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Memorandum

To	George Meservey, Director of Planning & Community Development Michael Domenica, PE, Program Manager
CC	Betsy Shreve, AICP, AECOM Project Director James Begley, LSP, MT Environmental AECOM PRB Team
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Task Number 10.1.B – NT Demonstration Projects** **Technical Memorandum for Eldredge Park Permeable Reactive Barriers Demonstration Overview of Baseline Sampling, Injection Activities and Post-Injection Groundwater Monitoring - Final**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date	March 1, 2017

Approvals	Date	Signature / Initials
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Michael Domenica, PE, Water Resources Associates, Program Manager		

1. Background

This technical memorandum summarizes monitoring well installation, baseline groundwater quality assessment, and emulsified vegetable oil (EVO) substrate injections for the Eldredge Park Permeable Reactive Barrier (PRB) demonstration test site. Initial post-injection monitoring data is also included. AECOM Technical Services, Inc. (AECOM) PRB Technical Team (AECOM and MT Environmental Restoration) prepared this technical memorandum for the Town of Orleans. AECOM is providing water quality and wastewater planning and engineering services to the Town to reduce excessive nitrogen loading to the Town's ponds, estuaries and embayments.

2. Introduction

A. The Project represents the first to implement a "Hybrid" approach under the Cape Cod 208 Water Quality Plan, which has been approved by both the United States Environmental Protection Agency (USEPA) and the Massachusetts Department of Environmental Protection (MassDEP). The Project consists of conceptual and preliminary design to update the Comprehensive Wastewater Management Plan (CWMP) completed by the Town in 2011 to reflect the Consensus Plan (Water Quality Management Plan) developed by the Town in 2015. The Project goal is to reduce the nitrate load to impacted estuaries in the most cost effective manner by maximizing the use of several non-traditional technologies (Coastal Habitat Restoration, Aquaculture, Floating Constructed Wetlands, and Permeable Reactive Barriers).

The Hybrid Plan was vetted through the Orleans Water Quality Advisory Panel (OWQAP), a panel consisting of stakeholder representatives (Orleans Selectmen and representatives of engaged citizen constituencies), and liaisons from key town boards and commissions, organizations, neighboring towns, and regional, state, and federal partners. Potential alternative planning scenarios to meet water quality standards were developed for the OWQAP.

B. The purpose of this technical memorandum is to provide a construction report for the implemented Eldredge Park Demonstration Tests for PRBs and outline future monitoring plans. PRBs are a non-traditional treatment technology with the potential to reduce the levels of nitrate in the groundwater by treating groundwater biologically before it reaches sensitive surface water bodies such as estuaries.

C. The results of the groundwater monitoring plans will be incorporated into an overall Adaptive Management Plan which will be implemented to evaluate the impacts of the technologies selected by the OWQAP on reducing nitrogen. AECOM will continue to work closely with the Town, its Water Quality Advisory Panel, and the regulatory agencies including the Cape Cod Commission (CCC) and MassDEP, in implementing the Adaptive Management Plan as it is critical to obtaining one of the first watershed permits granted by MassDEP.

D. The Demonstration Test aims to provide data to assess the cost effectiveness and applicability of PRBs as a treatment alternative for the Town. It is expected that the test will demonstrate the level of nitrate removal that can be achieved with PRBs and provide data to prepare a full scale design. The Demonstration Tests will be evaluated by the following performance objectives:

1) Achieve satisfactory distribution of the EVO substrate into the subsurface soils;

2) Establish and maintain necessary dissolved organic carbon concentrations and anaerobic (reducing) conditions in the groundwater while maintaining groundwater flow throughout the targeted treatment area;

3) Demonstrate reduced nitrate concentrations and the mass of nitrate transported in groundwater (nitrate flux) through groundwater monitoring;

4) Evaluate performance through compliance monitoring and assessment of treated water quality, including potential secondary water quality affects, through a groundwater monitoring program;

5) Evaluate the life expectancy of the EVO and time frame for technology performance;

6) Evaluate potential impacts to sensitive receptors (surface water, private wells, etc.); and

7) Obtain data for engineering evaluations and to optimize full scale design and implementation to meet nitrate reduction targets.

3. Summary of Demonstration Test – Monitoring Well Installation

A. AECOM evaluated numerous potential sites in the Town of Orleans, including locations identified by the Town, for consideration for placement of PRB Demonstration Tests in 2016, as described in the PRB Work Plan (AECOM 5/19/16). The Eldredge Park Demonstration Test site is located in the parking lot area between the Nauset Middle School playing fields and the Town-owned Eldredge Park baseball field. The demonstration site is owned by Nauset Public Schools. The Nauset Regional School Committee granted permission to install monitoring wells and conduct the PRB Demonstration Test at this location. Town Cove is located approximately 2,400 feet to the northeast of the Eldredge Park PRB Demonstration Test site. Groundwater generally flows in a northeasterly direction, toward Town Cove (Figure 1).

B. Existing groundwater monitoring wells were identified at the Nauset Regional Middle School (NRMS) in the recreational field and parking lot area. These wells were installed in 1992 as part of an ongoing program to monitor groundwater in the vicinity of the NRMS wastewater treatment facility's leaching fields. An irrigation well for Eldredge Park was also identified near the corner of Eldredge Park and South Orleans Road with an available boring log and groundwater quality data.

C. In September 2016, four groundwater monitoring wells were installed in the selected demonstration test area. Water levels were measured and the groundwater flow direction was estimated. The orientation of the proposed PRB was modified before installing the remaining nineteen groundwater monitoring wells in October 2016. All 23 new groundwater monitoring wells were installed in order to allow for water quality measurement upgradient, downgradient, and cross-gradient of the demonstration PRB. One of the existing groundwater monitoring wells (MW-12) was also used as an upgradient well. Two new wells (MW-12A and MW-12B) were installed at this location to monitor groundwater at deep and intermediate depths, respectively. The monitoring well network includes monitoring wells located along two transects (A to A' and B to B') oriented upgradient to downgradient in the direction of groundwater flow, perpendicular to the PRB layout. The location of all demonstration test monitoring wells can be seen on Figure 1. Cross-sections showing the multi-level monitoring well screen intervals along transects are presented in Figure 2 and Figure 3.

D. Monitoring wells were surveyed by Coastal Engineering for location and top of PVC casing elevation to the nearest 1/100 foot. Top of PVC casing elevations are included in Table 1, and the well coordinates are included in Appendix A. The screen intervals were typically 40 to 50 feet bgs in shallow "C" wells, 55 to 65 feet bgs in intermediate "B" wells, and 70 to 80 feet bgs in deep "A" wells. The depths to groundwater from the top of well casings were used to determine groundwater elevations and estimate the local direction of groundwater flow. The depth to groundwater ranged from approximately 30 to 35 feet bgs. Groundwater elevation data is included in Tables 2A through 2D. Groundwater contours generated from the groundwater elevation data on November 14, 2016 were plotted with a two-dimensional contouring and surface plotting program (Surfer, Golden Software, LLC) and are included as Figure 4 (Shallow), Figure 5 (Intermediate), and Figure 6 (Deep). The groundwater contours generally show a northeasterly flow consistent with regional groundwater flow toward Town Cove. However, there appears to be some differences in local groundwater flow direction in the immediate vicinity of the PRB depending on monitoring depth and location. The shallowest monitoring wells indicate the most variation in flow direction, likely associated with groundwater recharge patterns from storm drains and adjacent permeable ball field and impermeable paved surfaces. Variations in local flow direction may also be associated with heterogeneities in the aquifer material i.e. finer vs. coarser sand, and other factors including wastewater recharge from the Nauset Regional Middle School system located under the soccer field. Groundwater elevation and flow direction data will be monitored over the remainder of the Demonstration Test.

4. Summary of Demonstration Test – Carbon Substrate Injection

A. PRB Treatment Process Description

1) PRBs are a passive treatment technology, designed in this application to intercept and treat nitrate in groundwater through biological denitrification before groundwater reaches downgradient surface waters. The PRB treatment zone is located in the groundwater saturated zone below the water table, where amendments are added to form the PRB. PRBs are typically oriented perpendicular to the direction of groundwater flow and rely on the natural groundwater gradient to carry the contaminant through the PRB (ITRC, 2011). The system is permeable because the amendments added are designed not to interfere with groundwater flow.

2) The PRB in-situ (in place in the ground) treatment method typically introduces a carbon food substrate into the groundwater, allowing naturally occurring microbes in the groundwater to consume the carbon substrate while respiring oxygen and creating anoxic conditions (without oxygen) favorable for denitrifying bacteria. Under anoxic or anaerobic conditions, maximum energy is gained by microbes using nitrate as an electron acceptor (denitrification reaction). Nitrate is the preferred electron acceptor to soil microbes after oxygen is consumed. This process of bacterial metabolism results in the conversion of nitrate to inert nitrogen gas and requires both anoxic conditions and sufficient food substrate for bacterial growth.

Denitrification: $NO_3^- \rightarrow NO_2^- \rightarrow NO + N_2O \rightarrow N_{2\,(g)}$

B. Demonstration Test Layout

The current PRB Demonstration test is oriented cross-gradient northwest to southeast perpendicular to the northeasterly groundwater flow direction and the PRB is approximately 110 feet long. Future full-scale PRBs or sections or PRBs are anticipated to be longer (500 to 3,000 feet, depending on the location). Demonstration Test locations are shorter in length, selected to assess construction/implementation, and allow adequate monitoring of groundwater conditions in the vicinity of the PRBs to monitor the demonstration. A vertical treatment interval from the top of the groundwater table to approximately 35 feet into the saturated soils was selected for this Demonstration Test PRB.

C. Reactive Amendment Application Method

PRBs have been designed and implemented through several construction methods. During this demonstration test, direct-push methods were used place the EVO substrate in the subsurface. Direct–push injection is a method of soil boring modified with a down-hole injection screen and tubing used for placement of organic carbon electron donor EVO substrate. The direct-push injections are temporary injection points that are sealed following injection.

D. PRB Demonstration Test Substrate and System Details

Subsurface geology on Cape Cod typically consists of relatively permeable sandy formations with relatively high groundwater flow velocities (1 to 3 feet per day). An EVO solution with a larger droplet size was selected so that the EVO droplets will adhere to sand grains in the formation to minimize the advection, or distribution, of EVO after injection. EVO adheres to the sandy aquifer material in the treatment zone and provides a slow release of soluble organic carbon compounds that are distributed by advection, dispersion, and diffusion in groundwater. A larger droplet size will also maximize the persistence of the carbon substrate within the PRB. For this demonstration test, Terra System's 60 percent Large Droplet Slow Release EVO for Nitrate Reduction (SRS-NR) was used. The SRS NR is a modified formulation developed so that the emulsion is "stickier" in order to reduce migration after injection and increase persistence. Injecting EVO with added water enhances the distribution of EVO in the subsurface. The 60 percent EVO was mixed with water making a 15.5 percent solution for injection. Product information, including the Material Safety Data Sheets (MSDS) for EVO substrate is presented in Appendix B.

For in-situ remediation technologies, delivery of an appropriate amount of injected amendments is a primary factor to achieving successful treatment. Sufficient carbon substrate/electron donor material must be applied to establish nitrate reducing conditions in the PRB. Calculations supporting amendment dosages are presented in Appendix C. The Substrate Estimating Tool for Enhanced Anaerobic Bioremediation of Chlorinated Solvents developed for the Environmental Security Technology Certification Program (ESTCP) was used to support EVO quantities for the PRB Demonstration Tests. This tool estimates quantities of various carbon substrates to provide sufficient amendment for the sum of electron donor demand from electron acceptors (dissolved oxygen, nitrate, and sulfate) as well as dissolved volatile organic compounds if present. For the Demonstration Test, the EVO dosage was determined primarily to meet the electron donor demand based on site conditions including expected nitrate concentrations. Actual quantities of EVO used to establish the Demonstration Test treatment zone are summarized in Table 4-1 and can be seen on the injection field reports shown in Appendix D.

The metabolism of added carbon substrate by soil microbes can result in a decrease in groundwater pH, and a neutralization agent (i.e., sodium bicarbonate) is sometimes injected with the carbon substrate to counteract changes in pH. Groundwater pH is typically between pH 5.5 and pH 6 across Cape Cod. Denitrifying bacteria are most active in circumneutral groundwater (pH 6 to 8). Based on groundwater data indicating a lower pH (5.5-6.5) at the site, sodium bicarbonate was used as a pH buffer with the EVO. Approximately 10.3 pounds of sodium bicarbonate was added per 300-gallons of EVO solution.

Table 4-1 - Summary of Design Parameters for Permeable Reactive Barrier Demonstration Test

Parameter	Demonstration Test Site
Area Description	Parking lot between the playing fields off Eldredge Park
Depth to Ground Water	30 to 40 feet below grade
Demonstration Test PRB Length	110 feet
Injection Interval	38 to 68 feet below grade
Injection Point Spacing	10 feet
Injection Points	17
Injection Pore Volume	12 percent (assumed effective porosity of 25 percent)
Total Injection Volume (gal)	10,800
Injection Volume Per Point (gal)	600 (Three points received 720, 820, 860 gal in order to use the remainder of the EVO.)
EVO Dilution	15.5 percent (~3.9:1 dilution from 60 percent EVO delivered)
Total EVO (gal)	2,620 (60 percent soy bean oil)

E. Substrate Delivery Record

Isotec, Inc. performed the injections on November 15 through 18, 2016 with oversight by the AECOM PRB Team. Injection of carbon substrate was performed directly through direct-push (i.e., GeoProbe®) rods, configured in 4-foot or 8-foot intervals with thin, laser cut injection holes. During the Demonstration Test, there were few geological limitations observed. The majority of the EVO was injected successfully with wellhead/injection pressure reading of 0 psi indicating no measureable resistance to injection. Several wells had higher wellhead pressures, close to 20 psi, particularly at their deepest intervals (56 to 68 feet). The higher pressure indicates injection into lower permeability material such as finer sand and silt. All wellhead pressure observations can be seen on the daily injection reports in Appendix D. The 17 injection points were spaced approximately 10 feet apart. The western side of the PRB consisted of seven points, spaced 10 feet apart. In order to assess the effect of injections point density and injection volume, the eastern side of the PRB consisted of 10 points configured in two parallel, offset lines of five points each. The five points were spaced approximately 10 feet from each other. The second line was five feet downgradient and off-set by five feet. Injection locations are depicted on Figure 1.

F. Field Injection Activities

The system for preparation, mixing, and injection of substrate solutions consisted of mixing tanks, mixers, pumps, piping, meters, valves, and fittings. All components were selected from materials that are compatible for use with the selected amendments. Injection batches were prepared in 300-gallon plastic tanks by adding appropriate quantities of water to achieve the selected dilution concentration. Mobile above-ground pumps and hoses were used to convey EVO directly to the injection points. Flow totalizers, pressure gauges, and shut-off valves were used to monitor injection pressure, flow rates, and total volume added to each injection interval at each injection point.

At each injection point, a direct-push drill rig advanced injection tooling to a targeted depth of 68 feet below grade. Seventy-five gallons of the diluted EVO solution were injected per four-foot interval. Both 4-foot and 8-foot injection points were used for injection. The injection rods were lifted up four (or 8) feet to the subsequent injection target depth and the process was repeated. This method of direct-push injection is referred to as bottom-up injection. To minimize mounding and improve delivery, injection was generally not performed at adjacent points at the same time. A field log was maintained to record the solution composition, volume of solution delivered to each injection interval at injection point, length of time required for injection, and the injection pressure. Electricity to power remediation equipment was provided by a gasoline-powered generator. Potable water for batching and injection was collected from a nearby hydrant.

5. Permitting

The EPA Underground Injection Control (UIC) Program is responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage and disposal. The UIC Program requirements were developed by EPA and designed to be adopted by states. The Massachusetts Department of Environmental Protection (MassDEP) UIC Program is defined in 310 CMR 27.00: Underground Injection Control Regulations and details the regulation of injection of fluids within Massachusetts.

To implement the Demonstration Test a UIC permit application (MassDEP form BRPWS 06) was filed with MassDEP under the category “Aquifer Remediation.” Similar injections of carbon substrates to enhance biodegradation of groundwater chemicals have been commonly implemented in Massachusetts, and many of these sites are exempt from the UIC registration process if the injections are conducted for waste site cleanup in accordance with the Massachusetts Contingency Plan (MCP, 310 CMR 40.0000) or similar federal statutes. In implementing the Demonstration Test all injections associated with the PRB complied with the requirements of the Massachusetts UIC regulations and the MCP requirements, including all required monitoring. MassDEP issued UIC Registration ID# MAS41A224209-5B6 for the Demonstration Test.

6. PRB Demonstration Test Performance Monitoring Plan

A. General

Performance monitoring of the PRB Demonstration Test is being implemented to assess nitrate reduction, concentrations of biogeochemical indicators, and the distribution of the injected reagents. It is anticipated that the monitoring program will be frequently evaluated and modified to respond to observations, adjusting the monitoring as necessary. This section provides details the performance monitoring program.

Groundwater samples will be collected from selected monitoring wells in the Demonstration Test area. The monitoring well network includes multi-level monitoring wells upgradient and downgradient of the PRB. These wells are aligned in two transects in addition to cross gradient and more regional monitoring wells. The monitoring network plan view is presented on Figure 1 and PRB monitoring well cross sections are shown in cross-section on Figure 2 and Figure 3. The monitoring wells upgradient and downgradient of the PRB will be used to evaluate changes to nitrate concentrations and groundwater quality based on PRB performance. Monitoring wells downgradient of the PRB are located at selected distances from the PRB along the transects to assess distance of emulsion travel, extent of reducing conditions for denitrification, potential for metals mobilization, and for collection of groundwater elevation data for flow direction and groundwater flow velocity monitoring.

B. Sampling Method, Frequency, and Analyses

Groundwater samples are collected using a submersible pump. Groundwater quality parameters measured in the field include pH, oxidation reduction potential (ORP), dissolved oxygen (DO), specific conductivity, temperature, and turbidity. Field parameters are monitored with the use of a multi-parameter probe in a flow-through cell. Samples are collected after field water quality parameters stabilize.

Groundwater samples were collected prior to EVO injection to provide a comparative baseline to evaluate performance of the Demonstration Test. Baseline groundwater samples were analyzed to determine pre-treatment concentrations of nitrate and other indicator parameters whose change will be indicative of the impact of the PRB. In addition, a synoptic water level event was conducted after additional monitoring wells were installed but prior to the start of injections to further assess the groundwater flow direction and gradient.

During injection activities, select groundwater wells were monitored for field parameters (pH, temperature, dissolved oxygen, oxidation-reduction potential, and conductivity). Additionally, the EVO vendor Terra Systems monitored the 10 foot and 20 foot downgradient monitoring wells using an in-well probe for these same parameters in order to observe any potential changes during injection. During the third full day of injections, select wells were sampled and analyzed for dissolved organic carbon (DOC) and alkalinity to estimate whether there had been any EVO migration. Generally DOC and alkalinity test results did not indicate EVO migration. Visual monitoring at test wells located 10 foot and 20 foot downgradient of injection points indicated sporadic observation of higher turbidity and what may have been dilute EVO during injection.

The first post-injection sampling event was a stand-alone sampling event approximately 7 weeks from the injections with samples collected on January 5 and January 10, 2017. It is anticipated that additional routine groundwater sampling will be performed quarterly for a period of three years. Primary objectives of the post-injection sampling will be to:

1) Assess potential reduction in nitrate concentrations in groundwater compared to baseline samples and/or wells upgradient of the PRB;
2) Identify distance traveled by EVO emulsion and DOC;
3) Identify extent of generated reducing conditions;
4) Evaluate potential for reduction in aquifer permeability as a result of EVO application;
5) Evaluate persistence of EVO emulsion and anaerobic conditions favorable for denitrifying bacteria after PRB injection; and
6) Assess changes in groundwater monitoring parameters as a result of the PRB.

As a result of the generation of reducing conditions in groundwater, temporary mobilization of some metals native to the aquifer material may result. Laboratory analysis of select metals will be conducted as part of performance monitoring in select wells. Table 6-1 presents an overview of the Demonstration Test performance monitoring analyses and relevance to the PRB Demonstration Test. It is anticipated the monitoring program will be dynamic and continuously evaluated to adjust the selected monitoring parameters and frequency of monitoring based on data collected and observations.

7. PRB Demonstration Test Performance Monitoring Results To Date

A. Baseline Groundwater Monitoring

Preliminary baseline groundwater monitoring samples were collected on October 4th 2016 at a total of six wells, including three previously existing wells that are part of the Nauset Middle School quarterly sampling plan. After all PRB demonstration monitoring wells were installed, baseline groundwater monitoring sampling was conducted. This sampling occurred on November 3rd and 4th 2016, where a total of 21 groundwater samples were collected. Field parameters and analytical results are shown in Table 3. Overall, baseline sampling indicated nitrate concentrations ranging from 0.357 mg/L (MW-BU2A) to 37 mg/L (MW-1050A).

Table 6-1 - Summary of Analyses for Groundwater Performance Evaluation

Parameter	Relevance to PRB Demonstration Test
Nitrate	Primary groundwater compound targeted for treatment.
Nitrite	Intermediate nitrogen species from the aerobic nitrification of ammonia to nitrate.
Ammonia	Reduced inorganic nitrogen species that occurs in proximity of septic system leach fields and landfills.
Total Nitrogen	Analyses provide a summation of all organic and inorganic nitrogen species in groundwater as a result of leach fields and landfill.
CENSUS-DNA (Denitrifying Bacteria)	Analyses quantify relative abundance of denitrifying bacteria.
Metals (Fe, Mn, As)	Mobility of metals can be impacted by groundwater geochemistry changes, notably pH and ORP.
DOC	Dissolved Organic Carbon is the limiting factor in enhancing denitrification- and is increased by injection of EVO. DOC tracks the area of influence of the PRB.
Sulfate	Sulfate will decrease with generation of sufficiently anaerobic conditions favorable for sulfate-reducing bacteria.
pH	Denitrification optimal pH (6.0 and 8.5). Groundwater pH can decrease as a result of fermentation of injected carbon substrates.
ORP	ORP will decrease with generation of reducing conditions following injection of carbon substrate.
Chloride	Chloride concentrations indicate potentially infiltrating stormwater.
Alkalinity	Denitrification reactions generate alkalinity (3.57 mg of $CaCO_3$ for each mg of nitrate reduced).
Boron	Boron is present in laundry detergents and is an indicator of groundwater flow emanating from leach fields.

B. Monitoring during Injection Activities

During the demonstration injections, field parameters were monitored at select upgradient and downgradient wells. Overall, no distinct patterns between the field parameters (temperature, pH, dissolved oxygen, conductivity, and turbidity) were observed before, during, and immediately following the injections. Raw field data, as monitored by TerraSystems and AECOM, is included in Appendix D.

Laboratory dilutions were completed by Terra Systems producing stock solutions of EVO at various dilutions to determine a reasonable correlation between turbidity and the estimated SRS-NR concentrations. Based on these dilutions and the turbidity measured, data suggests the potential for movement of the SRS-NR emulsion up to 20 feet from the injection at certain depths. However, the conductivity was variable and did not correlate to turbidity. Field visual observations did not indicate significant quantities of emulsion at the downgradient wells. There was potentially a dilute "milky" coloration to the groundwater at the 10 foot and 20 foot wells, however, these observations were soon followed by indications of "clearer" water. These observations support the target area distribution of EVO along the PRB. EVO was not observed following completion of injection indication the injected material was stable and not migrating.

Groundwater samples were collected from seven wells on November 17, 2016 and analyzed for alkalinity and DOC. Alkalinity was measured as a potential indication of the pH buffer that was added with the injections and DOC was measured as a potential indication of the EVO. The alkalinity at the downgradient wells (MW-1010C, MW-1020C, MW-2010C, and MW-2020B) ranged from 11 to 20 mg/L, which is slightly higher than the upgradient and cross-gradient wells (MW-12C, MW-BC2C, and MW-BU2C), which ranged from 4 to 13 mg/L. DOC ranged from 0.576 to 0.852 mg/L and was similar for both upgradient/cross-gradient and downgradient wells.

C. Initial Post-Injection Sampling (7 weeks)

A total of 14 groundwater samples were collected from select wells on 1/5/17 and 1/10/17. The wells sampled included upgradient wells MW-12A/B/C and MW-BU2A/B/C, cross-gradient well MW-BC2C, and downgradient wells MW-B1010C, MW-B1020B/C, MW-B1050A, MW-B2020B/C, and MW-B2050A. MW-B2010C was unable to be sampled due to snow cover. Analytical data is presented in Table 3. Laboratory reports are included in Appendix E.

8. Summary, Schedule, and Coordination

Completed PRB Demonstration Test milestones include:

- PRB groundwater monitoring network installation;
- Baseline groundwater quality data collection;
- PRB construction with injection of EVO as planned; and
- Initial post-injection water quality data collection.

No significant trends in data would be expected at the initial post-injection sampling point. During the elapsed time period since injection the biomass necessary for denitrification is likely developing in the immediate vicinity of injection. The recommended plan includes collecting quarterly samples for a period of three years. Periodic reporting will be conducted to share results and observations with the Town, regulatory agencies, and the public. The first quarterly sampling event is scheduled for mid-February 2017 and results are expected to be summarized in a report by the end of March 2017. The anticipated monitoring schedule is summarized in Table 8-1 and is expected to be followed through November 2019.

Table 8-1 - Summary of Sampling Events for Groundwater Performance Evaluation

Quarterly Sampling Event	Quarterly Sampling Report
February	March
May	June
August	September
November	December

9. References

AECOM – Technical Memorandum Final for Preliminary Engineering Work Plan for Permeable Reactive Barriers. Submitted to Town of Orleans, MA. May 19, 2016.

Cape Cod Commission - Cape Code Regional Wastewater Management Plan Technology Assessment – Conventional Infrastructure, March 2013.

Cape Cod Commission - Cape Cod Area Wide Water Quality Management Plan Update, June 2015.

Interstate Technology & Regulatory Council (ITRC) - Permeable Reactive Barrier: Technology Update (PRB-5), November 2011.

Terra Systems - Personal communications with Michael Lee, PhD, 2016.

10. List of Appendices

Appendix A - Soil Boring Logs and Monitoring Well Coordinates

Appendix B- Emulsified Vegetable Oil Product Information and Material Safety Data Sheet

Appendix C - Environmental Security Technology Certification Program – Supporting Calculations for EVO Amendment Dosages

Appendix D - Daily Injection Field Reports and Monitoring Data

Appendix E - Analytical Laboratory Reports

Tables

Table 1 Orleans Monitoring Well Construction Details

Well ID	Surface Elevation (ft)	TOC Elevation (ft)	Total Well Depth (ft bgs)	Screen Beginning Depth (ft bgs)	Screen End Depth (ft bgs)	Top Screen Elevation (ft)	Bottom Screen Elevation (ft)	Mid-Screen Elevation (ft)	Screen Length (ft)	Inst. Date	Location
MW-12A	45.6	45.57	80.0	70.0	80.0	-24.40	-34.40	-29.40	10.0	October 2016	Eldredge Park
MW-12B	45.6	45.58	65.0	55.0	65.0	-9.40	-19.40	-14.40	10.0	October 2016	Eldredge Park
MW-BU1A	43.7	43.48	80.0	70.0	80.0	-26.30	-36.30	-31.30	10.0	September 2016	Eldredge Park
MW-BU1C	44.0	43.65	50.0	40.0	50.0	4.00	-6.00	-1.00	10.0	September 2016	Eldredge Park
MW-BU2A	45.1	44.56	80.0	70.0	80.0	-24.90	-34.90	-29.90	10.0	October 2016	Eldredge Park
MW-BU2B	45.1	44.70	65.0	55.0	65.0	-9.90	-19.90	-14.90	10.0	October 2016	Eldredge Park
MW-BU2C	45.1	44.68	50.0	40.0	50.0	5.10	-4.90	0.10	10.0	October 2016	Eldredge Park
MW-BC1C	42.5	42.50	50.0	40.0	50.0	2.50	-7.50	-2.50	10.0	September 2016	Eldredge Park
MW-BC2C[1]	N/A	N/A	55.0	45.0	55.0	N/A	N/A	N/A	10.0	October 2016	Eldredge Park
MW-B1010C	44.9	44.46	55.0	45.0	55.0	-0.10	-10.10	-5.10	10.0	October 2016	Eldredge Park
MW-B1020B	44.6	44.18	65.0	55.0	65.0	-10.40	-20.40	-15.40	10.0	October 2016	Eldredge Park
MW-B1020C	44.5	44.10	50.0	40.0	50.0	4.50	-5.50	-0.50	10.0	October 2016	Eldredge Park
MW-B1050A	43.9	43.42	80.0	70.0	80.0	-26.10	-36.10	-31.10	10.0	October 2016	Eldredge Park
MW-B1050B	43.9	43.54	65.0	55.0	65.0	-11.10	-21.10	-16.10	10.0	October 2016	Eldredge Park
MW-B1050C	44.9	43.55	50.0	40.0	50.0	4.90	-5.10	-0.10	10.0	October 2016	Eldredge Park
MW-B1075B	43.5	43.29	65.0	55.0	65.0	-11.50	-21.50	-16.50	10.0	October 2016	Eldredge Park
MW-B2010C	45.0	44.70	55.0	45.0	55.0	0.00	-10.00	-5.00	10.0	October 2016	Eldredge Park
MW-B2020B	44.9	44.50	65.0	55.0	65.0	-10.10	-20.10	-15.10	10.0	October 2016	Eldredge Park
MW-B2020C	44.8	44.45	50.0	40.0	50.0	4.80	-5.20	-0.20	10.0	October 2016	Eldredge Park
MW-B2050A	44.6	44.06	80.0	70.0	80.0	-25.40	-35.40	-30.40	10.0	October 2016	Eldredge Park
MW-B2050B	44.6	44.28	65.0	55.0	65.0	-10.40	-20.40	-15.40	10.0	October 2016	Eldredge Park
MW-B2050C	44.6	44.17	50.0	40.0	50.0	4.60	-5.40	-0.40	10.0	October 2016	Eldredge Park
MW-B2100	44.6	44.23	45.0	35.0	45.0	9.60	-0.40	4.60	10.0	September 2016	Eldredge Park

Notes:

N/A = Not Available

1. MW-BC2C has not yet been surveyed.

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-1	Eldredge Park	11/3/2016	41.31	30.1	11.21
MW-1	Eldredge Park	11/14/2016	41.31	30.2	11.11
MW-1	Eldredge Park	1/18/2017	41.31	30.4	10.88
MW-1	Eldredge Park	1/27/2017	41.31	30.3	11.06
MW-2	Eldredge Park	11/3/2016	44.82	33.7	11.17
MW-2	Eldredge Park	11/14/2016	44.82	33.8	10.99
MW-2	Eldredge Park	1/18/2017	44.82	34.0	10.79
MW-2	Eldredge Park	1/27/2017	44.82	33.9	10.91
MW-4	Eldredge Park	11/3/2016	46.57	35.5	11.04
MW-4	Eldredge Park	11/14/2016	46.57	35.7	10.86
MW-4	Eldredge Park	1/18/2017	46.57	36.0	10.59
MW-4	Eldredge Park	1/27/2017	46.57	35.8	10.74
MW-8	Eldredge Park	October 2016	46.16	35.3	10.86
MW-8	Eldredge Park	11/14/2016	46.16	35.2	10.94
MW-8	Eldredge Park	1/18/2017	46.16	35.6	10.54
MW-8	Eldredge Park	1/27/2017	46.16	35.5	10.66
MW-11	Eldredge Park	11/3/2016	45.14	34.2	10.94
MW-11	Eldredge Park	11/14/2016	45.14	34.2	10.94
MW-11	Eldredge Park	1/18/2017	45.14	34.4	10.72
MW-11	Eldredge Park	1/27/2017	45.14	33.3	11.83
MW-11S	Eldredge Park	11/3/2016	45.25	34.2	11.10
MW-11S	Eldredge Park	11/14/2016	45.25	34.3	11.00
MW-11S	Eldredge Park	1/18/2017	45.25	34.5	10.74
MW-11S	Eldredge Park	1/27/2017	45.25	34.4	10.89
MW-12A	Eldredge Park	11/3/2016	45.57	34.4	11.17
MW-12A	Eldredge Park	11/14/2016	45.57	35.0	10.56
MW-12A	Eldredge Park	1/18/2017	45.57	34.7	10.86
MW-12A	Eldredge Park	1/27/2017	45.57	34.6	11.00
MW-12B	Eldredge Park	11/3/2016	45.58	34.5	11.08
MW-12B	Eldredge Park	11/14/2016	45.58	34.9	10.68
MW-12B	Eldredge Park	1/18/2017	45.58	34.8	10.79
MW-12B	Eldredge Park	1/27/2017	45.58	34.6	10.94
MW-12 (Existing)	Eldredge Park	11/3/2016	46.61	36.3	10.34
MW-12 (Existing)	Eldredge Park	11/14/2016	46.61	36.0	10.62
MW-12 (Existing)	Eldredge Park	1/18/2017	46.61	36.2	10.40
MW-12 (Existing)	Eldredge Park	1/27/2017	46.61	36.1	10.55
MA-BU1A	Eldredge Park	11/3/2016	43.48	32.6	10.93
MA-BU1A	Eldredge Park	11/14/2016	43.48	32.4	11.04
MA-BU1A	Eldredge Park	1/18/2017	43.48	32.9	10.62
MA-BU1A	Eldredge Park	1/27/2017	43.48	32.7	10.74
MW-BU1C	Eldredge Park	11/3/2016	43.65	32.5	11.15
MW-BU1C	Eldredge Park	11/14/2016	43.65	N/A	N/A
MW-BU1C	Eldredge Park	1/18/2017	43.65	32.8	10.81
MW-BU1C	Eldredge Park	1/27/2017	43.65	32.7	10.93
MW-BU2A	Eldredge Park	11/3/2016	44.56	33.9	10.66
MW-BU2A	Eldredge Park	11/14/2016	44.56	34.0	10.53
MW-BU2A	Eldredge Park	1/18/2017	44.56	34.2	10.34
MW-BU2A	Eldredge Park	1/27/2017	44.56	34.1	10.51

Table 2 Orleans Groundwater Elevations

MW-BU2B	Eldredge Park	11/3/2016	44.70	33.9	10.77
MW-BU2B	Eldredge Park	11/14/2016	44.70	34.1	10.63
MW-BU2B	Eldredge Park	1/18/2017	44.70	34.3	10.39
MW-BU2B	Eldredge Park	1/27/2017	44.70	34.2	10.55
MW-BU2C	Eldredge Park	11/3/2016	44.68	34.0	10.69
MW-BU2C	Eldredge Park	11/14/2016	44.68	34.1	10.60
MW-BU2C	Eldredge Park	1/18/2017	44.68	34.3	10.38
MW-BU2C	Eldredge Park	1/27/2017	44.68	34.2	10.53
MW-BC1C	Eldredge Park	11/3/2016	42.50	31.4	11.14
MW-BC1C	Eldredge Park	11/14/2016	42.50	31.9	10.63
MW-BC1C	Eldredge Park	1/18/2017	42.50	31.8	10.69
MW-BC1C	Eldredge Park	1/27/2017	42.50	31.7	10.85
MW-BC2C[1]	Eldredge Park	11/3/2016	N/A	32.8	N/A
MW-BC2C[1]	Eldredge Park	11/14/2016	N/A	N/A	N/A
MW-BC2C[1]	Eldredge Park	1/18/2017	N/A	33.2	N/A
MW-BC2C[1]	Eldredge Park	1/27/2017	N/A	33.1	N/A
MW-B1010C	Eldredge Park	11/3/2016	44.46	33.6	10.86
MW-B1010C	Eldredge Park	11/14/2016	44.46	34.0	10.48
MW-B1010C	Eldredge Park	1/18/2017	44.46	34.0	10.49
MW-B1010C	Eldredge Park	1/27/2017	44.46	33.8	10.65
MW-B1020B	Eldredge Park	11/3/2016	44.18	33.4	10.76
MW-B1020B	Eldredge Park	11/14/2016	44.18	33.7	10.50
MW-B1020B	Eldredge Park	1/18/2017	44.18	33.8	10.37
MW-B1020B	Eldredge Park	1/27/2017	44.18	33.7	10.52
MW-B1020C	Eldredge Park	11/3/2016	44.10	33.2	10.94
MW-B1020C	Eldredge Park	11/14/2016	44.10	33.3	10.78
MW-B1020C	Eldredge Park	1/18/2017	44.10	33.5	10.57
MW-B1020C	Eldredge Park	1/27/2017	44.10	33.3	10.78
MW-B1050A	Eldredge Park	11/3/2016	43.42	32.8	10.58
MW-B1050A	Eldredge Park	11/14/2016	43.42	32.9	10.50
MW-B1050A	Eldredge Park	1/18/2017	43.42	32.9	10.51
MW-B1050A	Eldredge Park	1/27/2017	43.42	32.9	10.54
MW-B1050B	Eldredge Park	11/3/2016	43.54	32.7	10.89
MW-B1050B	Eldredge Park	11/14/2016	43.54	32.7	10.82
MW-B1050B	Eldredge Park	1/18/2017	43.54	33.0	10.56
MW-B1050B	Eldredge Park	1/27/2017	43.54	32.8	10.73
MW-B1050C	Eldredge Park	11/3/2016	43.55	32.8	10.75
MW-B1050C	Eldredge Park	11/14/2016	43.55	32.8	10.75
MW-B1050C	Eldredge Park	1/18/2017	43.55	33.0	10.53
MW-B1050C	Eldredge Park	1/27/2017	43.55	33.0	10.59
MW-B1075B	Eldredge Park	11/3/2016	43.29	32.6	10.74
MW-B1075B	Eldredge Park	11/14/2016	43.29	32.6	10.72
MW-B1075B	Eldredge Park	1/18/2017	43.29	32.8	10.51
MW-B1075B	Eldredge Park	1/27/2017	43.29	32.6	10.67
MW-B2010C	Eldredge Park	11/3/2016	44.70	34.0	10.75
MW-B2010C	Eldredge Park	11/14/2016	44.70	34.1	10.60
MW-B2010C	Eldredge Park	1/18/2017	44.70	34.4	10.29
MW-B2010C	Eldredge Park	1/27/2017	44.70	34.2	10.49
MW-B2020B	Eldredge Park	11/3/2016	44.50	33.9	10.60
MW-B2020B	Eldredge Park	11/14/2016	44.50	33.9	10.60
MW-B2020B	Eldredge Park	1/18/2017	44.50	34.2	10.35
MW-B2020B	Eldredge Park	1/27/2017	44.50	34.0	10.47

Table 2 Orleans Groundwater Elevations

MW-B2020C	Eldredge Park	11/3/2016	44.45	33.8	10.65
MW-B2020C	Eldredge Park	11/14/2016	44.45	34.0	10.47
MW-B2020C	Eldredge Park	1/18/2017	44.45	34.2	10.23
MW-B2020C	Eldredge Park	1/27/2017	44.45	34.1	10.38
MW-B2050A	Eldredge Park	11/3/2016	44.06	33.4	10.65
MW-B2050A	Eldredge Park	11/14/2016	44.06	33.6	10.46
MW-B2050A	Eldredge Park	1/18/2017	44.06	33.9	10.18
MW-B2050A	Eldredge Park	1/27/2017	44.06	33.6	10.42
MW-B2050B	Eldredge Park	11/3/2016	44.28	33.6	10.68
MW-B2050B	Eldredge Park	11/14/2016	44.28	33.7	10.55
MW-B2050B	Eldredge Park	1/18/2017	44.28	34.0	10.28
MW-B2050B	Eldredge Park	1/27/2017	44.28	33.8	10.44
MW-B2050C	Eldredge Park	11/3/2016	44.17	33.4	10.82
MW-B2050C	Eldredge Park	11/14/2016	44.17	33.5	10.66
MW-B2050C	Eldredge Park	1/18/2017	44.17	33.9	10.27
MW-B2050C	Eldredge Park	1/27/2017	44.17	33.9	10.30
MW-B2100	Eldredge Park	11/3/2016	44.23	33.5	10.73
MW-B2100	Eldredge Park	11/14/2016	44.23	33.7	10.58
MW-B2100	Eldredge Park	1/18/2017	44.23	33.9	10.36
MW-B2100	Eldredge Park	1/27/2017	44.23	33.7	10.57

Notes:

N/A = Not Available

1. MW-BC2C has not yet been surveyed.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-4**[3]	**MW-8**[3]	**MW-12A**		**MW-12B**		**MW-12C**[2,3]			
Top of Screen Elevation (ft)	4.50	19.70	-24.4		-9.4		8.60			
Bottom of Screen Elevation (ft)	-5.50	9.70	-34.4		-19.4		-1.40			
Sampling Date	10/4/2016	10/4/2016	11/03/2016[1]	1/5/2017	11/03/2016[1]	1/5/2017	10/4/2016	11/03/2016[1]	11/17/2016	1/5/2017
Type of Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
Field Measurements										
pH (SU)	5.52	5.23	6.94	5.46	6.90	5.43	4.98	6.45	5.23	5.09
Temperature (^{o}C)	15.54	15.87	14.38	11.78	14.50	11.82	17.50	14.08	14.42	12.60
Dissolved Oxygen (DO, mg/L)	7.9	9.6	1.1	3.7	1.1	1.2	6.9	0.8	0.7	1.6
Redox Potential (ORP; mV)	57.9	135.0	70.9	197.6	20.3	212.8	167.8	246.0	279.7	205.6
Specific Conductivity (µS/cm)[c]	171	190	667	572	231	243	178	216	156	199
Turbidity (NTU)	NM	NM	17.70	5.50	8.73	1.89	NM	0.60	2.58	0.84
Laboratory Analyses										
Nitrogen										
Nitrate as N (mg/L)	**2.45**	**9.24**	**0.783**	**0.669**	**6.17**	**5.08**	**6.74**	**6.51**	NM	**6.03**
Nitrite as N (mg/L)	NM	NM	<0.01	<0.01	<0.01	<0.01	NM	NM	NM	<0.01
Ammonia (mg/L)	**0.1**	<0.1	<0.1	<0.1	<0.1	**0.19**	<0.1	**0.11**	NM	**0.12**
Total Kjeldahl Nitrogen (TKN) (mg/L)	**0.71**	**1.7**	NM	<0.2	NM	**0.79**	**1.34**	NM	NM	**1.24**
Total Nitrogen (mg/L)	**3.15**	**10.9**	**1**	**0.669**	**6.44**	**5.87**	**8.08**	**6.51**	NM	**7.27**
Anions										
Chloride (mg/L)	**27.2**	**18.3**	**190**	**230**	**34.1**	**24.2**	**24.1**	NM	NM	**22.4**
Sulfate (mg/L)	**12.8**	**10.1**	**10**	**16.1**	**9.8**	**13.6**	**8.7**	**9.3**	NM	**8.6**
Elements										
Dissolved Iron (mg/L)	NM	NM	**0.7**	NM	**0.36**	NM	NM	<0.05	NM	NM
Dissolved Manganese (mg/L)	NM	NM	**0.325**	NM	**0.228**	NM	NM	**0.02**	NM	NM
Boron (mg/L)	NM	NM	<0.05	NM	<0.05	NM	NM	<0.05	NM	NM
Other										
DOC (mg/L)	<0.5	<0.5	**0.55**	NM	**1.82**	NM	<0.5	**0.87**	**0.674**	NM
Methane (µg/L)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Alkalinity as CaCO3 (mg/L)	NM	NM	NM	**5**	NM	**2**	NM	NM	**4**	**6**

Notes:

