Office of Solid Waste and
Emergency Response
(5102G)

EPA-540-R-11-007
October 2011
www.epa.gov/tio
www.clu-in.org/optimization

Remediation System Evaluation (RSE)
Eastern Surplus Superfund Site

Meddybemps, Maine

REMEDIATION SYSTEM EVALUATION

EASTERN SURPLUS SITE
MEDDYBEMPS, MAINE

Report of the Remediation System Evaluation
Conducted for the Eastern Surplus Site
June 7, 2011

Final Report
October 5, 2011

EXECUTIVE SUMMARY

Optimization Background

For more than a decade, the U.S. Environmental Protection Agency's Office of Superfund Remediation and Technology Innovation (EPA OSRTI) has provided technical support to EPA Regional offices through the use of third-party optimization evaluations. OSRTI has conducted more than 100 optimization studies at Superfund sites nationwide via Independent Design Reviews, Remediation System Evaluation (RSE), and Long-Term Monitoring Optimization (LTMO) reviews.

OSRTI is now implementing its National Strategy to Expand Superfund Optimization from Remedial Investigation to Site Completion (Strategy). The Strategy unifies previously independent optimization efforts (i.e., RSE, LTMO, Triad Approach, and Green Remediation) under the singular activity and term "optimization," which can be applied at any stage of the Superfund project life cycle. EPA's working definition of optimization as of June 2011 is as follows:

"A systematic site review by a team of independent technical experts, at any phase of a cleanup process, to identify opportunities to improve remedy protectiveness, effectiveness, and cost efficiency, and to facilitate progress toward site completion."

An optimization review at the remedy stage therefore considers the goals of the remedy, available site data, site conceptual model, remedy performance, protectiveness, cost-effectiveness, and closure strategy. A strong interest in sustainability has also developed in the private sector and within Federal, State, and Municipal governments. Consistent with this interest, optimization now routinely considers environmental footprint reduction during optimization reviews. An optimization review includes reviewing site documents, interviewing site stakeholders, potentially visiting the site for one day, and compiling a report that includes recommendations in the following categories:

- Protectiveness
- Cost-effectiveness
- Technical improvement
- Site closure
- Environmental footprint reduction

The recommendations are intended to help the site team identify opportunities for improvements in these areas. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation, and represent the opinions of the evaluation team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by the Region and other site stakeholders.

Site-Specific Background

The Eastern Surplus Company was a retailer of United States Department of Defense surplus and salvage items, from 1946 until 1976. During that time, numerous hazardous materials and chemicals were brought to and stored at the site. In addition, the site was used to store abandoned equipment, machinery and vehicles. The MEDEP conducted a site inspection and initiated removal actions in 1985. Between 1986 and 1990 the EPA, MEDEP and the Department of Defense performed extensive sampling and removed large quantities of hazardous materials including drums, cans, gas cylinders and transformers. In 1996, the site was added to the National Priorities List (NPL) so Superfund resources could be used to address the remaining site impacts. In 1998, the EPA determined that Non Time Critical Removal Action (NTCRA) was required to protect human health and prevent additional contaminant migration. In 1999, the NTCRA resulted in the excavation and offsite disposal of impacted soil and the construction of groundwater extraction and treatment system. The groundwater pump and treatment system include two separate extraction areas to address the two separate groundwater plumes. In September 2000, the Record of Decision (ROD) was signed for restoration of groundwater to drinking water standards. The P&T systems continued to operate for approximately 10 years. In-situ chemical oxidation has been applied at the site to address source area contamination. The P&T system for the northern plume continues to operate. The P&T system for the southern plume has been shut down due to low concentrations and low mass removal.

Summary of Conceptual Site Model (CSM)

In the northern portion of the site, groundwater occurs in both the overburden and bedrock units and discharges into Dennys River. The overburden and bedrock units are connected and during the seasonal rise of the water table and during system shut down, contaminated bedrock groundwater can enter into the overburden unit. The volatile organic compound (VOC) tetrachlorothene (PCE) is the principal contaminant of concern (COC) detected in both the overburden and bedrock aquifers. Analytical data suggests very little if any reductive chlorination is occurring in this area. Groundwater in the bedrock remains more contaminated than in the overburden unit, and the persistence of PCE following in-situ chemical oxidation (ISCO) applications suggests the presence of PCE residuals in the core area of the northern plume, and that this residual may in part be located in dead-end fractures that act as long-term sources.

The Remedial Investigation (RI) identified VOC-contaminated soils presence in the southern portion of the site that was the source of contaminated overburden and bedrock groundwater. These soils were removed during the 1999 NTCRA response action. The removal actions, ISCO, and groundwater extraction have been very successful in the area due in part to the limited bedrock impacts. This success has led to the shutdown of the southern extraction system in November 2010.

Summary of Findings

Plume capture appears to be complete for the northern plume in the overburden but appears to be incomplete for the northern plume in the bedrock. Contamination persists in the northern plume soil, overburden, and bedrock.

Summary of Recommendations

Recommendations are provided regarding effectiveness, cost reduction, technical improvement, site closure, and environmental footprint reduction as follows:

- Improving system effectiveness – evaluate and improve plume capture.
- Cost reduction – reduce operator labor, eliminate sampling for metals, reduce the extensive treatment system process sampling, and make permanent several recent changes, including the discontinuation of metals removal with ion exchange and discontinuation of the P&T system for the southern plume.

- Technical improvement – include additional groundwater sampling that could help improve system operation.

- Site closure – sample for PCE at the groundwater-surface water interface and evaluate if P&T system operation can be modified to a reduced scope. Findings from the study might suggest the potential for reduced focus on the diffuse plume and increased focus on the source area. Focus on the source area could involve focused P&T system operation, ISCO, or in-situ bioremediation. Several considerations are provided for in-situ bioremediation.

NOTICE

Work described herein was performed by Tetra Tech GEO, Inc. (Tetra Tech GEO) for the U.S. Environmental Protection Agency (U.S. E.P.A). Work conducted by Tetra Tech GEO, including preparation of this report, was performed under Work Assignment #48 of EPA contract EP-W-07-078 with Tetra Tech EM, Inc., Chicago, Illinois. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency Office of Superfund Remediation and Technology Innovation (U.S. EPA OSRTI) in support of the "Action Plan for Ground Water Remedy Optimization" (OSWER 9283.1-25, August 25, 2004). The objective of this project is to conduct Remediation System Evaluations (RSEs) at selected pump and treat (P&T) systems that are jointly funded by EPA and the associated State agency. The project contacts are as follows:

Organization	Key Contact	Contact Information
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1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000 and 2001 independent reviews called Remediation System Evaluations (RSEs) were conducted at 20 operating Fund-lead pump and treat (P&T) sites (i.e., those sites with P&T systems funded and managed by Superfund and the States). Due to the opportunities for system optimization that arose from those RSEs, EPA OSRTI has incorporated RSEs into a larger post-construction complete strategy for Fund-lead remedies as documented in *OSWER Directive No. 9283.1-25, Action Plan for Ground Water Remedy Optimization*. A strong interest in sustainability has also developed in the private sector and within Federal, State, and Municipal governments. Consistent with this interest, OSRTI has developed a Green Remediation Primer (http://cluin.org/greenremediation/) and now as a pilot effort considers green remediation during independent evaluations.

The RSE process involves a team of expert hydrogeologists and engineers that are independent of the site, conducting a third-party evaluation of the operating remedy. It is a broad evaluation that considers the goals of the remedy, site conceptual model, available site data, performance considerations, protectiveness, cost-effectiveness, closure strategy, and sustainability. The evaluation includes reviewing site documents, visiting the site for one day, and compiling a report that includes recommendations in the following categories:

- Protectiveness
- Cost-effectiveness
- Technical improvement
- Site closure
- Green remediation

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation, and represent the opinions of the evaluation team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by the Region and other site stakeholders.

The Eastern Surplus Site was selected by EPA OSRTI based on a nomination from EPA Region 1 and the State of Maine due to the upcoming transition of the site from a long-term remedial action (LTRA) to operations and maintenance (O&M).

1.2 TEAM COMPOSITION

The RSE team consists of the following individuals:

Name	Affiliation	Phone	Email
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Doug Sutton	Tetra Tech GEO	732-409-0344	Doug.sutton@tetratech.com

1.3 DOCUMENTS REVIEWED

The following documents were reviewed. The reader is directed to these documents for additional site information that is not provided in this report.

- Geohydrology and Groundwater-Quality, Eastern Surplus Superfund Site, Meddybemps Maine (USGS, 1998)
- Characteristics of fractures in Crystalline Bedrock Determined by Surfaceand Borehole Geophysical Surveys, Eastern Surplus Superfund Site, Meddybemps Maine (USGS, 1999)
- Remedial Investigation Groundwater Sampling Summary Report (Roy F. Weston, Inc. 1999)
- Remedial Investigation Report (TtNUS, July 1999).
- June 1999 Sampling - Data Summary Report (TtNUS, August 1999)
- Supplemental Bedrock Investigation Report (TtNUS, March 2000)
- EPA Superfund Record of Decision September 2000
- Preliminary Design Report (TtNUS, March 2001)
- Final Design Report (TtNUS July 2001)
- EPA Five Year Review (EPA, September 2006)
- Annual and monthly O&M reports (Nobis Engineering, Inc., 2008 – May 2011)
- Draft Bioremediation Technical Memorandum, Nobis Engineering, Inc., October 2010
- Groundwater Sampling Results (Nobis Engineering, Inc., pending publication, May 2011)

1.4 PERSONS CONTACTED

The following individuals participated in the site visit:

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MEDEP="Maine Department of Environmental Protection"

1.5 Basic Site Information and Scope of Review

1.5.1 Location

The Eastern Surplus Company Site ("the site") is located in Meddybemps, Washington County, Maine. The site is approximately 70 miles east-northeast of Bangor, Maine, at a latitude of 45° 02' 20" north, and a longitude of 67° 21' 30" west. Stone road is located to the west and northwest of the site, Meddybemps Lake is located to the north and northeast, the Denny's River is located to the east and southeast and State Route 191 run through the site dividing the northern portion of the site from the southern portion. The site is located approximately 175 feet above mean sea level and consists of approximately 4.5 acres north of State Route 191 and approximately 2.5 acres south of State Route 191. According to the United States Census Bureau, 2000 Census, Meddybemps has a population of approximately 145. There are approximately 200 private wells within a four mile radius of the site. The site is generally flat with a gentle slope to the Dennys River with a steeper slope immediately along the shore of the Dennys River. Figure RSE-1-1 (see Attachment A for figures) presents the site location and Figure RSE-1-2 presents the topography and key site features.

1.5.2 Site History, Potential Sources, and RSE Scope

The Eastern Surplus Company was a retailer of United States Department of Defense surplus and salvage items, from 1946 until 1976. During that time, numerous hazardous materials and chemicals were brought to and stored at the site including drums and cans containing solvents; calcium carbine, compressed gas cylinders, electrical transformers, capacitors and old ammunition. In addition, the site was used to store abandoned equipment, machinery and vehicles. The MEDEP conducted a site inspection and initiated removal actions in 1985. Between 1986 and 1990 the EPA, MEDEP and the Department of Defense performed extensive sampling and removed large quantities of hazardous materials including drums, cans, gas cylinders and transformers. Source area sampling during this period, identified the presence of PCBs, chlorinated organic solvents, heavy metals, acids, oils, asbestos and pesticides. Many of these compounds were confirmed to have impacted site soil, groundwater and sediments.

In 1996, the site was added to the National Priorities List (NPL) so Superfund resources could be used to address the remaining site impacts. In 1998, the EPA determined that Non Time Critical Removal Action (NTCRA) was required to protect human health and prevent additional contaminant migration. In 1999, the NTCRA resulted in the excavation and offsite disposal of impacted soil and the construction of groundwater extraction and treatment system. The groundwater pump and treatment system include two separate extraction areas to address the two separate groundwater plumes. The northern extraction system located north of State Route 191 became operational in January 2000 and the southern extraction system located south of State Route 191 became operational in early June 2001. In September 2000, the Record of Decision (ROD) was signed for restoration of groundwater to drinking water standards.

The ROD required completion of the mitigation of adverse effects upon the archaeological resources at the Site caused by the removal of soils and sediment as part of the 1999 NTCRA. These mitigation activities included the archaeological investigation of approximately 200 square meters performed over two field seasons in 2000 and 2001, development of a report documenting the findings of the field work, and development of a cultural study (including a video spanning each of the four seasons) and displays to be permanently placed at the Site as well as mobile displays for use in educational and tribal settings.

Between July 2000 and March 2001 a Phase I in-situ chemical oxidation pilot test was conducted at the site. The information obtained from the first pilot test was used to design the second in-situ chemical oxidation pilot test which was initiated in April 2001 and used improved oxidant delivery techniques. Full-scale chemical oxidation treatment was conducted between August 2002 and January 2003. The northern and southern extraction systems were shut down in January 2003 following chemical oxidation treatment and restarted in August 2003. In August 2006, both the extraction systems were shut down and then restarted in September 2007 when a new contractor began operating the treatment system. The southern system was shut down in November 2010 and the northern system has been in continual operational since September 2007. In October 2010, a Nobis Engineering, Inc. prepared a Bioremediation Technical Memorandum that summarized their evaluation of the northern plume area for potential treatment by enhanced reductive dechlorination.

This RSE focuses on all aspects of site remediation including the P&T system, sodium permanganate application, site-wide monitoring program and the potential application of enhanced reductive dechlorination in the northern plume area.

1.5.3 HYDROGEOLOGIC SETTING

Information in this section is primarily from site documents and does not include interpretation by the RSE team.

The site is in the Dennys River/Meddybemps Lake basin, which provides drainage for a 44.7 square mile area. The Dennys River flows generally south, discharging into Cobscock Bay and the Atlantic Ocean. The Dennys River is classified by the State of Maine as a "Class A waterway" (USGS, 1989). The Dennys River is also one of only a “few rivers in the United States with a wild Atlantic salmon run” (USGS, 1989).

Surficial Geology

The site is underlain by unconsolidated surficial deposits that in turn overlay crystalline bedrock. The surficial deposits are glacial in origin. During the last (Wisconsinan) glaciation (14,000 to 25,000 years ago), glacial ice advanced over the region, in a southeasterly direction, scouring the bedrock surface. As the glacier advanced, preexisting unconsolidated materials and weathered, fractured bedrock were ground up, incorporated into the ice and deposited at the base of ice as glacial till. On the western margin of the site, along Stone Road, a ridge of coarse-grained sand and gravel deposits marks the former location of the ice margin. The Meddybemps Delta, a significant sand and gravel aquifer, located about 0.5 mile west of the site, represents a second location of the former ice margin as it retreated from the area. The contact between topset and foreset (inclined) beds of sediment at the Meddybemps Delta represents a former sea level at a present elevation of 204 ft (Thompson and Others, 1989).

Figure RSE-1-3 is a site plan that includes the locations of wells and two geologic cross sections. Figure RSE-1-4 (A-A’) is a geologic cross section aligned approximately perpendicular to groundwater flow and through the line of extraction wells in the northern VOC plume. Similarly, Figure RSE-1-5 (B-B’) is a profile through the southern plume line of extraction wells. Both cross sections serve to illustrate the geology, saturated thickness under non-pumping and pumping conditions, and the extent of PCE dissolved in groundwater from the June 2001 sampling event.

The glacial outwash coarse-grained sand and gravel deposit (subaqueous fan), located along Stone Road, grades from coarse to medium sand beneath the central and southern portions of the site. These deposits overlie bedrock or glacial till, range in thickness from 0 to 14 ft and appear to extend to the Dennys River. As shown by Figures RSE-1-4 and RSE-1-5, the subaqueous fan pinches out against glacial-till in the northern portion of the site. Glacial till or till-like deposits consist of an unsorted mixture of pebbles, cobbles and boulders in a finer grained matrix of sand and silt. Boulders are common along the top of glacial till at a depth ranging from 11 to 14 ft below ground surface (bgs). The thickness of glacial till ranges from 0 to 15 ft on the west side of the Dennys River, increasing to 40 ft on the east side. Glacial till may be absent along the Dennys River.

As shown by both Figures RSE-1-4 and RSE-1-5, finer-grained glaciomarine deposits (Presumpscott Formation) overlie glacial till and coarse-grained subaqueous sand and gravel. These deposits consist of mostly silt with lesser fine sand and clay. The thickness of these fine-grained deposits ranges from 0 ft along the western margin of the site to 20 ft in the southern portion. In addition, a discontinuous boulder/cobble zone occurs in some areas beneath the site. This unit may be part of glacial till or fractured bedrock and extends east of the Dennys River to monitoring well MW-16B.

The natural surficial deposits are overlain by fill in some areas of the site. The fill consists of silty sand and gravel. The thickness of fill ranges from 0 to 20 ft. During NTCRA, fill was placed in excavations in both the northern and southern portions of the site. Both areas are north of Route 191. In both locations, the excavation extended to the top of rock. The total depth of excavation ranged from 0 to 10 ft in the northern area, and from 0 to 20 ft in the southern area.

Bedrock Geology

Plutonic igneous rocks of the Gabbro-diorite intrusive complex and the Meddybemps Granite characterize the regional bedrock geology. The Meddybemps Granite is light-colored, medium-grained, plutonic igneous rock that consists of quartz, plagioclase feldpsar, potassium feldspar, biotite, amphibole, apatite, zircon and opaque minerals. The elemental composition of these minerals consists primarily of silica, alumina, calcium, magnesium, potassium, sodium, iron and manganese. The Gabbro-diorite intrusive complex consists of fine to medium grained gabbro, diorite and gabbro-diorite. Gabbro is black to salt and pepper colored and consists primarily of plagioclase, hornblende, biotite, augite, orthoclase, apatite, zircon, sphene, epidote and opaque minerals. The elemental composition of these minerals consists primarily of silica, magnesium, alumina, iron, calcium, sodium, potassium, and manganese.

The Meddybemps granite is mapped west of Stone Road and beyond the margin of the Gabbro-diorite complex. The regional delineation is generally consistent with geologic and borehole geophysical logs for the site with the exception of where equigranular and foliated diorite occurs beneath overburden in the central portion of the site in the vicinity of the infiltration gallery (G1 through G-5), and in the northern portion near the Dennys River (RW-1). Meddybemps granite and/or diorite intrusions into the Gabbro-diorite complex were noted in boring and/or geophysical logs at wells located in the northern portion of the site (RW-3, RW-5, RW-8, MW-39B, MW-40B, MW-41B, MW-42B, MW-43B, IN-1B, IN-2B, IW-1, IW-3 and IW-4).

Meddybemps granite was not encountered in boreholes in the southern plume area of the site, where boreholes generally penetrated less than 100 ft of bedrock. The deepest borehole in the vicinity of the site is located immediately east of the Dennys River and north of Route 191 (Smith Well). A geophysical log of this well indicated possible granite from 244 to 421 ft (end of borehole).

Bedrock Fractures

Slickensides, sheared and polished surfaces, which are evidence of brittle fracturing, occur in rock outcrops throughout the Calais Quadrangle (Ludman and Hill 1990). High-angle faults that strike both north and northwest are mapped within 10 miles of the site. The nearest fault to the site, shown on the Bedrock Map of the Calais Quadrangle (Ludman and Hill, 1980), trends northwest-southeast and is inferred about 1 mile northeast of the site. The Dennys River is oriented northeast-southwest north of Route 191 and is oriented northwest-southeast south of Route 191. The orientation of the River may be influenced locally by the bedrock structure. Felsic and mafic plutons in the Calais quadrangle, including the Meddybemps Granite and the Gabbro-diorite intrusive complex, have undergone three episodes of deformation after earlier recumbent folding and faulting including the deformation that resulted from the removal of the weight of the continental ice sheet which created low-angle fractures parallel or subparallel to the bedrock surface. These fractures are referred to as unroofing joints by the USGS.

Geologic and borehole geophysical logs indicate the upper few feet of bedrock are weathered, broken and contain unroofing joints. Bedrock fractures are oriented in three primary directions based on studies by the USGS (Hansen and Others, 1999):

- a low-angle set striking NNE and dipping WNW;
- a high-angle set striking NNE and dipping ESE; and
- a second high-angle set striking ENE to E (nearly EW) and dipping SSE to S.

In contrast to the total fracture population, most of the water-yielding fractures dip to the south. In general, most of the high-angle water-yielding fractures generally strike NNE or ENE and dip ESE or SSE; and the low-angle water-yielding fractures generally strike NNE to WNW and dip WNW to SSW (Hansen and Others, 1999).

Site soils are generally composed of fine- to medium-grained sands, silt and clay, with varying amounts of gravel, to a depth of approximately 5 to 30 feet bgs. These deposits are underlain by the intrusive igneous bedrock that is encountered at about 20 to 30 feet bgs.

Near surface groundwater is located in the glacial till and shallow bedrock at depths of approximately 7 to 25 feet bgs, refer to Figures RSE-1-4 and RSE-1-5.

Site Hydrogeology

The groundwater beneath the site appears to exist in two aquifers: the surficial aquifer that exists in the overburden deposits and the bedrock aquifer. Generally, the depth to groundwater ranges from 4 to 10 feet bgs in the northern portion of the site and from 12 to 20 feet bgs in the southern portion of the site. Both of the overburden aquifers have been completely dewatered in the vicinity of operational extraction wells.

Groundwater levels throughout the site respond to recharge from precipitation and snowmelt. In addition, the northern-most portion of the site responds to lake level changes. Groundwater levels vary throughout the year but generally follow water-level trends in Meddybemps Lake. Overall, water levels in the lake and groundwater are highest in late December and early January after a fall recharge and runoff period. Water levels declined during January to March and rise again during the spring thaw in April. Water levels are their lowest during the months of October and November (USGS, 1998).

When water levels were high, the saturated thickness ranged from 0 to 5 feet over a majority of the site, with the exception of two areas, where the saturated thickness ranged from 5 to 10 feet. The first area is located in the central portion of the site, in the vicinity of MW-4S and MW-5S; and the second area is located in the southern portion of the site, in the vicinity of MW-17S and MW-18S extending to the south across Route 191 to MW-11S and the Dennys River. Vertical hydraulic gradient at paired wells indicate that the site has an overall downward vertical hydraulic gradient.

The surficial and bedrock aquifers are interconnected hydraulically; however, the differences in hydrostatic head measured in wells in the different aquifers, and the differences in responses to precipitation observed indicate that the two aquifers are separate to some degree, and the bedrock aquifer may be under semi-confined conditions. High angle fractures are potential pathways for migration of groundwater from the shallow to deeper bedrock and vice versa. Low angle fractures are potential pathways for groundwater migration in all directions.

The configuration of the potentiometric surface of the overburden aquifer shows the general direction of groundwater flow beneath the site is in a southeast direction toward the Dennys River. This indicates that the Dennys River is the local discharge point for the surficial and shallow bedrock aquifer. A more southerly component of flow occurs in the northern part of the site in the vicinity of Meddybemps Lake. Recharge from the Lake probably causes groundwater flow in a south-southwest direction toward a wetland area located on the west side of the river in the vicinity of the dam. Hydraulic conductivity of the coarse-grained glaciomarine sediments ranges from 17 to 78 ft/day and from about 0.1 to 1.0 ft/day for wells completed in glacial till (Lyford and Others, 1999).

The groundwater flow direction in the fractured bedrock aquifer varies across the site. In the northern portion of the site, groundwater flow is generally in a south-southwest direction toward the Dennys River. Vertical hydraulic gradients under non-pumping conditions indicate the potential for upflow in well clusters located near Meddybemps Lake (MW-34B, MW-28B), near the east bank of the Dennys River (MW-37B) and along the west bank of the Dennys River in the southern portion of the site (MW-11B). The potential for downflow exists at well couplets located in the northern portion of the site (MW-29B, MW-35B, MW-36B, IN-1B, IN-2B) and east of the Dennys River (MW-15B, MW-16B). Transmissivities in the fractured bedrock are reported to range from 0.03 to 150 ft^2/day (Lyford and Others, 1999). Similar to slightly higher transmissivity ranges, from approximately 65 to 225 ft^2/day, were found in the shallow bedrock in the vicinity of recovery well RW-4 (located in the northern plume) and at recovery well RWS-5 (located in the southern plume) (TtNUS, 1999).

In general, groundwater flow across the site (west side of Dennys River) is generally southeast toward the Dennys River, and groundwater flow on the east side of the Dennys River is southwest toward the River. The Dennys River represents a groundwater discharge area. Section 1.5.5 of this report describes the nature and extent of the two groundwater contaminant plumes underlying the site. In this section, groundwater quality data is presented and evaluated for contaminants detected in the groundwater at the site. The chemicals of concern in those plumes are primarily VOCs, particularly tetrachloroethene (PCE) and trichloroethene (TCE).

1.5.4 POTENTIAL RECEPTORS

Contaminant exposure pathways considered to be most significant at the site at the time of the ROD are summarized as follows:

- Exposure of residents to contaminated groundwater resulting from use of a well within the contaminated groundwater plume or by migration of groundwater contaminants to existing wells. Exposure may occur through ingestion or dermal contact with contaminated water. It would also be possible for exposure to occur through inhalation during household water usage.
- Exposure to ecological receptors resulting from contact with or ingestion of surface water or sediment and the consumption of organisms that have accumulated contamination.

The only potential receptors are associated with potential use of contaminated groundwater near the former Eastern Surplus Company.

1.5.5 DESCRIPTION OF GROUND WATER PLUME

The distribution of groundwater impacts has been investigated several times since the initiation of the remedial investigation in 1996. The following reports summarize the various phases of the groundwater investigations and recent groundwater trends:

- Remedial Investigation Groundwater Sampling Summary Report (Roy F. Weston, Inc. 1999)
- Remedial Investigation Report (TtNUS, July 1999).
- June 1999 Sampling - Data Summary Report (TtNUS, August 1999)
- Supplemental Bedrock Investigation Report (TtNUS, March 2000)
- Preliminary Design Report (TtNUS, March 2001)
- Final Design Report (TtNUS July 2001)
- EPA Five Year Review (EPA, September 2006)
- Annual and monthly O&M reports (Nobis Engineering, Inc., 2008 – May 2011)
- May 2011 Groundwater Sampling Results (Nobis Engineering, Inc, pending publication)

Historically the groundwater plume has consisted of chlorinated solvents and various metals. The plume has been focused in two locations, one 300 feet north of State Route 191 and one just south of State Route 191. Both locations are near the western shoreline of the Dennys River (RSE-1-6 through RSE-1-9). Waste removal actions, impacted soil excavation, chemical oxidation treatment and groundwater extraction have significantly lowered the concentration of groundwater impacts in both areas. Additional details regarding each plume are provided in the sections below.

Northern Plume

In the northern portion of the site, groundwater occurs in both the overburden and bedrock units and discharges into Dennys River. The overburden and bedrock units are connected and during the seasonal rise of the water table and during system shut down, contaminated bedrock groundwater can enter into the overburden unit. PCE is the principal contaminant of concern detected in both the overburden and bedrock aquifers. In May 2011, TCE was detected in a few wells at concentrations less than 9 µg/L and cis-DCE and vinyl chloride were not detected above the reporting limit suggesting very little if any reductive chlorination is occurring in this area. Groundwater in the bedrock remains more contaminated than in the overburden unit.

<u>Northern Plume Overburden Aquifer</u> - As the result of the NTCRA, contaminated soil overlying the northern plume was removed in 1999 and is no longer a source of PCE leaching to groundwater. Because the overburden unit is seasonally dry, groundwater samples could not be obtained consistently to evaluate dissolved-phase PCE presence. MW-3S previously contained 3,000 µg/L (April/May 2000 - prior to oxidation treatment), which could be attributed to contaminated bedrock groundwater that rose into the overburden unit due to seasonal fluctuations of the water table (MW-3B contained 12,000 µg/L in April/May 2000). MW-3S has not been sampled recently due to insufficient available water, but MW-23S which is nearby contained PCE at a concentration of 45 µg/L. MW-43S, MW-42S and MW-45S in the southern portion of the Northern Plume Area have been sampled in May 2011 and had PCE concentrations from 31 µg/L to 1.9 µg/L.

<u>Northern Plume Bedrock Aquifer</u> **-** Prior to chemical oxidation treatment, the highest detected PCE concentration in this plume was 7,200 µg/L in MW-35B1 and 12,000 µg/L in MW-3B. This portion of

the northern plume (bounded by wells MW-20B, MW-34B, MW-35N, IN-1B, and IN-2B) is located beneath an area where previously contaminated soil and leaking containers of paints and solvents were present. The May 2011 groundwater sampling results indicate that the highest groundwater impacts are still present in this area. MW-51B exhibited the highest PCE concentrations at 1,800 µg/L, MW-35-B1exhibited PCE concentrations at 660 µg/L and MW-36-B1 had PCE concentrations at 90 µg/L. All of the other monitoring wells sampled in May 2011 had PCE concentrations less than 50 µg/L and MW-3B1 had the lowest, with an estimated ("J" flagged) concentration of 1.9 µg/L.

Samples collected from 24 northern plume bedrock wells in Fall 2008, Spring 2010 and Spring 2011 were analyzed for metals and the following exceedances of applicable standards were observed:

Parameter	MCL	MEG	Fall 2008	Spring 2010	Spring 2011
Antimony	6		MW-36B1 (18)	MW-36B1 (16.8)	MW-36B1 (13.9)
Arsenic	10		MW-36B1 (10.6) IN-1B2 (13.3) Mw-41B2 (16.5) MW-42B2 (31.6) MW-43B1 (24.4) MW-43B2 (25.9) RW-4 (17.3)	MW-36B1 (15.8) MW-36B2 (10.1) IN-1B2 (12.7) MW-41B2 (10.9) MW-42B2 (31.7) MW-43B1 (13.5) MW-43B2 (21)	MW-36B1 (17.3) IN-1B2 (14.9) MW-41B2 (31) MW-43B1 (19) MW-43B2 (18)
Lead	15	20	RW-3 (61.7) RW-4 (15.4) RWS-6 (80.5)	MW-34B2 (32.6)	MW-43B2 (22.5)
Manganese		200	IN-1B1 (1060) IN-6B (737) MW-43B1 (206) RW-3 (1160) RW-4 (5760)	MW-43B2 (427) IN-6B (815)	MW-41B1 (272)

The current vertical extent of the plume is estimated to extend down to 100 to 200 feet below the top of the bedrock surface, based on sampling results acquired through June 2001. We are not aware of any recent vertical profiling to determine if significant impacts still remain at depth. Monitoring well MW-36 B2 screen is set with a mid point at 32.28 feet above mean sea level (approximately 115 feet below top of bedrock surface) and exhibited PCE concentration of 25 µg/L in May 2011.

Southern Plume

In the southern portion of the site and area south of Route 191, overburden and bedrock groundwater discharges in a southeasterly direction into the Dennys River. The Rl identified PCE as the principal contaminant in the southern plume, which originates in the southern portion of the site and extends offsite into an adjoining property south of State Route 191. The Rl identified VOC-contaminated soil presence in the southern portion of the site that was the source of contaminated overburden and bedrock groundwater. The onsite contaminated soils were removed during the 1999 NTCRA response action. The removal actions, chemical oxidation and groundwater extraction have been very successful in the area due in part to the limited bedrock impacts. This success has led to the shutdown of the southern extraction system in November 2010. Additional details are provided in the sections below.

Southern Plume Overburden Aquifer – No known source areas were identified south of State Route 191 and therefore, no soil excavation was performed south of State Route 191 during the NTCRA. VOCs contamination was believed to be present only within the saturated overburden. The plume extends southward to the vicinity of extraction well RWS-1.

MW-8S was the most contaminated well in the southern plume with PCE concentrations of 1600 µg/L that declined to 34 µg/L by June 2001 following chemical oxidation. This well along with results from other wells indicate that the in-situ oxidation coupled with removal of contaminated soil appear to have been effective in decreasing PCE presence in the most contaminated portion of the southern plume. In May 2010 all of the monitoring wells sampled in the Southern Plume Overburden Aquifer (IS-1S, IS-2S, MW-18S, MW-30S, MW32S, MW-49S and MW-50S) had PCE concentrations less than 5 µg/L. The system was shut down in November 2010 and the May 2011 sampling event indicated that all of the PCE concentrations in the monitoring wells sampled remain below 5 µg/L.

Southern Plume Bedrock Aquifer - The southern plume bedrock aquifer PCE concentrations have decreased since the contaminated soil was removal and the initial application of $NaMnO_4$. In May 2010 monitoring wells 1S-1B and 2S-2B both had PCE concentrations less than 1 µg/L. In May 2011 these wells rebounded slightly; at well 1S-1B PCE was detected at 2.8 ug/L, which is essentially at the cleanup level, and at well 2S-2B PCE was detected at 4.5 ug/L, which is slightly above the cleanup level..

1.5.6 Surface Water Monitoring

Surface water samples were collected in October 2002, August 2003, August 2004, August 2005, June 2006 and July 2008. In accordance with the approved work plan, surface water samples were analyzed for metals only. Analytical results were compared to MCLs and 1992 MEGs, Maine Ambient Water Quality Criteria, and the protective levels selected in the 2000 ROD. The last two are criteria for 21 aquatic organism protection, which is the primary purpose for the long-term monitoring of surface water. Of the four ROD-designated contaminants of concern (COCs) for surface water, aluminum, barium, and lead have occasionally been detected at higher concentrations than the ROD protective levels after the 1999 NTCRA while silver has not. Concentrations of aluminum, barium, and lead have varied since 1999. The exceedances include aluminum detected in samples from Meddybemps Lake, beyond the influence of the Site. The EPA states in the 2006 five Year review that "…Overall then, these metals do not appear to represent a threat to surface water quality…"

1.5.7 Sediment Monitoring

Sediment samples were collected at the same time as the surface water samples in October 2002, August 2003, August 2004, August 2005, June 2006, and July 2008. Sediment sampling has occurred at the same general locations as the surface water sampling. In accordance with the approved work plan, sediment samples were analyzed for SVOCs, total PCBs, and metals. Analytical results were compared with the ROD protective levels and the Ontario Ministry of the Environment's Lowest Effect Levels (LEL) guidelines. These levels are criteria for aquatic organism protection, which is the primary purpose for the long-term sediment monitoring.

Bis(2-ethylhexyl) phthalate (BEHP) has been frequently detected in sediment collected from the banks of Meddybemps Lake and the Dennys River adjacent to the Site (in all four samples from the lake in 2006; one of seven samples in 2006 and all five samples in 2005 from the Mill Pond (the local name for the reach of the river between the dam and Route 191)). BEHP is a commonly used plasticizer, used in manufacturing of plastics, and is pervasive in the environment. BEHP has also been detected in the field blanks, the quality control samples used to track sampling methodology. There are no benchmarks or ROD protective levels for BEHP.

Low levels of PAHs have been detected in locations adjacent to Route 191, and may be a result of road surface runoff from the asphalt pavement. The detected PAHs have not exceeded the ROD protective levels or the LEL values.

PCBs sediment samples have been collected from Meddybemps Lake, the Mill Pond, and the upper Dennys River just downstream of Route 191. Overall, PCBs in Meddybemps Lake have been well below the ROD level of 190 μg/kg and the OME LEL of 70 μg/kg. There were no values above either criteria in 2005 and only one in the 2006 sampling event. The highest concentration of PCBs detected during the 2008 sampling event was 289 μg/kg collected at L17. In total, the 2008 sampling event had one detection above the ROD level and four detections above the OME LEL but most of the samples were less than 10 μg/kg.

Total PCBs have been detected in the majority of sediment samples collected from the upper portion of the river. The median concentration has been below the ROD protective level. PCBs presence in pond and river sediments appears to be limited, and are likely attributable, in part, to past releases from the Site (though as found in the 2003 biota sampling, PCBs were found in mussel tissue collected near Fowler Point in Meddybemps Lake, which is about four miles north of the Site, thereby suggesting that the Site may not be the only source of PCBs in the river sediments).

