

# **DAPL EXTRACTION PILOT STUDY PERFORMANCE EVALUATION REPORT**

**OLIN CHEMICAL SUPERFUND SITE  
51 EAMES STREET  
WILMINGTON, MASSACHUSETTS**

*Submitted to:*

**United States Environmental Protection Agency  
Region I – New England  
5 Post Office Square, Suite 100; Mail Code 05RR07-4  
Boston, Massachusetts 02109-3912**

*Submitted by:*

**Olin Corporation  
3855 North Ocoee Street; Suite 200  
Cleveland, Tennessee 37312**

*Prepared by:*



**AMEC Environment & Infrastructure, Inc.  
511 Congress Street, Suite 200  
Portland, Maine 04101**

**November 7, 2014**



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

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Peter Thompson  
Project Manager

A handwritten signature in black ink, appearing to read "Rod Pendleton".

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Rod Pendleton  
Project Principal

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## LIST OF ACRONYMS AND ABBREVIATIONS

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|            |                                                      |
|------------|------------------------------------------------------|
| AMEC       | AMEC Environment & Infrastructure, Inc.              |
| DAPL       | Dense Aqueous Phase Liquid                           |
| DAPL Pilot | DAPL Extraction Pilot Test                           |
| DI         | deionized                                            |
| gpm        | gallons per minute                                   |
| I/CO       | inspection/cleanout manhole                          |
| MCP        | Massachusetts Contingency Plan                       |
| MassDEP    | Massachusetts Department of Environmental Protection |
| mg/L       | milligrams per liter                                 |
| off-PWD    | off-Property West Ditch                              |
| Olin       | Olin Corporation                                     |
| OM&PM      | Operation, Maintenance & Performance Monitoring Plan |
| ORP        | oxidation-reduction potential                        |
| PVC        | polyvinyl chloride                                   |
| SOP        | standard operating procedure                         |
| μmhos/cm   | micro-ohms per centimeter                            |
| USEPA      | United States Environmental Protection Agency        |
| VFD        | variable frequency drive                             |

## 1.0 INTRODUCTION

A Dense Aqueous Phase Liquid Extraction Pilot Test (DAPL Pilot Test) was conducted from 2012 to 2014 at the Olin Chemical Superfund Site (Site) in Wilmington, Massachusetts to evaluate the feasibility of DAPL extraction in the off-Property West Ditch (off-PWD) Study Area. This DAPL Extraction Performance Evaluation Report has been prepared on behalf of Olin Corporation (Olin) by AMEC Environment & Infrastructure, Inc. (AMEC). This introduction is intended to:

- Provide a summary discussion of the bench-scale test including conclusions from the bench-scale test which helped form the basis for extraction rate expectations for the DAPL Pilot Test,
- Provide a general discussion of the scope and objectives of the Pilot Test,
- Identify scope and purpose of the Performance Evaluation Report and how the results will be assimilated within the RI/FS process, and
- Summarize the general time line from design to construction, operation (including unscheduled shutdowns) and ultimate shut down of Pilot System.

Section 2 of the report discusses Pilot Test methods and materials as well as any deviations from the final Operation, Maintenance, and Monitoring (OM&M) Plan (AMEC, 2012); Section 3 presents results of water quality and water level monitoring; and Section 4 offers conclusions and recommendations for use of the data in follow-on studies, such as the Groundwater Operable Unit 3 Feasibility Study.

A detailed description of the definition of DAPL is presented in Section 3.0. For the Pilot Test, the working field definition for DAPL is the dense fluid with specific conductivity greater than 20,600 micro-mhos per centimeter ( $\mu\text{mhos/cm}$ ) and Diffuse Layer material being that overlying layer with specific conductivity between 20,600 and 3,000  $\mu\text{mhos/cm}$ . Overlying groundwater is defined as having specific conductivity less than 3,000  $\mu\text{mhos/cm}$ .

### 1.1 DAPL Extraction Pilot Test Objectives and Scope

The overall objective of the DAPL Pilot Test was to:

- Assess the feasibility of recovering DAPL from the subsurface in a manner that minimizes disturbance of the DAPL pool surface and mixing with overlying Diffuse Layer material and overlying groundwater, and
- Develop information to be used in the Operable Unit (OU) 3 Feasibility Study (FS) evaluation of remedial alternatives.

One of the Pilot Test goals was to remove DAPL in a manner that minimizes intrusion of overlying groundwater and Diffuse Layer into the DAPL, thereby preventing or minimizing

hydraulic and geochemical conditions that could result in undesirable effects as discussed in the Pilot Test OM & M Plan (AMEC, 2012) and in the bullets that follow.

The underlying principal for the Pilot Test is that the movement of the DAPL is governed by density-driven flow mechanisms. The DAPL is contained within a shallow sloping bedrock depression, which forms a “bowl-shaped” sloping aquifer with a central low point, or bottom. Extraction of fluid from the low point of this depression will result in DAPL movement along this sloping boundary toward the central extraction point. For a DAPL removal strategy to be effective and efficient, the rate at which the DAPL is pumped should not exceed the density-driven flow rate towards the extraction point. Pumping at an excessive rate over an extended period of time could create several conditions that would favor inefficiency or failure of the extraction strategy. These include:

- Causing the Diffuse Layer and overlying groundwater intrusion into the DAPL material resulting potentially in mineralization (i.e., precipitation of aluminum, iron and chromium hydroxides, acid sulfates and other minerals) and aquifer clogging;
- Causing excessive drawdown of the DAPL/Diffuse Layer interface in the vicinity of the pumping wells with similar potential detrimental effects;
- Causing a disturbance of either the DAPL or the Diffuse Layer that could induce convective flow patterns and potentially cause impacts to spread over a broader area and/or increase concentrations of DAPL constituents at shallower depths in the aquifer; and
- Causing an expansion of the Diffuse Layer thickness.

The approach for the Pilot Test was to pump the DAPL from a well with a short screened interval positioned as near the bottom of the DAPL pool as feasible. The pumping rate was varied in three steps over a pre-determined range and a monitoring well network around the extraction well was monitored to evaluate changes in the DAPL/ Diffuse Layer and overlying groundwater interfaces. The pumping rates were designed to be within and above the estimated rate at which DAPL could be replenished gravimetrically to the well screen. Geomega (Geomega, 2004a) made an initial estimate of the density-driven flow rate for the upper DAPL pool in the off-PWD Study Area. This estimate, which ranges from 0.2 to 0.8 gallons per minute (gpm), is a function of the DAPL density, bedrock slope, aquifer porosity and hydraulic conductivity. This estimate was developed by modeling conducted consistent with the concepts of density driven movement of liquids in sloping aquifers (Dorgarten and Tsang, 1991). The DAPL pool is known to be density stratified with the more concentrated and denser layers at the bottom of the DAPL pool. If the pumping strategy is executed properly and successfully, the denser DAPL will be removed in the early stages of extraction, and density will decrease with time as the DAPL interface becomes lower and less dense DAPL is removed. Density therefore is a variable that is expected to change with time and as density of the fluid becomes less, the density-driven flow rate will decrease.

Based on our understanding of density-stratified material, the appropriate expectation is that the level of DAPL within the pool will be uniformly lowered when the extraction rate equals the gravity-driven replenishment rate of DAPL to the extraction well screen. This is especially true with a short extraction well screen. If the pumping rate exceeds the gravity-driven flow rate along the bottom of the pool, shallower DAPL around the extraction well will be pulled downward along a shorter flow path to the well screen resulting in localized drawdown of the DAPL/diffuse layer interface. This will also eventually result in intrusion of overlying Diffuse Layer material and overlying groundwater into the DAPL around the extraction well.

The Pilot Test scope included collecting geophysical (induction logging) and chemical data to gauge how the DAPL pool responded to each pumping rate over time. The induction logging serves to map changes in the vertical profile of in-situ fluid conductivity within the DAPL near the extraction well. The chemical data collected from closely spaced multiport piezometers allows vertical tracking of changes in the DAPL/Diffuse layer interface based on field fluid conductivity measurements. The DAPL extraction rates tested were 0.5, 1.0 and 2.0 gallons per minute (gpm) for target durations of 90, 120, and 180 days, respectively. The third pumping step at 2.0 gpm could not be sustained for the entire target duration (180 days). We have continued to monitor recovery of the DAPL /Diffuse Layer interface since the final pumping step was terminated on May 22, 2014 after discussion with USEPA. The DAPL Pilot system has not been decommissioned or removed and all equipment is being maintained.

During the execution of the Pilot Test, monitoring data was plotted and submitted to USEPA by Olin on a frequent basis. USEPA was apprised on the progress of the Pilot Test and was aware the final pumping rate of 2.0 gpm was not sustainable due to excessive drawdown of the DAPL / Diffuse Layer interface. At the time of test failure (i.e., drawdown of the DAPL/diffuse material interface into the extraction well screen) the mix of DAPL and diffuse material and/or overlying groundwater being extracted no longer possessed the characteristics of DAPL.

## **1.2 Scope and Purpose of Performance Evaluation Report**

The scope of this report includes:

- providing a general description of the design history and design elements and function of the Pilot system
- providing data supporting the current interpretation of the physical dimensions and volume of the Off-PWD DAPL pool
- tabulating, presenting, and interpreting induction logging data, groundwater chemical data, and groundwater elevation data collected during the pilot test, and
- providing conclusions and recommendations

The purpose of this report is to provide conclusions and recommendations pertaining to:

- achievable long term DAPL extraction limits and strategies
- factors that affect efficiency of DAPL extraction, and
- use of this information in the OU3 Feasibility Study Process.

### **1.3 Project Timeline**

The timeline for the entire DAPL Pilot Study includes activities that pre-dated the actual extraction of DAPL, and extends back more than a decade and includes Planning, Design, Construction and Extraction Phases which are summarized briefly below.

#### **1.3.1 Planning Phase**

Evaluation of DAPL extraction as a remedial strategy predated the listing of the Olin Site as a Superfund Site under CERCLA including the collection of intact cores from the DAPL saturated aquifer soils to support bench scale column testing (Geomega, 2004b and Geomega, 2004c). In 2004, the results of this bench-scale column study to simulate DAPL pumping were published and an initial estimate of DAPL removal rates was established in response to MassDEP comments (Geomega, 2004a). These results were incorporated into a conceptual plan to conduct a pilot test at field scale using a single extraction well, including identifying a proposed location for the extraction well (MACTEC, 2004). Additional seismic refraction studies were conducted in 2005 in an attempt to better define the location for an extraction well on 8 Jewel Drive within a low point in the bedrock depression that contained the DAPL pool.

The bench scale column studies focused on the geochemical effects of displacing DAPL in the soil cores with diffuse layer and fresh water into former DAPL saturated soil with continued pumping. The primary findings of the column testing included:

- after 1.5 pore volumes for flushing (1 volume representing initial displacement of DAPL), approximately 80 % of the aqueous mass was removed and sub-DAPL conditions in groundwater might be achieved,
- after 1.5 pore volumes of flushing the column system began plugging due to precipitation of mineral solids,
- after 1.5 pore volumes of flushing mass removal rates became asymptotic,
- residual mineral phases, primarily acid sulfates, are expected to result in elevated concentrations for some solutes for an unknown period, and
- slower pumping rates favored the chance of avoiding perturbations of DAPL that could exacerbate ex-solution of solutes into overlying groundwater and additional formation of precipitates.

### **1.3.2 Design Phase**

Detailed designs were developed for the Pilot Test following listing of the Olin Chemical Superfund Site and negotiation of an Agreement on Consent (AOC) and Statement of Work (SOW) in 2007. USEPA rejected the first design, which incorporated a rail loading facility for the off-site transport of the DAPL for treatment and disposal. A second design was completed at USEPA's request that utilized storage tanks located on the private property (8 Jewel Drive) near the extraction well from which tanker trucks could be loaded for off-site DAPL transport (MACTEC, 2008). This design was rejected by the property owner. The final, and third design incorporated a DAPL conveyance pipeline to a storage tank located on the Olin Property and placement of the DAPL extraction pump, controllers, flow meter and well within a subsurface vault on the 8 Jewel Drive Property. This design required an additional access agreement with PanAM Railways to allow construction of the DAPL conveyance pipeline under the intervening railroad tail-track, which is considered an active, in service rail line.

### **1.3.3 Construction Phase**

The first stage of construction was initiated in May 2011 and included installation of the extraction and nearby monitoring wells. As we installed the monitoring wells, we found that the depth to bedrock and extent of the bedrock depression was inconsistent with interpretations developed from seismic activities conducted previously. The actual depth to bedrock based on drilling observations was approximately 20% more shallow than what had been interpreted from the seismic data. A direct-push boring program was implemented to confirm the depth to bedrock in the vicinity of the extraction well and to re-evaluate options for locating the extraction well. The results of these investigations and the recommended re-location of the extraction well were communicated to USEPA and a revised location agreed upon in July 2011 as shown in **Figure 1-1** (MACTEC, 2011). The well was placed to avoid underground utilities and not be closer to the building than desired by the property owner who may consider a future building expansion. The well location is on the western side of the DAPL pool at the lowest elevation along that side of the bedrock depression. The interpreted middle of the DAPL pool and bedrock depression lies under the existing building at 8 Jewel Drive and it is not known whether the elevation of bedrock under the building is appreciably deeper. Given these site constraints, Olin, AMEC and USEPA concurred that the proposed well location was suitable for conducting the Pilot Test. With the final location of the extraction well resolved, construction of the Pilot System commenced. The construction of the entire DAPL pilot system was completed in October 2012.

### **1.3.4 Extraction Phase**

The DAPL Extraction Phase of the Pilot Test commenced on November 6, 2012. Each pumping step period was completed over a predetermined number of operating days. The Pilot system did experience unanticipated, non-scheduled shut down periods primarily due to failure of the variable frequency drive for the extraction pump and an alarm condition caused by a low voltage

instrumentation wire short circuit resulting from water intrusion and corrosion of a wiring splice. Although these issues resulted in gaps in the pumping period, monitoring data indicate they did not adversely affect the continuity of the data collected. The DAPL extraction phase was completed on May 22, 2014. Rebound of the DAPL/Diffuse Layer interface is currently being monitored.

## 2.0 METHODS AND MATERIALS

This section reviews the essential components of the system design and functions including the DAPL extraction and conveyance system, and details of the monitoring well network that was used to monitor system performance. The system operations are also reviewed, including the pumping step rate change schedule, and the monitoring schedule, as well as discussion of system down-time.

### 2.1 System Design and Functions

Details of the extraction system are provided in construction plans and specifications in Appendix A. Major components of the system, including the DAPL extraction and storage system, and monitoring network are described below and in subsequent sections.

#### **2.1.1 DAPL Extraction, Storage and Shipping**

The DAPL extraction well and associated monitoring well network are located on the property at 8 Jewel Drive and are shown in relation to the revised bedrock contours and direct-push investigation locations in **Figure 2-1**. The extraction well (EW-1) is screened within the bottom five feet of the DAPL pool and is located within a 6-foot by 6-foot by 3-foot 11-inch deep enclosure vault with double-leaf access doors on the 8 Jewel Drive property. The extraction well was installed in the deepest accessible portion of the bedrock depression where DAPL approaches its maximum thickness. The ground surface elevation is approximately 88 feet MSL at the extraction well, and the top of the DAPL interface at the start of the test was approximately 55 feet MSL and the top of bedrock near 43 feet MSL. The DAPL pool has an estimated thickness of 12 feet.

The extraction well is a 6-inch diameter, Schedule 40 polyvinyl chloride (PVC) well with a 5-foot long, continuous slot (0.010-inch) well screen. The top of screen was installed at a depth of 40.9 ft below ground surface. The extraction well was installed by roto sonic drilling methods to minimize physical disturbance of the formation. The extraction well includes a two-foot sump installed into the top of bedrock. Above the sump, the well screens the bottom 5 feet of the DAPL which sits above the top of rock and a thin basal till zone. The sand pack was constructed from #00 U.S Silica Filpro™ well sand, extends two feet above the top of screen and is sealed with three feet of bentonite chips. The remainder of the well annulus is grouted to the surface with a cement/bentonite grout. A ½ -inch diameter PVC drop tube is positioned within the bottom of the well screen and connected to the peristaltic pump.

The extraction pump is an electrically-operated variable speed peristaltic type pump with a maximum flow rate of 11 gpm and rated discharge pressure of 230 pounds per square inch (psi). The pump rotation speed and discharge is regulated by a variable frequency drive that is set and monitored by a control panel located adjacent to the DAPL storage tank at the Olin Property. An ultrasonic flow meter located in the vault measures flow rate. These rates were checked by manual measurement from a T-valve at the pump discharge and by tracking DAPL

tank storage volumes. The use of a peristaltic pump isolates the mechanical pump parts from the DAPL to address potential corrosion-related issues. The pump discharges through a heat-traced conveyance system comprised of a 1½-inch diameter high density polyethylene (HDPE) carrier pipe contained within a 4-inch diameter PVC containment pipe. The carrier pipe runs in an underground utility trench from the pump enclosure vault through a series of Inspection/Cleanout (I/CO) structures to I/CO-3 located on the 51 Eames Street Olin property. From there, the carrier pipe runs above ground on the Olin property where it discharges into an above-ground 8,700 gallon dual-wall HDPE storage tank located on the dock of the West Warehouse building.

The height of extracted DAPL in the dual-wall storage tank is measured with a sonic liquid level sensor and volume is calculated by comparison to a control chart. These measurements were back checked with the flow meter and expected time duration to fill the tank at a given flow rate.

The tank is equipped with a high level and high-high level switch and alarms that would initiate alarm condition alerts through an auto-dialer, and then initiate an automatic shutdown of the extraction pump. Safety interlocks also included warning and system shut downs in the event of high pressure and low pressure/ no-flow conditions at the pump, failure of the heat trace system or sensors, failure of the VFD, or pump motor high temperature conditions.

The DAPL tank discharge system includes a manually operated vacuum release valve and a discharge shut-off valve on the discharge line. During unloading operations, the vacuum pipe from the tanker truck was connected to the DAPL tank discharge pipe, and a portable spill pan was placed under that connection. The discharge valve was then opened and the discharge pipe vacuum release valve closed. After loading the allowable volume of liquid to the tanker truck, the vacuum release valve was opened and the remaining DAPL in the pipe evacuated prior to final shut down of the vacuum transfer pump. The discharge valve was then closed and the transfer pipes disconnected.

### **2.1.2 Monitoring Well Network**

The monitoring system for the Pilot Test required installation of a specialized monitoring network including induction logging wells and closely spaced multi-port wells to observe conditions in proximity to the extraction well with a high degree of resolution.

The monitoring network around the pumping well includes two multilevel piezometers (ML-1 and ML-2) and two induction logging wells (ILW-1 and ILW-2). The configuration of the monitoring well network was adapted to a revised location for the extraction well agreed upon with USEPA. The multilevel piezometers are located at distances approximately 6 and 17 feet upgradient from the extraction well. The two induction monitoring wells are located at distances of approximately 19 and 34 feet upgradient from the extraction well. This configuration, as shown in **Figure 2-2**, pairs one induction logging well with a multilevel piezometer approximately 18 feet upgradient from the extraction well.

Well installation logs for the monitoring network are included in Appendix B. The multilevel wells were developed by purging prior to initial sampling and were not formally developed by removing larger volumes of water to negate vertical mixing within the interfaces.

### **2.1.3 Induction Logging Wells**

The induction logging wells are two-inch diameter, flush threaded, Schedule 40 PVC risers with a solid cap bottom. These wells were filled with deionized (DI) water as they were constructed and installed down the borehole to help overcome buoyancy. The DI water remains in the wells for logging. The PVC induction wells were centered in the borehole and the annulus backfilled with #00 U.S Silica Filpro™ well sand to near the ground surface. The drill casing was removed as the annulus was backfilled. The induction logging wells were completed within a flush-mounted road box. The road box was bedded in gravel to facilitate drainage.

The induction wells were inductively logged prior to and during the extraction test period. The induction logging data was plotted with depth from ground surface and the resulting profiles used to confirm changes in conductivity with depth in the DAPL pool as the test progressed. The changes in conductivity with depth was used to indicate changes in the DAPL/Diffuse material interface in response to DAPL extraction. Two other wells, GW-43DR and GW-42D, were also inductively logged to observe conditions approximately 200 feet away in the Upper DAPL pool.

Induction logging was conducted with a Geonics EM39 probe that provides measurement of the electrical conductivity of the soil and fluids surrounding the monitoring well using an inductive electromagnetic technique.

The probe was lowered into the borehole and retrieved using a Geonics dedicated winch and console system. Measurements were recorded with a digital data logger while the probe was lowered (down-hole) and retrieved (up-hole). The standard operating procedure for induction logging is included in Appendix C. The data plots typically used the up-hole log for comparison since by the time the probe was retrieved it had been immersed in the borehole fluid longer and had attained more consistent equilibration with the temperature of the borehole fluids.

### **2.1.4 Multilevel Piezometer Construction**

The 2-inch diameter multilevel piezometers were constructed using the Model 401 Waterloo System from Solinst™ with single stem PVC sample ports. The piezometers were constructed within a temporarily-cased 6-inch diameter borehole completed by roto sonic drilling methods. The casing was withdrawn as the annulus of the well was carefully backfilled using a tremie pipe with sand and bentonite chips around the sampling ports and riser pipe sections of the multilevel piezometer, respectively. The sand pack around the sample ports are #000 U.S Silica Filpro™ well sand. After a sand pack was completed around a sample port, a bentonite pellet seal was placed between it and the next sand pack and sample port. The depth to ground surface and the diameter of the tubing were recorded in the log book and on the well construction diagram (Appendix B).

The number of multilevel ports that can be installed is dependent on the tubing diameter. A larger diameter port tubing (1/2" OD x 3/8"ID) was used to facilitate physical measurement of the potentiometric surface at three selected ports as shown on the construction diagrams. The other remaining port sample tubes are smaller diameter (3/8"OD x 1/4"ID) to permit the tubing bundle to fit within the well casing and manifold. All ports are suitable for sample collection using a peristaltic pump. The larger diameter tubing includes one port in the overlying groundwater, one port in the Diffuse Layer, and one port in the DAPL to allow physical measurement of potentiometric surfaces in all three of these zones.

## **2.2 Systems Operation and Monitoring**

This section summarizes the pumping step periods, the monitoring schedule and approach as well as deviations from the OM&M plan.

The technical approach to performance monitoring included a baseline phase prior to extraction system startup, and a DAPL extraction phase. The monitoring included collection of groundwater samples from multilevel piezometers and the extraction well, logging of induction wells, and gauging water levels. During each pumping step of the extraction phase, the frequency and type of monitoring was gradually reduced as changes in the behavior of the system became more predictable.

Deviations from the OM&M plan during pumping step 1 included several instances in the winter when frozen ground conditions (including significant accumulation of ice) prevented access to the flush mounted multiport monitoring wells for sampling and water level gauging. The most important deviation from the OM&M was by agreement with USEPA. Early in pumping step 2, the monitoring plan was adapted by focusing the sampling on ML-1 and ML-2 ports 3 through 6. Monitoring was also limited to collection of field parameters and on-site chemical analysis was discontinued as part of the regularly planned sampling. The basis for this change was agreement that the most vital and useful data collected to date was pH and specific conductance, and the induction logging.

### **2.2.1 Pumping Steps**

As mentioned previously, the Pilot Test called for pumping at three increasing pumping rates of 0.5, 1.0 and 2.0 gpm for predetermined target durations of 90, 120 and 180 days respectively. The pumping period of the test was preceded by baseline monitoring of induction logging wells and the multilevel piezometers.

The schedule for initiating and completing the baseline monitoring and three pumping step phases is indicated below.

| Period Description  | Date Initiated | Date Completed         |
|---------------------|----------------|------------------------|
| Baseline Monitoring | 10/26/2012     | 11/02/2012             |
| 0.5 GPM Step 1      | 11/6/2012      | 03/04/2013             |
| 1.0 GPM Step 2      | 03/5/2013      | 12/02/2013             |
| 2.0 GPM Step 3      | 12/03/2013     | 5/22/2014 <sup>1</sup> |

1. The final pumping step was terminated with USEPA concurrence and comment.

### **2.2.2 Non-Operating Time**

Periods of non-operating time in each of the three pumping steps are indicated in **Table 2-1**, with an explanation of the cause and corrective actions of the problem that resulted in system down time. Some of the lead times for system corrective actions involving equipment replacement were due to manufacturer backlogs and delays. The operation periods were extended to account for these unscheduled delays such that the target durations were met (with the exception of the final 2 gpm phase, which was cut short due to excessive drawdown in EW-1).

These non-scheduled shut downs do not affect the interpretation or use of the data and in some cases may provide useful insights. If the pumping rate is within the DAPL gravity flow rate, there is no drawdown cone of depression in the DAPL around the extraction well, and ceasing pumping simply arrests DAPL flow by gravity drainage farther out in the pool. If the DAPL is being pumped at a rate faster than gravity driven flow, during a temporary shutdown DAPL will continue to flow toward the extraction well location as the depression in the DAPL surface tries to recover and rebound. These effects are being monitored over a longer time frame currently in the recovery period.

### **2.2.3 Monitoring Schedule and Approach**

#### **Baseline Period**

The baseline monitoring consisted of two induction logging events at IL-1, IL-2, GW-43DR, and GW-42D, and two multilevel piezometer sampling events at ML-1, ML-2 and MP-2 prior to system start up. The multilevel monitoring program included collection of samples from all ports within ML-1 and ML-2 in the DAPL, Diffuse Layer, and overlying groundwater zones. Monitoring of water levels occurred in one port from each zone (ports 4, 9 and 12) in ML-1 and ML-2, the extraction well, and one event in GW-343DR and GW-42. The schedule for baseline water quality sampling is provided in **Table 2-2**.

The baseline data served two primary purposes including:

- providing an initial assessment of variability in monitoring parameters in individual multilevel piezometer ports; and
- estimating the elevation of the DAPL/Diffuse Layer and Diffuse Layer/overlying groundwater interfaces based on chemical and induction logging data.

The schedules for induction logging, multilevel piezometer sampling and water level gauging varied, since the frequency of sampling decreased as each pumping step progressed, and confidence increased in the existence of trends within the data. Prior to and immediately after increasing the recovery pumping rate to the next step, a round of water level, induction logging, and multiport groundwater samples were generally collected.

### **Pumping Step 1**

Water quality monitoring was conducted in accordance with methods and procedures outlined in the OM&M Plan (AMEC, 2012), and initially included collection of samples for on-site and off-site analysis from ML-1, and ML-2, including all ports for the first three days following start of the first pumping step. Analysis included sulfate, chloride, ammonia, and ferrous and total iron by Olin personnel using HACH field kits with a portable spectrophotometer and ion specific probes. The purpose in monitoring these parameters was to provide data that could be relevant to the role of water quality changes and potential mineralization within the aquifer. The DAPL is iron rich and precipitous changes in the ferrous and ferric iron ratios and/or concentrations could be indicative of solid hydroxide formation. In less dilute waters, increases in sulfate could indicate dissolution of precipitated acid sulfate phases. Ammonia and chloride are conservative and should not be affected by such pH and redox sensitive reactions.

A calibration check sample was run at a frequency of 5 percent (one every twenty samples), or once per day if less than twenty samples are analyzed. An AMEC chemist provided training and conducted periodic review of the data and results, the laboratory analytical notebook, records, as well as raw and calculated final results. Field duplicate samples were collected for on-site analysis at a frequency of five percent for each parameter to assess the measurement precision of the overall sampling and analytical system. Water quality parameters including pH, specific-conductance, oxidation-reduction potential (ORP), temperature, and turbidity were obtained with a calibrated water quality meter in a flow-through cell prior to sample collection.

QA split duplicate samples were collected for off-site analysis by Test America at a frequency of 10 percent from the two baseline monitoring events, and the first and a middle sample event from the first step of the DAPL recovery. The off-site samples included analysis of sulfate, chloride, ammonia, chromium, calcium, and sodium.

The schedule for water quality sampling during pumping step 1 is provided in Table 2-3.

During pumping step 1, induction logging was conducted 12 times in the induction logging wells and five times at GW-43DR and GW-42D. The schedule for induction logging is provided in Table 2-4. The schedule for water level gauging is provided in Table 2-5.

## **Pumping Step 2**

Upon conclusion of the first pumping step, the on-site analytical data and the water quality monitoring parameter data were reviewed with USEPA and it was apparent the most reliable indicators in system response to pumping were pH and specific conductance. Therefore during the second pumping step, by agreement with USEPA, collection of groundwater samples for on-site and off-site analysis ceased, and was replaced by monitoring water quality parameters only.

The last regularly scheduled sampling event for on-site groundwater analysis occurred on March 22, 2013. Prior to terminating the second pumping step, EW-1, ML-1, ML-2 Ports 3 through 6 were again sampled on November 1, 2013. No on-site groundwater analysis occurred from March 22 to November 1.

A summary of the water quality monitoring schedule for the second pumping step is presented in Table 2-6.

During pumping step 2, induction logging was conducted 14 times in the induction logging wells and six times at GW-43DR and GW-42D. The schedule for induction logging is provided in Table 2-4. The schedule for water level gauging is provided in Table 2-5.

## **Pumping Step 3**

Water quality monitoring during pumping step 3 was conducted almost entirely by measurement of water quality parameters as indicated in Table 2-7. EW-1 and MP-2 Ports 1, 3, 4 and 6 were also sampled for on-site analysis on May 14, 2014, toward the end of the test for comparison purposes.

During pumping step 3, induction logging was conducted 9 times in the induction logging wells and 4 times at GW-43DR and 3 times at GW-42D. The schedule for induction logging is provided in Table 2-4. The schedule for water level gauging is provided in Table 2-5.

## **Recovery Period**

The OM&M Plan scope did not include monitoring the post pumping period of DAPL extraction, since the Pilot Test did not envision the large amount of drawdown that ultimately occurred in the DAPL in response to being pumped at 2.0 gpm. A decision to monitor recovery was made prior to terminating pumping step 3. Data in the recovery period is still being collected (water quality parameters and induction logging) and initial results are discussed in Section 3.

### 3.0 RESULTS

The following subsections present and discuss the results of monitoring conducted during the Pilot Test, including water quality monitoring, induction logging and water level gauging. The most instructive data collected, as indicated in Section 2, are the water quality parameters for pH and specific conductance, in addition to the induction logging. Since one of the primary monitoring objectives of the Pilot Test is to understand the effect of pumping on the DAPL/Diffuse layer interface, the basis for the DAPL/Diffuse Layer and overlying groundwater criteria are reviewed below.

Geomega established criteria defining the DAPL/Diffuse layer interface (Geomega, 1999). Based on 1998 sample data, Geomega determined that sample populations of DAPL and Diffuse Layer material were statistically different at a 95 % confidence level when a specific gravity of 1.025 was used as a cutoff point between the sample populations. Chemical parameters were then evaluated to see which one produced significant correlations with DAPL or Diffuse Layer material based on this cutoff. Specific conductivity ( $>20,600$  micro-mhos per centimeter [ $\mu\text{mhos/cm}$ ]), sulfate ( $>16,000$  milligrams per liter [ $\text{mg/L}$ ]) chloride ( $>2,800$   $\text{mg/L}$ ), ammonia ( $>1,250$   $\text{mg/L}$ ), magnesium ( $>270$   $\text{mg/L}$ ), and sodium ( $>1,700$   $\text{mg/L}$ ) were all determined to have a strong correlation at these values to the 1.025 specific gravity DAPL cutoff point. Other parameters, such as pH, were determined to have only a weak correlation. Specific conductance will, therefore, be the primary criteria used to discriminate between DAPL, the Diffuse Layer, and overlying groundwater.

Criteria to discriminate between the Diffuse Layer and the overlying groundwater were based on the results of induction logging and multiple-level piezometer data collected during the March 2003 sampling event (Geomega 2003). At a 95% confidence level, a specific conductance value of  $3,000 \mu\text{mhos/cm}$  was determined as the cutoff between the Diffuse Layer and overlying groundwater.

#### 3.1 Water Quality Monitoring

The tabulated results for water quality monitoring are presented in a series of tables for each pumping step, listing wells and ports, sample and analysis dates and results. These tables include Table 3-1 for Pumping Step 1, Table 3-2 for pumping step 2, and Table 3-3 for pumping step 3. Only pumping step 1 contains a significant amount of on-site chemical data, while the other steps consist primarily of water quality monitoring data.

The baseline conductivity data placed the DAPL/Diffuse Layer interface within ML-2 Port 5 which is at an elevation of approximately 55 feet MSL (33 feet below ground surface (BGS)) and is consistent with earlier interpretations concerning the elevation of DAPL in the Off-PWD DAPL pool. Baseline data from ML-2 next to the extraction well placed the top of the Diffuse Layer/Overlying groundwater interface at an elevation of approximately 59.5 feet MSL (28 feet BGS). The thickness of DAPL at the extraction well was therefore approximately 12 feet, and the thickness of the Diffuse Layer approximately 4.5 feet prior to the start of the Pilot Test.

Time-trend plots of sulfate, iron, chloride, and ammonia concentrations from the on-site analysis were reviewed for ML-1 and ML-2 ports 1-5, and the variability in these parameters did not indicate consistent patterns compared to specific conductance and pH under a pumping regime of 0.5 gpm. In several of the DAPL ports in ML-1 and ML-2, total iron appeared to increase towards the end of pumping step 1, yet specific conductance in these ports had tended to decline slightly over the same time interval. Due to these observations, the on-site water quality data has not been formally plotted and presented in this report. That data is presented in tabulated form only.

Plots of water quality parameters for ML-1, ML-2, EW-1, and MP-2 for specific conductance and pH are, however, provided in Appendix D for the entire Pilot Test. These plots focus on ports that straddle the DAPL and Diffuse Layer interface (ports 1 through 6).

### **EW-1**

The plot for pH in EW-1 remained essentially unchanged throughout the entire Pilot Test, while specific conductivity in EW-1 remained constant only during the first pumping step with a rate of 0.5 gpm. The specific conductance in EW-1 declined approximately 10-20% over the second pumping step of 1.0 gpm and 30-40% over the third pumping step of 2.0 gpm.

Since the cessation of pumping, specific conductivity in EW-1 has recovered to 90% of its original baseline value.

### **ML-2 and ML-1**

Specific conductivity and pH plots for ports 1 through 6 in ML-2 and corresponding ports in ML-1 were essentially identical. Based on plots provided in Appendix D, there was no definitive change in specific conductance within each port during the first pumping step at 0.5 gpm.

During the progress of the Pilot Test (primarily during pumping step 2 and pumping step 3, a large, gradual, and pronounced decrease occurred in specific conductivity in all six ports in ML-1 and ML-2, to the point where at the end of the Pilot Test active extraction period, DAPL was no longer present in any port in ML-1 or ML-2. This change is mirrored, as expected by an increase in pH.

In ML-1 there was no distinguishable pH increase in any port during pumping step 1, however through the progress of steps 2 and 3, pH increased in all ports initially in DAPL (ports 1 through 5), with the most pronounced increase in port 4 initially just below in the DAPL/Diffuse Layer interface. Port 6, which had a higher initial pH indicated relatively little to no change in pH through the pumping phase. ML-2 indicated similar pH changes in ports 1 through 4.

### **MP-2**

Historically, since it was constructed, port 5 in MP-2, has not yielded enough water to allow sampling of that port. Port 4 is in DAPL, while port 6 is in the Diffuse Layer. Thus the DAPL/

Diffuse Layer interface in MP-2 is in port 5 at an elevation between 54.14 and 57.14 feet MSL, which corresponds well to the interface elevation observed in ML-1 and ML-2. Specific conductance increased in ports 3, 4, and 6 in MP-2 during the first pumping step of 0.5 gpm, then declined in pumping steps 2 and 3. Port 4 transitioned from DAPL to Diffuse Layer during pumping step 2. Port 3 remained in DAPL throughout pumping steps 2 and 3, although specific conductance in port 3 was reduced by approximately 50% from baseline values over that period. Port 3 is at an elevation of 51.64 feet MSL. The specific conductance in port 1 at the end of pumping step 3 was consistent with historical data from 2010. Port 1 is at an elevation of 46.64 feet MSL.

The pH measured in ports 3, 4, and 6 all remained unchanged during pumping step 1, but increased noticeably in ports 4 and 6 in pumping step 2, and leveled off in pumping step 3. pH increased gradually in port 3 during pumping step 3.

### **3.2 Induction Logging**

The induction logging data is very useful in confirming the response of the DAPL under pumping conditions over the duration of the test. The induction logs, provided in Appendix E, show similar patterns of reduction in groundwater conductance with depth over time during progress of the Pilot Test. The induction log units are different than those measured in water, and since the measurement is induced and in-situ it also reflects effects imposed by the electrical properties of the saturated geologic formation. Therefore, there is not a direct correspondence between conductance values measured in-situ, and specific conductance values in water sampled from various ports.

The fall 2012 baseline induction logs for IL-1 show a change in slope (increasing conductivity) at a depth from 25 to 26 feet bgs, which is just above the interpreted elevation of the top of the Diffuse Layer (28 feet bgs). Another slope change occurs from 31 to 33 feet bgs in the transition zone from Diffuse Layer into DAPL. The baseline DAPL elevation determined from multiport sampling is at 33 feet bgs. Below 33 feet the slope of the curve is very consistent, with increasing conductivity with depth, until the logging tool reaches the physical limitation of the borehole bottom where conductivity drops off. The baseline logs for IL-2 show a similar shape and elevation at which changes in slope or inflection points occur.

The IL-1 and IL-2 induction logs included in Appendix E plot induction measurements with depth (feet bgs) over the entire test, and show little change or decrease in conductivity with depth over time during pumping step 1. During pumping step 2 at 1.0 gpm a progressive reduction in conductivity with depth in both the shallower and deeper zones within the DAPL is apparent. This decreasing conductivity pattern continues and becomes more pronounced in pumping step 3.

### **3.3 Water Levels**

Water level gauging was conducted in the baseline monitoring and prior to and after step changes. A tabulation of water elevation measurements is provided in Table 3-4. Calculated vertical hydraulic gradients within the multilevel ports and vertical components toward the extraction well are indicated in Table 3-5. Hydraulic gradients, as expected increased with increases in pumping rates, inducing a vertical hydraulic gradient and movement of overlying groundwater toward the extraction well. These gradient and flow directions calculated from the data are depicted in three hydrogeologic cross-sections for illustration purposes during the second pumping step in Figures 3-1 through 3-3.

### **3.4 DAPL/Diffuse Interface Changes Due to Pumping**

As described in Section 3.1, the DAPL and Diffuse interface remained stable, within measurement limitations, during pumping step 1 at 0.5 gpm. The DAPL/ Diffuse Interface declined by one port (port 4) in ML-1 and ML-2 during pumping step 2 at 1.0 gpm based on specific conductance data. Based on specific conductance, the DAPL/ Diffuse interface declined by three additional ports (port 1, 2, and 3) in ML-1 and ML-2 during pumping step 3 at 2.0 gpm data. Pumping step 3 was terminated prematurely due to concerns that Diffuse Layer material was already impinging on the well screen in EW-1. Continued pumping at EW-1 at 2.0 gpm was clearly not sustainable and it was only a matter of time before the material being extracted would be so diluted as to not meet the criteria of DAPL.

### **3.5 Rebound Monitoring**

Rebound monitoring is still in progress. Data plots in Appendix D indicate since the cessation of pumping, specific conductivity in ML-1 and ML-2 has continued to recover in ports 1, 2, 3 and 4. Specific conductivity values in ports 1 and 2 have returned to a DAPL condition; however, it is too early in the recovery process to determine if specific conductance in ports 3 and 4 will increase to values representative of DAPL.

Since the cessation of pumping, specific conductivity in MP-2 continued to decline in ports 3 and 4, and remained stable in port 5 (Appendix D). These trends appear to be stabilizing in these three ports based on most recent data. These data seem to reflect MP-2 is still experiencing a pumping-like response as DAPL continues to flow by gravity toward the depression in the DAPL surface caused by over pumping EW-1 at a rate that exceeded the DAPL gravity drainage rate.

The induction logs show the same pattern as the multilevel data. During the recovery period, a larger increase in conductivity is apparent in the deeper portions of the DAPL pool near the extraction well, and a slower, more gradual increase in conductivity is occurring at progressively shallower elevations, once occupied by DAPL.

## **4.0 CONCLUSIONS AND RECOMMENDATIONS**

This section provides summary conclusions and recommendations for use of the Pilot Test data in the OU3 Feasibility Study. This section reviews the total DAPL removed, estimates the total uniform decline in DAPL elevation this volume should represent, and discusses factors that affect the efficiency of DAPL removal.

### **4.1 Total DAPL Removed**

Based on the transportation and disposal records, a total of 596,727 gallons of DAPL had been removed from the off-PWD DAPL Pool. Based on the specific conductance data obtained in EW-1 during pumping step 3, the DAPL removed during the latter part of the Pilot Test had been diluted by 30-40%, therefore the actual in-place volume of DAPL removed by the Pilot Test is somewhat less than the total liquid removed.

Based on the revised bedrock contours developed during installation of the extraction well and depicted in Figure 4-1, a re-evaluation of the DAPL pool volume has been conducted. The volume estimate is based on a simple end-area calculation using the contours as slices of DAPL within the pool, using the 55 foot elevation for the top of the DAPL pool. These calculations are presented in Table 4-1 and compared to an earlier estimated DAPL volume based on the prior interpretation of the bedrock contours.

Based on the revised shallower depth and more limited extent of the DAPL pool the current estimate of the DAPL pool volume is approximately 3.1 million gallons.

Table 4-2 presents an estimate of the uniform DAPL pool elevation change that would be required for the volume of DAPL removed during the Pilot Test and the degree to which that DAPL was diluted by intrusion of overlying Diffuse Material and groundwater. These estimates range from 1.66 feet to 1.33 feet depending on the degree of dilution (20% assumed).

The decline in DAPL elevation in MP-2 over the test was from port 4 to port 3 and has not recovered to date. The elevation difference between the center of the two ports is 2.5 feet, and the ports themselves are screened over a six inch sand pack. Since the interface could be at any elevation within the sand pack of the screened ports, the measurement accuracy of this observed DAPL decline at MP-2 is between 1.5 and 2.5 feet. This is within the range calculated on Table 4-2.

### **4.2 DAPL Removal Efficiency**

The efficiency of DAPL removal is dependent on a sustainable pumping rate, drawdown, and long-term dilution.

At the initial pumping rate of 0.5 gpm, there was no observed drawdown of the DAPL interface near the extraction well (i.e., in ML-1 and ML-2). This indicates the pumping rate was close to but did not appear to exceed the rate of gravity drainage of DAPL to the extraction well. This is the most efficient pumping scenario of the three rates tested based on the Pilot Test objectives.

At the pumping rate of 1.0 gpm, the DAPL being extracted experienced some dilution (about 10% based on specific conductance of EW-1), and the DAPL interface was drawn down about 1 to 2 feet in ML-1 and ML-2, with less apparent drawdown in MP-2. Based on this data, the 1.0 gpm pumping rate was in excess of the rate of gravity drainage to the extraction well, and, would not be an efficient long term pumping rate due to both dilution and eventual excessive drawdown of the DAPL around the extraction well.

The 2.0 gpm pumping rate resulted in more than five feet of DAPL drawdown in the immediate vicinity of the extraction well within a relatively short time period after increasing the pumping rate. If the pumping test progressed for an extended time at 2.0 gpm, the liquid removed would no longer be classified as DAPL due to dilution. In the short term, 2.0 gpm would not be an efficient pumping rate due to dilution, and in the longer term would put the extraction well at risk of fouling as higher pH, oxygenated, overlying groundwater is entrained in the well screen and mixed with Diffuse Layer material and DAPL. Long term, pumping at an unsustainably high rate could also lead to instability in the DAPL surface and convective mixing with potential for increased mineralization within the formation, the extraction well sand pack, and the conveyance system piping.

The total cost of transport and disposal of diluted DAPL, compared to undiluted DAPL, is directly proportional to the dilution. If the DAPL is diluted by over pumping, a correspondingly larger volume of liquid must be pumped and disposed of. The long term cost of transporting and disposing of DAPL more than doubles within 6 months at 2.0 gpm when the DAPL becomes diluted by 50%.

#### **4.3 Effect of Pumping Rate on Interface Stability**

The pumping rate has a profound influence on the stability of the DAPL and Diffuse Layer interface. A stable interface would have the same uniform drawdown measured over time at the extraction well as out in the DAPL pool. DAPL is denser than water, and to remove it efficiently requires a different strategy. Owing to its greater density, it should be pumped at a rate that allows it to flow by gravity along the bottom of the bedrock depression toward the extraction point without drawing the shallower interface downward around the extraction well.

Based on the Pilot Test results, the DAPL interface should be stable over long periods of time under pumping conditions at, or less than, 0.5 gpm. The pumping rate of 1.0 gpm was causing progressively greater DAPL drawdown near the extraction well than at MP-2 and therefore exceeded the gravity drainage rate to the extraction well.

#### **4.4 Recommendations**

The Pilot Test results support a conclusion that long-term pumping of DAPL is both technically feasible as long as the pumping rate does not exceed the gravity drainage rate of the DAPL. The cost of DAPL extraction is a function of transport and disposal costs long term. If DAPL is diluted long term by excessive pumping rates, the cost of DAPL extraction will increase in

proportionally to the amount of dilution and the volume of material that is extracted will be proportionally higher. Such additional costs would need to be considered in the FS. In addition, excessive pumping rates (between 1 and 2 gpm), that were experienced during the Pilot Test pose potential for causing long-term operational problems and increases in operational costs (well replacement, well rehabilitation, long recovery periods when DAPL cannot be extracted).

Data currently being collected during the recovery period indicates there is no advantage to cycling the pumping to a higher rate that exceeds the gravity drainage rate of DAPL and then having to wait long periods for the DAPL to recover. In addition, data from earlier column studies (Geomega, 2004b) indicate that such pore volume exchange of oxygenated groundwater through zones occupied by DAPL and Diffuse material ganglia may result in significant mineralization and may have a negative effect on the efficiency of dissolved mass removal rates. The dilution of the pumped DAPL itself means that much larger volumes of liquid would need to be removed and treated at large costs under a cycling approach. There is also the possibility that cyclical extraction may increase the potential for convective mixing in the zone(s) above the DAPL surface, which may in turn negatively impact environmental conditions downgradient of the upper DAPL pool. Cyclical extraction would most certainly result in additional mineralization in the saturated soils and result in less effective removal of solute mass long term.

The potential use of horizontal well screens does not change the physics of gravity drainage, and while such strategies may be appropriate for collecting water, they are not likely to provide significant benefit to DAPL removal over a vertical well. The pilot results indicate a short 4-inch diameter well screen placed at the bottom of the DAPL pool is an effective well construction method. Since the extraction approach relies on density driven flow, the slope of the bedrock depression is more important than the thickness of the DAPL in controlling gravity drainage rates. Therefore placement of the well near the edge of the DAPL pool did not limit the wells efficiency.

The baseline cost and performance evaluation for DAPL extraction should be based on a maximum 0.5 gpm extraction rate in the OU3 FS which has been demonstrated to be a sustainable extraction rate.

## 5.0 REFERENCES

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- Geomega, 2004c. Olin Wilmington Technical Series XXXVII: Conclusion of the Laboratory Column Test Simulating Aquifer Pumping for DAPL Removal. Geomega, Inc., Boulder CO. December 2004.
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- MACTEC, 2011. 2011 GeoProbe Data, DAPL Extraction Pilot Test Well Area, Olin Chemical Superfund Site, Wilmington, MA July, 2011.

## FIGURES



**Legend**

- Interpretive Refusal Contour Lines, Based on GeoProbe Borings (Ft. MSL)
- - - Inferred Refusal Contour Lines, Based on GeoProbe Borings (Ft. MSL)
- GeoProbe Location (Estimated Refusal Elevation, Ft. MSL)
- ⊕ Inductance Logging Well Currently Installed
- Former Proposed Extraction Well Location
- ⊕ Monitoring Well
- ⬢ Revised Proposed Extraction Well Location



AMEC Environment & Infrastructure  
271 Mill Road  
Chelmsford, MA 01824

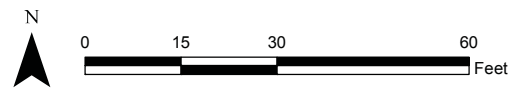
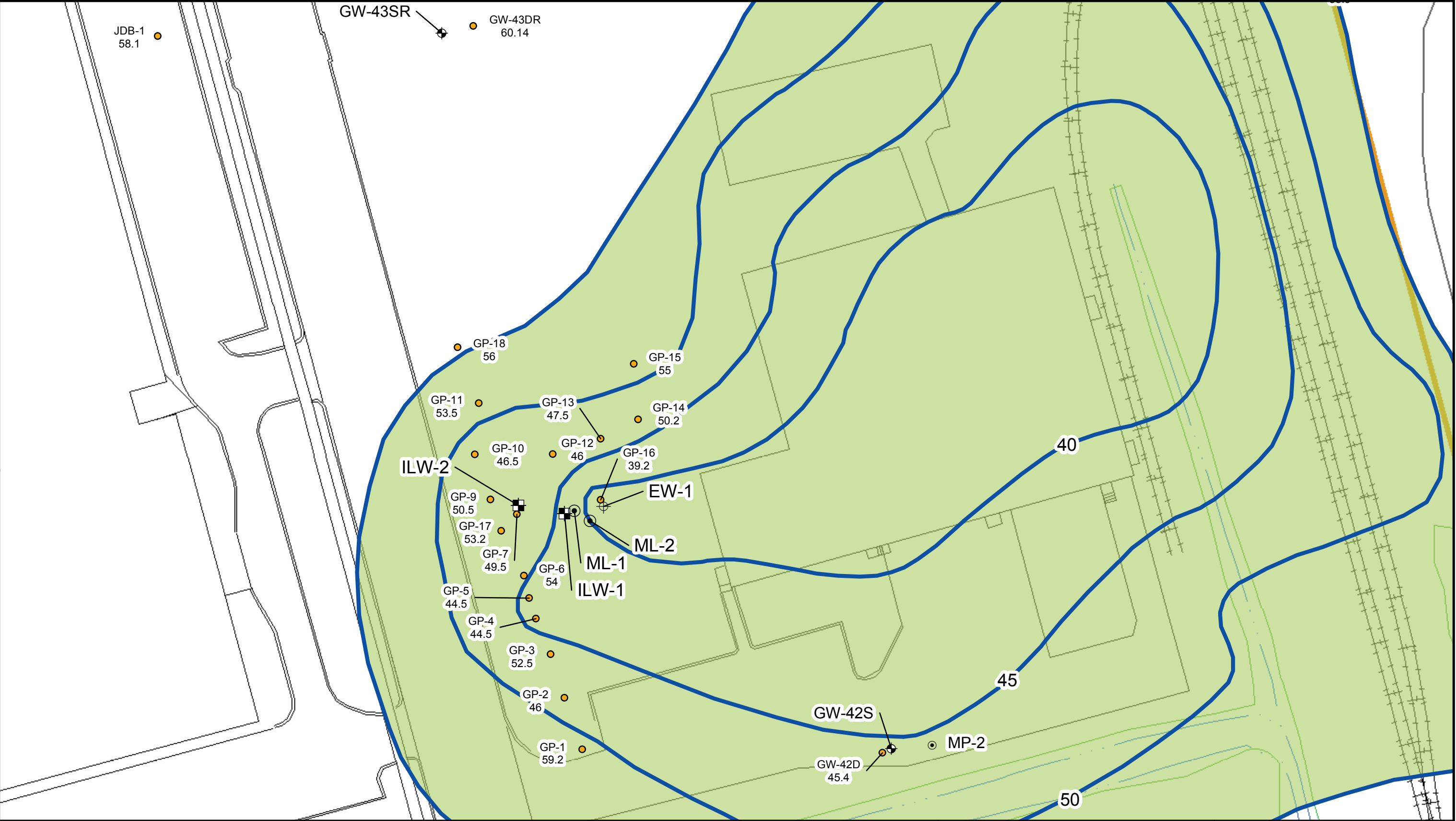


**Figure 1-1**  
**Results of Direct Push Investigation**

**Olin Chemical Superfund Site**  
**Wilmington, Massachusetts**

Prepared by BJR

Checked by PHT



**Legend**

|                          |                                                             |              |                                |
|--------------------------|-------------------------------------------------------------|--------------|--------------------------------|
| Monitoring Well Location | Updated Bedrock Contours                                    | Railroad     | Surface Water                  |
| Induction Logging Well   | Interpreted Extent of DAPL Off Property Below 55 ft Contour | Paved Road   | Trails                         |
| Multi Level Well         | Exploration Confirming Bedrock Elevation                    | Unpaved Road | Wetland Symbol                 |
| Extraction Well          |                                                             | Sidewalks    | Wetland Boundary               |
|                          |                                                             |              | 51 Eames St. Property Boundary |

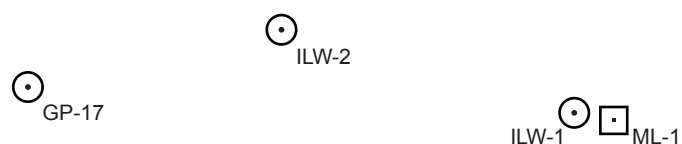
**amec** AMEC Environment & Infrastructure  
271 Mill Road  
Chelmsford, MA 01824

N  
0 20 40 80 Feet

**Figure 2-1**  
**Location of Extraction Well and Monitoring Well Network**

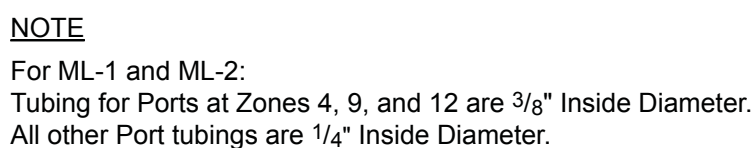
**Olin Chemical Superfund Site**  
**Wilmington, Massachusetts**

|                 |                |
|-----------------|----------------|
| Prepared by BJR | Checked by PHT |
|-----------------|----------------|

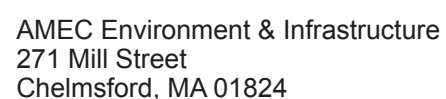


ILW = Induction Logging Well  
ML = MultiLevel Well  
EW = Extraction Well  
GP = GeoProbe  
 = Sand Filter Around ML Port Zones  
 = Bentonite Seal in ML Wells

3 Jewel Drive



Olin Chemical Superfund Site  
Wilmington, Massachusetts



## Extraction and Monitoring Well Configuration DAPL Extraction Pilot Test

Proj. No.: 6107140016

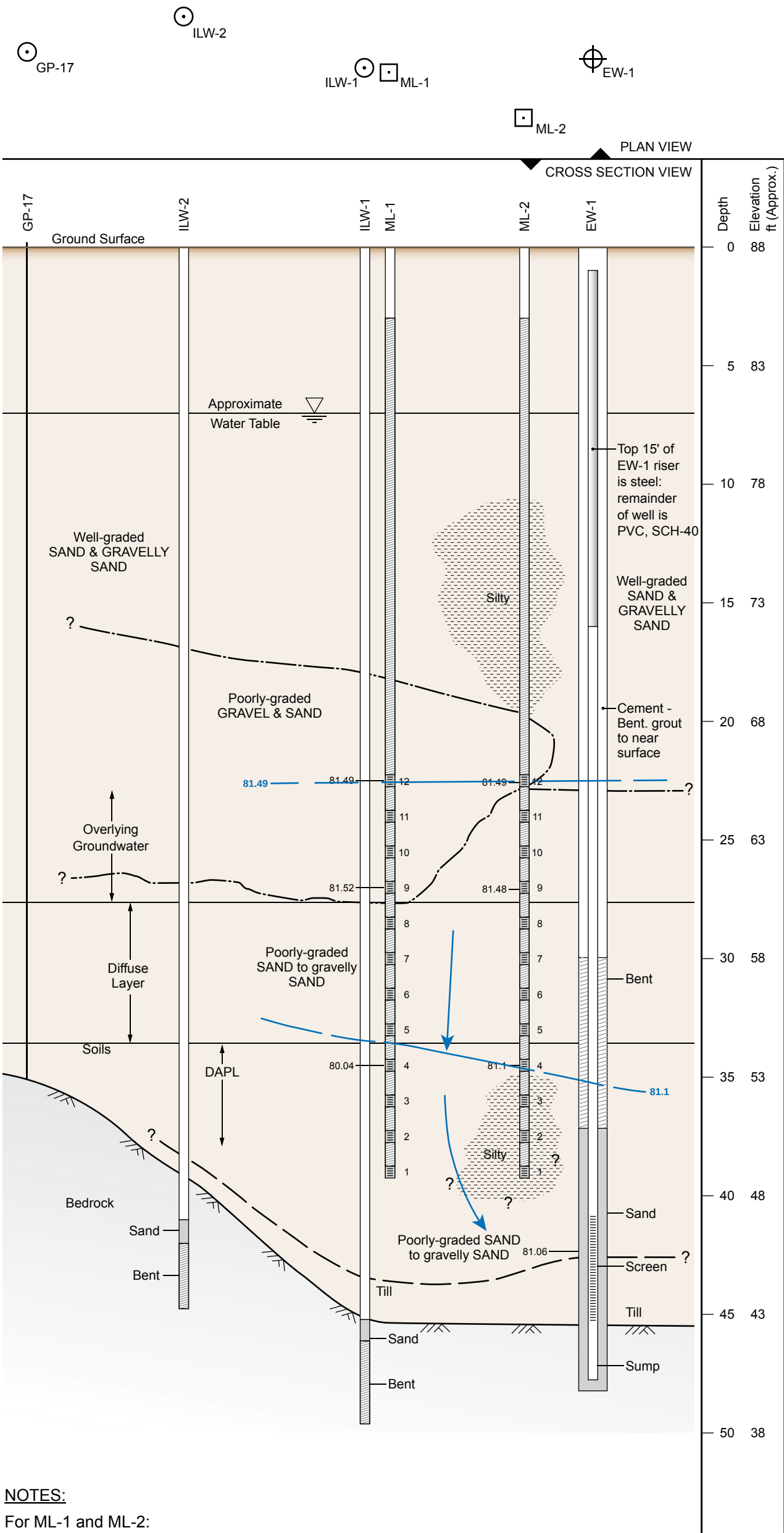
Figure 2-2



LEGEND

- ILW = Induction Logging Well
- ML = MultiLevel Well
- EW = Extraction Well
- GP = GeoProbe
- = Sand Filter Around ML Port Zones
- = Bentonite Seal in ML Wells

Horz. 1" = 10'  
Vert. 1" = 5'



NOTES:

For ML-1 and ML-2:  
Tubing for Ports at Zones 4, 9, and 12 are 3/8" Inside Diameter.  
All other Port tubings are 1/4" Inside Diameter.  
The depicted DAPL Diffuse Layer Interface is based at start of  
DAPL Pilot Test.

