51778

AECOM

CD Scanned
PM Copy

AECOM
10 Patewood Drive
Building 6, Suite 500
Greenville, SC 29615

T (864) 234-3000
F (864) 234-3069

October 13, 2017

RECEIVED
OCT 16 2017
SITE ASSESSMENT, REMEDIATION & REVITALIZATION

Ms. Addie Walker
Bureau of Land and Waste Management
SC Department of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

RE: Limestone Aquifer Groundwater Assessment Work Plan
Delavan Spray Technologies Site
Bamberg, South Carolina
SCDHEC VCC Number: 13-4762-RP
SCDHEC File Number: 51778
AECOM Project Number: 60314964

Dear Ms. Walker:

AECOM Technical Services, Inc. (AECOM), on behalf of United Technologies Corporation (UTC), is submitting to SCDHEC a copy of the Limestone Aquifer Groundwater Assessment Work Plan for the Delavan Spray Technologies Site in Bamberg, South Carolina. The proposed assessment activities have been prepared in response to your correspondence of June 26, 2017. A .pdf copy of the work plan is also included on the attached Compact Disk.

Please feel free to contact me if you have any questions or need additional information.

Sincerely,
AECOM Technical Services, Inc.

Walter C. Gerald

WALTER C. GERALD REGISTERED No. 146 SOUTH CAROLINA PROFESSIONAL GEOLOGIST

Walter C. Gerald, PG
Project Manager
walter.gerald@aecom.com
864-234-8925

cc: William Penn – United Technologies Corporation (1 copy via e-mail)
Kanistha Coombs – UTC Aerospace Systems (1 copy via e-mail)
Leslee Alexander – AECOM (1 copy via e-mail)
Matthew Zenker – AECOM (1 copy via e-mail)

Enclosure

99

51778

CD Scanned
PM Copy

Limestone Aquifer Groundwater Assessment Work Plan

United Technologies Corporation Delavan Spray Technologies Site 4334 Main Highway US Highway 301 South Bamberg, South Carolina

VCC 13-4762-RP

Prepared for:

United Technologies Corporation
9 Farm Springs Road - MS 101
Farmington, CT 06032

Prepared by:

AECOM Technical Services, Inc.
10 Patewood Drive
Building 6, Suite 500
Greenville, South Carolina

October 13, 2017

99

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

The Delavan Spray Technologies Site is located at 4334 Main Highway (US Highway 301 South) in the town of Bamberg, South Carolina (Figure 1). Previous assessments have documented chlorinated volatile organic compounds (VOCs) in soil and groundwater related to their historic use at the facility.

In 2014 a Remedial Investigation (RI) was completed at the site to assess soils, surface water, groundwater and vapor intrusion pathways (AECOM, July 2014). As part of the RI, a Baseline Risk Assessment (BRA) was performed to evaluate potential risks to human and ecological receptors. Based on comments received from the SC Department of Health and Environmental Control (SCDHEC) to the *RI Report* and to the subsequent *Fall 2014 Semi-Annual Groundwater Monitoring Report* (AECOM, January 2015), a Post-Remedial Investigation was conducted and a report issued (AECOM, May 2016).

In a letter, dated July 12, 2016, SCDHEC stated the following, in part:

> *…..the groundwater plume must be fully delineated. The analytical results included in the referenced report indicate PCE concentrations exceeding the MCL of 5 ug/L in all three of the newly installed wells. Therefore, further assessment must be performed. A work plan for delineation of the shallow and deep groundwater plumes should be submitted to my attention….*

A work plan for groundwater delineation was prepared in response to comments received from SCDHEC. The additional delineation activities were performed in the spring of 2017 and reported to SCDHEC in the *Groundwater Delineation Report* (AECOM, June 2017a).

Groundwater screening of the shallow aquifer (9 locations) and deeper limestone aquifer unit (10 locations) was performed as part of the delineation. Three shallow boring locations and three deeper limestone aquifer locations were converted to groundwater monitoring wells.

Based on field screening and subsequent groundwater sampling/analysis, tetrachloroethene (PCE) was detected above the United States Environmental Protection Agency (USEPA) maximum contaminant level (MCL) for drinking water in the deep limestone aquifer in forested areas south of the Delavan Site. In response to the findings of the groundwater delineation, SCDHEC again requested further delineation of groundwater quality in the deeper limestone aquifer unit (SCDHEC, June 26, 2017).

The purpose of this Limestone Groundwater Assessment Work Plan is to present the proposed approach and methods to acquire the additional environmental quality data to address SCDHEC concerns.

1.1 Groundwater Quality – Limestone Aquifer Unit

Groundwater quality has most recently been evaluated at the site and vicinity during conduct of the RI, Post-RI, and subsequent Groundwater Delineation (AECOM, July 2014, May 2016, and June 2017a, respectively). In addition, the on-going semi-annual groundwater quality monitoring program also provides useful information on the distribution and concentration of VOCs beneath the Delavan Site and vicinity.

An aerial map of the Delavan Site and vicinity is presented as Figure 2. The most recent groundwater screening locations and current network of limestone aquifer monitoring wells are illustrated on the figure. The limestone aquifer potentiometric contours from the *Spring 2017 Semi-Annual Groundwater Monitoring Report* (AECOM, June 2017b) are also illustrated on Figure 2. As shown by the equal potential lines, the groundwater elevations from the newly installed wells to the south of the Site indicate that the horizontal groundwater flow direction is to the south-southwest, which is consistent with regional topography, drainage, and findings from prior investigations conducted at the Site.

The horizontal hydraulic conductivity in the limestone aquifer unit was estimated from slug tests to be 10.7 ft/day to 161 ft/day, with a geometric mean of 63.5 ft /day. This is comparable to previous slug test results from the limestone aquifer that yielded a geometric mean hydraulic conductivity of 47.8 ft/day (AECOM, May 2016).

Prior investigations have shown that PCE has migrated from beneath the manufacturing facility downward into the deeper limestone aquifer unit. PCE concentrations exceed the USEPA MCL for drinking water in off-site down-gradient wells. Newly installed monitoring wells MW-30D and MW-31D confirmed the presence of PCE above the MCL in the limestone aquifer unit to the western boundary of the investigation area (Figure 2). Deeper aquifer monitoring wells MW-30D and MW-31D appear to be in the core of the dilute PCE plume as it moves off-Site to the southwest in deeper groundwater. The location of monitoring well MW-32DR appears to be outside of the centerline of the plume and helps to delineate it on the southern edge of the plume near the powerline right-of-way.

2.0 ADDITIONAL ASSESSMENT

The proposed additional assessment of the deeper limestone aquifer unit will help to delineate and determine the lateral extent of PCE plume migration off-Site beneath the forested land to the south / southwest of the Delavan Site.

Field data acquisition methodologies are designed to be in general accordance with the USEPA Region 4 Science and Ecosystem Support Division (SESD) Field Branches Quality System and Technical Procedures document (http://www.epa.gov/region4/sesd/fbqstp/) (most recent version). To be consistent with the RI and Post-RI, those specific field methods, analytical procedures, and quality assurance/quality control (QA/QC) procedures applicable to the scope of work will follow those presented in Section 1 (Field Sampling and Analysis) and Section 2 (Field Quality Assurance Samples) of Appendix B to the *RI Work Plan* (Hart & Hickman, August 2013).

The assessment of the deeper limestone aquifer unit will proceed in a similar manner as that outlined in the *Groundwater Delineation Work Plan* (AECOM, revised December 2016). The groundwater delineation will be conducted by first installing series of boreholes in pre-determined locations to obtain groundwater samples. The samples will be screened for site-related chlorinated VOCs (specifically PCE). This screening level information will be used guide the investigation in an effort to fully assess the occurrence of Site-related PCE in groundwater above its MCL. Once screening-level data are received and evaluated, locations will be selected for the installation of permanent groundwater monitoring wells to provide long-term monitoring of the PCE plume in the off-Site areas.

