ADVANTAGE ENVIRONMENTAL CONSULTANTS, LLC

Corrective Action Plan Addendum

Gasoline Fueling Station – Royal Farms #96
500 Mechanics Valley Road
North East, Cecil County, Maryland 21901

OCP Case No. 2011-0729-CE
MDE Facility No. 13326

AEC Project Number: 05-056 RF096

Prepared for:
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1.0 INTRODUCTION

1.1 Project Overview

As required in Maryland Department of the Environment (MDE) Oil Control Program (OCP) correspondence, dated June 29, 2011, Advantage Environmental Consultants, LLC (AEC) has prepared this Corrective Action Plan (CAP) Addendum which presents the final design of a dual-phase enhanced fluid recovery (EFR) system for the property located at 500 Mechanics Valley Road in North East, Maryland. A Site Vicinity Map is provided in Appendix A as Figure 1. The MDE OCP Case Number is 2011-0729-CE. The MDE Facility Identification Number is 13326. This report was prepared in accordance with the MDE OCP guidelines set forth in the Maryland Environmental Assessment Technology (MEAT) for Leaking Underground Storage Tanks (LUSTs) document, Revised February 2003.

1.2 Site Description and Previous Work History

The Site is situated in a commercial/residential area located southeast of the intersection of Mechanics Valley Road and Pulaski Highway in North East, Cecil County, Maryland. The Site is developed with a convenience store/gasoline fueling station and associated asphalt- and concrete-paved areas. The Site currently operates three fiberglass wrapped composite steel underground storage tanks (USTs) which distribute fuel to 12 product dispensers (two diesel and 10 gasoline). The system consists of the following: a 20,000 gallon unleaded regular UST, a 12,000 gallon super unleaded UST, and a 12,000 gallon diesel UST. A Site Features Map is included as Figure 2 in Appendix A. The surrounding properties include single family residences to the west, and commercial properties to the south, east and north. A Site Area Map is included as Figure 3 in Appendix A.

On June 8, 2011, AEC was performing an annual groundwater sampling event in accordance with Code of Maryland Regulations (COMAR) 26.10.02.03-04, when approximately two-inches of Liquid Phase Hydrocarbon (LPH) was detected in groundwater monitoring well MW-3. The LPH was observed to be golden in color, indicating ‘un-weathered’ gasoline. AEC inspected the submersible turbine pump (STP) containment sumps, which were observed to be free of LPH. Royal Farms was informed of the field observations made by AEC and a suspected release of petroleum was reported to the MDE on June 8, 2011. On June 13, 2011 the MDE OCP opened a case in response to a report of evidence of a petroleum spill at the Site. The exact cause of the release is still being investigated. Upon determination of the cause of the release a report will be prepared and submitted to the MDE.

Pursuant to the MDE OCP Report of Observations dated June 14, 2011, AEC performed a subsurface investigation between June 16 and 21, 2011. This investigation included the collection of soil samples from 24 boring locations (B-1 through B-24) in order to delineate the extent of hydrocarbon impact. The borings were advanced to depths ranging from 15 to 20 feet below ground surface (bgs). Temporary piezometers were installed in all but one of the borings in order to delineate the extent of LPH and dissolved-phase hydrocarbon (DPH) impact. The initial borings were advanced around MW-3 and the subsequent borings arrayed outward from MW-3. A map illustrating the soil boring/temporary piezometer locations is included as Figure 4 in Appendix A.

The temporary piezometers have been gauged daily since installation. Static groundwater was measured at depths within the temporary piezometers ranging from approximately 6.96 feet bgs in B-23 to 14.62 feet bgs in B-12. The maximum measurable LPH thicknesses were detected in the following piezometers: B-2 at a thickness of 0.81 feet on June 20, 2011; B-6 at a thickness of 1.20 feet on June 26, 2011; B-9 at a thickness of 1.40 feet on July 19, 2011; B-10 at a thickness of 1.29 feet on June 24, 2011; B-13 at a thickness of 0.55 feet on July 19, 2011; and, B-22 at a thickness of 6.91 feet on July 11, 2011. LPH sheen was observed in B-1, B-8 and B-15 on June 28, 2011. All of the other temporary piezometers did not contain LPH during any of the gauging events.

Soil samples were collected from each boring at the time of drilling activities, and groundwater samples were collected from the temporary piezometers using a disposable high-density polyethylene (HDPE) bailer between June 22 and June 24, 2011. At least 5 days elapsed between piezometers installation and sample collection. Temporary piezometers which contained LPH were not sampled.

The results of the soil sample laboratory analyses identified no detectible concentrations of benzene, toluene, ethylbenzene, total xylenes (BTEX), methyl tert-butyl ether (MTBE), Total Petroleum Hydrocarbons (TPH) Gasoline Range Organics (GRO), or TPH Diesel Range Organics (DRO) in soil samples B-3-7’, B-7-20’, B-8-13’, B-12-20’, B-17-20’, B-18-7’, B-20-20’, B-21-20’, B-22-7’, B-23-6’, and B-24-14’. BTEX, MTBE, TPH DRO and/or TPH GRO were present in soil samples B-2-7’, B-4-12’, B-5-8’, B-9-7’, B-10-6’, B-11-12’, B-12-10’, B-14-7’, B-16-7’, B-18-7’, and B-19-8’ at concentrations less than their respective MDE Non-Residential Cleanup Standards for Soil (i.e., Generic Numeric Cleanup Standards for Groundwater and Soil – Interim Final Guidance Update No. 2.1 – June, 2008). BTEX, MTBE, TPH DRO and/or TPH GRO were present in soil samples B-1-9’, B-6-8’, B-10-13’, and B-15-11’ at concentrations greater than their respective MDE Non-Residential Cleanup Standards for Soil.

The results of the groundwater sample laboratory analyses identified varying concentrations of BTEX, MTBE, naphthalene, TPH GRO, and/or TPH DRO greater than their respective MDE Cleanup Standards for Type I and Type II Aquifers in all of the groundwater samples collected from the temporary piezometers. Groundwater samples were not collected from B-3, B-19, B-21, and B-24 because they were dry at the time the groundwater sampling activities were performed. No samples were collected from B-6, B-10, B-13, and B-22 based on the presence of LPH.

Other activities conducted as part of the investigation included the following: collection and analysis of groundwater samples from the potable drinking water wells located at 463, 475, 487, 493, 505, and 513 Mechanics Valley Road; and, installation of granular activated carbon (GAC) filtration systems on the potable drinking water wells located at 505 and 513 Mechanics Valley Road.

The results of the June 14, 2011 offsite potable well sample laboratory analyses identified no detectible concentrations of Volatile Organic Compounds (VOCs) in the sample collected from 487 Mechanics Valley Road. No detectible concentrations of VOCs, with the exception of MTBE, were detected in samples collected from 493 (3.43 micrograms per liter (µg/L), 505 (89.8 µg/L), and 513 Mechanics Valley Road (82.2 µg/L). Based on the sample results, GAC filtration systems were installed at the 505 and 513 Mechanics Valley Road properties on Tuesday, July 5, 2011. Subsequent sampling of these potable wells on July 12, 2011 indicated effluent samples with no detectable VOCs concentrations.

Follow up samples were also collected from the 487 and 493 Mechanics Valley Road properties on July 12, 2011. No detectible concentrations of VOCs, with the exception of MTBE, were detected in the sample collected from the 493 Mechanics Valley Road property (3.8 µg/L). BTEX (11.2 µg/L) and MTBE (4.1 µg/L) were detected in the follow up sample collected from the 487 Mechanics Valley Road property. None of the BTEX or MTBE concentrations detected during the July 12, 2011 sampling event were greater than their respective MDE Cleanup Standards for Type I and Type II Aquifers.

The results of the June 29, 2011 offsite potable well sample laboratory analyses identified no detectible concentrations of VOCs with the exception of MTBE in samples collected from 463 (0.71 µg/L) and 475 Mechanics Valley Road (1.7 µg/L). None of the MTBE concentrations detected in samples collected during the June 29, 2011 sampling event were greater than the MDE Cleanup Standards for Type I and Type II Aquifers. No VOCs were detected in the sample collected from 10 Montgomery Drive.

This work is discussed in greater detail in the Emergency Subsurface Environmental Investigation Report, prepared by AEC and dated July 19, 2011.

Also pursuant to the MDE OCP Report of Observations dated June 14, 2011, AEC installed six groundwater recovery and five groundwater monitoring wells between July 14 and 19, 2011. This investigation included the collection of soil samples from the borings in order to delineate the extent of hydrocarbon impact. The results of the soil sample analysis have not yet been completed and will be forwarded to the MDE under separate cover. The wells were completed to depths ranging from 24 to 26 feet bgs. The wells were constructed using 4-inch outside diameter (OD) poly vinyl chloride (PVC) screen and riser. The wells were developed using surge-block and over-pumping techniques between July 21 and July 22, 2011. A map illustrating the recovery and monitoring well locations is included as Figure 2 in Appendix A.

