

SUPPLEMENTAL PRE-DESIGN INVESTIGATION

FIRE WATER RESERVOIR

EMERSON POWER TRANSMISSION FACILITY

ITHACA, NEW YORK

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Site No. 7-55-010

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1 Introduction

1.1 GENERAL

On behalf of Emerson Electric Co. and its subsidiary, Emerson Power Transmission Corp. (EPT), WSP Environment & Energy (WSP) conducted a series of supplemental pre-design investigations within and around the south and north tanks of the fire water reservoir at the EPT site in Ithaca, New York (Figure 1). The objective of the supplemental investigations was to gather additional data on groundwater quality immediately below and around the fire water reservoir and develop a more comprehensive understanding of potential migration pathways within bedrock underlying the area. This report details the scope and results of the supplemental pre-design investigations.

The supplemental pre-design investigations were conducted between October 2009 and April 2011 and were used to fill data gaps identified following the initial pre-design activities completed in June of 2009 and described in a report titled Supplemental Pre-Design Investigation, Fire Water Reservoir – South Tank, Emerson Power Transmission Facility, Ithaca, New York, dated August 26, 2009. The scope of the investigations included the following activities:

- removing the fire water reservoir interior liner
- installing horizontal sample ports into the perimeter walls of the reservoir
- cutting and removing sections of the concrete slab in the south tank and logging and sampling observed bedrock fractures
- installing and sampling three additional monitoring points in the south tank and five monitoring points in the north tank
- excavating test pits on the western side of the fire water reservoir to locate and evaluate an existing drain pipe connected to the south tank
- conducting supplemental surface and downhole geophysics and installing, logging, and sampling four additional bedrock monitoring wells near the fire water reservoir

This report has been prepared in accordance with an Administrative Order on Consent (Index #A7-0125-87-09) entered into by the New York State Department of Environmental Conservation (NYSDEC) and EPT on July 13, 1987.

Section 2.0 of this report provides a description of the firewater reservoir and an updated conceptual site model. Section 3.0 presents the scope of work completed within, below, and around the firewater reservoir and Section 4.0 presents a summary of these results. Sections 5.0 and 6.0 detail the scope and results of the supplemental geophysics and downhole logging completed to further evaluate groundwater migration pathways. Finally, Section 7.0 presents the conclusions of the pre-design investigations.



2 Fire Water Reservoir Description and Site Model

2.1 DESCRIPTION OF FIRE WATER RESEVOIR

As part of the facility closing and decommissioning, the firewater reservoir was taken out of service in October 2009. The reservoir consists of two interconnected tanks, designated the north tank and the south tank. The tanks have a total capacity of 200,000 gallons. Figure 2 is a schematic of the firewater reservoir and includes a plan view and cross sectional view of the reservoir. As shown in the schematic, each tank is approximately 33 feet long, 31 feet wide and 19 feet deep. The tanks are constructed of reinforced concrete and the base is approximately 7 feet into bedrock. Building 19, which was formerly above the reservoir, was demolished in late 2010. The concrete slab covering the top of the reservoir is supported by columns and is approximately 6 inches thick. The base of the reservoir varies in thickness from 2 to 6 inches and is constructed on competent bedrock and some minor amount of fill material. There is an opening between the tanks that allows water to flow into each tank and equilibrate. A 6- to 8-inch suction line extends along the east wall of the north tank and is connected to the facility's fire suppression pump located in the adjacent boiler house. With the closing of the facility, a portion of the fire suppression system has been converted to a dry system and the pump and suction line are no longer used as part of the facility's fire suppression system. A 4-inch drain line is located in each tank along the base of the western wall.

2.2 STRUCTURAL FRAMEWORK AND UPDATED CONCEPTUAL SITE MODEL

2.2.1 Joint Measurements and Trends

The orientation of bedrock joint sets was previously measured at seven bedrock outcrops across the site. Two primary joint sets were identified, one oriented north-northwest and another oriented east-northeast. The north-northwest trending joint set was more common and better expressed in the observed bedrock outcrops. A total of 22 measurements were made of the north-northwest trending joint set and 3 measurements of the east-northeast trending joint set. The average joint orientation of the 22 north-northwest trending joint set measurements was N18W/82E. The mean joint orientation of the 3 north-northeast trending joint set measurements was S72W/81N. These orientations are consistent with published regional trends, as well as previous measurements collected by Radian and WSP.

2.2.2 Geophysical Observations

As part of the Supplemental Pre-Design Investigations, additional surface geophysics and downhole logging and sampling of new wells were completed to develop a more comprehensive understanding of potential migration pathways within bedrock underlying the area and to build on the data collected from previous investigations. The geophysical logging confirms that two types of well-defined fractures are present beneath the firewater reservoir area. The first type is horizontal bedding plane fractures. The second type consists of three orientations of nearly vertical joint sets. The bedding plane fractures extend laterally a few inches or feet and intersect to create an interconnecting network of relatively planar, paper-thin, horizontal planes of effective porosity. The individual vertical joint sets extend tens of feet laterally and vertically to create an intersecting network of permeable vertical conduits that are bounded by blocks of bedrock.

In addition, the results of two additional exploratory borings installed near the firewater reservoir confirm the presence of bedding plane fractures at elevations of approximately 550 feet, 544 feet, and 515 feet above mean sea level (amsl). These three bedding planes have been identified as major migration pathways for affected groundwater beneath the firewater reservoir area.



2.2.3 Groundwater Flow

Groundwater flow within the overburden and underlying B-zone (highly fractured and jointed bedrock) generally mimics surface topography, which slopes to the northwest. Groundwater flow within the siltstone bedrock is significantly affected by the vertical and horizontal distribution of vertical joint sets and horizontal bedding plane fractures within the upper sections of bedrock.

Groundwater near the firewater reservoir area is present within the overburden and bedrock. Overburden groundwater is perched and is restricted to limited areas of the site where the discontinuous cover of soil is thickest. In areas where the soil cover is thin (i.e., steep slopes along South Cayuga Street), the overburden or upper portion of fractured bedrock is not saturated. Based on water level measurements collected during groundwater sampling, the overburden groundwater in the remediation area is in hydraulic communication with the underlying bedrock of the B-zone, and the two units appear to be acting as a single hydraulic unit. In addition, the results of previous aquifer testing conducted within the remediation area indicate that as a result of the highly fractured and jointed nature of the B-zone, the unit responds as porous media. In the less fractured and jointed deeper sections of bedrock (C-zone), the system responds as a fracture flow network with both primary and secondary porosity.

2.2.4 Updated Conceptual Site Model – Fire Water Reservoir Area

An updated conceptual site model (CSM; Figure 3) was developed for the firewater reservoir area based on the results of the supplemental pre-design investigations to illustrate the relationship between the constituents of concern, transport pathways, and the current remediation system.

The firewater reservoir is constructed of concrete and extends approximately 19 feet below ground surface (bgs). Unsaturated soil is present to a depth of approximately 12 feet, which is underlain by highly fractured bedrock to a depth of approximately 18 feet bgs. The base of the reservoir is constructed on competent bedrock. Groundwater is encountered at the soil bedrock contact at approximately 12 feet below bgs, which is approximately 7 feet above the base of the reservoir. The bedrock surrounding the reservoir is jointed and fractured siltstone.

As shown in Figure 3, the dissolved constituents migrated vertically downward via open joints sets that intersect three prominent bedding plane fractures. The main transport mechanisms for the releases are through the vertical joint sets and horizontal bedrock bedding planes. These migration pathways form an interconnected network for groundwater transport. The horizontal bedding planes (fractures) significantly decrease in frequency with depth. The vertical joint sets remain open and do not change with depth but appear to terminate at lithologic contacts.

A prominent horizontal bedding plane was identified at an elevation between 515 to 518 feet amsl (base of C-zone) beneath the firewater reservoir area. This nearly horizontal feature is encountered approximately 52 feet below the base of the reservoir (Figure 3).

Two additional prominent horizontal bedding planes have been identified at an elevation between 544 feet and 550 feet amsl (upper C-zone) beneath the firewater reservoir area. These horizontal features are encountered between 17 and 21 feet below the base of the reservoir and appear to discharge directly into the B-zone within the remediation area west of the firewater reservoir.

Figure 3 shows the migration pathways for affected groundwater downgradient of the fire water reservoir within the highly fractured B-zone and within the C-zone bedding plane fractures at 515 feet, 544 feet, and 550 feet amsl along generalized cross section line A-A'. Cross section A-A' generally shows the firewater reservoir and subsurface areas to the west.

As shown in the CSM block diagram on Figure 3, groundwater generally occurs within the upper portion of fractured bedrock (B-zone) and within bedding plane fractures encountered at 515 feet, 544 feet, and 550 feet amsl (C-zone). The bedding plane fractures and associated vertical joint sets are the primary migration pathways for affected groundwater. The Interim Remedial Measure (IRM) implemented in early



2009 was designed to intercept and remove mass from the B-zone and the three bedding plane fractures identified within the C-zone. The current placement and design of the extraction well network is appropriate to address the primary migration pathways for affected groundwater.



3 Fire Water Reservoir Scope of Work

This section describes the scope of work completed to further evaluate conditions immediately below and around the firewater reservoir. The work was implemented in phases, as depicted in Figure 4, between October 2009 and January 2010. Photographs taken during the fieldwork are provided in Appendix A and disposal certificates and waste manifests are provided in Appendix B.

3.1 RESERVOIR LINER REMOVAL

In October 2009, the firewater reservoir was permanently taken out of service as part of the closing and decommissioning of the EPT facility.

The reservoir liner was removed on October 20 and October 21, 2009 to evaluate conditions in each tank. The liner consisted of 40-millimeter thick EPDM rubber membrane glued to a 40-millimeter thick felt backing. The liner was fastened to the outer reservoir walls via metal cleats and screws. Removal was completed using utility knives and electric shears. Personnel conducting this work were confined space entry trained and the required confined space entry permits were in-place during all work completed within the tanks.

Following removal of the liner, groundwater was observed entering the reservoir at three locations, one within the south tank and two within the north tank. Samples of water were collected at each location and submitted to a laboratory for analysis of volatile organic compounds (VOCs) using U.S. Environmental Protection Agency (EPA) Method 8260B. The samples were designated as SouthTank102209, NorthTank102109, and NorthTank102209 (Table 1). Following sample collection, a quickset hydraulic cement was used to seal the leaks in the concrete.


All liner materials removed from the reservoir, personal protection equipment, and containment zone plastic were contained in a 20-yard hazardous waste roll-off staged east of the reservoir area for later disposal. On November 3, 2009, a waste characterization sample was collected and analyzed for VOCs using EPA Method 8260B (Rolloff110309 – Table 2). The roll-off container was transported from the site on November 24, 2009 by Hazmat Environmental Group Inc. The hazardous waste manifest and certification of disposal is included in Appendix B.

All water that entered the reservoir during the liner removal was pumped directly to a 21,000-gallon frac tank staged near the groundwater treatment building. A total of 8,443 gallons of water from the frac tank was subsequently treated in the IRM groundwater treatment system.

3.2 HORIZONTAL POINT INSTALLATION AND SAMPLING

A series of horizontal points were drilled through the walls of the reservoir in order to assess groundwater quality outside the reservoir. Four horizontal sample points (HP-1, HP-2, HP-3, and HP-4) were installed in the south tank on November 2, 2009 and November 3, 2009 and two (HP-5 and HP-6), were installed in the north tank on November 5, 2009 (Figure 4). A pneumatic hammer drill equipped with a 6-foot long, 1.375-inch drill bit was used to install each sample point. The height of the sample points ranged from 14 inches (HP-1) to 34 inches (HP-3) above the base of the reservoir. Each sample point was fitted with a sample port constructed of a 0.75-inch outer diameter galvanized steel pipe and ball valve (i.e., spigot). Hydraulic cement was used to patch and repair the wall around each sample point. Grab water samples were collected at HP-2, HP-3, and HP-6 directly from the spigot and analyzed for VOCs using EPA Method 8260B. No water collected in horizontal points HP-1, HP-4, and HP-5, thus aqueous samples could not be collected.

Prior to the installation of the sample port at HP-1, a decontaminated steel rod was inserted into the point to obtain a sample of the tightly packed fill material located behind the south wall of the south tank. The



sample was designated HP-1 SED (Table 2), collected in a 4-ounce glass jar, and analyzed for VOCs using EPA Method 8260B.

3.3 MONITORING POINT INSTALLATION AND SAMPLING

On November 3, 2009 and November 5, 2009, eight additional monitoring points were installed and sampled within the firewater reservoir (Figure 4). The monitoring points were designed to evaluate groundwater quality immediately beneath the base of the reservoir. At each sample location, the 6-inch concrete slab was drilled with an electric hammer drill equipped with a 0.50-inch outer diameter drill bit. A plumb-bob was lowered through the 0.50-inch hole to locate the vertical match point on the base of the reservoir. The concrete was then marked on top of the reservoir to indicate where a core would be drilled if casings were to be installed to the top of the reservoir, as MP-1 through MP-5 were previously constructed in June 2009.

A coring machine equipped with a 6.25-inch inside diameter coring bit was used to core a hole through the concrete base, which ranged from 3.5 to 6 inches thick. The monitoring points were designated MP-6 through MP-8 in the south tank and MP-9 through MP-13 in the north tank as shown in Figure 4.

Casing materials (4-inch steel) were lowered into the reservoir and installed in the 6-inch open core locations and sealed with the link-seal and quick-set grout. The bottom of each casing was notched prior to installation to allow groundwater to flow into the monitoring points. The monitoring points were completed with approximately 5 feet of casing rising above the base of the reservoir and fitted with watertight lockable caps. Information on the construction of each monitoring point was recorded in a field notebook and a representative photograph of the final construction is included in Appendix A. A schematic of the monitoring construction is shown as a detail in Figure 4.


Groundwater grab samples were collected from the monitoring points on November 3 and November 5, 2009 (Table 3). The monitoring points were purged a minimum of three casing volumes or until dry before collecting the samples. Groundwater samples were collected using dedicated disposable Teflon bailers. Bailers were lowered slowly into the monitoring points to avoid agitating the water. VOC samples were collected in three pre-cleaned 40-ml vials and shipped under chain of custody to the laboratory for analysis VOCs using EPA Method 8260.

During the installation of the monitoring points, a petroleum sheen was visible on the water entering the east side of the south tank. This water was segregated into a second 21,000 gallon frac tank, located parallel to the first frac tank, due to the inability of the IRM system to treat petroleum product. On November 10, 2009, a 5,000 gallon capacity vacuum truck removed 3,488 gallons of water and trace amounts of petroleum product from the frac tank. The water was shipped under manifest to Michigan Disposal Waste for treatment and disposal. A copy of the hazardous waste manifest is presented Appendix B.

3.4 EXISTING DRAIN PIPE EVALUATION

During the removal of the reservoir liner, two 4-inch cast iron pipes were identified along the base of the western wall in both the north and south tanks of the reservoir. A dark brown to black colored sediment was observed inside the south tank pipe and was sampled for VOCs using Method 8260B (South P-1; Figure 4 and Table 2).

A plumbing company was contracted to video tape the pipes using a fiber optic camera. On November 5 and 6, 2009 both pipes were investigated and viewed using the fiber optic camera. The pipes were determined to be plugged/sealed 6.5 feet and 7 feet from the tank opening, respectively. A valve appeared to be sealing off the north tank pipe and a concrete plug was observed in the south tank pipe. The pipes leading up to the valve were intact and appeared to have no bends or turns. Onsite



reconnaissance on the hillside west of the reservoir discovered a vertical stand pipe attached to the south tank piping. The top of the stand pipe was approximately 6 feet below the top of the reservoir and plugged with concrete approximately 11 feet below the top of casing. No evidence (i.e., a valve or stand pipe) was found at ground level west of the north tank.

3.5 FLOOR CUT INVESTIGATION

3.5.1 Initial Floor Cut Investigation

To assess conditions below the base of the concrete slab, two diagonal (NE to SW) sections of the floor (Trench-1 and Trench-2) were cut along the base of the south tank (Figure 4) on November 4, 2009. The floor cuts, which are referred to as trenches, were saw-cut with a 14-inch electric saw to a width of 6-inches. Trench-1 was cut to a length of approximately 240 inches and Trench-2 was cut to a length of approximately 177 inches. The trenches were oriented based on the predominant direction (N18°W) of vertical joint sets identified in the area, such that the length of the trenches would perpendicularly intersect northwest trending vertical bedrock fractures.

Once the concrete floor was cut and the concrete removed, a shop vac was used to remove debris and clean the top of the bedrock surface for visual logging. The exposed bedrock surface was then inspected, photographed, and logged. All observable fractures and joints were noted and the trend of the fracture recorded in the field log book. Trend measurements were made using a Brunton compass adjusted for magnetic declination of Ithaca, New York at the time of the investigation (12° 12' W).

Trench-1 contained a single joint that trends N16W and a parallel joint set that trends N18W. Groundwater was observed discharging from the parallel joint set and a grab sample (T-1), was collected from the joint set and analyzed for VOCs using EPA Method 8260B (Table 4). Figure 4 shows the location at which grab samples of groundwater were collected and the bedrock fracture trends.

Trench-2 was intersected by three single joints (N15W, N2W, and N40W) and one parallel joint set (N17W), as shown in Figure 4. A sample (T-2) was collected near the parallel joint set towards the center of the trench cut and analyzed for VOCs using EPA Method 8260B (Table 4). A light-phase petroleum product sheen was observed seeping into the center of the trench cut near the location of sample (T-2). Photographs of trench cuts and observed petroleum product are provided in Appendix A.


Following logging and sampling, both floor trenches were sealed using a quick-set grout and hydraulic cement. A layer of grout was installed first, directly on top of the underlying bedrock. After allowing the grout to set up, hydraulic cement was installed above the grout to create a tight seal with the existing concrete.

The saw-cut concrete and debris was removed from the reservoir at the end of the investigation and was contained in a 20-yard hazardous waste roll-off with the materials generated during the reservoir liner removal. Personal protective equipment and containment zone plastic were also added to the roll-off. The roll-off was picked up on November 24, 2009 by Hazmat Environmental Group Inc. The hazardous waste manifest and certification of disposal can be found in Appendix B.

3.5.2 Follow-Up Floor Cut Investigation

Approximately 21,000 gallons of water, primarily surface water run-off, accumulated in the south tank during the period between November 2009 and January 2010. An electric submersible pump was used to extract water from the south tank to a frac tank located north of the groundwater treatment building for temporary storage. The water was managed in the IRM groundwater treatment system between January 25 and January 29, 2010.

On January 26, 2010, three additional trenches (Trench-3, Trench-4, and Trench-5) were installed within the south tank to further assess the parallel joint set identified within Trench-2. The additional trenches



were installed at locations to the northwest and southeast of Trench-2 as shown in Figure 4. Sections of Trench-2 were also re-opened and re-sampled. The floor cuts were installed in a similar manner as Trenches 1 and 2.

Trench-3 contained a single joint that trends N17W and appeared to intersect Trench-2. Groundwater was observed seeping into the floor cut near the joint and a sample (T-3), was collected and analyzed for VOCs using EPA Method 8260B (Table 4).

Trench-4 also contained a NW trending joint (N18W) that appeared to intersect T-2. A sample (T-4) was collected near the joint and analyzed for VOCs using EPA Method 8260B (Table 4).

Trench-5 contained a single joint that trends N34W. Groundwater was observed seeping into the trench and a sample (T-5) was collected from the joint and analyzed for VOCs using EPA Method 8260B (table 4). The joint observed in Trench-5 does appear to intersect the other trench cuts.

Following sampling and logging, the four trenches were sealed in a similar manner as Trenches 1 and 2. A layer of grout was installed first, directly on top of the underlying bedrock. After allowing the grout to set up, hydraulic cement was installed above the grout to create a tight seal with the existing concrete.


Saw-cut concrete generated during the additional floor trench investigation was removed from the reservoir and contained in 55-gallon Department of Transportation (DOT) authorized drums. Personal protective equipment was added to a satellite accumulation drum located inside the EPT facility. A total of two concrete debris drums were generated. The hazardous waste manifests and waste disposal certificates are included in Appendix B for the drum shipment completed on February 16, 2010.

The water generated during the follow up trench work was contained in 55-gallon DOT authorized drums stationed directly above the reservoir. The water was drummed due to the light petroleum product sheen observed during the installation of the horizontal and monitoring point locations. The hazardous waste manifests and waste disposal certificates are included in Appendix B for the drum shipment completed on February 16, 2010.

3.6 TEST PITS

Between April 19 and April 23, 2010, a series of test pits were excavated on the western side of the fire water reservoir to locate and assess the drain pipe exiting the base of the south tank as described in Section 3.4. A test pit excavated on the west side of the stand pipe uncovered a brick valve box structure, approximately 2-cubic feet in dimension, at a depth of 11 feet bgs (Figure 5). The vertical stand pipe, identified during previous reconnaissance (see Section 3.4), entered the top of the brick structure and a horizontal 4-inch cast-iron pipe exited the west side of the structure. The vertical stand pipe was broken approximately 1-foot above the brick structure. A concrete plug was apparent inside the brick structure and inside the vertical stand pipe where the stand pipe was broken. Some soil staining was noted around the brick structure and soil samples were taken on the west (WStandPipe-8 and WStandPipe-11), northwest (NWStandPipe-11), northeast (NEStandPipe-11), southwest (SWStandPipe-11), and southeast (SEStandPipe-11) sides of the brick structure at 11 feet bgs (Table 5). Groundwater and a slight sheen of petroleum product began to seep into the test pit during the excavation. A sample of the seepage (WStandPipeAq-11 – Table 6) was collected and submitted to the laboratory for analysis of VOCs using Method EPA 8260B.

In order to trace the location of the cast iron pipe, the excavation was extended further west to determine where the cast-iron pipe terminated. Additional soil samples were collected 5 feet west of the stand pipe, 1 foot north of the trench (W5StandPipe-11; Table 5), and 7 feet west of the stand pipe (W7StandPipe-10). The 4-inch cast-iron pipe transitioned into a 4-inch clay pipe approximately 3 feet west of the stand pipe. The transition from cast-iron to clay was damaged during the excavation and a soil sample from around the clay pipe transition was collected (ClayPipe-11; Table 5). Using a fish-tape reel, the pipe was



determined to be plugged approximately 18 feet west (down the hillside) of the clay transition. A test pit was installed at the end of the fish tape to intercept the end of the pipe. A 4-inch cast iron pipe was found in the north end of the test pit, but the end of the pipe was not uncovered. Using the excavator bucket, the cast-iron pipe was pulled vertically and the end of the pipe was discovered.

The section of cast-iron pipe was approximately 6 feet long, which correlated to the pipe terminating approximately 2 feet from the drainage ditch. A sample (Table 5) was collected from inside the pipe that remained in the hillside, where the 6-foot section was broken off (CIPipeSludge-5). This section was subsequently sealed with concrete. A sample (S5CIPipe-3) was also collected 5 feet south of where the 6-foot section was broken off (Table 5). Three additional test pits were installed and sampled (Table 5) southeast (TestPit1-5), northeast (TestPit2-6), and south (TestPit3-4) of the existing piping and near Outfall 001. Soil at TestPit3-4 was visually impacted by petroleum and, thus was sampled and analyzed using New York State Department of Health (NYSDOH) Method 310.13 for petroleum fingerprinting Table 6) and VOCs using EPA Method 8260B (Table 5). A test pit (WDitch-ST-5) installed northwest of the end of the cast-iron pipe filled with seepage water, and therefore, a soil sample could not be collected. A sample of the seepage water (WDitch-ST-5) was collected and analyzed for VOCs using Method EPA 8260B (Table 7).

Two test pits were installed west of the north tank, but no evidence of the pipe exiting the north tank was found. A soil sample was collected from each test pit and labeled WDitchSoil-NT-5 and TestPit4-8 (Table 5). The test pit west of the drainage ditch was allowed to accumulate seepage water, which was then sampled (WDitch-NT-5) and analyzed for VOCs using EPA Method 8260B (Table 7).

All soil excavated during the test pit activities was placed back into the ground at the end of the activities. The hillside was compacted with the excavator bucket and an erosion mat and hay bales were used to ensure erosion into Outfall 001 was minimized.

3.7 C-ZONE MONITORING WELL INSTALLATION AND SAMPLING (MW-12C AND MW-13C)

Two shallow C-zone monitoring wells were installed to the east of the fire water reservoir to further evaluate groundwater quality (Figure 4). Monitoring well MW-12C was installed approximately 20 feet east of the south tank and monitoring well MW-13C was installed approximately 20 feet south east of the south tank. The monitoring wells were installed on April 27, 2010 and construction details are included in Appendix C.

3.7.1 Monitoring Well Installation and Development

Wells MW-12C and MW-13C were installed using hollow-stem auger, air rotary, and rock coring methods. Parratt-Wolff, Inc., of East Syracuse, New York, a driller licensed in the state of New York in accordance with § 15-1525 of the New York Environmental Conservation Law, provided the drilling services. Each boring was drilled through the overburden using 6.25-inch inside-diameter (ID) hollow-stem augers. Continuous soil samples were collected from the ground surface to refusal at bedrock using 2-foot-long, split-spoon samplers. The soils recovered from the split spoons were screened for organic vapors in the field using a photoionization detector (PID). Sample descriptions and PID readings were recorded in a field notebook.

Each borehole was advanced through the hollow stem auger rods into competent bedrock using nominal 6-inch air rotary methods. A 4-inch steel surface casing was then installed in the borehole to a depth of 12.5 feet bgs. The annular space was backfilled with a bentonite-cement slurry grout mixture (tremie piped from the bottom to the top as the hollow stem augers were removed) and allowed to set for at least 18 hours.

The boreholes were advanced to the terminal depth (30 feet bgs) using HX rock coring methods. Each section of rock core recovered from the borings was logged (e.g., lithology, structure, weathering, and



fracture characterization, which were recorded in a field notebook. The total recovery, modified recovery, and Rock Quality Designation (RQD) were also calculated for each coring run.

The monitoring wells were constructed of 2-inch-ID threaded, flush jointed, Schedule 40 PVC blank casing attached to screens with 0.010-inch horizontal slots. Both monitoring wells were constructed with a 5-foot screen length and screened interval from 24 to 29 feet bgs.

A clean sand filter pack was placed from the bottom of the well borehole to approximately 2 feet above the top of the screen. The remaining annular space was backfilled with hydrated bentonite chips from the top of the sand filter pack to 1-foot bgs. Each monitoring well was completed with a flush-mount protective steel well cover, and the PVC casing for each well was fitted with a watertight expandable plug and padlock. Well construction information was recorded in a field notebook, and boring logs and as-built well construction diagrams were prepared for each monitoring well after completion of the field activities (Appendix C). The monitoring wells were completed and installed by Parratt-Wolff, Inc. of East Syracuse, New York.

Following installation, the monitoring wells were developed by pumping groundwater using a submersible pump to remove sediments, ensure effective communication between the open borehole and fractures in the surrounding formation, and prepare the wells for groundwater sampling. Development continued until the discharge was relatively free of suspended sediments or until the wells were purged dry two to three times. Water generated during well development activities was collected in drums and managed in the same manner as other investigation-derived waste. All development activities were conducted with clean equipment to prevent potential cross-contamination between well locations.

3.7.2 Groundwater Sampling

On May 25, 2010, groundwater samples were collected from MW-12C and MW-13C. Prior to sampling, the wells were purged of three well volumes, or until the boreholes went dry and the purge water was processed through the groundwater extraction system immediately. The pH, specific conductance, temperature, turbidity, and dissolved oxygen were monitored during the purging process with a water quality meter to ensure that representative groundwater quality samples were collected. The wells were purged with dedicated air-displacement pumps operated by a QED Well Wizard pump controller and sampled using dedicated Teflon bailers. The wells were allowed to recharge for a period of no more than 2 hours, or until water was present in the borehole, before samples were collected. The groundwater samples were analyzed for VOCs by EPA Method 8260B.



4 Fire Water Reservoir Sampling Results

This section details the results the supplemental investigation conducted around and below the fire water reservoir. The results of samples collected from each phase of investigation are presented in Figures 6 and 7. The results are listed in Tables 1 through Table 7. Analytical laboratory data packages are included in Appendix D.

4.1 RESERVOIR LINER REMOVAL - SEEPAGE WATER RESULTS

Three samples (SouthTank102209, NorthTank102109, and NorthTank102209) were collected to evaluate the quality of water seeping into the tanks following removal of the liner. The results show that only trace levels of VOCs were detected in each sample. The sample results are presented in Table 1.