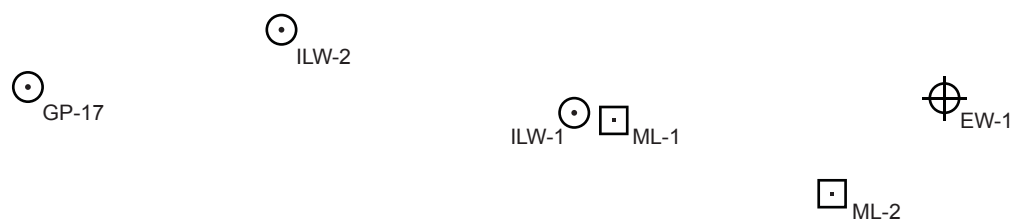
DAPL Pumping Rate = 1 gpm  
81.49 = Groundwater Elevations  
measured on 3/27/2013  
= Hydrostatic equipotential line  
showing inferred direction of  
groundwater movement  
Vertical Gradient ≈ 0.02ft/ft

Prepared by: JPH 7/11/13  
Checked by: TDL 7/11/13

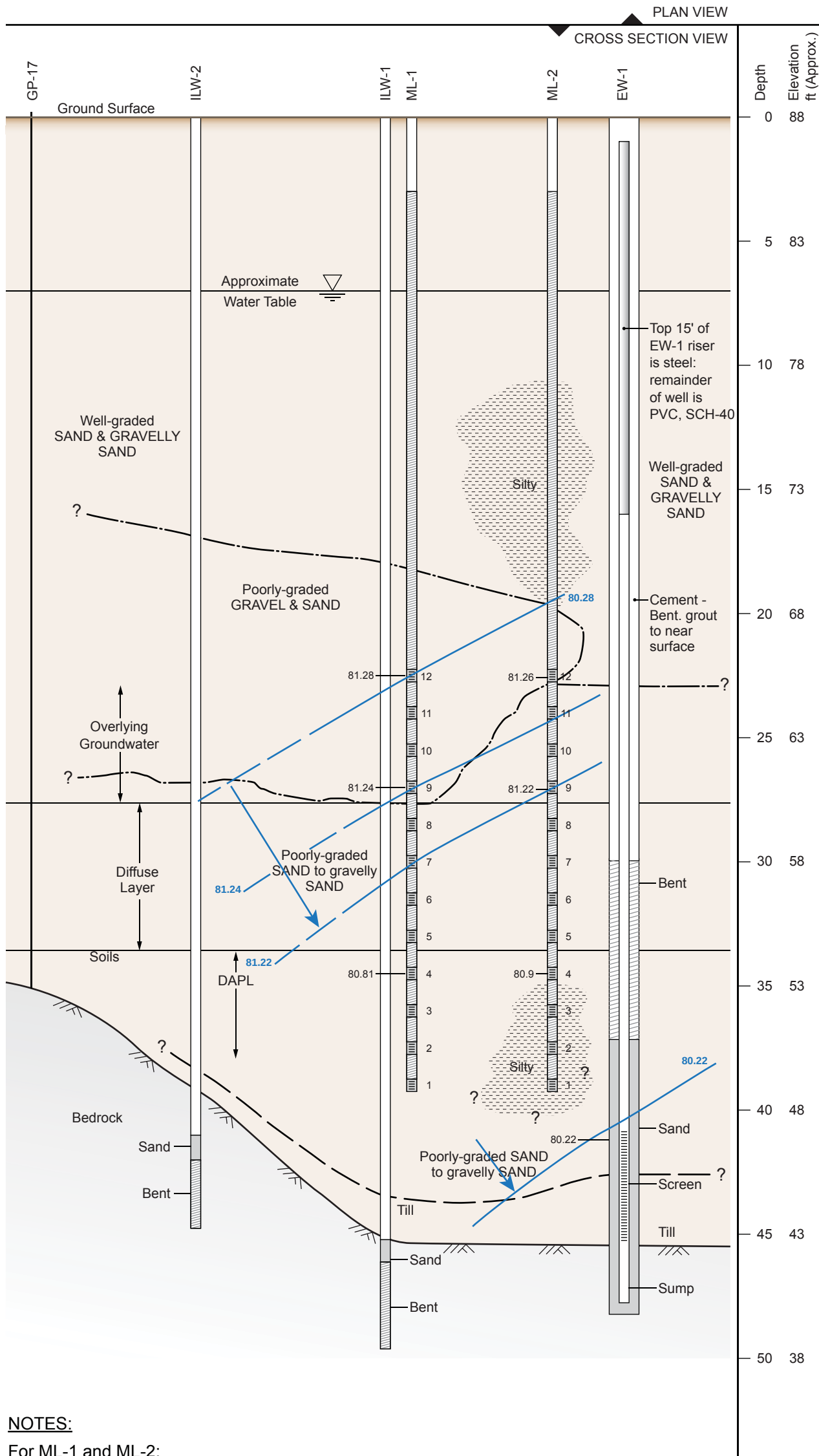
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Wilmington, Massachusetts

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Chelmsford, MA 01824

Extraction and Monitoring Well  
Hydrogeological Section 3/27/2013  
DAPL Extraction Pilot Test  
Proj. No.: 6107140016  
Figure 3-1



Horz. 1" = 10'  
Vert. 1" = 5'



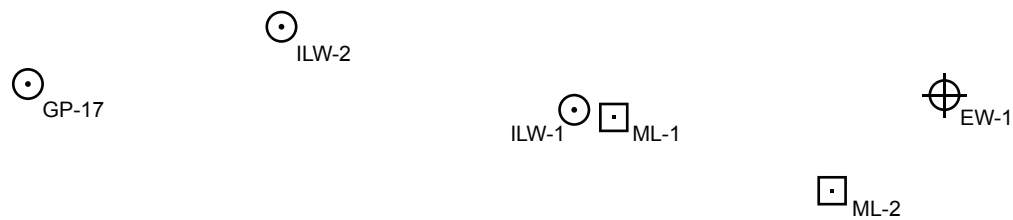
For ML-1 and ML-2:  
Tubing for Ports at Zones 4, 9, and 12 are 3/8" Inside Diameter.  
All other Port tubings are 1/4" Inside Diameter.

The depicted DAPL Diffuse Layer Interface is based at start of  
DAPL Pilot Test.

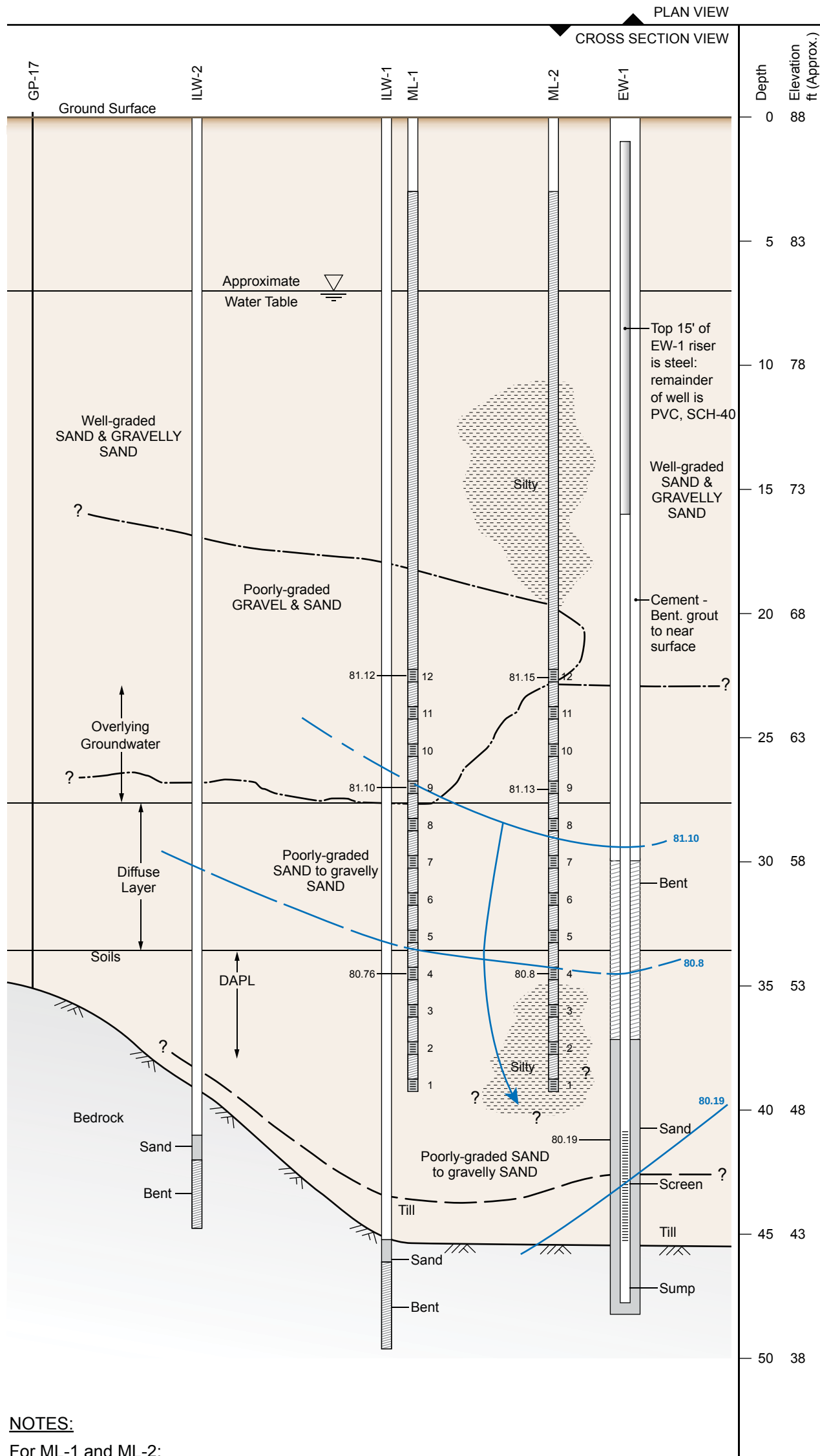
Vertical Gradient  $\approx 0.05\text{ft}/\text{ft}$

Prepared by: JPH 7/11/13  
Checked by: TDL 7/11/13

Extraction and Monitoring Well  
Hydrogeological Section 4/17/2013  
DAPL Extraction Pilot Test  
Proj. No.: 6107140016 Figure 3-2



Horz. 1" = 10'  
Vert. 1" = 5'

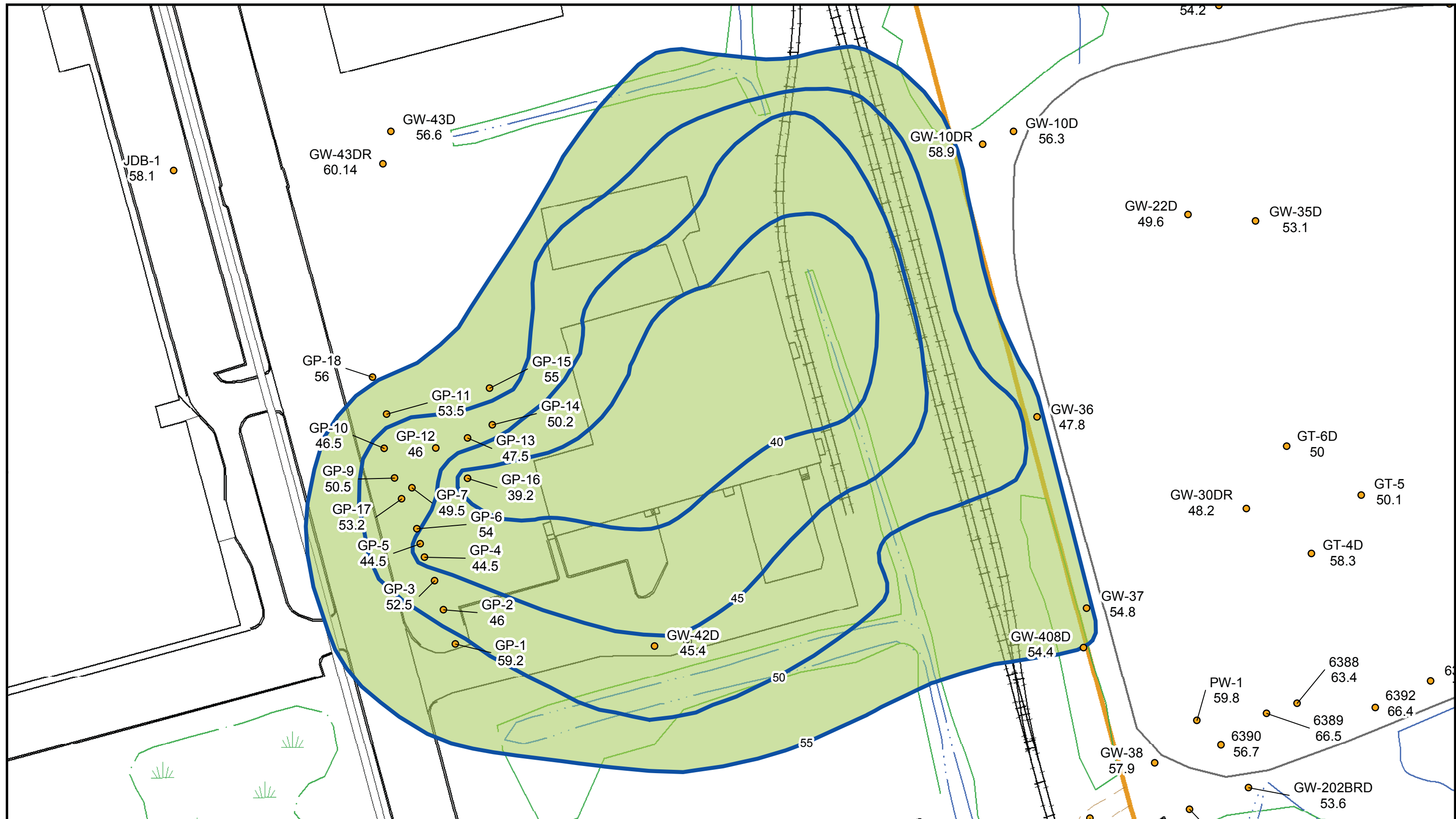


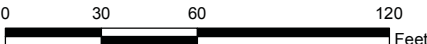
For ML-1 and ML-2:  
Tubing for Ports at Zones 4, 9, and 12 are 3/8" Inside Diameter.  
All other Port tubings are 1/4" Inside Diameter.

The depicted DAPL Diffuse Layer Interface is based at start of  
DAPL Pilot Test.

Prepared by: JPH 7/11/13  
Checked by: TDL 7/11/13

Extraction and Monitoring Well  
Hydrogeological Section 5/16/2013  
DAPL Extraction Pilot Test  
Proj. No.: 6107140016 Figure 3-3



|                                                               |                |                                                                                                                                                                     |                                                                                                                                                    |  |
|---------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Legend</b>                                                 |                | <br>AMEC Environment & Infrastructure<br>271 Mill Road<br>Chelmsford, MA 01824 | <b>Figure 4-1</b><br><b>Interpreted Extent of Off-PWD DAPL Pool</b><br><br><b>Olin Chemical Superfund Site</b><br><b>Wilmington, Massachusetts</b> |  |
| — Updated Bedrock Contours                                    | — Railroad     |                                                                                                                                                                     |                                                                                                                                                    |  |
| ● Bedrock Boring                                              | — Paved Road   | — Trails                                                                                                                                                            | <br>Feet                                                      |  |
| — Interpreted Extent of DAPL Off Property Below 55 ft Contour | — Unpaved Road | — Wetland Symbol                                                                                                                                                    |                                                                                                                                                    |  |
|                                                               | — Sidewalks    | — Wetland Boundary                                                                                                                                                  |                                                                                                                                                    |  |
|                                                               |                | — 51 Eames St. Property Boundary                                                                                                                                    |                                                                                                                                                    |  |

## TABLES

**Table 2-1: Non-Operating Periods  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Pumping Step | Non-Operating Period |            |      | Reason                                        | Corrective Action                                                                |
|--------------|----------------------|------------|------|-----------------------------------------------|----------------------------------------------------------------------------------|
|              | Beginning            | End        | Days |                                               |                                                                                  |
| Step 1       | 12/3/2012            | 12/17/2012 | 14   | VFD Failure<br>Personnel Absence -<br>Holiday | Replaced                                                                         |
| Step 1       | 12/27/2012           | 1/6/2013   | 10   |                                               |                                                                                  |
| Step 2       | 3/11/2013            | 3/19/2013  | 8    | VFD Failure                                   | Replaced                                                                         |
| Step 2       | 3/28/2013            | 4/10/2013  | 13   | VFD Failure                                   | Replaced                                                                         |
| Step 2       | 8/9/2013             | 10/15/2013 | 67   | VFD Failure                                   | Replacement with Larger<br>Unit (Unit Backordered);<br>Electrical Wiring Changes |
| Step 3       | 25-Feb-14            | 10-Apr-14  | 44   | Wiring Alarm, Short<br>Circuit                | Installed Additional<br>Junction Box                                             |

Notes:

VFD = Variable Frequency Drive

Prepared by PHT 11/06/2014

Checked by JMC 11/07/2014

**Table 2-2: Schedule for Baseline Water Quality Sampling  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Location ID | 10/25/2012 | 10/26/2012 | 11/1/2012 | 11/2/2012 |
|-------------|------------|------------|-----------|-----------|
| EW1         |            |            |           |           |
| ML1 Port 1  |            | B          | B         |           |
| ML1 Port 2  |            | B          | B         |           |
| ML1 Port 3  |            | B          | B         |           |
| ML1 Port 4  |            | B          | B         |           |
| ML1 Port 5  |            | B          | B         |           |
| ML1 Port 6  |            | B          | B         |           |
| ML1 Port 7  |            | B          | B         |           |
| ML1 Port 8  |            | B          | B         |           |
| ML1 Port 9  |            | B          | B         |           |
| ML1 Port 10 |            | B          | B         |           |
| ML1 Port 11 |            | B          | B         |           |
| ML1 Port 12 |            | B          | B         |           |
| ML2 Port 1  | B          |            |           | B         |
| ML2 Port 2  | B          |            |           | B         |
| ML2 Port 3  | B          |            |           | B         |
| ML2 Port 4  | B          |            |           | B         |
| ML2 Port 5  | B          |            | B         |           |
| ML2 Port 6  | B          |            | B         |           |
| ML2 Port 7  | B          |            | B         |           |
| ML2 Port 8  | B          |            | B         |           |
| ML2 Port 9  | B          |            | B         |           |
| ML2 Port 10 | B          |            | B         |           |
| ML2 Port 11 | B          |            | B         |           |
| ML2 Port 12 | B          |            | B         |           |
| MP2 Port 1  |            |            |           |           |
| MP2 Port 3  |            | B          |           | B         |
| MP2 Port 4  |            | B          |           | B         |
| MP2 Port 6  |            | B          |           | B         |
| MP2 Port 7  |            | B          |           | B         |
| MP2 Port 10 |            | B          |           | B         |
| MP2 Port 11 |            | B          |           | B         |
| MP2 Port 12 |            | B          |           | B         |
| MP2 Port 13 |            | B          |           | B         |

**Notes:**

B - Field chemistry and field parameters collected

Prepared by: BJR 11/03/2014  
Checked by: PHT 11/03/2014

**Table 2-3: Schedule for Pumping Step 1 Water Quality Sampling  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Location ID | 11/6/2012 | 11/7/2012 | 11/8/2012 | 11/13/2012 | 11/16/2012 | 11/19/2012 | 11/26/2012 | 11/27/2012 | 1/7/2013 | 1/8/2013 | 1/9/2013 | 1/28/2013 | 1/29/2013 | 1/30/2013 | 2/12/2013 | 2/13/2013 |
|-------------|-----------|-----------|-----------|------------|------------|------------|------------|------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| EW1         | A         | A         | A         | F          | B          | B          |            | B          |          |          |          | B         |           |           | B         |           |
| ML1 Port 1  | B         | B         | B         | B          | B          | B          |            | B          |          | B        |          |           | B         |           |           | B         |
| ML1 Port 2  | B         | B         | B         | B          | B          | B          |            |            |          | B        |          |           | B         |           |           | B         |
| ML1 Port 3  | B         | B         | B         | B          | B          | B          |            | B          |          | B        |          |           | B         |           |           | B         |
| ML1 Port 4  | B         | B         | B         | B          | B          | B          |            | B          |          | B        |          |           | B         |           |           | B         |
| ML1 Port 5  | B         | B         | B         | B          | B          | B          |            | B          |          | B        |          |           | B         |           |           | B         |
| ML1 Port 6  | B         | B         | B         | B          | B          | B          |            | B          |          | B        |          |           | B         |           |           | B         |
| ML1 Port 7  | B         | B         | B         | B          | B          | B          |            | B          |          | B        |          |           | B         |           |           | B         |
| ML1 Port 8  | B         | B         | B         | B          | B          | B          |            | B          |          | B        |          |           | B         |           |           | B         |
| ML1 Port 9  | B         | B         | B         | B          | B          | B          |            | B          |          | B        |          |           | B         |           |           | B         |
| ML1 Port 10 | B         | B         | B         | B          | B          | B          | B          |            |          | B        |          |           | B         |           |           | B         |
| ML1 Port 11 | B         | B         | B         | B          | B          | B          | B          |            |          | B        |          |           | B         |           |           | B         |
| ML1 Port 12 | B         | B         | B         | B          | B          | B          | B          |            |          | B        |          |           | B         |           |           | B         |
| ML2 Port 1  | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 2  | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 3  | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 4  | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 5  | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 6  | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 7  | B         | B         | B         | B          | B          | B          |            |            | B        |          |          | B         |           |           | B         |           |
| ML2 Port 8  | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 9  | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 10 | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 11 | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| ML2 Port 12 | B         | B         | B         | B          | B          | B          |            | B          | B        |          |          | B         |           |           | B         |           |
| MP2 Port 1  |           |           |           |            |            |            |            |            |          |          |          |           |           |           |           |           |
| MP2 Port 3  |           |           |           |            |            | B          |            |            |          |          | B        |           |           | B         |           |           |
| MP2 Port 4  |           |           |           |            |            | B          |            |            |          |          | B        |           |           | B         |           |           |
| MP2 Port 6  |           |           |           |            |            | B          |            |            |          |          | B        |           |           | B         |           |           |
| MP2 Port 7  |           |           |           |            |            | B          |            |            |          |          | B        |           |           | B         |           |           |
| MP2 Port 10 |           |           |           |            |            | B          |            |            |          |          | B        |           |           | B         |           |           |
| MP2 Port 11 |           |           |           |            |            | B          |            |            |          |          | B        |           |           | B         |           |           |
| MP2 Port 12 |           |           |           |            |            | B          |            |            |          |          | B        |           |           |           |           |           |
| MP2 Port 13 |           |           |           |            |            | B          |            |            |          |          | B        |           |           | B         |           |           |

**Notes:**

A - Field chemistry data collected

B - Field chemistry and field parameters collected

F - Field parameters collected

Prepared by: BJR 11/03/2014  
Checked by: PHT 11/03/2014

**Table 2-4: Schedule for Induction Logging  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| DATE       | Period Description | Location ID |         |       |       |
|------------|--------------------|-------------|---------|-------|-------|
|            |                    | GW-42DR     | GW-43DR | ILW-1 | ILW-2 |
| 11/2/2012  | 0.5 GPM Step 1     |             |         | X     | X     |
| 11/5/2012  | 0.5 GPM Step 1     |             |         | X     | X     |
| 11/6/2012  | 0.5 GPM Step 1     |             |         | X     | X     |
| 11/7/2012  | 0.5 GPM Step 1     |             |         | X     | X     |
| 11/8/2012  | 0.5 GPM Step 1     |             |         | X     | X     |
| 11/12/2012 | 0.5 GPM Step 1     | X           | X       | X     | X     |
| 11/15/2012 | 0.5 GPM Step 1     |             |         | X     | X     |
| 11/19/2012 | 0.5 GPM Step 1     | X           | X       | X     | X     |
| 11/26/2012 | 0.5 GPM Step 1     |             |         | X     | X     |
| 12/19/2012 | 0.5 GPM Step 1     | X           | X       | X     | X     |
| 1/10/2013  | 0.5 GPM Step 1     |             |         | X     | X     |
| 1/30/2013  | 0.5 GPM Step 1     | X           | X       | X     | X     |
| 2/6/2013   | 0.5 GPM Step 1     | X           | X       | X     | X     |
| 2/19/2013  | 0.5 GPM Step 1     |             |         | X     | X     |
| 3/5/2013   | 1.0 GPM Step 2     | X           |         | X     | X     |
| 3/7/2013   | 1.0 GPM Step 2     |             |         | X     | X     |
| 3/11/2013  | 1.0 GPM Step 2     |             |         | X     | X     |
| 3/18/2013  | 1.0 GPM Step 2     | X           | X       | X     | X     |
| 3/25/2013  | 1.0 GPM Step 2     |             |         | X     | X     |
| 4/24/2013  | 1.0 GPM Step 2     |             |         | X     | X     |
| 5/13/2013  | 1.0 GPM Step 2     |             | X       | X     | X     |
| 6/13/2013  | 1.0 GPM Step 2     |             |         | X     | X     |
| 6/25/2013  | 1.0 GPM Step 2     | X           | X       | X     | X     |
| 7/16/2013  | 1.0 GPM Step 2     | X           | X       | X     | X     |
| 10/28/2013 | 1.0 GPM Step 2     | X           | X       | X     | X     |
| 12/2/2013  | 1.0 GPM Step 2     |             | X       | X     | X     |
| 12/3/2013  | 2.0 GPM Step 3     |             | X       | X     | X     |
| 12/5/2013  | 2.0 GPM Step 3     |             |         | X     | X     |
| 12/9/2013  | 2.0 GPM Step 3     |             |         | X     | X     |
| 12/16/2013 | 2.0 GPM Step 3     | X           |         | X     | X     |
| 12/23/2013 | 2.0 GPM Step 3     |             |         | X     | X     |
| 1/13/2014  | 2.0 GPM Step 3     |             | X       | X     | X     |
| 2/3/2014   | 2.0 GPM Step 3     |             |         | X     | X     |
| 3/4/2014   | 2.0 GPM Step 3     |             |         | X     | X     |
| 4/11/2014  | 2.0 GPM Step 3     | X           | X       | X     | X     |
| 5/2/2014   | 2.0 GPM Step 3     |             |         | X     | X     |
| 5/9/2014   | 2.0 GPM Step 3     | X           | X       | X     | X     |
| 7/23/2014  | Recovery           |             |         | X     | X     |
| 7/31/2014  | Recovery           |             |         | X     | X     |
| 8/14/2014  | Recovery           | X           |         | X     | X     |
| 9/5/2014   | Recovery           | X           | X       | X     | X     |
| 9/11/2014  | Recovery           | X           | X       | X     | X     |
| 10/21/2014 | Recovery           | X           |         | X     | X     |

**Notes:**

X = Logging conducted

Prepared by: LJ 11/04/2014  
Checked by: PHT 11/05/2014

**Table 2-5: Schedule for Water Level Gauging  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| <b>Well Location</b> | <b>EW1</b> | <b>ML-1</b> | <b>ML-2</b> | <b>MP-2</b> | <b>GW-42D</b> | <b>GW-43DR</b> |
|----------------------|------------|-------------|-------------|-------------|---------------|----------------|
| 10/25/2012           |            | X           | X           |             |               |                |
| 11/1/2012            |            | X           |             |             |               |                |
| 11/2/2012            |            |             |             |             | X             | X              |
| 11/6/2012            | X          | x           | X           |             |               |                |
| 11/7/2012            | X          |             | X           |             |               |                |
| 11/8/2012            | X          |             | X           |             |               |                |
| 11/12/2012           |            |             |             |             | X             | X              |
| 11/13/2012           | X          | X           | X           |             |               |                |
| 11/16/2012           | X          | X           | X           |             |               |                |
| 11/19/2012           | NM         |             | X           | X           | X             | X              |
| 11/26/2012           |            | X           |             |             |               |                |
| 11/27/2012           | X          |             | X           |             |               |                |
| 12/12/2011           |            |             |             |             | X             |                |
| 12/14/2011           |            |             |             |             | X             |                |
| 9/20/2012            |            |             |             |             |               | X              |
| 12/19/2012           |            |             |             |             | X             | X              |
| 12/20/2011           |            |             |             |             |               | X              |
| 1/3/2013             |            |             | X           |             |               |                |
| 1/7/2013             | X          |             | X           |             |               |                |
| 1/8/2013             |            | X           |             |             |               |                |
| 1/9/2013             |            |             |             | X           |               |                |
| 1/10/2013            |            |             |             |             | X             | X              |
| 1/28/2013            | X          |             | X           |             |               |                |
| 1/29/2013            |            | X           |             |             |               |                |
| 1/30/2013            |            |             |             | X           |               |                |
| 12/2/2013            |            |             |             |             |               |                |
| 2/6/2013             |            |             |             |             | X             | X              |
| 2/12/2013            | X          |             | X           |             |               |                |
| 2/13/2013            |            | X           |             |             |               |                |
| 2/20/2013            | X          |             |             |             |               |                |
| 3/5/2013             | X          | X           | X           |             | X             | X              |
| 3/7/2013             |            | X           | X           |             |               |                |
| 3/18/2013            |            |             |             |             | X             | X              |
| 3/27/2013            | X          | X           | X           |             |               |                |
| 4/17/2013            | X          | X           | X           | X           | X             |                |
| 4/24/2013            | X          | X           | X           |             |               |                |
| 5/13/2013            |            |             |             |             | X             | X              |
| 5/16/2013            | X          | X           | X           | X           |               |                |
| 5/21/2013            | X          |             |             |             |               |                |
| 5/27/2013            | X          |             |             |             |               |                |

**Table 2-5: Schedule for Water Level Gauging  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| <b>Well Location</b> | <b>EW1</b> | <b>ML-1</b> | <b>ML-2</b> | <b>MP-2</b> | <b>GW-42D</b>         | <b>GW-43DR</b> |
|----------------------|------------|-------------|-------------|-------------|-----------------------|----------------|
| 6/13/2013            |            |             |             |             |                       |                |
| 6/18/2013            | X          |             |             |             |                       |                |
| 6/25/2013            |            |             |             |             | X                     | X              |
| 6/26/2013            | X          | X           | X           |             |                       |                |
| 7/5/2013             | X          |             |             |             |                       |                |
| 7/12/2013            | X          |             |             |             |                       |                |
| 7/16/2013            |            |             |             |             | X                     | X              |
| 12/2/2013            | X          | X           | X           |             | X                     | X              |
| 12/3/2013            | X          | X           | X           |             | X                     | X              |
| 12/4/2013            | X          | X           | X           |             | X                     | X              |
| 12/5/2013            | X          |             |             |             | X                     |                |
| 12/6/2013            | X          | X           | X           |             | under water           | X              |
| 12/11/2013           | X          | X           | X           |             | X                     | X              |
| 12/16/2013           |            |             |             |             | X                     | pile           |
| 12/19/2013           | X          | X           | X           |             |                       |                |
| 1/13/2014            | X          |             |             |             | under snow<br>and ice | X              |
| 2/3/2014             | X          |             |             |             | under snow<br>and ice | X              |
| 2/4/2014             | X          | x           | *           |             | under snow<br>and ice |                |
| 4/9/2014             |            |             |             |             | X                     | X              |
| 4/11/2014            | X          | X           | X           |             |                       |                |

**Notes:**

NM= not measured

\*=no water level was obtained meter tested ok but would not detect water level

Prepared by: LJ 11/04/2014

Checked by: PHT 11/04/2014

**Table 2-6: Schedule for Pumping Step 2 Water Quality Sampling**  
**DAPL Extraction Pilot Study**  
**Performance Evaluation Report**

**Olin Wilmington Superfund Site**  
**Wilmington, MA**

| Location ID | 3/5/2013 | 3/7/2013 | 3/8/2013 | 3/22/2013 | 3/27/2013 | 4/24/2013 | 5/16/2013 | 6/6/2013 | 6/26/2013 | 7/18/2013 | 10/29/2013 | 11/1/2013 |
|-------------|----------|----------|----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|------------|-----------|
| EW1         | B        | B        |          | B         |           | F         | F         | F        | F         | F         | F          | B         |
| ML1 Port 1  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML1 Port 2  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML1 Port 3  | B        | B        |          | B         | F         | F         | F         | F        | F         | F         | F          | B         |
| ML1 Port 4  | B        | B        |          | B         | F         | F         | F         | F        | F         | F         | F          | B         |
| ML1 Port 5  | B        | B        |          | B         | F         | F         | F         | F        | F         | F         | F          | B         |
| ML1 Port 6  | B        | B        |          | B         | F         | F         | F         | F        | F         | F         | F          | B         |
| ML1 Port 7  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML1 Port 8  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML1 Port 9  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML1 Port 10 |          |          |          |           |           |           |           |          |           |           |            |           |
| ML1 Port 11 |          |          |          |           |           |           |           |          |           |           |            |           |
| ML1 Port 12 |          |          |          |           |           |           |           |          |           |           |            |           |
| ML2 Port 1  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML2 Port 2  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML2 Port 3  | B        |          | B        | B         | F         | F         | F         | F        | F         | F         | F          | B         |
| ML2 Port 4  | B        |          | B        | B         | F         | F         | F         | F        | F         | F         | F          | B         |
| ML2 Port 5  | B        | B        |          | B         | F         | F         | F         | F        | F         | F         | F          | B         |
| ML2 Port 6  | B        | B        |          | B         | F         | F         | F         | F        | F         | F         | F          | B         |
| ML2 Port 7  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML2 Port 8  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML2 Port 9  |          |          |          |           |           |           |           |          |           |           |            |           |
| ML2 Port 10 |          |          |          |           |           |           |           |          |           |           |            |           |
| ML2 Port 11 |          |          |          |           |           |           |           |          |           |           |            |           |
| ML2 Port 12 |          |          |          |           |           |           |           |          |           |           |            |           |
| MP2 Port 1  |          |          |          |           |           |           |           |          |           |           |            |           |
| MP2 Port 3  |          |          |          |           |           |           | F         |          |           |           |            |           |
| MP2 Port 4  |          |          |          |           |           |           | F         |          |           |           |            |           |
| MP2 Port 6  |          |          |          |           |           |           | F         |          |           |           |            |           |
| MP2 Port 7  |          |          |          |           |           |           | F         |          |           |           |            |           |
| MP2 Port 10 |          |          |          |           |           |           |           |          |           |           |            |           |
| MP2 Port 11 |          |          |          |           |           |           |           |          |           |           |            |           |
| MP2 Port 12 |          |          |          |           |           |           |           |          |           |           |            |           |
| MP2 Port 13 |          |          |          |           |           |           |           |          |           |           |            |           |

**Notes:**

B - Field chemistry and field parameters collected

F - Field parameters collected

Prepared by: BJR 11/03/2014

Checked by: PHT 11/03/2014

**Table 2-7: Schedule for Pumping Step 3 Water Quality Sampling  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Location ID | 12/4/2013 | 12/6/2013 | 12/11/2013 | 12/19/2013 | 12/31/2013 | 2/4/2014 | 4/11/2014 | 5/5/2014 | 5/14/2014 | 7/22/2014 | 7/29/2014 | 8/7/2014 | 8/14/2014 | 8/20/2014 | 9/10/2014 | 10/20/2014 |
|-------------|-----------|-----------|------------|------------|------------|----------|-----------|----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|------------|
| EW1         | F         | F         | F          | F          | F          | F        |           | F        | B         | F         | F         | F        | F         | F         | F         | F          |
| ML1 Port 1  |           |           |            |            |            |          |           | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML1 Port 2  |           |           |            |            |            |          |           |          | F         | F         | F         | F        | F         | F         | F         | F          |
| ML1 Port 3  | F         | F         | F          | F          | F          | F        | F         | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML1 Port 4  | F         | F         | F          | F          | F          | F        | F         | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML1 Port 5  | F         | F         | F          | F          |            | F        | F         | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML1 Port 6  | F         | F         | F          | F          | F          | F        | F         | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML1 Port 7  |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML1 Port 8  |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML1 Port 9  |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML1 Port 10 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML1 Port 11 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML1 Port 12 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML2 Port 1  |           |           |            |            |            |          |           | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML2 Port 2  |           |           |            |            |            |          |           | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML2 Port 3  | F         | F         | F          | F          | F          | F        | F         | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML2 Port 4  | F         | F         | F          | F          | F          | F        | F         | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML2 Port 5  | F         | F         | F          | F          | F          | F        | F         | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML2 Port 6  | F         | F         | F          | F          | F          | F        | F         | F        | F         | F         | F         | F        | F         | F         | F         | F          |
| ML2 Port 7  |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML2 Port 8  |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML2 Port 9  |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML2 Port 10 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML2 Port 11 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| ML2 Port 12 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| MP2 Port 1  |           |           |            |            |            |          |           |          | B         |           |           |          |           | F         | F         | F          |
| MP2 Port 3  | F         | F         |            |            |            |          |           | F        | B         |           |           |          |           | F         | F         | F          |
| MP2 Port 4  | F         | F         |            |            |            |          |           | F        | B         |           |           |          |           | F         | F         | F          |
| MP2 Port 6  | F         | F         |            |            |            |          |           | F        | B         |           |           |          |           | F         | F         | F          |
| MP2 Port 7  |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| MP2 Port 10 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| MP2 Port 11 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| MP2 Port 12 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |
| MP2 Port 13 |           |           |            |            |            |          |           |          |           |           |           |          |           |           |           |            |

**Notes:**

B - Field chemistry and field parameters collected

F - Field parameters collected

Prepared by: BJR 11/03/2014  
Checked by: PHT 11/03/2014

**Table 3-1: Water Quality Monitoring Results for Pumping Step 1  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments  |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|-----------|
| EW      | 1    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 17:40         | 38000          | 12900           | 7950           | 1980                | 1760              |                         |      |                     |                 |             |           |
| ML1     | 2    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 14:55         | 37000          | 10500           | 2195           | 1045                | 2120              | 65858                   | 3.75 | 0.42                | 3.72            | 192         |           |
| ML1     | 3    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 14:25         | 31000          | 9500            | 12760          | 336                 | 1510              | 56193                   | 3.85 | 0.49                | 2.09            | 187.9       |           |
| ML1     | 4    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 14:15         | 21600          | 5060            | 7810           | 234                 | 812               | 36659                   | 4.07 | 0.55                | 0.63            | 177.1       |           |
| ML1     | 5    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 11:55         | 6200           | 1710            | 3140           | 78.5                | 173               | 14380                   | 5.04 | 2.28                | 79.6            | 148.4       |           |
| ML1     | 5    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 12:00         | 6200           | 2410            | 3750           | 145                 | 233               |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 11:20         | 1900           | 808             | 813            | 63.5                | 62.5              | 6048                    | 6.00 | 1.19                | 1.31            | 9.7         |           |
| ML1     | 7    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 11:10         | 750            | 434             | 301            | 18.1                | 17.8              | 3277                    | 5.81 | 0.99                | 0.76            | 49.2        |           |
| ML1     | 8    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 10:50         | 850            | 303             | 116            | 13.1                | 29.3              | 2476                    | 6.05 | 0.97                | 0.76            | 16.2        |           |
| ML1     | 9    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 10:10         | 260            | 479             | 31.7           | 9.2                 | 16.4              | 1589                    | 6.21 | 1.2                 | 1.91            | -10.3       |           |
| ML1     | 10   | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 9:50          | 20             | 347             | 15.4           | 12.2                | 8.3               | 962                     | 6.62 | 0.74                | 0.92            | -75.3       |           |
| ML1     | 11   | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 9:20          | 30             | 334             | 12.9           | 9.9                 | 8.2               | 895                     | 6.71 | 0.6                 | 1.22            | -84.8       |           |
| ML1     | 12   | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 9:10          | 40             | 179             | 10.1           | 8.1                 | 8.1               | 1168                    | 6.27 | 2.6                 | 1.69            | -38.3       |           |
| ML2     | 1    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 17:15         | 19000          | 3100            | 1360           | 1770                | 5480              | 82600                   | 3.68 | 0.33                | 10.8            | 201.6       |           |
| ML2     | 2    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 16:35         | 39000          | 13700           | 4250           | 1600                | 2060              | 75700                   | 3.80 | 0.42                | 12.09           | 202.7       |           |
| ML2     | 3    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 16:19         | 19000          | 10200           | 5200           | 720                 | 1060              | 62870                   | 3.97 | 0.81                | 240             | 193.5       |           |
| ML2     | 4    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 16:00         | 14800          | 1310            | 836            | 212                 | 574               | 35020                   | 4.30 | 0.59                | 49.1            | 151.4       |           |
| ML2     | 5    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 15:50         | 5400           | 1360            | 732            | 136                 | 162               | 15700                   | 5.52 | 1.04                | 31.9            | 66          |           |
| ML2     | 6    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 15:30         | 1950           | 609             | 491            | 34                  | 38                | 6419                    | 5.92 | 1.31                | 6.1             | 49          |           |
| ML2     | 7    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 10:30         | 900            | 342             | 200            | 15.9                | 21.5              | 3700                    | 6.08 | 0.63                | 39.7            | 32.2        |           |
| ML2     | 8    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 8:55          | 500            | 368             | 190            | 9.2                 | 10.4              | 2620                    | 5.53 | 0.7                 | 1.48            | 113.4       |           |
| ML2     | 9    | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 8:40          | 58             | 360             | 44.2           | 1.69                | 4.06              | 1191                    | 6.01 | 1.47                | 3.86            | 84.2        |           |
| ML2     | 10   | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 8:05          | 31             | 298             | 11.3           | 0.06                | 0.18              | 973                     | 5.61 | 0.97                | 2.26            | 140.2       |           |
| ML2     | 10   | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 8:20          | 39             | 332             | 18             | 0.04                | 0.04              |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 7:30          | 37             | 333             | 10.4           | 1.49                | 2.23              | 946                     | 5.93 | 0.91                | 15.1            | 82.9        |           |
| ML2     | 12   | 11/6/2012       | 11/7/2012     | 0.5 GPM Step 1     | 7:20          | 45             | 232             | 13.4           | 1.21                | 1.35              | 902                     | 6.60 | 1.75                | 1.47            | 12          |           |
| EW      | 1    | 11/7/2012       | 11/13/2012    | 0.5 GPM Step 1     | 10:30         | 8000           | 17900           | 3900           | 220                 | 270               |                         |      |                     |                 |             |           |
| ML1     | 1    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 17:35         | 20000          | 5850            | 4360           | 1000                | 1070              | 73530                   | 3.99 | 0.59                | 7.64            | 179.2       |           |
| ML1     | 2    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 17:25         | 52000          | 3470            | 11400          | 665                 | 5160              | 66300                   | 4.02 | 0.1                 | 7.64            | 184.4       |           |
| ML1     | 3    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 16:55         | 4500           | 5640            | 4170           | 230                 | 520               | 56570                   | 4.11 | 0.08                | 30              | 173.5       |           |
| ML1     | 4    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 16:35         | 12600          | 1580            | 1608           | 81.5                | 968               | 35920                   | 4.33 | 0.25                | 862             | 151.1       |           |
| ML1     | 5    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 14:45         | 2000           | 965             | 365.5          | 38.8                | 51                | 14110                   | 5.30 | 0.06                | 99.8            | 113.6       |           |
| ML1     | 5    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 15:05         | 2450           | 720             | 233.5          | 32.8                | 73.5              |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 14:25         | 150            | 238.5           | 106.5          | 19.2                | 38.8              | 5790                    | 6.23 | 0.28                | 6.5             | 7.5         |           |
| ML1     | 7    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 13:55         | 370            | 65.5            | 357            | 19                  | 21.1              | 5238                    | 6.03 | 0.39                | 4.72            | 37.7        |           |
| ML1     | 8    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 13:35         | 150            | 300             | 375            | 2.61                | 5.8               | 2460                    | 6.25 | 0.22                | 5.19            | 79          |           |
| ML1     | 9    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 9:15          | 195            | 467             | 193.6          | 1.03                | 12.35             | 1589                    | 6.52 | 0.23                | 9.88            | -18.5       |           |
| ML1     | 10   | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 8:55          | 25             | 351             | 12             | 1.44                | 0.6               | 922                     | 6.85 | 0.06                | 14.6            | -96         |           |
| ML1     | 11   | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 13:05         | 14             | 269             | 5.32           | 2.4                 | 5.66              | 898                     | 6.90 | 0.25                | 4.66            | -71.2       |           |
| ML1     | 12   | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 12:55         | 21             | 290             | 4.59           | 1.03                | 4.84              | 887                     | 6.61 | 0.66                | 20.96           | -23.1       |           |
| ML2     | 1    | 11/7/2012       | 11/13/2012    | 0.5 GPM Step 1     | 9:35          | 38000          | 11100           | 1845           | 1810                | 2200              | 72079                   | 3.63 | 0.79                | 8.9             | 220.8       |           |
| ML2     | 2    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 12:40         | 4000           | 2790            | 1050           | 430                 | 390               | 66114                   | 3.75 | 1.14                | 3.09            | 223.6       |           |
| ML2     | 3    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 12:15         | 26500          | 10600           | 1730           | 860                 | 1290              | 54737                   | 3.91 | 0.91                | 18.6            | 203.4       |           |
| ML2     | 4    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 11:50         | 7000           | 3150            | 1440           | 1450                | 495               | 28836                   | 4.30 | 0.77                | 2.63            | 165.7       |           |
| ML2     | 5    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 11:35         | 4700           | 655             | 2755           | 115.5               | 119               | 13754                   | 5.07 | 1.25                | 45              | 113.2       |           |
| ML2     | 6    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 11:00         | 5000           | 555             | 367            | 13                  | 65.5              | 5727                    | 5.70 | 1.02                | 4.61            | 78.3        |           |
| ML2     | 7    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 10:40         | 1200           | 197.5           | 429            | 14.4                | 21.1              | 3361                    | 5.84 | 0.7                 | 2.19            | 50.1        |           |
| ML2     | 8    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 10:00         | 300            | 383             | 107            | 6.4                 | 4.8               | 2159                    | 5.37 | 0.51                | 3.62            | 128.6       |           |
| ML2     | 9    | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 9:40          | 71             | 393             | 45.4           | 1.97                | 2.5               | 1051                    | 5.90 | 0.66                | 4.29            | 65.9        |           |
| ML2     | 10   | 11/7/2012       | 11/13/2012    | 0.5 GPM Step 1     | 9:00          | 46             | 176             | 3.52           | 0.05                | 0.19              | 862                     | 5.48 | 0.82                | 0.72            | 143.7       |           |

Prepared by: LJ 11/04/2014  
Checked by: PHT 11/04/2014

**Table 3-1: Water Quality Monitoring Results for Pumping Step 1  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments  |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|-----------|
| ML2     | 10   | 11/7/2012       | 11/13/2012    | 0.5 GPM Step 1     | 9:15          | 37             | 291             | 4.46           | 0.08                | 0.06              |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 8:40          | 35             | 326             | 14.5           | 1.49                | 1.75              | 842                     | 5.70 | 0.85                | 0.76            | 85          |           |
| ML2     | 12   | 11/7/2012       | 11/8/2012     | 0.5 GPM Step 1     | 8:25          | 38             | 206             | 17.7           | 2.1                 | 6.1               | 801                     | 6.08 | 1.28                | 2.33            | 10.3        |           |
| EW      | 1    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 15:10         | 45000          | 22100           | 6430           | 2050                | 2260              |                         |      |                     |                 |             |           |
| ML1     | 1    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 14:50         | 48000          | 8590            | 1330           | 1970                | 2970              | 74600                   | 4.72 | 0.27                | 8.61            | 173.7       |           |
| ML1     | 2    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 14:30         | 62000          | 10850           | 2225           | 1890                | 2140              | 66910                   | 4.73 | 0.26                | 4.01            | 185         |           |
| ML1     | 3    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 13:35         | 32000          | 13400           | 3255           | 1040                | 2050              | 56820                   | 4.81 | 0.09                | 6.4             | 169.2       |           |
| ML1     | 4    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 13:15         | 12800          | 5760            | 1338           | 336                 | 570               | 35700                   | 5.04 | 0.2                 | 36.01           | 146.4       |           |
| ML1     | 5    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 11:50         | 5400           | 1842            | 463.5          | 72                  | 131.5             | 13790                   | 5.87 | 0.05                | 12.7            | 113.4       |           |
| ML1     | 5    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 12:05         | 3800           | 2800            | 487            | 109                 | 113               |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 11:40         | 800            | 706             | 195.4          | 29.4                | 48.8              | 5760                    | 6.93 | 0.8                 | 3.6             | 12.9        |           |
| ML1     | 7    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 11:25         | 760            | 337             | 67.4           | 13.2                | 15.2              | 3269                    | 6.70 | 0.88                | 3.6             | 49.8        |           |
| ML1     | 8    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 11:10         | 640            | 323             | 52             | 13.3                | 20.5              | 2500                    | 7.03 | 0.21                | 14.9            | 17.8        |           |
| ML1     | 9    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 10:55         | 140            | 420             | 20.6           | 8.2                 | 9                 | 1637                    | 7.20 | 0.25                | 4               | -16.3       |           |
| ML1     | 10   | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 10:45         | 20             | 277             | 1.48           | 7.05                | 13.35             | 943                     | 7.56 | 0.49                | 3.66            | -66         |           |
| ML1     | 11   | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 10:35         | 20             | 328             | 1.04           | 3.1                 | 7.65              | 915                     | 7.75 | 0.42                | 6.94            | -73.1       |           |
| ML1     | 12   | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 10:15         | 29             | 284             | 1.27           | 1.29                | 5.88              | 919                     | 7.32 | 0.83                | 24.6            | -35         |           |
| ML2     | 1    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 10:00         | 24000          | 1710            | 663            | 920                 | 1260              | 71304                   | 3.51 | 0.49                | 4.98            | 214         |           |
| ML2     | 2    | 11/8/2012       | 11/12/2012    | 0.5 GPM Step 1     | 9:46          | 82000          | 2190            | 1600           | 1760                | 2640              | 65380                   | 3.62 | 0.39                | 3.22            | 209.6       |           |
| ML2     | 3    | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 11:25         | 11500          | 8310            | 4070           | 480                 | 490               | 53765                   | 3.74 | 0.34                | 22.1            | 189.4       |           |
| ML2     | 4    | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 11:05         | 5000           | 2200            | 2040           | 18.1                | 255               | 29058                   | 4.12 | 4.12                | 16.9            | 186.3       |           |
| ML2     | 5    | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 10:00         | 800            | 2165            | 354.5          | 20.9                | 18                | 13104                   | 4.93 | 0.78                | 20.6            | 118         |           |
| ML2     | 6    | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 9:40          | 620            | 479             | 273            | 13.7                | 10.1              | 5665                    | 5.36 | 0.43                | 2.36            | 951         |           |
| ML2     | 7    | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 9:30          | 440            | 185.5           | 186.5          | 15.4                | 7                 | 3316                    | 5.74 | 0.54                | 2.91            | 63.6        |           |
| ML2     | 8    | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 9:15          | 230            | 304             | 70.5           | 8.55                | 4.05              | 2205                    | 5.36 | 0.68                | 1.91            | 128.1       |           |
| ML2     | 9    | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 8:55          | 72             | 332             | 8.1            | 2.02                | 4.4               | 1051                    | 5.84 | 0.91                | 1.92            | 90.2        |           |
| ML2     | 10   | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 8:30          | 43             | 276             | 4.99           | 0.03                | 0.02              | 860                     | 5.45 | 1.05                | 2.7             | 124.5       |           |
| ML2     | 10   | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 8:40          | 39             | 287             | 2.66           | 0.04                | 0.1               |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 8:15          | 40             | 286             | 7.66           | 2.08                | 2.25              | 841                     | 5.66 | 0.96                | 2.9             | 94.4        |           |
| ML2     | 12   | 11/8/2012       | 11/9/2012     | 0.5 GPM Step 1     | 8:05          | 43             | 249             | 11.7           | 2.2                 | 3.75              | 870                     | 5.85 | 0.93                | 1.69            | 82.8        |           |
| EW      | 1    | 11/13/2012      |               | 0.5 GPM Step 1     |               |                |                 |                |                     |                   | >99,000                 | 3.42 | < 0.01              | 1.9             | 183         |           |
| ML1     | 1    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 14:10         | 59000          | 620             | 8050           | 4520                | 3600              | 92400                   | 3.64 | 0.19                | 7.5             | 151         |           |
| ML1     | 2    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 13:50         | 51000          | 3710            | 4300           | 2010                | 1660              | 84700                   | 3.66 | 0.05                | 3.4             | 157         |           |
| ML1     | 3    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 13:35         | 13000          | 2695            | 3075           | 950                 | 670               | 75500                   | 3.69 | < 0.01              | 16.3            | 151         |           |
| ML1     | 4    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 13:25         | 7000           | 3130            | 1205           | 480                 | 380               | 46600                   | 3.92 | < 0.01              | 25.9            | 133         |           |
| ML1     | 5    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 12:25         | 20000          | 3560            | 2200           | 170                 | 920               | 74400                   | 3.69 | < 0.01              | 3.1             | 159         |           |
| ML1     | 5    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 12:40         | 18500          | 5350            | 2375           | 805                 | 710               |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 9:35          | 540            | 386.5           | 182            | 32                  | 13.6              | 7640                    | 5.92 | < 0.01              | 2               | -38         |           |
| ML1     | 7    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 9:20          | 1020           | 230.5           | 31.5           | 7.5                 | 14.6              | 4280                    | 5.68 | < 0.01              | 4               | 13          |           |
| ML1     | 8    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 8:25          | 300            | 232             | 173.6          | 12.2                | 8.8               | 3380                    | 5.90 | 0.014               | 11              | -18         |           |
| ML1     | 9    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 8:10          | 145            | 371             | 70.7           | 13.9                | 9.7               | 2180                    | 6.09 | < 0.01              | 69              | -46         |           |
| ML1     | 10   | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 7:55          | 24             | 292             | 11.8           | 4.24                | 9.04              | 1250                    | 6.24 | < 0.01              | 3.1             | -110        |           |
| ML1     | 11   | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 7:40          | 10             | 302             | 9.09           | 3.02                | 3.76              | 1200                    | 6.51 | < 0.01              | 7.2             | 732         |           |
| ML1     | 12   | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 7:20          | 39             | 267             | 7.74           | 2.51                | 1.86              | 1220                    | 6.14 | < 0.01              | 5.3             | -83         |           |
| ML2     | 1    | 11/13/2012      | 11/15/2012    | 0.5 GPM Step 1     | 10:10         | 60000          | 13900           | 1680           | 2340                | 3200              | 77032                   | 3.53 | 0.74                | 3.22            | 201.9       |           |
| ML2     | 2    | 11/13/2012      | 11/15/2012    | 0.5 GPM Step 1     | 8:05          | 52000          | 10700           | 4120           | 2530                | 4520              | 71407                   | 3.65 | 0.61                | 0.89            | 191.7       |           |
| ML2     | 3    | 11/13/2012      | 11/15/2012    | 0.5 GPM Step 1     | 7:40          | 24500          | 11550           | 3430           | 1500                | 1610              | 58548                   | 3.76 | 1.76                | 61.8            | 211.5       |           |
| ML2     | 4    | 11/13/2012      | 11/15/2012    | 0.5 GPM Step 1     | 7:20          | 18000          | 1342            | 1026           | 270                 | 628               | 33430                   | 4.05 | 1.3                 | 16.8            | 1739        |           |
| ML2     | 5    | 11/13/2012      | 11/15/2012    | 0.5 GPM Step 1     | 7:00          | 2720           | 2005            | 563            | 29.6                | 72                | 14374                   | 5.05 | 1.39                | 63.2            | 128.9       |           |
| ML2     | 6    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 14:45         | 640            | 341.5           | 348            | 15.9                | 20.8              | 6195                    | 5.59 | 1.09                | 3.09            | 87.2        |           |