The proposed study area to the south of the Delavan Site is bounded by Main Highway (US Highway 301) to the west, Broxton Bridge Road (US Highway 601) to the east, and Lemon Creek and Orangegrove Roads (SC-S-5-41) to the south (Figure 2).

One boring is proposed to be installed on private property, contingent on obtaining the owner's written permission. However, due to the large number of private properties in the area of investigation, this work plan proposes to install all other borings and any subsequently recommended monitoring wells within the right-of-way along public roads (Lemon Creek and Orangegrove Roads [SC-S-5-41] Broxton Bridge Road [US Highway 601] and Main Highway [US Highway 301]). Should the findings dictate, other individual property owners could subsequently be contacted for permission to conduct sampling on their respective properties. However, any expansion of the assessment onto other private properties would be contingent on obtaining the owner's written permission.

The means and methods to perform the limestone aquifer groundwater assessment are presented in the following subsections.

2.1 Pre-Investigation Activities

2.1.1 Site Access

The soil borings and monitoring wells proposed for this limestone aquifer groundwater assessment will be located on properties not owned by Delavan Spray Technologies; therefore, an access agreement and highway encroachment permits will need to be negotiated between UTC and the respective property owners prior to conducting intrusive sampling activities on their properties. Should UTC have difficulties in gaining access to the off-Site properties, SCDHEC will be notified.

2.1.2 Monitoring Well Approval

A monitoring well approval letter will be obtained from SCDHEC for the anticipated subsurface drilling and sampling work. A monitoring well approval application and proposed boring/monitoring well construction details are included in Appendix A of this Work Plan. If additional borings or monitoring wells are deemed necessary based on an evaluation of the field data, SCDHEC will be contracted for authorization to install additional borings / wells to complete the assessment of the PCE plume.

2.1.3 Subsurface Utility Locating

Upon obtaining access to the public road and highway right-of-ways and prior to conducting intrusive sampling activities, the South Carolina One-Call public utility service will be contacted to mark public utilities at the site and vicinity. A private utility locator will also be contracted to confirm the one-call markings and to mark the location of potential private subsurface utilities in the areas of the proposed sampling locations.

2.2 Additional Groundwater Assessment

For the purposes of this work plan, PCE was chosen as a surrogate compound for the other chlorinated VOCs based on its occurrence and concentration in the deeper limestone aquifer unit beneath the Site and vicinity. PCE is the only Site-related compound to occur in off-Site areas at concentrations in excess of its USEPA MCL, which for PCE is 5 micrograms per liter (μg/L).

Groundwater delineation will be conducted by first installing series of boreholes to obtain groundwater samples. The groundwater samples will be analyzed by an off-site analytical laboratory with 24-hour turnaround time for PCE analysis. This information will be used to guide the investigation to further assess the occurrence of VOCs in groundwater.

Once the screening analytical data are received and evaluated, locations will be selected for the installation of permanent groundwater monitoring wells to provide long-term monitoring of the VOC plume. An estimated two to three additional Type III limestone aquifer monitoring wells (estimated to be about 50 to 75 ft deep) are proposed to be drilled and installed using sonic drilling techniques. However, other technologies may be used, if necessary, such as: direct push technology (DPT), hollow-stem auger or mud rotary drilling methods.

PCE concentrations detected during the most recent semi-annual monitoring event are illustrated on Figure 2 for the deeper limestone aquifer unit (AECOM, June 2017b). The approximate locations of the proposed boreholes, therefore, are based on likely down-gradient locations that would represent the leading edge of PCE in the deeper limestone aquifer unit.

2.2.1 Deeper Limestone Aquifer Groundwater Screening

Based on the known occurrence of PCE in groundwater from the limestone aquifer unit, as described above and illustrated on Figure 2, eight (8) screening locations were selected to assess the occurrence of PCE further to the south / southwest of the Delavan Site, beyond the locations of monitoring wells MW-30D, MW-31D, and MW-32DR where PCE exceeds the MCL in groundwater (Figure 2). Note: the groundwater screening locations are preliminary and may be adjusted based on accessibility. Furthermore, the number of locations may be reduced if results of the screening indicate that all eight locations are not needed to delineate the occurrence of PCE in the limestone aquifer.

The screening locations will be evaluated by advancing a soil boring from land surface to approximately 50 to 75 feet below land surface (bls) (GW-LS-11D through GW-LS-18D; Table 1 and Figure 2). The soils will be continuously sampled using a Geoprobe® or mini-sonic drilling rig and a continuous core sampler. The lithology of the soils will be described by an AECOM geologist. The soils will be screened in the field using a photo-ionization detector (PID) for the presence of VOCs. The soils will also be examined for visual signs of impact and any observations will be measured and recorded. Borehole drilling methods are described in further detail in Section 2.3 below.

Based on the PID field screening results, up to two groundwater screening samples will be collected from the limestone aquifer at each drilling location using an inflatable packer and screen point sampler as described in Section 2.4 below.

2.3 Borehole Drilling

For the deep limestone aquifer borings, sonic drilling techniques are expected to be used to advance each boring to the target depth (e.g., a track-mounted Geoprobe® 8140LS sonic rig, or similar). However, other technologies may be used, if necessary, such as: DPT, hollow-stem auger or mud rotary. It is expected that the sonic rig will utilize a 6-inch diameter outer casing and a 4-inch diameter inner core

barrel. Soil samples will be extruded from the inner core barrel into plastic sleeves for lithological logging and soil screening by an AECOM geologist. Pending approval by SCDHEC, a permanent surface casing will not be needed for the limestone aquifer monitoring wells if sonic techniques are used – the temporary drill casing will provide a sufficient seal for the upper surficial aquifer during drilling and subsequent well installation. Soil cuttings will be containerized in 55-gallon drums and temporarily stored on-site as investigation-derived waste (IDW) until they are profiled and disposed, as described in Section 2.14 below. Borings and/or temporary wells installed for groundwater screening will be abandoned by forced injection grouting from total depth to land surface with a non-shrink neat bentonite/cement grout.

2.4 Groundwater Screening

Groundwater screening samples will be collected using a 5-foot long stainless steel screen with an inflatable packer made up to 2-inch steel threaded pipe. The assembly will be inserted through the 6-inch sonic casing to the target sampling depth. The 5-foot long stainless steel screen will then be pushed to target depth based on the evaluation of the sonic core. The packer assembly will be inflated with an air compressor to hydraulically seal off the sample depth interval. A water level will be measured and a temporary well volume will be calculated. A small electric submersible pump will then be used to purge the groundwater.

Groundwater from the screened interval will be purged to ensure a representative sample is collected. During purging, pH, temperature, specific conductance, dissolved oxygen (DO), oxidation reduction potential (ORP), and turbidity will be measured and recorded. Purging will continue until pH, temperature, and specific conductance have stabilized to within approximately 10 percent (0.2 standard units [s.u.] for pH).

Groundwater samples collected for analysis of PCE will be kept chilled on ice to about 4 degrees Celsius under chain of custody protocol after collection. The samples will be delivered via courier to Shealy Environmental Services (Shealy), located in West Columbia, SC for analysis of PCE by USEPA Method 8260B. Shealy is a National Environmental Laboratory Accreditation Program (NELAP) accredited laboratory and State of South Carolina certified laboratory. Sample results are expected to be requested for 1-day turn-around-time.

2.5 Monitoring Well Installation

Based on the results of the screening of the soils and groundwater quality, Type III monitoring wells will be drilled and installed to depths of approximately 50 to 75 feet bls at two or three of the initial boring locations to provide long-term monitoring of the groundwater plume (Table 2). Additional information pertinent to the construction of the monitoring wells is included in Appendix A so that SCDHEC can issue a monitoring well approval letter for the proposed work.

