GROUNDWATER MONITORING PLAN

PLANT McMANUS – INACTIVE ASH POND AP-1
GLYNN COUNTY, GEORGIA

FOR

Georgia Power

FEBRUARY 2021

GEORGIA REGISTERED No. 26609 PROFESSIONAL ENGINEER KENNETH L. BROOKE

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I. CERTIFICATION

I hereby certify that this Groundwater Monitoring Plan was prepared by, or under the direct supervision of, a "Qualified Groundwater Scientist," in accordance with the Rules of Solid Waste Management. According to 391-3-4-.01(57), a Qualified Groundwater Scientist is "a professional engineer or geologist registered to practice in Georgia who has received a baccalaureate or post-graduate degree in the natural sciences or engineering and has sufficient training and experience in groundwater hydrology and related fields that enable individuals to make sound professional judgments regarding groundwater monitoring, contaminant fate and transport, and corrective action." The design of the groundwater monitoring system was developed in compliance with the Georgia Environmental Protection Division (EPD) Rules of Solid Waste Management, Chapter 391-3-4.10(6).

Signature: Kenneth L Brooke

Date: 2/19/2021

GEORGIA REGISTERED No. 26609 PROFESSIONAL ENGINEER KENNETH L. BROOKE

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
Approved
Solid Waste Management Program
Approved By: John Sayer Digitally signed by John Sayer Date: 2021.04.23 17:10:14 -04'00'

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1. INTRODUCTION

Groundwater monitoring is required by the Georgia Environmental Protection Division (EPD) to detect and quantify potential changes in groundwater chemistry. This Groundwater Monitoring Plan (plan) describes the groundwater monitoring program for the Plant McManus former Ash Pond (AP-1). This plan meets the requirements of EPD rules and uses EPD's Manual for Ground Water Monitoring dated September 1991 as a guide. Groundwater monitoring well details are presented in Appendix A, and groundwater monitoring well locations are presented on Figure 1 of Appendix B. Well construction details are provided in Table B1 of Appendix B.

Monitoring will occur in accordance with 391-3-4-.10 of the Georgia Solid Waste Management Rules. If the monitoring requirements specified in this plan conflict with EPD rules (391-3-4), the EPD rules will take precedent.

In accordance with the United States Environmental Protection Agency (USEPA) Coal Combustion Rule (§257.90), which is incorporated by Georgia State CCR Rule by reference, a detection monitoring well network for AP-1 has been installed. The existing monitoring wells were installed following the guidelines presented herein. Additionally, this plan documents the methods for future monitoring well installation and/or replacement, and procedures for well abandonment. As required by 391-3-4.10(6)(g), a minor modification will be submitted to the EPD prior to the installation or decommissioning of monitoring wells. Well installation must be directed by a qualified groundwater scientist.

2. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Plant McManus (site) is located along the Turtle River in Brunswick, Glynn County, Georgia. The site was originally constructed on an island adjacent to the Turtle River. A road (Crispen Island Drive) and a railroad were constructed from the mainland to the island. The approximately 80-acre ash pond (AP-1) was constructed between the island and the mainland in the 1950s, with a northwestern dike and the southeastern dike formed by Crispen Island Drive. The northeastern extent of the ash pond is the mainland, and the southwestern extent is the island. AP-1 received ash from 1959 to 1972. Following 1972, AP-1 was used for low volume waste treatment and discharge. In 2016, Georgia Power began closure by removal of the inactive AP-1. Excavation activites completed in October 2019.

The Brunswick area is underlain by three regional aquifer systems which extend to depths exceeding 1,100 feet. The uppermost regional aquifer is the surficial aquifer. In the Brunswick area, this aquifer extends to a depth of approximately 180 feet. Although the surficial aquifer is defined on a regional scale as extending to approximately 180 feet below ground surface (bgs), Clarke and others (1990) acknowledge that localized lower permeability units can create confined or semi-confined conditions within limited areas of the surficial aquifer (ATC Associates Inc., 1997).

Regionally, the surficial aquifer is composed of geologic formations overlying the Hawthorn Formation. These formations include the Satilla and Cypresshead Formations, and, where present, the Charlton or equivalent Raysor Formation. In the Brunswick area, the Satilla is described as extending to approximately 28 feet bgs and the Cypresshead to approximately 50 feet bgs. Underlying the Satilla and Cypresshead Formations are sands, gravels, and clays which have been described by Weems and Edwards (2001) as two pairs of alternating confining units and water-bearing zones of the Ebenezer Formation. These alternating units of the Ebenezer Formation are described as an uppermost confining unit extending from approximately 50 to 75 feet bgs, followed by a water-bearing zone from approximately 75 to 110 feet bgs, another confining unit from approximately 110 to 15 feet bgs, and then another water-bearing zone from approximately 150 to 185 feet bgs. These sediments were deposited in marginal to shallow marine beds which are overlain by marine terrace deposits. Fluvial or residual deposits overlay the terrace deposits (Miller, 1986; Clarke et al, 1990) (ATC Associates Inc., 1997).

The regional surficial aquifer is underlain by approximately 90 feet of lower-permeability portions (Miocene Unit A) of the Hawthorn Formation (Miocene Units A, B, & C). This stratum forms the upper confining bed for the Brunswick aquifer system. The Brunswick aquifer system is composed of two confined aquifers (the Upper Brunswick aquifer and the Lower Brunswick aquifer) that are separated and confined above and below by less permeable units of the Hawthorn Formation. Regionally, the Upper Brunswick aquifer extends from approximately 270 feet to 350 feet bgs, and the Lower Brunswick aquifer extends from approximately 400 feet to 470 feet bgs (Clarke *et al,* 1990) (ATC Associates Inc., 1997).

Based on information collected during subsurface investigations, Plant McManus is underlain by very fine sands and clays from land surface (or beneath a shallow fill layer) to depths ranging from 33 to 43 feet bgs. Very fine sands are predominant, but discontinuous clay layers of varying thickness were encountered during drilling activities. The clay layers varied from less than one inch to approximately ten feet in thickness. These very fine sands and discontinuous clay layers are interpreted to be the Upper Satilla Formation (ATC Associates, Inc., 1997).

Underlying the Upper Satilla Formation are fine to medium sands with greater silt content, and apparently lower permeability, than the sands of the Upper Satilla. These siltier sands, which were interpreted to be the Lower Satilla Formation, were encountered at depths greater than 35 feet bgs during the Site investigation performed in the 1990s (ATC Associates Inc., 1997). These sands may also correspond to the Cypresshead Formation of Huddleston (1988). Sands and clays below the Cypresshead and above the confining unit of the Brunswick aquifer system have been described by Weems and Edwards (2001) as two pairs of alternating confining units and water-bearing zones of the Ebenezer Formation, extending from approximately 50 feet bgs to 185 feet bgs in the Brunswick area.

The Brunswick aquifer system is composed of two confined aquifers (the Upper Brunswick aquifer and the Lower Brunswick aquifer) that are separated and confined above and below by less permeable units of the Hawthorn Formation. The regional surficial aquifer that contains the Upper and Lower Satilla Formations is underlain by approximately 90 feet of lower-permeability portions (Miocene Unit A) of the Hawthorn Formation (Miocene Units A, B, & C). This stratum forms the upper confining bed for the Brunswick Aquifer System. Visual and gamma logging of stratigraphic borings performed at the Site in 2019, confirmed the top of the Miocene Unit A confining layer is present at a depth of approximately 240 to 250 feet bgs.

Groundwater flows from two directions toward the former AP-1. One groundwater flow component originates on the mainland, northeast of the facility, and flows southwest, while the other flow component originates on Crispen Island and flows north and northeast. Groundwater elevations in the monitoring wells on the mainland (MCM-02, -15, and -16) and on the island (MCM-08 and -11) have consistently exhibited higher groundwater elevations than the monitoring wells and piezometers installed along the dikes, with MCM-01 and -04 exhibiting intermediate elevations between the mainland and dike wells. The potentiometric surface of the surficial aquifer and the resultant groundwater flow direction in the vicinity of the former AP-1 is a reflection of the topography of the mainland, Crispen Island, and the tides in the marsh surrounding the area.

