared to advection, dispersion, and other processes. Dissolved phase concentrations at the BMC site do not suggest the presence of NAPL.

No significant sources of groundwater contaminants are known to remain at the Site. Source control has occurred 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 LRA 2, upgradient from cVOCs detected in LR-MW-129, included removing soil with metals and oily contamination that was not known to contain cVOCs. Above-ground structures and below-ground tanks associated with former manufacturing operations have been removed as of early 2008, and it is possible that these structures included source materials. Except for arsenic, groundwater contaminants are generally found below the water table, which suggests that there are no continuing releases from the surface or shallow soils.

The installed well network and sampling procedures described in this report meet the design requirements identified in the FIR. Monitoring wells are focused along plume centerlines and discharge areas. Monitoring locations include shallow, deep, and bedrock screens as appropriate to measure changes in nature and extent of contaminants.

5.2 OMM Revisions or Corrective Measures

MNA will be continued as a Permanent Solution 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. Determination of satisfactory reductions in concentrations considers multiple lines of evidence including temporal trends in individual wells, estimates of mass reduction, and distribution of contaminants and geochemical conditions. The data presented in this report indicate that natural attenuation is occurring in the areas of MMCL exceedances. No significant changes in the CSM are warranted based on the latest measurements, and the estimated remediation timeframe of 10 years from 2012 is assumed to be the same.

The previous semiannual RMR coincided with one year of initial process monitoring as described in the FIR (AMEC 2012). Initial process monitoring had confirmed that key MNA processes were underway and that a transition to long-term performance monitoring was appropriate. Long-term monitoring is designed to confirm that site conditions remain suitable for MNA, and that overall contaminant concentrations and mass are decreasing within a reasonable timeframe. This is the first semiannual RMR to be submitted since the long-term monitoring program was implemented. As discussed in Section 3.0, long-term monitoring consists of continued quarterly sampling at six locations within the plumes that have had significant fluctuations in recent contaminant concentrations above the MMCLs. Semiannual sampling is performed for 9 other wells within the horizontal and vertical extent of the plume areas where previous quarterly sampling shows little variation in concentrations. Annual sampling is performed for 23 wells along the plume lateral or vertical edges where concentrations are below MMCLs. Analytes for long-term monitoring consist of the contaminants exceeding MMCLs and their primary breakdown products. The long-term monitoring schedule is presented in Table 1. Water levels at all of the monitoring wells, including those sampled on a semi-annual or annual basis, continue to be gauged on a quarterly basis. The results for this monitoring period do not suggest the need for changes to OMM at this time.

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 a rate 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).

5.3 Remedy Operation Status

Remedy Operation Status was achieved in February 2013. Based on the data presented in this RMR and the conclusions summarized in Sections 5.1 and 5.2, MNA is still considered a viable Permanent Solution for the Site and meets the requirements for Remedy Operation Status.

6.0 REFERENCES

AMEC 2013a. Phase V Status and Remedial Monitoring Report, Prepared by AMEC Environment &Infrastructure, Inc. for Baker Hughes Inc. Final, August 2013.

AMEC 2013b. Remedy Operation Status Opinion, Former Bird Machine Company Site. Prepared by AMEC Environment &Infrastructure, Inc. for Baker Hughes Inc. Final, February 13, 2013.

AMEC 2012. Phase IV Final Inspection Report, Former Bird Machine Company Site. Prepared by AMEC Earth & Environmental Inc. for Baker Hughes Inc. Final, August 2012.

AMEC 2011a. 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 2011b. 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 2011c. 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.

AMEC 2011d. 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.

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 2007a. Phase II Comprehensive Site Assessment for Demolition Debris Area, RTN 4-3024105. Prepared by Weston Solutions Inc. for Baker Process Inc. July 30, 2007.

Weston 2007b. 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.