All monitoring wells will be installed through the center of the sonic core barrel and will be constructed of 2-inch diameter Schedule 40 polyvinylchloride (PVC) casing and 10 feet of 0.010-inch machine slotted PVC screen. Filter sand will be placed into the annular space of each well to approximately two feet or more above the top of the well screens. A pelletized bentonite clay seal with a minimum thickness of two feet will be placed in the annular space above the filter sand and hydrated with potable water, as necessary. As the filter sand and bentonite clay are added, the core barrels will be pulled from the borehole to ensure the annulus is completely filled. Depths to sand and bentonite will be monitored with a weighted tape measure as the installation progresses. A neat cement-bentonite grout will then be injected from above the bentonite seal to land surface via a tremie pipe as the core barrel is pulled.

The surface completions for the Type III monitoring wells will be finished at grade within an 8-inch diameter cast-iron vault with a bolt down lid. The protective covers will be set into a two-foot by two-foot square by 6-inch thick concrete pad, which will act as a surface seal. The monitoring well construction details are illustrated in Appendix A.

2.6 Well Development

Upon installation, the groundwater monitoring wells will be developed so that they produce representative groundwater samples. The monitoring wells will be developed by AECOM personnel by surging and pumping with an electric submersible pump. Groundwater indicator parameters (e.g., pH, temperature, specific conductance, DO, ORP and turbidity) will be measured using a water quality meter and recorded on AECOM Monitoring Well Development logs. Development of monitoring wells will continue until parameters have stabilized to within approximately 10% (0.2 s.u. for pH) and the turbidity of the water is reduced as much as possible.

Purge water from well development will be containerized in 55-gallon drums and temporarily stored at a designated location at the Delavan Spray Technologies Site as IDW pending disposal.

2.7 Surveying

Following the boring (i.e., groundwater screening sample locations) and well installation, the top of casing, land surface elevations, and the horizontal locations of the borings and new monitoring wells will be surveyed by a professional land surveyor licensed in South Carolina. Horizontal locations will be reported in South Carolina State Plane Coordinates referenced to the North American Datum of 1983 (NAD-83) to the nearest 0.01 foot. Ground surface elevations and well top of casing measuring point elevations will be referenced to the North American Vertical Datum of 1988 (NAVD-88) to the nearest 0.01 foot. The survey information will be used to update summary tables and the site base map.

2.8 Water Level Measurements

The depth to water in the newly installed monitoring wells and the approved monitoring well network will be measured with an electronic water level indicator relative to the surveyed top of casing measuring point and recorded. The depth to water measurements will then be corrected to groundwater elevations to provide an evaluation of groundwater levels and flow directions across the Site and vicinity.

2.9 Groundwater Sampling

As part of the additional limestone aquifer assessment activities, groundwater samples will be collected from the newly installed monitoring wells. Groundwater samples will be collected using low flow/low stress sampling methods in accordance with the *RI Work Plan* (Hart & Hickman, August 2013) and EPA's *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures* (EPA/540/S-95/504 dated April 1996) and as described in Appendix B of the *RI Work Plan*. Groundwater sampling will be completed using a peristaltic pump and flow-through cell for field parameter measurement.

A summary of the analytes is provided below:

- The groundwater samples will be analyzed for target compound list (TCL) VOCs by USEPA Method 8260B.
- Field groundwater quality measurements of pH, conductivity, temperature, DO, ORP and turbidity will be collected from the sampled monitoring wells during the well purging process using a flow through cell.

Groundwater samples from permanent monitoring wells will be kept chilled to about 4 degrees Celsius on ice under chain-of-custody protocol until they are shipped via Federal Express to Accutest Laboratories, a NELAP-accredited laboratory and State of South Carolina certified laboratory located in Orlando, Florida. Standard turn-around-time will be requested for the definitive groundwater samples obtained from the monitoring wells installed as part of this assessment work.

The next semi-annual groundwater monitoring events are scheduled for October 2017 and April 2018. If the groundwater delineation field work outlined in this work plan coincides with a planned semi-annual sampling program, the newly installed wells will be sampled at that time. As part of the planned semi-annual effort, a site-wide round of water level measurements will also be collected from the existing wells and newly installed wells. Data from this event will be used to update groundwater potentiometric and flow maps of each aquifer unit.

2.10 Surface Water Sampling

During communications with a property owner during recent groundwater delineation activities, AECOM was informed that there was a spring on the Priester property along US HWY-301 west of the Site. At this location, the aerial photo shows a surface water body that appears to be formed from an old borrow pit and is located approximately 550 feet east of US HWY-301 (SW-001 on Figure 2). AECOM will attempt to verify this information with the property owner during any access agreement communication and initial site visits. If it is determined that the surface water body on the Presiter property is spring fed, a surface water sample will be collected to determine if VOCs from the deeper limestone aquifer unit have impacted this surface water feature. The proposed surface water sampling location is listed on Table 3 and illustrated on Figure 2.

The surface water sample will be collected directly into the sample containers, if water depth allows. Otherwise, a stainless steel dipper will be used to collect the water sample and transfer it to the sample bottles. Information pertinent to the collection of the surface water sample will be recorded on a Surface Water/Sediment Data Form. Upon collection of the surface water sample, field water quality indicator parameters of pH, conductivity, temperature, DO, OPR, and turbidity will be measured in-situ and recorded. Other sample handling procedures will follow those outlined in Appendix B of the *RI Work Plan* (Hart & Hickman, August 2013).

The surface water sample will be handled, stored and shipped in a similar manner as the groundwater samples. The surface water sample will be analyzed by Accutest laboratories for TCL VOCs by USEPA Method 8260B.

2.11 Quality Assurance/Quality Control

To provide quantitative data on the precision and accuracy of the sampling and analysis program, quality assurance and quality control (QA/QC) samples consisting of duplicate, matrix spike / matrix spike duplicate (MS/MSD), equipment blank, and trip blank samples will be collected, as detailed in Appendix B of the *RI Work Plan* (Hart & Hickman, August 2013). In summary, the QA/QC samples will be collected as specified below for the definitive surface water and groundwater samples collected from the newly installed monitoring wells:

- Duplicate – 1 duplicate sample per 20 samples.
- MS / MSD – 1 MS and 1 MSD sample per 20 samples.
- Equipment Blank – 1 equipment blank from sampling equipment (screen point sampler or dipper) for each 20 samples.
- Trip Blank – 1 trip blank for each cooler containing samples that require VOC analysis.

With the exception of trip blanks, QA/QC samples will not be collected for the groundwater screening samples collected from the temporary borings. The QA/QC samples outlined above will be collected and analyzed as part of the definitive groundwater and surface water sampling.

2.12 Slug Testing

Slug tests will be conducted on the newly installed monitoring wells in order to better estimate the range of hydrologic properties of the limestone aquifer unit. Slug tests may be conducted by two methods, falling head or rising head tests. Falling head tests will be conducted by inserting a decontaminated, solid PVC cylinder (aka, "slug") into the well; observing an immediate rise in the water level, and then monitoring the water levels as they decline downward toward the static level. Rising head tests will be conducted by removing the slug from a well; observing an immediate decline in the water level, and then and monitoring the water levels as they rise up toward the static level. Falling head slug tests will not be performed in wells with partially saturated screens.

Initially, the static water level in the well will be measured and recorded. A decontaminated pressure transducer will then be lowered at least 5 feet below the static water level (or more if the slug is greater than 5-foot long) or within one foot of the bottom of the well. The static water level will again be measured and recorded and the measurement will be repeated until water level equilibrium is verified (i.e., two equal readings taken at least 5 minutes apart). The slug will then be attached to clean, new synthetic rope. The falling head test will be initiated by instantaneously lowering the cylinder into the well, which will result in an immediate water level rise. The data logger will be activated to measure the declining (falling) water levels. When the water level has returned to static conditions, the rising head slug test will be conducted. For the rising head test, the data logger will be activated as the cylinder is instantaneously removed from the well (resulting in an immediate water level decline) and the rising water levels will be measured and recorded. Water levels will be monitored until they are within 10 percent of their original static level.