Horizontal groundwater flow velocities were calculated for three well/piezometer pairs at high and low tide using groundwater elevations collected on the January 23, 2020. Groundwater flow velocities representing groundwater flowing from the mainland to former AP-1 (0.081 feet per day [ft/day] between MCM-02 and MCM-16) and from the island to former AP-1 (0.049 ft/day between MCM-11 and MCM-12) were the same at high and low tide. However, groundwater flow velocities between the marsh and former AP-1 (MCM-08/PZ-12) were 0.016 ft/day at high tide and 0.008 ft/day at low tide. The groundwater direction during high tide was from the marsh to former AP-1 and at low tide from former AP-1 to the marsh. Average groundwater flow velocities were 0.049 ft/day or 17.74 feet per year (ft/year) at high tide and 0.046 ft/day or 16.75 ft/yr at low tide. While there is a reversal in flow direction between the MCM-08/PZ-12 well/piezometer pair, the flow velocities are similar, likely creating a stagnation of groundwater within the dike as the tide rises and falls.

Vertical hydraulic conductivity tests were performed at specified depths within the surficial aquifer by collecting Shelby tube samples and using flexible wall permeameter testing following ASTM D 5084-10. Representative samples collected from the intervals screened in the compliance monitoring well network showed a range of vertical conductivities between 1.72 x 10^{-6} centimeters per second (cm/s) to 1.27x10^{-3} cm/s. Representative samples collected from slightly deeper intervals of the surficial aquifer (Lower Satilla, Cypresshead, or potentially the Ebenezer Formation) identified as a potential aquitard on gamma logs showed a range of vertical conductivities between 1.08x10^{-7} cm/s to 1.65 x 10^{-4} cm/s.

The average horizontal conductivity measured in the interval screened in the compliance well network is two orders of magnitude greater than the average vertical hydraulic conductivity measured in the Lower Satilla Formation, indicating the formation limits downward vertical flow at the Site.

3. SELECTION OF WELL LOCATIONS

Groundwater monitoring wells are installed to monitor the uppermost occurrence of groundwater beneath the site. Locations are selected based on disposal cell layouts and site geologic and hydrogeologic considerations. GPC follows the recommendation as stated in Chapter 2 of the Manual for Groundwater Monitoring (1991) to determine well spacing based on site-specific conditions. A map depicting the monitoring well network for AP-1 is included in Appendix B, Monitoring System Details. Appendix B also includes a tabulated list of individual monitoring wells and piezometers in Tables B1 and B2, respectively, with well construction details such as location coordinates, top-of-casing elevation, well depths and screened intervals. The groundwater monitoring network currently includes 15 monitoring wells (MCM-01, -02, -04, -05, -06, -07, -11, -12, -14, -15, -16, -17, -18, -19, and -20). Thirty additional piezometers (MCM-03, MCM-08, MCM-10, MCM-13, MW-01R through MW-07, MW-09 through MW-12, PZ-09 through PZ-12, DPZ-01 through DPZ-06, and TPZ-1 through TPZ-5) are utilized for groundwater elevation measurements around the former AP-1. Monitoring wells and piezometers were resurveyed on April 16, 2020 for coordinates, top-of-casing elevations, and mag nail elevations. The resurveyed information is reflected in Tables B1 and B2. Dewatering wells RW-1 through RW-10 and piezometers PZ-01 through PZ-08 were installed for construction dewatering during ash pond excavation and are also utilized as piezometers. In August 2019, piezometers PZ-01 through -08 were abandoned in accordance with the Groundwater Monitoring Plan. In December 2019, MCM-09 was abandoned in accordance with the Groundwater Monitoring Plan to facilitate construction activities. The dewatering wells (RW-1 through RW-10) are no longer in use due to the end of excavation activities. They will be evaluated and may be abandoned. Wells and piezometers will be abandoned in accordance with the Groundwater Monitoring Plan. Any change to the groundwater monitoring network will be made by a minor modification to the permit pursuant to subparagraph (4) (b) 7 of Rule 391-3-4-.02.

4. MONITORING WELL DRILLING, CONSTRUCTION, ABANDONMENT & REPORTING

4.1 DRILLING

A variety of well drilling methods are available for the purpose of installing groundwater wells. Drilling methodology may include, but not be limited to: hollow stem augers, direct push, air rotary, mud rotary, or rotosonic techniques. The drilling method shall minimize the disturbance of subsurface materials and shall not cause impact to the groundwater. Borings will be advanced using an appropriate drilling technology capable of drilling and installing a well in site-specific geology. Drilling equipment shall be decontaminated before use and between borehole locations using the procedures described in the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Field Equipment Cleaning and Decontamination as a guide.

Sampling and/or coring may be used to help determine the stratigraphy and geology. Samples will be logged by a qualified groundwater scientist. Screen depths will be chosen based on the depth of the uppermost aquifer.

The drilling for any subsurface hydrologic investigation, installation or abandonment of groundwater monitoring wells will be performed by a driller that has, at the time of installation, a performance bond on file with the Water Well Standards Advisory Council.

Monitoring wells will be installed using the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Design and Installation of Monitoring Wells as a general guide for best practices.

4.2 DESIGN AND CONSTRUCTION

Well construction materials will be sufficiently durable to resist chemical and physical degradation and will not interfere with the quality of groundwater samples.

<u>WELL CASINGS AND SCREENS</u>

ASTM, NSF rated, Schedule 40, 2-inch polyvinyl chloride (PVC) pipe with flush threaded connections will be used for the well riser and screens. Compounds that can cause PVC to deteriorate (e.g., organic compounds) are not expected at this facility. If conditions warrant, other appropriate materials may be used for construction with prior written approval from the EPD.

WELL INTAKE DESIGN

The design and construction of the intake of the groundwater wells shall: (1) allow sufficient groundwater flow to the well for sampling; (2) minimize the passage of formation materials (turbidity) into the well; and (3) ensure sufficient structural integrity to prevent the collapse of the intake structure.

Each groundwater monitoring well will include a well screen designed to limit the amount of formation material passing into the well when it is purged and sampled. Screens with 0.010-inch slots have proven effective for the earth materials at the site and will be used unless geologic conditions discovered at the time of installation dictate a different size. Screen length shall not exceed 10 feet without justification as to why a longer screen is necessary (e.g. significant variation in groundwater level). If the above prove ineffective for developing a well with sufficient yield or acceptable turbidity, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

Pre-packed dual-wall well screens may be used for well construction. Pre-packed well screens combine a centralized inner well screen, a developed filter sand pack, and an outer conductor screen in one integrated unit composed of inert materials. Pre-packed well screens will be installed following general industry standards and using the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Design and Installation of Monitoring Wells as a general guide. If the dual-wall pre-packed-screened wells do not yield sufficient water or are excessively turbid after development, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

FILTER PACK AND ANNULAR SEAL

The materials used to construct the filter pack will be clean quartz sand of a size that is appropriate for the screened formation. Fabric filters will not be used as filter pack material. Sufficient filter material will be placed in the hole and measurements taken to ensure that no bridging occurs. Upon placement of the filter pack, the well may be pumped to assure settlement of the pack. If pumping is performed, the top of filter pack depth will be measured, and additional sand added if necessary. The filter pack will extend approximately one to two feet above the top of the well screen.