Prepared by: LJ 11/04/2014  
Checked by: PHT 11/04/2014

**Table 3-1: Water Quality Monitoring Results for Pumping Step 1  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments  |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|-----------|
| ML2     | 7    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 14:20         | 320            | 102.5           | 226            | 14.75               | 20.8              | 3621                    | 5.79 | 1.79                | 11.6            | 77.4        |           |
| ML2     | 8    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 16:00         | 85             | 262             | 97.5           | 2.8                 | 1                 | 2488                    | 5.29 | 0.63                | 6.91            | 129.2       |           |
| ML2     | 9    | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 15:30         | 65             | 245             | 19.5           | 1.9                 | 2.9               | 1186                    | 5.74 | 1.72                | 3.31            | 1058        |           |
| ML2     | 10   | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 14:50         | 20             | 227             | 8.92           | 0.04                | 0.06              | 962                     | 5.41 | 0.73                | 2.71            | 115.2       |           |
| ML2     | 10   | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 15:05         | 39             | 222             | 10.2           | 0.02                | 0.06              |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 14:40         | 45             | 179             | 8.26           | 1.97                | 1                 | 939                     | 5.59 | 1.32                | 1.98            | 89.6        |           |
| ML2     | 12   | 11/13/2012      | 11/14/2012    | 0.5 GPM Step 1     | 14:25         | 40             | 180             | 10.9           | 1.13                | 6.2               | 932                     | 6.03 | 1.4                 | 0.91            | 60.2        |           |
| EVV     | 1    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 8:03          | 76000          | 18900           | 6660           | 2780                | 3160              | > 99,000                | 3.57 | < 0.01              | 0.62            | 184         |           |
| ML1     | 1    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 7:50          | 128000         | 13500           | 6670           | 2820                | 6360              | >99,000                 | 3.71 | < 0.01              | 1.45            | 152         |           |
| ML1     | 2    | 11/16/2012      | 11/20/2012    | 0.5 GPM Step 1     | 13:45         | 32000          | 27500           | 4970           | 1860                | 2550              | >99,000                 | 3.72 | < 0.01              | 2.01            | 16          |           |
| ML1     | 3    | 11/16/2012      | 11/20/2012    | 0.5 GPM Step 1     | 13:35         | 18500          | 16500           | 3095           | 1800                | 1900              | 84200                   | 3.79 | < 0.01              | 6.4             | 155         |           |
| ML1     | 4    | 11/16/2012      | 11/20/2012    | 0.5 GPM Step 1     | 13:15         | 9000           | 5280            | 1402           | 566                 | 458               | 52900                   | 4.01 | < 0.01              | 53.6            | 134         |           |
| ML1     | 5    | 11/16/2012      | 11/20/2012    | 0.5 GPM Step 1     | 11:25         | 7100           | 735             | 354.5          | 94                  | 113.6             | 21600                   | 4.96 | < 0.01              | 210             | 111         |           |
| ML1     | 5    | 11/16/2012      | 11/20/2012    | 0.5 GPM Step 1     | 11:50         | 6600           | 775             | 481            | 162                 | 178               |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 11/16/2012      | 11/20/2012    | 0.5 GPM Step 1     | 11:00         | 1140           | 252.5           | 195.5          | 19.6                | 23.2              | 4990                    | 5.83 | < 0.01              | 0.2             | 10          |           |
| ML1     | 7    | 11/16/2012      | 11/20/2012    | 0.5 GPM Step 1     | 10:45         | 1400           | 150.5           | 170            | 22.6                | 22.4              | 4900                    | 5.81 | < 0.01              | 1               | 15          |           |
| ML1     | 8    | 11/16/2012      | 11/16/2012    | 0.5 GPM Step 1     | 10:55         | 680            | 276             | 130.4          | 14.3                | 21.7              | 3770                    | 6.01 | < 0.01              | 4.6             | -14         |           |
| ML1     | 9    | 11/16/2012      | 11/16/2012    | 0.5 GPM Step 1     | 10:40         | 180            | 430             | 52             | 14.2                | 16.2              | 2470                    | 6.16 | < 0.01              | 9.2             | -37         |           |
| ML1     | 10   | 11/16/2012      | 11/16/2012    | 0.5 GPM Step 1     | 10:30         | 25             | 333             | 6.99           | 10.75               | 16.4              | 1410                    | 6.49 | < 0.01              | 1               | -112        |           |
| ML1     | 11   | 11/16/2012      | 11/16/2012    | 0.5 GPM Step 1     | 10:15         | 25             | 289             | 5.64           | 1.95                | 9.75              | 1340                    | 6.51 | < 0.01              | 3.7             | -123        |           |
| ML1     | 12   | 11/16/2012      | 11/16/2012    | 0.5 GPM Step 1     | 10:05         | 14             | 289             | 6.57           | 1.04                | 8.32              | 1310                    | 6.20 | < 0.01              | 2.1             | -68         |           |
| ML2     | 1    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 12:40         | 12000          | 16180           | 7700           | 750                 | 780               | 75299                   | 3.31 | 0.91                | 5.06            | 194.7       |           |
| ML2     | 2    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 12:20         | 40000          | 18400           | 8240           | 1016                | 2336              | 69764                   | 3.64 | 0.77                | 1.92            | 184.7       |           |
| ML2     | 3    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 12:00         | 13500          | 13500           | 6220           | 540                 | 692               | 57439                   | 3.76 | 1.18                | 70.2            | 188.7       |           |
| ML2     | 4    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 11:45         | 3400           | 3410            | 2412           | 283                 | 698               | 32680                   | 4.05 | 1.17                | 43              | 176.4       |           |
| ML2     | 5    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 11:00         | 2600           | 1440            | 265            | 118.8               |                   | 13677                   | 5.10 | 1.98                | 48.9            | 126.8       |           |
| ML2     | 6    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 10:40         | 1440           | 596             | 140            | 27.3                | 29                | 5954                    | 5.53 | 1.99                | 2.91            | 106.9       |           |
| ML2     | 7    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 10:20         | 420            | 194.6           | 109.2          | 10.35               | 12.2              | 3525                    | 5.21 | 2.88                | 3399            | 98.1        |           |
| ML2     | 8    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 10:10         | 94             | 259             | 68.4           | 3.26                | 2.02              | 2529                    | 5.27 | 1.76                | 2.7             | 145.8       |           |
| ML2     | 9    | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 9:55          | 74             | 231             | 18.8           | 2.8                 | 2.98              | 1209                    | 5.83 | 1.51                | 1.63            | 99.1        |           |
| ML2     | 10   | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 9:20          | 41             | 188             | 4.95           | 0.03                | 0.06              | 955                     | 5.31 | 1.79                | 3.06            | 121.5       |           |
| ML2     | 10   | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 9:35          | 43             | 191             | 5.09           | 0.02                | 0.06              |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 8:50          | 30             | 226             | 5.74           | 1.86                | 2.16              | 928                     | 5.60 | 1.03                | 2.91            | 105.4       |           |
| ML2     | 12   | 11/16/2012      | 11/21/2012    | 0.5 GPM Step 1     | 8:40          | 43             | 157             | 8.27           | 2.94                | 5.55              | 903                     | 6.04 | 2.15                | 2.92            | 106.9       |           |
| EVV     | 1    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 16:25         | 28500          | 16450           | 4310           | 1185                | 2990              | 79960                   | 3.63 | 0.3                 | 0.42            | 192.5       |           |
| ML1     | 1    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 12:10         | 43000          | 18100           | 4950           | 1140                | 2880              | 68800                   | 3.71 | 0.35                | 0.84            | 164.3       |           |
| ML1     | 2    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 11:50         | 55000          | 11900           | 4220           | 1350                | 1345              | 61870                   | 3.72 | 0.32                | 0.95            | 170.1       |           |
| ML1     | 3    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 11:35         | 23500          | 7250            | 2480           | 260                 | 825               | 50820                   | 3.79 | 0.31                | 1.55            | 162.2       |           |
| ML1     | 4    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 11:15         | 6600           | 5620            | 2060           | 298                 | 241               | 30570                   | 4.06 | 0.42                | 2.3             | 144.9       |           |
| ML1     | 5    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 9:55          | 1240           | 1920            | 900            | 49.6                | 119.2             | 11620                   | 5.01 | 0.38                | 49.2            | 116.8       |           |
| ML1     | 5    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 10:45         | 1300           | 2310            | 976            | 106.5               | 139.5             |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 9:35          | 1120           | 828             | 383            | 8.4                 | 22.2              | 5365                    | 5.95 | 0.45                | 1.1             | -4.4        |           |
| ML1     | 7    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 9:20          | 510            | 374             | 205.5          | 20                  | 19.4              | 3157                    | 5.77 | 0.52                | 0.87            | 22.4        |           |
| ML1     | 8    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 8:55          | 550            | 260             | 155.8          | 17.2                | 20.5              | 2500                    | 5.95 | 0.69                | 0.63            | -0.7        |           |
| ML1     | 9    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 8:45          | 142            | 292             | 69.3           | 10.1                | 12.4              | 1670                    | 6.17 | 0.73                | 1.65            | -21.5       |           |
| ML1     | 10   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 8:30          | 26             | 255             | 9.6            | 5.82                | 8.4               | 962                     | 6.50 | 0.67                | 0.43            | 63.7        |           |
| ML1     | 11   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 8:15          | 22             | 310             | 7.8            | 3.76                | 5.76              | 928                     | 6.56 | 0.44                | 0.35            | -102.1      |           |
| ML1     | 12   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 8:00          | 41             | 214             | 9.5            | 2.81                | 4.34              | 960                     | 6.22 | 1.03                | 3.12            | -71.1       |           |
| ML2     | 1    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 20:50         | 46000          | 4100            | 5300           | 1190                | 1490              | 59318                   | 3.52 | 1.05                | 18.7            | 188.3       |           |
| ML2     | 2    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 20:35         | 51000          | 4400            | 6100           | 1330                | 1530              | 54960                   | 3.65 | 1.09                | 13.9            | 174         |           |

**Table 3-1: Water Quality Monitoring Results for Pumping Step 1  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments  |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|-----------|
| ML2     | 3    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 20:20         | 32000          | 10250           | 3505           | 1000                | 1670              | 44924                   | 3.77 | 1.43                | 264             | 171.1       |           |
| ML2     | 4    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 20:10         | 10000          | 1885            | 1430           | 261                 | 800               | 24984                   | 4.13 | 0.81                | 4.82            | 150.6       |           |
| ML2     | 5    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 19:40         | 2550           | 1860            | 838            | 26.4                | 146.5             | 10550                   | 5.16 | 1.68                | 51.7            | 92.6        |           |
| ML2     | 6    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 19:15         | 1650           | 550             | 300.5          | 22.3                | 15.6              | 4654                    | 5.58 | 1.26                | 1.72            | 65.3        |           |
| ML2     | 7    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 18:55         | 1088           | 258             | 184.2          | 12.4                | 7.8               | 2774                    | 5.73 | 0.55                | 2.09            | 54.7        |           |
| ML2     | 8    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 18:40         | 230            | 333             | 56.3           | 1.45                | 5.05              | 1971                    | 5.33 | 0.76                | 1.66            | 105.4       |           |
| ML2     | 9    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 18:30         | 155            | 293             | 17.6           | 9.75                | 10.65             | 974                     | 5.84 | 1.45                | 16.4            | 86.1        |           |
| ML2     | 10   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 18:00         | 45             | 309             | 10.2           | 0.04                | 0.07              | 763                     | 5.37 | 1.75                | 1.25            | 99.1        |           |
| ML2     | 10   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 18:15         | 47             | 290             | 9.35           | 0.04                | 0.04              |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 17:40         | 15             | 271             | 9.75           | 1                   | 0.55              | 739                     | 5.62 | 1.09                | 2.01            | 95.6        |           |
| ML2     | 12   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 17:30         | 47             | 282             | 13.3           | 2.1                 | 3.95              | 937                     | 5.60 | 1.93                | 2               | 133.4       |           |
| MP2     | 3    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 16:05         | 19600          | 7540            | 2060           | 410                 | 584               | 52370                   | 3.67 | 0.18                | 0.71            | 197         |           |
| MP2     | 4    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 15:50         | 7600           | 2410            | 1000           | 194                 | 318               | 28730                   | 3.82 | 0.2                 | 0.8             | 178.3       |           |
| MP2     | 6    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 15:15         | 1220           | 671             | 266            | 12.2                | 20.8              | 5462                    | 4.47 | 0.2                 | 0.23            | 127.3       |           |
| MP2     | 6    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 15:25         | 1280           | 278             | 177            | 18.2                | 26.2              |                         |      |                     |                 |             | Duplicate |
| MP2     | 7    | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 14:55         | 840            | 570             | 225.5          | 16                  | 18.2              | 4693                    | 4.69 | 0.27                | 0.38            | 119.7       |           |
| MP2     | 10   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 14:45         | 710            | 5954            | 185            | 16                  | 19.5              | 4070                    | 4.81 | 0.7                 | 1.96            | 94.3        |           |
| MP2     | 11   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 14:35         | 380            | 306             | 98.3           | 5.28                | 5.78              | 2064                    | 4.95 | 0.23                | 0.4             | 35.5        |           |
| MP2     | 12   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 14:20         | 30             | 234             | 0.8            | 1.34                | 1.36              | 732                     | 4.81 | 0.4                 | 0.71            | 1.5         |           |
| MP2     | 13   | 11/19/2012      | 11/27/2012    | 0.5 GPM Step 1     | 14:10         | 3              | 156             | 0.83           | 1.04                | 1.38              | 575                     | 5.38 | 0.35                | 1.32            | -52.5       |           |
| ML1     | 10   | 11/26/2012      | 11/28/2012    | 0.5 GPM Step 1     | 8:55          | 46             | 335             | 11             | 13                  | 14.55             | 1260                    | 6.50 | < 0.01              | 0.52            | -115        |           |
| ML1     | 11   | 11/26/2012      | 11/28/2012    | 0.5 GPM Step 1     | 8:40          | 32             | 318             | 8.58           | 5.12                | 10.52             | 1119                    | 6.47 | < 0.01              | 0.93            | -124        |           |
| ML1     | 12   | 11/26/2012      | 11/28/2012    | 0.5 GPM Step 1     | 8:30          | 48             | 265             | 9.76           | 1.85                | 1.81              | 1160                    | 6.08 | < 0.01              | 2.27            | -64         |           |
| EVV     | 1    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 13:05         | 80000          | 16500           | 7170           | 1800                | 3120              | >99,000                 | 3.52 | 2.17                | 1.24            | 184         |           |
| ML1     | 1    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 12:45         | 61000          | 2430            | 1670           | 1380                | 1850              | >99,000                 | 3.64 | < 0.01              | 3.8             | 153         |           |
| ML1     | 2    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 12:35         | 34000          | 3970            | 2420           | 970                 | 1260              | 80800                   | 3.76 | < 0.01              | 49              | 155         |           |
| ML1     | 3    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 12:20         | 64000          | 13600           | 4720           | 1025                | 1720              | 93900                   | 3.68 | < 0.01              | 3.31            | 159         |           |
| ML1     | 4    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 11:20         | 20800          | 7590            | 5640           | 464                 | 498               | 48200                   | 3.98 | < 0.01              | 17.9            | 129         |           |
| ML1     | 5    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 10:35         | 6900           | 2400            | 1895           | 85                  | 182               | 20200                   | 4.95 | < 0.01              | 80.9            | 97          |           |
| ML1     | 5    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 10:55         | 5800           | 2740            | 2285           | 156                 | 161               |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 10:05         | 2040           | 545             | 604            | 45.2                | 57.4              | 8200                    | 5.92 | < 0.01              | 0.63            | -30         |           |
| ML1     | 7    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 9:50          | 1020           | 233             | 295            | 19.4                | 20.2              | 4650                    | 5.68 | < 0.01              | 2.08            | 12          |           |
| ML1     | 8    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 9:35          | 500            | 245.5           | 217            | 21.2                | 24.4              | 3580                    | 5.87 | < 0.01              | 1.82            | -10         |           |
| ML1     | 9    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 9:20          | 270            | 418             | 95.6           | 15.8                | 17.4              | 2290                    | 5.80 | < 0.01              | 1.52            | -17         |           |
| ML2     | 1    | 11/27/2012      | 11/29/2012    | 0.5 GPM Step 1     | 9:20          | 50000          | 21000           | 3770           | 2050                | 2550              | >99,000                 | 3.56 | 0.18                | 12.77           | 193         |           |
| ML2     | 2    | 11/27/2012      | 11/29/2012    | 0.5 GPM Step 1     | 8:50          | 34000          | 17300           | 3650           | 1870                | 2390              | 99300                   | 3.71 | < 0.01              | 9.47            | 179         |           |
| ML2     | 3    | 11/27/2012      | 11/29/2012    | 0.5 GPM Step 1     | 8:15          | 18000          | 7550            | 1975           | 1032                | 1052              | 81800                   | 3.80 | 0.11                | > 800           | 101         |           |
| ML2     | 4    | 11/27/2012      | 11/29/2012    | 0.5 GPM Step 1     | 8:00          | 10000          | 6550            | 1660           | 294                 | 290               | 47200                   | 4.08 | 0.48                | 34.9            | 150         |           |
| ML2     | 5    | 11/27/2012      | 11/29/2012    | 0.5 GPM Step 1     | 7:45          | 4700           | 690             | 332            | 65                  | 107               | 20400                   | 5.40 | < 0.01              | 64.9            | 21          |           |
| ML2     | 6    | 11/27/2012      | 11/29/2012    | 0.5 GPM Step 1     | 7:25          | 3300           | 311             | 230            | 35                  | 35                | 8390                    | 5.69 | < 0.01              | 13.3            | -1          |           |
| ML2     | 8    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 14:45         | 40             | 328             | 79.6           | 5.84                | 3.65              | 3430                    | 5.39 | < 0.01              | 3.24            | 63          |           |
| ML2     | 9    | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 14:30         | 62             | 350             | 11.9           | 2.16                | 2.41              | 1710                    | 5.65 | < 0.01              | 130             | 49          |           |
| ML2     | 10   | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 13:50         | 43             | 289             | 4.85           | 0.05                | 0.07              | 1330                    | 5.45 | < 0.01              | 3.09            | 96          |           |
| ML2     | 10   | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 14:10         | 48             | 277             | 5.13           | 0.8                 | 0.04              |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 13:35         | 27             | 299             | 4.82           | 2.16                | 1.35              | 1410                    | 5.65 | < 0.01              | 12.8            | 43          |           |
| ML2     | 12   | 11/27/2012      | 11/28/2012    | 0.5 GPM Step 1     | 13:20         | 43             | 260             | 6.3            | 1.78                | 6.5               | 1680                    | 5.86 | < 0.01              | 22.7            | 75          |           |
| ML2     | 1    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 14:25         | 98000          | 17150           | 14500          | 3980                | 5780              | >99,000                 | 3.73 | 1.51                | 2.32            | 206         |           |
| ML2     | 2    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 14:10         | 84000          | 15180           | 10800          | 2470                | 5920              | 95800                   | 4.02 | 0.55                | 3.98            | 179         |           |
| ML2     | 3    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 13:55         | 33500          | 9660            | 22150          | 1200                | 1380              | 75800                   | 3.99 | 0.77                | 194             | 184         |           |
| ML2     | 4    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 13:30         | 10000          | 4825            | 3590           | 117                 | 594               | 41300                   | 4.33 | 1.59                | 103             | 173         |           |

Prepared by: LJ 11/04/2014  
Checked by: PHT 11/04/2014

**Table 3-1: Water Quality Monitoring Results for Pumping Step 1  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments  |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|-----------|
| ML2     | 5    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 13:10         | 2680           | 488             | 774            | 44                  | 82.4              | 17800                   | 5.94 | 0.11                | 35.9            | -32         |           |
| ML2     | 6    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 12:55         | 690            | 509             | 400            | 12.1                | 35.4              | 7200                    | 5.93 | < 0.01              | 13.7            | -25         |           |
| ML2     | 7    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 12:40         | 110            | 256             | 213            | 7.7                 | 21.9              | 4580                    | 6.00 | 0.2                 | 9.18            | -46         |           |
| ML2     | 8    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 12:30         | 42             | 239             | 183            | 2.12                | 8.65              | 3350                    | 5.44 | < 0.01              | 2.65            | 47          |           |
| ML2     | 9    | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 12:15         | 48             | 286             | 19             | 2.25                | 1.8               | 1400                    | 5.56 | 1.21                | 13              | 37          |           |
| ML2     | 10   | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 11:55         | 46             | 238             | 9.8            | 0.3                 | 0.03              | 1130                    | 5.39 | < 0.01              | 18.7            | 101         |           |
| ML2     | 10   | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 12:05         | 32             | 229             | 9.18           | 0.05                | 0.04              |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 11:40         | 46             | 212             | 9.16           | 0.92                | 1.4               | 1050                    | 5.60 | < 0.01              | 11.2            | 35          |           |
| ML2     | 12   | 1/7/2013        | 1/8/2013      | 0.5 GPM Step 1     | 11:25         | 18             | 254             | 13.3           | 2.3                 | 4.8               | 1180                    | 5.80 | < 0.01              | 3.2             | -65         |           |
| ML1     | 1    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 13:45         | 28000          | 17400           | 3180           | 800                 | 1260              | >99,000                 | 3.77 | < 0.01              | 1.73            | 164         |           |
| ML1     | 2    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 13:35         | 96000          | 21700           | 6900           | 2200                | 5820              | 91000                   | 3.85 | < 0.01              | 1.01            | 159         |           |
| ML1     | 3    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 13:15         | 20400          | 7140            | 5890           | 864                 | 2272              | 74600                   | 3.94 | < 0.01              | 9.88            | 160         |           |
| ML1     | 4    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 12:45         | 4400           | 5160            | 1220           | 159                 | 328               | 43200                   | 4.23 | < 0.01              | 15.5            | 165         |           |
| ML1     | 5    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 11:35         | 700            | 2650            | 222            | 18.2                | 43.4              | 17600                   | 5.11 | < 0.01              | 40.9            | 96          |           |
| ML1     | 5    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 11:55         | 840            | 2935            | 188            | 19                  | 42                |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 11:20         | 200            | 1025            | 76.5           | 9.7                 | 12.8              | 2160                    | 6.18 | < 0.01              | 5.68            | -38         |           |
| ML1     | 7    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 10:50         | 690            | 636             | 110            | 14.3                | 17.9              | 4570                    | 5.83 | < 0.01              | 1.29            | 5           |           |
| ML1     | 8    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 10:35         | 390            | 594             | 180            | 10.1                | 21                | 3550                    | 6.01 | < 0.01              | 4.94            | -12         |           |
| ML1     | 9    | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 10:25         | 74             | 677             | 76.8           | 5                   | 9                 | 2140                    | 6.11 | < 0.01              | 12.5            | -23         |           |
| ML1     | 10   | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 10:10         | 18             | 492             | 8.08           | 8.5                 | 10.9              | 1230                    | 6.57 | < 0.01              | 2.53            | -117        |           |
| ML1     | 11   | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 10:00         | 11             | 451             | 6.48           | 4.15                | 6.6               | 1200                    | 6.69 | < 0.01              | 15              | -133        |           |
| ML1     | 12   | 1/8/2013        | 1/9/2013      | 0.5 GPM Step 1     | 9:50          | 13             | 14340           | 6.14           | 3.78                | 4.32              | 1090                    | 6.18 | < 0.01              | 6.01            | -45         |           |
| MP2     | 3    | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 13:20         | 32000          | 12050           | 4020           | 785                 | 1030              | 81000                   | 3.59 | < 0.01              | 1.12            | 190         |           |
| MP2     | 4    | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 13:05         | 28500          | 5300            | 2248           | 855                 | 1460              | 44800                   | 3.74 | < 0.01              | 0.67            | 172         |           |
| MP2     | 6    | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 11:20         | 2080           | 1160            | 134            | 29.6                | 37.2              | 9690                    | 4.38 | < 0.01              | 0.39            | 158         |           |
| MP2     | 6    | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 11:30         | 1800           | 782             | 814            | 32.2                | 36.6              |                         |      |                     |                 |             | Duplicate |
| MP2     | 7    | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 9:50          | 1260           | 750             | 477            | 25.6                | 32.4              | 8450                    | 4.74 | < 0.01              | 1.15            | 123         |           |
| MP2     | 10   | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 9:30          | 500            | 845             | 340            | 25                  | 27.6              | 7630                    | 4.74 | < 0.01              | 23.1            | 122         |           |
| MP2     | 11   | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 9:00          | 430            | 348             | 158            | 3.58                | 8.4               | 3440                    | 4.96 | < 0.01              | 2.19            | 74          |           |
| MP2     | 12   | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 8:35          | 26             | 149             | 0.76           | 1.51                | 1.53              | 694                     | 4.78 | < 0.01              | 0.73            | 76          |           |
| MP2     | 13   | 1/9/2013        | 1/10/2013     | 0.5 GPM Step 1     | 8:25          | 4              | 198             | 1.66           | 1.1                 | 1.32              | 870                     | 5.47 | < 0.01              | 5.92            | -1          |           |
| EW      | 1    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 15:20         | 54000          | 17300           | 8000           | 1000                | 2480              | >99,000                 | 3.60 | < 0.01              | 0.97            | 180         |           |
| ML2     | 1    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 15:00         | 40000          | 21300           | 8150           | 1040                | 2040              | 97600                   | 3.60 | < 0.01              | 3.94            | 183         |           |
| ML2     | 2    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 14:45         | 71000          | 12200           | 17800          | 3010                | 6060              | 93200                   | 3.90 | 0.13                | 10              | 178         |           |
| ML2     | 3    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 13:45         | 48000          | 3895            | 4560           | 1055                | 970               | 73700                   | 3.90 | < 0.01              | 293             | 172         |           |
| ML2     | 4    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 13:20         | 12600          | 2490            | 1572           | 342                 | 546               | 38600                   | 4.30 | 0.16                | 57.4            | 149         |           |
| ML2     | 5    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 12:50         | 3350           | 1180            | 910            | 56                  | 92                | 16300                   | 5.80 | < 0.01              | 25.9            | -14         |           |
| ML2     | 6    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 12:30         | 1300           | 458             | 336            | 23.9                | 17.9              | 6830                    | 5.80 | < 0.01              | 11.5            | 1           |           |
| ML2     | 7    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 12:20         | 700            | 326             | 210            | 13.6                | 18.2              | 4450                    | 5.80 | < 0.01              | 2.3             | -1          |           |
| ML2     | 8    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 12:05         | 490            | 193             | 165.6          | 2.4                 | 3.4               | 3340                    | 5.30 | < 0.01              | 3.72            | 91          |           |
| ML2     | 9    | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 11:50         | 49             | 221             | 19.3           | 2.18                | 2.51              | 1240                    | 5.50 | < 0.01              | 8.97            | 90          |           |
| ML2     | 10   | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 11:30         | 38             | 220             | 11.3           | 0.03                | 0.02              | 1120                    | 5.20 | < 0.01              | 0.37            | 159         |           |
| ML2     | 10   | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 11:40         | 37             | 225             | 11.8           | 0.03                | 0.05              |                         |      |                     |                 |             | Duplicate |
| ML2     | 11   | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 11:15         | 31             | 185             | 8.55           | 0.69                | 1.15              | 1070                    | 5.40 | < 0.01              | 0.48            | 90          |           |
| ML2     | 12   | 1/28/2013       | 1/29/2013     | 0.5 GPM Step 1     | 10:35         | 48             | 195             | 11.4           | 4.95                | 6.6               | 943                     | 5.90 | < 0.01              | 1.62            | -10         |           |
| ML1     | 1    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 14:20         | 54000          | 10900           | 2220           | 424                 | 2620              | 98500                   | 3.70 | < 0.01              | 2.43            | 161         |           |
| ML1     | 2    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 14:00         | 98000          | 9900            | 6840           | 274                 | 4180              | 90600                   | 3.80 | < 0.01              | 2.64            | 153         |           |
| ML1     | 3    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 13:40         | 94000          | 5300            | 6450           | 472                 | 4120              | 74000                   | 3.80 | < 0.01              | 22.3            | 156         |           |
| ML1     | 4    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 13:00         | 12400          | 4200            | 2040           | 181                 | 534               | 40700                   | 4.20 | < 0.01              | 9.48            | 123         |           |
| ML1     | 5    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 12:20         | 1340           | 655             | 366            | 18.2                | 31.4              | 15800                   | 5.00 | < 0.01              | 30.8            | 83          |           |

**Table 3-1: Water Quality Monitoring Results for Pumping Step 1  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments  |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|-----------|
| ML1     | 5    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 12:35         | 1380           | 690             | 405            | 19.1                | 34.6              |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 11:55         | 1180           | 435             | 264            | 25.2                | 40.6              | 6640                    | 6.00 | < 0.01              | 30.7            | -51         |           |
| ML1     | 7    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 11:30         | 960            | 313             | 189            | 10.3                | 17.6              | 4380                    | 5.70 | < 0.01              | 1.5             | -3          |           |
| ML1     | 8    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 11:15         | 700            | 184             | 160.5          | 14.7                | 20.1              | 3420                    | 5.70 | < 0.01              | 6.17            | -15         |           |
| ML1     | 9    | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 11:00         | 120            | 282             | 50.5           | 8.35                | 11.4              | 1730                    | 5.90 | < 0.01              | 8.62            | -33         |           |
| ML1     | 10   | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 10:50         | 25             | 191             | 7.6            | 6.35                | 10.3              | 1150                    | 6.30 | < 0.01              | 0.62            | -120        |           |
| ML1     | 11   | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 10:30         | 35             | 188             | 6.37           | 4.3                 | 6.7               | 1120                    | 6.40 | < 0.01              | 1.3             | -137        |           |
| ML1     | 12   | 1/29/2013       | 1/30/2013     | 0.5 GPM Step 1     | 10:20         | 42             | 188             | 6.39           | 2.57                | 7.84              | 951                     | 5.80 | < 0.01              | 9.51            | -26         |           |
| MP2     | 3    | 1/30/2013       | 1/31/2013     | 0.5 GPM Step 1     | 11:30         | 90000          | 9480            | 1742           | 350                 | 3320              | 70000                   | 3.70 | < 0.01              | 1.15            | 191         |           |
| MP2     | 4    | 1/30/2013       | 1/31/2013     | 0.5 GPM Step 1     | 11:00         | 12600          | 4910            | 899            | 157                 | 510               | 38100                   | 3.90 | < 0.01              | 1.15            | 175         |           |
| MP2     | 6    | 1/30/2013       | 1/31/2013     | 0.5 GPM Step 1     | 9:50          | 2360           | 975             | 240            | 28.4                | 37.6              |                         |      |                     |                 |             | Duplicate |
| MP2     | 6    | 1/30/2013       | 1/31/2013     | 0.5 GPM Step 1     | 10:10         | 2200           | 1000            | 234            | 29.2                | 35.6              | 8420                    | 4.50 | < 0.01              | 0.59            | 183         |           |
| MP2     | 7    | 1/30/2013       | 1/31/2013     | 0.5 GPM Step 1     | 9:25          | 1760           | 850             | 268            | 25                  | 31.2              | 7230                    | 4.90 | < 0.01              | 2.5             | 138         |           |
| MP2     | 10   | 1/30/2013       | 1/31/2013     | 0.5 GPM Step 1     | 9:05          | 1680           | 910             | 291            | 14.2                | 27.6              | 6740                    | 4.80 | < 0.01              | 42.7            | 158         |           |
| MP2     | 11   | 1/30/2013       | 1/31/2013     | 0.5 GPM Step 1     | 7:55          | 380            | 397             | 90.2           | 9.9                 | 10.3              | 3190                    | 5.00 | < 0.01              | 8.38            | 58          |           |
| MP2     | 13   | 1/30/2013       | 1/31/2013     | 0.5 GPM Step 1     | 7:30          | 15             | 113             | 0.68           | 0.68                | 0.83              | 439                     | 5.10 | < 0.01              | 119             | -1          |           |
| EVV     | 1    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 12:40         | 72000          | 34400           | 8080           | 2560                | 3180              | > 99,900                | 3.70 | < 0.01              | 1.12            | 175         |           |
| ML2     | 1    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 12:20         | 88000          | 21300           | 5560           | 3120                | 7320              | 86500                   | 3.80 | < 0.01              | 3.16            | 176         |           |
| ML2     | 2    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 12:05         | 28000          | 16900           | 5310           | 1340                | 1580              | 81300                   | 4.00 | < 0.01              | 1.76            | 164         |           |
| ML2     | 3    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 11:40         | 58000          | 11650           | 3765           | 730                 | 4380              | 65000                   | 4.00 | < 0.01              | 35.1            | 160         |           |
| ML2     | 4    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 10:35         | 11000          | 2950            | 1645           | 188                 | 342               | 32100                   | 4.60 | < 0.01              | 4.74            | 87          |           |
| ML2     | 5    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 10:10         | 2900           | 1335            | 570            | 76                  | 87                | 13800                   | 6.00 | < 0.01              | 15.1            | -51         |           |
| ML2     | 6    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 9:50          | 1550           | 378             | 107            | 28.1                | 37.4              | 5860                    | 5.90 | < 0.01              | 0.9             | -32         |           |
| ML2     | 7    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 9:35          | 960            | 342             | 171.5          | 7.6                 | 5.75              | 4000                    | 6.00 | < 0.01              | 2.13            | -47         |           |
| ML2     | 8    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 9:15          | 550            | 259             | 91.2           | 2.88                | 6.6               | 2720                    | 5.40 | < 0.01              | 3.33            | 49          |           |
| ML2     | 9    | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 8:55          | 41             | 302             | 11.8           | 1.57                | 2.03              | 965                     | 5.40 | < 0.01              | 6.55            | 60          |           |
| ML2     | 10   | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 8:25          | 37             | 181             | 10             | 0.01                | 0.12              | 947                     | 5.30 | < 0.01              | 0.2             | 118         |           |
| ML2     | 10   | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 8:40          | 33             | 172             | 10.4           | 0.07                | 0.11              | 0                       |      |                     |                 |             | Duplicate |
| ML2     | 11   | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 8:15          | 38             | 240             | 7.84           | 0.76                | 0.65              | 894                     | 5.40 | < 0.01              | 0.72            | 48          |           |
| ML2     | 12   | 2/12/2013       | 2/14/2013     | 0.5 GPM Step 1     | 8:05          | 46             | 263             | 9.87           | 1.51                | 6.3               | 975                     | 5.90 | < 0.01              | 1.62            | -53         |           |
| ML1     | 1    | 2/13/2013       | 2/15/2013     | 0.5 GPM Step 1     | 9:20          | 47000          | 17200           | 4360           | 1410                | 1860              | 83400                   | 3.80 | < 0.01              | 1.11            | 148         |           |
| ML1     | 2    | 2/13/2013       | 2/15/2013     | 0.5 GPM Step 1     | 9:00          | 34000          | 14500           | 2230           | 1270                | 1860              | 77100                   | 3.80 | < 0.01              | 2.95            | 148         |           |
| ML1     | 3    | 2/13/2013       | 2/15/2013     | 0.5 GPM Step 1     | 8:45          | 92000          | 7600            | 1665           | 595                 | 4640              | 62000                   | 3.90 | < 0.01              | 235             | 148         |           |
| ML1     | 4    | 2/13/2013       | 2/15/2013     | 0.5 GPM Step 1     | 8:30          | 9000           | 4220            | 1112           | 300                 | 368               | 34200                   | 4.20 | < 0.01              | 23.5            | 96          |           |
| ML1     | 5    | 2/13/2013       | 2/15/2013     | 0.5 GPM Step 1     | 8:05          | 3100           | 1135            | 655            | 90.5                | 99.5              | 13200                   | 5.10 | < 0.01              | 7.39            | 70          |           |
| ML1     | 5    | 2/13/2013       | 2/15/2013     | 0.5 GPM Step 1     | 8:20          | 3300           | 1190            | 713            | 88.5                | 94.5              | 0                       |      |                     |                 |             | Duplicate |
| ML1     | 6    | 2/13/2013       | 2/15/2013     | 0.5 GPM Step 1     | 7:50          | 2800           | 530             | 297            | 33.4                | 40.8              | 5340                    | 6.00 | < 0.01              | 4.32            | -66         |           |
| ML1     | 7    | 2/13/2013       | 2/14/2013     | 0.5 GPM Step 1     | 13:55         | 820            | 336             | 188            | 13.8                | 17.2              | 3670                    | 5.70 | < 0.01              | 1.83            | -18         |           |
| ML1     | 8    | 2/13/2013       | 2/14/2013     | 0.5 GPM Step 1     | 13:40         | 390            | 303             | 106            | 14.5                | 21.6              | 2890                    | 5.80 | < 0.01              | 11.7            | -33         |           |
| ML1     | 9    | 2/13/2013       | 2/14/2013     | 0.5 GPM Step 1     | 13:30         | 100            | 377             | 34.3           | 7.4                 | 10.5              | 1340                    | 5.80 | < 0.01              | 33.8            | -37         |           |
| ML1     | 10   | 2/13/2013       | 2/14/2013     | 0.5 GPM Step 1     | 13:15         | 30             | 347             | 5.87           | 2.68                | 10.7              | 1080                    | 6.30 | < 0.01              | 1.67            | -142        |           |
| ML1     | 11   | 2/13/2013       | 2/14/2013     | 0.5 GPM Step 1     | 13:05         | 38             | 247             | 4.74           | 1.4                 | 7.7               | 946                     | 6.40 | < 0.01              | 1.58            | -161        |           |
| ML1     | 12   | 2/13/2013       | 2/14/2013     | 0.5 GPM Step 1     | 12:55         | 19             | 264             | 5.11           | 1.45                | 5.64              | 862                     | 6.00 | < 0.01              | 3.04            | -90         |           |

**Notes:**

mg/L = micrograms per Liter

umohs/cm = microOhms per centimeter

NTU = nephelometric

mV = millivolts

Blank cells indicate data collection not required.

**Table 3-2: Water Quality Monitoring Results for Pumping Step 2  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments  |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|-----------|
| EW      | 1    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 12:35         | 98000          | 25600           | 20400          | 4400                | 6440              | 84460                   | 3.90 | 0.25                | 1.51            | 164         |           |
| ML1     | 3    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 12:10         | 21500          | 9410            | 9580           | 845                 | 1390              | 53462                   | 4.10 | 0.28                | 4.03            | 111         |           |
| ML1     | 4    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 11:55         | 29000          | 3100            | 2500           | 1060                | 1405              | 27982                   | 4.40 | 0.42                | 2               | 41          |           |
| ML1     | 5    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 11:25         | 920            | 915             | 855            | 58.6                | 68                | 10239                   | 5.20 | 0.87                | 0.96            | -64         |           |
| ML1     | 5    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 11:40         | 2600           | 1020            | 1280           | 73                  | 77.5              |                         |      |                     |                 |             | Duplicate |
| ML1     | 6    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 11:15         | 900            | 359.5           | 269            | 22                  | 30                | 4454                    | 6.00 | 4.3                 | 2.31            | -44         |           |
| ML2     | 3    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 14:00         | 26000          | 8000            | 7610           | 935                 | 1210              | 54059                   | 4.10 | 0.45                | 26.3            | 130         |           |
| ML2     | 4    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 13:30         | 8400           | 2880            | 2472           | 114                 | 244               | 24718                   | 4.70 | 0.45                | 1.29            | 30          |           |
| ML2     | 5    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 13:10         | 3800           | 940             | 690            | 26                  | 72                | 10803                   | 6.00 | 0.33                | 2.76            | -83         |           |
| ML2     | 6    | 3/5/2013        | 3/11/2013     | 1.0 GPM Step 2     | 12:55         | 4200           | 369             | 345.5          | 43                  | 57                | 4632                    | 5.80 | 0.5                 | 0.87            | -68         |           |
| EW      | 1    | 3/7/2013        | 3/12/2013     | 1.0 GPM Step 2     | 10:30         | 56000          | 31400           | 13200          | 2220                | 2260              | 88200                   | 3.80 | < 0.01              | 0.74            | 177         |           |
| ML1     | 3    | 3/7/2013        | 3/12/2013     | 1.0 GPM Step 2     | 9:15          | 29000          | 5950            | 7960           | 1050                | 1780              | 55900                   | 4.00 | 0.02                | 98.1            | 149         |           |
| ML1     | 4    | 3/7/2013        | 3/12/2013     | 1.0 GPM Step 2     | 7:30          | 13800          | 3220            | 1778           | 372                 | 502               | 28200                   | 4.30 | 0.21                | 2.71            | 86          |           |
| ML1     | 5    | 3/7/2013        | 3/12/2013     | 1.0 GPM Step 2     | 8:55          | 2900           | 1000            | 1090           | 29                  | 38.5              | 10700                   | 5.00 | 0.23                | 22.2            | 94          |           |
| ML1     | 6    | 3/7/2013        | 3/12/2013     | 1.0 GPM Step 2     | 7:15          | 10             | 441             | 33.1           | 2.9                 | 3.5               | 1350                    | 5.20 | 0.4                 | 6.96            | 26          |           |
| ML2     | 5    | 3/7/2013        | 3/12/2013     | 1.0 GPM Step 2     | 10:10         | 2600           | 1184            | 2040           | 30                  | 56                | 11600                   | 5.60 | 0.27                | 18.3            | -49         |           |
| ML2     | 6    | 3/7/2013        | 3/12/2013     | 1.0 GPM Step 2     | 9:45          |                | 407             | 47.2           | 1.1                 | 2.3               | 1300                    | 5.00 | 0.01                | 785             | 79          |           |
| ML2     | 3    | 3/8/2013        | 3/12/2013     | 1.0 GPM Step 2     | 11:20         | 65000          | 9910            | 6350           | 1235                | 4100              | 64800                   | 4.00 | 0.08                | 83              | 159         |           |
| ML2     | 4    | 3/8/2013        | 3/12/2013     | 1.0 GPM Step 2     | 10:55         | 10400          | 4240            | 3685           | 250                 | 312               | 26500                   | 4.50 | < 0.01              | 16.2            | 79          |           |
| EW      | 1    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 11:50         | 94000          | 25600           | 15900          | 1880                | 3000              | 73530                   | 3.62 | 1.52                | 7.35            | 203.5       |           |
| ML1     | 3    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 12:55         | 62000          | 5930            | 6520           | 855                 | 3620              | 44484                   | 3.86 | 0.83                | 55.6            | 180.6       |           |
| ML1     | 4    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 12:40         | 11200          | 2070            | 4340           | 396                 | 476               | 21830                   | 4.29 | 1.34                | 9.22            | 191.1       |           |
| ML1     | 5    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 12:15         | 2250           | 940             | 1170           | 56.5                | 67.5              | 12850                   | 4.50 | 1.03                | 16.9            | 173.1       |           |
| ML1     | 5    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 12:25         | 2850           | 805             | 890            | 54.5                | 69.5              | 12850                   | 4.50 | 1.03                | 16.9            | 173.1       | Duplicate |
| ML1     | 6    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 12:05         | 760            | 404             | 380.5          | 16.8                | 21.2              | 9048                    | 4.77 | 0.95                | 43.3            | 103.5       |           |
| ML2     | 3    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 11:30         | 116000         | 7150            | 4860           | 2280                | 3840              | 45551                   | 3.93 | 1.36                | 174             | 206.8       |           |
| ML2     | 4    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 11:15         | 8600           | 1590            | 1110           | 137                 | 262               | 19405                   | 4.53 | 0.67                | 13.3            | 127.4       |           |
| ML2     | 5    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 11:00         | 2800           | 680             | 581            | 49                  | 68.5              | 10285                   | 5.14 | 1.04                | 78.3            | 40          |           |
| ML2     | 6    | 3/22/2013       | 3/26/2013     | 1.0 GPM Step 2     | 10:45         | 1100           | 283.6           | 244            | 6                   | 11                | 4024                    | 5.38 | 2.41                | 8.38            | 90.2        |           |
| ML1     | 3    | 3/27/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 60000                   | 3.89 | < 0.01              | 25.4            | 150         |           |
| ML1     | 4    | 3/27/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 28500                   | 4.24 | < 0.01              | 2.05            | 120         |           |
| ML1     | 5    | 3/27/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 11000                   | 4.91 | < 0.01              | 0.83            | 101         |           |
| ML1     | 6    | 3/27/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 4320                    | 5.63 | < 0.01              | 0.57            | -8          |           |
| ML2     | 3    | 3/27/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 62200                   | 3.92 | < 0.01              | 35.8            | 159         |           |
| ML2     | 4    | 3/27/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 26300                   | 4.43 | < 0.01              | 105             | 91          |           |
| ML2     | 5    | 3/27/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 11300                   | 5.55 | < 0.01              | 10.7            | -12         |           |
| ML2     | 6    | 3/27/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 5210                    | 5.51 | < 0.01              | 11.4            | 8           |           |
| EW      | 1    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 99500                   | 3.73 | 0.07                | 1.84            | 173         |           |
| ML1     | 3    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 57200                   | 3.94 | < 0.01              | 39.2            | 151         |           |
| ML1     | 4    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 27000                   | 4.32 | < 0.01              | 3.01            | 124         |           |
| ML1     | 5    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 9540                    | 4.88 | < 0.01              | 15.3            | 53          |           |
| ML1     | 6    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 4070                    | 5.62 | < 0.01              | 0.69            | -48         |           |
| ML2     | 3    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 58700                   | 3.92 | < 0.01              | 279             | 167         |           |
| ML2     | 4    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 25200                   | 4.40 | < 0.01              | 29.9            | 99          |           |
| ML2     | 5    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 10500                   | 5.69 | < 0.01              | 5.7             | -44         |           |
| ML2     | 6    | 4/24/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 4560                    | 5.49 | 0.01                | 8.8             | -6          |           |
| EW      | 1    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 80869                   | 3.65 | 0.23                | 0.62            | 186.2       |           |
| ML1     | 3    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 43729                   | 3.88 | 0.25                | 2.81            | 149.6       |           |
| ML1     | 4    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 19233                   | 4.48 | 0.37                | 1.51            | 120.3       |           |
| ML1     | 5    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 7496                    | 5.15 | 0.3                 | 1.62            | 44.2        |           |

**Table 3-2: Water Quality Monitoring Results for Pumping Step 2  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|----------|
| ML1     | 6    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 3449                    | 5.83 | 0.43                | 1.62            | -24.5       |          |
| ML2     | 3    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 43806                   | 3.92 | 0.41                | 10.9            | 184.7       |          |
| ML2     | 4    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 16791                   | 4.87 | 1.43                | 71.3            | 96.7        |          |
| ML2     | 5    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 7337                    | 5.86 | 0.65                | 4.02            | -3.7        |          |
| ML2     | 6    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 3285                    | 5.81 | 1.14                | 2.81            | -0.3        |          |
| MP2     | 3    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 47883                   | 3.66 | 0.17                | 2.09            | 213.7       |          |
| MP2     | 4    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 29512                   | 3.85 | 0.17                | 4.94            | 189.8       |          |
| MP2     | 6    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 5438                    | 4.54 | 0.32                | 0.81            | 158.9       |          |
| MP2     | 7    | 5/16/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 5371                    | 5.00 | 0.25                | 0.72            | 125.9       |          |
| EW      | 1    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 87500                   | 3.77 | < 0.01              | 1.05            | 169         |          |
| ML1     | 3    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 43500                   | 4.02 | < 0.01              | 1.57            | 121         |          |
| ML1     | 4    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 19000                   | 4.60 | < 0.01              | 0.98            | 83          |          |
| ML1     | 5    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 7670                    | 5.00 | < 0.01              | 21.7            | 40          |          |
| ML1     | 6    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 3730                    | 5.83 | < 0.01              | 2.31            | -84         |          |
| ML2     | 3    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 39900                   | 4.05 | < 0.01              | 6.31            | 141         |          |
| ML2     | 4    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 16200                   | 4.92 | 3.21                | 70.2            | 80          |          |
| ML2     | 5    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 7190                    | 5.60 | < 0.01              | 9.48            | -39         |          |
| ML2     | 6    | 6/6/2013        |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 3720                    | 5.72 | < 0.01              | 6.42            | -48         |          |
| EW      | 1    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | > 99,000                | 4.32 | < 0.01              | 0.41            | 170         |          |
| ML1     | 3    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 80600                   | 4.53 | < 0.01              | 3.14            | 125         |          |
| ML1     | 4    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 34900                   | 5.25 | < 0.01              | 6.19            | 82          |          |
| ML1     | 5    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 13800                   | 5.45 | < 0.01              | 3.92            | 48          |          |
| ML1     | 6    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 8860                    | 6.02 | < 0.01              | 41.6            | -13         |          |
| ML2     | 3    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 82800                   | 4.56 | 0.33                | 22.3            | 162         |          |
| ML2     | 4    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 32000                   | 5.93 | 0.21                | 68.4            | 18          |          |
| ML2     | 5    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 13800                   | 6.06 | < 0.01              | 2.7             | -8          |          |
| ML2     | 6    | 6/26/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 6360                    | 6.09 | < 0.01              | 3.6             | 12          |          |
| EW      | 1    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 93000                   | 3.44 | < 0.01              | 0.8             | 166         |          |
| ML1     | 3    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 36900                   | 3.70 | < 0.01              | 15.5            | 119         |          |
| ML1     | 4    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 15000                   | 4.54 | < 0.01              | 8.59            | 76          |          |
| ML1     | 5    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 6470                    | 4.60 | < 0.01              | 3.55            | 53          |          |
| ML1     | 6    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 3410                    | 5.38 | < 0.01              | 0.62            | -61         |          |
| ML2     | 3    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 38400                   | 3.71 | < 0.01              | 7.56            | 134         |          |
| ML2     | 4    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 14400                   | 5.29 | < 0.01              | 31.5            | -55         |          |
| ML2     | 5    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 6710                    | 5.33 | < 0.01              | 2.64            | -66         |          |
| ML2     | 6    | 7/18/2013       |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 4970                    | 4.56 | < 0.01              | 22.7            | 74          |          |
| EW      | 1    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 94400                   | 3.72 | < 0.01              | 1.91            | 164         |          |
| ML1     | 3    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 37700                   | 3.93 | < 0.01              | 6.75            | 126         |          |
| ML1     | 4    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 15600                   | 4.81 | < 0.01              | 19.1            | 84          |          |
| ML1     | 5    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 7360                    | 4.90 | < 0.01              | 5.01            | 70          |          |
| ML1     | 6    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 3790                    | 5.55 | 0.01                | 2.96            | -36         |          |
| ML2     | 3    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 38100                   | 4.02 | < 0.01              | 99.1            | 113         |          |
| ML2     | 4    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 14400                   | 5.71 | 0.04                | 35              | -31         |          |
| ML2     | 5    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 7100                    | 5.62 | < 0.01              | 0.81            | -8          |          |
| ML2     | 6    | 10/29/2013      |               | 1.0 GPM Step 2     |               |                |                 |                |                     |                   | 3380                    | 5.44 | < 0.01              | 0.69            | 28          |          |
| EW      | 1    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 13:50         | 90000          | 11000           | 4820           | 3160                | 2640              | 89200                   | 3.73 | < 0.01              | 1.6             | 164         |          |
| ML1     | 3    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 12:35         | 12400          | 4540            | 114            | 306                 | 402               | 33700                   | 3.96 | < 0.01              | 4.38            | 131         |          |
| ML1     | 4    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 12:15         | 6900           | 1410            | 885            | 68                  | 114               | 14300                   | 4.84 | < 0.01              | 20              | 106         |          |
| ML1     | 5    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 12:00         | 3200           | 526             | 407            | 9.4                 | 19.6              | 6620                    | 5.07 | < 0.01              | 2.99            | 84          |          |
| ML1     | 6    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 11:40         | 350            | 221.5           | 174            | 12.4                | 29.6              | 3310                    | 5.63 | < 0.01              | 0.55            | -20         |          |

**Table 3-2: Water Quality Monitoring Results for Pumping Step 2  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) | Comments |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|----------|
| ML2     | 3    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 13:40         | 24400          | 3160            | 2648           | 428                 | 324               | 37200                   | 4.00 | < 0.01              | 14.5            | 111         |          |
| ML2     | 4    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 13:25         | 1840           | 1170            | 932            | 31.2                | 55                | 13800                   | 5.79 | < 0.01              | 11.6            | -45         |          |
| ML2     | 5    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 13:10         | 1520           | 499             | 382            | 14.7                | 27.6              | 6710                    | 5.62 | < 0.01              | 3.06            | -23         |          |
| ML2     | 6    | 11/1/2013       | 11/1/2013     | 1.0 GPM Step 2     | 12:50         | 760            | 374             | 184            | 5.9                 | 13.6              | 3550                    | 5.53 | < 0.01              | 8.8             | 3           |          |

**Notes:**

mg/L = micrograms per Liter

umohs/cm = microOhms per centimeter

NTU = nephelometric

mV = miliVolts

Blank cells indicate data collection not required.