Multiple tests will be conducted on each well to ensure a representative test result.

2.13 Equipment Decontamination

Single-use, factory cleaned sampling equipment will generally be used when possible. Water interface probes will be washed with a detergent (e.g. Liqui-Nox®) and rinsed with de-ionized water (DI water) between monitoring wells. Probes used for field measurements will be rinsed with DI water between each sample location. Flow-thru cells will be rinsed with DI water between sampling locations, and thoroughly washed with detergent and DI water at the end of the day. Core barrels will be decontaminated using a high-pressure water sprayer between each boring.

If decontamination is performed in the field, rinse water will be contained. Sampling personnel will avoid contacting bailers, pumps and lines, and core barrels with the surrounding soils or unprotected hands. All

sampling equipment that have contacted any soil, unprotected hands, or anything that may contaminate the equipment will be decontaminated according to the above procedures.

2.14 IDW Management

Waste materials consisting of decontamination water, well development/purge water, and soils from drilling activities will be designated as IDW. Personal protective equipment will be consolidated and be disposed daily as non-hazardous solid waste in municipal trash collection containers.

Soil and groundwater IDW will be containerized in Department of Transportation (DOT) compliant 55-gallon steel drums, labeled, and temporarily staged at a designated location on the Delavan Spray Technologies Site until receipt of characterization analysis. For characterization and disposal purposes, drums of IDW soil will be sampled for Toxicity Characteristic Leaching Procedure (TCLP) VOCs, TCLP semi-volatile organic compounds (SVOCs), and TCLP Priority Pollutant Metals (or analytes required by the disposal facility). Drums of IDW decontamination water will be sampled for VOCs. Drums of well development/purge water will be characterized using sampling results from the monitoring wells.

Following receipt of IDW characterization and monitoring well groundwater sampling data, Delavan facility personnel will coordinate the profiling and disposal of the IDW materials by a licensed disposal transporter/facility.

3.0 LIMESTONE AQUIFER GROUNDWATER ASSESSMENT REPORT

After completion of the field activities and receipt of the analytical data, a brief report will be prepared. The report will include a summary and evaluation of the current assessment activities conducted to determine the extent of chlorinated VOCs (e.g., PCE) in the deeper limestone aquifer unit downgradient of the Delavan Spray Technologies Site. Specifically, the report will include a description of the soil boring and field screening procedures and results. The monitoring well drilling, installation and development procedures will also be presented. Soil boring and monitoring well construction details will be included in an appendix to the report along with laboratory analytical data reports.

To provide a comprehensive overview in the deeper limestone aquifer zone in the Site vicinity, groundwater elevation data from the newly installed and existing deep limestone aquifer monitoring wells will be used to generate a potentiometric map of the aquifer units. From this information, groundwater flow lines can be inferred.

The groundwater quality data generated during the assessment activities will be validated and tabular summaries prepared for the water quality and QA/QC data. To provide an evaluation of the distribution and occurrence of PCE at the site and vicinity, the water quality data will also be posted to an iso-concentration contour map. This map will be compiled using the data from the most recent semi-annual groundwater quality monitoring event (e.g., Fall 2017 or Spring 2018) and the newly acquired data generated during the groundwater assessment activities.

Pertinent conclusions and/or recommendations will be developed based on the evaluation of the potentiometric and groundwater quality data.

4.0 REFERENCES

AECOM, July 2014, *Remedial Investigation Report*, United Technologies Corporation, Delavan Spray Technologies Site, 4334 Main Highway, US Highway 301 South, Bamberg, South Carolina, VCC 12-4762-RP.

AECOM, January 2015, *Fall 2014 Semi-Annual Groundwater Monitoring Report*, Delavan Spray Technologies Site, Bamberg, South Carolina.

AECOM, May 2016, *Post-Remedial Investigation Report*, United Technologies Corporation, Delavan Spray Technologies Site, 4334 Main Highway, US Highway301 South, Bamberg, South Carolina, VCC 12-4762-RP.

AECOM, Revised December 2016. *Groundwater Delineation Work Plan,* Delavan Spray Technologies Site, Bamberg, South Carolina.

AECOM, June 2017a, *Groundwater Delineation Report*, United Technologies Corporation, Delavan Spray Technologies Site, 4334 Main Highway, US Highway301 South, Bamberg, South Carolina, VCC 12-4762-RP.

AECOM, June 2017b, *Spring 2017 Semi-Annual Groundwater Monitoring Report*, United Technologies Corporation, Delavan Spray Technologies Site, 4334 Main Highway, US Highway301 South, Bamberg, South Carolina, VCC 12-4762-RP.

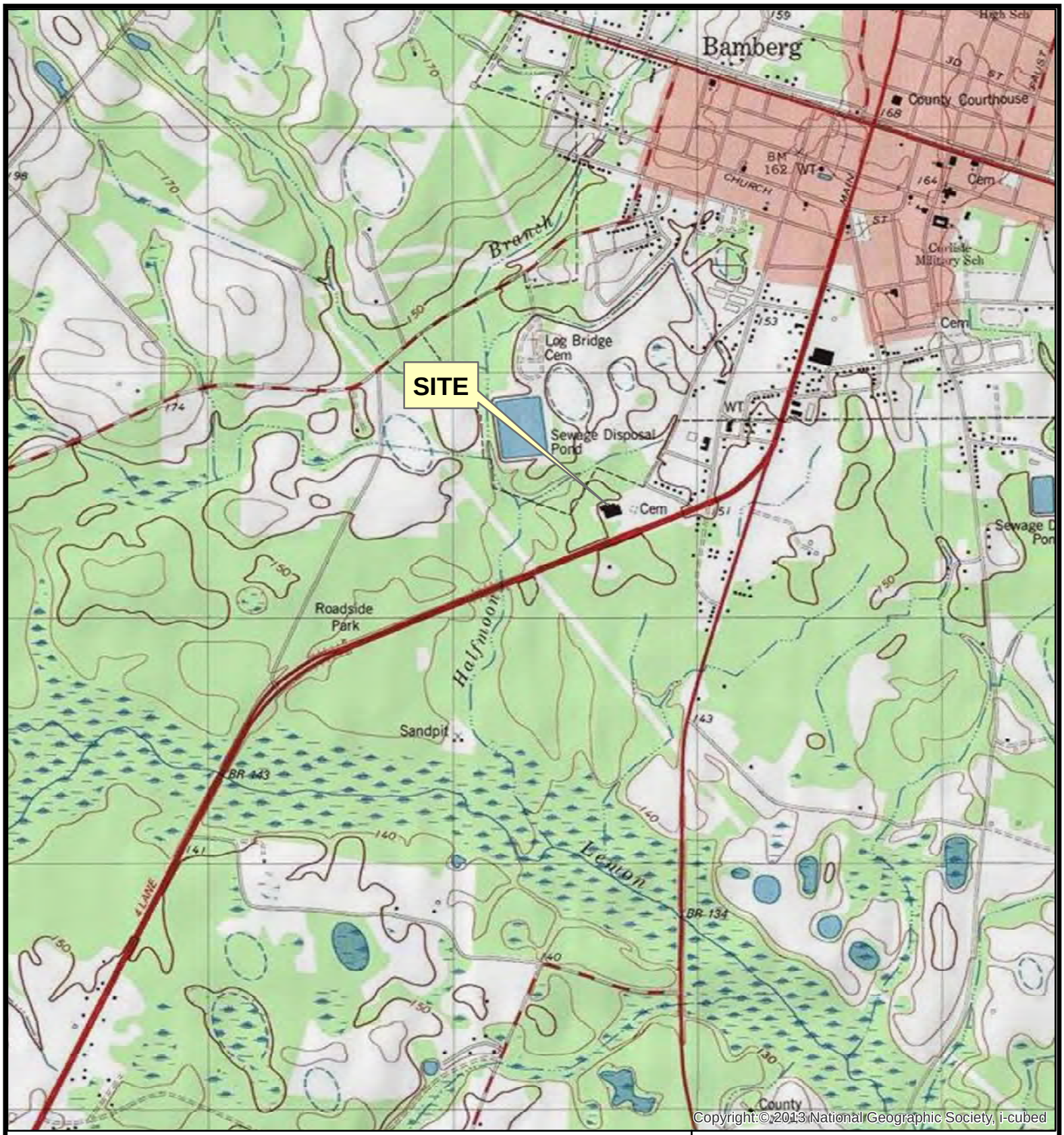
Hart & Hickman, August 2013, *Remedial Investigation Work Plan*, Delavan Spray Technologies Site, Bamberg, South Carolina, VCC 12-4762-RP.