The materials used to seal the annular space must prevent hydraulic communication between strata and prevent migration from overlying areas into the well screen interval. A minimum of two feet of fine sand or bentonite (chips, pellets, or slurry) will be placed immediately above the filter pack. Fine sand (approximately 35/65) will be used in areas of high TDS groundwater (e.g., dike wells). The seal will extend up to the base of any overlying confining zone or the top of the water-bearing zone to prevent cementitious grout from entering the water-bearing or screened zone.

The annulus above the bentonite seal will be grouted with a cement and bentonite mixture (approximately 94 pounds cement / 3 to 5 pounds bentonite / 6.5 gallons of potable water) placed via tremie pipe from the top of the bentonite seal. During grouting, care will be taken to assure that the bentonite seal is not disturbed by locating the base of the tremie pipe approximately 2 feet above the bentonite seal and injecting grout at low pressure/velocity.

PROTECTIVE CASING AND WELL COMPLETION

After allowing the grout to settle, the well will be finished by installing an above-ground protective casing and building a surface cap. The surface cap will extend from the top of the cementitious grout to ground surface, where it will become a concrete apron extending outward with a radius of at least 1.5 feet from the edge of the well casing and sloped to drain water away from the well. The location and elevation of each monitoring well and piezometer top-of-casing and ground surface will be surveyed by a Registered Land Surveyor.

Each well will be fitted with a cap that contains a hole or opening to allow the pressure in the well to equalize with atmospheric pressure. The space between the well casing and the protective casing will be filled with coarse sand or pea-gravel to within approximately 6 inches of the top of the well casing. A small weep hole will be drilled at the base of the metal casing for the drainage of moisture from the casing. Protective covers will be locked. Well ID's will be listed on metal plaques attached to the outside of the protective casing for easy identification.

Protective bollards will be installed around groundwater monitoring wells completed above the ground surface. Well construction in high traffic areas will generally be limited unless site conditions warrant otherwise.

The groundwater monitoring well detail attached in Appendix A, Groundwater Monitoring Well Detail, illustrates the general design and construction details for a monitoring well.

WELL DEVELOPMENT

After well construction is completed, wells will be developed by alternately purging and surging until relatively clear discharge water with little turbidity is observed. The goal will be to achieve a turbidity of less than 10 nephelometric turbidity units (NTUs); however, formation-specific conditions may not allow this target to be accomplished. Additionally, the stabilization criteria contained in Appendix C should be met. A variety of techniques may be used to develop site groundwater monitoring wells. The method used must create reversals or surges in flow to eliminate bridging by particles around the well screen. These reversals or surges can be created by using surge blocks, bailers, or pumps. The wells will be developed using a pump capable of inducing the stress necessary to achieve the development goals. Well development equipment will be decontaminated prior to first use and between wells.

In low yielding wells, potable water may be added to the well to facilitate surging of the well screen interval and removal of fine-grained sediment. If water is added, the volume will be documented and at minimum, an equal volume purged from the well.

Many geologic formations contain clay and silt particles that are small enough to work their way through the wells' filter packs over time. Therefore, the turbidity of the groundwater from the monitoring wells may gradually increase over time after initial well development. As a result, the monitoring wells may have to be redeveloped periodically to remove the silt and clay that has worked its way into the filter pack of the monitoring wells. Each monitoring well should be redeveloped when sample turbidity values have significantly increased since initial development or since prior redevelopment. The redevelopment should be performed as described above.

4.3 MAINTENANCE AND ABANDONMENT

The monitoring wells, piezometers and other measurement, sampling and analytical devices will be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program. Monitoring wells and piezometers will be inspected during each groundwater measuring or sampling event. The well pads will be observed for cracks and erosion. The outer castings will be observed for corrosion and functionality of the locks and hinges. The inner casting will be observed for cracks or other wear, measuring point mark, biological growth or chemical precipitation, and proper assembly of the dedicated pump, where applicable. Where deficiencies are observed and are immediately rectifiable, they will be properly corrected. When they are not immediately rectifiable, they will be noted in the field book so that the proper supplies and equipment may be obtained to implement the repair as soon as practical. In the event a monitoring well is dry (has a water level insufficient for sample collection) for two consecutive monitoring events, the well will be replaced as required by Georgia Rule 391-3-4-.10(6)(g).

Monitoring wells will be abandoned using industry-accepted practices, the Manual for Groundwater Monitoring (1991), and Georgia Water Well Standards Act (1985) as guides. The wells will be abandoned under the direction of a geologist or engineer registered in Georgia. Neat Portland cement or bentonite will be used as appropriate to complete abandonment and seal the well borehole. Piezometers or groundwater wells located within the footprint of AP-1 will be over-drilled prior to abandonment.

Prior to the abandonment or replacement of a monitoring well, a minor modification shall be submitted in accordance with subparagraph (4)(b)7 of Rule 391-3-4-.02.

4.4 DOCUMENTATION

Within 60 days of the construction, development, or abandonment of each groundwater monitoring well completed under the direction of a qualified groundwater scientist or engineer, a well installation/abandonment report will be submitted to the EPD. The installation/abandonment report will contain the information described below. When wells are installed, a Georgia-registered professional surveyor shall certify that the horizontal accuracy for the installed monitoring wells is ±0.5 feet, and vertical accuracy for elevations to 0.01 feet using a known datum.

- Well Identification
- Name of drilling contractor and type of drill rig

- Documentation that the driller, at the time the monitoring wells were installed, had a bond on file with the Water Well Advisory Council
- Dates of drilling and initial well emplacement
- Drilling technique and type of drilling fluid, if used
- Well location within an accuracy of ±0.5 feet based upon survey from an acceptable survey point
- Borehole diameter and well casing diameter
- Well depth (±0.1 ft.)
- Lithologic logs
- Type of protective well cap and sump dimensions for each well
- Casing and screen joint type
- Screen length and slot size
- Screened interval in feet bgs and elevation
- Details of filter pack construction including material
- Filter pack emplacement method (narrative)
- Seal emplacement method and type/volume of sealant
- Surface seal and volumes/mix of annular seal material
- Well development date
- Well turbidity following development
- Narrative of well development method-specific well development procedure
- Documentation of ground surface elevation (±0.1 ft.)
- Documentation of top of casing elevation (±0.01 ft.)
- Schematic of the well with dimensions

5. GROUNDWATER MONITORING PARAMETERS AND FREQUENCY

The following describes groundwater sampling requirements with respect to parameters for analysis, sampling frequency, sample preservation and shipment, and analytical methods. Groundwater samples used to provide compliance monitoring data will not be filtered prior to collection.

Table 1, Groundwater Monitoring Parameters and Frequency, presents the groundwater monitoring parameters and sampling frequency. A minimum of eight independent samples from each groundwater well will be collected and analyzed for 40 CFR 257, Subpart D, Appendix III and Appendix IV test parameters to establish a background statistical dataset. Subsequently, in accordance with 391-3-4-.10(6), the monitoring frequency for the Appendix III parameters will be at least semi-annual during the active life of the facility and the post-closure care period. If required, assessment monitoring will be performed per Georgia Chapter 391-3-4-.10, Rules for Solid Waste Management.

When referenced throughout this plan, Appendix III and Appendix IV parameters refer to the parameters contained in Appendix III and Appendix IV of 40 CFR 257, Subpart D, 80 Fed. Reg. 21468 (April 17, 2015).

As shown on Table 2, Analytical Methods, the groundwater samples will be analyzed using methods specified in USEPA Manual SW-846, EPA 600/4-79-020, Standard Methods for the Examination of Water and Wastewater (SM18-20), USEPA Methods for the Chemical Analysis of Water and Wastes (MCAWW), American Society for Testing and Materials (ASTM), or other suitable analytical methods approved by the Georgia EPD. The method used will be able to reach a suitable practical quantification limit to detect natural background conditions at the facility. The groundwater samples will be analyzed by licensed and accredited laboratories through the National Environmental Laboratory Accreditation Conference (NELAC). Field instruments used to measure pH must be accurate and reproducible to within 0.2 Standard Units (S.U.).