4.2 HORIZONTAL POINT AND DRAIN LINE SEDIMENT RESULTS

Samples of the sediment collected from HP-1 (HP-1-SED) and within the existing drain line in the south tank (South P-1) contained low levels of two chlorinated solvents trichloroethane (TCE) and *cis*-1,2-dichloroethene (*cis*-1,2-dichlorethene [DCE]; Table 2). The highest concentration of TCE and *cis*-1,2-DCE was detected in the sample South P-1 at 240 micrograms per kilogram ($\mu\text{g}/\text{kg}$) and 87 $\mu\text{g}/\text{kg}$, respectively. Total VOCs at HP-1-SED and South P-1 contained 155 $\mu\text{g}/\text{kg}$ and 769 $\mu\text{g}/\text{kg}$, respectively.

4.3 MONITORING POINT AND HORIZONTAL POINT GROUNDWATER SAMPLE RESULTS

Results for the groundwater samples collected from the eight new monitoring points and the three horizontal points that contained water are shown in Figure 6 and summarized in Table 3. TCE, *cis*-1,2-DCE, and vinyl chloride were the primary VOCs detected. TCE concentrations ranged from 15 micrograms per liter ($\mu\text{g}/\text{l}$; MP-10) to 5,300 $\mu\text{g}/\text{l}$ (MP-8) and *cis*-1,2-DCE ranged from 71 $\mu\text{g}/\text{l}$ (MP-10) to 2,600 $\mu\text{g}/\text{l}$ (MP-8). Vinyl chloride concentrations ranged from 60 $\mu\text{g}/\text{l}$ in MP-10 to 290 $\mu\text{g}/\text{l}$ in MP-7. Samples collected from the horizontal points had lower concentrations than detected in the monitoring points. In the horizontal points, TCE ranged from 11 $\mu\text{g}/\text{l}$ (HP-6) to 30 $\mu\text{g}/\text{l}$ (HP-3), *cis*-1,2-DCE ranged from 18 $\mu\text{g}/\text{l}$ (HP-2) to 35 $\mu\text{g}/\text{l}$ (HP-6), and vinyl chloride ranged from 3.3 $\mu\text{g}/\text{l}$ (HP-2) to 7.1 $\mu\text{g}/\text{l}$ (HP-6).

4.4 FLOOR CUT INVESTIGATION RESULTS

The results for groundwater samples collected from the floor trenches (Figure 6) and identified joint sets within the trenches contained predominantly TCE, *cis*-1,2-DCE, and vinyl chloride (Table 4). The highest concentrations of VOCs were detected in the initial groundwater samples collected from Trench -2. TCE was detected at 19,000 $\mu\text{g}/\text{l}$, *cis*-1,2-DCE at 1,300 $\mu\text{g}/\text{l}$, and vinyl chloride at 370 $\mu\text{g}/\text{l}$ in this sample. Follow up samples collected from Trench-2 (samples T-2A and T-2B) contained significantly lower levels of VOCs when compared to the initial trench sample. Total VOC levels were reported at 4,556 $\mu\text{g}/\text{l}$ for sample T-2A and 6,174 $\mu\text{g}/\text{l}$ for sample T-2B (Table 4).

Groundwater samples collected from the three additional floor trench cuts also contained predominantly TCE, *cis*-1,2-DCE, and vinyl chloride at levels generally consistent with concentrations detected in the surrounding monitoring point locations. TCE levels ranged from 164 $\mu\text{g}/\text{l}$ (T-5) to 804 $\mu\text{g}/\text{l}$ (T-4) and levels of *cis*-1,2-DCE ranged from 82 $\mu\text{g}/\text{l}$ (T-3) to 2,080 $\mu\text{g}/\text{l}$ (T-5). Vinyl chloride concentrations ranged from 38 $\mu\text{g}/\text{l}$ (T-3 duplicate) and 270 $\mu\text{g}/\text{l}$ (T-5).

4.5 TEST PIT SAMPLE RESULTS

4.5.1 Soil Sample Results

Soil samples collected from the test pits west of the reservoir (Figures 7 and 8) contained trace levels of VOCs, with total VOCs ranging from non-detect to 195 µg/kg (CIPipeSludge-5; Table 5). CIPipeSludge-5 had the highest detection of cis-1,2-DCE (101 µg/kg) and the only detection of TCE (94 µg/kg). The sample from TestPit3-4 was also analyzed for petroleum fingerprinting using the NYSDOH Method 310.13. The sample was found to contain primarily Lube Oil (3,180,000 µg/kg) and partially Diesel Fuel #2 (330,000 µg/kg; Table 6).

4.5.2 Groundwater Sample Results

The three water samples WDitch-ST-5, WStandPipeAq-11, and WDitch-NT-5 collected from the test pits contained 233 µg/l, 211 µg/l, and 2 µg/l of total VOCs, respectively (Table 7). The highest concentration of cis-1,2-DCE was found in WStandPipeAq-11 (116 µg/l) and the highest detection of TCE was found in WDitchST-5 (107 µg/l). Groundwater results are shown in Figure 7 and Figure 8.

4.6 C-ZONE MONITORING WELL RESULTS (MW-12C AND MW-13C)

4.6.1 Groundwater

The results of groundwater samples collected from monitoring wells MW-12C and MW-13C indicate that groundwater quality in the shallow fractured bedrock between 24 feet and 29 feet bgs east of the reservoir has been only moderately impacted compared to downgradient wells closer to the reservoir (Figure 6). TCE and cis-1,2-DCE were the predominant VOCs detected at these locations. The sample collected from MW-12C contained TCE at 1.0 µg/l and cis-1,2-DCE at 3.0 µg/l. The groundwater sample collected from MW-13C contained TCE at a concentration of 339 µg/l and cis-1,2-DCE at a concentration of 41.8 µg/l. Groundwater sample results are summarized in Table 8.

4.7 SUMMARY OF FIRE WATER RESERVOIR INVESTIGATION

The base of the reservoir slab varies in thickness from 2 to 6 inches and is constructed directly on competent bedrock and some minor amount of fill material. Following liner removal, groundwater water was observed seeping into the reservoir; however, the results of samples collected from the horizontal point locations and seepage areas did not contain elevated levels of VOCs. No significant mass and no TCE product was identified immediately around the south or north tank. TCE, cis-1,2-DCE, and vinyl chloride were detected in water samples collected from the eight additional monitoring points; however, the concentrations detected were well below VOC levels detected in monitoring and extraction wells installed near and downgradient of the reservoir.



5 Geophysics and Exploratory Boring Scope of Work

5.1 SURFACE GEOPHYSICS AND CROSS HOLE TOMOGRAPHY

A geophysical survey was conducted south and east of the fire water reservoir to further evaluate potential groundwater migration pathways (Figure 8). The survey, which used electrical resistivity (ER) to remotely image the subsurface, was conducted by Mid-Atlantic Geosciences of Lancaster, Pennsylvania in September 2010.

Surface resistivity measurements were collected by introducing an electrical current in the ground using electrodes at the ground surface. The apparent resistivity of the subsurface was determined by measuring the voltage difference between the electrodes. The depth and volume of the subsurface zone represented by the measured apparent resistivity is a function of the geometry of the current and potential electrodes located at the surface. Electrodes were set at specific depths in the borehole to collect crosshole measurements between two boreholes and were used in conjunction with the surface electrodes (up-hole measurements).

Using an AGI Super Sting R8/IP resistivity meter and Swift automated electrode switching system, apparent resistivity readings were collected along two profiles located east and south of the fire water reservoir area (Figure 8). Along each profile, electrodes were spaced at the ground surface at 1-meter intervals. To collect electrical imaging data, a dipole-dipole array was used. The measured apparent resistivities were plotted as resistivity pseudo-sections depicting the apparent resistivity versus nominal survey depth for each profile in order to confirm data quality.


The apparent resistivity pseudo-sections were mathematically inverted using EarthImager 2D by Advanced Geosciences, Inc., to produce a color-coded cross sectional images or profiles for each transect line displaying the distribution of resistivities between the various subsurface materials. Each resistivity measurement was assigned a color from dark blue to red. Bedrock, a typically highly resistive material, generally yields resistivity measurements of 200 to 5,000-ohm meters, which plot as regions of light green, yellow, and red. Regions with resistivities below 200 ohm-meters generally plot as shades of green and light blue. Water-bearing zones, which have dramatically reduced resistivities due to the highly conductive nature of groundwater, typically yield regions of blue or dark blue within the more resistive areas. The focus of the geophysical interpretation was to identify and generally locate the highly conductive water bearing zones within the subsurface.

5.2 EXPLORATORY BORING AND LOGGING

Following the geophysical survey, two exploratory bedrock borings/monitoring wells (MW-14C and MW-15C) were installed and sampled in the area south and east of the fire water reservoir. The exploratory borings/monitoring wells were drilled to 45 feet bgs between March 14 and 18, 2011 at the locations shown in Figure 8. Exploratory boring MW-14C was installed approximately 4 feet south of the south tank. The area was previously inaccessible due to the location of an electrical substation, which was demolished in late 2010 along with Building 19.

5.2.1 Drilling Methods

The exploratory borings/monitoring wells were installed using hollow-stem auger, mud rotary, and rock coring methods. Parratt-Wolff, Inc., provided the drilling services. Each boring was drilled through the overburden using 6.25-inch ID hollow-stem augers. The soils recovered from the cuttings were screened for organic vapors in the field using a PID. Sample descriptions and PID readings were recorded in a field notebook.



Each borehole was advanced through the hollow stem auger rods into competent bedrock using nominal 6-inch air rotary methods. Rock cores were collected and logged from 15 to 25 feet bgs at each location using HX rock coring methods. The rock core depth interval was selected so that the depth corresponded to the base of the reservoir, which is at approximately 19 feet bgs. Each section of rock core recovered from the borings was logged (e.g. lithology, structure, weathering, and fracture characterization) and descriptions were recorded in a field notebook. The total recovery, modified recovery, and RQD were also calculated for each coring run. Following core collection and logging, a 4-inch steel surface casing was installed in the borehole. The annular space was backfilled with a bentonite-cement slurry grout mixture (tremie piped from the bottom to the top as the hollow stem augers were removed) and allowed to set for at least 18 hours. The length of the surface casing was 25 feet at each location. The boreholes were then advanced to the terminal depth of 45 feet bgs using nominal 4-inch mud rotary drilling methods.

The exploratory borings were completed as open boreholes with a stick-up protective steel outer well covering, and the inner surface casing was fitted with a watertight lockable cap. Well construction information was recorded in a field notebook, and boring logs and as-built well construction diagrams were prepared for each exploratory boring after completion of the field activities (Appendix C).

5.2.2 Rock Core Sampling Methods

WSP collected rock core grab samples from MW-14C and MW-15C, which were drilled adjacent to the fire water reservoir. The rock core samples were collected from intervals where elevated PID readings or visual observations indicated potential for impacts. At MW-14C a rock core sample was collected from 17.5-18 feet bgs, 19.5 to 20.0 feet bgs, and 20.0 to 20.5 feet bgs. At MW-15C a rock core sample was collected from 20.4 to 20.9 feet bgs. These depths correspond to the bottom of the fire water reservoir.

The selected interval was first placed in a plastic bag and crushed in the field using a rock hammer and mallet. Once the rock core grab sample was crushed, the lithic fragments were placed in a 4-oz. glass jar, labeled, and packed on ice for shipment to Test America Laboratory in Amherst, New York. The grab samples were analyzed for VOCs using EPA Method 8260B.

5.2.3 Borehole Development

The exploratory borings were developed by removing groundwater using a submersible pump to remove sediments, ensure effective communication between the open borehole and fractures in the surrounding formation, and prepare the boreholes for downhole geophysical logging. Development continued until the discharge was relatively free of suspended sediments or until the borehole had been purged dry two to three times. Water generated during well development activities was collected in drums and managed in the same manner as other investigation-derived waste. All development activities were conducted with clean equipment to prevent potential cross-contamination between boring locations.

5.3 DOWN HOLE GEOPHYSICAL LOGGING AND GROUNDWATER SAMPLING

5.3.1 Downhole Logging

On March 21, 2011, Mid-Atlantic Geosciences completed downhole geophysical logging of exploratory borings MW-14C and MW-15C. Downhole logging was also conducted on existing well MW-5-40 which, is an open borehole monitoring well east of the reservoir, in August 2010 (Figure 8). The geophysical logs and report are included as Appendix E. The geophysical logging techniques were the same as those used during the site Remedial Investigation conducted in 2007 in the remediation area and included logging of fluid temperature, fluid conductivity, natural gamma radiation, borehole diameter and surface structure using a three-arm caliper, and optical/high resolution acoustic televiewer (OPTV/HRAT) imaging of the borehole walls.



The purpose of the geophysical logging was to identify potential open fracture zones where groundwater was entering or exiting the borehole. A fluid probe was used to measure changes in temperature and conductivity of the undisturbed water column in the boreholes. A three-arm caliper provided a mechanical measurement of the borehole wall diameter and was used to identify the location of fractures along the borehole wall. The natural gamma radiation logs were used to identify lithologic changes in the borehole and for stratigraphic correlation between boring locations.

Both the temperature/conductivity logs and caliper logs were verified by the OPTV/HRAT survey. The OPTV uses a downhole camera equipped with a hyperbolic mirror to examine the borehole walls. Unlike a standard downhole television camera, this device uses successive image scans (0.5 millimeter in length) to build a continuous optical record that is ultimately transferred to a paper log for analysis. In wells with low visibility (due to groundwater with a high particle load), the HRAT is substituted for the OPTV. The HRAT uses an acoustical signal to build a similar log of the borehole. Onboard magnetometers measure the orientation of the OPTV/HRAT during its descent allowing the strike and dip of fractures or bedding planes to be measured directly from the output log.

The OPTV/HRAT survey provided for direct visual examination of the potential fracture zones identified by the logs to determine the fracture abundance and their potential for transmitting groundwater. This information was used to select specific open or partially open fractures for collecting discrete interval groundwater samples.

5.3.2 Groundwater Sampling

On March 23 through March 25, 2011, groundwater samples were collected from newly installed monitoring wells MW-14C and MW-15C and existing well MW-5-40. Samples were collected using a bailer and standard purge and sample techniques. The samples were collected, labeled, packed on ice, and shipped to Pace Laboratory of Greensburg, Pennsylvania for VOC analysis using EPA Method 8260B.

The wells were purged of three water volumes, or until the boreholes went dry, and the purge water was processed through the groundwater extraction system immediately. The pH, specific conductance, temperature, turbidity, and dissolved oxygen were monitored during the purging process with a water quality meter to ensure that representative groundwater quality samples were collected. The wells were purged with dedicated air-displacement pumps run by a QED Well Wizard pump controller and sampled using dedicated Teflon bailers. The wells were allowed to recharge for a period of no more than 2 hours, or until water was present in the borehole, before samples were collected. The groundwater samples were analyzed for VOCs by EPA Method 8260B.



6 Geophysics and Exploratory Boring Results

6.1 SURFACE GEOPHYSICS FINDINGS AND OBSERVATIONS

As shown in Figure 9, the two inverted resistivity cross-sections are presented for transects CH01 and E12-SB-01. These represent a cross-hole tomography profile and an up-hole profile, respectively. The image for CH01 is a cross-hole resistivity tomography profile collected between wells EXB-01 and EXB-02. These two wells are located approximately 58 feet apart and were installed to a depth of approximately 80 feet bgs. Both wells were constructed with approximately 20 feet of steel casing set into bedrock with the remainder of the well left as an open bedrock hole. In order to ensure that the steel casing did not produce erroneous results, the upper electrodes in both wells were lowered to a depth of 30 feet bgs. Note that data collected between the ground surface and 30 feet bgs (hachured area in Figure 10) was not used.


In applying resistivity tomography at lithologically complex sites with numerous subsurface utilities, some erroneous data is collected during a survey. To counteract this, a number of computer algorithms were calculated and used to smooth the data. This process removes as little of the data as necessary to achieve a legible profile. During processing of survey CH01, 18 points out of the 477 points were smoothed (3.77% of the data). Survey E12-SB-01, however, required that 454 points out of 1,316 points be smoothed, i.e., 35.5% of the data. This transect had a high amount of background noise due to the numerous intersecting utilities, which appear clearly in the profile (Figure 10). The areas in question (represented with hatched lines) are reconstructed with an algorithm, and should not be considered a true representation of the underlying geology.

Results for Profile CH01 indicate three distinct conductive (low resistivity) anomalies (A, B, C, in Figure 10). Anomaly A is located at approximately 35 to 45 feet bgs and is approximately 25 feet wide. This conductive feature is consistent with perched groundwater observed in monitoring MW-5-40, which is located east of the south tank of the reservoir. Anomaly B ranges from approximately 50 – 75 feet bgs and is approximately 48 feet wide. This feature is consistent with the C-zone bedding plane fracture identified across the area. Anomaly C is a small isolated conductive anomaly at approximately 55 feet bgs and is about 10 feet wide. Anomalies A and B are indicative of water-bearing bedding plane fractures in bedrock.

Profile E12-SB-01 is a surface-to-borehole resistivity profile that was collected instead of a standard surface resistivity profile due to several subsurface utilities that cross and run parallel to the transect line. Due to the presence of a thick layer of concrete near EXB-02, the first surface electrode was placed approximately 45 feet away from the borehole. This is the reason for the hachured zone from 0 – 45 feet along the profile moving away from EXB-02 (Figure 10). Results from Profile E12-SB-01 indicate a very noisy shallow subsurface, due to the location of several utilities. The red resistive features in the shallow depths below the surface electrodes (from 75 to 190 feet along-profile) are likely attributed to dry resistive fractures in shallow bedrock. Anomalies D, E, F, and G are all conductive anomalies that are indicative of water-bearing fractures.

6.2 DOWNHOLE OBSERVATIONS

The reports for the downhole geophysical logging conducted in wells MW-14C, MW-15C, and MW-5-40 are included in Appendix E. On August 25, 2010, MW-5-40 was logged using an Optical Televiewer, 3-Arm Caliper, and a Robertson Geologging, LTD. Micrologger II and/or a Mount Sopris Matrix to collect fluid temperature, fluid conductivity, and natural gamma readings. At the time of the geophysical logging, the water level in MW-5-40 was 30 feet bgs. Two small high-angle features were identified above the water table at depths of 18.7 feet and 20.6 feet bgs. Within the water column at 38.5 feet bgs (549 feet



amsl), a sealed bedding plane fracture was identified. This directly correlates to a bedding plane fracture previously observed beneath the remediation area.

On March 21, 2011, exploratory borings MW-14C and MW-15C were also logged using an Optical Televiwer, 3-Arm Caliper, and a Robertson Geologging, LTD. Micrologger II and/or a Mount Sopris Matrix. At the time of the geophysical logging, the water level in MW-14C was 21.8 feet bgs. Few planar features were recognizable on the televiwer logs. Within the water column at 37.3 feet bgs (550 feet amsl), an open fracture was identified. An open fracture zone was also identified from 43.3 to 43.6 feet bgs (544 feet amsl).

At the time of the geophysical logging, the water level in MW-15C was 42.8 feet bgs. No planar features were observed in the downhole log. Above the recorded water column at 37.5 feet bgs (550 feet amsl), a bedding plane fracture was identified. Within the water column, a sealed second fracture was identified at 43.5 feet bgs.

As discussed in Section 2.0, an updated CSM has been prepared to show the distribution of the bedding plane fractures and to conceptualize the vertical and horizontal movement of groundwater in the fire water reservoir area. The CSM has been updated to incorporate the supplemental geophysical data and the bedding plane fractures observed at 550 feet and 544 feet amsl. These bedding plane fractures along with the bedding plane fracture previously identified at 515 feet amsl are considered the primary horizontal migration pathways for affected groundwater beneath the fire water reservoir area.

6.3 ROCK CORE SAMPLE RESULTS

Results of the rock core sampling indicate that dissolved VOCs are present within the rock matrix and micro fractures of the unsaturated bedrock below the reservoir's south tank (Table 9). However, no residual source material (TCE product) was found in the rock core grab samples collected from just below the elevation of the reservoir (boring MW-14C). In the boring installed immediately south of the south tank (MW-14C), TCE levels ranged from 4,310 µg/kg to 8,450 µg/kg. The highest concentration of TCE was detected in the interval between 19.5 feet bgs and 20.0 feet bgs. Cis-1,2-DCE was detected at concentrations between 343 µg/kg and 429 µg/kg at depths between 17.5 feet and 20 feet bgs. Lower levels (<30 µg/kg) of methylene chloride, PCE, and trans-1,2-DCE were also detected in the samples. Low levels of VOCs were detected in the rock core samples collected east of the north tank in the borehole for well MW-15C. The concentration of TCE was 35.5 µg/kg in the rock core sample collected from 20.4 feet bgs to 20.9 feet bgs and the concentration of cis-1,2-DCE was 185 µg/kg.

6.4 GROUNDWATER SAMPLING RESULTS

On March 23 through March 25, 2011, groundwater samples were collected from wells MW-14C and MW-15C and existing well MW-5-40. Existing well MW-5-40 was selected for additional sampling because the well is open from 17 to 40 feet bgs and intersects the bedding plane fracture encountered at approximately 550 feet amsl. This well does not intersect the lower bedding plane fracture observed at 544 feet amsl. Laboratory Reports are included in Appendices D. Groundwater sample results are summarized in Table 8.

The highest concentration of total VOCs (104,220 µg/l) was detected in well MW-14C, which is located within 5 feet of the south tank of the reservoir (Figure 6). TCE and its associated degradation products, cis-1,2-DCE and vinyl chloride, were the predominant compounds detected in the groundwater sample. TCE was detected at a concentration of 89,600 µg/l and cis-1,2-DCE was detected at a concentration of 13,500 µg/l. Vinyl chloride was detected at a concentration 414 µg/l.



The sample collected from MW-15C contained a lower level of total VOCs (1,890 µg/l) compared to levels hydraulically downgradient of the fire water reservoir. TCE was detected at 1,290 µg/l, cis-1,2-DCE at 544 µg/l, and vinyl chloride at 14.6 µg/l.

The groundwater sample collected from well MW-5-40, located between wells MW-14C and MW-15C (Figure 6), had concentrations of TCE at 6,390 µg/l, cis-1,2-DCE at 18,000 µg/l, and vinyl chloride at 774 µg/l. The results of the sample collected from MW-5-40 are consistent with previous sampling results.

6.5 GEOPHYSICS AND GROUNDWATER SUMMARY

As discussed in Section 2.0 and shown in Figure 3, an updated CSM has been prepared to conceptualize the vertical and horizontal movement of groundwater flow in the fire water reservoir area. The CSM has been updated to incorporate the bedding plane fractures observed at 550 feet and 544 feet amsl. Based on the results of the supplemental downhole geophysics investigation and groundwater samples collected from monitoring wells MW-5-40, MW-14C, and MW-15C, the bedding plane fractures identified at 550 feet and 544 feet amsl are significant pathways for affected groundwater movement beneath the fire water reservoir area. Elevated VOC concentrations in groundwater are present within these two bedding plane fractures, which are between 17 and 21 feet below the base of the reservoir. These fractures, as well as the deeper bedding plane fracture previously identified at 515 feet amsl, are considered the primary migration pathways for affected groundwater at the site.



7 Conclusions

The results of the supplemental pre-design investigations show that there is not TCE product or dense non aqueous phase liquid (DNAPL) material immediately below or around the south or north tank of the fire water reservoir. The total concentrations of TCE, cis-1,2-DCE, and vinyl chloride detected in aqueous samples collected from the eight additional monitoring points and from rock core samples collected from elevations corresponding to depths below the reservoir were well below VOC levels detected in monitoring and extraction wells installed near and downgradient of the reservoir.

Soil and water samples collected from the existing drain pipe that exits the south tank did not contain elevated levels of VOCs, and no TCE product or significant VOC mass was encountered in any of the test pit samples collected in the vicinity of the drain pipe.

Results of the rock core sampling indicate that VOCs are present within the rock matrix and micro fractures present at depth below the south tank and surrounding area. However, no residual TCE product was detected in the rock core samples.

Results of the geophysical investigation and additional groundwater characterization show that elevated levels of VOCs are present within two bedding plane fractures between 17 feet and 21 feet below the base of the south tank of the reservoir. These fractures, as well as the deeper bedding plane fracture previously identified at 515 feet amsl, are likely the primary migration pathways for affected groundwater at the site. Based on a review of system performance data previously submitted to the NYSDEC and the elevation of the current extraction wells compared to the location of the subsurface mass, the IRM implemented in early 2009 is effective in intercepting and removing mass from the B-zone and the three bedding plane fractures identified within the C-zone. The shallow B-zone extraction wells intersect and contain affected groundwater present in the B-zone and the bedding plane fractures at 550 feet and 544 feet amsl. The C-zone extraction wells intersect and contain affected groundwater present in the bedding plane fractures encountered at 544 feet and 515 feet amsl.