Concentrations of arsenic, chromium, copper, lead, manganese, and nickel have been detected in levels exceeding the ROD protective levels or the OME LELs throughout the long-term sediment sampling program. An evaluation of the data leads to the following observations:

- ROD protective levels for arsenic, chromium, copper, lead, and nickel were all set below the ROD-identified background levels; Several of the metals showed decreases from 1999 to 2001 (the NTCRA removal of soils and sediments occurred after the 1999 sampling event), then increased slightly in 2002, and have appeared consistent since then.
- 22 arsenic sample concentrations in lake sediments have been higher than both samples collected from Mill Pond from 1999 through 2006 and samples collected from the upper river from 1999 through 2004, with results from nearly all sample locations between the ROD protective levels and the background concentration (6 mg/kg to 19 mg/kg).
- Chromium concentrations have remained relatively consistent since 1999 with median concentrations, and generally the 75th quartile below the protective level.
- Maximum copper concentrations were above both the ROD protective level and background level in 2002 and 2003 in the Mill Pond and 2004 in the upper river samples. The median and 75th quartile have been bracketed between the two criteria.
- Maximum lead concentrations were similar to copper, above the protective level in the Mill Pond in 2002, 2003, and 2004, and above the protective level in 2004 in the upper river samples. Overall, the median and 75th quartile have remained below the protective level since 1999.
- Manganese concentrations appear to have slightly decreased in all sampling locations since 1999, with the median and 75th quartile below the protective level since 2001. Maximum concentrations in Meddybemps Lake samples have exceeded the protective level in all seven years of monitoring, suggesting sources beyond the Site.
- Median and 75th quartile nickel concentrations have been consistently above the protective level of 16 mg/kg, fluctuating around the background level of 26 mg/kg. Overall, sediment metal concentrations appear to either slightly decreased or remained stable since 2002, and at levels below the pre-NTCRA 1999 samples.

As the 2000 ROD concluded that the 1999 sediment concentrations did not pose an unacceptable risk, the current levels are not considered to pose an unacceptable risk to aquatic organisms.

During the 2008 sampling event, 23 TAL Metals were analyzed from 22 sediment samples collected from the 20 sediment sampling locations. Arsenic, chromium, copper, manganese, and nickel all had detections above the ROD PL. Arsenic and nickel we detected in nearly every sample above the criteria but were less than 2 times the standard.

1.5.8 BIOTA MONITORING

The remedy selected in the 2000 ROD included biota sampling, as necessary, to evaluate the protectiveness of the remedy. An initial biota sampling event had been performed by USF&WS in 1997. That study concluded that there were no major site-related impacts of metals to fish and mussels in Meddybemps Lake and in the Dennys River. Polychlorinated biphenyls (PCBs) detected in fish samples collected from and adjacent to and downstream from the Site were higher in concentrations than in fish samples obtained from the reference locations on the Dennys River. Mean PCB levels however were not highly elevated when compared to regional data from other lakes and streams in Maine. In 1997 and 1999, Maine DEP performed benthic invertebrate assessments in the river just downstream of the Site. Both assessments indicated that the water quality in the river was Class C, which is the lowest surface water classification in Maine. However, the Dennys River has been designated a Class AA (highest classification) because it is one of seven rivers in Maine designated for the restoration of Atlantic salmon. Since it was not clear whether the Site was contributing to the Class C designation of the river, it was decided to conduct a benthic study after the completion of the NTCRA and start-up of the groundwater extraction and treatment system. The ecological risk assessment completed during the RI/FS concluded that there were no substantial risks to ecological receptors posed by site-related contaminants of concern. Nonetheless, the ROD identified fish and mussels as media of potential concern and designated PCBs, several polynuclear 23 aromatic hydrocarbon compounds (PAHs) and several metals as COCs in surface water and sediments.

As a result, EPA conducted a three-part biota sampling program: in October 2002, intertidal clams were collected in Dennys Bay, near the mouth of the Dennys River; in July 2003, fish and mussels were collected from Meddybemps Lake and Dennys River; and a benthic study was performed during the summer of 2003.

Intertidal Clam Study

The intertidal clam study was conducted at three stations in Dennys Bay, which is located approximately 20 miles downstream of the Site. The stations were selected by a member of the Sipayik Environmental Department, Pleasant Point Passamaquoddy Tribal Government as these were areas of active soft-shell clam ("steamers") harvesting. Ten clams were collected at each station and the tissue was analyzed for metals and PCBs. Results of the analyses indicated that PCB concentrations in the clam samples were low, generally less than seven percent of the Maine Fish Tissue Action Levels (FTALs) values. Of the metals, only arsenic and lead concentrations in the clam samples exceed the FTALS. While there are no specific guidelines or action levels for clams, Maine Bureau of Health and Maine DEP use the FTALs to screen clam tissue data.

With the available information, it is unknown how much, if any, of the arsenic and lead present in the clam tissue samples can be attributed to the Site. The flow from Meddybemps Lake at the dam is approximately 9.3 cubic feet second (cfs, or about 70 gallons per second), while the flow at Dennysville, about 18 miles downstream from the Site, is 203 cfs (about 1500 gallons per second) indicating that the river receives considerable contribution from numerous tributaries and groundwater discharge downstream of the Site. Dennys Bay also receives other surface water than from Dennys River, such as from Hardscrabble River. And finally, Dennys Bay is tidally influenced, and therefore there could be additional sources of PCBs and metals beyond the freshwater sources. Sediment metal concentrations from samples that were previously collected in Dennys Bay were comparable to the concentration ranges observed in background locations (five samples obtained from Meddybemps Lake not affected by past activities or releases from the Site).

2003 Biota Study

During the July 2003 sampling round, 58 fish and 28 freshwater mussels were collected from two locations in Meddybemps Lake and two reaches in the Dennys River for mussels and five reaches in the river for fish. The 2003 samples were analyzed for metals, total PCBs, and PCB congeners. The results of the analyses indicate a general decline in metals and PCB median concentrations per sampling location for fish and mussel tissue between 1997 and 2003. For smallmouth bass, the median concentrations for metals and PCBs were below the FTALs at all locations except in the dead water reach south of Route 191 and the whole body median metals concentration did not exceed the wildlife protection criteria at any location. Pumpkinseed sunfish also showed a general decrease in metals and PCBs from 1997 to 2003. Mercury concentrations in the fillet median value of both species exceeded the FTAL, a result not inconsistent with the statewide advisory for mercury for fish consumption. For freshwater mussels, the median values for PCBs and mussels were generally lower in 2003 than in 1997 (though neither was elevated when compared to criteria).

Mercury median values were slightly higher in mussels collected from Meddybemps Lake than from the Dennys River 2003 Benthic Study From July 18 through August 15, 2003, sampling of the river bottom adjacent to and downriver of the Site was conducted using various collection devices in accordance with Maine DEP methodology and guidance. The classification determination for the river remained Class C, the same result as the 1997 and 1999 Maine DEP results. This determination however, was biased by two factors that prevented an assessment of whether the Site was contributing to the classification. The presence of the dam upstream of the sample stations creates a condition where the river in the vicinity of the Site cannot meet either Class AA or Class A of the State's surface water quality designations. Second, use of the rock bag sampling devices, one of the state sampling methods selectively favors the dominance of filter feeders and this also contributes to the lowered water quality classification. Therefore, it appears that current conditions and the required sampling methods prevent the possibility of the river attaining a higher water quality classification, irrespective of any possible contribution from the Site.

2.0 SYSTEM DESCRIPTION

The operational remedies include a pump & treat (P&T) system and in-situ chemical oxidation. The P&T system began operation in 2000 and in-situ chemical oxidation was implemented from August 2002 through January 2003. Each of these remedies is discussed in more detail below.

2.1 P&T SYSTEM

The P&T system consists of ten (northern plume) and five (southern plume) extraction wells. The extraction well locations are depicted in Figure RSE -2-1. The extraction wells are constructed to intersect the interface of the overburden sediments and shallow bedrock.

Groundwater is extracted from the subsurface utilizing bladderless pneumatically operated pumps. The pumps are installed in below-grade, concrete manways that are secure from surficial influences. Compressed air is supplied to each pump via subsurface pipelines that are either buried at a depth of six feet bgs, to prevent freezing, or are heat traced and are enclosed in polymer enclosures installed at grade. Groundwater discharge lines are similarly constructed. The subsurface water from the northern and southern plumes is pumped to the onsite treatment building. The treatment building consists of a pre-engineered structure that is 24 feet long and 16 feet wide with 10 foot high eaves. Power is supplied by a 200 amp, single phase 240 volt service. The building is heated by a ceiling mounted electric heater that is set to 55 degrees Fahrenheit when not occupied.

Extracted groundwater enters the building and is filtered by a 10 micron bag filter prior to discharging to an equalization tank that allows for a steady flow rate through the entire system. Following the equalization tank the water is filtered by a 1 micron bag filter to remove remaining suspended solids prior to entering the liquid-phase granular activated carbon (GAC) system where volatile organic compounds (VOCs), primarily PCE and TCE are removed. The GAC system consists of six 200 pound vessels that are operated in series as two sets of three parallel vessels. Specifically, water is divided into three streams after the bag filter and conveyed to GAC 1, GAC 3, and GAC 5 then is filtered by a 1 micron canister and sent to GAC 2, GAC 4 and GAC 6. Each vessel has 10 gpm capacity so the current GAC configuration has a total treatment capacity of 30 gpm. The treated groundwater is then discharged into an infiltration gallery, located between the two plumes, where it is reintroduced into the overburden aquifer.

Previously, dissolved metals, primarily manganese, were removed from the extracted groundwater via ion exchange system after the GAC. Influent concentrations have dropped significantly prompting the recent bypass of the ion exchange system. The treatment system has telemetery that was not operational during the site visit. Several sensors are connected to a program logical control that instructs a Sensaphone Model Scada 3000 to dial four numbers.

- The sensors are programmed to monitor for the following alarm conditions:
  - Abnormally high liquid level in the equalization tanks
  - Abnormally high transfer pump discharge pressure
  - Excessive pressure drop through the first or second stage bag filter
  - Excessive pressure drop through the GAC system

- Excessive pressure drop through the ion exchange system
- Abnormally high liquid level in the treatment building floor sump
- Abnormally high liquid level in the treated groundwater infiltration gallery

- The four alarm messages include:
  - Abnormally high liquid level in the equalization tanks
  - Abnormally high transfer pump discharge pressure
  - Abnormally high liquid level in the treatment building floor
  - Common trouble, which covers all other alarmed conditions

The total amount of groundwater that has flowed through the groundwater P&T system, from September 2007 through March 2011, is approximately 18,666,530 gallons. The average system flow rate during this period was 10.0 gpm, and the average influent concentration varies from approximately 42 µg/L to 88 µg/L. The portion of the system extracting groundwater from the southern plume was taken off-line on November 2, 2010. In March 2011, the system effluent total was 266,160 gallons indicating that the northern plume extraction system was running at an average extraction rate of 6.4 gpm.

2.2 IN-SITU CHEMICAL OXIDATION

A two-phase pilot study was conducted to assess the potential application and effectiveness of in-situ-chemical oxidation of residual VOCs in the core portions of the two groundwater plumes. Phase 1 was initiated in July 2000 and concluded in April 2001. Phase 2 ran from April to June 2001. The pilot study was followed by a full-scale application from August 2002 through January 2003. Phase 1 consisted of adding sodium permanganate of varying volume and concentration (from 1 to 40% solution) into the bedrock in the northern plume and into the overburden and bedrock in the southern plume. The northern plume received three permanganate additions during Phase 1 while the southern plume received only one addition. Concentrations of PCE increased in the core of the northern plume after the first two additions and declined slightly after the third addition (from a maximum concentration of 12,000 µg/L prior to permanganate application to 16,000 µg/L then to 22,000 µg/L then back to 9,700 µg/L after the third addition). Concentrations in the southern plume decreased from maximum concentrations of 570 µg/L in the overburden and 200 µg/L in bedrock prior to permanganate application to 160 µg/L and 77 µg/L, respectively. Since the concentrations continued to decrease in the southern plume to 11 µg/L in the overburden and 46 µg/L in the bedrock, no Phase 2 additions were made into the southern plume.

Phase 2 of the in-situ chemical oxidation for the northern plume began in April 2001. Using a grid pattern of direct push wells in order to create a more widespread application, 1440 gallons of 40% permanganate solution were added to 73 direct push wells. Sampling of wells immediately following the Phase 2 application indicated decreases in most of the wells (generally a 50 to 80% decrease) with a couple low-yield wells showing marked increases. Sampling performed six months after the permanganate application found that some wells showed significant rebound, essentially back to pre-Phase 1 PCE concentrations whereas other wells continued to decline.

The persistence of PCE suggested the presence of PCE residuals in the core area of the northern plume, and that this residual may in part be located in dead-end fractures that act as long-term sources. In addition, the permanganate may have oxidized the materials to which PCE was adsorbed, thereby causing the PCE to become mobile and partition into the aqueous phase. A full-scale in-situ chemical oxidation program was implemented from August 2002 to January 2003. As part of this full-scale program, five open-hole bedrock wells were installed in the northern plume as supplemental oxidant application wells, and four new overburden application wells were installed in the southern plume to supplement the existing wells. The in-situ chemical oxidation consisted of establishing a groundwater recirculation system in each plume so that contaminated groundwater could be extracted and treated, then amended with sodium permanganate oxidizer and injected back into the plumes.

In the northern plume, the full-scale permanganate addition was conducted in two stages. The first stage targeted the plume core by extracting from MW-35B (highest concentration have typically been detected in this well) while adding permanganate to surrounding wells. The second stage distributed permanganate throughout the entire plume, switching MW-35B from extraction well into an addition well. Over the five months of the full-scale program, PCE concentrations decreased in 7 of 11 extraction wells. Upon conclusion of the full-scale program, rebounding of concentrations occurred in some wells, again suggesting there is a residual source of PCE within the bedrock.

In the southern plume, the full-scale in-situ treatment was directed at the entire plume. Over the five months of operation, PCE concentrations did not significantly decrease. Analytical data suggested that much of the permanganate was expended in metal oxidation reactions, as evidenced by the temporary increases in concentrations of several metals.

2.3 MONITORING PROGRAM

2.3.1 PROCESS MONITORING

Only extraction well MW-35B was sampled during the Fall 2010 sampling event. Influent, mid-system and effluent samples are collected from the system and analyzed for VOCs and dissolved metals. Specifically, system samples (2 influent, 1 influent combined, 2 bag filters, 4 GAC, 3 effluent and one trip blank) are collected monthly for VOCs and 23 metals are also analyzed at each of the 12 sample locations described above on a monthly basis.

2.3.2 GROUNDWATER MONITORING

Prior to 2007, groundwater samples were collected from 62 wells (both extraction and monitoring) in the northern plume, 31 wells (both extraction and monitoring) in the southern plume and select non-plume wells on a semi-annual basis and submitted for laboratory analysis of VOCs and dissolved metals. Water levels have been monitored during groundwater sampling events.

The long-term monitoring program was adjusted in 2007 to reduce the number of groundwater sampling locations. In accordance with an August 22, 2007 electronic mail from Mr. Terry Connelly, EPA Task Order Project Officer (TOPO), 22 monitoring locations within the northern plume and 10 monitoring locations within the southern plume constitute the current long-term monitoring program for the Site. During the Spring and Fall 2010 monitoring rounds, an additional 5 monitoring wells in the northern plume area were added to the long-term monitoring program to better define the plume geometry. In addition, one well in the southern plume area has been destroyed and is no longer included in the long-term monitoring. Currently the long term monitoring sampling locations include 27 wells located in the northern plume area and 9 wells in the southern plume area. The current analytical program is summarized below:

Monitoring Round	Northern Plume		Southern Plume	
	VOCs	TAL Metals (22 Metals)	VOCs	TAL Metals (22 Metals)
Fall	27 wells			
Spring	27 wells	27 wells	9 wells	9 wells

Note: *VOCs are analyzed using CLP OLC0 3.2. TAL Metals are analyzed by CLP ILMO 5.3.*

2.3.3 Surface Water Monitoring

The last time surface water samples were collected was in July 2008 when a total of 22 sediment samples were collected from 20 locations for analysis of PCBs and TAL Metals. Since additional sampling has not occurred in 2009 and 2010 we suspect that surface water sampling may no longer be required at the site.

2.3.4 Sediment Monitoring

The last time surface water samples were collected was in July 2008 when a total of 22 sediment samples were collected from 20 locations for analysis of PCBs and TAL Metals. Since additional sampling has not occurred in 2009 and 2010 we suspect that sediment sampling may no longer be required at the site.

2.3.5 Biota Monitoring

Biota samples have been collected was in 1997 and 2003. Overall, there was a decline in the chemical of concern concentrations between the 1997 and 2003 sampling events. We suspect that biota sampling is no longer required.

3.0 SYSTEM OBJECTIVES, PERFORMANCE, AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The ROD for the Eastern Supply Company Site identifies the following Remedial Action Objectives (RAOs):

- Prevent the ingestion of groundwater contaminants that exceed federal or state maximum contaminant levels (MCLs), non-zero maximum contaminant level goals (MCLGs), State of Maine Department of Environmental Protection (Maine DEP) maximum exposure guidelines (MEGs), or in their absence, an excess cancer risk of 1 x 10-6 or a hazard quotient of 1 per contaminant;
- Prevent, to the extent practicable, the off-site migration of groundwater with contamination above cleanup levels;
- Restore groundwater to meet federal or state MCLs, non-zero MCLGs, Maine DEP MEGs, or in their absence, an excess cancer risk of 1 x 10-6 or a hazard quotient of 1 per contaminant; and
- Provide long-term monitoring of surface water, sediments, groundwater, and fish to verify that the cleanup actions at the site are protective of human health and the environment.

The 2000 ROD specified the use of the MCL and or Maine DEP MEG cleanup criteria for the groundwater, based on the Environmental Response Act, 1982 PA 307, as amended.

The following table provides a summary of the groundwater Contaminants of Concern as stated in the Final Design Report and the ROD:

Contaminant of Concern	**Cleanup Criteria (µg/L)**	**Basis**
1,1,2 Trichlorethane	3	MEG
Trichloroethene	5	MCL
Tetrachloroethene	3	MEG
Chloromethane	3	MEG
Methylene Chloride	5	MCL
Total Polychlorinated Biphenyls (PCBs)	0.05	MEG
Bis (2-ethyl hexyl) phthalate	6	MCL
Cis-1,2 dichloroethene	70	MCL/MCLG
Manganese	200	MEG
Antimony	6	MCL/MCLG
Cadmium	5	MCL/MCLG
Lead	15	Action Level
Xylene	600	MEG
1,1-dichloroethane	5	MEG

3.2 TREATMENT PLANT OPERATION STANDARDS

There is no formal permit for the P&T system located at the site. The treated groundwater is re-injected into the subsurface at the site and is, therefore, a closed system without discharge to a surface water body or a municipal sewer system. However, because the water is returned to the subsurface it must meet applicable MCL/MEG.

4.0 FINDINGS

4.1 GENERAL FINDINGS

The observations provided below are not intended to imply a deficiency in the work of the system designers, system operators, or site managers but are offered as constructive suggestions in the best interest of the EPA and the public. These observations have the benefit of being formulated based upon operational data unavailable to the original designers. Furthermore, it is likely that site conditions and general knowledge of ground water remediation have changed over time.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 GROUNDWATER FLOW AND PLUME CAPTURE

Northern Plume Overburden

Groundwater levels under non-pumping conditions were measured before system start-up in 2001 for the overburden wells in the northern plume area (Figure RSE 4-1) which shows the natural groundwater flow is generally from north to south with an easterly component influenced by the Dennys River. Groundwater levels under pumping conditions at start-up in 2001 (Figure RSE 4-2) show significant response across the area with wells at the north end going dry, wells in the middle showing a decrease in water levels of approximately 4-5 feet and wells at the south end showing a decrease of approximately 1-2 feet.

More recent water level maps show comparable water level conditions in the Spring of 2010 (Figure RSE 4-3) and even lower water levels in the Fall of 2010 (Figure RSE 4-4). Although there are no overburden wells between the river and the extraction system, the water levels in line with the extraction system (MW-45S and MW-46S) are lower than stream stage (approximately 162 feet) in both the Spring and Fall of 2010. These data indicate good plume capture for the overburden plume.

Northern Plume Bedrock

Groundwater levels under non-pumping conditions were measured before system start-up in 2001 for the upper bedrock wells in the northern plume area (Figure RSE 4-5) and show natural groundwater flow is generally from north to south with an easterly component influenced by the Dennys River. The vertical hydraulic gradient within the bedrock is downward at most couplet well locations.

Groundwater levels under pumping conditions at start-up in 2001 (Figure RSE 4-6) show significant response across the area with wells at the north end (prior to pumping at MW-35B) showing a decrease in water levels of approximately 0.5-2.5 feet. Wells MW-23B and MW-36B are located downgradient of the extraction system between the river and the line of extraction wells and show decreases of approximately 3 to 6 feet in response to pumping. Wells MW-42B and MW-43B are located upgradient of the southern part of the extraction system and showed water level decreases of approximately 6 to 17 feet.

More recent water level maps show comparable water level conditions in the Spring of 2010 (Figure RSE 4-7) and even lower water levels in the Fall of 2010 (Figure RSE 4-8). The 2010 contour maps are largely dependent on assumed water levels at the extraction wells based on the intake elevation of the pneumatic submersible pumps in the extraction wells because there are not enough bedrock monitoring wells to adequately determine the capture zone. This practice of considering the water levels in extraction wells often leads to overestimating the extent of capture. The contours on these maps are also drawn with relatively sharp corners (which is not realistic) and do not seem to appropriately consider measured water elevations in some monitoring wells. As a result of these items, RSE team does not consider these maps reliable for interpreting capture.

Vertical hydraulic gradients during the last five sampling events are summarized in the table below. All of the measurements were taken while the extraction system was operating. The vertical gradients are consistently downward in the core of the northern plume area (IN-1B, IN-2B, and MW-34B). Note that the screened intervals of the deeper wells are significantly shallower than the pump settings in extract wells making it unlikely that the extraction is causing the observed vertical gradient from shallow to deep. The vertical gradients are also downward in the Spring at MW-36B but upwards in the Fall. At MW-43B and MW-41B the gradients have been consistently upwards. The downward vertical gradients, even while the extraction system is pumping, indicates the lack of hydraulic control in the deeper bedrock in those areas and/or times of the year.

		Oct-08		May-09		Oct-09		May-10		Oct-10	
	Mid-Screen Elevation	Water Elev.	Vert. Grad.	Water Elev.	Vert. Grad.	Water Elev.	Vert. Grad.	Water Elev.	Vert. Grad.	Water Elev.	Vert. Grad.
IN-1B1	156.14	170.6	0.08	171.31	0.07	170.72	0.08	170.31	0.10	169.96	0.05
IN-1B2	90.16	165.13		166.61		165.2		163.57		166.39	
IN-2B1	161.94	169.39	0.05	170.32	0.04	169.17	0.05	167.94	0.03	168.31	0.03
IN-2B2	73.97	164.96		166.73		165.04		165.29		165.36	
MW-34B1	165.88	171.65	0.02	172.43	0.01	171.56	0.02	171.14	0.01	170.54	0.01
MW-34B2	120.88	170.9		172.2		170.55		170.70		170.29	
MW-36B1	132.28	160.1	0.07	162.03	0.05	138.2	-0.17	154.28	0.02	147.17	-0.07
MW-36B2	32.28	153.04		156.99		155.19		151.90		154.37	
MW-41B1	68.75	166.81	-0.10	153.85	-0.33	155.09	-0.27	155.09	-0.28	150.38	-0.35
MW-41B2	8.75	172.61		173.44		171.06		172.11		171.08	
MW-43B1	69.72	156.95	-0.12	146.61	-0.37	146.52	-0.27	146.18	-0.38	147.80	-0.33
MW-43B2	19.72	162.83		164.99		160.07		165.19		164.16	

Charts for 10 bedrock wells are provided in Attachment B. There are two wells that have not shown any significant reduction; IN-1B2 and MW-36B2. Both of these wells are in the deeper bedrock and the results are consistent with the hydraulic data that shows downward vertical gradients under pumping conditions. These results suggest a lack of capture for the deeper plume. There are relatively persistent concentrations (a slight decreasing trend) observed at MW-23B and MW-36B, which are between the river and the extraction system. These persistent concentrations also suggest that capture is not complete. It should be noted that previous tracer tests (NUS, 2001) showed hydraulic connection (and lack of hydraulic control) between the deeper bedrock at MW-35B in the core of the plume and MW-36B.

Southern Plume Overburden

Groundwater levels under non-pumping conditions were measured before system start-up in 2001 for the overburden wells in the southern plume area (Figure RSE 4-9) which shows the natural groundwater flow is generally from northwest to southeast toward the Dennys River. Groundwater levels under pumping conditions at start-up in 2001 (Figure RSE 4-10) shows a drawdown of approximately 2.5 to 3 feet in non-pumping wells in the vicinity of the extraction system. A more recent water level map from spring 2010 (Figure RSE 4-11) does not seem to show a defined capture zone due to a lack of measurement points.

Southern Plume Bedrock

Groundwater levels under non-pumping conditions were measured before system start-up in 2001 for the upper bedrock wells in the southern plume area (Figure RSE 4-12) and show the natural groundwater flow is generally from northwest to southeast toward the Dennys River. Groundwater levels under pumping conditions at start-up in 2001 (Figure RSE 4-13) shows good capture with drawdown of 2.5 to 7 feet in non-pumping wells in the vicinity of the extraction system and inward gradients. There were an insufficient number of bedrock water levels in the 2008, 2009 and 2010 monitoring reports to prepare a water level map. The southern extraction system was turned off indefinitely in November, 2010.

4.2.2 GROUND WATER CONTAMINANT CONCENTRATIONS

Northern Plume Overburden

Monitoring wells MW-42S and MW-43S show long term decreasing trends in PCE concentrations. Sharp temporary increases (see Charts in Attachment B) in concentrations were evident in MW-42S and MW-43S when the system was temporarily shut down between August 2006 and September 2007. Note that the increased concentration at MW-43S to 950 µg/L in August 2007 is a higher concentration than observed throughout the monitoring history at MW-43B. The increase at MW-43S (and possibly at MW-42S) is therefore likely due to water levels increasing in the absence of pumping and coming into contact with shallower contamination in the weathered bedrock zone. It is unclear if this shallow contamination is still present and would cause a similar rebound if pumping were discontinued again or if the contamination was mostly removed when the water table rose to saturate the weathered bedrock interval.

MW-23S was the only well that exceeded the PCE cleanup standard in the most recent sampling conducted in May 2011. This well is frequently dry and it is likely that residual contaminants desorbed from the soils when the water level rose to saturate the soils.

Northern Plume Bedrock

Charts for 10 bedrock wells are provided in Attachment B. Most of the wells show long term decreasing trends with reductions ranging from one to three orders of magnitude. Some bedrock wells may have had rebounding concentrations during the system shutdown between August 2006 and September 2007 (e.g., IN-1B1, IN-1B2, and MW-34B2). The changes in IN-1B2 and MW-34B2 (deeper wells) may have been due to a complete lack of capture during the system shutdown. The concentrations at most other bedrock wells (with the exception of the deeper wells discussed in Section 4.2.1) appear to have decreasing contaminant concentrations and do not appear to have experienced increases in concentrations during the system shutdown.

Southern Plume Overburden

Monitoring wells MW-50S, IS-1S and IS-2S show long term decreasing trends. The most recent sampling conducted in May 2011 indicates PCE concentrations are below the MCL (5 µg/L) at all wells but above the MEG (3 µg/L) at four locations.

Southern Plume Bedrock

Monitoring wells IS-1B and IS-2B show long term decreasing trends. The most recent sampling conducted in May 2011 indicates PCE concentrations are below the MCL (5 µg/L) at both wells but above the MEG (3 µg/L) at IS-2B.

Metals

As indicated in Section 1.5.5 trace levels of certain metals remain above the MCL and MEG in the Northern Plume Area. Influent concentration have been below the applicable MCLs and MEGs for many sampling events and the ion exchange system is currently being bypassed.

4.3 COMPONENT PERFORMANCE

4.3.1 GROUNDWATER EXTRACTION SYSTEM

Northern Plume

The groundwater extraction system for the north plume is comprised of 10 wells with pneumatic pumps. PCE concentrations at each extraction well for Oct 2008 and May 2009 are summarized below and show the highest concentrations at the northern most wells (MW-35B, RW-2, RW-3 and RW-4). The concentrations at the southern most wells (RW-11 and MW-40B) are at or below cleanup criteria.

	North Extraction System PCE Concentrations (ug/L)									
	MW-35B	RW-2	RW-3	RW-4	RW-8	RW-9	MW-39B	RW-10	RW-11	MW-40B
Oct 2008	810	170	240	86	33	16	26	6.9	2.9	5.3
May 2009	600	190	340	100	21	20	16	8.8	2.2	4.1

The design rate for the north system was a combined flow of 8.05 gpm. Actual instantaneous pumping rates measured in 2010 based on pump cycle counts show a total of 5.67 gpm. The extraction rates in RW-2, RW-3 and RW-4, which have relatively high PCE concentrations, are particularly low compared to design yield.

	North Extraction System Pumping Rates (gpm)										
	MW-35B	RW-2	RW-3	RW-4	RW-8	RW-9	MW-39B	RW-10	RW-11	MW-40B	Total
Design Yield	0.25	0.50	1.00	1.40	1.40	1.00	0.25	1.00	1.00	0.25	8.05
2010 Average	1.19	0.02	0.29	0.12	1.33	0.52	0.25	0.56	1.29	0.10	5.67

No individual well data for Nov & Dec 2010

Combined extraction rates from monthly reports in 2010 and the first three months of 2011 are summarized in the table below and indicate an effective pumping rate of 4.7 gpm which takes into account down time and is slightly lower than the instantaneous flow measurements reported in the monthly reports. Based on the monthly influent concentrations the calculated total mass removed during the period from January 2010 through March 2011 was 3.62 pounds of PCE.

	North Extraction System Performance Data				
	Total Gallons	Effective GPM	Influent PCE	lbs/gal	lbs/mo
Jan-10	221570	5.0	86	7.18E-07	0.159
Feb-10	186950	4.6	120	1.00E-06	0.187
Mar-10	242080	5.4	140	1.17E-06	0.283
Apr-10	238670	5.5	140	1.17E-06	0.279
May-10	174600	3.9	200	1.67E-06	0.291
Jun-10	150480	3.5	230	1.92E-06	0.289
Jul-10	128510	2.9	200	1.67E-06	0.214
Aug-10	115750	2.6	320	2.67E-06	0.309
Sep-10	122700	2.7	250	2.09E-06	0.256
Oct-10	90240	2.0	380	3.17E-06	0.286
Nov-10	49085	1.1	67	5.59E-07	0.027
Dec-10	257855	5.8	88	7.34E-07	0.189
Jan-11	198940	4.5	200	1.67E-06	0.332
Feb-11	99000	2.2	190	1.59E-06	0.157
Mar-11	226160	5.1	190	1.59E-06	0.359
Total	2502590	4.7	187	1.56E-06	3.62

Southern Plume

The groundwater extraction system for the south plume is comprised of 5 wells with pneumatic pumps. PCE concentrations at each extraction well for Oct 2008 and May 2009 are summarized below and show the wells individual well concentrations near or below cleanup criteria.

	South Extraction System PCE Concentrations (µg/L)				
	RWS-7	RWS-6	RWS-5	RWS-3	RWS-1
Oct 2008	2.7	3.1	2.8	2	0.48
May 2009	3.2	4.7	6.2	2.2	0.54

The design rate was a combined flow of 12 gpm. Actual instantaneous pumping rates measured in 2010 based on pump cycle counts show a total of 6.85 gpm.

	South Extraction System Pumping Rates (gpm)					
	RWS-7	RWS-6	RWS-5	RWS-3	RWS-1	Total
Design Yield	2.50	2.50	2.50	2.50	2.00	12.00
2010 Average	1.98	0.12	1.17	2.02	1.56	6.85

South extraction system shut down indefinitely on November 2, 2010

Combined extraction rates from monthly reports in 2010 and the first three months of 2011 are summarized in the table below and indicate an effective pumping rate of 6.2 gpm which takes into account down time and is lower than the instantaneous flow measurements reported in the monthly reports. Based on the monthly influent concentrations the calculated total mass removed during the period from January 2010 through November 2010 was 0.028 pounds of PCE.

	South Extraction System Performance Data				
	Total Gallons	Effective GPM	Influent PCE	lbs/gal	lbs/mo
Jan-10	271090	6.1	1.8	1.5E-08	0.004072
Feb-10	247040	6.1	0.75	6.26E-09	0.001546
Mar-10	281050	6.3	0.75	6.26E-09	0.001759
Apr-10	243850	5.6	2.1	1.75E-08	0.004274
May-10	229900	5.2	0.7	5.84E-09	0.001343
Jun-10	210740	4.9	1.6	1.34E-08	0.002814
Jul-10	177900	4.0	1.8	1.5E-08	0.002672
Aug-10	180110	4.0	2.2	1.84E-08	0.003307
Sep-10	183740	4.1	1.6	1.34E-08	0.002453
Oct-10	121530	2.7	2.5	2.09E-08	0.002536
Nov-10	66320	23.0	2.3	1.92E-08	0.001273
Total	2213270	6.2	1.64545	1.37E-08	0.028049

South extraction system shut down indefinitely on November 2, 2010

4.3.2 Bag Filters

Bag filters are located prior to the equalization tank, after the equalization tank, and between the lead and lag GAC vessels. Monthly operational reports indicate that bag filters are changed approximately once every two to three weeks based on pressure build-up.

4.3.3 Granular Activated Carbon

The effluent sampling results demonstrate that the granular activated carbon units are effective at reducing the VOC concentrations to below treatment standards (MCL or MEG). The three lead GAC units are changed out approximately once per year. At the time of change out the lag GAC units are moved into the lead position and the new GAC units are put in the lag position.

4.3.4 ION EXCHANGE

Ion exchange units were used to remove metals from extracted groundwater. Because the metals concentrations in the extracted groundwater do not exceed cleanup criteria (MCLs or MEGs), the ion exchange units were taken off-line and are no longer used.

4.3.5 SYSTEM CONTROLS AND ALARMS

Site documentation indicates that the programmable logic controller has several alarm conditions that will shutdown the compressor and release compressed air to shut down the extraction pumps. The alarms are indicated at the site and are communicated to an autodialer that calls up to four site team members in a pre-determined order. The site team reported during the site visit that the autodialer was not operational and alarms were not communicated to the contractor. Alarm conditions include high liquid levels in the equalization tanks, high transfer pump discharge pressure, and high liquid level in the building sump.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

The RSE team was informed that the annual expenditures for the site are approximately $350,000 per year but was not provided a breakdown of these costs. The RSE team has therefore estimated that annual costs for P&T operation and groundwater monitoring based on professional judgment. The values in the table for these remedy components are estimates by the RSE team and add to a total of $267,500, which is substantially less than the overall value provided by the project team. Part of the difference may be related to efforts associated with the evaluation of other remedial alternatives for the northern plume area. The RSE team has included a recommendation in Section 6.2 of this report to review the site annual costs.