SCDHEC, July 12, 2016, Comments to the Post Remedial Investigation Report, dated May 27, 2016 and requesting a work plan for delineation of the shallow and deep groundwater plumes.

SCDHEC, June 26, 2017, Comments to the Groundwater Delineation Report, dated June 23, 2017.

USEPA, 1996, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures* (EPA/540/S-95/504 dated April 1996.

FIGURES



N

0 500 1,000 2,000 3,000 4,000
Feet

U.S.G.S. QUADRANGLE MAP

BAMBERG, SC 1979 (PHOTO REVISED 1987)

QUADRANGLE
7.5 MINUTE SERIES (TOPOGRAPHIC)

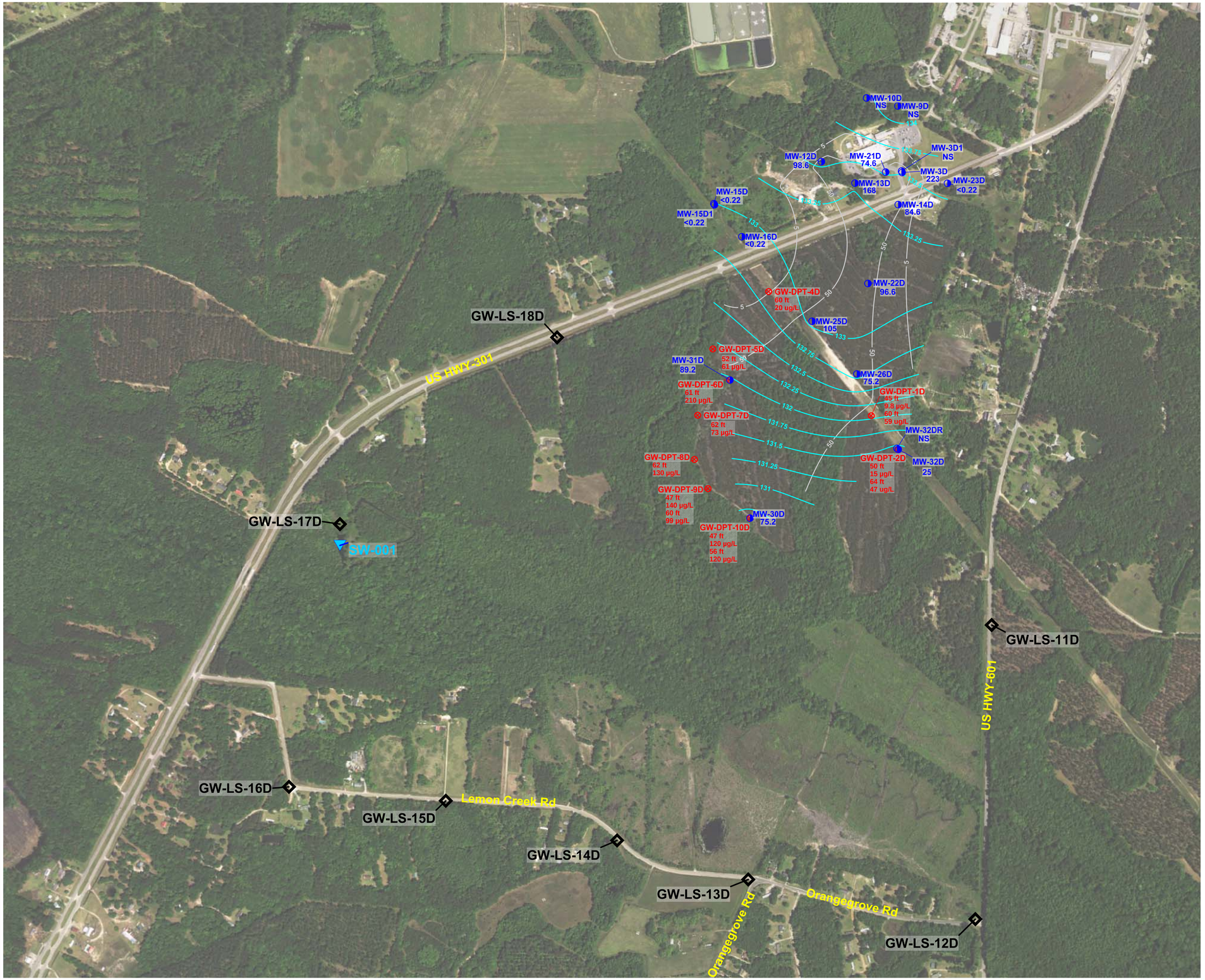
AECOM
10 Patewood Drive, Building 6, Suite 500
Greenville, SC 29615
T: (864) 234-3000 F: (864)234-3069

UTC Delavan Spray Technologies Site
Bamberg, South Carolina

Site Location Map

Project No.	Prepared by	Date	
60314964	K. Clark	October 2017	Figure 1

Path: L:\Projects\60314964\900-CAD-GIS\920 GIS-Graphics\Maps\June 2017\Figure 1 Site Location Map.mxd



LEGEND

- Proposed Limestone Aquifer Groundwater Sample
- Proposed Surface Water Sample
- Monitoring Well Sampled April 2017
- <0.2 PCE Concentration in Groundwater (µg/L)
- DPT Installed March/April 2017
- <0.2 PCE Concentration in Groundwater (µg/L)
- PCE Isoconcentration Contour (µg/L)
- Potentiometric Contour - April 2017 (ft)

Notes:
µg/L - micrograms per liter
DPT - Direct Push Technology
PCE - Tetrachloroethene
1) Data was contoured using log and anti-log grid math and the natural neighbor gridding method in Surfer 12.
2) Half the detection limit was used to contour non-detects.

N

0 400 800
FEET

AECOM

FIGURE 2

EXTENT OF CURRENT DATA AND PROPOSED SAMPLING LOCATIONS LIMESTONE AQUIFER GROUNDWATER ASSESSMENT

UTC DELAVAN SPRAY SITE
BAMBERG, SOUTH CAROLINA

60314964

L:\Projects\60314964\400-Technical\406 Surfer\2017 Deep GW Delineation\F1_Deeper Delineation Locations August 2017_rev1.srf

TABLES

Table 1
Proposed Borings for Groundwater Screening
Limestone Aquifer Groundwater Assessment
Delavan Spray Technology Site
Bamberg, South Carolina