NS - Not Sampled / NM-Not Measured

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	MA-BU1A	MW-BU1C	MW-BU2A		MW-BU2B		MW-BU2C			MW-BC1C
Top of Screen Elevation (ft)	-26.3	4	-24.9		-9.9		5.1			2.5
Bottom of Screen Elevation (ft)	-36.3	-6	-34.9		-19.9		-4.9			-7.5
Sampling Date	10/4/2016	10/4/2016	11/03/2016[1]	1/5/2017	11/03/2016[1]	1/5/2017	11/03/2016[1]	11/17/2016	1/10/2017	10/4/2016
Type of Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
Field Measurements										
pH (SU)	5.44	5.27	6.73	6.00	7.11	5.94	7.14	5.46	5.49	5.48
Temperature (^{o}C)	13.75	13.95	14.15	11.75	14.70	12.07	15.20	14.89	12.78	13.37
Dissolved Oxygen (DO, mg/L)	7.6	8.8	1.2	1.3	1.3	1.1	1.3	2.2	2.4	7.8
Redox Potential (ORP; mV)	70.9	130.9	37.5	127.0	20.2	136.3	203.0	51.2	194.1	70.1
Specific Conductivity (µS/cm)[c]	1464	351	406	421	379	362	535	516	569	1029
Turbidity (NTU)	NM	NM	44.50	257	102	146	11.40	14.20	5.55	NM
Laboratory Analyses										
Nitrogen										
Nitrate as N (mg/L)	**0.443**	**1.97**	**0.357**	**0.426**	**1.06**	**0.826**	**5.39**	NM	**7.42**	**0.481**
Nitrite as N (mg/L)	NM	NM	<0.01	<0.01	<0.01	<0.01	<0.01	NM	<0.01	NM
Ammonia (mg/L)	**0.24**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM	**0.1**	NM
Total Kjeldahl Nitrogen (TKN) (mg/L)	**0.38**	**0.4**	NM	<0.2	NM	<0.2	NM	NM	<0.2	NM
Total Nitrogen (mg/L)	**0.827**	**2.37**	**0.357**	**0.426**	**1.06**	**0.826**	**5.39**	NM	NM	**0.481**
Anions										
Chloride (mg/L)	**458**	**96.1**	**103**	**118**	**97.3**	**92.2**	**134**	NM	**143**	**438**
Sulfate (mg/L)	**6.9**	**9.1**	**7.2**	**5.2**	<5	<5	<5	NM	<5	**11.5**
Elements										
Dissolved Iron (mg/L)	**0.799**	**0.099**	**1.09**	NM	**0.667**	NM	**0.817**	NM	NM	NM
Dissolved Manganese (mg/L)	**0.185**	**0.047**	**0.18**	NM	**0.088**	NM	**0.26**	NM	NM	NM
Boron (mg/L)	<0.05	<0.05	<0.05	NM	<0.05	NM	<0.05	NM	NM	NM
Other										
DOC (mg/L)	<0.5	<0.5	<0.5	NM	**0.612**	NM	**0.684**	**0.728**	<0.5	<0.5
Methane (µg/L)	<2	<2	NM	NM	<2	NM	<2	NM	NM	NM
Alkalinity as CaCO3 (mg/L)	NM	NM	NM	**11**	NM	**18**	NM	**13**	**11**	NM

Notes:

NS - Not Sampled / NM-Not Measured

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-BC2C**			**MW-B1010C**			**MW-B1020B**		**MW-B1020C**		
Top of Screen Elevation (ft)	N/A			-0.1			-10.4		4.5		
Bottom of Screen Elevation (ft)	N/A			-10.1			-20.4		-5.5		
Sampling Date	11/04/2016	11/17/2016	1/10/2017	11/03/2016[1]	11/17/2016	1/5/2017	11/04/2016[1]	1/5/2017	11/04/2016[1]	11/17/2016	1/5/2017
Type of Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
Field Measurements											
pH (SU)	7.05	5.40	5.55	6.90	5.18	5.61	6.78	5.20	6.88	5.27	5.38
Temperature (^{o}C)	15.25	14.54	12.65	14.60	14.28	12.22	13.70	11.94	14.24	14.66	12.73
Dissolved Oxygen (DO, mg/L)	1.7	1.7	1.9	0.9	0.7	0.5	1.0	0.6	1.4	0.6	0.3
Redox Potential (ORP; mV)	74.8	100.7	169.0	110.7	231.6	190.8	45.0	190.7	50.3	106.7	194.8
Specific Conductivity (µS/cm)[c]	368	340	363	262	230	289	465	355	242	227	269
Turbidity (NTU)	6.00	19.2	16.6	16.00	5.97	10.60	67.90	321.00	321.00	15.60	6.31
Laboratory Analyses											
Nitrogen											
Nitrate as N (mg/L)	**4.16**	NM	**5.91**	**13.6**	NM	**6.74**	**28.4**	**17.9**	**10.6**	NM	**11.1**
Nitrite as N (mg/L)	NM	NM	<0.01	NM	NM	**0.509**	NM	<0.01	NM	NM	<0.01
Ammonia (mg/L)	<0.1	NM	<0.1	<0.1	NM	<0.1	**0.53**	**0.11**	<0.1	NM	**0.19**
Total Kjeldahl Nitrogen (TKN) (mg/L)	NM	NM	<0.2	NM	NM	**1.36**	NM	**1.79**	NM	NM	**1.99**
Total Nitrogen (mg/L)	**4.43**	NM		**13.9**	NM	**8.61**	**28.5**	**19.6**	**10.6**	NM	**13.1**
Anions					NM						
Chloride (mg/L)	**83.8**	NM	**85.4**	**27.5**	NM	**24.3**	**49.8**	**33.6**	**25.5**	NM	**25.6**
Sulfate (mg/L)	**6.4**	NM	<5	NM	NM	**23.7**	NM	<5	NM	NM	**5.6**
Elements											
Dissolved Iron (mg/L)	NM	NM	NM	NM	NM	NM	**2.52**	NM	**2.23**	NM	NM
Dissolved Manganese (mg/L)	NM	NM	NM	NM	NM	NM	**0.948**	NM	**0.249**	NM	NM
Boron (mg/L)	NM	NM	NM	NM	NM	NM	<0.05	NM	**0.085**	NM	NM
Other											
DOC (mg/L)	**0.764**	**0.576**	<0.5	NM	**0.696**	NM	NM	NM	NM	**0.85**	NM
Methane (µg/L)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Alkalinity as CaCO3 (mg/L)	NM	**8**	**9**	NM	**11**	**31**	NM	**9**	NM	**13**	**11**

Notes:

NS - Not Sampled / NM-Not Measured

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B1050A**		**MW-B1050B**	**MW-B1050C**	**MW-B1075B**	**MW-B2010C**		**MW-B2020B**		
Top of Screen Elevation (ft)	-26.1		-11.1	4.9	-11.5	0		-10.1		
Bottom of Screen Elevation (ft)	-36.1		-21.1	-5.1	-21.5	-10		-20.1		
Sampling Date	11/04/2016[1]	1/5/2017	11/04/2016[1]	11/04/2016[1]	11/04/2016[1]	11/03/2016[1]	11/17/2016	11/03/2016[1]	11/17/2016	1/10/2017
Type of Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
Field Measurements										
pH (SU)	7.15	5.60	7.06	7.20	7.19	7.04	5.32	7.00	5.22	5.05
Temperature (^{o}C)	13.77	11.87	14.08	14.55	15.20	15.12	14.58	14.91	14.39	12.23
Dissolved Oxygen (DO, mg/L)	1.3	0.3	1.2	1.3	0.7	0.7	0.6	1.2	0.6	0.9
Redox Potential (ORP; mV)	43.0	142.2	80.3	48.6	82.2	12.4	213.8	90.8	182.6	170.5
Specific Conductivity (µS/cm)[c]	612	505	446	571	631	333	304	321	307	344
Turbidity (NTU)	962.00	297.00	3.97	8.21	13.00	149.00	44.40	14.30	17.40	6.95
Laboratory Analyses										
Nitrogen										
Nitrate as N (mg/L)	**37**	**26.6**	**25.7**	**3.83**	**1.93**	**15.7**	NM	**16.9**	NM	**25.6**
Nitrite as N (mg/L)	NM	**0.105**	NM	NM	NM	NM	NM	**0.022**	NM	<0.01
Ammonia (mg/L)	**1.93**	**1.72**	**0.19**	<0.1	**3.73**	**0.14**	NM	**0.1**	NM	<0.1
Total Kjeldahl Nitrogen (TKN) (mg/L)	NM	**3.75**	NM	NM	NM	NM	NM	NM	NM	<0.2
Total Nitrogen (mg/L)	**37.2**	**30.5**	**26**	**4.05**	**6.36**	**16.1**	NM	**17.2**	NM	NM
Anions										
Chloride (mg/L)	**54.8**	**48.9**	**48.2**	**141**	**96.3**	**38.6**	NM	**32.5**	NM	**34.9**
Sulfate (mg/L)	NM	**6.1**	NM	NM	NM	**11**	NM	**7.7**	NM	**6**
Elements										
Dissolved Iron (mg/L)	**4.29**	NM	**0.734**	**0.493**	NM	NM	NM	**1.2**	NM	NM
Dissolved Manganese (mg/L)	**0.655**	NM	**0.332**	**0.146**	NM	NM	NM	**0.126**	NM	NM
Boron (mg/L)	<0.05	NM	<0.05	<0.05	NM	NM	NM	<0.05	NM	NM
Other										
DOC (mg/L)	NM	NM	NM	NM	NM	**2.18**	**0.852**	**1.45**	**0.694**	<0.5
Methane (µg/L)	NM	NM	NM	NM	NM	NM	NM	<2	NM	NM
Alkalinity as CaCO3 (mg/L)	NM	**24**	NM	NM	NM	NM	**16**	NM	**20**	**12**

Notes:

NS - Not Sampled / NM-Not Measured

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B2020C**		**MW-B2050A**		**MW-B2050B**	**MW-B2050C**	**MW-B2100**	
Top of Screen Elevation (ft)	4.8		-25.4		-10.4	4.6	9.6	
Bottom of Screen Elevation (ft)	-5.2		-35.4		-20.4	-5.4	-0.4	
Sampling Date	11/03/2016[1]	1/10/2017	11/03/2016[1]	1/10/2017	11/03/2016[1]	11/03/2016[1]	10/4/2016	11/03/2016[1]
Type of Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
Field Measurements								
pH (SU)	7.00	5.12	7.11	5.39	7.06	7.22	5.26	6.98
Temperature (^{o}C)	15.20	12.90	14.44	11.96	14.95	16.72	14.42	14.95
Dissolved Oxygen (DO, mg/L)	1.3	1.3	0.6	0.1	1.3	1.1	5.9	1.5
Redox Potential (ORP; mV)	29.8	201.5	0.8	182.8	80.5	82.5	110.5	124.7
Specific Conductivity (µS/cm)[c]	249	251	540	520	512	658	272	297
Turbidity (NTU)	28.00	5.81	50.70	8.10	123.00	212.00	NM	8.44
Laboratory Analyses								
Nitrogen								
Nitrate as N (mg/L)	**8.71**	**12.6**	**35**	**39.3**	**4.75**	**3.01**	**1.29**	**1.29**
Nitrite as N (mg/L)	**0.016**	<0.01	NM	**0.025**	NM	NM	NM	NM
Ammonia (mg/L)	**0.24**	<0.1	**1.05**	**0.87**	<0.1	**0.11**	<0.1	<0.1
Total Kjeldahl Nitrogen (TKN) (mg/L)	NM	<0.2	NM	**3.32**	NM	NM	**0.72**	NM
Total Nitrogen (mg/L)	**9.02**	NM	**35.3**	NM	**5.15**	**3.3**	**2.01**	**1.29**
Anions								
Chloride (mg/L)	**26.8**	**31**	**49.9**	**64.5**	**123**	NM	**65.4**	**67.8**
Sulfate (mg/L)	**11.6**	**9.7**	**5.6**	**5.6**	**11.5**	**11.9**	**14.1**	**16.2**
Elements								
Dissolved Iron (mg/L)	**1.42**	NM	**3.2**	NM	**0.551**	NM	**0.115**	NM
Dissolved Manganese (mg/L)	**1.14**	NM	**0.407**	NM	**0.258**	NM	**0.126**	NM
Boron (mg/L)	<0.05	NM	<0.05	NM	<0.05	NM	<0.05	NM
Other								
DOC (mg/L)	**1.17**	<0.5	**1.61**	NM	**1.15**	**1.13**	<0.5	**0.866**
Methane (µg/L)	<2	NM	NM	NM	NM	NM	<2	NM
Alkalinity as CaCO3 (mg/L)	NM	**10**	NM	**17**	NM	NM	NM	NM

Notes:

NS - Not Sampled / NM-Not Measured

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

Figures

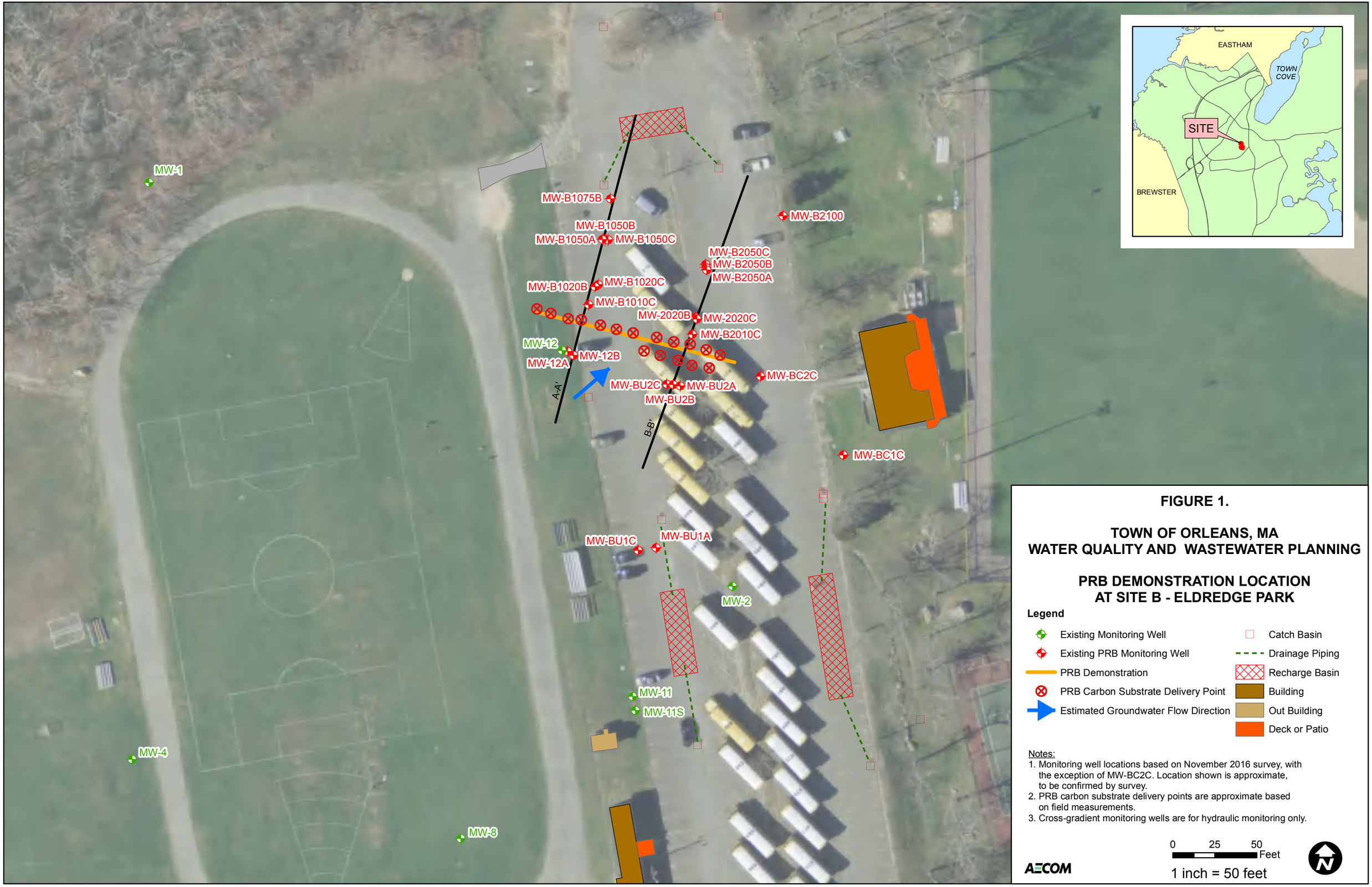

FIGURE 1.

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

PRB DEMONSTRATION LOCATION AT SITE B - ELDREDGE PARK

Legend

- Existing Monitoring Well
- Existing PRB Monitoring Well
- PRB Demonstration
- PRB Carbon Substrate Delivery Point
- Estimated Groundwater Flow Direction
- Catch Basin
- Drainage Piping
- Recharge Basin
- Building
- Out Building
- Deck or Patio

Notes:
1. Monitoring well locations based on November 2016 survey, with the exception of MW-BC2C. Location shown is approximate, to be confirmed by survey.
2. PRB carbon substrate delivery points are approximate based on field measurements.
3. Cross-gradient monitoring wells are for hydraulic monitoring only.

0 25 50 Feet

1 inch = 50 feet

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A
SOUTHWEST

A'
NORTHEAST

MW-12B
MW-12
MW-12A
MW-B1010C
MW-B1020B
MW-B1020C
MW-B1050A
MW-B1050B
MW-B1050C
MW-B1075B

Approximate
Ground Surface

Approximate
Water Table

Approximate
Groundwater
Flow Direction

Unsaturated
Zone

Saturated
Zone

PRB
INJECTION
ZONE

MW-12
EL. 5.12
EL. -4.90

MW-12B
EL. -9.90
EL. -19.90

MW-12A
EL. -24.40
EL. -34.90

MW-B1010C
EL. 0
EL. -10.90

MW-B1020C
EL. 4.80
EL. -5.20

MW-B1020B
EL. -10.10
EL. -20.10

MW-B1050C
EL. 4.60
EL. -5.40

MW-B1050B
EL. -10.40
EL. -20.40

MW-B1050A
EL. -35.40
EL. -35.40

MW-B1075B
EL. -10.40
EL. -20.40

Elevation (ft)
40
30
20
10
0
-10
-20
-30
-40

Feet Below Ground Surface
0
-5
-15
-25
-35
-45
-55
-65
-75
-85

0 10 20 30 40 50 60 70 80 90 100 110 120 130 138
Horizontal Scale (ft)

Project Management Initials: Designer: Checked: Approved: ANSI B 11" x 17"

Last saved by: BOURDEAUJ (2017-02-27) Last Plotted: 2017-02-27
Filename: P:\JOBS\NDL_SERVICE\PROJECT FILES\ORLEANS\CROSS_SECTIONS.DWG

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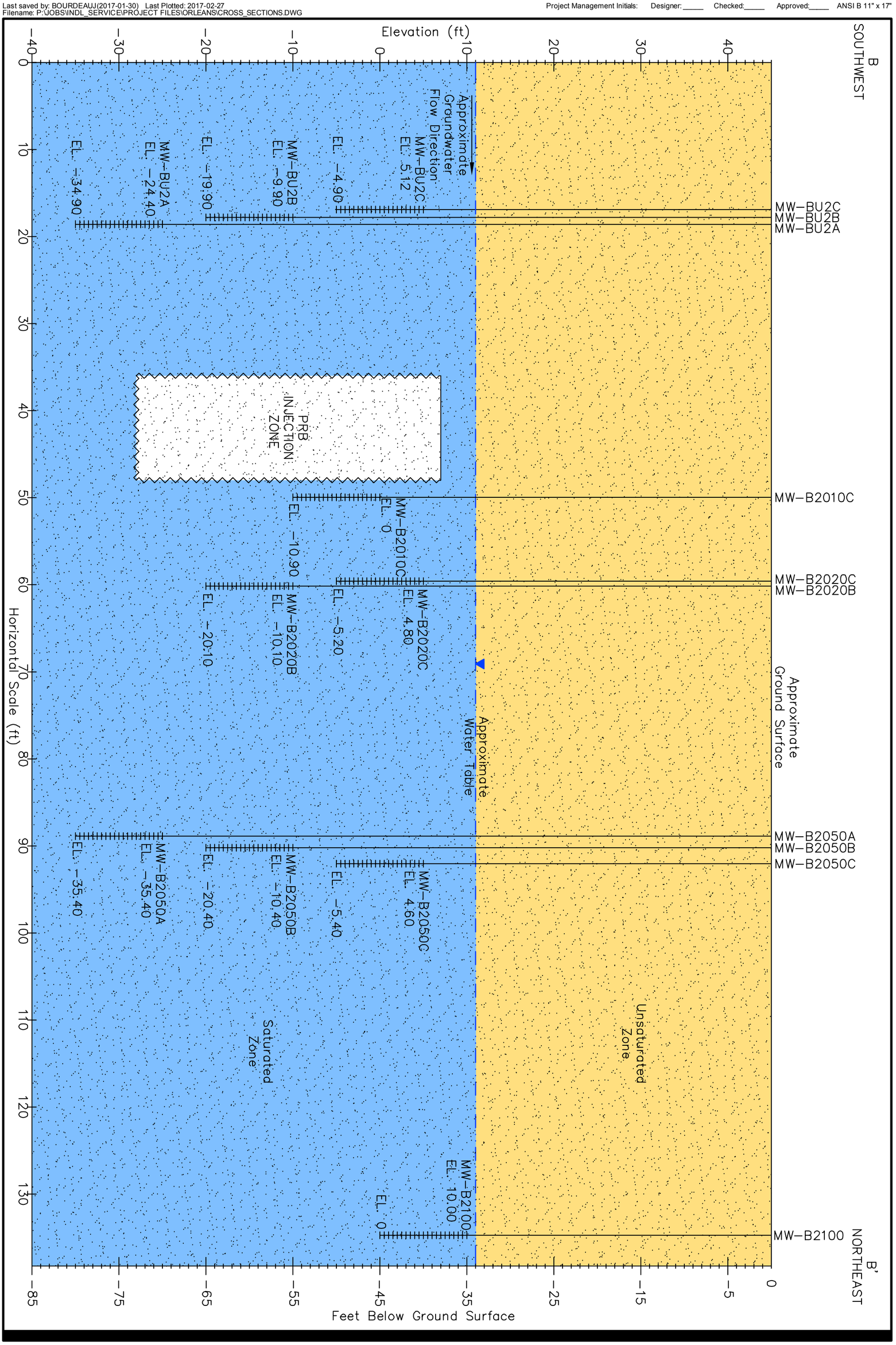
Figure: 2

CROSS SECTION A-A'
WATER QUALITY AND WASTEWTER PLANNING
TOWN OF ORLEANS, MA
Project No.: 60476644 Date: 2017-01-23



CROSS SECTION B-B'
WATER QUALITY AND WASTEWTER PLANNING
TOWN OF ORLEANS, MA
Project No.: 60476644 Date: 2017-01-23

AECOM

Figure: 3

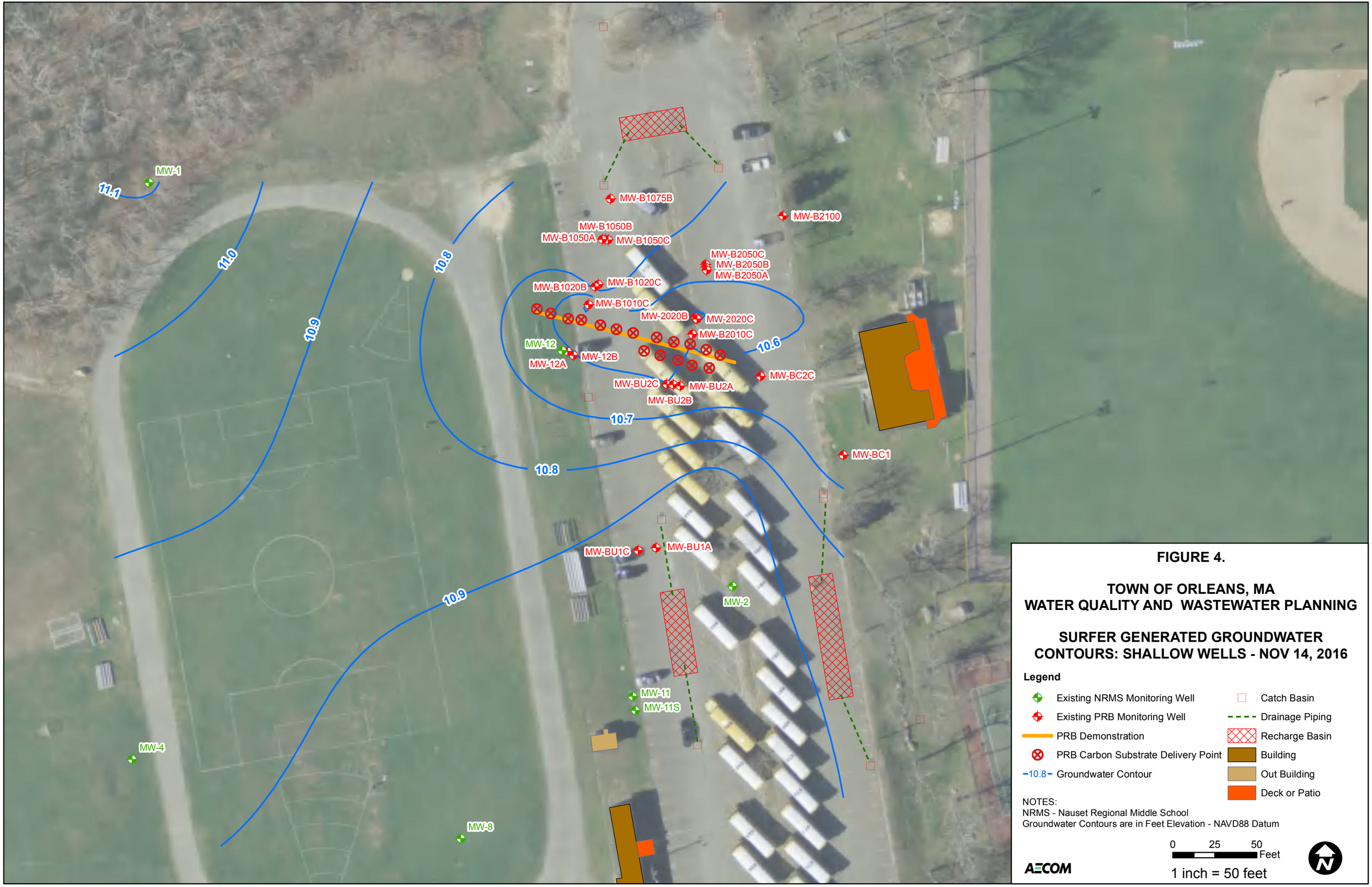


FIGURE 4.

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

SURFER GENERATED GROUNDWATER CONTOURS: SHALLOW WELLS - NOV 14, 2016

Legend

- Existing NRMS Monitoring Well
- Existing PRB Monitoring Well
- PRB Demonstration
- PRB Carbon Substrate Delivery Point
- 10.8 Groundwater Contour
- Catch Basin
- Drainage Piping
- Recharge Basin
- Building
- Out Building
- Deck or Patio

NOTES:
NRMS - Nauset Regional Middle School
Groundwater Contours are in Feet Elevation - NAVD88 Datum

0 25 50 Feet

1 inch = 50 feet

AECOM

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FIGURE 5.

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

SURFER GENERATED GROUNDWATER CONTOURS: INTERMEDIATE WELLS - NOV 14, 2016

Legend

- Existing NRMS Monitoring Well
- Existing PRB Monitoring Well
- PRB Demonstration
- PRB Carbon Substrate Delivery Point
- 10.8 Groundwater Contour
- Catch Basin
- Drainage Piping
- Recharge Basin
- Building
- Out Building
- Deck or Patio

NOTES:
NRMS - Nauset Regional Middle School
Groundwater Contours are in Feet Elevation - NAVD88 Datum

0 25 50 Feet

1 inch = 50 feet

AECOM

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G:\Projects\MUNI\60476644\ORL\Maps\GWContour_11-14-2016_deep.mxd

FIGURE 6.

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

SURFER GENERATED GROUNDWATER CONTOURS: DEEP WELLS - NOV 14, 2016

Legend

- Existing NRMS Monitoring Well
- Existing PRB Monitoring Well
- PRB Demonstration
- PRB Carbon Substrate Delivery Point
- 10.8 Groundwater Contour
- Catch Basin
- Drainage Piping
- Recharge Basin
- Building
- Out Building
- Deck or Patio

NOTES:
NRMS - Nauset Regional Middle School
Groundwater Contours are in Feet Elevation - NAVD88 Datum

0 25 50 Feet

1 inch = 50 feet

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Appendix A

Soil Boring Logs and Monitoring Well Coordinates

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GEOLOGIC LOG

PROJECT : **Town of Orleans, MA Preliminary Investigation**		SHEET	BORING NO.
SITE LOCATION: Eldredge Park	JOB NO.: **60476644**	1 of 4	**MW-BU2**
Groundwater Monitoring Wells	LOCATION: Eldredge Park N: E:	Elevation:	Total Depth: 80
DRILL CONTRACTOR : NE Geotech	ENG/GEO : Briley Morrill	BEGUN :	10/31/16 8:30 AM
DRILL RIG : Geo-probe	DRILLER : K. Hoffman	FINISHED :	10/31/16 12:30 PM
Hole Size :	Weather : Overcast, windy, 45 F	Ground Water (Date/Depth) :	10/31/16 35 ft
Drilling Method : Direct push	Drilling Fluid : Potable Water	Top of Rock (Depth/Elev.) :	Not Encountered

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Percent Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
							2" PVC Casing from 80' to Ground Surface
				90	densely packed fine sand dark orange, light brown		well screen from 70' to 80'
							Sand Pack - 72-80
5				100	5-8 dense, fine brown sand		Bentonite Seal - 68-72
							Natural fill 68' to ground surface
					8-9 looser, lighter brown sand		
					9-9.5 dense dark brown sand, with some trace rust coloration		
					9.5-10 loose light brown sand		
10				90	10-14 loose light brown/orangish fine to medium sand		
					14-15 tan, very fine sand		
15				90	15-20 loose light brown fine sand		
20				100	20-23 loose, light brown fine sand		
					23-25 fine to medium coarse sand		

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
▒ = Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, MA Preliminary Investigation**		SHEET	BORING NO.
SITE LOCATION: Eldredge Park	JOB NO.: **60476644**	2 of 4	**MW-BU2**
Groundwater Monitoring Wells	LOCATION: N: 0 E: 0	Elevation:	Total Depth: 80

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Percent Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
25				90	25-30 loose, fine to medium coarse sand through out, light tan to orangish		
30				100	30-35 loose, fine to medium sand 30-33 light tan 33-35 orange wet at 35		
35				100	35-37 fine tan/orange sand		
40				80	37-40 dense silty sand, tan 40-45 dense silty sand, light brown some greyish "clay-like" material marbled throughout, especially at 44.5-45		
45				90	45-45.5 very fine brown sand 45.5-46 silty brown sand 46-47 fine to medium brown sand 47-50 very dense silty sand with some "claylike" material		

Sample Types:	trace 0 to 5%	SPT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
▒ = Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, MA Preliminary Investigation**		SHEET	BORING NO.
SITE LOCATION: Eldredge Park	JOB NO.: **60476644**	3 of 4	**MW-BU2**
0	LOCATION: N: 0 E: 0	Elevation:	Total Depth: 80

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
50				90	50-53 fine brown sand 53-55 fine to medium sand with a grey "claylike" dense layer at 55		
55				90	55-60 fine brown sand with some silt		
60					60-65 fine brown sand		
65					65-70 silty fine brown sand, some "claylike" material through out		
70					70-75 fine sand, light brown and some orangish		

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
▒ = Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, MA Preliminary Investigation**		SHEET	BORING NO.
Eldredge Park	JOB NO.: **60476644**	4 of 4	**MW-BU2**
0	LOCATION: N: 0 E: 0	Elevation:	Total Depth: 80

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
75					75-80 fine light brown sand		
80							

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
▒ = Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

AECOM

GEOLOGIC LOG

PROJECT : **Town of Orleans, MA Preliminary Investigation**		SHEET	BORING NO.
SITE LOCATION: Eldredge Park	JOB NO.: **60476644**	1 of 4	**MW-12A**
Groundwater Monitoring Wells	LOCATION: Eldredge Park N: E:	Elevation:	Total Depth: 80
DRILL CONTRACTOR : NE Geotech	ENG/GEO : Briley Morrill	BEGUN :	10/31/2016 13:30:00 P
DRILL RIG : Geo-probe	DRILLER : K. Hoffman	FINISHED :	11/01/16 11:00 AM
Hole Size :	Weather : Overcast, windy, 45 F	Ground Water (Date/Depth) :	
Drilling Method : Direct push	Drilling Fluid : Potable Water	Top of Rock (Depth/Elev.) : Not Encountered	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
				80	0-5 fine, light brown sand		
5					5-10 fine sand, light brown to orange		
10					10-15 find light brown sand, loosely packed		
15					15-20 loose, fine sand, orange to brown		

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
▒ = Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, MA Preliminary Investigation**		SHEET	BORING NO.
SITE LOCATION: Eldredge Park	JOB NO.: **60476644**	2 of 4	**MW-12A**
Groundwater Monitoring Wells	LOCATION: Eldredge Park N: 0 E: 0	Elevation:	Total Depth: 80

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
20					20-23 lookse fine sand, light brown		
					23-25 dense, fine sand with some silts		
25					25-28 loose, fine sand, light orange		
					28-30 dense silty sand, brown		
30					30-35 fine, brown sand		
					Wet at 35		
35					35-37 fine to medium sand, with some coarser material mixed through out, brown and some orange		
					37-40 dense, fine silty sand		
40					40-45 fine sand with some coarser material at bottom		
					EOD @ 1620		

Sample Types:	trace 0 to 5%	SPT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

AECOM

GEOLOGIC LOG

PROJECT : **Town of Orleans, MA Preliminary Investigation**		SHEET	BORING NO.
SITE LOCATION: Eldredge Park	JOB NO.: **60476644**	3 of 4	**MW-12A**
0	LOCATION: Eldredge Park N: 0 E: 0	Elevation:	Total Depth: 80

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
45					45-50 fine brown sand with some coarser material at bottom		
50					50-54 fine brown sand,some silt 54-54.5 dense grey claylike material 54.5-55 fine sand		
55					55-60 fine, light orange sand at bottom 3inches silty sand large rock rock (size of case) at top		
60					60-65 fine brown sand 6 inche very silty sand layer at 62		
65					65-70 fine brown sand 2 inch layer of silty sand at 69		

Sample Types:	trace 0 to 5%	SPT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, MA Preliminary Investigation**		SHEET	BORING NO.
SITE LOCATION: Eldredge Park	JOB NO.: **60476644**	4 of 24	**MW-12A**
0	LOCATION: Eldredge Park N: 0 E: 0	Elevation:	Total Depth: 80

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
70					70-75 light brown, fine sand, slighty coarse		
75					75-80 light brown fine sand		
80							

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
= Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

AECOM

GEOLOGIC LOG

PROJECT : Town of Orleans, MA Preliminary Investigation		SHEET	BORING NO.
SITE LOCATION: Orleans, MA	JOB NO.: **60476644**	1 of 4	MW-B1050
Groundwater Monitoring Wells	LOCATION: Eldredge Park N: E:	Elevation:	Total Depth: ft 80
DRILL CONTRACTOR : NE Geotech	ENG/GEO : Briley Morrill	BEGUN :	11/1/16 12:00 PM
DRILL RIG : Geo-probe	DRILLER : K. Hoffman	FINISHED :	11/01/2016 17:30:00 P
Hole Size:	Weather : Sunny, 35 F	Ground Water (Date/Depth):	
Drilling Method : Direct push	Drilling Fluid :	Top of Rock (Depth/Elev.) :	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					0-5 ft - fine orange sand		
5					5-10 ft. fine, orange sand		
10					10-15 ft. fine, orange sand		
15					15-20 ft fine, orange sand with 25% smal angular gravel		

(continued)

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
= Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : Town of Orelans, MA Preliminary Investigation		SHEET	BORING NO.
SITE LOCATION: Orleans, MA	JOB NO.:	2 of 4	MW-B1050
Groundwater Monitoring Wells	LOCATION: Eldredge Park N: E:	Elevation:	Total Depth: 80 ft
DRILL CONTRACTOR : NE Geotech	ENG/GEO : Briley Morrill	BEGUN :	11/1/16 12:00 PM
DRILL RIG :	DRILLER : K. Hoffman	FINISHED :	11/01/2016 17:30:00 P
Hole Size:	Weather : Overcast and cold, High 40, low 32.	Ground Water (Date/Depth):	
Drilling Method : Direct push	Drilling Fluid :	Top of Rock (Depth/Elev.) :	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
20					20-25 ft fine light brown sand 2 inch of rock layer at 21		
25					25-30 ft fine, orange sand		
30					30-35 ft fine brown/orange sand with some silt Wet at 35ft		
35					35-36 ft light brown and orange fine sand 36-37 ft silty material, brown 37-40 ft light brown fine sand		
					some gravel throughout, 25%		

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
= Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : Town of Orleans, PRB		SHEET 3 of 4	BORING NO. MW-B1050
SITE LOCATION: Orleans, MA	JOB NO.:		
Groundwater Monitoring Wells	LOCATION: Town of Orleans N: E:	Elevation:	Total Depth: 80 ft
DRILL CONTRACTOR : NE Geotech	ENG/GEO : Briley Morrill	BEGUN : 11/1/16 12:00 PM	
DRILL RIG : Geo Probe	DRILLER : K. Hoffman	FINISHED : 11/01/2016 17:30:00 F	
Hole Size:	Weather : sunny, 35ft	Ground Water (Date/Depth):	
Drilling Method : direct push	Drilling Fluid :	Top of Rock (Depth/Elev.) :	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
40					40-44 ft fine to medium orange sand with 25% small angular gravel		
					44-45 ft densely packed fine light brown sand		
45					45-49 ft dense silty brown sand, 25% gravel		
					49-50 ft fine to medium sand, brown		
50					50-55 ft fine light brown sand with some coarser material and silt mixed throughout		
55					55-60 ft fine to medium light brown sand with 25% silt		
					60% recovery		

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
= Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : Town of Orleans, MA Preliminary Investigation		SHEET 4 of 4	BORING NO. MW-B1050
SITE LOCATION: Orleans, MA	JOB NO.:		
Groundwater Discharge Beds	LOCATION: Eldredge Park N: E:	Elevation:	Total Depth: 80 ft
DRILL CONTRACTOR : NE Geotech	ENG/GEO : Briley Morrill	BEGUN : 11/1/16 12:00 PM	
DRILL RIG : Geo-Probe	DRILLER : K. Hoffman	FINISHED : 11/01/2016 17:30:00 F	
Hole Size:	Weather : sunny, 35 F	Ground Water (Date/Depth): Jan 21, 2016 / 55 f	
Drilling Method : Direct push	Drilling Fluid :	Top of Rock (Depth/Elev.) :	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
60					60-65 ft fine to medium light brown sand with 40% silt		
65					65-70 ft fine, silty light brown sand, dense material 25% small angular gravel		
70					70-75 ft fine, densely packed brown sand with 25% silt through out		
75					75-80ft layers of very fine sand and very fine silty material, light brown and orangish		
80							

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	trace	0 to 5%			
ST = Shelby Tube	few	5 to 10%			
R = Rock Core	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
= Lab Sample	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, PRB**		SHEET	BORING NO.
SITE LOCATION:	JOB NO.: **60476644**	1 of 4	**MW-B2050**
Orleans, MA	LOCATION: Eldredge Park N: E:	Elevation:	Total Depth: 80 ft
DRILL CONTRACTOR : Ne Geotech	ENG/GEO : Briley Morrill	BEGUN :	11/2/16 10:40 AM
DRILL RIG : Geo-probe	DRILLER : K. Hoffman	FINISHED :	11/2/2016 14:30:00 PM
Hole Size :	Weather : Sunny, 60 F	Ground Water (Date/Depth) :	
Drilling Method : Direct push	Drilling Fluid : Potable Water	Top of Rock (Depth/Elev.) :	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					0-5 ft loose, fine sand, light brown and orange		
5					5-10 ft loose, fine sand, light brown and orange		
					25% small round and angular gravel		
10					10-15 ft loose, fine sand, light brown and orange		
					25% small round and angular gravel		
					3 inch dark brown layer at 11', possible organic?		
15					15-20 ft loose, fine sand, light brown and orange		
					25% small round and angular gravel		

Sample Types:	trace 0 to 5%	PT Resistance	Approve/Date
SS = Split Spoon	few 5 to 10%		
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consiste 0-2 Very Soft
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, PRB**							SHEET	BORING NO.
SITE LOCATION:			JOB NO.:				2 of 4	**MW-B2050**
Orleans, MA			LOCATION: Eldredge Park				Elevation:	Total Depth:
			N: 0		E: 0			80 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
20					20-25 ft lose, fine sand, light brown and orange about 50% small round and angular gravel through out		
25					25-30 ft loose, fine sand, brown 25% small round/angular gravel		
30					30-35 ft fine sand, some 25% silt, 25% gravel dense, silty materal at bottom plug Wet at 35 ft		
35					35-40 ft mostly fine to medium sand some layers of fine sandy silt material throughout		
40					40-45 ft fine, brown sand 25% silty material		

Sample Types:	trace 0 to 5%	PT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consiste 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
▒ = Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, PRB**		SHEET	BORING NO.
SITE LOCATION:	JOB NO.:	3 of 4	**MW-B2050**
Orleans, MA	LOCATION: Eldredge Park N: 0 E: 0	Elevation:	Total Depth: 80 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
45					45-50 ft dense, fine silty sand, brown		
50					50-55 ft dense, fine organish sand, 25% silt		
55					55-60 ft fine brown sand, some coarser sand throughout		
60					60-63 ft fine light brown sand 63-64 ft layers of silty sand		
65					64-65 ft fine light brown sand 65-66ft fine sand, brown, dense 66-66.5 ft layer of fine silty sand 66.5-68 ft fine, brown sand 68-70 ft silty brown sand		

Sample Types:	trace 0 to 5%	PT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consiste 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

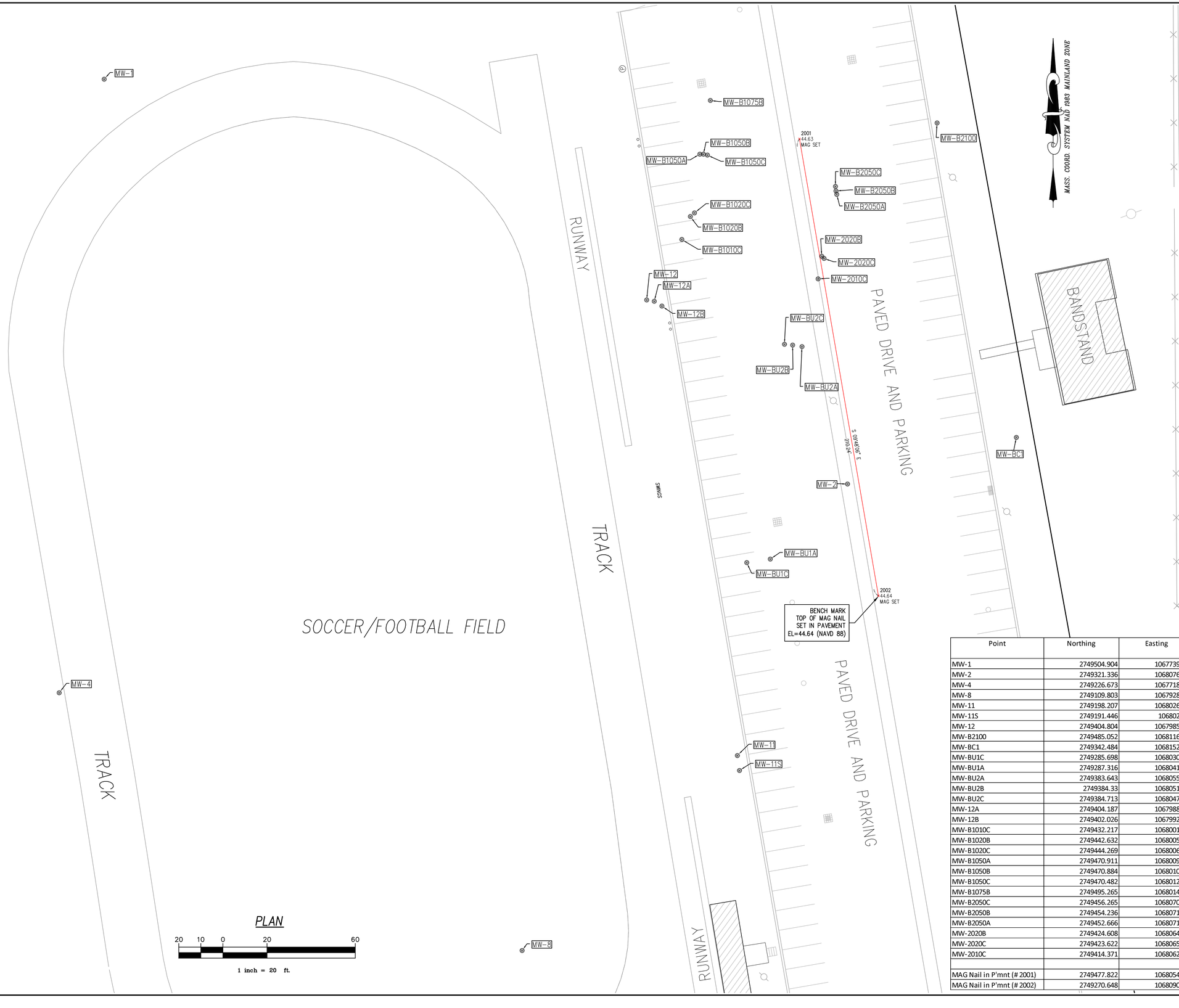
GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, PRB**			SHEET	BORING NO.
SITE LOCATION:	JOB NO.:		4 of 4	**MW-B2050**
Orleans, MA	LOCATION: Eldredge Park N: 0 E: 0		Elevation:	Total Depth: 80 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
70					70-72 ft fine brown sand		
					72-73 ft silty sand, brown		
					73-74 ft fine brown sand		
					74-75 ft dense silty sand, brown		
75					75-80 ft fine brown sand, 25% silty sand		
80							

Sample Types:	trace 0 to 5%	PT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consiste 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	



PLAN

20 10 0 20 60

1 inch = 20 ft.