TABLE 1
GROUNDWATER MONITORING PARAMETERS & SAMPLING FREQUENCY

MONITORING PARAMETER		GROUNDWATER MONITORING	
		Background	**Semi-Annual Events**
Field Parameters	Temperature	X	X
	pH	X	X
	ORP	X	X
	Turbidity	X	X
	Specific Conductance	X	X
	Dissolved Oxygen	X	X
Appendix III (Detection)	Boron	X	X
	Calcium	X	X
	Chloride	X	X
	Fluoride	X	X
	pH	X	X
	Sulfate	X	X
	Total Dissolved Solids	X	X
Appendix IV (Assessment)	Antimony	X	Assessment sampling frequency and parameter list determined in accordance with Georgia Chapter 391-3-4.10(6).
	Arsenic	X	
	Barium	X	
	Beryllium	X	
	Cadmium	X	
	Chromium	X	
	Cobalt	X	
	Fluoride	X	
	Lead	X	
	Lithium	X	
	Mercury	X	
	Molybdenum	X	
	Selenium	X	
	Thallium	X	
	Radium 226 & 228	X	

TABLE 2
ANALYTICAL METHODS

Parameters	EPA Method Number
Boron	6010B/6020
Calcium	6010B/6020
Chloride	300.0/300.1/9250/9251/9253/9056A
Fluoride	300.0/300.1/9214/9056A
pH	150.1field/90405C
Sulfate	9035/9036/9038300.0/300.1/9056A
Total Dissolved Solids (TDS)	160/2540C
Antimony	EPA 7040/7041/6010B/6020
Arsenic	EPA 7060A/7061A/6010B/6020
Barium	EPA 7080A/7081/6010B/6020
Beryllium	EPA 7090/7091/6010B/6020
Cadmium	EPA 7130/7131A/6020
Chromium	EPA 7190/7191/6010B/6020
Cobalt	EPA 7200/7201/6010B/6020
Fluoride	300.0/300.1/9214/90569214
Lead	EPA 7420/7421/6010B/6020
Lithium	6010/6020B
Mercury	7470
Molybdenum	6010/6020B
Selenium	EPA 7740/7741A/6010B/6020
Thallium	EPA 7840/7841/6010/6020
Radium 226 and 228 combined	EPA 903/9320/9315

6. SAMPLE COLLECTION

During each sampling event, samples will be collected and handled in accordance with the procedures specified in Appendix C, Groundwater Sampling Procedures. Sampling procedures were developed using standard industry practice and USEPA Region 4 Field Branches Quality System and Technical Procedures as a guide. Low-flow sampling methodology will be utilized for sample collection. Specific groundwater sampling methodology, including both purging and sampling must include the type of sampling equipment used and must be given as narrative in the groundwater semi-annual sampling reports. Alternative industry accepted sampling techniques may be used when appropriate with prior EPD approval.

Water level measurements from groundwater monitoring wells will be measured using an electronic water level probe or measuring tape capable of measuring water levels with accuracy to 0.1 foot.

For groundwater sampling, positive gas displacement Teflon or stainless-steel bladder pumps will be used for purging. If dedicated bladder pumps are not used, portable bladder pumps or peristaltic pumps (with dedicated or disposable tubing) may be used. When non-dedicated equipment is used, it will be decontaminated prior to use and between wells in general accordance with USEPA SESDPROC-2015-R3.

Groundwater wells that are determined to be dry for two consecutive sampling events should be replaced, unless an alternate schedule has been approved by EPD.

7. CHAIN-OF-CUSTODY

Samples will be handled under chain-of-custody (COC) procedures beginning in the field. The COC record will contain the following information:

- Sample identification numbers
- Signature of collector
- Date and time of collection
- Sample type
- Sample point identification
- Number of sample containers
- Signature of persons involved in the chain of possession
- Dates and times of possession by each individual

The samples will remain in the custody of assigned personnel, an assigned agent, or the laboratory. If the samples are transferred to other employees for delivery or transport, the sampler or possessor must relinquish possession, and the samples must be received by the new owner, including documentation of transfer times and dates between other employees or individuals on the COC.

If the samples are being shipped, a hard copy COC will be signed and enclosed within the shipping container.

Samplers must use COC forms provided by the analytical laboratory or use a COC form similarly formatted and containing the information listed above.

8. FIELD AND LABORATORY QUALITY ASSURANCE / QUALITY CONTROL

Field quality control samples will be prepared the same as compliance samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected during each sampling event:

Field Equipment Rinsate Blanks - Where sampling equipment is not new or dedicated, an equipment rinsate blank will be collected at a rate of one blank per 10 samples using non-dedicated equipment.

Field Duplicates - Field duplicates are collected by filling additional containers at the same location, and the field duplicate is assigned a unique sample identification number. One blind field duplicate will be collected for every 10 samples.

Field Blanks - Field blanks are collected in the field using the same water source that is used for decontamination. The water is poured directly into the supplied sample containers in the field and submitted to the laboratory for analysis of target constituents. One field blank will be collected for every 10 samples.

Field Instrument Calibration Program – Calibration of field instruments will occur daily and follow the recommended (specific) instrument calibration procedures provided by the manufacturer and/or equipment manual specific to each instrument. Daily calibration will be documented on field forms and these field forms will be included in the groundwater monitoring reports.

9. REPORTING RESULTS

A semi-annual groundwater report that documents the results of sampling and analysis will be submitted to EPD. Semi-annual groundwater monitoring reports will be submitted to the EPD within 90 days of receipt of the groundwater analytical data from the laboratory. At a minimum, semi-annual reports will include:

1. A narrative describing sampling activities and findings including a summary of the number of samples collected, the dates the samples were collected and whether the samples were required by the detection or assessment monitoring programs.

2. Field log books and forms shall be kept for each sampling event, and will include, but may not be limited to, well signage, well access, sampling and purging equipment condition, and any site conditions that may affect sampling.

3. A narrative of purging/sampling methodologies, which includes type of sampling equipment used.

4. Discussion of results.

5. Recommendations for the future monitoring consistent with the Rules.

6. Potentiometric surface contour map for the aquifer(s) being monitored, signed and sealed by a Georgia-registered P.G. or P.E.

7. Table of as-built information for groundwater monitoring wells including top of casing elevations, ground elevations, screened elevations, current groundwater elevations and depth to water measurements.

8. Groundwater flow rate and direction calculations.

9. Identification of any groundwater wells that were installed or decommissioned during the preceding year, along with a narrative description of why these actions were taken.

10. A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels.

11. If applicable, semi-annual assessment monitoring results.

12. Any alternate source demonstration completed during the previous monitoring period, if applicable.

13. Laboratory Reports.

14. COC documentation.

15. Field sampling logs including field instrument calibration, indicator parameters and parameter stabilization data.

16. Documentation of non-functioning wells.

17. Table of current analytical results for each well, highlighting statistically significant increases and concentrations above maximum contaminant level (MCL).

18. Statistical analyses.

19. Certification by a qualified groundwater scientist.

10. STATISTICAL ANALYSIS

Groundwater quality data from each sampling event will be statistically evaluated to determine if there has been a statistically significant change in groundwater chemistry. Historical background data will be used to determine statistical limits. Statistical analysis techniques are consistent with the USEPA document *Statistical Analysis of Groundwater Data at RCRA Facilities Unified Guidance* (Unified Guidance) (USEPA, 2009).

According to EPD Rule (391-3-4-.10(6)(a)) the site must specify in the operating record the statistical methods to be used in evaluating groundwater monitoring data for each hazardous constituent. The statistical test chosen shall be conducted separately for each hazardous constituent in each well. As authorized by the Rule, statistical tests that will be used include:

1. A prediction interval procedure in which an interval for each constituent is established from the distribution of the background data, and the level of each constituent in each compliance well is compared to the upper prediction limit [§257.93(f)(3)].