Boring Identification Number	Approximate Location	Boring Target Depth (feet bls)	Bottles	Preservative	Aquifer Unit	Sampling Methodology
GW-DPT-11D	US Highway 601	50 - 75	3 - 40 ml glass vials	HCl, 4° C	Deeper Limestone Unit	Each boring will be screened for VOCs using a PID. 1 to 2 groundwater samples will be collected from each boring at the depth interval(s) with the highest PID reading(s). Groundwater samples will be analyzed by a local laboratory for PCE by USEPA Method 8260B.
GW-DPT-12D	Intersection of US-601 and Orangegrove Rd.	50 - 75	3 - 40 ml glass vials	HCl, 4° C	Deeper Limestone Unit	
GW-DPT-13D	Lemon Creek Rd and Orangegrove Rd (State Rd S-5-41)	50 - 75	3 - 40 ml glass vials	HCl, 4° C	Deeper Limestone Unit	
GW-DPT-14D	Lemon Creek Road (State Rd S-5-41)	50 - 75	3 - 40 ml glass vials	HCl, 4° C	Deeper Limestone Unit	
GW-DPT-15D	Lemon Creek Road (State Rd S-5-41)	50 - 75	3 - 40 ml glass vials	HCl, 4° C	Deeper Limestone Unit	
GW-DPT-16D	Lemon Creek Road (State Rd S-5-41)	50 - 75	3 - 40 ml glass vials	HCl, 4° C	Deeper Limestone Unit	
GW-DPT-17D	Priester Property	50 - 75	3 - 40 ml glass vials	HCl, 4° C	Deeper Limestone Unit	
GW-DPT-18D	US Highway 301	50 - 75	3 - 40 ml glass vials	HCl, 4° C	Deeper Limestone Unit	

Notes:

With the exception of GW-DPT-17, the borings are proposed to be installed within a road/highway ROW.
Locations may be adjusted in the field due to access issues or the presence of utilities/infrastructure.
Boring locations are illustrated on Figure 2.
bls - below land surface
° C - Degrees Celsius
HCl - Hydrochloric Acid
PCE - tetrachloroethene
PID - photo ionization detector
ROW - right of way
TCL - Target Compound List
VOCs - Volatile Organic Compounds

Table 2
Proposed Monitoring Wells
Limestone Aquifer Groundwater Assessment
Delavan Spray Technologies Site
Bamberg, South Carolina

Proposed Monitoring Well Number	Location	Target Aquifer Unit[1]	Monitoring Well Target Screened Interval (feet bls)	Screen Length (feet)	Analytical Testing	Comments
MW-33D	TBD based on field screening results from test borings	Limestone Aquifer	50 - 75	10	TCL VOCs by USEPA Method 8260B Field Parameters[2]	2 or 3 wells will be installed to delineate the extent of PCE in the Deep Limestone Aquifer Unit
MW-34D	TBD based on field screening results from test borings	Limestone Aquifer	50 - 75	10		
MW-35D	TBD based on field screening results from test borings	Limestone Aquifer	50 - 75	10		

Notes:

[1] - The deeper limestone aquifer unit monitoring wells have typically screened between 40 and 50 feet bls. Actual screened intervals will be determined based on field results.

[2] - pH, specific conductivity, temperature, turbidity, dissolved oxygen, and oxidation-reduction potential.

bls - below land surface

TBD - to be determined

TCL VOCs - target compound list volatile organic compounds

Table 3
Proposed Surface Water Sample
Limestone Aquifer Groundwater Assessment
Delavan Spray Technology Site
Bamberg, South Carolina

Sample Identification Number	Approximate Location	Description	Bottles	Preservative	Sampling Methodology
SW-001	Priester Property - US-301 Southwest of the Delavan Facility	Surface water spring in an apparent old Borrow Pit	3 - 40 ml glass vials	HCl, 4° C	See Text, Section 2.10. The surface water sample will be analyzed by a laboratory for TCL VOCs by USEPA Method 8260B.

Notes:

Location may be adjusted in the field due to access issues and availability of standing water during the sampling effort.
The proposed surface water sampling location is illustrated on Figure 2.
° C - Degrees Celsius
HCl - Hydrochloric Acid
TCL - Target Compound List
VOCs - volatile organic compounds

APPENDIX A

MONITORING WELL PERMIT APPLICATION AND PROPOSED CONSTRUCTION DETAILS

Monitoring Well Application

1. Proposed Location of Monitoring Well(s):

Street Address: US HWY-301; US HWY-601; and LEMON CREEK AND ORANGEGROVE ROADS

City (including Zip): BAMBERG 29906

County: BAMBERG

Please attach Scaled Map or Plat - FIGURE A-1

2. Well Owner's Information:

Name (Last then First):

Company: UNITED TECHNOLOGY CORP.

Complete Address:
9 FARM SPRINGS ROAD
FARMINGTON, CT 06032

Telephone Number:
860-728-6542

3. Property Owner's Information:

☐ Check if same as Well Owner

Name (Last then First):

Company: BAMBERG CO. & SCDOT

Address: ROADWAY RIGHT-OF-WAYS WITH ENCROACHMENT PERMIT

Telephone Number:

4. Proposed Drilling Date: NOVEMBER 2017

5. Intended Purpose of Well(s):

Pre-Purchase ☐

Investigation ☒

NOTE: If this request is for an existing DHEC project, please enter the Program area and ID number below.

Program Area: LAND AND WASTE MANAGEMENT

Project or Site ID #: FILE #51778

6. Proposed number of monitoring wells: 8 BORINGS 3 WELLS

7. Proposed parameters to be analyzed (check all that apply), please specify analytical method beside check box:

VOCs	☒	METHOD 8260B
BTEX	☐	
MtBE	☐	
Naphthalene	☐	
PAHs	☐	
Metals	☐	
Nitrates	☐	
Base, Neutral & Acid Ex.	☐	
Pesticides/Herbicides	☐	
Phenols	☐	
Radionuclides	☐	
PCBs	☐	
Other (specify below)	☐	

8. Proposed construction details (complete and attach proposed monitoring well schematics):

SONIC DRILLING, GROUNDWATER SCREENING TYPE III MONITORING WELL INSTALLATIONS.

SEE FIGURES A-2 AND A-3.

South Carolina Department of Health and Environmental Control (SCDHEC) summary of standards for monitoring well construction (per South Carolina Well Standards and Regulations R. 61-71)

Approval and License Requirements

Prior Department approval is required for the installation or abandonment of all monitoring wells including direct push, geoprobe or other temporary type monitoring wells. The attached monitoring well approval document should be completed, submitted and approved prior to construction of any monitoring well. A monitoring well is any well used to obtain water samples for water quality analyses or to measure groundwater levels. There are no fees for approvals. All monitoring wells must be drilled by a driller that is registered in South Carolina with the Board of Certification of the Environmental Systems Operators. If any of the information on the application including the proposed drilling date, well construction details or well placement changes, the Department (i.e. project manager issuing the well approval) must be notified 24 hours prior to well construction.

Location

Due to the nature and purpose of a monitoring well, the depth and location requirements in respect to surface water bodies, potential contamination sources, etc., are variable, and shall be approved on a case by case basis by the Department.

Construction and Material

Casing should be of sufficient strength to withstand normal forces encountered during and after well installation and be composed of material so as to minimally affect water quality analyses. Casing should have a sufficient diameter to allow for efficient sample collection (i.e., to provide access for sampling equipment). The diameter of the drilled hole needs to be large enough on all sides (1.5 inches of annular space) to allow forced injection of grout through a tremie pipe. All monitoring wells should have a cement pad or aggregate reinforced concrete at the ground surface which extends at least six inches beyond the bore hole diameter and six inches below ground surface to prevent infiltration between the surface casing and the bore hole. All monitoring wells should be grouted from the top of the bentonite seal to the surface with a neat cement, high solids bentonite or neat cement, bentonite mixture approved by the Department. A hydrated bentonite seal with a minimum thickness of 12 inches is to be placed above the filter pack to prevent infiltration of grout if the well has a filter pack. The monitoring well intake or screen design should minimize the amount of formational materials entering the well. The gravel
pack should be utilized opposite the well screen as appropriate so that parameters analyses will be minimally affected. All monitoring wells should have a locking cap or other security device to prevent damage and/or vandalism. Any monitoring well which is destroyed, rendered unusable or is abandoned should be reported to the Department and be properly abandoned, revitalized or replaced as appropriate or required by permit or regulation.