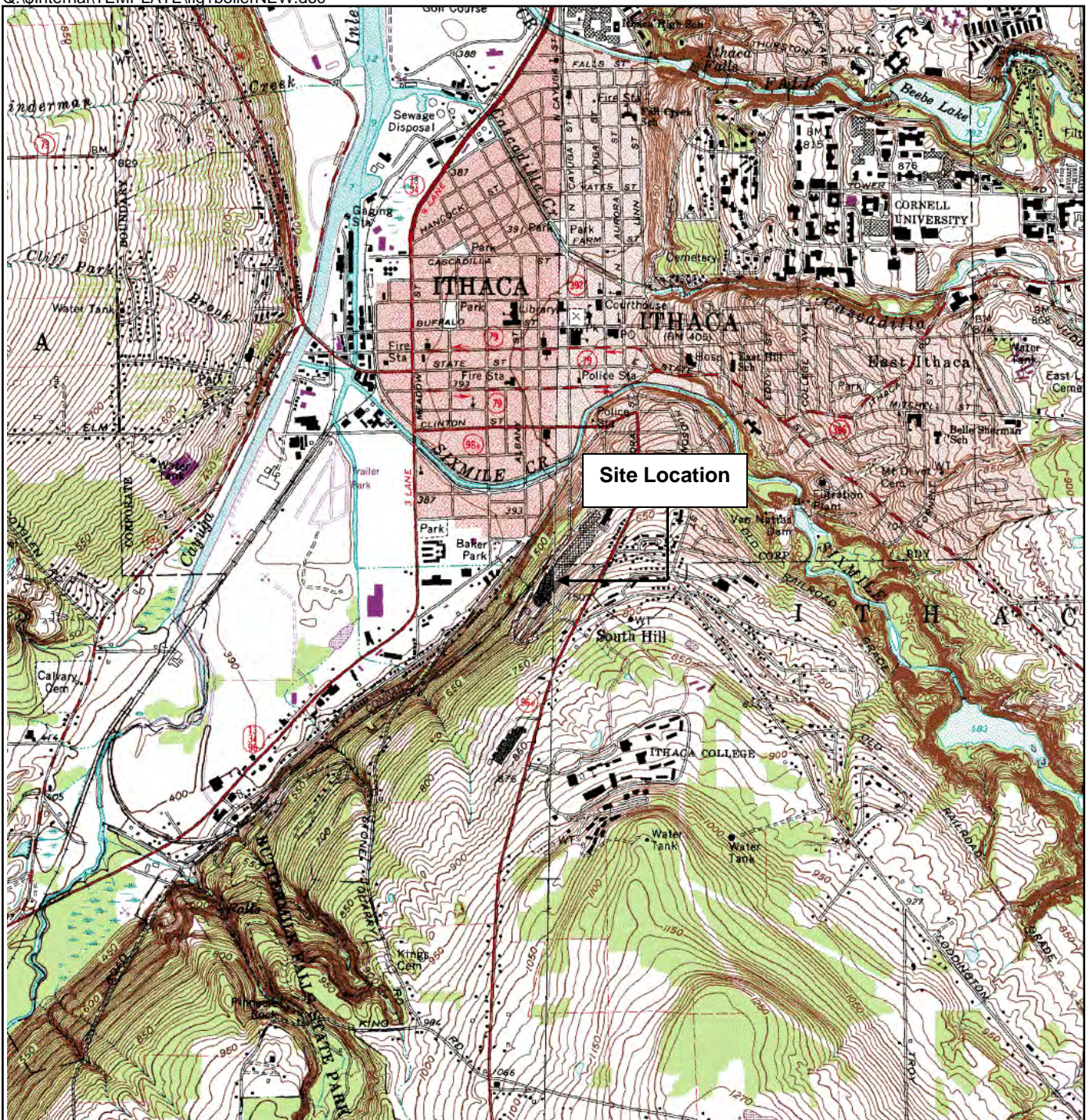
Acronyms

μg/kg	micrograms per kilogram
μg/l	micrograms per liter
amsl	above mean sea level
bgs	below ground surface
CSM	conceptual site model
DCE	<i>cis</i> -1,2-dichloroethene
DNAPL	dense non aqueous phase liquid
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
EPT	Emerson Power Transmission
ER	electrical resistivity
ID	inside diameter
IRM	Interim Remedial Measure
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OPTV/HRAT	optical/high resolution acoustic televiewer
PID	photoionization detector
RQD	Rock Quality Designation
TCE	trichloroethene
VOC	volatile organic compounds



Figures





Reference

7.5 Minute Series Topographic Quadrangle
Ithaca East, New York
Photorevised 1976 Scale 1:24,000



Quadrangle Location



Scale in Feet



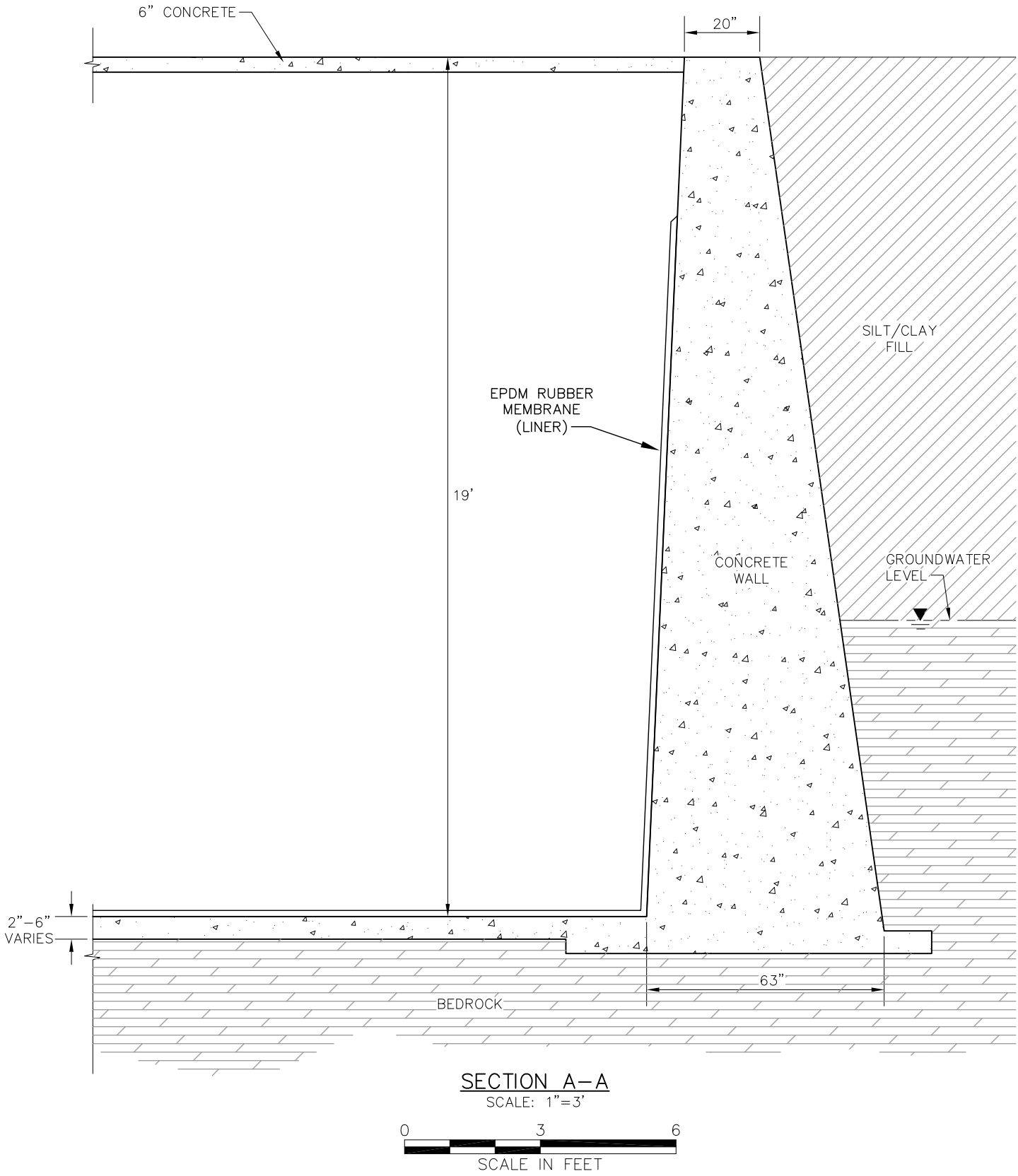
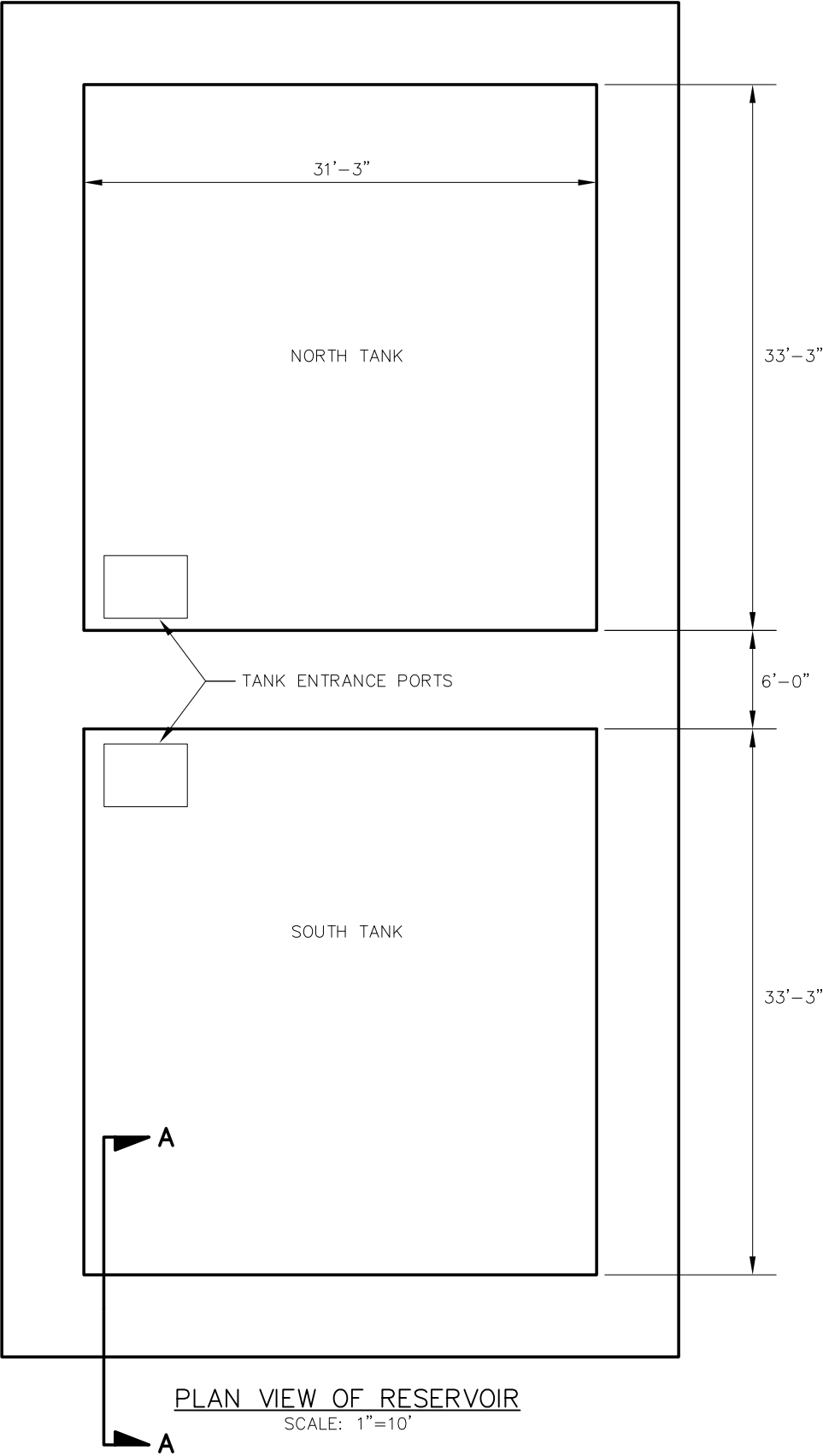
WSP Environment & Energy
11190 Sunrise Valley Drive
Suite 300
Reston, Virginia 20191
703-709-6500

Figure 1
Site Location
Emerson Power Transmission
Ithaca, New York

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B

REFERENCE: MORSE CHAIN CO., ITHACA, NEW YORK DRAWING NO. A-176252 ENTITLED "FIRE RESERVOIR- ORIGINAL CONSTRUCTION" SCALE 1/4"=1'-0", DATED FEBRUARY 2, 1976.



NOTICE: THIS DRAWING HAS BEEN PREPARED UNDER THE DIRECTION OF A PROFESSIONAL. DO NOT ALTER THIS DOCUMENT IN ANY WAY WITHOUT THE WRITTEN CONSENT OF WSP ENVIRONMENT & ENERGY, LLC.

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Approved: SPH 05132011
DWG Name: 00004507-012

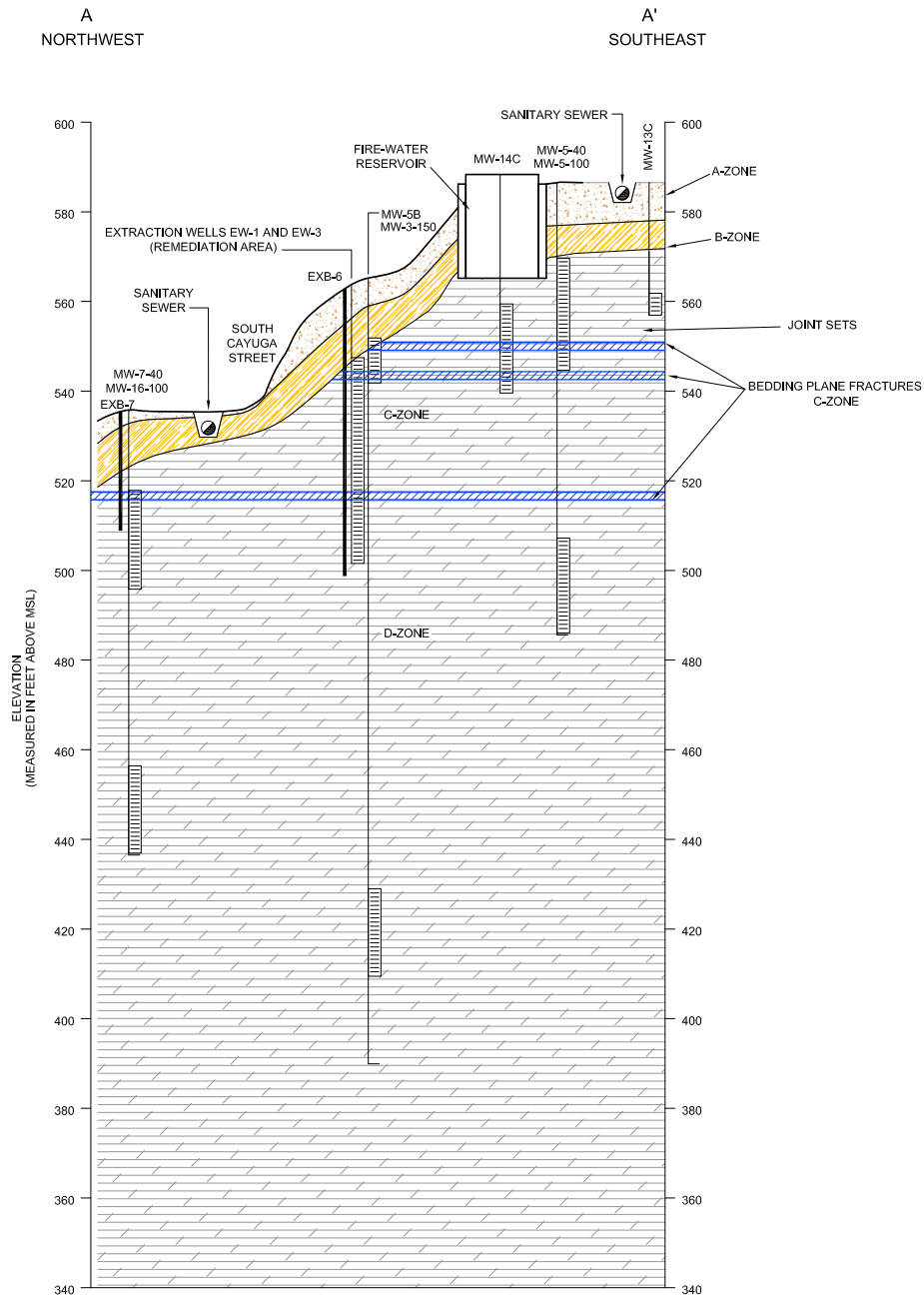
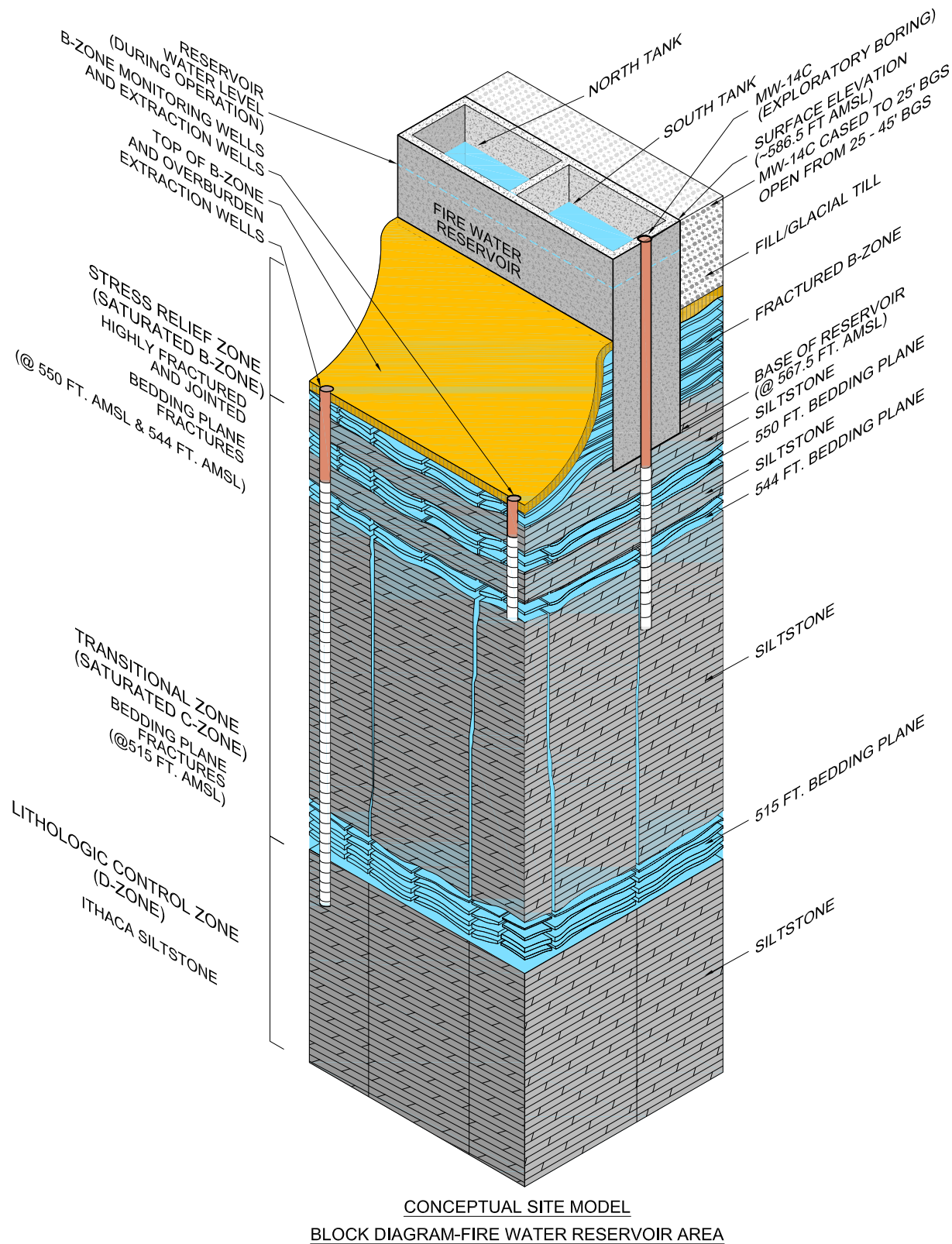
EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
PREPARED FOR
EMERSON

Figure 2
FIRE WATER RESERVOIR SCHEMATIC

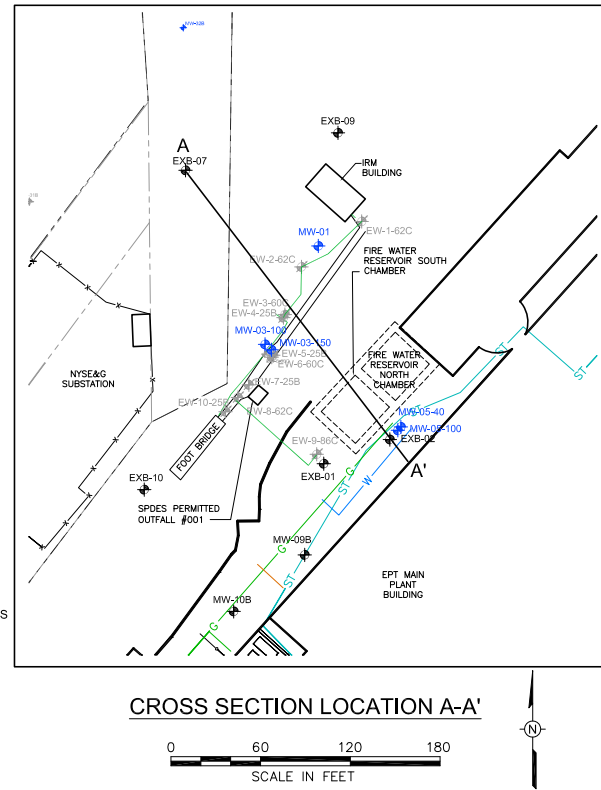
WSP
WSP Environment & Energy, LLC
11190 Sunrise Valley Drive, Suite 300
Reston, Virginia 20191
(703) 709-6500
www.wspenvironmental.com/usa

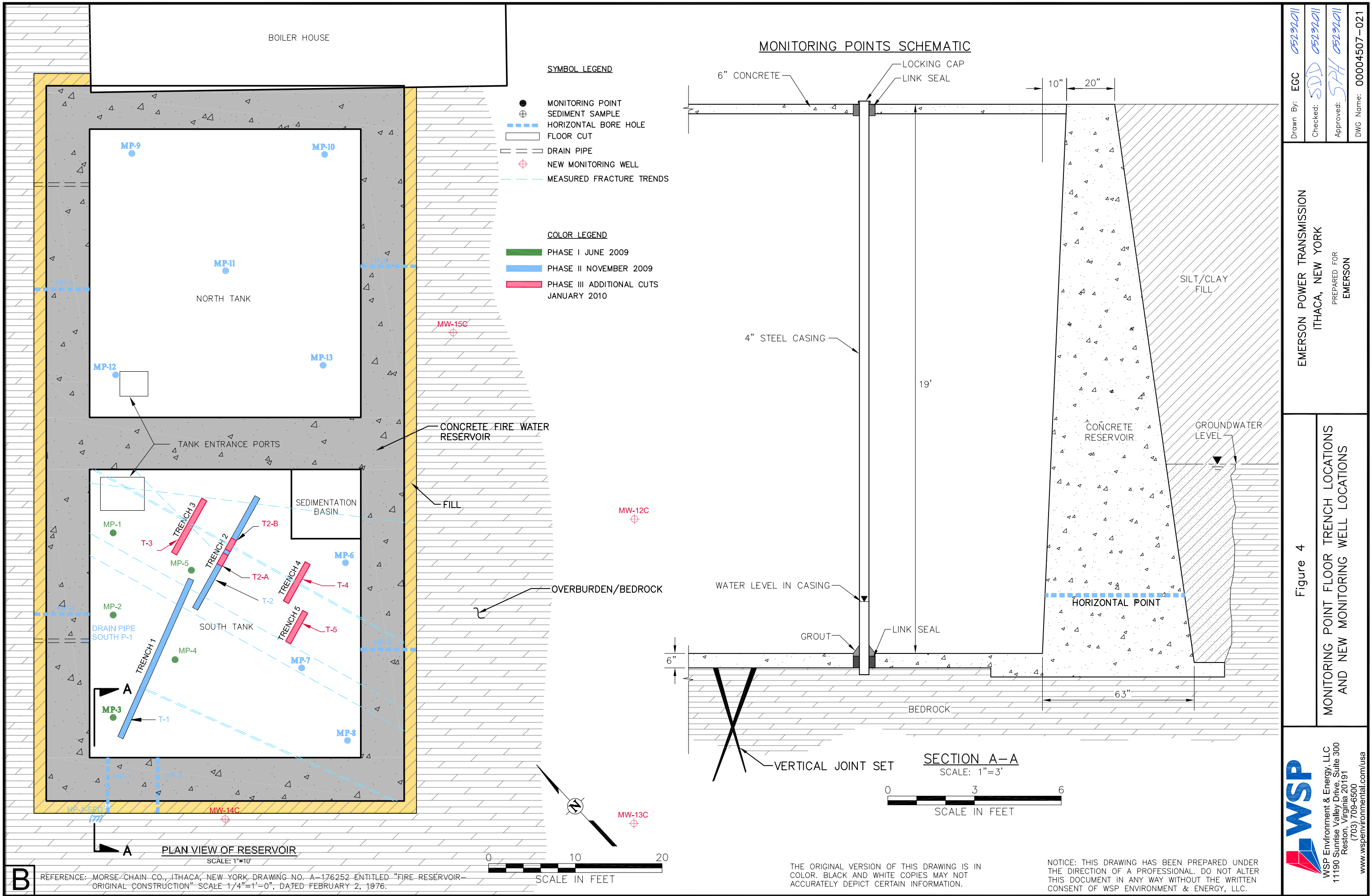
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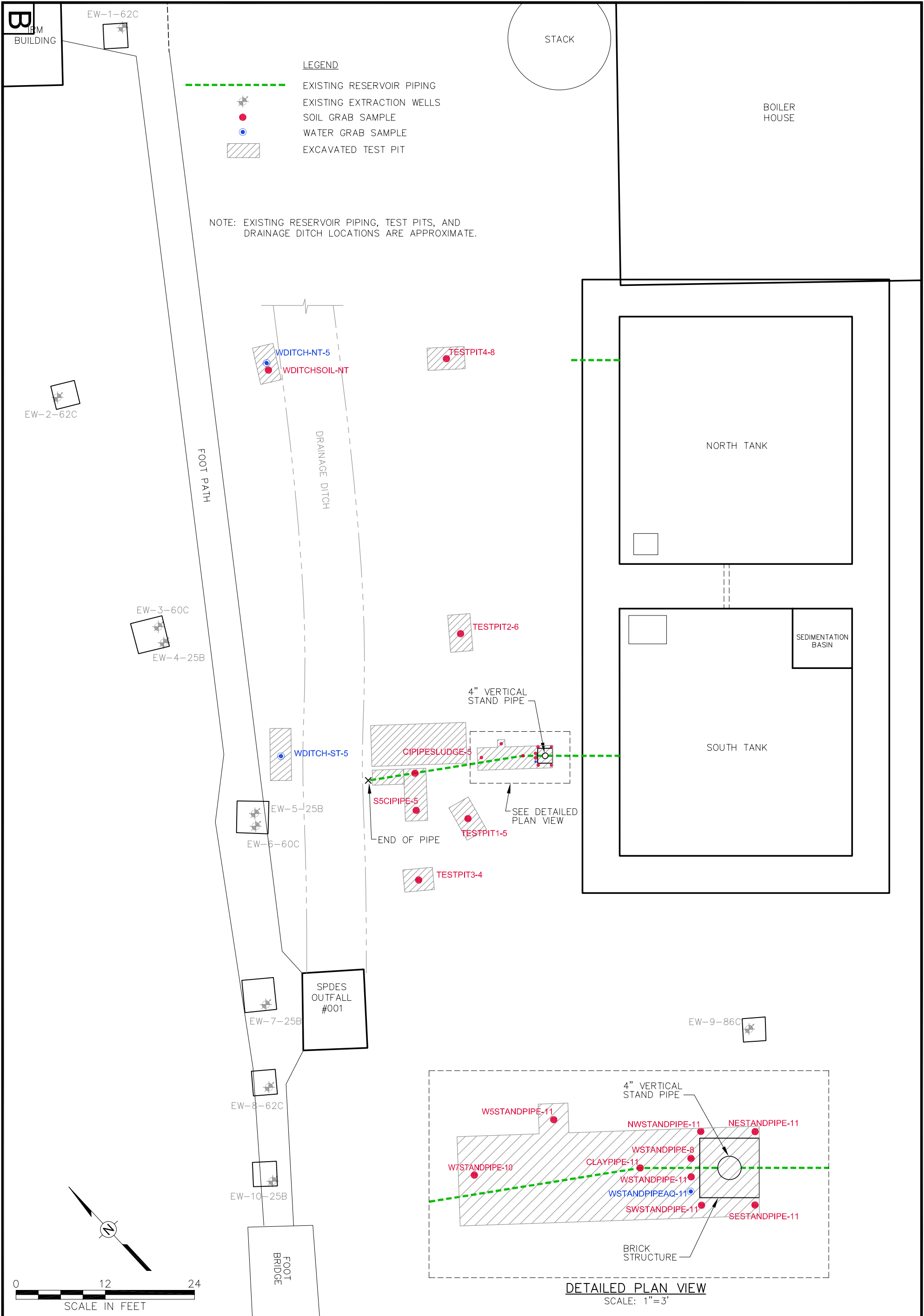
D



NOTE:
BEDDING PLANE FRACTURES AT 544' AMSL AND 550' AMSL,
AND 515' AMSL. WELL MW-14C SCREENED BETWEEN 542'
AMSL AND 562' AMSL.







B

NOTES:

1. CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS REPORTED IN MICROGRAMS PER LITER (ug/l)
2. CONCENTRATIONS IN BOLD EXCEED THE EVALUATION CRITERIA LISTED IN THE NEW YORK STATE DIVISION OF WATER TECHNICAL AND OPERATIONAL GUIDANCE SERIES (TOGS) 1.1.1, TABLE 5: NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (JUNE 1998).
3. CONCENTRATION OF DIESEL REPORTED IN MILLIGRAMS PER LITER (mg/l).