2. A control chart approach that gives control limits for each constituent [§257.93(f)(4)].

3. Another statistical test method (such as prediction limits or control charts) that meets the performance standards of paragraph §257.93(g) [§257.93(f)(5)]. A justification for an alternative method will be placed in the operating record and the Director notified of the use of an alternative test. The justification will demonstrate that the alternative method meets the performance standards of §257.93(g).

An interwell statistical method will be used to compare Appendix III groundwater monitoring data to background conditions. Confidence intervals will be constructed for each downgradient well and used to compare Appendix IV groundwater monitoring data to groundwater protection standards.

A site-specific statistical analysis plan that provides details regarding the statistical methods to be used will be placed in the site's operating record pursuant to 391-3-4-.10(6). Figure 1, Statistical Analysis Plan Overview, includes a flowchart that depicts the process that will be followed to develop the site-specific plan. Figure 2, Decision Logic For Computing Prediction Limits, presents the logic that will be used to calculate site-specific statistical limits and test compliance results against those limits.

FIGURE 1. STATISTICAL ANALYSIS PLAN OVERVIEW

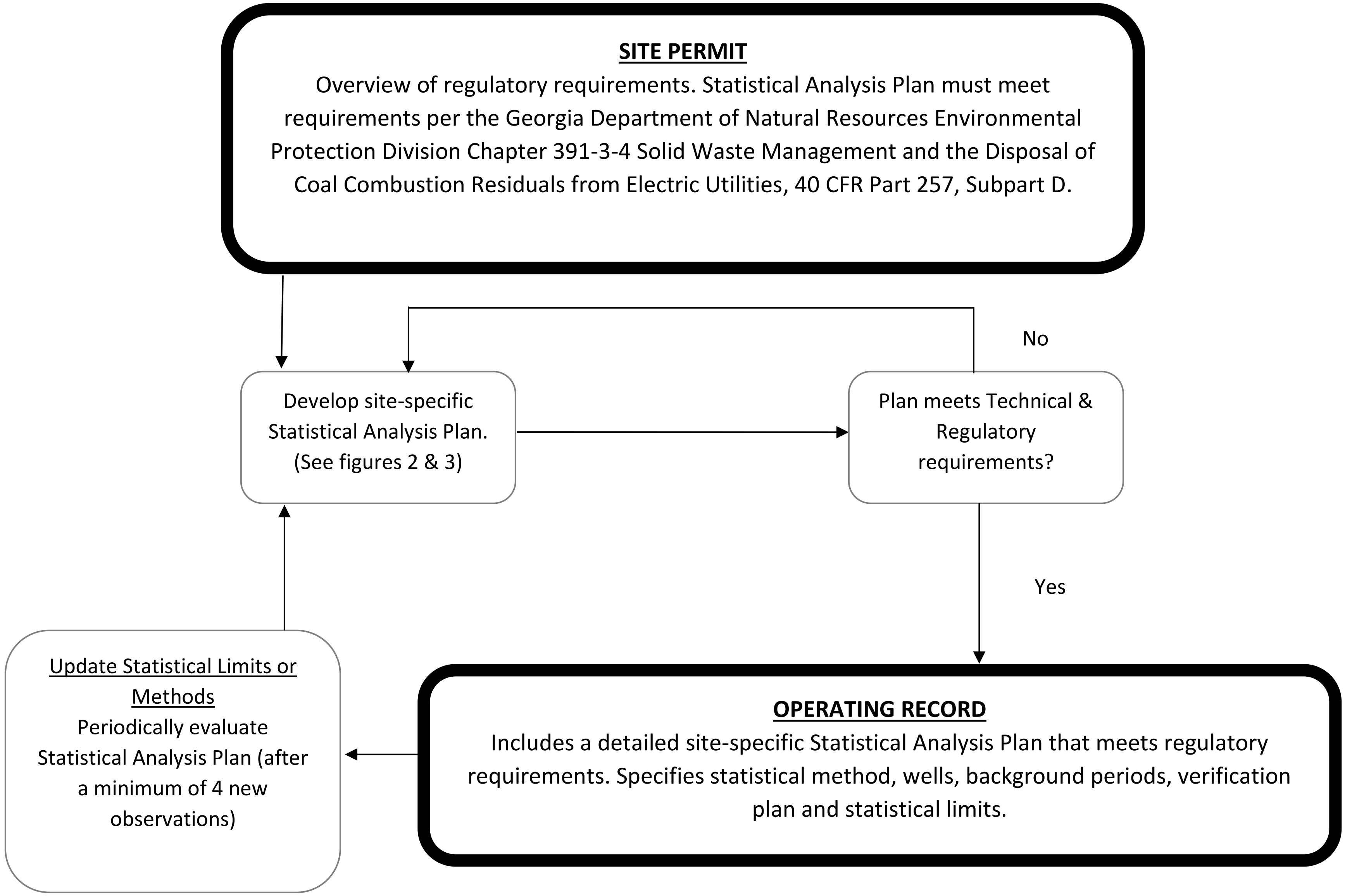
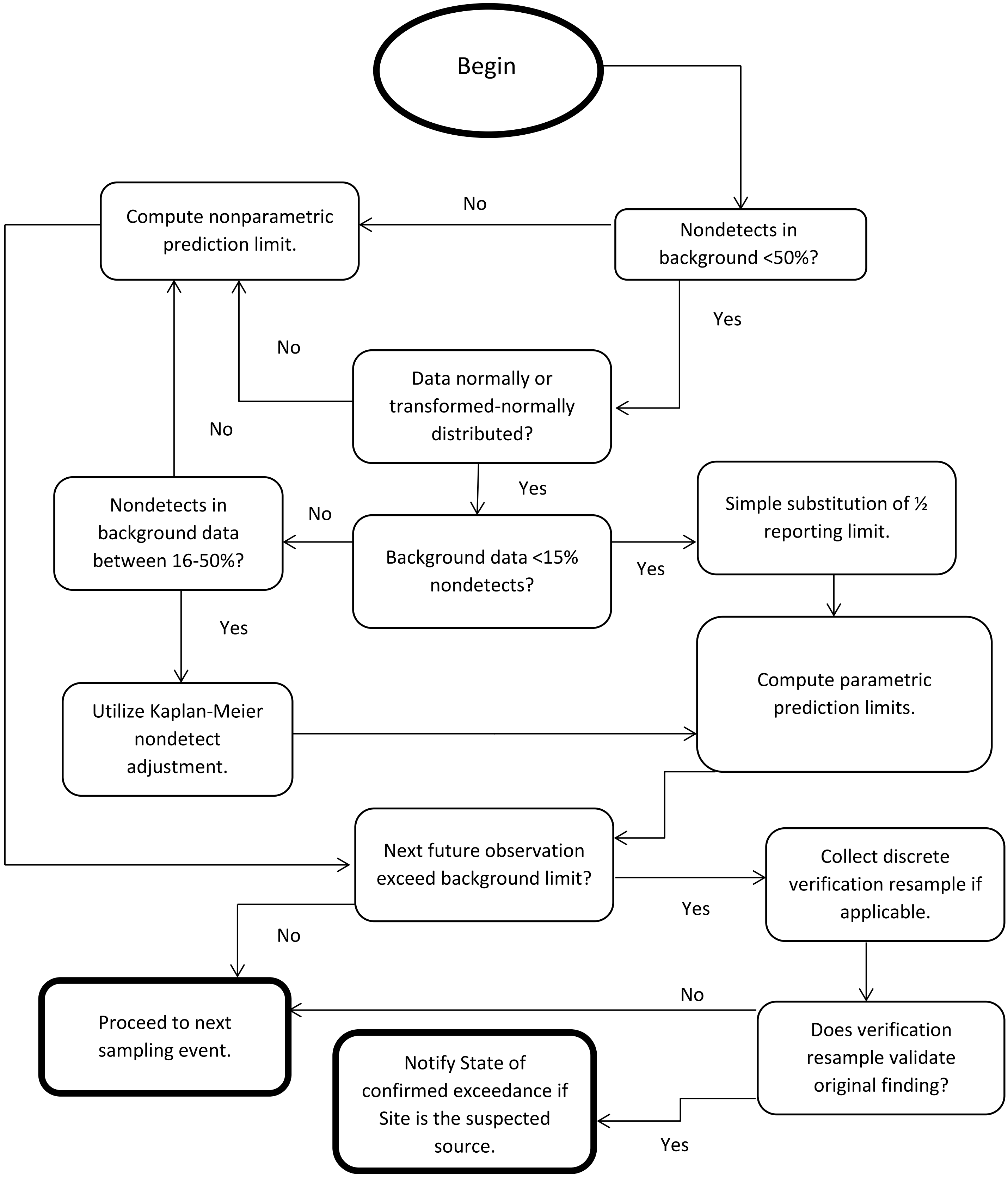