Figures

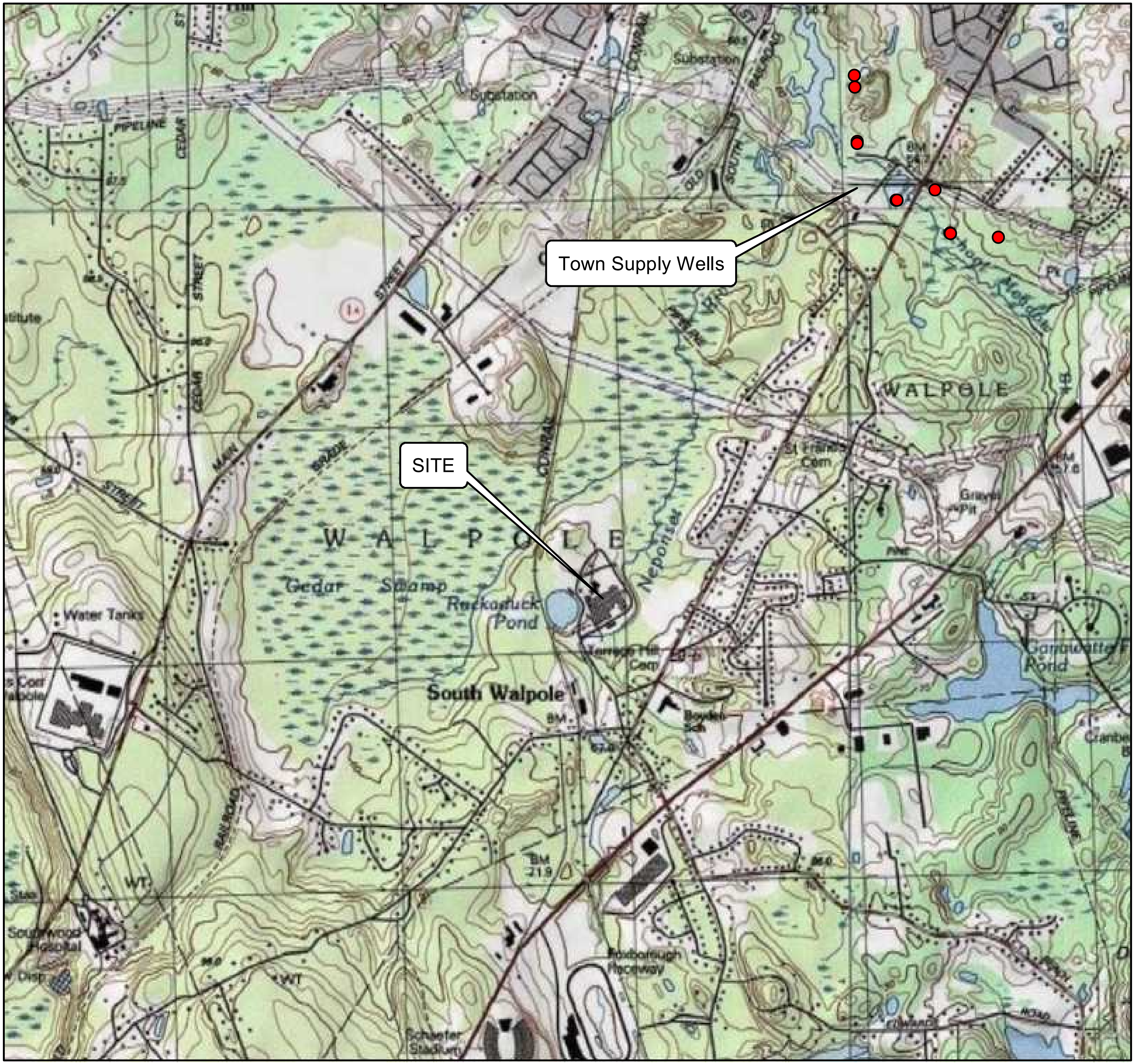


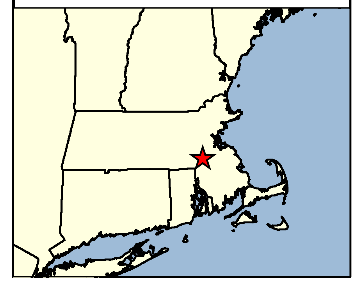
FIGURE 1

SITE LOCATION MAP

Former Bird Machine Company

100 Neponset Street
Walpole, MA

Location of Site



Source: Topo quad provided by National Geographic TOPO! Series: 2008
Town Supply Wells by MassGIS, 2012.