The new recovery and monitoring wells have been gauged daily since installation. Static groundwater was measured at depths within the temporary piezometers ranging from approximately 11.54 feet bgs in RW-5 to 14.38 feet bgs in MW-6. The maximum measurable LPH thicknesses were detected in the following wells: MW-3 at a thickness of 1.75 feet on June 13, 2011; RW-1 at a thickness of 0.09 feet on July 20, 2011; and, RW-2 at a thickness of 0.30 feet on July 16, 2011. LPH sheen was observed in RW-3 on July 16, 2011. All of the other wells did not contain LPH during any of the gauging events.

AEC has conducted EFR operations via a vac-truck since June 13, 2011. The EFR is conducted using a "stinger" tube which is lowered into the wells to a depth of approximately two-feet below the static water level. The stinger tube is then sealed at the well head with a rubber Fernco boot to allow for both fluid and vapor extraction. Between June 13 and July 18, 2011 the vac-truck EFR operations were conducted on MW-3. As the recovery wells became operational between July 16 and July 19, 2011, they were added to the EFR program via a piping manifold. The vac-truck EFR operation is conducted daily for four hours. As of July 22, 2011, an estimated total of 37,538 gallons of fluid have been extracted from the Site. 701 gallons of this material is estimated to be LPH.

Based on abbreviated EFR pilot studies conducted on July 21 and 22, 2011 a CAP was prepared and submitted to the MDE on July 25, 2011. This CAP lacked some final design parameters associated with the feasibility of the technology and process/treatment equipment sizing. An additional pilot study was conducted on July 27, 2011 using equipment which enabled the necessary design data to be collected. This CAP Addendum is formatted similar to the original CAP in that it includes the revised report sections of the original CAP. Sections of the original CAP which did not change after completion of the pilot study are not included in this Addendum.

Based on the recent pilot study findings it should be recognized that the fairly high permeability of the coarse grained material below the Site presents a challenging environment for the EFR remedy. The combined water flow rate necessary for providing hydraulic control and meeting the primary remedial objective (LPH removal to a sheen) will necessitate the use of relatively large capacity process equipment for this type of Site. The EFR remedy offers a potentially viable approach to reaching the target cleanup goals in groundwater, but the time period to perform this task may extend over the course of one to two years. The EFR remedy is technically feasible but other approaches to LPH removal may offer significantly reduced time frames for completion of this task. As such, AEC is currently developing a contingency approach to LPH removal. This approach will be provided to the MDE under separate cover.

2.0 EFR PILOT STUDY

In order to collect additional design data for a scaled-up system, an EFR pilot study was conducted on recovery well RW-6 on July 27, 2011. The pilot study was conducted in two steps for a combined total of 195 minutes. During step 1 a high vacuum was induced at 2-feet below static water level for 86 minutes. During step 2 the vacuum was induced at 4.5-feet below static water level for 109 minutes.

The vacuum source consisted of a Squire Cogswel Model 110A water sealed liquid-ring pump (LRP). The pump is driven by a three phase 10-horsepower motor and capable of producing 124-standard cubic feet per minute (scfm) at its maximum achievable vacuum of 22-inches of mercury (inch-Hg). Power was supplied to the LRP skid via a 20 KVA, 3-phase mobile generator. The RW-6 well head was fitted with a down-hole "stinger-tube", well head piping, valve, and a vacuum hose. The stinger-tube was fixed to a depth of 2-feet (step 1) and 4.5-feet (step-2) below the static groundwater level. The wellhead was sealed with a rubber Fernco fitting to eliminate vacuum leaks. The fluids were piped to a 500-gallon poly tank and the vapor was discharged to the atmosphere via a 3-inch diameter stack. During the study the evacuated water was removed from the holding tank via a vac-truck and appropriately disposed as hydrocarbon impacted liquids.

During the RW-6 pilot study the following wells/piezometers were monitored for vacuum and groundwater levels: MW-3, B-2, B-1, B-9 and RW-5. Prior to and during the pilot study groundwater levels were measured in each well/piezometer using an electronic interface probe accurate to 0.01-feet. The vacuum readings were collected using magnehelic differential vacuum gauges attached to the well heads. LRP vapor discharge stack effluent air flow and quality were measured using a Dwyer Series 470 Thermal Aneometer and a MiniRAE 2000 portable Photoionization Device (PID). Groundwater flow was estimated for each step using a water flow totalizer meter installed on the LRP fluid effluent line. The measurements are provided in both tabular and graphic forms in Appendix B.

The EFR study was initiated with a vacuum of 177-inch H_2O (approximately 13-inch Hg) applied to extraction well RW-6. The initial vacuum applied to the well remained stable throughout the duration of the study. Vacuum influence readings were recorded at minimum 3-minute intervals from the vacuum monitoring points throughout the study. Field observations indicated that the vacuum influences in the observation wells generally stabilized approximately 25 minutes after step 1 was initiated and 15 minutes after step 2 was initiated. The vacuum readings in MW-3, immediately adjacent to the extraction well, showed measured vacuums as high as 56-inch H_2O and had an average vacuum of 49-inch H_2O during step 2. Recorded vacuum influence occurred in B-9 (26-feet from RW-6) but did not occur in RW-5 located 43 feet from RW-6. The vacuum readings were similar in both B-1 and B-9 although B-9 is 16-feet further from RW-6 than B-1. This response is consistent with the previously described lithology (inter connected layers and lenses of courser grained material within a generally finer grained setting). Vacuum influence versus distance for each pilot study is presented graphically in figures presented in Appendix B. As the figure demonstrates, an effective vacuum influence of 0.1-inch H_2O

may be expected at a distance of approximately 25 feet from the recovery wells with 177-inch H_2O vacuum applied.

Gauging of the wells/piezometers prior to initiation of the pilot studies and at regular intervals throughout the study indicate that the groundwater elevation decreased in all of the surrounding wells/piezometers. Groundwater levels in MW-3, immediately adjacent to the extraction well, fluctuated greatly during the study and were measured to be higher during the study than at static conditions. This is due to turbulence during measurement collection and groundwater mounding from the extraction activity in RW-6. Groundwater level decreases in wells further from RW-6 ranged from 1.22 feet in B-2 (located 9 feet from the extraction well) to 0.55 feet in RW-5 (located 43 feet from the extraction well). The lithologic affects on groundwater flow to the recovery well are also evident while comparing drawdown on wells B-1 and B-2 which are at approximately the same distance from RW-6 (10 feet). Total groundwater drawdown in B-1 (1.22 feet) is significantly greater than drawdown in B-2 (0.41 feet).

PID readings from the LRP vapor stack ranged from 917 to 712 parts per million (ppm) and showed a slightly declining trend in concentration as the study progressed. Air flow readings from the LRP vapor stack ranged from 45 to 71 scfm and showed a distinct increase in air flow as step 2 of the study progressed.

At the conclusion of step 1 of the pilot study, 323 gallons of groundwater had been recovered at an average recovery rate of 4.25 gallons per minute (gpm). Step 2 recovered 772 gallons of water at an average recovery rate of 6.77 gpm.

Based on the pilot study vacuum influence data, a radius of influence (ROI) of 25 feet has been developed. This ROI represents the anticipated distance from an extraction point where at least 0.1-inch H_2O is applied. The 0.1-inch H_2O vacuum has been determined through extensive studies to be a reasonable value concerning effective ROI for EFR and soil vapor extraction. Using the different step test flow rates an individual EFR recovery well flow rate of approximately 6 gpm for a stinger-tube depth of 4 feet below static groundwater is estimated. Using multiple recovery points with partially overlapping capture zones it is expected that between 2- to 4-feet of groundwater drawdown could be realized in the target remediation zone. The lithologic heterogeneities do influence fluid flow under EFR conditions. It is expected that the more permeable layers and lenses will contribute the bulk of the flow to the recovery total but these are also the same areas that will contain the bulk of recoverable LPH.

3.0 PLANNED REMEDIATION ACTIVITIES

3.1 Remediation Plan Summary

The remediation approach proposed in this CAP Addendum is based upon data collected from the EFR pilot studies performed in July 2011, as well as site characterization investigations, review of historical well gauging/sampling data, and vac-truck EFR performance characteristics.

Based on the presence of LPH, in-situ chemical oxidation (ISCO), in-situ bioremediation, and air-sparging will not be effective means of remediation at this time. Based upon feasibility and the past effectiveness of the vac-truck EFR work, the recommended remedial approach consists of using dual-phase EFR technology to substantially remediate both soil and groundwater. Once the LPH is removed and dissolved phase levels in the source area are reduced it may be necessary to perform secondary remediation. This may entail using one of the technologies mentioned above. If the secondary remediation is necessary, pilot studies will be conducted and this CAP will be amended.

The results of the EFR pilot study performed from the recovery points indicate that EFR would effectively remove LPH, dissolved phase hydrocarbon (DPH) and absorbed phase hydrocarbon (APH) from the subsurface. By mitigating the hydrocarbon presence and achieving hydraulic control over the remediation zone, the future impact to downgradient receptors should be reduced. Secondarily, the significant vacuum influence observed during the EFR test, as well as the recorded air flow and expected mass hydrocarbon recovery rates, indicate that the application of vapor extraction via high vacuum extraction should: directly withdraw residual VPH from the soil pore spaces; mobilize sorbed phase hydrocarbons within the soil pore spaces; potentially accelerate aerobic degradation by delivering oxygen into the vadose and artificial vadose zones thereby stimulating indigenous microbiological hydrocarbon degradation in these zones; and, potentially mitigate dissolved phase hydrocarbons in groundwater through volatilization where the groundwater is not directly recovered.