**Table 3-3: Water Quality Monitoring Results for Pumping Step 3  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|
| EW      | 1    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 77200                   | 3.63 | < 0.01              | 0.9             | 205         |
| ML1     | 3    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 26600                   | 3.98 | < 0.01              | 1.36            | 177         |
| ML1     | 4    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 11800                   | 5.22 | < 0.01              | 10.3            | 106         |
| ML1     | 5    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 5810                    | 5.53 | 0.08                | 10.6            | 83          |
| ML1     | 6    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 3240                    | 5.94 | 0.37                | 10.4            | 43          |
| ML2     | 3    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 22200                   | 4.14 | < 0.01              | 1.98            | 147         |
| ML2     | 4    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 11400                   | 6.04 | < 0.01              | 8.2             | 13          |
| ML2     | 5    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 6040                    | 5.86 | < 0.01              | 1.11            | 36          |
| ML2     | 6    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 3140                    | 5.83 | < 0.01              | 3.59            | 55          |
| MP2     | 3    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 42800                   | 3.75 | 0.07                | 4.2             | 230         |
| MP2     | 4    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 13000                   | 4.16 | 0.12                | 9.8             | 229         |
| MP2     | 6    | 12/4/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2840                    | 4.61 | 0.48                | 0.2             | 2.8         |
| EW      | 1    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 70500                   | 3.64 | < 0.01              | 0.41            | 202         |
| ML1     | 3    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 21400                   | 4.01 | < 0.01              | 1.84            | 165         |
| ML1     | 4    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 9370                    | 5.28 | 0.05                | 14              | 105         |
| ML1     | 5    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 5250                    | 5.46 | 0.23                | 0.92            | 90          |
| ML1     | 6    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2880                    | 5.96 | 0.35                | 2.68            | 45          |
| ML2     | 3    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 23300                   | 4.05 | < 0.01              | 1.64            | 148         |
| ML2     | 4    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 9620                    | 5.91 | < 0.01              | 5.02            | 26          |
| ML2     | 5    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4990                    | 5.82 | < 0.01              | 0.72            | 48          |
| ML2     | 6    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2890                    | 5.80 | < 0.01              | 1.54            | 67          |
| MP2     | 3    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 37600                   | 3.72 | 0.2                 | 2.37            | 231         |
| MP2     | 4    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 10900                   | 4.19 | 0.3                 | 1.41            | 232         |
| MP2     | 6    | 12/6/2013       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2430                    | 4.76 | 0.6                 | 0.23            | 212         |
| EW      | 1    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 77500                   | 3.67 | < 0.01              | 0.63            | 206         |
| ML1     | 3    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 20500                   | 4.15 | < 0.01              | 27.6            | 186         |
| ML1     | 4    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 9690                    | 5.54 | < 0.01              | 18              | 92          |
| ML1     | 5    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4900                    | 5.48 | 0.44                | 2.58            | 100         |
| ML1     | 6    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2740                    | 6.09 | 0.66                | 0.97            | 40          |
| ML2     | 3    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 21300                   | 4.19 | < 0.01              | 12.7            | 167         |
| ML2     | 4    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 9380                    | 6.04 | < 0.01              | 9.39            | 30          |
| ML2     | 5    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4990                    | 5.90 | 0.1                 | 2.3             | 51          |
| ML2     | 6    | 12/11/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2750                    | 5.97 | 0.54                | 3.11            | 63          |
| EW      | 1    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 72300                   | 3.69 | < 0.01              | 1.08            | 220         |
| ML1     | 3    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 18700                   | 4.09 | 0.02                | 3.07            | 202         |
| ML1     | 4    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 9130                    | 5.56 | 0.02                | 7.45            | 84          |
| ML1     | 5    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4370                    | 5.52 | 0.22                | 2.41            | 90          |
| ML1     | 6    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2690                    | 5.73 | 0.88                | 0.7             | 80          |
| ML2     | 3    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 20000                   | 4.41 | 0.08                | 10.1            | 168         |
| ML2     | 4    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 9410                    | 5.83 | 0.34                | 18.2            | 60          |
| ML2     | 5    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4860                    | 5.66 | < 0.01              | 0.73            | 77          |
| ML2     | 6    | 12/19/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2830                    | 5.68 | 0.08                | 7.31            | 94          |
| EW      | 1    | 12/31/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 69515                   | 3.77 | 0.77                | 15.2            | 191         |
| ML1     | 3    | 12/31/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 16175                   | 4.39 | 1.21                | 3.81            | 114.2       |
| ML1     | 4    | 12/31/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 8109                    | 5.43 | 1.31                | 3.26            | 0.8         |
| ML1     | 6    | 12/31/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2649                    | 5.96 | 0.66                | 0.72            | -11.9       |
| ML2     | 3    | 12/31/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 17566                   | 4.29 | 0.78                | 5.22            | 120.5       |
| ML2     | 4    | 12/31/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 8088                    | 6.05 | 2.93                | 1.62            | -9.9        |
| ML2     | 5    | 12/31/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4411                    | 5.88 | 0.69                | 1.69            | -33         |
| ML2     | 6    | 12/31/2013      |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2607                    | 5.74 | 0.61                | 6.27            | -61.2       |
| EW      | 1    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 68300                   | 3.77 | < 0.01              | 7.52            | 212         |
| ML1     | 3    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 12100                   | 4.40 | < 0.01              | 16.3            | 184         |
| ML1     | 4    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 6980                    | 5.80 | 0.12                | 11.9            | 93          |
| ML1     | 5    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 3380                    | 5.31 | 0.24                | 3.59            | 125         |
| ML1     | 6    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2600                    | 6.10 | 0.58                | 0.61            | 38          |

**Table 3-3: Water Quality Monitoring Results for Pumping Step 3  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Well ID | Port | Collection Date | Analysis Date | Period Description | Analysis Time | Sulfate (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Ferrous Iron (mg/L) | Total Iron (mg/L) | Conductivity (umohs/cm) | pH   | Dissolved O2 (mg/L) | Turbidity (NTU) | ORP/Eh (mV) |
|---------|------|-----------------|---------------|--------------------|---------------|----------------|-----------------|----------------|---------------------|-------------------|-------------------------|------|---------------------|-----------------|-------------|
| ML2     | 3    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 13100                   | 4.60 | < 0.01              | 6.77            | 166         |
| ML2     | 4    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 6150                    | 6.04 | < 0.01              | 85.9            | 60          |
| ML2     | 5    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 3750                    | 5.92 | 0.02                | 8.23            | 64          |
| ML2     | 6    | 2/4/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2480                    | 5.94 | < 0.01              | 0.8             | 91          |
| ML1     | 3    | 4/11/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4930                    | 4.47 | < 0.01              | 3.63            | 170         |
| ML1     | 4    | 4/11/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2780                    | 5.80 | 0.04                | 6.87            | 48          |
| ML1     | 5    | 4/11/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2370                    | 5.24 | 0.09                | 0.48            | 104         |
| ML1     | 6    | 4/11/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2450                    | 5.97 | < 0.01              | 0.92            | 28          |
| ML2     | 3    | 4/11/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 12300                   | 4.59 | < 0.01              | 1.33            | 151         |
| ML2     | 4    | 4/11/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 6030                    | 6.09 | 0.02                | 1.82            | 4           |
| ML2     | 5    | 4/11/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 5730                    | 5.97 | 0.23                | 2.97            | 30          |
| ML2     | 6    | 4/11/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2370                    | 5.68 | 0.53                | 1.63            | 95          |
| EW      | 1    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 63500                   | 3.76 | < 0.01              | 2.12            | 208         |
| ML1     | 1    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 21500                   | 4.07 | < 0.01              | 1.49            | 209         |
| ML1     | 2    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 10500                   | 4.24 | 0.03                | 0.85            | 219         |
| ML1     | 3    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 6430                    | 4.51 | < 0.01              | 0.76            | 168         |
| ML1     | 4    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4530                    | 6.05 | < 0.01              | 2.6             | 31          |
| ML1     | 5    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2380                    | 5.26 | 0.1                 | 0.42            | 107         |
| ML1     | 6    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2300                    | 6.01 | 0.28                | 1.16            | 44          |
| ML2     | 1    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 17800                   | 4.03 | < 0.01              | 1.1             | 204         |
| ML2     | 2    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 13200                   | 4.34 | < 0.01              | 2.12            | 197         |
| ML2     | 3    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 8520                    | 4.88 | < 0.01              | 144             | 132         |
| ML2     | 4    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 5310                    | 6.18 | < 0.01              | 1.92            | -3          |
| ML2     | 5    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2870                    | 5.86 | 1.04                | 0.48            | 47          |
| ML2     | 6    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2260                    | 5.85 | 0.26                | 0.67            | 72          |
| MP2     | 3    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 27000                   | 3.84 | < 0.01              | 2.16            | 248         |
| MP2     | 4    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 8200                    | 4.56 | < 0.01              | 2.18            | 246         |
| MP2     | 6    | 5/5/2014        |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 3290                    | 4.67 | 0.18                | 1.71            | 202         |
| EW      | 1    | 5/14/2014       | 5/14/2014     | 2.0 GPM Step 3     | 11:10         | 15200          | 8400            | 4360           | 374                 | 308               | 56800                   | 3.72 | 3.91                | 1.9             | 25          |
| ML1     | 1    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 15200                   | 4.09 | < 0.01              | 1.76            | 216         |
| ML1     | 2    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 7960                    | 4.30 | 0.25                | 0.84            | 207         |
| ML1     | 3    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4720                    | 4.92 | 0.19                | 1.22            | 127         |
| ML1     | 4    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 3330                    | 5.93 | < 0.01              | 2.71            | 43          |
| ML1     | 5    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2060                    | 5.27 | 0.33                | 0.82            | 100         |
| ML1     | 6    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2090                    | 5.83 | 0.23                | 0.57            | 42          |
| ML2     | 1    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 13600                   | 4.05 | 0.2                 | 0.75            | 212         |
| ML2     | 2    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 10500                   | 4.34 | 0.25                | 1.39            | 198         |
| ML2     | 3    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 6060                    | 5.08 | 0.12                | 1.62            | 113         |
| ML2     | 4    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 4200                    | 6.05 | 0.14                | 1.21            | 1           |
| ML2     | 5    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 2320                    | 5.69 | 0.19                | 1.03            | 45          |
| ML2     | 6    | 5/14/2014       |               | 2.0 GPM Step 3     |               |                |                 |                |                     |                   | 1950                    | 5.51 | 0.52                | 0.95            | 91          |
| MP2     | 1    | 5/14/2014       | 5/14/2014     | 2.0 GPM Step 3     | 11:25         | 24000          | 8250            | 5770           | 306                 | 876               | 77000                   | 3.58 | < 0.01              | 1.45            | 217         |
| MP2     | 3    | 5/14/2014       | 5/14/2014     | 2.0 GPM Step 3     | 11:45         | 18800          | 675             | 1030           | 223                 | 336               | 24100                   | 3.84 | < 0.01              | 1.18            | 233         |
| MP2     | 4    | 5/14/2014       | 5/14/2014     | 2.0 GPM Step 3     | 12:00         | 4600           | 525             | 877            | 36                  | 52                | 7140                    | 4.62 | < 0.01              | 0.74            | 207         |
| MP2     | 6    | 5/14/2014       | 5/14/2014     | 2.0 GPM Step 3     | 12:35         | 145            | 675             | 644            | 2.92                | 9.15              | 2750                    | 4.64 | 0.38                | 1.22            | 221         |

**Notes:**

mg/L = micrograms per Liter  
umohs/cm = microOhms per centimeter  
NTU = nephelometric  
mV = millivolts  
Blank cells indicate data collection not required.

Table 3-4: Tabulated Water Level Data  
DAPL Extraction Pilot Study  
Performance Evaluation Report

Olin Wilmington Superfund Site  
Wilmington, MA

| Well Location                | EW1      |              | ML-1     |              |          |              |          |              | ML-2     |              |          |              |          |              | MP-2     |              |          |              |          |              | GW-42D   |              | GW-43DR  |              |
|------------------------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|
| Port (for multilevels)       |          |              | ML1 P-12 |              | ML1 P-9  |              | ML1 P-4  |              | ML2 P-12 |              | ML2 P-9  |              | ML2 P-4  |              | MP2 P-16 |              | MP2 P-10 |              | MP2 P-2  |              |          |              |          |              |
| Reference Datum              | TOG      |              | TOST     |              | TOST     |              | TOST     |              | TOST     |              | TOST     |              | TOST     |              | TOC      |              | TOC      |              | TOC      |              | TOC      |              | TOC      |              |
| Reference Elevation (FT MSL) | 84.8     |              | 87.15    |              | 87.20    |              | 87.13    |              | 87.22    |              | 87.21    |              | 87.18    |              | 87.56    |              | 87.32    |              | 87.25    |              | 84.16    |              | 88.14    |              |
| Water Table Measurement      | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) |
| 10/25/2012                   |          |              | 5.8      | 81.35        | 5.8      | 81.40        | 5.8      | 81.33        | 5.8      | 81.42        | 5.8      | 81.41        | 5.8      | 81.38        |          |              |          |              |          |              |          |              |          |              |
| 11/1/2012                    |          |              | 4.0      | 83.15        | 4.0      | 83.20        | 4.0      | 83.13        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 11/2/2012                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 2.45     | 81.71        | 4.43     | 83.71        |
| 11/6/2012                    | 3.78     | 81.02        |          |              | 5.25     | 81.95        | 6        | 81.13        | 5.25     | 81.97        | 5.25     | 81.96        | 6.0      | 81.2         |          |              |          |              |          |              |          |              |          |              |
| 11/7/2012                    | 3.78     | 81.02        |          |              | 5.25     | 81.95        | 6        | 81.13        | 5.25     | 81.97        | 5.25     | 81.96        | 6.0      | 81.2         |          |              |          |              |          |              |          |              |          |              |
| 11/8/2012                    | 3.78     | 81.02        |          |              | 5.25     | 81.95        | 6        | 81.13        | 5.25     | 81.97        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 11/12/2012                   |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 3.48     | 80.68        | 6.57     | 81.57        |
| 11/13/2012                   | 3.78     | 81.02        | 6.75     | 80.40        | 6.75     | 80.45        | 6.33     | 80.80        |          |              | 5.25     | 81.96        | 6.0      | 81.2         |          |              |          |              |          |              |          |              |          |              |
| 11/16/2012                   | 3.75     | 81.05        | 5.25     | 81.90        | 5.25     | 81.95        | 5.25     | 81.88        |          |              | 5.25     | 81.96        | 6.0      | 81.2         |          |              |          |              |          |              |          |              |          |              |
| 11/19/2012                   | NM       |              |          |              |          |              |          |              |          |              | 5        | 82.21        | 5.5      | 81.7         | 10.5     | 77.06        | 5.5      | 81.82        | 7.5      | 79.75        | 3.79     | 80.37        | 6.61     | 81.53        |
| 11/26/2012                   |          |              | 5.55     | 81.60        | 5.5      | 81.70        | 4.5      | 82.63        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 11/27/2012                   | 3.79     | 81.01        |          |              |          |              |          |              | 5.4      | 81.82        | 6.15     | 81.06        | 6.15     | 81.0         |          |              |          |              |          |              |          |              |          |              |
| 12/4/2012                    | PD       |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 12/12/2011                   |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 1.89     | 82.27        |          |              |
| 12/14/2011                   |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 1.89     | 82.27        |          |              |
| 9/20/2012                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 7.01     | 81.13        |
| 12/19/2012                   |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 0.25     | 83.91        | 6.37     | 81.77        |
| 12/20/2011                   |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 6.41     | 81.73        |
| 1/3/2013                     |          |              |          |              |          |              |          |              | 5.25     | 81.97        | 5.4      | 81.81        | 5.85     | 81.3         |          |              |          |              |          |              |          |              |          |              |
| 1/7/2013                     | 3.66     | 81.14        |          |              |          |              |          |              | 5.4      | 81.82        | 5.4      | 81.81        | 5.85     | 81.3         |          |              |          |              |          |              |          |              |          |              |
| 1/8/2013                     |          |              | 5.90     | 81.25        | 5.94     | 81.26        | 5.96     | 81.17        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 1/9/2013                     |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 5.85     | 81.71        | 5.40     | 81.92        | 7.05     | 80.2         |          |              |          |              |
| 1/10/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 1.88     | 82.28        | 6.42     | 81.72        |
| 1/28/2013                    | 3.77     | 81.03        |          |              |          |              |          |              | 5.98     | 81.24        | 5.78     | 81.43        | 5.78     | 81.4         |          |              |          |              |          |              |          |              |          |              |
| 1/29/2013                    |          |              | 5.75     | 81.40        | 5.75     | 81.45        | 5.98     | 81.15        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 1/30/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 5.95     | 81.61        | NM       |              | 7.35     | 79.9         |          |              |          |              |
| 12/2/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 2/6/2013                     |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 3.85     | 80.31        | 6.54     | 81.6         |
| 2/12/2013                    | 3.71     | 81.09        |          |              |          |              |          |              | 5.1      | 82.12        | 5.1      | 82.11        | 5.94     | 81.2         |          |              |          |              |          |              |          |              |          |              |
| 2/13/2013                    |          |              | 4.65     | 82.50        | 3.6      | 83.60        | 5.7      | 81.43        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 2/20/2013                    | 3.72     | 81.08        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 3/5/2013                     | 3.31     | 81.49        | 5.58     | 81.57        | 5.66     | 81.54        | 6.11     | 81.02        | 5.64     | 81.58        | 5.65     | 81.56        | 6.02     | 81.2         |          |              |          |              |          |              | 0.77     | 83.39        | 6.11     | 82.03        |
| 3/7/2013                     |          |              | 5.61     | 81.54        | 5.25     | 81.95        | 4.55     | 82.58        | 5.71     | 81.51        | 5.7      | 81.51        | 4.75     | 82.4         |          |              |          |              |          |              |          |              |          |              |
| 3/18/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 0.75     | 83.41        | 6.19     | 81.95        |
| 3/27/2013                    | 3.74     | 81.06        | 5.66     | 81.49        | 5.68     | 81.52        | 6.09     | 81.04        | 5.73     | 81.49        | 5.73     | 81.48        | 6.07     | 81.1         |          |              |          |              |          |              |          |              |          |              |
| 4/17/2013                    | 4.58     | 80.22        | 5.87     | 81.28        | 5.96     | 81.24        | 6.32     | 80.81        | 5.96     | 81.26        | 5.99     | 81.22        | 6.32     | 80.9         |          |              |          | 2.37         | 84.88    | 1.94         | 82.22    |              |          |              |
| 4/24/2013                    | 4.51     | 80.29        | 5.82     | 81.33        | 5.87     | 81.33        | 6.28     | 80.85        | 5.67     | 81.55        | 5.67     | 81.54        | 6.32     | 80.86        |          |              |          |              |          |              |          |              |          |              |
| 5/13/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 4.01     | 80.15        | 6.52     | 81.62        |
| 5/16/2013                    | 4.61     | 80.19        | 6.03     | 81.12        | 6.1      | 81.10        | 6.37     | 80.76        | 6.07     | 81.15        | 6.08     | 81.13        | 6.38     | 80.80        | 4.84     | 82.72        | 2.78     | 84.54        | 2.41     | 84.84        |          |              |          |              |
| 5/21/2013                    | 4.67     | 80.13        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 5/27/2013                    | 4.63     | 80.17        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 6/13/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 6/18/2013                    | 4.35     | 80.45        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |
| 6/25/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 2.5      | 81.66        | 6.21     | 81.93        |
| 6/26/2013                    | 4.24     | 80.56        | 5.75     | 81.40        | 5.82     | 81.38        | 6.02     | 81.11        | MNR      |              | 5.82     | 81.39        | 6.01     | 81.17        |          |              |          |              |          |              |          |              |          |              |

Table 3-4: Tabulated Water Level Data  
DAPL Extraction Pilot Study  
Performance Evaluation Report

Olin Wilmington Superfund Site  
Wilmington, MA

| Well Location                | EW1      |              | ML-1     |              |          |              |          |              | ML-2     |              |          |              |          |              | MP-2     |              |          |              |          |              | GW-42D             |              | GW-43DR         |              |
|------------------------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|--------------|--------------------|--------------|-----------------|--------------|
| Port (for multilevels)       |          |              | ML1 P-12 |              | ML1 P-9  |              | ML1 P-4  |              | ML2 P-12 |              | ML2 P-9  |              | ML2 P-4  |              | MP2 P-16 |              | MP2 P-10 |              | MP2 P-2  |              |                    |              |                 |              |
| Reference Datum              | TOG      |              | TOST     |              | TOST     |              | TOST     |              | TOST     |              | TOST     |              | TOST     |              | TOC      |              | TOC      |              | TOC      |              | TOC                |              | TOC             |              |
| Reference Elevation (FT MSL) | 84.8     |              | 87.15    |              | 87.20    |              | 87.13    |              | 87.22    |              | 87.21    |              | 87.18    |              | 87.56    |              | 87.32    |              | 87.25    |              | 84.16              |              | 88.14           |              |
| Water Table Measurement      | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT) | ELEV (FTMSL) | DTW (FT)           | ELEV (FTMSL) | DTW (FT)        | ELEV (FTMSL) |
| 7/5/2013                     | 4.32     | 80.48        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
| 7/12/2013                    | 4.5      | 80.30        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
| 7/16/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 3.28               | 80.88        | 6.61            | 81.53        |
| 12/2/2013                    | 4.02     | 80.78        | 6.12     | 81.03        | 6.19     | 81.01        | 6.30     | 80.83        | 6.22     | 81           | 6.22     | 80.99        | 6.08     | 81.10        |          |              |          |              |          |              | 2.88               | 81.28        | 6.69            | 81.45        |
| 12/3/2013                    | 4.88     | 79.92        | 6.16     | 80.99        | 6.22     | 80.98        | 6.32     | 80.81        | 6.24     | 80.98        | 6.24     | 80.97        | 6.36     | 80.82        |          |              |          |              |          |              | 3.41               | 80.75        | 6.72            | 81.42        |
| 12/4/2013                    | 4.92     | 79.88        | 6.20     | 80.95        | 6.22     | 80.98        | 6.34     | 80.79        | 6.29     | 80.93        | 6.28     | 80.93        | 6.31     | 80.87        |          |              |          |              |          |              | 2.72               | 81.44        | 6.74            | 81.4         |
| 12/5/2013                    | 4.92     | 79.88        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 2.1                | 82.06        |                 |              |
| 12/6/2013                    | 4.95     | 79.85        | 6.24     | 80.91        | 6.24     | 80.96        | 6.24     | 80.89        | 6.31     | 80.91        | 6.29     | 80.92        | 6.26     | 80.92        |          |              |          |              |          |              | under water        |              | 6.77            | 81.37        |
| 12/9/2013                    |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
| 12/11/2013                   | 4.8      | 80.00        | 6.19     | 80.96        | 6.18     | 81.02        | 6.18     | 80.95        | 6.19     | 81.03        | 6.21     | 81.00        | 6.29     | 80.89        |          |              |          |              |          |              | 0.25               | 83.91        | 6.65            | 81.49        |
|                              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
| 12/16/2013                   |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 1.63               | 82.53        | under snow pile |              |
| 12/19/2013                   | 4.85     | 79.95        | 6.18     | 80.97        | 6.23     | 80.97        | 6.23     | 80.90        | 6.25     | 80.97        | 6.24     | 80.97        | 6.36     | 80.82        |          |              |          |              |          |              |                    |              |                 |              |
| 12/23/2013                   |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
|                              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
| 1/13/2014                    | 4.25     | 80.55        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | under snow and ice |              | 6.29            | 81.85        |
|                              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | under snow and ice |              | 6.53            | 81.61        |
| 2/3/2014                     | 4.31     | 80.49        |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
| 2/4/2014                     | 4.32     | 80.48        | *        |              |          |              | 6.05     | 81.08        | *        |              | *        |              | *        |              |          |              |          |              |          |              | *                  |              |                 |              |
| 3/4/2014                     |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
| 4/9/2014                     |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              | 5.68               | 78.48        | 6.07            | 82.07        |
| 4/11/2014                    | 3.24     | 81.56        | 5.64     | 81.51        | 5.53     | 81.67        | 5.53     | 81.60        | *        |              | 5.66     | 81.55        | 5.81     | 81.37        |          |              |          |              |          |              |                    |              |                 |              |
|                              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |
|                              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |          |              |                    |              |                 |              |

Notes:

Meaurement Datums

Reference Datum is the Measurement Point

TOG =Top of Fiberglass Grate in Extraction Pump Vault

TOST = Top of Sample Tube for Multilevel Wells

TOC = Top of casing for conventional wells

Reference Elevation = Elevation of Reference Datum in Feet Mean Sea level

Water Level Measurements

DTW = Depth to Water Measured in Feet from the Reference Datum

ELEV (FTMSL) = Calculated Elevation of Water Table in Feet above Mean Sea Level (Reference Elevation - DTW)

Other

MNR= Meter not responding

NM= not measured

PD= Pump Down (12/04/2012)

\*=no water level was obtained meter tested ok but would not detect water level

TP=Water level obtained from tip of probe

Prepared by: BJR 4/30/2013

Checked by: PHT 7/16/2014

**Table 3-5: Calculated Vertical Hydraulic Gradient  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

Olin Wilmington Superfund Site  
Wilmington, MA

| Well Location<br>Port | EW1  |       | ML-1     |       |         |       |         |       | ML-2     |       |         |       |         |       | ML1/ML2 Horiz Gradient |          |           |
|-----------------------|------|-------|----------|-------|---------|-------|---------|-------|----------|-------|---------|-------|---------|-------|------------------------|----------|-----------|
|                       |      |       | ML1 P-12 |       | ML1 P-9 |       | ML1 P-4 |       | ML2 P-12 |       | ML2 P-9 |       | ML2 P-4 |       | P-12                   | P-9      | P-4       |
| Meaurement in Feet    | DTW  | DTW   | DTW      | DTW   | DTW     | DTW   | DTW     | DTW   | DTW      | DTW   | DTW     | DTW   | DTW     | DTW   |                        |          |           |
| Reference Datum       | TOG  | TOST  | TOST     | TOST  | TOST    | TOST  | TOST    | TOST  | TOST     | TOST  | TOST    | TOST  | TOST    | TOST  | TOST                   | TOST     |           |
| Reference Elevation   | 84.8 | 87.15 | 87.2     | 87.13 | 87.22   | 87.21 | 87.18   | 87.22 | 87.21    | 87.18 | 87.22   | 87.21 | 87.18   | 87.22 | 87.21                  | 87.18    |           |
| 4/17/2013             | 4.58 | 80.22 | 5.87     | 81.28 | 5.96    | 81.24 | 6.32    | 80.81 | 5.96     | 81.26 | 5.99    | 81.22 | 6.32    | 80.9  | 0.00133                | 0.001333 | -0.003333 |
| 4/24/2013             | 4.51 | 80.29 | 5.82     | 81.33 | 5.87    | 81.33 | 6.28    | 80.85 | 5.67     | 81.55 | 5.67    | 81.54 | 6.32    | 80.9  | -0.0147                | -0.014   | -0.000667 |
| 5/16/2013             | 4.61 | 80.19 | 6.03     | 81.12 | 6.10    | 81.10 | 6.37    | 80.76 | 6.07     | 81.15 | 6.08    | 81.13 | 6.38    | 80.8  | -0.002                 | -0.002   | -0.002667 |
| 12/2/2013             | 4.02 | 80.78 | 6.12     | 81.03 | 6.19    | 81.01 | 6.30    | 80.83 | 6.22     | 81    | 6.22    | 80.99 | 6.08    | 81.1  | 0.002                  | 0.001333 | -0.018    |
| 12/3/2013             | 4.88 | 79.92 | 6.16     | 80.99 | 6.22    | 80.98 | 6.32    | 80.81 | 6.24     | 80.98 | 6.24    | 80.97 | 6.36    | 80.8  | 0.00067                | 0.000667 | -0.000667 |
| 12/4/2013             | 4.92 | 79.88 | 6.20     | 80.95 | 6.22    | 80.98 | 6.34    | 80.79 | 6.29     | 80.93 | 6.28    | 80.93 | 6.31    | 80.9  | 0.00133                | 0.003333 | -0.005333 |
| 12/6/2013             | 4.95 | 79.85 | 6.24     | 80.91 | 6.24    | 80.96 | 6.24    | 80.89 | 6.31     | 80.91 | 6.29    | 80.92 | 6.26    | 80.9  | 9.5E-16                | 0.002667 | -0.002    |
| 12/11/2013            | 4.8  | 80.00 | 6.19     | 80.96 | 6.18    | 81.02 | 6.18    | 80.95 | 6.19     | 81.03 | 6.21    | 81.00 | 6.29    | 80.9  | -0.0047                | 0.001333 | 0.004     |
| 12/19/2013            | 4.85 | 79.95 | 6.18     | 80.97 | 6.23    | 80.97 | 6.23    | 80.90 | 6.25     | 80.97 | 6.24    | 80.97 | 6.36    | 80.8  | 0                      | 0        | 0.005333  |
| 4/11/2014             | 4.24 | 80.56 | 5.64     | 81.51 | 5.53    | 81.67 | 5.53    | 81.60 |          |       | 5.66    | 81.55 | 5.81    | 81.4  |                        | 0.008    | 0.015333  |

| Elevation References | EW-1      | ML1 P-12    | ML1 P-9     | ML1 P-4     | ML2 P-12    | ML2 P-9     | ML2 P-4     |
|----------------------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| Midpoint of Screen   | 45 ft MSL |             |             |             |             |             |             |
| Midpoint of Port     |           | 65.2 ft MSL | 60.8 ft MSL | 53.4 ft MSL | 65.2 ft MSL | 60.8 ft MSL | 53.4 ft MSL |

| Vertical Gradient Calculation- EW-1 to: | ML1 P-12 |       | ML1 P-9 |       | ML1 P-4 |       | ML2 P-12 |       | ML2 P-9 |       | ML2 P-4 |       |
|-----------------------------------------|----------|-------|---------|-------|---------|-------|----------|-------|---------|-------|---------|-------|
| Distance EW-1 to MP Ports               | dL       | 20.2  | dL      | 15.8  | dL      | 8.4   | dL       | 20.2  | dL      | 15.8  | dL      | 8.4   |
| Head Difference and Gradient            | dH       | dH/dL | dH      | dH/dL | dH      | dH/dL | dH       | dH/dL | dH      | dH/dL | dH      | dH/dL |
| 4/17/2013                               | 1.06     | 0.05  | 1.02    | 0.06  | 0.59    | 0.07  | 1.04     | 0.05  | 1.00    | 0.06  | 0.64    | 0.08  |
| 4/24/2013                               | 1.04     | 0.05  | 1.04    | 0.07  | 0.56    | 0.07  | 1.26     | 0.06  | 1.25    | 0.08  | 0.57    | 0.07  |
| 5/16/2013                               | 0.93     | 0.05  | 0.91    | 0.06  | 0.57    | 0.07  | 0.96     | 0.05  | 0.94    | 0.06  | 0.61    | 0.07  |
| 12/2/2013                               | 0.25     | 0.01  | 0.23    | 0.01  | 0.05    | 0.01  | 0.22     | 0.01  | 0.21    | 0.01  | 0.32    | 0.04  |
| 12/3/2013                               | 1.07     | 0.05  | 1.06    | 0.07  | 0.89    | 0.11  | 1.06     | 0.05  | 1.05    | 0.07  | 0.90    | 0.11  |
| 12/4/2013                               | 1.07     | 0.05  | 1.10    | 0.07  | 0.91    | 0.11  | 1.05     | 0.05  | 1.05    | 0.07  | 0.99    | 0.12  |
| 12/6/2013                               | 1.06     | 0.05  | 1.11    | 0.07  | 1.04    | 0.12  | 1.06     | 0.05  | 1.07    | 0.07  | 1.07    | 0.13  |
| 12/11/2013                              | 0.96     | 0.05  | 1.02    | 0.06  | 0.95    | 0.11  | 1.03     | 0.05  | 1.00    | 0.06  | 0.89    | 0.11  |
| 12/19/2013                              | 1.02     | 0.05  | 1.02    | 0.06  | 0.95    | 0.11  | 1.02     | 0.05  | 1.02    | 0.06  | 0.87    | 0.10  |
| 4/11/2014                               | 0.95     | 0.05  | 1.11    | 0.07  | 0.95    | 0.11  |          |       | 0.99    | 0.06  | 0.81    | 0.10  |

**Notes:**

Gradient = dH/dL      Positive value indicates downward gradient  
Difference in Head =dH      dH= Port water elevation minus EW-1 water elevation  
Measurement Distance =dL      dL = distance between EW-1 screen midpoint and port midpoint

Prepared by: BJR 4/30/2013  
Checked by: PHT 7/16/2014

P-9 = Port 9  
DTW = DTW in feet from Measurement point

Measurement Points

TOG=Top of Fiberglass Grate in Vault  
TOST = Top of Sample Tube

**Table 4-1: Revised DAPL Pool Volume Estimate  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| Calculation of Revised Bedrock Contours |                         |          |        |         |         |                    |        |                     |                   | Porosity   | 0.3 |
|-----------------------------------------|-------------------------|----------|--------|---------|---------|--------------------|--------|---------------------|-------------------|------------|-----|
| Bedrock<br>Contour                      | Area (ft <sup>2</sup> ) | Interval | H (ft) | Sum     | Average | Slice<br>Volume CF | gal/cf | Slice<br>Volume Gal | Volume of<br>DAPL |            |     |
| 55                                      | 172,091                 | 55-50    | 5      | 283,564 | 141,782 | 708,910            | 7.48   | 5,302,647           | 1,590,794         |            |     |
| 50                                      | 111,473                 | 50-45    | 5      | 176,254 | 88,127  | 440,635            | 7.48   | 3,295,950           | 988,785           |            |     |
| 45                                      | 64,781                  | 45-40    | 5      | 91,678  | 45,839  | 229,195            | 7.48   | 1,714,379           | 514,314           |            |     |
| 40                                      | 26,897                  |          |        |         |         |                    |        |                     |                   |            |     |
| <b>Total</b>                            |                         |          |        |         |         | 1,378,740          | 7.48   | 10,312,975          | <b>3,093,893</b>  | <b>Gal</b> |     |

This spreadsheet provides an end area calculation of DAPL Pool Volume based on surface area of contours in bedrock contours figures

**Notes:**

ft = foot or feet

ft<sup>2</sup> = feet squared

cf = cubic feet

Gal= gallon

gal/cf = gallons per cubic foot

Slice Volume = average area of bedrock contour multiplied by thickness (average end area)

Prepared by PHT 2/8/2012

Checked by BJR 2/8/2012

**Table 4-2: Estimated Uniform DAPL Pool Elevation Change  
DAPL Extraction Pilot Study  
Performance Evaluation Report**

**Olin Wilmington Superfund Site  
Wilmington, MA**

| <b>Calculation of Revised Bedrock Contours</b>     |                              |                 |                |                   |                |                                |               |                             |                     |  |                           |
|----------------------------------------------------|------------------------------|-----------------|----------------|-------------------|----------------|--------------------------------|---------------|-----------------------------|---------------------|--|---------------------------|
| <b>Bedrock<br/>Contour</b>                         | <b>Area (ft<sup>2</sup>)</b> | <b>Interval</b> | <b>H (ft)</b>  | <b>Slice Area</b> |                | <b>Slice<br/>Volume<br/>CF</b> | <b>gal/cf</b> | <b>Slice<br/>Volume Gal</b> | <b>Porosity 0.3</b> |  | <b>Volume of<br/>DAPL</b> |
|                                                    |                              |                 |                | <b>Sum</b>        | <b>Average</b> |                                |               |                             |                     |  |                           |
| 55                                                 | 172,091                      | 55              |                |                   |                |                                |               |                             |                     |  | -                         |
| 54                                                 | 159,967                      | 55-54           | 1              | 332,058           | 166,029        | 166,029.2                      | 7.48          | 1,241,898                   |                     |  | 372,570 Gal               |
| 53                                                 | 147,844                      | 54-53           | 1              | 307,811           | 153,906        | 153,905.6                      | 7.48          | 1,151,214                   |                     |  | 345,364 Gal               |
| 52                                                 | 135,720                      | 53-52           |                |                   |                |                                |               |                             |                     |  |                           |
| 51                                                 | 123,597                      | 52-51           |                |                   |                |                                |               |                             |                     |  |                           |
| 50                                                 | 111,473                      | 50              |                |                   |                |                                |               |                             |                     |  |                           |
| per foot                                           | 12,124                       |                 |                |                   |                |                                |               |                             |                     |  |                           |
| <b>Total Drawdown (Based on T&amp;D gallons)</b>   |                              |                 | <b>1.66 ft</b> |                   |                |                                |               |                             |                     |  | <b>596,727 Gal</b>        |
| <b>Total Drawdown (Based on undiluted gallons)</b> |                              |                 | <b>1.33 ft</b> |                   |                |                                |               |                             |                     |  | <b>477,382 Gal</b>        |

This spreadsheet provides an end area calculation of DAPL Pool Volume Based on surface area of contours in bedrock contour figure  
DAPL Extraction Pumping Test

|                             |                           |
|-----------------------------|---------------------------|
| Pilot Max Target            | 756,000 gallons           |
| Pumped to date (T&D 5/20/20 | 596,727 gallons T&D       |
| Potential Dilution          | 20% dilution              |
| Minimum DAPL Pumped         | 477,382 gallons undiluted |

Prepared by PHT 5/24/2014  
Checked by BJR 11/04/2014

**Notes:**

ft = foot or feet

ft<sup>2</sup> = feet squared

cf = cubic feet

Gal= gallons

gal/cf = gallons per cubic foot

Slice Volume = average area of bedrock contour multiplied by thickness (average end area)

## **APPENDIX A**

### **DAPL EXTRACTION SYSTEM DRAWINGS**

DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

ISSUED FOR CONSTRUCTION  
MARCH 2011

DRAWING INDEX

| INCLUDED<br>IN THIS<br>SUBMITTAL | SHEET<br>NUMBER | DRAWING TITLE                                                  | DISCIPLINE<br>NUMBER |
|----------------------------------|-----------------|----------------------------------------------------------------|----------------------|
| •                                | 1               | COVER SHEET                                                    | G-001                |
| •                                | 2               | PROPOSED SITE PLAN                                             | C-101                |
| •                                | 3               | PROPOSED PIPING PROFILE                                        | C-201                |
| •                                | 4               | PROPOSED PROFILE PIPE SLEEVES UNDER RAILROAD SPURS AND DETAILS | C-202                |
| •                                | 5               | CIVIL DETAILS                                                  | C-301                |
| •                                | 6               | CIVIL DETAILS                                                  | C-302                |
| •                                | 7               | CIVIL DETAILS                                                  | C-303                |
| •                                | 8               | CONSTRUCTION SPECIFICATIONS                                    | C-304                |
| •                                | 9               | PIPING AND INSTRUMENTATION DIAGRAM                             | D-601                |
| •                                | 10              | ELECTRICAL GENERAL NOTES AND LEGEND                            | E-001                |
| •                                | 11              | PROPOSED ELECTRICAL SITE PLAN                                  | E-101                |
| •                                | 12              | ELECTRICAL PLANS AND DETAIL                                    | E-102                |
| •                                | 13              | ELECTRICAL DETAILS                                             | E-103                |
| •                                | 14              | ONE-LINE, HEAT TRACE RISERS, WIRING DIAGRAMS, SCHEDULES        | E-601                |
| •                                | 15              | ELECTRICAL SPECIFICATIONS AND SEQUENCE OF OPERATIONS           | E-602                |

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|-----|----------|-------------------------|-----|-----|
| 2   | 03/09/11 | ISSUED FOR CONSTRUCTION | REO | MAP |
| 1   | 02/12/10 | FINAL                   | REO | MAP |
| 0   | 12/07/09 | ISSUED FOR BID          | REO | MAP |
| A   | 11/12/09 | FOR CLIENT REVIEW       | REO | MAP |

|                   |                             |
|-------------------|-----------------------------|
| DRAWN:<br>DEL     | PROJECT NO:<br>6107-10-0016 |
| ENGINEER:<br>MAP  | SCALE:<br>-                 |
| CHECKED:<br>REO   | APPROVED:<br>PHT            |
| DATE:<br>12/08/10 | DATE:<br>12/08/10           |



**MACTEC**

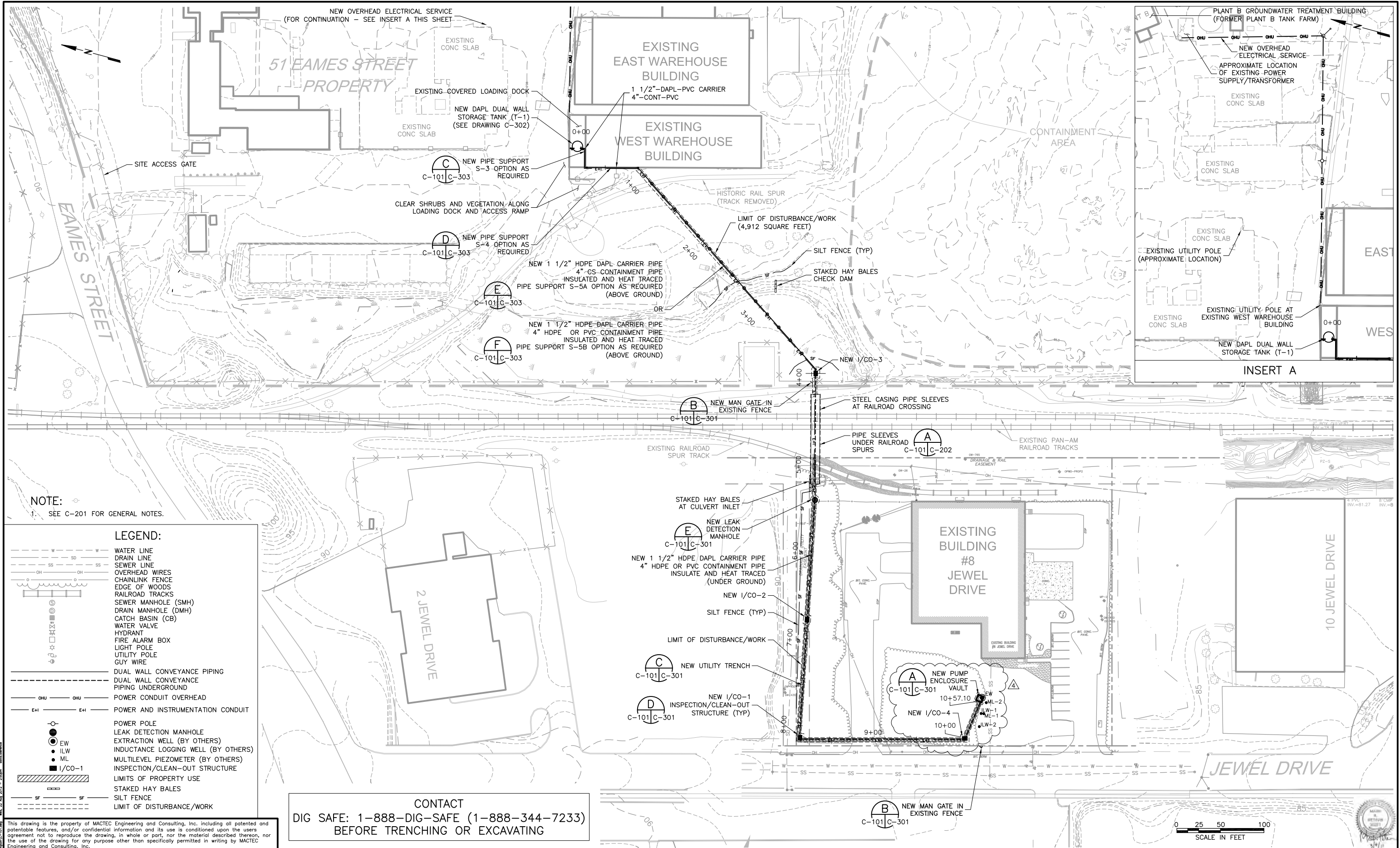
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(207) 775-5401

DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

GENERAL  
COVER SHEET



|                      |
|----------------------|
| DRAWING NO:<br>G-001 |
| 1<br>15              |



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|-----|----------|---------------------------------------|-----|-----|
| 4   | 11/03/11 | REVISED LOCATION FOR EW AND VAULT     | REO | MAP |
| 3   | 04/05/11 | ADDRESSED TOWN OF WILMINGTON COMMENTS | REO | MAP |
| 2   | 03/09/11 | ISSUED FOR CONSTRUCTION               | REO | MAP |
| 1   | 02/12/10 | FINAL                                 | REO | MAP |
| 0   | 12/07/09 | ISSUED FOR BID                        | REO | MAP |
| A   | 11/12/09 | FOR CLIENT REVIEW                     | REO | MAP |

CONTACT  
DIG SAFE: 1-888-DIG-SAFE (1-888-344-7233)  
BEFORE TRENCHING OR EXCAVATING

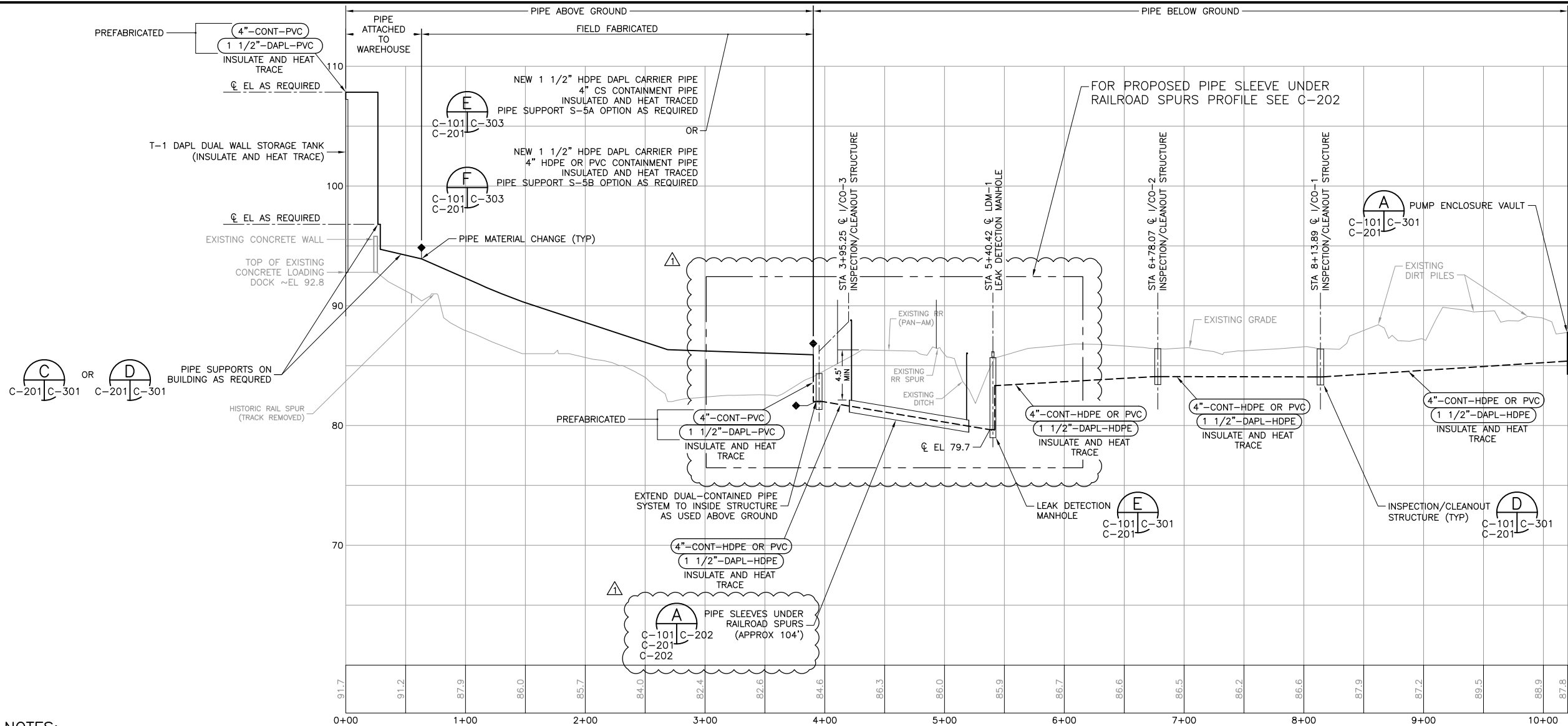
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DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

CIVIL  
PROPOSED SITE PLAN

DRAWING NO:  
C-101  
2  
15

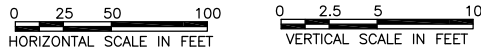


- NOTES:
- FOR PIPING ELEVATIONS AT STRUCTURES, SEE DRAWING C-301.

GENERAL NOTES:

- COORDINATE USE OF THE SITE WITH OLIN, THE ENGINEER, AND THE SITE'S CURRENT OWNER.
- KNOWN UNDERGROUND UTILITIES AND STRUCTURES ARE SHOWN ON THE DRAWINGS. THE LOCATION OF THESE EXISTING UNDERGROUND UTILITIES AND STRUCTURES SHOULD BE CONSIDERED APPROXIMATE THEREFORE, PRIOR TO THE COMMENCEMENT OF SITE ACTIVITIES, THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES OR STRUCTURES IN THE AREAS OF WORK: DIG SAFE: 1-888-DIG-SAFE (1-888-344-7233). IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION.
- SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE UTILITY OWNER AND ENGINEER IMMEDIATELY FOR DIRECTIONS. COOPERATE WITH THE ENGINEER AND UTILITY OWNER IN KEEPING RESPECTIVE FACILITIES IN OPERATION. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE UTILITY OWNER.
- DO NOT INTERRUPT EXISTING UTILITIES SERVING OCCUPIED FACILITIES, EXCEPT WHEN PERMITTED IN WRITING BY THE OWNER AND ENGINEER AND THEN ONLY AFTER ACCEPTABLE TEMPORARY UTILITY SERVICES HAVE BEEN PROVIDED.
- EXISTING SITE ACCESS DRIVES SHALL BE MAINTAINED AT ALL TIMES EXCEPT WHEN PERMITTED IN WRITING BY THE CURRENT OWNER AND OLIN.
- BITUMINOUS PAVEMENT SHALL BE DEMOLISHED AND REMOVED FROM EXCAVATION/TRENCHING AREAS AND PROPERLY DISPOSED OFFSITE. PAVEMENT SHALL BE SAW CUT AT LIMITS OF REMOVAL.
- EXISTING BITUMINOUS PAVEMENT, LAWN, FENCING AND ANY OTHER FEATURES DISTURBED BY THE WORK SHALL BE RESTORED TO EXISTING CONDITIONS UPON COMPLETION OF THE WORK.
- SOURCE OF BASE MAP: EXISTING CONDITIONS & SPOT ELEVATIONS SHOWN ON THE DRAWINGS ARE THE RESULT OF AN ON THE GROUND SURVEY PERFORMED BY DANA F. PERKINS, INC. ON JUNE 27 & 29, 2005.