0 2,000 Feet

amec

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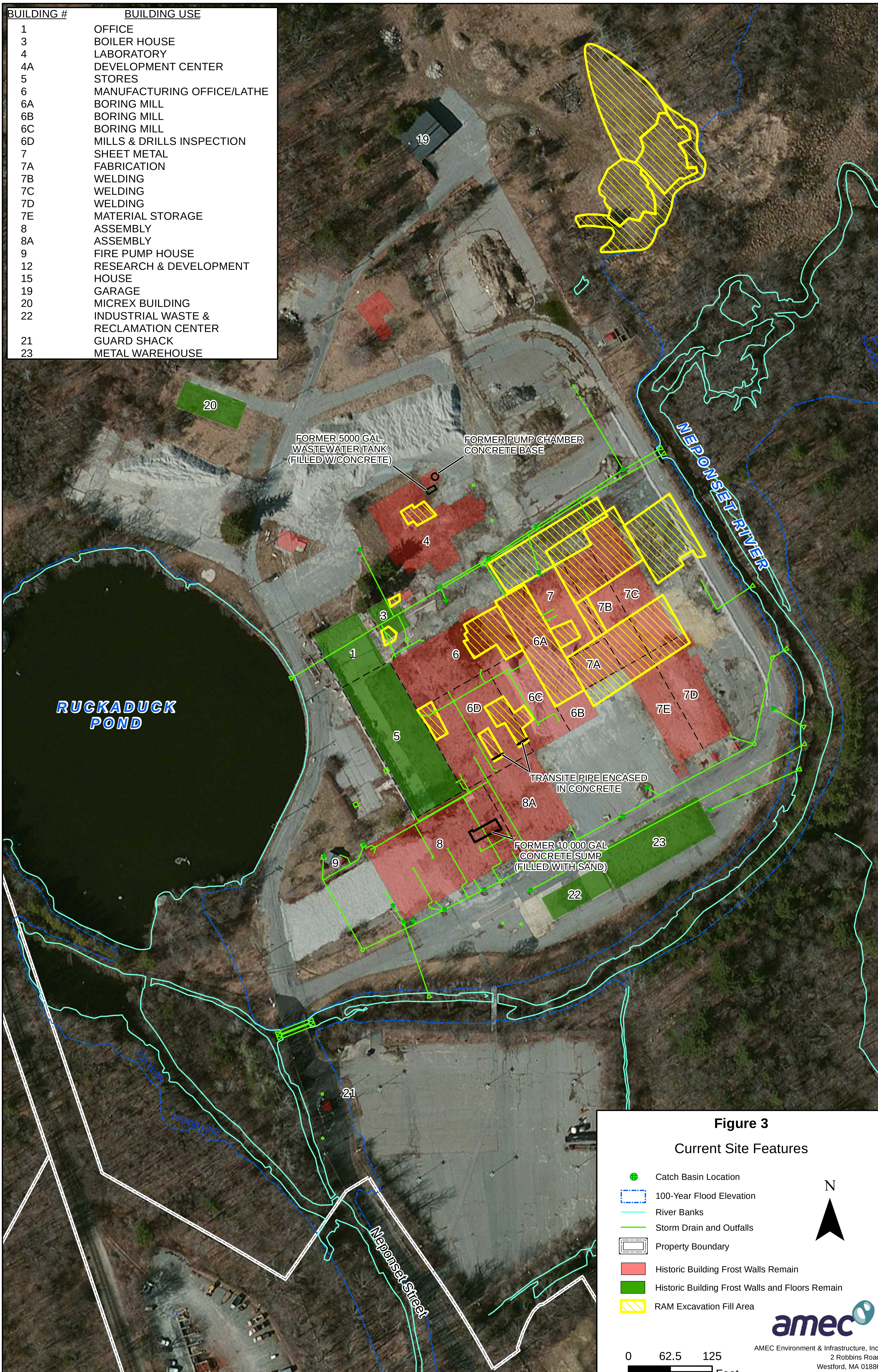
271 Mill Road
Chelmsford, MA 01824
(978) 692-9090

H:\BirdMachineCo\Task12\MXD\SiteMap.mxd February 04, 2014 DWN: jonathan.penney CHKD: AKN

H:\BirdMachineCo\Task18\MXD\Figure2_DisposalSiteBoundary.mxd June 27, 2012 DWN: jonathan.penney CHKD: AKN



H:\BirdMachineCo\Task17\MXD\Figure3.mxd June 27, 2012 DWN: jonathan.penney CHKD: AKN

Source: Building data from Weston Solutions. Imagery provided by BING, 2010.