LEGEND

EXISTING

- CATCH BASIN
- DRAIN MANHOLE
- MONITORING WELL
- POST
- UTILITY POLE

Point	Northing	Easting	Elevation (Top of Casing)	Elevation (Ground)
MW-1	2749504.904	1067739.369	41.31	40.8
MW-2	2749321.336	1068076.302	44.82	44.6
MW-4	2749226.673	1067718.987	46.57	46.1
MW-8	2749109.803	1067928.803	46.16	46.9
MW-11	2749198.207	1068026.362	45.14	45.4
MW-11S	2749191.446	1068027.32	45.25	45.4
MW-12	2749404.804	1067985.282	46.61	45.6
MW-B2100	2749485.052	1068116.909	44.23	44.6
MW-BC1	2749342.484	1068152.835	42.14	42.5
MW-BU1C	2749285.698	1068030.642	43.65	44.0
MW-BU1A	2749287.316	1068041.311	43.48	43.7
MW-BU2A	2749383.643	1068055.658	44.56	45.1
MW-BU2B	2749384.33	1068051.435	44.70	45.1
MW-BU2C	2749384.713	1068047.731	44.68	45.1
MW-12A	2749404.187	1067988.719	45.11	45.6
MW-12B	2749402.026	1067992.169	45.18	45.6
MW-B1010C	2749432.217	1068001.195	44.46	44.9
MW-B1020B	2749442.632	1068005.074	44.18	44.6
MW-B1020C	2749444.269	1068006.933	44.10	44.5
MW-B1050A	2749470.911	1068009.358	43.42	43.9
MW-B1050B	2749470.884	1068010.994	43.54	43.9
MW-B1050C	2749470.482	1068012.793	43.55	44.9
MW-B1075B	2749495.265	1068014.141	43.29	43.5
MW-B2050C	2749456.265	1068070.821	44.17	44.6
MW-B2050B	2749454.236	1068071.071	44.28	44.6
MW-B2050A	2749452.666	1068071.421	44.06	44.6
MW-2020B	2749424.608	1068064.631	44.50	44.9
MW-2020C	2749423.622	1068065.677	44.45	44.8
MW-2010C	2749414.371	1068062.963	44.70	45.0
MAG Nail in P'mnt (# 2001)	2749477.822	1068054.547		44.63
MAG Nail in P'mnt (# 2002)	2749270.648	1068090.338		44.64

COASTAL engineering co.
260 Cranberry Hwy, Orleans, MA 02653
508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM
NAUSET REGIONAL MIDDLE SCHOOL - OFF ELDREDGE PARK WAY ORLEANS, MA

SHEET TITLE
WELL PLAN OF LAND
SHOWING MONITOR WELL LOCATIONS

SCALE AS NOTED
DRAWING FILE C18470-C3D-NRMS.dwg
DATE 1/26/2017
DRAWN BY BPM
CHECKED BY

SKC-5

⊥ OF ⊥ SHEETS

PROJECT NO. C18470.00

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Appendix B

Emulsified Vegetable Oil Product Information and Material Safety Data Sheet

Terra Systems, Inc.
60% SRS®-NR Large Droplet Emulsified Vegetable Oil (EVO) Substrate for Nitrate Reduction
United States Patent No. RE40,448

The anaerobic bioremediation process uses native microorganisms to degrade nitrate to the innocuous end product nitrogen gas. An organic substrate must be added to the groundwater to generate reducing conditions and provide the necessary carbon and hydrogen to support reduction of the nitrate. The organic substrate can be a slow release substrate like Terra Systems' patented small droplet SRS® emulsified vegetable oil substrate. Terra Systems new and patented SRS®-NR, contains a proprietary anionic emulsifier package, which combined with the large droplet size, allows the emulsified soybean oil to more effectively adhere to soil particles and is designed specifically for applications where adherence to the formation is key to making contact with the bacteria. It is particularly useful in high groundwater flow formations such as fractured bedrock formations or sands. It is designed to release bio-available hydrogen over a period of 1 to 3 years thus enhancing the long-term anaerobic biodegradation of the nitrate. SRS®-NR optimizes the naturally occurring biodegradation system by supplying the rate limiting factor (in this case hydrogen) in the degradation of nitrate.

SRS®-NR Substrate Specifications

Terra Systems, Inc.'s manufacturing facility is configured to allow us to provide our customers with custom blended substrate packages without a cost premium. SRS®-NR package contains the following components:

Ingredient	Percent	SRS®-NR Emulsified Soybean Oil Substrate
Food Grade Soybean Oil	60%	SRS®-NR is added to the groundwater to generate reducing conditions and provide the necessary carbon and hydrogen to support biodegradation of nitrate.
Proprietary Emulsifiers	5 – 15%	The proprietary emulsion package used with SRS®-NR combined with the large droplet size allows the emulsified soybean oil to more effectively adhere to the high groundwater flow formations.
Water	25-35%	
Droplet Size	NA	Mean droplet size of 5 microns

KEY BENEFITS OF SRS®-NR Emulsified Vegetable Oil (EVO) Substrate Include:

- Promotes biodegradation of nitrate to non-toxic end products
- Large droplet size and proprietary emulsion package is ideal for maximum adherence in high groundwater flow formations.
- Low cost
- In situ application minimizes site disruptions
- Slow release formula eliminates continuous substrate additions
- SRS®-NR contains only non-toxic food grade materials, which results in green, sustainable remediation
- Can be used as a PRB to cuts off plume migration
- Effective in source zones
- Reduces treatment time from decades to months and years

For more information, contact: **Michael Free**
Terra Systems, Inc.
130 Hickman Road, Suite 1
Claymont DE 19703 USA
(office): (302)798-9553 or (cell) 484-889-2214
e-mail: mfree@terrasystems.net
On the Web@ http:/www.terrasystems.net/

60% LARGE DROPLET SLOW RELEASE EMULSIFIED VEGETABLE OIL SUBSTRATE FOR NITRATE REDUCTION (SRS®-NR) SAFETY DATA SHEET

1. Product Identification

Synonyms:	60% Large Droplet Slow Release Substrate (SRS®-NR) Emulsified Vegetable Oil (EVO)
Recommended Use:	Treatment of groundwater contaminated with nitrate and other anaerobically degradable compounds.
Supplier:	Terra Systems, Inc. 130 Hickman Road, Suite 1 Claymont, Delaware 19703 Telephone (302) 798-9553 Fax (302) 798-9554 www.terrasystems.net

2. Hazards Identification

Emergency Overview	
Caution:	May cause eye irritation.
Health Rating:	1 - Slight
Flammability Rating:	0 - Slight
Reactivity Rating:	0 - Slight
Contact Rating:	1 - Slight
Protective Equipment:	Goggles; Proper Gloves
Storage Color Code:	Green (General Storage)
Potential Health Effects	
Inhalation:	Not expected to be a health hazard. If heated, may produce vapors or mists that irritate the mucous membranes and cause irritation, dizziness, and nausea. Remove to fresh air.
Ingestion:	Not expected to be a health hazard via ingestion. Large doses may produce abdominal spasms, diarrhea.
Skin Contact:	No adverse effects expected. May cause irritation or sensitization in sensitive individuals.
Eye Contact:	May cause mild irritation, possible reddening.
Chronic Exposure:	No information found.
Aggravation of Pre-existing Conditions:	No information found.

3. Composition/Information on Ingredients

Ingredient	Synonyms	CAS #	Percent	Hazardous
Soy bean oil	Soya oil	8001-22-7	60%	No
Emulsifiers		Mixture	5 – 15%	No
Water		7732-18-5	25 - 35%	No

The emulsifiers are a trade secret and consists of ingredients of unknown acute toxicity.

4. First Aid Measures

Inhalation: Not expected to require first aid measures. Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion: If large amounts were swallowed, give water to drink and get medical advice.

Skin Contact: Not expected to require first aid measures. Wash exposed area with soap and water. Get medical advice if irritation develops.

Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention if irritation persists.

5. Fire Fighting Measures

Fire: Flash point: >200 C (>392 F). Not considered to be a fire hazard. Isolate from heat and open flame.

Explosion: Not considered to be an explosion hazard. Closed containers may explode if exposed to extreme heat.

Fire Extinguishing Media: Dry chemical, foam, or carbon dioxide. Water spray may be ineffective on fire, but can protect fire-fighters and cool closed containers. Use fog nozzles if water is used.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full face piece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Clean-up personnel may require protective clothing. Absorb in sand, paper towels, “Oil Dry”, or other inert material. Scoop up and containerize for disposal. Flush trace residues to sewer with soap and water. Containerized waste may be sent to an approved waste disposal facility.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material are not hazardous when empty since they do vapors or harmful substances; observe all warnings and precautions listed for the product. Do not store

above 49 C (120 F). Keep container tightly closed and upright when not in use to prevent leakage.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:	None established.
Ventilation System:	Not expected to require any special ventilation.
Personal Respirators (NIOSH Approved):	Not expected to require personal respirator usage.
Skin Protection:	Wear protective gloves and clean body-covering clothing.
Eye Protection:	Use chemical safety goggles and/or a full face shield where splashing is possible. Provide readily accessible eye wash stations and safety showers.
Slips, Trips, and Falls:	Material is slippery when spilled. Clean up with sand, paper towels, “Oil Dry”, or other inert material.

9. Physical and Chemical Properties

Appearance:	White liquid.
Odor:	Vegetable oil.
Solubility:	Miscible in water.
Specific Gravity (water=1):	0.95-0.98. 8.09 pounds per gallon.
pH:	6-7 (40% aqueous solution)
% Volatiles by volume @ 21C (70F):	Negligible.
Boiling Point:	≥ 100C (≥ 212F)
Melting Point:	No information found.
Flash Point (F):	No information found.
Autoignition Temperature:	No information found.
Decomposition Temperature:	No information found.
Vapor Density (Air=1):	No information found.
Vapor Pressure (mm Hg):	< 1.0 @ 20C (68F).
Evaporation Rate (BuAc=1):	No information found.
Viscosity @23 C (73 F):	213 centipoises (1.2 centipoises diluted 1:10)
Partition Coefficient (octanol/water):	No information found.

10. Stability and Reactivity

Stability:	Stable under ordinary conditions of use and storage.
Reactivity:	Not reactive under ordinary conditions.
Hazardous Decomposition Products:	Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:	Will not occur.
Incompatibilities:	Strong oxidizers, acids.
Conditions to Avoid:	Incompatibles. Isolate from heat and open flame.

11. Toxicological Information

Soybean Oil: No information found on toxicology. It is not a carcinogen listed by IARC, NTP, NIOSH, OSHA, or ACGIH.

Emulsifier Mixture: No information found on toxicology. It is not a carcinogen listed by IARC, NTP, NIOSH, OSHA, or ACGIH.

SRS-NR: The toxicity of the mixture has not been measured.

12. Ecological Information

Environmental Fate: No information found.

Environmental Toxicity: No information found.

Degradability: This product is completely biodegradable under both aerobic and anaerobic conditions.

Soil Mobility: This compound will move with groundwater until the adsorbed onto the soil. Degradation products may be mobile.

Bioaccumulation Potential: No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

OSHA STATUS: This product is not hazardous under the criteria of the Federal OSHA hazard Communication Standard 29 CFR 1910.1200. However, thermal processing and decomposition fumes from this product may be hazardous as noted in Section 10.

TSCA STATUS: No component of this product is listed on the TSCA inventory.

CERCLA (Comprehensive Response Compensation, and Liability Act): Not reportable.

SARA TITLE III (Superfund Amendments and Reauthorization Act)
Section 312 Extremely Hazardous Substances: None
Section 311/312 Hazard Categories: Non-hazardous Under Section 311/312
Section 313 Toxic Chemicals: None

RCRA STATUS: If discarded in its purchased form, this product would not be a hazardous waste either by listing or by characteristic. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste. (40 CFR 261.20-24)

CALIFORNIA PROPOSITION 65: The following statement is made in order to comply with the California safe Drinking Water and Toxic Enforcement Act of 1986. The product contains no chemicals known to the State of California to cause cancer.

16. Other Information

NFPA Ratings:	Health: **1** Flammability: **0** Reactivity: **0**
Date Prepared:	March 3, 2016
Revision Information:	SDS Section(s) changed since last revision of document include: None.
Disclaimer:	Terra Systems, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. TERRA SYSTEMS, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, TERRA SYSTEMS, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
Prepared by:	Terra Systems, Inc.
Phone Number:	(302) 798-9553 (U.S.A.)

Appendix C

Environmental Security Technology Certification Program

Supporting Calculations for EVO Amendment Dosages

SUBSTRATE ESTIMATING TOOL FOR ENHANCED ANAEROBIC BIOREMEDIATION OF CHLORINATED SOLVENTS

Version 1.2
November 2010

Site Data Input Table

TABLE S.1 - INPUT TABLE

Calculation Tables

Table S.2 - Substrate Calculations in Hydrogen

Table S.3 - Hydrogen Produced by Common Substrates

Table S.4 - Estimated Substrate Requirements for

Output Summary Table

TABLE S.5 - OUTPUT TABLE

PRINT SUMMARY TABLE

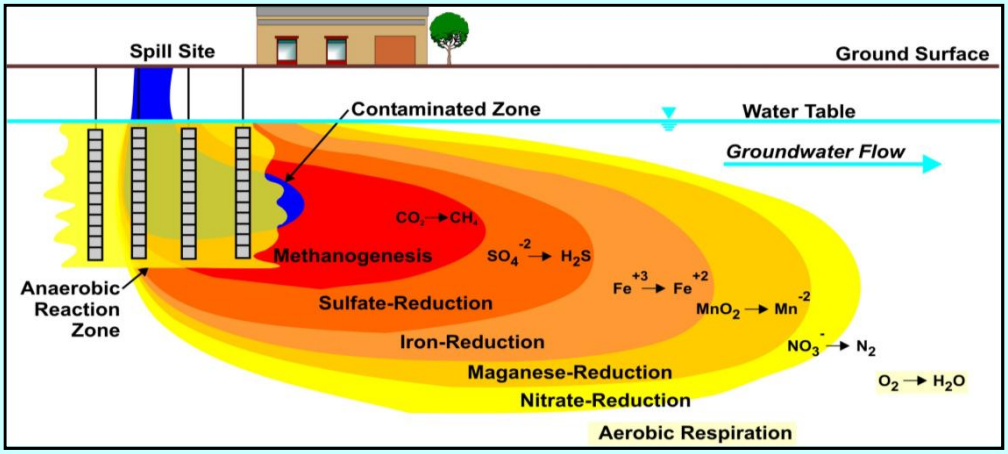


Table S.1 Input for Substrate Requirements in Hydrogen Equivalents

Site Name: PRB Demonstration Test - Site B

RETURN TO COVER PAGE

NOTE: Unshaded boxes are user input.

1. Treatment Zone Physical Dimensions	Values	Range	Units	User Notes
Width (Perpendicular to predominant groundwater flow direction)	110	1-10,000	feet	
Length (Parallel to predominant groundwater flow)	13	1-1,000	feet	PRB orientation, 7 points in one row; 10 points in two rows
Saturated Thickness	30	1-100	feet	Assumed
Treatment Zone Cross Sectional Area	3300	--	ft^2	
Treatment Zone Volume	42,900	--	ft^3	
Treatment Zone Total Pore Volume (total volume x total porosity)	96,293	--	gallons	
Treatment Zone Effective Pore Volume (total volume x effective porosity)	80,244	--	gallons	
Design Period of Performance	2.5	.5 to 5	year	
Design Factor (times the electron acceptor hydrogen demand)	2.0	2 to 20	unitless	Lower design factor applied for denitrification PRB
2. Treatment Zone Hydrogeologic Properties				
Total Porosity	30%	.05-50	percent	Assumed value for well graded sands
Effective Porosity	25%	.05-50	percent	
Average Aquifer Hydraulic Conductivity	225	.01-1000	ft/day	Estimate from other Cape Cod sites
Average Hydraulic Gradient	0.002	0.0001-0.1	ft/ft	Estimate from other Cape Cod sites
Average Groundwater Seepage Velocity through the Treatment Zone	1.80	--	ft/day	Set to be 1.8 feet/day
Average Groundwater Seepage Velocity through the Treatment Zone	657.0	--	ft/yr	
Average Groundwater Discharge through the Treatment Zone	4,055,431	--	gallons/year	
Soil Bulk Density	1.7	1.4-2.0	gm/cm^3	
Soil Fraction Organic Carbon (foc)	0.02%	0.01-10	percent	
3. Native Electron Acceptors				
A. Aqueous-Phase Native Electron Acceptors				
Oxygen	6.0	0.01 to 10	mg/L	Average DO in AECOM wells along Main Street
Nitrate	10.00	0.1 to- 20	mg/L	Max. concentration based on monitoring wells near police station
Sulfate	16	10 to 5,000	mg/L	
Carbon Dioxide (estimated as the amount of Methane produced)	10.0	0.1 to 20	mg/L	
B. Solid-Phase Native Electron Acceptors				
Manganese (IV) (estimated as the amount of Mn (II) produced)	1	0.1 to 20	mg/L	Estimate from other Cape Cod sites
Iron (III) (estimated as the amount of Fe (II) produced)	10	0.1 to 20	mg/L	Estimate from other Cape Cod sites
4. Contaminant Electron Acceptors				
Tetrachloroethene (PCE)	0.000	--	mg/L	no CVOCs assumed
Trichloroethene (TCE)	0.000	--	mg/L	
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.000	--	mg/L	
Vinyl Chloride (VC)	0.000	--	mg/L	
Carbon Tetrachloride (CT)	0.000	--	mg/L	
Trichloromethane (or chloroform) (CF)	0.000	--	mg/L	
Dichloromethane (or methylene chloride) (MC)	0.000	--	mg/L	
Chloromethane	0.000	--	mg/L	
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	--	mg/L	
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.000	--	mg/L	
Dichloroethane (1,1-DCA and 1,2-DCA)	0.000	--	mg/L	
Chloroethane	0.000	--	mg/L	
Perchlorate	0.000	--	mg/L	
5. Aquifer Geochemistry (Optional Screening Parameters)				
A. Aqueous Geochemistry				
Oxidation-Reduction Potential (ORP)	50	-400 to +500	mV	Based on AECOM monitoring near Main St.
Temperature	15	5.0 to 30	ºC	
pH	5.8	4.0 to 10.0	su	Based on AECOM monitoring near Main St.
Alkalinity	55	10 to 1,000	mg/L	
Total Dissolved Solids (TDS, or salinity)	100	10 to 1,000	mg/L	
Specific Conductivity	650	100 to 10,000	µs/cm	Based on AECOM monitoring near Main St.
Chloride	10	10 to 10,000	mg/L	
Sulfide - Pre injection	0.0	0.1 to 100	mg/L	
Sulfide - Post injection	0.0	0.1 to 100	mg/L	
B. Aquifer Matrix				
Total Iron	5000	200 to 20,000	mg/kg	
Cation Exchange Capacity	NA	1.0 to 10	meq/100 g	
Neutralization Potential	10.0%	1.0 to 100	Percent as $CaCO_3$	

NOTES:

Table S.2 Substrate Calculations in Hydrogen Equivalents

Site Name: PRB Demonstration Test - Site B

RETURN TO COVER PAGE

NOTE: Open cells are user input.

1. Treatment Zone Physical Dimensions

	Values	Range	Units
Width (Perpendicular to predominant groundwater flow direction)	110	1-10,000	feet
Length (Parallel to predominant groundwater flow)	13	1-1,000	feet
Saturated Thickness	30	1-100	feet
Treatment Zone Cross Sectional Area	3300	--	ft^2
Treatment Zone Volume	42,900	--	ft^3
Treatment Zone Effective Pore Volume (total volume x effective porosity)	80,244	--	gallons
Design Period of Performance	2.5	.5 to 5	year

2. Treatment Zone Hydrogeologic Properties

Total Porosity	0.30	.05-50	
Effective Porosity	0.25	.05-50	
Average Aquifer Hydraulic Conductivity	225	.01-1000	ft/day
Average Hydraulic Gradient	0.002	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the Treatment Zone	1.80	--	ft/day
Average Groundwater Seepage Velocity through the Treatment Zone	657.0	--	ft/yr
Average Groundwater Flux through the Treatment Zon 0	4,055,431	--	gallons/year
Soil Bulk Density	1.7	1.4-2.0	gm/cm^3
Soil Fraction Organic Carbon (foc)	0.0002	0.0001-0.1	

3. Initial Treatment Cell Electron-Acceptor Demand (one total pore volume)

A. Aqueous-Phase Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	6.0	4.02	7.94	0.51	4
Nitrate (denitrification)	10.0	6.70	12.30	0.54	5
Sulfate	16	10.71	11.91	0.90	8
Carbon Dioxide (estimated as the amount of methane produced)	10.0	6.70	1.99	3.36	8
Soluble Competing Electron Acceptor Demand (lb.)				**5.31**	

B. Solid-Phase Native Electron Acceptors (Based on manganese and iron produced)	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Manganese (IV) (estimated as the amount of Mn (II) produced)	1.4	119.38	27.25	4.38	2
Iron (III) (estimated as the amount of Fe (II) produced)	10.0	852.71	55.41	15.39	1
Solid-Phase Competing Electron Acceptor Demand (lb.)				**19.77**	

C. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	0.000	0.00	20.57	0.00	8
Trichloroethene (TCE)	0.000	0.00	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.000	0.00	24.05	0.00	4
Vinyl Chloride (VC)	0.000	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.000	0.00	22.06	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	0.000	0.00	24.55	0.00	4
Chloroethane	0.000	0.00	32.00	0.00	2
Perchlorate	0.000	0.00	12.33	0.00	6
Total Soluble Contaminant Electron Acceptor Demand (lb.)				**0.00**	

D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	Soil Conc. (mg/kg)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	263	0.00	0.00	20.57	0.00	8
Trichloroethene (TCE)	107	0.00	0.00	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	45	0.00	0.00	24.05	0.00	4
Vinyl Chloride (VC)	3.0	0.00	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)	224	0.00	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	63	0.00	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	28	0.00	0.00	21.06	0.00	4
Chloromethane	25	0.00	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	117	0.00	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	105	0.00	0.00	22.06	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	30	0.00	0.00	24.55	0.00	4
Chloroethane	3	0.00	0.00	32.00	0.00	2
Perchlorate	0.0	0.00	0.00	12.33	0.00	6
Total Sorbed Contaminant Electron Acceptor Demand (lb.)					**0.00**	

(continued)

Table S.2 Substrate Calculations in Hydrogen Equivalents

4. Treatment Cell Electron-Acceptor Flux (per year)

A. Soluble Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	6.0	203.04	7.94	25.57	4
Nitrate (denitrification)	10.0	338.41	10.25	33.02	5
Sulfate	16	541.45	11.91	45.46	8
Carbon Dioxide (estimated as the amount of Methane produced)	10	338.41	1.99	170.05	8
Total Competing Electron Acceptor Demand Flux (lb/yr)				**274.1**	

B. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	0.000	0.00	20.57	0.00	8
Trichloroethene (TCE)	0.000	0.00	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.000	0.00	24.05	0.00	4
Vinyl Chloride (VC)	0.000	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.000	0.00	22.06	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	0.000	0.00	24.55	0.00	4
Chloroethane	0.000	0.00	32.00	0.00	2
Perchlorate	0.000	0.00	12.33	0.00	6
Total Soluble Contaminant Electron Acceptor Demand Flux (lb/yr)				**0.00**	

Initial Hydrogen Requirement First Year (lb)	**299.2**
Total Life-Cycle Hydrogen Requirement (lb)	**710.3**

5. Design Factors

Microbial Efficiency Uncertainty Factor	2X - 4X
Methane and Solid-Phase Electron Acceptor Uncertainty	2X - 4X
Remedial Design Factor (e.g., Substrate Leaving Reaction Zone)	1X - 3X
Design Factor	**2.0**
Total Life-Cycle Hydrogen Requirement with Design Factor (lb)	**1,420.7**

6. Acronyns and Abbreviations

°C =degrees celsius
µs/cm = microsiemens per centimeter
cm/day = centimeters per day
cm/sec = centimeters per second
ft^2 = square feet
ft/day = feet per day
ft/ft = foot per foot
ft/yr = feet per year
gm/cm^3 = grams per cubic centimeter
kg of CaCO3 per mg = kilograms of calcium carbonate per milligram
lb = pounds
meq/100 g = milliequivalents per 100 grams
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
m/m = meters per meters
mV = millivolts
m/yr = meters per year
su = standard pH units
wt/wt H2 = concetration molecular hydrogen, weight per weight

Table S.3

Hydrogen Produced by Fermentation Reactions of Common Substrates

RETURN TO COVER PAGE

Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H_2/Mole Substrate
Lactic Acid	$C_3H_6O_3$	90.1	2	0.0448	**2 to 3**
Molasses (assuming 100% sucrose)	$C_{12}H_{22}O_{11}$	342	8	0.0471	**8 to 11**
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	$C_6H_{12}O_6$	180	4	0.0448	**4 to 6**
Ethanol	C_2H_6O	46.1	2	0.0875	**2 to 6**
Whey (assuming 100% lactose)	$C_{12}H_{22}O_{11}$	342	11	0.0648	**11**
HRC® (assumes 40% lactic acid and 40% glycerol by weight)	$C_{39}H_{56}O_{39}$	956	28	0.0590	**28**
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	$C_{18}H_{32}O_2$	281	16	0.1150	**16**

Table S.4

Estimated Substrate Requirements for Hydrogen Demand in Table S.3

Design Life (years): 2.5

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	2.0	31,740	31,740	1.44E+10	372
Sodium Lactate Product (60 percent solution)	2.0	31,740	65,851	1.44E+10	372
Molasses (assuming 6 0	2.0	30,153	50,254	1.37E+10	354
HFCS (assuming 40% fructose and 40% glucose by weight)	2.0	31,747	39,684	1.44E+10	372
Ethanol Product (assuming 80% ethanol by weight)	2.0	16,233	20,291	7.36E+09	190
Whey (assuming 100% lactose)	2.0	21,910	31,300	9.94E+09	257
HRC® (assumes 40% lactic acid and 40% glycerol by weight)	2.0	24,061	24,061	1.09E+10	226
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	2.0	12,354	12,354	5.60E+09	145
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	2.0	12,354	20,591	5.60E+09	145

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.
2. Molecular weight of sodium lactate (CH_3-CHOH-COONa) = 112.06.
3. Molecular weight of lactic Acid ($C_6H_6O_3$) = 90.08 .
4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.
5. Weight of sodium lactate product = 11.0 pounds per gallon.
6. Pounds per gallon of lactic acid in product = 1.323 x 8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.
2. HRC® weighs approximately 9.18 pounds per gallon.

NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.
2. Soybean oil is 7.8 pounds per gallon.
3. Assumes specific gravity of emulsion product is 0.96.

Table S.5 Output for Substrate Requirements in Hydrogen Equivalents

Site Name: PRB Demonstration Test - Site B

RETURN TO COVER PAGE

1. Treatment Zone Physical Dimensions

	Values	Units	Values	Units
Width (perpendicular to groundwater flow)	110	feet	34	meters
Length (parallel to groundwater flow)	13	feet	4.0	meters
Saturated Thickness	30	feet	9.1	meters
Design Period of Performance	2.5	years	2.5	years

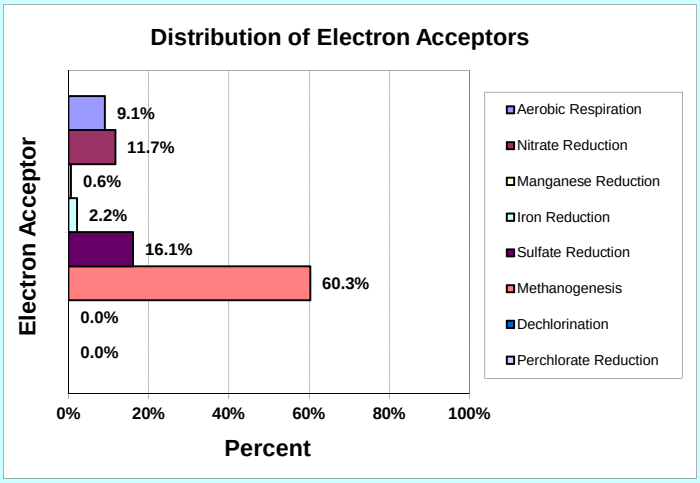
2. Treatment Zone Hydrogeologic Properties

	Values	Units	Values	Units
Total Porosity	0.3	percent	0.3	percent
Effective Porosity	0.25	percent	0.25	percent
Average Aquifer Hydraulic Conductivity	225	ft/day	7.9E-02	cm/sec
Average Hydraulic Gradient	0.002	ft/ft	0.002	m/m
Average Groundwater Seepage Velocity	1.80	ft/day	5.5E+01	cm/day
Average Groundwater Seepage Velocity	657	ft/yr	200.3	m/yr
Effective Treatment Zone Pore Volume	80,244	gallons	303,750	liters
Groundwater Flux (per year)	4,055,431	gallons/year	15,351,047	liters/year
Total Groundwater Volume Treated (over entire design period)	10,218,822	gallons total	38,681,369	liters total

3. Distribution of Electron Acceptor Demand

	Percent of Total	Hydrogen Demand (lb)
Aerobic Respiration	9.1%	64.437
Nitrate Reduction	11.7%	83.083
Sulfate Reduction	16.1%	114.554
Manganese Reduction	0.6%	4.381
Iron Reduction	2.2%	15.389
Methanogenesis	60.3%	428.499
Dechlorination	0.0%	0.000
Perchlorate Reduction	0.0%	0.000
Totals:	**100.00%**	**710.34**

Hydrogen demand in pounds/gallon:	6.95E-05
Hydrogen demand in grams per liter:	8.33E-03



4. Substrate Equivalents: Design Factor = 2.0

Product	Quantity (lb)	Quantity (gallons)	Effective Concentration (mg/L)	Effective concentration is for total volume of groundwater treated.
1. Sodium Lactate Product	65,851	5,986	372	as lactic acid
2. Molasses Product	50,254	4,188	354	as sucrose
3. Fructose Product	39,684	3,543	372	as fructose
4. Ethanol Product	20,291	2,941	190	as ethanol
5. Sweet Dry Whey (lactose)	31,300	sold by pound	257	as lactose
6. HRC®	24,061	sold by pound	226	as 40% lactic acid/40% glycerol
7. Linoleic Acid (Soybean Oil)	12,354	1,584	145	as soybean oil
8. Emulsified Vegetable Oil	20,591	2,640	145	as soybean oil

Notes:

1. Quantity assumes product is 60% sodium lactate by weight.
2. Quantity assumes product is 60% sucrose by weight and weighs 12 pounds per gallon.
3. Quantity assumes product is 80% fructose by weight and weighs 11.2 pounds per gallon.
4. Quantity assumes product is 80% ethanol by weight and weighs 6.9 pounds per gallon.
5. Quantity assumes product is 70% lactose by weight.
6. Quantity assumes HRC® is 40% lactic acid and 40% glycerol by weight.
7. Quantity of neat soybean oil, corn oil, or canola oil.
8. Quantity assumes commercial product is 60% soybean oil by weight.

Town of Orleans, MA - Water Quality and Wastewater Planning
PRB Demonstration Tests - Electron Donor Volume and Dosage Calculations

Injection Area	Electron Donor	Area (sq ft)	Treatment Interval (ft bgs)	Average Treatment Thickness (ft)	Grid Spacing (ft)	Injection Points	Soil Volume (cu ft)	Pore Volume (gallons)	Injection Volume (gallons)	EVO To Be Shipped (60%) (gallons)	EVO dosage	Field Dilution	Injection Volume per Point (gallons)	Dilution Water (gallons)
Eldredge Park Demonstration	EVO	1,560		30	10	17	46,800	87,522	10503	2620	15.0%	4	620	7883
TOTAL		1,560				17	46,800	87,522	10,503	2,620				

EVO Injection Pore Volume Target 12.0%

Effective Porosity	0.25	
Water Density	8.34	lb/gallon
Volume Conversion	7.48	gallon/ft3

Appendix D

Daily Injection Field Reports and Monitoring Data

11 Princess Road, Suite A Lawrenceville, NJ 08648 609-275-8500	Treatment Program Daily Report	ISOTEC

Date:	14-Nov-16		Client:	AECOM - Site B-Eldredge Park			Personnel:	TM, MM, PD		
Project #:	802166		Location:	Orleans, MA			Weather:			

Personnel	Time		Mobilization	Safety	Equipment	Injection	Sampling	Equipment	Data	Lunch	Work
	Start	Stop	To/From Site	Meeting	Preparation	Time	Time	Breakdown	Entry	Break	Delay(s)
Thomas Musser	5:00 AM	5:15 PM	7.00	0.25	4.50			0.50		0.25	
Marlon Mendoza	5:00 AM	5:15 PM	7.00	0.25	4.50			0.50		0.25	
Paul Dombrowski	5:00 AM	5:15 PM	5.00	0.25	4.50			0.50		0.25	
Total Hours On Site:			12.25			Total Injection Hours:		0.00			

Major Work Activities Performed:

Daily tailgate H&S meeting. Setup equipment and fork lift was dropped off. Filled mixing tanks with non-potable water from the fire hydrant. AECOM performed depth to water reading on the surrounding monitoring wells.

Health and Safety Items Covered:

Proper lifting when moving equipment.

Other On-Site Personnel

Mark Owen - AECOM

Date Completed	Injection Point ID	Screen Interval (ft bgs)	SRS-NR Injection Time (mins)	SRS-NR Volume (gal)	SRS-NR Flow Rate (gpm)	Well Head Pressures (psi)	Comments
					#DIV/0!		
					#DIV/0!		
					#DIV/0!		
					#DIV/0!		
					#DIV/0!		
					#DIV/0!		
					#DIV/0!		
Totals				0		Injection Total:	0

SRS-NR = 15% SRS-NR EVO
mins = minutes
ft = feet
bgs = below ground surface
gal = gallons
gpm = gallons per minute
psi = pounds per square inch

11 Princess Road, Suite A
Lawrenceville, NJ 08648
609-275-8500

Treatment Program Daily Report

ISOTEC

Date:	15-Nov-16			Client:	AECOM - Site B-Eldredge Park			Personnel:	TM, MM, PD		
Project #:	802166			Location:	Orleans, MA			Weather:			
Personnel	Time		Mobilization	Safety	Equipment	Injection	Sampling	Equipment	Data	Lunch	Work
	Start	Stop	To/From Site	Meeting	Preparation	Time	Time	Breakdown	Entry	Break	Delay(s)
Thomas Musser	7:00 AM	6:00 PM	0.25	0.25	1.50	7.75		1.25		0.25	
Marlon Mendoza	7:00 AM	6:00 PM	0.25	0.25	1.50	7.75		1.25		0.25	
Paul Dombrowski	7:00 AM	6:00 PM	0.25	0.25	1.50	7.75		1.25		0.25	
Total Hours On Site:			11.00	Total Injection Hours:				7.75			

Major Work Activities Performed:

Daily tailgate H&S meeting. Setup and breakdown of equipment. AECOM sampled adjacent wells to injection points for influence (ROI). Received 9 totes of SRS-NR. Installed E-8, E-10, W-4 and W-7. Attempted to install W-6 the pre-clear was done on a angle and the 2.25" rod could not be installed at that injection location.

Health and Safety Items Covered:

Proper PPE and vehicle traffic.

Other On-Site Personnel

John Chase - Geosearch
Mark Owen, Julianne Marrion - AECOM
Michael Lee - Terra Systems

Date Completed	Injection Point ID	Screen Interval (ft bgs)	SRS-NR Injection Time (mins)	SRS-NR Volume (gal)	SRS-NR Flow Rate (gpm)	Well Head Pressures (psi)	Comments
15-Nov-16	E-8	64-68	8	75	9.38	20	
15-Nov-16	E-8	60-64	7	75	10.71	20	
15-Nov-16	E-8	56-60	5	75	15.00	0	
15-Nov-16	E-8	52-56	10	75	7.50	0	
15-Nov-16	E-8	48-52	11	75	6.82	0	
15-Nov-16	E-8	44-48	25	75	3.00	0	
15-Nov-16	E-8	40-44	10	75	7.50	0	
15-Nov-16	E-8	36-40	16	75	4.69	8	
15-Nov-16	E-10	64-68	21	75	3.57	22	
15-Nov-16	E-10	60-64	22	75	3.41	10	
15-Nov-16	E-10	56-60	32	75	2.34	0	
15-Nov-16	E-10	52-56	12	75	6.25	0	
15-Nov-16	E-10	48-52	25	75	3.00	0	
15-Nov-16	E-10	44-48	15	75	5.00	0	
15-Nov-16	E-10	40-44	16	75	4.69	0	
15-Nov-16	E-10	36-40	10	75	7.50	0	
15-Nov-16	W-4	64-68	8	75	9.38	0	
15-Nov-16	W-4	60-64	9	75	8.33	0	
15-Nov-16	W-4	56-60	12	75	6.25	0	
15-Nov-16	W-4	52-56	9	75	8.33	0	
15-Nov-16	W-4	48-52	9	75	8.33	10	
15-Nov-16	W-4	44-48	12	75	6.25	0	
15-Nov-16	W-4	40-44	10	75	7.50	0	
15-Nov-16	W-4	36-40	10	75	7.50	0	
15-Nov-16	W-7	64-68	5	75	15.00	20	
15-Nov-16	W-7	60-64	17	75	4.41	4	
15-Nov-16	W-7	56-60	20	75	3.75	0	
15-Nov-16	W-7	52-56	10	75	7.50	8	
15-Nov-16	W-7	48-52	20	75	3.75	0	
15-Nov-16	W-7	44-48	22	75	3.41	0	
15-Nov-16	W-7	40-44	26	55	2.12	20	Screen fouled raised to next interval to resolve issue.
15-Nov-16	W-7	36-40	15	45	3.00	15	Screen fouled will complete interval on 11/16/16.
						Injection Total:	2350

SRS-NR = 15% SRS-NR EVO
mins = minutes
ft = feet
bgs = below ground surface
gal = gallons
gpm = gallons per minute
psi = pounds per square inch

11 Princess Road, Suite A
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609-275-8500

Treatment Program Daily Report

ISOTEC

Date:	16-Nov-16		Client:	AECOM - Site B-Eldredge Park			Personnel:	TM, MM, PD		
Project #:	802166		Location:	Orleans, MA			Weather:			

Personnel	Time		Mobilization	Safety	Equipment	Injection	Sampling	Equipment	Data	Lunch	Work
	Start	Stop	To/From Site	Meeting	Preparation	Time	Time	Breakdown	Entry	Break	Delay(s)
Thomas Musser	7:00 AM	5:15 PM	0.25	0.25	0.25	9.25		0.25		0.25	
Marlon Mendoza	7:00 AM	5:15 PM	0.25	0.25	0.25	9.25		0.25		0.25	
Paul Dombrowski	7:00 AM	5:15 PM	0.25	0.25	0.25	9.25		0.25		0.25	
Total Hours On Site:			10.25			Total Injection Hours:		9.25			

Major Work Activities Performed:

Daily tailgate H&S meeting. Setup and breakdown of equipment. AECOM sampled adjacent wells to injection points for influence (ROI). Forklift was picked up. Installed W-2, 3, 5, 6 and E-2.

Health and Safety Items Covered:

S/T/F.