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| NO. | DATE     | REVISIONS                             | BY  | CHK |
|-----|----------|---------------------------------------|-----|-----|
| 3   | 04/05/11 | ADDRESSED TOWN OF WILMINGTON COMMENTS | REO | MAP |
| 2   | 03/09/11 | ISSUED FOR CONSTRUCTION               | REO | MAP |
| 1   | 02/12/10 | FINAL                                 | REO | MAP |
| 0   | 12/07/09 | ISSUED FOR BID                        | REO | MAP |
| A   | 11/12/09 | FOR CLIENT REVIEW                     | REO | MAP |

|           |          |             |              |
|-----------|----------|-------------|--------------|
| DRAWN:    | MRS      | PROJECT NO: | 6107-10-0016 |
| ENGINEER: | MAP      | SCALE:      | AS NOTED     |
| CHECKED:  | REO      | APPROVED:   | PHT          |
| DATE:     | 03/09/11 | DATE:       | 03/09/11     |

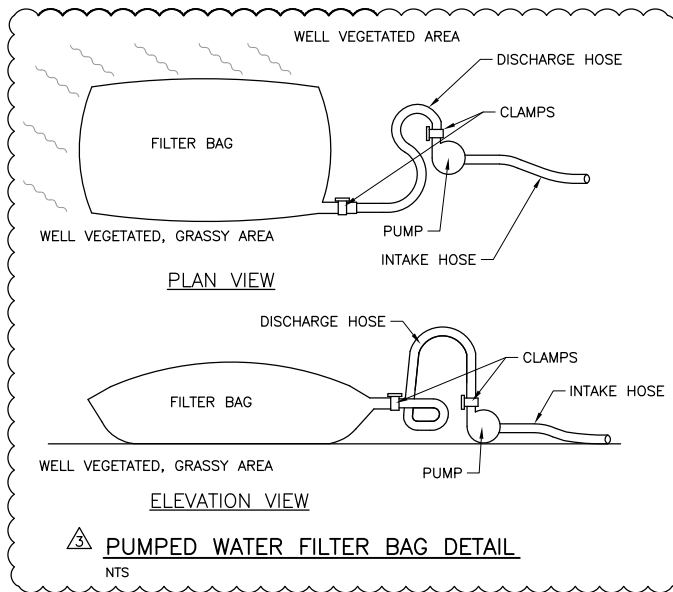


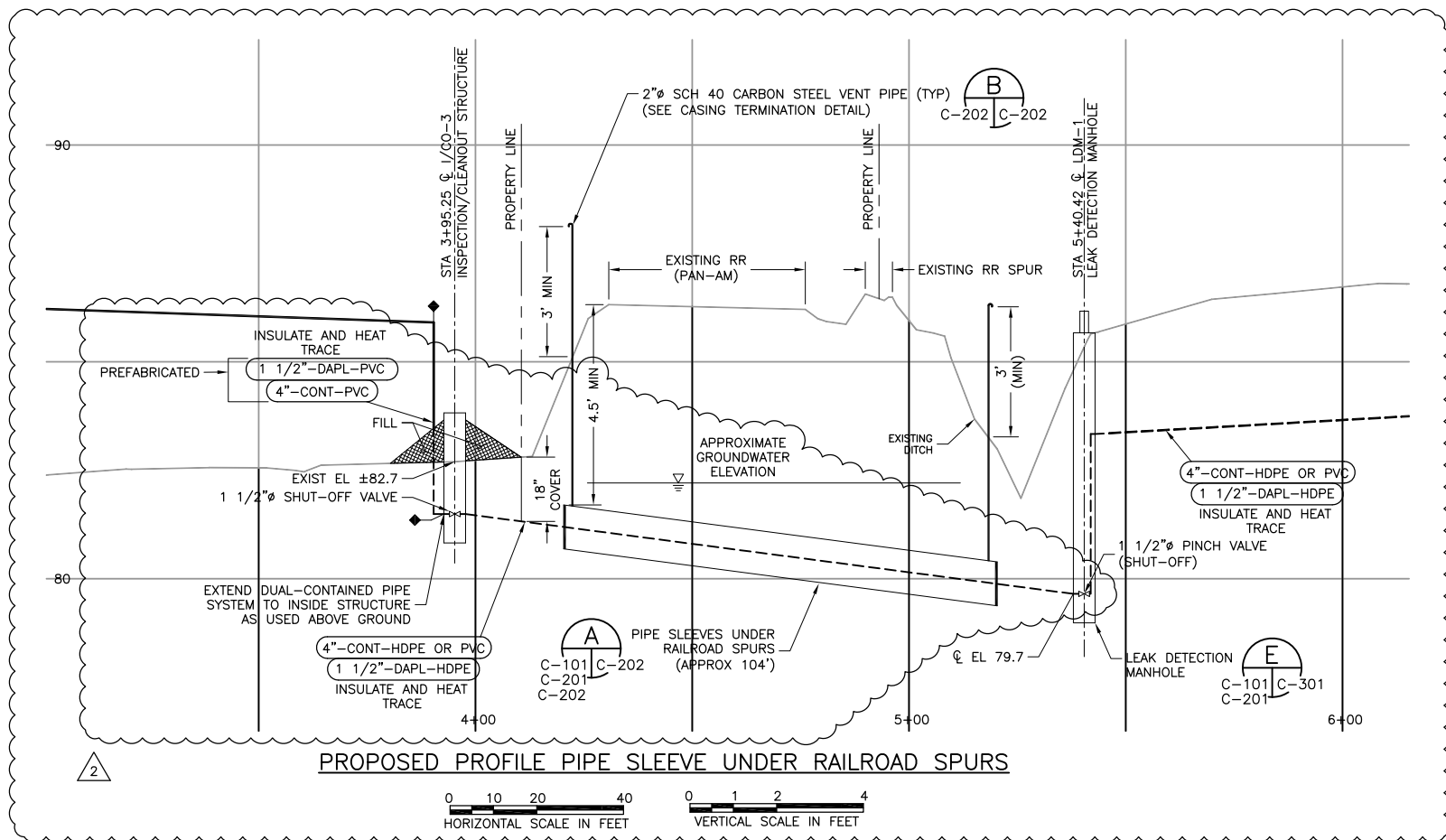
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DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

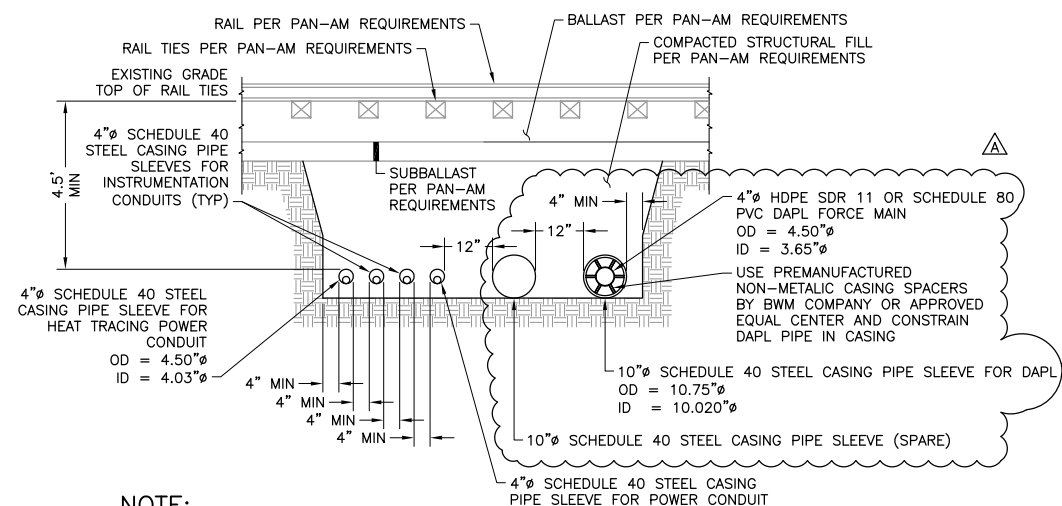
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PROPOSED PIPING PROFILE

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C-201  
3  
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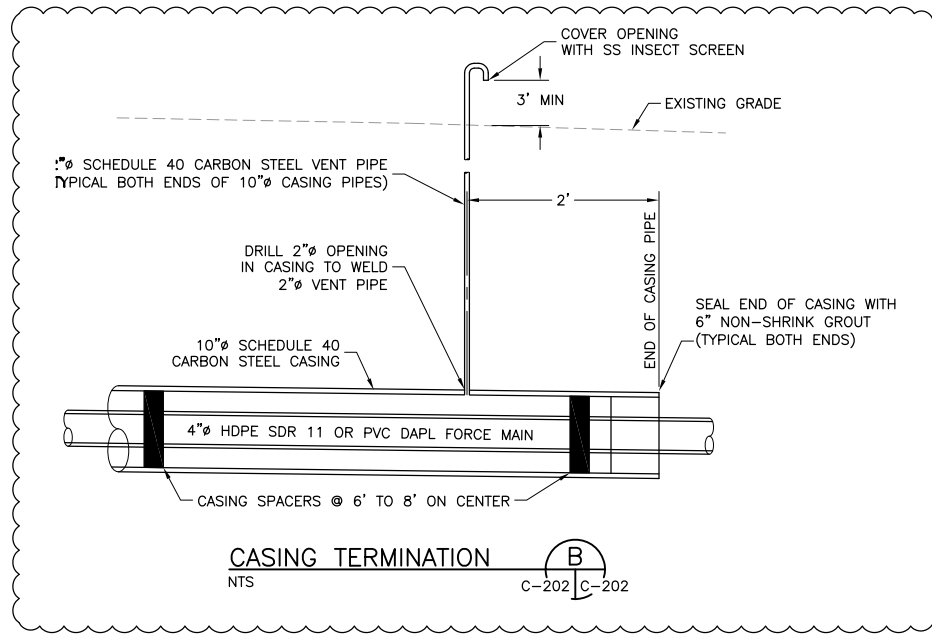


- NOTES:**
- FOR PIPING ELEVATIONS AT STRUCTURES, SEE DRAWING C-301.
- RAILROAD UTILITY CROSSING NOTES:**
- THE RAILROAD WORK AREA IS PART OF THE WOBURN LOOP IS CONSIDERED AN ACTIVE TRACK AND THEREFORE A POTENTIALLY HAZARDOUS WORK AREA. ALL WORK MUST BE COORDINATED WITH PAN AM RAILWAY FOR TRAIN MOVEMENTS. REPRESENTATIVES FOR THE CONTRACTOR, OLIN, MACTEC, USEPA, MADEP, AND SUBCONTRACTORS MUST BE ACCOMPANIED BY A RAILROAD FLAGMAN/INSPECTOR PER FEDERAL RAILROAD ADMINISTRATION REGULATIONS AND PAN AM SPECIFICATIONS.
  - ANY WORK ACTIVITIES THAT AFFECT THE PAN AM RAILWAY RIGHT-OF-WAY (ROW) AND/OR OPERATIONS DURING THIS PROJECT WILL REQUIRE PRIOR PAN AM APPROVAL AND THE PRESENCE OF A RAILROAD FLAGMAN/INSPECTOR.
  - THE CONTRACTOR WILL BE REQUIRED TO SUBMIT A PIPING INSTALLATION PROCEDURE TO PAN AM RAILWAY DETAILING THE MATERIALS AND METHODS OF CONSTRUCTION TO BE UTILIZED DURING THE RAILROAD UTILITY CROSSING WORK AFFECTING THE PAN AM ROW. ADDITIONALLY, THE CONTRACTOR MUST EXECUTE A STANDARD RAILROAD SERVICE CONTRACT OR PROPERTY ACCESS AND INDEMNIFICATION AGREEMENT AND PROVIDE AN ACCEPTABLE RAILROAD-PROTECTIVE INSURANCE POLICY TO THE PAN AM RAILWAY REAL ESTATE DEPARTMENT.
  - THE PROPOSED PIPE CROSSING WORK WILL IMPACT EXISTING FREIGHT SERVICE OPERATIONS FOR THE GLEN FALLS SAND & GRAVEL FACILITY. THE PAN AM RAILWAY TRANSPORTATION DEPARTMENT WILL BE REQUIRED TO APPROVE THE TRACK OUTAGE REQUIRED TO ACCOMMODATE THE INSTALLATION WORK AND ISSUE A SAFETY BULLETIN TO RAILROAD PERSONNEL AND GLEN FALLS EMPLOYEES OF THE RESTRICTED FREIGHT OPERATION LIMITS AND OTHER POTENTIAL HAZARDS DURING THE PROJECT. THE CONTRACTOR SHALL PROVIDE AN ESTIMATED SCHEDULE PROVIDING DATES AND DURATION TO CONDUCT THE PIPE CROSSING WITH THE PIPING INSTALLATION PROCEDURE.
  - THE PROPOSED UTILITY CROSSING WILL BE INSTALLED VIA OPEN CUT AND DIRECT BURY PROCEDURES. PAN AM RAILROAD FORCES OR A PAN AM APPROVED SUBCONTRACTOR WILL BE REQUIRED TO CONSTRUCT THE RAILROAD WORK, INCLUDING REMOVAL AND REPLACEMENT OF RAIL, TIES, AND BALLAST STONE THROUGHOUT THE RAILROAD UTILITY CROSSING WORK AREA.
  - THE PIPE SLEEVES OR CASING PIPE SHALL BE STEEL PIPE CONFORMING TO ASTM A 53 OR API SPEC 5L, GRADE B (35,000 PSI MINIMUM YIELD STRESS), TYPE E OR S, SCHEDULE 40 BLACK STEEL PIPE.
    - 10-INCH, SCHEDULE 40, WALL THICKNESS = 0.365 INCHES.
    - 4-INCH, SCHEDULE 40, WALL THICKNESS = 0.237 INCHES
  - AS INDICATED SHUT-OFF VALVES WILL BE INSTALLED ON THE DAPL DISCHARGE PIPE IN BOTH THE LEAK DETECTION MANHOLE AND INSPECTION/CLEANOUT STRUCTURE 1/CO-3 LOCATED AT BOTH ENDS OF THE PIPELINE CROSSING.
  - BOTH ENDS OF THE PIPE SLEEVE OR CASING PIPE CARRYING THE DAPL PIPING SHALL BE PROVIDED WITH CASING SEALS AND VENTS AS INDICATED.
  - THE DAPL PIPE SHALL BE CENTERED WITHIN THE PIPE SLEEVE OR CASING PIPE USING PRE-MANUFACTURED NON-METALLIC CASING SPACERS. THE SPACERS SHALL BE LOCATED AT 6 TO 8 FEET ON CENTERED ALONG THE ENTIRE PIPE CASING LENGTH.
  - EXCAVATION AND BACKFILL ACTIVITIES MUST BE PERFORMED IN CONFORMANCE WITH APPLICABLE PAN AM RAILWAY SPECIFICATIONS AND AS OUTLINED HEREIN:
    - ESTIMATED GROUNDWATER LEVELS INDICATE THAT THE PIPING INSTALLATION IS EXPECTED TO OCCUR SEVERAL FEET BELOW THE GROUNDWATER ELEVATION. THE CONTRACTOR SHALL PROVIDE ADEQUATE DEWATERING FACILITIES TO MAINTAIN EXCAVATED AREAS SUFFICIENTLY DRY FROM GROUNDWATER AND/OR SURFACE WATER RUNOFF TO ALLOW PROPER BACKFILL AND COMPACTION AND THAT WILL NOT ADVERSELY AFFECT CONSTRUCTION PROCEDURES NOR CAUSE EXCESSIVE DISTURBANCE OF UNDERLYING NATURAL GROUND. THE DRAINAGE OF ALL WATER RESULTING FROM PUMPING SHALL BE MANAGED SO AS NOT TO CAUSE PHYSICAL OR ENVIRONMENTAL DAMAGE TO ADJACENT AREAS. PUMPING SHALL BE CONTINUOUS, AS REQUIRED, TO PROTECT THE WORK AND/OR TO MAINTAIN SATISFACTORY PROGRESS IN THE WORK. (SEE PUMPED WATER FILTER BAG DETAIL ON DRAWING C-201).
    - THE TRENCH SHALL BE BACKFILLED WITH STRUCTURAL FILL CONSISTING OF GRAVEL BORROW MEETING THE REQUIREMENTS OF MASSHIGHWAY SPECIFICATION SECTION M1.03.0 TYPE A, B, OR C. IT SHALL BE OF SUCH A GRADATION AND MATERIAL THAT IT CAN BE COMPACTED TO THE MINIMUM SPECIFIED DRY DENSITY INDICATED BELOW.
    - TRENCH BACKFILL SHALL BE COMPACTED TO MINIMUM OF 95% MODIFIED PROCTER BASED ON AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) DESIGNATION T-180, OR ASTM D 1557. TRENCH BACKFILL MATERIAL SHALL BE PLACED IN A MAXIMUM 8-INCH LOOSE LIFTS. IN PLACE DENSITY AND MOISTURE TESTING PER ASTM D 6938 AT A MINIMUM RATE OF 2 TESTS PER LIFT SHALL BE TAKEN AND DOCUMENTED DURING THE WORK.
    - BALLAST STONE, TIES AND RAIL MATERIAL AND INSTALLATION SHALL BE CONDUCTED PER PAN AM RAILWAY REQUIREMENTS AND SPECIFICATIONS.



- NOTE:**
- RAILROAD WORK SHALL BE CONDUCTED BY AN APPROVED PAN-AM SUBCONTRACTOR HIRED BY THE CONTRACTOR. THE CONTRACTOR SHALL PROVIDE PIPING AND CONDUIT MATERIALS, INCLUDING CASING PIPE, AND COORDINATE PIPE INSTALLATION WITH THE PAN-AM APPROVED SUBCONTRACTOR.
  - CASING PIPE SHALL EXTEND A MINIMUM OF 25' FROM CENTERLINE OF OUTSIDE RAIL LINE.

**PIPE SLEEVES UNDER RAILROAD SPURS**  
NTS  
C-101 C-202



May 22 Aug 2011 - 30days

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| NO. | DATE     | REVISIONS                             | BY  | CHK |
|-----|----------|---------------------------------------|-----|-----|
| 2   | 02/14/12 | REVISED DUE TO FIELD CONDITIONS       | MAP | REO |
| 1   | 04/05/11 | ADDRESSED TOWN OF WILMINGTON COMMENTS | REO | MAP |
| 0   | 03/09/11 | ISSUED FOR CONSTRUCTION               | REO | MAP |
| A   | 02/12/10 | FINAL                                 | REO | MAP |

|                                 |                              |
|---------------------------------|------------------------------|
| DRAWN:<br>DEL                   | PROJECT NO:<br>6107-10-0016  |
| ENGINEER:<br>SCALE:<br>AS NOTED | CHECKED:<br>APPROVED:<br>PHT |
| DATE:<br>03/09/11               | DATE:<br>03/09/11            |



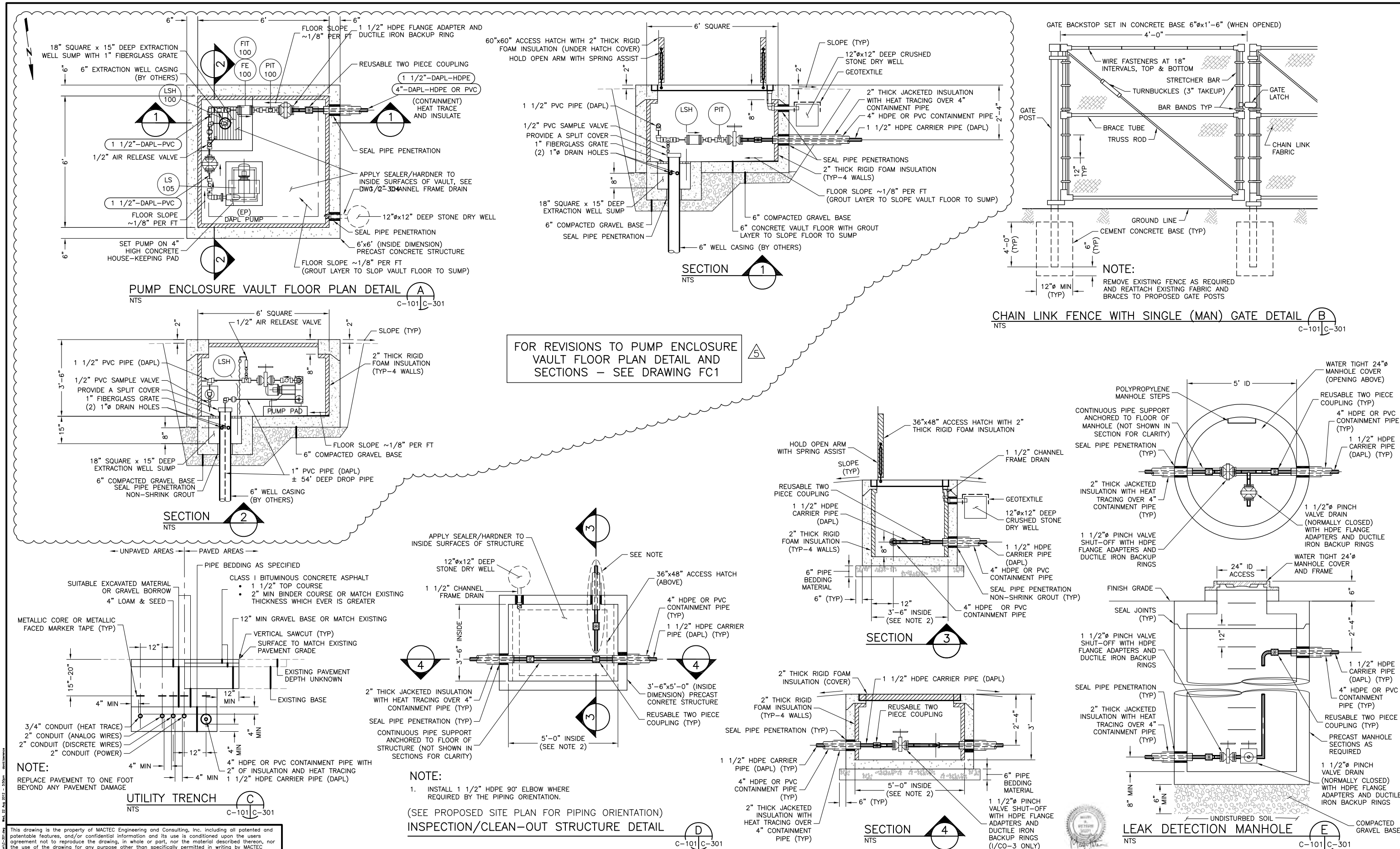
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DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

CIVIL  
PROPOSED PROFILE  
PIPE SLEEVES UNDER RAILROAD SPURS  
AND DETAILS



DRAWING NO:  
C-202  
4  
15



|                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |                                               |
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| 5                                                                                                                                                                                                                                                                                                                                                                                                                                  | 05/15/12 | REVISED VAULT                                 |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                  | 12/19/11 | REVISED VAULT ORIENTATION FOR NEW EW LOCATION |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                  | 03/09/11 | ADDRESSED TOWN OF WILMINGTON COMMENTS         |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                  | 03/19/11 | ISSUED FOR CONSTRUCTION                       |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                  | 02/12/10 | FINAL                                         |
| 0                                                                                                                                                                                                                                                                                                                                                                                                                                  | 12/07/09 | ISSUED FOR BID                                |
| NO.                                                                                                                                                                                                                                                                                                                                                                                                                                | DATE     | REVISIONS                                     |
| BY                                                                                                                                                                                                                                                                                                                                                                                                                                 | CHK      |                                               |

|     |     |           |              |
|-----|-----|-----------|--------------|
| DEL | MAP | DRAWN:    | PROJECT NO:  |
| REO | MAP | DEL       | 6107-10-0016 |
| REO | MAP | ENGINEER: | SCALE:       |
| REO | MAP | MAP       | NONE         |
| REO | MAP | CHECKED:  | APPROVED:    |
| REO | MAP | REO       | PHT          |
| REO | MAP | DATE:     | DATE:        |
| REO | MAP | 03/09/11  | 03/09/11     |

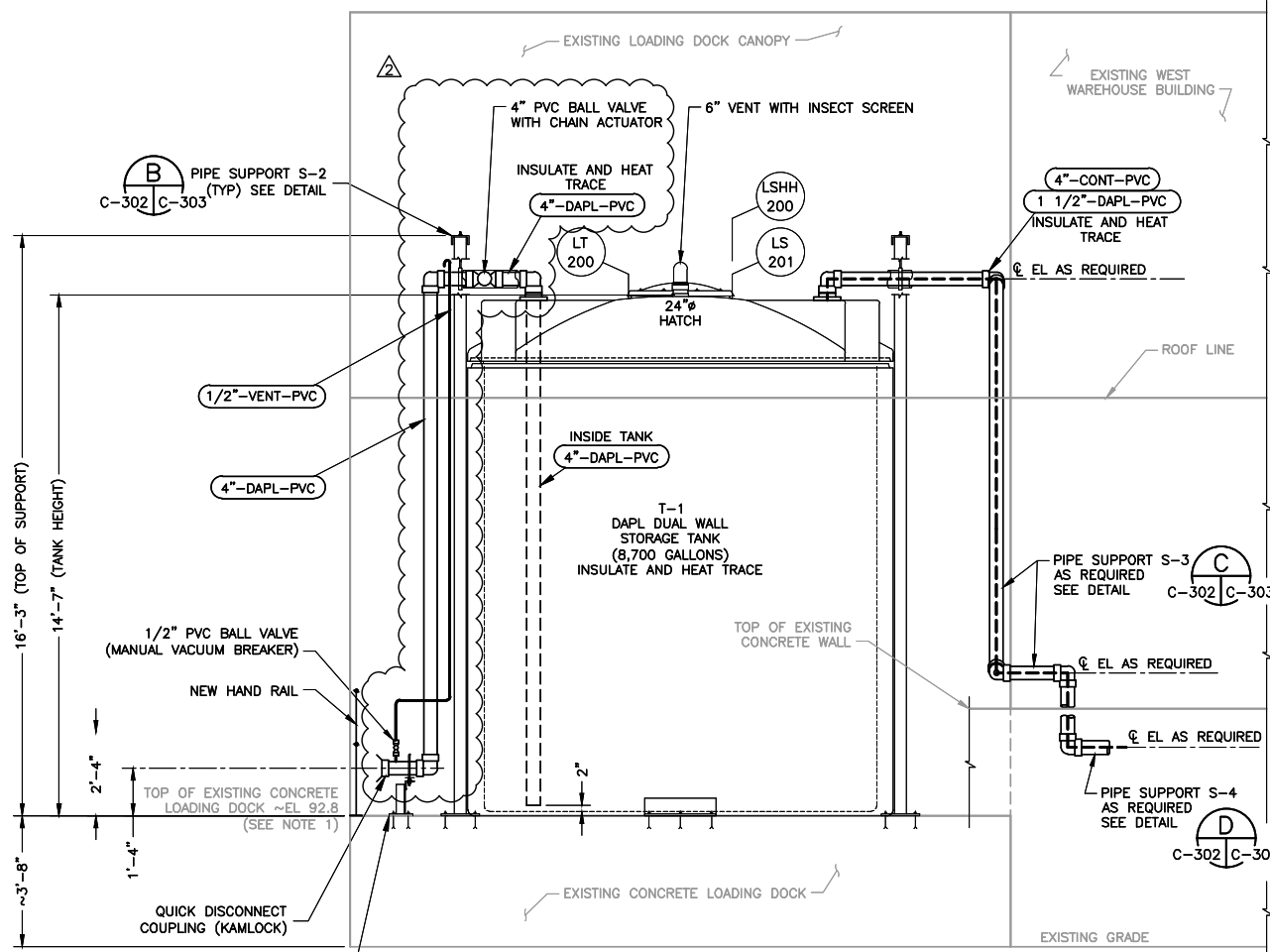


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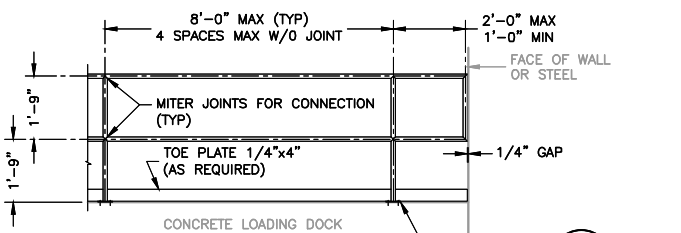
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OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

CIVIL  
CIVIL DETAILS

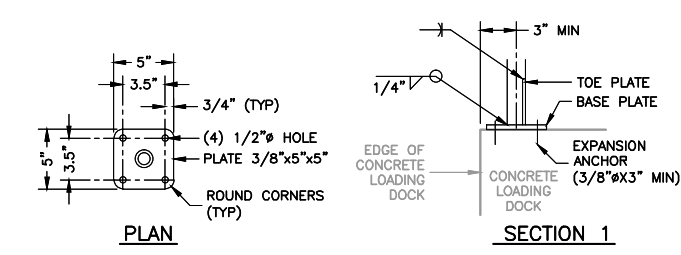
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| DRAWING NO: | C-301 |
| 5           |       |
| 15          |       |



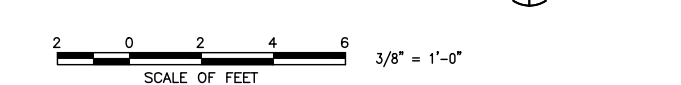
**SECTION 2**  
3/8"=1'-0" C-302 C-303



**STANDARD HANDRAIL DETAIL**  
NTS C-302 C-303



**HANDRAIL POST CONNECTION**  
NTS C-302 C-303



**PLAN**  
3/8"=1'-0" C-302 C-303

**HANDRAIL NOTES:**

- HANDRAIL MATERIAL:  
A. ALUMINUM: 6063-TS  
B. STEEL: ASTM A53 GRADE B
- POSTS SHALL BE 1 1/2" NPS SCH 80 AND RAILS 1 1/2" NPS SCH 40 WELDED CONSTRUCTION WITH TYPE "A" MILL FINISH.
- ALL SHARP CORNERS AND ROUGH EDGES TO BE GROUND SMOOTH AFTER FABRICATION.
- WHERE PRACTICAL, RAILS TO BE DISCONTINUOUS AT CHANGES IN DIRECTION OR ELEVATION.
- COAT CONTACT SURFACES OR DISSIMILAR MATERIALS WITH COAL TAR EPOXY. (ALUMINUM ONLY).
- FINISH: ONE COAT LATEX PRIMER, ONE COAT LATEX FINISH TOP COAT (COLOR YELLOW).

**NOTES:**

- TOP OF LOADING DOCK IS 3'-8" ABOVE ADJACENT ASPHALT DRIVE (APPROXIMATE ELEVATION 92.7). ACTUAL ELEVATIONS MAY BE FIELD ADJUSTED BASED ON ACTUAL ELEVATION DEVELOPED FROM SITE SUBGRADE PREPARATION. RELATED ELEVATIONS BETWEEN SITE FEATURES SHALL BE MAINTAINED AS APPROVED.
- LAYOUT AND DIMENSIONS MAY BE FIELD ADJUSTED BASED ON ACTUAL TANKS AND EQUIPMENT USED AND AS APPROVED.

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| 2   | 03/09/11 | ISSUED FOR CONSTRUCTION | REO | MAP |
| 1   | 02/12/10 | FINAL                   | REO | MAP |
| 0   | 12/07/09 | ISSUED FOR BID          | REO | MAP |
| A   | 11/12/09 | FOR CLIENT REVIEW       | REO | MAP |

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|-------------------|-----------------------------|
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| CHECKED:<br>REO   | APPROVED:<br>PHT            |
| DATE:<br>03/09/11 | DATE:<br>03/09/11           |

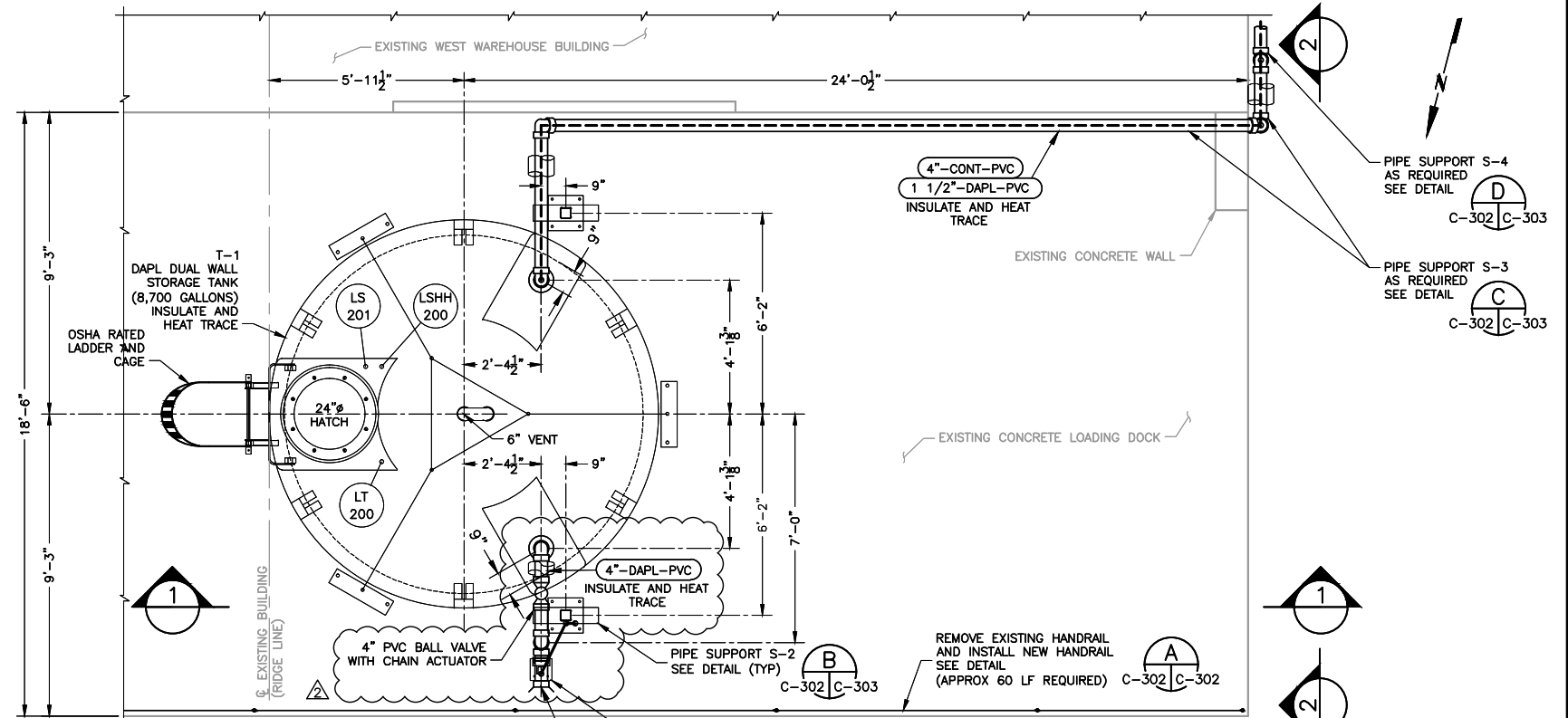


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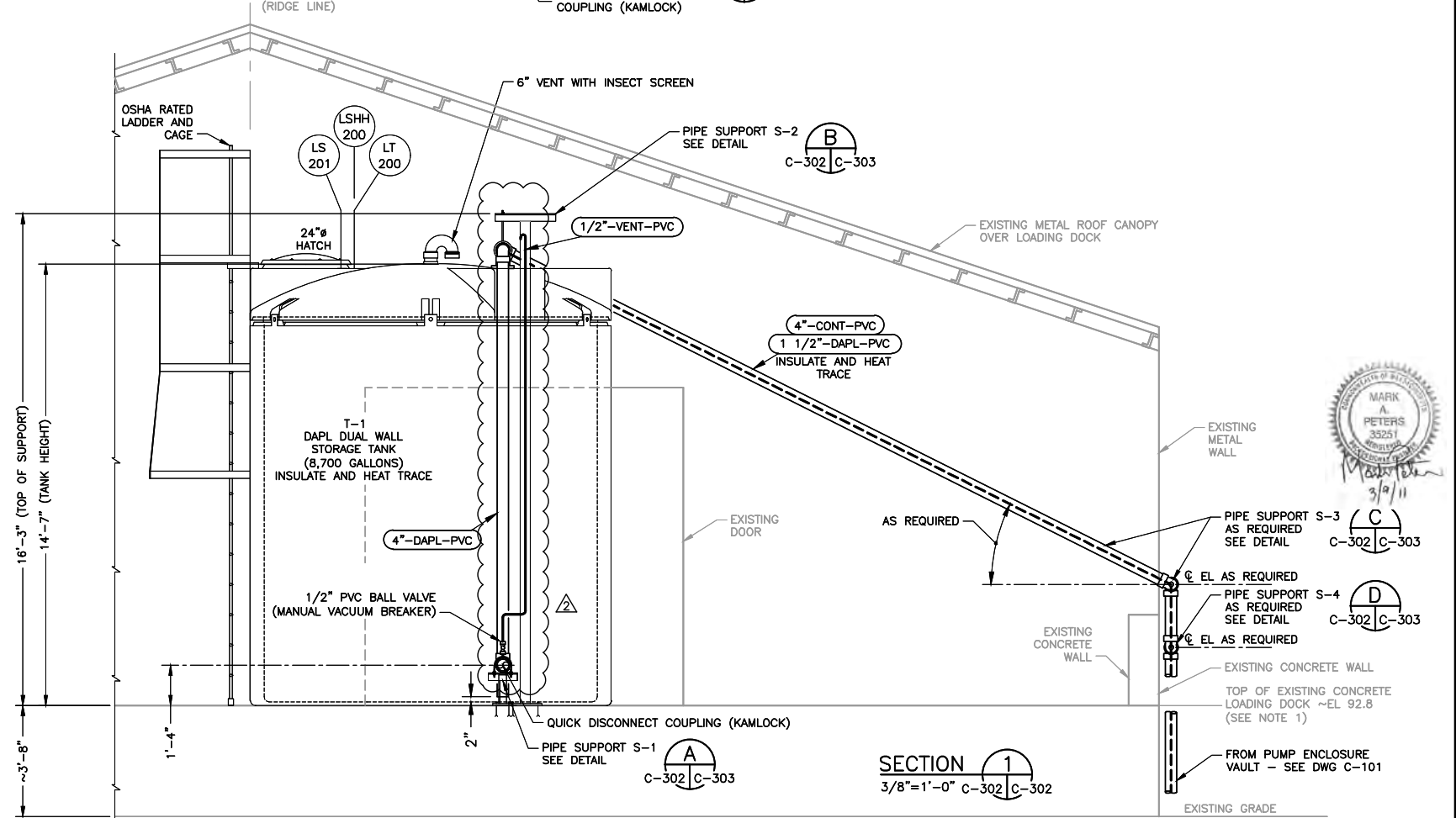
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OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

CIVIL  
CIVIL DETAILS

DRAWING NO:  
C-302  
6  
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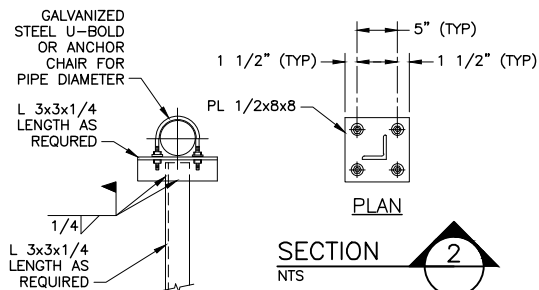


**PLAN**  
3/8"=1'-0" C-302 C-303

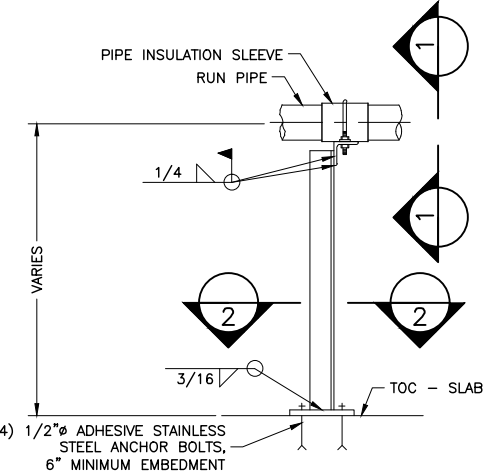


**SECTION 1**  
3/8"=1'-0" C-302 C-303

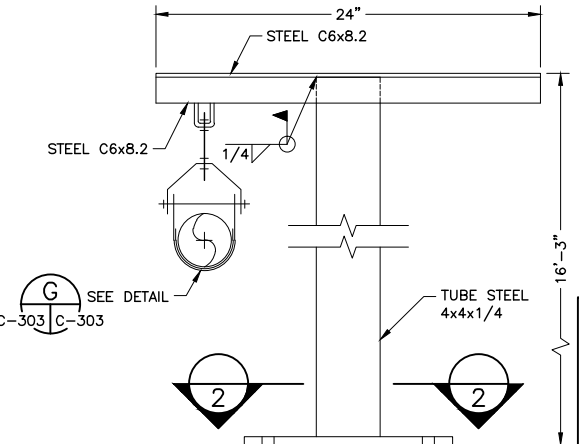




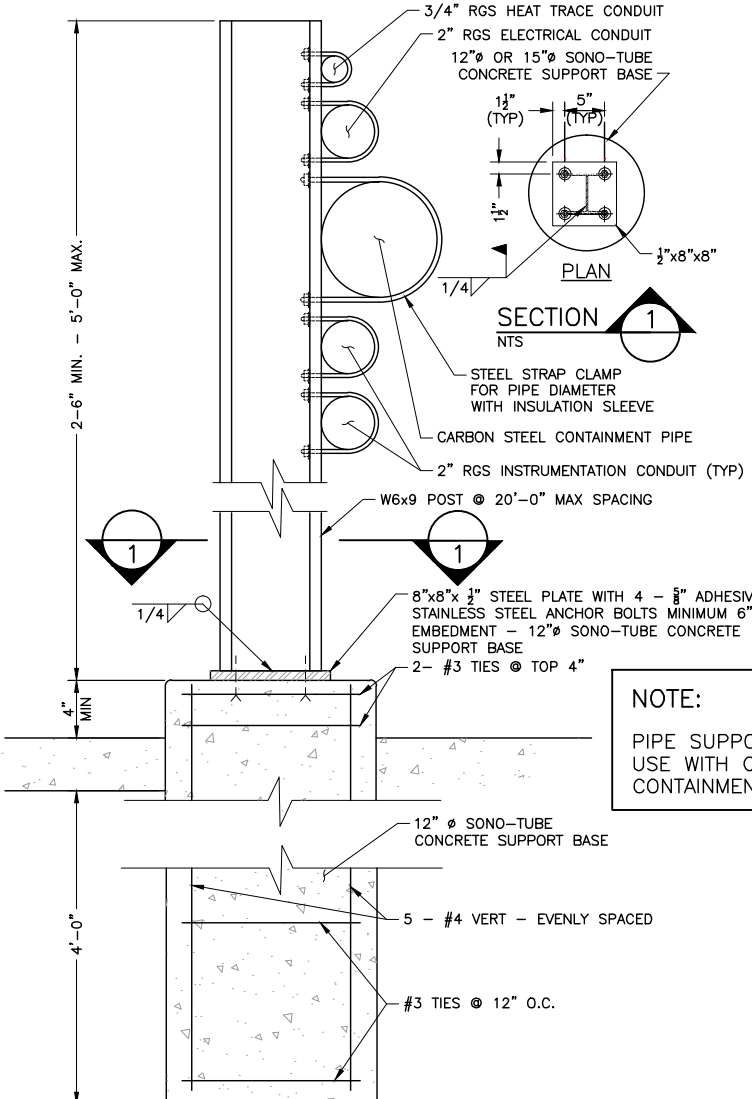
PIPE SUPPORT S-1 DETAIL (A)  
NTS C-302 C-303



PIPE SUPPORT S-1 DETAIL (A)  
NTS C-302 C-303



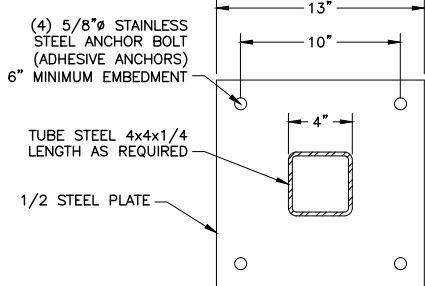
PIPE SUPPORT S-2 DETAIL (B)  
NTS C-302 C-303



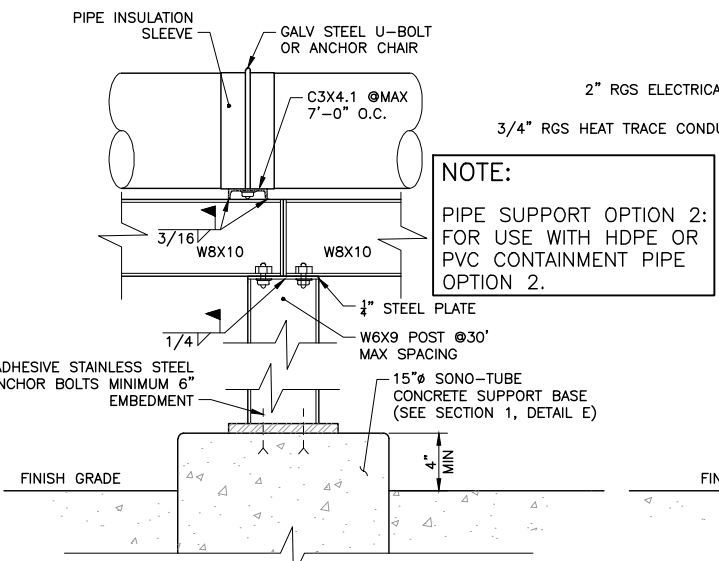
PIPE SUPPORT S-5A DETAIL (E)  
NTS C-101 C-303 C-303

NOTE:  
PIPE SUPPORT OPTION:  
SUPPORT ROD HANGER WITH  
CLEVIS HANGER FROM EXISTING  
BUILDING PURLINS, CONSULT  
ENGINEER FOR APPROVAL.

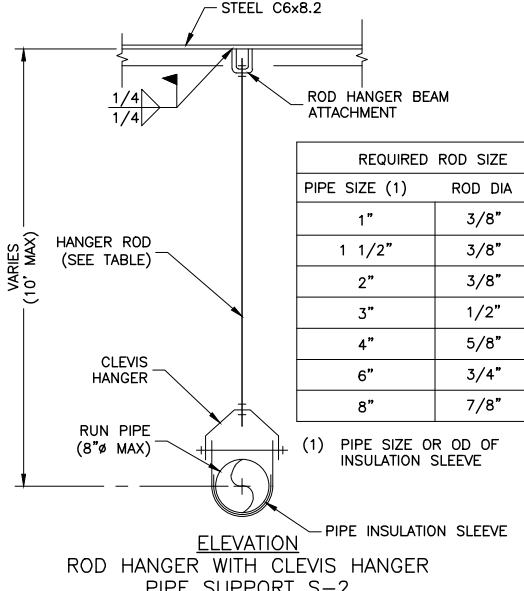
NOTE:  
PIPE SUPPORT OPTION 1: FOR  
USE WITH CARBON STEEL  
CONTAINMENT PIPE OPTION 1.



PIPE SUPPORT S-3 DETAIL (C)  
NTS C-101 C-303 C-302



PIPE SUPPORT S-5B DETAIL (F)  
NTS C-101 C-303 C-302



PIPE SUPPORT S-2 DETAIL (G)  
NTS C-303 C-303

| REQUIRED ROD SIZE |         |
|-------------------|---------|
| PIPE SIZE (1)     | ROD DIA |
| 1"                | 3/8"    |
| 1 1/2"            | 3/8"    |
| 2"                | 3/8"    |
| 3"                | 1/2"    |
| 4"                | 5/8"    |
| 6"                | 3/4"    |
| 8"                | 7/8"    |

NOTE:  
TIGHTEN ALL STEEL STRAP CLAMPS,  
ALLOWING FOR PIPE EXPANSION AND  
CONTRACTION - DO NOT OVER TIGHTEN.

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| 2                                                                                                                                                                                                                                                                                                                                                                                                                                  | 03/09/11 | ISSUED FOR CONSTRUCTION | REO |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                  | 02/12/10 | FINAL                   | MAP |
| 0                                                                                                                                                                                                                                                                                                                                                                                                                                  | 12/07/09 | ISSUED FOR BID          | REO |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                  | 11/12/09 | FOR CLIENT REVIEW       | MAP |

|                   |                             |
|-------------------|-----------------------------|
| DRAWN:<br>DEL     | PROJECT NO:<br>6107-10-0016 |
| ENGINEER:<br>MAP  | SCALE:<br>NONE              |
| CHECKED:<br>REO   | APPROVED:<br>PHT            |
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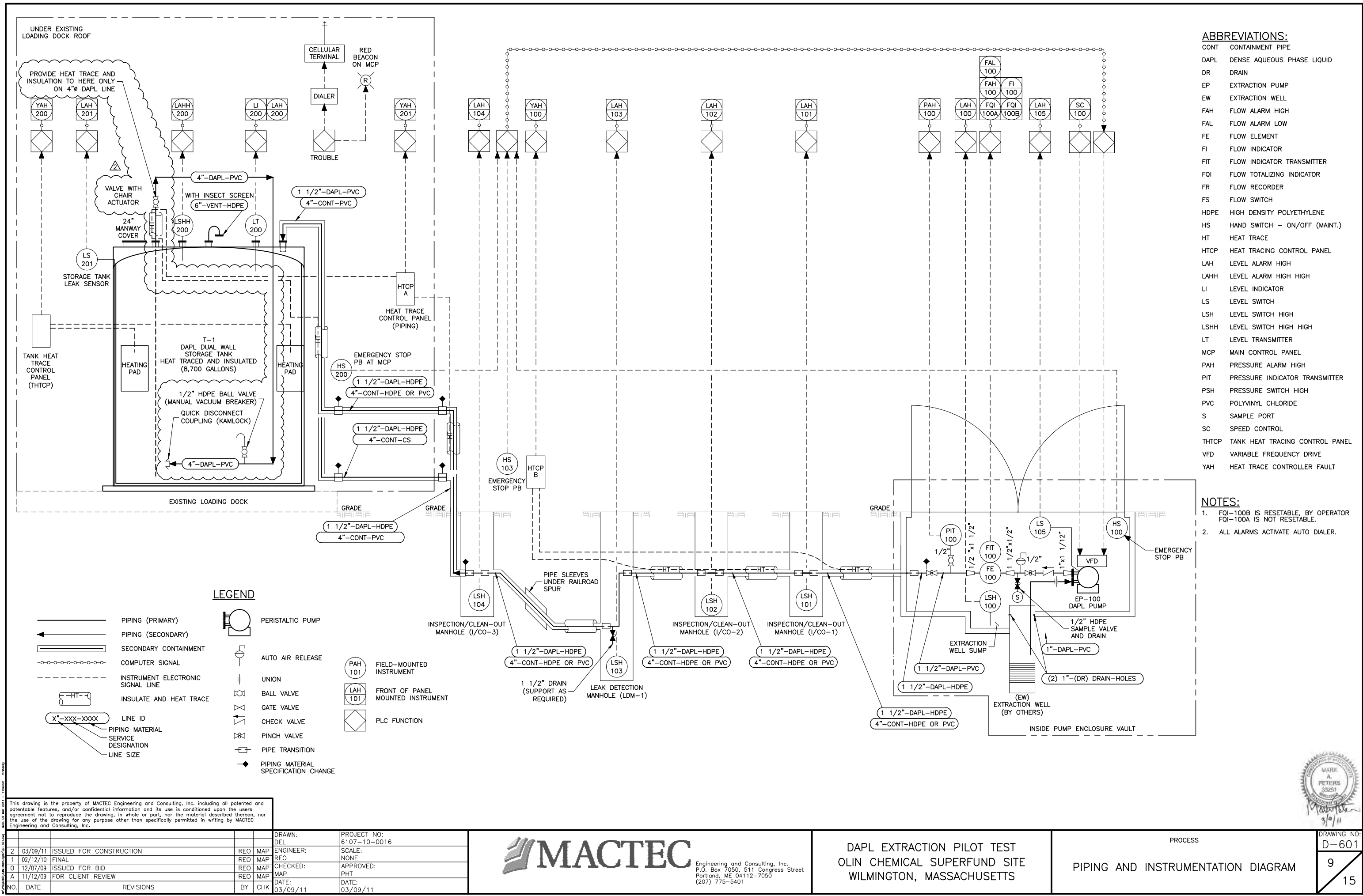
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OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

CIVIL  
CIVIL DETAILS



|                      |
|----------------------|
| DRAWING NO:<br>C-303 |
| 7                    |
| 15                   |





ABBREVIATIONS:

|       |                                 |
|-------|---------------------------------|
| CONT  | CONTAINMENT PIPE                |
| DAPL  | DENSE AQUEOUS PHASE LIQUID      |
| DR    | DRAIN                           |
| EP    | EXTRACTION PUMP                 |
| EW    | EXTRACTION WELL                 |
| FAH   | FLOW ALARM HIGH                 |
| FAL   | FLOW ALARM LOW                  |
| FE    | FLOW ELEMENT                    |
| FI    | FLOW INDICATOR                  |
| FIT   | FLOW INDICATOR TRANSMITTER      |
| FQI   | FLOW TOTALIZING INDICATOR       |
| FR    | FLOW RECORDER                   |
| FS    | FLOW SWITCH                     |
| HDPE  | HIGH DENSITY POLYETHYLENE       |
| HS    | HAND SWITCH - ON/OFF (MAINT.)   |
| HT    | HEAT TRACE                      |
| HTCP  | HEAT TRACING CONTROL PANEL      |
| LAH   | LEVEL ALARM HIGH                |
| LAHH  | LEVEL ALARM HIGH HIGH           |
| LI    | LEVEL INDICATOR                 |
| LS    | LEVEL SWITCH                    |
| LSH   | LEVEL SWITCH HIGH               |
| LSHH  | LEVEL SWITCH HIGH HIGH          |
| LT    | LEVEL TRANSMITTER               |
| MCP   | MAIN CONTROL PANEL              |
| PAH   | PRESSURE ALARM HIGH             |
| PIT   | PRESSURE INDICATOR TRANSMITTER  |
| PSH   | PRESSURE SWITCH HIGH            |
| PVC   | POLYVINYL CHLORIDE              |
| S     | SAMPLE PORT                     |
| SC    | SPEED CONTROL                   |
| THTCP | TANK HEAT TRACING CONTROL PANEL |
| VFD   | VARIABLE FREQUENCY DRIVE        |
| YAH   | HEAT TRACE CONTROLLER FAULT     |

NOTES:

- FQI-100B IS RESETTABLE, BY OPERATOR  
FQI-100A IS NOT RESETTABLE.
- ALL ALARMS ACTIVATE AUTO DIALER.