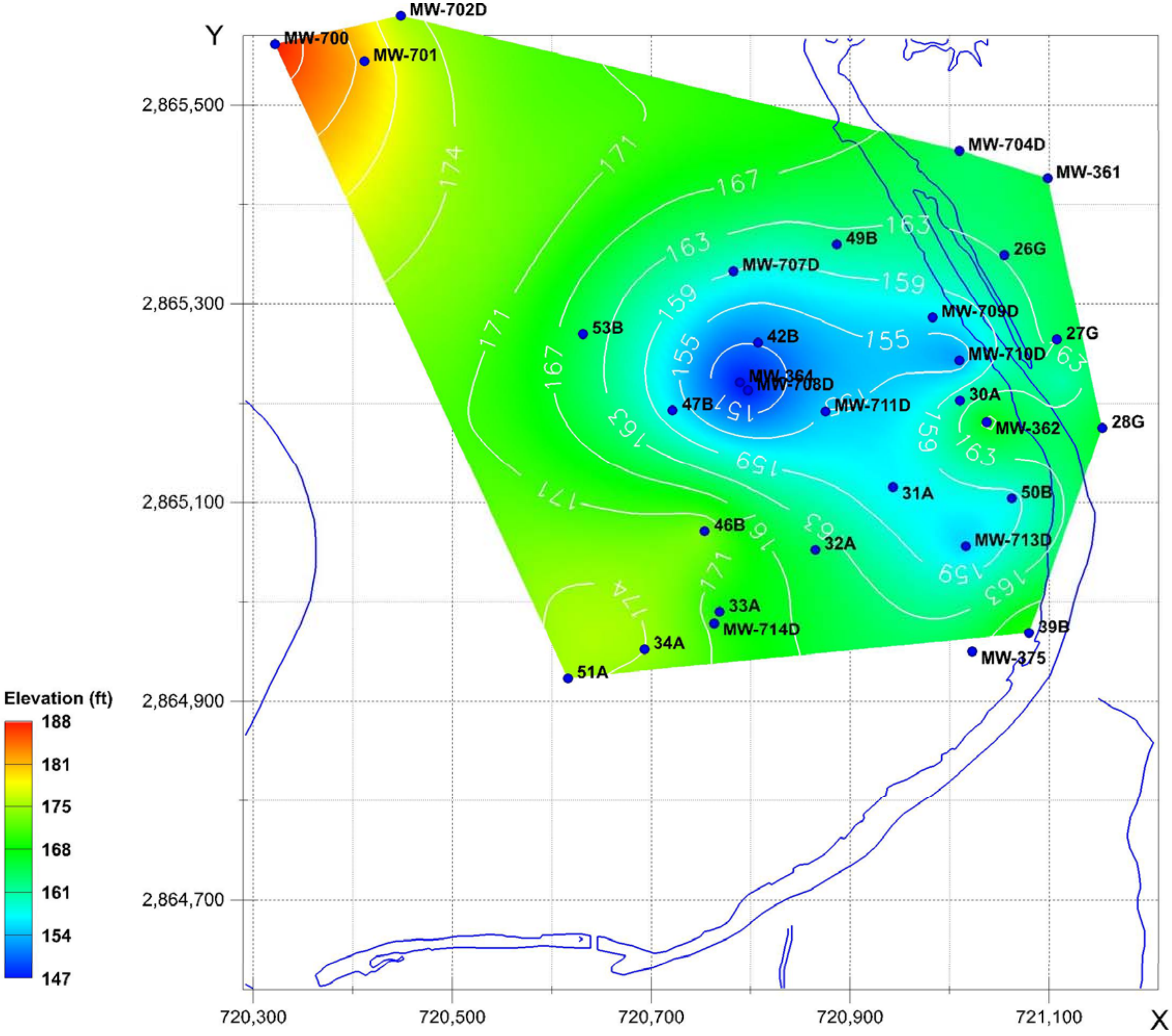