3.2 Target Cleanup Zone

The dual-phase EFR system will address LPH, DPH, and APH impacted soil within the defined remediation zone illustrated on Figure 5 in Appendix A. The boundaries of this zone were developed using the monitoring and temporary piezometers which currently and historically contained LPH. The extent of the EFR application footprint dimensions is approximately 6,000-square feet. To establish hydraulic control of the remediation zone in relation to the capture zone dimensions, the addition of four EFR wells will be required. This is in addition to the four existing recovery wells (RW-1 RW-3, RW-4 and RW-6). The existing wells and the proposed EFR wells are identified on Figure 5 in Appendix A. Additional EFR wells will be installed if cleanup criteria are not achieved or, if during well installation procedures, additional LPH areas are identified.

4.0 REMEDIATION SYSTEM DESIGN

4.1 Remediation System Design Summary

The proposed remediation system is designed to recover APH from subsurface soils and remove DPH and LPH from extracted groundwater via vertical recovery wells. By depressing the groundwater table, additional soils are exposed to soil vapor extraction. By using EFR, both liquid and vapor phase recovery should be maximized. The remediation system will be designed to treat recovered groundwater at a rate of 85 gpm and vapors at a rate of 740 cfm. Pilot studies have indicated that a recovery well flow rate of 6 gpm fluids and 60 cfm vapors is adequate in depressing the water table for effective EFR operation. The proposed number of recovery wells is eight which equates to a system flow rate of 48 gpm fluids and 480 cfm which is within the capacity of the system design flow rates.

System equipment will be stationed to the east of the Site building at the southeastern corner of the Site property (equipment compound). The system control panel and electrical panel will be mounted on the outside of the system building. The interior of the system building will house a liquid ring dual phase extraction pump, phase separation tanks, an oil-water separator and air-stripper for LPH and dissolved phase hydrocarbon removal, a poly sump, two fluid transfer pumps, two activated carbon canisters connected in series for final groundwater treatment, and a flow totalizer to record total volume of groundwater treated. The equipment and wiring in the treatment room is rated for explosive environments. The exterior of the equipment compound will contain a catalytic oxidation unit for vapor treatment, and two activated carbon canisters connected in series for contingency vapor treatment.

Total fluids and soil vapors will be extracted from the eight vertical extraction wells by a skid-mounted liquid ring vacuum pump. Extracted fluids and vapors from the recovery wells will pass through primary and secondary vapor knock-out tanks for separation of recovered liquid and vapor phases. Separated liquids will be directed to an oil-water separator for LPH removal via a transfer pump then to an air stripper for groundwater stripping. The LPH will be directed to a storage tank for collection, and the stripped water will be directed through two carbon vessels connected in series for final polishing prior to discharge. Should the air pressure from the stripper blower fall below a set-point (i.e. the blower is not operating), or should a high liquid level condition occur, an electrical relay into the system control panel will read an alarm condition and will shut power off for all system components and indicate an alarm condition.

The integrated transfer sumps in the oil/water separator and air stripper are equipped with a high level alarm switch and a level differential control switch. When the water level in the sump reaches a set level, the level differential control switch becomes activated and signals the control panel to actuate the transfer pumps. The air stream from the liquid ring pump will be routed for treatment by a catalytic oxidation unit for off-gas control. A fail safe control device will be installed within the catalytic oxidation unit so that should an operating fault occur within the oxidation unit, the system control panel will disable the recovery and treatment process. This will ensure that untreated vapors do not escape into the atmosphere. The air stripper off-gases will be temporarily treated using vapor phase carbon then discharged directly into the air. During remote startup procedures the vapor stream will be temporarily directed through the vapor phase carbon vessels. Items concerning discharge streams and allowable emissions are discussed under the permitting section of this CAP. System drawings illustrating the piping and instrumentation are supplied as Figure 6 in Appendix A.

4.2 Equipment Information and Specifications

The following sections provide information about each major component of the remedial system. Equipment summaries are supplied that detail the equipment functions, operations, and the suggested supplier and/or manufacturer information. Equipment manufacturer and model numbers are supplied only as reference. Equipment of equal operations and capacities manufactured by others may be substituted.

4.2.1 System Control Panel & Logic Components

The control panel contains the logic and drive components for the remedial equipment. The control panel will control operation of the transfer pumps, the liquid ring pump, and the air stripper blower, including motor starters. Each motor starter will be equipped with thermal protection. Logic components will be required as follows:

1) Transfer pump on/off liquid differential float switches will be installed within the knock-out tanks, poly transfer sump, oil-water separator and air stripper sumps. Each transfer pump will be able to be controlled by hand/off/auto switches at the control panel.

2) High level alarm floats will be installed within the knock-out tanks, oil-water separator, poly transfer sump, LPH holding tank, and air stripper sump. When a high alarm condition occurs, the control panel will disable operations to the liquid ring pump and the transfer pumps.

3) The air stripper will be equipped by the manufacturer with either a low air flow switch and/or a low pressure switch. When an alarm condition signifying the air stripper air flow conditions are not being met, the control panel will disable the liquid ring and transfer pumps.

4) The common line serving the liquid phase carbon vessel series will be equipped with a high pressure switch. The set point of the high pressure switch will be dependent upon the design pressure allowed by the carbon vessels installed. When a high pressure condition occurs at the carbon treatment, the control panel will disable the system.

5) The knock-out tanks will be equipped with a low level float switch. The low level float switch ensures that an adequate seal-water supply is available for the liquid ring pump. Should a low level alarm occur, the control panel will disable the liquid ring pump.

6) The catalytic oxidation unit will be provided with an independent control panel. The independent control panel for the oxidation unit will contain alarm output terminals signifying low/high air flow conditions and operating temperature faults. Wiring from the oxidation unit to the control panel will be installed so that the system control panel may disable the liquid ring pump should the oxidation unit shut down.

The controls will also include a telemetry system with eight analog inputs and four digital outputs. The system will have an integrated data logger and a surge suppression system. The telemetry controls will be capable of remote startup and shutdown operations and real time operations monitoring.

4.2.2 Liquid Ring Vacuum/Knock-Out Tanks and Transfer Pump

Dual phase extraction (liquid and vapor) from the vertical wells will be performed using a Model TRSC 125-1250 Travaini Liquid Ring Vacuum Pump. The vacuum pump, knock-out tanks and transfer pump are package supplied and skid mounted. The liquid ring pump is equipped with a 50 HP, 230/460/3/60 Class I, Group D, explosion proof motor. The liquid ring pump should be capable of providing an air flow rate of 740 acfm at up to 20 inches of mercury applied vacuum.

4.2.3 Oil-Water Separator and Low Profile Air Stripper

The oil-water separator and low profile air stripper are manufactured by MKE Inc. (Model C85 Coalescing Oil/Water Separator and Model LP150-3 Low Profile Cascade Air Stripper, respectively). Influent from the air/water separator (knock-out tank) is evacuated via a transfer pump and flows into the inlet of the oil-water separator through a diffusion baffle. The influent then passes through a cross corrugated coalescing media and product skimming weir. A rotary pipe skimmer collects separated floating product which gravity feeds into a 500-gallon capacity storage tank. The equipment is equipped with a low, high, and high-high level alarm switches as necessary.

Separated water is directed to the air stripper via a transfer pump. The air stripper consists of three trays fitted with nylon tube aerators and a 7.5 hp aluminum blower. The equipment is equipped with a low, high, and high-high level alarm switches. The flow rates of the oil-water separator and low profile air stripper are rated for 85 and 150 gpm, respectively. The oil-water separator portion of the system will be vented. Groundwater is evacuated from the air stripper sump by a system transfer pump. The air stripper will be equipped with a low flow pressure switch to shut down the system in the event of stripper blower malfunction.

4.2.4 Groundwater Carbon Polishing

The air stripper transfer pump evacuates treated groundwater collected in the air stripper sump through the carbon vessels for final treatment before discharge. Granular activated carbon vessels will be connected in a series of two for final polishing prior to discharge. The carbon treatment line will be capable of treating 85 gpm. A high pressure switch will be installed.

4.2.5 Catalytic Oxidation Unit

The catalytic oxidation unit will be a MKE Model 500E electric oxidizer. The unit has a design flow rate of 500 cfm. The thermal oxidation unit installed at the site will have the following options: skid mounted; equipped with an independent control panel with alarm output terminals to be wired to the system control panel; a flame arrestor; and, a minimum stack height of 12 feet above ground surface. The unit will be supplied with an air-water separator knock-out tank to minimize condensed fluids from entering the burner or vapor phase carbon canisters. The vapor treatment line will also include two vapor phase carbon canisters (model VF-400) for odor control and vapor capture when the oxidizer is off and during remote restart conditions.