LEGEND

- MONITORING POINT
- EW

 EXTRACTION WELL
- MW-X

 MONITORING WELL
- HORIZONTAL BORE HOLE
- FLOOR CUT
- (151)

 TOTAL VOC CONCENTRATIONS (MEASURED IN ug/l) - 2009 / 2010
- [77]

 TOTAL VOC CONCENTRATIONS (MEASURED IN ug/kg)
- E

 UTILITY BANK
- O

 OXYGEN LINE
- G

 GAS LINE
- ST

 STORM SEWER
- W

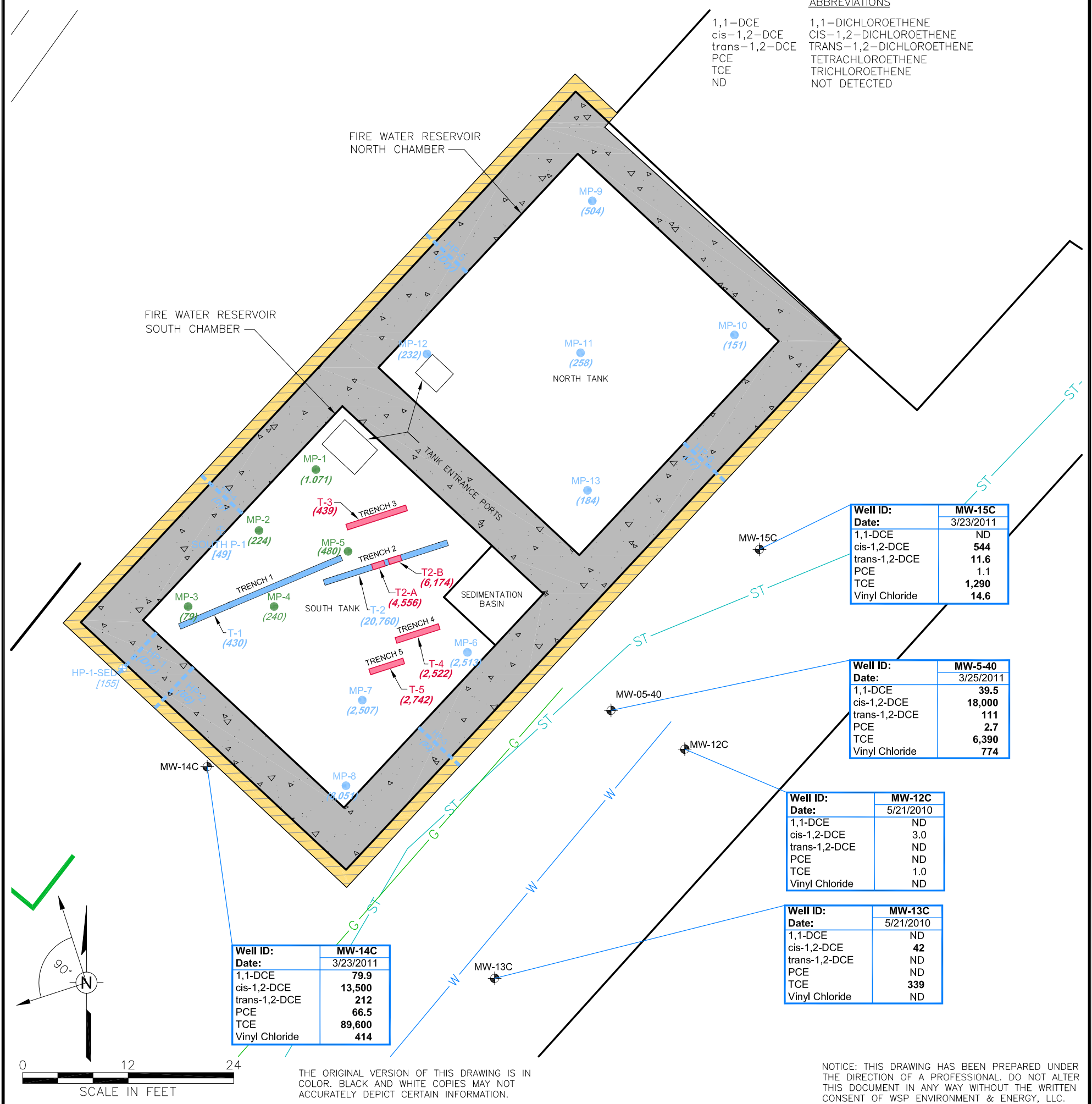
 WATER LINE

COLOR LEGEND

- PHASE I AUGUST 2009
- PHASE II NOVEMBER 2009
- PHASE III ADDITIONAL CUTS JANUARY 2010

ABBREVIATIONS

- 1,1-DCE 1,1-DICHLOROETHENE
- cis-1,2-DCE CIS-1,2-DICHLOROETHENE
- trans-1,2-DCE TRANS-1,2-DICHLOROETHENE
- PCE TETRACHLOROETHENE
- TCE TRICHLOROETHENE
- ND NOT DETECTED



LEGEND

SOIL GRAB SAMPLE



WATER GRAB SAMPLE



EXCAVATED TEST PIT

RED DENOTES SOIL GRAB SAMPLE (ug/kg)

DEPTH IN FEET BGS

CONCENTRATION

SAMPLE NAME:

BLUE DENOTES WATER GRAB SAMPLE (ug/L)

NESTANDPIPE-11	11
MEK	ND
TCE	23
cis-1,2-DCE	ND
Vinyl Chloride	ND

W5STANDPIPE-11	11
cis-1,2-DCE	ND
MEK	ND
TCE	ND
Vinyl Chloride	ND

W7STANDPIPE-10	10
cis-1,2-DCE	ND
MEK	ND
TCE	ND
Vinyl Chloride	ND

CLAYPIPE-11	11
cis-1,2-DCE	10
MEK	13
TCE	ND
Vinyl Chloride	ND

WSTANDPIPE-8	8
cis-1,2-DCE	ND
MEK	ND
TCE	ND
Vinyl Chloride	ND

WSTANDPIPEAQ-11	11
cis-1,2-DCE	116
MEK	16
TCE	2.1
Vinyl Chloride	9.4

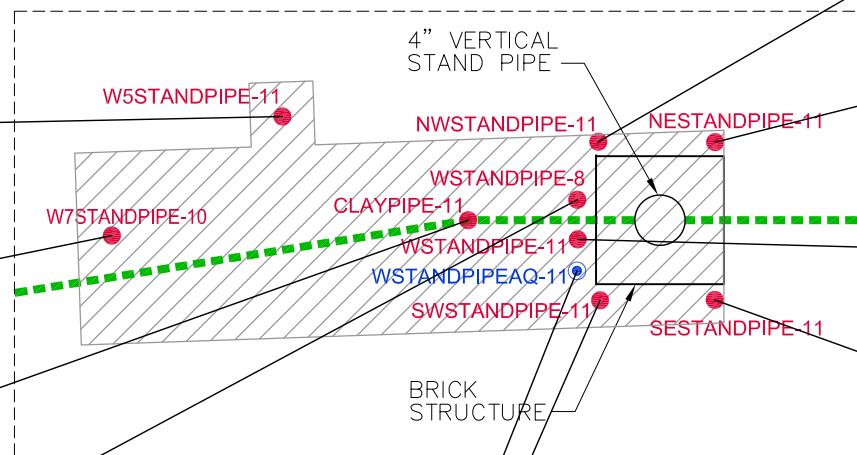
SWSTANDPIPE-11	11
cis-1,2-DCE	7.1
MEK	16
TCE	ND
Vinyl Chloride	5.2

NWSTANDPIPE-11	11
cis-1,2-DCE	ND
MEK	63
TCE	ND
Vinyl Chloride	ND

NESTANDPIPE-11	11
cis-1,2-DCE	ND
MEK	23
TCE	ND
Vinyl Chloride	ND

WSTANDPIPE-11	11
cis-1,2-DCE	ND
MEK	40
TCE	ND
Vinyl Chloride	ND

SESTANDPIPE-11	11
cis-1,2-DCE	ND
Methylcyclohexane	13
MEK	21
TCE	ND
Vinyl Chloride	ND



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0 3 6
SCALE IN FEET

A



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Figure 8

FIRE WATER RESERVOIR
EXISTING PIPE INVESTIGATION
DETAILED PLAN VIEW

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION

Drawn By: EGC 06282011

Checked: LK 06282011

Approved: SPH 06282011

DWG Name: 00004507-023

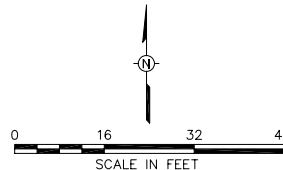


NOTES:

1. CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS REPORTED IN MICROGRAMS PER LITER ($\mu\text{g/l}$)
2. CONCENTRATIONS IN BOLD EXCEED THE EVALUATION CRITERIA LISTED IN THE NEW YORK STATE DIVISION OF WATER TECHNICAL AND OPERATIONAL GUIDANCE SERIES (TOGS) 1.1.1, TABLE 5: NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (JUNE 1998).
3. CONCENTRATION OF DIESEL REPORTED IN MILLIGRAMS PER LITER (mg/l).

LEGEND

ER-SB-01	ER LINES (SURFACE GEOPHYSICS AND CROSS HOLE TOMOGRAPHY)
E	UTILITY BANK
O	OXYGEN LINE
G	GAS LINE
ST	STORM SEWER
W	WATER LINE
	CONDUCTIVE FEATURE



**SURFACE GEOPHYSICS AND
CROSS HOLE TOMOGRAPHY**
EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION

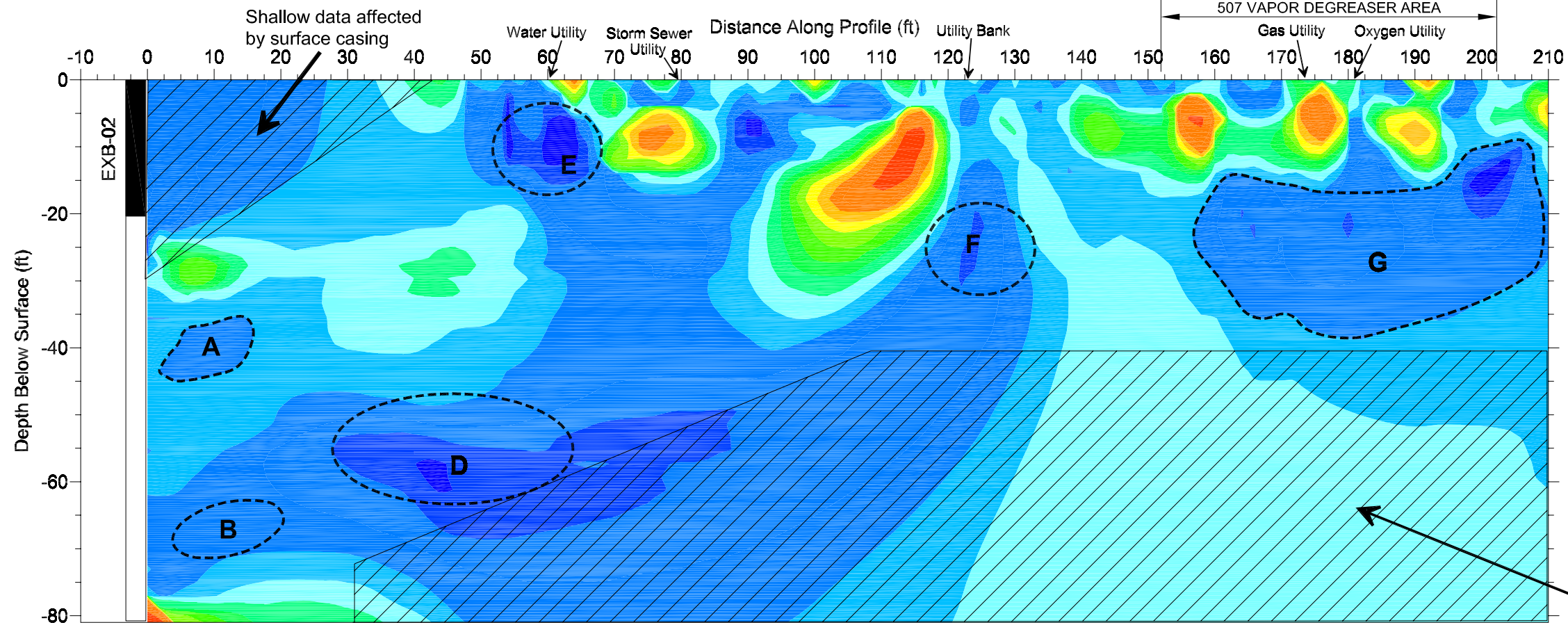
DRAWN BY	EGC
CHECKED	SPH
APPROVED	
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SEAL

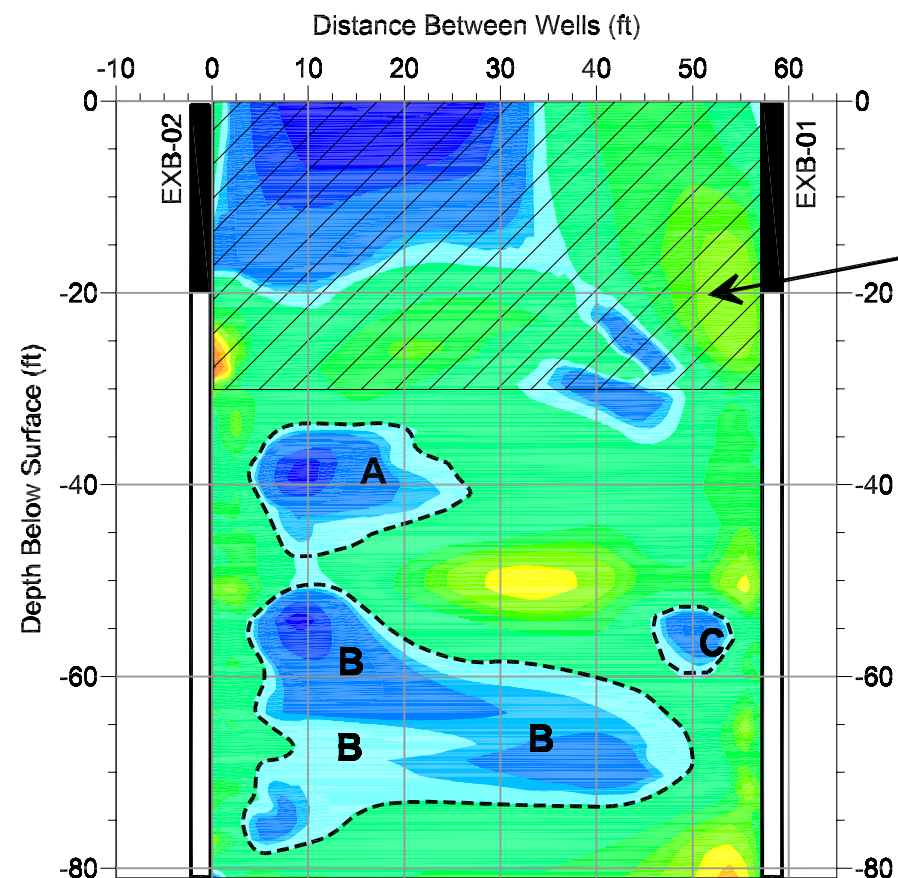
DATE

REVISIONS			
REV	DESCRIPTION		
1	Revised:	Chkd:	Appr:
2	Revised:	Chkd:	Appr:
3	Revised:	Chkd:	Appr:

R:\ACAD\CADD\0004507-Ithaca\CAD\0004507-011.dwg 6/21/2011 4:35 PM Usec01012



ELECTRICAL RESISTIVITY LINE - E12-SB-01



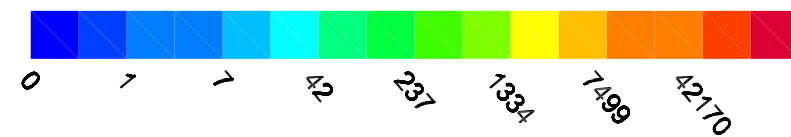
CROSS HOLE TOMOGRAPHY LINE - CH01

A, B, C Resistivity Anomalies

----- Resistivity Anomaly Boundary

Model Interpolation with No Supporting Data

Apparent Resistivity (Ohm-m)



Electrical resistivity data collected at 1m electrode spacings with a AGI SuperSting R8 Resistivity/IP Meter.

Two tomographies were collected:
1) borehole-to-borehole and
2) surface-to-borehole.

Borehole-to-borehole collected between EXB-02 and EXB-01 starting at 30 feet below ground surface (bgs) down to 81 feet bgs.

Apparent Resistivity (Ohm-m)

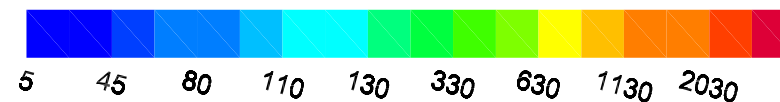


Figure 10

SURFACE GEOPHYSICS AND
CROSS HOLE TOMOGRAPHY RESULTS

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
PREPARED FOR
EMERSON

Drawn By: EGC 05/23/2011
Checked: SDD 05/23/2011
Approved: SPH 05/23/2011
DWG Name: 00004507-011

WSP
WSP Environment & Energy, LLC
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B

REFERENCE: ENVIROSCAN, INC. FIGURE 2, TITLED ERT SURVEY RESULTS, PROJECT NO. 061037A, DATED 08/27/10.



Tables



Table 1

**Reservoir Wall Seepage - Groundwater Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
October 2009**

VOCs (µg/L)	Description:	Sample ID: NorthTank102109	NorthTank102209	SouthTank102209
		Matrix: Water	Water	Water
		Date: 10/21/2009	10/22/2009	10/22/2009
		Groundwater Grab Sample	Groundwater Grab Sample	Groundwater Grab Sample
Bromodichloromethane		4.2	1.6	6.0
Chloroform		29.0	15.0	33.0
Dibromochloromethane		1.9	1.0 U	2.6
cis-1,2-Dichloroethene		4.9	2.8	2.0
Methylene Chloride		1.0	0.6 J	1.0 U
Trichloroethene		1.0	1.0	1.4
Vinyl chloride		1.0	1.0 U	1.0 U
Total VOCs:		43	21	45

a\ VOCs = volatile organic compounds; µg/l = micrograms per liter; U = analyte not detected above reporting limit; J = analyte detected at a level less than the reporting limit and greater than or equal to the method detection limit; D = dilution required due to high concentration of target analytes.

b\ Concentrations in bold exceed evaluation criteria. Evaluation criteria for VOCs are from the New York State Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1, Table 5: New York State Ambient Water Quality Standards and Guidance Values (June 1998).

Table 2

Sediment and Waste Characterization Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
November 2009

	Sample ID:	HP-1 SED	South P-1	Rolloff110309
	Matrix:	Solid	Solid	Solid
	Date:	11/3/2009	11/3/2009	11/3/2009
	Location:	HP-1	South Tank	Roll-off
		Soil Grab	Pipe	Container
		Sample	Soil Grab	Composite
VOCs (µg/kg)	Description:	Sample	Sample	Grab Sample
2-Butanone		14.0 J	310.0 U	7.8 J
Acetone		87.0	250.0 J	74.0
Carbon disulfide		1.5 J	62.0 U	5.9 U
Chloroform		6.4 J	62.0 U	5.9 U
cis-1,2-Dichloroethene		9.1	87.0	4.1 J
Ethylbenzene		7.4 U	16.0 J	5.9 U
Methylene Chloride		6.8 J	47.0 J	3.9 J
Toluene		7.4 U	62.0 U	1.7 J
Trichloroethene		29.0	240.0	29.0
Vinyl chloride		1.5 J	56.0 J	12.0 U
Xylenes, total		15.0 U	73.0 J	1.4 J
Total VOCs		155	769	122

- a\ VOCs = volatile organic compounds; µg/kg = micrograms per kilogram; D = dilution required due to high concentration of target analytes; J = analyte detected at a level less than the reporting limit and than or equal to the method detection limit; U = analyte not detected above reporting limit.

Table 3

Horizontal and Monitoring Points - Groundwater Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
November 2009

	Sample ID:	MP-6	MP-7	MP-8	MP-9	MP-10	MP-11	MP-12
	Matrix:	Water	Water	Water	Water	Water	Water	Water
	Date:	11/3/2009	11/3/2009	11/3/2009	11/5/2009	11/5/2009	11/5/2009	11/5/2009
		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
VOCs (µg/l)	Description:	Sample	Sample	Sample	Sample	Sample	Sample	Sample
Acetone		25.0 U	6.2	25.0 U	36.0	5.1	5.0 U	4.9 J
Bromodichloromethane		5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	0.6 J
2-Butanone		25.0 U	5.0 U	25.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Carbon disulfide		5.0 U	1.0 U	5.0 U	1.0 U	0.6 J	1.0 U	1.0 U
Chloroethane		5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.4
Chloroform		5.0 U	0.6 J	5.0 U	2.2	2.0	1.0 U	4.8
Chloromethane		5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dibromochloromethane		5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene		5.2	6.3	7.4	2.8	0.5 J	0.7 J	0.7 J
cis-1,2-Dichloroethene		1,600.0 D	2,100.0 D	2,600.0 D	200.0 D	71.0	150.0 D	110.0 D
trans-1,2-Dichloroethene		9.2	9.8	11.0	1.7	0.9 J	2.5	2.0
Ethylbenzene		5.0 U	0.7 J	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Isopropylbenzene		5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Methylene Chloride		5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene		3.8 J	0.8 J	8.2	1.2	1.0 U	1.0 U	0.5 J
Toluene		5.0 U	0.6 J	5.0 U	1.2	1.0 U	1.0 U	1.0 U
Trichloroethene		760.0 D	99.0 D	5,300.0 D	210.0 D	15.0	26.0	44.0
Vinyl chloride		130.0	290.0 D	120.0	85.0 D	60.0	77.0	69.0
Xylenes, total		3.3 U	3.5	10.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total VOCs:		2,508	2,517	8,047	540	155	256	238

Table 3

**Horizontal and Monitoring Points - Groundwater Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
November 2009**

	Sample ID:	MP-13	HP-2	HP-3	HP-6
	Matrix:	Water	Water	Water	Water
	Date:	11/5/2009	11/3/2009	11/3/2009	11/5/2009
VOCs (µg/l)	Description:	Groundwater Sample	Groundwater Grab Sample	Groundwater Grab Sample	Groundwater Grab Sample
Acetone		15.0	5.0 U	5.0 U	5.0 U
Bromodichloromethane		1.0 U	1.1	4.4	0.8 J
2-Butanone		2.1 J	5.0 U	5.0 U	5.0 U
Carbon disulfide		0.4 J	1.0 U	1.0 U	1.0 U
Chloroethane		1.0 U	1.0 U	1.0 U	1.0 U
Chloroform		3.5	19.0	25.0	12.0
Chloromethane		1.0 U	1.0 U	1.3	1.0 U
Dibromochloromethane		1.0 U	1.0 U	2.2	1.0 U
1,1-Dichloroethene		0.8 J	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene		75.0	18.0	25.0	35.0
trans-1,2-Dichloroethene		0.5 J	1.6	1.0 U	0.5 J
Ethylbenzene		1.0 U	1.0 U	1.0 U	1.0 U
Isopropylbenzene		1.0 U	1.0 U	1.4	1.0 U
Methylene Chloride		1.0 U	1.0 U	1.0 U	0.7 J
Tetrachloroethene		1.0 U	1.0 U	1.0 U	1.0 U
Toluene		0.9 J	1.0 U	1.0 U	1.0 U
Trichloroethene		19.0	23.0	30.0	11.0
Vinyl chloride		84.0	3.3	3.8	7.1
Xylenes, total		2.0 U	2.0 U	2.0 U	2.0 U
Total VOCs:		201	66	93	67

a\ VOCs = volatile organic compounds; µg/l = micrograms per liter; U = analyte not detected above reporting limit; J = analyte detected at a level less than the reporting limit and greater than or equal to the method detection limit; D = dilution required due to high concentration of target analytes.

b\ Concentrations in bold exceed evaluation criteria. Evaluation criteria for VOCs are from the New York State Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1, Table 5: New York State Ambient Water Quality Standards and Guidance Values (June 1998).

Table 4

Trench Samples - Groundwater Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
November 2009 and January 2010

	Sample ID:	T-1	T-2	T-2A	T-2B	T-3	T-3-100 (c)	T-4	T-5
	Matrix:	Water	Water	Water	Water	Water	Water	Water	Water
	Date:	11/4/2009	11/4/2009	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010
		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
VOCs (µg/L)	Description:	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Acetone		3.2 J	200.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U
Chloroform		2.6	40.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane		1.0 U	40.0 U	1.0 U	1.0 U	1.0 U	1.1	1.0 U	1.0 U
1,1-Dichloroethene		0.84 J	40.0 U	3.3	4.1	1.0 U	1.0 U	8.7	10.2
cis-1,2-Dichloroethene		210.0 D	1300.0	345.0	391.0	82.1	82.9	1,520.0 D	2,080.0 D
trans-1,2-Dichloroethene		1.2	40.0 U	2.8	3.6	1.0 U	1.0 U	10.4	21.7
Tetrachloroethene		1.3	120.0	12.6	17.7	1.0 U	1.0 U	4.5	1.0 U
Toluene		1.0 U	40.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.5	1.1
Trichloroethene		170.0 D	19,000.0 D	4,110.0 D	5,660.0 D	316.0	279.0	804.0 D	164.0
Vinyl chloride		43.0	370.0	82.0	97.3	40.7	37.9	173.0	270.0
Total VOCs		432	20,790	4,556	6,174	439	401	2,522	2,547

a\ VOCs = volatile organic compounds; µg/l = micrograms per liter; U = analyte not detected above Reporting Limit; J = analyte detected at a level less than the Reporting Limit and greater than or equal to the Method Detection Limit; D = dilution required due to high concentration of target analytes.

b\ Concentrations in bold exceed evaluation criteria. Evaluation criteria for VOCs are from the New York State Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1, Table 5: New York State Ambient Water Quality Standards and Guidance Values (June 1998).

c\ T-3-100 is a duplicate of T-3.

Table 5

Test Pits - Soil Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
April 2010

	Sample ID: Matrix: Date:	WStandpipe-8 Solid 4/20/2010	WStandPipe-11 Solid 4/20/2010	NWStandPipe-11 Solid 4/21/2010	NEStandPipe-11 Solid 4/21/2010	SWStandPipe-11 Solid 4/21/2010
VOCs (µg/kg)	Description:	Soil Grab Sample	Soil Grab Sample	Soil Grab Sample	Soil Grab Sample	Soil Grab Sample
2-Butanone		11.5 UJ	39.6 J	62.2 J	23.4 J	15.6 J
Acetone		11.5 UJ	13.9 J	11.1 UJ	11.5 UJ	12.6 J
cis-1,2-Dichloroethene		5.8 UJ	5.2 UJ	5.5 UJ	5.8 UJ	7.1 J
Methylcyclohexane		11.5 UJ	10.3 UJ	11.1 UJ	11.5 UJ	9.3 UJ
Trichloroethene		5.8 UJ	5.2 UJ	5.5 UJ	5.8 UJ	4.6 UJ
Vinyl chloride		5.8 UJ	5.2 UJ	5.5 UJ	5.8 UJ	5.2 J
Total VOCs			54	62	23	41

Table 5

Test Pits - Soil Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
April 2010

	Sample ID: Matrix: Date:	SEStandPipe-11 Solid 4/21/2010	W7StandPipe-10 Solid 4/21/2010	ClayPipe-11 Solid 4/21/2010	S5CIPipe-3 Solid 4/21/2010	CIPipeSludge-5 Solid 4/22/2010 Pipe Sludge Grab Sample
VOCs (µg/kg)	Description:	Soil Grab Sample	Soil Grab Sample	Soil Grab Sample	Soil Grab Sample	
2-Butanone		21.0 J	11.5 UJ	12.6 J	24.9 J	41.7 UJ
Acetone		19.2 J	11.5 UJ	15.3 J	17.8 J	41.7 UJ
cis-1,2-Dichloroethene		5.7 UJ	5.7 UJ	10.4 J	19.9 J	101.0 J
Methylcyclohexane		13.3 J	11.5 UJ	9.5 UJ	13.3 UJ	41.7 UJ
Trichloroethene		5.7 UJ	5.7 UJ	4.7 UJ	6.7 UJ	93.6 J
Vinyl chloride		5.7 UJ	5.7 UJ	4.7 UJ	6.7 UJ	20.9 UJ
Total VOCs		54		38	63	195

Table 5

Test Pits - Soil Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
April 2010

	Sample ID: W5StandPipe-11	TestPit1-5	TestPit2-6	TestPit3-4	TestPit4-8	W Ditch Soil-NT
	Matrix: Solid	Solid	Solid	Solid	Solid	Solid
	Date: 4/21/2010	4/22/2010	4/22/2010	4/23/2010	4/23/2010	4/22/2010
VOCs (µg/kg)	Description: Soil Grab Sample	Soil Grab Sample	Soil Grab Sample	Soil Grab Sample	Soil Grab Sample	Soil Grab Sample
2-Butanone	10.0 UJ	9.7 UJ	11.5 UJ	58.9 J	11.6 J	56.6 J
Acetone	10.0 UJ	9.7 UJ	11.5 UJ	19.5 J	8.5 UJ	21.0 J
cis-1,2-Dichloroethene	5.0 UJ	4.9 UJ	5.7 UJ	7.4 J	4.2 UJ	5.6 UJ
Methylcyclohexane	10.0 UJ	9.7 UJ	11.5 UJ	13.1 UJ	8.5 UJ	11.2 UJ
Trichloroethene	5.0 UJ	4.9 UJ	5.7 UJ	6.5 UJ	4.2 UJ	5.6 UJ
Vinyl chloride	5.0 UJ	4.9 UJ	5.7 UJ	6.5 UJ	4.2 UJ	5.6 UJ
Total VOCs				86	12	78

a) VOCs = volatile organic compounds; µg/kg = micrograms per kilogram; UJ = estimated, analyte not detected above reporting limit.
 J = analyte detected at an estimated concentration

Table 6

**Test Pit 3 - Petroleum Fingerprinting Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
April 2010**

	Sample ID:	TestPit3-4 (a)
	Matrix:	Solid
	Date:	4/23/2010
Analyte (µg/kg)	Description:	Soil Grab Sample
Diesel Fuel		330,000
Lube Oil		3,180,000

-
- a\ Analyzed using NYSDOH Method 310.13.
b\ µg/kg = micrograms per kilogram.