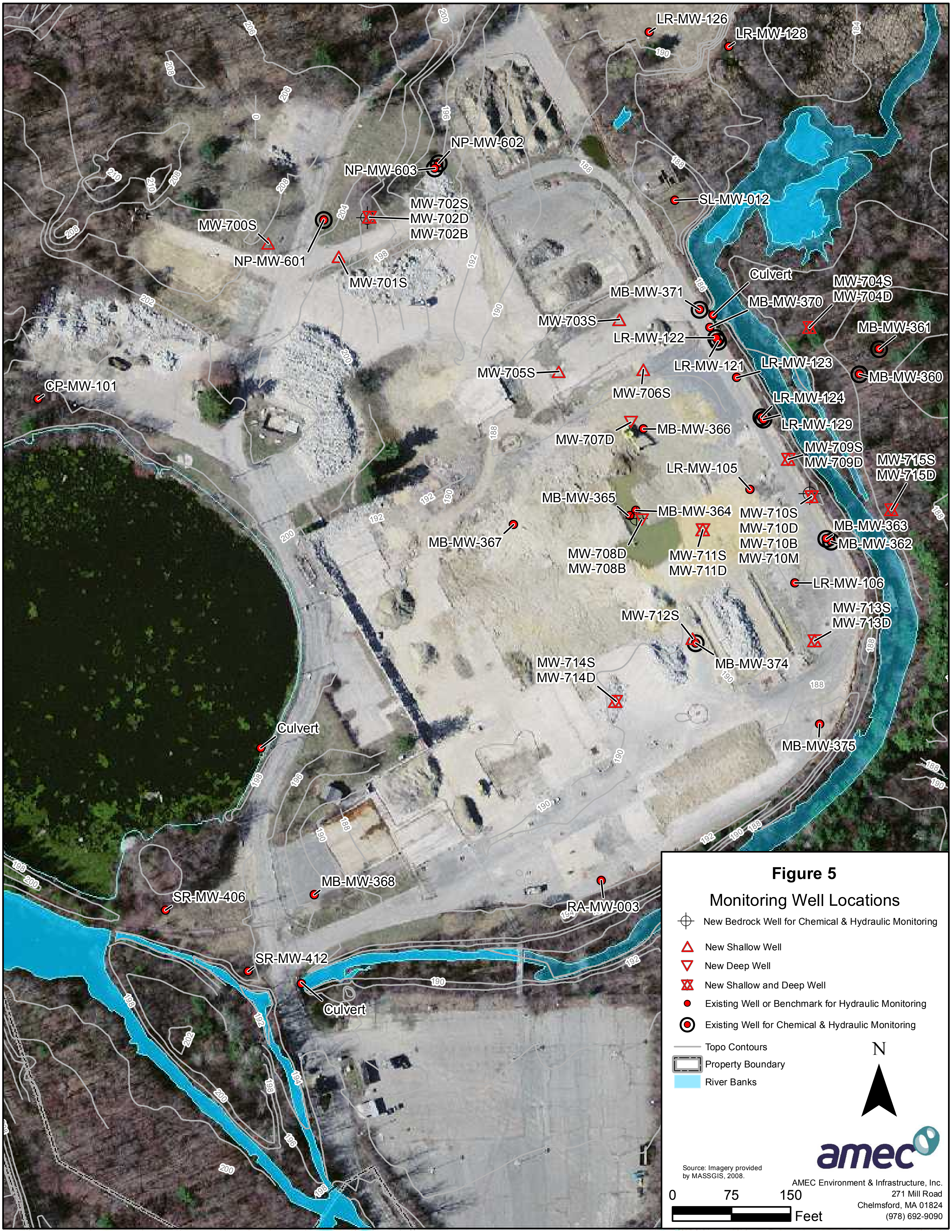