Item Description	**RSE Estimated Annual Cost**
Project management and technical support	$36,000
Reporting (monthly O&M)	$24,000
Reporting (annual summary)	$10,000
Routine system O&M labor	$60,000
Electricity	$6,500
Materials	Negligible
Carbon disposal	$6,000
Groundwater monitoring labor (Semiannual)	$35,000
Laboratory analysis – process water	$50,000
Laboratory analysis – groundwater	$20,000
Non-routine maintenance	$20,000
Total	**$267,500**

4.4.1 UTILITIES

Electricity costs are based on estimated electricity usage by the following motors:

- Air Compressors: two 5 HP (alternating use)
- Transfer Pump: one 3 HP
- Electric resistive heater (approximately 5kW)

The air compressor motor is assumed to operate continuously at 75% efficiency and at 80% load. The transfer pump is assumed to operate 30% of the time (due to its higher capacity than the current influent rate) at 75% efficiency and 80% load. The electric resistive heater is assumed to operate 50% of the time from November through April (180 days). Based on these assumptions, the total electricity usage is approximately 50,000 kWh per year. Assuming the average state electricity rate from www.eia.gov of \$0.13 per kWh, this translates to a cost of approximately \$6,500 per year.

Electric space heaters are used to heat the treatment building and site office trailer, however, insufficient information is available to the RSE team to estimate usage.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

There is typically one GAC change out per year in which the 600 lbs of GAC in the lead units is replaced. The cost of the GAC may only be \$1,000, but despite the small amount of carbon that is replaced, the cost for this change is likely on the order of \$5,000 due to the significant mobilization required. The estimate total is therefore approximately \$6,000 per year.

4.4.3 LABOR

Labor costs for project management assume 24 hours per month at \$125 per hour. Routine O&M costs assume three 4-hour visits per week at \$75 per hour. A monthly 12-hour visit for process sampling is also assumed at \$75 per hour plus \$250 in travel costs per trip. Groundwater sampling assumes six wells are sampled per day by a two-person team that costs \$2,500 for labor, materials, sampling equipment, and travel expenses. An additional \$5,000 is assumed for additional mobilization and demobilization costs due to the remote nature of the site.

4.4.4 CHEMICAL ANALYSIS

Chemical analysis assumes a cost of \$140 per sample for VOCs and \$190 per sample for analysis of 12 metals based on prices obtained by the laboratories where samples have been analyzed for this site. Trip blanks, duplicate samples, and various other quality assurance samples are included.

4.5 APPROXIMATE ENVIRONMENTAL FOOTPRINTS ASSOCIATED WITH REMEDY

4.5.1 ENERGY, AIR EMISSIONS, AND GREENHOUSE GASES

Direct energy usage for the site includes electricity, gasoline associated with personnel transportation, and diesel associated GAC transportation. Energy is also associated with manufacturing and disposal of GAC and laboratory analysis. Air emissions of greenhouse gases, nitrogen oxides (NOx) and sulfur oxides

(SOx) result from the direct energy usage and from manufacturing site-related materials. Greenhouse gas emissions are of global concern, and other pollutants are of more local concern as they adversely affect local/regional air quality. Briefly, NOx are respiratory irritants and precursors to ground level ozone. Sulfur dioxide is also a respiratory irritant and is a precursor to acid rain. Emissions of other pollutants may also be of concern, but these common pollutants were selected because emissions information is more readily available for them and they may be adequate indicators for other potential air emissions.

Footprint analysis spreadsheets currently under testing by USEPA Region 9 were used to calculate the energy and emissions footprints for the remedy on an annual basis (see Appendix B). Footprint results are summarized in the following table.

Green Remediation Parameter	**Annual Value (per year)**
Greenhouse gas emissions (carbon dioxide equivalents [CO_{2e}])	120,000 lbs
Criteria pollutant emissions	1,000 lbs
Hazardous air pollutant (HAP) emissions	14 lbs
Total energy use	1,100 MMBtus
% from renewable resources	~25%
Net groundwater extracted (extracted – reinjected)	0 gallons
Potable water use	0 gallons

Notes: CO_2e = carbon dioxide equivalents of global warming potential
Criteria pollutant emissions are limited to NOx, SOx, and PM emissions
MMBtus = 1,000,000 Btus

For the greenhouse gas emissions (CO_2e) approximately 31% is associated with electricity generation and transmission, 58% is associated with laboratory analysis, 10% is from transportation, and 1% is from GAC regeneration. The footprint associated with laboratory analysis is based on estimated factors to convert the analyses performed to green remediation parameters. These estimated factors are loose approximations because conversion factors associated with laboratory activities are not readily available. The laboratory footprint may therefore be higher or lower than that presented.

Material usage is limited to a small amount of GAC and bag filters. Waste disposal associated with this remedy is minimal (limited to the GAC). There are no activities associated with remedy operation that affect ecosystem services.

4.6 RECURRING PROBLEMS OR ISSUES

The site team did not report any recurring problems or issues.

4.7 REGULATORY COMPLIANCE

The remedy reliably meets regulatory requirements.

4.8 SAFETY RECORD

The site team did not report any health and safety incidents associated with remedy operation.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

The groundwater extraction and treatment system is preventing off-site migration of contaminants from the northern plume and has reduced concentration levels in the southern plume to cleanup levels. Minor amounts of PCE may be discharging to the Dennys River, but the impacted groundwater flux to the Dennys River is significantly less than the flow in the river. In addition, recent ecological sampling data indicate that remaining impacts do not pose and unacceptable risk to ecological receptors.

The properties north of Route 191 are owned by Maine DEP assuring that the groundwater will not be used prior to its attaining the cleanup levels and thereby ensuring the Site remains protective of human health. Sampling results of monitoring wells and residential water wells have demonstrated that there is no off-site contaminant migration to the east of the Dennys River. The monitoring program will continue to ensure that migration from the Site does not occur.

5.2 SURFACE WATER

Concentration levels in surface water, sediment, and biota sampling data have shown reductions in concentrations of contaminants of concern from the pre-ROD levels. As the 2000 ROD determined that those levels did not pose an unacceptable risk, the current data confirm that the Site is not posing an unacceptable risk to ecological receptors.

5.3 AIR

Air is not known to be an affected media.

5.4 SOIL

Site surface soils have been remediated, no known sources of soil impacts remain at the site.

5.5 WETLANDS AND SEDIMENTS

Please refer to Section 5.1 and 5.2.

6.0 RECOMMENDATIONS

Cost estimates provided herein have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30%/+50%), and these cost estimates have been prepared in a manner generally consistent with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, July, 2000. The costs presented do not include potential costs associated with community or public relations activities that may be conducted prior to field activities. The costs and sustainability impacts of these recommendations are summarized in Tables 6-1 and 6-2.

The recommendations provided in Sections 6.1 through 6.3 pertain to optimizing operation of the existing P&T system with the assumption that plume capture should prevent, to the degree possible, the plume from discharging to the Dennys River. Implementing the majority of these recommendations might require $40,000 in capital costs but could avoid $175,000 in costs per year bringing the cost for system operation to approximately $175,000 per year, which is more reasonable for this type of system. Section 6.4 provides an exit strategy with various options. Depending on EPA's interpretation of the exit strategy and choice regarding next steps, some of the recommendations presented in 6.1 through 6.3 may not apply. The reader is encouraged to read and evaluate Section 6.4 prior to deciding on a course of action on the recommendations in Sections 6.1 through 6.3.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 LOWER PNEUMATIC PUMPS IN NORTHERN EXTRACTION WELLS

Plume capture, particularly from MW-34B to MW-36B and vertical capture, appears to be incomplete. To improve vertical and horizontal capture and increase mass removal it is recommended that the pneumatic submersible pumps be lowered in the four northern most extractions wells in the north plume area. Based on the extraction well depth the pumps could be lowered approximately 35 feet in MW-35B, 15 feet in RW-2, 30 feet in RW-3, and 5 feet in RW-4. Pneumatic pumps fill and discharge faster when submerged under more water, even if the total head against the pump is the same. For example, a pneumatic pump that operates at 2 gpm at a depth of 110 feet and submerged under 20 feet of water may pump approximately 25% more than the same pump at a depth of 100 feet submerged under 10 feet of water as long as the air compressor provides a sufficient volume of air. The system was design to yield 30 gpm; therefore, the compressor should provide sufficient air for increased pumping rates. This recommendation could be implemented in short order in a few days with limited supplies. Assuming a day for travel, plus two days on site for two people, plus $4,000 for travel and supplies and preparation, this recommendation could be implemented for under $7,500. Implementing this recommendation should improve plume capture, but may still not result in complete capture.

6.1.2 EVALUATE CAPTURE BY MONITORING VERTICAL GRADIENTS AND CONCENTRATIONS IN SELECT WELLS

The process for evaluating plume capture should be revised. First, potentiometric surface maps prepared by Nobis should be improved for clarity and accuracy. Vertical gradients should be analyzed, and an even or upward gradient should be attempted in key well pairs (e.g., IN-1B1/1B2). Concentrations in IN-

1B2, MW-36B1, and MW-36B2 should be evaluated for decreasing concentrations. If capture is complete concentrations should eventually decrease in these wells to non-detect. Concentration decreases to non-detect in these wells would help confirm plume capture, but the wells would likely become recontaminated above standards if pumping was subsequently decreased or discontinued. Implementing this recommendation would not result in an increase in costs because the data collection and management is already being done.

6.2 RECOMMENDATIONS TO REDUCE COSTS

6.2.1 PERMANENTLY SHUT DOWN SOUTHERN EXTRACTION WELLS

The south extraction system has already been shut down indefinitely based on the low concentrations of PCE in this area. The most recent sampling results collected in May 2011 would support the decision to shut down this system permanently. While there are still PCE concentrations slightly above the MEG (but below the MCL) we believe these concentrations will naturally attenuate and result in no off-site migration of groundwater with contamination above cleanup levels at the property boundary/river interface. Groundwater monitoring should continue at the current frequency in the Southern Plume for a five-year period at which time the need to restart the system (unlikely) or decrease the monitoring frequency can be reevaluated. No costs or cost savings are associated with this recommendation because it generally reflects conditions at the time of the RSE site visit.

6.2.2 PERMANENTLY DISCONTINUE ION EXCHANGE TREATMENT FOR METALS

The use of ion exchange for metals removal has already been discontinued based on the low concentrations of metals (below MCL or MEG cleanup criteria) in the extracted groundwater. We agree that ion exchange treatment should be discontinued permanently. No costs or cost savings are associated with this recommendation because it generally reflects conditions at the time of the RSE site visit.

6.2.3 ELIMINATE METALS ANALYSIS

Based on past groundwater and process water analyses it is recommended that analysis of TAL metals be discontinued for all process water monitoring and significantly limited or reduced for groundwater monitoring. With the ion exchange system removed, the P&T system does not treat metals and extracted groundwater is reinjected into the aquifer. The continued metals analysis in the process sampling therefore does not provide information with respect to compliance or with respect to system operation. TAL metals in groundwater are limited to antimony, arsenic, lead, and manganese. The arsenic and manganese are likely due to natural conditions, and in the case of manganese, to the addition of sodium permanganate. The antimony is limited to one location, and lead is limited to five locations. Based on the last three rounds of sampling there does not appear to be any significant trends (up or down) in metals concentrations. Discontinuing metals analysis in the process sampling should save approximately $27,000 per year. Substantially reducing or eliminating metals analysis for groundwater should save approximately $5,000 to $8,000 per year.

6.2.4 REDUCE VOC PROCESS SAMPLING

Process sampling currently includes 11 samples (13 including a duplicate and trip blank) analyzed for VOCs per month. The two influent samples can be eliminated now that the Southern Extraction system has been shut down, and the two bag filter samples can be eliminated because bag filters do not address

VOCs and they are therefore redundant with the influent sample. The three samples collected between the GAC units can be reduced to quarterly or even less frequently given that the GAC change out schedule is relatively well established and lag units are available for treatment. Because the three lead GAC units are replaced together and the majority of the GAC replacement costs are due to mobilization rather than the cost of the GAC, a sample port should be added to the common piping between the GAC vessels so that only one mid-GAC sample is needed. The three effluent samples should be replaced with one blended sample. This may also require installation of a sample port. Making the changes would reduce the number of samples from 156 per year to 52 per year. This reduction should reduce analytical costs by approximately $15,000 per year and should also facilitate sample collection and data management and reporting. The site team should also consider using method 8260B or 624. Using these methods should not significantly affect data quality and could result in substantial reductions in laboratory analysis. Typical costs for 8260B are approximately $90 to $100 per sample compared to the $140 per sample quoted by the laboratory where analyses have been conducted for this site.

6.2.5 REDUCE OPERATOR AND PROCESS SAMPLING LABOR

The site contractor currently visits the site 3 days per week and performs inspections and records treatment system pressures and extraction well pump cycles. Based on the monthly reports, there is very little day to day change in the pressures or pump cycles. Maintenance items (e.g., bag filters and compressor maintenance) could be done on a weekly basis. Most systems of this nature/simplicity within the Superfund program are visited on a weekly basis. It is recommended that site visits be reduced to one day per week with 4 to 8 hours required per visit. Additional visits may be merited if non-routine issues arise.

The site contractor should train local staff to collect and ship the process samples. Sampling labor and travel associated with this travel could be almost eliminated because the sampling could be done during a routine visit, especially if fewer samples are needed (no metals analysis and reduced VOC sample points).

The RSE team estimates that these modifications will reduce labor from 12 hours per week to 6 hours per week and monthly labor from 12 hours per month to 2 hours per month. Travel costs associated with the monthly sampling (assume $250 per trip) will also be eliminated. In sum, the RSE team estimates that this will reduce annual costs by approximately $35,000 per year.

The site team should consider repairing the autodialer if the number of site visits is reduced to weekly. However, the recommendation for labor reduction should be implemented even if the autodialer cannot be repaired for some reason. If an alarm condition occurs, the system will shutdown, and the contractor can restart the system on the next visit. As long as upsets do not occur too frequently, the absence of the autodialer will not result in noticeable decreases in plume capture and remedy performance. Repair of the autodialer should be feasible for $5,000 to $10,000, including parts and on-site repair work.

6.2.6 SWITCH TO PASSIVE DIFFUSION BAG SAMPLING FOR GROUNDWATER MONITORING

With the elimination of metals analysis we recommend switching from low-flow sampling to passive diffusion bag (PDB) sampling procedures. This procedure would cut sampling labor costs in half for a savings of approximately $15,000 per year. There may need to be a comparison test on selected wells to demonstrate that PDB sampling produces comparable result to low flow sampling. The comparison test could be done for under $10,000. Alternatively, the site team could use Snap samplers or a comparable in-situ sampling device. Outfitting all wells with such devices would likely cost $25,000 or more and would result similar savings, but “pilot to purchase” programs are often available.

6.2.7 ELIMINATE ANNUAL SEDIMENT AND SURFACE WATER SAMPLING EVENTS

The long-term monitoring plan called for monitoring surface water, sediments, groundwater, and biota over the first 10 years of O&M to verify that the cleanup action at the Site is protective of human health and the environment. Based on the past results of theses sampling events it is recommended that sediment, surface water and biota sampling be discontinued because the cleanup action has been demonstrated to be protective of human health and the environment. Please refer to the summary of surface water, sediment, and biota sampling in Section 1.5.

6.2.8 THOROUGHLY REVIEW ANNUAL COSTS

The site team should thoroughly review the annual costs incurred by the site and compare them to the breakdown of costs provided by the RSE team in Section 4.4 of this report to determine where the additional costs are being incurred. Streamlining of the costs should be possible. Although savings from this review may not be realized under the EPA contract, they may be realized under operation by the State. Several P&T systems that were operated by EPA during LTRA were operated for substantially less by the States during O&M. The RSE team believes that savings on the order of $75,000 per year could be realized.

6.3 RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

6.3.1 SAMPLE EXTRACTION WELLS ANNUALLY

The last time individual extraction wells were sampled was in May 2009. We recommend annual sampling of the extraction wells to determine influent PCE concentrations and if and when certain wells can be shutdown. This sampling could be done during one of the semi-annual sampling events. It would not require extra labor, but would require extra cost associated with laboratory analysis of approximately $1,000 per year.

6.3.2 COLLECT VERTICAL PROFILE GROUNDWATER SAMPLES

To update the vertical distribution of PCE concentrations in the bedrock, a string of passive diffusion bags (or snap samplers) could be deployed and sampled in select monitoring and extraction wells in the northern plume. The PDBs could be spaced 10 to 20 feet apart (vertically) to identify concentration gradients and/or fracture zones containing relatively higher PCE concentrations. This information could be used to fine tune the vertical placement of the extraction well pumps and/or provide valuable information when considering the use of other remedial technologies. Assuming 40 additional PDBs are deployed during one of the semi-annual sampling events, the cost for implementing this recommendation should be under $15,000, including planning, laboratory analysis, processing the data, and summarizing the results in an annual report.

6.4 CONSIDERATIONS FOR GAINING SITE CLOSE OUT

6.4.1 DEVELOP AN EXIT STRATEGY BASED ON GROUNDWATER DISCHARGE TO THE RIVER

The concentration of PCE in groundwater still exceeds the cleanup criteria. However, the flux of PCE mass that ultimately discharges to Denny's River under current conditions (assuming incomplete capture) may be protective of human health and the environment. Analysis of the P&T system extraction rates and influent concentration suggests that approximately 3 pounds per year of PCE is removed by the P&T system. Therefore, in the absence of remedy pumping, an additional 3 pounds per year would discharge to the Dennys River. The Maine Atlantic Salmon Commission's Dennys River Instream Flow Study, October 2002 indicates that a minimum of 6 cfs is released through the fishway from Meddybemps Lake to the Dennys River but that actual flow is typically between 10 cfs and 30 cfs. Site documents have suggested an average flow of 9.3 cfs. If ideal mixing, no loss to vaporization, and a discharge of 3 lbs per year are assumed (equal to the mass currently captured by the P&T system) translates to a concentration of approximately 0.07 to 0.3 ug/L (for 30 to 6 cfs, respectively) in the Dennys River. The Federal surface water quality criteria, which the State of Maine adopts, has established values of 0.59 ug/L for consumption of drinking water and fish and 1.77 ug/L for consumption of fish. There are no aquatic life standards. Based on the above simplified calculation, this theoretical concentration would be protective of human health and the environment, but concentrations would likely be higher at the surface water groundwater interface where contaminated groundwater enters the river.

The site team could talk to Region 1 ecologists and State regulators to confirm what concentration of PCE would be acceptable for groundwater discharging to the Dennys River or for water in Dennys River. The site team could then devise and implement a sampling plan (during pumping conditions) to sample water in several locations at the groundwater surface water interface for PCE. The RSE team estimates that the cost of this type of study might be on the order of $75,000 to work with the above stakeholders, develop a plan, collect/analyze the samples, and document the results. The results of the analysis could be compared to the PCE concentration confirmed by the ecologist and State regulators. If the results exceed the standards, then improved plume capture is necessary and the site team will need to undertake efforts to improve extraction and demonstrate plume capture. If the results are under the set concentration, then pumping could likely continue. If the results are far under the set concentration, then efforts to capture the plume with the P&T system could be diminished in favor of more focused source area remediation. Below, considerations for each of these study conclusions are discussed:

- Decreased Contaminant Flux to River is Required – If this conclusion is reached, then plume capture needs to be improved in the area of highest VOC concentrations within and downgradient of the hot spot. If reducing contaminant flux to an acceptable level can be accomplished by lowering the well pumps in and downgradient of the hot spot using existing extraction wells, then little to no cost increase would be expected because changes or costs to operate the treatment plant would be relatively minimal given that the system was designed to extract and treat 30 gpm. However, investment would be required if additional extraction infrastructure and monitoring are needed to decrease the contaminant flux to acceptable levels. Using an alternate technology (e.g., bioremediation or in-situ chemical oxidation) to reduce contaminant flux would likely be difficult and costly to implement given the breadth and diffuse nature of the plume and the low levels that would need to be achieved. Source zone remediation could be considered, but would likely add substantial cost with an uncertain payback in terms of reduced remedy duration. Therefore, the RSE team believes focus should be placed on maintaining plume capture with the most streamlined cost-effective P&T system practical.

- Current Contaminant Flux is Acceptable – If this conclusion is reached, then the site team can choose between continuing to operate an optimized P&T system or implementing an alternate technology that would need to address the same volume of the aquifer that is currently captured. This volume is relatively substantial and may be several hundred feet by several hundred feet wide and up to 100 feet deep. The RSE team believes that operation of an optimized P&T system is likely more cost-effective than investing in the testing, infrastructure, implementation, and monitoring of the alternate technology.

- Increased Contaminant Flux to River is Acceptable – If this conclusion is reached, then the site team has the opportunity to focus remedial efforts on limited source areas. This could be done by focusing on source area groundwater extraction or by using alternative technologies. A source area groundwater remedy would involve operation of the current system with focus only on source area extraction wells. The costs for operating this system would be similar to current costs (perhaps a little less). Under this scenario, some of the extraction wells should be pulsed to see if the rebounding water level could help mobilize and clean contamination in the overburden (e.g., near MW-43S). An alternate technology (e.g., in-situ chemical oxidation or in-situ bioremediation) could likely benefit from the existing injection wells. The RSE team notes that the chemical oxidation efforts in the northern plume were successful in reducing concentrations. Although concentrations rebounded, they rebounded lower than the original concentrations, and several repeated injection events could significantly accelerate remediation. In-situ bioremediation could also be attempted by adding electron donor to the subsurface to promote anaerobic degradation. The following information is offered to the site team when considering in-situ bioremediation.

    - The primary challenge with in-situ bioremediation (or in-situ chemical oxidation) is delivering the reagents to the contamination. This is particularly challenging in a fractured bedrock environment. For this reason, testing efforts should be placed on a field pilot test that incorporates reagent delivery rather than on bench testing various electron donors for reductive dechlorination. Many electron donors have been proven successful and delivery rates are more often based on an estimate of the soil adsorptive capacity than on water quality stoichiometry. The RSE team recommends a prepared emulsified vegetable oil product delivered in a 2% to 5% solution. The existing infrastructure could be easily modified to test electron donor circulation within the impacted zone in the northern plume area. For example, a circulation couplet could be established between MW-35B and RW-4. Electron donor could be applied to MW-35B and RW-4 could help pull the electron donor in that direction. There are several monitoring wells in the area that could help determine the lateral distribution the electron donor. The RSE team recommends that a tracer test be performed ahead of electron donor injection to help predict the potential pathways. The tracer an also be used to estimate effective porosity and groundwater travel times. Donor longevity, distribution and success initiating reductive dechlorination could be assessed. Dehalococcoides containing bacterial culture could be added after a few months if favorable conditions have been established and ethene production is lacking. Monitoring should include VOCs, methane, ethane, ethene, total organic carbon, ferrous iron, and oxidation-reduction potential.

    - Bioremediation may mobilize metals from the formation, including iron, manganese, arsenic, and other metals. These mobilized metals, particularly the arsenic, may be more hazardous to human health and the environment than the PCE that is the target of remediation.

- The primary porosity of the Gabbro-diorite and granite bedrock is almost zero, and the secondary porosity may be as low as 1% to 2%. This low porosity can result in fast transport from the injection area to other locations, comparable to what was witnessed in the previous chloride tracer test. As a result, electron donor, mobilized metals, and/or the oxygen demand the electron donor places on the groundwater may transport rapidly to MW-36B and/or the Dennys River. The site team should review the previous chemical oxidation tests to determine if evidence of rapid transport to the river was evident.

- The P&T system should be shut down during the full extent of the pilot test. For bioremediation to be successful, anaerobic conditions need to be maintained. Pumping enhances mixing of oxygenated water which can eliminate anaerobic conditions and promote substantial biological growth and fouling. In addition the GAC in the treatment plant would remove the organic carbon that has been delivered to the subsurface to enhance bioremediation.

- The duration of the donor in the subsurface and the frequency of future maintenance injections is uncertain. At sites with high groundwater flow, maintenance injections can be required once every one to two years. At sites with tighter formations, maintenance injections may be required once every five or more years. Although groundwater flow at this site is relatively low, the porosity is also very low, suggesting that groundwater may move very quickly in fractures. It is therefore difficult to predict how long the electron donor will last.

- Assuming existing infrastructure can be used and a treatment volume of 50 feet by 100 feet in area and a depth of 100 feet is assumed, the cost for pilot test may be on the order of $200,000, including planning, implementation, monitoring quarterly for a two year period from 10 wells, and documenting results. Additional funding may be required to continue groundwater monitoring at some or all of the wells not included in the 10 performance monitoring wells. Future events could likely be done with a slightly modified plan, semi-annual performance sampling, and simplified reporting for approximately $125,000. Once again, additional funding may be needed to continue groundwater monitoring at some or all of the wells not included in the performance monitoring program. If adverse conditions (e.g., mobilized arsenic) are not observed, degradation appears to be occurring, and repeat injections are required once every year or more, then it is likely more cost-effective to continue with future injection events than to reduce P&T operation.

Based on the findings from the groundwater surface water interaction study, the site team should determine the maximum concentration that can be left in groundwater to naturally attenuate without active treatment or containment.

6.5 Recommendations for Additional Green Practices

Most of the recommendations provided above have a significant influence on green remediation factors. The effects are summarized in Table 6.2.

Table 6-1. Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-Cycle Costs $*	Discounted Estimated Change in Life-Cycle Costs $**
6.1.1 LOWER PNEUMATIC PUMPS IN NORTHERN EXTRACTION WELLS	Effectiveness	$7,500	$0	$7,500	$7,500
6.1.2 EVALUATE CAPTURE BY MONITORING VERTICAL GRADIENTS AND CONCENTRATIONS IN SELECT WELLS	Effectiveness	$0	$0	$0	$0
6.2.1 PERMANENTLY SHUT DOWN SOUTHERN EXTRACTION WELLS	Cost Reduction	$0	$0	$0	$0
6.2.2 PERMANENTLY DISCONTINUE ION EXCHANGE TREATMENT FOR METALS	Cost Reduction	$0	$0	$0	$0
6.2.3 ELIMINATE METALS ANALYSIS	Cost Reduction	$0	($35,000)	($1,050,000)	($686,000)
6.2.4 REDUCE VOC PROCESS SAMPLING	Cost Reduction	$0	($15,000)	($450,000)	($294,000)
6.2.5 REDUCE OPERATOR AND PROCESS SAMPLING LABOR	Cost Reduction	$5,000 To $10,000	($35,000)	($1,045,000) To ($1,040,000)	($681,000) To ($676,000)
6.2.6 SWITCH TO PASSIVE DIFFUSION BAG SAMPLING FOR GROUNDWATER MONITORING	Cost Reduction	$10,000	($15,000)	($440,000)	($284,000)
6.2.7 ELIMINATE ANNUAL SEDIMENT AND SURFACE WATER SAMPLING EVENTS	Cost Reduction	$0	$0	$0	$0

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-Cycle Costs $*	Discounted Estimated Change in Life-Cycle Costs $**
6.2.8 THOROUGHLY REVIEW ANNUAL COSTS	Cost Reduction	$0	($75,000)	($2,250,000)	($1,470,000)
6.3.1 SAMPLE EXTRACTION WELLS ANNUALLY	Technical Improvement	$0	$1,000	$30,000	$19,600
6.3.2 COLLECT VERTICAL PROFILE GROUNDWATER SAMPLES	Technical Improvement	$15,000	$0	$15,000	$15,000
6.4.1 DEVELOP AN EXIT STRATEGY BASED ON GROUNDWATER DISCHARGE TO THE RIVER	Site Closure	$75,000	Not quantified		

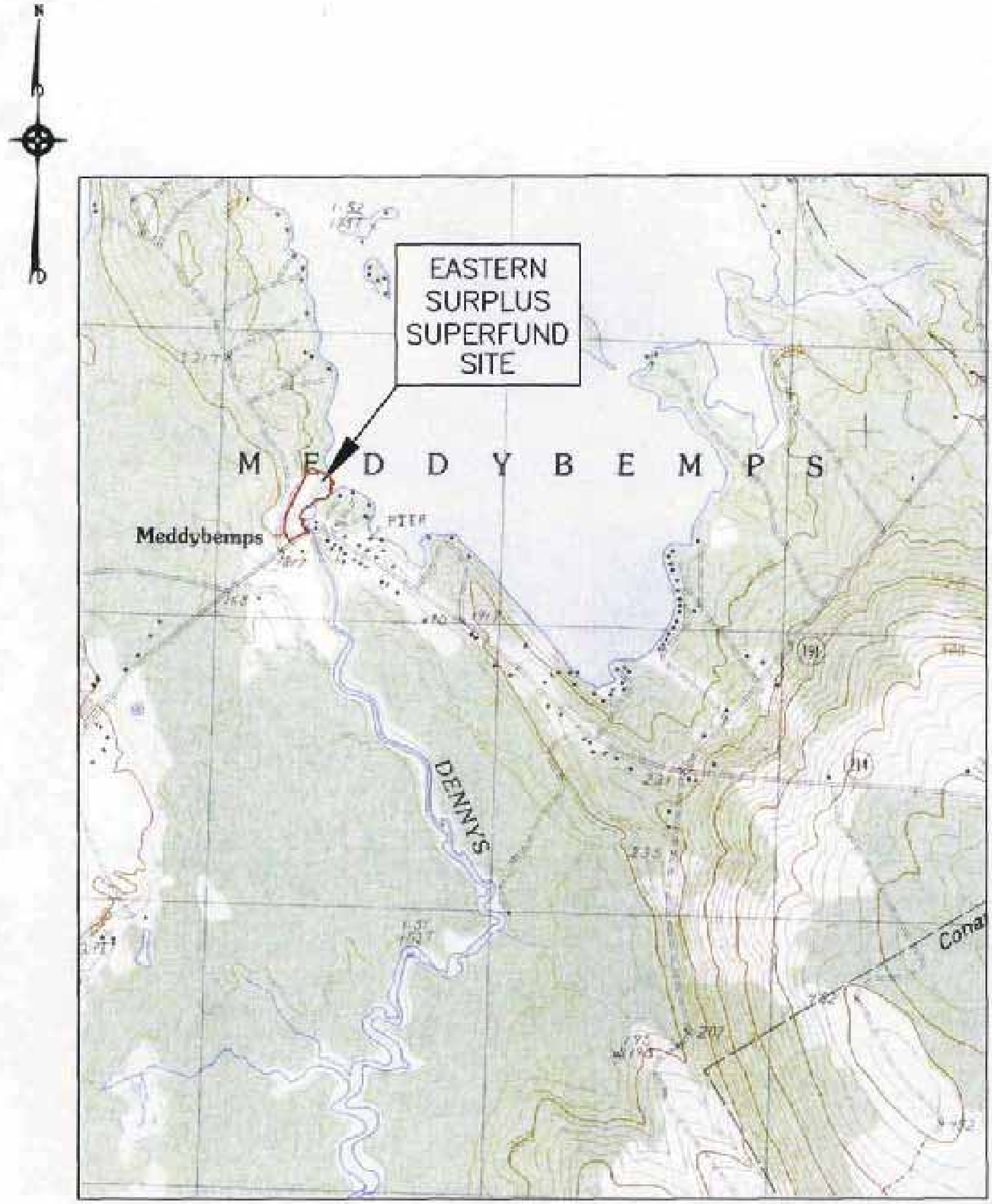
Costs in parentheses imply cost reductions
* assumes 30 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 30 years of operation with a discount rate of 3%

Table 6-2. Green Remediation Summary Table

Recommendation	Reason	Green Remediation Effects
6.1.1 LOWER PNEUMATIC PUMPS IN NORTHERN EXTRACTION WELLS	Effectiveness	Minimal effect on any green remediation parameters
6.1.2 EVALUATE CAPTURE BY MONITORING VERTICAL GRADIENTS AND CONCENTRATIONS IN SELECT WELLS	Effectiveness	Minimal effect on any green remediation parameters
6.2.1 PERMANENTLY SHUT DOWN SOUTHERN EXTRACTION WELLS	Cost Reduction	Should help reduce electricity use by air compressor and transfer pump, but the reduction is not quantified. Reductions in electricity use will result in reductions in energy use, greenhouse gas emissions and criteria air pollutants.
6.2.2 PERMANENTLY DISCONTINUE ION EXCHANGE TREATMENT FOR METALS	Cost Reduction	Minimal effect because this is a continuation of practices observed at the time of the RSE site visit
6.2.3 ELIMINATE METALS ANALYSIS	Cost Reduction	Based on the estimated footprint conversion factors used in this study for laboratory analysis, this recommendation should help lead to a substantial reduction in energy and emission footprints.
6.2.4 REDUCE VOC PROCESS SAMPLING	Cost Reduction	Based on the estimated footprint conversion factors used in this study for laboratory analysis, this recommendation should help lead to a substantial reduction in energy and emission footprints.
6.2.5 REDUCE OPERATOR AND PROCESS SAMPLING LABOR	Cost Reduction	Implementing this recommendation should reduce personnel transportation to and from the site, which will reduce fuel usage and the associated energy and emission footprints.
6.2.6 SWITCH TO PASSIVE DIFFUSION BAG SAMPLING FOR GROUNDWATER MONITORING	Cost Reduction	The primary reductions associated with this approach will be in reducing transportation to and from the site. The footprints associated with sample collection are relatively minimal.

Recommendation	Reason	Green Remediation Effects
6.2.7 ELIMINATE ANNUAL SEDIMENT AND SURFACE WATER SAMPLING EVENTS	Cost Reduction	Based on the estimated footprint conversion factors used in this study for laboratory analysis, this recommendation should help lead to a substantial reduction in energy and emission footprints.
6.2.8 THOROUGHLY REVIEW ANNUAL COSTS	Cost Reduction	Minimal effect on any green remediation parameters
6.3.1 SAMPLE EXTRACTION WELLS ANNUALLY	Technical Improvement	Slight increase in the energy and other metrics
6.3.2 COLLECT VERTICAL PROFILE GROUNDWATER SAMPLES	Technical Improvement	Based on the estimated footprint conversion factors used in this study for laboratory analysis, this recommendation, could contribute to slight increases in the energy and emission footprints.
6.4.1 DEVELOP AN EXIT STRATEGY BASED ON GROUNDWATER DISCHARGE TO THE RIVER	Site Closure	Implementation of the first stage of this recommendation will lead to slight increases in the energy and emission footprint. The results of the recommendation could lead to remedy modifications that could substantially modify the remedy footprint. These modifications are too uncertain to quantify at this time.