LEGEND

|  |                                     |  |                                      |
|--|-------------------------------------|--|--------------------------------------|
|  | PIPING (PRIMARY)                    |  | PERISTALTIC PUMP                     |
|  | PIPING (SECONDARY)                  |  | AUTO AIR RELEASE                     |
|  | SECONDARY CONTAINMENT               |  | UNION                                |
|  | COMPUTER SIGNAL                     |  | BALL VALVE                           |
|  | INSTRUMENT ELECTRONIC SIGNAL LINE   |  | GATE VALVE                           |
|  | INSULATE AND HEAT TRACE             |  | CHECK VALVE                          |
|  | LINE ID                             |  | PINCH VALVE                          |
|  | PIPING MATERIAL SERVICE DESIGNATION |  | PIPE TRANSITION                      |
|  | LINE SIZE                           |  | PIPING MATERIAL SPECIFICATION CHANGE |
|  | FIELD-MOUNTED INSTRUMENT            |  |                                      |
|  | FRONT OF PANEL MOUNTED INSTRUMENT   |  |                                      |
|  | PLC FUNCTION                        |  |                                      |

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|                |                          |
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| DRAWN: DEL     | PROJECT NO: 6107-10-0016 |
| ENGINEER: REO  | SCALE: NONE              |
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DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

PROCESS  
PIPING AND INSTRUMENTATION DIAGRAM



|                   |
|-------------------|
| DRAWING NO: D-601 |
| 9                 |
| 15                |

ABBREVIATIONS

|       |                                  |      |                            |
|-------|----------------------------------|------|----------------------------|
| A     | AMPERE                           | S    | SIGNAL                     |
| AC    | ALTERNATING CURRENT              | SEC  | SECONDARY                  |
| AD    | AUTO DIALER                      | SHLD | SHIELDED CABLE             |
| AFF   | ABOVE FINISHED FLOOR             | SOHE | SECONDARY OH ELECTRIC      |
| AFG   | ABOVE FINISHED GRADE             | SV   | SOLENOID VALVE             |
| AIC   | AMPERES INTERRUPTING CAPACITY    | SW   | SWITCH                     |
| ATC   | AUTOMATIC TEMPERATURE CONTROL    | SYM  | SYMMETRICAL                |
| ATS   | AUTOMATIC TRANSFER SWITCH        | T    | TELEPHONE                  |
| AUX   | AUXILIARY                        | TD   | TELEDIALER                 |
| AWG   | AMERICAN WIRE GAUGE              | TDR  | TIME DELAY RELAY           |
| BKR   | BREAKER                          | TEL  | TELEPHONE                  |
| C     | CONDUIT                          | TM   | TELEMETRY                  |
| CB    | CIRCUIT BREAKER                  | TS   | TEMPERATURE SWITCH         |
| CKT   | CIRCUIT                          | TR   | TRANSFORMER                |
| CT    | CURRENT TRANSFORMER              | UG   | UNDERGROUND                |
| CU    | COPPER                           | UPS  | UNINTERRUPTED POWER SUPPLY |
| DC    | DIRECT CURRENT                   | UT   | UTILITY                    |
| DISC  | DISCONNECT                       | V    | VOLT                       |
| EG    | EQUIPMENT GROUND                 | VA   | VOLT-AMPERE                |
| EH    | ELECTRICALLY HELD                | VFD  | VARIABLE FREQUENCY DRIVE   |
| EM    | EMERGENCY                        | VM   | VOLT METER                 |
| EMT   | ELECTRICAL METALLIC TUBING       | VR   | VOLTAGE REGULATOR          |
| EPR   | ETHYLENE PROPYLENE RUBBER        | W    | WATT                       |
| EMH   | ELECTRICAL MANHOLE               | WH   | WATT HOUR                  |
| EQUIP | EQUIPMENT                        | WP   | WEATHERPROOF               |
| ES    | EMERGENCY STOP                   | XFMR | TRANSFORMER                |
| EUH   | ELECTRIC UNIT HEATER             | XLP  | CROSS LINKED POLYETHYLENE  |
| EX    | EXTERIOR                         |      | EXPLOSION PROOF            |
| EXTG  | EXISTING                         |      |                            |
| FA    | FIRE ALARM                       |      |                            |
| FC    | FOOT-CANDLE                      |      |                            |
| FDR   | FEEDER                           |      |                            |
| FLUOR | FLUORESCENT                      |      |                            |
| FS    | FLOW SWITCH (FA SYSTEM)          |      |                            |
| FVNR  | FULL VOLTAGE NON REVERSING       |      |                            |
| FVR   | FULL VOLTAGE REVERSING           |      |                            |
| GEN   | GENERATOR                        |      |                            |
| GF    | GROUND FAULT                     |      |                            |
| GFI   | GROUND FAULT CIRCUIT INTERRUPTER |      |                            |
| GND   | GROUND                           |      |                            |
| H     | HAND HOLE                        |      |                            |
| HOA   | HAND-OFF-AUTOMATIC               |      |                            |
| HP    | HORSE POWER                      |      |                            |
| HPS   | HIGH PRESSURE SODIUM             |      |                            |
| HT    | HEAT TRACE                       |      |                            |
| HV    | HIGH VOLTAGE                     |      |                            |
| HZ    | HERTZ                            |      |                            |
| IG    | ISOLATED GROUND                  |      |                            |
| JB    | JUNCTION BOX                     |      |                            |
| KV    | KILOVOLT                         |      |                            |
| KVA   | KILO VOLT-AMPERE                 |      |                            |
| KW    | KILOWATT                         |      |                            |
| KWH   | KILOWATT HOUR                    |      |                            |
| LPS   | LOW PRESSURE SODIUM              |      |                            |
| LTG   | LIGHTING                         |      |                            |
| LSH   | LEVEL SWITCH HIGH                |      |                            |
| LV    | LOW VOLTAGE                      |      |                            |
| MCB   | MAIN CIRCUIT BREAKER             |      |                            |
| MCC   | MOTOR CONTROL CENTER             |      |                            |
| MCP   | MOTOR CIRCUIT PROTECTION         |      |                            |
| MDP   | MAIN DISTRIBUTION PANEL          |      |                            |
| MH    | METAL HALIDE                     |      |                            |
| MOD   | MOTOR OPERATED DAMPER            |      |                            |
| MS    | MANUAL STARTER OIL/RIL           |      |                            |
| MTS   | MANUAL TRANSFER SWITCH           |      |                            |
| MVA   | MEGAVOLT-AMPERE                  |      |                            |
| OH    | OVERHEAD                         |      |                            |
| OIT   | OPERATOR INTERFACE TERMINAL      |      |                            |
| OL    | OVER LOAD                        |      |                            |
| OOA   | ON-OFF-AUTOMATIC                 |      |                            |
| P     | POLE                             |      |                            |
| PB    | PUSH BUTTON                      |      |                            |
| PF    | POWER FACTOR                     |      |                            |
| PH    | PHASE                            |      |                            |
| PNL   | PANEL                            |      |                            |
| POHE  | PRIMARY OH ELECTRIC              |      |                            |
| PRI   | PRIMARY                          |      |                            |
| PT    | POTENTIAL TRANSFORMER            |      |                            |
| PVC   | POLYVINYL CHLORIDE               |      |                            |
| RGSC  | RIGID GALVANIZED STEEL CONDUIT   |      |                            |
| RVSS  | REDUCED VOLTAGE SOLID STATE      |      |                            |
| RSC   | RIGID STEEL CONDUIT              |      |                            |

POWER

| DESCRIPTION                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------|
|  200/3 UNFUSED SAFETY SWITCH, RATING AS NOTED             |
|  POLES                                                    |
|  AMPERES                                                  |
|  30/15/3 FUSED SAFETY SWITCH, RATING AS NOTED             |
|  POLES                                                    |
|  FUSE AMPERE RATING                                       |
|  SWITCH AMPERE RATING                                     |
|  1 MAGNETIC MOTOR STARTER, RATING AS NOTED                |
|  NEMA SIZE                                                |
|  COMBINATION TYPE MAGNETIC MOTOR STARTER, RATING AS NOTED |
|  PUSHBUTTON OR SELECTOR SWITCH STATION                  |
|  EMERGENCY STOP P.B.                                    |
|  LIGHTING OR POWER CONTACTOR                            |
|  ENCLOSED CIRCUIT BREAKER                               |
|  THERMOSTAT                                             |
|  COOLING ONLY                                           |
|  FREEZESTAT                                             |
|  DUCT-MOUNTED                                           |
|  UTILITY METER                                          |
|  PANELBOARD, SURFACE MTD.                               |
|  PANELBOARD, FLUSH MTD.                                 |
|  EQUIPMENT, TERMINAL, OR CONTROL CABINET                |
|  THREE PHASE MOTOR (HP AS SHOWN)                        |
|  SINGLE PHASE MOTOR                                     |
|  TRANSFORMER                                            |
|  ELECTRICAL HANDHOLE                                    |
|  JUNCTION BOX                                           |

SINGLE LINE DIAGRAM

| DESCRIPTION                                                                                               |
|-----------------------------------------------------------------------------------------------------------|
|  TRANSFORMER           |
|  CURRENT TRANSFORMER   |
|  POTENTIAL TRANSFORMER |
|  100AF FRAME SIZE      |
|  70AT CIRCUIT BREAKER  |
|  TRIP AMPS             |
|  SURGE CAPACITOR       |
|  LIGHTNING ARRESTER    |
|  DELTA CONNECTION      |
|  WYE CONNECTION        |
|  GROUND CONNECTION     |

LIGHTING FIXTURES

|                                                                                     |                             |
|-------------------------------------------------------------------------------------|-----------------------------|
|  | H.I.D. WALL MOUNTED FIXTURE |
|-------------------------------------------------------------------------------------|-----------------------------|

WIRING

|                                                                                                         |                                                                                                    |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
|  OHE                 | OVERHEAD ELECTRICAL WIRING, CONCEALED IN FINISHED AREAS, EXPOSED WHERE PERMITTED BY SPECIFICATIONS |
|                      | WIRING INSTALLED IN OR BELOW FLOOR SLAB                                                            |
|  LP1/2               | HOME RUN TO PANEL (CKT. NO. AS SHOWN)                                                              |
|                      | HOME RUN (NO. REFERS TO COND. & WIRE SCHED.)                                                       |
|  DC                  | DC WIRING                                                                                          |
|  3/4"C (2#12, 1#12G) | CONDUIT (WIRES)                                                                                    |
|                      | CONDUIT DOWN                                                                                       |
|  US                  | CONDUIT UP                                                                                         |
|                      | UNSWITCHED                                                                                         |
|                    | BURIED ELECTRIC                                                                                    |

HEAT TRACING

|                                                                                          |      |                                         |
|------------------------------------------------------------------------------------------|------|-----------------------------------------|
|  HT | HTCP | HEAT TRACE POWER CONNECTION             |
|  HT | HTCP | HEAT TRACE END KIT WITH POWER INDICATOR |
|     | HTCP | HEAT TRACE CONTROL PANEL                |
|     | HT   | HEAT TRACE LINE                         |

WIRING DEVICES

| <u>DESCRIPTION</u>                                                                                  |                                                      |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------|
|                  | 20 AMPERE, 120 VOLT DUPLEX RECEPTACLE                |
|  +48" | INDICATES INCHES AFF MOUNTING HEIGHT                 |
|  WP              | WEATHERPROOF                                         |
|  GFI             | GROUND FAULT INTERRUPTER                             |
|                  | 20 AMPERE, 120 VOLT QUAD RECEPTACLE                  |
|                  | 20 AMPERE, 120 VOLT SINGLE RECEPTACLE                |
|  W               | TELEPHONE OUTLET, +18" AFF<br>WALL MOUNTED, +54" AFF |
|                  | SINGLE SPECIAL PURPOSE RECEPTACLE                    |
|  30              | INDICATES AMPERE SIZE                                |

SCHEMATIC DIAGRAM

|                                                                                       |                                                             |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------|
|    | CONTROL RELAY                                               |
|    | MOTOR CONTACTOR                                             |
|    | CONTACT NORMALLY OPEN                                       |
|    | CONTACT NORMALLY CLOSED                                     |
|    | OVERLOAD HEATER ELEMENT                                     |
|    | SINGLE POLE SINGLE THROW SWITCH                             |
|    | SELECTOR SWITCH                                             |
|    | START PUSHBUTTON, MOMENTARY CONTACT                         |
|   | STOP PUSHBUTTON, MOMENTARY CONTACT                          |
|  | RED MUSHROOM-HEAD MAINTAINED-TYPE EMERGENCY STOP PUSHBUTTON |
|  | LIMIT SWITCH                                                |
|  | TEMPERATURE SWITCH                                          |
|  | FLOAT SWITCH                                                |
|  | PRESSURE SWITCH                                             |
|  | TIMED CONTACT                                               |
|  | PILOT LIGHT, LETTER INDICATES COLOR                         |
|  | G GREEN                                                     |
|  | R RED                                                       |
|  | A AMBER                                                     |

NEMA CLASSIFICATIONS FOR ELECTRICAL

EQUIPMENT AND ENCLOSURES

(UNLESS OTHERWISE NOTED OR SPECIFIED)

| LOCATION       | CLASSIFICATION |
|----------------|----------------|
| EXTERIOR POWER | NEMA 3R        |
| INTERIOR POWER | NEMA 1         |

GENERAL NOTES

- ALL CONDUIT AND EQUIPMENT SHALL BE INSTALLED AND GROUNDED IN ACCORDANCE WITH THE RULES AND REGULATIONS OF THE CURRENT NATIONAL ELECTRICAL CODE.
- CONDUIT RUNS ARE SHOWN DIAGRAMMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT AND STRUCTURES. CONDUITS SHALL BE CONCEALED IN WALLS, AND ABOVE ANY SUSPENDED CEILINGS WHERE APPLICABLE. EXPOSED CEILING CONDUITS SHALL BE PERMITTED WHERE SUSPENDED CEILINGS ARE NOT USED. EXPOSED CONDUITS SHALL BE INSTALLED PARALLEL TO BEAMS AND WALLS.
- CONDUITS SHALL BE PROPERLY TERMINATED WITH NEAT CONNECTIONS TO ALL ASSOCIATED EQUIPMENT.
- CONTROL AND INSTRUMENTATION CONDUIT SIZES AND NUMBER OF CONDUCTORS ARE TO BE DETERMINED FROM SCHEMATIC DIAGRAMS, INSTRUMENTATION DIAGRAMS, AND/OR SPECIFICATIONS, IF NOT DIRECTLY SHOWN ON POWER PLANS. THE WIRING DIAGRAMS, QUANTITY AND SIZE OF WIRES AND CONDUIT REPRESENT A SUGGESTED ARRANGEMENT BASED UPON SELECTED STANDARD COMPONENTS OF ELECTRICAL AND INSTRUMENTATION EQUIPMENT. MODIFICATIONS REVIEWED BY THE ENGINEER WITH NO EXCEPTIONS TAKEN, MAY BE MADE BY THE CONTRACTOR TO ACCOMMODATE EQUIPMENT ACTUALLY PURCHASED. THE BASIC SEQUENCE AND METHOD OF CONTROL MUST BE MAINTAINED AS INDICATED ON THE DRAWINGS AND SPECIFICATIONS. EACH CONTROL AND INSTRUMENTATION CONDUIT SHALL ALSO CONTAIN 10 PER CENT SPARE CONDUCTORS, WITH A MINIMUM OF TWO SPARES, UP TO THE LIMIT OF CONDUIT FILL AS SPECIFIED BY THE NATIONAL ELECTRICAL CODE. INSTRUMENTATION SHIELDED CABLES SHALL BE INSTALLED IN RGS CONDUIT SEPARATE FROM OTHER POWER WIRING. PVC IS ALLOWED FOR INSTRUMENTATION UNDERGROUND.
- EACH CONDUIT TO CARRY GROUND WIRE(S) ACCORDING TO NATIONAL ELECTRIC CODE IN ADDITION TO NUMBER OF CONDUCTORS SHOWN ON DRAWINGS OR PER NOTE 4 ABOVE. ALL GROUNDING MUST CONFORM TO ARTICLE 250 OF CURRENT NATIONAL ELECTRICAL CODE.
- MINIMUM CONDUIT SIZE SHALL BE 3/4". MINIMUM POWER WIRING SHALL BE 2C#12 AWG WITH GROUND, AND 2C#14 FOR CONTROL. INSTRUMENTATION CABLE SHALL BE 2C#16 TWS AND 3C#16 TWS FOR SPEED POTENTIOMETER INSTALLED PER NEC. PROVIDE CONDUIT AND WIRING AS INDICATED.
- ALL PANELBOARDS SHALL BE MOUNTED SO THAT THE DISTANCE FROM THE TOP CIRCUIT BREAKER OPERATING HANDLE TO FINISHED FLOOR SHALL NOT EXCEED 6'-6".
- ALL SURFACE MOUNTED PANELS AND PANELBOARDS ON EXTERIOR WALLS ABOVE GRADE, SHALL BE MOUNTED TO MAINTAIN A 1/4" AIR SPACE BETWEEN THE ENCLOSURE AND THE WALL.
- ELECTRICAL EQUIPMENT LOCATIONS ARE APPROXIMATE ONLY. COORDINATE LOCATIONS WITH PROCESS PIPING, ARCHITECTURAL, STRUCTURAL, AND MECHANICAL DRAWINGS. CONTRACTOR SHALL COORDINATE MANUFACTURERS EQUIPMENT REQUIREMENTS WITH SPACE AVAILABLE. FINAL CONTROL PANEL LOCATIONS SHALL BE FIELD COORDINATED.
- ALL FIELD CONTROL CONDUCTORS WILL TERMINATE AT INDIVIDUAL TERMINAL BLOCKS WITHIN THE CONTROL ENCLOSURE. SERIES AND PARALLEL CONNECTION OF FIELD CONTROL CONDUCTORS WILL BE MADE ONLY AT CONTROL PANEL TERMINAL BLOCKS.
- GROUND ALL CONDUCTOR SHIELDS AT PANEL ONLY - DO NOT GROUND SHIELDS AT BOTH ENDS.
- AT THE FOLLOWING LOCATIONS, UNLESS OTHERWISE NOTED, PULL, JUNCTION, TERMINAL, SWITCH, AND OUTLET BOXES SHALL BE CAST IRON WHERE STEEL CONDUIT IS TERMINATED; OR SHALL BE CAST ALUMINUM WHERE ALUMINUM CONDUIT IS TERMINATED:  
A - AT LOCATIONS WHERE VAPORTIGHT LIGHTING FIXTURES AND/OR WATERTIGHT RECEPTACLES ARE INDICATED.  
B - AT LOCATIONS ON OR IN ALL OUTSIDE WALLS.  
C - OUTDOORS
- NAMEPLATES SHALL CONFORM STRICTLY TO INSTRUCTIONS IN THE ELECTRICAL SPECIFICATIONS AND ON THE DRAWINGS. THE FOLLOWING SHALL HAVE NAMEPLATES:  
A - ALL LOCAL CONTROL STATIONS AT OR NEAR EQUIPMENT.  
B - ALL PANELBOARDS AND CONTROL PANELS.
- PIPE SLEEVES FOR CONDUITS PASSING FROM NON-HAZARDOUS AREAS TO HAZARDOUS AREAS SHALL HAVE CAULKING APPLIED TO MAKE THE INSTALLATION GASTIGHT.
- CONTRACTOR SHALL PROVIDE ALL CONDUIT, WIRING, EQUIPMENT, AND CONTROL DEVICES AS INDICATED BY SCHEMATICS, SINGLE LINE DIAGRAMS, SCHEDULES, PLANS, SPECIFICATIONS, AND VENDOR DOCUMENTATION TO PROVIDE A COMPLETE WORKING SYSTEM.
- PROVIDE CONDUIT FREEZE EXPANSION FITTINGS FOR ALL EXTERIOR CONDUIT SYSTEMS AS REQUIRED.
- CONTRACTOR SHALL PROVIDE A COMPLETE WORKING OPERATING SYSTEM IN ACCORDANCE WITH ALL DRAWINGS, SPECIFICATIONS, CODES AND STANDARDS.
- ALL CONDUIT UNDERGROUND SHALL BE SCHEDULE 80 PVC.
- ALL GENERAL NOTES, SYMBOL LISTS, AND ABBREVIATIONS SHALL BE CONSIDERED AS APPLICABLE TO ALL ELECTRICAL DRAWINGS FOR THIS PROJECT. SYMBOLS AND ABBREVIATIONS SHOWN ON THIS SHEET ARE FOR REFERENCE ONLY AND DO NOT INDICATE THEIR INCORPORATION IN THE DESIGN.

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| NO. | DATE     | REVISIONS               | BY  | CHK |
|-----|----------|-------------------------|-----|-----|
| 2   | 03/09/11 | ISSUED FOR CONSTRUCTION | REO | MAP |
| 1   | 02/12/10 | FINAL                   | REO | MAP |
| 0   | 12/07/09 | ISSUED FOR BID          | REO | BDE |
| A   | 12/07/09 | FOR CLIENT REVIEW       | REO | BDE |

|                |                          |
|----------------|--------------------------|
| DRAWN: BDE     | PROJECT NO: 6107-10-0016 |
| ENGINEER: BDE  | SCALE: NONE              |
| CHECKED: REO   | APPROVED: PHT            |
| DATE: 03/09/11 | DATE: 03/09/11           |



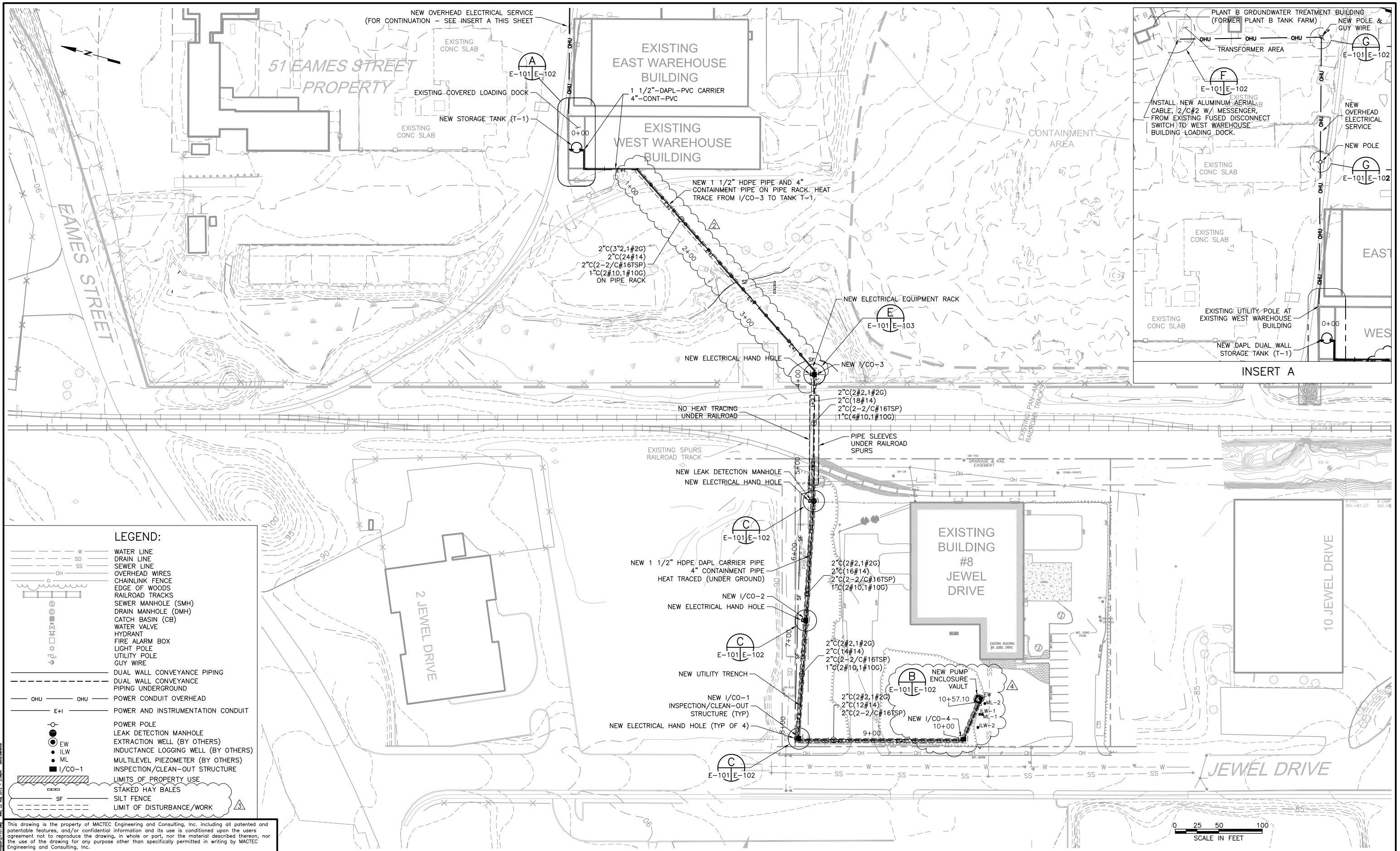
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DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

ELECTRICAL  
ELECTRICAL GENERAL NOTES AND LEGEND

|                      |
|----------------------|
| DRAWING NO:<br>E-001 |
| 10                   |
| 15                   |





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|     |          |                                       |     |     |           |              |
|-----|----------|---------------------------------------|-----|-----|-----------|--------------|
| 4   | 11/03/12 | REVISED LOCATION FOR EW AND VAULT     | REO | MAP | DRAWN:    | PROJECT NO:  |
| 3   | 04/05/11 | ADDRESSED TOWN OF WILMINGTON COMMENTS | REO | MAP | DEL       | 6107-10-0016 |
| 2   | 03/09/11 | ISSUED FOR CONSTRUCTION               | REO | MAP | ENGINEER: | SCALE:       |
| 1   | 02/12/10 | FINAL                                 | REO | MAP | BDE       | 1" = 50'     |
| 0   | 12/07/09 | ISSUED FOR BID                        | REO | BDE | CHECKED:  | APPROVED:    |
| A   | 11/12/09 | FOR CLIENT REVIEW                     | REO | BDE | REO       | PHT          |
| NO. | DATE     | REVISIONS                             | BY  | CHK | DATE:     | DATE:        |

|     |     |           |              |
|-----|-----|-----------|--------------|
| REO | MAP | DRAWN:    | PROJECT NO:  |
| REO | MAP | DEL       | 6107-10-0016 |
| REO | MAP | ENGINEER: | SCALE:       |
| REO | MAP | BDE       | 1" = 50'     |
| REO | BDE | CHECKED:  | APPROVED:    |
| REO | BDE | REO       | PHT          |
| BY  | CHK | DATE:     | DATE:        |

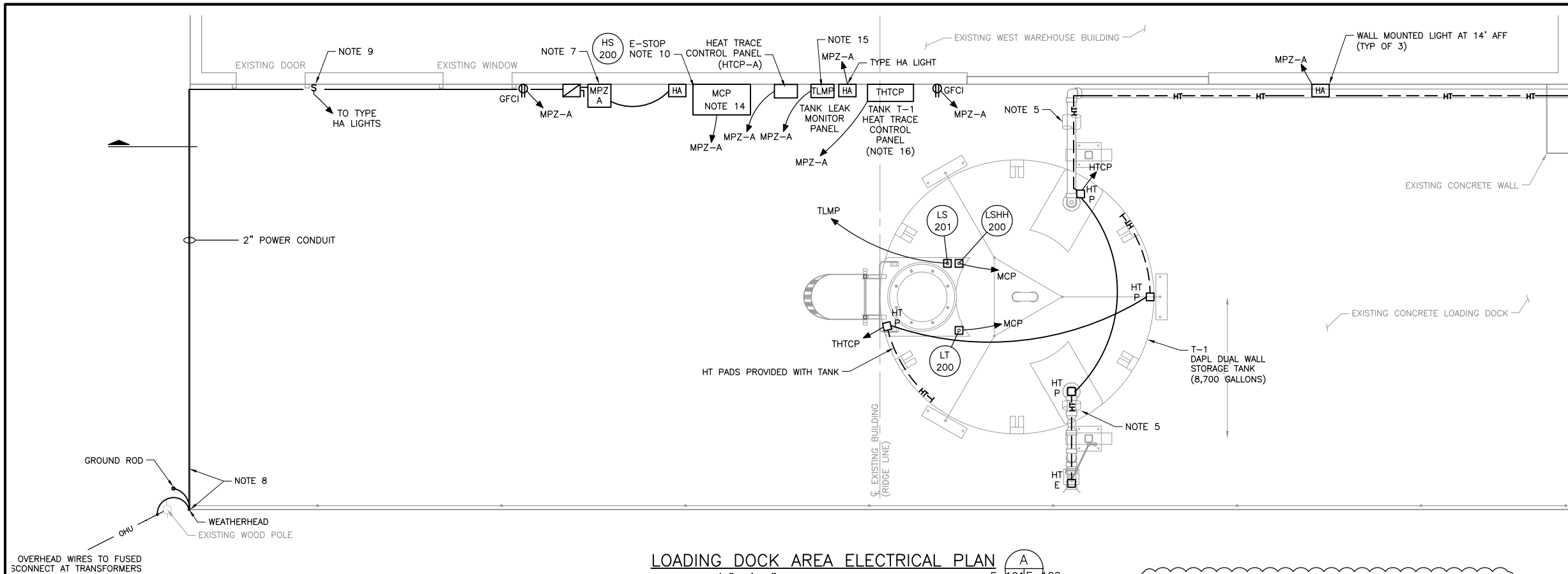


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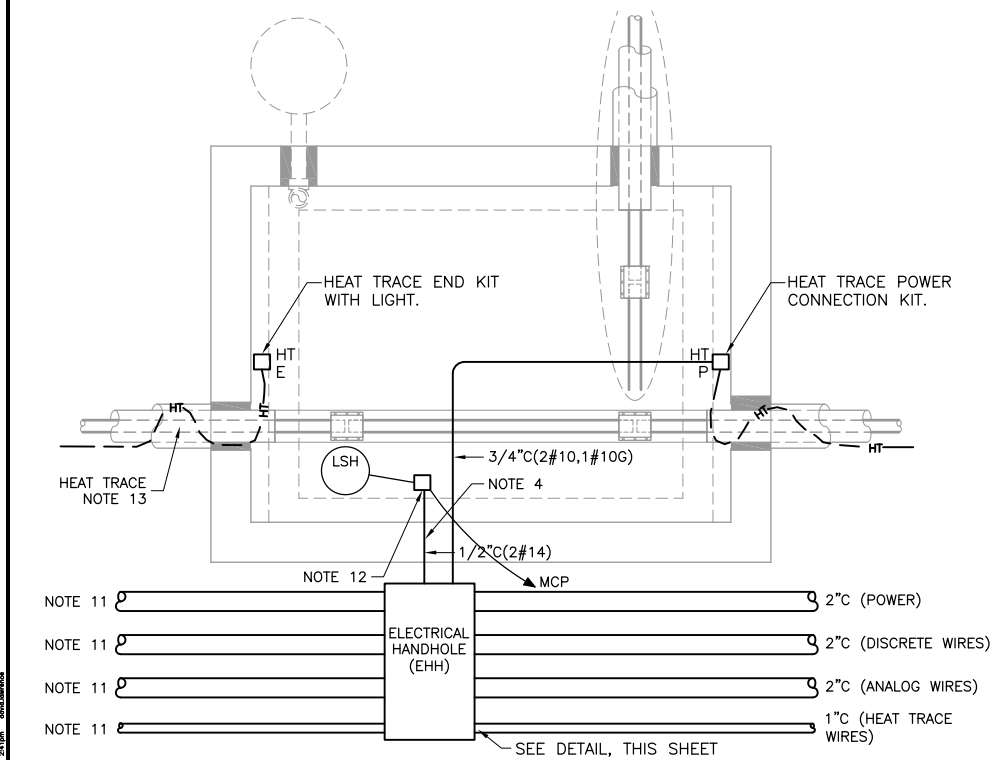
DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

ELECTRICAL  
PROPOSED ELECTRICAL SITE PLAN

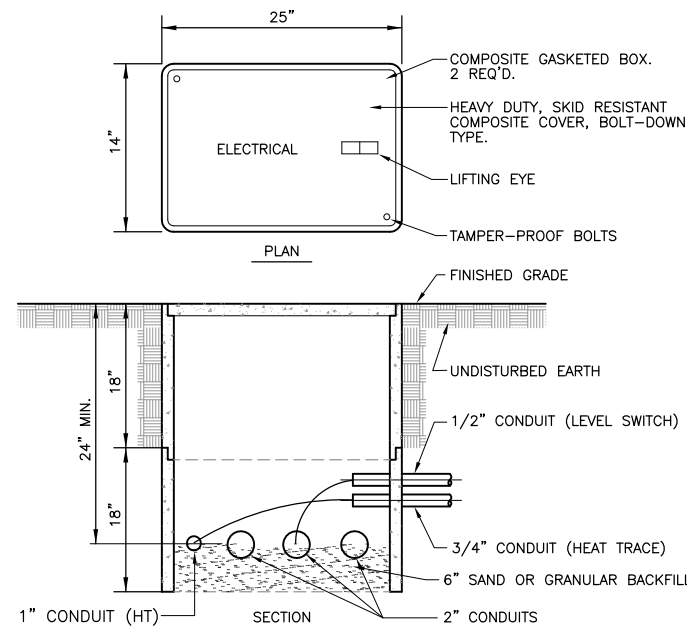
|             |       |
|-------------|-------|
| DRAWING NO: | E-101 |
| 11          | 15    |



**LOADING DOCK AREA ELECTRICAL PLAN (A)**  
 SCALE: 3/8"=1'-0"  
 E-101E-102

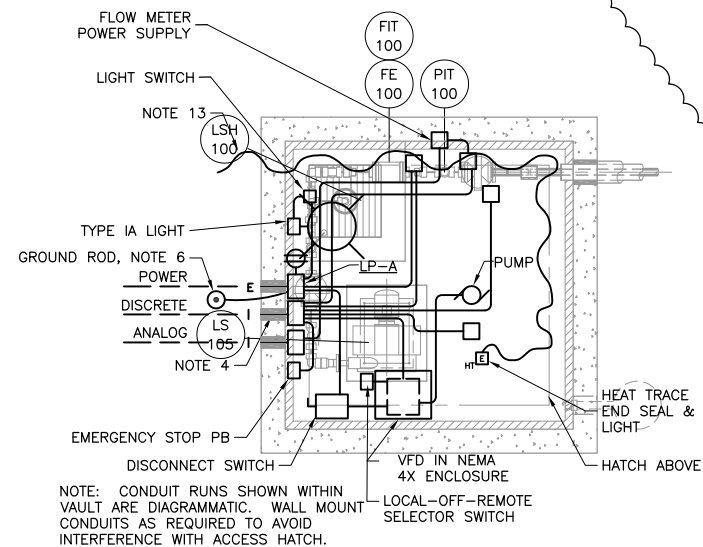


**TYPICAL INSPECTION/CLEAN-OUT STRUCTURE ELECTRICAL PLAN (C)**  
 NTS E-101E-102



**ELECTRICAL HANDHOLE DETAIL (NTS)**

**FOR REVISIONS TO PUMP ENCLOSURE VAULT FLOOR PLAN DETAIL – SEE DRAWING C-301**



**PUMP ENCLOSURE VAULT ELECTRICAL PLAN (B)**  
 NTS E-101E-102

**NOTES:**

- SEE DRAWING E-001 FOR SYMBOLS AND LEGEND.
- SEE DRAWING E-101 FOR ELECTRICAL SITE PLAN.
- SEE DRAWING E-602 FOR ELECTRICAL SPECIFICATIONS.
- SEAL CONDUIT PENETRATIONS THROUGH ALL BELOW GRADE WALLS.
- HEAT TRACE AND INSULATE 4" PVC CONTAINMENT PIPE, 4" PVC TANK DISCHARGE PIPE EXTERNAL TO PUMP ENCLOSURE VAULT, UNLESS OTHERWISE INDICATED.
- INSTALL GROUND ROD AND GROUND CONDUCTOR TO LP-A.
- MOUNT ELECTRICAL EQUIPMENT ON GALVANIZED STEEL CHANNEL RACK BOLTED TO BUILDING WALL. SEE DETAIL D, SHEET E-103.
- INSTALL WEATHERHEAD ON SIDE OF BUILDING. INSTALL CONDUIT TO WIREWAY ABOVE DISCONNECTS AND MPZ-A.
- WALL MOUNT LIGHT SWITCH.
- MOUNT EMERGENCY STOP PUSHBUTTON AND PUMP SPEED POTENTIOMETER ON FACE OF MAIN CONTROL PANEL, 54" ABOVE LOADING DOCK FLOOR.
- ROUTE CONDUITS FROM PUMP VAULT AREA TO TANK AREA FOLLOWING PIPING. ROUTE CONDUITS TO EACH DEVICE AS REQUIRED IN FIELD. COORDINATE INSTALLATION WITH PIPING AND SUPPORT REQUIREMENTS.
- INSPECTION CLEAN-OUT STRUCTURE LEVEL SWITCH. SEE DRAWING D-601 FOR INSTRUMENTATION NUMBER FOR EACH DEVICE. PROVIDE JUNCTION BOX FOR WIRING FROM DISCRETE CONDUIT. SET FOR DETECTION AT 2" ABOVE FINISHED BASE. COORDINATE LOCATION WITH PIPING REQUIREMENTS.
- HEAT TRACE AND INSULATE 4" PVC CONTAINMENT PIPE EXTERNAL TO INSPECTION/CLEAN-OUT STRUCTURES AND LEAK DETECTION MANHOLE.
- CONTROL PANEL SHALL CONTAIN PLC FOR SYSTEM, TELEPHONE DIALER, OPERATOR INTERFACE TOUCH SCREEN DISPLAY, PUMP SPEED CONTROL & CELLULAR TERMINAL.
- TANK LEAK MONITOR CONTROL PANEL PROVIDED WITH TANK.
- TANK HEAT TRACE CONTROL PANEL FURNISHED WITH TANK.
- POWER FOR INSTRUMENTS ON TANK T-1 SHALL ORIGINATE AT THE MAIN CONTROL PANEL. ALL REQUIRED CONVERTERS AND POWER SUPPLIES FOR FIELD DEVICES SHALL BE PROVIDED WITH MAIN CONTROL PANEL.

**WORK IN PUMP ENCLOSURE VAULT:**

- INSTALL LOAD CENTER LP-A, DISCONNECT SWITCH, VFD AND ENCLOSURE (PROVIDED BY PUMP SUPPLIER), LOCAL-OFF-REMOTE SWITCH, DAPL PUMP, LIGHT AND SWITCH, EMERGENCY STOP PUSHBUTTON, FE-100 POWER SUPPLY AND GFCI RECEPTACLE.
- INSTALL WIRING TO FLOAT SWITCH, FLOW ELEMENT AND TRANSMITTER, PRESSURE TRANSMITTER AND GLYCOL PRESSURE SWITCH (IN PUMP). INSTALL WIRES FROM DEVICES TO MAIN CONTROL PANEL VIA ANALOG OR DISCRETE CONDUITS AS REQUIRED. SEE D-601.
- INSTALL HEAT TRACING CABLE, END KIT, AND WIRE AND CONDUIT TO HEAT TRACE CONTROL PANEL HTCP-B. MOUNT HTCP-B ON EQUIPMENT RACK. SEE HEAT TRACE RISERS ON E-601.
- PROVIDE 6"x6"x4" GASKETED JUNCTION BOXES ON ENDS OF 2" INSTRUMENTATION CONDUITS WITHIN VAULT. EXTEND CONDUITS AND CONDUCTORS FROM JUNCTION BOXES TO LOADS WITHIN VAULT. FIELD ROUTE CONDUITS AS REQUIRED. COORDINATE WITH MECHANICAL PIPING.
- PRESSURE TRANSMITTER PIT-100 SHALL BE LOOP POWERED, 24VDC, WITH 4-20mA OUTPUT AND LOCAL DISPLAY, 0-100PSIG. DWYER 619-4 OR EQUAL.
- 120VAC INPUT, 24-VOLT, DC OUTPUT POWER SUPPLY FOR FIT-100 SHALL BE MOUNTED IN A NEMA 3R ENCLOSURE IN THE PUMP VAULT NEAR THE FLOW TRANSMITTER. TRC ELECTRONICS LPV-20-24, SOLA OR EQUAL.

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|     |          |                                       |     |     |           |              |
|-----|----------|---------------------------------------|-----|-----|-----------|--------------|
| 4   | 05/15/12 | REVISED VAULT                         | REO | MAP | DRAWN:    | PROJECT NO:  |
| 3   | 04/05/11 | ADDRESSED TOWN OF WILMINGTON COMMENTS | REO | MAP | DEL       | 6107-10-0016 |
| 2   | 03/09/11 | ISSUED FOR CONSTRUCTION               | REO | MAP | ENGINEER: | SCALE:       |
| 1   | 02/12/10 | FINAL                                 | REO | MAP | KWD       | AS NOTED     |
| 0   | 12/07/09 | ISSUED FOR BID                        | REO | BDE | CHECKED:  | APPROVED:    |
| A   | 11/12/09 | FOR CLIENT REVIEW                     | REO | BDE | REO       | PHT          |
| NO. | DATE     | REVISIONS                             | BY  | CHK | DATE:     | DATE:        |
|     |          |                                       |     |     | 03/09/11  | 03/09/11     |

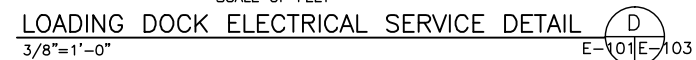
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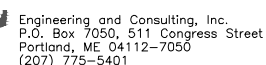
ELECTRICAL  
 ELECTRICAL PLANS AND DETAIL

DRAWING NO:  
 E-102  
 12  
 15

1. SEE MAIN CONTROL PANEL DETAIL, SHEET E-601.



|   |           |              |
|---|-----------|--------------|
| 1 | DRAWN:    | PROJECT NO:  |
| 2 | BDE       | 6107-10-0016 |
| 3 | ENGINEER: | SCALE:       |
| 4 | BDE       | AS NOTED     |
| 5 | CHECKED:  | APPROVED:    |
| 6 | REO       | PHT          |
| 7 | DATE:     | DATE:        |
| 8 | 03/09/11  | 003/09/11    |

ELECTRICAL  
ELECTRICAL DETAILS

DRAWING NO:  
E-103

13

15

| LUMINAIRE SCHEDULE |              |          |          |              |                 |         |                                                                                      |
|--------------------|--------------|----------|----------|--------------|-----------------|---------|--------------------------------------------------------------------------------------|
| CODE               | LIGHT SOURCE |          | MOUNTING | MANUFACTURER | CATALOG NO.     | VOLTS   | DESCRIPTION                                                                          |
|                    | TYPE         | LAMPING  |          |              |                 |         |                                                                                      |
| HA                 | METAL HALIDE | 175 WATT | WALL     | LITHONIA     | TWP-175M-120-SF | 120 VAC | WALL PACK LUMINAIRE, CAST ALUM. HOUSING, POLYCARBONATE REFRACTOR, DARK BRONZE FINISH |
| IA                 | INCANDESCENT | 150 WATT | WALL     | CROUSE-HINDS | VXHB15GP        | 120 VAC | ENCLOSED AND GASKETED LUMINAIRE, CAST ALUM. HOUSING, TEMPERED GLASS GLOBE, GUARD     |

MPZ-A SCHEDULE

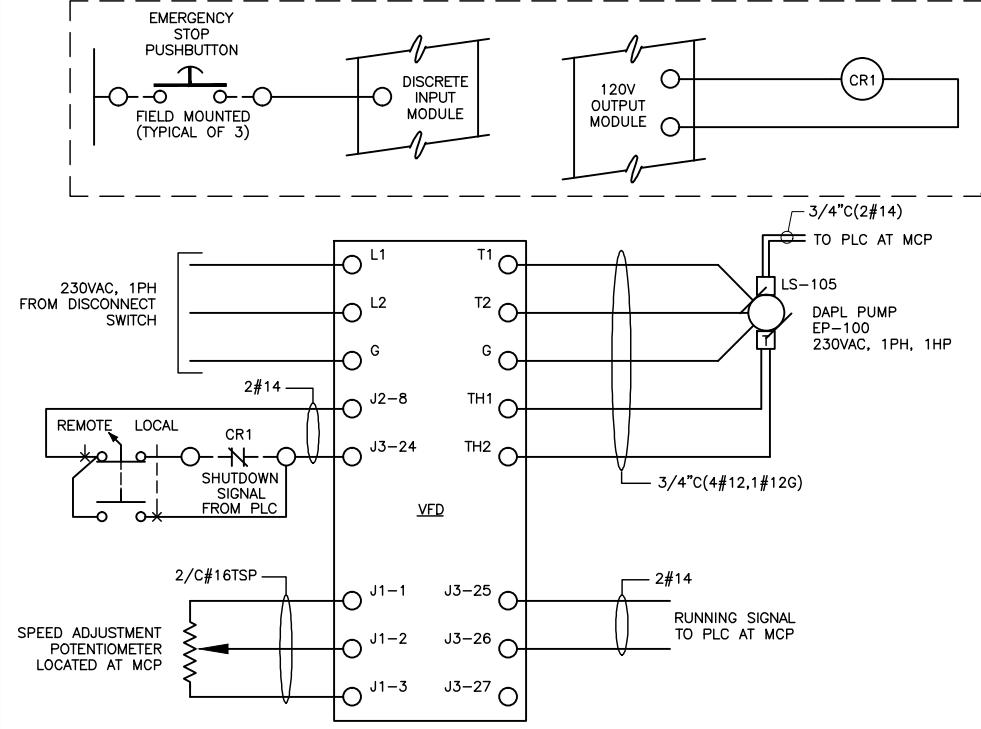
| TRANSFORMER SIZE: 10KVA<br>MOUNTING TYPE: SURFACE<br>MAIN CB RATING: 30A<br>SEC CB RATING: 60A |         |                                   |         | SUPPLY VOLTAGE: 480V, 1PH, 3W<br>SECONDARY VOLTAGE: 120/240V, 1PH, 3W<br>FED FROM: FUSED DISC AT LOADING DOCK<br>SC RATING (KAIC): 18KAIC |         |         |         |                               |           |
|------------------------------------------------------------------------------------------------|---------|-----------------------------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|---------|-------------------------------|-----------|
| LOAD AMPS                                                                                      | CB SIZE | LOAD DESCRIPTION                  | CKT NO. | PH-A VA                                                                                                                                   | PH-B VA | CKT NO. | CB SIZE | LOAD DESCRIPTION              | LOAD AMPS |
| 5                                                                                              | 20      | MAIN CONTROL PANEL (MCP)          | 1       | 600                                                                                                                                       |         | 2       | 20      | SPARE                         | 0         |
| 18                                                                                             | 30      | HEAT TRACE CONTROL PANEL (HTCP-A) | 3       |                                                                                                                                           | 3360    | 4       | 20      | GFCI RECEPTACLES              | 10        |
| 0                                                                                              | 20      | SPARE                             | 5       | 600                                                                                                                                       |         | 6       | 20      | LEVEL SENSORS AND TRANSMITTER | 5         |
| 0                                                                                              | 20      | SPARE                             | 7       |                                                                                                                                           | 0       | 8       | 20      | SPARE                         | 0         |
| 24                                                                                             | 30      | TANK HEAT TRACE PANEL (THTCP)     | 9       | 3600                                                                                                                                      |         | 10      | 20      | LIGHTS                        | 5         |
| LOAD PER PHASE (AMPS)                                                                          |         |                                   |         | 40                                                                                                                                        |         | 28      |         |                               |           |
| LOAD PER PHASE (KVA)                                                                           |         |                                   |         | 4.8                                                                                                                                       |         | 3.36    |         |                               |           |

MPZ-B SCHEDULE

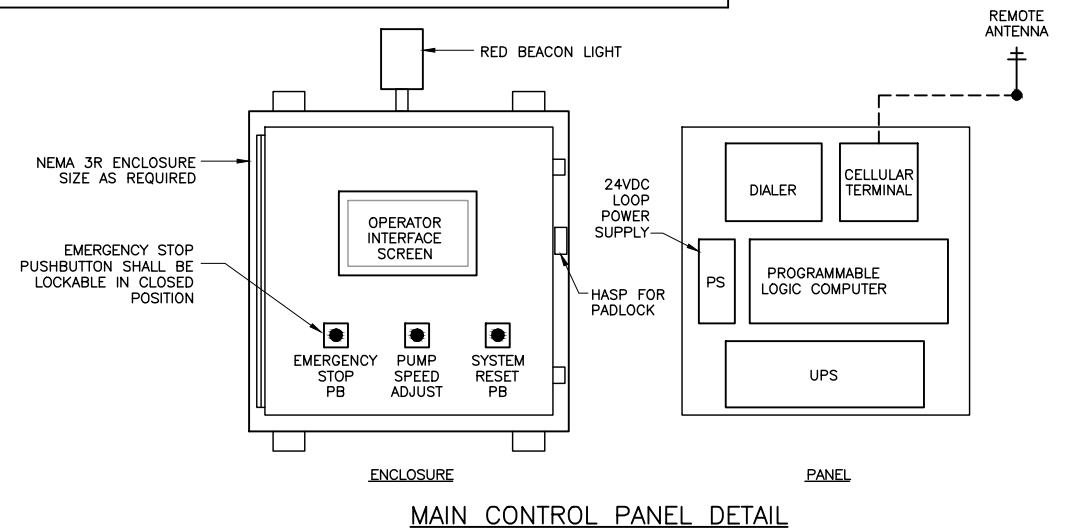
| TRANSFORMER SIZE: 10KVA<br>MOUNTING TYPE: SURFACE<br>MAIN CB RATING: 30A<br>SEC CB RATING: 60A |         |                         |         |         |         | SUPPLY VOLTAGE: 480V, 1PH, 3W<br>SECONDARY VOLTAGE: 120/240V, 1PH, 3W<br>FED FROM: FUSED DISC AT EQUIP. RACK<br>SC RATING (KAIC): 18kAIC |         |                                   |           |  |  |
|------------------------------------------------------------------------------------------------|---------|-------------------------|---------|---------|---------|------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------------------------|-----------|--|--|
| LOAD AMPS                                                                                      | CB SIZE | LOAD DESCRIPTION        | CKT NO. | PH-A VA | PH-B VA | CKT NO.                                                                                                                                  | CB SIZE | LOAD DESCRIPTION                  | LOAD AMPS |  |  |
| 6                                                                                              | 20      | PANEL LP-A (PUMP VAULT) | 1       | 720     |         | 2                                                                                                                                        | 20      | SPARE                             | 0         |  |  |
| 9                                                                                              |         |                         | 3       |         | 4080    | 4                                                                                                                                        | 30      | HEAT TRACE CONTROL PANEL (HTCP-B) | 25        |  |  |
| 10                                                                                             | 20      | GFCI RECEPTACLE         | 5       | 1800    |         | 6                                                                                                                                        | 20      | FLOW METER & PRESSURE TRANSMITTER | 5         |  |  |
| 0                                                                                              | 20      | SPARE                   | 7       |         | 0       | 8                                                                                                                                        | 20      | SPARE                             | 0         |  |  |
| 0                                                                                              | 20      | SPARE                   | 9       | 0       |         | 10                                                                                                                                       | 20      | SPARE                             | 0         |  |  |
| LOAD PER PHASE (AMPS)                                                                          |         |                         |         | 21      | 34      |                                                                                                                                          |         |                                   |           |  |  |
| LOAD PER PHASE (KVA)                                                                           |         |                         |         | 2.52    | 4.08    |                                                                                                                                          |         |                                   |           |  |  |

LP-A SCHEDULE

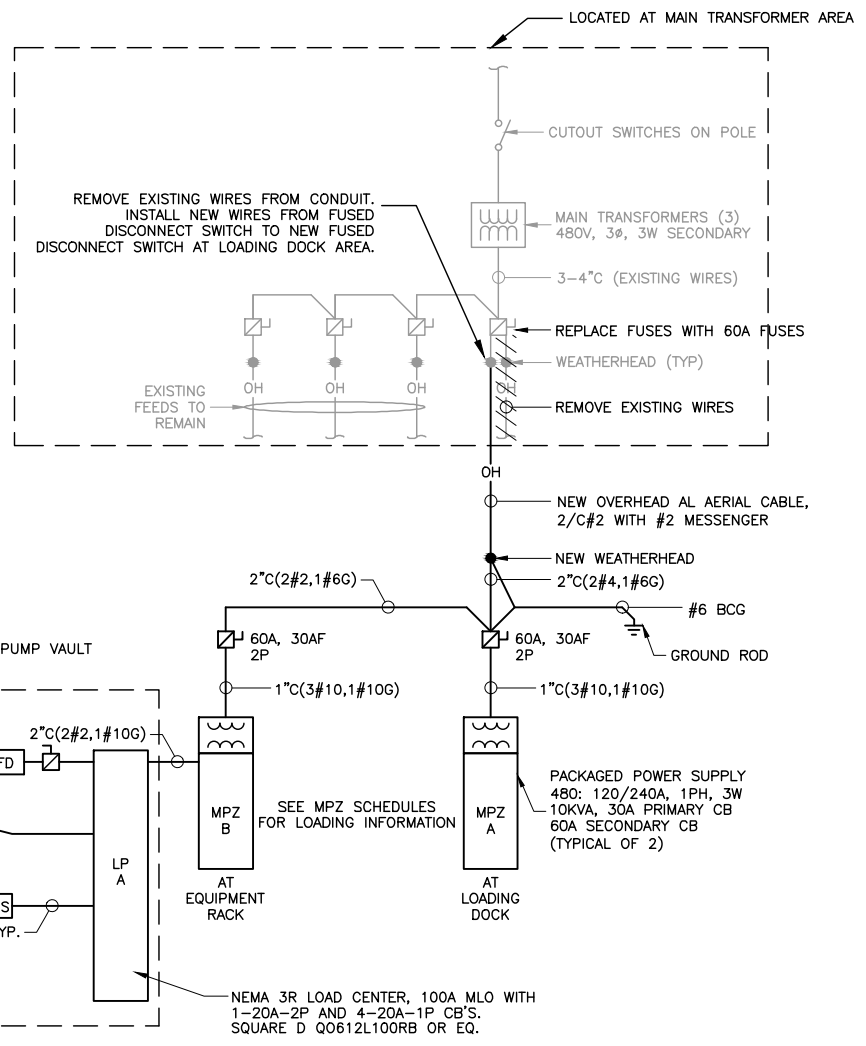
| MOUNTING TYPE: SURFACE<br>RATING: 100A BUS<br>MAIN LUGS ONLY |         |                                    |         |         |         | LOCATION: PUMP VAULT<br>SUPPLY VOLTAGE: 120/240V, 1PH, 3W<br>FED FROM: MPZ-B<br>SC RATING (KAIC): 18kAIC |         |                  |           |  |  |
|--------------------------------------------------------------|---------|------------------------------------|---------|---------|---------|----------------------------------------------------------------------------------------------------------|---------|------------------|-----------|--|--|
| LOAD AMPS                                                    | CB SIZE | LOAD DESCRIPTION                   | CKT NO. | PH-A VA | PH-B VA | CKT NO.                                                                                                  | CB SIZE | LOAD DESCRIPTION | LOAD AMPS |  |  |
| 4                                                            | 20      | DAPL PUMP & VFD                    | 1       | 480     |         | 2                                                                                                        | 20      | SPARE            | 0         |  |  |
| 4                                                            |         |                                    | 3       |         | 1080    | 4                                                                                                        | 20      | GFCI RECEPTACLE  | 5         |  |  |
| 1                                                            | 20      | FLOW TRANSMITTER FIT-100 24VDC P/S | 5       | 240     |         | 6                                                                                                        | 20      | VAULT LIGHT      | 1         |  |  |
| LOAD PER PHASE (AMPS)                                        |         |                                    |         | 6       | 9       |                                                                                                          |         |                  |           |  |  |
| LOAD PER PHASE (KVA)                                         |         |                                    |         | 0.72    | 1.08    |                                                                                                          |         |                  |           |  |  |



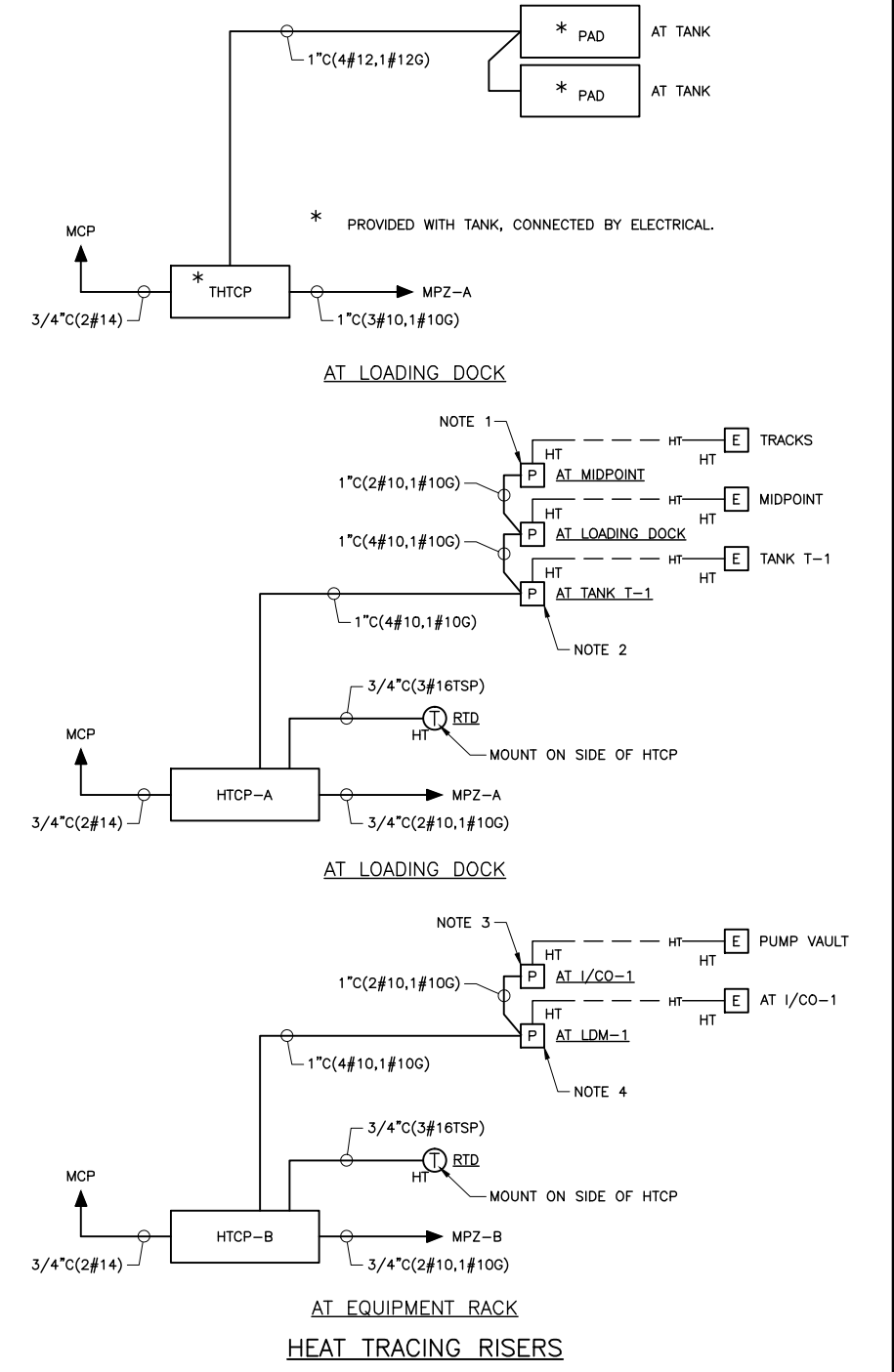
DAPL PUMP VFD AND E-STOP WIRING DIAGRAM



MAIN CONTROL PANEL DETAIL



POWER ONE-LINE DIAGRAM



- HEAT TRACING NOTES:
1. INSTALL POWER CONNECTION KIT AT A POINT MIDWAY BETWEEN THE WAREHOUSE BUILDING AND THE NEW ELECTRICAL EQUIPMENT RACK, APPROX. STA. 2+00. INSTALL HEAT TRACE CABLE ON EXPOSED PIPING FROM POWER KIT TO EQUIPMENT RACK.
  2. INSTALL POWER CONNECTION KIT AT TANK T-1. CONDUIT AND WIRE FROM TANK T-1 TO A POINT MIDWAY BETWEEN THE WAREHOUSE BUILDING AND THE NEW ELECTRICAL EQUIPMENT RACK. INSTALL END SEAL KIT WITH LIGHT. ALSO INSTALL POWER CONNECTION KIT, HEAT TRACE CABLE AND END KIT WITH LIGHT AT TANK DISCHARGE PIPE, POWERED FROM THE SAME CIRCUIT.
  3. INSTALL POWER CONNECTION KIT IN LEAK DETECTION MANHOLE LDM-1. INSTALL CONDUIT AND WIRES TO MPZ-B VIA SLEEVE UNDER TRACKS. INSTALL HEAT TRACE CABLE FROM LDM-1 TO I/CO-1. INSTALL END SEAL KIT WITH LIGHT.
  4. INSTALL POWER CONNECTION KIT AT I/CO-1. INSTALL HEAT TRACE CABLE FROM I/CO-1 TO PUMP VAULT. INSTALL END SEAL KIT WITH LIGHT.