FIGURE 2. DECISION LOGIC FOR COMPUTING PREDICTION LIMITS



11. REFERENCES

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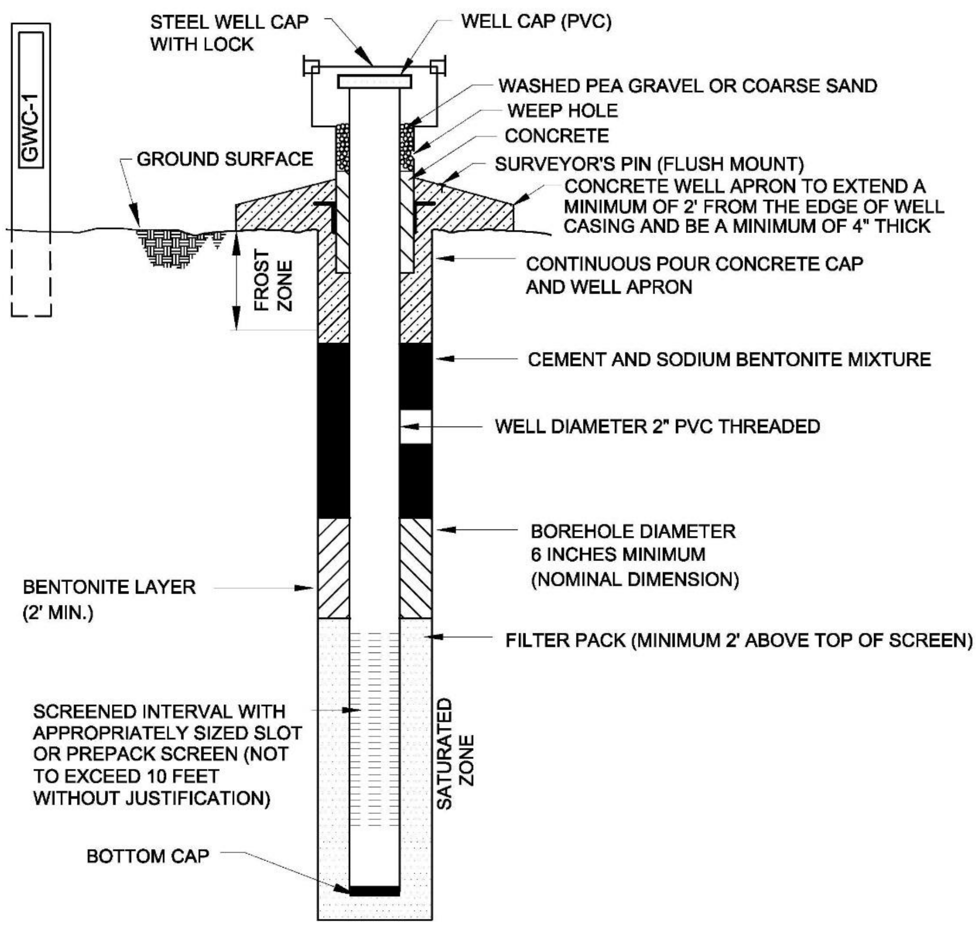
APPENDICES

A. GROUNDWATER MONITORING WELL DETAIL
B. MONITORING SYSTEM DETAILS
C. GROUNDWATER SAMPLING PROCEDURES

A. GROUNDWATER MONITORING WELL DETAIL



GROUNDWATER MONITORING WELL (TYP.)

B. MONITORING SYSTEM DETAILS

Groundwater monitoring system details are presented on the following maps of the groundwater monitoring network (Figure 1), piezometer locations (Figure 2), and the attached tables of groundwater monitoring well (Table B1) and piezometer details (Table B2).

Table B1
Well Construction Details
Groundwater Monitoring Network
Plant McManus
Brunswick, GA

Well ID	Well Function	Northing[1] (ft)	Easting[1] (ft)	Top of Casing Elevation[2] (ft NAVD 88)	Ground Surface Elevation[2,3] (ft NAVD 88)	Total Depth[4] (ft BTOC)	Top of Screen Elevation[2] (ft NAVD 88)	Bottom of Screen Elevation[2] (ft NAVD 88)
MCM-01	Upgradient Monitoring	443727.31	852732.08	8.63	5.70	27.32	-7.93	-17.93
MCM-02	Upgradient Monitoring	444496.53	852663.64	11.25	8.25	27.35	-5.22	-15.22
MCM-04	Downgradient Monitoring	444804.73	851695.27	12.39	9.50	28.57	-5.18	-15.18
MCM-05	Downgradient Monitoring	444716.63	851309.91	10.04	7.80	28.05	-7.25	-17.25
MCM-06	Downgradient Monitoring	444407.22	850782.11	10.15	7.87	27.20	-6.27	-16.27
MCM-07	Downgradient Monitoring	444059.38	850195.96	10.20	7.52	23.75	-2.76	-12.76
MCM-11	Upgradient Monitoring	442429.80	851072.91	10.23	7.52	24.00	-3.34	-13.34
MCM-12	Sidegradient Monitoring	442821.17	851312.45	11.87	8.99	29.00	-6.12	-16.12
MCM-14	Sidegradient Monitoring	443358.82	852317.59	11.50	8.66	28.11	-6.23	-16.23
MCM-15	Upgradient Monitoring	444825.53	851949.02	12.84	10.18	26.60	-4.53	-14.53
MCM-16	Upgradient Monitoring	444551.32	852716.60	16.02	13.04	28.39	-1.72	-11.72
MCM-17	Sidegradient Monitoring	443074.41	851899.68	11.49	9.09	27.44	-4.81	-14.81
MCM-18	Upgradient Monitoring	442067.07	851698.41	9.00	6.01	27.86	-8.76	-18.76
MCM-19	Upgradient Monitoring	441157.82	852338.86	8.71	5.77	28.32	-9.53	-19.53
MCM-20	Upgradient Monitoring	440944.40	852185.15	10.07	7.07	23.05	-2.98	-12.98

Notes:

1. Georiga State Plane - NAD 83 East Zone.
2. NAVD 88 - North American Vertical Datum of 1988
3. Ground Surface measured at the mag nail in the concrete pad
4. ft BTOC - feet below top of casing

Updated by: VF 5/21/20
Checked by: WL 5/21/20

GEORGIA PROFESSIONAL LAND SURVEYOR No. 3395 DAVID E. DOWDY

SURVEY DATA CERTIFICATION FOR SOUTHERN COMPANY TO DETERMINE NORTHING, EASTING, AND VERTICAL ELEVATION OF MAG NAIL IN THE CONCRETE PAD FOR THE WELL
DATE OF FIELD SURVEY & INSPECTION: APRIL 16, 2020
FIELD SURVEY TOLERANCE = 0.10 FEET HORIZONTAL - NAD 83 & 0.01 FEET VERTICAL - NAVD88
EQUIPMENT USED TO RECORD DATA: CHAMPION WR1 GPS