ATTACHMENT A
FIGURES FROM EXISTING REPORTS
(with RSE figure number labeled by RSE team)



BASEMAP: U.S.G.S. QUADRANGLE MAP: MEDDYBEMPS LAKE EAST, MAINE, PROVISIONAL EDITION, 1987

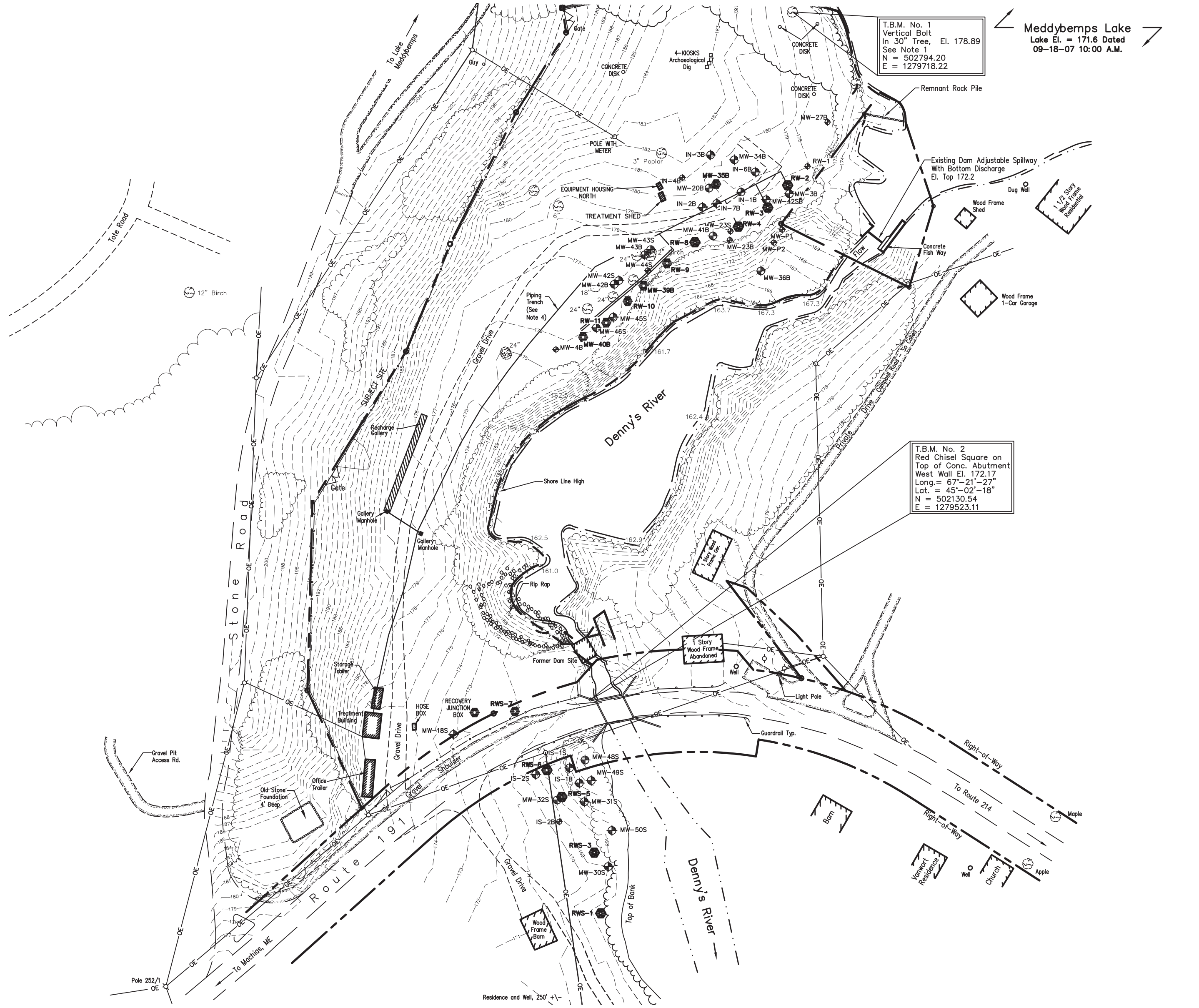
½ 0 ½ 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

QUADRANGLE LOCATION

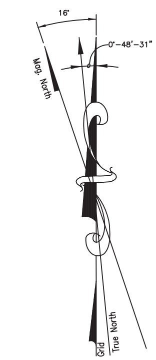
Site Location Map	FYR Figure 1 RSE-1-1
EASTERN SURPLUS COMPANY SITE	TETRA TECH NUS, INC.
MEDDYBEMPS, MAINE	55 Jonspin Road Wilmington, MA 01887 (978)658-7899

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	K. O'NEILL	DATE:	AUGUST 29, 2006
SCALE:	AS SHOWN	ACAD NAME:	\1477\0750\R0813780\FIG_1-1.DWG

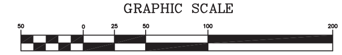


LEGEND

- MW-23B — MONITORING WELL
- MW-35B — RECOVERY WELL USED AS MONITORING WELL
- RW-1 — RECOVERY WELL (5' DIA. CONCRETE MANHOLE)
- UTILITY POLE
- IRON PIN FOUND (AS NOTED)
- MONUMENT (AS NOTED)
- EXISTING TREES: HDWD & EVERGREEN
- AQUIFER ZONE BOUNDARY
- PROPERTY LINE
- ABUTTING PROPERTY LINE
- EXISTING TREE LINE
- OE — EXISTING OVERHEAD ELECTRIC & TELEPHONE
- EXISTING GUARDRAIL
- EXISTING FENCE
- BROOK / POND
- GRAVEL / BIT — EXISTING ROAD OR DRIVEWAY
- EXISTING CULVERT
- EXISTING BUILDING



GRAPHIC SCALE



(IN FEET)
1 inch = 100 ft.

General Notes:

1. ELEVATIONS ARE BASED ON U.S.G.S. NGVD 1929 MEAN SEA LEVEL. INFORMATION TO DATUM WAS SUPPLIED BY THE REGIONAL MANAGER OF ME – VT– CT SUPERFUND

2. TOPOGRAPHIC/INSTRUMENT SURVEY PERFORMED BY OEST ASSOCIATES, INC. DATED, SEPTEMBER, 2007. INSTRUMENTS USED: LIETZ SOKKIA SET 3-B WITH ELECTRONIC FIELD BOOK, SDR33.

3. UTILITIES SHOWN ON PLAN ARE LOCATED APPROXIMATELY AND SHALL BE FIELD VERIFIED PRIOR TO EXCAVATION DIG SAFE. LOCATIONS SHOWN ARE BASED ON PHYSICAL LOCATIONS AND/OR MAPS FROM THE RESPECTIVE UTILITY COMPANIES.

4. RECOVERY PIPE TRENCH LOCATED UNDER DIRECTION OF SITE ENGINEER DURING JANUARY 2000. THE ENTIRE TRENCH SYSTEM HAS NOT BEEN FIELD LOCATED.

Nobis
Nobis Engineering, Inc.
Concord, NH
Lowell, MA
www.nobisengineering.com

DESIGN	OEST
DRAFTING	DWG
CHECKED	SWH
APPROVED	SWH

DATE	REVISIONS	CK
1/14/09	REVISION 0	SWH

PROJECT NAME & ADDRESS:
EASTERN SURPLUS COMPANY SITE
ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: OCTOBER 2010

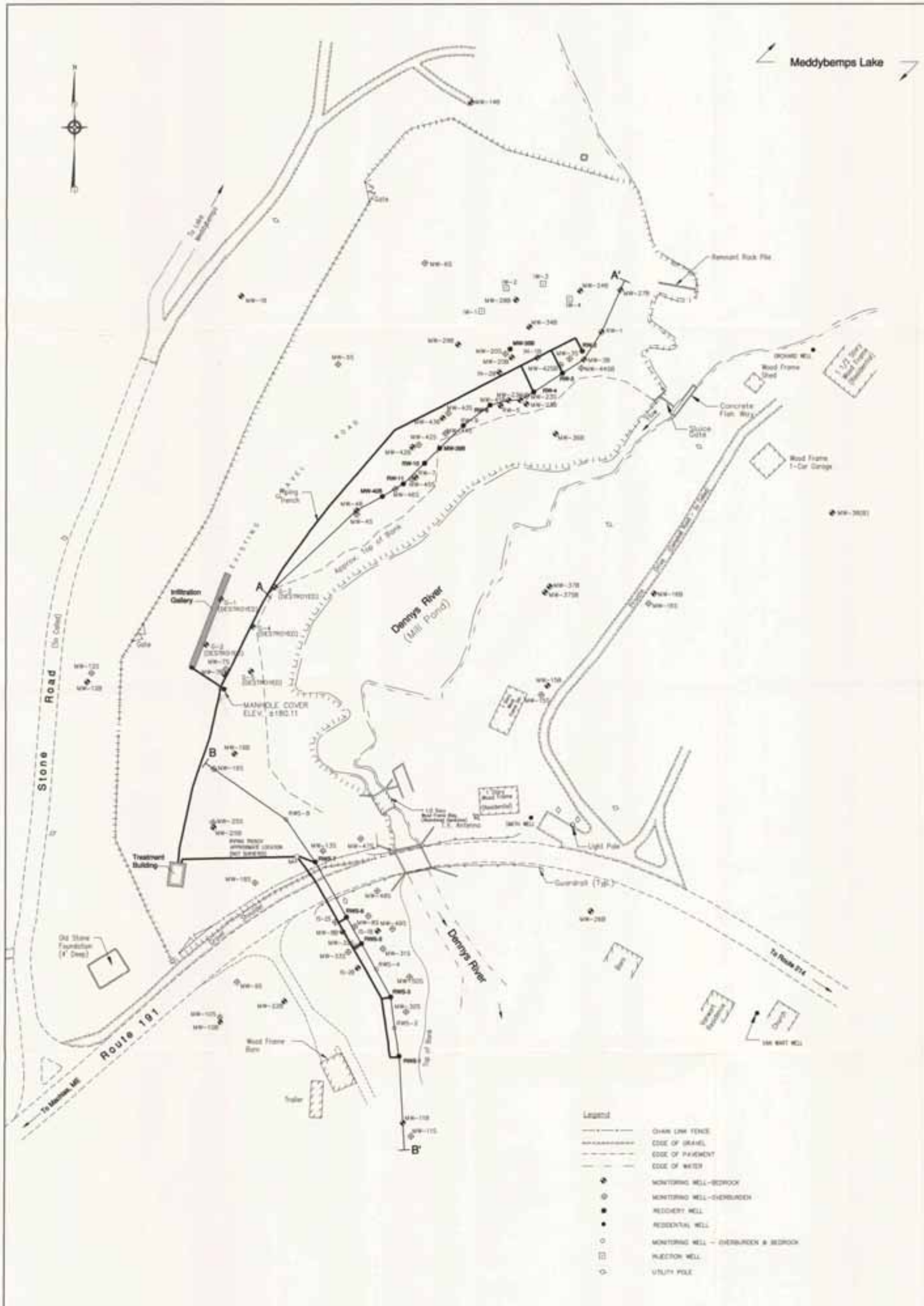
DRAWING NAME:
SITE PLAN WITH AQUIFER ZONES

PROJECT #: 80005.01

FIGURE 2–1

RSE1-2

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW Spring 2010.dwg



NOTES:
1. ELEVATIONS ARE BASED ON U.S.G.S. (NGVD 1929) MEAN SEA LEVEL.
2. BEARINGS ARE BASED ON MAINE STATE GRID COORDINATE SYSTEM (EAST ZONE) "NAD 83". DISTANCES SHOWN ARE GROUND DISTANCES AND ARE NOT REDUCED BY GRID AND ELEVATION FACTORS. CONTROL STATIONS USED: GREEN......N = [illegible] E = [illegible] ALEX......N = [illegible] E = [illegible]
3. WELLS MW-47S TO MW-50S LOCATIONS APPROXIMATE, ALL OTHER WELL LOCATIONS SURVEYED.
4. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
5. PLAN NOT TO BE USED FOR DESIGN.

GRAPHIC SCALE
1 INCH = 40 FEET

DRAWN BY: D.W. MACDOUGALL
PREPARED BY: G. RACE
CHECKED BY: C. RACE
PROJECT MANAGER: L. CHU
PROGRAM MANAGER: G. GARDNER

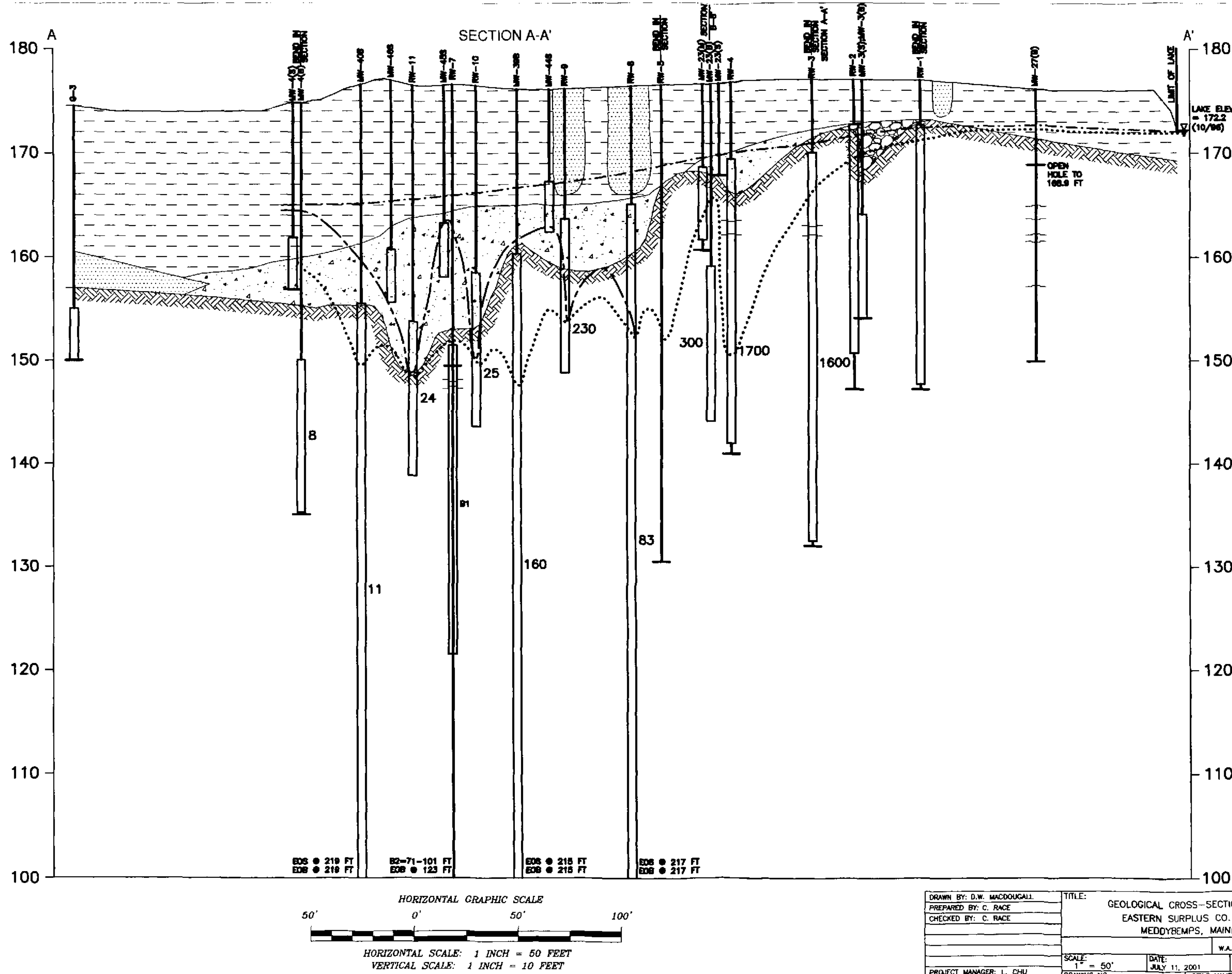
TITLE: WELL LOCATIONS AND CROSS SECTION LINES
EASTERN SURPLUS CO. SITE – MEDDYBEMPS, MAINE

SOURCE: TOPOGRAPHIC/INSTRUMENT SURVEY PERFORMED BY EAST ASSOC. INC. DATED: OCTOBER 1998, UPDATED: JAN. 2000, APR. 2001

SCALE: 1" = 40'
DATE: JULY 21, 2001
DRAWING NO.: FIGURE 1-2

RSE-1-3

TETRA TECH NUS, INC.



NOTES:

1. THE DEPTH, THICKNESS, AND CONTINUITY OF THE SUBSURFACE MATERIALS INDICATED ON THE PROFILES WERE GENERALIZED FROM, AND INTERPOLATED BETWEEN SUBSURFACE BORINGS FROM DATA REPORTED ON BORING LOGS. INFORMATION REGARDING SUBSURFACE CONDITIONS AND WATER LEVELS EXISTS ONLY AT THE SPECIFIC LOCATION OF EACH BORING AND AT THE TIME THE BORING WAS SAMPLED. THE LINES DEPICTING THE DISTRIBUTION OF THE SUBSURFACE MATERIALS REPRESENT AN ESTIMATED, APPROXIMATE BOUNDARY, AND THE ACTUAL BOUNDARIES MAY DIFFER FROM THOSE SHOWN. THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN SOIL CONDITIONS AND/OR WATER LEVELS FROM THOSE SHOWN.

2. PLAN NOT TO BE USED FOR DESIGN.

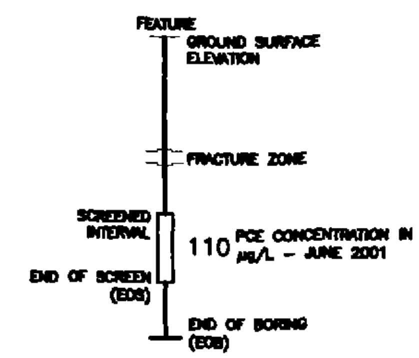
3. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.

LEGEND:

- SAND/SILT/GRAVEL
- SANDS/GRAVEL (FILL)
- SILT/CLAY/SAND/GRAVEL (TILL)
- BOULDERS/COBBLES
- BEDROCK

- OVERBURDEN POTENTIOMETRIC SURFACE – NON-PUMPING CONDITIONS – JUNE 6, 2001
- OVERBURDEN POTENTIOMETRIC SURFACE – NORTHERN EXTRACTION WELLS PUMPING – JUNE 22, 2001
- SHALLOW BEDROCK POTENTIOMETRIC SURFACE – NORTHERN EXTRACTION WELLS PUMPING – JUNE 22, 2001

FEATURE LEGEND:

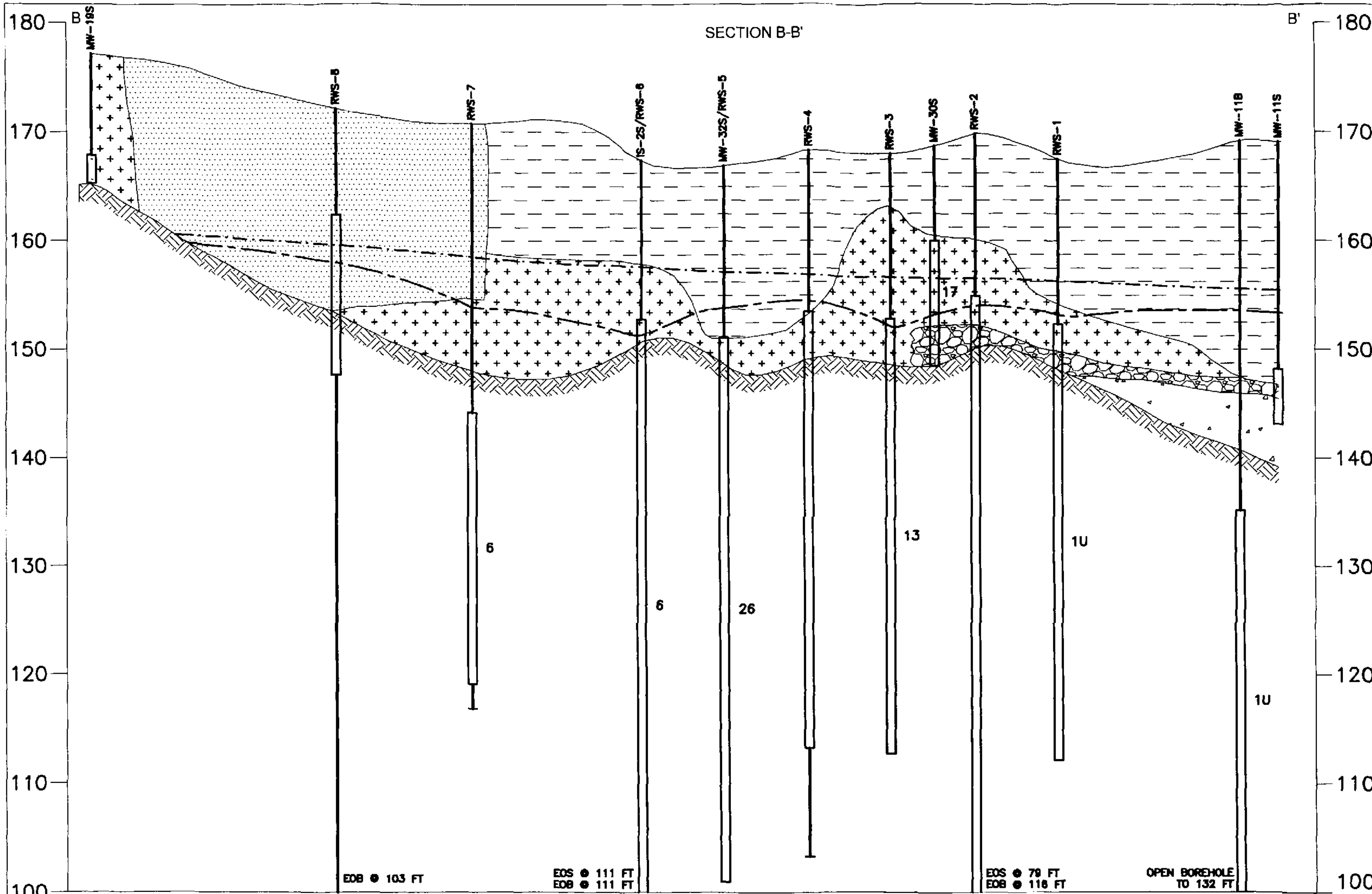


DRAWN BY: D.W. MACDOUGALL	TITLE: GEOLOGICAL CROSS-SECTION A-A' EASTERN SURPLUS CO. SITE MEDDYBEMPS, MAINE
PREPARED BY: C. RACE	W.A.NO.: 015-RICO-0189
CHECKED BY: C. RACE	SCALE: 1" = 50' / DATE: JULY 11, 2001 / PROJ. NO: 7631.0640
PROJECT MANAGER: L. CHU	DRAWING NO: FIGURE 1-3 / ACFILE NAME: DWG\3000\1102\FIG_1-3.DWG / REV: 0
PROGRAM MANAGER: G. GARDNER	

RSE-1-4

TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658-7899

See Figure RSE 1-3 for Cross-Section Location



1. THE DEPTH, THICKNESS, AND CONTINUITY OF THE SUBSURFACE MATERIALS INDICATED ON THE PROFILES WERE GENERALIZED FROM, AND INTERPOLATED BETWEEN SUBSURFACE BORINGS FROM DATA REPORTED ON BORING LOGS. INFORMATION REGARDING SUBSURFACE CONDITIONS AND WATER LEVELS EXISTS ONLY AT THE SPECIFIC LOCATION OF EACH BORING AND AT THE TIME THE BORING WAS SAMPLED. THE LINES DEPICTING THE DISTRIBUTION OF THE SUBSURFACE MATERIALS REPRESENT AN ESTIMATED, APPROXIMATE BOUNDARY, AND THE ACTUAL BOUNDARIES MAY DIFFER FROM THOSE SHOWN. THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN SOIL CONDITIONS AND/OR WATER LEVELS FROM THOSE SHOWN.

2. PLAN NOT TO BE USED FOR DESIGN.

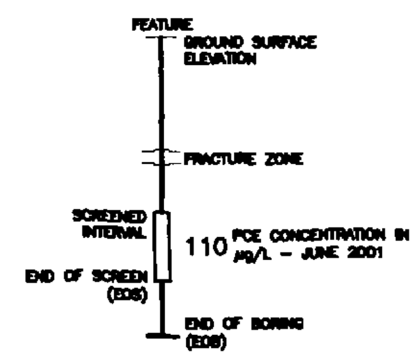
3. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.

4. LOCATIONS OF MW-3(B), MW-3(S), RW-2 WERE PROJECTED TO SECTION LINE.

LEGEND:

- SAND/SILT/GRAVEL
- SANDS/GRAVEL
- SANDS/GRAVEL (FILL)
- SILT/CLAY/SAND/GRAVEL (TILL)
- BOULDERS/COBBLES
- BEDROCK
- OVERBURDEN POTENTIOMETRIC SURFACE – NON-PUMPING CONDITIONS – JUNE 6, 2001
- OVERBURDEN POTENTIOMETRIC SURFACE – SOUTHERN EXTRACTION WELLS PUMPING – JUNE 11, 2001

FEATURE LEGEND:



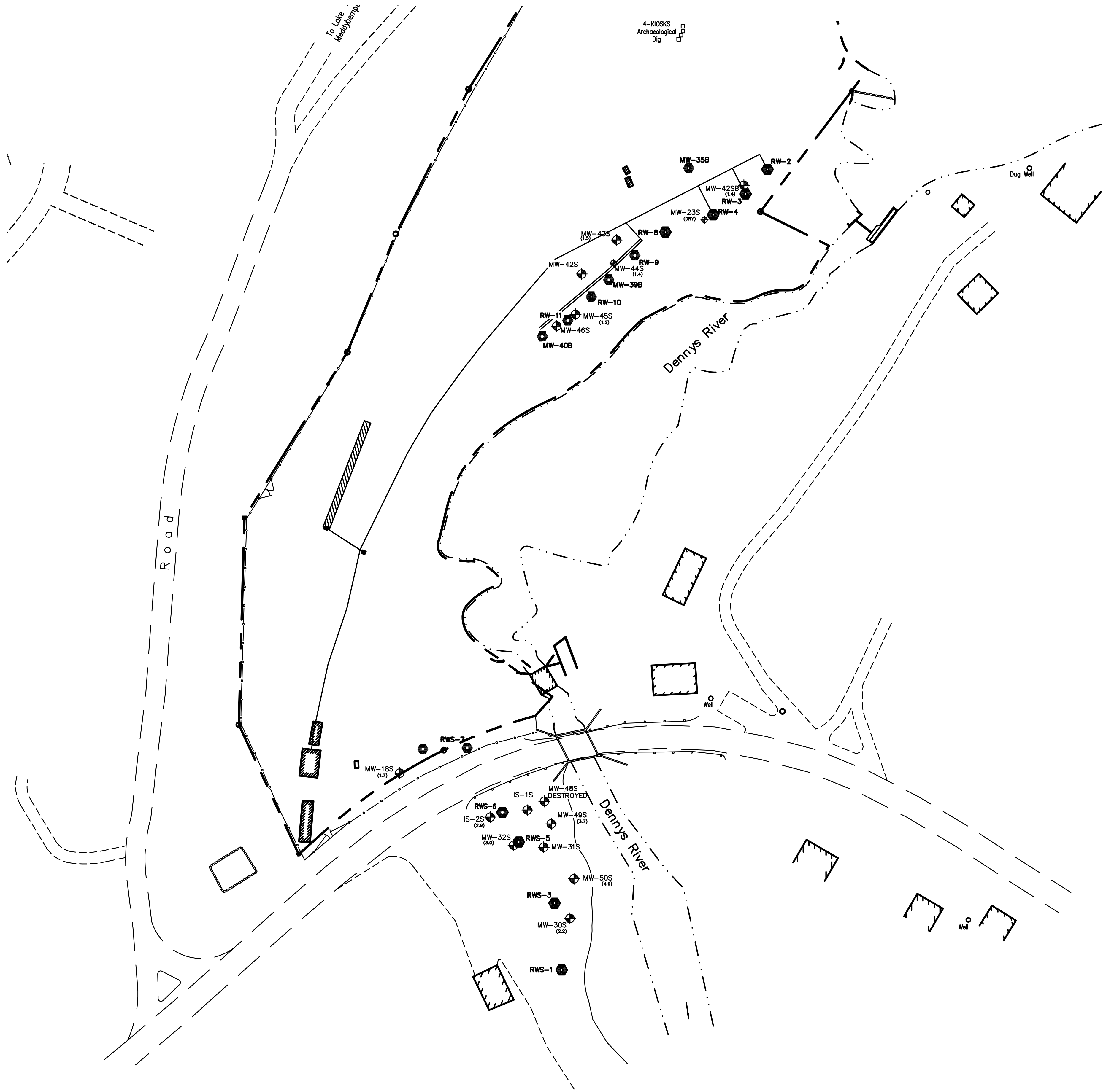
HORIZONTAL GRAPHIC SCALE

40' 0' 40' 80'

HORIZONTAL SCALE: 1 INCH = 40 FEET
VERTICAL SCALE: 1 INCH = 10 FEET

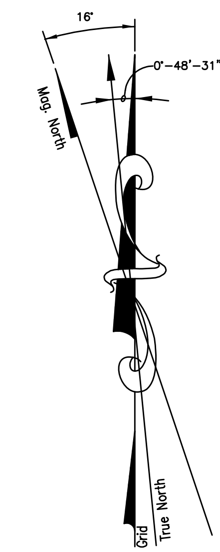
DRAWN BY: D.W. MACDOUGALL	TITLE: GEOLOGICAL CROSS-SECTION B-B' EASTERN SURPLUS CO. SITE MEDDYBEMPS, MAINE	RSE-1-5
PREPARED BY: C. RACE	W.A.NO.: 015-RICO-0189	TETRA TECH NUS, INC.
CHECKED BY: C. RACE	SCALE: 1" = 50'	DATE: JULY 11, 2001	PROJ. NO: 7631.0640	55 JONSPIN ROAD WILMINGTON, MASSACHUSETTS 01887 (978)658-7899
PROJECT MANAGER: L. CHU	DRAWING NO: FIGURE 1-4	ACFILE NAME: [illegible]	REV: 0
PROGRAM MANAGER: G. GARDNER		

See Figure RSE 1-3 for Cross-Section Location



LEGEND

⊕	MW-34B (30)	MONITORING WELL AND PCE CONCENTRATION (ug/L, SPRING 2010)
⬢	RW-1	RECOVERY WELL (5' DIA. CONCRETE MANHOLE)



GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 100 ft.

General Notes:

1. REFER TO FIGURE 1-2 FOR ADDITIONAL NOTES AND LEGEND.

2. DISSOLVED-PHASE PCE CONCENTRATIONS WERE OBTAINED FROM GROUNDWATER SAMPLES COLLECTED BY NOBIS ENGINEERING, INC. BETWEEN MAY 10, 2010 AND MAY 14, 2010, IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE OVERBURDEN AQUIFER ZONE.

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Concord, New Hampshire 03301
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www.nobiseng.com

DESIGN	OEST
DRAFTING	DWG
CHECKED	SWH
APPROVED	SWH

DATE	REVISIONS	CK
1/14/09	REVISION 0	SWH

PROJECT NAME & ADDRESS:
EASTERN SURPLUS COMPANY SITE
ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

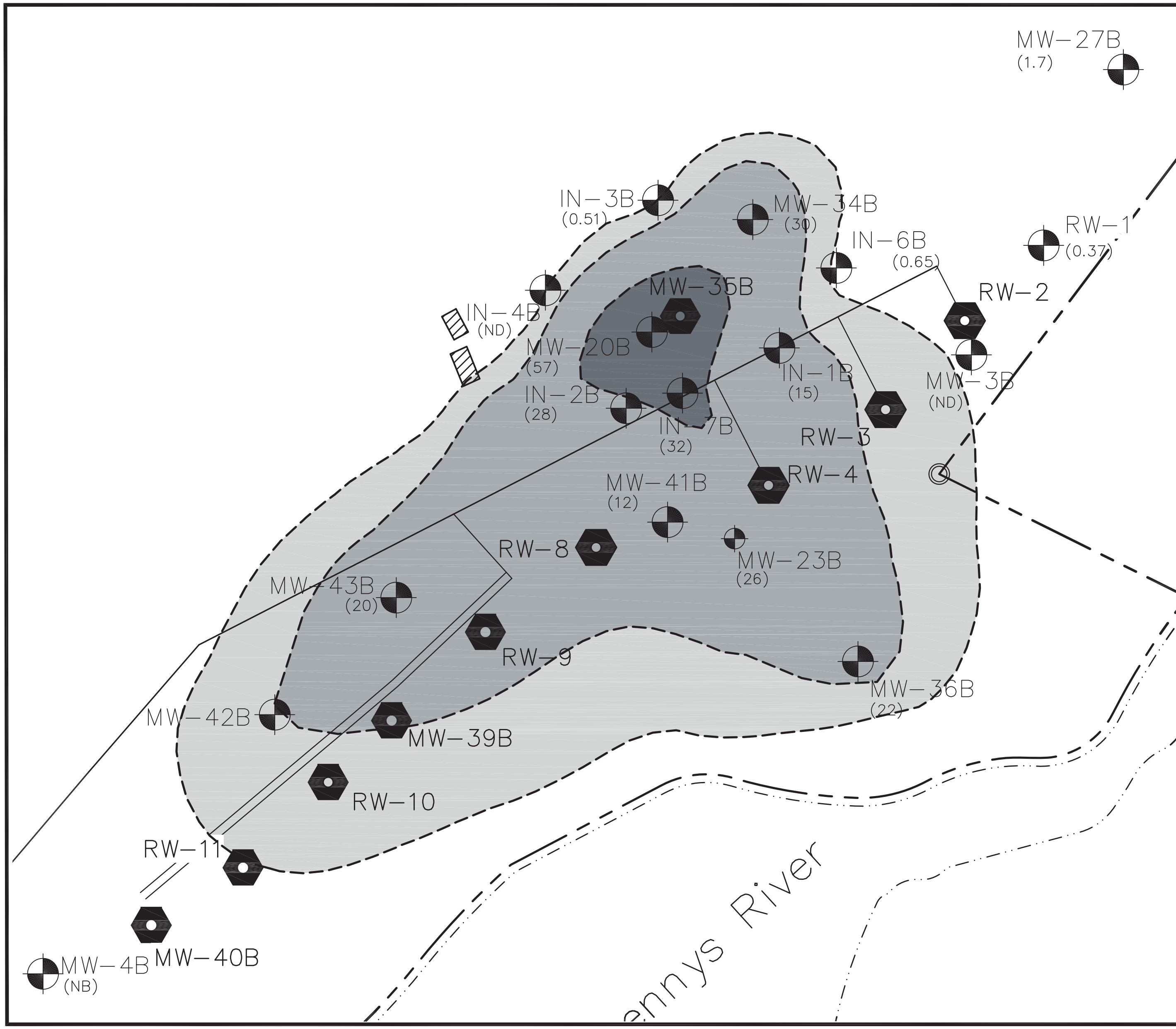
DRAWING NAME:
SPRING 2010 OVERBURDEN PCE CONCENTRATION DISTRIBUTION

PROJECT #: 80005.05

FIGURE 3-1

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW ADS 2010.dwg

RSE-1-6



LEGEND

MW-34B (30) — MONITORING WELL AND PCE CONCENTRATION (ug/L, SPRING 2010)

MW-35B — RECOVERY WELL (5' DIA. CONCRETE MANHOLE)

PCE CONCENTRATIONS (ug/L) – SPRING 2010

- 3 – 10
- 11 – 30
- 31 – 50

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 100 ft.

General Notes:

1. REFER TO FIGURE 1–2 FOR ADDITIONAL NOTES AND LEGEND.

2. DISSOLVED–PHASE PCE CONCENTRATIONS WERE OBTAINED FROM GROUNDWATER SAMPLES COLLECTED BY NOBIS ENGINEERING, INC. BETWEEN MAY 10, 2010 AND MAY 14, 2010 IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE UPPER BEDROCK AQUIFER ZONES.