Other On-Site Personnel

John Chase - Geosearch
Mark Owen, Julianne Marrion - AECOM
Michael Lee - Terra Systems

Date Completed	Injection Point ID	Screen Interval (ft bgs)	SRS-NR Injection Time (mins)	SRS-NR Volume (gal)	SRS-NR Flow Rate (gpm)	Well Head Pressures (psi)	Comments
16-Nov-16	W-7	36-40	14	50	3.57	0	
16-Nov-16	W-3	64-68	8	75	9.38	6	
16-Nov-16	W-3	60-64	10	75	7.50	10	
16-Nov-16	W-3	56-60	18	75	4.17	18	
16-Nov-16	W-3	52-56	8	75	9.38	16	
16-Nov-16	W-3	48-52	7	75	10.71	8	
16-Nov-16	W-3	44-48	11	75	6.82	16	
16-Nov-16	W-3	40-44	13	75	5.77	16	
16-Nov-16	W-3	36-40	9	75	8.33	16	
16-Nov-16	W-5	64-68	12	75	6.25	4	
16-Nov-16	W-5	60-64	13	75	5.77	0	
16-Nov-16	W-5	56-60	16	75	4.69	2	
16-Nov-16	W-5	52-56	13	75	5.77	2	
16-Nov-16	W-5	48-52	15	75	5.00	18	
16-Nov-16	W-5	44-48	19	75	3.95	0	
16-Nov-16	W-5	40-44	19	75	3.95	12	
16-Nov-16	W-5	36-40	15	75	5.00	14	
16-Nov-16	W-2	60-68	23	150	6.52	0	8' interval.
16-Nov-16	W-2	52-60	18	150	8.33	0	8' interval.
16-Nov-16	W-2	44-52	33	150	4.55	28	8' interval.
16-Nov-16	W-2	36-44	23	150	6.52	0	8' interval.
16-Nov-16	W-6	60-68	25	150	6.00	2	8' interval.
16-Nov-16	W-6	52-60	29	150	5.17	0	8' interval.
16-Nov-16	W-6	44-52	23	150	6.52	0	8' interval.
16-Nov-16	W-6	36-44	35	150	4.29	0	8' interval.
16-Nov-16	E-2	60-68	18	150	8.33	0	8' interval.
16-Nov-16	E-2	52-60	28	150	5.36	18	8' interval.
						Injection Total:	2750

SRS-NR = 15% SRS-NR EVO
mins = minutes
ft = feet
bgs = below ground surface
gal = gallons
gpm = gallons per minute
psi = pounds per square inch

11 Princess Road, Suite A Lawrenceville, NJ 08648 609-275-8500	Treatment Program Daily Report	ISOTEC

Date:	17-Nov-16		Client:	AECOM - Site B-Eldredge Park			Personnel:	TM, MM, PD		
Project #:	802166		Location:	Orleans, MA			Weather:			
Personnel	Time		Mobilization	Safety	Equipment	Injection	Sampling	Equipment	Data	Lunch	Work
	Start	Stop	To/From Site	Meeting	Preparation	Time	Time	Breakdown	Entry	Break	Delay(s)
Thomas Musser	7:00 AM	5:15 PM	0.25	0.25	0.50	9.00		0.25		0.25	
Marlon Mendoza	7:00 AM	5:15 PM	0.25	0.25	0.50	9.00		0.25		0.25	
Paul Dombrowski	7:00 AM	5:15 PM	0.25	0.25	0.50	9.00		0.25		0.25	
Total Hours On Site:			10.25	Total Injection Hours:				9.00			

Major Work Activities Performed:

Daily tailgate H&S meeting. Setup and breakdown of equipment. AECOM sampled adjacent wells to injection points for influence (ROI). Installed E-1, 3, 4, 5, 6 and W-1.

Health and Safety Items Covered:

Communication between field crew.

Other On-Site Personnel

John Chase - Geosearch
Julianne Marrion - AECOM
Michael Lee - Terra Systems

Date Completed	Injection Point ID	Screen Interval (ft bgs)	SRS-NR Injection Time (mins)	SRS-NR Volume (gal)	SRS-NR Flow Rate (gpm)	Well Head Pressures (psi)	Comments
17-Nov-16	E-2	44-52	20	150	7.50	10	8' interval.
17-Nov-16	E-2	36-44	25	150	6.00	6	8' interval.
17-Nov-16	E-3	60-68	22	150	6.82	2	8' interval.
17-Nov-16	E-3	52-60	24	150	6.25	2	8' interval.
17-Nov-16	E-3	44-52	23	150	6.52	4	8' interval.
17-Nov-16	E-3	36-44	24	150	6.25	0	8' interval.
17-Nov-16	W-1	60-68	21	150	7.14	2	8' interval.
17-Nov-16	W-1	52-60	23	150	6.52	0	8' interval.
17-Nov-16	W-1	44-52	26	150	5.77	12	8' interval.
17-Nov-16	W-1	36-44	29	150	5.17	0	8' interval.
17-Nov-16	E-4	60-68	26	150	5.77	0	8' interval.
17-Nov-16	E-4	52-60	16	150	9.38	0	8' interval.
17-Nov-16	E-4	44-52	20	150	7.50	2	8' interval.
17-Nov-16	E-4	36-44	30	150	5.00	0	8' interval.
17-Nov-16	E-1	60-68	21	150	7.14	0	8' interval.
17-Nov-16	E-1	52-60	26	150	5.77	0	8' interval.
17-Nov-16	E-1	44-52	22	150	6.82	0	8' interval.
17-Nov-16	E-1	36-44	28	150	5.36	0	8' interval.
17-Nov-16	E-5	60-68	20	150	7.50	0	8' interval.
17-Nov-16	E-5	52-60	20	150	7.50	0	8' interval.
17-Nov-16	E-5	44-52	20	150	7.50	0	8' interval.
17-Nov-16	E-5	36-44	27	150	5.56	0	8' interval.

11 Princess Road, Suite A Lawrenceville, NJ 08648 609-275-8500	Treatment Program Daily Report	ISOTEC

Date:	18-Nov-16			Client:	AECOM - Site B-Eldredge Park			Personnel:	TM, MM, PD		
Project #:	802166			Location:	Orleans, MA			Weather:			
Personnel	Time		Mobilization	Safety	Equipment	Injection	Sampling	Equipment	Data	Lunch	Work
	Start	Stop	To/From Site	Meeting	Preparation	Time	Time	Breakdown	Entry	Break	Delay(s)
Thomas Musser	7:00 AM	11:00 PM	8.00	0.25	0.50	5.00		2.25		0.25	
Marlon Mendoza	7:00 AM	11:00 PM	8.00	0.25	0.50	5.00		2.25		0.25	
Paul Dombrowski	7:00 AM	7:15 PM	4.00	0.25	0.50	5.00		2.25		0.25	
Total Hours On Site:			16.00	Total Injection Hours:				5.00			

Major Work Activities Performed:

Daily tailgate H&S meeting. Setup and breakdown of equipment. AECOM sampled adjacent wells to injection points for influence (ROI). Installed E-7 and E-9. All injections were completed. ISOTEC demobbed all equipment and personnel from the site and it was restored to its previous condition.

Health and Safety Items Covered:

Proper lifting procedures.

Other On-Site Personnel

John Chase - Geosearch

Date Completed	Injection Point ID	Screen Interval (ft bgs)	SRS-NR Injection Time (mins)	SRS-NR Volume (gal)	SRS-NR Flow Rate (gpm)	Well Head Pressures (psi)	Comments
18-Nov-16	E-6	44-52	74	200	2.70	20	8' interval.
18-Nov-16	E-6	36-44	42	220	5.24	6	8' interval.
18-Nov-16	E-9	60-68	45	200	4.44	20	8' interval.
18-Nov-16	E-9	52-60	31	220	7.10	2	8' interval.
18-Nov-16	E-9	44-52	29	220	7.59	0	8' interval.
18-Nov-16	E-9	36-44	32	220	6.88	10	8' interval.
18-Nov-16	E-7	60-68	28	200	7.14	0	8' interval.
18-Nov-16	E-7	52-60	72	175	2.43	28	8' interval, surfaced up though annular space of rod. Injections ceased and point was sealed with bentonite.
18-Nov-16	E-7	44-52	52	220	4.23	8	8' interval.
18-Nov-16	E-7	36-44	37	225	6.08	0	8' interval.
						Injection Total:	2100

SRS-NR = 15% SRS-NR EVO
mins = minutes
ft = feet
bgs = below ground surface
gal = gallons
gpm = gallons per minute
psi = pounds per square inch

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B1010C

				Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
				Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
	Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
Back	11/15/2016	2:12:30 PM	0	56.85	-14.113	29.87	281.3	2.447	0.8	5.32	4.32	41.8214	29.49
Inject	11/15/2016	3:08:51 PM	0	56.76	-14.204	29.865	225.8	2.447	0.81	5.23	5.2	50.3103	30.43
	11/15/2016	3:10:56 PM	2.0833	56.84	-14.12	29.863	79.1	2.447	0.82	5.22	5.12	49.5767	29.88
	11/15/2016	3:13:01 PM	4.1667	56.75	-14.455	29.861	89.8	2.499	0.81	5.22	5.21	50.3389	31.8
	11/15/2016	3:15:06 PM	6.25	56.71	-14.57	29.859	87.8	2.525	0.81	5.25	5.28	51.011	31.52
	11/15/2016	3:17:11 PM	8.3333	56.71	-14.608	29.86	250.9	2.473	0.81	5.24	5.29	51.141	31.89
	11/15/2016	3:19:16 PM	10.4167	56.7	-14.627	29.86	196	2.499	0.81	5.24	5.36	51.8445	32.04
	11/15/2016	3:21:21 PM	12.5	56.71	-14.545	29.86	72.6	2.447	0.84	5.24	5.36	51.835	32.13
	11/15/2016	3:23:26 PM	14.5833	56.75	-14.204	29.858	40.3	2.499	0.82	5.24	5.37	51.9752	30.8
	11/15/2016	3:25:31 PM	16.6667	56.78	-14.127	29.856	27.8	2.525	0.82	5.24	5.33	51.5762	30.16
	11/15/2016	3:27:36 PM	18.75	56.72	-14.488	29.855	37.9	2.499	0.82	5.23	5.44	52.629	31.78
	11/15/2016	3:29:41 PM	20.8333	56.69	-14.596	29.852	15.3	2.525	0.82	5.22	5.41	52.2471	31.77
	11/15/2016	3:31:46 PM	22.9167	56.7	-14.621	29.85	30.1	2.447	0.82	5.23	5.34	51.626	31.89
	11/15/2016	3:33:51 PM	25	56.69	-14.634	29.85	29.2	2.473	0.82	5.23	5.38	52.0024	31.92
	11/15/2016	3:35:56 PM	27.0833	56.7	-14.64	29.848	12.5	2.525	0.82	5.23	5.38	51.9967	31.79
	11/15/2016	3:38:01 PM	29.1667	56.7	-14.634	29.847	-4.1	2.473	0.82	5.23	5.38	52.0284	31.84
	11/15/2016	3:40:06 PM	31.25	56.72	-14.255	29.849	-29.2	2.473	0.83	5.23	5.38	51.9859	32.43
	11/15/2016	3:42:11 PM	33.3333	56.78	-14.178	29.849	-28.6	2.447	0.83	5.23	5.18	50.1322	31.25
	11/15/2016	3:44:16 PM	35.4167	56.79	-14.133	29.848	-27.2	2.447	0.82	5.23	5.12	49.5378	30.31
	11/15/2016	3:46:21 PM	37.5	56.72	-14.437	29.845	7.6	2.473	0.82	5.23	5.18	50.091	31.81
	11/15/2016	3:48:26 PM	39.5833	56.7	-14.583	29.844	-16.9	2.499	0.82	5.23	5.03	48.6725	31.68
	11/15/2016	3:50:31 PM	41.6667	56.7	-14.659	29.846	-3.3	2.525	0.84	5.22	4.91	47.4319	31.9
	11/15/2016	3:52:36 PM	43.75	56.69	-14.672	29.843	5.8	2.499	0.82	5.23	4.89	47.2397	31.74
	11/15/2016	3:54:41 PM	45.8333	56.7	-14.666	29.842	3.8	2.525	0.82	5.23	4.89	47.3161	31.69
	11/15/2016	3:56:46 PM	47.9167	56.7	-14.369	29.839	-20.6	2.525	0.82	5.23	4.88	47.1603	32.17
	11/15/2016	3:58:51 PM	50	56.73	-14.242	29.839	-27.3	2.525	0.82	5.23	4.81	46.503	31.82
	11/15/2016	4:00:56 PM	52.0833	56.71	-14.298	29.836	-15.3	2.525	0.83	5.23	4.79	46.3303	32.92
	11/15/2016	4:03:01 PM	54.1667	56.7	-14.394	29.836	-8.4	2.499	0.83	5.22	4.89	47.3105	31.52
	11/15/2016	4:05:06 PM	56.25	56.72	-14.407	29.833	-16.5	2.499	0.82	5.2	4.88	47.2008	31.51
	11/15/2016	4:07:11 PM	58.3333	56.69	-14.419	29.834	-22.6	2.499	0.83	5.17	4.83	46.6851	31.44
	11/15/2016	4:09:16 PM	60.4167	56.7	-14.337	29.833	-32.9	2.473	0.83	5.19	4.85	46.9346	31.86
	11/15/2016	4:11:21 PM	62.5	56.7	-14.262	29.832	-35.7	2.499	0.89	5.19	4.76	46.0295	32.28
	11/15/2016	4:13:26 PM	64.5833	56.7	-14.236	29.831	-35.7	2.525	0.9	5.2	4.69	45.3837	32.66
	11/15/2016	4:15:31 PM	66.6667	56.69	-14.381	29.831	-34.2	2.525	0.83	5.2	4.76	46.0379	32.04
	11/15/2016	4:17:36 PM	68.75	56.71	-14.514	29.829	-37.3	2.499	0.83	5.2	4.82	46.6465	33.19
	11/15/2016	4:19:41 PM	70.8333	56.71	-14.495	29.828	-38.9	2.499	0.83	5.21	4.84	46.8815	33.48
	11/15/2016	4:21:46 PM	72.9167	56.73	-14.488	29.824	-36.2	2.499	0.83	5.21	4.85	46.9657	34.31
	11/15/2016	4:23:51 PM	75	56.74	-14.494	29.827	-36.5	2.499	0.83	5.22	4.81	46.5426	35.13
	11/15/2016	4:25:56 PM	77.0833	56.74	-14.5	29.825	-37.2	2.473	0.85	5.22	4.8	46.4306	37.4
	11/15/2016	4:28:01 PM	79.1667	56.8	-14.361	29.825	-33.7	2.499	0.83	5.22	4.8	46.5278	39.57
	11/15/2016	4:30:06 PM	81.25	56.88	-14.271	29.829	-27	2.499	0.93	5.24	4.72	45.7462	37.09
	11/15/2016	4:32:11 PM	83.3333	56.85	-14.252	29.826	-29.6	2.473	0.82	5.27	4.79	46.48	37.45
	11/15/2016	4:34:16 PM	85.4167	56.81	-14.423	29.819	-31.2	2.473	0.83	5.28	4.79	46.4352	37.68
	11/15/2016	4:36:21 PM	87.5	56.85	-14.455	29.818	-30.5	2.473	0.84	5.28	4.76	46.1674	36.18
	11/15/2016	4:38:26 PM	89.5833	56.87	-14.454	29.82	-32.1	2.525	0.85	5.3	4.76	46.1912	42.99
	11/15/2016	4:40:31 PM	91.6667	56.92	-14.454	29.821	-30.1	2.473	0.87	5.29	4.71	45.7379	43.3
	11/15/2016	4:42:36 PM	93.75	56.93	-14.435	29.82	-30	2.499	0.94	5.3	4.68	45.4637	48.75
	11/15/2016	4:44:41 PM	95.8333	57	-14.308	29.82	-31.6	2.499	0.9	5.35	4.73	45.9076	50.45
	11/15/2016	4:46:46 PM	97.9167	56.94	-14.327	29.821	-23.6	2.499	0.94	5.41	4.71	45.6732	45.8
	11/15/2016	4:48:51 PM	100	56.88	-14.333	29.824	-26.7	2.499	0.83	5.45	4.74	45.9415	41.81
	11/15/2016	4:50:56 PM	102.0833	56.82	-14.454	29.827	-31	2.525	0.83	5.5	4.74	45.9191	37.43
	11/15/2016	4:53:01 PM	104.1667	56.85	-14.498	29.823	-34.1	2.525	0.82	5.53	4.72	45.7771	37.61
	11/15/2016	4:55:06 PM	106.25	56.9	-14.448	29.824	-36.6	2.499	0.82	5.51	4.68	45.4362	46.01
	11/15/2016	4:57:11 PM	108.3333	56.99	-14.415	29.823	-31.6	2.499	0.81	5.56	4.74	46.0078	50.75
	11/15/2016	4:59:16 PM	110.4167	57.01	-14.402	29.823	-32.1	2.499	0.91	5.68	4.6	44.7014	52.88
	11/15/2016	5:01:21 PM	112.5	57	-14.396	29.821	-31.9	2.499	0.92	5.75	4.66	45.2605	52.73
	11/15/2016	5:03:26 PM	114.5833	56.81	-14.693	29.818	-30.8	2.499	0.84	5.73	4.77	46.2118	38.35
	11/15/2016	5:05:31 PM	116.6667	56.91	-14.44	29.819	-28.1	2.473	0.83	5.69	4.75	46.143	51.1

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B1010C

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/17/2016	7:50:50 AM	0	56.64	-20.81	29.915	5804.7	2.551	1.14	5	28.84	278.0184	55.84
11/17/2016	7:51:20 AM	0.5	56.7	-20.831	29.913	4994.9	2.525	1.12	5.03	28.33	273.3173	54.54
11/17/2016	7:51:50 AM	1	56.71	-20.847	29.913	4173.9	2.551	1.08	5.04	27.97	269.8662	54.74
11/17/2016	7:52:20 AM	1.5	56.71	-20.863	29.911	3467.9	2.551	1.07	5.06	27.6	266.3861	54.9
11/17/2016	7:52:50 AM	2	56.73	-20.881	29.909	3291.6	2.525	1.23	5.08	26.46	255.3889	54.79
11/17/2016	7:53:20 AM	2.5	56.72	-20.899	29.91	3652.1	2.525	1.24	5.09	26.16	252.4559	54.57
11/17/2016	7:53:50 AM	3	56.7	-20.904	29.909	3495.3	2.551	1.09	5.09	26.5	255.714	54.43
11/17/2016	7:54:20 AM	3.5	56.72	-20.916	29.91	3474.1	2.551	1.07	5.1	26.25	253.3801	54.45
11/17/2016	7:54:50 AM	4	56.72	-20.922	29.91	3093.6	2.551	1.05	5.1	25.93	250.2754	54.26
11/17/2016	7:55:20 AM	4.5	56.72	-20.935	29.909	2813.5	2.551	1.04	5.11	25.61	247.1366	54.39
11/17/2016	7:55:50 AM	5	56.72	-20.941	29.907	2449.4	2.551	1.04	5.12	25.11	242.4246	54.69
11/17/2016	7:56:20 AM	5.5	56.74	-20.947	29.909	2314.2	2.525	1.03	5.12	24.64	237.8947	54.61
11/17/2016	7:56:50 AM	6	56.75	-19.368	29.907	1702.7	2.525	1.01	5.11	24.24	234.086	50.68
11/17/2016	7:57:20 AM	6.5	56.75	-19.387	29.906	1576.8	2.525	1.01	5.12	23.91	230.8279	49.93
11/17/2016	7:57:50 AM	7	56.74	-19.374	29.908	865.1	2.551	1.03	5.13	23.36	225.5238	49.67
11/17/2016	7:58:20 AM	7.5	56.76	-19.374	29.907	607.6	2.525	1.02	5.13	22.88	220.9839	49.82
11/17/2016	7:58:50 AM	8	56.76	-19.387	29.908	615.5	2.551	1.02	5.13	22.32	215.5617	49.82
11/17/2016	7:59:20 AM	8.5	56.77	-19.4	29.908	518.7	2.551	1.01	5.13	21.88	211.3499	49.82
11/17/2016	7:59:50 AM	9	56.76	-19.419	29.908	557	2.551	1.01	5.13	21.61	208.6984	49.77
11/17/2016	8:00:20 AM	9.5	56.76	-19.431	29.907	378.5	2.525	1	5.13	21.44	207.0064	49.78
11/17/2016	8:00:50 AM	10	56.77	-19.444	29.908	391.7	2.551	1.01	5.13	21.24	205.1375	49.69
11/17/2016	8:01:20 AM	10.5	56.76	-19.463	29.907	268.2	2.551	1.01	5.13	21.17	204.4409	49.55
11/17/2016	8:01:50 AM	11	56.75	-19.469	29.908	183.2	2.525	1.01	5.13	21.08	203.564	49.67
11/17/2016	8:02:20 AM	11.5	56.76	-19.482	29.907	140.3	2.551	1.01	5.14	20.94	202.1779	49.82
11/17/2016	8:02:50 AM	12	56.76	-19.488	29.906	81.7	2.551	1.01	5.14	20.81	200.9452	50.03
11/17/2016	8:03:20 AM	12.5	56.75	-19.494	29.908	56.9	2.525	1.01	5.14	20.71	199.9353	49.81
11/17/2016	8:03:50 AM	13	56.75	-17.455	29.905	319.3	2.525	0.98	5.12	20.72	200.1227	49.65
11/17/2016	8:04:20 AM	13.5	56.74	-17.468	29.904	279.8	2.525	0.99	5.14	20.61	199.015	49.78
11/17/2016	8:04:50 AM	14	56.75	-17.48	29.905	312.5	2.551	0.99	5.14	20.5	197.9654	49.75
11/17/2016	8:05:20 AM	14.5	56.76	-17.493	29.905	321.9	2.551	0.99	5.14	20.41	197.135	49.65
11/17/2016	8:05:50 AM	15	56.76	-17.468	29.904	243.8	2.525	0.99	5.15	20.33	196.331	49.72
11/17/2016	8:06:20 AM	15.5	56.76	-17.43	29.905	159.9	2.525	0.99	5.15	20.2	195.0847	49.73
11/17/2016	8:06:50 AM	16	56.76	-17.373	29.904	122.2	2.551	0.99	5.15	19.84	191.664	49.77
11/17/2016	8:07:20 AM	16.5	56.76	-17.253	29.905	80.7	2.525	0.99	5.15	19.7	190.2608	49.78
11/17/2016	8:07:50 AM	17	56.76	-17.164	29.906	62.9	2.525	0.99	5.15	19.62	189.499	49.45
11/17/2016	8:08:20 AM	17.5	56.76	-17.101	29.907	60.8	2.551	1	5.16	19.54	188.716	49.28
11/17/2016	8:08:50 AM	18	56.79	-14.43	29.903	807.8	2.499	0.98	5.14	19.59	189.2408	48.23
11/17/2016	8:09:20 AM	18.5	56.81	-14.341	29.902	717.4	2.525	0.98	5.17	19.6	189.4245	48.78
11/17/2016	8:09:50 AM	19	56.8	-14.322	29.903	663.6	2.525	0.99	5.17	19.43	187.7577	48.84
11/17/2016	8:10:20 AM	19.5	56.81	-14.297	29.902	587.5	2.551	1	5.17	19.33	186.8282	48.69
11/17/2016	8:10:50 AM	20	56.8	-14.284	29.902	580.6	2.499	0.99	5.18	19.43	187.7226	48.77
11/17/2016	8:11:20 AM	20.5	56.81	-14.278	29.904	546.2	2.551	0.99	5.18	19.34	186.8522	48.72
11/17/2016	8:11:50 AM	21	56.82	-14.258	29.904	518.8	2.551	0.99	5.18	19.27	186.2758	48.76
11/17/2016	8:12:20 AM	21.5	56.8	-14.239	29.904	479.4	2.551	1.01	5.18	19.18	185.2916	48.87
11/17/2016	8:12:50 AM	22	56.81	-14.239	29.903	479.7	2.525	0.99	5.18	19.21	185.6388	48.94

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B1020C

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/17/2016	8:42:31 AM	0	57.11	-15.863	29.91	205.9	2.499	0.86	5.78	24.79	240.4302	63.5
11/17/2016	8:43:01 AM	0.5	57.11	-15.865	29.91	228.1	2.499	0.86	5.82	23.95	232.2759	64.53
11/17/2016	8:43:31 AM	1	57.11	-15.866	29.911	254.3	2.473	0.85	5.86	23.32	226.1342	65.17
11/17/2016	8:44:01 AM	1.5	57.11	-15.866	29.91	234.3	2.499	0.85	5.89	22.85	221.5703	65.9
11/17/2016	8:44:31 AM	2	57.11	-15.86	29.91	241.3	2.473	0.85	5.91	22.49	218.1317	66.16
11/17/2016	8:45:01 AM	2.5	57.11	-15.866	29.911	231.3	2.525	0.85	5.93	22.2	215.2355	66.22
11/17/2016	8:45:31 AM	3	57.11	-15.86	29.911	218.6	2.473	0.85	5.95	21.94	212.725	66.27
11/17/2016	8:46:01 AM	3.5	57.09	-15.861	29.91	217.9	2.499	0.85	5.97	21.73	210.7137	66.41
11/17/2016	8:46:31 AM	4	57.1	-15.861	29.911	202.3	2.499	0.85	5.98	21.55	208.9939	66.58
11/17/2016	8:47:01 AM	4.5	57.1	-15.861	29.912	199.4	2.525	0.85	5.99	21.38	207.2843	66.76
11/17/2016	8:47:31 AM	5	57.09	-15.854	29.913	180.7	2.473	0.85	6	21.26	206.1024	67.54
11/17/2016	8:48:01 AM	5.5	57.09	-15.855	29.913	182.3	2.473	0.85	6.01	21.14	204.9759	68.09
11/17/2016	8:48:31 AM	6	57.26	-13.738	29.912	2859	2.499	0.85	5.96	21.32	207.1178	58.86
11/17/2016	8:49:01 AM	6.5	57.25	-13.743	29.912	2617.8	2.525	0.86	5.87	21.13	205.3089	58.99
11/17/2016	8:49:31 AM	7	57.24	-13.743	29.912	2528.1	2.473	0.86	5.81	21.3	206.8425	59.09
11/17/2016	8:50:01 AM	7.5	57.25	-13.743	29.913	2410.1	2.525	0.87	5.76	21.21	206.0397	59.17
11/17/2016	8:50:31 AM	8	57.26	-13.742	29.913	2331	2.499	0.86	5.72	21.18	205.7637	59.35
11/17/2016	8:51:01 AM	8.5	57.23	-13.742	29.913	2272.3	2.525	0.87	5.7	21.14	205.2763	59.51
11/17/2016	8:51:31 AM	9	57.24	-13.742	29.914	2214.4	2.525	0.87	5.68	21.06	204.4945	59.39
11/17/2016	8:52:01 AM	9.5	57.24	-13.742	29.915	2147.7	2.525	0.88	5.66	20.94	203.3458	59.57
11/17/2016	8:52:31 AM	10	57.23	-13.742	29.912	2092.4	2.499	0.86	5.65	20.96	203.5633	59.56
11/17/2016	8:53:01 AM	10.5	57.23	-13.742	29.915	2037.6	2.499	0.87	5.64	20.88	202.7807	59.17
11/17/2016	8:53:31 AM	11	57.46	-11.19	29.911	1975.3	2.525	0.83	5.61	21.05	205.016	57.24
11/17/2016	8:54:01 AM	11.5	57.46	-11.169	29.911	1722.6	2.473	0.86	5.6	20.93	203.8597	57.46
11/17/2016	8:54:31 AM	12	57.45	-11.175	29.911	1667.4	2.499	0.85	5.58	20.9	203.5532	57.52
11/17/2016	8:55:01 AM	12.5	57.46	-11.174	29.912	1703.6	2.525	0.85	5.57	20.82	202.7877	57.47
11/17/2016	8:55:31 AM	13	57.44	-11.173	29.913	1592.7	2.525	0.85	5.56	20.75	202.0394	57.61
11/17/2016	8:56:01 AM	13.5	57.45	-11.173	29.911	1571.5	2.525	0.85	5.56	20.68	201.3432	57.68
11/17/2016	8:56:31 AM	14	57.45	-11.173	29.911	1505.6	2.473	0.86	5.55	20.57	200.3064	57.63
11/17/2016	8:57:01 AM	14.5	57.44	-11.173	29.913	1424.3	2.499	0.86	5.55	20.53	199.8625	57.57
11/17/2016	8:57:31 AM	15	57.44	-11.173	29.914	1409.8	2.525	0.86	5.55	20.41	198.7308	57.5
11/17/2016	8:58:01 AM	15.5	57.44	-11.173	29.913	1373.1	2.525	0.88	5.54	20.24	197.0618	57.37
11/17/2016	8:58:31 AM	16	57.44	-9.005	29.911	1945.7	2.473	0.81	5.49	20.74	201.965	56.65
11/17/2016	8:59:01 AM	16.5	57.59	-8.998	29.911	1753.1	2.499	0.86	5.52	20.43	199.3114	56.49
11/17/2016	8:59:31 AM	17	57.58	-8.997	29.911	1662.9	2.525	0.86	5.52	20.3	198.0057	56.74
11/17/2016	9:00:01 AM	17.5	57.58	-8.996	29.91	1564	2.525	0.87	5.52	20.21	197.0781	56.69
11/17/2016	9:00:31 AM	18	57.58	-8.996	29.91	1525.5	2.525	0.87	5.52	20.11	196.127	56.76
11/17/2016	9:01:01 AM	18.5	57.58	-8.996	29.912	1455.7	2.499	0.87	5.52	19.99	194.9697	56.67
11/17/2016	9:01:31 AM	19	57.58	-8.996	29.911	1396.3	2.473	0.87	5.52	19.84	193.5364	56.72

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B1020B

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/17/2016	8:16:46 AM	0	56.5	-30.93	29.927	-46.3	2.499	0.81	6.15	21.31	204.9554	64.4
11/17/2016	8:17:16 AM	0.5	56.5	-30.95	29.927	-46.5	2.525	0.79	6.25	20.94	201.4316	64.54
11/17/2016	8:17:46 AM	1	56.51	-30.969	29.929	-44.9	2.551	0.8	6.33	20.39	196.155	65.01
11/17/2016	8:18:16 AM	1.5	56.5	-30.988	29.928	-44.1	2.499	0.81	6.39	19.99	192.2837	64.9
11/17/2016	8:18:46 AM	2	56.51	-31.014	29.928	-44.5	2.499	0.8	6.45	19.77	190.2124	64.84
11/17/2016	8:19:16 AM	2.5	56.5	-31.02	29.928	-46.6	2.525	0.81	6.49	19.53	187.8806	64.57
11/17/2016	8:19:46 AM	3	56.51	-31.02	29.928	-45.1	2.525	0.81	6.53	19.28	185.4994	64.69
11/17/2016	8:20:16 AM	3.5	56.52	-31.027	29.928	-43.9	2.499	0.84	6.57	18.83	181.146	64.65
11/17/2016	8:20:46 AM	4	56.51	-31.027	29.928	-43.2	2.499	0.82	6.6	18.67	179.6372	64.75
11/17/2016	8:21:16 AM	4.5	56.51	-31.033	29.929	-42.8	2.499	0.83	6.63	18.47	177.6907	64.84
11/17/2016	8:21:46 AM	5	56.51	-31.033	29.928	-42.9	2.525	0.82	6.66	18.38	176.8545	64.93
11/17/2016	8:22:16 AM	5.5	56.5	-31.04	29.928	-42.8	2.525	0.82	6.69	18.36	176.6591	64.97
11/17/2016	8:22:46 AM	6	56.51	-31.046	29.927	-45.8	2.525	0.82	6.71	17.86	171.8459	64.97
11/17/2016	8:23:16 AM	6.5	56.51	-31.059	29.929	-43.8	2.525	0.82	6.73	17.6	169.3282	64.99
11/17/2016	8:23:46 AM	7	56.54	-28.843	29.927	2935.9	2.525	0.82	6.78	17.63	169.7284	72.3
11/17/2016	8:24:16 AM	7.5	56.53	-28.843	29.927	5131.9	2.525	0.83	6.66	17.54	168.8203	73.72
11/17/2016	8:24:46 AM	8	56.53	-28.856	29.927	5730.2	2.525	0.84	6.56	17.48	168.2075	74.43
11/17/2016	8:25:16 AM	8.5	56.54	-28.868	29.927	5960.8	2.525	0.84	6.48	17.74	170.8004	75.13
11/17/2016	8:25:46 AM	9	56.55	-28.874	29.926	5898.1	2.525	0.84	6.42	17.87	172.0417	74.85
11/17/2016	8:26:16 AM	9.5	56.55	-28.881	29.926	5172.6	2.525	0.84	6.36	17.9	172.3231	74.88
11/17/2016	8:26:46 AM	10	56.55	-28.881	29.927	4837.2	2.525	0.84	6.31	17.87	171.9975	75.1
11/17/2016	8:27:16 AM	10.5	56.53	-28.887	29.925	4109	2.499	0.84	6.27	17.84	171.7519	75.87
11/17/2016	8:27:46 AM	11	56.53	-28.893	29.925	3393.2	2.525	0.84	6.22	17.85	171.7486	76.15
11/17/2016	8:28:16 AM	11.5	56.55	-28.887	29.925	2910.7	2.525	0.83	6.19	17.86	171.9736	75.92
11/17/2016	8:28:46 AM	12	56.53	-28.893	29.924	2418.1	2.525	0.83	6.16	17.87	171.9881	80.49
11/17/2016	8:29:16 AM	12.5	56.54	-28.887	29.925	2089.3	2.525	0.83	6.12	17.82	171.5606	80.43
11/17/2016	8:29:46 AM	13	56.54	-28.899	29.925	2465.3	2.551	0.83	6.08	17.79	171.2195	80.55
11/17/2016	8:30:16 AM	13.5	56.56	-26.583	29.922	3296.9	2.525	0.84	6.02	17.82	171.6353	75.58
11/17/2016	8:30:46 AM	14	56.57	-26.576	29.922	3288.9	2.499	0.84	5.92	17.83	171.7515	76.01
11/17/2016	8:31:16 AM	14.5	56.58	-26.576	29.921	3195.7	2.525	0.85	5.85	17.78	171.3044	76.23
11/17/2016	8:31:46 AM	15	56.57	-26.576	29.923	2989.8	2.499	0.84	5.79	17.78	171.2429	76.53
11/17/2016	8:32:16 AM	15.5	56.57	-26.589	29.923	2760.9	2.525	0.84	5.75	17.8	171.389	76.75
11/17/2016	8:32:46 AM	16	56.58	-26.589	29.923	2617.8	2.525	0.84	5.71	17.76	171.0901	76.55
11/17/2016	8:33:16 AM	16.5	56.57	-26.589	29.922	2363.3	2.499	0.85	5.68	17.69	170.3886	77.11
11/17/2016	8:33:46 AM	17	56.57	-26.589	29.922	2192.7	2.499	0.85	5.65	17.67	170.1797	77.1
11/17/2016	8:34:16 AM	17.5	56.6	-24.215	29.921	2257.7	2.499	0.8	5.6	17.89	172.3702	73.15
11/17/2016	8:34:46 AM	18	56.6	-24.177	29.92	2085.4	2.473	0.84	5.54	17.8	171.5259	73.34
11/17/2016	8:35:16 AM	18.5	56.6	-24.177	29.918	1831.7	2.525	0.84	5.5	17.77	171.1816	73.38
11/17/2016	8:35:46 AM	19	56.6	-24.176	29.919	1699.6	2.499	0.84	5.47	17.73	170.8211	73.74
11/17/2016	8:36:16 AM	19.5	56.61	-24.176	29.917	1579.9	2.499	0.84	5.45	17.73	170.8324	74.19
11/17/2016	8:36:46 AM	20	56.6	-24.176	29.919	1504.8	2.525	0.85	5.44	17.68	170.4011	74.43
11/17/2016	8:37:16 AM	20.5	56.6	-24.176	29.918	1396.6	2.525	0.88	5.43	17.56	169.2291	74.56
11/17/2016	8:37:46 AM	21	56.61	-24.17	29.917	1349.3	2.499	0.85	5.41	17.64	170.0346	75.3
11/17/2016	8:38:16 AM	21.5	56.61	-24.119	29.918	1259.3	2.525	0.85	5.41	17.63	169.9007	75.05
11/17/2016	8:38:46 AM	22	56.61	-24.018	29.918	1127	2.499	0.86	5.4	17.6	169.6495	73.01

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2010C

				Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
				Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
	Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
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Back	11/15/2016	9:15:39 AM	0	57.56	-19.75	30.044	1473.4	2.577	0.8	5.64	4.09	39.7409	41.9
Back +5	11/15/2016	9:19:50 AM	0	57.68	-14.497	30.038	463	2.603	0.81	5.53	3.97	38.5774	40.29
Back +10	11/15/2016	9:23:21 AM	0	58.21	-9.639	30.033	38.1	2.629	0.81	5.51	3.58	34.9957	39.86
Inject	11/15/2016	11:17:43 AM	0	57.37	-20.695	29.971	1115.4	2.655	0.83	5.65	3.2	31.058	31.66
	11/15/2016	11:27:26 AM	0	57.38	-21.143	29.956	1123.4	2.629	0.84	5.66	3.19	31.0071	31.34
	11/15/2016	11:36:27 AM	0	57.37	-20.941	29.954	1123.3	2.603	0.83	5.68	3.17	30.827	31.34
	11/15/2016	12:02:20 PM	0	57.57	-22.1	29.946	-26.2	2.629	0.8	5.38	3.71	36.1326	34.63
	11/15/2016	12:04:42 PM	0	57.59	-22.675	29.947	-47.1	2.655	0.79	5.37	3.68	35.838	33.06
	11/15/2016	12:25:31 PM	0	57.61	-21.271	29.936	-29.2	2.655	0.81	5.38	3.64	35.4976	35.16
	11/15/2016	12:42:42 PM	0	57.63	-21.138	29.921	-31.1	2.629	0.81	5.38	3.62	35.3474	35.32
	11/15/2016	12:49:49 PM	0	57.64	-21.22	29.917	-40.1	2.655	0.82	5.37	3.67	35.7808	34.12
	11/16/2016	9:12:54 AM	0	57.41	-20.464	29.739	2634.1	2.525	0.92	6.77	35.01	342.7446	49.61
	11/16/2016	9:13:09 AM	0.25	57.42	-20.473	29.736	1613.9	2.551	0.89	6.66	34.62	338.9577	49.54
	11/16/2016	9:13:24 AM	0.5	57.44	-20.478	29.736	313.7	2.551	0.88	6.57	34.25	335.4586	50.02
	11/16/2016	9:13:39 AM	0.75	57.45	-20.476	29.735	440.5	2.499	0.9	6.49	33.88	331.8255	50.56
	11/16/2016	9:13:54 AM	1	57.44	-20.455	29.735	486.4	2.473	0.89	6.41	33.6	329.0922	50.97
	11/16/2016	9:14:09 AM	1.25	57.42	-20.429	29.733	504.1	2.473	0.88	6.34	33.45	327.5922	51.21
	11/16/2016	9:14:24 AM	1.5	57.42	-20.428	29.734	513.3	2.499	0.89	6.28	33.22	325.3031	51.06
	11/16/2016	9:14:39 AM	1.75	57.41	-20.433	29.732	518.2	2.473	0.88	6.22	33.26	325.7247	50.82
	11/16/2016	9:14:54 AM	2	57.41	-20.432	29.732	521.7	2.473	0.88	6.16	33.03	323.4811	50.9
	11/16/2016	9:15:09 AM	2.25	57.41	-20.437	29.732	526.1	2.473	0.88	6.12	32.77	320.8785	50.83
	11/16/2016	9:15:24 AM	2.5	57.41	-20.443	29.734	529.4	2.473	0.89	6.08	32.57	318.9265	50.43
	11/16/2016	9:15:39 AM	2.75	57.39	-20.449	29.733	529.6	2.473	0.88	6.05	32.5	318.1116	50.23
	11/16/2016	9:15:54 AM	3	57.38	-20.473	29.73	531	2.473	0.88	6.01	32.05	313.7099	49.5
	11/16/2016	9:16:09 AM	3.25	57.38	-20.486	29.73	530.6	2.473	0.9	5.98	31.84	311.6922	49.12
	11/16/2016	9:16:24 AM	3.5	57.4	-20.542	29.732	528.5	2.473	0.9	5.96	31.48	308.2428	48.64
	11/16/2016	9:16:39 AM	3.75	57.38	-20.51	29.731	530.7	2.473	0.93	5.93	31.14	304.7969	48.11
	11/16/2016	9:16:54 AM	4	57.38	-20.504	29.73	535.6	2.473	0.93	5.91	30.85	301.945	47.72
	11/16/2016	9:17:09 AM	4.25	57.39	-20.478	29.731	538.6	2.473	0.93	5.89	30.58	299.3734	47.25
	11/16/2016	9:17:24 AM	4.5	57.38	-20.44	29.732	540.1	2.499	0.93	5.87	30.3	296.569	47.2
	11/16/2016	9:17:39 AM	4.75	57.38	-20.402	29.732	543.2	2.473	0.94	5.86	29.95	293.1806	46.97
	11/16/2016	9:17:54 AM	5	57.38	-20.37	29.731	546	2.499	0.94	5.85	29.7	290.7253	46.65
	11/16/2016	9:18:09 AM	5.25	57.39	-20.345	29.732	550.9	2.473	0.94	5.84	29.47	288.5414	46.52
	11/16/2016	9:18:24 AM	5.5	57.46	-17.938	29.727	4853.6	2.447	0.85	5.82	29.45	288.6039	48.61
	11/16/2016	9:18:39 AM	5.75	57.52	-15.214	29.727	2611.6	2.473	0.85	5.77	29.35	287.8409	48.39
	11/16/2016	9:18:54 AM	6	57.51	-15.163	29.727	2771.6	2.447	0.86	5.73	29.15	285.8516	47.76
	11/16/2016	9:19:09 AM	6.25	57.5	-15.15	29.728	2514.4	2.499	0.87	5.7	28.95	283.8487	47.67
	11/16/2016	9:19:24 AM	6.5	57.51	-15.131	29.728	2370.3	2.499	0.91	5.68	28.56	280.0742	47.25
	11/16/2016	9:19:39 AM	6.75	57.5	-15.118	29.728	2339.9	2.473	0.88	5.66	28.47	279.1141	47.2
	11/16/2016	9:19:54 AM	7	57.5	-15.124	29.727	2265.6	2.447	0.88	5.64	28.11	275.6344	46.96
	11/16/2016	9:20:09 AM	7.25	57.51	-15.118	29.727	2203.8	2.473	0.88	5.63	27.73	271.8665	46.81
	11/16/2016	9:20:24 AM	7.5	57.5	-15.111	29.725	2139.3	2.473	0.89	5.61	27.38	268.501	46.6
	11/16/2016	9:20:39 AM	7.75	57.5	-15.105	29.727	2094.2	2.473	0.88	5.6	27.21	266.7584	46.24
	11/16/2016	9:20:54 AM	8	57.5	-15.098	29.726	2003.2	2.499	0.91	5.59	26.95	264.2502	45.87
	11/16/2016	9:21:09 AM	8.25	57.52	-15.092	29.726	1961.2	2.499	0.88	5.58	26.89	263.6685	45.63
	11/16/2016	9:21:24 AM	8.5	57.51	-15.085	29.726	1926.7	2.499	0.89	5.57	26.69	261.7379	45.5
	11/16/2016	9:21:39 AM	8.75	57.51	-15.085	29.726	1821.6	2.473	0.88	5.56	26.6	260.8866	45.35
	11/16/2016	9:21:54 AM	9	57.51	-15.073	29.726	1738.5	2.473	0.88	5.55	26.64	261.2135	44.97
	11/16/2016	9:22:09 AM	9.25	57.5	-15.06	29.726	1701.4	2.473	0.89	5.55	26.54	260.238	44.71
	11/16/2016	9:22:24 AM	9.5	57.52	-15.053	29.724	1601.5	2.473	0.89	5.54	26.62	261.0773	44.48
	11/16/2016	9:22:39 AM	9.75	57.53	-15.053	29.722	1529.5	2.447	0.89	5.53	26.49	259.8628	44.33
	11/16/2016	9:22:54 AM	10	57.54	-15.053	29.723	1476.5	2.473	0.89	5.53	26.52	260.1216	43.91
	11/16/2016	9:23:09 AM	10.25	57.54	-15.047	29.725	1067.5	2.473	0.89	5.52	26.65	261.4743	43.69
	11/16/2016	9:23:24 AM	10.5	57.55	-15.04	29.725	1167.8	2.473	0.9	5.52	26.66	261.5811	43.37
	11/16/2016	9:23:39 AM	10.75	57.56	-15.04	29.725	1039.7	2.499	0.88	5.51	26.1	256.1047	43.08
	11/16/2016	9:23:54 AM	11	57.57	-15.039	29.725	949.4	2.473	0.89	5.51	25.9	254.1533	42.79