4.2.6 Remediation System Compound

The remediation equipment will be stored within an 8.5 foot wide by 28 foot long by 9 foot high fully insulated aluminum/steel enclosure. The enclosure will be rated for explosive environments (explosion proof or XP). Lockable access ways will be installed on the enclosure. The oxidizer and vapor phase carbon canisters will be stored outside of the enclosure. A privacy fence will be erected surrounding the remedial compound to prevent access and tampering by unauthorized individuals and aesthetic purposes.

4.2.7 Ancillary Items

Other items to be installed with the remediation system include electric service, electrical components, plumbing, and valves. The remediation system will be supplied with an independent 200 amp, three phase electric service/panel and meter. The interior of the enclosure will be equipped with an XP heater and thermostat, an XP ventilation fan, a XP lighting fixture, and XP switches or receptacles for each motor. XP wiring will be within rigid conduit/seal-offs, or as applicable according to local fire codes. All motors/pump equipment will be installed so that the equipment may be easily pulled for servicing (i.e. flexible hanger couplings).

The recovery lines from the wells will be manifolded into a common line. All plumbing will be performed so that 'quick connect' type fittings are installed prior to and after each equipment item. Piping will be standard schedule 40 PVC. Elbows and couplings will be pressure type fittings.

4.2.8 Subsurface Piping &Trenching

Subsurface recovery piping will be installed to eight recovery wells shown on Figure 7 in Appendix A. Road grade vaults will be installed over each recovery well. The depth of the trenching will be 35 inches. Two-inch schedule 40 PVC piping will be inserted into each recovery well (stinger tube) and connected to the well head with a sanitary seal. A flow adjustment valve will be attached to each stinger tube inside the well vault. The sanitary seal will also have an ambient relief fitting with a valve inside the well vault. The stinger tube depths will be adjustable and are expected to be set at approximately 2- to 4-feet below static water levels. Two-inch schedule 40 PVC recovery piping will be used to connect each well head to 3-inch diameter schedule 40 PVC header lines. It is anticipated that two to four recovery wells will be connected to each of two header lines. The two header lines will be connected to a 4-inch schedule 40 PVC trunk line. All underground piping will be emplaced within the trenching with a minimum of 30 inches of cover. All piping connections will be accomplished using primed and glued pressure couplings. The piping will be set in a bed of 10 inches of pea gravel (4 inches below and 6 inches above). Native soils may be backfilled into the trench in 6- to 8-inch lifts and compacted. The remainder of the trench will be completed by placing 3- to 4-inches of stone as sub base and four inches of finished asphalt to the surface. Trenching and well vault details are shown on Figure 8 in Appendix A.

APPENDIX A

FIGURES

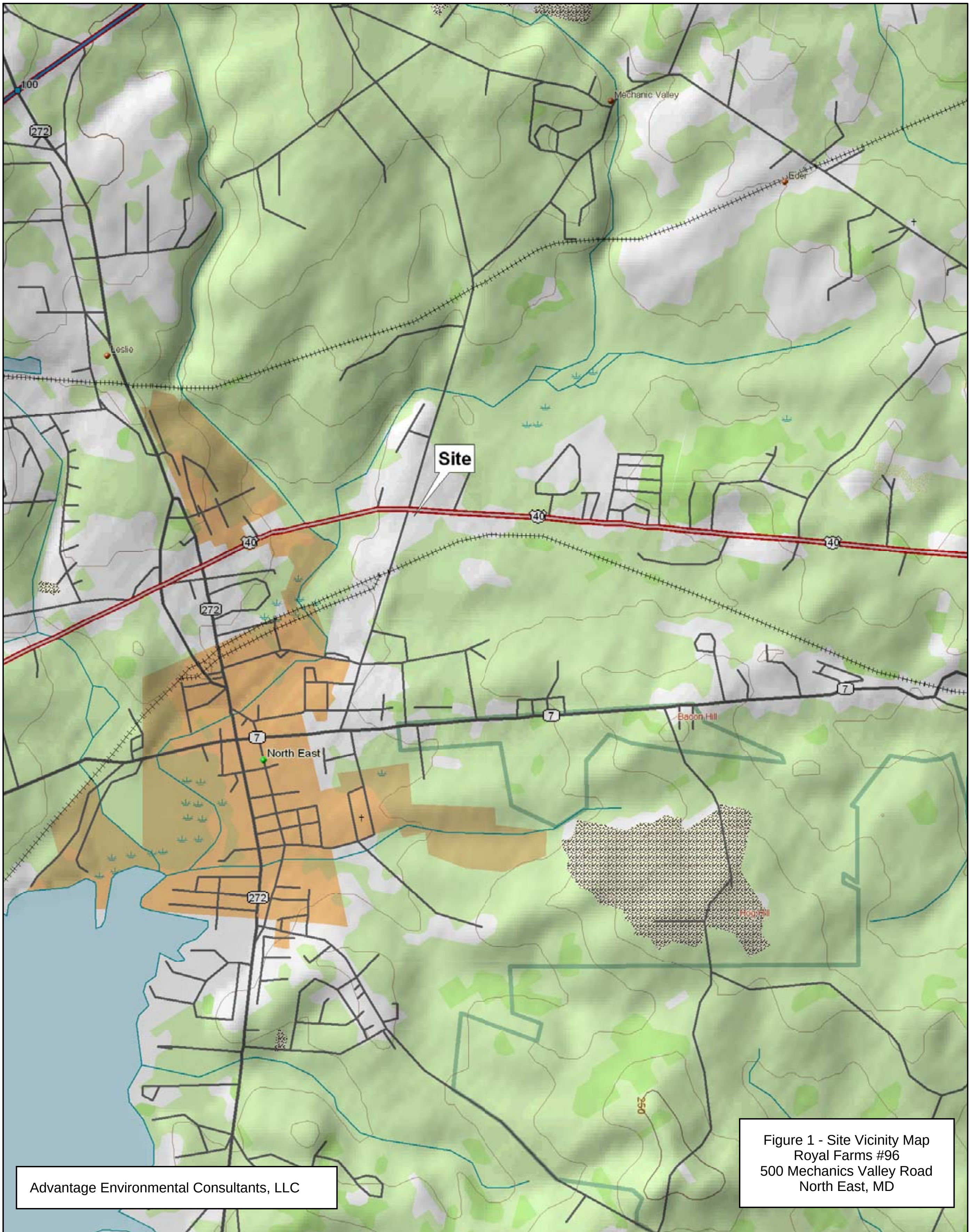
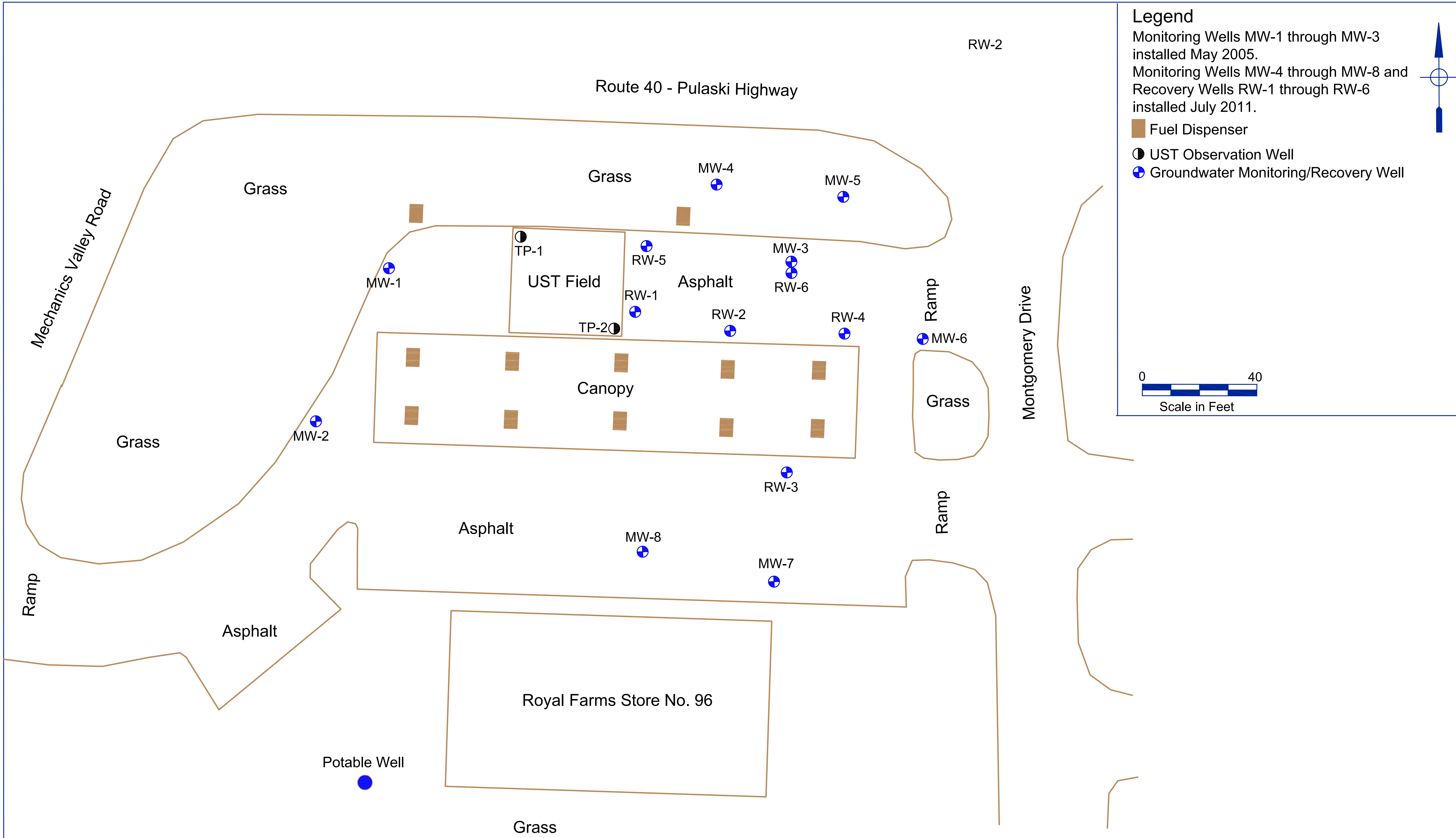