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DATE	REVISIONS	CK

PROJECT NAME & ADDRESS:
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ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

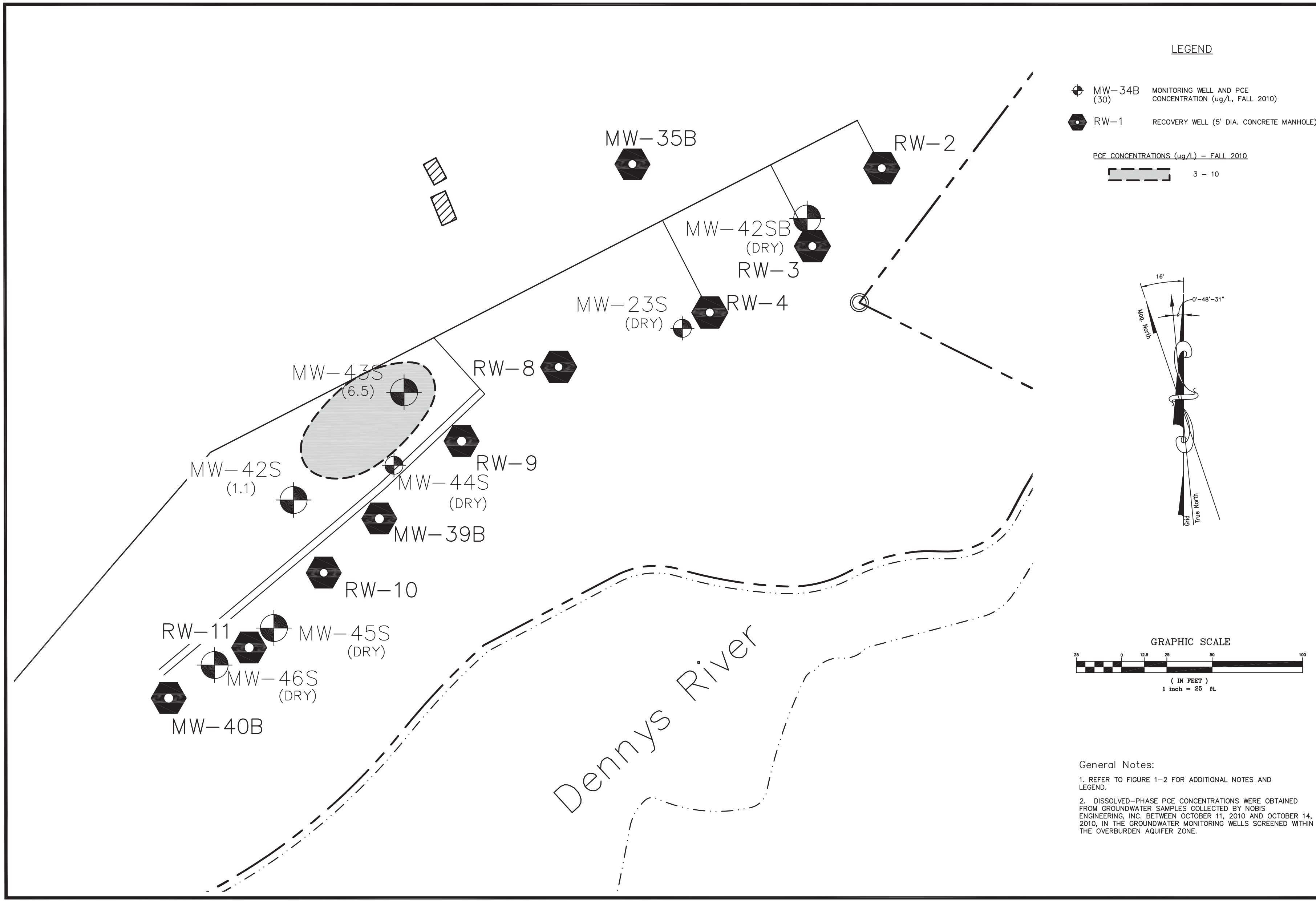
DRAWING NAME:
SPRING 2010 NORTHERN BEDROCK PCE CONCENTRATION DISTRIBUTION

PROJECT #: 80005.05

FIGURE 3–2

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW ADS 2010.dwg

RSE-1-7



LEGEND

MW−34B (30) MONITORING WELL AND PCE CONCENTRATION (ug/L, FALL 2010)

RW−1 RECOVERY WELL (5' DIA. CONCRETE MANHOLE)

PCE CONCENTRATIONS (ug/L) − FALL 2010

3 − 10

GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

General Notes:

1. REFER TO FIGURE 1−2 FOR ADDITIONAL NOTES AND LEGEND.

2. DISSOLVED−PHASE PCE CONCENTRATIONS WERE OBTAINED FROM GROUNDWATER SAMPLES COLLECTED BY NOBIS ENGINEERING, INC. BETWEEN OCTOBER 11, 2010 AND OCTOBER 14, 2010, IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE OVERBURDEN AQUIFER ZONE.

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APPROVED	SWH

DATE	REVISIONS	CK
1/14/09	REVISION 0	SWH

PROJECT NAME & ADDRESS:
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ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

DRAWING NAME:
FALL 2010 NORTHERN OVERBURDEN PCE CONCENTRATION DISTRIBUTION

PROJECT #: 80005.05

FIGURE 3−3

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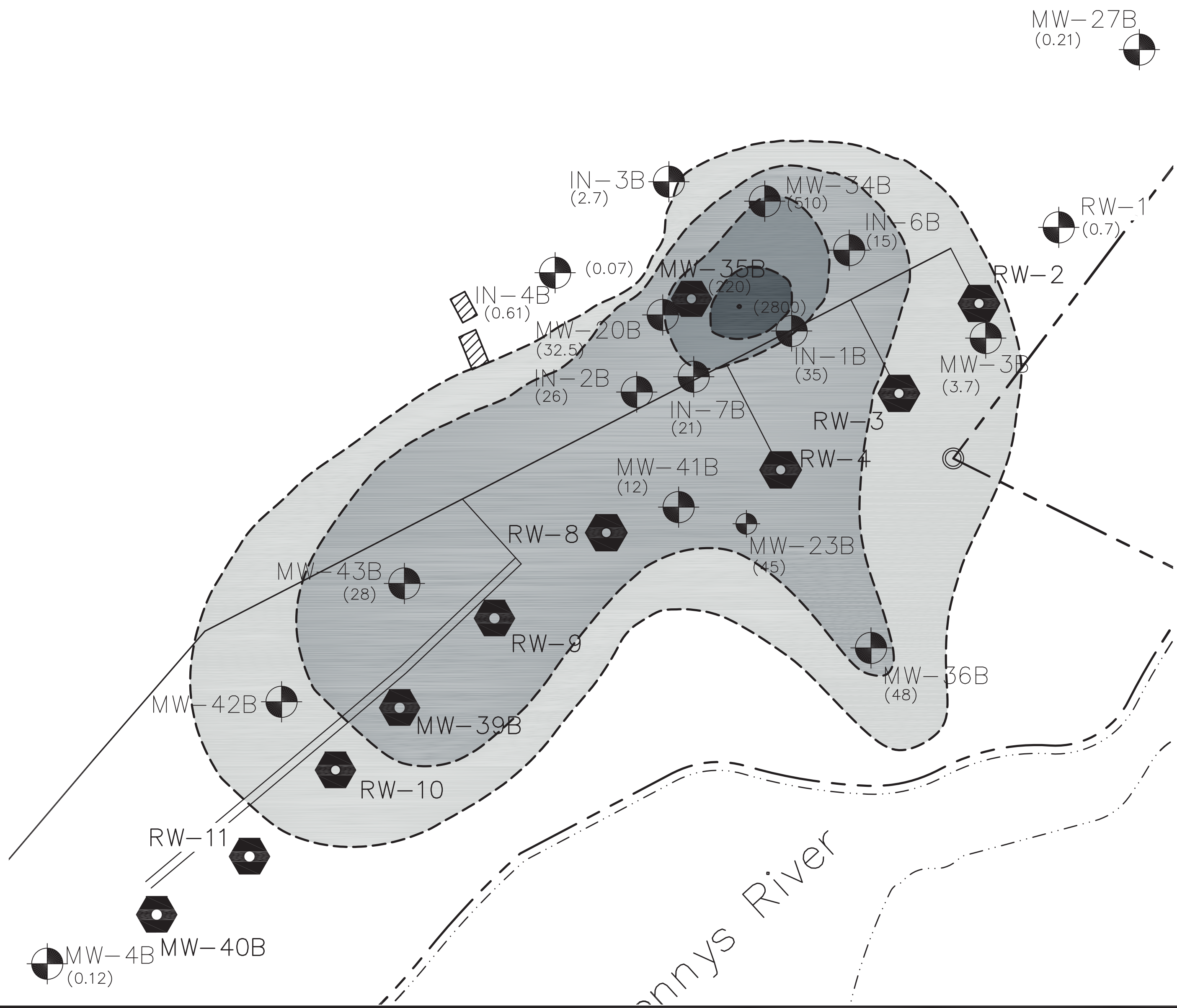
RSE-1-8



LEGEND

MW-34B (30)	MONITORING WELL AND PCE CONCENTRATION (PPB, SPRING 2010)
MW-35B	RECOVERY WELL (5' DIA. CONCRETE MANHOLE)

PCE CONCENTRATIONS (ug/L) – FALL 2010

- 3 – 10
- 10 – 100
- 101 – 1000
- 1001 – 2800

GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 50 ft.

General Notes:

1. REFER TO FIGURE 1-2 FOR ADDITIONAL NOTES AND LEGEND.

2. DISSOLVED-PHASE PCE CONCENTRATIONS WERE OBTAINED FROM GROUNDWATER SAMPLES COLLECTED BY NOBIS ENGINEERING, INC. BETWEEN MAY 10, 2010 AND MAY 14, 2010 IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE UPPER BEDROCK AQUIFER ZONES.

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DATE	REVISIONS	CK

PROJECT NAME & ADDRESS:
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ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

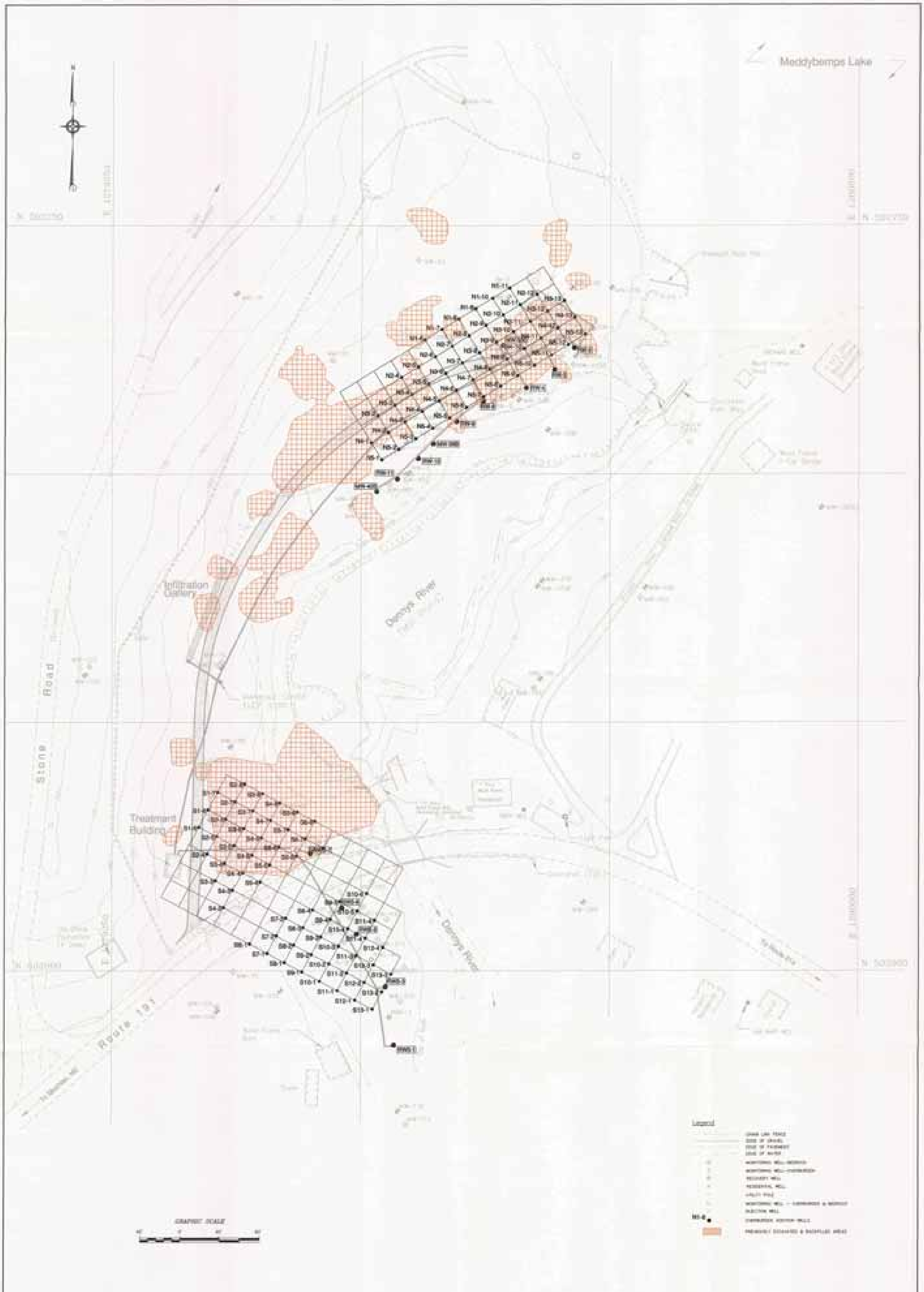
DRAWING NAME:
FALL 2010 NORTHERN BEDROCK PCE CONCENTRATION DISTRIBUTION

PROJECT #: 80005.05

FIGURE 3-4

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW ADS 2010.dwg

RSE-1-9



NOTES:
1. ELEVATIONS ARE BASED ON U.S.G.S. DATUM (NGVD 1929) MEAN SEA LEVEL.
2. BEARINGS ARE BASED ON MAINE STATE GRID COORDINATE SYSTEM (EAST ZONE) "NAD 83". DISTANCES SHOWN ARE GROUND DISTANCES AND ARE NOT REDUCED BY GRID AND ELEVATION FACTORS.
3. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.

DRAWN BY: P.G. DOWSHAP
PREPARED BY: J. RACE
CHECKED BY: L. LYU
PROJECT MANAGER: L. LYU
PROGRAM MANAGER: C. GARDNER

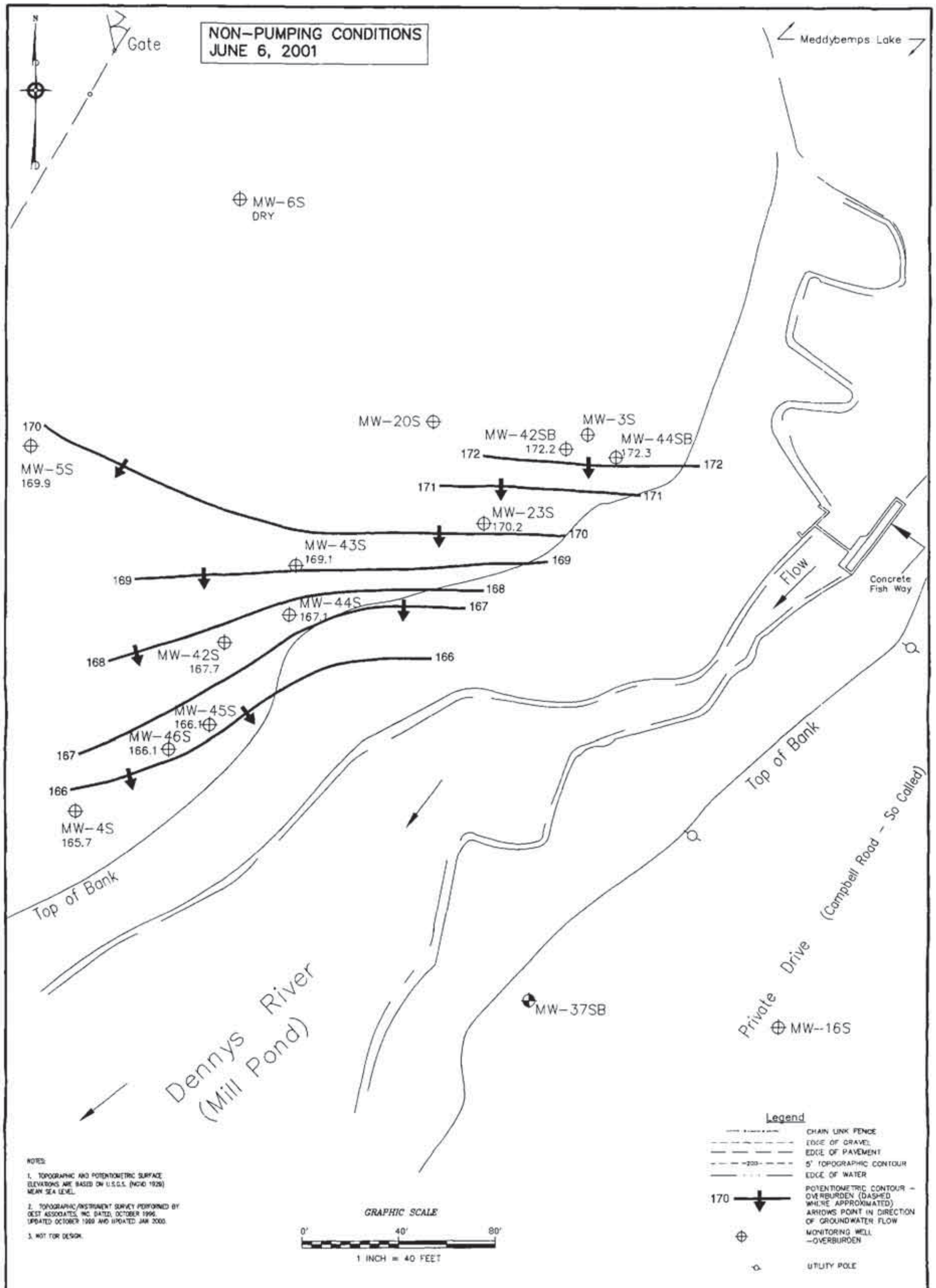
TITLE: WELL LOCATIONS
EASTERN SURPLUS CO. SITE – MEDDYBEMPS, MAINE

SOURCE: TOPOGRAPHIC/INSTRUMENT SURVEY PERFORMED BY GEST ASSOC. INC. DATED OCTOBER 1999, UPDATED JAN. 2000, APR. 2001

SCALE: AS SHOWN
DATE: JANUARY 7, 2002
DRAWING NO.: FIGURE 2-1

TETRA TECH NUS, INC.

RSE-2-1



OVERBURDEN POTENTIOMETRIC SURFACE - NORTH AREA

FIGURE 2-1

RSE 4-1

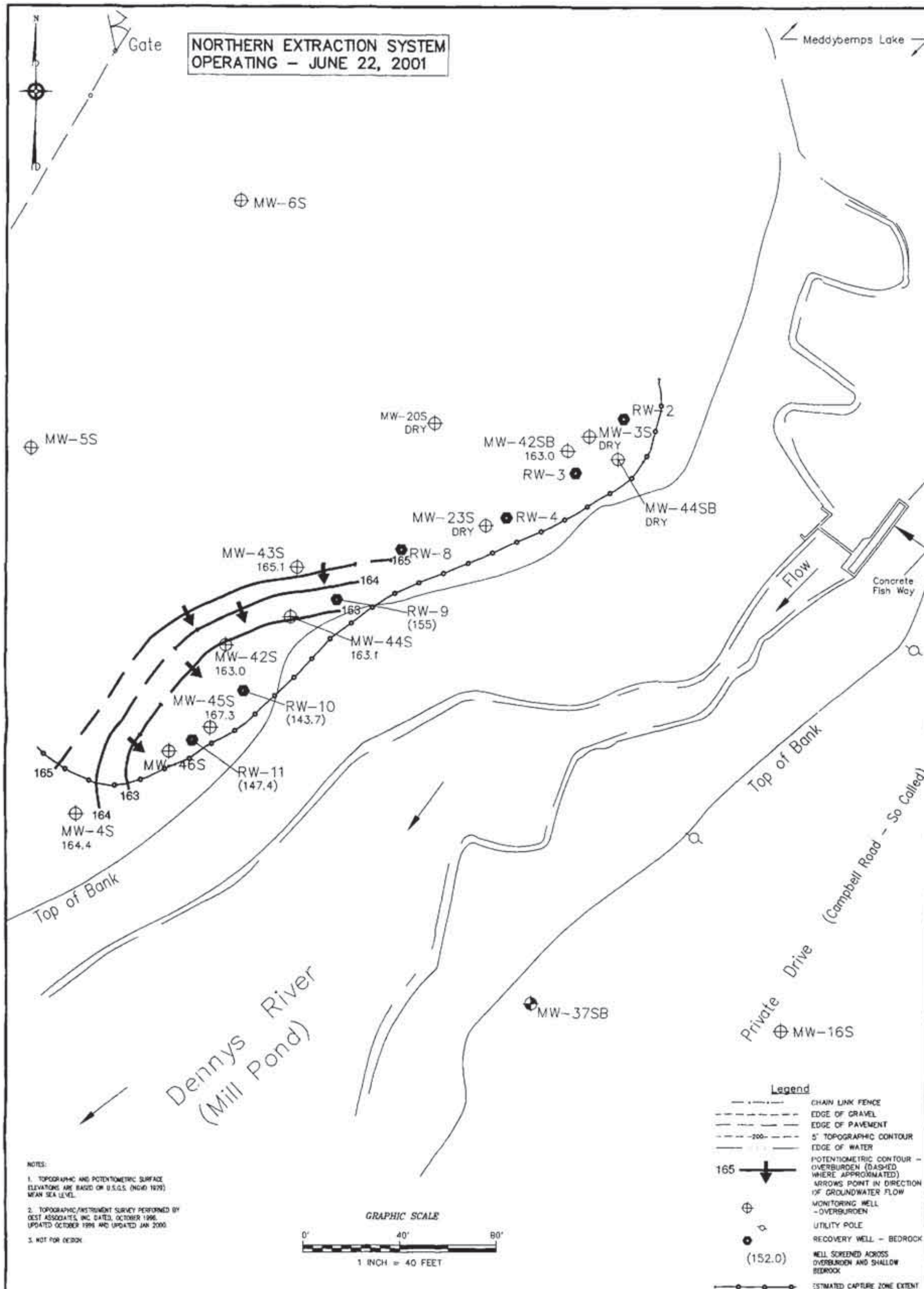
EASTERN SURPLUS COMPANY SITE

MEDDYBEMPS, MAINE

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	C. RACE	DATE:	JULY 5, 2001
SCALE:	1" = 40'	FILE NO.:	\DWG\3998\1102\FIG_2-1.DWG

TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658-7899



OVERBURDEN POTENTIOMETRIC SURFACE – NORTH AREA

EASTERN SURPLUS COMPANY SITE

MEDDYBEMPS, MAINE

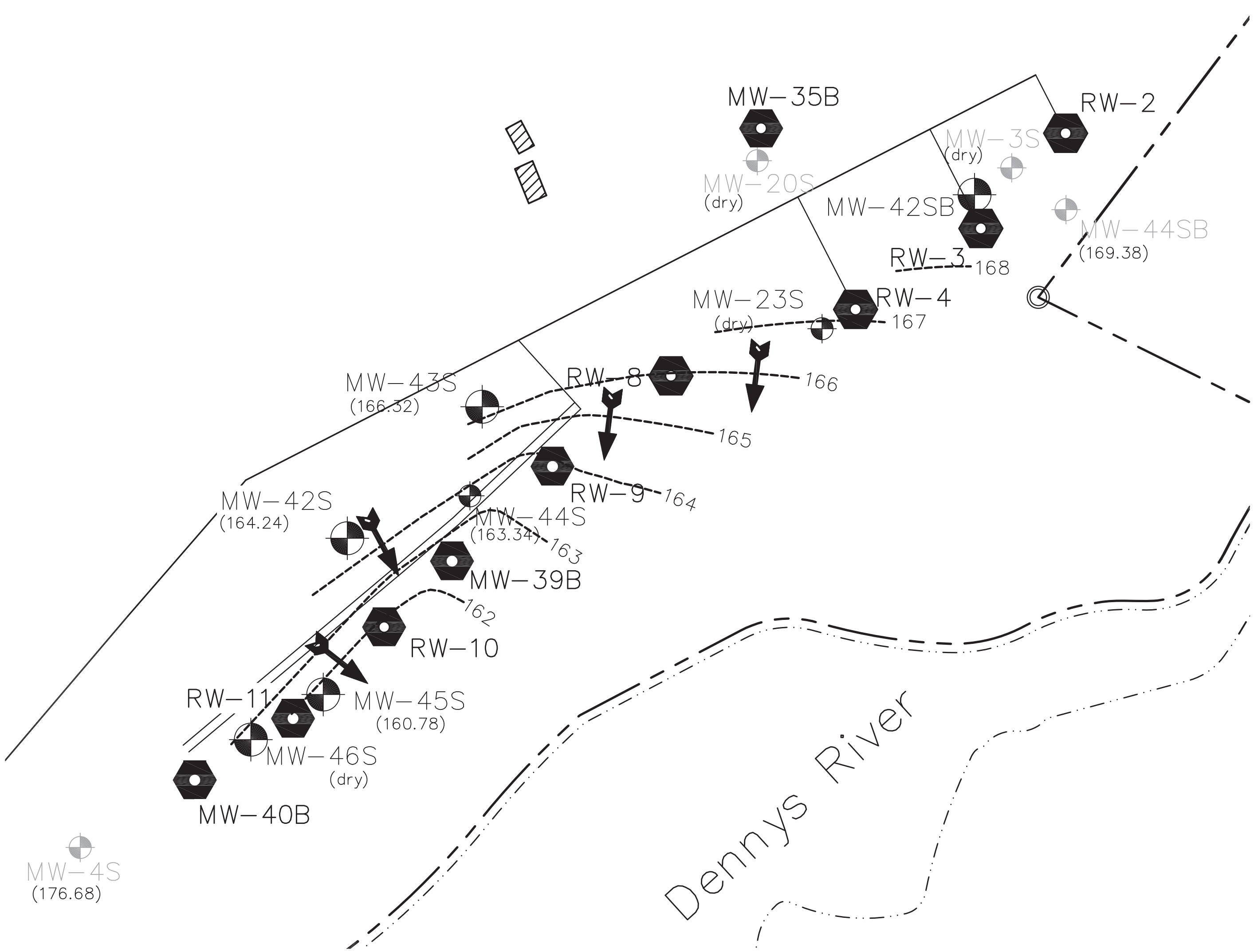
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	C. RACE	DATE:	JULY 5, 2001
SCALE:	1" = 40'	FILE NO.:	\DWG\3998\1102\FIG_2-3.DWG

FIGURE 2-3

RSE 4-2

TETRA TECH NUS, INC.

55 Jonspin Road Wilmington MA 01887
(978)658-7899



LEGEND

MW-23B (170.01)	MONITORING WELL AND GROUNDWATER ELEVATION (FEET, SPRING 2010)
RW-2	RECOVERY WELL (5' DIA. CONCRETE MANHOLE)
	APPROXIMATE GROUNDWATER FLOW DIRECTION
	PROPERTY LINE
	ABUTTING PROPERTY LINE
165	POTENTIOMETRIC SURFACE CONTOUR (FEET)

GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

General Notes:

1. REFER TO FIGURE 1-2 FOR ADDITIONAL NOTES AND LEGEND.

2. POTENTIOMETRIC SURFACE MEASUREMENTS WERE OBTAINED BY NOBIS ENGINEERING, INC. BETWEEN MAY 10, 2010 AND MAY 13, 2010 IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE NORTH AND SOUTH PLUME OVERBURDEN AQUIFER ZONES.

3. POTENTIOMETRIC SURFACE CONTOURS DEVELOPED BY SURFER 8 BY GOLDEN SOFTWARE, INC. USING NATURAL NEIGHBOR GRIDDING METHOD. THE CONTOURS DISPLAYED ARE ONE INTERPRETATION OF THE DATA; OTHER INTERPRETATIONS ARE POSSIBLE.

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APPROVED	SWH

DATE	REVISIONS	CK
1/14/09	REVISION 0	SWH

PROJECT NAME & ADDRESS:
EASTERN SURPLUS COMPANY SITE
ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

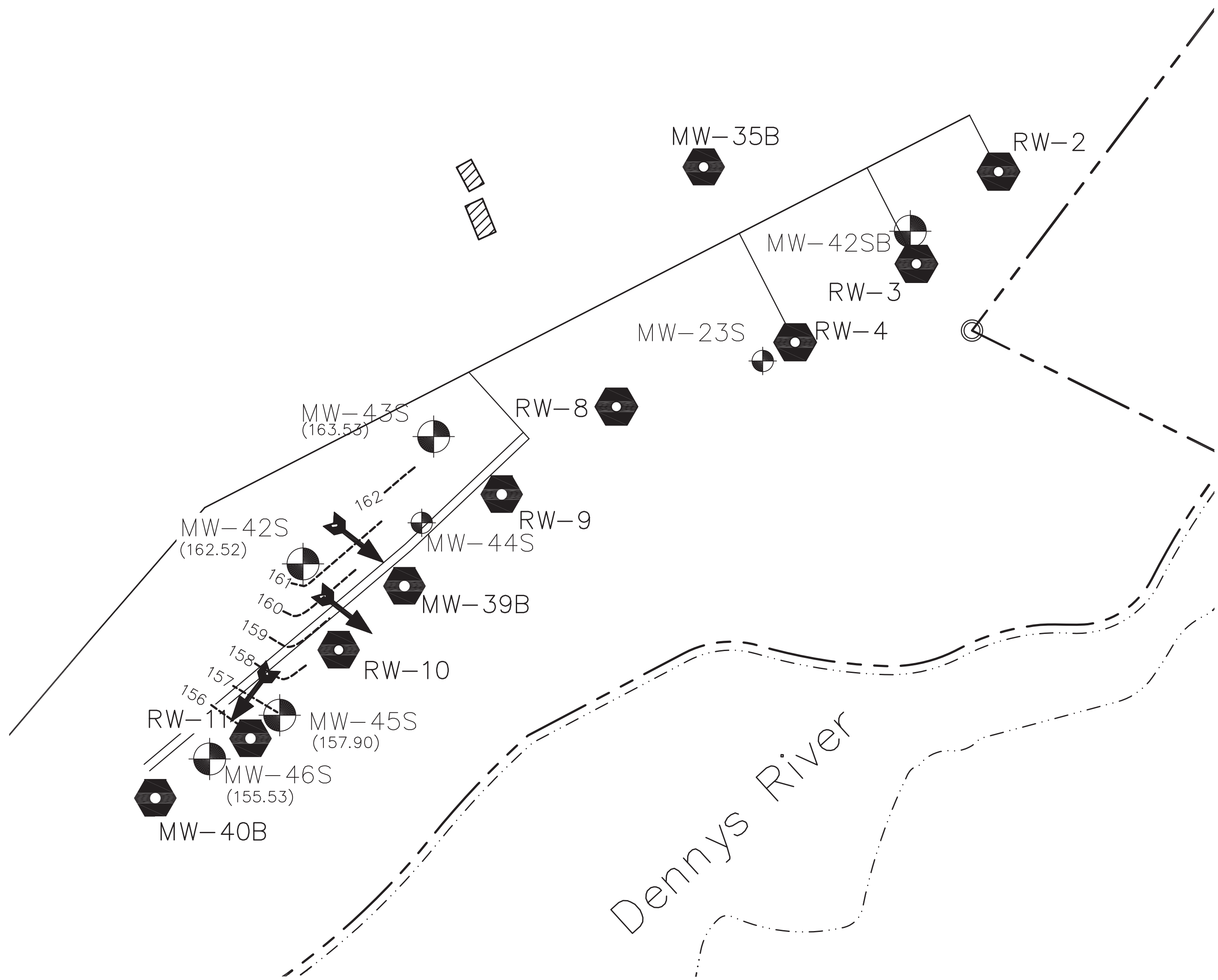
DRAWING NAME:
SPRING 2010
NORTHERN OVERBURDEN
POTENTIOMETRIC SURFACE

PROJECT #: 80005.05

FIGURE
2-1

RSE 4-3

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW ADS 2010.dwg



LEGEND

- MW−23B (170.01) — MONITORING WELL AND GROUNDWATER ELEVATION (FEET, FALL 2010)
- RW−1 — RECOVERY WELL (5' DIA. CONCRETE MANHOLE)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- PROPERTY LINE
- ABUTTING PROPERTY LINE
- 165 — POTENTIOMETRIC SURFACE CONTOUR (FEET)

GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

General Notes:

1. REFER TO FIGURE 1−2 FOR ADDITIONAL NOTES AND LEGEND.

2. POTENTIOMETRIC SURFACE MEASUREMENTS WERE OBTAINED BY NOBIS ENGINEERING, INC. BETWEEN MAY 10, 2010 AND MAY 13, 2010 IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE NORTH AND SOUTH PLUME OVERBURDEN AQUIFER ZONES.

3. POTENTIOMETRIC SURFACE CONTOURS DEVELOPED BY SURFER 8 BY GOLDEN SOFTWARE, INC. USING NATURAL NEIGHBOR GRIDDING METHOD. THE CONTOURS DISPLAYED ARE ONE INTERPRETATION OF THE DATA; OTHER INTERPRETATIONS ARE POSSIBLE.