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| NO. | DATE     | REVISIONS               | BY  | CHK |
|-----|----------|-------------------------|-----|-----|
| 2   | 03/09/11 | ISSUED FOR CONSTRUCTION | REO | MAP |
| 1   | 02/12/10 | FINAL                   | REO | MAP |
| 0   | 12/07/09 | ISSUED FOR BID          | REO | BDE |
| A   | 11/12/09 | FOR CLIENT REVIEW       | REO | BDE |

|                |                          |
|----------------|--------------------------|
| DRAWN: BDE     | PROJECT NO: 6107-10-0016 |
| ENGINEER: BDE  | SCALE: NONE              |
| CHECKED: REO   | APPROVED: PHT            |
| DATE: 03/09/11 | DATE: 03/09/11           |



Engineering and Consulting, Inc.  
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(207) 775-5401

DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

ELECTRICAL  
ONE-LINE, HEAT TRACE RISERS  
WIRING DIAGRAMS, SCHEDULES

|                   |
|-------------------|
| DRAWING NO: E-601 |
| 14                |
| 15                |

1.01 DESCRIPTION

A. THE DRAWINGS ARE DIAGRAMMATIC AND SHOW ONLY APPROXIMATE LOCATIONS OF EQUIPMENT, FIXTURES, PANELBOARDS, WIRING DEVICES, ETC.

B. THE GENERAL RUN OF ELECTRICAL FEEDERS, BRANCH CIRCUITS, CONDUITS, ETC. IS INDICATED ON THE DRAWINGS. IT IS NOT INTENDED THAT THE EXACT ROUTING BE DETERMINED THEREFROM.

C. CIRCUIT DESIGNATIONS ON SINGLE LINE DIAGRAM, ELECTRICAL SCHEMATICS, INSTRUMENTATION SCHEMATICS, PANELBOARD SCHEDULES AND IN THE FORM OF "HOME RUNS" ON THE DRAWINGS, INDICATES THE DESIGNATION OF THE BRANCH CIRCUIT. THE SIZE AND QUANTITY OF BRANCH CIRCUIT CONDUCTORS, THE BRANCH CIRCUIT OVERCURRENT DEVICE RATING AND THE PANELBOARD OR INTERCONNECTION BOX FROM WHICH THE BRANCH CIRCUIT IS SERVED.

D. ALL EQUIPMENT, ACCESSORIES AND ASSOCIATED RACEWAYS, ETC., SHALL BE INSTALLED IN SUCH A MANNER THAT AMPLE MAINTENANCE AND PASSAGE SPACE AND CODE REQUIREMENT SPACE/ACCESS IS PROVIDED.

E. WHERE MORE THAN ONE TRADE IS INVOLVED IN AN AREA, ALL SHALL COOPERATE AND INSTALL THEIR OWN WORK TO UTILIZE THE SPACE EQUALLY BETWEEN THEM IN PROPORTION TO THEIR INDIVIDUAL REQUIREMENTS.

F. PROVIDE AND INSTALL ALL GROUNDING AND APPURTENANCES AS SHOWN ON THE DRAWINGS AND AS SPECIFIED HEREIN.

G. FURNISH AND INSTALL COMPLETE INSTRUMENTATION AND PROCESS CONTROL SYSTEMS AS DESCRIBED AND SPECIFIED HEREIN AND AS SHOWN ON THE CONTRACT DRAWINGS.

H. FURNISH AND INSTALL ALL INSTRUMENTATION DEVICES, CONVERTERS, POWER SUPPLIES AND OTHER APPURTENANCES REQUIRED FOR A COMPLETE SYSTEM.

1.02 QUALITY ASSURANCE

A. IN GENERAL, THE WORKMANSHIP OF THE ELECTRICAL INSTALLATION SHALL BE AS DESCRIBED IN THE N.E.C.A. ELECTRICAL DESIGN GUIDELINES. ALL METHODS OF CONSTRUCTION, DETAILS OF WORKMANSHIP, ETC. THAT ARE NOT SPECIFICALLY DESCRIBED THEREIN OR INDICATED IN THE CONTRACT DOCUMENTS, SHALL BE SUBJECT TO THE CONTROL AND APPROVAL OF THE ENGINEER.

1.03 SUBMITTALS

A. SUBMIT VENDOR DATA FOR PERFORMANCE, FUNCTIONS, MATERIALS, AND OPERATION FOR ALL PRODUCTS LISTED IN PART 2 - PRODUCTS. WHERE APPLICABLE, SUBMIT OPERATION AND MAINTENANCE MANUALS.

B. UPON COMPLETION OF PROJECT, SUBMIT AS-CONSTRUCTED DRAWINGS SHOWING ACTUAL LOCATION OF DEVICES AND WIRING. SUBMIT IN AUTOCAD DRAWING FORMAT.

PART 2 - PRODUCTS

2.01 MATERIALS

A. CONDUIT

1. RIGID HEAVY WALL STEEL CONDUIT (RSC OR RGS) SHALL BE CONSTRUCTED OF HOT DIPPED GALVANIZED OR ELECTRO-GALVANIZED STEEL. ACCEPTABLE MANUFACTURERS: REPUBLIC, TRIANGLE PWC, ALLIED, WHEATLAND.

2. PVC CONDUIT SHALL BE SCHEDULE 80. MANUFACTURERS: CARLON, HUBBELL, CANTEX, SOUTHERN PIPE.

3. ALL FITTINGS SHALL BE OF THE SAME MATERIAL AS THE RESPECTIVE RACEWAY SYSTEM.

4. FITTINGS FOR SEALING AROUND CONDUITS PASSING THROUGH NEW BELOW-GRADE CONCRETE WALLS SHALL BE O.Z./GEDNEY CO. TYPE FSK, OR EQUIVALENT.

B. CONDUCTORS AND CABLE

1. UNLESS SHOWN OTHERWISE ON THE DRAWINGS, ALL POWER CONDUCTORS SHALL BE INSULATED FOR 600 VOLTS AND SHALL BE STANDARD AWG AND MCM SIZES. CONDUCTORS SHALL BE 98 PERCENT COPPER, STRANDED, HEAT AND MOISTURE RESISTANT AND THERMAL PLASTIC INSULATED FOR ALL SIZES NO. 12 AWG AND LARGER. CONDUCTORS SHALL BE LABELED WITH U.L. APPROVAL AND BE MARKED WITH THE MANUFACTURER'S NAME, WIRE SIZE AND INSULATION TYPE. INSULATION FOR ALL 600 VOLT CONDUCTORS SHALL BE TYPE THWN/THHN OR TYPE XHHW. ALL WIRING SHALL BE SUITABLE FOR WET, WATER-FILLED APPLICATIONS. ACCEPTABLE MANUFACTURERS: OKONITE, SOUTHWIRE, PIRELLI, CABLEC, BIW.

2. ALL DISCRETE CONTROL CONDUCTORS SHALL BE INSULATED FOR 600 VOLTS, UNLESS OTHERWISE NOTED, AND SHALL BE NO. 14 AWG MINIMUM SIZE. CONDUCTORS SHALL BE 98 PERCENT COPPER, STRANDED, HEAT AND MOISTURE RESISTANT, AND THERMAL PLASTIC INSULATED. ACCEPTABLE MANUFACTURERS: OKONITE, SOUTHWIRE, PIRELLI.

3. ALL ANALOG CONTROL WIRING CONDUCTORS SHALL BE INSULATED FOR 250 VOLTS, UNLESS OTHERWISE NOTED, AND SHALL BE 2/C#16 TWISTED SHIELDED PAIR (TSP). ACCEPTABLE MANUFACTURERS: BELDEN, SOUTHWIRE, AMERICAN INSULATED WIRE CORP, GENERAL CABLE.

C. OUTLET BOXES

1. OUTLET BOXES EXPOSED TO MOISTURE SHALL BE CADMIUM CAST ALLOY COMPLETE WITH HUBS AND GASKETED SCREW FASTENED COVERS. ACCEPTABLE MANUFACTURERS: STEEL CITY, APPLETON, CROUSE-HINDS, RACO.

D. PULL AND JUNCTION BOXES

1. BOXES SHALL BE SUITABLE FOR SURFACE MOUNTING IN ACCORDANCE WITH THE LOCATION TO BE INSTALLED. BOXES INSTALLED IN DAMP LOCATIONS SHALL BE OF WATERTIGHT CONSTRUCTION WITH GASKETED COVER AND CONDUIT HUBS.

E. WIRING DEVICES

1. WIRING DEVICES SHALL BE SPECIFICATION GRADE AS DESCRIBED HEREIN. PROVIDE IN-USE COVER PLATES FOR RECEPTACLES AND SWITCHES. ACCEPTABLE MANUFACTURERS: HUBBELL, GENERAL ELECTRIC, ARROW-HART, PASS AND SEYMOR, BRYANT.

2. TOGGLE SWITCHES

a. 20 AMPERE, 1-POLE, 240 VOLT: HUBBELL 1221

b. 20 AMPERE, 3-WAY, 220 VOLT: HUBBELL 12233.

3. RECEPTACLES

a. 20 AMPERE, 125 VOLT, DUPLEX G.F.I. RECEPTACLE: HUBBELL GF-5362

b. 20 AMPERE, 125 VOLT, DUPLEX, WEATHERPROOF: CROUSE HINDS WLDR-1 WITH GFI RECEPTACLE AND IN-USE COVER.

F. SAFETY SWITCHES

1. FURNISH AND INSTALL 600-VOLT, HEAVY-DUTY SAFETY SWITCHES AS INDICATED ON THE PLANS. SWITCHES SHALL BE THREE-POLE OR SINGLE POLE, SINGLE THROW AS INDICATED ON THE PLANS, FUSIBLE OR NON-FUSIBLE AS INDICATED. ALL SAFETY SWITCHES SHALL BE NEMA TYPE HD AND UL LISTED. ENCLOSURE SHALL BE RATED NEMA 3R. SERVICE ENTRANCE RATED, WITH GROUND LUG. ACCEPTABLE MANUFACTURERS: SQUARE D, EATON, CUTLER-HAMMER, SIEMENS, GENERAL ELECTRIC.

G. GROUNDING MATERIALS

1. PROVIDE EQUIPMENT GROUNDING AS SHOWN ON THE DRAWINGS

2. PROVIDE GROUNDING CONDUCTORS FROM GROUND ELECTRODES TO EQUIPMENT.

3. DO NOT USE CONDUIT AS THE GROUND AND/OR BONDING CONDUCTOR.

4. BOND GROUND TERMINAL OF RECEPTACLES TO OUTLET BOXES WITH #12 AWG GREEN INSULATED WIRE.

5. GROUND CONDUIT SYSTEM AND NEUTRAL CONDUCTOR OF WIRING SYSTEM WITH A CONNECTION AT THE MAIN ELECTRICAL SERVICE.

6. GROUND RODS

a. GROUND RODS SHALL BE COPPER-CLAD STEEL, 3/4-INCH IN DIAMETER AND 10 FEET LONG. THE RODS SHALL HAVE A HARD, CLEAN, SMOOTH, CONTINUOUS, SURFACE THROUGHOUT.

H. HEAT TRACING EQUIPMENT

1. HEATING CABLE

a. SELF REGULATING WITH A NOMINAL POWER OUTPUT OF 5 W/FT.

b. TEMPERAUTE ID NUMBER OF T6, 185 DEG F, CONSISTENT WITH NEC.

c. MINIMUM BEND RADIUS OF 0.5" AT 68 DEG F.

d. EQUAL TO RAYCHEM 5BTV.

2. END SEAL KIT

a. COMPATIBLE WITH BTV-CT HEAT CABLE.

b. ABOVE INSTALLATION MOUNTED END SEAL WITH RED LED SIGNAL LIGHT.

c. INGRESS PROTECTION NEMA 4X

d. EQUAL TO RAYCHEM E-100-L2-A.

3. SINGLE ENTRY POWER KIT

a. FOR USE WITH CONDUIT.

b. COMPATIBLE WITH BTV-CT HEAT CABLE.

c. INGRESS PROTECTION NEMA 4X

d. MAXIMUM CONDUCTOR SIZE - 8 AWG.

e. EQUAL TO RAYCHEM JBS-100-A.

4. CONTROL SYSTEM

a. NEMA 4X PROTECTION.

b. RELATIVE HUMIDITY - 0% TO 90%, NONCONDENSING

c. RELAY TYPES - 2-POLE, SOLID STATE, NORMALLY OPEN

d. VOLTAGE, MAXIMUM - 120VAC NOMINAL, 50/60 HZ

e. CURRENT, MAXIMUM - 30A @ 104°F

f. CONTROL ALGORITHMS - LINE SENSING ON/OFF, PROPORTIONAL, PROPORTIONAL AMBIENT, POWER LIMITING, SOFT START

g. EQUAL TO DIGITRACE 920 SSR

5. AMBIENT TEMPERATURE THERMOSTAT

a. ENCLOSURE - NEMA 4X, CAST ALUMINUM, POLYURETHANE COATED

b. SET POINT RANGE - -40°F TO 140°F

c. SENSOR MATERIAL - 300 STAINLESS STEEL

d. SENSOR TYPE - FIXED FLUID-FILLED BULB AND CAPILLARY

e. ELECTRICAL RATING - 22A AT 120-480VAC

f. CONDUIT ENTRY - 3/4" NPT CONDUIT HUB

g. EQUAL TO DIGI-TRACE AMC-1A

I. LEVEL SWITCHES

1. MERCURY-FREE, POLYPROPYLENE HOUSING FLOAT SWITCH, TETHERED MOUNTING. 10A, 250VAC RATED SWITCH. EQUAL TO W.E. ANDERSON SERIES FSW.

2. NORTHEAST FLUID CONTROL MODEL 7010-A-4-20 WIDE ANGLE FLOAT, PUMP DOWN OR EQUAL.

J. LEVEL TRANSMITTERS

1. NORTHEAST FLUID CONTROL MODEL LU81-5101 ECHO SPAN 2-WIRE. 16.4 FOOT RANGE, DISPLAY, 2 INCH NPT, NEMA 4X.

K. FLOW METER

1. ULTRASONIC CLAMP ON FLOW METER FOR 0.5" PVC PIPE. FLOW RANGE 0.5 GPM TO 2 GPM. FLOW RATE AND TOTALIZER DISPLAY. TOTALIZER DISPLAY IN THOUSANDS OF GALLONS. 4-20 mA OUTPUT SIGNAL. SUITABLE FOR ENVIRONMENT. COORDINATE PIPE REQUIREMENTS WITH MECHANICAL. EQUAL TO DYNASONICS TXFL SERIES.

L. AUTO DIALER

1. FOUR CHANNEL INPUT, 4 CUSTOM VOICE CALLOUTS, 1 CONTACT OUTPUT. EQUAL TO SENSAPHONE 400 MODEL.

M. PLC CONTROLLER

1. ALL INPUTS SHALL TERMINATE AT PLC IN MAIN CONTROL PANEL. PLC SHALL ACTIVATE ALL OUTPUT NOTIFICATION DEVICES. .

2. MIN. MEMORY: 16 KILOBYTES OF PROGRAMMABLE RAM MEMORY AND 8K OF DATA STORAGE WITH EEPROM BACKUP.

3. MIN. NUMBER OF I/O POINTS (DISCRETE OR ANALOG): 960

4. POWER: 110/220 VAC POWER SUPPLY. THE PLC SHALL BE CONNECTED TO AN UNINTERRUPTIBLE POWER SUPPLY (UPS).

5. REQUIRED AGENCY APPROVALS: UL LISTED (UL 508), CSA CERTIFIED (CSA 142).

6. EXTERNAL COMMUNICATIONS VIA RS-232/485/ETHERNET PORTS.

7. PROGRAMMING AND DIAGNOSTIC SOFTWARE SHALL BE IBM-COMPATIBLE (WINDOWS BASED) VIA RELAY LADDER LOGIC (RL), BASIC, AND CUSTOM PROGRAMMING TOOLS FOR THE PLC. PROVIDE TO THE ENGINEER AND OWNER A LICENSED COPY OF ALL PROGRAMMING SOFTWARE USED TO CONFIGURE AND PROGRAM THE PLC AND PC. THE SOFTWARE SHALL INCLUDE BOTH THE SOFTWARE AND HARDWARE (I.E. CABLES, INTERFACE BOX, ETC.) REQUIRED FOR DIRECT PLC-TO-PC COMMUNICATIONS FOR PLC PROGRAMMING. ALL SOFTWARE SHALL BE PROVIDED ON CD ROM. A COPY OF THE PLC PROGRAM SHALL BE PROVIDED TO THE ENGINEER AND OWNER. ALL PLCs SHALL BE PROGRAMMABLE AND OPERATE ON THE SAME SOFTWARE LICENSE.

8. PROVIDE PROGRAMMING TIME REQUIRED TO CONFIGURE PLC TO PROVIDE COMPLETE CONTROL AND MONITORING FUNCTIONS AS DESCRIBED IN DRAWINGS AND DESCRIBED HEREIN.

9. THE EXTRACTION PUMP SHALL OPERATE CONTINUOUSLY. THE FOLLOWING DEVICES SHALL STOP THE EXTRACTION PUMP IMMEDIATELY AND INITIATE THE PLC SEQUENCE FOR ALARM CONDITION; VAULT SUMP HIGH LEVEL SWITCH, STORAGE TANK CONTAINMENT HIGH LEVEL, INSPECTION/CLEANOUT MANHOLES HIGH LEVEL, STORAGE TANK HIGH HIGH LEVEL. ONCE THE PUMP IS STOPPED BY AN ALARM CONDITION IT CAN ONLY BE RESTARTED MANUALLY AT THE CONTROL PANEL. THE PUMP WILL ONLY START WHEN ALL ALARMS ARE CLEAR. WHEN THE COMMON ALARM IS ACTIVATED, THE PLC SHALL INITIATE THE AUTODIALER

10. PLC SHALL BE ALLEN-BRADLEY MICROLOGIX 1100 OR EQUAL.

11. PROVIDE ALLEN-BRADLEY PANELVIEW 500 OR EQUAL, FOR TANK LEVEL READOUTS, FLOW TOTALS, PRESSURE INDICATION AND ALARM INDICATION/ACKNOWLEDEMENT.

N. CONTROL PANEL HARDWARE

1. ALL ALARM INDICATING DEVICES SHALL BE PILOT LIGHT LED TYPE, SHALL BE THROUGH-DOOR TYPE SEALED WITH EQUIPMENT MANUFACTURERS RECOMMENDATIONS.

2. ALL H-O-A SWITCHES AND PUSH BUTTON SWITCHES, SHALL BE THROUGH-DOOR FLUSH MOUNTED AND SEALED IN ACCORDANCE WITH RESPECTIVE EQUIPMENT AND CONTROL PANEL MANUFACTURERS RECOMMENDATIONS

O. WEATHERHEAD

1. FURNISH AND INSTALL A THREADED, CAST-ALUMINUM, WIRE ENTRANCE CAP (WEATHERHEAD) AT LOCATIONS INDICATED ON THE PLANS. WEATHERHEAD SHALL HAVE FIVE POWER CONDUCTOR OPENINGS AND ONE GROUND CONDUCTOR OPENING. ACCEPTABLE MANUFACTURERS: APPLETON (F200), EATON, CUTLER-HAMMER, SQUARE D, SIEMENS.

P. AERIAL CABLE

1. FURNISH AND INSTALL 600-VOLT TRIPLEX SERVICE DROP AERIAL CONDUCTORS WITH INTEGRAL MESSENGER CABLE. CONDUCTORS SHALL BE SIZED AS INDICATED ON THE PLANS AND SHALL BE SUITABLE FOR EXTERIOR INSTALLATIONS. CONDUCTORS SHALL BE ALUMINUM WITH XLPE PVC INSULATION, 75-DEGREE C. MESSENGER CABLE SHALL BE USED AS THE GROUNDING CONDUCTOR AND SHALL BE GROUND TO THE EXISTING SYSTEM GROUND AND TO THE NEW GROUND ROD AND SERVICE EQUIPMENT. ACCEPTABLE MANUFACTURERS: SOUTHWIRE, OKONITE, GENERAL CABLE, SERVICE WIRE CO., AMERICAN INSULATED WIRE CORP.

Q. TREATED WOOD UTILITY POLES

1. FURNISH AND INSTALL TREATED WOOD UTILITY POLES AT LOCATIONS INDICATED. POLES SHALL BE CLASS 3, 40' MINIMUM, TAPERED SOUTHERN PINE WITH PRESERVATIVE TREATMENT. MINIMUM TIP CIRCUMFERENCE SHALL BE 23-INCHES. POLES SHALL BE LABELED WITH SUPPLIER'S CODE OR TRADEMARK, PLANT AND YEAR OF TREATMENT, POLE SPECIES AND PRESERVATIVE USED AND CIRCUMFERENCE CLASS AND LENGTH. ACCEPTABLE MANUFACTURERS: APACHE FOREST PRODUCTS, NORTH PACIFIC GROUP INC., POWERTECH EQUIPMENT INC.

R. FUSES

1. FURNISH AND INSTALL NEW CLASS RK5, DUAL ELEMENT, TIME-DELAY 600-VOLT RATED FUSES IN EXISTING 400-AMP FUSED DISCONNECT SWITCHES AND SAFETY SWITCHES AS INDICATED ON THE DRAWINGS. FUSES SHALL BE NON-RENEWABLE CARTRIDGE TYPE. PROVIDE REDUCERS IF REQUIRED TO INSTALL FUSES IN EXISTING SPACE. ACCEPTABLE MANUFACTURERS: COOPER BUSSMAN, FERRAZ SHAWMUT, LITTELFUSE, INC.

S. WIREWAY

1. FURNISH AND INSTALL A NEMA 3R WIREWAY IN LOCATION INDICATED ON THE DRAWINGS. WIREWAY SHALL BE GANGABLE, OUTDOOR RAINTIGHT WITH DRIP SHIELD. MANUFACTURED FROM GALVANIZED STEEL WITH GRAY POLYESTER FINISH, GASKETED END PLATES, GASKETED COVER WITH MOUNTING CLAMPS AND WALL-MOUNTING HARDWARE. UL LISTED AS STEEL ENCLOSED WIREWAY. ACCEPTABLE MANUFACTURERS: SQUARE D, EATON, CUTLER-HAMMER, SIEMENS.

T. ELECTRICAL HANDHOLE

1. FURNISH AND INSTALL AN ELECTRICAL HANDHOLE, LOAD RATED A8, AT LOCATIONS INDICATED ON THE DRAWINGS. HANDHOLE SHALL BE STACKABLE COMPOSITE TYPE WITH OPEN BOTTOM AND GASKETED TOP COVER. TWO HANDHOLES AND ONE COVER ARE REQUIRED AT EACH LOCATION. PROVIDE WITH TAMPER-PROOF BOLTS. ACCEPTABLE MANUFACTURERS: QUAZITE, SHAKESPHERE, GALLOWAY.

U. CELLULAR TERMINAL

1. FURNISH AND INSTALL A FIXED CELLULAR TERMINAL IN MAIN CONTROL PANEL. UNIT SHALL BE 200mW, 800MHz WITH DUAL RJ-11 PHONE JACKS, DIPOLE ANTENNA, LED STATUS INDICATORS. ACCEPTABLE MANUFACTURER: TELULAR MODEL SX5T-505C OR APPROVED EQUAL.

PART 3 - EXECUTION

3.01 INSTALLATION

A. UNLESS OTHERWISE NOTED, WIRING FOR ALL SYSTEMS INDICATED IN THE CONTRACT DOCUMENTS SHALL CONSIST OF INSULATED CONDUCTORS INSTALLED IN RACEWAYS. RACEWAYS SHALL BE CONTINUOUS FROM OUTLET BOX TO OUTLET BOX AND FROM OUTLET BOX TO CABINET, JUNCTION OR PULL BOX. SECURE AND BOND RACEWAYS TO ALL BOXES AND CABINETS SUCH THAT EACH SYSTEM OF RACEWAYS WILL BE ELECTRICALLY CONTINUOUS THROUGHOUT.

B. INSTALL ALL CONDUCTORS IN THE FOLLOWING APPLICABLE RACEWAY SYSTEM:

1. CONDUCTORS 600 VOLTS OR LESS IN OUTDOOR, ABOVE GRADE LOCATIONS: GALVANIZED RIGID HEAVY WALL STEEL CONDUIT.

2. CONDUCTORS 600 VOLTS OR LESS IN WET LOCATIONS: GALVANIZED RIGID HEAVY WALL STEEL CONDUIT.

3. CONDUCTORS 600 VOLTS OR LESS IN BELOW-GRADE LOCATIONS: PVC SCHEDULE 80 PLASTIC CONDUIT.

4. WATER-TIGHT, FLEXIBLE METAL CONDUIT SHALL BE USED FOR FINAL CONNECTION TO ALL MOTORS, ROTATING OR VIBRATING EQUIPMENT. MAXIMUM LENGTH OF FLEXIBLE CONDUIT SHALL BE 36 INCHES.

C. RACEWAYS:

1. SIZE AS INDICATED ON THE DRAWINGS. WHERE SIZES ARE NOT INDICATED, RACEWAYS SHALL BE SIZED PER THE NATIONAL ELECTRICAL CODE IN ACCORDANCE WITH THE QUANTITY, SIZE, TYPE AND INSULATION OF CONDUCTORS TO BE INSTALLED.

2. POWER RACEWAYS SHALL BE MINIMUM THREE-QUARTER (3/4") TRADE SIZE.

3. CONDUITS TO INSTRUMENTATION DEVICES SHALL BE SIZED TO ACCOMODATE THE DEVICE CONNECTIONS. MINIMUM HALF-INCH (1/2") TRADE SIZE.

4. INSTALL TO PROVIDE ADEQUATE GROUNDING BETWEEN ALL OUTLETS AND THE ESTABLISHED ELECTRICAL SYSTEM GROUND.

5. CUT RACEWAYS SQUARE, REMOVE BURRS FORMED BY FIELD CUTTING OR DURING MANUFACTURING. BUSH WHERE NECESSARY.

6. INSTALL WITH EXTERIOR SURFACES NOT LESS THAN SIX INCHES (6") FROM ANY SURFACE WITH A TEMPERATURE OF 200 DEGREES F OR HIGHER.

7. PLUG THE ENDS OF EACH ROUGHED-IN RACEWAY WITH AN APPROVED CAP OR DISC TO PREVENT THE ENTRANCE OF FOREIGN MATERIALS DURING CONSTRUCTION

8. INSTALL PARALLEL OR PERPENDICULAR TO FLOORS, WALLS AND CEILINGS.

9. ARRANGE IN A NEAT MANNER FOR ACCESS AND ALLOW FOR ACCESS TO WORK INSTALLED BY OTHER TRADES.

10. PROVIDE A BUSHING AT EACH CONDUIT TERMINATION, UNLESS FITTING AT BOX WHERE CONDUIT TERMINATES AT HUBS, DESIGNED IN SUCH A MANNER TO AFFORD EQUIVALENT PROTECTION TO CONDUCTORS. PROVIDE GROUNDING TYPE INSULATED BUSHINGS ON ALL CONDUIT SIZES ONE AND ONE-QUARTER INCH (1-1/4") TRADE SIZE AND LARGER, AND ON ALL FEEDER RACEWAYS REGARDLESS OF SIZE. PROVIDE STANDARD BUSHINGS FOR CONDUITS ONE INCH (1") AND SMALLER UNLESS OTHERWISE STATED. PROVIDE SEALING BUSHINGS FOR ALL CONDUITS ENTERING FROM BELOW GRADE.

D. BECOME FAMILIAR WITH THE GENERAL CONSTRUCTION OF THE SITE AND PLACE SLEEVES, INSERTS, ETC., AS REQUIRED. ALL PENETRATIONS THROUGH NEW BELOW-GRADE CONCRETE WALLS OR FLOORS SHALL BE SEALED USING FITTINGS AS SPECIFIED IN ABOVE.

E. WIRING METHODS

1. DO NOT PULL CONDUCTORS INTO RACEWAYS UNTIL RACEWAY SYSTEM, INCLUDING ALL OUTLETS, CABINETS, BUSHINGS AND FITTINGS, IS COMPLETED. VERIFY THAT ALL WORK OF OTHER TRADES WHICH MAY CAUSE CONDUCTOR DAMAGE IS COMPLETED. USE ONLY U.L. APPROVED CABLE LUBRICANTS WHEN NECESSARY. DO NOT USE MECHANICAL MEANS TO PULL CONDUCTORS.

2. CONDUCTORS SHALL BE THE SAME SIZE FROM THE LAST PROTECTIVE DEVICE TO THE LOAD.

3. ALL WIRING SYSTEMS SHALL BE PROPERLY GROUNDED AND CONTINUOUSLY POLARIZED THROUGHOUT, FOLLOWING STANDARD COLOR CODING.

4. FOR SPLICES AND TAPS, NO. 10 AWG AND SMALLER, USE SOLDERLESS "THREAD-ON" CONNECTORS HAVING SPIRAL STEEL SPRING AND INSULATED WITH A VINYL CAP AND SKIRT, AS MANUFACTURED BY 3M CO. (PRE- INSULATED "SCOTCH-LOCK") OR IDEAL ("WING-NUTS").

5. FOR SPLICES AND TAPS, NO. 8 AND LARGER, USE SOLDERLESS "SPLIT BOLT" TYPE CONNECTOR AS MANUFACTURED BY ANDERSON, BURNDY, KEARNEY, THOMAS & BETTS, OR APPROVED EQUAL.

6. USE CAST CONNECTIONS, CADWELD OR THERMOWELD, FOR GROUND CONDUCTORS.

7. MAKE ALL SPLICES AND CONNECTIONS IN ACCESSIBLE BOXES AND CABINETS ONLY.

8. AT RECEPTACLE AND SWITCH BOXES, LEAVE A MINIMUM OF EIGHT INCHES (8") FREE CONDUCTOR FOR INSTALLATION OF DEVICES.

9. INSTALL HEAT TRACE CABLES, EQUIPMENT AND CONNECTIONS PER MANUFACTURERS REQUIREMENTS.

F. OUTLET BOXES

1. LOCATION OF OUTLETS SHOWN ON DRAWINGS IS APPROXIMATE ONLY. LOCATE OUTLET SO THAT WHEN PLACED IN POSITION, OUTLET WILL SERVE ITS DESIRED PURPOSE WITHOUT INTERFERING.

2. OUTLET BOXES SHALL BE MINIMUM 4 INCHES SQUARE, 1-1/2 INCHES DEEP, GALVANIZED SHEET METAL.

3. SURFACE MOUNTED OUTLET BOXES SHALL BE CAST TYPE WITH THREADED HUBS AND GASKETED COVER PLATES SECURED BY NON-FERROUS SCREWS.

4. INSTALL LOCKABLE IN-USE COVER PLATES ON ALL EXTERIOR RECEPTACLES AND SWITCHES.

G. JUNCTION AND PULL BOXES

1. INSTALL JUNCTION AND PULL BOXES IN READILY ACCESSIBLE LOCATIONS. ACCESS TO BOXES SHALL NOT BE BLOCKED BY EQUIPMENT, PIPING, DUCTS AND THE LIKE. PROVIDE ALL NECESSARY JUNCTION OR PULL BOXES REQUIRED DUE TO FIELD CONDITIONS AND AS REQUIRED BY THE NATIONAL ELECTRICAL CODE.

H. HANGERS AND SUPPORTS

1. PROVIDE STEEL ANGLES, CHANNELS AND OTHER MATERIALS NECESSARY FOR THE PROPER SUPPORT AND ERECTION OF EQUIPMENT.

I. GROUNDING INSTALLATION

1. MAKE CONNECTIONS TO GROUND RODS WITH AN EXOTHERMIC WELDING PROCESS. MECHANICAL CONNECTIONS MAY BE MADE AT EQUIPMENT ONLY.

2. ENSURE THAT A GROUND LOOP IS NOT FORMED BETWEEN EQUIPMENT GROUND IN ELECTRICAL CONDUIT AND GROUNDING ELECTRODE CONDUCTORS DIRECTLY CONNECTED TO GROUND ELECTRODES.

3. EQUIP EXPOSED "PIGTAILS" OR GROUNDING ELECTRODE CONDUCTORS WITH AN ARMORED SHEATH.

4. GROUP AND BOND GROUND WIRES TO PANELS, BOXES, RECEPTACLES, ETC., NOT TO SYSTEM NEUTRAL.

5. MAKE CONNECTION TO VAULT HATCH COVERS WITH A SUITABLE GROUND CLAMP OR LUG CONNECTION.

3.02 TESTS

A. BRANCH CIRCUITS SHALL BE TESTED DURING INSTALLATION FOR CONTINUITY AND IDENTIFICATION AND SHALL PASS OPERATIONAL TESTS TO DETERMINE THAT ALL CIRCUITS PERFORM THE FUNCTION FOR WHICH THEY ARE DESIGNED.

SEQUENCE OF OPERATIONS

A. NORMAL OPERATION

REFERENCE D-601 FOR DEVICE LOCATION IN PROCESS.

ALL ALARMS MUST BE CLEAR TO BEGIN OPERATION.

THE EXTRACTION PUMP SHALL BEGIN OPERATION WHEN THE OPERATOR PRESSES THE RESET PUSHBUTTON ON CONTROL PANEL.

WHILE NORMAL OPERATION CONTINUES FLOW TOTALIZER FQI-100A SHALL TOTALIZE THE QUANTITY OF PUMPED PRODUCT FROM INCEPTION. FQI-100A SHALL NOT BE RESETABLE. FLOW TOTALIZER FQI-100B SHALL TOTALIZE THE CURRENT BATCH PUMPED TO THE TANKS. FQ101B SHALL BE CONFIGURABLE AND RESETABLE BY THE OPERATOR.

B. WARNING CONDITION

YAH-100, LAH-200, YAH-200, YAH-201, LAH-101, LAH-102, LAH-103 AND LAH-104 SHALL INITIATE THE AUTO-DIALER WARNING CONDITION. WARNING CONDITIONS SHALL NOT SHUT OFF THE EXTRACTION PUMP. WARNING CONDITIONS SHALL NOTIFY OF PENDING STORAGE TANK FULL, TANK HEATER FAULT.

WHILE IN ALARM OR WARNING STATUS, THE AUTODIALER WILL CONTINUE TO CALL OUT UNTIL ACKNOWLEDGED.

C. ALARM CONDITION

THE EXTRACTION PUMP SHALL CONTINUE TO OPERATE UNTIL ONE OR MORE OF THE FOLLOWING CONDITIONS EXISTS:

1. E-STOP HS-200, HS-103 OR HS-100 IS PRESSED.

2. FQI-100B REACHES THE BATCH SETPOINT. BATCH SETPOINT IS SET BY THE OPERATOR ON CONTROL PANEL.

3. PAH-100 EXISTS. (LINE PRESSURE IS TOO HIGH)

4. LAH-100 EXISTS. (EXTRACTION WELL SUMP IS AT HIGH LEVEL)

5. LAHH-200 EXISTS. (TANK OVERFILLED)

6. LAH-105 IS ACTIVE. (HIGH LEVEL INTERNAL TO EXTRACTION PUMP-HOSE BREAK)

7. FAL-100 OR FAH-100 EXISTS. (LOW OR HIGH FLOW OCCURS IN THE DAPL CARRIER PIPE LINE).

8. LAH-201 EXISTS. (TANK HAS A LEAK)

EACH CONDITION ABOVE SHALL SHUTDOWN THE EXTRACTION PUMP AND INITIATE THE AUTO-DIALER ALARM CONDITION. THE SYSTEM WILL REMAIN INOPERABLE UNTIL ALL ALARM CONDITIONS ARE CLEAR AND THE RESET PUSHBUTTON ON THE CONTROL PANEL HAS BEEN ACTIVATED.

ALL WARNING AND ALARM SIGNALS SHALL ACTIVATE A STROBE AT THE MAIN CONTROL PANEL.

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2

03/09/11

ISSUED FOR CONSTRUCTION

REO

MAP

1

02/12/10

FINAL

REO

MAP

0

12/07/09

ISSUED FOR BID

REO

BDE

A

11/12/09

FOR CLIENT REVIEW

REO

BDE

NO.

DATE

REVISIONS

BY

CHK

DRAWN: BDE

ENGINEER: BDE

CHECKED: REO

DATE: 03/09/11

PROJECT NO: 6107-10-0016

SCALE: NONE

APPROVED: PHT

DATE: 03/09/11

MACTEC

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(207) 775-5401

DAPL EXTRACTION PILOT TEST

OLIN CHEMICAL SUPERFUND SITE

WILMINGTON, MASSACHUSETTS

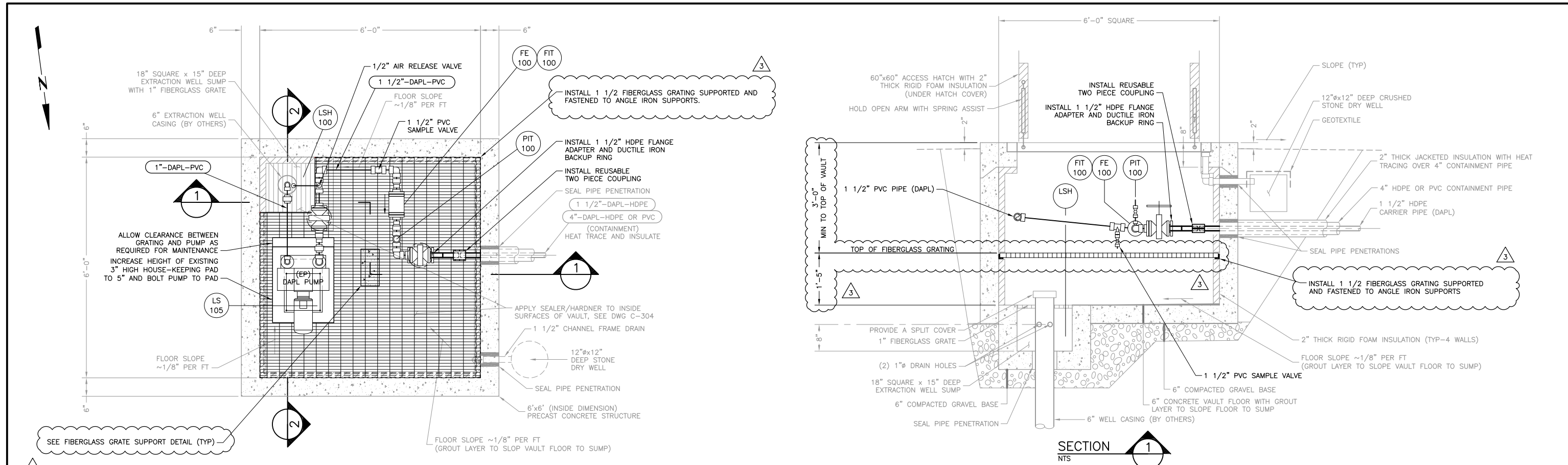
ELECTRICAL

ELECTRICAL SPECIFICATIONS AND SEQUENCE OF OPERATIONS

DRAWING NO: E-602

15

15



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| NO. | DATE       | REVISIONS                                | BY  | CHK |
|-----|------------|------------------------------------------|-----|-----|
| 3   | 07/16/2012 | ATTACHED GRATING SUPPORTS REVISED        | DEL | MAP |
| 2   | 06/08/12   | ATTACHED GRATING SUPPORTS TO VAULT FLOOR | DEL | MAP |
| 1   | 05/18/12   | FIELD CHANGE 1                           | DEL | MAP |

|           |          |             |              |
|-----------|----------|-------------|--------------|
| DRAWN:    | DEL      | PROJECT NO: | 6107-10-0016 |
| ENGINEER: | MAP      | SCALE:      | NONE         |
| CHECKED:  | REO      | APPROVED:   | PHT          |
| DATE:     | 05/18/12 | DATE:       | 05/18/12     |

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(207) 775-5401

DAPL EXTRACTION PILOT TEST  
OLIN CHEMICAL SUPERFUND SITE  
WILMINGTON, MASSACHUSETTS

CIVIL  
PUMP ENCLOSURE VAULT  
PLAN DETAIL AND SECTIONS

|             |     |
|-------------|-----|
| DRAWING NO: | FC1 |
| 1           | 1   |

## **APPENDIX B**

### **WELL INSTALLATION CONSTRUCTION DIAGRAMS**

# WELL CONSTRUCTION DIAGRAM

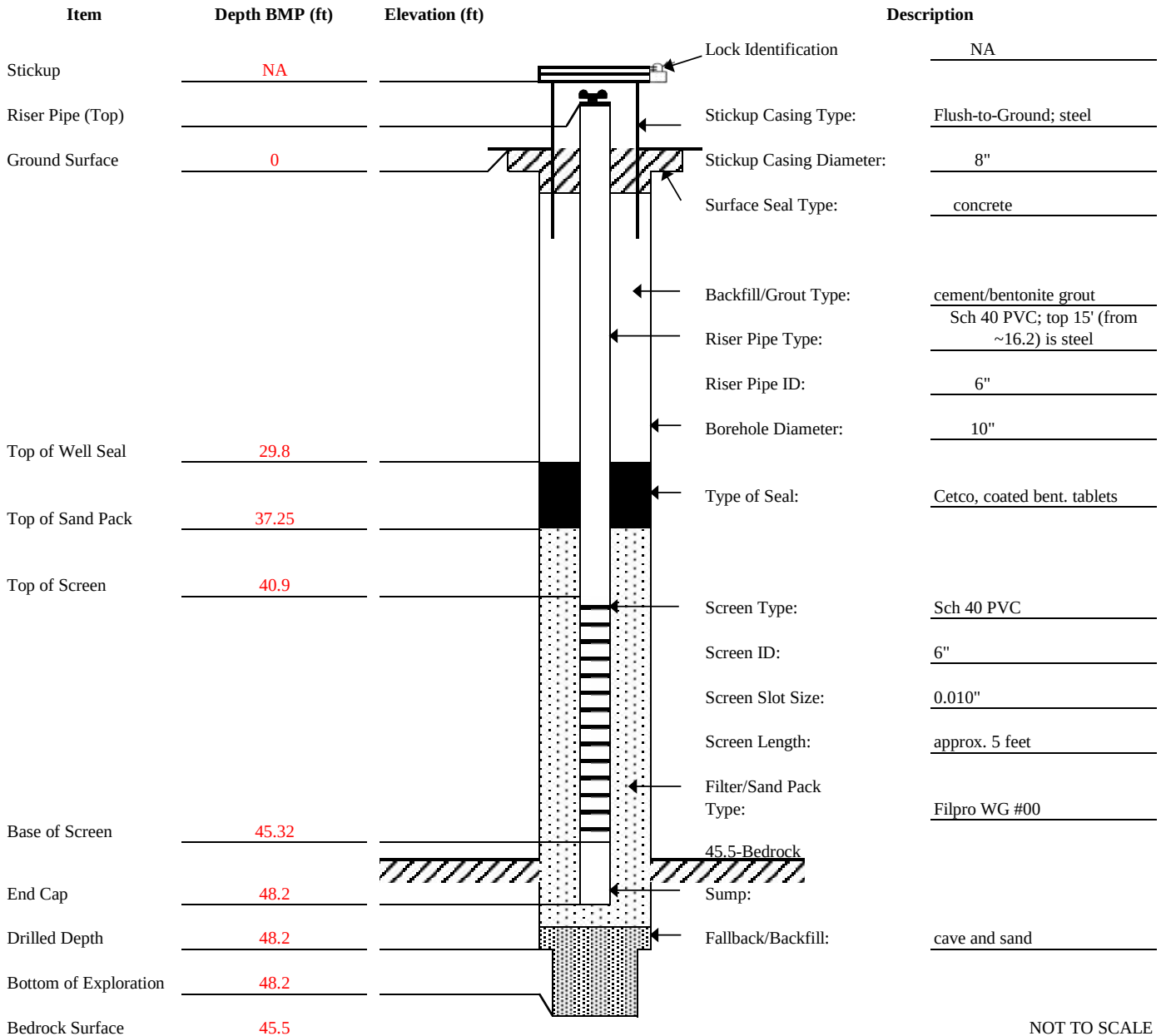
LOCATION ID: EW-1

Project Name: Olin Chemical Superfund Site  
 Project Location: Wilmington, MA  
 Project Number: 6107110016 Task Number 2  
 Subcontractor: Boart Longyear Drilling Method: Sonic  
 Development Method: Development Date:  
 Bucking Posts/Ballards: None  
 Notes: Protective Casing is a Flush-to-Ground, temporary 8" x 1' Steel Casing  
 Well is completed as a Flush-to-Ground completion - will be incorporated into a surface vault in the future; the top 15' of casing is steel; the remainder is SCH 40 PVC

Date Started: 12/5/2011 Date Completed: 12/6/2011  
 Logged By: T. Longley  
 Checked By: Checked Date:

## Measuring Point Information

Measuring Point (MP) Type: Ground Surface (GS)  
 MP Elevation (ft):



NOT TO SCALE



511 Congress Street, Portland Maine 04101

# WELL CONSTRUCTION DIAGRAM

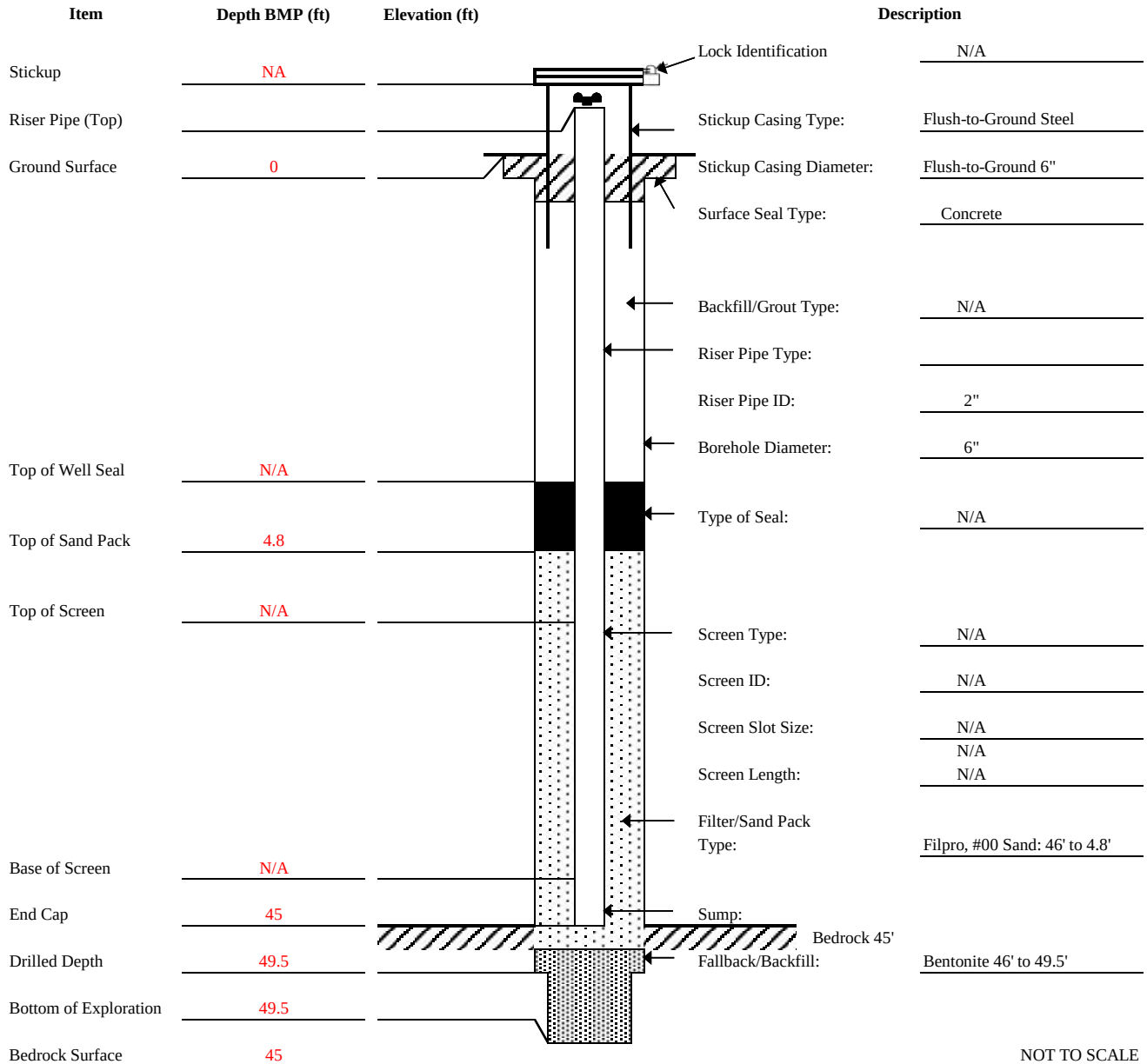
LOCATION ID: ILW-1

Project Name: Olin Chemical Superfund Site  
 Project Location: Wilmington, MA  
 Project Number: 6107110016 Task Number: 2  
 Subcontractor: Boart Longyear Drilling Method: Sonic  
 Development Method: Not Applicable Development Date: N/A  
 Bucking Posts/Ballards: None  
 Notes: Well is a Flush-to-Ground completion, no screen; solid 2"-ID PVC filled with di-ionized water to ground surface

Date Started: 5/24/2011 Date Completed: 5/25/2011  
 Logged By: T. Longley  
 Checked By: Checked Date:

## Measuring Point Information

Measuring Point (MP) Type: Ground Surface (GS)  
 MP Elevation (ft):



NOT TO SCALE



511 Congress Street, Portland Maine 04101

# WELL CONSTRUCTION DIAGRAM

LOCATION ID: ILW-2

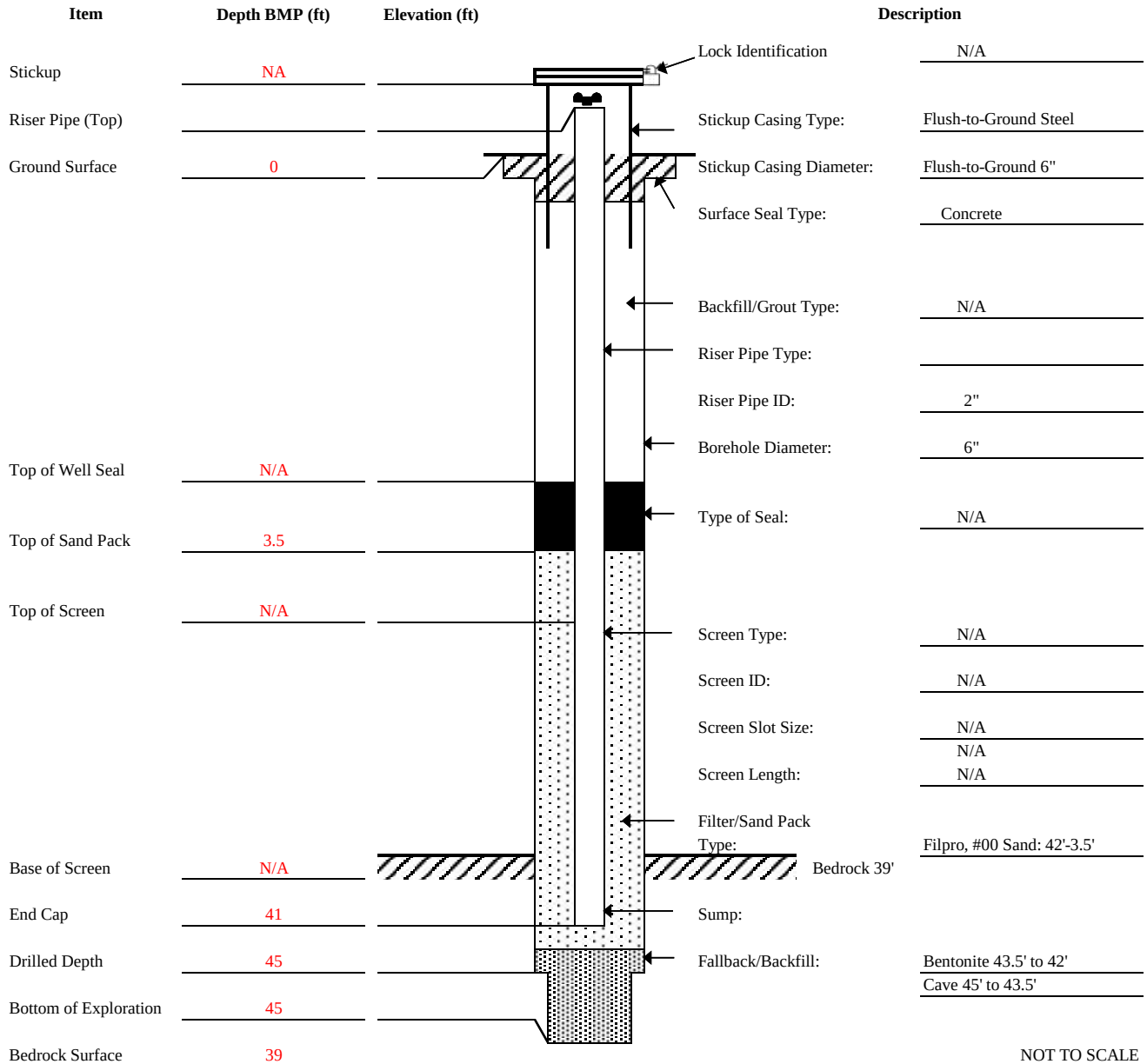
Project Name: Olin Chemical Superfund Site  
 Project Location: Wilmington, MA  
 Project Number: 6107110016 Task Number: 2  
 Subcontractor: Boart Longyear Drilling Method: Sonic  
 Development Method: Not Applicable Development Date: N/A  
 Bucking Posts/Ballards: None  
 Notes: Well is a Flush-to-Ground completion, no screen; solid 2"-ID PVC filled with di-ionized water to ground surface  
 Fractured rock 39' to 43.5'

Date Started: 5/25/2011 Date Completed: 5/25/2011  
 Logged By: T. Longley  
 Checked By: Checked Date:

## Measuring Point Information

Measuring Point (MP) Type: Ground Surface (GS)

MP Elevation (ft):