Figure 1 - Site Vicinity Map
Royal Farms #96
500 Mechanics Valley Road
North East, MD

Zoom Level: 12-7 Datum: WGS84

TN
MN
11.7°W



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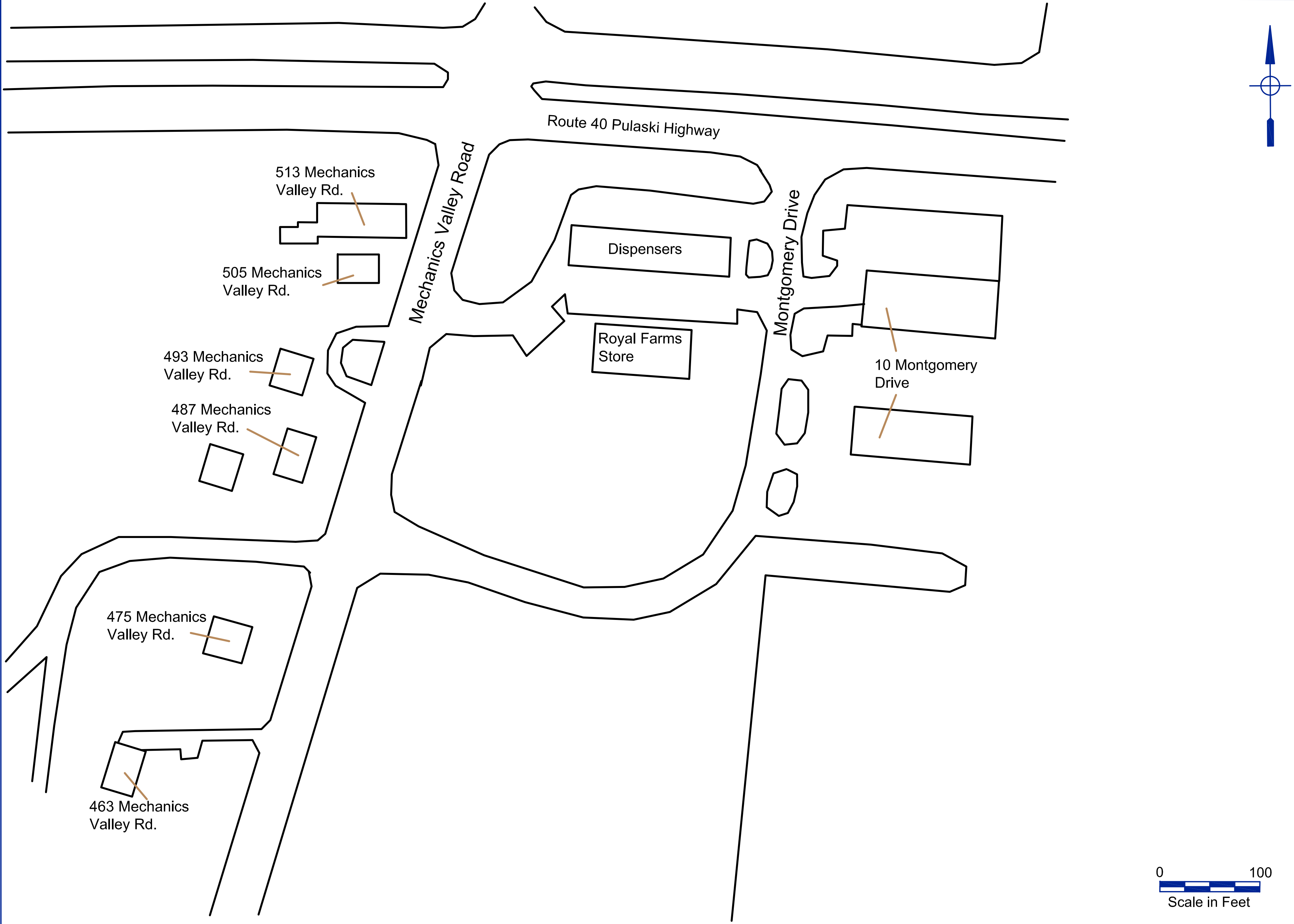
Project No.: 05-056	Drawn by: JSS
Task No.: RF96	Date: 6-22-11
File: Site Features	Revision No.: 1

Figure 2 - Site Features Map
Royal Farms No. 96
500 Mechanics Valley Road
North East, MD



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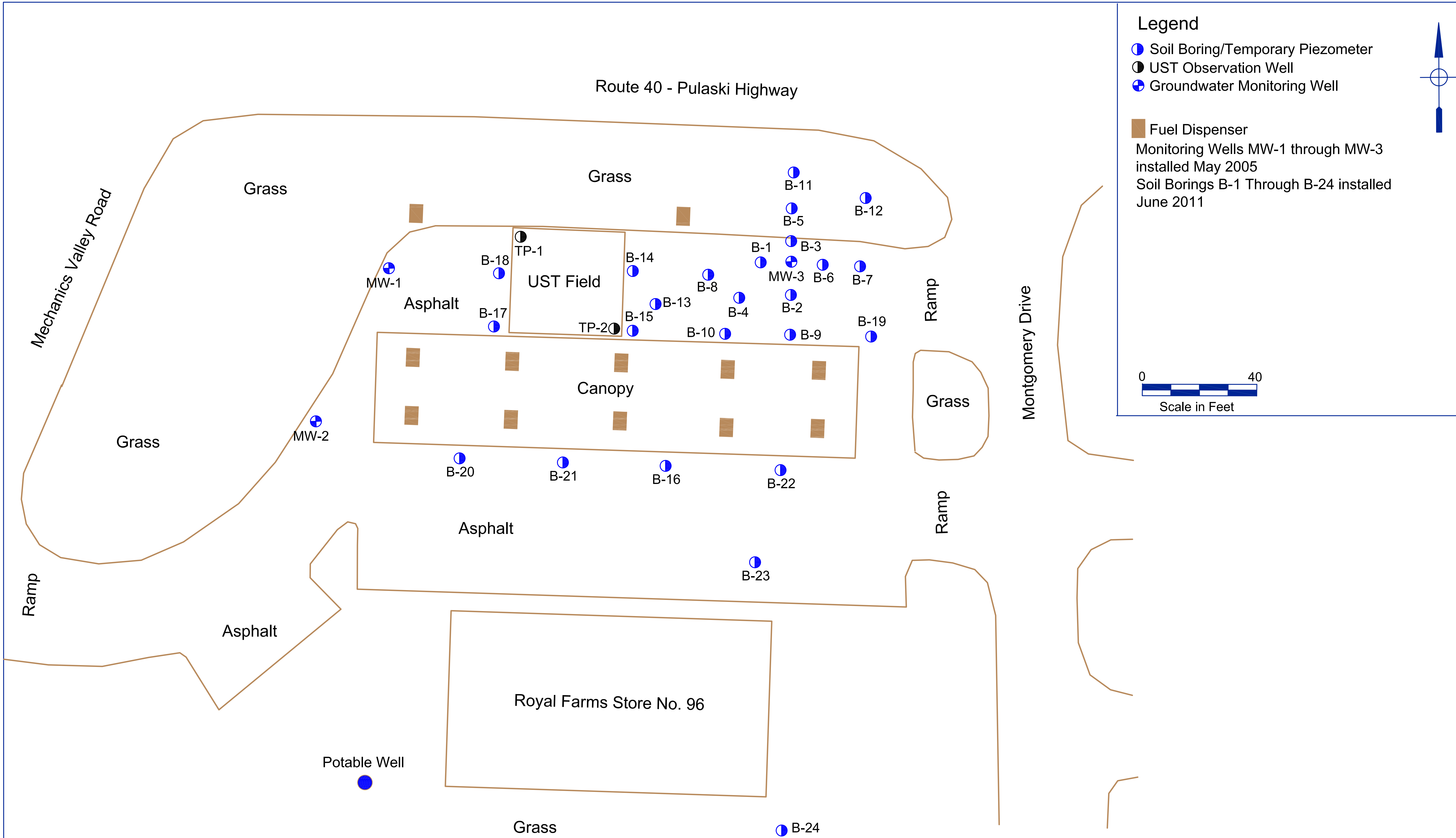
Project No.: 05-056	Drawn by: JSS
Task No.: RF96	Date:7-14-11
File: Site Area	Revision No.: 1