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PROJECT NAME & ADDRESS:
EASTERN SURPLUS COMPANY SITE
ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

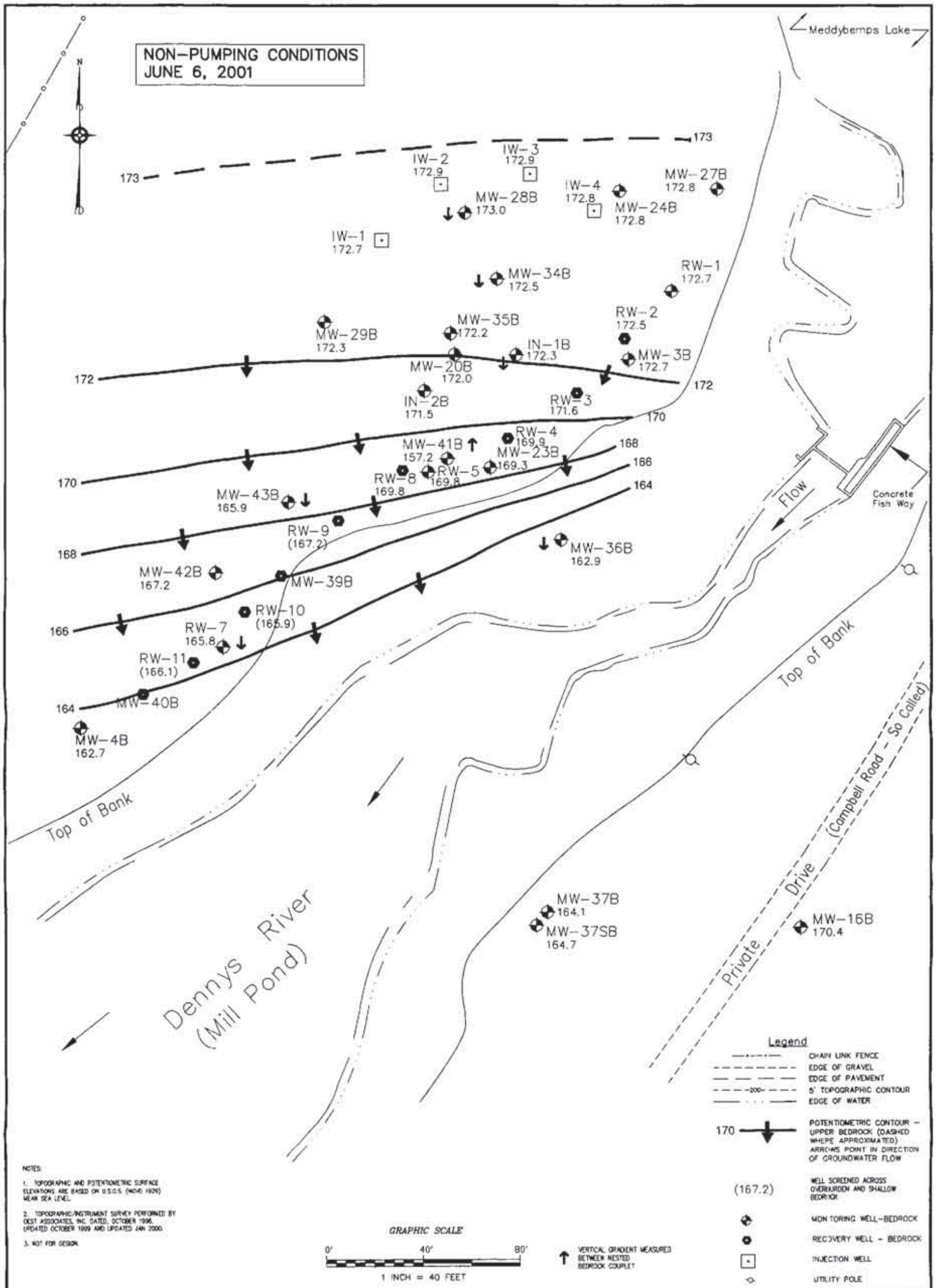
DRAWING NAME:
FALL 2010 OVERBURDEN POTENTIOMETRIC SURFACE

PROJECT #: 80005.05

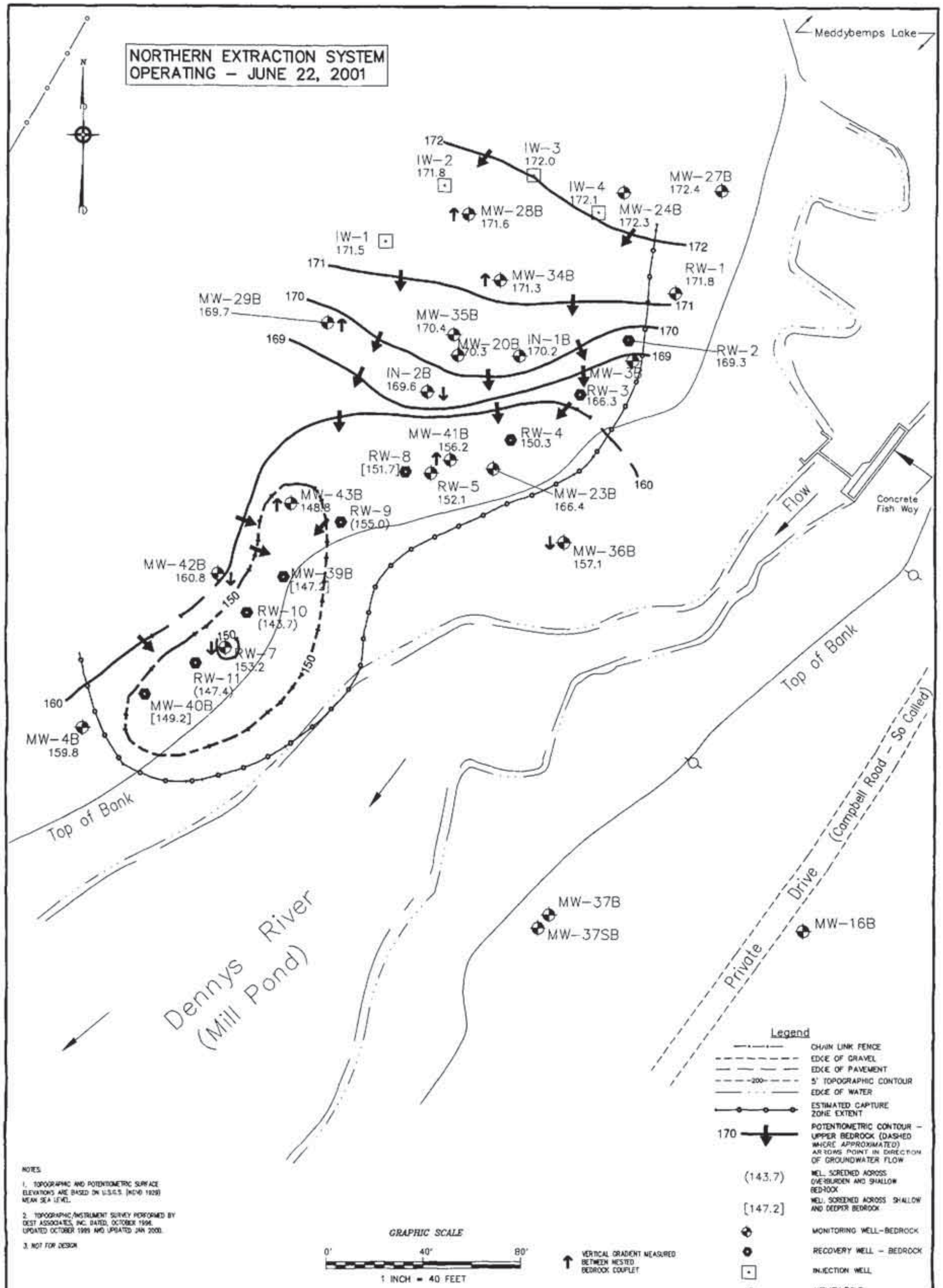
FIGURE 2−4

RSE 4-4

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW ADS 2010.dwg



SHALLOW BEDROCK POTENTIOMETRIC SURFACE – NORTH AREA				FIGURE 2-2 RSE 4-5
EASTERN SURPLUS COMPANY SITE				TETRA TECH NUS, INC.
MEDDYBEMPS, MAINE				
DRAWN BY:	D.W. MACDOUGALL	REV.:	0	
CHECKED BY:	C. RACE	DATE:	JULY 6, 2001	55 Jonspin Road Wilmington, MA 01887
SCALE:	1" = 40'	FILE NO.: \DWG\3998\1102\FIG_2-2.DWG		(978)658-7899



SHALLOW BEDROCK POTENTIOMETRIC SURFACE - NORTH AREA

FIGURE 2-4

RSE 4-6

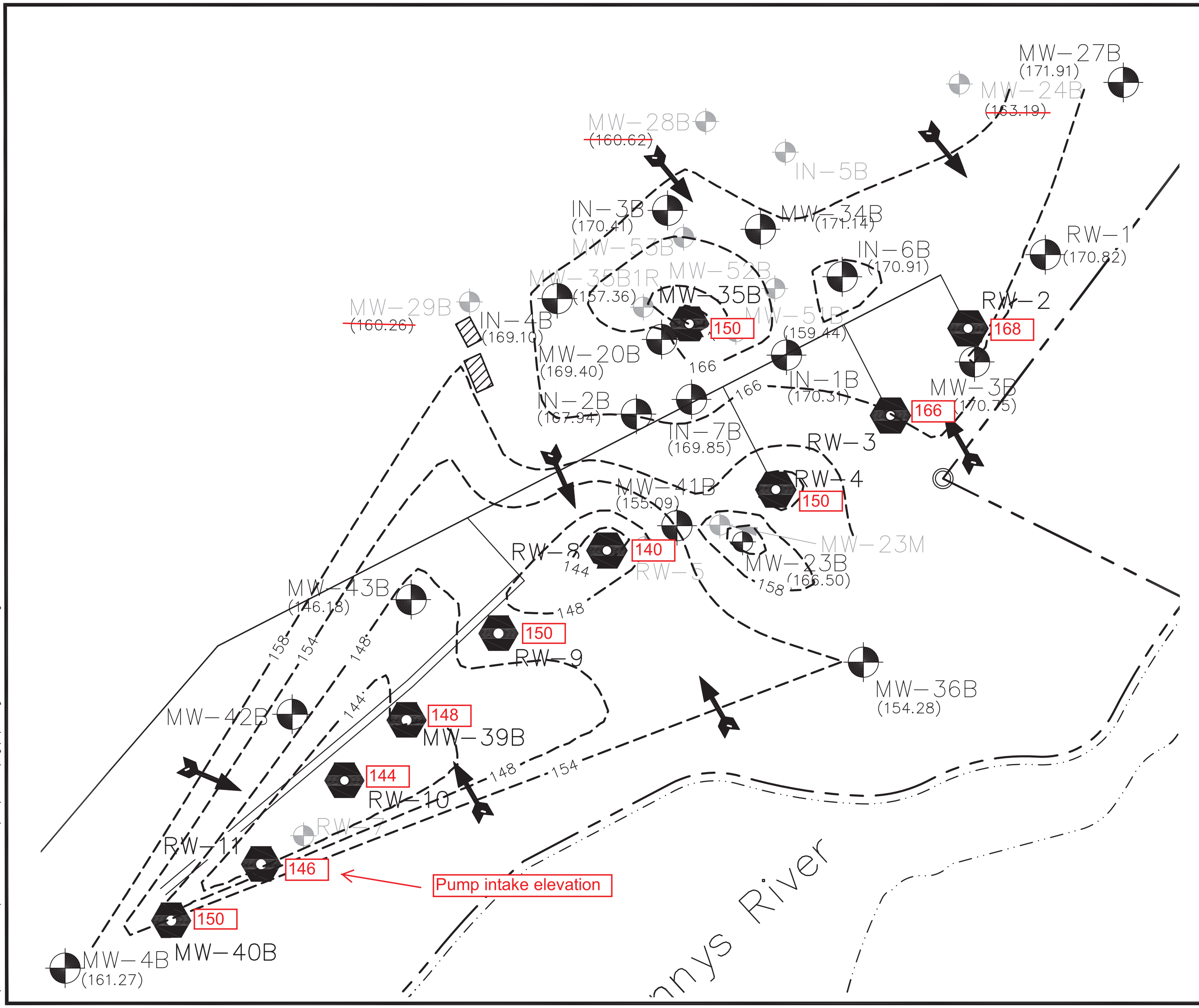
EASTERN SURPLUS COMPANY SITE

MEDDYBEMPS, MAINE

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	C. RACE	DATE:	JULY 6, 2001
SCALE:	1" = 40'	FILE NO.: \DWG\3998\1102\FIG_2-4.DWG	

TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658-7899



LEGEND

- MW-23B (170.01) MONITORING WELL AND GROUNDWATER ELEVATION (FEET, SPRING 2010)
- RW-2 RECOVERY WELL (5' DIA. CONCRETE MANHOLE)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- PROPERTY LINE
- ABUTTING PROPERTY LINE
- 155 POTENTIOMETRIC SURFACE CONTOUR (FEET)

16° 0°-48'-31" Mag. North True North Grid

GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

General Notes:

1. REFER TO FIGURE 1-2 FOR ADDITIONAL NOTES AND LEGEND.

2. POTENTIOMETRIC SURFACE MEASUREMENTS WERE OBTAINED BY NOBIS ENGINEERING, INC. BETWEEN MAY 10, 2010 AND MAY 13, 2010 IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE NORTH PLUME SHALLOW BEDROCK AQUIFER ZONE.

3. POTENTIOMETRIC SURFACE CONTOURS DEVELOPED BY SURFER 8 BY GOLDEN SOFTWARE, INC. USING NATURAL NEIGHBOR GRIDDING METHOD. THE CONTOURS DISPLAYED ARE ONE INTERPRETATION OF THE DATA; OTHER INTERPRETATIONS ARE POSSIBLE.

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1/14/09	REVISION 0	SWH

PROJECT NAME & ADDRESS:
EASTERN SURPLUS COMPANY SITE
ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

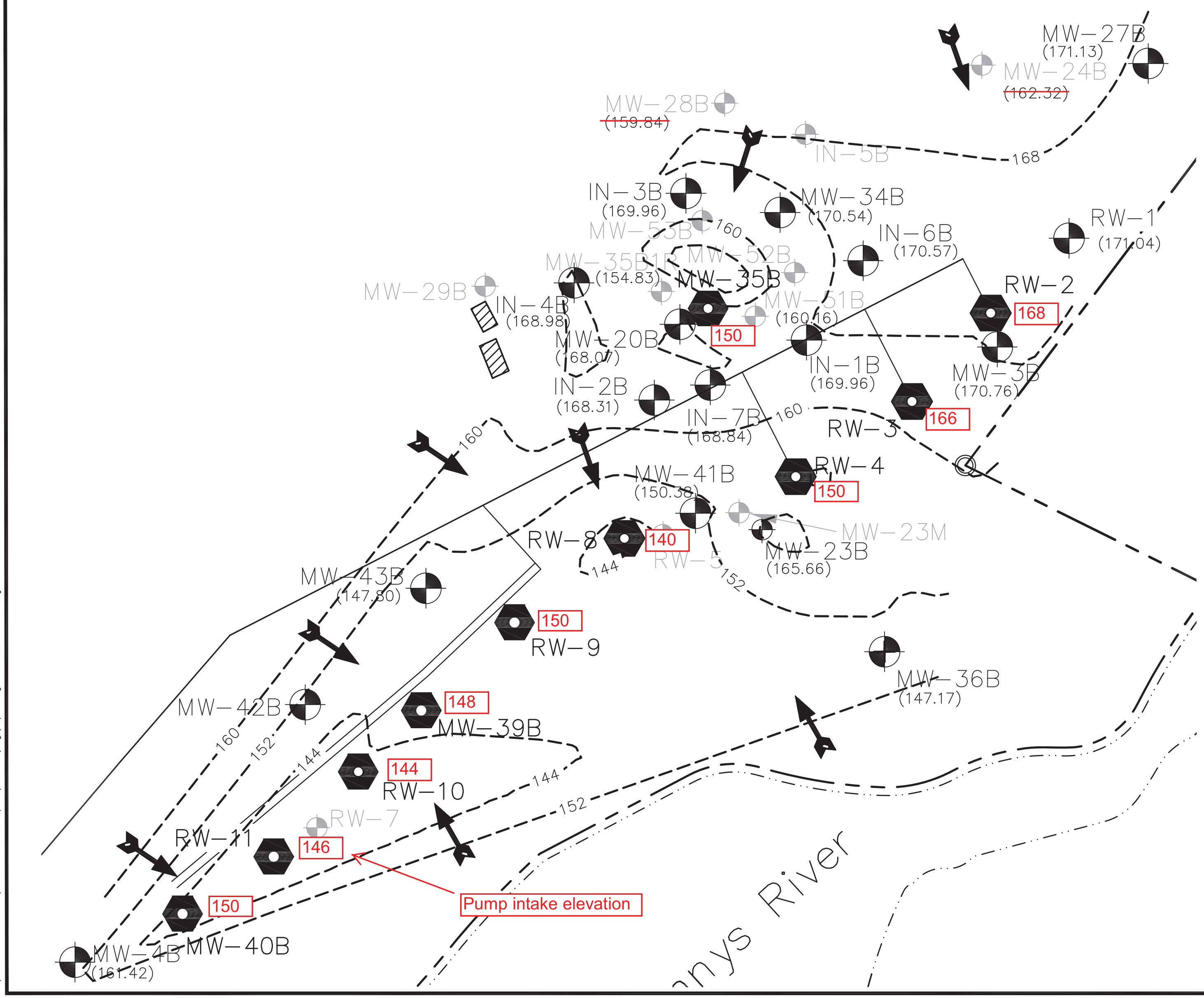
DRAWING NAME:
SPRING 2010 BEDROCK
POTENTIOMETRIC SURFACE

PROJECT #: 80005.05

FIGURE 2-3

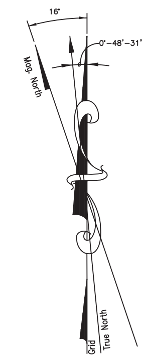
RSE 4-7

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW ADS 2010.dwg



LEGEND

MW–23B (170.01)	MONITORING WELL AND GROUNDWATER ELEVATION (FEET, SPRING 2010)
RW–2	RECOVERY WELL (5' DIA. CONCRETE MANHOLE)
	APPROXIMATE GROUNDWATER FLOW DIRECTION
	PROPERTY LINE
	ABUTTING PROPERTY LINE
165	POTENTIOMETRIC SURFACE CONTOUR (FEET)



GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

General Notes:

1. REFER TO FIGURE 1–2 FOR ADDITIONAL NOTES AND LEGEND.

2. POTENTIOMETRIC SURFACE MEASUREMENTS WERE OBTAINED BY NOBIS ENGINEERING, INC. BETWEEN OCTOBER 11, 2010 AND OCTOBER 14, 2010 IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE NORTH PLUME SHALLOW BEDROCK AQUIFER ZONE.

3. POTENTIOMETRIC SURFACE CONTOURS DEVELOPED BY SURFER 8 BY GOLDEN SOFTWARE, INC. USING NATURAL NEIGHBOR GRIDDING METHOD. THE CONTOURS DISPLAYED ARE ONE INTERPRETATION OF THE DATA; OTHER INTERPRETATIONS ARE POSSIBLE.

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PROJECT NAME & ADDRESS:
EASTERN SURPLUS COMPANY SITE
ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

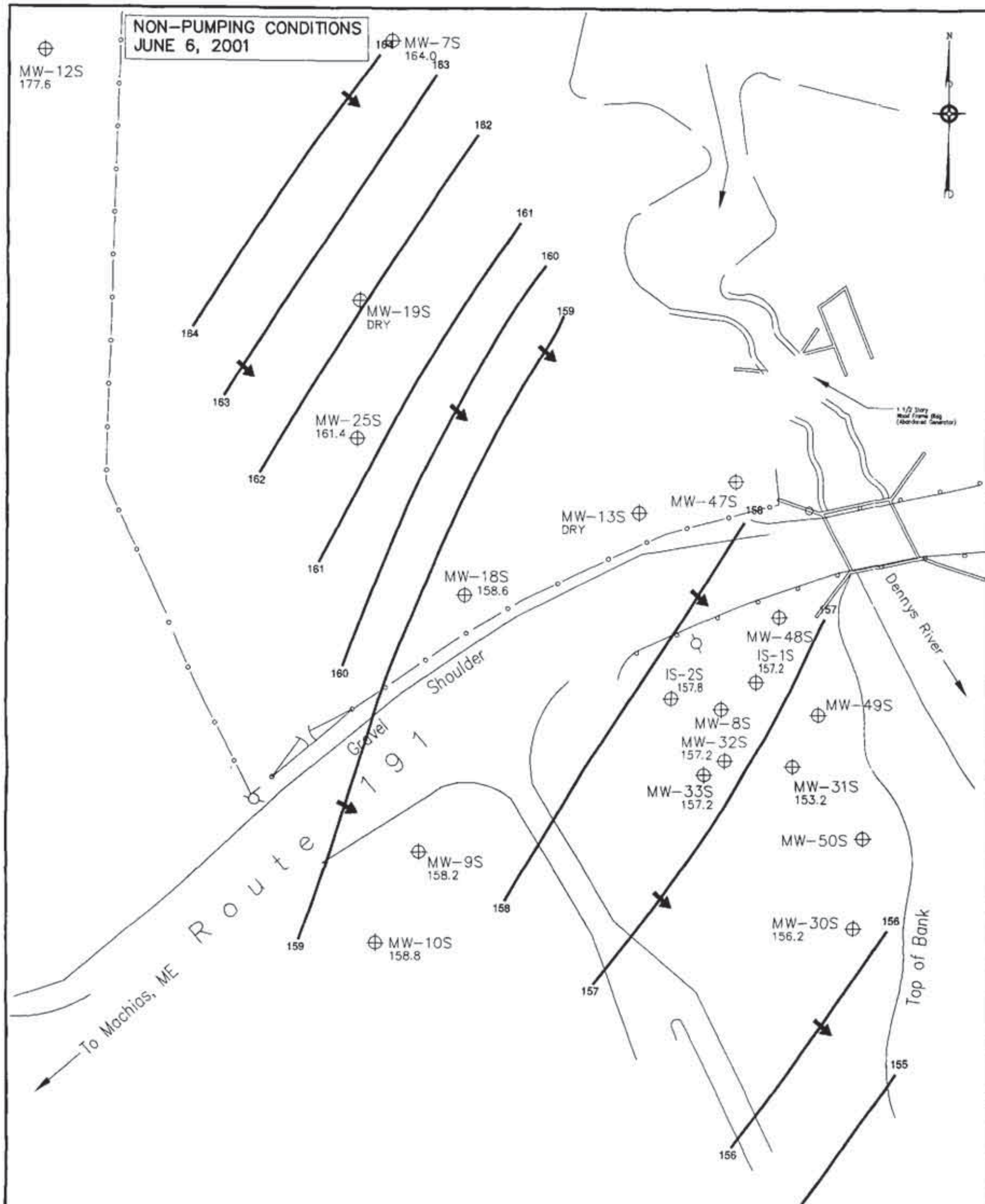
DRAWING NAME:
FALL 2010 BEDROCK
POTENTIOMETRIC SURFACE

PROJECT #: 80005.05

FIGURE
2–5

RSE 4-8

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW ADS 2010.dwg



NOTES:

1. TOPOGRAPHIC AND POTENTIOMETRIC SURFACE ELEVATIONS ARE BASED ON U.S.G.S. (NGVD 1929) MEAN SEA LEVEL.

2. TOPOGRAPHIC/INSTRUMENT SURVEY PERFORMED BY GEST ASSOCIATES, INC. DATED, OCTOBER 1996. UPDATED OCTOBER 1999 AND UPDATED JAN 2000.

3. NOT FOR DESIGN.

4. MW-47S THROUGH MW-50S LOCATIONS ARE APPROXIMATE.

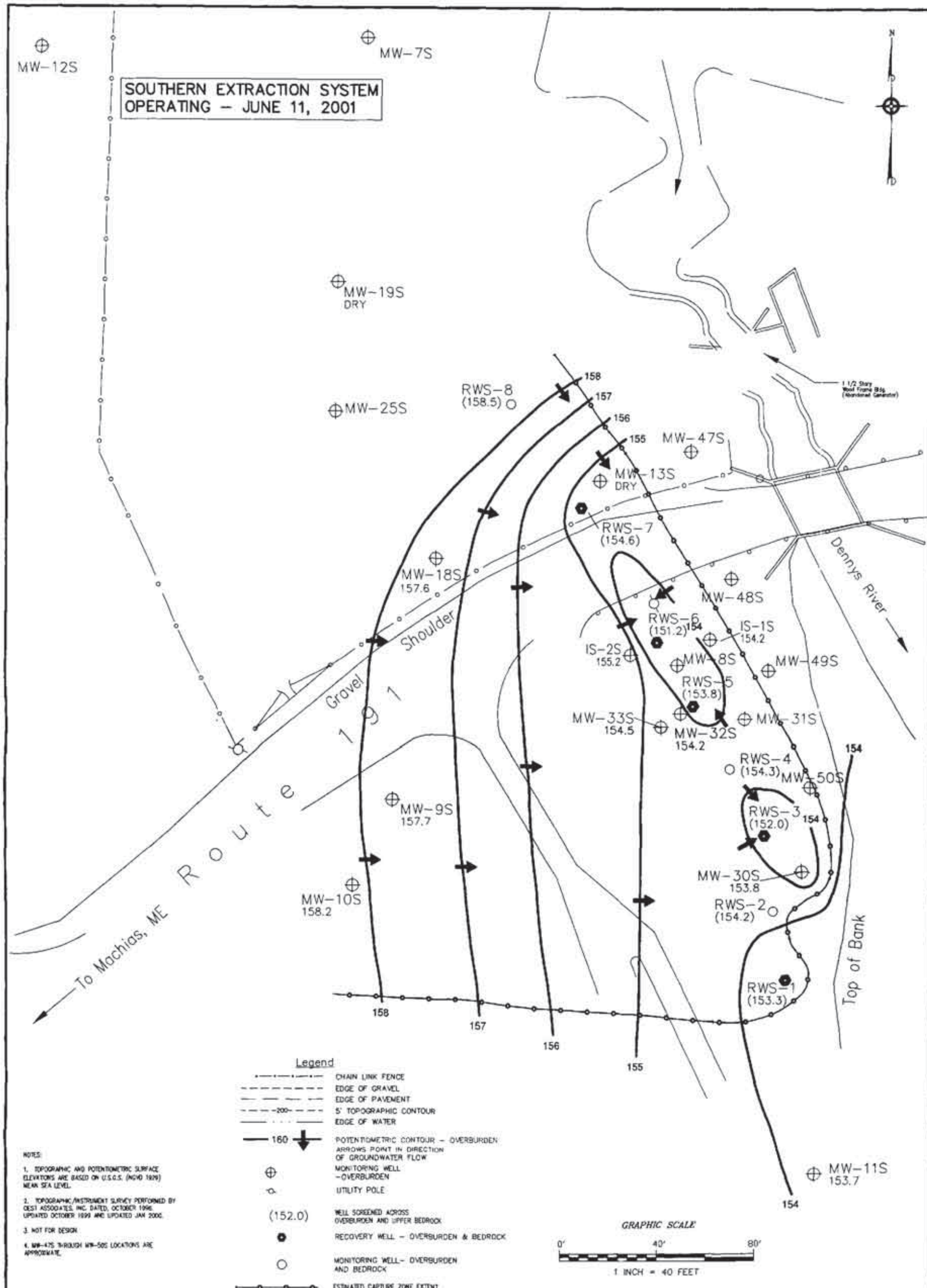
Legend

- CHAIN LINK FENCE
- EDGE OF GRAVEL
- EDGE OF PAVEMENT
- -200- 5' TOPOGRAPHIC CONTOUR
- EDGE OF WATER
- 160 POTENTIOMETRIC CONTOUR – OVERBURDEN ARROWS POINT IN DIRECTION OF GROUNDWATER FLOW
- MONITORING WELL –OVERBURDEN
- UTILITY POLE

GRAPHIC SCALE
0' 40' 80'
1 INCH = 40 FEET

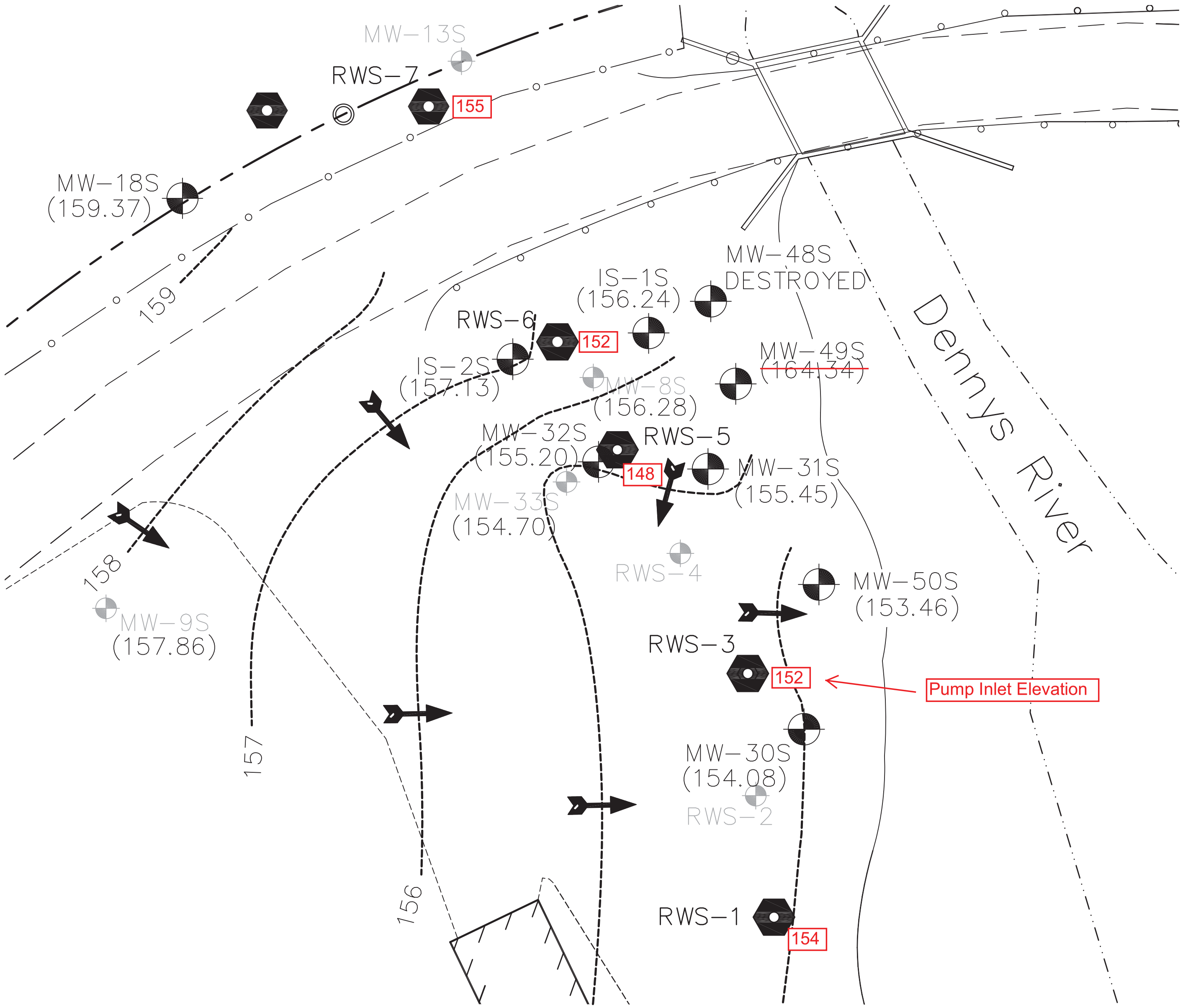
OVERBURDEN POTENTIOMETRIC SURFACE – SOUTH AREA				FIGURE 2-7
EASTERN SURPLUS COMPANY SITE				TETRA TECH NUS, INC.
MEDDYBEMPS, MAINE				
DRAWN BY:	D.W. MACDOUGALL	REV.:	0	55 Jonspin Road Wilmington, MA 01887
CHECKED BY:	C. RACE	DATE:	JULY 5, 2001	(978)658-7899
SCALE:	1" = 40'	FILE NO.: \DWG\3998\1102\FIG_2-7.DWG		

RSE 4-9



OVERBURDEN POTENTIOMETRIC SURFACE – SOUTH AREA				FIGURE 2-9
EASTERN SURPLUS COMPANY SITE				TETRA TECH NUS, INC.
MEDDYBEMPS, MAINE				
DRAWN BY:	D.W. MACDOUGALL	REV.:	0	55 Jonspin Road Wilmington, MA 01887
CHECKED BY:	C. RACE	DATE:	JULY 5, 2001	(978)658-7899
SCALE:	1" = 40'	FILE NO.:	\DWG\3998\1102\FIG_2-9.DWG	

RSE 4-10



LEGEND

- MW-23B (170.01) — MONITORING WELL AND GROUNDWATER ELEVATION (FEET, SPRING 2010)
- RW-2 — RECOVERY WELL (5' DIA. CONCRETE MANHOLE)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- PROPERTY LINE
- ABUTTING PROPERTY LINE
- 155 — POTENTIOMETRIC SURFACE CONTOUR (FEET)

16°
0°-48'-31"
Mag. North
Grid
True North

GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 50 ft.

General Notes:

1. REFER TO FIGURE 1-2 FOR ADDITIONAL NOTES AND LEGEND.

2. POTENTIOMETRIC SURFACE MEASUREMENTS WERE OBTAINED BY NOBIS ENGINEERING, INC. BETWEEN MAY 10, 2010 AND MAY 13, 2010 IN THE GROUNDWATER MONITORING WELLS SCREENED WITHIN THE NORTH AND SOUTH PLUME OVERBURDEN AQUIFER ZONES.

3. POTENTIOMETRIC SURFACE CONTOURS DEVELOPED BY SURFER 8 BY GOLDEN SOFTWARE, INC. USING NATURAL NEIGHBOR GRIDDING METHOD. THE CONTOURS DISPLAYED ARE ONE INTERPRETATION OF THE DATA; OTHER INTERPRETATIONS ARE POSSIBLE.