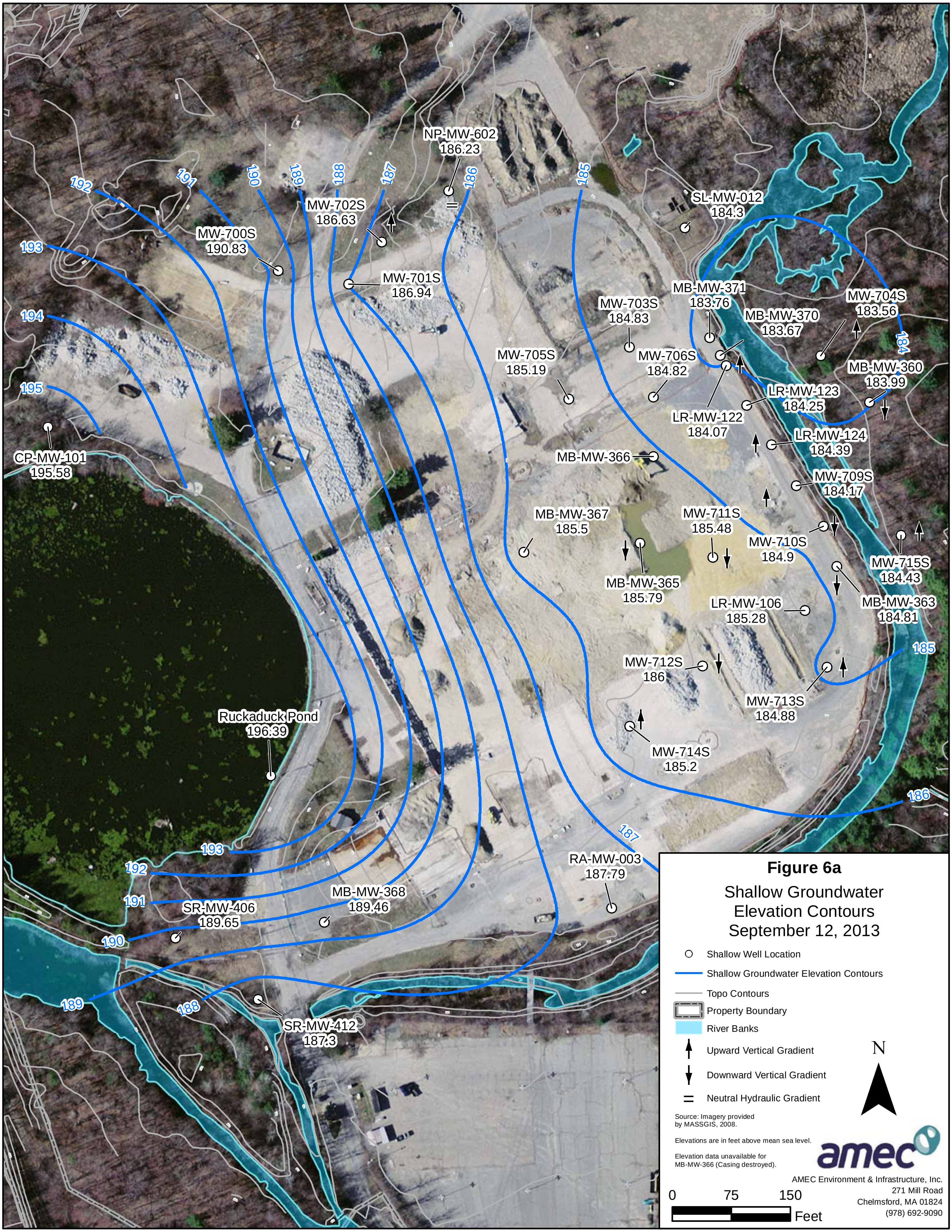