NOT TO SCALE



511 Congress Street, Portland Maine 04101

# WELL CONSTRUCTION DIAGRAM

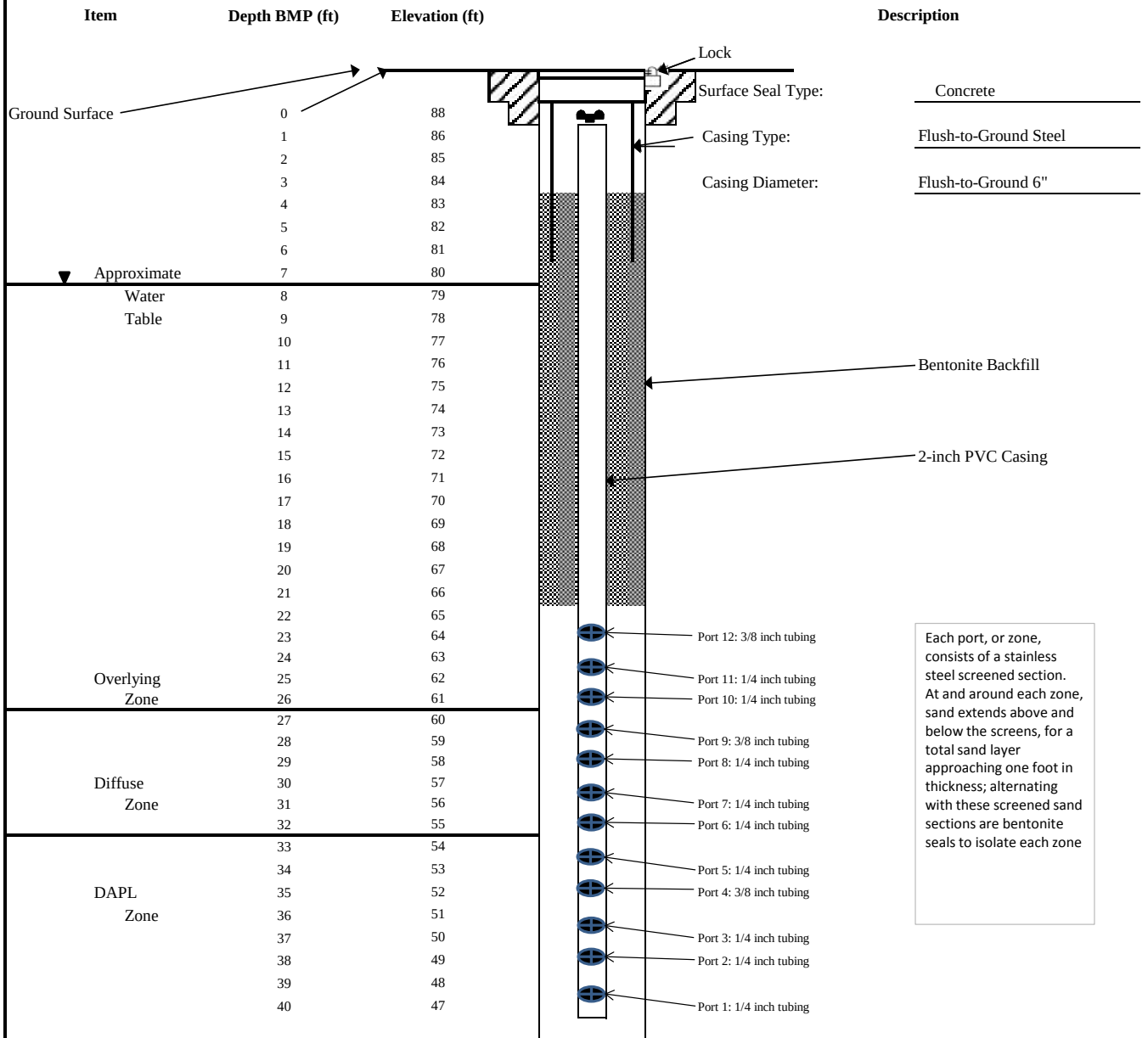
LOCATION ID: ML-1

Project Name: Olin Chemical Superfund Site  
 Project Location: Wilmington, MA  
 Project Number: 6107110016 Task Number 2  
 Subcontractor: Boart Longyear Drilling Method: Sonic  
 Development Method: Not Applicable Development Date: N/A  
 Bucking Posts/Ballards: None  
 Notes: Well is a Flush-to-Ground completion  
 Surface completion includes a manifold for the tubing from each zone; well is  
 a 2-inch dia. Solinst Multi-level Piezometer; sandpack around zones is 000 sand

Date Started: 12/6/2011 Date Completed: 12/8/2011  
 Logged By: T. Longley  
 Checked By: Checked Date:

## Measuring Point Information

Measuring Point (MP) Type: Ground Surface (GS)  
 MP Elevation (ft):



NOT TO SCALE



511 Congress Street, Portland Maine 04101

# WELL CONSTRUCTION DIAGRAM

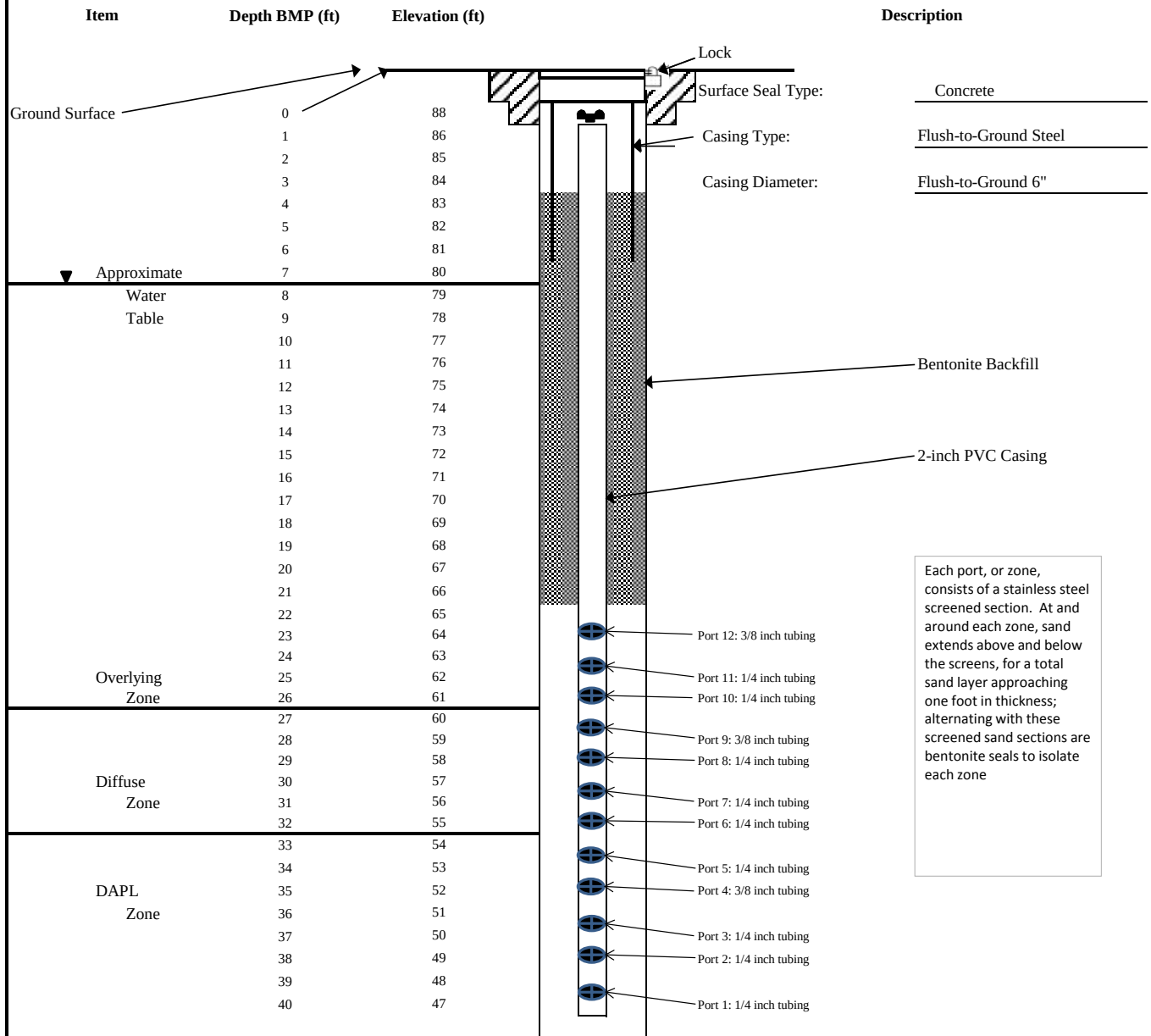
LOCATION ID: ML-2

Project Name: Olin Chemical Superfund Site  
 Project Location: Wilmington, MA  
 Project Number: 6107110016 Task Number 2  
 Subcontractor: Boart Longyear Drilling Method: Sonic  
 Development Method: Not Applicable Development Date: N/A  
 Bucking Posts/Ballards: None  
 Notes: Well is a Flush-to-Ground completion  
 Surface completion includes a manifold for the tubing from each zone; well is  
 a 2-inch dia. Solinst Multi-Level Piezometer; sandpack around zones is 000 sand

Date Started: 12/8/2011 Date Completed: 12/9/2011  
 Logged By: T. Longley  
 Checked By: Checked Date:

## Measuring Point Information

Measuring Point (MP) Type: Ground Surface (GS)  
 MP Elevation (ft): ~88' MSL



NOT TO SCALE



511 Congress Street, Portland Maine 04101

## **APPENDIX C**

### **STANDARD OPERATING PROCEDURES FOR INDUCTION LOGGING**

SOP No. S-1

**AMEC E&I STANDARD OPERATING PROCEDURE**  
**GENERAL PROCEDURE FOR INDUCTION LOGGING IN**  
**WELLS**

## **1.0 SCOPE AND APPLICABILITY**

This Standard Operating Procedure (SOP) describes the use of induction logging in monitoring wells. Induction logging may be used to determine spatial and temporal changes in electrical conductivity in the subsurface due to dissolved contaminants in groundwater. This SOP is intended to compliment (not replace) information, procedures and guidelines as supplied by the logging equipment vendor and/or manufacturer and associated equipment-specific procedures.

## **2.0 EQUIPMENT**

The following equipment and supplies are recommended prior to initiating field activities:

### **2.1 MEASUREMENT SPECIFIC SUPPLIES**

- Induction log probe (Geonics EM 39, or equivalent)
- Wire line winch system compatible with the log probe
- Tripod and pulley apparatus
- Field-capable computer or data logger with the required software for the logging system
- 12V battery (fully charged)
- 12V to AC inverter
- Keys and necessary tools to open wells
- Duct tape
- Water level meter

### **2.2 FIELD DATA AND RECORD KEEPING SPECIFIC SUPPLIES**

- Field notebook and pen with indelible ink
- Well construction details for the well(s) to be logged (total depth, etc.)

### **2.3 DECONTAMINATION SUPPLIES**

- Deionized (DI) water
- Alconox<sup>TM</sup> detergent, or equivalent
- Paper towels

### **2.4 HEALTH AND SAFETY EQUIPMENT**

- As required per site Health and Safety plan

### **3.0 PREPARATION**

The induction logging probe has been factory calibrated and does not require calibration prior to each field deployment. In the unlikely event calibration is required; calibration may be performed by the vendor from which the equipment has been supplied. Calibration may be checked per the manufacturer's guidelines with the calibration ring provided with the equipment. Instrument calibration should be performed only by vendor- or manufacturer-supplied procedures and guidelines. Atmosphere should provide a zero conductivity value as a quick operational check. It is a good general practice to re-log a portion of at least one hole on a daily basis (perhaps twenty feet where value changes are noted) for repeatability check. Checking calibration at the beginning and conclusion of each logging event is recommended.

Verify the charge status of the 12V battery (fully charged). If the 12V battery in the vehicle is being used, the motor should be off.

Before proceeding to the first well to be logged, set up all equipment to be used in the field (12V battery, inverter, wire line console, probe, and computer or data logger) and verify that the signal is being received and recorded.

### **4.0 PROCEDURES**

1. Open the well cap and check the wellhead and breathing space atmosphere for worker health (as required by the applicable Site Health and Safety Plan). Record the results if measurements are collected. Take appropriate respiratory precautions (including leaving the area) if conditions warrant.
2. Measure and record the groundwater water level below the top of casing or other established datum. Measure to the nearest 0.01 foot, unless specified otherwise by the Site work plan or Data Quality Objectives (DQO). Compare the result to historic values, if available, and note any significant deviations.
3. Verify the total depth (TD) of the well from completion logs or other validated data source. The total depth of the well may be measured using the water level probe.
4. Connect all associated equipment (probe, cable, PC/data logger, inverter, battery) per manufacture's and/or vendor's guidelines, and before turning power on to the logging unit.
5. Turn the power on to the logger (Note: NEVER attach probe to cable with power on!).
6. Lower probe into the well and set the point where the probe and cable attach at the surveyed measuring point of the well casing. This is the point at which the depth measurements will be "zeroed" and must be set consistently so that previous and subsequent logging data can be compared. Use the tripod and pulley system as allowed by local site and well construction conditions.
7. Open the data logging software and follow the on-screen procedures to zero the depth, set the desired sampling interval (0.1 ft is recommended), and create a data file with a unique file name. Verify that an ASCII-format data file is being created so that data can be accessed by appropriate software for post processing.

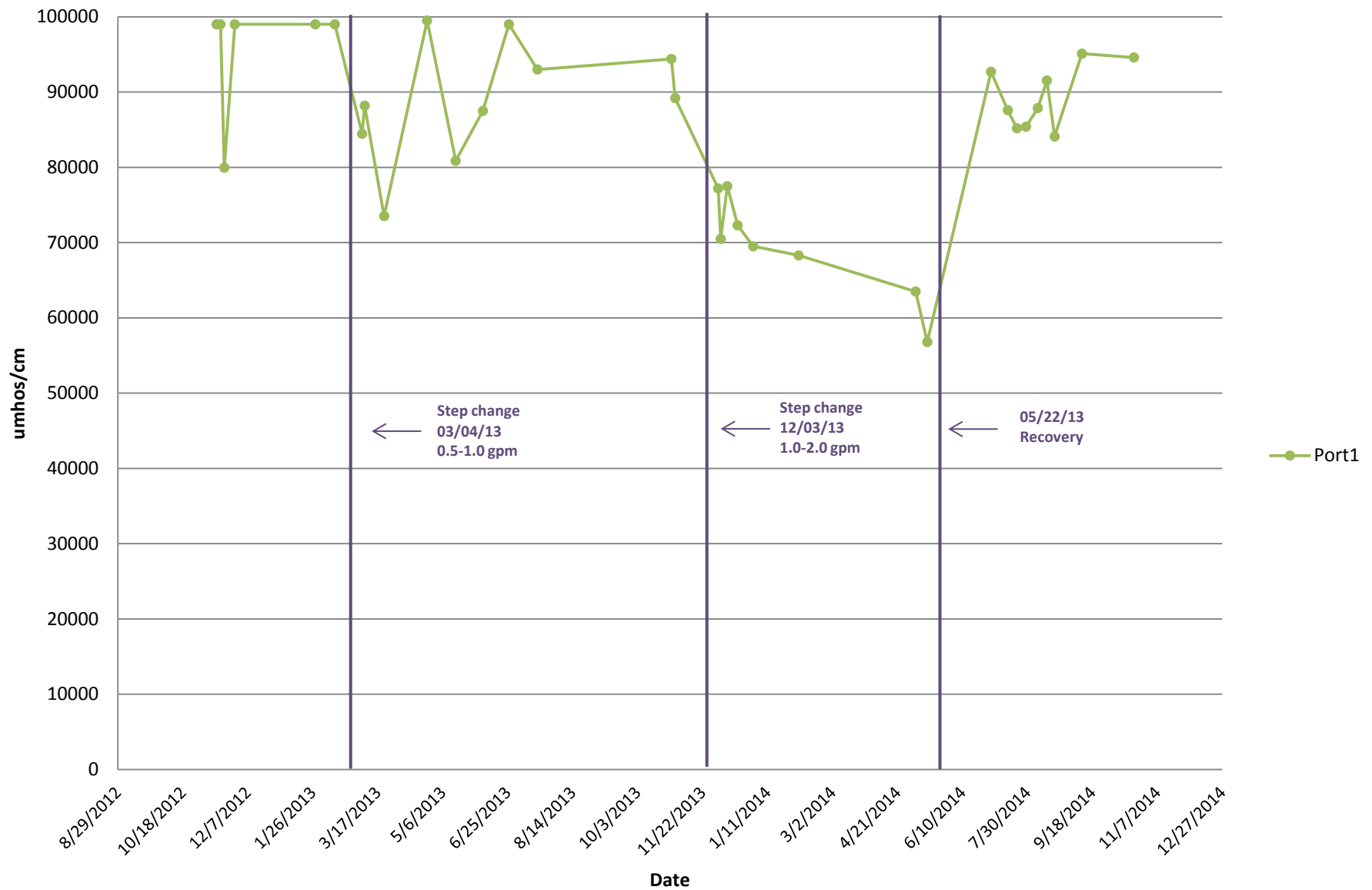
8. Record the time, well or location ID, and data file name in the field log book or field recording form.
9. Activate the winch to lower the probe down the well, adjusting the speed so that the system can acquire quality data at a specified sampling rate (10 ft/min. is recommended for 0.1 ft sampling interval). Monitor the software display to ensure that data is being received and recorded.
10. Monitor the depth of the probe to ensure that excess cable slack is not generated when probe reaches the bottom of the well.
11. When the probe reaches the bottom of the well, stop the winch and, if desired, close the data file. A new data file may be created for recording the data when the probe is raised from the well. Alternatively, the file may be kept open and recording as the winch is stopped and reversed with the ascending data separated during post-processing.
12. Closely monitor the depth of the probe as it is being raised to ensure that it is stopped before it reaches the top of the well.
13. When the logging is complete close and save the data file before removing the probe. Also verify that the file contains appropriate data before removing the probe from the well. Re-log the well if needed.
14. **TURN OFF POWER TO PROBE AND DISCONNECT POWER SUPPLY BEFORE DISASSEMBLING SYSTEM! NEVER REMOVE THE PROBE FROM CABLE WITH THE POWER ON!**
15. If necessary, decontaminate the probe with Alconox™ solution and DI water rinse. The cable may be decontaminated by holding a wet rag on the cable as the tool is being retrieved, but care must be taken not to interfere with the function of the depth recording apparatus on the winch.
16. Secure the well and record the time in the log book or field data form. Also record any pertinent observations made during the logging that may affect data processing and interpretation.
17. At the earliest convenience, backup recorded logging data from the data logger or computer onto other media (from data logger to computer, from computer to USB flash drive, etc.) to minimize the potential for data loss or corruption prior to data analyses.

## **APPENDIX D**

### **WATER QUALITY PLOTS**

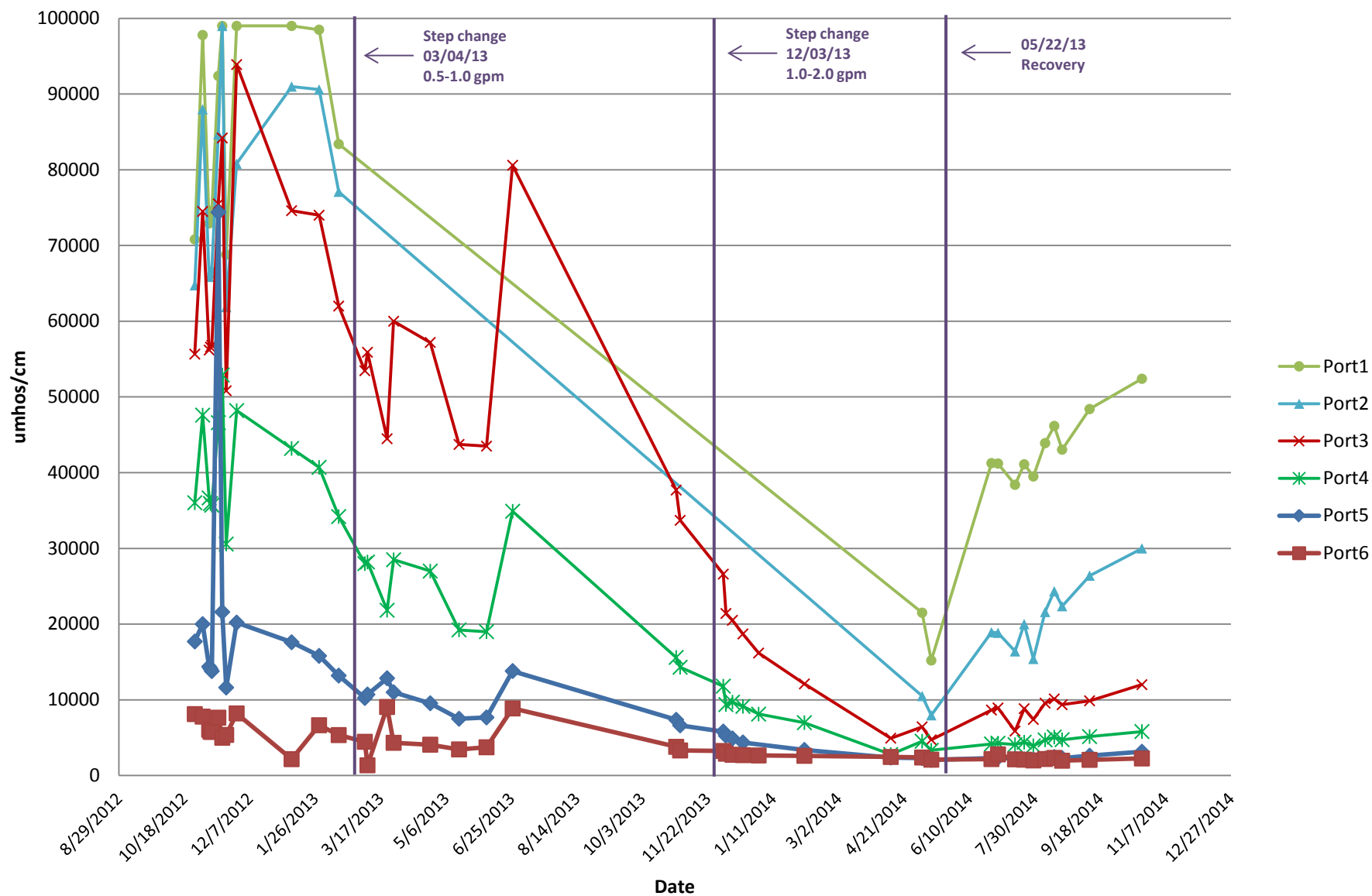
# EW-1

## Specific Conductivity in Groundwater



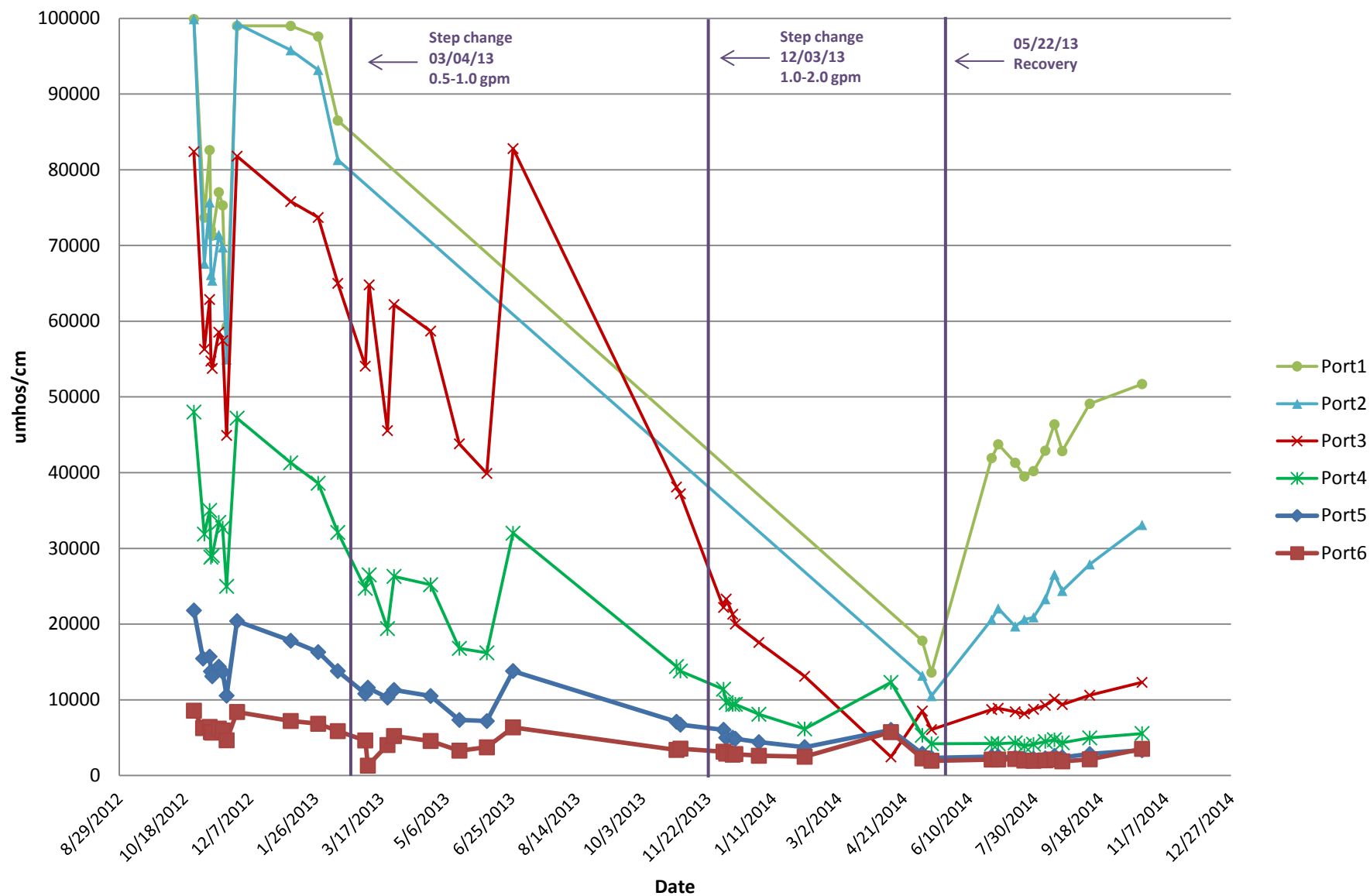
# ML1

## Specific Conductivity in Groundwater



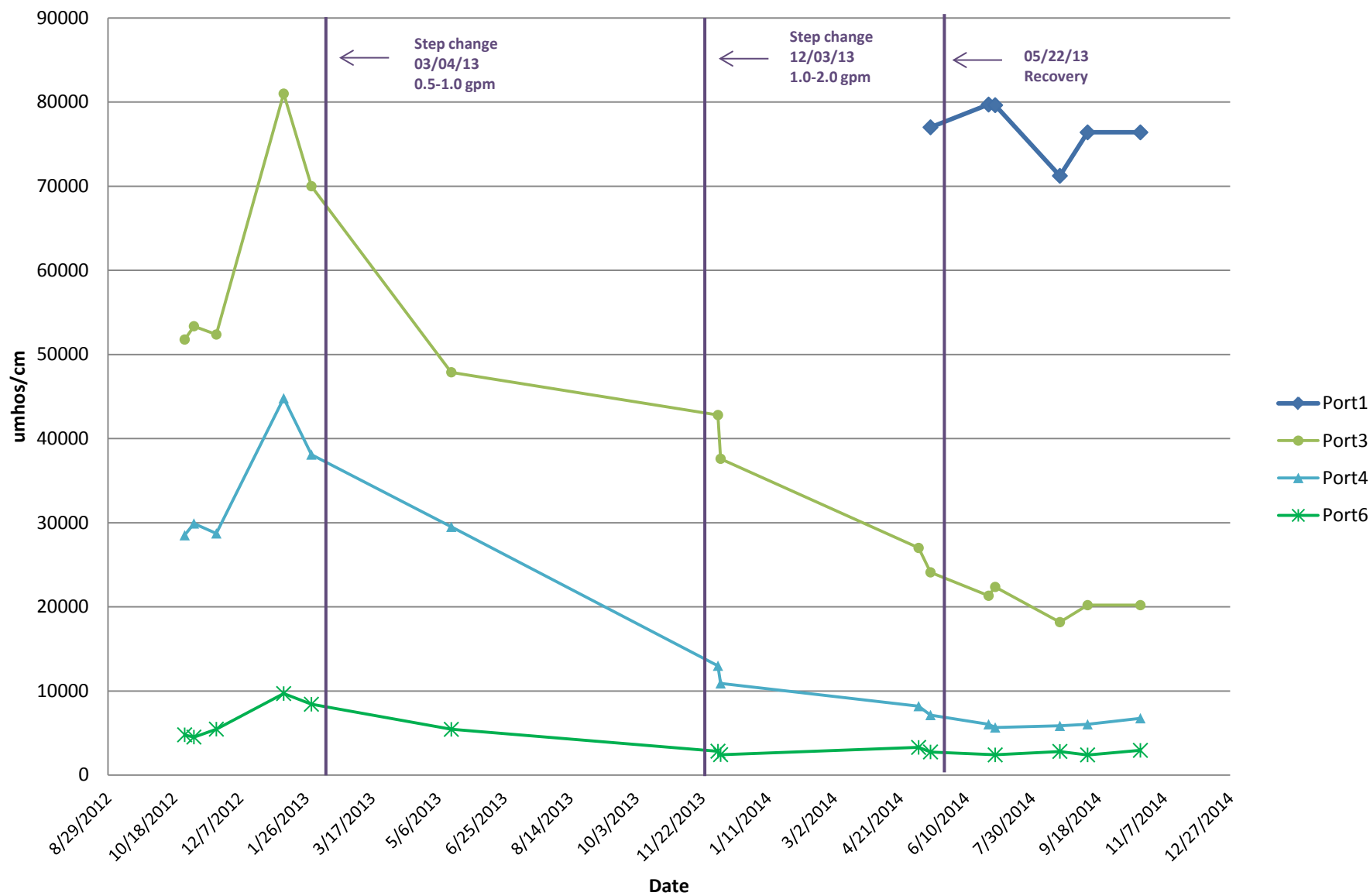
# ML2

## Specific Conductivity in Groundwater



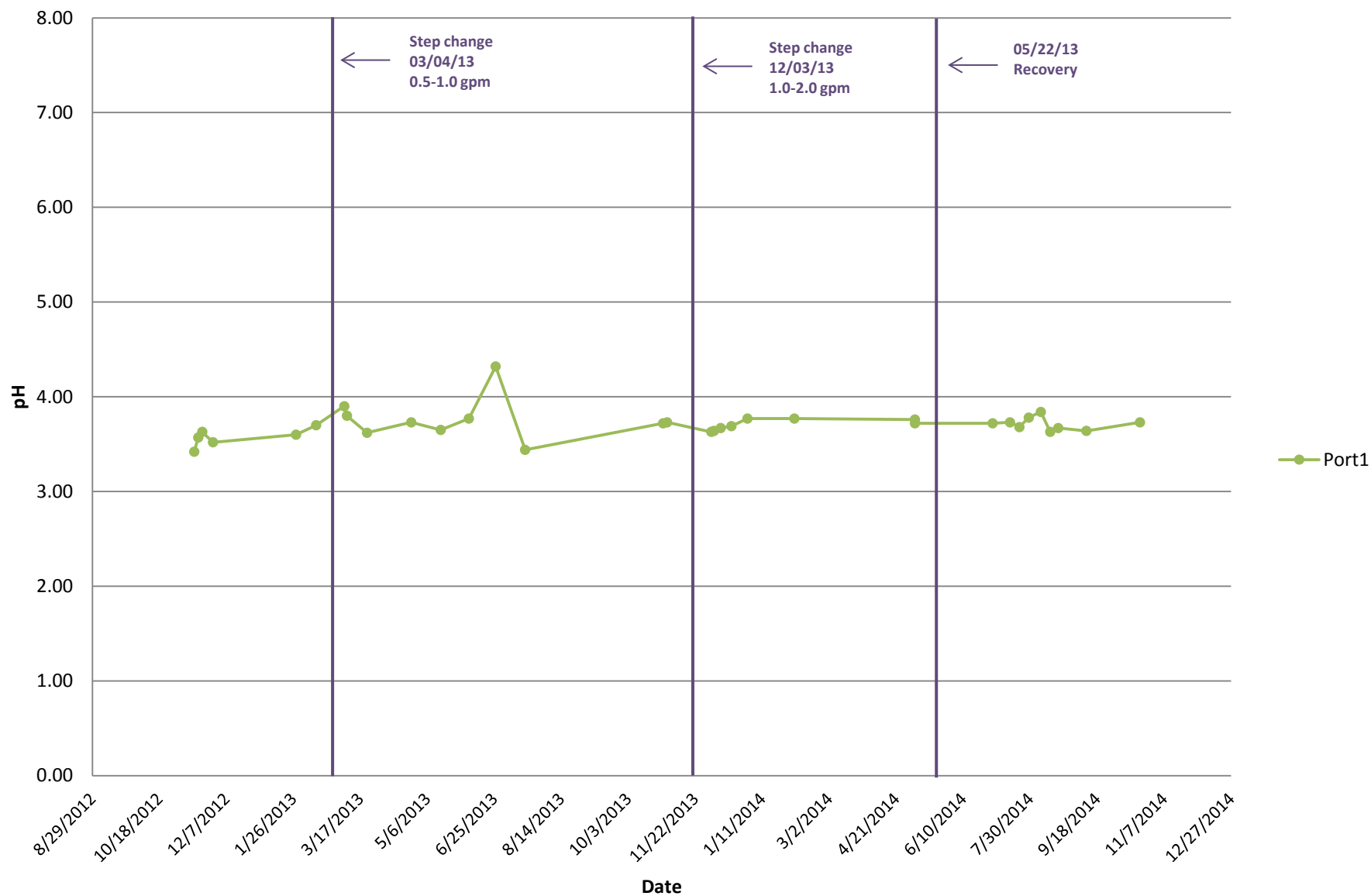
# MP2

## Specific Conductivity in Groundwater



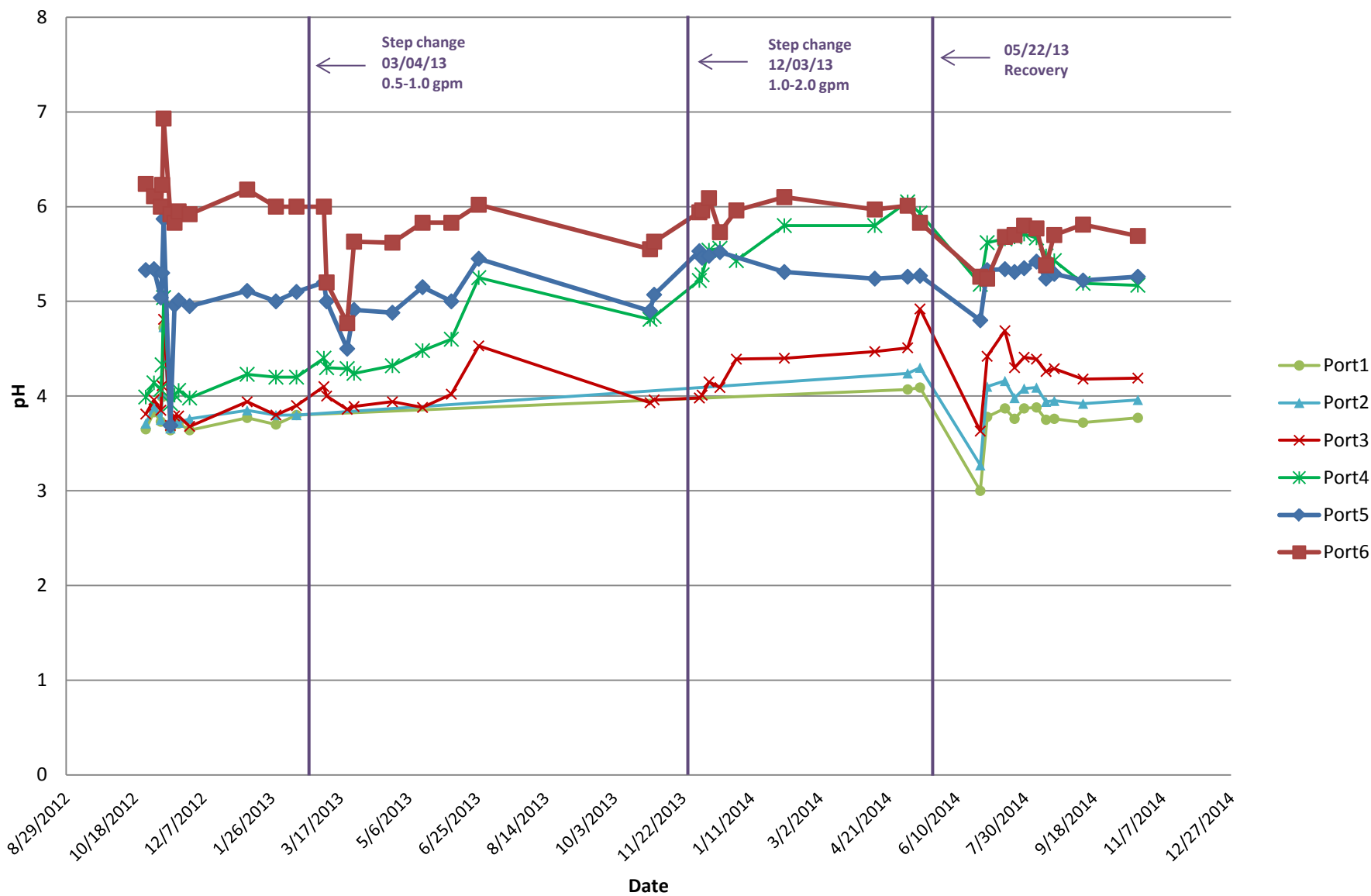
# EW-1

## pH in Groundwater

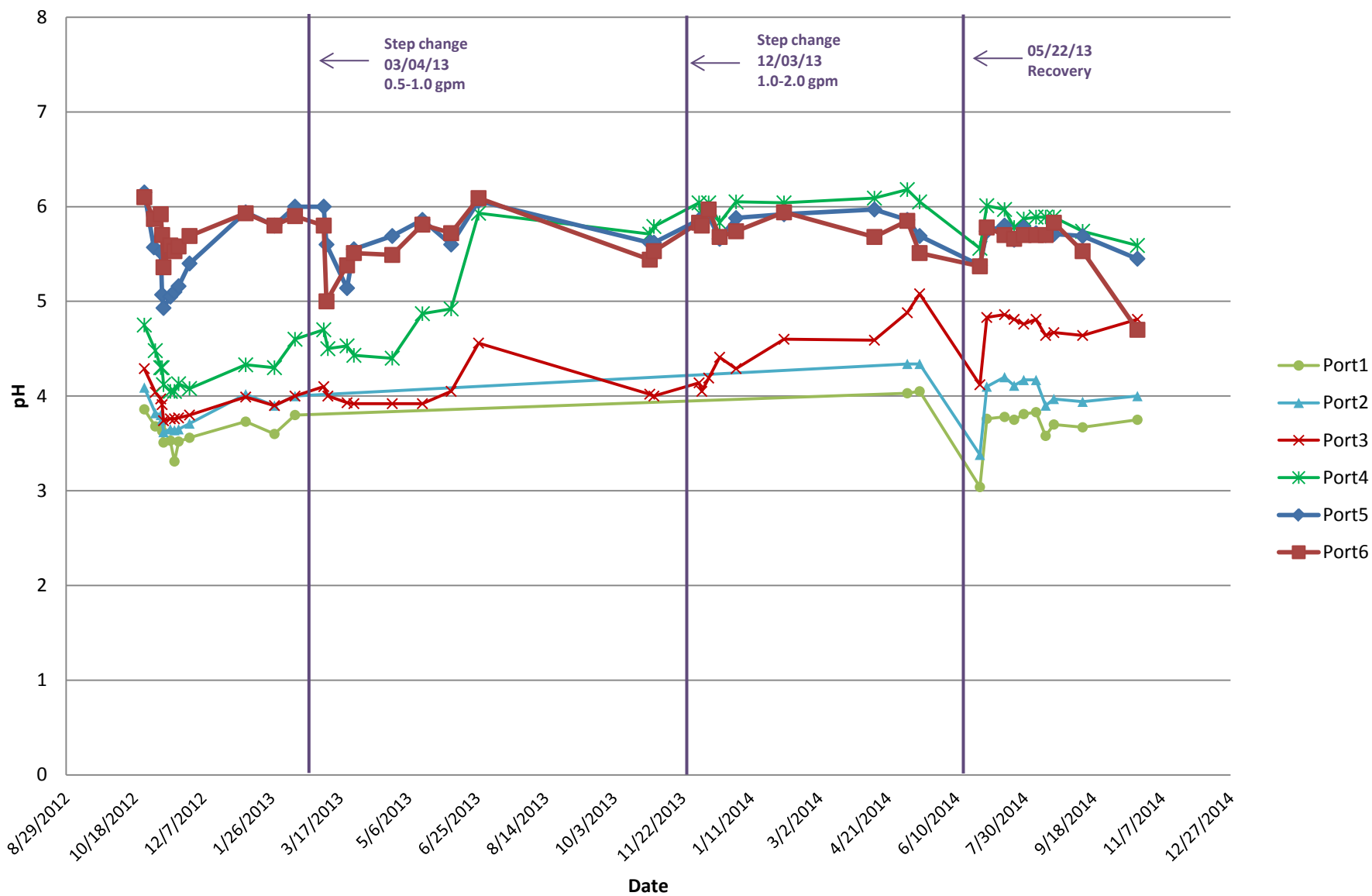


# ML1

## pH in Groundwater

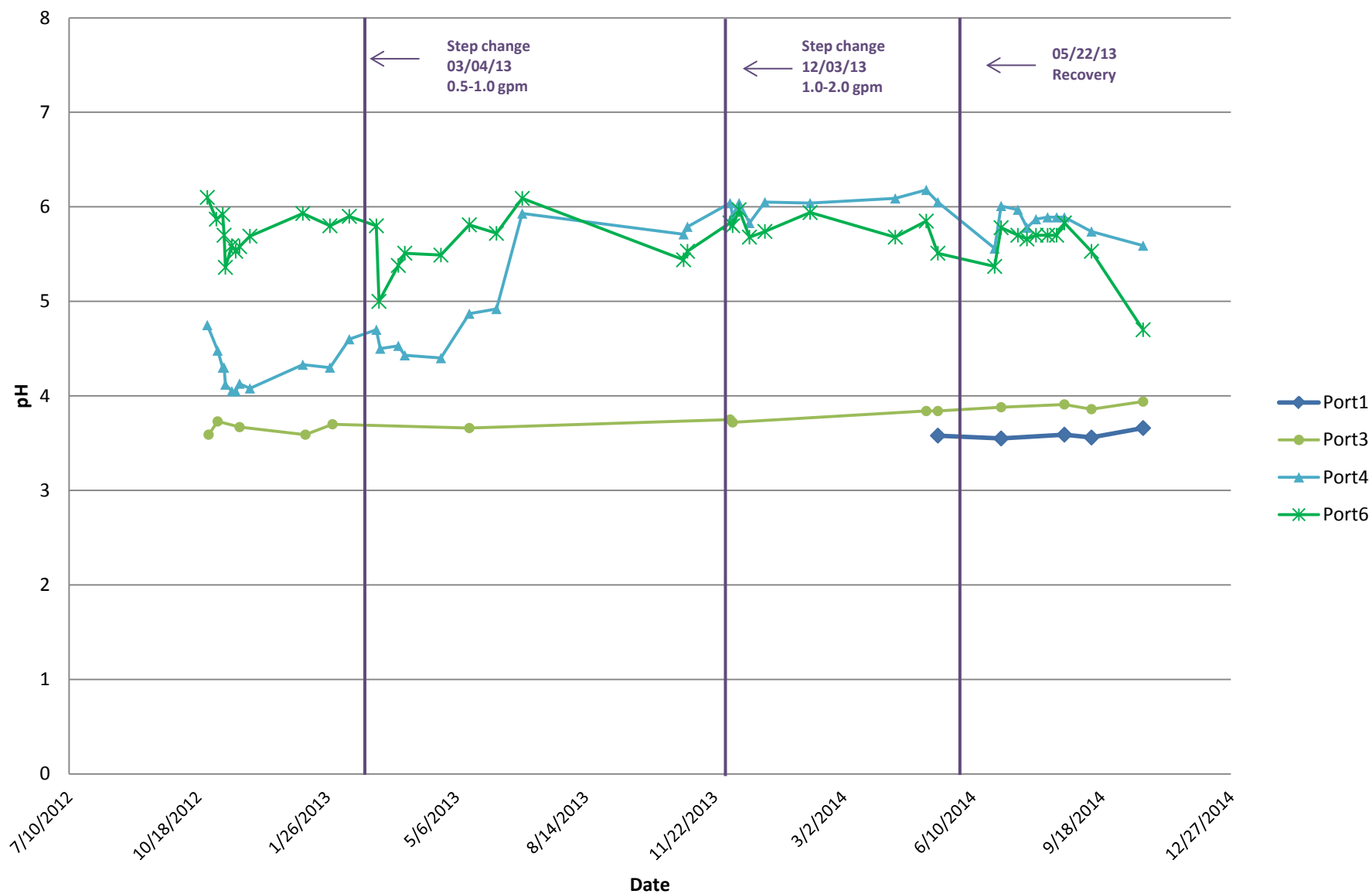


## ML2 pH in Groundwater



## MP2

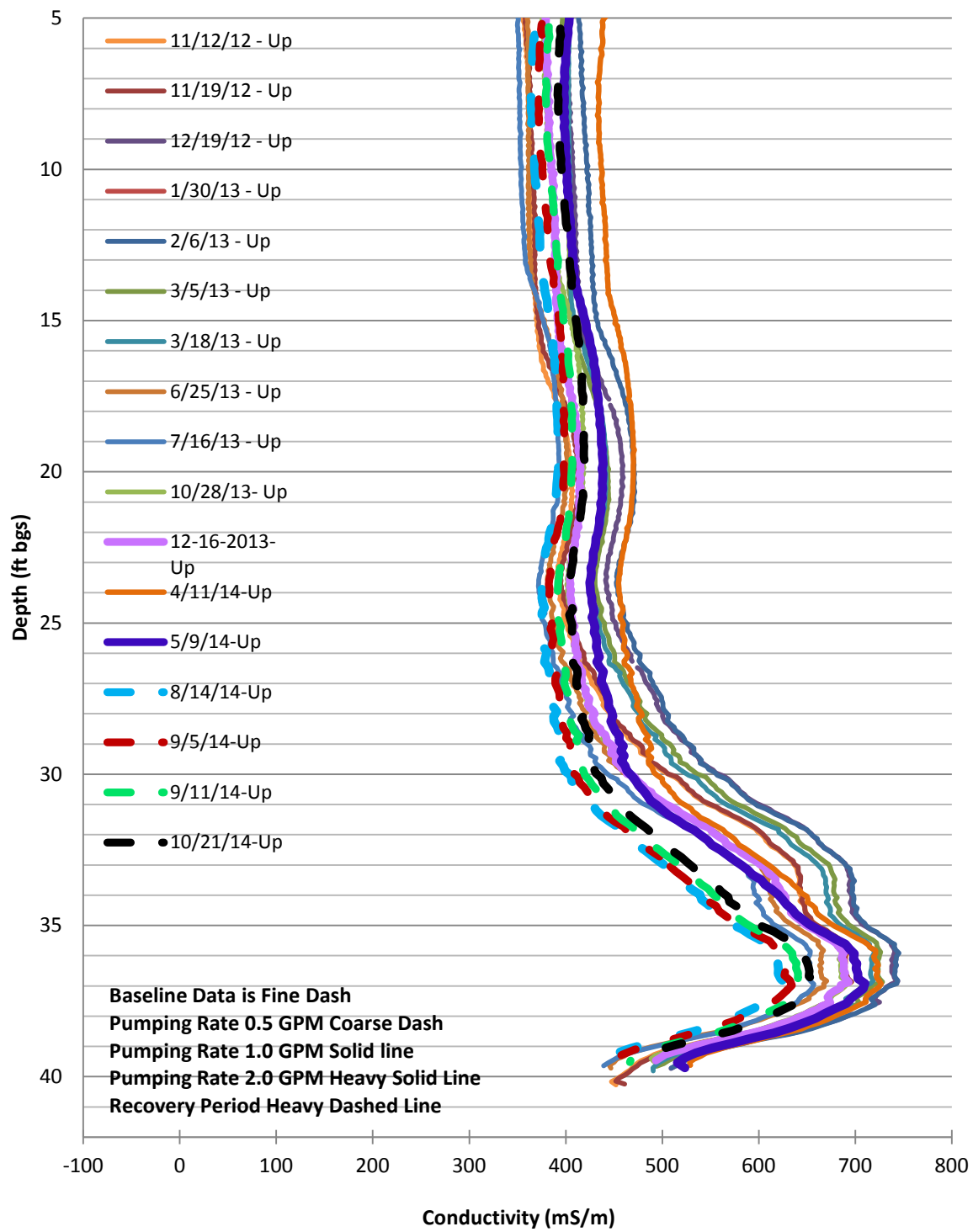
### pH in Groundwater



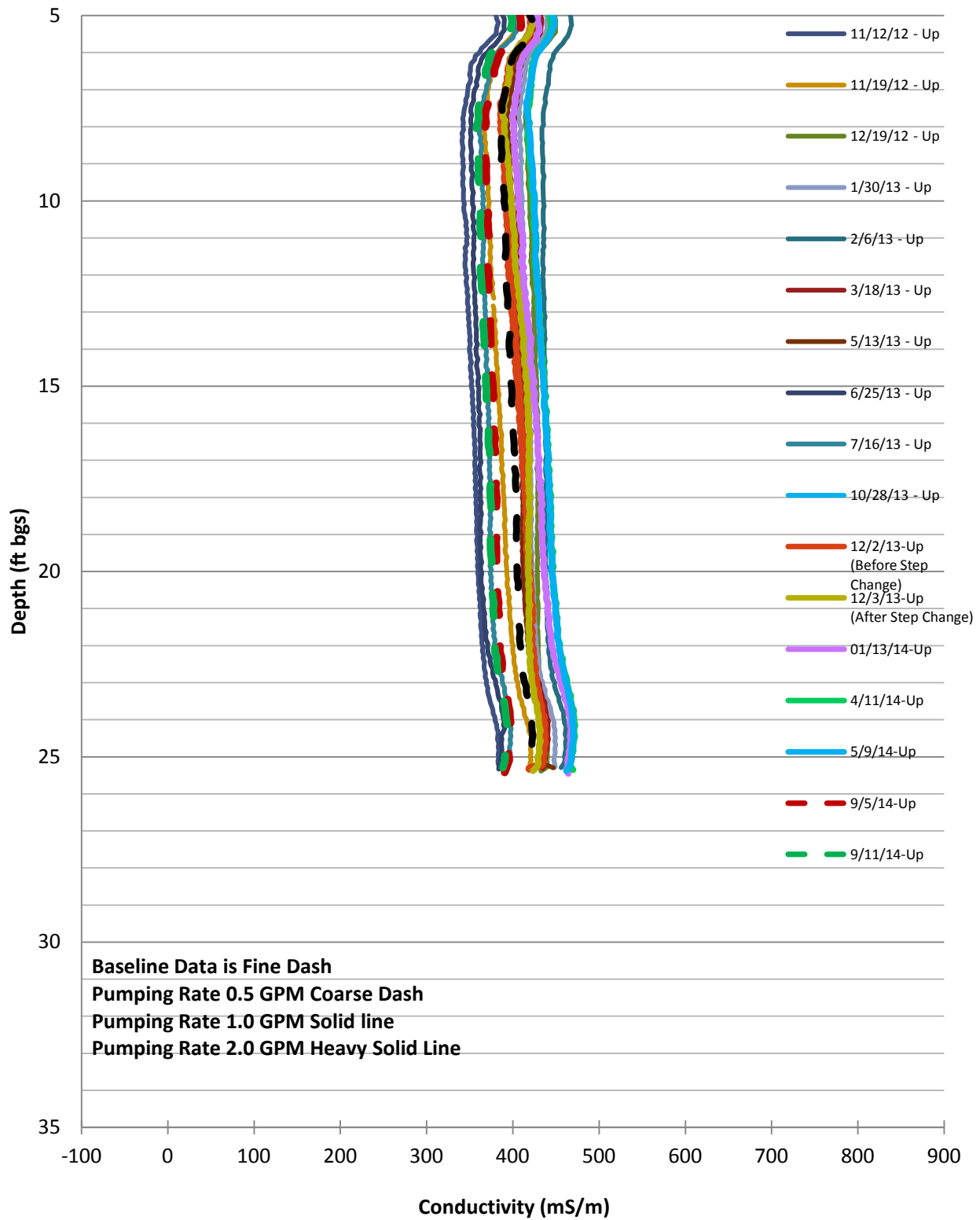
## **APPENDIX E**

### **INDUCTION LOGGING PLOTS**

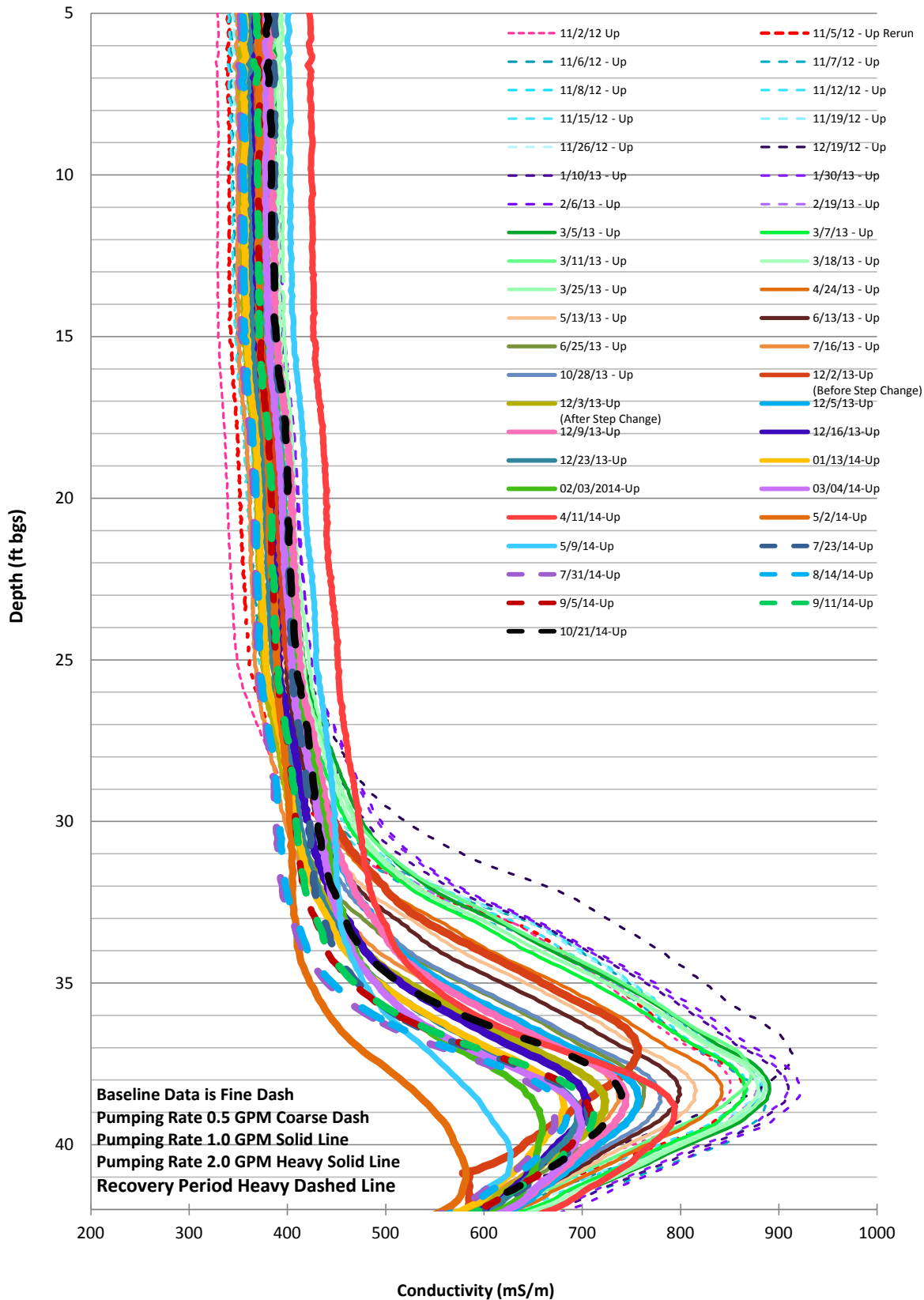
# GW-42DR



# GW-43DR



# ILW-1



# ILW-2