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2010C

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/16/2016	9:24:09 AM	11.25	57.57	-15.033	29.725	931.5	2.473	0.88	5.51	25.77	252.9232	42.38
11/16/2016	9:24:24 AM	11.5	57.56	-15.032	29.724	848.8	2.499	0.88	5.5	25.66	251.7816	42.14
11/16/2016	9:24:39 AM	11.75	57.58	-15.026	29.725	746.1	2.499	0.89	5.5	25.45	249.7922	42.07
11/16/2016	9:24:54 AM	12	57.56	-15.051	29.723	725.6	2.473	0.89	5.5	25.36	248.8774	41.75
11/16/2016	9:25:09 AM	12.25	57.56	-15.089	29.723	688.1	2.473	0.88	5.49	25.26	247.8871	41.65
11/16/2016	9:25:24 AM	12.5	57.57	-15.133	29.724	742.8	2.499	0.9	5.49	25.05	245.8431	41.26
11/16/2016	9:25:39 AM	12.75	57.56	-15.171	29.724	762.1	2.499	0.91	5.49	24.75	242.8673	40.95
11/16/2016	9:25:54 AM	13	57.55	-15.203	29.723	752	2.473	0.87	5.48	24.69	242.2201	40.75
11/16/2016	9:26:09 AM	13.25	57.55	-15.235	29.724	803.7	2.499	0.87	5.48	24.43	239.6929	40.66
11/16/2016	9:26:24 AM	13.5	57.54	-15.26	29.721	862.4	2.525	0.89	5.48	24.18	237.2604	40.26
11/16/2016	9:26:39 AM	13.75	57.54	-15.286	29.722	1199.2	2.525	0.88	5.47	24.16	236.9707	39.96
11/16/2016	9:26:54 AM	14	57.53	-15.311	29.722	1285.2	2.499	0.88	5.47	28.39	278.4823	39.52
11/16/2016	9:27:09 AM	14.25	57.53	-15.324	29.722	1471.2	2.525	0.88	5.47	27.17	266.505	39.25
11/16/2016	9:27:24 AM	14.5	57.52	-15.343	29.722	1420.4	2.499	0.95	5.47	26.39	258.8398	38.76
11/16/2016	9:27:39 AM	14.75	57.52	-15.363	29.72	1490.6	2.499	0.96	5.46	25.99	254.9257	38.52
11/16/2016	9:27:54 AM	15	57.52	-15.382	29.722	1628	2.499	0.87	5.46	25.78	252.8244	38.35
11/16/2016	9:28:09 AM	15.25	57.51	-15.388	29.722	1533.9	2.551	0.91	5.46	25.39	248.9981	37.85
11/16/2016	9:28:24 AM	15.5	57.51	-15.401	29.723	1244.8	2.551	0.89	5.46	25.34	248.4883	37.87
11/16/2016	9:28:39 AM	15.75	57.52	-15.408	29.722	1310.2	2.525	0.88	5.45	25.12	246.3482	37.66
11/16/2016	9:28:54 AM	16	57.51	-15.421	29.722	1307.9	2.499	0.88	5.45	25.01	245.2254	37.38
11/16/2016	9:29:09 AM	16.25	57.5	-15.427	29.722	1791.1	2.551	0.87	5.45	24.98	244.9946	37.3
11/16/2016	9:29:24 AM	16.5	57.5	-15.434	29.722	1844.5	2.551	0.87	5.45	24.81	243.2316	37.12
11/16/2016	9:29:39 AM	16.75	57.48	-15.44	29.723	3869.6	2.525	0.87	5.44	24.76	242.7615	37.94
11/16/2016	9:29:54 AM	17	57.46	-15.447	29.722	3593.4	2.551	0.87	5.44	24.56	240.7159	38.84
11/16/2016	9:30:09 AM	17.25	57.48	-15.453	29.722	3995.1	2.525	0.87	5.44	24.43	239.496	39.65
11/16/2016	9:30:24 AM	17.5	57.47	-15.453	29.721	4185.9	2.551	0.87	5.44	24.29	238.1319	39.81
11/16/2016	9:30:39 AM	17.75	57.47	-15.46	29.722	4148.8	2.551	0.87	5.43	24.16	236.8111	39.98
11/16/2016	9:30:54 AM	18	57.47	-15.46	29.722	4166.1	2.525	0.86	5.43	24.07	235.9787	40.06
11/16/2016	9:31:09 AM	18.25	57.47	-15.466	29.722	4062.2	2.525	0.87	5.43	24.39	239.0508	40.3
11/16/2016	9:31:24 AM	18.5	57.46	-15.467	29.722	4042.3	2.499	0.88	5.43	24.46	239.7239	40.36
11/16/2016	9:31:39 AM	18.75	57.47	-15.467	29.722	3691.5	2.499	0.88	5.43	24.34	238.5973	40.47
11/16/2016	9:31:54 AM	19	57.47	-15.467	29.722	3760	2.499	0.87	5.42	24.27	237.9155	40.65
11/16/2016	9:32:09 AM	19.25	57.46	-15.467	29.722	3581.5	2.525	0.89	5.42	23.98	235.0271	40.61
11/16/2016	9:32:24 AM	19.5	57.47	-15.473	29.721	3430.8	2.551	0.88	5.42	23.84	233.636	40.86
11/16/2016	9:32:39 AM	19.75	57.47	-15.473	29.722	3366.3	2.525	0.96	5.43	23.41	229.4585	40.47
11/16/2016	9:32:54 AM	20	57.46	-15.473	29.721	3178.5	2.525	0.88	5.42	23.54	230.7304	40.87
11/16/2016	9:33:09 AM	20.25	57.46	-15.454	29.72	3039.8	2.525	0.89	5.42	23.45	229.8835	40.36
11/16/2016	9:33:24 AM	20.5	57.47	-15.422	29.721	2427.8	2.499	0.88	5.42	23.36	228.9589	40.22
11/16/2016	9:33:39 AM	20.75	57.46	-15.378	29.72	3049.9	2.525	0.89	5.42	23.23	227.7103	40.79
11/16/2016	9:33:54 AM	21	57.47	-15.34	29.72	2836.5	2.525	0.88	5.42	23.16	227.0261	39.72
11/16/2016	9:34:09 AM	21.25	57.47	-15.308	29.72	2721.2	2.525	0.88	5.42	23.06	226.0956	39.15
11/16/2016	9:34:24 AM	21.5	57.47	-15.289	29.719	2478.2	2.525	0.89	5.42	22.96	225.0991	38.58
11/16/2016	9:34:39 AM	21.75	57.47	-15.264	29.721	2260.3	2.499	0.88	5.42	22.85	223.953	38.46
11/16/2016	9:34:54 AM	22	57.46	-15.239	29.72	2050	2.525	0.88	5.42	22.71	222.5888	38.23
11/16/2016	9:35:09 AM	22.25	57.46	-15.22	29.719	1811	2.525	0.96	5.42	22.23	217.9125	37.97
11/16/2016	9:35:24 AM	22.5	57.46	-15.201	29.72	1612.1	2.525	0.91	5.41	22.34	218.9778	37.78
11/16/2016	9:35:39 AM	22.75	57.47	-15.182	29.72	1554.7	2.499	0.88	5.41	22.25	218.0873	37.67
11/16/2016	9:35:54 AM	23	57.47	-15.169	29.719	1450	2.525	0.88	5.41	22.02	215.8596	37.55
11/16/2016	9:36:09 AM	23.25	57.47	-15.15	29.72	1308	2.525	0.87	5.41	21.87	214.3668	37.28
11/16/2016	9:36:24 AM	23.5	57.47	-15.138	29.719	1382.8	2.499	0.88	5.41	21.71	212.8541	37.01
11/16/2016	9:36:39 AM	23.75	57.48	-15.131	29.719	1355.1	2.551	0.88	5.41	21.71	212.879	36.91
11/16/2016	9:36:54 AM	24	57.48	-15.125	29.719	1328.9	2.525	0.88	5.41	21.7	212.7517	36.75
11/16/2016	9:37:09 AM	24.25	57.47	-15.112	29.72	1241.1	2.551	0.89	5.41	21.3	208.8125	36.59
11/16/2016	9:37:24 AM	24.5	57.48	-15.099	29.72	1228.9	2.499	0.88	5.41	21.15	207.3704	36.52
11/16/2016	9:37:39 AM	24.75	57.48	-15.093	29.721	1128.2	2.499	0.88	5.41	21.03	206.1428	36.47
11/16/2016	9:37:54 AM	25	57.48	-15.087	29.72	1079.9	2.499	0.88	5.41	20.85	204.3653	36.46
11/16/2016	9:38:09 AM	25.25	57.48	-15.087	29.719	1011.5	2.551	0.88	5.41	20.65	202.441	36.19
11/16/2016	9:38:24 AM	25.5	57.48	-15.08	29.72	960.2	2.551	0.88	5.41	20.5	200.973	36.09

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2010C

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/16/2016	9:38:39 AM	25.75	57.49	-15.074	29.719	894	2.525	0.88	5.41	20.41	200.137	35.92
11/16/2016	9:38:54 AM	26	57.48	-15.067	29.718	833	2.499	0.88	5.41	20.41	200.087	35.91
11/16/2016	9:39:09 AM	26.25	57.48	-15.067	29.718	728.1	2.525	0.88	5.41	20.47	200.7151	35.86
11/16/2016	9:39:24 AM	26.5	57.49	-15.061	29.719	652.9	2.499	0.88	5.41	20.41	200.0867	35.86
11/16/2016	9:39:39 AM	26.75	57.49	-15.054	29.72	619.8	2.551	0.88	5.41	20.3	199.0682	35.82
11/16/2016	9:39:54 AM	27	57.5	-15.054	29.721	569.2	2.551	0.88	5.41	20.15	197.582	35.69
11/16/2016	9:40:09 AM	27.25	57.5	-15.054	29.72	479.3	2.525	0.88	5.41	20.04	196.5419	35.74
11/16/2016	9:40:24 AM	27.5	57.72	-12.508	29.718	1394.2	2.525	0.84	5.39	20.09	197.5584	35.89
11/16/2016	9:40:39 AM	27.75	57.75	-12.438	29.717	1586.5	2.525	0.87	5.41	19.89	195.6994	35.45
11/16/2016	9:40:54 AM	28	57.74	-12.411	29.718	1636	2.525	0.87	5.41	19.77	194.4485	35.27
11/16/2016	9:41:09 AM	28.25	57.76	-12.41	29.719	1476.5	2.499	0.88	5.42	19.66	193.3865	35.19
11/16/2016	9:41:24 AM	28.5	57.77	-12.41	29.719	1419.9	2.499	0.89	5.42	19.47	191.5666	35.06
11/16/2016	9:41:39 AM	28.75	57.76	-12.41	29.719	1391.4	2.525	0.88	5.42	19.58	192.6052	35.11
11/16/2016	9:41:54 AM	29	57.76	-12.41	29.72	1352.4	2.525	0.88	5.42	19.49	191.7076	35.05
11/16/2016	9:42:09 AM	29.25	57.76	-12.409	29.721	1329.3	2.499	0.89	5.43	19.38	190.646	34.95
11/16/2016	9:42:24 AM	29.5	57.77	-12.408	29.722	1299.1	2.525	0.88	5.43	19.41	190.9161	34.86
11/16/2016	9:42:39 AM	29.75	57.78	-12.409	29.721	1308.2	2.525	0.88	5.43	19.4	190.8353	34.83
11/16/2016	9:42:54 AM	30	57.77	-12.409	29.72	1262.1	2.525	0.88	5.43	19.45	191.3741	34.77
11/16/2016	9:43:09 AM	30.25	57.77	-12.408	29.72	1257.8	2.499	0.89	5.43	19.48	191.6255	34.75
11/16/2016	9:43:24 AM	30.5	57.77	-12.408	29.72	1244	2.499	0.88	5.43	19.62	193.0476	34.78
11/16/2016	9:43:39 AM	30.75	57.76	-12.427	29.721	1234.7	2.499	0.88	5.43	19.59	192.7357	34.71
11/16/2016	9:43:54 AM	31	57.75	-12.503	29.721	1182	2.499	0.88	5.43	19.59	192.7238	34.67
11/16/2016	9:44:09 AM	31.25	57.77	-12.496	29.722	1248.3	2.499	0.88	5.43	19.55	192.3138	34.48
11/16/2016	9:44:24 AM	31.5	57.77	-12.522	29.722	1239.9	2.525	0.88	5.43	19.51	191.912	34.45
11/16/2016	9:44:39 AM	31.75	57.76	-12.54	29.721	1210.6	2.525	0.88	5.43	19.48	191.6685	34.33
11/16/2016	9:44:54 AM	32	57.76	-12.559	29.721	1226.8	2.499	0.88	5.43	19.47	191.559	34.24
11/16/2016	9:45:09 AM	32.25	57.76	-12.572	29.721	1197.1	2.525	0.88	5.43	19.46	191.4472	33.94
11/16/2016	9:45:24 AM	32.5	57.75	-12.585	29.72	1203.8	2.499	0.88	5.43	19.45	191.2878	33.87
11/16/2016	9:45:39 AM	32.75	57.74	-12.591	29.721	1219.9	2.499	0.88	5.43	19.41	190.9328	33.83
11/16/2016	9:45:54 AM	33	57.75	-12.603	29.722	1189.1	2.499	0.88	5.43	19.41	190.9257	33.72
11/16/2016	9:46:09 AM	33.25	57.75	-12.61	29.722	1167.7	2.525	0.88	5.43	19.49	191.6768	33.66
11/16/2016	9:46:24 AM	33.5	57.75	-12.616	29.721	1141.5	2.499	0.89	5.43	19.49	191.741	33.54
11/16/2016	9:46:39 AM	33.75	57.74	-12.629	29.721	1123	2.499	0.88	5.43	19.56	192.3622	33.4
11/16/2016	9:46:54 AM	34	57.74	-12.641	29.722	1088.4	2.499	0.88	5.43	19.54	192.1333	33.47
11/16/2016	9:47:09 AM	34.25	57.73	-12.648	29.722	1101.6	2.525	0.88	5.43	19.85	195.1384	33.4
11/16/2016	9:47:24 AM	34.5	57.72	-12.654	29.72	1078.2	2.499	0.88	5.43	19.53	192.0508	33.35
11/16/2016	9:47:39 AM	34.75	57.72	-12.66	29.72	1060.3	2.525	0.88	5.43	19.51	191.8378	33.26
11/16/2016	9:47:54 AM	35	57.73	-12.667	29.72	1056.1	2.499	0.88	5.43	19.47	191.4404	33.21
11/16/2016	9:48:09 AM	35.25	57.73	-12.673	29.72	1036.8	2.525	0.88	5.43	19.38	190.562	33.34
11/16/2016	9:48:24 AM	35.5	57.72	-12.68	29.721	1023.7	2.499	0.88	5.43	19.33	190.0818	33.23
11/16/2016	9:48:39 AM	35.75	57.85	-11.289	29.72	668.6	2.525	0.83	5.41	19.32	190.3092	33.19
11/16/2016	9:48:54 AM	36	58.08	-10.385	29.72	453.2	2.499	0.84	5.41	19.06	188.2381	33.18
11/16/2016	9:49:09 AM	36.25	58.11	-10.231	29.72	503.9	2.473	0.88	5.42	18.69	184.5999	33.17
11/16/2016	9:49:24 AM	36.5	58.11	-10.236	29.719	458.9	2.499	0.88	5.43	18.51	182.8936	33.27
11/16/2016	9:49:39 AM	36.75	58.1	-10.242	29.718	454.8	2.473	0.88	5.44	18.35	181.2427	33.36
11/16/2016	9:49:54 AM	37	58.1	-10.247	29.718	385.6	2.525	0.89	5.44	18.14	179.1494	33.47
11/16/2016	9:50:09 AM	37.25	58.1	-10.247	29.717	425	2.525	0.88	5.44	17.91	176.9023	33.56
11/16/2016	9:50:24 AM	37.5	58.1	-10.246	29.718	371.7	2.525	0.88	5.44	17.69	174.7766	33.68
11/16/2016	9:50:39 AM	37.75	58.1	-10.252	29.717	339.8	2.525	0.88	5.44	17.53	173.1977	33.76
11/16/2016	9:50:54 AM	38	58.1	-10.252	29.717	318.2	2.525	0.88	5.44	17.35	171.393	33.86
11/16/2016	9:51:09 AM	38.25	58.11	-10.258	29.717	350.2	2.525	0.89	5.44	17.25	170.3986	33.79
11/16/2016	9:51:24 AM	38.5	58.1	-10.258	29.717	330.8	2.499	0.89	5.44	17.12	169.0838	33.82
11/16/2016	9:51:39 AM	38.75	58.1	-10.232	29.717	313.2	2.499	0.89	5.44	17.14	169.3507	33.77
11/16/2016	9:51:54 AM	39	58.09	-10.207	29.718	343.2	2.525	0.89	5.45	16.98	167.7268	33.78
11/16/2016	9:52:09 AM	39.25	58.09	-10.181	29.719	335.9	2.499	0.89	5.45	16.92	167.0674	33.7
11/16/2016	9:52:24 AM	39.5	58.08	-10.168	29.718	332.4	2.525	0.89	5.45	16.84	166.3053	33.77
11/16/2016	9:52:39 AM	39.75	58.09	-10.155	29.719	320.3	2.499	0.89	5.45	16.82	166.1234	33.7
11/16/2016	9:52:54 AM	40	58.08	-10.136	29.719	321	2.525	0.89	5.45	16.71	165.0281	33.64

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2010C

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			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/16/2016	9:53:09 AM	40.25	58.1	-10.117	29.718	318.8	2.525	0.89	5.45	16.63	164.3196	33.57
11/16/2016	9:53:24 AM	40.5	58.11	-10.104	29.717	317	2.473	0.89	5.45	16.57	163.7024	33.62
11/16/2016	9:53:39 AM	40.75	58.09	-10.091	29.718	310.9	2.499	0.9	5.45	16.51	163.1063	33.55
11/16/2016	9:53:54 AM	41	58.12	-10.078	29.718	303.9	2.499	0.9	5.45	16.57	163.6929	33.57
11/16/2016	9:54:09 AM	41.25	58.12	-10.066	29.718	299.6	2.525	0.9	5.45	16.43	162.3812	33.54
11/16/2016	9:54:24 AM	41.5	58.11	-10.059	29.718	296.2	2.525	0.9	5.45	16.37	161.7601	33.59
11/16/2016	9:54:39 AM	41.75	58.13	-10.046	29.718	289.4	2.473	0.9	5.45	16.36	161.6559	33.55
11/16/2016	9:54:54 AM	42	58.13	-10.04	29.718	283.9	2.525	0.9	5.45	16.32	161.2316	33.57
11/16/2016	9:55:09 AM	42.25	58.13	-10.033	29.716	278.5	2.499	0.9	5.45	16.27	160.802	33.61
11/16/2016	9:55:24 AM	42.5	58.15	-10.027	29.716	270.8	2.525	0.9	5.45	16.44	162.5293	33.51
11/16/2016	9:55:39 AM	42.75	58.14	-10.014	29.717	258.7	2.525	0.91	5.45	17.64	174.359	33.57
11/16/2016	9:55:54 AM	43	58.14	-10.001	29.716	244	2.525	0.9	5.45	17.7	174.9157	33.6
11/16/2016	9:56:09 AM	43.25	58.15	-10.001	29.716	237.1	2.473	0.91	5.45	17.63	174.2389	33.63
11/16/2016	9:56:24 AM	43.5	58.15	-9.994	29.718	212.7	2.525	0.91	5.45	17.64	174.325	33.67
11/16/2016	9:56:39 AM	43.75	58.15	-9.988	29.718	202.2	2.525	0.91	5.45	17.7	174.9438	33.68
11/16/2016	9:56:54 AM	44	58.16	-9.988	29.717	189.6	2.525	0.91	5.45	17.79	175.8503	33.67
11/16/2016	9:57:09 AM	44.25	58.15	-9.981	29.717	185.2	2.473	0.91	5.45	17.75	175.4407	33.7
11/16/2016	9:57:24 AM	44.5	58.15	-9.975	29.717	181.2	2.525	0.91	5.45	17.68	174.7831	33.63
11/16/2016	9:57:39 AM	44.75	58.17	-9.975	29.717	174.9	2.499	0.91	5.45	17.61	174.1501	33.65
11/16/2016	9:57:54 AM	45	58.16	-9.968	29.718	170.5	2.499	0.91	5.45	17.59	173.9218	33.69
11/16/2016	9:58:09 AM	45.25	58.17	-9.969	29.719	169.4	2.499	0.91	5.45	17.59	173.9515	33.72
11/16/2016	9:58:24 AM	45.5	58.17	-9.962	29.719	167	2.499	0.91	5.45	17.5	172.9996	33.75
11/16/2016	9:58:39 AM	45.75	58.16	-9.987	29.718	180.9	2.525	0.9	5.45	17.37	171.7642	33.88
11/16/2016	9:58:54 AM	46	58.16	-10.019	29.718	243.6	2.525	0.91	5.45	17.26	170.6591	33.88
11/16/2016	9:59:09 AM	46.25	58.15	-10.051	29.718	272.7	2.473	0.91	5.45	17.05	168.5433	33.83
11/16/2016	9:59:24 AM	46.5	58.13	-10.07	29.718	260.3	2.525	0.89	5.45	16.78	165.8015	33.96
11/16/2016	9:59:39 AM	46.75	58.13	-10.089	29.718	181.9	2.499	0.89	5.45	16.66	164.6399	33.89
11/16/2016	9:59:54 AM	47	58.12	-10.108	29.718	200.3	2.499	0.89	5.45	16.71	165.1048	33.88
11/16/2016	10:00:09 AM	47.25	58.12	-10.127	29.717	237.2	2.499	0.92	5.45	16.47	162.7321	33.89
11/16/2016	10:00:24 AM	47.5	58.11	-10.134	29.716	222.2	2.499	0.89	5.45	16.47	162.702	33.86
11/16/2016	10:00:39 AM	47.75	58.12	-10.141	29.718	219.1	2.499	0.89	5.45	16.29	160.931	33.86
11/16/2016	10:00:54 AM	48	58.13	-10.147	29.717	224	2.473	0.9	5.45	16.11	159.215	33.9
11/16/2016	10:01:09 AM	48.25	58.12	-10.153	29.717	230.6	2.499	0.9	5.45	15.99	158.0424	33.93
11/16/2016	10:01:24 AM	48.5	58.11	-10.16	29.717	233.5	2.499	0.9	5.45	15.92	157.31	33.93
11/16/2016	10:01:39 AM	48.75	58.11	-10.173	29.717	236.7	2.499	0.9	5.45	15.87	156.8309	34
11/16/2016	10:01:54 AM	49	58.12	-10.173	29.715	242.3	2.499	0.9	5.45	15.82	156.3599	33.99
11/16/2016	10:02:09 AM	49.25	58.1	-10.179	29.718	247	2.499	0.9	5.45	15.81	156.2092	33.98
11/16/2016	10:02:24 AM	49.5	58.12	-10.185	29.718	248.6	2.525	0.9	5.45	15.77	155.8003	34.05
11/16/2016	10:02:39 AM	49.75	58.11	-10.185	29.718	249.8	2.499	0.9	5.45	15.73	155.418	34
11/16/2016	10:02:54 AM	50	58.12	-10.198	29.719	254.6	2.473	0.9	5.45	15.88	156.909	34.07
11/16/2016	10:03:09 AM	50.25	58.11	-10.205	29.717	260.1	2.525	0.9	5.45	15.88	156.9474	34.05
11/16/2016	10:03:24 AM	50.5	58.12	-10.223	29.717	261.1	2.525	0.9	5.45	15.75	155.5848	34.04
11/16/2016	10:03:39 AM	50.75	58.12	-10.23	29.718	254	2.525	0.9	5.45	15.71	155.2656	34.11
11/16/2016	10:03:54 AM	51	58.12	-10.236	29.717	256.2	2.499	0.9	5.45	15.67	154.8828	34.04
11/16/2016	10:04:09 AM	51.25	58.12	-10.243	29.716	259.7	2.525	0.9	5.45	15.69	155.0188	34.1
11/17/2016	9:11:04 AM	0	57.57	-20.254	29.925	652.8	2.499	0.86	5.47	15.44	150.5151	67.14
11/17/2016	9:11:34 AM	0.5	57.58	-20.241	29.926	650.2	2.473	0.85	5.46	15.32	149.3554	67.13
11/17/2016	9:12:04 AM	1	57.57	-20.304	29.927	1036.8	2.499	0.85	5.44	14.9	145.1962	67
11/17/2016	9:12:34 AM	1.5	57.58	-20.463	29.926	1133.8	2.473	0.85	5.43	14.6	142.3382	66.96
11/17/2016	9:13:04 AM	2	57.57	-20.538	29.926	1258	2.525	0.85	5.43	14.4	140.3331	66.85
11/17/2016	9:13:34 AM	2.5	57.58	-20.639	29.924	1612.6	2.525	0.84	5.42	14.15	137.9971	66.82
11/17/2016	9:14:04 AM	3	57.58	-20.728	29.925	1814.1	2.473	0.84	5.42	13.99	136.4001	66.89
11/17/2016	9:14:34 AM	3.5	57.59	-20.804	29.925	1657.6	2.499	0.84	5.41	13.86	135.1015	66.74
11/17/2016	9:15:04 AM	4	57.57	-20.873	29.926	2177.3	2.499	0.84	5.41	13.77	134.228	66.48
11/17/2016	9:15:34 AM	4.5	57.61	-18.776	29.923	2499.8	2.499	0.84	5.39	13.61	132.7777	66.85
11/17/2016	9:16:04 AM	5	57.62	-18.851	29.923	1522.4	2.499	0.85	5.4	13.51	131.791	67.11
11/17/2016	9:16:34 AM	5.5	57.6	-18.908	29.923	1054.8	2.525	0.86	5.4	13.46	131.2849	67.41

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2010C

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			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/17/2016	9:17:04 AM	6	57.6	-18.946	29.924	863.9	2.525	0.86	5.4	13.41	130.793	67.4
11/17/2016	9:17:34 AM	6.5	57.61	-18.984	29.923	961.8	2.525	0.85	5.4	13.41	130.7738	67.45
11/17/2016	9:18:04 AM	7	57.61	-19.009	29.924	837.8	2.499	0.85	5.4	13.38	130.4888	67.81
11/17/2016	9:18:34 AM	7.5	57.6	-19.041	29.924	648	2.525	0.86	5.4	13.31	129.7519	67.88
11/17/2016	9:19:04 AM	8	57.61	-19.072	29.923	525.8	2.499	0.86	5.4	13.28	129.5416	67.87
11/17/2016	9:19:34 AM	8.5	57.6	-19.097	29.921	486	2.499	0.86	5.4	13.26	129.3336	68
11/17/2016	9:20:04 AM	9	57.6	-19.129	29.923	375.8	2.525	0.85	5.4	13.27	129.4045	68.02
11/17/2016	9:20:34 AM	9.5	57.61	-19.148	29.923	325.7	2.499	0.85	5.4	13.24	129.1083	68.13
11/17/2016	9:21:04 AM	10	57.62	-17.126	29.921	760	2.499	0.82	5.38	13.24	129.1667	66.96
11/17/2016	9:21:34 AM	10.5	57.61	-17.164	29.919	388.3	2.525	0.85	5.39	13.18	128.5963	67.25
11/17/2016	9:22:04 AM	11	57.62	-17.202	29.919	254	2.499	0.86	5.4	13.15	128.279	67.07
11/17/2016	9:22:34 AM	11.5	57.62	-17.24	29.921	210.6	2.499	0.86	5.4	13.14	128.1712	66.95
11/17/2016	9:23:04 AM	12	57.63	-17.29	29.919	109.6	2.499	0.86	5.4	13.12	128.0435	66.66
11/17/2016	9:23:34 AM	12.5	57.63	-17.341	29.917	130.8	2.499	0.86	5.4	13.1	127.8269	66.24
11/17/2016	9:24:04 AM	13	57.63	-17.391	29.919	76.6	2.499	0.86	5.4	13.06	127.4458	65.89
11/17/2016	9:24:34 AM	13.5	57.63	-17.429	29.921	47.9	2.525	0.86	5.4	13.04	127.2028	65.83
11/17/2016	9:25:04 AM	14	57.64	-17.467	29.919	31.8	2.525	0.86	5.4	13.03	127.1588	65.91
11/17/2016	9:25:34 AM	14.5	57.65	-15.287	29.917	1617.9	2.499	0.8	5.36	13.05	127.3492	66.52
11/17/2016	9:26:04 AM	15	57.66	-15.186	29.917	3000.4	2.499	0.84	5.38	12.92	126.0759	66.78
11/17/2016	9:26:34 AM	15.5	57.66	-15.217	29.918	2995.6	2.525	0.85	5.39	12.86	125.4874	66.99
11/17/2016	9:27:04 AM	16	57.67	-15.236	29.916	2565.2	2.499	0.85	5.39	12.84	125.3952	67.28
11/17/2016	9:27:34 AM	16.5	57.68	-15.255	29.917	2070.8	2.499	0.86	5.39	12.81	125.0737	67.03
11/17/2016	9:28:04 AM	17	57.67	-15.274	29.917	1650.1	2.525	0.86	5.39	12.81	125.0542	66.62
11/17/2016	9:28:34 AM	17.5	57.68	-15.299	29.915	1121.9	2.525	0.86	5.39	12.75	124.4547	66.24
11/17/2016	9:29:04 AM	18	57.68	-15.324	29.918	917.8	2.499	0.86	5.39	12.76	124.5401	66.2
11/17/2016	9:29:34 AM	18.5	57.68	-15.349	29.918	797.1	2.525	0.86	5.39	12.74	124.4052	66.2
11/17/2016	9:30:04 AM	19	57.68	-15.362	29.919	665.4	2.525	0.86	5.39	12.71	124.1048	66.02

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2020C

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/16/2016	10:08:04 AM	0	58.22	-13.811	29.725	95.9	2.499	0.89	5.39	21.52	212.8297	26.09
11/16/2016	10:08:34 AM	0.5	58.22	-13.808	29.723	85.6	2.499	0.9	5.37	20.19	199.6617	26.84
11/16/2016	10:09:04 AM	1	58.22	-13.816	29.722	88.9	2.473	0.9	5.36	19.8	195.8283	27.32
11/16/2016	10:09:34 AM	1.5	58.22	-13.817	29.721	67.2	2.473	0.9	5.35	19.28	190.7438	27.51
11/16/2016	10:10:04 AM	2	58.22	-13.818	29.722	117.4	2.473	0.9	5.35	18.84	186.35	27.76
11/16/2016	10:10:34 AM	2.5	58.21	-13.819	29.723	144.8	2.499	0.89	5.34	18.51	183.0219	27.84
11/16/2016	10:11:04 AM	3	58.21	-13.819	29.722	164	2.499	0.89	5.34	18.28	180.7579	27.93
11/16/2016	10:11:34 AM	3.5	58.22	-13.82	29.721	224.9	2.473	0.89	5.34	18.06	178.6651	28.03
11/16/2016	10:12:04 AM	4	58.24	-13.814	29.722	209.2	2.473	0.9	5.34	17.82	176.335	27.94
11/16/2016	10:12:34 AM	4.5	58.22	-13.821	29.721	243.6	2.499	0.91	5.33	17.59	174.0125	27.81
11/16/2016	10:13:04 AM	5	58.21	-13.821	29.721	263.6	2.473	0.9	5.33	17.3	171.0594	27.97
11/16/2016	10:13:34 AM	5.5	58.22	-13.821	29.721	285.1	2.473	0.9	5.33	17.26	170.7178	27.99
11/16/2016	10:14:04 AM	6	58.21	-13.822	29.719	307.5	2.499	0.9	5.33	17.19	170.0209	28.02
11/16/2016	10:14:34 AM	6.5	58.21	-13.816	29.72	359.4	2.473	0.9	5.33	17.14	169.5733	28.07
11/16/2016	10:15:04 AM	7	58.21	-13.822	29.722	365.9	2.525	0.9	5.33	17.04	168.4832	28.1
11/16/2016	10:15:34 AM	7.5	58.22	-13.816	29.722	429.6	2.525	0.9	5.33	16.96	167.7982	28.08
11/16/2016	10:16:04 AM	8	58.21	-13.815	29.722	582.6	2.499	0.9	5.33	16.91	167.2142	28.03
11/16/2016	10:16:34 AM	8.5	58.21	-13.822	29.723	547.6	2.499	0.9	5.32	16.83	166.4608	28.08
11/16/2016	10:17:04 AM	9	58.2	-13.822	29.723	655	2.525	0.9	5.32	16.8	166.1049	28.04
11/16/2016	10:17:34 AM	9.5	58.2	-13.822	29.723	738.9	2.473	0.9	5.32	16.72	165.3311	28.06
11/16/2016	10:18:04 AM	10	58.21	-13.822	29.725	703.6	2.525	0.9	5.32	16.67	164.8787	28.07
11/16/2016	10:18:34 AM	10.5	58.19	-13.822	29.725	791.3	2.499	0.9	5.32	16.65	164.6311	28.08
11/16/2016	10:19:04 AM	11	58.2	-13.829	29.722	838.7	2.499	0.9	5.32	16.57	163.8434	28.12
11/16/2016	10:19:34 AM	11.5	58.2	-13.828	29.723	859.2	2.499	0.9	5.32	16.53	163.4341	28.05
11/16/2016	10:20:04 AM	12	58.05	-15.238	29.725	-29.2	2.499	0.89	5.31	16.21	159.9926	27.84
11/16/2016	10:20:34 AM	12.5	58.22	-12.937	29.723	3628.3	2.499	0.89	5.3	16.32	161.4153	29.71
11/16/2016	10:21:04 AM	13	58.23	-12.936	29.722	3475	2.499	0.9	5.3	16.21	160.3315	31.09
11/16/2016	10:21:34 AM	13.5	58.21	-12.942	29.722	3190.4	2.499	0.91	5.3	16.17	159.8857	31.33
11/16/2016	10:22:04 AM	14	58.21	-12.942	29.723	2824.1	2.499	0.9	5.3	16.14	159.6044	30.02
11/16/2016	10:22:34 AM	14.5	58.23	-12.948	29.718	2507.8	2.499	0.9	5.3	16.08	159.093	28.83
11/16/2016	10:23:04 AM	15	58.23	-12.947	29.721	2166.2	2.525	0.9	5.3	16.02	158.469	28.31
11/16/2016	10:23:34 AM	15.5	58.23	-12.947	29.72	2037.2	2.499	0.91	5.3	15.99	158.1768	28.01
11/16/2016	10:24:04 AM	16	58.24	-12.947	29.721	1820.2	2.473	0.9	5.3	15.99	158.1587	27.87
11/16/2016	10:24:34 AM	16.5	58.23	-12.947	29.722	1712.4	2.525	0.91	5.3	15.93	157.6252	27.82
11/16/2016	10:25:04 AM	17	58.23	-12.947	29.723	1532.2	2.525	0.91	5.3	15.87	157.0113	27.72
11/16/2016	10:25:34 AM	17.5	58.23	-12.946	29.72	1567.1	2.525	0.91	5.3	15.83	156.6622	27.79
11/16/2016	10:26:04 AM	18	58.22	-12.953	29.719	1424.8	2.525	0.91	5.3	15.83	156.5656	27.78
11/16/2016	10:26:34 AM	18.5	58.22	-12.953	29.719	1284.1	2.525	0.91	5.3	15.8	156.2764	27.73
11/16/2016	10:27:04 AM	19	58.2	-12.947	29.719	1357.6	2.525	0.91	5.3	15.8	156.2659	27.86
11/16/2016	10:27:34 AM	19.5	58.22	-12.947	29.719	1206.6	2.499	0.91	5.3	15.74	155.7101	27.84
11/16/2016	10:28:04 AM	20	58.2	-12.953	29.718	1159.9	2.525	0.91	5.3	15.8	156.2756	27.85
11/16/2016	10:28:34 AM	20.5	58.21	-12.953	29.717	1158.5	2.525	0.92	5.3	15.65	154.8349	27.76
11/16/2016	10:29:04 AM	21	58.22	-12.953	29.718	1156.3	2.499	0.91	5.3	15.67	154.9892	27.81
11/16/2016	10:29:34 AM	21.5	58.22	-12.953	29.718	1109.6	2.525	0.91	5.3	15.63	154.5997	27.79
11/16/2016	10:30:04 AM	22	58.21	-12.953	29.718	1015.8	2.525	0.91	5.3	15.61	154.4233	27.8
11/16/2016	10:30:34 AM	22.5	58.22	-12.953	29.719	1010.2	2.525	0.91	5.3	15.58	154.1506	27.74
11/16/2016	10:31:04 AM	23	58.22	-13.257	29.717	2277.6	2.499	0.86	5.29	15.76	155.8736	27.49
11/16/2016	10:31:34 AM	23.5	58.36	-10.721	29.715	2312.5	2.499	0.91	5.29	15.69	155.5401	27.33
11/16/2016	10:32:04 AM	24	58.35	-10.72	29.715	2102.6	2.499	0.91	5.29	15.67	155.2674	27.17
11/16/2016	10:32:34 AM	24.5	58.36	-10.72	29.716	1931.6	2.473	0.92	5.3	15.56	154.1753	27.17
11/16/2016	10:33:04 AM	25	58.36	-10.719	29.714	1744.7	2.499	0.92	5.3	15.51	153.7069	27.3
11/16/2016	10:33:34 AM	25.5	58.37	-10.719	29.712	1555.1	2.499	0.93	5.3	15.47	153.3351	27.35
11/16/2016	10:34:04 AM	26	58.38	-10.718	29.714	1251.5	2.499	0.92	5.3	15.47	153.3679	27.33
11/16/2016	10:34:34 AM	26.5	58.38	-10.725	29.714	1082.9	2.499	0.92	5.29	15.47	153.3215	27.55
11/16/2016	10:35:04 AM	27	58.38	-10.718	29.715	945	2.499	0.92	5.29	15.4	152.6584	27.64
11/16/2016	10:35:34 AM	27.5	58.38	-10.724	29.714	819.6	2.499	0.92	5.29	15.41	152.7328	27.73
11/16/2016	10:36:04 AM	28	58.38	-10.724	29.715	833.1	2.525	0.92	5.3	15.4	152.6247	27.78
11/16/2016	10:36:34 AM	28.5	58.37	-10.724	29.714	748	2.499	0.93	5.3	15.36	152.2253	27.93
11/16/2016	10:37:04 AM	29	58.37	-10.724	29.712	745.7	2.525	0.93	5.29	15.35	152.163	28.07
11/16/2016	10:37:34 AM	29.5	58.38	-10.73	29.713	644.4	2.499	0.93	5.29	15.32	151.8943	28.12
11/16/2016	10:38:04 AM	30	58.37	-10.73	29.712	635.5	2.499	0.93	5.29	15.3	151.6162	28.26

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2020C

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/16/2016	10:38:34 AM	30.5	58.37	-10.731	29.713	530	2.499	0.93	5.29	15.26	151.2263	28.28
11/16/2016	10:39:04 AM	31	58.38	-10.731	29.714	465	2.499	0.93	5.29	15.27	151.3968	28.4
11/16/2016	10:39:34 AM	31.5	58.37	-10.731	29.714	478.7	2.525	0.93	5.29	15.29	151.5752	28.52
11/16/2016	10:40:04 AM	32	58.61	-8.353	29.709	1087.8	2.499	0.9	5.27	15.59	154.956	27.66
11/16/2016	10:40:34 AM	32.5	58.62	-8.345	29.71	1064.1	2.499	0.92	5.28	15.51	154.2386	27.47
11/16/2016	10:41:04 AM	33	58.6	-8.344	29.71	1020.2	2.525	0.93	5.28	15.47	153.7455	27.48
11/16/2016	10:41:34 AM	33.5	58.59	-8.343	29.71	999.2	2.525	0.93	5.28	15.41	153.1914	27.54
11/16/2016	10:42:04 AM	34	58.6	-8.336	29.71	959.3	2.525	0.93	5.28	15.41	153.2314	27.6
11/16/2016	10:42:34 AM	34.5	58.6	-8.342	29.711	923.4	2.499	0.93	5.28	15.37	152.8248	27.71
11/16/2016	10:43:04 AM	35	58.59	-8.335	29.711	884.1	2.499	0.93	5.28	15.34	152.4198	27.77
11/16/2016	10:43:34 AM	35.5	58.59	-8.335	29.713	850	2.499	0.93	5.28	15.32	152.2833	27.84
11/16/2016	10:44:04 AM	36	58.59	-8.335	29.71	815.6	2.499	0.94	5.28	15.27	151.7572	28.22
11/16/2016	10:44:34 AM	36.5	58.59	-8.341	29.709	787.7	2.525	0.94	5.28	15.24	151.5222	28.42
11/16/2016	10:45:04 AM	37	58.58	-8.335	29.71	763.5	2.525	0.94	5.28	15.24	151.4762	28.45
11/16/2016	10:45:34 AM	37.5	58.58	-8.334	29.711	736.5	2.525	0.94	5.28	15.19	150.9372	28.47
11/16/2016	10:46:04 AM	38	58.59	-8.341	29.71	697.2	2.525	0.94	5.28	15.16	150.6562	28.47
11/16/2016	10:46:34 AM	38.5	58.59	-8.347	29.705	673.1	2.551	0.94	5.28	15.13	150.4564	28.44
11/16/2016	10:47:04 AM	39	58.6	-8.334	29.708	654.8	2.525	0.94	5.28	15.08	149.8711	28.43
11/16/2016	10:47:34 AM	39.5	58.6	-8.334	29.709	618.3	2.551	0.94	5.28	15.05	149.5859	28.44
11/16/2016	10:48:04 AM	40	58.94	-5.741	29.701	480.4	2.499	0.92	5.27	16.62	165.9406	28.05
11/16/2016	10:48:34 AM	40.5	58.9	-5.732	29.707	356.7	2.525	0.93	5.28	16.84	168.0568	28.16
11/16/2016	10:49:04 AM	41	58.9	-5.73	29.705	348.4	2.525	0.93	5.28	16.99	169.498	28.35
11/16/2016	10:49:34 AM	41.5	58.89	-5.729	29.704	342.2	2.499	0.94	5.28	16.95	169.1379	28.59
11/16/2016	10:50:04 AM	42	58.92	-5.729	29.706	343.9	2.525	0.94	5.28	16.96	169.2913	28.63
11/16/2016	10:50:34 AM	42.5	58.92	-5.728	29.706	339.9	2.525	0.94	5.28	16.94	169.0611	28.81
11/16/2016	10:51:04 AM	43	58.92	-5.728	29.706	348.1	2.551	0.94	5.28	16.93	168.9579	28.98
11/16/2016	10:51:34 AM	43.5	58.93	-5.728	29.706	341.2	2.499	0.94	5.28	16.92	168.8799	29.15
11/16/2016	10:52:04 AM	44	58.93	-5.727	29.703	331.4	2.499	0.94	5.28	16.89	168.6308	29.35
11/17/2016	9:33:28 AM	0	58.04	-15.313	29.919	92	2.525	0.83	5.33	13.42	131.5605	48.72
11/17/2016	9:33:58 AM	0.5	58.01	-15.307	29.92	17.4	2.551	0.83	5.33	13.39	131.2271	49.04
11/17/2016	9:34:28 AM	1	58.02	-15.314	29.92	46.5	2.551	0.83	5.32	13.31	130.4779	49.41
11/17/2016	9:34:58 AM	1.5	58.02	-15.308	29.92	36.2	2.551	0.84	5.32	13.26	129.9883	49.63
11/17/2016	9:35:28 AM	2	58	-15.308	29.919	40	2.525	0.84	5.32	13.23	129.6523	49.77
11/17/2016	9:35:58 AM	2.5	57.99	-15.308	29.921	54.8	2.525	0.84	5.32	13.24	129.7632	49.89
11/17/2016	9:36:28 AM	3	57.98	-15.302	29.92	88.8	2.525	0.85	5.32	13.24	129.7037	49.52
11/17/2016	9:36:58 AM	3.5	58.19	-13.343	29.92	4674.2	2.551	0.85	5.31	13.12	128.8903	48.91
11/17/2016	9:37:28 AM	4	58.18	-13.349	29.921	3569.1	2.525	0.86	5.32	13.15	129.1263	49.37
11/17/2016	9:37:58 AM	4.5	58.2	-13.348	29.921	2664.6	2.525	0.85	5.32	13.16	129.315	49.19
11/17/2016	9:38:28 AM	5	58.2	-13.347	29.922	2238.2	2.525	0.85	5.32	13.15	129.2054	49.08
11/17/2016	9:38:58 AM	5.5	58.19	-13.347	29.921	1555.1	2.551	0.85	5.31	13.14	129.0556	49.18
11/17/2016	9:39:28 AM	6	58.18	-13.347	29.922	1368.7	2.525	0.85	5.31	13.07	128.3428	49.24
11/17/2016	9:39:58 AM	6.5	58.18	-13.347	29.922	1319.1	2.551	0.85	5.31	13.05	128.1678	49.26
11/17/2016	9:40:28 AM	7	58.18	-13.347	29.921	1273.3	2.551	0.85	5.31	13.06	128.2479	49.32
11/17/2016	9:40:58 AM	7.5	58.18	-13.347	29.922	1355.2	2.551	0.85	5.31	13.06	128.2186	49.23
11/17/2016	9:41:28 AM	8	58.18	-13.145	29.921	1965.2	2.551	0.8	5.29	13.11	128.7156	48.44
11/17/2016	9:41:58 AM	8.5	58.33	-10.893	29.921	2513.5	2.551	0.84	5.29	13.03	128.2078	48.46
11/17/2016	9:42:28 AM	9	58.32	-10.898	29.921	2198.9	2.525	0.85	5.29	13.05	128.4244	48.49
11/17/2016	9:42:58 AM	9.5	58.33	-10.898	29.92	1894	2.551	0.85	5.29	13.04	128.2944	48.56
11/17/2016	9:43:28 AM	10	58.32	-10.891	29.921	1681.1	2.525	0.85	5.29	13.05	128.3839	48.62
11/17/2016	9:43:58 AM	10.5	58.32	-10.891	29.92	1501.7	2.525	0.85	5.29	13.04	128.2916	48.66
11/17/2016	9:44:28 AM	11	58.33	-10.89	29.921	1340.8	2.525	0.85	5.29	13.04	128.3378	48.97
11/17/2016	9:44:58 AM	11.5	58.32	-10.89	29.92	1277.2	2.525	0.85	5.29	13.02	128.1246	49.09
11/17/2016	9:45:28 AM	12	58.33	-10.884	29.92	1226.2	2.525	0.85	5.29	13.01	127.9781	49.17
11/17/2016	9:45:58 AM	12.5	58.34	-10.89	29.92	1041.2	2.551	0.85	5.29	12.99	127.7707	49.11
11/17/2016	9:46:28 AM	13	58.48	-8.633	29.918	2302.3	2.551	0.81	5.27	13.01	128.2625	47.92
11/17/2016	9:46:58 AM	13.5	58.54	-8.537	29.918	1938.2	2.525	0.85	5.28	12.95	127.7852	48.3
11/17/2016	9:47:28 AM	14	58.54	-8.536	29.919	1797.7	2.551	0.85	5.28	12.93	127.5607	48.46
11/17/2016	9:47:58 AM	14.5	58.53	-8.535	29.919	1745.6	2.551	0.85	5.28	12.9	127.264	48.55
11/17/2016	9:48:28 AM	15	58.54	-8.534	29.919	1655.4	2.525	0.85	5.28	12.89	127.1476	48.46
11/17/2016	9:48:58 AM	15.5	58.53	-8.534	29.918	1567.5	2.551	0.86	5.28	12.91	127.3596	48.51
11/17/2016	9:49:28 AM	16	58.53	-8.534	29.92	1488.9	2.551	0.86	5.28	12.89	127.1191	48.71