Table 7

**Test Pit Seepage - Water Results
Fire Water Reservoir Investigation (a)
Emerson Power Transmission
Ithaca, New York
April 2010**

Analyte	Description:	Sample ID:	WDitch-ST-5	WStandPipeAq-11	WDitch-NT-5
		Matrix:	Water	Water	Water
		Date:	4/20/2010	4/21/2010	4/21/2010
			Water Grab	Water Grab	Water Grab
			Sample	Sample	Sample
VOCs (µg/L)					
Acetone			10.0 UJ	66.8 J	10.0 UJ
2-Butanone			10.0 UJ	16.4 J	10.0 UJ
cis-1,2-Dichloroethene			109.0 J	116.0 J	2.0 J
Trichloroethene			107.0 J	2.1 J	1.0 UJ
Vinyl chloride			16.5 J	9.4 J	1.0 UJ
Total VOCs			233	211	2

a) VOCs = volatile organic compounds; µg/l = micrograms per liter; UJ = estimated, analyte not detected above reporting limit; J = analyte detected at an estimated concentration; D = dilution required due to high concentration of target analytes.

b) Concentrations in bold exceed evaluation criteria. Evaluation criteria for VOCs are from the New York State Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1, Table 5: New York State Ambient Water Quality Standards and Guidance Values (June 1998).

Table 8

Groundwater Sampling Results of New Wells (a)
Emerson Power Transmission
Ithaca, NY
March 2011

	Sample ID:	MW-14C	MW-15C	MW-5-40	MW-12C	MW-13C
	Matrix:	Water	Water	Water	Water	Water
	Date:	3/23/2011	3/23/2011	3/25/2011	5/21/2010	5/21/2010
		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Analyte	Description:	Sample	Sample	Sample	Sample	Sample
VOCs (µg/l)						
Acetone		15.1 J	22.2	10.0 U	12.8	14.2
Benzene		2.5 J	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane		1.0 U	1.0 U	1.0 U	3.4	3.2
Chloroform		1.3 J	2.6	1.0 U	16.6	4.7
1,1-Dichloroethane		6.3 J	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene		79.9 J	1.0 U	39.5	1.0 U	1.0 U
cis-1,2-Dichloroethene		13,500.0 D	544.0 D	18,000.0 D	3.0	41.8
trans-1,2-Dichloroethene		212.0 J	11.6	111.0	1.0 U	1.0 U
Ethylbenzene		1.3 J	1.0 U	1.0 U	1.0 U	1.0 U
Isopropylbenzene		2.7 J	1.0 U	1.0 U	1.0 U	1.0 U
Methylene Chloride		1.2 J	1.0 U	1.0 U	1.0 U	1.0 U
Methylcyclohexane		296.0 J	10.0 U	10.0 U	10.0 U	10.0 U
Tetrachloroethene		66.5 J	1.1	2.7	1.0 U	1.0 U
Toluene		11.5 J	4.3	1.0 U	1.2	2.3
Trichloroethene		89,600.0 D	1,290.0 D	6,390.0 D	1.0	339.0
Vinyl chloride		414.0 D	14.6	774.0 D	1.0 U	1.0 U
Xylenes, total		9.7 J	3.0 U	3.0 U	3.0 U	3.9
Total VOCs		104,220	1,890	25,317	38	409

a\ VOCs = volatile organic compounds; µg/l = micrograms per liter; U = analyte not detected above Reporting Limit;
J = analyte detected at a level less than the Reporting Limit and greater than or equal to the Method Detection Limit;
D = dilution required due to high concentration of target analytes; NA - not analyzed

b\ Concentrations in bold exceed evaluation criteria. Evaluation criteria for VOCs are from the New York State Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1, Table 5: New York State Ambient Water Quality Standards and Guidance Values (June 1998).

Table 9

**Rock Core Grab Sample Results (a)
Emerson Power Transmission
Ithaca, NY
March 2011**

	Sample ID: MW14c (17.5-18 bgs)	MW-14c (19.5-20 bgs)	MW-14c (20-20.5 bgs)	MW-15c (20.4-20.9 bgs)
	Matrix: Solid	Solid	Solid	Solid
	Date: 3/15/2011	3/15/2011	3/15/2011	3/15/2011
Analyte	Description: Rock Grab Sample	Rock Grab Sample	Rock Grab Sample	Rock Grab Sample
VOCs (µg/kg)				
cis-1,2-Dichloroethene	429.0	343.0	5.5 U	185.0
Methylene Chloride	6.2 U	13.4	10.6	11.8
Tetrachloroethene	6.2 U	25.9	9.2	6.3 U
trans-1,2-Dichloroethene	6.2 U	7.1 U	5.8	19.0
Trichloroethene	4,310.0	8,450.0	4,370.0	35.5
Vinyl chloride	6.2 U	7.1 U	5.5 U	11.4
Total VOCs	4,739	8,832	4,396	263

a\ VOCs = volatile organic compounds; µg/kg = micrograms per kilogram; U = analyte not detected above reporting limit.



Appendix A – Site Photographs





Photograph 1: Cutting the EPDM in strips inside the south tank.



Photograph 2: Decontamination area leading to the hazardous waste roll-off.



Photograph 3: Removing the EPDM liner inside the south tank.



Photograph 4: Sealed crack that was painted.



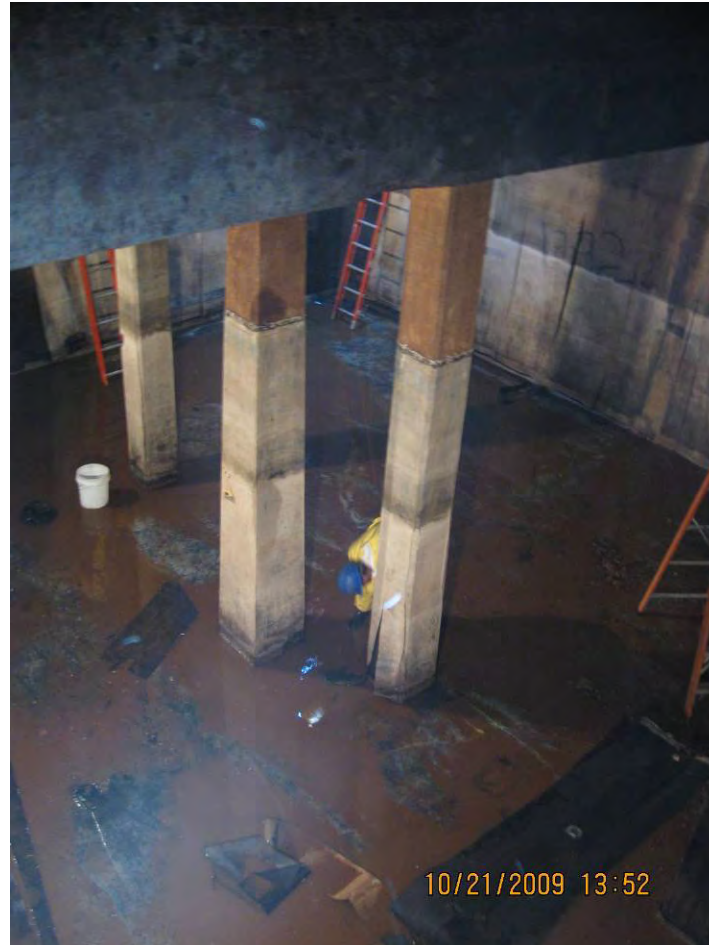
Photograph 5: Cutting the felt backing into squares for disposal into the hazardous waste roll-off.



Photograph 6: West wall of the south tank after removal of the liner.



Photograph 7: Pipe exiting the south tank at the west wall.



Photograph 8: Removing the liner from the columns in the north tank.



Photograph 9: 2-inch EPDM line running to the 21,000 gallon frac tank stationed in front of the IRM shed.



Photograph 10: Hole patched at the northern end of the eastern wall of the north tank.



Photograph 11: Hazardous waste roll-off after the removal of liner from the reservoir.



Photograph 12: Installing horizontal point HP-2.



Photograph 13: Completed horizontal point HP-6.



Photograph 14: Completed monitoring point MP-9.



Photograph 15: Vacuuming water from a vertical joint located in T-1.



Photograph 16: Measuring the trend of a vertical joint in T-1 (N17W).



Photograph 17: Petroleum product entering T-2 below floor slab.



Photograph 18: Measuring the trend of a vertical joint found in T-1.



Photograph 19: Measuring the alignment of the vertical fracture producing petroleum product.



Photograph 20: Measuring the alignment of the vertical fracture producing petroleum product.



Photograph 21: Dam created around the pipe exiting the north tank to allow for fiber optic viewing.



Photograph 22: Vacuuming out the vertical stand pipe located on the west side of the south tank.



Photograph 23: Test pit installed directly west of the pipe exiting the north tank.



Photograph 24: Excavating up to the vertical stand pipe.



Photograph 25: Brick structure found at the base of the vertical stand pipe – the pipe exiting to the west is visible.



Photograph 26: Petroleum product and groundwater entering the open test pit.



Photograph 27: Transition from cast-iron pipe to clay tile.



Photograph 28: Test pit installed to find the end of the pipe near the drainage ditch.



Photograph 29: Pulling the end of the pipe out of the test pit.



Photograph 30: The end of the pipe (6-foot cast-iron pipe) removed at the edge of the drainage ditch.



Photograph 31: Sample location – CI Pipe Sludge-5.



Photograph 32: Installing hay and erosion mat over the excavated areas.



Appendix B – Disposal Certificates and Waste Manifests



UNIFORM HAZARDOUS WASTE MANIFEST		1. Generator ID Number NYD002228625	2. Page 1 of 1	3. Emergency Response Phone (800) 483-3719	4. Manifest Tracking Number 002944618 FLE	
5. Generator's Name and Mailing Address Emerson Power Transmission 620 S. Aurora Street Ithaca, NY 14850			Generator's Site Address (if different than mailing address) SAME			
Generator's Phone: (620) 331-1200			U.S. EPA ID Number MAD039322250			
6. Transporter 1 Company Name Clean Harbors Environmental Services Inc			U.S. EPA ID Number			
7. Transporter 2 Company Name			U.S. EPA ID Number			
8. Designated Facility Name and Site Address Clean Harbors of Baltimore Inc 1910 Russell Street Baltimore, MD 21230			U.S. EPA ID Number MDD980555189			
Facility's Phone: (410) 244-8200						
9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers		11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
		No.	Type			
X	1. HA3082, HAZARDOUS WASTE, LIQUID, N.O.S., (CIS-1, 2-DICHLOROETHENE), 9, PG III	001	TT	3488	G	F001 T
	2.					
	3.					
	4.					
14. Special Handling Instructions and Additional Information 1. 20940-1 ERG#171 md. Hwy # 022503 TANK MEASUREMENT 35'1/2						
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement (as defined in 40 CFR 262.27(a)) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.						
Generator's/Offeror's Printed/Typed Name AS authorized agent of Emerson Scott Peterson				Signature Scott Peterson		Month Day Year 11 10 09
16. International Shipments		<input type="checkbox"/> Import to U.S.		<input type="checkbox"/> Export from U.S.		Port of entry/exit: _____
Transporter signature (for exports only):		Date leaving U.S.: _____				
17. Transporter Acknowledgment of Receipt of Materials						
Transporter 1 Printed/Typed Name Jeffrey Carpenter		Signature Jeffrey Carpenter		Month Day Year 11 10 09		
Transporter 2 Printed/Typed Name		Signature		Month Day Year		
18. Discrepancy						
18a. Discrepancy Indication Space		<input type="checkbox"/> Quantity		<input type="checkbox"/> Type		<input type="checkbox"/> Residue
		<input type="checkbox"/> Partial Rejection		<input type="checkbox"/> Full Rejection		
		Manifest Reference Number				
18b. Alternate Facility (or Generator)		U.S. EPA ID Number				
Facility's Phone:						
18c. Signature of Alternate Facility (or Generator)		Month Day Year				
19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)						
1. H129		2.		3.		4.
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.						
Printed/Typed Name George E. Johnson		Signature George E. Johnson		Month Day Year 11 10 09		



Clean Harbors of Baltimore Inc
1910 Russell Street
Baltimore MD, 21230
MDD980555189
(410) 244-8200

CERTIFICATE OF DISPOSAL

Generator Contact Name:
Generator Facility Name: Emerson Power Transmission
Generator Address: 620 S. Aurora Street
Ithaca, NY 14850

Sales Order #: 722591372
Date Received: 11/10/2009

Generator EPA ID: NYD002228625

Manifest #: 002944618FLE

Line #	Profile/Description	Disposal Date	Method of Disposal	Disposal Facility
1	20940-1 FOO1 IDW Groundwater Investigation	11/23/2009	Clean Extraction System (liquid-liquid extraction)	Baltimore, MD Facility

Under Civil and Criminal Penalties of Law for the making or submission of false or fraudulent statements or representations (18 U.S.C. 1001 and 15 U.S.C. 2615), I certify that the information contained in or accompanying this document is true, accurate, and complete. As to the identified section(s) of this document for which I cannot personally verify truth and accuracy, I certify as the company official having supervisory responsibility for the persons who, acting under my direct instructions, made the verification that this information is true, accurate, and complete.

Name:

Paul F. Mello

Title:

Director Facility Applications

Date:

Tuesday, March 08, 2011

RTL7

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Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST		1. Generator ID Number NYD 002 228 625	2. Page 1 of 1	3. Emergency Response Phone (607) 761-1436	4. Manifest Tracking Number 006170137 JJK	
5. Generator's Name and Mailing Address EMERSON POWER TRANSMISSION 620 S. AURORA STREET ATTN: MIKE YAPLE ITHACA, NY 14850 Generator's Phone: (607) 272-7220						
6. Transporter 1 Company Name Hazard Environmental Group Inc				U.S. EPA ID Number NY0980769947		
7. Transporter 2 Company Name				U.S. EPA ID Number		
8. Designated Facility Name and Site Address MICHIGAN DISPOSAL WASTE TREATMENT PI 49350 N I-94 SERVICE DRIVE BELLEVILLE, MI 48111 Facility's Phone: (800) 592-5489				U.S. EPA ID Number MID 000 724 831		
9a. HW	9b. U.S. DOT Description (Including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
X1	RD, NA3077, HAZARDOUS WASTE SOLID, N.O.S. (TRICHLOROETHENE), 9, PGIII, (F001)	001	CM	20	Y	F001 L
2						
3						
4						
14. Special Handling Instructions and Additional Information 1. K094004MDI / WATER RESEVOIR LINER AND DEBRIS						
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/packaged, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.						
Generator's/Officer's Printed/Typed Name As authorized agent of Emerson: Scott Petersen				Signature Scott B. Petersen		Month Day Year 11 24 09
16. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: Date leaving U.S.:						
17. Transporter Acknowledgment of Receipt of Materials Transporter 1 Printed/Typed Name Kevin Maggard Signature Kevin Maggard Month Day Year 11 24 09 Transporter 2 Printed/Typed Name Signature Month Day Year						
18. Discrepancy 18a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection Manifest Reference Number: U.S. EPA ID Number 18b. Alternate Facility (or Generator) Facility's Phone: 18c. Signature of Alternate Facility (or Generator) Month Day Year						
19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems) 1. H075 2. 3. 4.						
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in item 18a Printed/Typed Name Lamy Lehigh Signature Lamy Lehigh Month Day Year 11 25 09						

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

CERTIFICATE OF DISPOSAL



This certificate is to verify the wastes specified on Manifest # 006170137JJK

have been properly disposed of in accordance with all local, state and federal regulations.

"Disposed of" means either: 1) Burial or 2) Processed as specified in 40 CFR et seq.

FACILITY NAME:
(Please check one)

☒ Michigan Disposal Waste Treatment Plant
(EPA I.D. # MID000724831)

☐ Wayne Disposal, Inc.
(EPA I.D. # MID048090633)

ADDRESS:

49350 N. I-94 Service Drive
Belleville, Michigan 48111

PHONE NUMBER:

1-800-592-5489

FAX NUMBER:

1-800-593-5329

Authorized Signature: _____

THE ENVIRONMENTAL QUALITY COMPANY 49350 N. I-94 SERVICE DRIVE BELLEVILLE MICHIGAN 48111

Form # REC-FM-013-BEL

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8/25/08

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Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST		1. Generator ID Number NYD 002 228 625	2. Page 1 of 1	3. Emergency Response Phone 607-7611436	4. Manifest Tracking Number 007194843 JJK	
5. Generator's Name and Mailing Address EMERSON POWER TRANSMISSION 620 S. AURORA STREET ATTN: MIKE YAPLE ITHACA, NY 14850 Generator's Phone: (607) 272-7220						
6. Transporter 1 Company Name HAZMAT ENVIRONMENTAL GROUP INC. U.S. EPA ID Number NYD 980769947						
7. Transporter 2 Company Name EQ Industrial Services U.S. EPA ID Number MID 000 263 871						
8. Designated Facility Name and Site Address MICHIGAN DISPOSAL WASTE TREATMENT P1 49350 N I-94 SERVICE DRIVE BELLEVILLE, MI 48111 Facility's Phone: (800) 592-5489 U.S. EPA ID Number MID 000 724 831						
GENERATOR	9a. HW	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))		10. Containers No. Type	11. Total Quantity	12. Unit Wt/Vol.
	X	1. RQ, NA3077, HAZARDOUS WASTE SOLID, N.O.S. (TRICHLOROETHENE), 9, PGII (F001)		2 DM	654	P
13. Waste Codes F001 T						
14. Special Handling Instructions and Additional Information 1. K084004MDH / WATER RESEVOIR LINER AND DEBRIS						
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.						
Generator's/Officer's Printed/Typed Name As authorized agent of Emerson: Scott Petersen Signature <i>[Signature]</i> Month Day Year 3 3 10						
TRANSPORTER INTL	16. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: _____ Date leaving U.S.: _____					
	17. Transporter Acknowledgment of Receipt of Materials Transporter 1 Printed/Typed Name DOUGLAS RACKL Signature <i>[Signature]</i> Month Day Year 03 03 10					
	Transporter 2 Printed/Typed Name Tanya W. Howard Signature <i>[Signature]</i> Month Day Year 03 10 10					
DESIGNATED FACILITY	18. Discrepancy 18a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection Manifest Reference Number: _____ U.S. EPA ID Number _____					
	18b. Alternate Facility (or Generator) Facility's Phone: _____ U.S. EPA ID Number _____					
	18c. Signature of Alternate Facility (or Generator) Month Day Year 3 16 10					
	19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems) 1. H075 2. _____ 3. _____ 4. _____					
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a Printed/Typed Name Michael Rohde Signature <i>[Signature]</i> Month Day Year 3 16 10						

CERTIFICATE OF DISPOSAL

This certificate is to verify the wastes specified on Manifest # 007194843 JJK
have been properly disposed of in accordance with all local, state and federal regulations.

"Disposed of" means either: 1) Burial or 2) Processed as specified in 40 CFR et seq.

FACILITY NAME:
(Please check one)

☒ Michigan Disposal Waste Treatment Plant
(EPA I.D. # MID000724831)

☐ Wayne Disposal, Inc.
(EPA I.D. # MID048090633)

ADDRESS:

49350 N. I-94 Service Drive
Belleville, Michigan 48111

PHONE NUMBER:

1-800-592-5489

FAX NUMBER:

1-800-593-5329

Authorized Signature: _____

Richard J. Emery



THE ENVIRONMENTAL QUALITY COMPANY 49350 N. I-94 SERVICE DRIVE BELLEVILLE MICHIGAN 48111

Form # REC-FM-013-BEL

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722735947

SC PPW 1/20/2010

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UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number

NYD002228625

2. Page 1 of 1

3. Emergency Response Phone

(800) 483-3718

4. Manifest Tracking Number

002944260 FLE

5. Generator's Name and Mailing Address

Emerson Power Transmission
620 S. Aurora Street
Ithaca, NY 14850

Generator's Site Address (if different than mailing address)

SAME

Generator's Phone:

(620) 331-1200

6. Transporter 1 Company Name

Clean Harbors Environmental Services Inc

U.S. EPA ID Number

MAD039322250

7. Transporter 2 Company Name

FRANKS Vacuum Truck Service Inc

U.S. EPA ID Number

NYD982792814

8. Designated Facility Name and Site Address

Clean Harbors El Dorado LLC
309 American Circle
El Dorado, AR 71730

U.S. EPA ID Number

ARD069748192

Facility's Phone:

(870) 863-7173

9a. HM

9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))

10. Containers

No.

Type

11. Total Quantity

12. Unit Wt./Vol.

13. Waste Codes

1. NA3082, HAZARDOUS WASTE, LIQUID, N.O.S.
(TRICHLOROETHENE, CIS-1,2-DICHLOROETHENE), 9, PG III

006 DM 2170 P

F001

B

14. Special Handling Instructions and Additional Information

1.20940-2

ERG#171

15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Officer's Printed/Typed Name

MICHAEL YAPLE

Signature

Michael Yaple

Month Day Year

2 16 10

16. International Shipments

☐ Import to U.S.

☐ Export from U.S.

Port of entry/exit:

Date leaving U.S.:

Transporter signature (for exports only):

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name

Kelly Horton

Signature

Kelly Horton

Month Day Year

2 16 10

Transporter 2 Printed/Typed Name

Tom Watersen

Signature

Tom Watersen

Month Day Year

2 19 10

18. Discrepancy

18a. Discrepancy Indication Space

☐ Quantity

☐ Type

☐ Residue

☐ Partial Rejection

☐ Full Rejection

18b. Alternate Facility (or Generator)

Manifest Reference Number:

U.S. EPA ID Number

Facility's Phone:

18c. Signature of Alternate Facility (or Generator)

Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1. H040

2.

3.

4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name

Kelly Horton

Signature

Kelly Horton

Month Day Year

2 13 10

EPA Form 8700-22 (Rev. 3-03) Previous editions are obsolete.

(DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED))

Clean Harbors has the appropriate permits for and will accept the waste the generator is shipping.

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UNIFORM HAZARDOUS WASTE MANIFEST
(Continuation Sheet)

21. Generator ID Number

MD 002228625

22. Page

43

23. Manifest Tracking Number

MD2944260715

24. Generator's Name

Amerson Power Transmission

25. Transporter 3 Company Name

Clean Harbors Environmental Services Inc.

U.S. EPA ID Number

MAD030322250

26. Transporter 4 Company Name

Clean Harbors Env. Services

U.S. EPA ID Number

1MAD039322250

27a. HM 27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))

28. Containers

No.

Type

29. Total Quantity

30. Unit Wt./Vol.

31. Waste Codes

GENERATOR

32. Special Handling Instructions and Additional Information

33. Transporter 3 Acknowledgment of Receipt of Materials

Printed/Typed Name

As an agent for Clean Harbors Nicole Erdy

Signature

Nicole Erdy

Month Day Year

12 26 10

34. Transporter Acknowledgment of Receipt of Materials

Printed/Typed Name

Tim Hill

Signature

Tim Hill

Month Day Year

2 26 10

35. Discrepancy

DESIGNATED FACILITY

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved, OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST
(Continuation Sheet)

21. Generator ID Number

NYD002228625

22. Page

3

23. Manifest Tracking Number

002944260 FLE

24. Generator's Name

Emerson Power Trans.

25. Transporter

5

Company Name

Clean Harbors Environmental Services Inc.

U.S. EPA ID Number

MAD039122250

26. Transporter

Company Name

U.S. EPA ID Number

27a.
HM

27b. U.S. DOT Description (Including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))

28. Containers

No.

Type

29. Total
Quantity

30. Unit
Wt./Vol.

31. Waste Codes

GENERATOR

32. Special Handling Instructions and Additional Information

33. Transporter

Acknowledgment of Receipt of Materials

Printed/Typed Name

J. J. Williamson (Agent for CHES)

Signature

[Signature]

Month Day Year

1 31 2 10

34. Transporter

Acknowledgment of Receipt of Materials

Printed/Typed Name

Signature

Month Day Year

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

TRANSPORTER

DESIGNATED FACILITY



Clean Harbors El Dorado LLC
309 American Circle
El Dorado AR, 71730
ARD069748192
(870) 863-7173

CERTIFICATE OF DISPOSAL

Generator Contact Name:
Generator Facility Name: Emerson Power Transmission
Generator Address: 620 S. Aurora Street
Ithaca, NY 14850

Sales Order #: 722735947
Date Received: 3/3/2010

Generator EPA ID: NYD002228625

Manifest #: 002944260FLE

Line #	Profile/Description	Disposal Date	Method of Disposal	Disposal Facility
1	20940-2 FOO1 IDW Groundwater Investigation	3/17/2010	Incineration	El Dorado, AR Facility

Under Civil and Criminal Penalties of Law for the making or submission of false or fraudulent statements or representations (18 U.S.C. 1001 and 15 U.S.C. 2615), I certify that the information contained in or accompanying this document is true, accurate, and complete. As to the identified section(s) of this document for which I cannot personally verify truth and accuracy, I certify as the company official having supervisory responsibility for the persons who, acting under my direct instructions, made the verification that this information is true, accurate, and complete.