Development

Monitoring wells shall be properly developed. Development shall include the removal of
formation cuttings and drilling fluids from the well bore hole. Development shall be complete when the well produces water typical of the aquifer being monitored.

Reporting Requirements

A monitor well record form (1903) or equivalent to include the following should be completed and submitted to the Department within 30 days after completion of the monitoring wells:

Name and address of facility/owner;
Surveyed or global positioning system location of monitor well(s) on a scaled map or plat;
Driller and certification number;
Date drilled;
Driller's or Geologist's log;
Total depth;
Screened interval;
Diameter and construction details;
Depth to water table with date and time measured;
Surveyed elevation of measuring point with respect to established benchmark;
Monitoring well approval number issued by the Department.

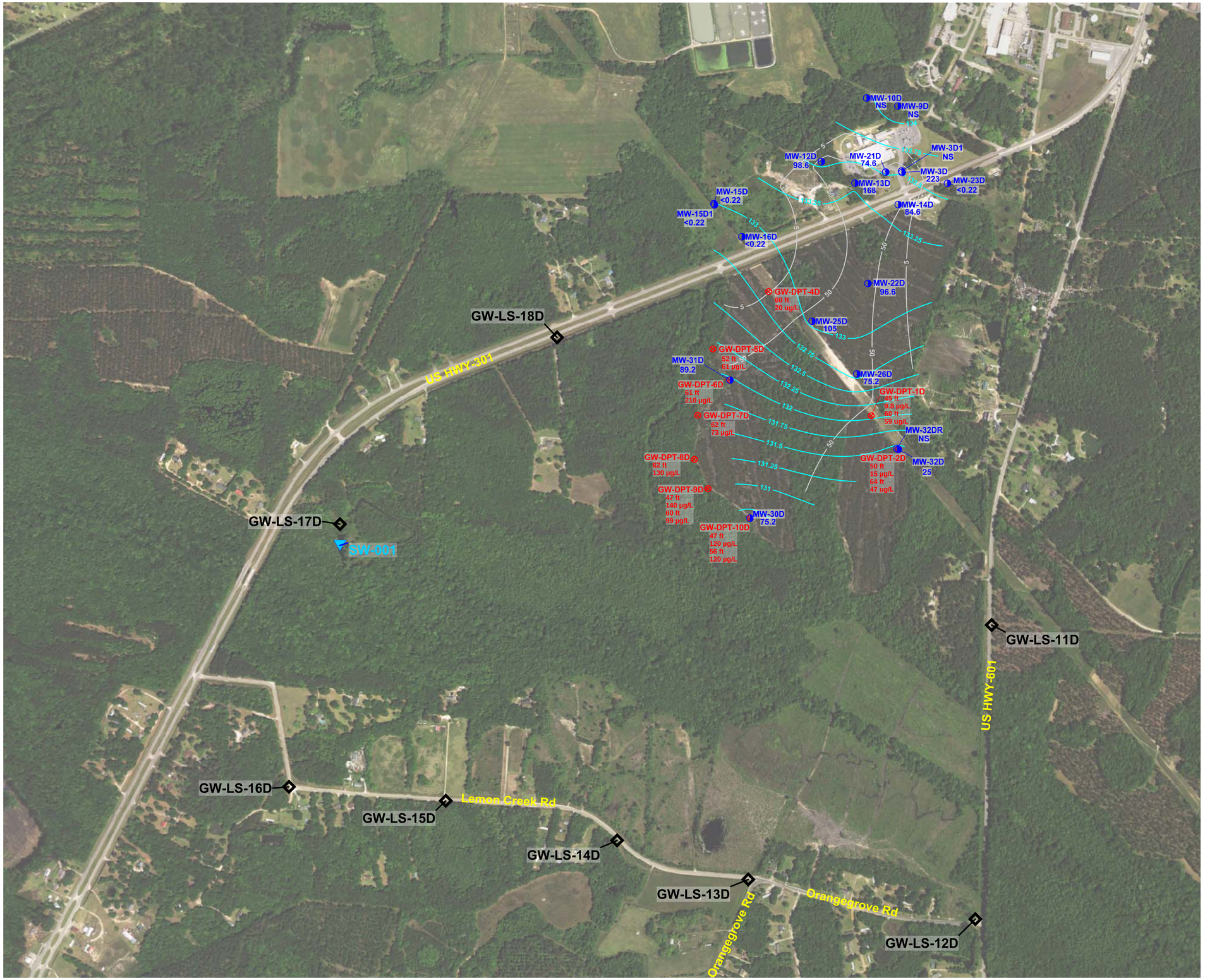
Additionally, the groundwater and soil (if taken) analytical results should be submitted to the Department within 30 days of receipt from the laboratory.

Abandonment

All monitoring wells shall be properly abandoned, when deemed appropriate by the Department. Any well that acts as a source of contamination shall be repaired or permanently abandoned immediately after receipt of notice from the Department. Abandonment shall be by forced injection of grout or pouring through a tremie pipe starting at the bottom of the well and proceeding to the surface in one continuous operation. The well shall be filled with either neat cement, bentonite-cement, or 20% high solids sodium bentonite grout, from the bottom of the well to the land surface.

* This summary of standards for monitoring well construction may not include a listing of all information necessary to obtain an approval to install monitoring wells. Final approval of monitoring well installation will be dependant upon the regulatory requirements for the Department program area for which the monitoring wells are to be installed.

* Some areas of the Department may require a detailed justification of the placement of monitoring wells and the depth of monitoring well screened zones prior to granting installation approval.



LEGEND

- Proposed Limestone Aquifer Groundwater Sample
- Proposed Surface Water Sample
- Monitoring Well Sampled April 2017
- <0.2 PCE Concentration in Groundwater (µg/L)
- DPT Installed March/April 2017
- <0.2 PCE Concentration in Groundwater (µg/L)
- PCE Isoconcentration Contour (µg/L)
- Potentiometric Contour - April 2017 (ft)

Notes:
µg/L - micrograms per liter
DPT - Direct Push Technology
PCE - Tetrachloroethene
1) Data was contoured using log and anti-log grid math and the natural neighbor gridding method in Surfer 12.
2) Half the detection limit was used to contour non-detects.