Table B2
Well Construction Details
Piezometers and Other Wells
Plant McManus
Brunswick, GA

Well ID	Well Function	Northing[1] (ft)	Easting[1] (ft)	Top of Casing Elevation[2] (ft NAVD 88)	Ground Surface Elevation[2,3] (ft NAVD 88)	Total Depth[4] (ft BTOC)	Top of Screen Elevation[2] (ft NAVD 88)	Bottom of Screen Elevation[2] (ft NAVD 88)
MW-01R	Piezometer	443632.5586	852715.1308	12.61	NA	27.44	0.17	-14.83
MW-02	Piezometer	443354.3859	852304.1959	11.10	NA	26.80	-0.70	-15.70
MW-03	Piezometer	443081.3356	851904.8549	11.26	NA	27.00	-0.60	-15.60
MW-04	Piezometer	442854.6307	851408.1446	9.20	NA	27.40	-3.00	-18.00
MW-05	Piezometer	442578.1982	850752.3477	13.24	NA	27.60	0.90	-14.10
MW-06R	Piezometer	442378.5335	850499.0375	13.25	NA	20.00	3.25	-6.75
MW-07	Piezometer	442792.9894	850224.3520	9.94	NA	21.50	3.40	-11.60
MW-08	Piezometer	443310.0596	849977.9965	8.95	NA	27.70	-3.70	-18.70
MW-09	Piezometer	443736.7716	849920.8976	10.10	NA	24.20	0.80	-14.20
MW-10	Piezometer	444045.1224	850181.4059	10.24	NA	27.10	-2.80	-17.80
MW-11	Piezometer	444359.5263	850709.3205	10.42	NA	32.20	-8.20	-23.20
MW-12	Piezometer	444667.3620	851186.9003	10.08	NA	32.30	-8.60	-23.60
MCM-03	Piezometer	444414.8800	851984.6700	9.97	7.10	27.70	-7.73	-17.73
MCM-08	Piezometer	443758.8000	849716.9600	9.42	6.55	28.29	-8.39	-18.39
MCM-09	Piezometer	443252.1584	850147.7478	Abandoned				
MCM-10	Piezometer	442791.8800	850453.0500	11.75	8.61	23.96	-1.25	-11.25
MCM-13	Piezometer	443030.2300	851826.1900	12.56	9.79	27.46	-4.90	-14.90
PZ-1	Piezometer for Dewatering	444127.6813	850308.3200	Abandoned				
PZ-2	Piezometer for Dewatering	444196.6588	850423.4598	Abandoned				
PZ-3	Piezometer for Dewatering	444264.8108	850540.0935	Abandoned				
PZ-4	Piezometer for Dewatering	444335.4506	850656.4801	Abandoned				
PZ-5	Piezometer for Dewatering	444471.1060	850888.7994	Abandoned				
PZ-6	Piezometer for Dewatering	444538.4862	851005.4620	Abandoned				
PZ-7	Piezometer for Dewatering	444605.9569	851121.6527	Abandoned				
PZ-8	Piezometer for Dewatering	444674.4265	851238.6722	Abandoned				
PZ-09	Piezometer	444082.13	849471.64	9.41	6.57	24.05	-4.56	-14.56
PZ-10	Piezometer	444949.09	851673.98	12.17	9.74	22.91	-0.66	-10.66
PZ-11	Piezometer	443222.86	849280.51	9.37	6.57	19.08	-4.63	-9.63
PZ-12	Piezometer	443593.34	849396.87	7.90	5.02	18.70	-5.72	-10.72
DPZ-01	Piezometer	444695.71	851277.40	9.71	7.36	40.78	-25.99	-30.99
DPZ-02	Piezometer	444391.02	850757.94	9.54	7.34	43.46	-28.84	-33.84
DPZ-03	Piezometer	444073.16	850218.83	9.46	7.04	47.57	-33.03	-38.03
DPZ-04	Piezometer	443062.60	851881.94	11.45	8.96	51.23	-34.70	-39.70
DPZ-05	Piezometer	443376.32	852342.11	11.00	8.60	51.20	-35.12	-40.12
DPZ-06	Piezometer	444614.79	851846.27	12.04	9.59	40.50	-23.38	-28.38
RW-1	Dewatering for Construction	444094.0012	850251.1636	9.39	NA	26.42	-2.61	-12.61
RW-2	Dewatering for Construction	444161.8377	850367.2034	9.96	NA	27.27	-2.83	-12.83
RW-3	Dewatering for Construction	444228.4307	850479.7659	9.89	NA	32.29	-3.07	-13.07
RW-4	Dewatering for Construction	444299.3305	850599.2604	9.49	NA	26.88	-2.97	-12.97
RW-5	Dewatering for Construction	444369.6765	850714.2378	10.11	NA	37.22	-2.92	-22.92
RW-6	Dewatering for Construction	444436.3732	850831.7225	10.25	NA	36.58	-2.67	-22.67
RW-7	Dewatering for Construction	444504.5857	850949.3512	10.19	NA	38.17	-7.69	-22.69
RW-8	Dewatering for Construction	444572.9068	851064.4671	10.22	NA	31.62	-2.80	-17.80
RW-9	Dewatering for Construction	444641.6045	851181.2956	10.26	NA	37.71	-7.66	-22.66
RW-10	Dewatering for Construction	444706.8701	851295.5011	10.56	NA	37.80	-7.54	-22.54

Notes:
1. Georiga State Plane - NAD 83 East Zone.
2. NAVD 88 - North American Vertical Datum of 1988
3. Ground Surface measured at the mag nail in the concrete pad
4. ft BTOC - feet below top of casing
5. PZ- 1 through PZ-8 were abandoned in 2019
6. MCM-09 was abandoned in 2020
NA - Not Available
Updated by : VF 5/21/20
Checked by: KB 5/22/20

GEORGIA PROFESSIONAL LAND SURVEYOR No. 3395 DAVID E. DOWDY

David E. Dowdy

SURVEY DATA CERTIFICATION FOR SOUTHERN COMPANY TO DETERMINE NORTHING, EASTING, AND VERTICAL ELEVATION OF MAG NAIL IN THE CONCRETE PAD FOR THE WELL
DATE OF FIELD SURVEY & INSPECTION: APRIL 16, 2020
FIELD SURVEY TOLERANCE = 0.10 FEET HORIZONTAL - NAD 83 & 0.01 FEET VERTICAL - NAVD88
EQUIPMENT USED TO RECORD DATA: CHAMPION WR1 GPS RECEIVER, TRIMBLE S5 TOTAL STATION, SOKKIA AUTO LEVEL