Name:

Paul J. Mello

Title:

Director Facility Applications

Date:

Tuesday, March 08, 2011



Appendix C – Boring Logs and Well Construction Diagrams



Boring Log: MW-12C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** April 27, 2010**Surface Elevation (feet AMSL*):** 586.94**TOC Elevation (feet AMSL*):** 586.35**Total Depth (feet):** 30**Borehole Diameter (inches):** 8.25/6

*AMSL = Above mean sea level



Sample Data					Subsurface Profile		Well Details
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	
						Ground Surface	A vertical diagram of the well casing, showing a central pipe with a smaller inner pipe, and a surrounding annulus. The casing is shown extending from the ground surface down to a depth of approximately 12 feet.
						Concrete	
2						Overburden Overburden (not sampled).	
4							
6							
8							
10							
12							
						Siltstone Weathered Siltstone bedrock (not sampled).	
14	1	NA	-	Total: 100% RQD: 35%		Siltstone Gray siltstone; moderate to strong field strength; aphanitic, massive texture, some lamination visible below 24 feet; fresh to slightly decomposed, slightly disintegrated, becoming competent and fresh at 22 to 30 feet; moderate to intensely fractured, fracture frequency decreasing below 21.5 feet; bedding plane fractures and microfractures prevalent between 14 and 15.5 feet; some clay infilling and moisture apparent at 15.7 feet and 18 feet; possible healed fracture zone between 24 and 24.3 feet, infilling and cement visible.	A vertical diagram of the well casing, showing a central pipe with a smaller inner pipe, and a surrounding annulus. The casing is shown extending from the ground surface down to a depth of approximately 12 feet.
16			-				
18			-				
20	2	NA	-	Total: 100% RQD: 20%			
			-				
			-				
			-				
			-				
			-				
			-				

Geologist(s): Erik S. Reinert & David P. Bouchard**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:** Bill Rice**Method:** Hollow Stem Auger/Air Rotary**WSP Environment & Energy**

5 Sullivan Street

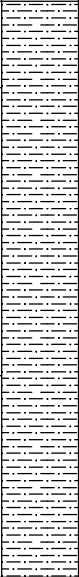
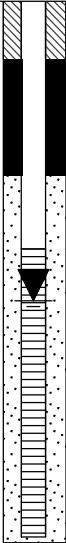
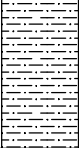
Cazenovia, New York 13035

(315) 655-3900

Boring Log: MW-12C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** April 27, 2010**Surface Elevation (feet AMSL*):** 586.94**TOC Elevation (feet AMSL*):** 586.35**Total Depth (feet):** 30**Borehole Diameter (inches):** 8.25/6

*AMSL = Above mean sea level



Sample Data					Subsurface Profile		Well Details
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	
22	3	NA	-	Total: 100% RQD: 62.5%		Siltstone Gray siltstone; moderate to strong field strength; aphanitic, massive texture, some lamination visible below 24 feet; fresh to slightly decomposed, slightly disintegrated, becoming competent and fresh at 22 to 30 feet; moderate to intensely fractured, fracture frequency decreasing below 21.5 feet; bedding plane fractures and microfractures prevalent between 14 and 15.5 feet; some clay infilling and moisture apparent at 15.7 feet and 18 feet; possible healed fracture zone between 24 and 24.3 feet, infilling and cement visible. <i>(continued)</i>	
24			-				
26			-				
28	4	NA	-	Total: 100% RQD: 76%			
30			-				
32						Bottom of Boring at 30 feet	
34							
36							
38							
40							

Geologist(s): Erik S. Reinert & David P. Bouchard**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:** Bill Rice**Method:** Hollow Stem Auger/Air Rotary**WSP Environment & Energy**

5 Sullivan Street

Cazenovia, New York 13035

(315) 655-3900

Boring Log: MW-13C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** April 27, 2010**Surface Elevation (feet AMSL*):** 587.13**TOC Elevation (feet AMSL*):** 586.62**Total Depth (feet):** 30**Borehole Diameter (inches):** 8.25/6

*AMSL = Above mean sea level



Sample Data					Subsurface Profile		Well Details
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	
						Ground Surface	
						Concrete	
2						Overburden Overburden (not sampled).	
4							
6							
8							
10							
12						Siltstone Weathered Siltstone bedrock (not sampled).	
14	1	NA	-	Total: 100% RQD: 35%		Siltstone Gray siltstone; moderate to strong field strength; aphanitic, massive texture; fresh to slightly decomposed, slightly disintegrated, becoming competent and fresh at 22 to 30 feet; intensely fractured, 85-degree dipping joint with orangish-brown iron staining and possible oil sheen, all other fractures are horizontal with no infilling or mineralization, petroleum odor and oily sheen in horizontal fracture at 20.6 feet.	
16			-				
18			-				
20	2	NA	-	Total: 100% RQD:			


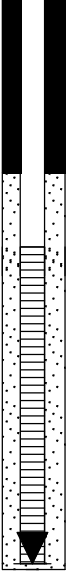

Geologist(s): Erik S. Reinert & David P. Bouchard
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Bill Rice
Method: Hollow Stem Auger/Air Rotary

WSP Environment & Energy
 5 Sullivan Street
 Cazenovia, New York 13035
 (315) 655-3900

Boring Log: MW-13C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** April 27, 2010**Surface Elevation (feet AMSL*):** 587.13**TOC Elevation (feet AMSL*):** 586.62**Total Depth (feet):** 30**Borehole Diameter (inches):** 8.25/6

*AMSL = Above mean sea level



Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
22	3	NA	-	20%		Siltstone Gray siltstone; moderate to strong field strength; aphanitic, massive texture; fresh to slightly decomposed, slightly disintegrated, becoming competent and fresh at 22 to 30 feet; intensely fractured, 85-degree dipping joint with orangish-brown iron staining and possible oil sheen, all other fractures are horizontal with no infilling or mineralization, petroleum odor and oily sheen in horizontal fracture at 20.6 feet. <i>(continued)</i>	
24			-	Total: 100% RQD: 62.5%			
26			-				
28	4	NA	-	Total: 100% RQD: 76%			
30			-				
32						Bottom of Boring at 30 feet	
34							
36							
38							
40							

Geologist(s): Erik S. Reinert & David P. Bouchard**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:** Bill Rice**Method:** Hollow Stem Auger/Air Rotary**WSP Environment & Energy**


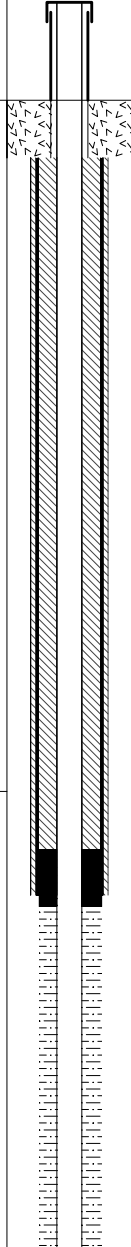
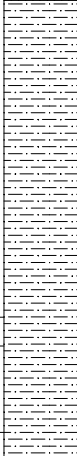
5 Sullivan Street

Cazenovia, New York 13035

(315) 655-3900

Boring Log: MW-14C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** March 15, 2011**Surface Elevation (feet AMSL*):** 586.61**TOC Elevation (feet AMSL*):** 588.31**Total Depth (feet):** 45**Borehole Diameter (inches):** 4

*AMSL = Above mean sea level

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
2	1	0.0	-			Silty Clay Dark brown, moist, silty clay overburden	
4			-				
6			-				
8	2	0.0	-				
10			-				
12			-				
14			-			Ithaca siltstone Light gray siltstone; weak to moderate field strength; thinly bedded; fresh to slightly decomposed; slightly disintegrated; intensely to moderately fractured with near vertical joints with iron staining at 14.5 to 15 feet and 19 feet, all other fractures are thin and horizontal.	
16			-				
18	3	2.3	-	31			
20	4	12.0	-	75			
			-				
			-				

Geologist(s): Rob Wallace**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:****Method:** Air Rotary**WSP Environment & Energy**

11190 Sunrise Valley Drive

Suite 300

Reston, VA 20191

Boring Log: MW-14C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** March 15, 2011**Surface Elevation (feet AMSL*):** 586.61**TOC Elevation (feet AMSL*):** 588.31**Total Depth (feet):** 45**Borehole Diameter (inches):** 4

*AMSL = Above mean sea level

Sample Data					Subsurface Profile		Well Details
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	
5	5	14.3	-	75		<i>Ithaca siltstone</i> Light gray siltstone; weak to moderate field strength; thinly bedded; fresh to slightly decomposed; slightly disintegrated; intensely to moderately fractured with near vertical joints with iron staining at 14.5 to 15 feet and 19 feet, all other fractures are thin and horizontal. <i>(continued)</i>	
22	6	6.1	-	75			
24			-				
26			-				
28			-				
30			-				
32			-				
34			-				
36			-				
38			-				
40			-				

Geologist(s): Rob Wallace**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:****Method:** Air Rotary**WSP Environment & Energy**

11190 Sunrise Valley Drive

Suite 300

Reston, VA 20191

Boring Log: MW-14C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** March 15, 2011**Surface Elevation (feet AMSL*):** 586.61**TOC Elevation (feet AMSL*):** 588.31**Total Depth (feet):** 45**Borehole Diameter (inches):** 4

*AMSL = Above mean sea level

Sample Data					Subsurface Profile	
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description
42						<i>Ithaca siltstone</i> Light gray siltstone; weak to moderate field strength; thinly bedded; fresh to slightly decomposed; slightly disintegrated; intensely to moderately fractured with near vertical joints with iron staining at 14.5 to 15 feet and 19 feet, all other fractures are thin and horizontal. <i>(continued)</i>
44						
46						Bottom of Boring at 45 feet
48						
50						
52						
54						
56						
58						
60						

Geologist(s): Rob Wallace**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:****Method:** Air Rotary**WSP Environment & Energy**

11190 Sunrise Valley Drive

Suite 300

Reston, VA 20191

Boring Log: MW-15C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** March 16, 2011**Surface Elevation (feet AMSL*):** 586.76**TOC Elevation (feet AMSL*):** 586.27**Total Depth (feet):** 45**Borehole Diameter (inches):** 4

*AMSL = Above mean sea level

Sample Data					Subsurface Profile		Well Details
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	
						Ground Surface	
2						Silty Clay Dark brown, moist, silty clay overburden	
4							
6							
8							
10							
12	1	0.0	-	0		Ithaca siltstone Light gray siltstone; moderate field strength; thinly bedded; fresh to slightly decomposed; slightly disintegrated, becoming competent at 13.3 to 21.3 feet; intensely fractured with 30-degree dipping joint with iron staining at 12.8 feet, all other fractures are thin and horizontal.	
14							
16	2	0.0	-	53			
18							
20	3	0.0	-	26			

Geologist(s): Rob Wallace**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:****Method:** Air Rotary**WSP Environment & Energy**

11190 Sunrise Valley Drive

Suite 300

Reston, VA 20191

Boring Log: MW-15C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** March 16, 2011**Surface Elevation (feet AMSL*):** 586.76**TOC Elevation (feet AMSL*):** 586.27**Total Depth (feet):** 45**Borehole Diameter (inches):** 4

*AMSL = Above mean sea level

Sample Data					Subsurface Profile		Well Details
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	
4	4	0.0	-	26		<i>Ithaca siltstone</i> Light gray siltstone; moderate field strength; thinly bedded; fresh to slightly decomposed; slightly disintegrated, becoming competent at 13.3 to 21.3 feet; intensely fractured with 30-degree dipping joint with iron staining at 12.8 feet, all other fractures are thin and horizontal. <i>(continued)</i>	
22							
24							
26							
28							
30							
32							
34							
36							
38							
40							

Geologist(s): Rob Wallace**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:****Method:** Air Rotary**WSP Environment & Energy**

11190 Sunrise Valley Drive

Suite 300

Reston, VA 20191

Boring Log: MW-15C**Project:** Emerson Power Transmission**Project No.:** 4507/Legacy 127491**Location:** Ithaca, New York**Completion Date:** March 16, 2011**Surface Elevation (feet AMSL*):** 586.76**TOC Elevation (feet AMSL*):** 586.27**Total Depth (feet):** 45**Borehole Diameter (inches):** 4

*AMSL = Above mean sea level

Sample Data					Subsurface Profile	
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Well Details
42					<i>Ithaca siltstone</i> Light gray siltstone; moderate field strength; thinly bedded; fresh to slightly decomposed; slightly disintegrated, becoming competent at 13.3 to 21.3 feet; intensely fractured with 30-degree dipping joint with iron staining at 12.8 feet, all other fractures are thin and horizontal. <i>(continued)</i>	
44						
46						
48						
50					Bottom of Boring at 45 feet	
52						
54						
56						
58						
60						

Geologist(s): Rob Wallace**Subcontractor:** Parratt Wolff, Inc.**Driller/Operator:****Method:** Air Rotary**WSP Environment & Energy**

11190 Sunrise Valley Drive

Suite 300

Reston, VA 20191



Appendix D – Laboratory Reports (on CD)





Appendix E – Geophysical Survey and Downhole Logging Report





**Final Report
Borehole Geophysical Logging Program
Two Wells – MW-14C and MW-15C
Emerson Power Transmission Facility
Ithaca, NY
MAG Reference Number 021143**

**Prepared For: WSP Environmental & Energy
Prepared By: Mid-Atlantic Geosciences
April 6, 2011**





April 6, 2011

Mr. Robert Wallace
WSP Environmental & Energy
11190 Sunrise Valley Drive
Suite 300
Reston, VA 20191

RE: Borehole Geophysical Logging Program
Two Wells – MW-14C and MW-15C
Emerson Power Transmission Facility
Ithaca, NY
MAG Reference Number 021143

Dear Mr. Wallace:

Pursuant to our proposal dated February 28, 2011, Mid-Atlantic Geosciences (MAG – the borehole logging division of Enviroscan, Inc.) completed the above-referenced survey on March 24, 2011. The objective of the survey was to locate and characterize fractures and potential water-bearing zones intersecting the wells. To accomplish these objectives, MAG conducted Optical Televiwer, Acoustic Televiwer, 3-Arm Caliper, Fluid Temperature, Fluid Conductivity, and Natural Gamma logging in the wells.

Logging Equipment

Mid-Atlantic Geosciences conducts borehole geophysics, televiwer, and video logging using a Robertson Geologging, Ltd. Micrologger II and/or a Mount Sopris Matrix. These units record digital data for on-site log playback, reproduction, and field interpretation, as well as post-processing and report presentation. The systems are driven by field PCs running software supplied by the manufacturer for data acquisition, log replay, probe control, probe calibration, and logging environment compensation. Video data (if collected) are recorded in real time to the hard drive of a DVD player/recorder, and can be burned in the field to a DVD that is left with the client's on-site representative.

All of the logging instruments are permanently mounted in a dedicated Ford F350 or Dodge RAM2500 enclosed-bed truck, each with a self-contained power supply, and support and decontamination equipment. The downhole probes or sondes are connected to either a Robertson Geologging Smartwinch with approximately 600 feet of 0.375-inch coaxial cable, or a Robertson 2000m winch with approximately 3000 feet of 0.25-inch coaxial cable – depending on the depth of the wells logged.



Mr. Wallace
April 6, 2011
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Logging Parameters and Methodology

Geophysical well logging in general involves lowering sondes in a borehole and recording parameters that are related to the properties of the adjacent soil or rock, the fluids in the borehole or formation, and/or construction details of the well. There are many tools and techniques that have been developed to provide specific information in different environments and constructions of drilled holes. The data collected can define the nature and extent of geologic formations and formation fluids, and can be used to provide correlation between holes.

The sondes used for this survey are described below. Note that before any of these tools are put into service for a particular job, MAG personnel test them for proper function and recalibrate as necessary. This is essential to the proper acquisition of downhole data and the ability to relate the data from one borehole to another.

Optical Televiewer

The borehole optical televiewer (OPTV) or Optical Borehole Imager (OBI) provides a high-resolution digital optical scan of the interior of a borehole using visible wavelength light. From the accurately-scaled, continuous image it is possible to identify the depth and character of features such as fractures, bedding planes, veins, solution openings, etc. In particular, it is possible to calculate the strike, dip, and aperture of planar features. The OPTV operates by using a high-resolution color downhole camera which views a reflection of the borehole walls in a hyperbolic correction mirror. At successive depth increments of 0.5 mm, rings of pixels corresponding to circular scans of the borehole wall are acquired from the probe and stacked into a continuous image. The image is rectangular – representing the interior of a cylinder that has been sliced open and rolled-out flat. The image is oriented to north based on data from three magnetometers and accelerometers in the sonde. Note that the use of magnetometers for orientation leads to image distortion in steel-cased holes, and within several feet of the base of steel casing in open holes. All OPTV sondes require an open borehole, or one filled with a clear fluid.

Mr. Wallace
April 6, 2011
Page 3

Planar features intersecting a cylindrical borehole appear sinusoidal on the flattened cylindrical image. The azimuth of the peak/trough of the sinusoid, and the amplitude of the sinusoid can be measured and used to calculate the strike and dip (see Appendix A) of such features. Based on their visual character, planar features on the optical televiewer (and HRAT – see below) logs have been categorized on the log sheets as various types of geologic interface (fractures, bedding planes, veins, etc.). The features observed on the OPTV log can also be characterized based on the Paillet Ranking System developed by the US Geological Survey, Water Resources Division, Borehole Geophysics Research Project. This system is a semi-subjective evaluation of transmissivity potential. The ranking system assigns a number value between zero and five to observed features. A rank of zero indicates a feature that appears sealed – with no water likely passing through it. Note that the geologic classification of features (e.g. bedding plane, lithologic contact, joint, fracture, foliation, etc.) is not specified in the Paillet System since only water-bearing potential is considered. A rank of five corresponds to a grossly porous zone with large openings (e.g. a major fracture, fault or solution cavity). The ranking system, with examples, is provided in Appendix B.

Tables listing the depth, aperture, strike, dip and type of feature are included in this report, for each well, as Appendix C. Feature apertures are listed in tenths of an inch. An aperture of zero for an open fracture simply means that while it appears to be a continuous open feature, the opening is smaller than the line thickness on the log (~0.015 inches). Note that because of the subjectivity involved in Paillet ranking, MAG has listed fractures in Appendix C only as either open or sealed. Specific Paillet rankings can be assigned by the client, if desired, by comparing the standard pictures in Appendix B to the OPTV log.

Note also that it has been the experience of MAG that the aperture or Paillet rank of a feature is not always a strong indicator of its water-producing potential. Thin, discrete features sometimes produce as much or more water (as evidence by flowmeter logging – see below) than wide, open fractures or fracture zones.

Acoustic Televiewer

The high-resolution acoustic televiewer (HRAT) provides a scan or image of the interior of the borehole that is created not by reflected visible wavelength light, but by reflected ultrasound. Since ultrasonic pulses are used, it is possible to record both the amplitude and travel time of each pulse, and construct two separate images. The amplitude log is analogous to a visual scan, while the travel time data are affected primarily by the local diameter of the borehole (i.e. the larger the bore, the later the arrival of the reflected pulse), and therefore can supplement or replace a caliper log. The main advantage of the HRAT probe is that it can be used in larger boreholes than optical tools, and in holes with turbid or particle-loaded fluids that would be opaque to optical methods.

Mr. Wallace
April 6, 2011
Page 4

The HRAT operates by using a fixed acoustic transducer and a rotating acoustic mirror capable of focusing on the borehole wall at any distance from the probe diameter upwards. The acoustic transducer is focused based on the borehole diameter and impedance-matched to the borehole fluid to provide optimum image resolution and reflected amplitude. Mirror rotation speed (i.e. circumferential resolution), sampling rate (i.e. depth resolution), signal gain (i.e. amplitude image contrast), and recording time gate (i.e. travel time image contrast) are all variable and under operator control to provide the best image possible under borehole-specific conditions.

HRAT logs are presented as accurately-scaled and accurately-oriented cylindrical images that are sliced open and laid flat. Therefore, planar dipping features appear as sinusoids from which the strike and dip of the feature can be calculated (see Appendix A). Selected and representative televiewer features are listed in Appendix C and on the log sheet. Based on their visual character, planar features have been categorized as various types of geologic interface (fractures, bedding planes, veins, etc.). Feature apertures are listed in tenths of an inch. An aperture of zero for an open fracture simply means that while it appears to be a continuous open feature, the opening is smaller than the line thickness on the log (~0.015 inches). Note that it has been the experience of MAG that the aperture or Paillet rank of a feature is not always a strong indicator of its water-producing potential. Thin, discrete features sometimes produce as much or more water (as evidence by flow meter logging or packer testing) than wide, open fractures or fracture zones.

Caliper

Caliper measurements represent the average diameter of the borehole or well at a given depth. The caliper tool collects and transmits the data from three spring-loaded arms as the tool is lifted upwards through the borehole. The caliper tool is used to locate solution openings or fractures (where the borehole is typically enlarged due either to the presence of natural openings, or to plucking of broken rock by the drill bit), and to determine the length of casing intervals (as evident from small changes in casing diameter, or the small enlargements at threaded junctions, or narrowing due to the bead at welded junctions).

Caliper logs are collected by calibrating the downhole tool with a measuring template, lowering the tool to the base of the well, remotely opening the arms, and then logging the open borehole and casing diameter in an upward direction. Caliper logs are acquired with a logging speed of no more than 12 feet per minute.

Mr. Wallace
April 6, 2011
Page 5

Fluid Temperature

Fluid temperature logs provide the temperature of the air or fluid in a borehole as a function of depth. Temperature logs can indicate where water is entering or leaving a borehole – and thereby disturbing the normal geothermal gradient. Deviations, offsets, or changes in the slope of the temperature log can be used to locate zones of water movement within the borehole. Temperature logs must be run in wells that have been allowed to fully equilibrate to the local geothermal gradient following any prior drilling, construction, pumping or sampling. During a temperature survey, data accuracy is ensured by maintaining a downward logging speed of approximately 10 feet per minute (fpm). This provides an adequate time buffer to allow sensors to respond to minor temperature changes.

Fluid Conductivity

Fluid conductivity logs provide a continuous measurement of the electrical conductivity of the borehole fluid – i.e. zero in air or hydrocarbons, greater than zero in water. In water, electrical conductivity is mostly a function of electrolytic content. Water with very low dissolved solid concentrations will yield low fluid conductivity, while water containing a high level of dissolved solids will be proportionally more conductive. Fluid conductivity logs often deflect where water-producing features are transmitting water into or out of the well (since the well water may have a differing electrolytic chemistry than the formation water). The fluid conductivity log is usually collected simultaneously with the temperature log – since for both, data from a fully equilibrated water column is required.

Natural Gamma

Gamma logs are one of the most widely used geophysical logs in groundwater applications. They are used primarily to identify changes in lithology – specifically the relative amounts of clay in various sedimentary units.

A gamma log provides a record of the total natural gamma radiation detected within a given energy range. In water-bearing rocks and sediments that are not contaminated by artificial radioisotopes, the most significant naturally-occurring, gamma-emitting radioisotopes are potassium-40 and the daughter products of the uranium and thorium decay series. If gamma-emitting artificial radioisotopes have been introduced by humans into the groundwater system, they will also produce part of the radiation measured.

Mr. Wallace
April 6, 2011
Page 6

The amplitude of gamma-log deflections is affected by any borehole condition that alters the density of the material through which gamma photons must pass or the length of the travel path. The bedding of a gamma-emitting formation must be thick to obtain a quantitative value since the detector will be affected by the radiation from the formation as the tool approaches and passes the bed. Although increases in borehole diameter or the presence of steel casing will decrease the recorded gamma count, it is possible to collect usable information in both cased and open portions of the borehole using the gamma sonde. The presence of potassium-rich (and therefore gamma-emitting) bentonite clay commonly used in well construction will generally produce high gamma count peaks on a natural gamma log. MAG has natural gamma detectors on many sondes, and comparison of the multiple gamma logs collected for any given well logging program are used to ensure that the depths of differing logs are not erroneously shifted. Therefore, the gamma log presented for any well may have been collected simultaneously with any of the other logs from the same well.

Logging Results

The wells were logged on March 24, 2011. The logging results for the wells are presented on the enclosed digital logs and tables, and briefly summarized below.

Note that since analysis of borehole geophysical logs can be quite subjective, and the level of detail is dependent upon the specific goals of the geologist, the analysis by MAG below covers the major features of each log, as well as some possibly minor features to serve as examples or guides for further interpretation by geologists familiar with the site, local geology, and/or project goals. In general, logs may display deviations (i.e. "spikes" where the parameter deviates from, and then returns to, "background" level), offsets (changes in background level), or slope changes. Any of these could be considered significant in certain situations, or when compared to correlating features at the same depth on other logs. If there are any questions about the features discussed (or not discussed) below, please do not hesitate to contact MAG.

Mr. Wallace
April 6, 2011
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MW-14C

Noted Features

- The total depth (TD) of the well was logged at approximately 44.8 feet below ground surface (BGS).
- The depth to water (DTW) was measured at 21.8 feet BGS at the time of the survey.
- The diameter of the casing at the surface was measured to be four inches, and the bottom of the casing (BOC) was located at approximately 24.9 feet BGS.
- The caliper (borehole diameter) log reveals no significant enlargements.
- The fluid temperature log shows no significant deviations, offsets, or changes in slope except at the top of the water column.
- The fluid conductivity log shows no significant deviations, offsets, or changes in slope except at the top of the water column.
- Few planar features were recognizable on the televiewer logs. The depth, strike, dip, aperture, and feature type are listed on the log, as well as on the accompanying table in Appendix C.
- The natural gamma log shows generally smooth variations that are probably related primarily to the clay content of the formation.

Mr. Wallace
April 6, 2011
Page 8

MW-15C

Noted Features

- The total depth (TD) of the well was logged at approximately 44.6 feet below ground surface (BGS).
- The depth to water (DTW) was measured at 42.8 feet BGS at the time of the survey. Note that since the borehole needed to be filled with potable water from an on-site source, the DTW in the acoustic travel time and amplitude logs are much higher than what was originally recorded.
- The diameter of the casing at the surface was measured to be four inches, and the bottom of the casing (BOC) was located at approximately 24.9 feet BGS.
- The caliper (borehole diameter) log reveals no significant enlargements.
- The fluid temperature log shows no significant deviations, offsets, or changes in slope except at the top of the water column.
- The fluid conductivity log shows no significant deviations, offsets, or changes in slope except at the top of the water column.
- Few planar features were recognizable on the televiwer logs. The depth, strike, dip, aperture, and feature type are listed on the log, as well as on the accompanying table in Appendix C.
- The natural gamma log shows generally smooth variations that are probably related primarily to the clay content of the formation.

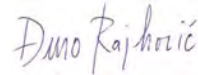
Mr. Wallace
April 6, 2011
Page 9

Limitations

In making verbal or written interpretation of logs, MAG personnel give the client the benefit of their best professional judgment. However, since all interpretations are based on inference from electrical, magnetic, or other indirect measurements, MAG does not, and cannot, guarantee the accuracy or the correctness of any such interpretations. MAG shall not be liable for any loss, damages, or expenses resulting from reliance on such interpretations. MAG does not warrant the accuracy of log data transmitted by any electronic process and will not be responsible for intentional interpretation of log data by others. MAG makes no warranties – neither explicit nor implied. Under no circumstances shall MAG, its parent company Enviroscan, Inc., or their personnel be liable for consequential damages.

We appreciate this opportunity to have worked with you again. If you have any questions, please do not hesitate to contact me.

Sincerely,
Mid-Atlantic Geosciences



Duro Rajkovic
Project Geophysicist

Technical Review By:
Mid-Atlantic Geosciences



Felicia Kegel Bechtel, M.Sc., P.G.
President

enc.: MW-14C: Televiewer and Geophysical Logs
MW-15C: Televiewer and Geophysical Logs
Appendix A: Planar Feature Orientation Parameters
Appendix B: Paillet Ranking System
Appendix C: Planar Feature Characterizations Table



Mid-Atlantic Geosciences
Title: *Televiewer and Geophysical Logs*

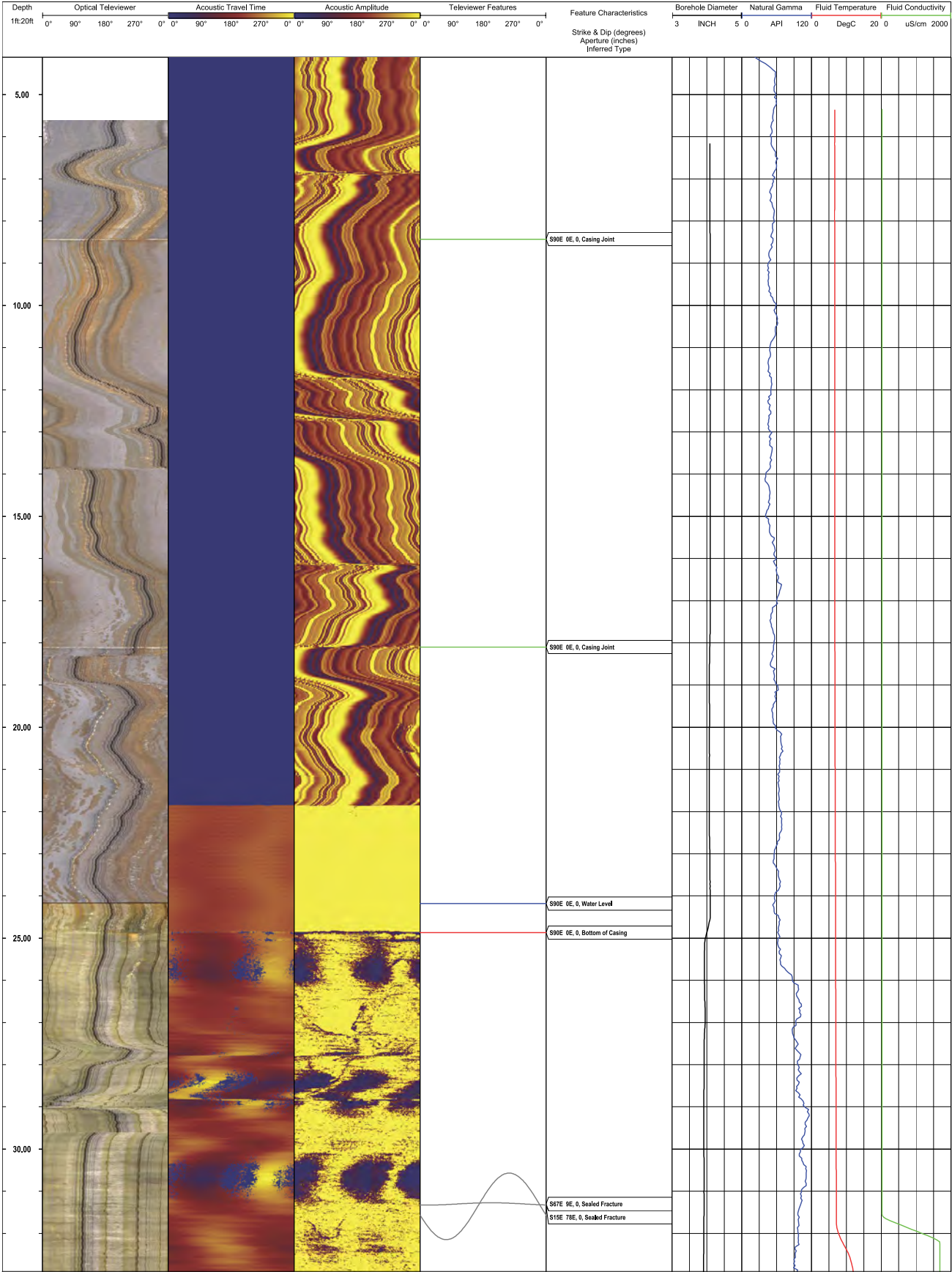
WELL ID
MW-14C

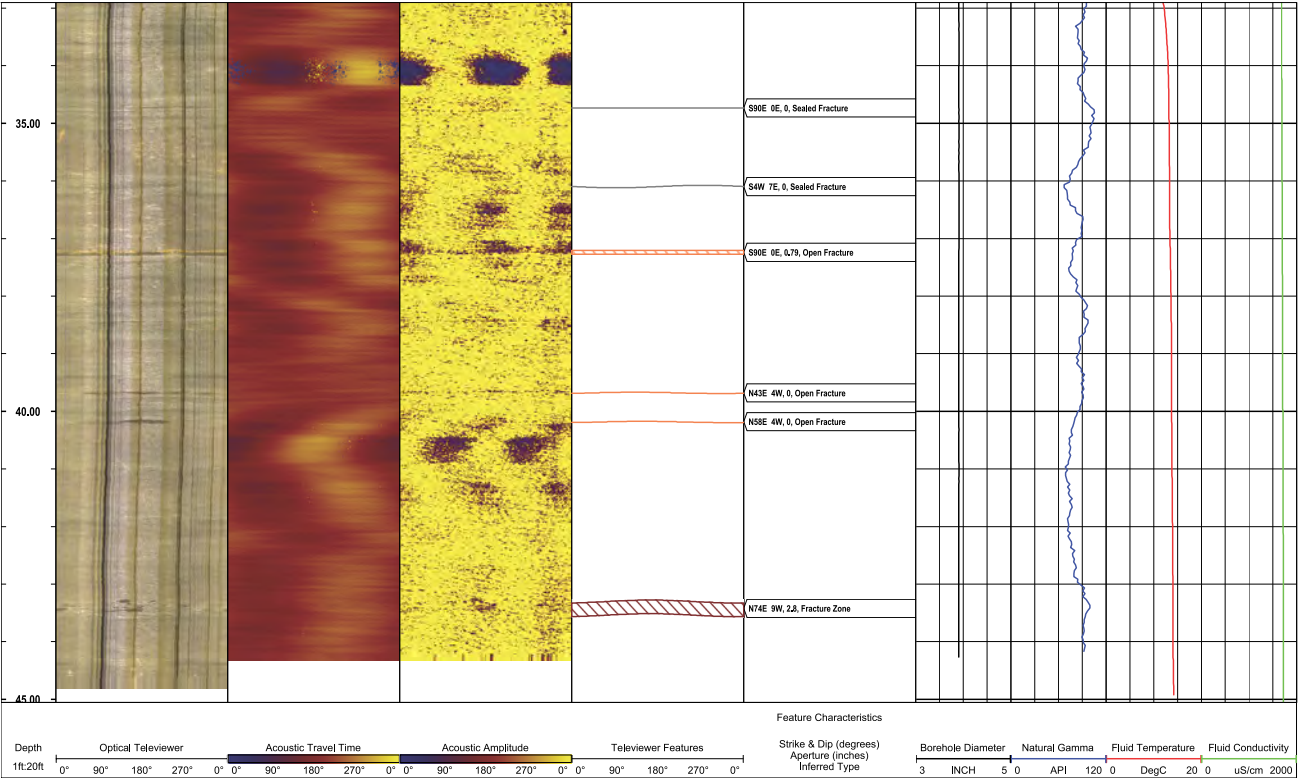
Logging Date: *03.21.2011*
Logging Datum: *Ground Surface*
BOC: *24.9'* DTW: *21.8'* TD: *44.8'*