Figure 4 – Bedrock Elevations from Drilling



H:\BirdMachineCo\Task18\MXD\Fig5_MW_Locations.mxd February 04, 2014 DWN: jonathan.penney CHKD: JDP



H:\BirdMachineCo\Task19\MXD\Shallow_Groundwater_Contours_091213.mxd February 17, 2014 DWN: andrew.nelson CHKD: JDP

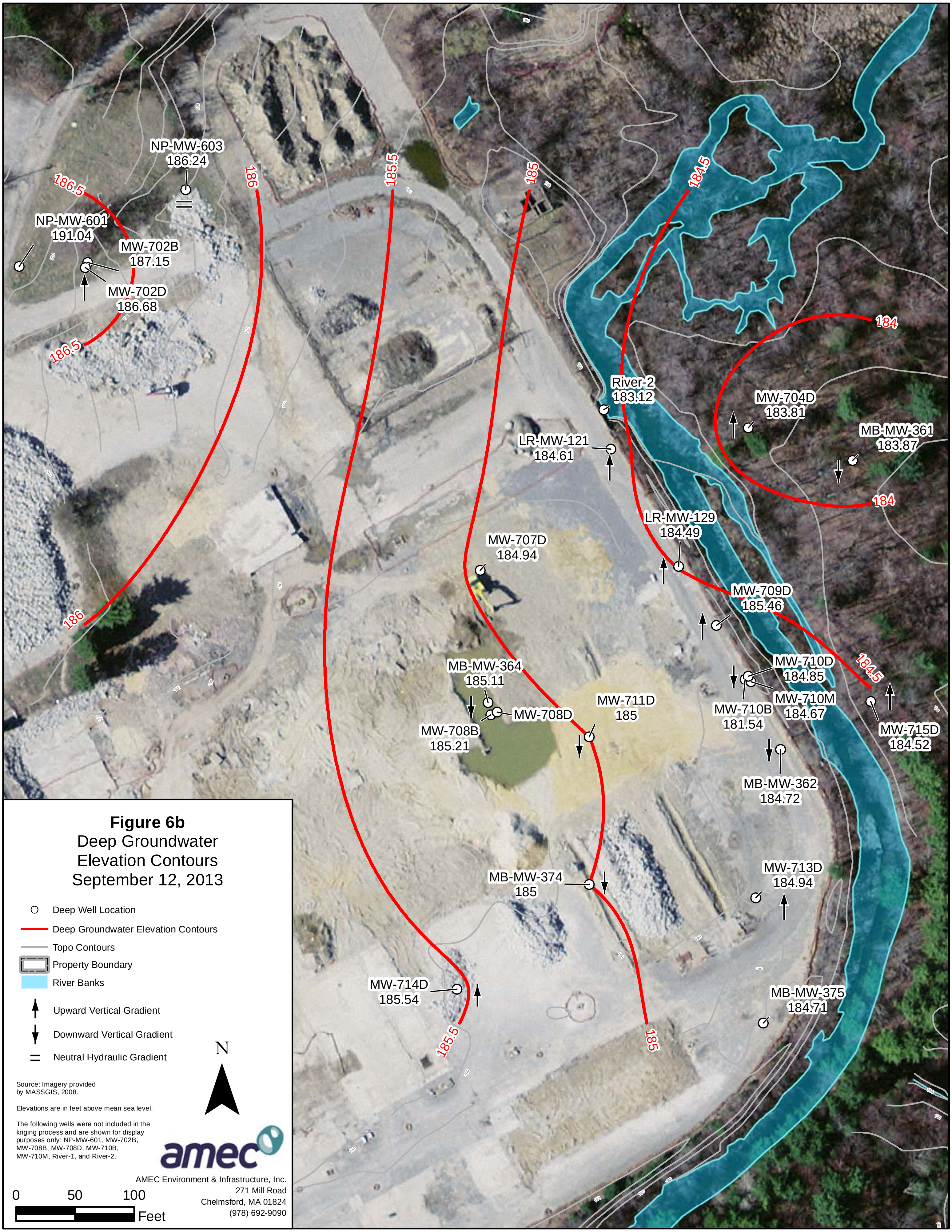


Figure 6b
Deep Groundwater
Elevation Contours
September 12, 2013

- Deep Well Location
- Deep Groundwater Elevation Contours
- Topo Contours
- Property Boundary
- River Banks
- Upward Vertical Gradient
- Downward Vertical Gradient
- Neutral Hydraulic Gradient

Source: Imagery provided by MASSGIS, 2008.

Elevations are in feet above mean sea level.

The following wells were not included in the kriging process and are shown for display purposes only: NP-MW-601, MW-702B, MW-708B, MW-708D, MW-710B, MW-710M, River-1, and River-2.

0 50 100 Feet

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