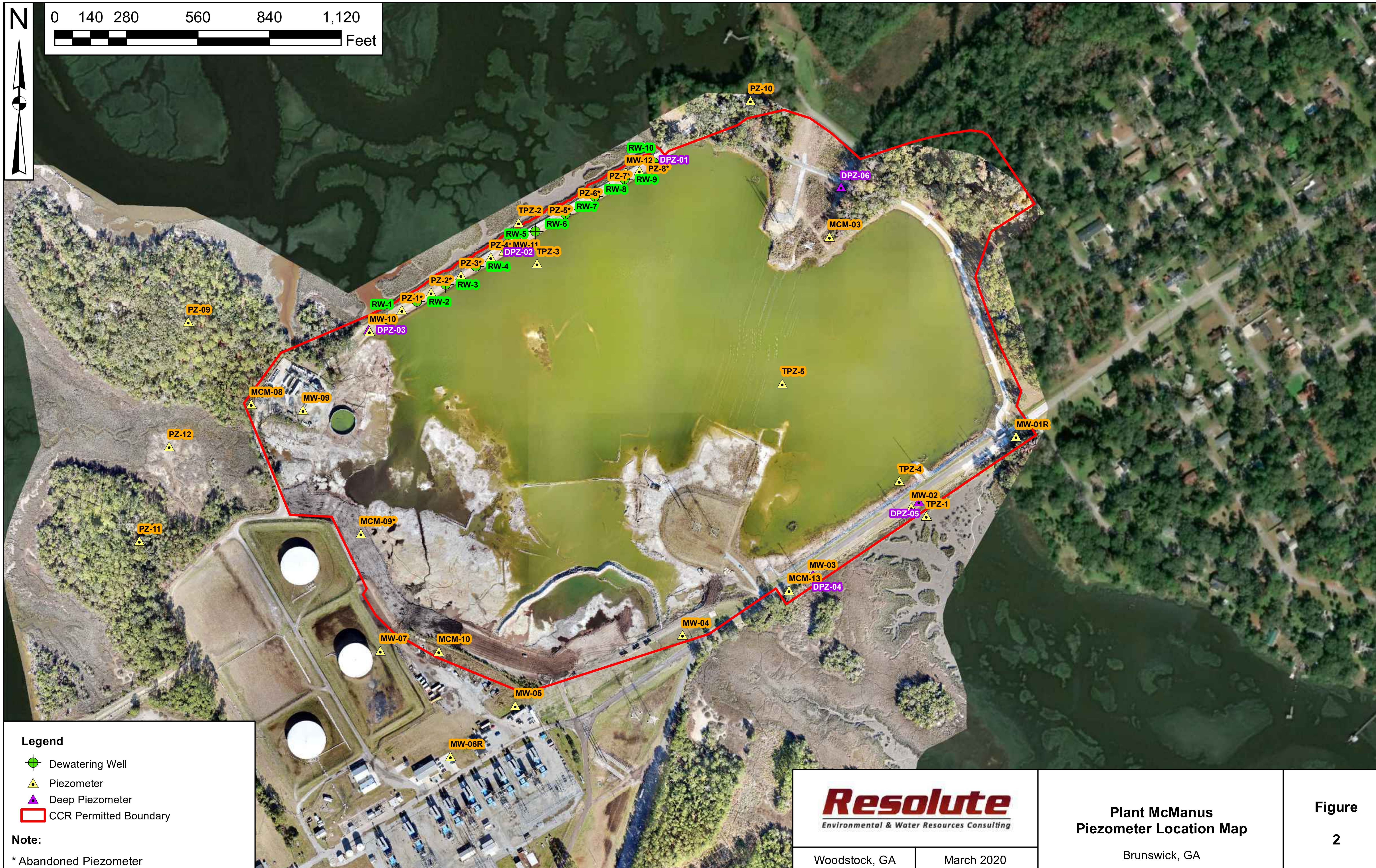
X:\ArcGIS\McManus\2020\CCR\CCR Permitting\GWMP

Legend

- Monitoring Wells
- CCR Permitted Boundary

Resolute
Environmental & Water Resources Consulting

Woodstock, GA	March 2020	**Plant McManus** **Site Plan and Well Location Map** Brunswick, GA	**Figure** **1**



Legend

- Dewatering Well
- Piezometer
- Deep Piezometer
- CCR Permitted Boundary

Note:

* Abandoned Piezometer

Resolute Environmental & Water Resources Consulting		Plant McManus Piezometer Location Map Brunswick, GA	Figure 2
Woodstock, GA	March 2020		

C. GROUNDWATER SAMPLING PROCEDURES

Groundwater sampling will be conducted using USEPA Region 4 Field Quality and Technical Procedures as a guide. The following procedures describe the general methods associated with groundwater sampling at the site. Prior to sampling, the well must be evacuated (purged) to ensure that representative groundwater is obtained. Any item coming in contact with the inside of the well casing or the well water will be kept in a clean container and handled only with gloved hands.

GPC will follow the procedures below at each well to ensure that a representative sample is collected:

1. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations and notify GPC if it appears that the well has been compromised.

2. Measure and record the depth to water in the wells to be sampled prior to purging. The water measuring device shall consist of a probe and measuring tape capable of measuring water levels with accuracy to 0.1 feet. Static water levels will be measured from each well within a 24-hour period. The water level measuring device will be decontaminated prior to lowering in each well.

3. Install Pump: If a dedicated pump is not present, slowly lower the pump into the well to the midpoint of the well screen or a depth otherwise approved by the hydrogeologist or project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and suspension of any sediment present in the bottom of the well. Record the depth to which the pump is lowered. Non-dedicated equipment will be decontaminated before use and between well locations in general accordance with Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division (SESD) guidance document, Operating Procedure - Field Equipment Cleaning and Decontamination (EPA, SESDGUID-205-R3), or the latest version of the document.

4. Measure Water Level: Immediately prior to purging, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

5. Purge Well: Begin pumping the well at approximately 100 to 500 milliliters per minute (ml/min). Monitor the water level continually. Maintain a steady flow rate that results in a stabilized water level with 0.3 ft. or less of variability. Avoid entraining air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

6. Monitor Indicator Parameters: Monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, ORP, and DO) approximately every three to five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings at a minimum:

   ±0.1 for pH

±10% for specific conductance (conductivity)

±10% for DO where DO>0.5mg/L. If DO<0.5mg/L no stabilization criteria apply

≤10 for turbidity

Temperature – Record only, not used for stabilization criteria

ORP – Record only, not used for stabilization criteria.

7. Collect samples at a flow rate between 50 and 250 ml/min and such that drawdown of the water level within the well is stable. Flow rate must be reduced if excessive drawdown is observed during sampling. Sample containers should be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.

8. Compliance samples will be unfiltered; however, to determine if turbidity is affecting sample results, duplicate samples may be filtered in the field prior to being placed in a sample container, clearly marked as filtered and preserved. Filtering will be accomplished by the use of 0.45 micron filters on the sampling line. At least two filter volumes of sample will pass through before filling sample containers. Filtered samples are not considered compliance samples and are only used to evaluate the effects of turbidity.

9. Sample bottles will be filled, capped, and placed in an ice containing cooler immediately after sampling where temperature control is required. Samples that do not require temperature control will be placed in a clean and secure container.

10. Sample containers and preservative will be appropriate for the analytical method being used.

11. Information contained on sample container labels will include:

    a. Name of facility

    b. Date and time of sampling

    c. Sample description (well number)

    d. Sampler's initials

    e. Preservatives

    f. Analytical method(s)

12. After samples are collected, samplers will remove non-dedicated equipment. Upon completion of activity the well will be closed and locked.

13. Samples will be delivered to the laboratory following appropriate COC and temperature control requirements. The goal for sample delivery will be within 48 hours of collection; however, at no time will samples be analyzed after the method-prescribed hold time.

Throughout the sampling process new latex or nitrile gloves will be worn by the sampling personnel. A clean pair of new, disposable gloves will be worn each time a different location is sampled and new gloves donned prior to filling sample bottles. Gloves will be discarded after sampling each well and before sampling the next well.

The goal when sampling is to attain a turbidity of less than 5 NTU; however, samples may be collected where turbidity is less than 10 NTU and the stabilization criteria described above are met.

If sample turbidity is greater than 5 NTU and the other stabilization criteria have been met, samplers will continue purging for 3 additional hours in order to reduce the turbidity to 5 NTU or less.

- If turbidity remains above 5 NTU but is less than 10 NTU, and the other parameters are stabilized, the well can be sampled.
- Where turbidity remains above 10 NTU, an unfiltered sample will be collected followed by a filtered sample that has passed through an in-line 0.45-micron filter attached to the discharge (sample collection) tube. Data from filtered samples will only be used to quantify the effects of turbidity on sample results.

Samplers will identify the sample bottle as containing a filtered sample on the sample bottle label and on COC form.