Site Name: *Emerson Power Transmission Facility*
Location: *Ithaca, NY*

Client: *WSP Environmental & Energy*
Project No.: *021143*

Revision Date: *04.04.2011*







Mid-Atlantic Geosciences

Title: *Televiewer and Geophysical Logs*

WELL ID

MW-15C

Logging Date: *03.21.2011*

Logging Datum: *Ground Surface*

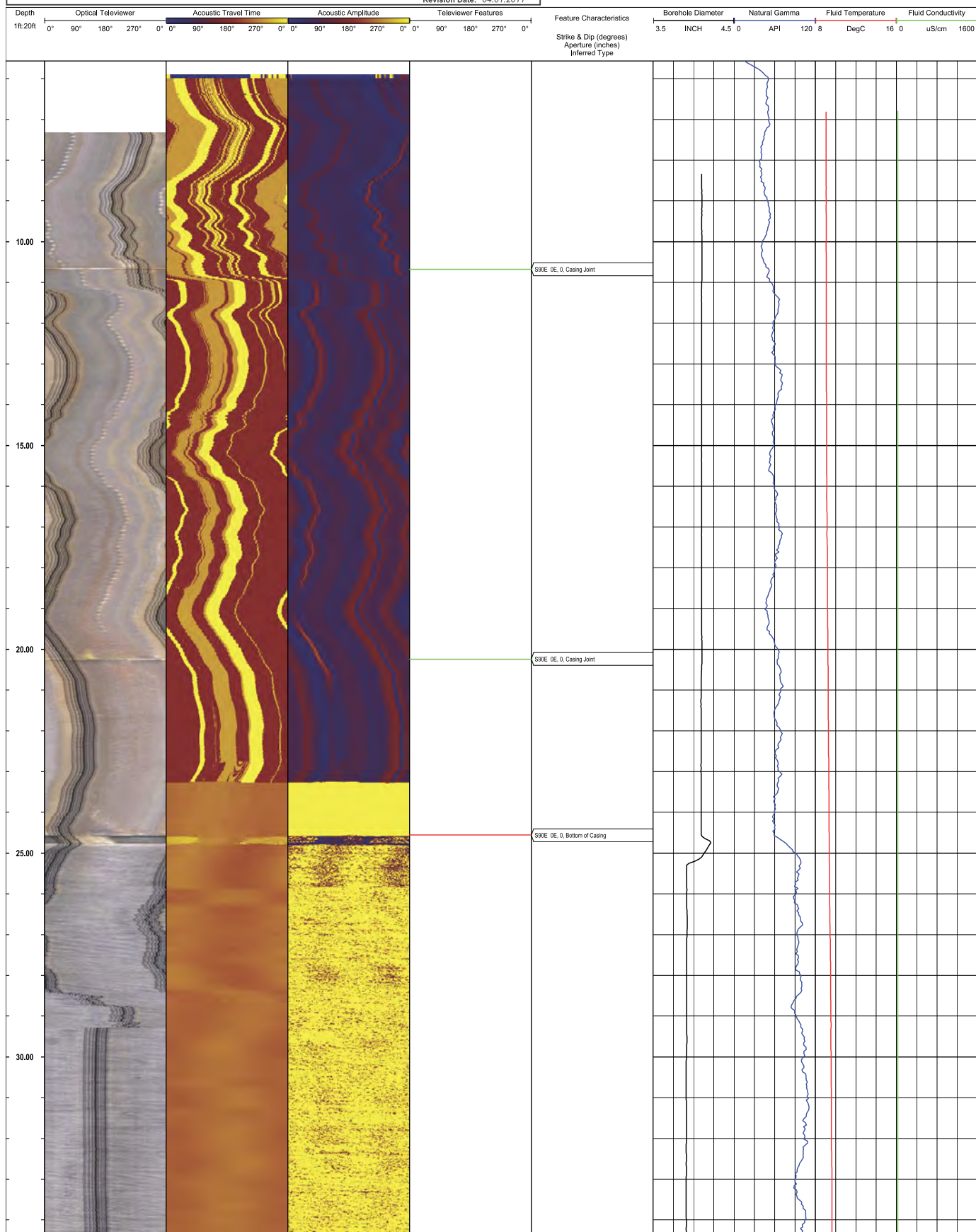
BOC: *24.6'* DTW: *42.8'* TD: *44.6'*

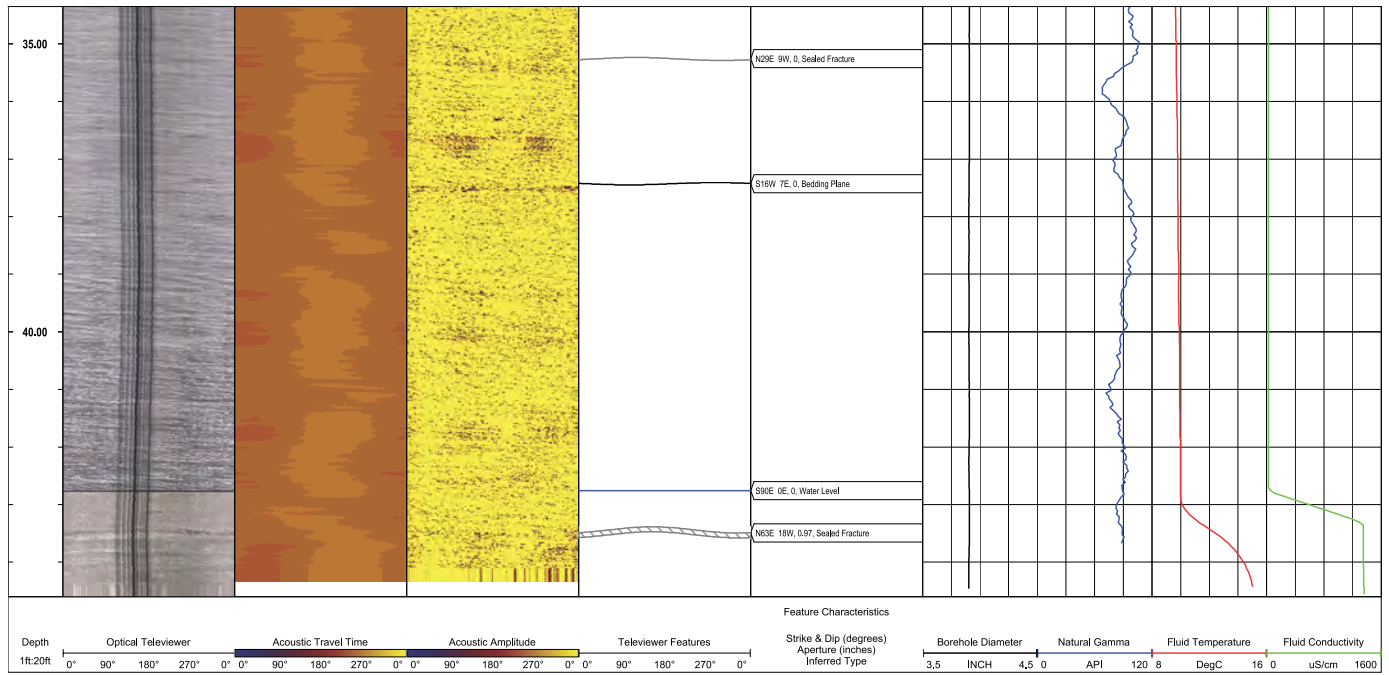
Site Name: *Emerson Power Transmission Facility*
Location: *Ithaca, NY*

Client: *WSP Environmental & Energy*

Project No.: *021143*

Revision Date: *04.01.2011*





Appendix A

Planar Feature Orientation Parameters

Planar Feature Orientation Parameters

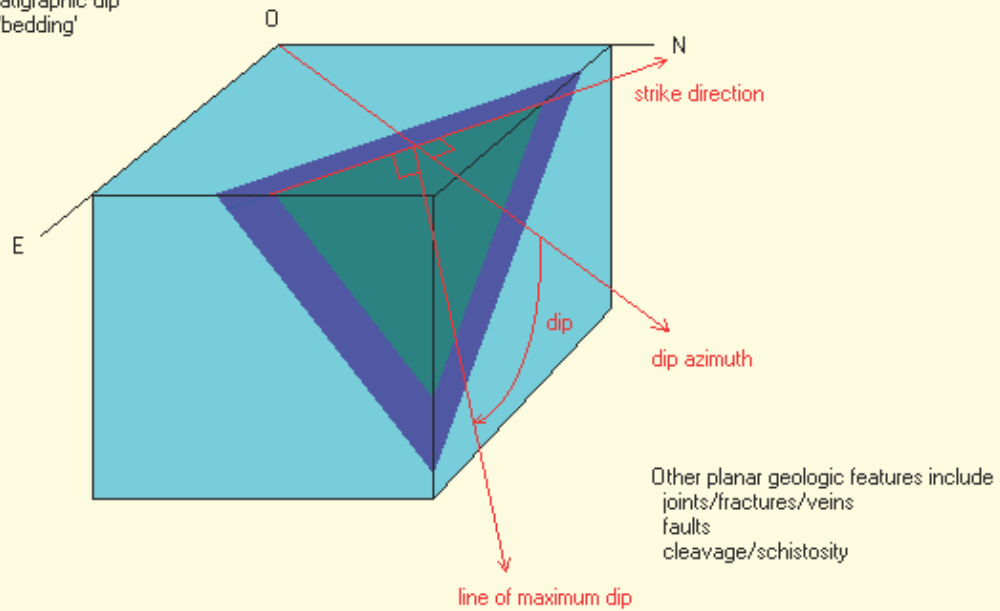
Dip = angle of inclination of the plane, downwards from the horizontal

Dip azimuth = azimuth of the line of maximum dip in the plane, clockwise from North

Strike direction = azimuth of a horizontal line in the plane (= dip azimuth - 90°)

e.g. dip and dip azimuth = 60° N041° or strike and dip = N311° 60°



e.g. Stratigraphic dip
or 'bedding'



Appendix B

Paillet Ranking System

Paillet Ranking System

Example OPTV Feature	Paillet Rank	Description
	0	Sealed feature – no flow
	1	Partial open fracture
	2	Continuous open fracture
	3	Wide open fracture or fractures
	4	Very wide fracture or multiple interconnected fractures
	5	Major fracture zone or breakout

Appendix C

Planar Feature Characterizations Tables

Mid-Atlantic Geosciences Planar Feature Characterizations



Well ID:	MW-14C	Client:	WSP Environmental & Energy
Site Name:	Emerson Power Transmission Facility	Project No.:	021143
Location:	Ithaca, NY	Revision Date:	04.04.2011

Depth	Aperture (in.)	Dip Azimuth (deg.)	Strike (deg.)	Dip (deg.)	Feature
8.4	0.0	0	S90E	0E	Casing J
18.1	0.0	0	S90E	0E	Casing J
21.9	0.0	0	S90E	0E	Water L
24.9	0.0	0	S90E	0E	Bottom of c
31.3	0.0	23	S67E	9E	Sealed Fr
31.4	0.0	75	S15E	78E	Sealed Fr
34.7	0.0	0	S90E	0E	Sealed Fr
36.1	0.0	94	S4W	7E	Sealed Fr
37.2	0.8	0	S90E	0E	Open Fra
39.7	0.0	313	N43E	4W	Open Fra
40.2	0.0	328	N58E	4W	Open Fra
43.4	2.8	344	N74E	9W	Fracture

Mid-Atlantic Geosciences Planar Feature Characterizations



Well ID:	MW-15C	Client:	WSP Environmental & Energy
Site Name:	Emerson Power Trans	Project No.:	021143
Location:	Ithaca, NY	Revision Date:	03.22.2011

Depth	Aperture (in.)	Dip Azimuth (deg.)	Strike (deg.)	Dip (deg.)	Feature
10.7	0.0	0	S90E	0E	Casing J
20.2	0.0	0	S90E	0E	Casing J
24.6	0.0	0	S90E	0E	Bottom of C
35.3	0.0	299	N29E	9W	Sealed Fr
37.4	0.0	106	S16W	7E	Bedding P
42.8	0.0	0	S90E	0E	Water L
43.5	1.0	333	N63E	18W	Sealed Fr



Final Report
Geophysical Survey – Emerson Power Transmission Facility
Electrical Resistivity/Cross-Hole Tomography
Ithaca, PA
Enviroscan Project Number 061037a

Prepared for: WSP Environmental Strategies
Prepared By: Enviroscan, Inc.
September 16, 2010





September 16, 2010

Mr. Scott Haitz

WSP Environmental Strategies

11190 Sunrise Valley Drive

Suite 300

Reston, VA 20191

RE: Geophysical Survey – Emerson Power Transmission Facility
Electrical Resistivity/Cross-Hole Tomography
Ithaca, PA
Enviroscan Project Number 061037a

Dear Mr. Haitz:

Pursuant to our proposal dated June 23, 2010, Enviroscan, Inc. (Enviroscan) has completed a geophysical investigation at the above-referenced site. The purpose of the survey was to identify the location(s) of possible preferential groundwater flow pathways in bedrock. Fieldwork for the survey was completed on August 23-25, 2010.

Site Description

The site is the Emerson Transmission Facility located on a hillside south of downtown Ithaca at the end of South Cayuga Street in Ithaca, NY. The site encompassed relatively steep slopes that fall to the river below the facility.

According to the Geologic Map of New York (<http://tin.er.usgs.gov/geology/state/>), the site is underlain by the Genesee Group, which is Upper Devonian in age. This group consists of the West River Shale, Genundewa Limestone, Penn Yan and Genesee Shales, and the North Evans Limestone. The dominant lithology is shale with a secondary rock type of limestone and tertiary rock types of siltstone and black shale (Ibid.).

For this study, the client designated the location of two electrical imaging profiles. One cross-hole tomography profile (CH-01) between wells EXB-01 and EXB-02; and one surface-to-borehole profile (SB-01) utilizing well EXB-02. Refer to Figure 1 for the locations of these profiles and identified utilities that crossed SB-01.



Mr. Haitz
September 16, 2010
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Survey Methods

Surface resistivity measurements involve driving an electrical current in the ground using two current electrodes at the ground surface. The apparent resistivity of the subsurface (essentially the mathematical inverse of terrain conductivity) is determined by measuring the potential difference or voltage between two potential electrodes with a known separation and position/orientation relative to the current electrodes. The depth and volume of the subsurface zone represented by the measured apparent resistivity is a function of the geometry of the current and potential electrodes located at the surface. The principles of electrical imaging are described in the accompanying Introduction to Electrical Imaging (Appendix A). Where suitable boreholes are available, electrodes can also be set at intervals in the holes and used alone (cross-hole measurements), or in conjunction with the surface electrodes (up-hole measurements).

Using an AGI Super Sting R8/IP resistivity meter, and Swift automated electrode switching system, apparent resistivity readings were collected along the two profiles (see Figure 1). Along each profile, electrodes were spaced at the ground surface at 1-meter intervals. To collect electrical imaging data, a dipole-dipole array (which is particularly sensitive to steeply-dipping tabular features) was used (Figure 2). The measured apparent resistivities (ρ_a 's) were plotted nightly (after each field day) as resistivity pseudo-sections depicting the apparent resistivity versus nominal survey depth for each profile in order to confirm data quality.

In post-field processing, the apparent resistivity pseudo-sections were mathematically inverted using EarthImager 2D by Advanced Geosciences, Inc., to provide color-contoured electrical images of true resistivity versus true depth along each profile as depicted in Figure 2. On these images, low resistivity (high conductivity) material is depicted in shades of blue, with high resistivity (low conductivity) material in shades of red to orange and moderately resistive/conductive materials in shades of green. Note that clay-rich and/or wet materials are typically represented by local resistivity lows (conductivity highs – shades of blue), while competent rock, and dry sands, gravels or other porous materials are typically represented by areas of resistivity highs (low conductivity – red to orange).

Mr. Haitz
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Page 3

Survey Results

In Figure 2, the two inverted resistivity cross sections are presented for Profiles CH-01 and SB-01. These represent a cross-hole tomography profile and an up-hole profile respectively.

Profile CH-01 was a cross-hole resistivity tomography profile collected between wells EXB-01 and -02. These two wells were situated 58 feet apart and were installed approximately 82 feet deep. Both wells were constructed with approximately 20 feet of steel casing set into bedrock with the rest of the well being open hole. In order to ensure that the steel casing did not produce erroneous results, the top-most electrodes in both wells were lowered to a depth of 30 feet below ground surface (bgs), well below the casing, and based on the rule of thumb, that electrodes should be at least two electrode spacings below an interference source. Note that no data were collected between the ground surface and 30 feet bgs (hachured area in Figure 2). At the client's request, the modeling interpolation in that zone was not blanked. Enviroscan will not support any interpretations or assumptions made from the inspection of this interpolation into an area with no data coverage.

Results for Profile CH-01 indicate three distinct conductive (low resistivity) anomalies (A, B, C, in Figure 2). Anomaly A is located at approximately 40 feet bgs and is approximately 30 feet wide. Anomaly B ranges from approximately 55 – 75 feet bgs and is approximately 48 feet wide. Anomaly C is a small conductive anomaly at approximately 55 feet bgs and is about 10 feet wide. All three of these anomalies are indicative of water-bearing fractures in bedrock.

Profile SB-01 was a surface-to-borehole resistivity profile that was collected instead of a standard surface resistivity profile due to the presence of numerous metallic utilities that both paralleled and bisected the resistivity profile. Due to the presence of a double layer of concrete in the vicinity of EXB-02, the first surface electrode was placed approximately 45 feet away from the borehole – hence the reason for the hachured zone from 0 – 45 feet from the borehole along the profile. Again, this hachured zone has not been blanked at the request of the client and Enviroscan will not support any interpretations or assumptions made from the inspection of this interpolation (Figure 2). Note the large hachured area at the bottom right corner of Profile SB-01. This was also hachured due to the likelihood that little data were collected in this zone due to the length of the profile versus the depth and the presence of metallic utilities, which create large amounts of noise in the data. Therefore, little resistivity variation is seen in this portion of the profile because there is very little data to model. In the hachured zone, the model is an interpolation from good quality data at the shallower depths above this zone. Enviroscan will not support any interpretations or assumptions made from the inspection of this interpolation.

Mr. Haitz
September 16, 2010
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Results from Profile SB-01 indicate a very noisy shallow subsurface, due presumably to the presence of numerous utilities. The red resistive features in the shallow depths below the surface electrodes (from 75 to 190 feet along-profile) could be the result of either resistive rock or dry resistive fractures. Anomalies D, E, F, and G are all conductive anomalies that are indicative of water-bearing fractures. The bottoms of these anomalous zones were not fully defined due the limited depth of penetration of the survey. This could not be avoided due to the weaker signal-to-noise ratio caused by the utilities.

Limitations

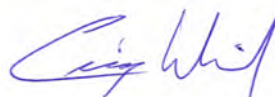
The geophysical survey described above was completed using standard and/or routinely accepted practices of the geophysical industry and equipment representing the best available technology. Enviroscan does not accept responsibility for survey limitations due to inherent technological limitations or unforeseen site-specific conditions. However, we make every effort to identify and notify the client of such limitations or conditions.

ENVIROSCAN, INC.

Mr. Haitz
September 16, 2010
Page 5

We have enjoyed and appreciated the opportunity to work with you. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,
Enviroscan, Inc.



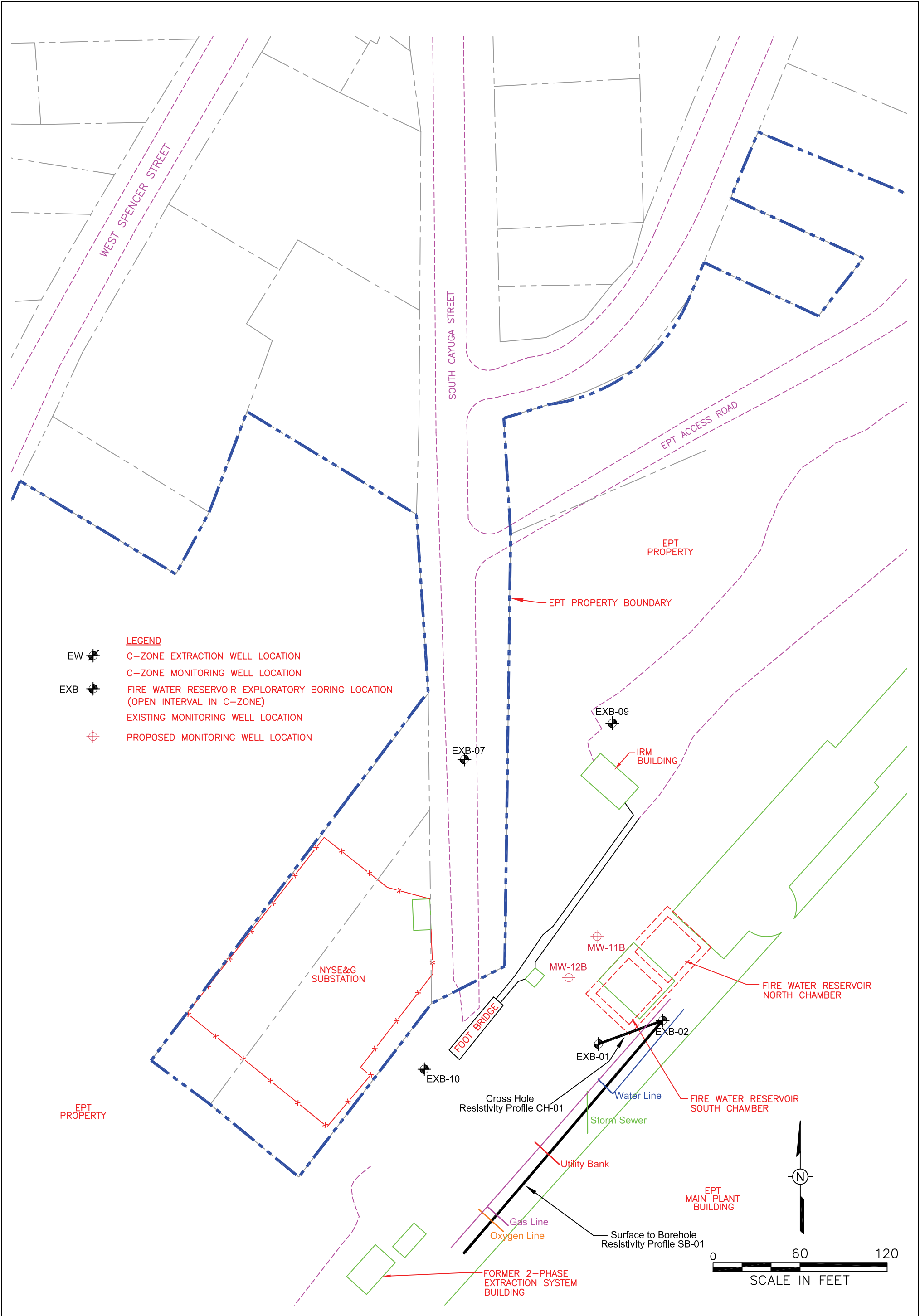
Craig Ulrich, M.Sc.,
Geophysics Project Manager

Technical Review By:
Enviroscan, Inc.