Figure 3 - Site Area Map
Royal Farms No. 96
500 Mechanics Valley Road
North East, MD



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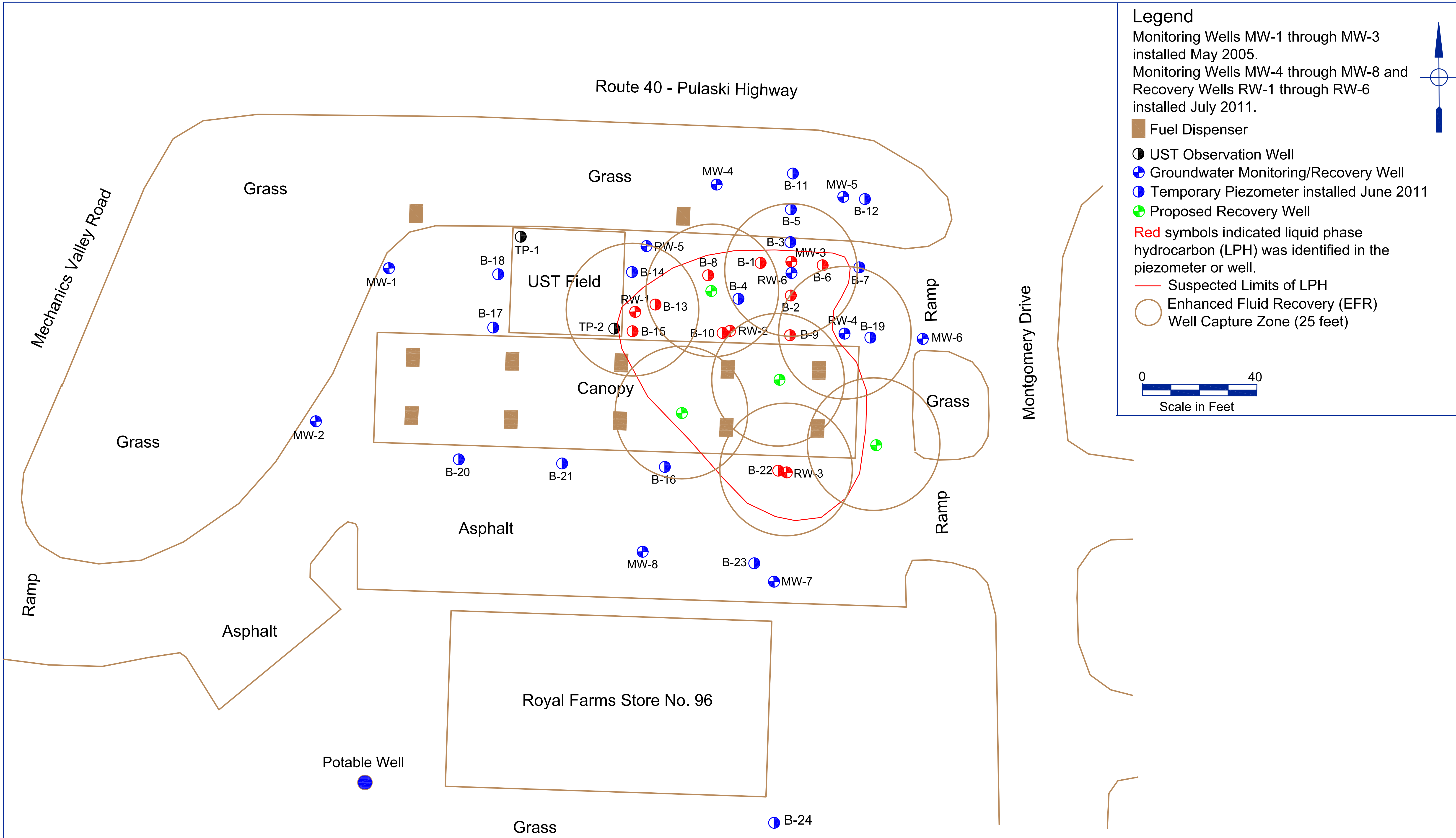
Project No.: 05-056	Drawn by: JSS
Task No.: RF96	Date: 6-27-11
File:	Revision No.: 1

Figure 4 - Boring/Temporary Piezometer Location Map
Royal Farms No. 96
500 Mechanics Valley Road
North East, MD



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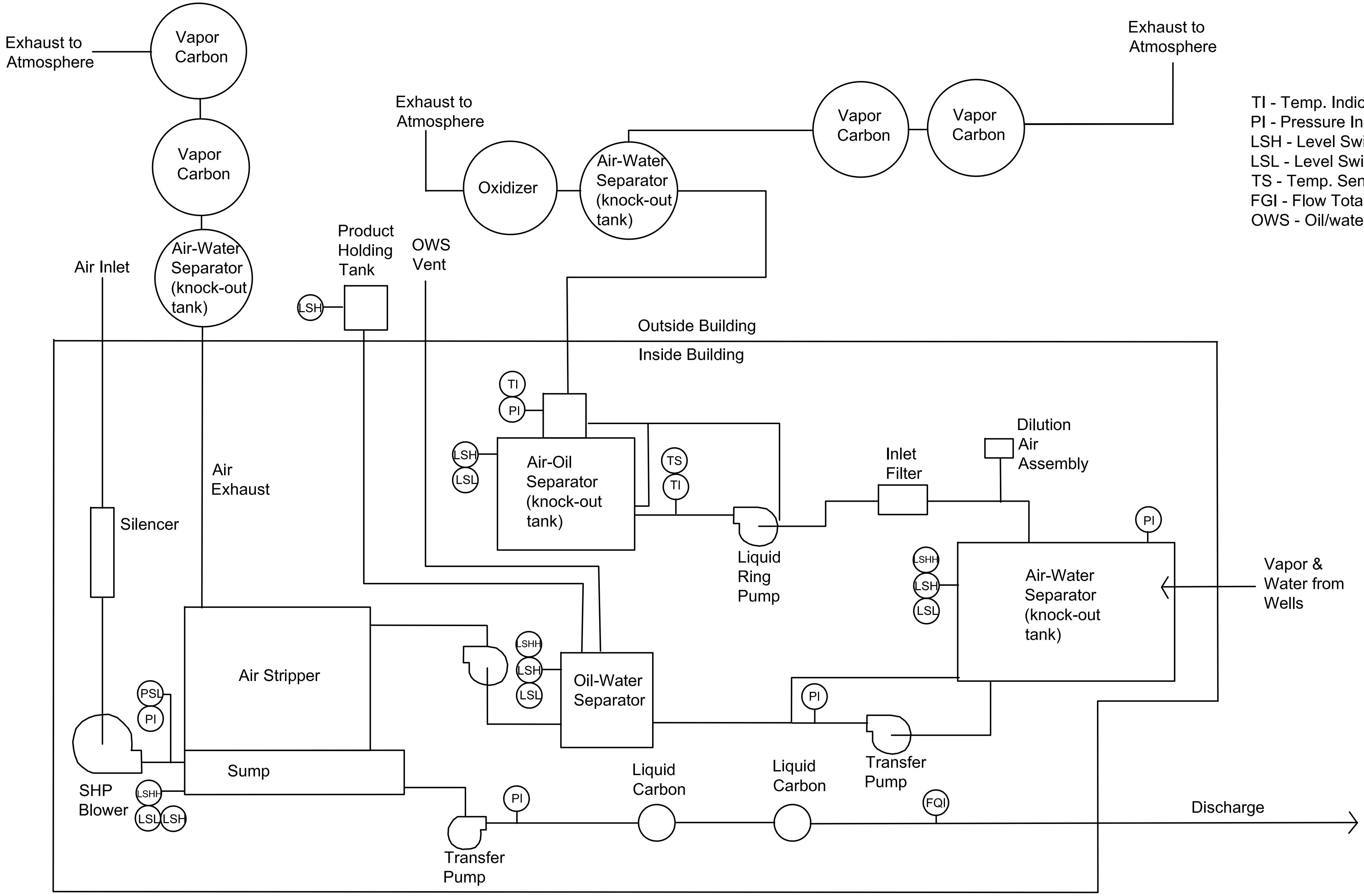
Project No.: 05-056	Drawn by: JSS
Task No.: RF96	Date: 8-2-11
File: Remed Zone	Revision No.: 1

Figure 5 - Proposed Remediation Zone Map
Royal Farms No. 96
500 Mechanics Valley Road
North East, MD



TI - Temp. Indicator
PI - Pressure Indicator
LSH - Level Switch High
LSL - Level Switch Low
TS - Temp. Sensor
FGI - Flow Totalizor
OWS - Oil/water Separator