N

0 400 800
FEET

AECOM

FIGURE A-1

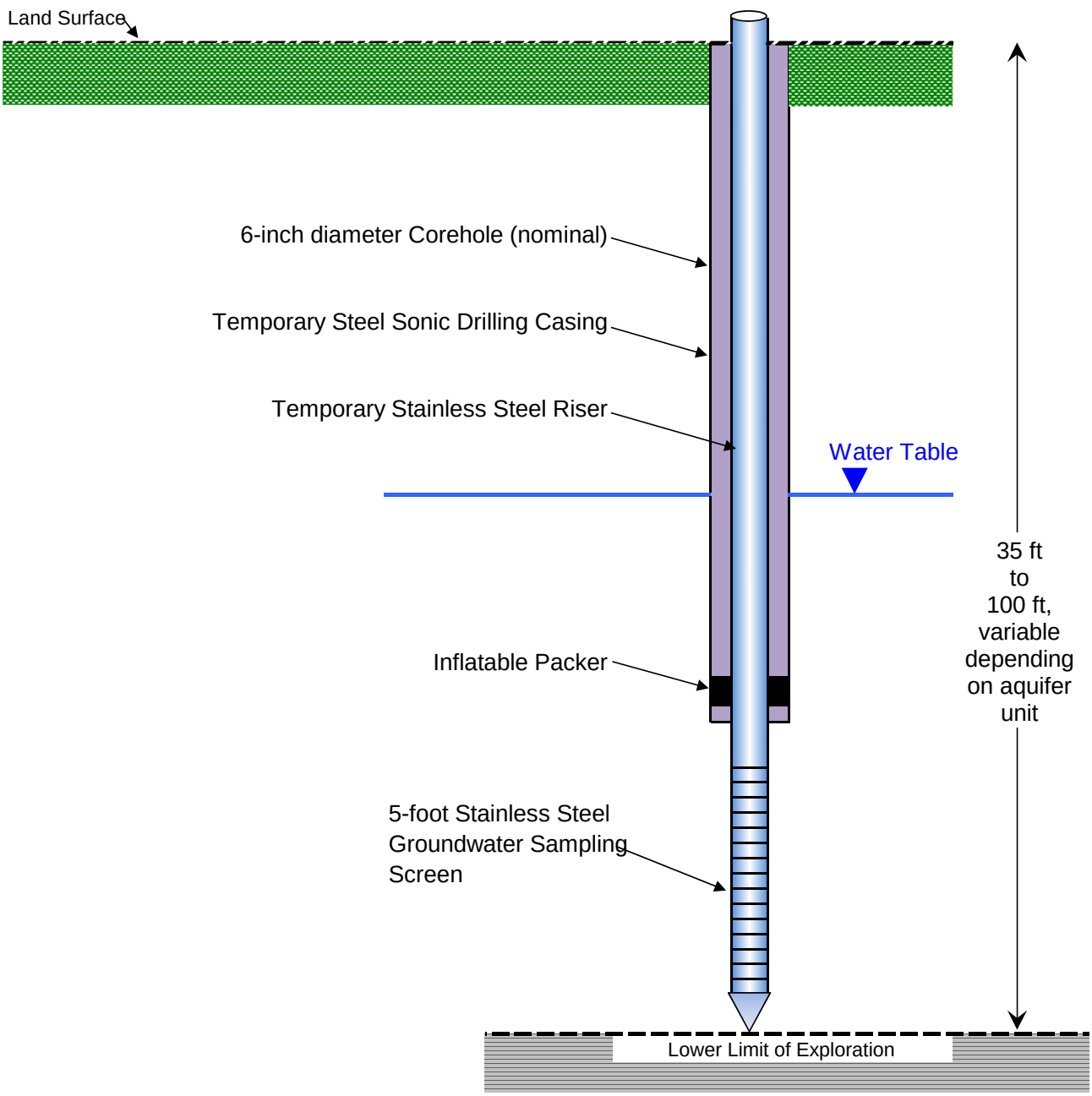
EXTENT OF CURRENT DATA AND PROPOSED SAMPLING LOCATIONS LIMESTONE AQUIFER GROUNDWATER ASSESSMENT

UTC DELAVAN SPRAY SITE
BAMBERG, SOUTH CAROLINA

60314964

L:\Projects\60314964\400-Technical\406 Surfer\2017 Deep GW Delineation\F1_Deeper Delineation Locations August 2017_rev1.srf

Project Name:	Delavan Spray Technologies	**Drilling Co.**		**Well Number:**	
Location:	Bamberg, South Carolina	**Driller:**		**Job Number:**	
Client:	United Technology Corporation	**Drilling Method:**	**Sonic Technology**	**Date Completed:**	
Geologist:		**Static WL:**		**Survey Datum:**	**NGVD-88**



Notes:
Drawing not to scale.

Sampling tools to be withdrawn from the boring after sample collection.

Boring to be abandoned by grouting with a neat Portland cement mixture.

AECOM

FIGURE A-2

SCHEMATIC DIAGRAM OF A GROUNDWATER SAMLER

DELAVAN SPRAY TECHNOLOGIES

BAMBERG, SOUTH CAROLINA

AECOM

FIGURE A-3

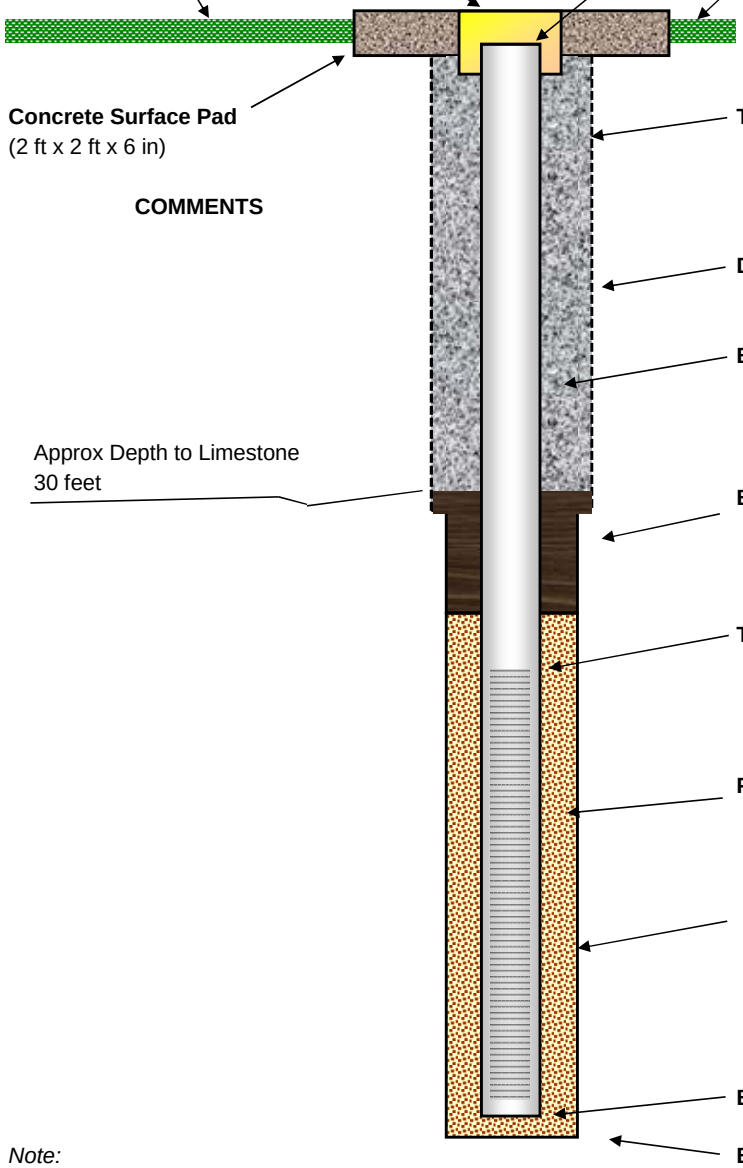
TYPE III GROUNDWATER MONITORING WELL INSTALLATION DETAIL

Project Name: Delavan Spray Technologies **Drilling Co:** _____ **Well Number:** _____

Location: Bamberg, South Carolina **Driller:** _____ **Job Number:** _____

Client: United Technology Corporation **Drilling Method:** Sonic **Date Completed:** _____

Geologist: _____ **Static Water Level:** _____ **b.TOC** **Survey Datum:** NAD-83, NGVD-88



8-inch diameter, steel vault

Grass, Asphalt/Concrete

Concrete Surface Pad
(2 ft x 2 ft x 6 in)

COMMENTS

Approx Depth to Limestone
30 feet

Top Of Casing Elevation _____ ft _____ ft Stickup

Land Surface Elevation _____ ft

Temp Surf Casing From _____ ft to _____ ft

Casing Type: **Temporary Steel**
Inside Diameter: **6** in

Diameter of Borehole (nominal)
6 in

Bentonite/Cement Grout
From _____ ft to _____ ft

Bentonite Pellet Seal
Type: _____
From _____ ft to _____ ft

Top of Screen Depth _____ ft
Screen Type: **SCH-40 PVC**
Screen Slot Size: **0.010-in** ID **2** in
Screen Length: **10** ft

Filter Sand for Screen
Sand Type: _____
From _____ ft to _____ ft

Diameter of Borehole (nominal)
4 in

Bottom of Well Depth _____ ft

Bottom of Boring (estimated) Depth **50 - 75** ft

Total Depth of Well, b. Top of Casing Depth _____ ft

Note:
Drawing Not to Scale
All Depths are Referenced to Ground Surface