Nobis
Engineering a Sustainable Future

DESIGN	OEST
DRAFTING	DWG
CHECKED	SWH
APPROVED	SWH

DATE	REVISIONS	CK
1/14/09	REVISION 0	SWH

PROJECT NAME & ADDRESS:
EASTERN SURPLUS COMPANY SITE
ROUTE 191 (887 MAIN STREET)
MEDDYBEMPS, MAINE

DATE: APRIL 2011

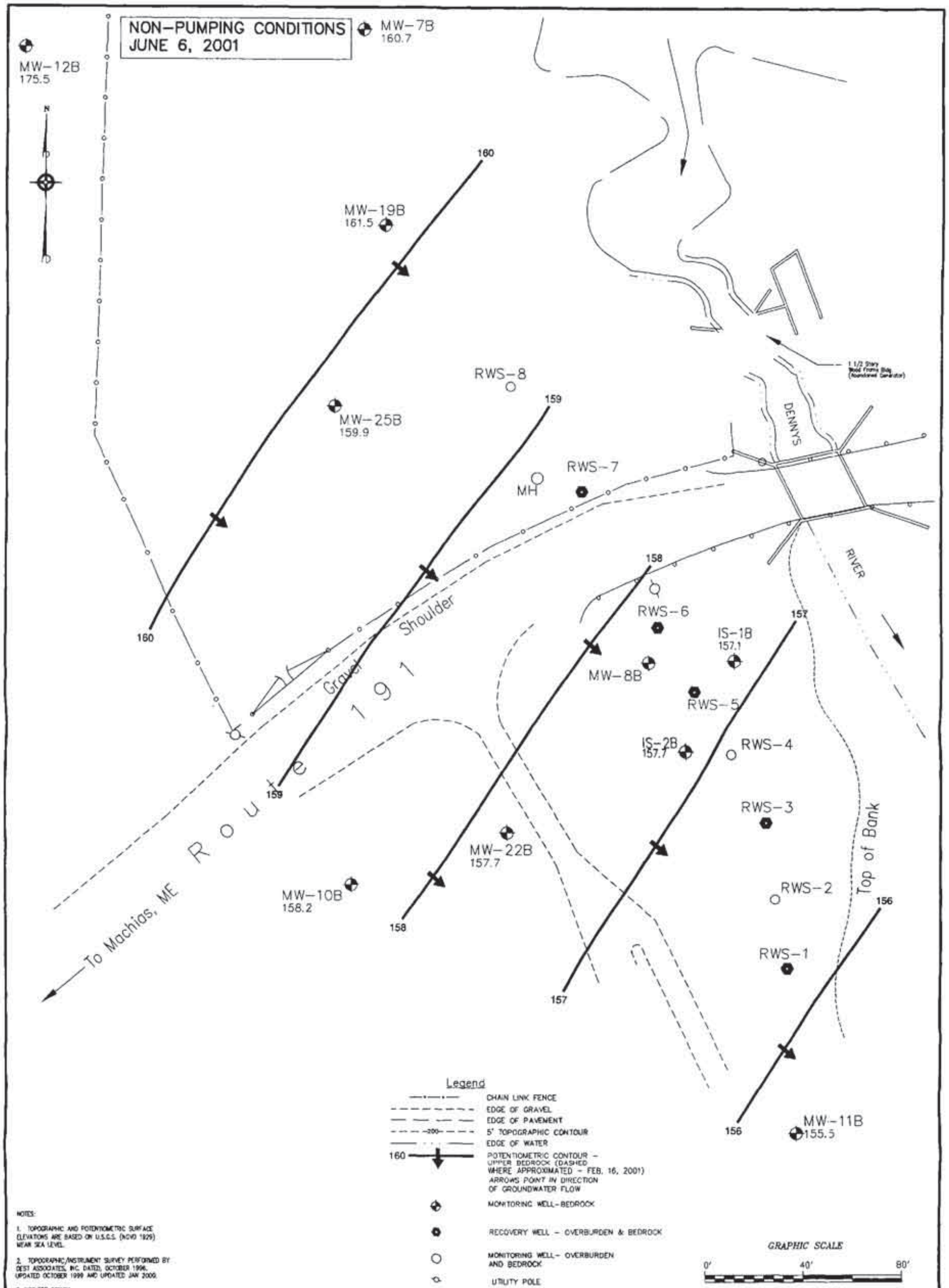
DRAWING NAME:
SPRING 2010
SOUTHERN OVERBURDEN
POTENTIOMETRIC SURFACE

PROJECT #: 80005.05

FIGURE
2-2

RSE 4-11

R:\80000 Task Orders\80005 Eastern Surplus\ES CAD\dwg\Report figures.GW ADS 2010.dwg



UPPER BEDROCK POTENTIOMETRIC SURFACE – SOUTH AREA

FIGURE 2-8

RSE 4-12

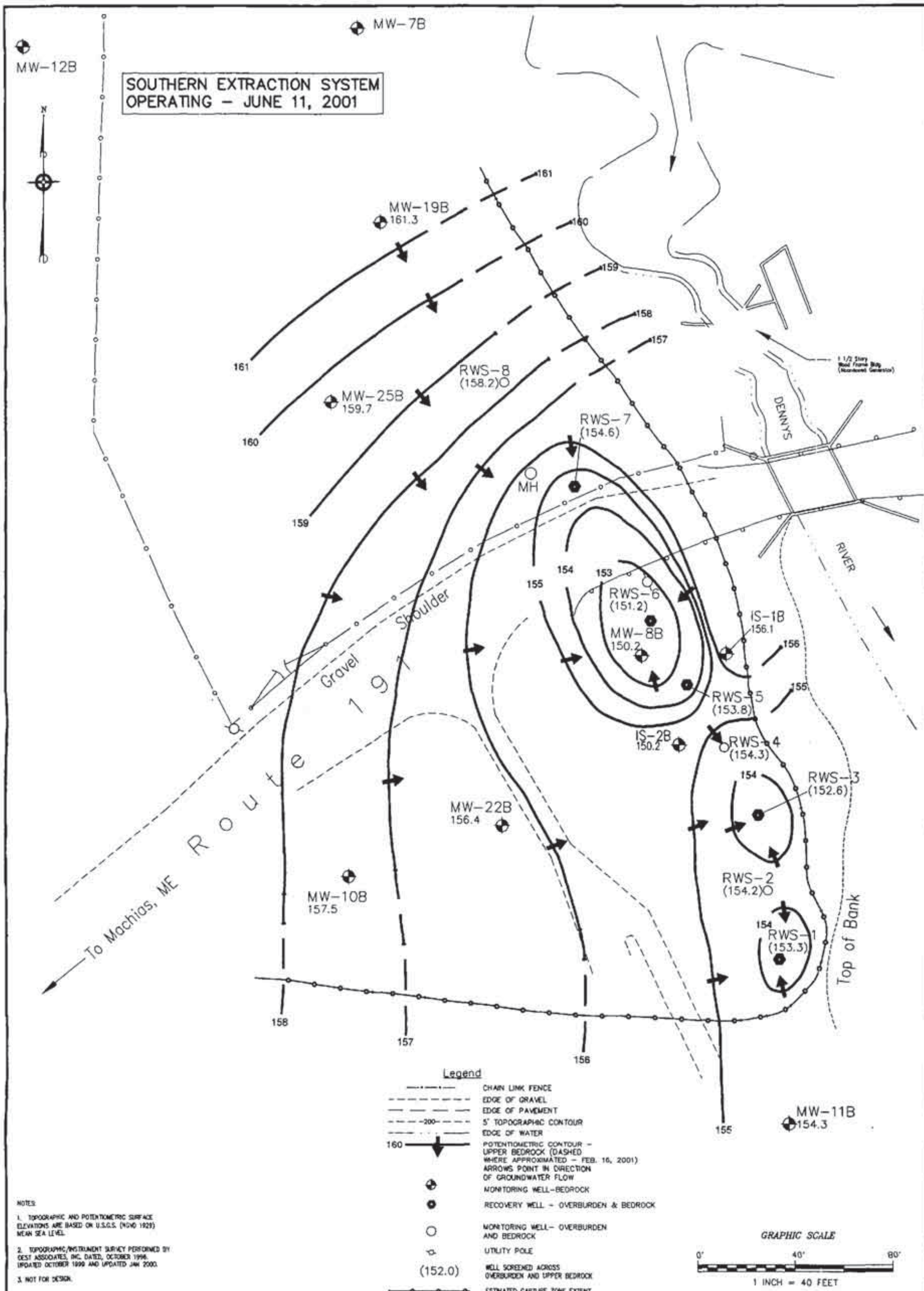
EASTERN SURPLUS COMPANY SITE

MEDDYBEMPS, MAINE

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	C. RACE	DATE:	JULY 5, 2001
SCALE:	1" = 40'	FILE NO.:	\DWG\3998\1102\FIG_2-8.DWG

TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658-7899



UPPER BEDROCK POTENTIOMETRIC SURFACE - SOUTH AREA

EASTERN SURPLUS COMPANY SITE

MEDDYBEMPS, MAINE

FIGURE 2-10

RSE 4-13

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	C. RACE	DATE:	JULY 5, 2001
SCALE:	1" = 40'	FILE NO.:	\DWG\3998\1102\FIG_2-10.DWG

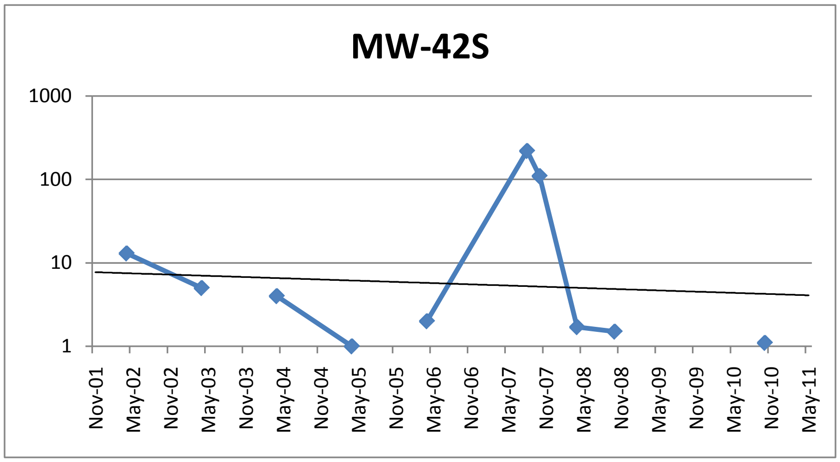
TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658-7899

ATTACHMENT B
CONCENTRATION TREND CHARTS

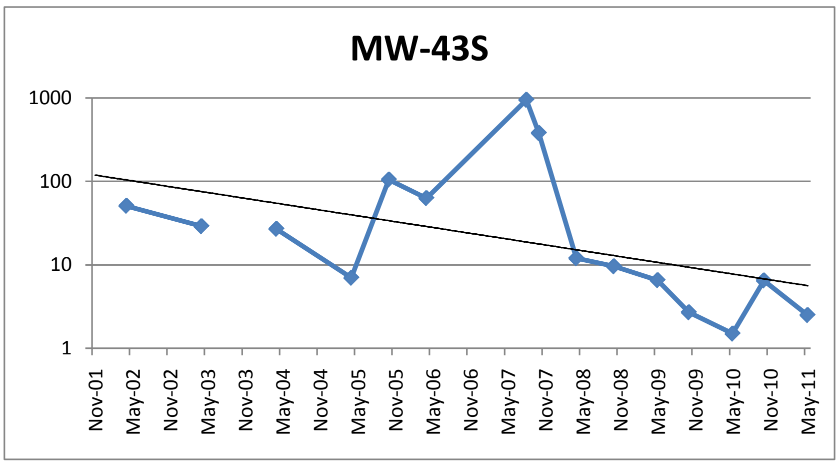
	MW-42S
Nov-01	
Apr-02	13
Apr-03	5.0
Oct-03	
Apr-04	4.0
Apr-05	1.0
Oct-05	
Apr-06	2.0
Aug-07	220
Oct-07	110
Apr-08	1.7
Oct-08	1.5
May-09	
Oct-09	
May-10	
Oct-10	1.1
May-11	

NO



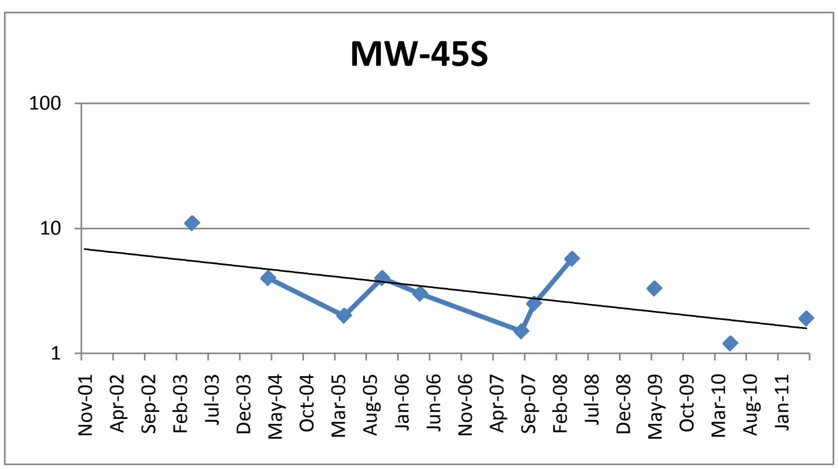
	MW-43S
Nov-01	
Apr-02	51
Apr-03	29
Oct-03	
Apr-04	27
Apr-05	7.0
Oct-05	105
Apr-06	63
Aug-07	950
Oct-07	380
Apr-08	12
Oct-08	10
May-09	6.6
Oct-09	2.7
May-10	1.5
Oct-10	6.5
May-11	2.5

NO



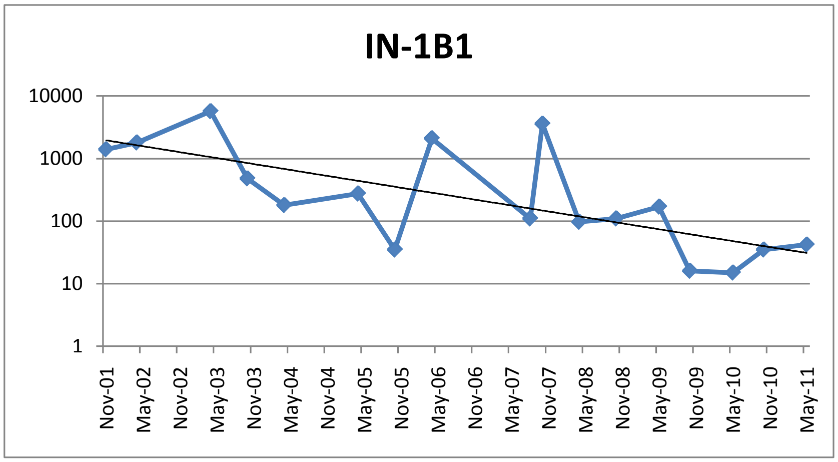
	MW-45S
Nov-01	
Apr-02	
Apr-03	11
Oct-03	
Apr-04	4.0
Apr-05	2.0
Oct-05	4.0
Apr-06	3.0
Aug-07	1.5
Oct-07	2.5
Apr-08	5.7
Oct-08	
May-09	3.3
Oct-09	
May-10	1.2
Oct-10	
May-11	1.9

NO



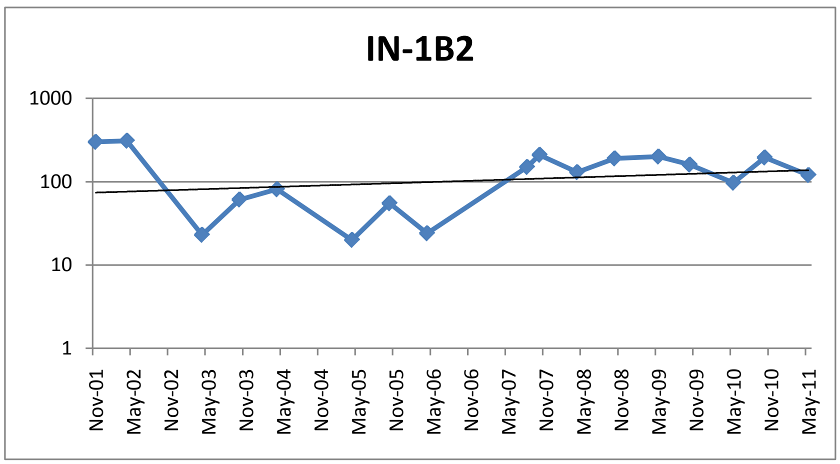
	IN-1B1
Nov-01	1400
Apr-02	1800
Apr-03	5700
Oct-03	480
Apr-04	180
Apr-05	275
Oct-05	35
Apr-06	2100
Aug-07	110
Oct-07	3600
Apr-08	97
Oct-08	110
May-09	170
Oct-09	16
May-10	15
Oct-10	35
May-11	42

NB



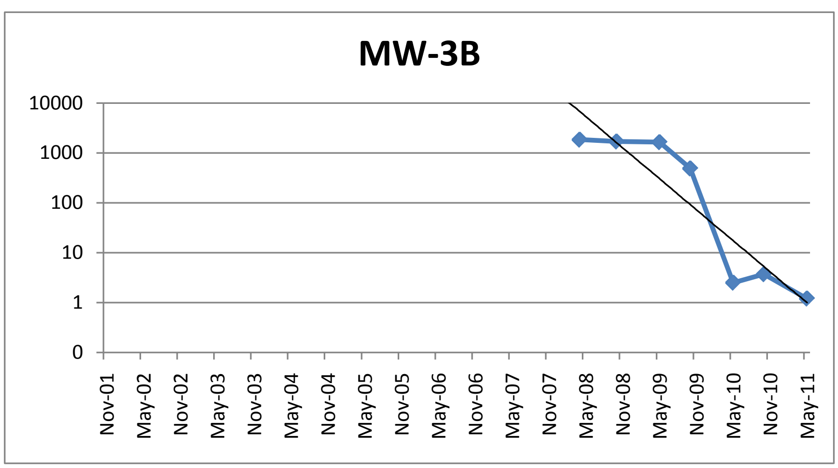
	IN-1B2
Nov-01	300
Apr-02	310
Apr-03	23
Oct-03	61
Apr-04	81
Apr-05	20
Oct-05	55
Apr-06	24
Aug-07	150
Oct-07	210
Apr-08	130
Oct-08	190
May-09	200
Oct-09	160
May-10	97
Oct-10	195
May-11	120

NB



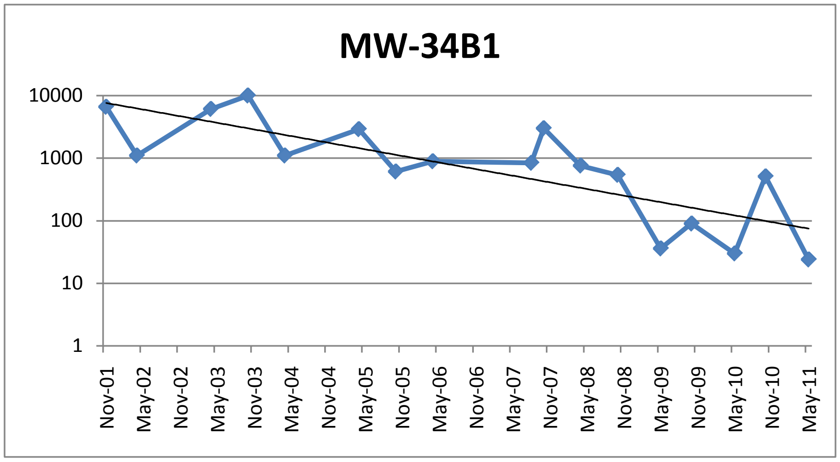
	MW-3B
Nov-01	
Apr-02	
Apr-03	
Oct-03	
Apr-04	
Apr-05	
Oct-05	
Apr-06	
Aug-07	
Oct-07	
Apr-08	1850
Oct-08	1700
May-09	1650
Oct-09	490
May-10	2.5
Oct-10	3.7
May-11	1.2

NB



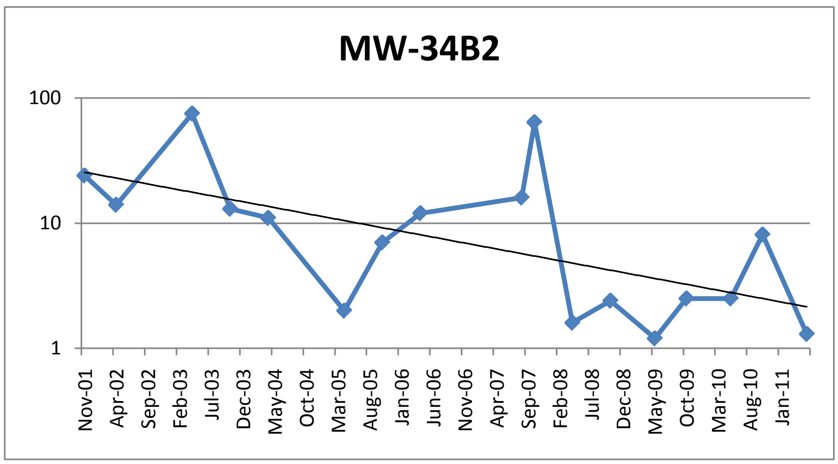
	MW-34B1
Nov-01	6600
Apr-02	1100
Apr-03	6100
Oct-03	10000
Apr-04	1100
Apr-05	2900
Oct-05	610
Apr-06	890
Aug-07	840
Oct-07	3000
Apr-08	760
Oct-08	540
May-09	36
Oct-09	90
May-10	30
Oct-10	510
May-11	24

NB



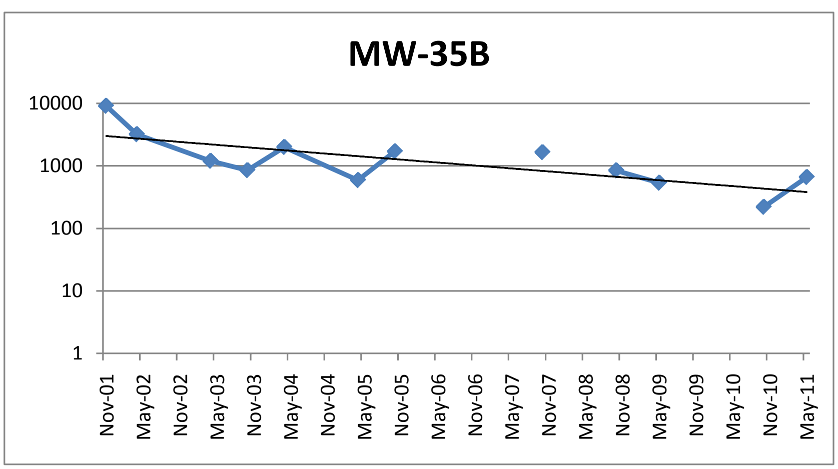
	MW-34B2
Nov-01	24
Apr-02	14
Apr-03	75
Oct-03	13
Apr-04	11
Apr-05	2.0
Oct-05	7.0
Apr-06	12
Aug-07	16
Oct-07	64
Apr-08	1.6
Oct-08	2.4
May-09	1.2
Oct-09	2.5
May-10	2.5
Oct-10	8.1
May-11	1.3

NB



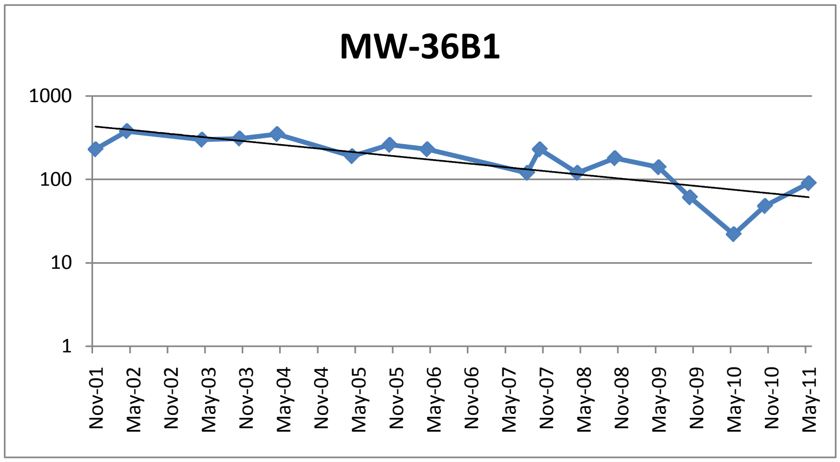
	MW-35B
Nov-01	9100
Apr-02	3200
Apr-03	1200
Oct-03	850
Apr-04	2000
Apr-05	590
Oct-05	1700
Apr-06	
Aug-07	
Oct-07	1650
Apr-08	
Oct-08	845
May-09	535
Oct-09	
May-10	
Oct-10	220
May-11	660

NB



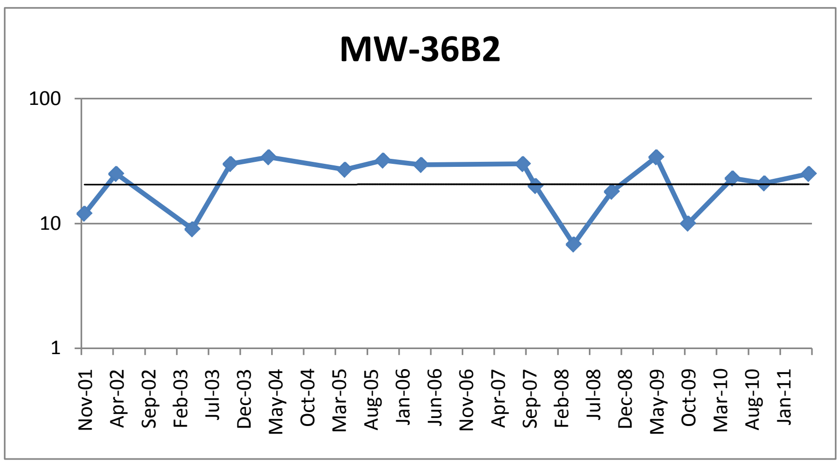
	MW-36B1
Nov-01	230
Apr-02	380
Apr-03	300
Oct-03	310
Apr-04	350
Apr-05	190
Oct-05	260
Apr-06	230
Aug-07	120
Oct-07	230
Apr-08	120
Oct-08	180
May-09	140
Oct-09	61
May-10	22
Oct-10	48
May-11	90

NB



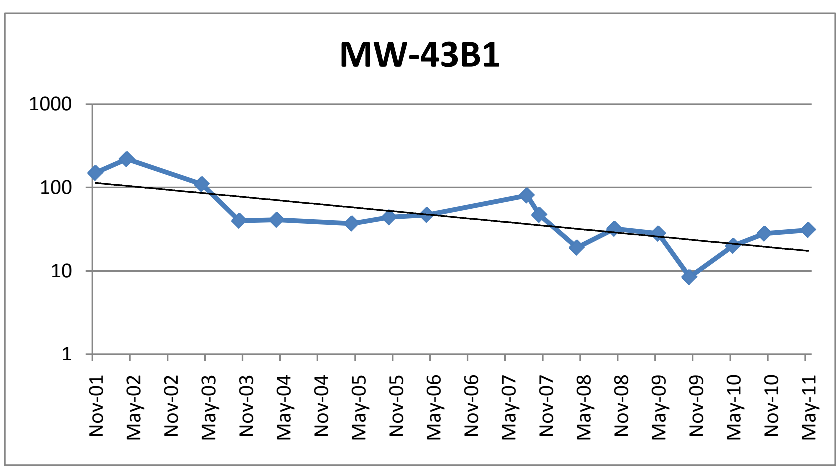
	MW-36B2
Nov-01	12
Apr-02	25
Apr-03	9.0
Oct-03	30
Apr-04	34
Apr-05	27
Oct-05	32
Apr-06	30
Aug-07	30
Oct-07	20
Apr-08	6.8
Oct-08	18
May-09	34
Oct-09	10
May-10	23
Oct-10	21
May-11	25

NB



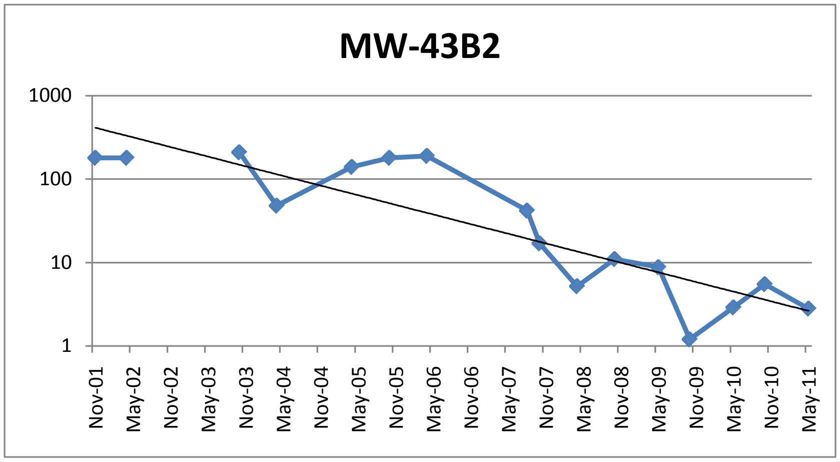
	MW-43B1
Nov-01	150
Apr-02	220
Apr-03	110
Oct-03	40
Apr-04	41
Apr-05	37
Oct-05	44
Apr-06	47
Aug-07	81
Oct-07	47
Apr-08	19
Oct-08	32
May-09	28
Oct-09	8.4
May-10	20
Oct-10	28
May-11	31

NB



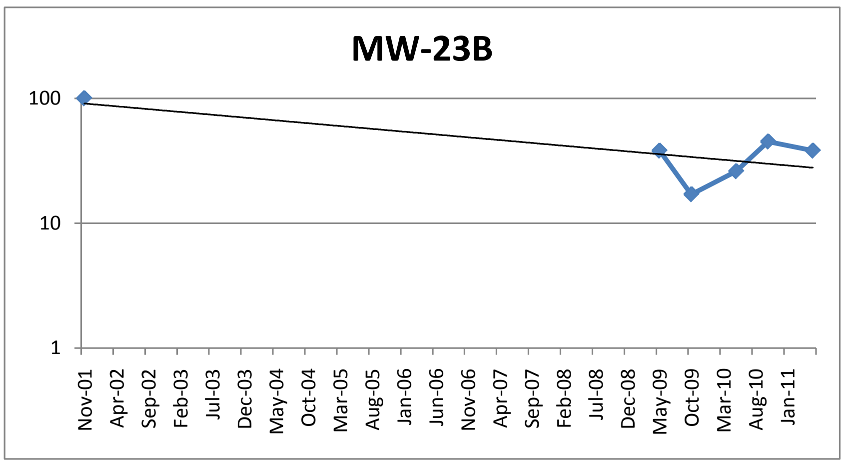
	MW-43B2
Nov-01	180
Apr-02	180
Apr-03	
Oct-03	210
Apr-04	48
Apr-05	140
Oct-05	180
Apr-06	190
Aug-07	42
Oct-07	17
Apr-08	5.2
Oct-08	11
May-09	8.8
Oct-09	1.2
May-10	2.9
Oct-10	5.5
May-11	2.8

NB



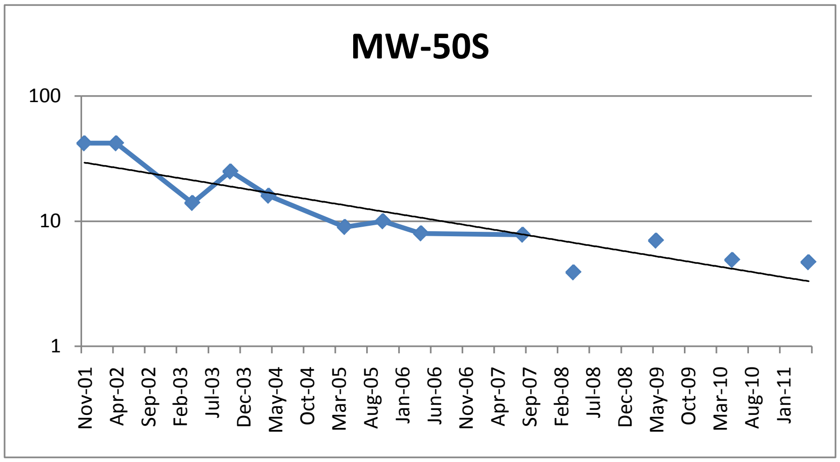
	MW-23B
Nov-01	100
Apr-02	
Apr-03	
Oct-03	
Apr-04	
Apr-05	
Oct-05	
Apr-06	
Aug-07	
Oct-07	
Apr-08	
Oct-08	
May-09	38
Oct-09	17
May-10	26
Oct-10	45
May-11	38

NB



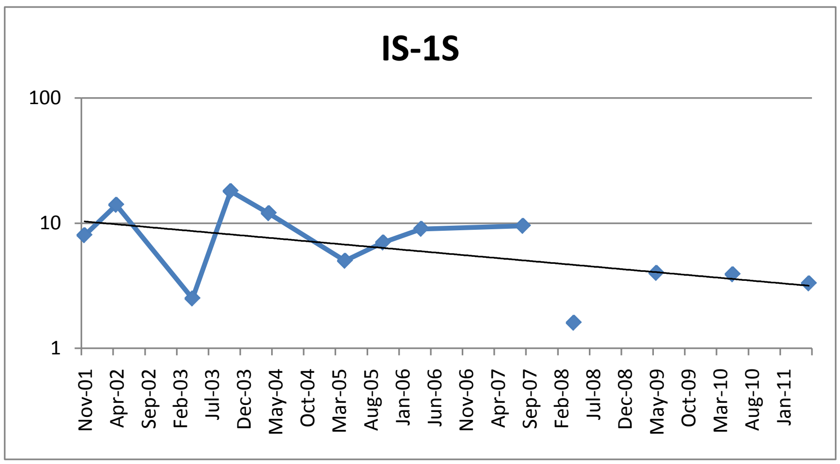
	MW-50S
Nov-01	42
Apr-02	42
Apr-03	14
Oct-03	25
Apr-04	16
Apr-05	9.0
Oct-05	10
Apr-06	8.0
Aug-07	7.8
Oct-07	
Apr-08	3.9
Oct-08	
May-09	7.0
Oct-09	
May-10	4.9
Oct-10	
May-11	4.7

SO



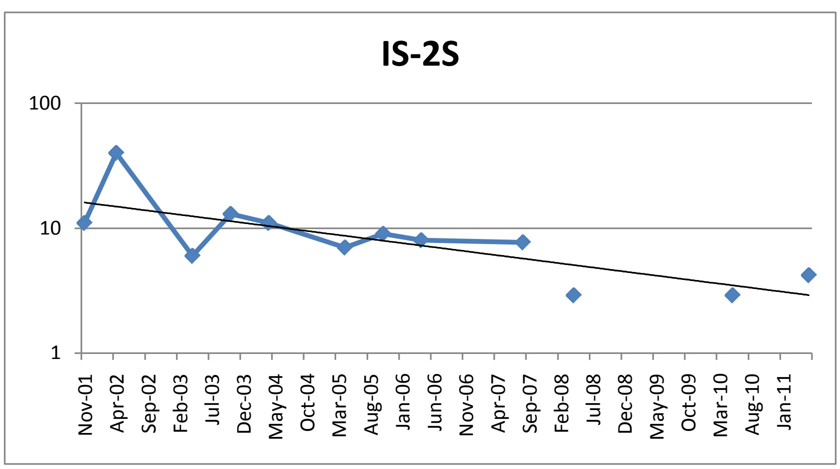
	IS-1S
Nov-01	8.0
Apr-02	14
Apr-03	2.5
Oct-03	18
Apr-04	12
Apr-05	5.0
Oct-05	7.0
Apr-06	9.0
Aug-07	10
Oct-07	
Apr-08	1.6
Oct-08	
May-09	4.0
Oct-09	
May-10	3.9
Oct-10	
May-11	3.3

SO



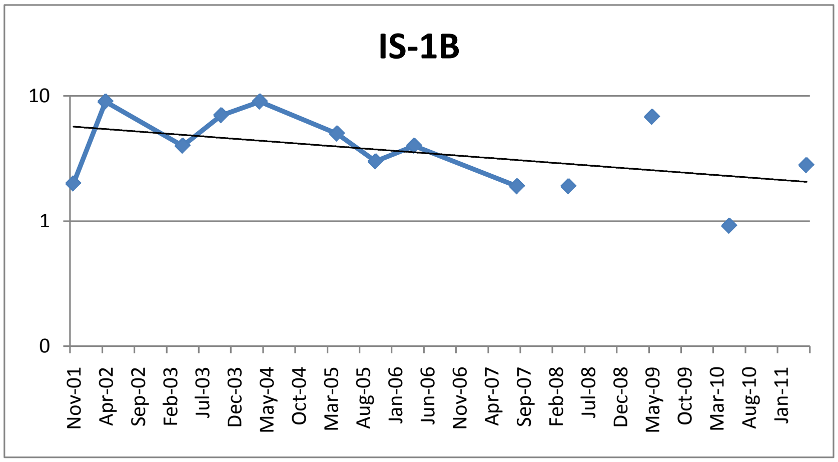
	IS-2S
Nov-01	11
Apr-02	40
Apr-03	6.0
Oct-03	13
Apr-04	11
Apr-05	7.0
Oct-05	9.0
Apr-06	8.0
Aug-07	7.7
Oct-07	
Apr-08	2.9
Oct-08	
May-09	
Oct-09	
May-10	2.9
Oct-10	
May-11	4.2

SO



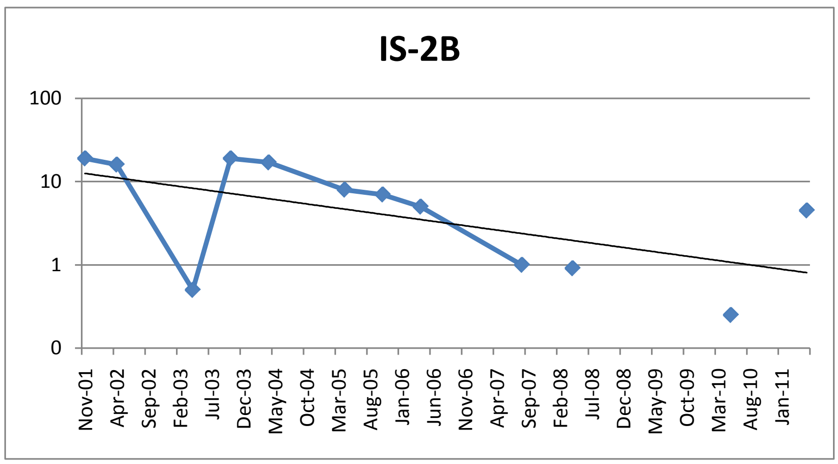
	IS-1B
Nov-01	2.0
Apr-02	9.0
Apr-03	4.0
Oct-03	7.0
Apr-04	9.0
Apr-05	5.0
Oct-05	3.0
Apr-06	4.0
Aug-07	1.9
Oct-07	
Apr-08	1.9
Oct-08	
May-09	6.8
Oct-09	
May-10	0.9
Oct-10	
May-11	2.8

SB



	IS-2B
Nov-01	19
Apr-02	16
Apr-03	0.5
Oct-03	19
Apr-04	17
Apr-05	8.0
Oct-05	7.0
Apr-06	5.0
Aug-07	1.0
Oct-07	
Apr-08	0.9
Oct-08	
May-09	
Oct-09	
May-10	0.3
Oct-10	
May-11	4.5

SB



ATTACHMENT C
GREEN REMEDIATION FOOTPRINT CALCULATIONS

Input for Annual O&M

General Scope	*Typical Scope Items*	*Useful Information*
- 3 visits per week by local operator - semi-annual groundwater sampling (6 days per event) - compressor, transfer pump, and heater operation - yearly changeout of 600 lbs of GAC - monthly travel for monthly sampling - laboratory analysis for process and groundwater sampling		

Labor, Mobilizations, Mileage, and Fuel

Participant	Crew Size	Number of Days	Hours Worked Per Day	Total Hours Worked	Trips to Site	Roundtrip Miles to Site	Mode of Transport.	Fuel Type	Total Miles Traveled	Miles Per Gallon	Total Fuel Used	Activity or Notes
local operator	1	156	4	624	156	10	Light-Duty Truck	Gasoline	1560	15	104	
monthly sampler	1	12	12	144	12	200	Light-Duty Truck	Gasoline	2400	15	160	
grounwater sampling techs	2	4	8	64	2	200	Light-Duty Truck	Gasoline	400	15	26.7	mob/demob
grounwater sampling techs	2	12	8	192	12	10	Light-Duty Truck	Gasoline	120	15	8	from local hotel

Equipment Use, Mobilization, and Fuel Usage

Equipment Type	HP	Load Factor	Equip. Fuel Type	Gallons Fuel Used per Hour	Total Hours Operated	Gallons Fuel Used On-Site	Trips to Site	Roundtrip Miles to Site	Total Miles Transported	Transport Fuel Type	Miles per Gallon	Gallons Fuel Used for Transport.	Activity or Notes

Electricity Usage

Equipment Type	HP	% Full Load	Efficiency	Electrical Rating (kW)	Hours Used	Energy Used (kWh)	Notes
compressor	5	80	75	3.9786667	8760	34853.12	
transfer pump	3	80	75	2.3872	2628	6273.5616	
Equip. with kW rating				3	2160	6480	heater
Equip. with kW rating							
Direct kWh info.							
			Totals	9.3658667		47606.6816	

Cells shaded in dark gray are not relevant to the equipment types noted

"Direct kWh info" refers to total electricity usage calculated or provided elsewhere (e.g., an electric meter).