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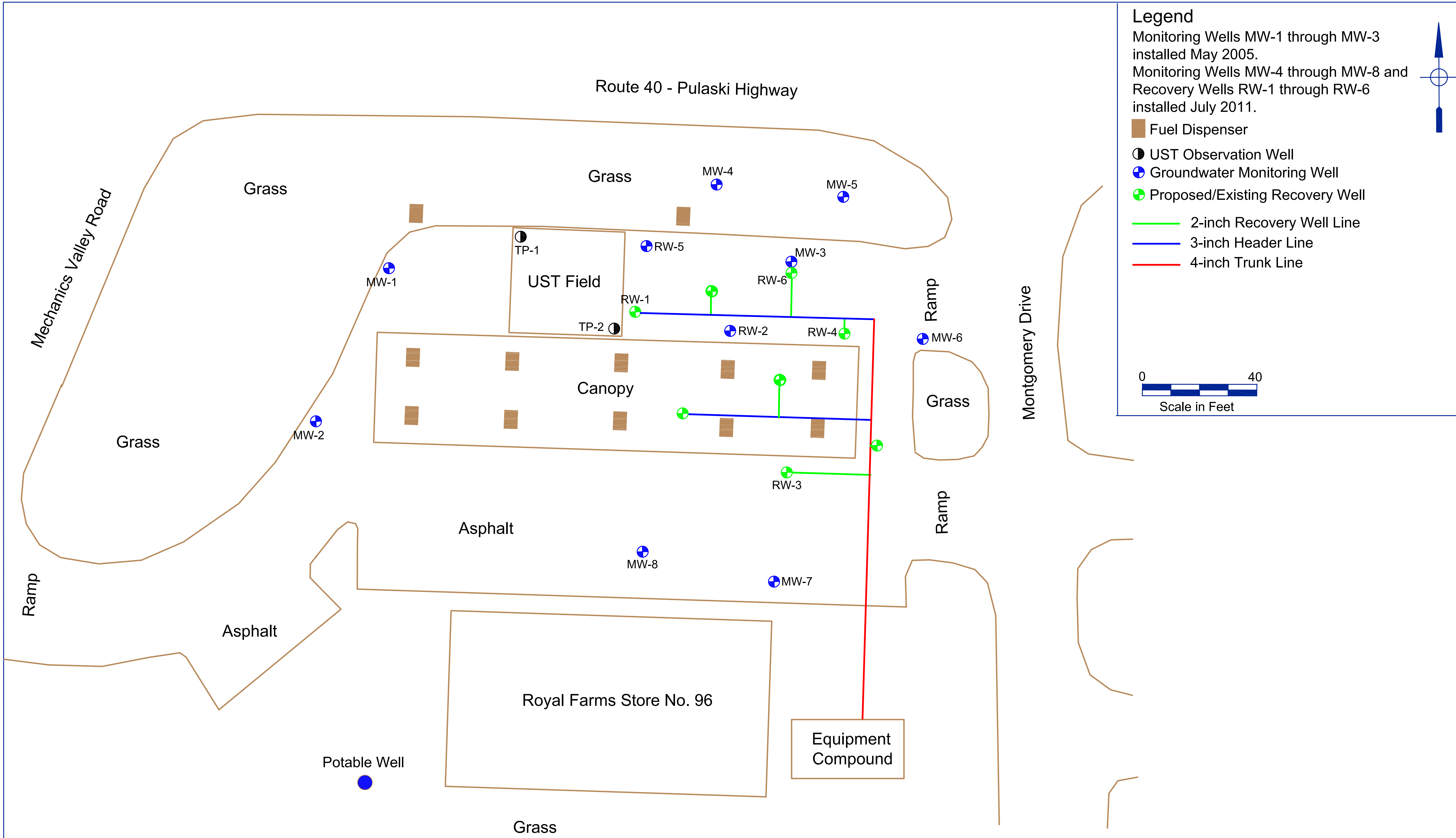
Drawn by: JSS	Checked by: JSS
Date: 8-2-11	Revision: First

Figure 6 - Process & Instrumentation Diagram
Royal Farms No. 96
500 Mechanics Valley Road
North East, Maryland



Project No.: 05-056	Drawn by: JSS	Figure 7 - Proposed Trench Configuration Map Royal Farms No. 96 500 Mechanics Valley Road North East, MD
Task No.: RF96	Date: 8-2-11	
File: Line Map	Revision No.: 1	

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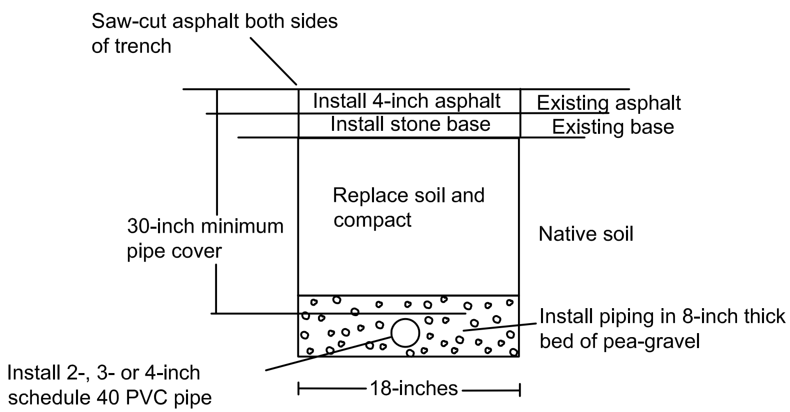
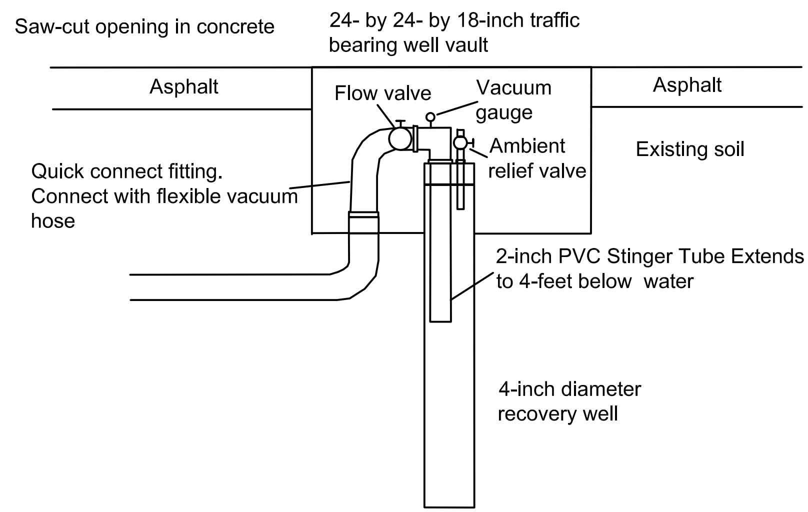
Trench Section (Typical)



Well Head Set Up (Typical)



Advantage Environmental Consultants, LLC 8610 Washington Boulavard, Suite 217 Jessup, Maryland 20794 301-776-0500	Drawn by: JSS	Checked by: JSS	Figure 8 - Vault and Trench Details Royal Farms No. 96 500 Mechanics Valley Road North East, Maryland
	Date: 8-2-11	Revision: First	

APPENDIX B

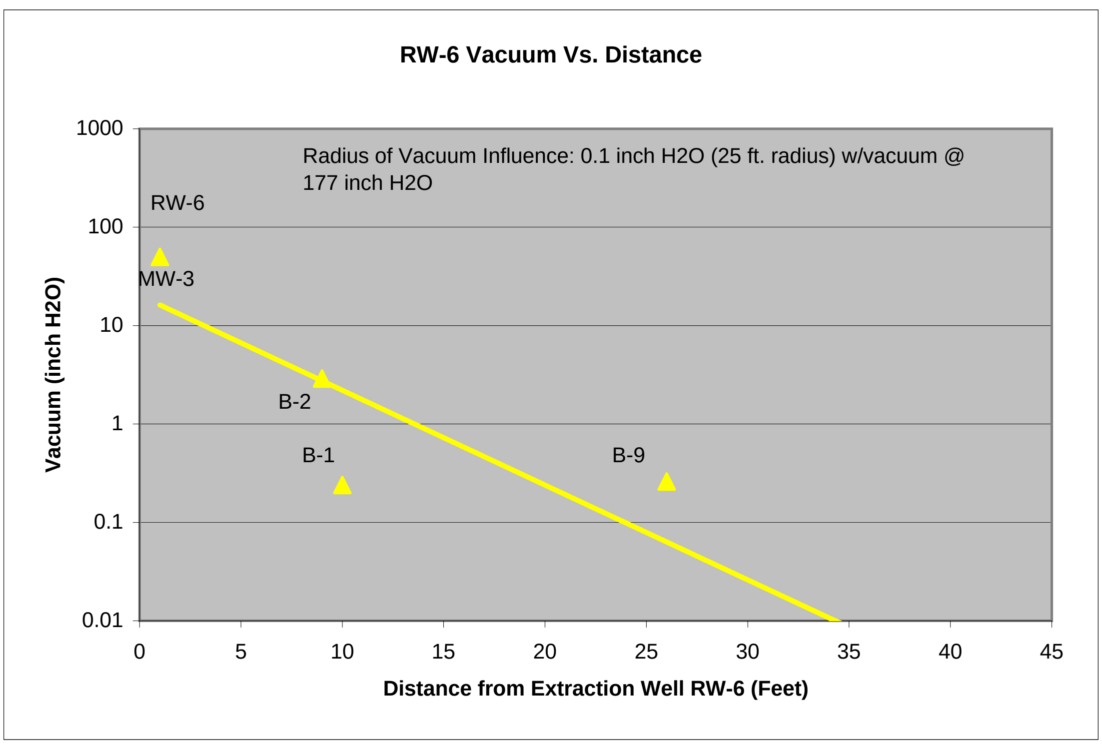
EFR PILOT STUDY DATA

Royal Farms Store No. 96
RW-6 Enhanced Fluid Recovery Test
Test Conducted 7-27-2011

Distance in feet is measured from RW-6 (Extraction Well).