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2020C

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/17/2016	9:49:58 AM	16.5	58.52	-8.54	29.919	1428.3	2.551	0.86	5.28	12.88	127.014	48.83
11/17/2016	9:50:28 AM	17	58.5	-8.54	29.92	1352.1	2.499	0.86	5.28	12.87	126.9321	48.75
11/17/2016	9:50:58 AM	17.5	58.51	-8.539	29.919	1281.8	2.525	0.86	5.28	12.87	126.9169	48.71

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2020B

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/16/2016	10:56:30 AM	0	57.09	-30.453	29.725	-8.4	2.577	0.78	5.76	15.34	149.6941	41.2
11/16/2016	10:57:00 AM	0.5	57.1	-30.45	29.726	3.4	2.577	0.77	5.88	14.72	143.5938	44.22
11/16/2016	10:57:30 AM	1	57.13	-30.446	29.726	35.3	2.577	0.77	5.96	14.39	140.4122	46.54
11/16/2016	10:58:00 AM	1.5	57.13	-30.428	29.727	-25.3	2.577	0.77	6.02	14.2	138.6096	48.27
11/16/2016	10:58:30 AM	2	57.12	-30.41	29.732	-5.8	2.577	0.77	6.07	14.04	137.0437	49.61
11/16/2016	10:59:00 AM	2.5	57.14	-30.392	29.733	-34.8	2.577	0.77	6.12	13.98	136.4213	50.72
11/16/2016	10:59:30 AM	3	57.14	-30.386	29.729	-33.3	2.577	0.78	6.15	13.9	135.6961	51.7
11/16/2016	11:00:00 AM	3.5	57.14	-30.373	29.726	-30	2.551	0.78	6.19	13.85	135.2025	52.73
11/16/2016	11:00:30 AM	4	57.15	-30.367	29.725	-30.7	2.577	0.77	6.21	13.75	134.2863	53.62
11/16/2016	11:01:00 AM	4.5	57.16	-30.361	29.725	-10.1	2.577	0.77	6.24	13.68	133.5964	54.24
11/16/2016	11:01:30 AM	5	57.17	-30.355	29.724	17.8	2.551	0.77	6.26	13.7	133.8053	55
11/16/2016	11:02:00 AM	5.5	57.19	-30.348	29.726	49.6	2.551	0.77	6.28	13.62	133.0736	55.55
11/16/2016	11:02:30 AM	6	57.15	-28.41	29.73	4198.8	2.577	0.75	6.41	13.7	133.705	51.13
11/16/2016	11:03:00 AM	6.5	57.14	-28.448	29.734	4777.6	2.551	0.78	6.21	13.81	134.8191	53
11/16/2016	11:03:30 AM	7	57.15	-28.461	29.729	4756.8	2.577	0.79	6.08	13.86	135.2706	53.88
11/16/2016	11:04:00 AM	7.5	57.15	-28.467	29.733	4600.4	2.577	0.8	5.99	13.85	135.2261	54.18
11/16/2016	11:04:30 AM	8	57.16	-28.474	29.733	4208.5	2.577	0.8	5.92	13.79	134.6228	54.39
11/16/2016	11:05:00 AM	8.5	57.16	-28.48	29.729	3671.6	2.577	0.81	5.86	13.74	134.1596	54.74
11/16/2016	11:05:30 AM	9	57.16	-28.48	29.731	3218.7	2.577	0.8	5.82	13.7	133.736	54.69
11/16/2016	11:06:00 AM	9.5	57.15	-28.48	29.729	2757	2.577	0.79	5.79	13.72	133.9782	53.72
11/16/2016	11:06:30 AM	10	57.15	-28.48	29.73	2463.1	2.577	0.8	5.76	13.68	133.5037	52.87
11/16/2016	11:07:00 AM	10.5	57.15	-28.486	29.727	2111.4	2.551	0.8	5.74	13.62	133.0039	52.82
11/16/2016	11:07:30 AM	11	57.14	-28.492	29.721	1868.4	2.551	0.8	5.72	13.62	132.9456	52.81
11/16/2016	11:08:00 AM	11.5	57.16	-28.492	29.725	1698.7	2.551	0.79	5.7	13.6	132.7968	52.85
11/16/2016	11:08:30 AM	12	57.15	-28.492	29.728	1553.8	2.577	0.79	5.68	13.58	132.6151	52.82
11/16/2016	11:09:00 AM	12.5	57.15	-28.492	29.727	1402.2	2.577	0.79	5.67	13.56	132.3968	52.88
11/16/2016	11:09:30 AM	13	57.16	-28.486	29.725	1272.1	2.577	0.79	5.65	13.55	132.3562	53
11/16/2016	11:10:00 AM	13.5	57.15	-28.492	29.724	1046.4	2.551	0.79	5.63	13.55	132.2626	53.29
11/16/2016	11:10:30 AM	14	57.17	-28.498	29.72	1119.8	2.577	0.79	5.62	13.52	132.1063	53.73
11/16/2016	11:11:00 AM	14.5	57.19	-26.054	29.717	1627.2	2.551	0.78	5.56	13.68	133.6982	51.56
11/16/2016	11:11:30 AM	15	57.2	-26.054	29.717	1457.5	2.551	0.79	5.52	13.73	134.2071	51.47
11/16/2016	11:12:00 AM	15.5	57.19	-26.054	29.72	1395.3	2.551	0.79	5.49	13.74	134.2346	51.46
11/16/2016	11:12:30 AM	16	57.19	-26.048	29.722	1342.6	2.551	0.79	5.47	13.71	133.9104	51.54
11/16/2016	11:13:00 AM	16.5	57.2	-26.048	29.72	1277.5	2.525	0.8	5.46	13.68	133.6738	51.56
11/16/2016	11:13:30 AM	17	57.19	-26.048	29.718	1182.8	2.551	0.8	5.45	13.65	133.4195	51.55
11/16/2016	11:14:00 AM	17.5	57.2	-26.054	29.718	1097.9	2.551	0.8	5.45	13.64	133.2727	51.66
11/16/2016	11:14:30 AM	18	57.19	-26.054	29.72	1037.6	2.551	0.79	5.44	13.62	133.0481	51.76
11/16/2016	11:15:00 AM	18.5	57.2	-26.073	29.717	901.1	2.525	0.8	5.43	13.72	134.0756	51.92
11/16/2016	11:15:30 AM	19	57.2	-26.079	29.712	926.5	2.551	0.8	5.43	13.55	132.4585	51.91
11/16/2016	11:16:00 AM	19.5	57.18	-26.073	29.721	866.9	2.525	0.8	5.42	13.55	132.3718	52.14
11/16/2016	11:16:30 AM	20	57.2	-26.073	29.721	752.9	2.551	0.8	5.42	13.52	132.1334	51.85
11/16/2016	11:17:00 AM	20.5	57.19	-26.079	29.716	842	2.525	0.8	5.42	13.51	131.9697	52.2
11/16/2016	11:17:30 AM	21	57.2	-26.073	29.713	770.1	2.525	0.8	5.41	13.49	131.8434	52.2
11/16/2016	11:18:00 AM	21.5	57.19	-26.06	29.716	812.6	2.525	0.8	5.41	13.48	131.6781	52.13
11/16/2016	11:18:30 AM	22	57.26	-23.388	29.711	1538.3	2.525	0.76	5.39	13.67	133.7246	50.42
11/16/2016	11:19:00 AM	22.5	57.27	-23.426	29.712	1369.7	2.525	0.79	5.39	13.66	133.6312	50.56
11/16/2016	11:19:30 AM	23	57.24	-23.413	29.713	1280.7	2.577	0.79	5.38	13.68	133.7929	50.68
11/16/2016	11:20:00 AM	23.5	57.26	-23.413	29.712	1234.7	2.551	0.79	5.38	13.71	134.1053	50.8
11/16/2016	11:20:30 AM	24	57.25	-23.401	29.713	1218.9	2.551	0.8	5.38	13.73	134.2283	50.88
11/16/2016	11:21:00 AM	24.5	57.25	-23.4	29.713	1121.3	2.551	0.8	5.37	13.81	135.0004	50.95
11/16/2016	11:21:30 AM	25	57.25	-23.394	29.716	1092	2.525	0.8	5.37	13.86	135.5499	51.02
11/16/2016	11:22:00 AM	25.5	57.27	-23.381	29.718	1061.9	2.551	0.8	5.37	13.9	135.9819	51.2
11/16/2016	11:22:30 AM	26	57.26	-23.381	29.716	1015.5	2.577	0.8	5.37	13.95	136.4473	51.3
11/16/2016	11:23:00 AM	26.5	57.26	-23.387	29.711	986.9	2.551	0.8	5.37	13.98	136.7012	51.67
11/16/2016	11:23:30 AM	27	57.27	-23.387	29.709	887.1	2.551	0.8	5.37	13.99	136.8522	51.71
11/16/2016	11:24:00 AM	27.5	57.26	-23.381	29.713	863.8	2.577	0.8	5.37	14.01	137.0826	51.83
11/16/2016	11:24:30 AM	28	57.27	-23.375	29.713	867.4	2.551	0.8	5.37	14.02	137.1113	51.78
11/16/2016	11:25:00 AM	28.5	57.27	-23.375	29.712	789	2.551	0.8	5.36	14.03	137.2676	51.83
11/16/2016	11:25:30 AM	29	57.28	-23.381	29.715	724.8	2.551	0.8	5.36	14.04	137.2949	51.99
11/16/2016	11:26:00 AM	29.5	57.27	-23.394	29.715	706	2.551	0.8	5.36	14.03	137.2148	52.06
11/16/2016	11:26:30 AM	30	57.28	-23.4	29.712	662.3	2.551	0.8	5.36	13.99	136.8542	51.95
11/16/2016	11:27:00 AM	30.5	57.28	-23.406	29.714	664.8	2.577	0.8	5.36	13.96	136.5605	51.87
11/16/2016	11:27:30 AM	31	57.27	-23.4	29.72	570.7	2.551	0.81	5.36	13.93	136.278	51.85
11/16/2016	11:28:00 AM	31.5	57.28	-23.4	29.721	623.3	2.577	0.81	5.36	13.91	136.045	51.93
11/16/2016	11:28:30 AM	32	57.28	-23.406	29.72	581.4	2.577	0.8	5.36	13.92	136.1852	52.04

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2020B

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/16/2016	11:29:00 AM	32.5	57.29	-23.406	29.721	587.4	2.577	0.81	5.36	13.87	135.7076	52.18
11/16/2016	11:29:30 AM	33	57.28	-23.4	29.719	520.3	2.551	0.81	5.36	13.85	135.451	52.16
11/16/2016	11:30:00 AM	33.5	57.28	-23.4	29.717	511.4	2.577	0.81	5.36	13.83	135.2549	52.06
11/16/2016	11:30:30 AM	34	57.3	-23.406	29.716	496.2	2.577	0.81	5.36	13.81	135.0867	52.09
11/16/2016	11:31:00 AM	34.5	57.27	-23.4	29.714	481.3	2.577	0.81	5.36	13.76	134.6288	52.14
11/16/2016	11:31:30 AM	35	57.29	-23.412	29.713	437.1	2.577	0.81	5.36	13.72	134.2377	52.16
11/16/2016	11:32:00 AM	35.5	57.41	-20.867	29.712	461.4	2.551	0.75	5.36	13.91	136.348	51.07
11/16/2016	11:32:30 AM	36	57.41	-20.929	29.71	405.6	2.577	0.8	5.38	13.63	133.5891	51.36
11/16/2016	11:33:00 AM	36.5	57.41	-20.929	29.709	372.2	2.577	0.8	5.38	13.53	132.565	51.55
11/16/2016	11:33:30 AM	37	57.42	-20.928	29.707	366.6	2.577	0.8	5.39	13.47	132.0184	51.68
11/16/2016	11:34:00 AM	37.5	57.4	-20.928	29.709	383.8	2.551	0.8	5.39	13.43	131.6007	51.85
11/16/2016	11:34:30 AM	38	57.41	-20.934	29.712	456.2	2.577	0.8	5.39	13.41	131.39	51.88
11/16/2016	11:35:00 AM	38.5	57.4	-20.941	29.709	460	2.577	0.8	5.39	13.38	131.1079	52.01
11/16/2016	11:35:30 AM	39	57.4	-20.941	29.712	445.5	2.577	0.8	5.39	13.34	130.7235	52.08
11/16/2016	11:36:00 AM	39.5	57.39	-20.934	29.712	430.8	2.577	0.81	5.39	13.32	130.4506	52.17
11/16/2016	11:36:30 AM	40	57.4	-20.953	29.713	473.9	2.577	0.8	5.39	13.31	130.3759	52.16
11/16/2016	11:37:00 AM	40.5	57.4	-20.991	29.712	552.8	2.551	0.8	5.39	13.3	130.2639	52.22
11/16/2016	11:37:30 AM	41	57.4	-21.004	29.714	512.8	2.577	0.81	5.39	13.28	130.0695	52.23
11/16/2016	11:38:00 AM	41.5	57.37	-20.991	29.711	497.1	2.577	0.81	5.39	13.4	131.2696	52.34
11/16/2016	11:38:30 AM	42	57.38	-20.966	29.707	470.1	2.577	0.81	5.39	13.31	130.4233	52.53
11/16/2016	11:39:00 AM	42.5	57.37	-20.966	29.707	470.9	2.577	0.81	5.39	13.29	130.2113	52.52
11/16/2016	11:39:30 AM	43	57.61	-18.641	29.708	79.3	2.577	0.76	5.38	13.41	131.7754	51.64
11/16/2016	11:40:00 AM	43.5	57.61	-18.665	29.708	39.5	2.551	0.8	5.4	13.19	129.6207	51.93
11/16/2016	11:40:30 AM	44	57.6	-18.67	29.706	30.3	2.551	0.81	5.4	13.1	128.7315	52.26
11/16/2016	11:41:00 AM	44.5	57.6	-18.632	29.703	26.7	2.551	0.82	5.41	13.05	128.1959	52.42
11/16/2016	11:41:30 AM	45	57.6	-18.619	29.697	22.2	2.551	0.81	5.41	13.02	127.9288	52.59
11/16/2016	11:42:00 AM	45.5	57.6	-18.631	29.706	29	2.577	0.81	5.41	13	127.7221	52.76
11/16/2016	11:42:30 AM	46	57.61	-18.656	29.706	29.2	2.551	0.81	5.41	12.98	127.536	52.9
11/16/2016	11:43:00 AM	46.5	57.6	-18.675	29.703	33.4	2.551	0.82	5.41	12.96	127.346	53.1
11/16/2016	11:43:30 AM	47	57.6	-18.656	29.706	19.5	2.577	0.83	5.41	12.91	126.7709	53.19
11/16/2016	11:44:00 AM	47.5	57.61	-18.631	29.707	17.2	2.577	0.83	5.41	12.89	126.6124	53.2
11/16/2016	11:44:30 AM	48	57.6	-18.612	29.707	20.2	2.577	0.83	5.41	12.87	126.4725	53.03
11/16/2016	11:45:00 AM	48.5	57.58	-18.599	29.705	15.1	2.577	0.83	5.41	12.86	126.2923	53.12
11/16/2016	11:45:30 AM	49	57.6	-18.58	29.703	14	2.577	0.84	5.41	12.83	126.0586	53.17
11/16/2016	11:46:00 AM	49.5	57.59	-18.573	29.705	15.4	2.577	0.82	5.41	12.87	126.4432	53.48
11/16/2016	11:46:30 AM	50	57.6	-18.567	29.704	17.1	2.577	0.82	5.41	12.86	126.3711	53.6
11/16/2016	11:47:00 AM	50.5	57.59	-18.555	29.704	16.1	2.577	0.82	5.41	12.86	126.3045	53.73
11/16/2016	11:47:30 AM	51	57.59	-18.555	29.702	12.3	2.551	0.82	5.41	12.92	126.9102	53.78
11/16/2016	11:48:00 AM	51.5	57.58	-18.548	29.705	12.6	2.551	0.82	5.41	12.84	126.1383	53.82
11/16/2016	11:48:30 AM	52	57.58	-18.554	29.703	17.5	2.577	0.81	5.42	12.83	125.9921	54.03
11/16/2016	11:49:00 AM	52.5	57.59	-18.605	29.702	23.5	2.577	0.82	5.41	12.77	125.4908	54.7
11/16/2016	11:49:30 AM	53	57.58	-18.624	29.701	25.5	2.577	0.82	5.41	12.75	125.2528	54.75
11/16/2016	11:50:00 AM	53.5	57.59	-18.599	29.7	12.7	2.551	0.82	5.41	12.7	124.7931	54.67
11/16/2016	11:50:30 AM	54	57.59	-18.592	29.701	8.6	2.577	0.82	5.41	12.68	124.5657	54.39
11/16/2016	11:51:00 AM	54.5	57.59	-18.574	29.701	8.9	2.551	0.82	5.42	12.66	124.3773	54.25
11/16/2016	11:51:30 AM	55	57.6	-18.567	29.705	6.7	2.577	0.82	5.42	12.65	124.2595	54.23
11/16/2016	11:52:00 AM	55.5	57.59	-18.574	29.702	6.9	2.551	0.82	5.42	12.6	123.8024	54.22
11/16/2016	11:52:30 AM	56	57.6	-18.567	29.703	9	2.577	0.82	5.42	12.52	122.9709	54.3
11/16/2016	11:53:00 AM	56.5	57.59	-18.561	29.705	9.4	2.551	0.82	5.42	12.47	122.448	54.32
11/16/2016	11:53:30 AM	57	57.59	-18.567	29.706	10.8	2.577	0.82	5.42	12.46	122.3448	54.41
11/17/2016	9:54:57 AM	0	57.13	-31.375	29.942	12.6		0.81	5.86	12.42	120.3468	77.22
11/17/2016	9:55:27 AM	0.5	57.12	-31.383	29.942	-17.7		0.81	5.92	12.43	120.4612	77.87
11/17/2016	9:55:57 AM	1	57.13	-31.39	29.942	-15.6		0.81	5.96	12.24	118.5778	78.39
11/17/2016	9:56:27 AM	1.5	57.12	-31.39	29.942	-26.8		0.82	6	12.25	118.673	78.66
11/17/2016	9:56:57 AM	2	57.12	-31.415	29.942	-30.8		0.82	6.03	12.12	117.4389	78.92
11/17/2016	9:57:27 AM	2.5	57.13	-31.435	29.941	-27.5		0.82	6.06	12.05	116.7896	79.21
11/17/2016	9:57:57 AM	3	57.14	-31.466	29.942	-0.5		0.82	6.08	12.01	116.3597	79.41
11/17/2016	9:58:27 AM	3.5	57.12	-31.466	29.942	29.8		0.82	6.11	11.99	116.153	79.7
11/17/2016	9:58:57 AM	4	57.13	-31.485	29.943	54.5		0.82	6.12	11.98	116.1101	79.91
11/17/2016	9:59:27 AM	4.5	57.11	-31.498	29.941	76.6		0.82	6.14	11.99	116.1708	80.12
11/17/2016	9:59:57 AM	5	57.14	-29.541	29.941	4372		0.83	6.14	12.01	116.431	70.35
11/17/2016	10:00:27 AM	5.5	57.13	-29.547	29.94	4362.2		0.83	5.99	12.21	118.3058	70.49
11/17/2016	10:00:57 AM	6	57.12	-29.56	29.94	4277		0.84	5.87	12.3	119.1585	70.83
11/17/2016	10:01:27 AM	6.5	57.12	-29.554	29.941	4038.8		0.84	5.79	12.34	119.5194	71.1

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by Terra Systems
MW-B2020B

			Chan[1]	Chan[2]	Chan[3]	Chan[4]	Chan[5]	Chan[11]	Chan[12]	Chan[25]	Chan[25]	Chan[45]
			Temperature	Pressure	Barometric	Turbidity	Battery	ORP	pH	Clark DO	Clark DO Sat	Conductivity
Date	Time	ET (min)	Fahrenheit	Feet H2O	Inches Hg	FNU	Volts	Volts	pH	milligrams/L	%Saturation	microSiemens/cm Actual Conductivity
11/17/2016	10:01:57 AM	7	57.13	-29.56	29.94	3767.1		0.84	5.73	12.33	119.5014	71.32
11/17/2016	10:02:27 AM	7.5	57.11	-29.567	29.94	3407.8		0.84	5.68	12.34	119.5882	71.51
11/17/2016	10:02:57 AM	8	57.1	-29.56	29.939	3299.6		0.84	5.65	12.34	119.5205	71.47
11/17/2016	10:03:27 AM	8.5	57.12	-29.573	29.94	2909		0.82	5.62	12.39	120.0041	71.41
11/17/2016	10:03:57 AM	9	57.1	-29.573	29.94	2704.8		0.82	5.6	12.38	119.8961	71.29
11/17/2016	10:04:27 AM	9.5	57.11	-29.573	29.94	2489.7		0.82	5.59	12.36	119.7762	71.29
11/17/2016	10:04:57 AM	10	57.13	-27.186	29.937	1190.4		0.82	5.54	12.35	119.6497	68.42
11/17/2016	10:05:27 AM	10.5	57.15	-27.18	29.937	1010.3		0.83	5.49	12.44	120.5526	68.59
11/17/2016	10:05:57 AM	11	57.14	-27.18	29.935	983		0.83	5.46	12.43	120.4989	68.71
11/17/2016	10:06:27 AM	11.5	57.14	-27.186	29.937	981.8		0.83	5.44	12.52	121.3855	68.59
11/17/2016	10:06:57 AM	12	57.14	-27.186	29.936	860.8		0.83	5.42	12.39	120.1136	68.61
11/17/2016	10:07:27 AM	12.5	57.14	-27.186	29.936	880.9		0.83	5.41	12.38	119.9746	68.57
11/17/2016	10:07:57 AM	13	57.13	-27.179	29.935	883.8		0.83	5.4	12.36	119.8214	68.73
11/17/2016	10:08:27 AM	13.5	57.14	-27.186	29.936	690.2		0.83	5.39	12.42	120.416	68.84
11/17/2016	10:08:57 AM	14	57.13	-27.192	29.934	741.3		0.83	5.38	12.51	121.2469	68.96
11/17/2016	10:09:27 AM	14.5	57.13	-27.186	29.936	632.9		0.83	5.37	12.44	120.5777	68.81
11/17/2016	10:09:57 AM	15	57.13	-26.977	29.934	817.6		0.8	5.37	12.6	122.1267	68.1
11/17/2016	10:10:27 AM	15.5	57.18	-24.855	29.932	577.7		0.84	5.35	12.53	121.4976	65.87
11/17/2016	10:10:57 AM	16	57.19	-24.786	29.931	689.2		0.83	5.35	12.54	121.6451	65.98
11/17/2016	10:11:27 AM	16.5	57.19	-24.697	29.931	716.8		0.84	5.35	12.45	120.8066	65.97
11/17/2016	10:11:57 AM	17	57.18	-24.501	29.933	565.6		0.83	5.35	12.45	120.7747	65.54
11/17/2016	10:12:27 AM	17.5	57.2	-24.28	29.933	570		0.84	5.35	12.45	120.8065	65.75
11/17/2016	10:12:57 AM	18	57.19	-24.128	29.933	554.7		0.84	5.35	12.43	120.605	66.08
11/17/2016	10:13:27 AM	18.5	57.19	-24.021	29.934	550.3		0.84	5.35	12.46	120.814	66.41
11/17/2016	10:13:57 AM	19	57.19	-23.869	29.934	584.4		0.84	5.35	12.54	121.6475	66.52

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by AECOM

MW-2020B

		11/15/2016														
		9:23 AM	9:28 AM	9:33 AM	9:38 AM	9:53 AM	10:12 AM	10:20 AM	10:25 AM	10:32 AM	10:37 AM	10:45 AM	10:50 AM	10:56 AM	11:25 AM	11:15 AM
Temperature	C	14.29	14.25	13.79	14.25	14.14	14.74	14.7	14.63	14.45	14.44	14.42	14.39	14.38	14.38	14.4
Conductivity	us/cm c	300	299	283	301	202	298	304	303	305	301	302	302	303	303	301
Conductivity	us/cm	239	237	222	239	239	239	244	243	243	241	241	241	242	243	240
DO	%	25.8	23.4	34.1	25.8	24.4	27.8	28.9	24.5	32.3	33.7	29.9	31.8	32.9	32	32.9
DO	mg/L	2.66	2.39	3.52	2.64	2.51	2.82	2.93	2.49	3.29	3.44	3.05	3.24	3.35	3.25	3.35
DO	ch	32.9	29.8	30.8	29.8	29.8	28.8	29.8	29.8	34.9	33.9	33.9	34.9	34.9	35.9	36.9
pH		5.47	5.39	5.68	5.39	5.31	5.33	5.32	5.29	5.26	5.27	5.29	5.27	5.26	5.24	5.24
ORP		106	118.1	125.6	130.5	134.2	92.7	121.7	123.4	145	153.7	157.2	166.5	171.2	177.8	184.9
Turbidity	NTU						133	152	138	72.7	34	30.4	10.6	12.5	19.6	15.7
Injection Nearby		Baseline					68-64		64-60			60-56			56-52	

MW-2020C

		11/15/2016											
		9:57 AM	10:02 AM	10:07 AM	11:25 AM	11:35 AM	11:43 AM	11:56 AM	12:05 PM	12:15 PM	12:27 PM	12:35 PM	12:45 PM
Temperature	C	14.71	14.88	14.99	14.93	14.93	14.91	14.89	14.84	14.84	14.86	14.9	14.9
Conductivity	us/cm c	231	229	226	225	225	224	226	226	228	229	229	229
Conductivity	us/cm	186	185	183	182	182	180	182	182	184	184	184	185
DO	%	33.5	30.7	32	27.2	27.5	29.5	41.1	41.5	39	35.4	35	34.9
DO	mg/L	3.39	3.1	3.22	2.73	2.76	2.98	4.15	4.19	3.94	3.58	3.54	3.53
DO	ch	30.8	28.8	29.8	24.7	24.7	26.7	31.8	31.8	29.8	29.8	28.8	29.8
pH		5.38	5.35	5.3	5.29	5.3	5.29	5.29	5.28	5.27	5.26	5.25	5.24
ORP		72	71.4	71.5	83.8	84.7	83.2	85.5	88	89.1	88.6	88.7	86.4
Turbidity	NTU				44.3	6.33	2.54	0.92	0.72	0.37	0.34	0.4	0.2
Injection Nearby		baseline			56-52	52-48		48-44		44-40	40-36		

MW-1020C

		11/15/2016										11/16/2016					
		1:47 PM	1:52 PM	1:57 PM	2:05 PM	2:15 PM	3:55 PM	4:00 PM	4:10 PM	4:20 PM	4:30 PM	8:28 AM	8:30 AM	8:35 AM	8:40 AM	8:45 AM	9:00 AM
Temperature	C	15.04	15.06	15.05	14.97	14.01	14.57	14.87	14.81	14.8	14.8	14.22	14.96	15.08	14.88	14.88	14.96
Conductivity	us/cm c	239	238	237	234	234	238	234	232	231	230	235	228	229	230	229	229
Conductivity	us/cm	194	193	191	189	189	190	189	187	186	186	187	185	186	186	185	186
DO	%	6.8	7.7	7.8	7.9	7.9	9	9.9	9.8	9.4	9.1	25.2	14.6	12.6	9.3	8	6.9
DO	mg/L	0.69	0.78	0.79	0.79	0.8	0.92	1	0.98	0.95	0.92	2.53	1.46	1.28	0.94	0.8	0.7
DO	ch	19.6	18.6	18.6	18.6	18.6	21.6	20.6	19.6	19.6	19.6	22.6	22.6	21.6	19.6	18.6	18.6
pH		5.4	5.39	5.37	5.35	5.34	5.47	5.37	5.31	5.3	5.29	5.58	5.29	5.32	5.27	5.27	5.27
ORP		107.3	114.4	112.6	106.3	103.6	58.4	73.6	83.1	86.5	89.1	132.2	135.4	128.6	120.3	114.7	107.4
Turbidity	NTU	677	182	108	60.4	35.2	257	97.5	27.3	16.3	9.93	overrange	293	56.7	24.8	11.6	8.88
Observations												yellow tint	white tint	clearing up			
Injection Nearby		baseline					56-52	52-48	48-44	44-40				begin W3 injections			

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by AECOM

MW-1020B

		11/15/2016								11/16/2016					
		2:35 PM	2:45 PM	2:53 PM	3:00 PM	3:05 PM	3:17 PM	3:30 PM	3:45 PM	8:03 AM	8:05 AM	8:08 AM	8:12 AM	8:17 AM	8:21 AM
Temperature	C	14.73	14.22	14.28	14.29	14.32	14.27	14.27	14.31	14.16	14.34	14.17	14.35	14.37	14.39
Conductivity	us/cm c	253	327	331	332	335	339	350	372	315	324	332	352	377	386
Conductivity	us/cm	206	259	263	265	267	270	278	296	250	258	163	280	300	308
DO	%	12	9.8	9.6	9.3	9.2	9.1	8.5	7.6	2.6	33	7.4	4	3.3	4
DO	mg/L	1.2	1.01	0.98	0.96	0.95	0.93	0.88	0.78	0.27	0.34	0.76	0.4	0.34	0.49
DO	ch	17.5	21	21.6	21.6	22.6	21.6	22.6	22.6	14.5	16.5	16.5	17.5	18.6	19.6
pH		5.92	5.23	5.3	5.31	5.33	5.32	5.29	5.26	5.13	5.12	5.18	5.16	5.2	5.22
ORP		20	123.1	112.5	97.3	83	73	68.8	65.2	161.5	178.3	189.9	184.1	144.3	115.4
Turbidity	NTU	43	21.2	4.33	1.97	1.25	0.56	0.66	0.4	2.55	554	101	61.3	17.5	4.31
Observations										Clear initially	Potentially a little milky	Clearer again			
Injection Nearby		baseline			68-64		64-60	60-56	56-52						

MW-1010C

		11/16/2016									
		7:50 AM	7:55 AM	8:00 AM	9:15 AM	9:35 AM	9:50 AM	10:05 AM	10:25 AM	10:45 AM	11:02 AM
Temperature	C	14.41	14.5	14.57	14.43	14.39	14.36	14.44	14.47	14.47	14.65
Conductivity	us/cm c	228	227	227	232	229	229	229	228	227	227
Conductivity	us/cm	182	182	182	186	182	182	182	182	182	182
DO	%	4.6	4.7	4.9	6.2	7.4	7.3	7	7.2	7.4	7.9
DO	mg/L	0.47	0.48	0.51	0.64	0.76	0.75	0.71	0.73	0.75	0.8
DO	ch	15.5	16.5	16.5	17.5	18.6	17.5	17.5	17.5	17.5	17.5
pH		5.18	5.17	5.16	5.27	5.2	5.18	5.18	5.16	5.18	5.18
ORP		196.7	205.8	209.8	170.2	191.4	198.1	202.6	208.3	208	212.8
Turbidity	NTU	466	649	527							
Turbidity	FAU					11	2	2	0	1	0
Observations		not as silty as usual, faint white tint									
Injections Nearby				Point W3	56-52		52-48	48-44	44-40	done	
				Point W5			68-64	64-60	60-56	56-52	

MW-1050B

		11/16/2016			
		11:27 AM	11:35 AM	11:45 AM	12:10 PM
Temperature	C	15.57	15.86	15.74	15.35
Conductivity	us/cm c	255	434	428	432
Conductivity	us/cm	211	358	353	353
DO	%	7.8	2.2	5.8	6.4
DO	mg/L	0.78	0.22	0.58	0.64
DO	ch	17.5	18.6	21.6	22.6
pH		6.12	5.27	5.24	5.18
ORP		-64.9	51	93.5	125.1
Turbidity	NTU				
Turbidity	FAU	1	141	0	0
Observations		clear	white tint	clear again	

Orleans, MA
PRB Demonstration - Eldredge Park
Monitoring by AECOM

MW-1050C

		11/16/2016			
		12:20 PM	12:25 PM	12:30 PM	12:45 PM
Temperature	C	15.43	15.77	15.33	15.7
Conductivity	us/cm c	505	574	573	569
Conductivity	us/cm	428	472	467	469
DO	%	11.7	7.5	8.6	12.2
DO	mg/L	1.12	0.74	0.86	1.22
DO	ch	21.6	21.6	22.6	26.7
pH		5.73	5.41	5.44	5.4
ORP		-34.6	71.5	78.1	77.1
Turbidity	NTU				
Turbidity	FAU	140	64	8	0
Observations		initially clear, then little white tint	clearing up		clear

MW-1050A

		11/16/2016		
		1:30 PM	1:45 PM	2:05 PM
Temperature	C	14.43	15.21	15.6
Conductivity	us/cm c	61	171	264
Conductivity	us/cm	49	138	217
DO	%	101.8	43.8	12.9
DO	mg/L	10.37	4.4	1.29
DO	ch	43.1	28.8	18.6
pH		6.51	6.01	5.87
ORP		94.8	114.1	52.1
Turbidity	NTU			
Turbidity	FAU	86	43	15

MW-12B

		11/16/2016	
		2:30 PM	2:40 PM
Turbidity	FAU	179	418
Observations		silty brown tint	

Town of Orleans, MA Water Quality and Wastewater Planning
Orleans, MA
Demonstration PRB – Eldredge Park Way

Injection Activities Photo Log

Figure 1: EVO Totes Staging Area

Figure 2: Mixing Tanks

Figure 3: Injection Transfer Pumps

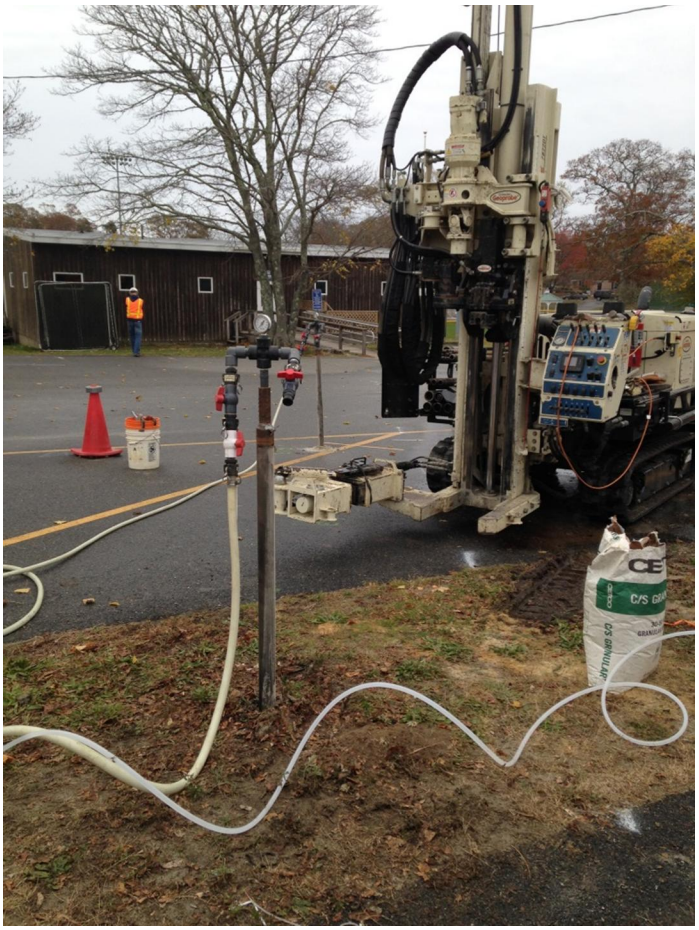

Figure 4: Direct-Push Injection Point and Geoprobe

Figure 5: Injection Slotted Rod

Figure 6: Direct Push Injection Point During Injection (Left) and After (Right)

Appendix E

Analytical Laboratory Reports

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644)
ESS Laboratory Work Order Number: 1610053

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 10:55 am, Oct 13, 2016

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with NELAC Standards, A2LA and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1610053

SAMPLE RECEIPT

The following samples were received on October 05, 2016 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1610053-01	MW-4	Ground Water	350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250
1610053-02	MW-8	Ground Water	350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250
1610053-03	MW-12	Ground Water	350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250
1610053-04	MW-B2100	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250, RSK175
1610053-05	MW-BC1C	Ground Water	353.2, 4500N, 5310B, 9038, 9250
1610053-06	MW-BU1C	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250, RSK175
1610053-07	MW-BU1A	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250, RSK175

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1610053

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1610053

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-4
Date Sampled: 10/04/16 13:15
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-01
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.10** (0.10)		350.1		1	JLK	10/06/16 16:10	mg/L	CJ60518
Chloride	**27.2** (3.0)		9250		1	EEM	10/07/16 13:11	mg/L	CJ60717
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	10/07/16 17:09	mg/L	[CALC]
Nitrate as N	**2.45** (0.110)		353.2		5	JLK	10/05/16 18:56	mg/L	[CALC]
Sulfate	**12.8** (5.0)		9038		1	EEM	10/07/16 16:50	mg/L	CJ60718
Total Kjeldahl Nitrogen as N	**0.71** (0.20)		351.2		1	EEM	10/11/16 15:12	mg/L	CJ60727
Total Nitrogen	**3.15** (0.300)		4500N		5	EEM	10/11/16 15:12	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8
Date Sampled: 10/04/16 14:25
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-02
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	JLK	10/06/16 16:11	mg/L	CJ60518
Chloride	**18.3** (3.0)		9250		1	EEM	10/07/16 13:14	mg/L	CJ60717
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	10/07/16 18:06	mg/L	[CALC]
Nitrate as N	**9.24** (0.210)		353.2		10	JLK	10/05/16 18:59	mg/L	[CALC]
Sulfate	**10.1** (5.0)		9038		1	EEM	10/07/16 16:50	mg/L	CJ60718
Total Kjeldahl Nitrogen as N	**1.70** (0.20)		351.2		1	EEM	10/11/16 15:14	mg/L	CJ60727
Total Nitrogen	**10.9** (0.400)		4500N		10	EEM	10/11/16 15:14	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12
Date Sampled: 10/04/16 15:08
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-03
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	JLK	10/06/16 16:12	mg/L	CJ60518
Chloride	**24.1** (3.0)		9250		1	EEM	10/07/16 13:15	mg/L	CJ60717
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	10/07/16 17:33	mg/L	[CALC]
Nitrate as N	**6.74** (0.210)		353.2		10	JLK	10/05/16 19:00	mg/L	[CALC]
Sulfate	**8.7** (5.0)		9038		1	EEM	10/07/16 16:50	mg/L	CJ60718
Total Kjeldahl Nitrogen as N	**1.34** (0.20)		351.2		1	EEM	10/11/16 15:15	mg/L	CJ60727
Total Nitrogen	**8.08** (0.400)		4500N		10	EEM	10/11/16 15:15	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2100
Date Sampled: 10/04/16 16:10
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.115** (0.050)		200.7		1	KJK	10/06/16 19:18	50	25	CJ60542
Manganese	**0.126** (0.010)		200.7		1	KJK	10/06/16 19:18	50	25	CJ60542

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2100
Date Sampled: 10/04/16 16:10
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	10/06/16 19:32	50	25	CJ60542