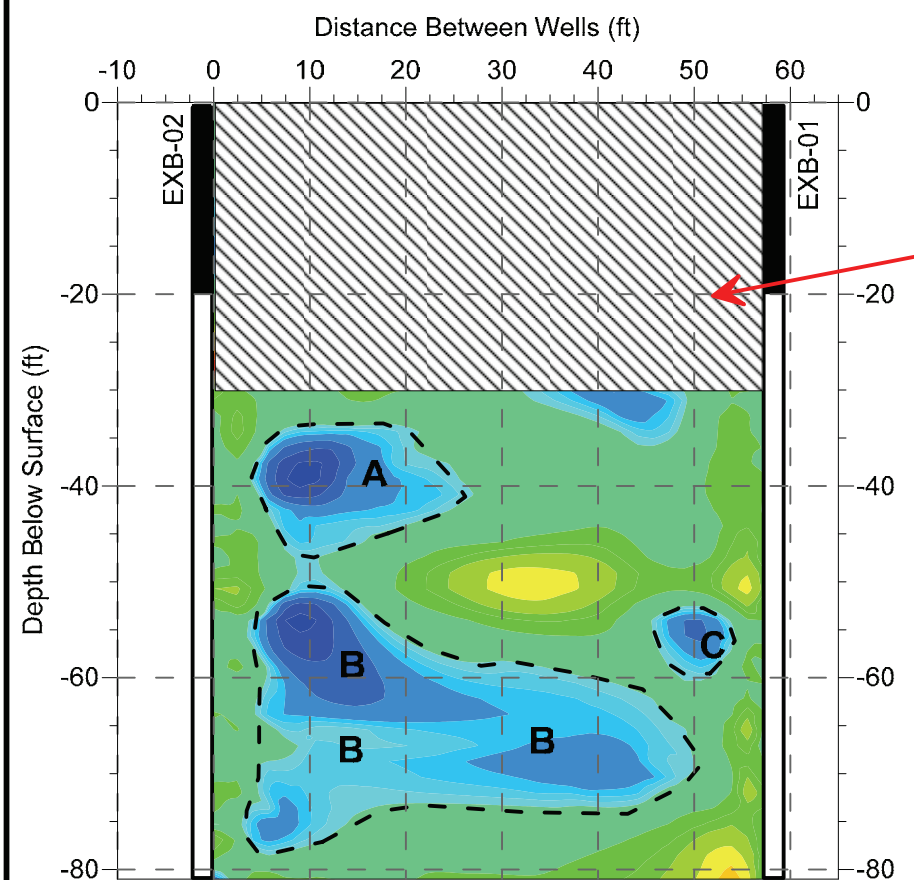
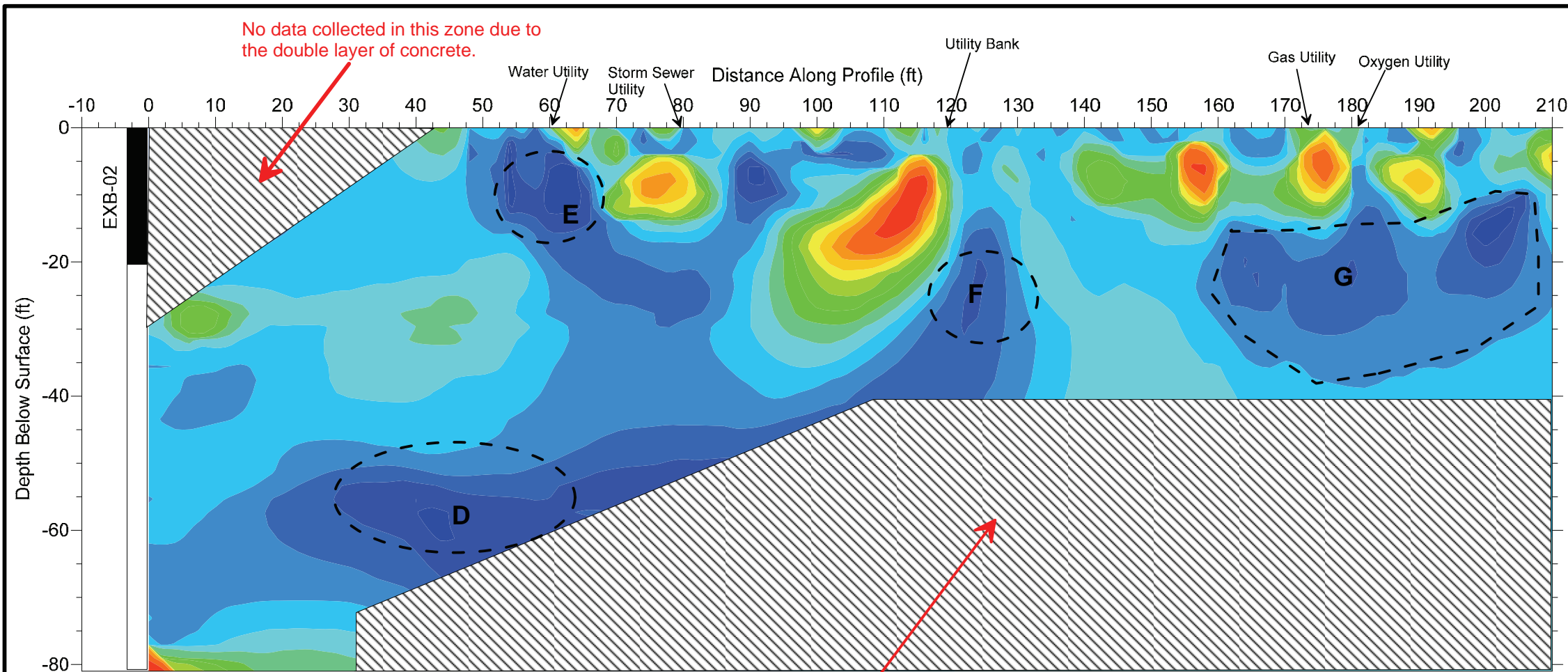


Felicia Kegel Bechtel, M.Sc., P.G.
President

enc.: Figure 1: Resistivity Profile Location Map
Figure 2: ERT Resistivity Survey Results
Appendix A: Introduction to Electrical Imaging



<div>Prepared by:</div> <div><div>Enviroscan, Inc. 1051 Columbia Avenue Lancaster, PA 17603 (717) 396-8922 www.enviroscan.com</div></div>	Resistivity Profile Location Map	Emerson Facility Ithaca, NY	Figure 1
		Project Number 061037a	Revision/Issue Rev. 09/08/10
		Original Scale 1" = 60'	Drawn by: CAU
			Approved by: FKB



Little to no data collected in this zone due to the depth-of-penetration limitation and numerous shallow utilities along the profile.

No data collected in this zone due to steel casing within the monitoring well.

A, B, C Resistivity Anomalies

--- Resistivity Anomaly Boundary

Model Interpolation with No Supporting Data

SB-01

Electrical resistivity data collected at 1m electrode spacings with a AGI SuperSting R8 Resistivity/IP Meter.

Two tomographies were collected:
1) borehole-to-borehole and
2) surface-to-borehole.

Borehole-to-borehole collected between EXB-02 and EXB-01 starting at 30 feet below ground surface (bgs) down to 81 feet bgs.

Prepared by:  Enviroscan, Inc. 1051 Columbia Ave. Lancaster PA 17603 717-396-8922 www.enviroscan.com	Title: ERT Survey Results	Project Location: Emerson Facility Ithaca, NY		Figure 2	
		Project Number 061037a	Revision/Issue Rev. 08/27/10	Drawn by: CAU	Approved by: FKB
		Original Scale NA	Survey Ending Date		

Appendix A

Introduction to Electrical Imaging





Introduction to Electrical Imaging

by

Timothy D. Bechtel, Ph.D., P.G.

Energy

Electrical currents injected into the subsurface between electrodes pushed into the ground surface or non-intrusive, protected capacitors.

Sensitivity

Detects changes in electrical resistivity (the inverse of conductivity).

Basic Equipment

Either (traditional “steel spike electrode” method):

Steel spike electrodes (called current electrodes) connected by wires to a current source (to inject current), and steel spike electrodes (called voltage electrodes) connected to a microvolt meter (to measure the surficial distribution of electrical potentials). Note that current and voltage electrodes differ only by that to which they are connected (i.e. current source or microvolt meter, respectively.) Modern systems use arrays of electrodes (connected to multi-channel cables and an automated electrode-switching/recording system) to take measurements from electrodes at different locations and spacings (which adjusts the survey depth and resolution). Electrodes are hand-pushed into the ground surface along desired survey profiles.

Or (innovative “capacitively-coupled electrode” method):

Straight-wire capacitors which are capable of driving subsurface electrical currents and measuring surface potentials. The wire lengths and the distance between wires can be varied to adjust the survey depth and resolution. Capacitors are encased in torpedo-like protectors between the wire lengths, and the entire array (similar to a swimming rope with flotation buoys) is hand- or vehicle-towed along desired survey profiles.



Common Applications

Electrical imaging produces color-contour cross sections (commonly called electrical images) of subsurface electrical resistivity variations. These images can depict a target that has a different electrical resistivity from its surroundings, such as: buried wastes (pits, trenches, etc.); conductive groundwater plumes; resistive hydrocarbon plumes; foundation elements; water-bearing or mineralized faults or fractures; clay seams in bedrock; soil moisture anomalies; soil voids; clay layers bounded by sand or sand lenses bounded by clay; the top of competent (non-water-bearing) rock.

Principles

Electrical imaging can be performed by driving a harmless, very low amperage (e.g. 1 milliamp) DC electrical current in the ground between two steel spike electrodes. The depth to which the current flows is dictated by the separation of the two electrodes, and by the resistivity of subsurface materials. The flow of electrical current is mapped by measuring the electrical potential at various points of the ground surface using a very high impedance microvolt meter. Data suitable for determining a cross-sectional electrical image can be collected by taking many voltage readings with differing current electrode separations (i.e. different effective measurement depths) using different current electrode positions and voltage electrode positions (i.e. different locations along a profile). A two-dimensional image or cross-section is produced by employing electrodes in a linear array. Three-dimensional images (or color-contoured blocks of data) can be calculated using multiple linear arrays or grids of electrodes. The field-measured voltages, together with associated electrode positions, are mathematically inverted to provide the statistically best-fitting model of the subsurface resistivity distribution.

Electrical imaging can also be performed using straight-wire capacitors to drive currents and measure voltages. In this case, the length of the transmitter wire and the separation between the transmitter and receiver wires dictate the effective survey depth. Two- or three-dimensional data is collected by varying the lengths and separations of the transmitter and receiver capacitor wires for a given survey profile (i.e. the same profile is traversed several times using different wire lengths and separations).

Capabilities

Electrical imaging can detect and delineate a target that has a different electrical resistivity from its surroundings. Particularly good targets for electrical imaging include: electrically conductive clay seams, and water-bearing or mineralized faults or fractures in resistive bedrock; electrically resistive hydrocarbon plumes in moist electrically conductive soils; highly conductive electrolytic groundwater plumes (e.g. leachate or saltwater intrusion); highly conductive or resistive wastes buried in “normal” soils; soil moisture anomalies (e.g. dam seepage or incipient sinkholes).

Where site conditions allow, capacitively-coupled electrode systems can collect greater quantities of data in a given time (or at a given cost) than the traditional steel spike systems. The capacitive systems can also be used on asphalt pavement (where steel spike systems would require drilling many electrode holes).

Limitations

Electrical resistivities of differing materials have wide and overlapping ranges, making it impossible to positively identify a subsurface material based on its resistivity alone. For instance, profiling of the top-of-rock can be done by electrical imaging, but it is often difficult to specify exactly what resistivity contour corresponds with the top of rock (particularly where there is a weathering or saprolite zone). Since electrical resistivity (unlike seismic velocity) does not correlate with rippability or density, it is not typically the method of choice for rock profiling.

Based largely on a single well-publicized incident, electrical imaging has been promoted (by others) as a method for detecting bedrock cavities. However, since an air-filled cavity and competent rock are both electrical resistors, many cavities are not detectable using electrical methods (in this case, gravity would be the method of choice since air and competent rock have very different densities).

Electrical imaging data is susceptible to interference from underground utilities that capture and channel the subsurface current flow. This can be minimized in two-dimensional surveys by orienting the trace of an image perpendicular to any existing utilities.

Capacitively-coupled electrode systems suffer loss of signal penetration depth in highly conductive terranes. In addition, they are difficult to use in rugged or brushy terrain.

Survey depths using steel spike electrode systems can be limited by high contact resistances between the spikes and highly resistive surficial material.



**Final Report
Borehole Geophysical Logging Program
One Well – (MW-540)
Emerson Power Transmission Facility
Ithaca, NY
MAG Reference Number 061037a**

**Prepared For: WSP Environmental Strategies
Prepared By: Mid-Atlantic Geosciences
September 17, 2010**





September 17, 2010

Mr. Scott Haitz
WSP Environmental & Energy
11190 Sunrise Valley Drive
Suite 300
Reston, VA 20191

RE: Borehole Geophysical Logging Program
One Well – (MW-540)
Emerson Power Transmission Facility
Ithaca, NY
MAG Reference Number 061037a

Dear Mr. Haitz:

Pursuant to our proposal dated July 8, 2010, Mid-Atlantic Geosciences (MAG – the borehole logging division of Enviroscan, Inc.) completed the above-referenced survey on August 25, 2010. The objective of the survey was to locate and characterize fractures and potential water-bearing zones intersecting the well. To accomplish these objectives, MAG conducted Optical Televiwer, 3-Arm Caliper, Fluid Temperature, Fluid Conductivity, and Natural Gamma, logging in the well.

Logging Equipment

Mid-Atlantic Geosciences conducts borehole geophysics, televiwer, and video logging using a Robertson Geologging, Ltd. Micrologger II and/or a Mount Sopris Matrix. These units record digital data for on-site log playback, reproduction, and field interpretation, as well as post-processing and report presentation. The systems are driven by field PCs running software supplied by the manufacturer for data acquisition, log replay, probe control, probe calibration, and logging environment compensation. Video data (if collected) are recorded in real time to the hard drive of a DVD player/recorder, and can be burned in the field to a DVD that is left with the client's on-site representative.

All of the logging instruments are permanently mounted in a dedicated Ford F350 or Dodge RAM2500 enclosed-bed truck, each with a self-contained power supply, and support and decontamination equipment. The downhole probes or sondes are connected to either a Robertson Geologging Smartwinch with approximately 600 feet of 0.375-inch coaxial cable, or a Robertson 2000m winch with approximately 3000 feet of 0.25-inch coaxial cable – depending on the depth of the wells logged.



Mr. Haitz
September 17, 2010
Page 2

Logging Parameters and Methodology

Geophysical well logging in general involves lowering sondes in a borehole and recording parameters that are related to the properties of the adjacent soil or rock, the fluids in the borehole or formation, and/or construction details of the well. There are many tools and techniques that have been developed to provide specific information in different environments and constructions of drilled holes. The data collected can define the nature and extent of geologic formations and formation fluids, and can be used to provide correlation between holes.

The sondes used for this survey are described below. Note that before any of these tools are put into service for a particular job, MAG personnel test them for proper function and recalibrate as necessary. This is essential to the proper acquisition of downhole data and the ability to relate the data from one borehole to another.

Optical Televiewer

The borehole optical televiewer (OPTV) or Optical Borehole Imager (OBI) provides a high-resolution digital optical scan of the interior of a borehole using visible wavelength light. From the accurately-scaled, continuous image it is possible to identify the depth and character of features such as fractures, bedding planes, veins, solution openings, etc. In particular, it is possible to calculate the strike, dip, and aperture of planar features. The OPTV operates by using a high-resolution color downhole camera which views a reflection of the borehole walls in a hyperbolic correction mirror. At successive depth increments of 0.5 mm, rings of pixels corresponding to circular scans of the borehole wall are acquired from the probe and stacked into a continuous image. The image is rectangular – representing the interior of a cylinder that has been sliced open and rolled-out flat. The image is oriented to north based on data from three magnetometers and accelerometers in the sonde. Note that the use of magnetometers for orientation leads to image distortion in steel-cased holes, and within several feet of the base of steel casing in open holes. All OPTV sondes require an open borehole, or one filled with a clear fluid.

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Planar features intersecting a cylindrical borehole appear sinusoidal on the flattened cylindrical image. The azimuth of the peak/trough of the sinusoid, and the amplitude of the sinusoid can be measured and used to calculate the strike and dip (see Appendix A) of such features. Based on their visual character, planar features on the optical televiewer (and HRAT – see below) logs have been categorized on the log sheets as various types of geologic interface (fractures, bedding planes, veins, etc.). The features observed on the OPTV log can also be characterized based on the Paillet Ranking System developed by the US Geological Survey, Water Resources Division, Borehole Geophysics Research Project. This system is a semi-subjective evaluation of transmissivity potential. The ranking system assigns a number value between zero and five to observed features. A rank of zero indicates a feature that appears sealed – with no water likely passing through it. Note that the geologic classification of features (e.g. bedding plane, lithologic contact, joint, fracture, foliation, etc.) is not specified in the Paillet System since only water-bearing potential is considered. A rank of five corresponds to a grossly porous zone with large openings (e.g. a major fracture, fault or solution cavity). The ranking system, with examples, is provided in Appendix B.

Tables listing the depth, aperture, strike, dip and type of feature are included in this report, for each well, as Appendix C. Feature apertures are listed in tenths of an inch. An aperture of zero for an open fracture simply means that while it appears to be a continuous open feature, the opening is smaller than the line thickness on the log (~0.015 inches). Note that because of the subjectivity involved in Paillet ranking, MAG has listed fractures in Appendix C only as either open or sealed. Specific Paillet rankings can be assigned by the client, if desired, by comparing the standard pictures in Appendix B to the OPTV log.

Note also that it has been the experience of MAG that the aperture or Paillet rank of a feature is not always a strong indicator of its water-producing potential. Thin, discrete features sometimes produce as much or more water (as evidence by flowmeter logging – see below) than wide, open fractures or fracture zones.

Caliper

Caliper measurements represent the average diameter of the borehole or well at a given depth. The caliper tool collects and transmits the data from three spring-loaded arms as the tool is lifted upwards through the borehole. The caliper tool is used to locate solution openings or fractures (where the borehole is typically enlarged due either to the presence of natural openings, or to plucking of broken rock by the drill bit), and to determine the length of casing intervals (as evident from small changes in casing diameter, or the small enlargements at threaded junctions, or narrowing due to the bead at welded junctions).

Caliper logs are collected by calibrating the downhole tool with a measuring template, lowering the tool to the base of the well, remotely opening the arms, and then logging the open borehole and casing diameter in an upward direction. Caliper logs are acquired with a logging speed of no more than 12 feet per minute.

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Fluid Temperature

Fluid temperature logs provide the temperature of the air or fluid in a borehole as a function of depth. Temperature logs can indicate where water is entering or leaving a borehole – and thereby disturbing the normal geothermal gradient. Deviations, offsets, or changes in the slope of the temperature log can be used to locate zones of water movement within the borehole. Temperature logs must be run in wells that have been allowed to fully equilibrate to the local geothermal gradient following any prior drilling, construction, pumping or sampling. During a temperature survey, data accuracy is ensured by maintaining a downward logging speed of approximately 10 feet per minute (fpm). This provides an adequate time buffer to allow sensors to respond to minor temperature changes.

Fluid Conductivity

Fluid conductivity logs provide a continuous measurement of the electrical conductivity of the borehole fluid – i.e. zero in air or hydrocarbons, greater than zero in water. In water, electrical conductivity is mostly a function of electrolytic content. Water with very low dissolved solid concentrations will yield low fluid conductivity, while water containing a high level of dissolved solids will be proportionally more conductive. Fluid conductivity logs often deflect where water-producing features are transmitting water into or out of the well (since the well water may have a differing electrolytic chemistry than the formation water). The fluid conductivity log is usually collected simultaneously with the temperature log – since for both, data from a fully equilibrated water column is required.

Natural Gamma

Gamma logs are one of the most widely used geophysical logs in groundwater applications. They are used primarily to identify changes in lithology – specifically the relative amounts of clay in various sedimentary units.

A gamma log provides a record of the total natural gamma radiation detected within a given energy range. In water-bearing rocks and sediments that are not contaminated by artificial radioisotopes, the most significant naturally-occurring, gamma-emitting radioisotopes are potassium-40 and the daughter products of the uranium and thorium decay series. If gamma-emitting artificial radioisotopes have been introduced by humans into the groundwater system, they will also produce part of the radiation measured.

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The amplitude of gamma-log deflections is affected by any borehole condition that alters the density of the material through which gamma photons must pass or the length of the travel path. The bedding of a gamma-emitting formation must be thick to obtain a quantitative value since the detector will be affected by the radiation from the formation as the tool approaches and passes the bed. Although increases in borehole diameter or the presence of steel casing will decrease the recorded gamma count, it is possible to collect usable information in both cased and open portions of the borehole using the gamma sonde. The presence of potassium-rich (and therefore gamma-emitting) bentonite clay commonly used in well construction will generally produce high gamma count peaks on a natural gamma log. MAG has natural gamma detectors on many sondes, and comparison of the multiple gamma logs collected for any given well logging program are used to ensure that the depths of differing logs are not erroneously shifted. Therefore, the gamma log presented for any well may have been collected simultaneously with any of the other logs from the same well.

Logging Results

The well was logged August 25, 2010. The logging results for the well are presented on the enclosed digital logs and tables, and briefly summarized below.

Note that since analysis of borehole geophysical logs can be quite subjective, and the level of detail is dependent upon the specific goals of the geologist, the analysis by MAG below covers the major features of each log, as well as some possibly minor features to serve as examples or guides for further interpretation by geologists familiar with the site, local geology, and/or project goals. In general, logs may display deviations (i.e. "spikes" where the parameter deviates from, and then returns to, "background" level), offsets (changes in background level), or slope changes. Any of these could be considered significant in certain situations, or when compared to correlating features at the same depth on other logs. If there are any questions about the features discussed (or not discussed) below, please do not hesitate to contact MAG.

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Noted Features

- The total depth (TD) of the well was logged at approximately 39.4 feet below ground surface (BGS).
- The depth to water (DTW) was measured at 30 feet BGS at the time of the survey.
- The diameter of the casing at the surface was measured to be four inches, and the bottom of the casing (BOC) was located at approximately 17.6 feet BGS.
- The caliper (borehole diameter) log reveals a few variable zones, but no distinct major enlargements.
- The fluid temperature log shows no significant deviations, offsets, or changes in slope except at the top of the water column.
- The fluid conductivity log shows no significant deviations, offsets, or changes in slope except at the top of the water column.
- A few planar features were recognizable on the televiewer logs. The depth, strike, dip, aperture, and feature type are listed on the log, as well as on the accompanying table in Appendix C.
- The natural gamma logs show generally smooth variations that are probably related primarily to the clay content of the formation.

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Limitations

In making verbal or written interpretation of logs, MAG personnel give the client the benefit of their best professional judgment. However, since all interpretations are based on inference from electrical, magnetic, or other indirect measurements, MAG does not, and cannot, guarantee the accuracy or the correctness of any such interpretations. MAG shall not be liable for any loss, damages, or expenses resulting from reliance on such interpretations. MAG does not warrant the accuracy of log data transmitted by any electronic process and will not be responsible for intentional interpretation of log data by others. MAG makes no warranties – neither explicit nor implied. Under no circumstances shall MAG, its parent company Enviroscan, Inc., or their personnel be liable for consequential damages.

We appreciate this opportunity to have worked with you again. If you have any questions, please do not hesitate to contact me.

Sincerely,
Mid-Atlantic Geosciences



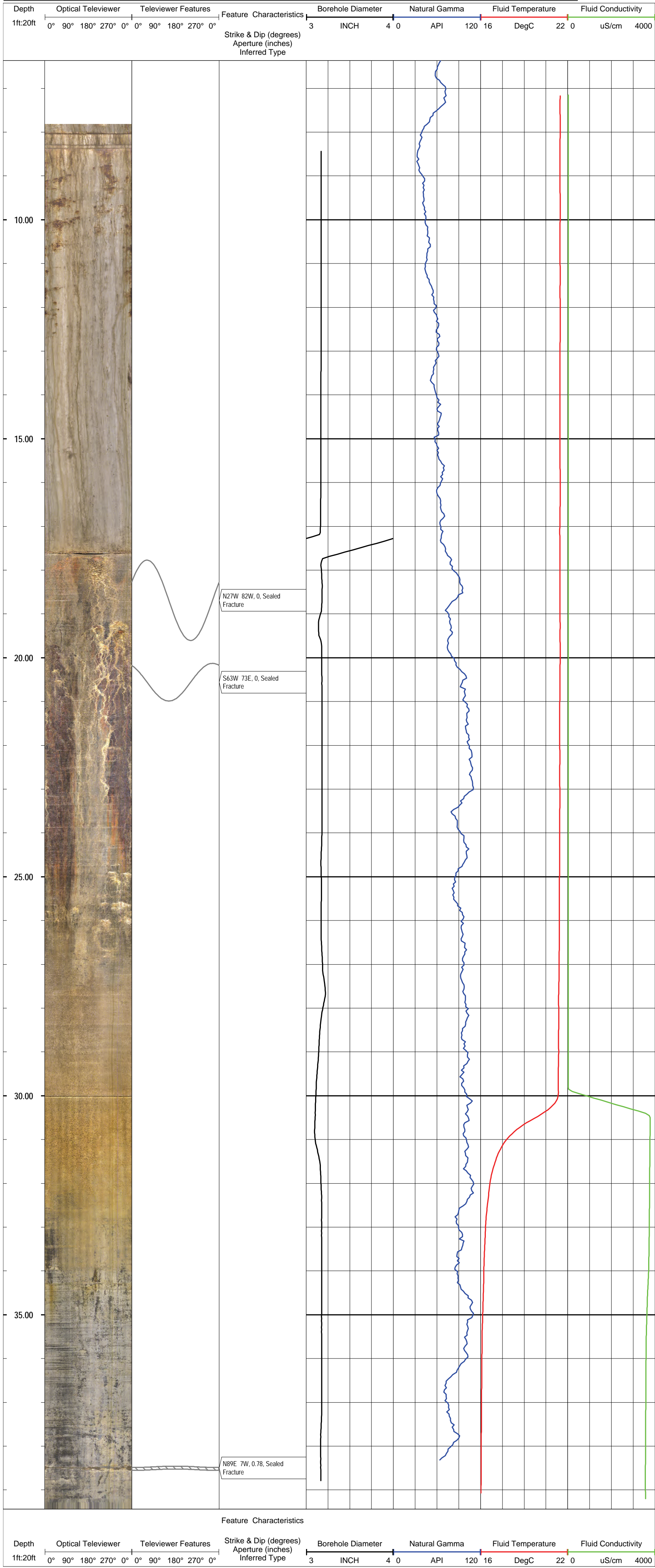
Duro Rajkovic
Project Geophysicist

Technical Review By:
Mid-Atlantic Geosciences



Felicia Kegel Bechtel, M.Sc., P.G.
President

enc.: MW-540: Televiewer and Geophysical Logs
Appendix A: Planar Feature Orientation Parameters
Appendix B: Paillet Ranking System
Appendix C: Planar Feature Characterizations Table



Appendix A

Planar Feature Orientation Parameters

Planar Feature Orientation Parameters

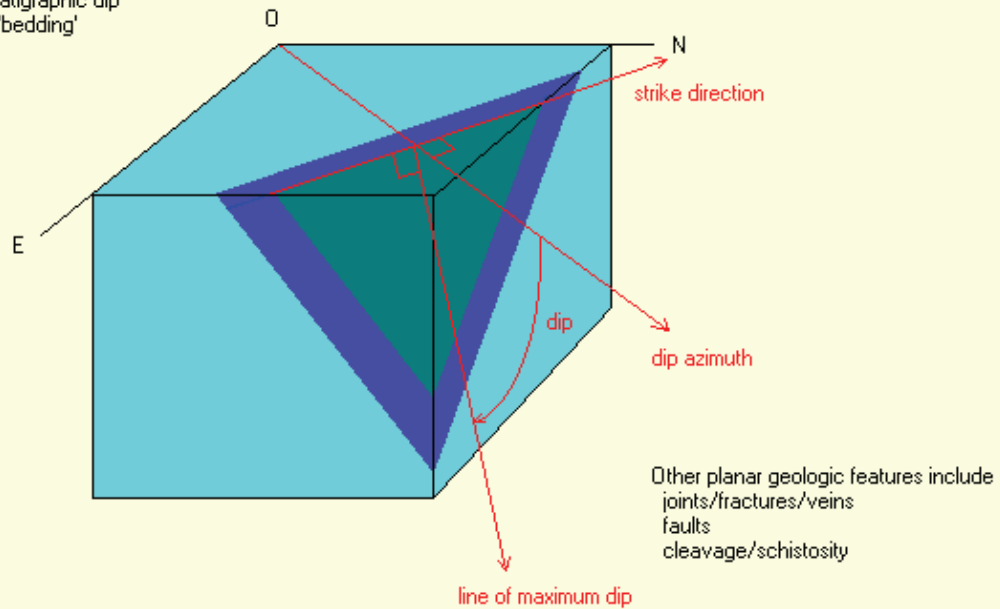
Dip = angle of inclination of the plane, downwards from the horizontal

Dip azimuth = azimuth of the line of maximum dip in the plane, clockwise from North

Strike direction = azimuth of a horizontal line in the plane (= dip azimuth - 90°)

e.g. dip and dip azimuth = 60° N041° or strike and dip = N311° 60°



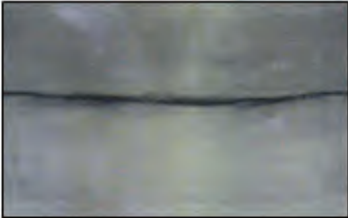


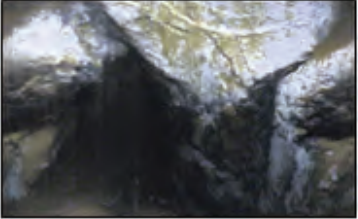
e.g. Stratigraphic dip
or 'bedding'



Appendix B

Paillet Ranking System

Paillet Ranking System

Example OPTV Feature	Paillet Rank	Description
	0	Sealed feature – no flow
	1	Partial open fracture
	2	Continuous open fracture
	3	Wide open fracture or fractures
	4	Very wide fracture or multiple interconnected fractures
	5	Major fracture zone or breakout

Appendix C

Planar Feature Characterizations Tables

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Planar Feature Characterizations



Well ID: MW-540 Client: WSP Environmental & Energy

Site Name: South Aurora Street Project No.: 061037a

Location: Ithaca, NY Revision Date: 08.27.2010

Depth	Aperture (in.)	Dip Azimuth (deg.)	Strike (deg.)	Dip (deg.)	Feature Type
18.7	0.0	243	N27W	82W	Sealed Fracture
20.6	0.0	153	S63W	73E	Sealed Fracture
38.5	0.8	359	N89E	7W	Sealed Fracture