Vacuum Readings (Inch H2O)

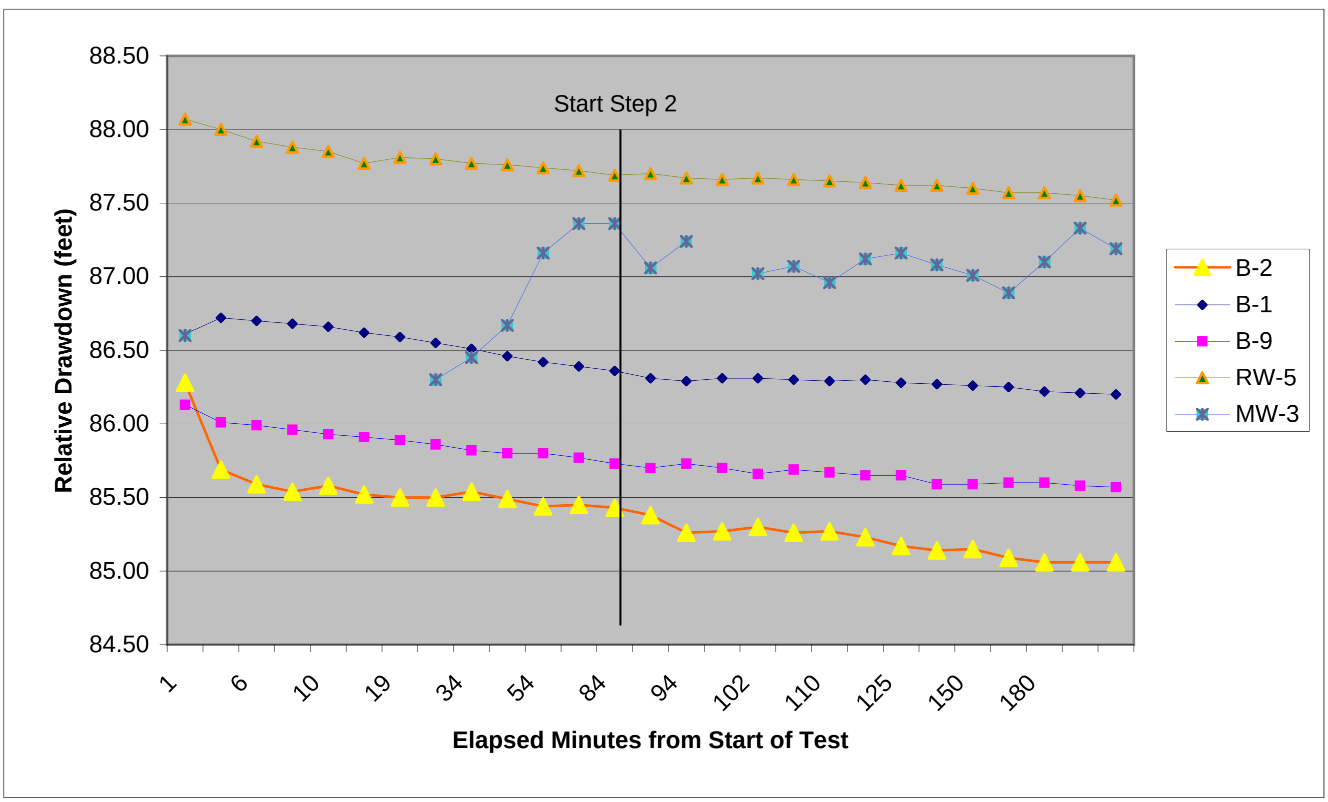
Time (min)	RW-6	MW-3	B-2	B-1	B-9	RW-5
1	177	NM	2.00	0.00	0.10	0.00
3	177	NM	3.30	0.14	0.16	0.00
6	177	NM	3.50	0.16	0.20	0.00
8	177	NM	3.50	0.22	0.22	0.00
10	177	NM	3.60	0.28	0.26	0.00
12	177	NM	3.50	0.28	0.16	0.00
19	177	50.00	3.50	0.28	0.22	0.00
24	177	56.00	2.90	0.20	0.22	0.00
34	177	44.00	3.00	0.26	0.20	0.00
44	177	NM	3.00	0.24	0.36	0.00
54	177	50.00	3.00	0.26	0.22	0.00
69	177	48.00	3.00	0.26	0.20	0.00
84	177	NM	2.50	0.22	0.26	0.00
Start Step 2						
92	177	NM	2.50	0.26	0.22	0.00
94	177	NM	2.60	0.28	0.22	0.00
97	177	52.00	2.70	0.20	0.20	0.00
102	177	48.00	3.10	0.22	0.20	0.00
108	177	48.00	2.90	0.22	0.20	0.00
110	177	NM	2.70	0.22	0.16	0.00
115	177	50.00	2.80	0.22	0.30	0.00
125	177	48.00	3.00	0.30	0.20	0.00
135	177	50.00	2.80	0.24	0.22	0.00
150	177	50.00	3.00	0.30	0.20	0.00
165	177	50.00	2.70	0.24	0.26	0.00
180	177	50.00	2.80	0.30	0.30	0.00
195	177	50.00	2.90	0.24	0.26	0.00
Average (Step 2)		49.60	2.81	0.25	0.23	0.00
Distance from RW-6		1	9	10	26	43



Depth to Water Measurements in Feet

Time (min)	MW-3	B-2	B-1	B-9	RW-5
Static	13.40	13.72	13.39	13.87	11.93
1	ND	14.31	13.28	13.99	12.00
3	ND	14.41	13.30	14.01	12.08
6	ND	14.46	13.32	14.04	12.12
8	ND	14.42	13.34	14.07	12.15
10	ND	14.48	13.38	14.09	12.23
12	ND	14.50	13.41	14.11	12.19
19	13.70	14.50	13.45	14.14	12.20
24	13.55	14.46	13.49	14.18	12.23
34	13.33	14.51	13.54	14.20	12.24
44	12.84	14.56	13.58	14.20	12.26
54	12.64	14.55	13.61	14.23	12.28
69	12.64	14.57	13.64	14.27	12.31
84	12.94	14.62	13.69	14.30	12.30
92	12.76	14.74	13.71	14.27	12.33
94	ND	14.73	13.69	14.30	12.34
97	12.98	14.70	13.69	14.34	12.33
102	12.93	14.74	13.70	14.31	12.34
108	13.04	14.73	13.71	14.33	12.35
110	12.88	14.77	13.70	14.35	12.36
115	12.84	14.83	13.72	14.35	12.38
125	12.92	14.86	13.73	14.41	12.38
135	12.99	14.85	13.74	14.41	12.40
150	13.11	14.91	13.75	14.40	12.43
165	12.90	14.94	13.78	14.40	12.43
180	12.67	14.94	13.79	14.42	12.45
195	12.81	14.94	13.80	14.43	12.48
Distance	1	9	10	26	43
Drawdown	-0.59	1.22	0.41	0.56	0.55

Distance is measured from RW-6 (Extraction Well). Distance and drawdown measurements in feet. ND - No data.



LRP and Effluent Stack Measurements

Elapsed Time (min)	Air Flow (cfm)	PID (PPM)	Vac (in-H2O)
Step 1			
15	46.00	860.00	177.00
22	63.00	917.00	177.00
27	55.00	810.00	177.00
34	45.00	776.00	177.00
44	47.00	720.00	177.00
54	54.00	827.00	177.00
74	56.00	722.00	177.00
Step 1 flow rate - 4.25 gpm			
Step 2 starts at 86 minutes			
88	55.00	771.00	177.00
97	59.00	722.00	177.00
102	62.00	725.00	177.00
108	59.00	728.00	177.00
110	69.00	723.00	177.00
115	59.00	712.00	177.00
125	51.00	706.00	177.00
135	55.00	729.00	177.00
150	69.00	960.00	177.00
165	71.00	720.00	177.00
180	70.00	713.00	177.00
195	65.00	742.00	177.00
Step 2 flow rate - 6.77 gpm			

cfm - cubic feet per minute
PPM - Parts per Million
gpm - gallons per minute