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2100
Date Sampled: 10/04/16 16:10
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-04
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	JLK	10/06/16 16:12	mg/L	CJ60518
Chloride	**65.4** (3.0)		9250		1	EEM	10/07/16 13:16	mg/L	CJ60717
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	10/07/16 17:45	mg/L	[CALC]
Nitrate as N	**1.29** (0.050)		353.2		2	JLK	10/05/16 19:01	mg/L	[CALC]
Sulfate	**14.1** (5.0)		9038		1	EEM	10/07/16 16:50	mg/L	CJ60718
Total Kjeldahl Nitrogen as N	**0.72** (0.20)		351.2		1	EEM	10/11/16 15:15	mg/L	CJ60727
Total Nitrogen	**2.01** (0.240)		4500N		2	EEM	10/11/16 15:15	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2100
Date Sampled: 10/04/16 16:10
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-04
Sample Matrix: Ground Water
Units: ug/L
Analyst: IBM
Prepared: 10/6/16 11:18

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	IBM	10/06/16 13:48	CZJ0069	CJ60621

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BC1C
Date Sampled: 10/04/16 17:03
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-05
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Chloride	**438** (15.0)		9250		5	EEM	10/07/16 13:24	mg/L	CJ60717
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	10/07/16 18:23	mg/L	[CALC]
Nitrate as N	**0.481** (0.030)		353.2		1	JLK	10/05/16 18:50	mg/L	[CALC]
Sulfate	**11.5** (5.0)		9038		1	EEM	10/07/16 16:50	mg/L	CJ60718
Total Nitrogen	**0.481** (0.020)		4500N		1	JLK	10/05/16 18:50	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU1C
Date Sampled: 10/04/16 17:30
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-06
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.099** (0.050)		200.7		1	KJK	10/06/16 19:23	50	25	CJ60542
Manganese	**0.047** (0.010)		200.7		1	KJK	10/06/16 19:23	50	25	CJ60542

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU1C
Date Sampled: 10/04/16 17:30
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-06
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	10/06/16 19:36	50	25	CJ60542

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU1C
Date Sampled: 10/04/16 17:30
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-06
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	JLK	10/06/16 16:13	mg/L	CJ60518
Chloride	**96.1** (3.0)		9250		1	EEM	10/07/16 13:18	mg/L	CJ60717
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	10/07/16 18:35	mg/L	[CALC]
Nitrate as N	**1.97** (0.110)		353.2		5	JLK	10/05/16 19:02	mg/L	[CALC]
Sulfate	**9.1** (5.0)		9038		1	EEM	10/07/16 16:50	mg/L	CJ60718
Total Kjeldahl Nitrogen as N	**0.40** (0.20)		351.2		1	EEM	10/11/16 15:16	mg/L	CJ60727
Total Nitrogen	**2.37** (0.300)		4500N		5	EEM	10/11/16 15:16	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU1C
Date Sampled: 10/04/16 17:30
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-06
Sample Matrix: Ground Water
Units: ug/L
Analyst: IBM
Prepared: 10/6/16 11:18

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	IBM	10/06/16 14:07	CZJ0069	CJ60621

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU1A
Date Sampled: 10/04/16 18:15
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.799** (0.050)		200.7		1	KJK	10/06/16 19:27	50	25	CJ60542
Manganese	**0.185** (0.010)		200.7		1	KJK	10/06/16 19:27	50	25	CJ60542

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU1A
Date Sampled: 10/04/16 18:15
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	10/06/16 19:53	50	25	CJ60542

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU1A
Date Sampled: 10/04/16 18:15
Percent Solids: N/A

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-07
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.24** (0.10)		350.1		1	JLK	10/06/16 17:21	mg/L	CJ60518
Chloride	**458** (30.0)		9250		10	EEM	10/07/16 13:33	mg/L	CJ60717
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	10/07/16 18:47	mg/L	[CALC]
Nitrate as N	**0.443** (0.030)		353.2		1	JLK	10/05/16 18:54	mg/L	[CALC]
Sulfate	**6.9** (5.0)		9038		1	EEM	10/07/16 16:50	mg/L	CJ60718
Total Kjeldahl Nitrogen as N	**0.38** (0.20)		351.2		1	EEM	10/11/16 15:23	mg/L	CJ60727
Total Nitrogen	**0.827** (0.220)		4500N		1	EEM	10/11/16 15:23	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU1A
Date Sampled: 10/04/16 18:15
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1610053
ESS Laboratory Sample ID: 1610053-07
Sample Matrix: Ground Water
Units: ug/L
Analyst: IBM
Prepared: 10/6/16 11:18

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	IBM	10/06/16 14:18	CZJ0069	CJ60621

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1610053

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Dissolved Metals										
Batch CJ60542 - 3005A										
Blank										
Iron	ND	0.050	mg/L							
Manganese	ND	0.010	mg/L							
LCS										
Iron	1.26	0.050	mg/L	1.250		101	80-120			
Manganese	0.258	0.010	mg/L	0.2500		103	80-120			
LCS Dup										
Iron	1.22	0.050	mg/L	1.250		98	80-120	4	20	
Manganese	0.255	0.010	mg/L	0.2500		102	80-120	1	20	
Total Metals										
Batch CJ60542 - 3005A										
Blank										
Boron	ND	0.050	mg/L							
LCS										
Boron	0.267	0.050	mg/L	0.2500		107	85-115			
LCS Dup										
Boron	0.256	0.050	mg/L	0.2500		103	85-115	4	20	
Classical Chemistry										
Batch CJ60518 - NH4 Prep										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.11	0.10	mg/L	0.09994		111	80-120			
LCS										
Ammonia as N	1.02	0.10	mg/L	0.9994		102	80-120			
Batch CJ60528 - [CALC]										
Blank										
Nitrate as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.262		mg/L	0.2497		105	90-110			
Batch CJ60529 - [CALC]										
Blank										
Nitrate as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Total Nitrogen	ND	0.020	mg/L							
LCS										

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1610053

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CJ60529 - [CALC]										
Nitrate as N	0.474		mg/L							
Nitrate/Nitrite as N	0.474		mg/L	0.5000		95	90-110			
Nitrate/Nitrite as N	0.474		mg/L	0.5000		95	90-110			
Total Nitrogen	0.474		mg/L							
Batch CJ60644 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	4.73	0.500	mg/L	5.000		95	80-120			
Dissolved Organic Carbon (2)	4.56	0.500	mg/L	5.000		91	80-120			
Dissolved Organic Carbon (Average)	4.65	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.41	0.500	mg/L	5.000		88	80-120	7	200	
Dissolved Organic Carbon (2)	4.36	0.500	mg/L	5.000		87	80-120	4	200	
Dissolved Organic Carbon (Average)	4.39	0.500	mg/L							
Batch CJ60717 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	31.3		mg/L	30.00		104	90-110			
Batch CJ60718 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.6		mg/L	9.988		96	85-115			
Batch CJ60727 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.200	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	27.1	2.00	mg/L	25.70		105	80-120			
Total Kjeldahl Nitrogen as N	27.1	2.00	mg/L	25.70		105	80-120			
Total Nitrogen	27.1	2.00	mg/L							
Methane / Ethane / Ethene by Headspace GCFID (RSK175)										
Batch CJ60621 - No Prep										
Blank										
Methane	ND	2.0	ug/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1610053

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Methane / Ethane / Ethene by Headspace GCFID (RSK175)										
Batch CJ60621 - No Prep										
LCS										
Methane	22.9	2.0	ug/L	36.00		64	60-140			
LCS Dup										
Methane	25.1	2.0	ug/L	36.00		70	60-140	9	30	

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1610053

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1610053

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/documents/AllLabs.xls

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.depweb.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1610053
Date Received: 10/5/2016
Project Due Date: 10/13/2016
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 5.7 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? No
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** Yes / No / NA
10. Were any analyses received outside of hold time? Yes / (No)

11. Any Subcontracting needed? Yes / (No)
    ESS Sample IDs:
    Analysis:
    TAT:
12. Were VOAs received? (Yes) / No
    a. Air bubbles in aqueous VOAs? Yes / (No)
    b. Does methanol cover soil completely? Yes / No / NA

13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

COC = MW-B01A 10/4/16 1815 Label = (ON HNO_3 Bottle) MW-B01C 1815 10/4/16
MS 10/5/16

14. Was there a need to contact Project Manager? (Yes) / No
    a. Was there a need to contact the client? Yes / No
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	71608	Yes	NA	Yes	1L Poly - Unpres	NP	
01	71614	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
01	71621	Yes	NA	Yes	250 mL Amber - Unpres	NP	
01	71649	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
01	71650	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
02	71607	Yes	NA	Yes	1L Poly - Unpres	NP	
02	71613	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
02	71620	Yes	NA	Yes	250 mL Amber - Unpres	NP	
02	71647	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
02	71648	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
03	71606	Yes	NA	Yes	1L Poly - Unpres	NP	
03	71612	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
03	71619	Yes	NA	Yes	250 mL Amber - Unpres	NP	
03	71645	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
03	71646	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
04	71605	Yes	NA	Yes	1L Poly - Unpres	NP	
04	71611	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
04	71618	Yes	NA	Yes	250 mL Amber - Unpres	NP	
04	71624	Yes	NA	Yes	250 mL Poly - Unpres	NP	
04	71627	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
04	71634	Yes	No	Yes	VOA Vial - HCl	HCL	
04	71635	Yes	No	Yes	VOA Vial - HCl	HCL	
04	71636	Yes	No	Yes	VOA Vial - HCl	HCL	
04	71643	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1610053
Date Received: 10/5/2016

04	71644	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
05	71604	Yes	NA	Yes	1L Poly - Unpres	NP
05	71617	Yes	NA	Yes	250 mL Amber - Unpres	NP
05	71641	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
05	71642	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
06	71603	Yes	NA	Yes	1L Poly - Unpres	NP
06	71610	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
06	71616	Yes	NA	Yes	250 mL Amber - Unpres	NP
06	71623	Yes	NA	Yes	250 mL Poly - Unpres	NP
06	71626	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
06	71631	Yes	No	Yes	VOA Vial - HCl	HCL
06	71632	Yes	No	Yes	VOA Vial - HCl	HCL
06	71633	Yes	No	Yes	VOA Vial - HCl	HCL
06	71639	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
06	71640	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
07	71602	Yes	NA	Yes	1L Poly - Unpres	NP
07	71609	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
07	71615	Yes	NA	Yes	250 mL Amber - Unpres	NP
07	71622	Yes	NA	Yes	250 mL Poly - Unpres	NP
07	71625	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
07	71628	Yes	No	Yes	VOA Vial - HCl	HCL
07	71629	Yes	No	Yes	VOA Vial - HCl	HCL
07	71630	Yes	No	Yes	VOA Vial - HCl	HCL
07	71637	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
07	71638	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4

2nd Review
Are barcode labels on correct containers? (Yes) No

Completed By: [signature] Date & Time: 10/5/16 1018

Reviewed By: [signature] Date & Time: 10/5/16 1036

Delivered By: [signature] 10/5/16 1039

ESS Laboratory

Division of Thielsch Engineering, Inc.

185 Frances Avenue, Cranston, RI 02910-2211

Tel. (401) 461-7181 Fax (401) 461-4486

www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1610053

Turn Time ______Standard Other______

Regulatory State: MA RI CT NH NJ NY ME Other______

Is this project for any of the following:(please circle)
MA-MCP Navy USACE CT DEP Other______

Reporting Limits - ______

Electonic Deliverables Excel Access PDF

Co. Name: AECOM		Project #:	Project Name: Orleans
Contact Person: Paul Dombrowski		Address: 250 Apollo DR	
City: Chelmsford	State: MA	Zip:	PO #:
Tel.	Fax.	email:	

ESS Lab ID	Date	Collection Time	Grab-G Composite-C	Matrix	Sample ID	Pres Code	# of Containers	Type of Container	Vol of Container	DOC	Amm TKN	TDT N NO3 SO4 Cl	Diss L mets	Tot met	methane				
1	10/04/16	1315	G	GW	MW-4		3			X	X	X							
2	10/04/16	1425	G	GW	MW-8		3			X	X	X							
3	10/04/16	1508	G	GW	MW-12		3			X	✓	X							
4	10/04/16	1610	G	GW	MW-B2100		8			X	X	X	X	X	X				
5	10/04/16	1703	G	GW	MW-BC1C		2			X		X							
6	10/04/16	1730	G	GW	MW-B[illegible]1C		8			X	X	X	X	X	X				
7	10/04/16	1815	G	GW	MW-BU1A		8			X	X	X	X	X	X				

Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA

Matrix: S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

Cooler Present ✓ Yes ____ No

Seals Intact ____ Yes ____ No NA: ✓

Cooler Temperature: 5.7°C 5.6°C 10/5/16

Internal Use Only

[✓] Pickup

[ ] Technician____

Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-______

Sampled by : TN cancelled for MW-BC1C mkm 10/7/16

Comments:

Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)
Bailey Morrell 10/05/16	[signature] 10/5/16	[signature] 10/5/16	[signature] 10/5/16 1003
Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)

* By circling MA-MCP, client acknowledges samples were collected in accordance with MADEP CAM VIIA

Please fax to the laboratory all changes to Chain of Custody

1 (White) Lab Copy

2 (Yellow) Client Receipt

ESS Laboratory

Division of Thielsch Engineering, Inc.

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Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF COUSTODY

ESS Lab # 1610053

Turn Time ______ Standard Other______

Regulatory State: MA RI CT NH NJ NY ME Other______

Is this project for any of the following:(please circle)
MA-MCP Navy USACE CT DEP Other______

Reporting Limits - ______

Electonic Deliverables Excel Access PDF

Co. Name: AECOM
Project #:
Project Name: Orleans
Contact Person: Paul Dombrowski
Address: 250 Apollo DR
City: Chelmsford
State: MA
Zip:
PO #:
Tel.:
Fax:
email:

ESS Lab ID	Date	Collection Time	Grab-G Composite-C	Matrix	Sample ID	Pres Code	# of Containers	Type of Container	Vol of Container	DOC	Amm TKN	TDT N NO3 SO4 Cl	Diss L Mets	Tot Met	Methane				
1	10/04/16	1315	G	GW	MW-4		3			X	X	X							
2	10/04/16	1425	G	GW	MW-8		3			X	X	X							
3	10/04/16	1508	G	GW	MW-12		3			X	✓	X							
4	10/04/16	1610	G	GW	MW-B2100		8			X	X	X	X	X	X				
5	10/04/16	1703	G	GW	MW-BC1C		2			X		X							
6	10/04/16	1730	G	GW	MW-BU1C		8			X	X	X	X	X	X				
7	10/04/16	1815	G	GW	MW-BU1A		8			X	X	X	X	X	X				

Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA

Matrix: S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

Cooler Present ✓ Yes ____ No

Seals Intact ____ Yes ____ No NA: ✓

Cooler Temperature: 5.7°C / 5.6°C 10/5/16

Internal Use Only
[✓] Pickup
[ ] Technician____

Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-______

Sampled by :

Comments:

Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)
Bailey Morrell 10/05/16	[signature] 10/5/16	[signature] 10/5/16	[signature] 10/5/16 1003
Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)

* By circling MA-MCP, client acknowledges samples were collected in accordance with MADEP CAM VIIA

Please fax to the laboratory all changes to Chain of Custody

1 (White) Lab Copy
2 (Yellow) Client Receipt

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644 task 08.2)
ESS Laboratory Work Order Number: 1611128

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 2:50 pm, Nov 14, 2016

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with NELAC Standards, A2LA and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611128

SAMPLE RECEIPT

The following samples were received on November 04, 2016 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1611128-01	MW-BU2A	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1611128-02	MW-12C (existing)	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038
1611128-03	MW-12A	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1611128-04	MW-12B	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1611128-05	MW-B1010C	Ground Water	350.1, 353.2, 4500N, 9250
1611128-06	MW-B2010C	Ground Water	350.1, 353.2, 4500N, 5310B, 9038, 9250
1611128-07	MW-BU2B	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250, RSK175
1611128-08	MW-BU2C	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250, RSK175
1611128-09	MW-B2050C	Ground Water	350.1, 353.2, 4500N, 5310B, 9038
1611128-10	MW-B2050B	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1611128-11	MW-B2050A	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1611128-12	MW-B2020B	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250, RSK175
1611128-13	MW-B2020C	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250, RSK175
1611128-14	MW-B2100 (existing)	Ground Water	350.1, 353.2, 4500N, 5310B, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611128

PROJECT NARRATIVE

Total Metals
CK60706-BSD1 **Blank Spike recovery is below lower control limit (B-).**
Boron (84% @ 85-115%)

No other observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611128

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2A
Date Sampled: 11/03/16 09:40
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**1.09** (0.050)		200.7		1	KJK	11/11/16 19:20	50	25	CK60706
Manganese	**0.180** (0.010)		200.7		1	KJK	11/11/16 19:20	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2A
Date Sampled: 11/03/16 09:40
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/11/16 17:57	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2A
Date Sampled: 11/03/16 09:40
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-01
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:15	mg/L	CK60830
Chloride	**103** (6.0)		9250		2	EEM	11/08/16 14:51	mg/L	CK60818
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	11/08/16 17:54	mg/L	[CALC]
Nitrate as N	**0.357** (0.030)		353.2		1	JLK	11/04/16 17:47	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	11/04/16 16:46	mg/L	CK60437
Sulfate	**7.2** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**0.357** (0.220)		4500N		1	JLK	11/09/16 16:56	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12C (existing)
Date Sampled: 11/03/16 10:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.050)		200.7		1	KJK	11/11/16 19:29	50	25	CK60706
Manganese	**0.020** (0.010)		200.7		1	KJK	11/11/16 19:29	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12C (existing)
Date Sampled: 11/03/16 10:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 16:40	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12C (existing)
Date Sampled: 11/03/16 10:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-02
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.11** (0.10)		350.1		1	EEM	11/09/16 12:16	mg/L	CK60830
Dissolved Organic Carbon (Average)	**0.870** (0.500)		5310B		1	DEL	11/08/16 19:55	mg/L	[CALC]
Nitrate as N	**6.51** (0.210)		353.2		10	JLK	11/04/16 18:13	mg/L	[CALC]
Sulfate	**9.3** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**6.51** (0.400)		4500N		10	JLK	11/09/16 16:58	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12A
Date Sampled: 11/03/16 11:05
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.700** (0.050)		200.7		1	KJK	11/11/16 19:42	50	25	CK60706
Manganese	**0.325** (0.010)		200.7		1	KJK	11/11/16 19:42	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12A
Date Sampled: 11/03/16 11:05
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 16:44	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12A
Date Sampled: 11/03/16 11:05
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-03
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:17	mg/L	CK60830
Chloride	**190** (15.0)		9250		5	EEM	11/08/16 14:52	mg/L	CK60818
Dissolved Organic Carbon (Average)	**0.550** (0.500)		5310B		1	DEL	11/08/16 20:08	mg/L	[CALC]
Nitrate as N	**0.783** (0.030)		353.2		1	JLK	11/04/16 17:51	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	11/04/16 16:50	mg/L	CK60437
Sulfate	**10.0** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**1.00** (0.220)		4500N		1	JLK	11/09/16 16:59	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12B
Date Sampled: 11/03/16 11:35
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.360** (0.050)		200.7		1	KJK	11/11/16 19:46	50	25	CK60706
Manganese	**0.228** (0.010)		200.7		1	KJK	11/11/16 19:46	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12B
Date Sampled: 11/03/16 11:35
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 16:48	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12B
Date Sampled: 11/03/16 11:35
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-04
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:18	mg/L	CK60830
Chloride	**34.1** (3.0)		9250		1	EEM	11/08/16 14:47	mg/L	CK60818
Dissolved Organic Carbon (Average)	**1.82** (0.500)		5310B		1	DEL	11/08/16 20:22	mg/L	[CALC]
Nitrate as N	**6.17** (0.210)		353.2		10	JLK	11/04/16 18:14	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	11/04/16 16:50	mg/L	CK60437
Sulfate	**9.8** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**6.44** (0.400)		4500N		10	JLK	11/09/16 16:59	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1010C
Date Sampled: 11/03/16 12:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-05
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:36	mg/L	CK60830
Chloride	**27.5** (3.0)		9250		1	EEM	11/08/16 14:48	mg/L	CK60818
Nitrate as N	**13.6** (0.410)		353.2		20	JLK	11/04/16 18:15	mg/L	[CALC]
Total Nitrogen	**13.9** (0.600)		4500N		20	JLK	11/09/16 17:00	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2010C
Date Sampled: 11/03/16 13:00
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-06
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.14** (0.10)		350.1		1	EEM	11/09/16 12:37	mg/L	CK60830
Chloride	**38.6** (3.0)		9250		1	EEM	11/08/16 15:06	mg/L	CK60819
Dissolved Organic Carbon (Average)	**2.18** (0.500)		5310B		1	DEL	11/08/16 20:35	mg/L	[CALC]
Nitrate as N	**15.7** (0.410)		353.2		20	JLK	11/04/16 18:17	mg/L	[CALC]
Sulfate	**11.0** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**16.1** (0.600)		4500N		20	JLK	11/09/16 17:01	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2B
Date Sampled: 11/03/16 13:50
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.667** (0.050)		200.7		1	KJK	11/11/16 19:50	50	25	CK60706
Manganese	**0.088** (0.010)		200.7		1	KJK	11/11/16 19:50	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2B
Date Sampled: 11/03/16 13:50
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 16:52	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2B
Date Sampled: 11/03/16 13:50
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-07
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:37	mg/L	CK60830
Chloride	**97.3** (3.0)		9250		1	EEM	11/08/16 15:09	mg/L	CK60819
Dissolved Organic Carbon (Average)	**0.612** (0.500)		5310B		1	DEL	11/08/16 20:47	mg/L	[CALC]
Nitrate as N	**1.06** (0.050)		353.2		2	JLK	11/04/16 18:18	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	11/04/16 16:55	mg/L	CK60437
Sulfate	ND (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**1.06** (0.240)		4500N		2	JLK	11/09/16 17:04	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2B
Date Sampled: 11/03/16 13:50
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-07
Sample Matrix: Ground Water
Units: ug/L
Analyst: DPS
Prepared: 11/4/16 15:00

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	DPS	11/04/16 20:10	CZK0098	CK60452

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2C
Date Sampled: 11/03/16 14:25
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-08
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.817** (0.050)		200.7		1	KJK	11/11/16 19:54	50	25	CK60706
Manganese	**0.260** (0.010)		200.7		1	KJK	11/11/16 19:54	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2C
Date Sampled: 11/03/16 14:25
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-08
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 16:56	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2C
Date Sampled: 11/03/16 14:25
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-08
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:38	mg/L	CK60830
Chloride	**134** (15.0)		9250		5	EEM	11/08/16 15:40	mg/L	CK60819
Dissolved Organic Carbon (Average)	**0.684** (0.500)		5310B		1	DEL	11/08/16 21:28	mg/L	[CALC]
Nitrate as N	**5.39** (0.210)		353.2		10	JLK	11/04/16 18:19	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	11/04/16 16:56	mg/L	CK60437
Sulfate	ND (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**5.39** (0.400)		4500N		10	JLK	11/09/16 17:04	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2C
Date Sampled: 11/03/16 14:25
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-08
Sample Matrix: Ground Water
Units: ug/L
Analyst: DPS
Prepared: 11/4/16 15:00

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	DPS	11/04/16 20:30	CZK0098	CK60452

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2050C
Date Sampled: 11/03/16 15:40
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-09
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.11** (0.10)		350.1		1	EEM	11/09/16 12:39	mg/L	CK60830
Dissolved Organic Carbon (Average)	**1.13** (0.500)		5310B		1	DEL	11/08/16 21:38	mg/L	[CALC]
Nitrate as N	**3.01** (0.110)		353.2		5	JLK	11/04/16 18:20	mg/L	[CALC]
Sulfate	**11.9** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**3.30** (0.300)		4500N		5	JLK	11/09/16 17:05	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2050B
Date Sampled: 11/03/16 16:00
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-10
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.551** (0.050)		200.7		1	KJK	11/11/16 20:11	50	25	CK60706
Manganese	**0.258** (0.010)		200.7		1	KJK	11/11/16 20:11	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2050B
Date Sampled: 11/03/16 16:00
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-10
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 17:01	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2050B
Date Sampled: 11/03/16 16:00
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-10
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:40	mg/L	CK60830
Chloride	**123** (15.0)		9250		5	EEM	11/08/16 15:43	mg/L	CK60819
Dissolved Organic Carbon (Average)	**1.15** (0.500)		5310B		1	DEL	11/08/16 21:51	mg/L	[CALC]
Nitrate as N	**4.75** (0.210)		353.2		10	JLK	11/04/16 18:23	mg/L	[CALC]
Sulfate	**11.5** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**5.15** (0.400)		4500N		10	JLK	11/09/16 17:06	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2050A
Date Sampled: 11/03/16 16:25
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-11
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**3.20** (0.050)		200.7		1	KJK	11/11/16 20:15	50	25	CK60706
Manganese	**0.407** (0.010)		200.7		1	KJK	11/11/16 20:15	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2050A
Date Sampled: 11/03/16 16:25
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-11
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 17:34	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2050A
Date Sampled: 11/03/16 16:25
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-11
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**1.05** (0.10)		350.1		1	EEM	11/09/16 12:41	mg/L	CK60830
Chloride	**49.9** (3.0)		9250		1	EEM	11/08/16 15:14	mg/L	CK60819
Dissolved Organic Carbon (Average)	**1.61** (0.500)		5310B		1	DEL	11/08/16 22:03	mg/L	[CALC]
Nitrate as N	**35.0** (2.01)		353.2		100	JLK	11/04/16 18:35	mg/L	[CALC]
Sulfate	**5.6** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**35.3** (2.20)		4500N		100	JLK	11/09/16 17:07	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020B
Date Sampled: 11/03/16 16:55
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-12
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**1.20** (0.050)		200.7		1	KJK	11/11/16 20:19	50	25	CK60706
Manganese	**0.126** (0.010)		200.7		1	KJK	11/11/16 20:19	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020B
Date Sampled: 11/03/16 16:55
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-12
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 17:38	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020B
Date Sampled: 11/03/16 16:55
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-12
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.10** (0.10)		350.1		1	EEM	11/09/16 12:42	mg/L	CK60830
Chloride	**32.5** (3.0)		9250		1	EEM	11/08/16 15:19	mg/L	CK60819
Dissolved Organic Carbon (Average)	**1.45** (0.500)		5310B		1	DEL	11/08/16 22:15	mg/L	[CALC]
Nitrate as N	**16.9** (0.410)		353.2		20	JLK	11/04/16 18:25	mg/L	[CALC]
Nitrite as N	**0.022** (0.010)		353.2		1	JLK	11/04/16 17:00	mg/L	CK60437
Sulfate	**7.7** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**17.2** (0.600)		4500N		20	JLK	11/09/16 17:07	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020B
Date Sampled: 11/03/16 16:55
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-12
Sample Matrix: Ground Water
Units: ug/L
Analyst: DPS
Prepared: 11/4/16 15:00

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	DPS	11/04/16 20:43	CZK0098	CK60452

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020C
Date Sampled: 11/03/16 17:15
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-13
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**1.42** (0.050)		200.7		1	KJK	11/11/16 20:29	50	25	CK60706
Manganese	**1.14** (0.010)		200.7		1	KJK	11/11/16 20:29	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020C
Date Sampled: 11/03/16 17:15
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-13
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/12/16 17:42	50	25	CK60706

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020C
Date Sampled: 11/03/16 17:15
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-13
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.24** (0.10)		350.1		1	EEM	11/09/16 12:43	mg/L	CK60830
Chloride	**26.8** (3.0)		9250		1	EEM	11/08/16 15:20	mg/L	CK60819
Dissolved Organic Carbon (Average)	**1.17** (0.500)		5310B		1	DEL	11/08/16 22:54	mg/L	[CALC]
Nitrate as N	**8.71** (0.210)		353.2		10	JLK	11/04/16 18:26	mg/L	[CALC]
Nitrite as N	**0.016** (0.010)		353.2		1	JLK	11/04/16 17:01	mg/L	CK60437
Sulfate	**11.6** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**9.02** (0.400)		4500N		10	JLK	11/09/16 17:08	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020C
Date Sampled: 11/03/16 17:15
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-13
Sample Matrix: Ground Water
Units: ug/L
Analyst: DPS
Prepared: 11/4/16 15:00

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	DPS	11/04/16 20:50	CZK0098	CK60452

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2100 (existing)
Date Sampled: 11/03/16 17:50
Percent Solids: N/A

ESS Laboratory Work Order: 1611128
ESS Laboratory Sample ID: 1611128-14
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:44	mg/L	CK60830
Chloride	**67.8** (3.0)		9250		1	EEM	11/08/16 15:21	mg/L	CK60819
Dissolved Organic Carbon (Average)	**0.866** (0.500)		5310B		1	DEL	11/08/16 23:06	mg/L	[CALC]
Nitrate as N	**1.29** (0.110)		353.2		5	JLK	11/04/16 18:27	mg/L	[CALC]
Sulfate	**16.2** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**1.29** (0.300)		4500N		5	JLK	11/09/16 17:09	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611128

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Dissolved Metals										
Batch CK60706 - 3005A										
Blank										
Iron	ND	0.050	mg/L							
Manganese	ND	0.010	mg/L							
LCS										
Iron	1.12	0.050	mg/L	1.250		89	80-120			
Manganese	0.227	0.010	mg/L	0.2500		91	80-120			
LCS Dup										
Iron	1.17	0.050	mg/L	1.250		94	80-120	5	20	
Manganese	0.240	0.010	mg/L	0.2500		96	80-120	6	20	
Total Metals										
Batch CK60706 - 3005A										
Blank										
Boron	ND	0.050	mg/L							
LCS										
Boron	0.219	0.050	mg/L	0.2500		88	85-115			
LCS Dup										
Boron	0.211	0.050	mg/L	0.2500		84	85-115	4	20	B-
Classical Chemistry										
Batch CK60437 - [CALC]										
Blank										
Nitrate as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.263		mg/L	0.2497		105	90-110			
Nitrite as N	0.263		mg/L	0.2497		105	90-110			
Batch CK60438 - [CALC]										
Blank										
Nitrate as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Total Nitrogen	ND	0.020	mg/L							
LCS										
Nitrate as N	0.466		mg/L							
Nitrate/Nitrite as N	0.466		mg/L	0.5000		93	90-110			
Nitrate/Nitrite as N	0.466		mg/L	0.5000		93	90-110			
Total Nitrogen	0.466		mg/L							
Batch CK60818 - General Preparation										

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611128

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CK60818 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	32.6		mg/L	30.00		109	90-110			
Batch CK60819 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	28.7		mg/L	30.00		96	90-110			
Batch CK60822 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.5		mg/L	9.988		95	85-115			
Batch CK60825 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.200	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	9.90	1.00	mg/L	9.810		101	80-120			
Total Nitrogen	9.90	1.00	mg/L							
Batch CK60830 - General Preparation										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.10	0.10	mg/L	0.09994		95	80-120			
LCS										
Ammonia as N	0.97	0.10	mg/L	0.9994		97	80-120			
Batch CK60844 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	4.51	0.500	mg/L	5.000		90	80-120			
Dissolved Organic Carbon (2)	4.82	0.500	mg/L	5.000		96	80-120			
Dissolved Organic Carbon (Average)	4.66	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.58	0.500	mg/L	5.000		92	80-120	2	200	
Dissolved Organic Carbon (2)	4.75	0.500	mg/L	5.000		95	80-120	1	200	
Dissolved Organic Carbon (Average)	4.67	0.500	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611128

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Methane / Ethane / Ethene by Headspace GCFID (RSK175)										
Batch CK60452 - No Prep										
Blank										
Methane	ND	2.0	ug/L							
LCS										
Methane	27.6		ug/L	36.00		77	60-140			
LCS Dup										
Methane	26.6		ug/L	36.00		74	60-140	4	30	

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611128

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
B-	Blank Spike recovery is below lower control limit (B-).
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611128

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/documents/AllLabs.xls

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.depweb.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1611128
Date Received: 11/4/2016
Project Due Date: 11/11/2016
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 4.6 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** (Yes) / No / NA
10. Were any analyses received outside of hold time? Yes / (No)

11. Any Subcontracting needed? Yes / (No)
    ESS Sample IDs:
    Analysis:
    TAT:
12. Were VOAs received? (Yes) / No
    a. Air bubbles in aqueous VOAs? Yes / (No)
    b. Does methanol cover soil completely? Yes / No / NA

13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / (No)
    a. Was there a need to contact the client? Yes / (No)
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	80966	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
01	80980	Yes	NA	Yes	1L Poly - Unpres	NP	
01	80994	Yes	NA	Yes	250 mL Poly - Unpres	NP	
01	81008	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
01	81022	Yes	NA	Yes	250 mL Amber - Unpres	NP	
01	81061	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
01	81062	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
02	80965	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
02	80979	Yes	NA	Yes	1L Poly - Unpres	NP	
02	80993	Yes	NA	Yes	250 mL Poly - Unpres	NP	
02	81007	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
02	81021	Yes	NA	Yes	250 mL Amber - Unpres	NP	
02	81059	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
02	81060	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
03	80964	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
03	80978	Yes	NA	Yes	1L Poly - Unpres	NP	
03	80992	Yes	NA	Yes	250 mL Poly - Unpres	NP	
03	81006	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
03	81020	Yes	NA	Yes	250 mL Amber - Unpres	NP	
03	81057	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
03	81058	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
04	80963	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
04	80977	Yes	NA	Yes	1L Poly - Unpres	NP	
04	80991	Yes	NA	Yes	250 mL Poly - Unpres	NP	

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1611128

Date Received: 11/4/2016

04	81005	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
04	81019	Yes	NA	Yes	250 mL Amber - Unpres	NP
04	81055	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
04	81056	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
05	80962	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
05	80976	Yes	NA	Yes	1L Poly - Unpres	NP
06	80961	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
06	80975	Yes	NA	Yes	1L Poly - Unpres	NP
06	80989	Yes	NA	Yes	250 mL Amber - Unpres	NP
06	81051	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
06	81052	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
07	80960	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
07	80974	Yes	NA	Yes	1L Poly - Unpres	NP
07	80988	Yes	NA	Yes	250 mL Poly - Unpres	NP
07	81002	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
07	81016	Yes	NA	Yes	250 mL Amber - Unpres	NP
07	81032	Yes	No	Yes	VOA Vial - HCl	HCl
07	81033	Yes	No	Yes	VOA Vial - HCl	HCl
07	81034	Yes	No	Yes	VOA Vial - HCl	HCl
07	81049	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
07	81050	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
08	80959	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
08	80973	Yes	NA	Yes	1L Poly - Unpres	NP
08	80987	Yes	NA	Yes	250 mL Poly - Unpres	NP
08	81001	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
08	81015	Yes	NA	Yes	250 mL Amber - Unpres	NP
08	81029	Yes	No	Yes	VOA Vial - HCl	HCl
08	81030	Yes	No	Yes	VOA Vial - HCl	HCl
08	81031	Yes	No	Yes	VOA Vial - HCl	HCl
08	81047	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
08	81048	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
09	80958	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
09	80972	Yes	NA	Yes	1L Poly - Unpres	NP
09	80986	Yes	NA	Yes	250 mL Amber - Unpres	NP
09	81045	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
09	81046	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
10	80957	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
10	80971	Yes	NA	Yes	1L Poly - Unpres	NP
10	80985	Yes	NA	Yes	250 mL Poly - Unpres	NP
10	80999	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
10	81013	Yes	NA	Yes	250 mL Amber - Unpres	NP
10	81043	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
10	81044	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
11	80956	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
11	80970	Yes	NA	Yes	1L Poly - Unpres	NP
11	80984	Yes	NA	Yes	250 mL Poly - Unpres	NP
11	80998	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
11	81012	Yes	NA	Yes	250 mL Amber - Unpres	NP
11	81041	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
11	81042	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
12	80955	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
12	80969	Yes	NA	Yes	1L Poly - Unpres	NP
12	80983	Yes	NA	Yes	250 mL Poly - Unpres	NP
12	80997	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
12	81011	Yes	NA	Yes	250 mL Amber - Unpres	NP
12	81026	Yes	No	Yes	VOA Vial - HCl	HCl
12	81027	Yes	No	Yes	VOA Vial - HCl	HCl
12	81028	Yes	No	Yes	VOA Vial - HCl	HCl
12	81039	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
12	81040	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
13	80954	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
13	80968	Yes	NA	Yes	1L Poly - Unpres	NP
13	80982	Yes	NA	Yes	250 mL Poly - Unpres	NP
13	80996	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
13	81010	Yes	NA	Yes	250 mL Amber - Unpres	NP
13	81023	Yes	No	Yes	VOA Vial - HCl	HCl
13	81024	Yes	No	Yes	VOA Vial - HCl	HCl
13	81025	Yes	No	Yes	VOA Vial - HCl	HCl
13	81037	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
13	81038	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1611128

Date Received: 11/4/2016

14	80953	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
14	80967	Yes	NA	Yes	1L Poly - Unpres	NP
14	81009	Yes	NA	Yes	250 mL Amber - Unpres	NP
14	81035	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
14	81036	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4

2nd Review

Are barcode labels on correct containers? (Yes / No)

Completed By: _____ Date & Time: 11/4/16 0834

Reviewed By: _____ Date & Time: 11/4/16 0902

Delivered By: _____ 11/4/16 0913

Katahdin ANALYTICAL SERVICES

600 Technology Way
Scarborough, ME 04074
Tel: (207) 874-2400
Fax: (207) 775-4029

CHAIN of CUSTODY 1611128

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

Page ____ of ____

Client: Orleans	Contact: Mark Owen	Phone #: (508) 8336964	Fax #: ( )
Address: 9 Jonathan Bourne Dr	City: Pocasset	State: MA	Zip Code:
Purchase Order #	Proj. Name / No.: Orleans PRB		Katahdin Quote #
Bill (if different than above)	Address		
Sampler (Print / Sign): Brileymorrill			Copies To:

LAB USE ONLY — WORK ORDER #: ____ KATAHDIN PROJECT NUMBER ____

REMARKS: ____

SHIPPING INFO: ☐ FED EX ☐ UPS ☐ CLIENT

AIRBILL NO: ____

TEMP°C ____ ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

ANALYSIS AND CONTAINER TYPE PRESERVATIVES

★	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	Filt. Y N Total N	Filt. Y N Nitrate	Filt. Y N Ammonia	Filt. Y N Nitrite	Filt. Y N Metals	Filt. Y N DOC	Filt. Y N Sulfate	Filt. Y N methane	Filt. Y N Chloride	Filt. Y N
1	MW-BU2A	11/03/16/0940	GW	5	X	X	X	X	X	X	X		X	
2	MW-12C(existing)	11/03/16/1020	GW		X	X	X		X	X	X			
3	MW-12A	11/03/16/1105	GW	5	X	X	X	X	X	X	X	X	X	
4	MW-12B	11/03/16/1135	GW	5	X	X	X	X	X	X	X	BM X	X	
5	MW-B1010C	11/03/16/1220	GW		X	X	X						X	
6	MW-B2010C	11/03/16/1300	GW		X	X	X			X	X		X	
7	MW-BU2B	11/03/16/1350	GW	8	X	X	X	X	X	X	X	X	X	
8	MW-BU2C	11/03/16/1425	GW	8	X	X	X	X	X	X	X	X	X	
9	MW-B2050C	11/03/16/1540	GW		X	X	X			X	X			
10	MW-B2050B	11/03/16/1600	GW		X	X	X		X	X	X		X	
11	MW-B2050A	11/03/16/1625	GW		X	X	X		X	X	X		X	
12	MW-B2020B	11/03/16/1655	GW	8	X	X	X	X	X	X	X	X	X	
13	MW-B2020C	11/03/16/1715	GW	8	X	X	X	X	X	X	X	X	X	
14	MW-B2100 (existing)	11/03/16/1750	GW	3	X	X	X			X	X		X	
		/												
		/												

COMMENTS 4.6°C Ice ISP3 8/15 11/4/16

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
Brileymorrill	11/04/16 0650	JCP	JCP	11/4/16 8/15	11/4/16 0820
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

THE TERMS AND CONDITIONS ON THE REVERSE SIDE HEREOF SHALL GOVERN SERVICES, EXCEPT WHEN A SIGNED CONTRACTUAL AGREEMENT EXISTS.

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644 task 08.2)
ESS Laboratory Work Order Number: 1611165

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 12:02 pm, Nov 22, 2016

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with NELAC Standards, A2LA and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611165

SAMPLE RECEIPT

The following samples were received on November 04, 2016 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

The dissolved samples for Iron and Manganese were filtered outside of the recommended holding time.