Natural Gas Usage

Equipment Type	Power Rating (btu/hr)	Efficiency	Total Hours Used	Btus Required	Total Therms Used	Notes
		Totals		0	0	

If heat load is known instead of unit power rating, then enter power rating as 125% of heat load and choose 80% for efficiency.

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For more information contact: scheuermann.karen@epa.gov or pachon.carlos@epa.gov.

Input for Annual O&M

Materials Usage

Material Type	Unit	Quantity	Site-Spec. One-Way Distance (miles)*	Number of Trips	Total One-Way Miles	Mode of Transport.	Fuel Type	Fuel Use Rate (mpg or gptm)	Total Fuel Use	Notes
GAC: regenerated	lbs	600		1	1000	Truck A (< 5 tons)	Diesel	8.5	117.6	
			Empty Return Trips			Truck A (< 5 tons)				

** Leave site-specific one-way miles blank if value is not known and a default will be used for*

Fuel Use Rate reported in miles per gallon (mpg) and gallons per ton-mile (gptm)

Laboratory Analysis

Parameter and Notes	Unit Cost	Number of Samples	Total Cost
VOCs	140	248	34720
SVOCs			0
PCBs/Pesticides			0
Metals	190	184	34960
Other			0
Other			0
Other			0
Other			0
Other			0
Other			0
	Totals	**432**	**69680**

Waste Generation

Waste Type	Unit	Quantity	Site-Spec. One-Way Distance (miles)	Number of Trips	Total One-Way Miles	Mode of Transport.	Fuel Type	Fuel Use Rate	Total Fuel Use	Notes
Non-hazardous landfill	tons	0.3		1	25	Truck A (< 5 tons)	Diesel	8.5	2.9	GAC disposal
	tons									
	tons									
	tons									
	tons									
			Empty Return Trips			Truck A (< 5 tons)				

** Leave site-specific one-way miles blank if value is not known and a default will be used for calculating total-one way miles*

gptm = gallons per ton-mile

On-Site Water Usage (1000 x gallons) / ***Fate of On-Site Water Usage (1000 x gallons)***

Resource Type	Quantity	Use of Resource	Discharge Location	Notes
		extracted water is reinjected		
Water table drawdown (ft)				

If potable water is trucked to site, use "potable water" in materials section to calculate fuel use. Only the potable water use from the On-Site Water Use Section will be input into the Summary tab. It is assumed that the quantity of potable water in the Materials section is accounted for in in the On-Site Water Use Section.

Miscellaneous Emissions and Reductions

Item	Quantity	Activity or Notes
Other HAP emissions		
Other GHG emissions		
Other GHG reductions		
Other NOx reductions		
Other SOx reductions		
Other PM reductions		

On-Site Renewable Energy Generation

Item	Quantity	Activity or Notes
Photovoltaic (kWh)		
Renewable Energy #1 (kWh)		
Renewable Energy #2 (kWh)		

Purchased Renewable Energy (including Renewable Energy Certificates "RECs")

Item	Quantity	Activity or Notes
Purchased from Utility (kWh)		
RECs (kWh)		

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For more information contact: scheuermann.karen@epa.gov or pachon.carlos@epa.gov.

	Totals For Parameters Used, Extracted, Emitted, or Generated - Eastern Surplus Superfund Site														
	Energy Used Mbtu	Grid Electricity Used MWh	All Water Used gal x 1000	Potable Water Used gal x 1000	Groundwater Extracted gal x 1000	CO2e Emitted lbs	NO x Emitted lbs	SO x Emitted lbs	PM Emitted lbs	Solid Waste Generated tons	Haz. Waste Generated tons	Air Toxics Emitted lbs	Mercury Released lbs	Lead Released lbs	Dioxins Released lbs
Level 1 - Construction															
On-Site	162,482.	48.	0	0	0	0	0	0	0	0.3	0	0	0	0	0
Electricity Generation	371,332.	3.	662.	0	0	32,849.	37.	267.	3.	0	0	4.3846	0.000095213	0.001904267	0.000000004761
Transportation	53,789.	0	0	0	0	8,566.	53.	2.	0	0	0	0.0122	0	0	0
Other Off-Site	486,052.	30.	129.	0	0	76,469.	356.	300.	28.	0	0	9.6472	0.000628203	0.006991482	0.000000006093
Construction Total	***1,073,655.***	***81.***	***791.***	***0***	***0***	***117,884.***	***446.***	***569.***	***31.***	***0.3***	***0***	***14.044***	***0.000723416***	***0.008895749***	***0.000000010854***
Level 2 - O&M															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O&M Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Level 3 - Monitoring															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monitoring Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Level 4 - Not Used															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Used Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Level 5 - Not Used															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Used Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Level 6 - Not Used															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Used Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Total	***1,073,655.***	***81.***	***791.***	***0***	***0***	***117,884.***	***446.***	***569.***	***31.***	***0.3***	***0***	***14.044***	***0.000723416***	***0.008895749***	***0.000000010854***

			All Levels - Parameters Used, Extracted, Emitted, or Generated - Eastern Surplus Superfund Site																															
			Energy		Grid Electricity		All Water		Potable Water		Groundwater		CO2e		NO x		SO x		PM		Solid Waste		Haz. Waste		Air Toxics		Mercury		Lead		Dioxins	
		Quantity Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Extracted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Generated	Conv. Factor	Generated	Conv. Factor	Emitted	Conv. Factor	Released	Conv. Factor	Released	Conv. Factor	Released
				Mbtu		MWh		gal x 1000		gal x 1000		gal x 1000		lbs		lbs		lbs		lbs		tons		tons		lbs		lbs		lbs		lbs
Totals				***1,073,655.***		***81.***		***791.***		***0***		***0***		***117,884.***		***446.***		***569.***		***31.***		***0***		***0***		***14.044***		***0.000723416***		***0.008895749***		***0.000000010854***
ON-SITE																																		
Energy																																		
Diesel (on-site use)	gal	0	139	0	0	0	0	0	0	0	0	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0	0	0	0	5E-06	0	0	0	0	0	0	0
Gasoline (on-site use)	gal	0	124	0	0	0	0	0	0	0	0	0	19.6	0	0.11	0	0.0045	0	0.0005	0	0	0	0	0	4E-05	0	0	0	0	0	0	0
Natural gas (on-site use)	ccf	0	103	0	0	0	0	0	0	0	0	0	12.2	0	0.01	0	6E-06	0	0.0008	0	0	0	0	0	8E-06	0	3E-08	0	5E-08	0	0	0
Electricity (on-site use)	MWh	47.606682	3413	162,482.	1	48.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Photovoltaic (on-site system)	MWh	0	37922	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Energy 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Energy 3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water																																		
Groundwater Extracted On-site	gal x 1000	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potable Water Used On-site	gal x 1000	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other On-Site Water 1	gal x 1000	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other On-Site Water 2	gal x 1000	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other On-Site Water 3	gal x 1000	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waste Generation																																		
On-Site Solid Waste Generation	ton	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
On-Site Solid Waste Disposal		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-Site Hazardous Waste Generation	ton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
On-Site Hazardous Waste Disposal		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other																																		
On-site process emissions (HAPs)	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
On-site process emissions (GHGs)	lbs CO2e	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site GHG storage	lbs CO2e	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site NOx reduction	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site SOx reduction	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site PM reduction	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ON-SITE TOTAL			0	**162,482.**	0	**48.**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**
ELECTRICITY GENERATION																																		
Electricity production	MWh	47.606682	7800	371,332.	0.06	3.	13.9	662.	0	0	0	0	690	32,849.	0.78	37.	5.6	267.	0.061	3.	0.0009	0	0	0	0.0921	4.3846	2E-06	0.000095213	4E-05	0.001904267	1E-10	0.000000004761
Purchased Renewa ble Electricity	MWh	0	0	0	0	0	-2	0	0	0	0	0	-1540	0	-3.9	0	-10	0	-0.94	0	-9E-04	0	0	0	-0.4	0	-2E-05	0	-2E-04	0	-2E-10	0
TRANSPORTATION																																		
Diesel (off-site use)	gal	120.5	139	16,750.	0	0	0	0	0	0	0	0	22.5	2,711.	0.17	20.	0.0054	1.	0.0034	0	0	0	0	0	5E-06	0.0006	0	0	0	0	0	0
Gasoline (off-site use)	gal	298.7	124	37,039.	0	0	0	0	0	0	0	0	19.6	5,855.	0.11	33.	0.0045	1.	0.0005	0	0	0	0	0	4E-05	0.0116	0	0	0	0	0	0
Natural gas (off-site use)	ccf	0	103	0	0	0	0	0	0	0	0	0	12.2	0	0.01	0	6E-06	0	0.0008	0	0	0	0	0	8E-06	0	3E-08	0	5E-08	0	0	0
Other Transportation 1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Transportation 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Transportation 3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Transportation 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Transportation 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRANSPORTATION TOTAL			0	**53,789.**	0	**0**	0	**0**	0	**0**	0	**0**	0	**8,566.**	0	**53.**	0	**2.**	0	**0**	0	**0**	0	**0**	0	**0.0122**	0	**0**	0	**0**	0	**0**

All Levels - Parameters Used, Extracted, Emitted, or Generated - Eastern Surplus Superfund Site

		Quantity Used	Energy		Grid Electricity		All Water		Potable Water		Groundwater		CO2e		NO x		SO x		PM		Solid Waste		Haz. Waste		Air Toxics		Mercury		Lead		Dioxins	
			Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Extracted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Generated	Conv. Factor	Generated	Conv. Factor	Emitted	Conv. Factor	Released	Conv. Factor	Released	Conv. Factor	Released
				Mbtu		MWh		gal x 1000		gal x 1000		gal x 1000		lbs		lbs		lbs		lbs		tons		tons		lbs		lbs		lbs		lbs
OFF-SITE OTHER																																
Materials																																
Asphalt	tons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bentonite	tons	0	55	0	0.0027	0	0.13	0	0	0	0	0	6.7	0	0.033	0	0.03	0	0.004	0	0	0	0	0	4E-07	0	6E-11	0	1E-09	0	2E-16	0
Borrow (clean soil)	tons	0	15.75	0	6E-05	0	8E-05	0	0	0	0	0	2.52	0	0.0176	0	0.0018	0	0.0004	0	4E-08	0	0	0	1E-05	0	5E-09	0	2E-07	0	3E-15	0
Cement	dry-ton	0	4100	0	0.13	0	0.41	0	0	0	0	0	1800	0	3.6	0	2.1	0	0.0063	0	0	0	0	0	0.058	0	6E-05	0	0.0001	0	9E-11	0
Cheese Whey	lbs	0	1.87	0	0	0	0	0	0	0	0	0	1.1	0	0.0083	0	0.0099	0	0.0002	0	0	0	0	0	0	0	0	0	0	0	0	0
Concrete	tons	0	3019	0	0.096	0	0.34	0	0	0	0	0	1322	0	2.6	0	1.5	0	0.0054	0	1E-08	0	0	0	0.043	0	4E-05	0	1E-04	0	6E-11	0
Diesel Produced	gal	120.5	18.5	2,229.	0.0006	0	0.0008	0	0	0	0	0	2.7	325.	0.0064	1.	0.013	2.	0.0003	0	4E-07	0	0	0	0.0001	0.0145	5E-08	0.000005784	2E-06	0.00018075	3E-14	0.000000000004
Emulsified vegetable oil	lbs	0	3.6	0	6E-05	0	2E-05	0	0	0	0	0	3.51	0	0.0265	0	0.031	0	0.0017	0	0	0	0	0	0	0	0	0	0	0	0	0
GAC: regenerated	lbs	600	9.6	5,760.	0.0004	0	0.0064	4.	0	0	0	0	2	1,200.	0.025	15.	0.015	9.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GAC: virgin coal-based	lbs	0	10.8	0	5E-05	0	0	0	0	0	0	0	4.5	0	0.12	0	0.074	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GAC: virgin coconut-based	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline Produced	gal	298.7	21	6,273.	0.0006	0	0.0008	0	0	0	0	0	4.4	1,314.	0.008	2.	0.019	6.	0.0005	0	4E-07	0	0	0	0.0002	0.0478	9E-08	0.00002539	2E-06	0.00065714	3E-14	0.000000000009
Gravel/sand/clay	ton	0	55	0	0.0027	0	0.13	0	0	0	0	0	6.7	0	0.033	0	0.03	0	0.004	0	0	0	0	0	4E-07	0	6E-11	0	1E-09	0	2E-16	0
HDPE	lb	0	31	0	0.0003	0	0.0023	0	0	0	0	0	1.9	0	0.0032	0	0.0041	0	0.0006	0	4E-07	0	1E-06	0	3E-06	0	3E-09	0	2E-09	0	1E-09	0
Hydrochloric acid (30%, SG = 1.18)	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrogen peroxide (50%, SG=1.19)	lbs	0	4.95	0	0.0006	0	0.019	0	0	0	0	0	1.35	0	0.0087	0	0.0066	0	0.0025	0	1E-05	0	5E-07	0	0.0002	0	0	0	0	0	0	0
Hydroseed	lbs	0	0.049	0	1E-07	0	0.0001	0	0	0	0	0	0.0046	0	3E-06	0	5E-05	0	3E-07	0	0	0	0	0	8E-07	0	2E-11	0	1E-10	0	0	0
Lime	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Molasses	lbs	0	1.31	0	5E-06	0	9E-05	0	0	0	0	0	0.4	0	0.003	0	0.0026	0	6E-05	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural Gas Produced	ccf	0	5.2	0	0.0003	0	8E-05	0	0	0	0	0	2.2	0	0.0037	0	0.0046	0	7E-05	0	0	0	0	0	6E-06	0	2E-08	0	9E-07	0	5E-14	0
Nitrogen fertilizer	lbs	0	16.2	0	2E-05	0	0	0	0	0	0	0	1.5	0	0.0008	0	0.0174	0	7E-05	0	0	0	0	0	0.0003	0	6E-09	0	4E-08	0	0	0
Other Material #1 - PV System	W	0	33.6	0	0.0003	0	0	0	0	0	0	0	4.47	0	0.015	0	0.032	0	0.0006	0	0	0	3E-06	0	3E-06	0	0	0	3E-06	0	0	0
Other Material #2 - Mulch	cy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Material #3 - acetic acid	lb	0	5.2	0	2E-05	0	0	0	0	0	0	0	0.67	0	0.0006	0	0.02	0	6E-05	0	0	0	0	0	0.0003	0	2E-09	0	1E-08	0	3E-15	0
Other Material #4 - guar gum	lb	0	0.91	0	5E-05	0	0.0001	0	0	0	0	0	1	0	0.073	0	0.0068	0	0.0001	0	0	0	0	0	1E-05	0	1E-09	0	1E-07	0	6E-14	0
Other Material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phosphorus fertilizer	lbs	0	3.39	0	7E-05	0	0	0	0	0	0	0	0.35	0	0.0017	0	0.017	0	0.0001	0	0	0	0	0	5E-05	0	2E-09	0	5E-08	0	0	0
Polymer	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potable Water	gal x 1000	0	9.2	0	0.0004	0	0.021	0	0	0	0	0	5	0	0.0097	0	0.0059	0	0.016	0	8E-07	0	0	0	2E-05	0	8E-09	0	7E-08	0	1E-13	0
Potassium permanganate	lbs	0	29.22	0	0.0016	0	0.003	0	0	0	0	0	4.5	0	0.021	0	0.016	0	0.0017	0	1E-06	0	0	0	0.0006	0	4E-08	0	4E-07	0	4E-13	0
PVC	lbs	0	22	0	0.0006	0	0.0069	0	0	0	0	0	2.6	0	0.0048	0	0.0076	0	0.0012	0	2E-06	0	2E-06	0	0.0005	0	3E-07	0	1E-07	0	7E-09	0
Sequestering agent	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sodium hydroxide (dry bulk)	lbs	0	6.6	0	0.0003	0	0.0012	0	0	0	0	0	1.37	0	0.003	0	0.0048	0	0.0005	0	2E-05	0	5E-07	0	6E-05	0	2E-07	0	3E-08	0	2E-14	0
Stainless Steel	lb	0	11.6	0	0.0006	0	0.0023	0	0	0	0	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.0006	0	0	0	0.0001	0	0	0	5E-07	0	2E-12	0
Steel	lb	0	4.4	0	0.0002	0	0.0006	0	0	0	0	0	1.1	0	0.0014	0	0.0017	0	0.0006	0	0.0003	0	0	0	7E-05	0	1E-07	0	3E-06	0	7E-12	0
Tree: root ball	trees	0	3.7	0	2E-06	0	0.004	0	0	0	0	0	0.6	0	0.003	0	0.0006	0	3E-05	0	1E-08	0	0	0	6E-06	0	2E-09	0	6E-08	0	0	0
Tree: whip	trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Off-Site Services																																
Off-site waste water treatment	gal x 1000	0	15	0	0.0007	0	0.0029	0	0	0	0	0	4.4	0	0.016	0	0.015	0	0.0017	0	0.0024	0	0	0	0.0006	0	4E-08	0	4E-07	0	3E-13	0
Off-site Solid Waste Disposal	ton	0.3	160	48.	0.0077	0	0.15	0	0	0	0	0	25	8.	0.14	0	0.075	0	0.4	0	8E-06	0	0	0	0.0014	0.0004	1E-06	0.000000291	8E-06	0.00000228	1E-11	0.000000000004
Off-site Haz. Waste Disposal	ton	0	176	0	0.0085	0	0.165	0	0	0	0	0	27.5	0	0.154	0	0.0825	0	0.44	0	9E-06	0	0	0	0.0015	0	1E-06	0	8E-06	0	1E-11	0
Off-site Laboratory Analysis	$	69680	6.49	452,223.	0.0004	24.	0.0007	46.	0	0	0	0	1	69,680.	0.0048	334.	0.0036	251.	0.0004	28.	0	0	0	0	0.0001	9.0584	8E-09	0.000585312	9E-08	0.0059228	8E-14	0.000000005505
Other 1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other																																
Potable Water Transported	gal x 1000	0	7.4	0	0.0006	0	0.0013	0	0	0	0	0	0.9948	0	0.0025	0	0.0065	0	0.0006	0	6E-07	0	0	0	0.0003	0	1E-08	0	1E-07	0	2E-13	0
Electricity transmission	MWh	47.606682	410	19,519.	0.12	6.	1.668	79.	0	0	0	0	82.8	3,942.	0.0936	4.	0.672	32.	0.0073	0	0.0001	0	0	0	0.0111	0.5261	2E-07	0.000011426	5E-06	0.000228512	1E-11	0.000000000571
Other 1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OFF-SITE OTHER TOTAL			0	486,052.	0	30.	0	129.	0	0	0	0	0	76,469.	0	356.	0	300.	0	28.	0	0	0	0	0	9.6472	0	0.000628203	0	0.006991482	0	0.000000006093

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Power Sources and Global Emissions Factors for Electricity Provided by

Information from www.eia.gov for Maine in 2009

Type	% Used*	Water (gal/kWh)		CO2e (lbs/kWh)		NOx (lbs/kWh)		SOx (lbs/kWh)		PM (lbs/kWh)		HAPs (lbs/kWh)		Lead (lbs/kWh)		Mercury (lbs/kWh)		Dioxins (lbs/kWh)	
		Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted
Biomass	8%	168	13.44	0	0	0.0015	0.00012	0.00060	0.000048	0.000084	0.00000672	0	0	0	0	0	0	0	0
Coal	0%	0.94	0.00376	2.4	0.0096	0.0067	0.0000268	0.015	0.00006	0.0017	0.0000068	0.0007	0.0000028	0.00000024	9.6E-10	0.000000042	1.68E-10	3.8E-13	1.4288E-15
Geothermal	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydro	26%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural Gas	45%	0.79	0.3555	1.4	0.63	0.0012	0.00054	0.012	0.0054	0.000088	0.0000396	0.000193	0.00008685	1.31E-08	5.895E-09	2.9E-09	1.305E-09	0	0
Nuclear	0%	0.72	0	0.024	0	0.000056	0.0000000	0.000131	0	0.0000126	0	0.0000053	0	5.2E-09	0	4.6E-10	0	2.9E-15	0
Oil	3%	3.52	0.09504	1.9	0.0513	0.0036	0.0000972	0.0041	0.0001107	0.00029	0.00000783	0.0000902	2.4354E-06	0.00000129	3.483E-08	1.01E-08	2.727E-10	1.04E-12	9.8842E-14
Solar	8%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind	8%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	2%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total based on kWh at plant	**100%**		**13.9**		**0.69**		**0.00078**		**0.0056**		**0.000061**		**0.0000921**		**0.00000004**		**2E-09**		**1E-13**
Total based on kWh at point of use (0.12 kWh/kWh lost in transmission)			**15.6**		**0.77**		**0.00087**		**0.0063**		**0.000068**		**0.000103**		**0.00000004**		**2E-09**		**1.1E-13**

** Based on the following:*

Obtain "generation mix" or "fuel blend" from the local utility provider and enter the percentages of each type of electrcity generation method into the "% Used" column of the above table. Percentages should add to 100%.*

The above table provides the conversion factors to convert each kWh of electricity from each generation type into each of the environmental parameters.

"Adjusted" refers to adjusting the footprint value by the percentage of electricity from that particular generation type (e.g., the adjusted value for CO2e emitted by nuclear is 10% of the full-load value if the % of electricity generated by nuclear is 10%).

Notes:

- *Water consumption for thermoelectric power plants in U.S. - 0.47 gallons per kWh**
- *Water consumption for hydroelectric power assumed to be 0 gallons per kWh (i.e., considers evaporation from reservoir as non-additive)*
- *Water consumption for coal resource extraction and fuel processing - 0.16 cubic meters per GJ of extracted energy, and 33% thermal energy conversion to electricity***
- *Water consumption for uranium resource extraction and fuel processing - 0.086 cubic meters per GJ of extracted energy and 33% thermal energy conversion to electricity***
- *Water consumption for natural gas resource extraction and fuel processing - 0.11 cubic meters per GJ of extracted energy and 33% thermal energy conversion to electricity***
- *Water consumption for oil resource extraction and fuel processing - 1.06 cubic meters per GJ of extracted energy and 33% thermal energy conversion to electricity***
- *Water consumption for biomass based on 55 cubic meters per GJ of extracted energy and 33% thermal energy conversion to electricity****
- *CO2e, Nox, SOx, and PM emissions from NREL LCI for each fuel type *****

** Consumptive Water Use for U.S. Power Production, December 2003 • NREL/TP-550-33905*

*** Gleick PH. Water and energy. Annu. Rev. Energy Environ. Vol 19, 1994. p 267-99.*

**** The Water Footprint of Energy Consumption : an Assessment of Water Requirements of Primary Energy Carriers, Winnie Gerbens-Leenes, Arjen Hoekstra, Theo an der Meer, ISESCO Science and Technology Vision, Volume 4 - Number 5, May 2008*

***** "NREL LCI" refers to the U.S. Dept. of Energy, National Renewable Energy Laboratory (NREL), Life-Cycle Inventory Database (www.nrel.gov/lci) maintained by the Alliance for Sustainable Energy, LLC.*

ATTACHMENT D

PHOTO LOG

Photo Documentation Log

Photo: 1	
Direction: NA	
Description: Monitoring wells MW-25S and MW-25B near northern parcel entrance. Wells are typical of monitoring wells located across the site. Several one inch diameter injection points are present in the background. These wells were used to apply chemical oxidants to impacted aquifer materials.	
Date: June 7, 2011	

Photo: 2	
Direction: East	
Description: View to the east of the northern parcel entrance, monitoring and injection wells are present, former hydroelectric power generation building and State Route 191 are in the background.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 3

Direction: North

Description:

Dennys River flowing beneath former power generation building (north face).

Date: June 7, 2011

Photo: 4

Direction: North

Description:

View north from former power generation building, shows Dennys River and the rip rap formerly associated with the power plant reservoir.

Date: June 7, 2011

Photo Documentation Log

Photo: 5	
Direction: South	
Description: Dennys River flowing beneath State Route 191.	
Date: June 7, 2011	

Photo: 6	
Direction: North	
Description: Dennys River flowing beneath former power generation building (south face).	
Date: June 7, 2011	

Photo Documentation Log

Photo: 7	
Direction: West	
Description: View west from former power generation toward northern parcel entrance, treatment building and field office are present in the background.	
Date: June 7, 2011	

Photo: 8	
Direction: NA	
Description: RW-7 well cover typical of all of the extraction wells.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 9	
Direction: NA	
Description: RW-7 extraction well with pneumatic pump and associated tubing.	
Date: June 7, 2011	

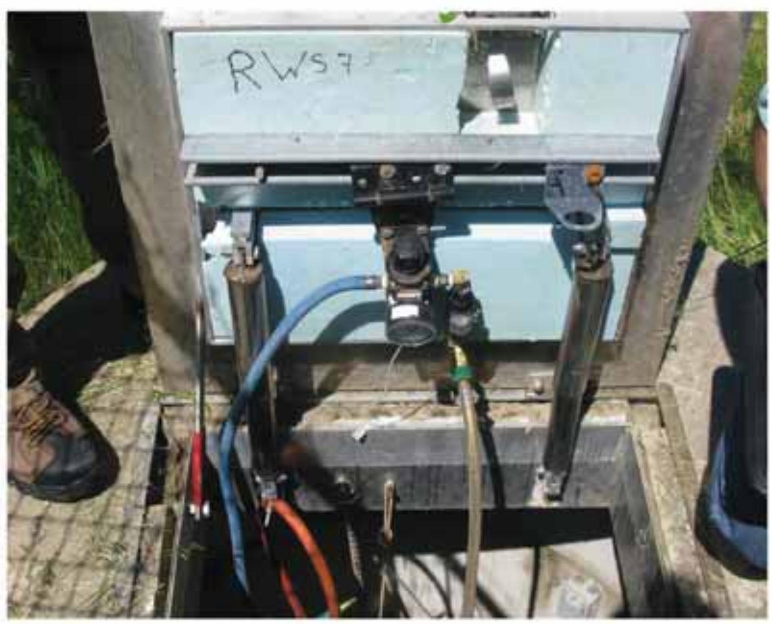
Photo: 10	
Direction: NA	
Description: RW-7 extraction well with pneumatic pump pressure regulator and gauge and typical vault cover.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 11

Direction: NA

Description:

Chemical feed pump housing near northern parcel entrance previously used for chemical oxidation treatment system.

Date: June 7, 2011

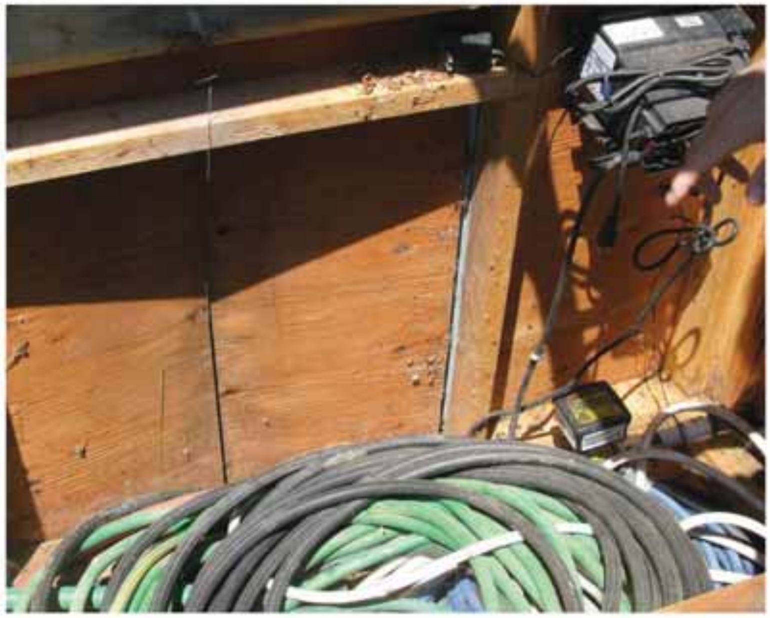


Photo: 12

Direction: South

Description:

Monitoring and extraction wells associated with the southern plume extraction wells (RWS-6 and RWS-5).

Date: June 7, 2011

Photo: 13	
Direction: North	
Description: Monitoring and extraction wells associated with the southern plume. RWS-1 is in the foreground and State Route 191 is in the background.	
Date: June 7, 2011	

Photo: 14	
Direction: North	
Description: View north from the southern plume extraction system. RWS-3 in the foreground.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 15	
Direction: North	
Description: Southern most monitoring wells MW-11S and MW-11B.	
Date: June 7, 2011	

Photo: 16	
Direction: Northeast	
Description: West bank of the Dennys River, area where passive vapor samples were collected by the USGS in 1996.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 17	
Direction: South	
Description: West bank of the Dennys River, looking south just downgradient of the Meddybemps Lake hydraulic control structure and fish ladder.	
Date: June 7, 2011	

Photo: 18	
Direction: North	
Description: Steep bank just south of and west of the northern parcel extraction system.	
Date: June 7, 2011	

Photo: 19

Direction: North

Description:

Chemical oxidation injection wells north end of southern plume (just north of State Route 191 and RWS-7).

Date: June 7, 2011

Photo: 20

Direction: NA

Description:

Drums of Fire Rocks collected during archeological site investigations.

Date: June 7, 2011

Photo Documentation Log

Photo: 21	
Direction: NA	
Description: Infiltration Trench Sump.	
Date: June 7, 2011	

Photo: 22	
Direction: Northeast	
Description: Northern system extraction well sumps and collection pipe gallery, MW-4B in the foreground - looking north.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 23	
Direction: Northeast	
Description: Northern system extraction well sumps and collection pipe gallery. MW-40B in the foreground and MW-46S is in the background.	
Date: June 7, 2011	

Photo: 24	
Direction: Southwest	
Description: Northern system extraction well sumps and collection pipe gallery, RW-9 in the foreground - looking south.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 25	
Direction: East	
Description: Monitoring well MW-23B.	
Date: June 7, 2011	

Photo: 26	
Direction: East	
Description: Monitoring well MW-36B.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 27	
Direction: NA	
Description: Meddybemps Lake hydraulic control structure - bottom.	
Date: June 7, 2011	

Photo: 28	
Direction: NA	
Description: Meddybemps Lake hydraulic control structure - top.	
Date: June 7, 2011	

Photo: 29	
Direction: NA	
Description: Dennys River discharge from Meddybemps Lake hydraulic control structure.	
Date: June 7, 2011	

Photo: 30	
Direction: NA	
Description: Fish ladder at Meddybemps Lake hydraulic control structure.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 31	
Direction: North	
Description: Northern most monitoring well MW-27B.	
Date: June 7, 2011	

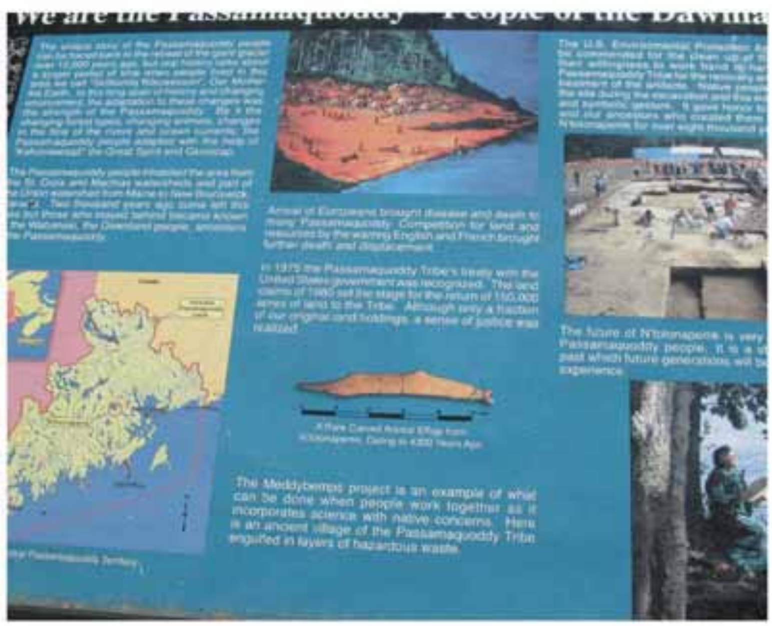
Photo: 32	
Direction: NA	
Description: Archeological description monument (one of four).	
Date: June 7, 2011	

Photo Documentation Log

<table>
<tr><td>Photo: 33</td><td rowspan="4"></td></tr>
<tr><td>Direction: NA</td></tr>
<tr><td>Description:
Archeological description monument with private residence in background.</td></tr>
<tr><td>Date: June 7, 2011</td></tr>
</table>

<table>
<tr><td>Photo: 34</td><td rowspan="4"></td></tr>
<tr><td>Direction: North</td></tr>
<tr><td>Description:
Northern plume main chemical oxidation injection area, includes extraction well MW -35B.</td></tr>
<tr><td>Date: June 7, 2011</td></tr>
</table>

Photo Documentation Log

Photo: 35

Direction: NA

Description:

Extraction Well MW-35B pneumatic pump pressure regulator and gauge.

Date: June 7, 2011

Photo: 36

Direction: NA

Description:

MW-35B pneumatic pump tubing.

Date: June 7, 2011

Photo Documentation Log

Photo: 37

Direction: North

Description:

Treatment system equalization tanks along north wall.

Date: June 7, 2011

Photo: 38

Direction: NA

Description:

Bag filters.

Date: June 7, 2011

Photo Documentation Log

Photo: 39	
Direction: North	
Description: Treatment system piping north wall.	
Date: June 7, 2011	

Photo: 40	
Direction: NA	
Description: Air compressor tanks.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 41	
Direction: NA	
Description: Northern compressor and air tank.	
Date: June 7, 2011	

Photo: 42	
Direction: NA	
Description: Ion exchange vessels (three to the left) and 200 pound GAC vessels (three to the right).	
Date: June 7, 2011	

Photo: 43	
Direction: NA	
Description: Compressor oil reservoirs.	
Date: June 7, 2011	

Photo: 44	
Direction: NA	
Description: Southern compressor and air tank.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 45	
Direction: NA	
Description: Equalization tank level control.	
Date: June 7, 2011	

Photo: 46	
Direction: NA	
Description: Air compressor controls.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 47	
Direction: NA	
Description: Heat trace controls.	
Date: June 7, 2011	

Photo: 48	
Direction: NA	
Description: Six of six GAC carbon vessels (one disconnected at time of site visit).	
Date: June 7, 2011	

Photo Documentation Log

Photo: 49	
Direction: NA	
Description: Old air compressors that had been replaced.	
Date: June 7, 2011	

Photo: 50	
Direction: North	
Description: South face of the former power generation building.	
Date: June 7, 2011	

Photo: 51	
Direction: Northwest	
Description: Southwest corner of the former power generation building.	
Date: June 7, 2011	

Photo: 52	
Direction: NA	
Description: Meddybemps Lake fish ladder.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 53	
Direction: NA	
Description: Meddybemps Lake fish ladder.	
Date: June 7, 2011	

Photo: 54	
Direction: West	
Description: Meddybemp Lake fish ladder and hydraulic control structure from east bank.	
Date: June 7, 2011	

Photo Documentation Log

Photo: 55	
Direction: North	
Description: Meddybemps Lake view north from hydraulic control structure.	
Date: June 7, 2011	