Lab Number	Sample Name	Matrix	Analysis
1611165-01	MW-B1020B	Ground Water	200.7, 350.1, 353.2, 4500N, 9250
1611165-02	MW-B1020C	Ground Water	200.7, 350.1, 353.2, 4500N, 9250
1611165-03	MW-B1050A	Ground Water	200.7, 350.1, 353.2, 4500N, 9250
1611165-04	MW-B1050B	Ground Water	200.7, 350.1, 353.2, 4500N, 9250
1611165-05	MW-B1050C	Ground Water	200.7, 350.1, 353.2, 4500N, 9250
1611165-06	MW-B1075B	Ground Water	350.1, 353.2, 4500N, 9250
1611165-07	MW-BC2C	Ground Water	350.1, 353.2, 4500N, 5310B, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611165

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611165

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020B
Date Sampled: 11/04/16 09:35
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**2.52** (0.100)		200.7		1	NAR	11/21/16 14:54	10	10	CK61436
Manganese	**0.948** (0.020)		200.7		1	NAR	11/21/16 14:54	10	10	CK61436

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020B
Date Sampled: 11/04/16 09:35
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/11/16 1:14	50	25	CK60705
Sodium	**27.5** (2.50)		200.7		1	KJK	11/11/16 1:14	50	25	CK60705

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020B
Date Sampled: 11/04/16 09:35
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-01
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.53** (0.10)		350.1		1	EEM	11/09/16 12:53	mg/L	CK60830
Chloride	**49.8** (3.0)		9250		1	EEM	11/08/16 15:34	mg/L	CK60819
Nitrate as N	**28.4** (1.01)		353.2		50	JLK	11/04/16 21:09	mg/L	[CALC]
Total Nitrogen	**28.5** (1.20)		4500N		50	JLK	11/09/16 17:09	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020C
Date Sampled: 11/04/16 10:10
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**2.23** (0.100)		200.7		1	NAR	11/21/16 14:59	10	10	CK61436
Manganese	**0.249** (0.020)		200.7		1	NAR	11/21/16 14:59	10	10	CK61436

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020C
Date Sampled: 11/04/16 10:10
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	**0.085** (0.050)		200.7		1	KJK	11/11/16 1:18	50	25	CK60705
Sodium	**13.4** (2.50)		200.7		1	KJK	11/11/16 1:18	50	25	CK60705

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020C
Date Sampled: 11/04/16 10:10
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-02
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	EEM	11/09/16 12:54	mg/L	CK60830
Chloride	**25.5** (3.0)		9250		1	EEM	11/08/16 15:35	mg/L	CK60819
Nitrate as N	**10.6** (0.410)		353.2		20	JLK	11/04/16 21:10	mg/L	[CALC]
Total Nitrogen	**10.6** (0.60)		4500N		20	JLK	11/09/16 17:10	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050A
Date Sampled: 11/04/16 10:55
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**4.29** (0.100)		200.7		1	NAR	11/21/16 15:03	10	10	CK61436
Manganese	**0.655** (0.020)		200.7		1	NAR	11/21/16 15:03	10	10	CK61436

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050A
Date Sampled: 11/04/16 10:55
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/11/16 1:22	50	25	CK60705
Sodium	**33.7** (2.50)		200.7		1	KJK	11/11/16 1:22	50	25	CK60705

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050A
Date Sampled: 11/04/16 10:55
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-03
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**1.93** (0.10)		350.1		1	EEM	11/09/16 12:54	mg/L	CK60830
Chloride	**54.8** (3.0)		9250		1	EEM	11/08/16 15:36	mg/L	CK60819
Nitrate as N	**37.0** (1.01)		353.2		50	JLK	11/04/16 21:11	mg/L	[CALC]
Total Nitrogen	**37.2** (1.20)		4500N		50	JLK	11/09/16 17:13	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050B
Date Sampled: 11/04/16 11:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.734** (0.100)		200.7		1	NAR	11/21/16 15:07	10	10	CK61436
Manganese	**0.332** (0.020)		200.7		1	NAR	11/21/16 15:07	10	10	CK61436

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050B
Date Sampled: 11/04/16 11:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/11/16 1:26	50	25	CK60705
Sodium	**26.8** (2.50)		200.7		1	KJK	11/11/16 1:26	50	25	CK60705

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050B
Date Sampled: 11/04/16 11:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-04
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.19** (0.10)		350.1		1	EEM	11/09/16 12:55	mg/L	CK60830
Chloride	**48.2** (3.0)		9250		1	EEM	11/08/16 15:37	mg/L	CK60819
Nitrate as N	**25.7** (1.01)		353.2		50	JLK	11/04/16 21:12	mg/L	[CALC]
Total Nitrogen	**26.0** (1.20)		4500N		50	JLK	11/09/16 17:14	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050C
Date Sampled: 11/04/16 11:45
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-05
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.493** (0.100)		200.7		1	NAR	11/21/16 15:11	10	10	CK61436
Manganese	**0.146** (0.020)		200.7		1	NAR	11/21/16 15:11	10	10	CK61436

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050C
Date Sampled: 11/04/16 11:45
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-05
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A
All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Boron	ND (0.050)		200.7		1	KJK	11/11/16 1:30	50	25	CK60705
Sodium	**81.6** (2.50)		200.7		1	KJK	11/11/16 1:30	50	25	CK60705

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050C
Date Sampled: 11/04/16 11:45
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-05
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	JLK	11/10/16 19:42	mg/L	CK61032
Chloride	**141** (6.0)		9250		2	EEM	11/08/16 15:55	mg/L	CK60819
Nitrate as N	**3.83** (0.210)		353.2		10	JLK	11/04/16 21:13	mg/L	[CALC]
Total Nitrogen	**4.05** (0.40)		4500N		10	JLK	11/09/16 17:14	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1075B
Date Sampled: 11/04/16 12:40
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-06
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**3.73** (0.10)		350.1		1	JLK	11/10/16 19:45	mg/L	CK61032
Chloride	**96.3** (3.0)		9250		1	EEM	11/08/16 15:39	mg/L	CK60819
Nitrate as N	**1.93** (0.110)		353.2		5	JLK	11/04/16 21:14	mg/L	[CALC]
Total Nitrogen	**6.36** (0.30)		4500N		5	JLK	11/09/16 17:15	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BC2C
Date Sampled: 11/04/16 14:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611165
ESS Laboratory Sample ID: 1611165-07
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	ND (0.10)		350.1		1	JLK	11/10/16 19:45	mg/L	CK61032
Chloride	**83.8** (3.0)		9250		1	EEM	11/08/16 16:09	mg/L	CK60820
Dissolved Organic Carbon (Average)	**0.764** (0.500)		5310B		1	DEL	11/08/16 23:31	mg/L	[CALC]
Nitrate as N	**4.16** (0.210)		353.2		10	JLK	11/04/16 21:15	mg/L	[CALC]
Sulfate	**6.4** (5.0)		9038		1	EEM	11/08/16 17:00	mg/L	CK60822
Total Nitrogen	**4.43** (0.40)		4500N		10	JLK	11/09/16 17:17	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611165

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Dissolved Metals										
Batch CK61436 - 200.7/6010BNoDigest										
Blank										
Iron	ND	0.100	mg/L							
Manganese	ND	0.020	mg/L							
Total Metals										
Batch CK60705 - 3005A										
Blank										
Boron	ND	0.050	mg/L							
Sodium	ND	2.50	mg/L							
LCS										
Boron	0.246	0.050	mg/L	0.2500		98	85-115			
Sodium	12.6	2.50	mg/L	12.50		101	85-115			
LCS Dup										
Boron	0.240	0.050	mg/L	0.2500		96	85-115	3	20	
Sodium	12.0	2.50	mg/L	12.50		96	85-115	5	20	
Classical Chemistry										
Batch CK60450 - [CALC]										
Blank										
Nitrate as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.267		mg/L	0.2497		107	90-110			
Batch CK60451 - [CALC]										
Blank										
Nitrate as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Total Nitrogen	ND	0.02	mg/L							
LCS										
Nitrate as N	0.478		mg/L							
Nitrate/Nitrite as N	0.478		mg/L	0.5000		96	90-110			
Nitrate/Nitrite as N	0.478		mg/L	0.5000		96	90-110			
Total Nitrogen	0.478		mg/L							
Batch CK60819 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	28.7		mg/L	30.00		96	90-110			
Batch CK60820 - General Preparation										

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611165

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CK60820 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	28.8		mg/L	30.00		96	90-110			
Batch CK60822 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.5		mg/L	9.988		95	85-115			
Batch CK60825 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.20	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	9.90	1.00	mg/L	9.810		101	80-120			
Total Nitrogen	9.90	1.00	mg/L							
Batch CK60826 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.20	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	10.1	1.00	mg/L	9.810		103	80-120			
Total Nitrogen	10.1	1.00	mg/L							
Batch CK60830 - General Preparation										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.10	0.10	mg/L	0.09994		95	80-120			
LCS										
Ammonia as N	0.97	0.10	mg/L	0.9994		97	80-120			
Batch CK60844 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	4.51	0.500	mg/L	5.000		90	80-120			
Dissolved Organic Carbon (2)	4.82	0.500	mg/L	5.000		96	80-120			
Dissolved Organic Carbon (Average)	4.66	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.58	0.500	mg/L	5.000		92	80-120	2	200	

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611165

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CK60844 - General Preparation										
Dissolved Organic Carbon (2)	4.75	0.500	mg/L	5.000		95	80-120	1	200	
Dissolved Organic Carbon (Average)	4.67	0.500	mg/L							
Batch CK61032 - NH4 Prep										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.08	0.10	mg/L	0.09994		83	80-120			
LCS										
Ammonia as N	1.18	0.10	mg/L	0.9994		118	80-120			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611165

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611165

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/documents/AllLabs.xls

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.depweb.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1611165
Date Received: 11/4/2016
Project Due Date: 11/11/2016
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? NA
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 0.9 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** (Yes) / No / NA
10. Were any analyses received outside of hold time? Yes / (No)

11. Any Subcontracting needed? Yes / (No)
    ESS Sample IDs:
    Analysis:
    TAT:
12. Were VOAs received? Yes / (No)
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / (NA)

13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / (No)
    a. Was there a need to contact the client? Yes / No
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	81312	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
01	81319	Yes	NA	Yes	1L Poly - Unpres	NP	
01	81324	Yes	NA	Yes	250 mL Poly - Unpres	NP	
01	81329	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
02	81311	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
02	81318	Yes	NA	Yes	1L Poly - Unpres	NP	
02	81323	Yes	NA	Yes	250 mL Poly - Unpres	NP	
02	81328	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
03	81310	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
03	81317	Yes	NA	Yes	1L Poly - Unpres	NP	
03	81322	Yes	NA	Yes	250 mL Poly - Unpres	NP	
03	81327	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
04	81309	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
04	81316	Yes	NA	Yes	1L Poly - Unpres	NP	
04	81321	Yes	NA	Yes	250 mL Poly - Unpres	NP	
04	81326	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
05	81308	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
05	81315	Yes	NA	Yes	1L Poly - Unpres	NP	
05	81320	Yes	NA	Yes	250 mL Poly - Unpres	NP	
05	81325	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
06	81307	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
06	81314	Yes	NA	Yes	1L Poly - Unpres	NP	
07	81306	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
07	81313	Yes	NA	Yes	1L Poly - Unpres	NP	

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1611165
Date Received: 11/4/2016

07	81330	Yes	NA	Yes	250 mL Amber - Unpres	NP
07	81357	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4
07	81358	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4

2nd Review
Are barcode labels on correct containers? (Yes) / No

Completed By: _____ Date & Time: 11/4/16 1819

Reviewed By: _____ Date & Time: 11/4/16 1825

Delivered By: _____ 11/4/16 1825

Katahdin ANALYTICAL SERVICES

600 Technology Way
Scarborough, ME 04074
Tel: (207) 874-2400
Fax: (207) 775-4029

CHAIN of CUSTODY 161165

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

Page 1 of 1

Client: AECOM	Contact: Markowen	Phone #: (508) 833-6961	Fax #: ( )
Address: 9 Jonathan Bourne Dr	City: Pocasset	State: MA	Zip Code: 02559
Purchase Order #	Proj. Name / No.: Orleans PRB		Katahdin Quote #
Bill (if different than above)	Address		
Sampler (Print / Sign): Briley Morrill Briley Morrill			Copies To:

LAB USE ONLY — WORK ORDER #:

KATAHDIN PROJECT NUMBER

REMARKS:

SHIPPING INFO: ☐ FED EX ☐ UPS ☐ CLIENT

AIRBILL NO:

TEMP°C ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

ANALYSIS AND CONTAINER TYPE PRESERVATIVES

★	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	Filt. Y N — Total N Nitrate BM	Filt. Y N — Nitrate	Filt. Y N — Ammonia	Filt. Y N — DOC	Filt. Y N — Metals	Filt. Y N — Chloride	Filt. Y N — Surface	Filt. Y N	Filt. Y N	Filt. Y N
1	MW-B1020B	11/04/16/ 0935	GW	4	X	X	X		X	X				
2	MW-B1020C	11/04/16/ 1010	GW	4	X	X	X		X	X				
3	MW-B1050A	11/04/16/ 1055	GW	4	X	X	X		X	X				
4	MW-B1050B	11/04/16 1120	GW	4	X	X	X		X	X				
5	MW-B1050C	11/04/16/ 1145	GW	4	X	X	X		X	X				
6	MW-B1075B	11/04/16/ 1240	GW	2	X	X	X			X				
7	MW-BC2C	11/04/16 1420	GW	3	X	X	X	X		X	X			

BRM 11/04/16

COMMENTS

MW-BC2B well NOT installed, so NOT sampled

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
Briley Morrill	11/04/16 1100	11/4/16 16:00		11/4/16 17:48	11/4/16 18:14
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

Temp 0.9 Ice

THE TERMS AND CONDITIONS ON THE REVERSE SIDE HEREOF SHALL GOVERN SERVICES, EXCEPT WHEN A SIGNED CONTRACTUAL AGREEMENT EXISTS.

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644 task)
ESS Laboratory Work Order Number: 1611560

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 11:27 am, Nov 29, 2016

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with NELAC Standards, A2LA and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611560

SAMPLE RECEIPT

The following samples were received on November 18, 2016 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1611560-01	MW-B1010C	Ground Water	2320B, 5310B
1611560-02	MW-12 (Existing)	Ground Water	2320B, 5310B
1611560-03	MW-B1020C	Ground Water	2320B, 5310B
1611560-04	MW-B2010C	Ground Water	2320B, 5310B
1611560-05	MW-B2020B	Ground Water	2320B, 5310B
1611560-06	MW-BC2C	Ground Water	2320B, 5310B
1611560-07	MW-BU2C	Ground Water	2320B, 5310B

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611560

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611560

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1010C
Date Sampled: 11/17/16 14:06
Percent Solids: N/A

ESS Laboratory Work Order: 1611560
ESS Laboratory Sample ID: 1611560-01
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**11** (2)		2320B		1	MJV	11/22/16 18:32	mg/L	CK62249
Dissolved Organic Carbon (Average)	**0.696** (0.500)		5310B		1	DEL	11/21/16 20:43	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12 (Existing)
Date Sampled: 11/17/16 14:20
Percent Solids: N/A

ESS Laboratory Work Order: 1611560
ESS Laboratory Sample ID: 1611560-02
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**4** (2)		2320B		1	MJV	11/22/16 18:32	mg/L	CK62249
Dissolved Organic Carbon (Average)	**0.674** (0.500)		5310B		1	DEL	11/21/16 21:47	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020C
Date Sampled: 11/17/16 15:10
Percent Solids: N/A

ESS Laboratory Work Order: 1611560
ESS Laboratory Sample ID: 1611560-03
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**13** (2)		2320B		1	MJV	11/22/16 19:26	mg/L	CK62250
Dissolved Organic Carbon (Average)	**0.850** (0.500)		5310B		1	DEL	11/21/16 21:59	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2010C
Date Sampled: 11/17/16 15:45
Percent Solids: N/A

ESS Laboratory Work Order: 1611560
ESS Laboratory Sample ID: 1611560-04
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**16** (2)		2320B		1	MJV	11/22/16 19:26	mg/L	CK62250
Dissolved Organic Carbon (Average)	**0.852** (0.500)		5310B		1	DEL	11/21/16 22:12	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020B
Date Sampled: 11/17/16 16:15
Percent Solids: N/A

ESS Laboratory Work Order: 1611560
ESS Laboratory Sample ID: 1611560-05
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**20** (10)		2320B		1	MJV	11/22/16 19:26	mg/L	CK62250
Dissolved Organic Carbon (Average)	**0.694** (0.500)		5310B		1	DEL	11/21/16 22:50	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BC2C
Date Sampled: 11/17/16 16:55
Percent Solids: N/A

ESS Laboratory Work Order: 1611560
ESS Laboratory Sample ID: 1611560-06
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**8** (2)		2320B		1	MJV	11/22/16 19:26	mg/L	CK62250
Dissolved Organic Carbon (Average)	**0.576** (0.500)		5310B		1	DEL	11/21/16 23:02	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BU2C
Date Sampled: 11/17/16 17:15
Percent Solids: N/A

ESS Laboratory Work Order: 1611560
ESS Laboratory Sample ID: 1611560-07
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**13** (2)		2320B		1	MJV	11/22/16 19:26	mg/L	CK62250
Dissolved Organic Carbon (Average)	**0.728** (0.500)		5310B		1	DEL	11/21/16 23:15	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611560

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CK62145 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	4.68	0.500	mg/L	5.000		94	80-120			
Dissolved Organic Carbon (2)	4.78	0.500	mg/L	5.000		96	80-120			
Dissolved Organic Carbon (Average)	4.73	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.67	0.500	mg/L	5.000		93	80-120	0.3	200	
Dissolved Organic Carbon (2)	5.15	0.500	mg/L	5.000		103	80-120	8	200	
Dissolved Organic Carbon (Average)	4.91	0.500	mg/L							
Batch CK62249 - General Preparation										
Blank										
Alkalinity as CaCO3	ND	10	mg/L							
LCS										
Alkalinity as CaCO3	98		mg/L	99.20		99	85-115			
Batch CK62250 - General Preparation										
Blank										
Alkalinity as CaCO3	ND	10	mg/L							
LCS										
Alkalinity as CaCO3	98		mg/L	99.20		99	85-115			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611560

Notes and Definitions

U	Analyte included in the analysis, but not detected
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1611560

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/documents/AllLabs.xls

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.depweb.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1611560
Date Received: 11/18/2016
Project Due Date: 11/29/2016
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 5.2 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** (Yes) / No / NA
10. Were any analyses received outside of hold time? Yes / (No)

11. Any Subcontracting needed? Yes / (No)
    ESS Sample IDs:
    Analysis:
    TAT:
12. Were VOAs received? Yes / (No)
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA

13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / (No)
    a. Was there a need to contact the client? Yes / No
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	85718	Yes	NA	Yes	250 mL Amber - Unpres	NP	
01	85731	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
01	85732	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
02	85717	Yes	NA	Yes	250 mL Amber - Unpres	NP	
02	85729	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
02	85730	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
03	85716	Yes	NA	Yes	250 mL Amber - Unpres	NP	
03	85727	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
03	85728	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
04	85715	Yes	NA	Yes	250 mL Amber - Unpres	NP	
04	85725	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
04	85726	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
05	85714	Yes	NA	Yes	250 mL Amber - Unpres	NP	
05	85723	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
05	85724	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
06	85713	Yes	NA	Yes	250 mL Amber - Unpres	NP	
06	85721	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
06	85722	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
07	85712	Yes	NA	Yes	250 mL Amber - Unpres	NP	
07	85719	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	
07	85720	Yes	NA	Yes	VOA Vial - H2SO4	H2SO4	

2nd Review

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1611560
Date Received: 11/18/2016

Are barcode labels on correct containers? Yes / No

Completed By: _____ Date & Time: 11/18/16 0955

Reviewed By: _____ Date & Time: 11/18/16 1121

Delivered By: _____ 11/18/16 1132

ESS Laboratory

Division of Thielsch Engineering, Inc.

185 Frances Avenue, Cranston, RI 02910-2211
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1611560

Turn Time ______ Standard Other______

Regulatory State: MA RI CT NH NJ NY ME Other______

Is this project for any of the following:(please circle)
MA-MCP Navy USACE CT DEP Other______

Reporting Limits - ______

Electonic Deliverables Excel Access PDF

Co. Name: AECOM
Contact Person: Julianne Mamon
City: Pocasset
State: MA
Tel.: 508-577-4090
Fax:
Project #:
Project Name: Orleans PRB
Address: 9 Jonathan Bourne DR
Zip: 02559
PO #:
email:

Analysis: DOC, Alkalinity

ESS Lab ID	Date	Collection Time	Grab-G Composite-C	Matrix	Sample ID	Pres Code	# of Containers	Type of Container	Vol of Container	DOC, Alkalinity
1	11/17/16	1406	G	GW	MW-B1010C	1	1	AG	250 ml	X
2	11/17/16	1420	G	GW	MW-12 (existing)	1	1	AG	250 ml	X
3	11/17/16	1510	G	GW	MW-B1020C	1	1	AG	250 ml	X
4	11/17/16	1545	G	GW	MW-B2010C	1	1	AG	250 ml	X
5	11/17/16	1615	G	GW	MW-B2020B	1	1	AG	250 ml	X
6	11/17/16	1655	G	GW	MW-BC2C	1	1	AG	250 ml	X
7	11/17/16	1715	G	GW	MW-BU2C	1	1	AG	250 ml	X

Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA

Matrix: S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

Cooler Present ✓ Yes ____ No

Seals Intact ____ Yes ____ No NA: ✓

Cooler Temperature: 5.2°C Ia KPO 11/18/16 9:21

Internal Use Only
[✓] Pickup
[ ] Technician____

Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-____

Sampled by :

Comments:

Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)
Bailey-Maville 11/18/16	[signature] 11/18/16	[signature] 11/18/16	[signature] 11/18/16 0945
Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)

* By circling MA-MCP, client acknowledges samples were collected in accordance with MADEP CAM VIIA

Please fax to the laboratory all changes to Chain of Custody

1 (White) Lab Copy
2 (Yellow) Client Receipt

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644 Task 10.1.B)
ESS Laboratory Work Order Number: 1701118

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 11:20 am, Jan 13, 2017

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state tandards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701118

SAMPLE RECEIPT

The following samples were received on January 06, 2017 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1701118-01	MW-12 (Existing)	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701118-02	MW-12A	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701118-03	MW-12B	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701118-04	MW-B1010C	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701118-05	MW-B1020B	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701118-06	MW-B1020C	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701118-07	MW-B1050A	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701118-08	MW-BV2A	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701118-09	MW-BV2B	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701118

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701118

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12 (Existing)
Date Sampled: 01/05/17 12:40
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-01
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**6** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	**0.12** (0.10)		350.1		1	JLK	01/12/17 16:45	mg/L	CA71107
Chloride	**22.4** (3.0)		9250		1	JLK	01/11/17 18:59	mg/L	CA71130
Nitrate as N	**6.03** (0.210)		353.2		10	JLK	01/06/17 21:16	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/06/17 18:58	mg/L	CA70634
Sulfate	**8.6** (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	**1.24** (0.20)		351.2		1	JLK	01/11/17 18:17	mg/L	CA71007
Total Nitrogen	**7.27** (0.400)		4500N		10	JLK	01/11/17 18:17	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12A
Date Sampled: 01/05/17 13:10
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-02
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**5** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	ND (0.10)		350.1		1	JLK	01/12/17 16:45	mg/L	CA71107
Chloride	**230** (15.0)		9250		5	JLK	01/11/17 19:02	mg/L	CA71130
Nitrate as N	**0.669** (0.030)		353.2		1	JLK	01/06/17 20:52	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/06/17 18:59	mg/L	CA70634
Sulfate	**16.1** (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	ND (0.20)		351.2		1	JLK	01/11/17 18:18	mg/L	CA71007
Total Nitrogen	**0.669** (0.220)		4500N		1	JLK	01/11/17 18:18	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12B
Date Sampled: 01/05/17 13:35
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-03
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**2** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	**0.19** (0.10)		350.1		1	JLK	01/12/17 16:46	mg/L	CA71107
Chloride	**24.2** (3.0)		9250		1	JLK	01/11/17 19:04	mg/L	CA71130
Nitrate as N	**5.08** (0.210)		353.2		10	JLK	01/06/17 21:17	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/06/17 19:00	mg/L	CA70634
Sulfate	**13.6** (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	**0.79** (0.20)		351.2		1	JLK	01/11/17 18:19	mg/L	CA71007
Total Nitrogen	**5.87** (0.400)		4500N		10	JLK	01/11/17 18:19	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1010C
Date Sampled: 01/05/17 14:05
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-04
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**31** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	ND (0.10)		350.1		1	JLK	01/12/17 16:47	mg/L	CA71107
Chloride	**24.3** (3.0)		9250		1	JLK	01/11/17 19:05	mg/L	CA71130
Nitrate as N	**6.74** (0.220)		353.2		10	JLK	01/06/17 21:18	mg/L	[CALC]
Nitrite as N	**0.509** (0.020)		353.2		2	JLK	01/06/17 19:23	mg/L	CA70634
Sulfate	**23.7** (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	**1.36** (0.20)		351.2		1	JLK	01/11/17 18:20	mg/L	CA71007
Total Nitrogen	**8.61** (0.400)		4500N		10	JLK	01/11/17 18:20	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020B
Date Sampled: 01/05/17 15:15
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-05
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**9** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	**0.11** (0.10)		350.1		1	JLK	01/12/17 16:51	mg/L	CA71107
Chloride	**33.6** (3.0)		9250		1	JLK	01/11/17 19:06	mg/L	CA71130
Nitrate as N	**17.9** (0.410)		353.2		20	JLK	01/06/17 21:19	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/06/17 19:02	mg/L	CA70634
Sulfate	ND (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	**1.79** (0.20)		351.2		1	JLK	01/11/17 18:22	mg/L	CA71007
Total Nitrogen	**19.6** (0.600)		4500N		20	JLK	01/11/17 18:22	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1020C
Date Sampled: 01/05/17 15:45
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-06
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**11** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	**0.19** (0.10)		350.1		1	JLK	01/12/17 16:52	mg/L	CA71107
Chloride	**25.6** (3.0)		9250		1	JLK	01/11/17 19:07	mg/L	CA71130
Nitrate as N	**11.1** (0.410)		353.2		20	JLK	01/06/17 21:20	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/06/17 19:04	mg/L	CA70634
Sulfate	**5.6** (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	**1.99** (0.20)		351.2		1	JLK	01/11/17 18:23	mg/L	CA71007
Total Nitrogen	**13.1** (0.600)		4500N		20	JLK	01/11/17 18:23	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B1050A
Date Sampled: 01/05/17 16:15
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-07
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**24** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	**1.72** (0.10)		350.1		1	JLK	01/12/17 16:53	mg/L	CA71107
Chloride	**48.9** (3.0)		9250		1	JLK	01/11/17 19:12	mg/L	CA71130
Nitrate as N	**26.6** (2.01)		353.2		100	JLK	01/06/17 21:40	mg/L	[CALC]
Nitrite as N	**0.105** (0.010)		353.2		1	JLK	01/06/17 19:05	mg/L	CA70634
Sulfate	**6.1** (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	**3.75** (0.20)		351.2		1	JLK	01/11/17 18:24	mg/L	CA71007
Total Nitrogen	**30.5** (2.20)		4500N		100	JLK	01/11/17 18:24	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BV2A
Date Sampled: 01/05/17 17:00
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-08
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**11** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	ND (0.10)		350.1		1	JLK	01/12/17 16:53	mg/L	CA71107
Chloride	**118** (6.0)		9250		2	JLK	01/11/17 19:32	mg/L	CA71130
Nitrate as N	**0.426** (0.030)		353.2		1	JLK	01/06/17 21:01	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/06/17 19:06	mg/L	CA70634
Sulfate	**5.2** (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	ND (0.20)		351.2		1	JLK	01/11/17 18:25	mg/L	CA71007
Total Nitrogen	**0.426** (0.220)		4500N		1	JLK	01/11/17 18:25	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BV2B
Date Sampled: 01/05/17 17:25
Percent Solids: N/A

ESS Laboratory Work Order: 1701118
ESS Laboratory Sample ID: 1701118-09
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**18** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	ND (0.10)		350.1		1	JLK	01/12/17 16:54	mg/L	CA71107
Chloride	**92.2** (3.0)		9250		1	JLK	01/11/17 19:14	mg/L	CA71130
Nitrate as N	**0.826** (0.030)		353.2		1	JLK	01/06/17 21:02	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/06/17 19:07	mg/L	CA70634
Sulfate	ND (5.0)		9038		1	EEM	01/10/17 16:25	mg/L	CA71022
Total Kjeldahl Nitrogen as N	ND (0.20)		351.2		1	JLK	01/11/17 18:25	mg/L	CA71007
Total Nitrogen	**0.826** (0.220)		4500N		1	JLK	01/11/17 18:25	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701118

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CA70634 - [CALC]										
Blank										
Nitrate as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.247		mg/L	0.2497		99	90-110			
Nitrite as N	0.247		mg/L	0.2497		99	90-110			
Batch CA70635 - [CALC]										
Blank										
Nitrate as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Total Nitrogen	ND	0.020	mg/L							
LCS										
Nitrate as N	0.476		mg/L							
Nitrate/Nitrite as N	0.476		mg/L	0.5000		95	90-110			
Nitrate/Nitrite as N	0.476		mg/L	0.5000		95	90-110			
Total Nitrogen	0.476		mg/L							
Batch CA71007 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.200	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	8.95	2.00	mg/L	9.810		91	80-120			
Total Kjeldahl Nitrogen as N	8.95	2.00	mg/L	9.810		91	80-120			
Total Nitrogen	8.95	2.00	mg/L							
Batch CA71022 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.5		mg/L	9.988		95	85-115			
Batch CA71107 - NH4 Prep										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.09	0.10	mg/L	0.09994		94	80-120			
LCS										
Ammonia as N	1.02	0.10	mg/L	0.9994		102	80-120			
Batch CA71123 - General Preparation										

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701118

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CA71123 - General Preparation										
Blank										
Alkalinity as CaCO3	ND	2	mg/L							
LCS										
Alkalinity as CaCO3	96		mg/L	99.20		97	85-115			
Batch CA71130 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	30.6		mg/L	30.00		102	90-110			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701118

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701118

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1701118
Date Received: 1/6/2017
Project Due Date: 1/13/2017
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 4.2 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** Yes / No / NA
10. Were any analyses received outside of hold time? Yes / (No)

11. Any Subcontracting needed? Yes / (No)
    ESS Sample IDs:
    Analysis:
    TAT:
12. Were VOAs received? Yes / (No)
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA

13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / (No)
    a. Was there a need to contact the client? Yes / No
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	97345	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
01	97354	Yes	NA	Yes	1L Poly - Unpres	NP	
01	97363	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
01	97372	Yes	NA	Yes	250 mL Poly - Unpres	NP	
02	97344	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
02	97353	Yes	NA	Yes	1L Poly - Unpres	NP	
02	97362	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
02	97371	Yes	NA	Yes	250 mL Poly - Unpres	NP	
03	97343	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
03	97352	Yes	NA	Yes	1L Poly - Unpres	NP	
03	97361	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
03	97370	Yes	NA	Yes	250 mL Poly - Unpres	NP	
04	97342	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
04	97351	Yes	NA	Yes	1L Poly - Unpres	NP	
04	97360	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
04	97369	Yes	NA	Yes	250 mL Poly - Unpres	NP	
05	97341	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
05	97350	Yes	NA	Yes	1L Poly - Unpres	NP	
05	97359	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
05	97368	Yes	NA	Yes	250 mL Poly - Unpres	NP	
06	97340	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
06	97349	Yes	NA	Yes	1L Poly - Unpres	NP	
06	97358	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
06	97367	Yes	NA	Yes	250 mL Poly - Unpres	NP	

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1701118
Date Received: 1/6/2017

07	97339	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
07	97348	Yes	NA	Yes	1L Poly - Unpres	NP
07	97357	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
07	97366	Yes	NA	Yes	250 mL Poly - Unpres	NP
08	97338	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
08	97347	Yes	NA	Yes	1L Poly - Unpres	NP
08	97356	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
08	97365	Yes	NA	Yes	250 mL Poly - Unpres	NP
09	97337	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
09	97346	Yes	NA	Yes	1L Poly - Unpres	NP
09	97355	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
09	97364	Yes	NA	Yes	250 mL Poly - Unpres	NP

2nd Review
Are barcode labels on correct containers? Yes / No

Completed By: _____ Date & Time: 1/6/17 1724

Reviewed By: _____ Date & Time: 1/6/17 1731

Delivered By: _____ 1/6/17 1733

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1701118

Turn Time 5 Rush

Regulatory State

Is this project for any of the following?: ○CT RCP ○MA MCP ○RGP

Reporting Limits

Electonic Deliverables ☐Limit Checker ☐Standard Excel ☐Other (Please Specify →)

Company Name	Project #	Project Name
AECOM	60476644	Orleans PRB

Contact Person	Address
Julianne Marrion	250 Apollo Drive

City	State	Zip Code	PO #
Chelmsford	MA	01824	

Telephone Number	FAX Number	Email Address
978-905-2419		julianne.marrion@aecom.com

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: NO_2, NO_3, AlK	TKN, tot N	Ammonia	Cl, SO_4
1	01/05/17	1240	GW	Grab	MW-12 (existing)	X	X	X	X
2	01/05/17	1310	GW	Grab	MW-12A	X	X	X	X
3	01/05/17	1335	GW	Grab	MW-12B	X	X	X	X
4	01/05/17	1405	GW	Grab	MW-B101OC	X	X	X	X
5	01/05/17	1515	GW	Grab	MW-B1020B	X	X	X	X
6	01/05/17	1545	GW	Grab	MW-B1020C	X	X	X	X
7	01/05/17	1615	GW	Grab	MW-B1050A	X	X	X	X
8	01/05/17	1700	GW	Grab	MW-BV2A	X	X	X	X
9	01/05/17	1725	GW	Grab	MW-BV2B	X	X	X	X

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer G-Glass O-Other P-Poly S-Sterile V-Vial — P P P P

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other* — 6 6 5 3

Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Ascorbic Acid 12-Other* — 1 3 3 1

Number of Containers per Sample:

Laboratory Use Only

Cooler Present: ✓

Seals Intact: ____

Cooler Temperature: 4.2 3.8 °C ice RB

Sampled by : Briley Morrill

Comments: Please specify "Other" preservative and containers types in this space

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
Briley Morrill 01/06/17	1/6/17 13:33	1/6/17 15:23	1/6/17 1700
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644 task 10.1.B)
ESS Laboratory Work Order Number: 1701169

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 4:55 pm, Jan 19, 2017

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state tandards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701169

SAMPLE RECEIPT

The following samples were received on January 10, 2017 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1701169-01	MW-B2020B	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250
1701169-02	MW-B2020C	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250
1701169-03	MW-B2050A	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1701169-04	MW-BVC2	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250
1701169-05	MW-BC2C	Ground Water	2320B, 350.1, 351.2, 353.2, 4500N, 5310B, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701169

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701169

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020B
Date Sampled: 01/10/17 11:30
Percent Solids: N/A

ESS Laboratory Work Order: 1701169
ESS Laboratory Sample ID: 1701169-01
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**12** (2)		2320B		1	MJV	01/11/17 15:00	mg/L	CA71123
Ammonia as N	ND (0.10)		350.1		1	JLK	01/12/17 16:57	mg/L	CA71107
Chloride	**34.9** (3.0)		9250		1	JLK	01/11/17 20:23	mg/L	CA71131
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	01/12/17 17:59	mg/L	[CALC]
Nitrate as N	**25.6** (2.01)		353.2		100	JLK	01/10/17 19:49	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/10/17 19:49	mg/L	CA71036
Sulfate	**6.0** (5.0)		9038		1	EEM	01/12/17 16:10	mg/L	CA71221
Total Kjeldahl Nitrogen as N	ND (0.20)		351.2		1	EEM	01/16/17 15:47	mg/L	CA71318
Total Nitrogen	**25.6** (2.20)		4500N		100	EEM	01/16/17 15:47	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2020C
Date Sampled: 01/10/17 12:00
Percent Solids: N/A

ESS Laboratory Work Order: 1701169
ESS Laboratory Sample ID: 1701169-02
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**10** (2)		2320B		1	MJV	01/13/17 15:27	mg/L	CA71328
Ammonia as N	ND (0.10)		350.1		1	JLK	01/12/17 16:57	mg/L	CA71107
Chloride	**31.0** (3.0)		9250		1	JLK	01/11/17 20:24	mg/L	CA71131
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	01/12/17 19:06	mg/L	[CALC]
Nitrate as N	**12.6** (0.410)		353.2		20	JLK	01/10/17 19:50	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/10/17 19:50	mg/L	CA71036
Sulfate	**9.7** (5.0)		9038		1	EEM	01/12/17 16:10	mg/L	CA71221
Total Kjeldahl Nitrogen as N	ND (0.20)		351.2		1	EEM	01/16/17 15:50	mg/L	CA71318
Total Nitrogen	**12.6** (0.600)		4500N		20	EEM	01/16/17 15:50	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2050A
Date Sampled: 01/10/17 12:35
Percent Solids: N/A

ESS Laboratory Work Order: 1701169
ESS Laboratory Sample ID: 1701169-03
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**17** (2)		2320B		1	MJV	01/13/17 15:27	mg/L	CA71328
Ammonia as N	**0.87** (0.10)		350.1		1	JLK	01/12/17 16:58	mg/L	CA71107
Chloride	**64.5** (3.0)		9250		1	JLK	01/11/17 20:25	mg/L	CA71131
Nitrate as N	**39.3** (2.01)		353.2		100	JLK	01/10/17 19:51	mg/L	[CALC]
Nitrite as N	**0.025** (0.010)		353.2		1	JLK	01/10/17 19:51	mg/L	CA71036
Sulfate	**5.6** (5.0)		9038		1	EEM	01/12/17 16:10	mg/L	CA71221
Total Kjeldahl Nitrogen as N	**3.32** (0.20)		351.2		1	EEM	01/19/17 12:37	mg/L	CA71844
Total Nitrogen	**42.6** (2.20)		4500N		100	EEM	01/19/17 12:37	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BVC2
Date Sampled: 01/10/17 13:15
Percent Solids: N/A

ESS Laboratory Work Order: 1701169
ESS Laboratory Sample ID: 1701169-04
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**11** (2)		2320B		1	MJV	01/13/17 15:27	mg/L	CA71328
Ammonia as N	**0.10** (0.10)		350.1		1	JLK	01/12/17 17:01	mg/L	CA71107
Chloride	**143** (6.0)		9250		2	JLK	01/11/17 20:39	mg/L	CA71131
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	01/12/17 19:18	mg/L	[CALC]
Nitrate as N	**7.42** (0.210)		353.2		10	JLK	01/10/17 19:52	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/10/17 19:52	mg/L	CA71036
Sulfate	ND (5.0)		9038		1	EEM	01/12/17 16:10	mg/L	CA71221
Total Kjeldahl Nitrogen as N	ND (0.20)		351.2		1	EEM	01/16/17 15:52	mg/L	CA71318
Total Nitrogen	**7.42** (0.400)		4500N		10	EEM	01/16/17 15:52	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BC2C
Date Sampled: 01/10/17 14:15
Percent Solids: N/A

ESS Laboratory Work Order: 1701169
ESS Laboratory Sample ID: 1701169-05
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Alkalinity as CaCO3	**9** (2)		2320B		1	MJV	01/13/17 15:27	mg/L	CA71328
Ammonia as N	ND (0.10)		350.1		1	JLK	01/12/17 17:01	mg/L	CA71107
Chloride	**85.4** (3.0)		9250		1	JLK	01/11/17 20:28	mg/L	CA71131
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	01/12/17 19:31	mg/L	[CALC]
Nitrate as N	**5.91** (0.210)		353.2		10	JLK	01/10/17 19:53	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	01/10/17 19:53	mg/L	CA71036
Sulfate	ND (5.0)		9038		1	EEM	01/12/17 16:10	mg/L	CA71221
Total Kjeldahl Nitrogen as N	ND (0.20)		351.2		1	EEM	01/16/17 15:52	mg/L	CA71318
Total Nitrogen	**5.91** (0.400)		4500N		10	EEM	01/16/17 15:52	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701169

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CA71036 - [CALC]										
Blank										
Nitrate as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.250		mg/L	0.2497		100	90-110			
Nitrite as N	0.250		mg/L	0.2497		100	90-110			
Batch CA71037 - [CALC]										
Blank										
Nitrate as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Total Nitrogen	ND	0.020	mg/L							
LCS										
Nitrate as N	0.483		mg/L							
Nitrate/Nitrite as N	0.483		mg/L	0.5000		97	90-110			
Nitrate/Nitrite as N	0.483		mg/L	0.5000		97	90-110			
Total Nitrogen	0.483		mg/L							
Batch CA71107 - NH4 Prep										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.09	0.10	mg/L	0.09994		94	80-120			
LCS										
Ammonia as N	1.02	0.10	mg/L	0.9994		102	80-120			
Batch CA71123 - General Preparation										
Blank										
Alkalinity as CaCO3	ND	2	mg/L							
LCS										
Alkalinity as CaCO3	96		mg/L	99.20		97	85-115			
Batch CA71131 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	30.8		mg/L	30.00		103	90-110			
Batch CA71221 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.5		mg/L	9.988		95	85-115			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701169

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CA71234 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	5.04	0.500	mg/L	5.000		101	80-120			
Dissolved Organic Carbon (2)	4.63	0.500	mg/L	5.000		93	80-120			
Dissolved Organic Carbon (Average)	4.83	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.96	0.500	mg/L	5.000		99	80-120	2	200	
Dissolved Organic Carbon (2)	4.54	0.500	mg/L	5.000		91	80-120	2	200	
Dissolved Organic Carbon (Average)	4.75	0.500	mg/L							
Batch CA71318 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.200	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	10.0	2.00	mg/L	9.810		102	80-120			
Total Kjeldahl Nitrogen as N	10.0	2.00	mg/L	9.810		102	80-120			
Total Nitrogen	10.0	2.00	mg/L							
Batch CA71328 - General Preparation										
Blank										
Alkalinity as CaCO3	ND	2	mg/L							
LCS										
Alkalinity as CaCO3	96		mg/L	99.20		97	85-115			
Batch CA71844 - General Preparation										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.200	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	9.96	2.00	mg/L	9.810		102	80-120			
Total Kjeldahl Nitrogen as N	9.96	2.00	mg/L	9.810		102	80-120			
Total Nitrogen	9.96	2.00	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701169

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1701169

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1701169
Date Received: 1/10/2017
Project Due Date: 1/17/2017
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 1.6 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** (Yes) / No / NA
10. Were any analyses received outside of hold time? Yes / (No)

11. Any Subcontracting needed? Yes / (No)
    ESS Sample IDs:
    Analysis:
    TAT:
12. Were VOAs received? Yes / (No)
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / (NA)

13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / (No)
    a. Was there a need to contact the client? Yes / No
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	97990	Yes	NA	Yes	1L Poly - Unpres	NP	
01	97995	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
01	98000	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
01	98005	Yes	NA	Yes	250 mL Poly - Unpres	NP	
01	98009	Yes	NA	Yes	250 mL Amber - Unpres	NP	
01	98031	Yes	No	Yes	VOA Vial - HCl	HCl	
01	98032	Yes	No	Yes	VOA Vial - HCl	HCl	
02	97989	Yes	NA	Yes	1L Poly - Unpres	NP	
02	97994	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
02	97999	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
02	98004	Yes	NA	Yes	250 mL Poly - Unpres	NP	
02	98008	Yes	NA	Yes	250 mL Amber - Unpres	NP	
02	98029	Yes	No	Yes	VOA Vial - HCl	HCl	
02	98030	Yes	No	Yes	VOA Vial - HCl	HCl	
03	97988	Yes	NA	Yes	1L Poly - Unpres	NP	
03	97993	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
03	97998	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
03	98003	Yes	NA	Yes	250 mL Poly - Unpres	NP	
04	97987	Yes	NA	Yes	1L Poly - Unpres	NP	
04	97992	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
04	97997	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
04	98002	Yes	NA	Yes	250 mL Poly - Unpres	NP	
04	98007	Yes	NA	Yes	250 mL Amber - Unpres	NP	
04	98027	Yes	No	Yes	VOA Vial - HCl	HCl	

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1701169
Date Received: 1/10/2017

04	98028	Yes	No	Yes	VOA Vial - HCl	HCl
05	97986	Yes	NA	Yes	1L Poly - Unpres	NP
05	97991	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
05	97996	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
05	98001	Yes	NA	Yes	250 mL Poly - Unpres	NP
05	98006	Yes	NA	Yes	250 mL Amber - Unpres	NP
05	98025	Yes	No	Yes	VOA Vial - HCl	HCl
05	98026	Yes	No	Yes	VOA Vial - HCl	HCl

2nd Review
Are barcode labels on correct containers? (Yes / No)

Completed By: _____ Date & Time: 1/10/17 1712

Reviewed By: _____ Date & Time: 1/10/17 1730

Delivered By: _____ 1/10/17 1730

CHAIN OF CUSTODY

ESS Laboratory
Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

ESS Lab # 1701169

Turn Time: Rush
Regulatory State:
Is this project for any of the following?: ○ CT RCP ○ MA MCP ○ RGP

Reporting Limits:
Electonic Deliverables: ☐ Limit Checker ☐ Standard Excel ☐ Other (Please Specify →)

Company Name: AECOM
Contact Person: Julianne Marron
City: Chelmsford
State: MA
Telephone Number:
FAX Number:
Project #: 60476649
Project Name: PRB Orleans
Address: 250 Apollo DR
Zip Code: 01824
PO #:
Email Address:

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	NO2, NO3, Alk	TKN, Total N	Ammonia	Cl, SO4	DOC
1	01/10/17	1130	G	GW	MW-B2020B	X	X	X	X	X
2	01/10/17	1200	G	GW	MW-B2020C	X	X	X	X	X
3	01/10/17	1235	G	GW	MW-B2050A	X	X	X	X	
4	01/10/17	1315	G	GW	MW-BV2C	X	X	X	X	X
5	01/10/17	1415	G	GW	MW-~~BZ~~ BC2C	X	X	X	X	X
Container Type						P	P	P	P	AG
Container Volume						6	6	5	3	3
Preservation Code						1	3	3	1	1
Number of Containers per Sample						'				

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer G - Glass O-Other P-Poly S-Sterile V-Vial

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*

Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Ascorbic Acid 12-Other*

Laboratory Use Only
Cooler Present: ✓
Seals Intact:
Cooler Temperature: 1.4 1.6 °C ice #8

Sampled by: Briley Morrill
Comments: Please specify "Other" preservative and containers types in this space
*

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
Briley Morrill 01/10/17 1535	[signature] 1/10/17	[signature] 1/10/17 16:55	[signature] 1/10/17 1700
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)