GROUNDWATER MONITORING PLAN

Chesterfield Power Station, Upper and Lower Ash Ponds
Solid Waste Permit No. 619
500 Coxendale Road
Chester, Virginia 23836

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1.0 INTRODUCTION

This *Groundwater Monitoring Plan* (GMP) has been prepared for Virginia Electric and Power Company (VEPCO) dba Dominion Energy Virginia (Dominion Energy) for two Coal Combustion Residuals (CCR) surface impoundments, the Upper Ash Pond (UAP) and Lower Ash Pond (LAP), located at the Chesterfield Power Station (Station) in Chesterfield County, Virginia. This GMP is designed to meet:

- applicable provisions of the U.S. Environmental Protection Agency's (USEPA's) *Disposal of Coal Combustion Residuals* (CCR) *from Electric Utilities* (CCR Rule; Federal Register Vol. 80, No. 74, 21302-21501) published on April 17, 2015 (40 CFR 257 *et seq*.) as amended per the following:
  - USEPA's CCR Rule amendment (Federal Register Vol. 81, No. 151, 51802-51808) published on August 5, 2016;
  - USEPA's CCR Rule amendment (Federal Register Vol. 83, No. 146, 36435-36456) published on July 30, 2018;
  - USEPA's CCR Rule amendment (Federal Register Vol. 85, No. 168, 53516-53566) published on August 28, 2020 (effective date of September 28, 2020);
  - USEPA's CCR Rule amendment (Federal Register Vol. 85, No. 219, 72506-72543) published on November 12, 2020 (effective date of December 14, 2020); and
- applicable provisions of the CCR Rule as adopted in the Virginia Solid Waste Management Regulations (VSWMR, 2016) on January 27, 2016, including adoption of 40 CFR Part 257 Subpart D by reference - Title 9 Virginia Administrative Code (VAC) Agency 20, Chapter 81-800 *et seq*. (9VAC20-81-800).

This GMP sets forth the requirements and procedures for collecting, analyzing, and managing groundwater samples and data from the uppermost aquifer underlying the UAP and LAP at the Station. In the event that future amendments to the VSWMR or Federal regulations conflict with any provisions of this GMP, the applicable regulation will supersede this GMP with the exception of DEQ-approved variances and Alternate Source Demonstrations (ASDs) and permit-specific conditions.

Revisions to this GMP may be required in the future due to changes in the monitoring network, sampling action, revisions to USEPA or VSWMR regulations, or at the request of the unit owner.

2.0 LOCATION INFORMATION

As presented on Drawing 1, the Station is located in Chesterfield County, east of I-95 on the south side of the James River (Dutch Gap Cutoff Channel) near its confluence with the Old Channel of the James River. The UAP and LAP are located on property owned and controlled by Dominion Energy and are part of the Station. The address for the Station is: 500 Coxendale Road, Chester, Virginia, 23836-2461.

As presented on Drawing 2, the Station covers approximately 841.82 acres and is comprised of seven parcels of property as follows:

Parcel Identification	Parcel Area (acres)	Primary Feature
8026654390	190	Industrial Landfill
8056662525	38	Greenspace
8066648063	206.31	Power Plant
8056627764	59.276	Offices/Training Facilities
8066628465	53.204	Wastewater Treatment Facility
8076601776	151	LAP
8116603332	144	UAP

The LAP, covering approximately 111 acres, is located to the south of the power plant on parcel No. 8076601776. The UAP, covering approximately 113 acres, is located to the southeast of the LAP on parcel No. 8116603332.

Site access to the Station is via Coxendale road near the intersection of Henricus Park Road. Access to the LAP is controlled with vehicle access provided via a locking gated entrance from Coxendale Road. Similarly, access to the UAP is controlled with vehicle access provided via a locking gated entrance entering from Henricus Park Road on the northeast corner of the Station or the LAP.

The LAP is bordered to the north by the Station; to the east by Henricus Park Road, across which is Aiken Swamp and Henricus Park; to the southeast by the UAP; to the south by the surface waters and undeveloped tidal flats and river bottom associated with Farrar Gut; and to the west by the Station's thermal discharge channel.

The UAP is bordered to the northwest by the LAP; to the north by Henricus Park Road, across which is Aiken Swamp and Henricus Park; to the east by Henricus Park and the Citie of Henricus; to the south and west by surface water and undeveloped tidal flats and river bottom associated with Farrar Gut.

2.1 Site Topography and Land Use

As shown on Drawing 1, a portion of the USGS 7½-minute topographic maps of Dutch Gap, Drewry's Bluff, Chester, and Hopewell, Virginia, the area in the vicinity of the Station has variable topography with incised uplands located to the west and low-lying river floodplain topography in the vicinity of the LAP and UAP and towards the north, east, and south. The local topography is dissected by drainages that discharge to the James River. Topographic

elevations at the Station range from near sea level around the perimeter of the LAP and UAP to more than 90 feet above mean sea level (AMSL) in the vicinity of the Station's Industrial Landfill on the west side of Proctors Creek.

In general, the Station property consists of wooded, open, and developed land on the south bank of the James River. The Station's northern, eastern, and southern boundaries are bordered primarily by the James River and associated floodplain areas. The western side is bordered by a combination of undeveloped and developed (industrial and commercial) properties.

2.2 Climate

Based on online National Oceanic and Atmospheric Administration (NOAA) data from Weatherspark (https://weatherspark.com/y/20218/Average-Weather-in-Chester-Virginia-United-States-Year-Round), the prevailing wind in the vicinity of the Station is from the south and west approximately 60% of the year on average with a prevailing wind from the north the remainder of the year (primarily in the months of February, March, September, and October). The wind speed averages approximately 5 miles per hour (mph), with November through April being the months with the highest average wind speed of 6.2 mph. The average monthly temperatures range from 89 F/70 F in July to 48 F/30 F in January.

Based on statistics presented in the *Soil Survey of Chesterfield County, Virginia* (https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/virginia/chesterfieldVA1906/chesterfieldVA1906.pdf), the average annual precipitation amount for the Station area ranges from 43.19 inches per year (Richmond) to 47.09 inches per year (Petersburg).

2.3 Site History

Available site history for the LAP and UAPs is discussed in the following sections.

2.3.1 Lower Pond Site History

VEPCO acquired the LAP property in 1959. The LAP was commissioned in 1964 by constructing dikes on its east, south and west sides. The east and west dikes tie into surrounding grades along the northern side of the LAP. The dikes are founded on native soils consisting of recent fine- and coarse-grained alluvial soils. The western, southern, and eastern dikes were raised approximately 5 feet in the late 1960's to increase the storage capacity of the LAP. The maximum height of the LAP dikes is approximately 19 feet above AMSL. Available design information for the LAP indicates that the base of the impoundment is located at an approximate elevation of 1.5 feet AMSL (Dames and Moore, 1984) with more recent CCR material delineation activities mapping the bottom of ash at a variable depth ranging from 10 feet below mean sea level (MSL) to 4 feet AMSL. Available site records indicate that the LAP historically received CCR and associated coal combustion process waste materials (O'Brien and Gere, 2010; Dames and Moore, 1983).

In October 2016, following the installation of additional monitoring wells around the perimeter of the active LAP, background sampling activities under the CCR Rule were initiated. The background sampling activities for the LAP under the CCR Rule were completed in August 2017. The initial CCR Rule Detection Monitoring Program event for the LAP was completed in September 2017. Based on the results from the initial CCR Rule Detection Monitoring Program sampling event, a CCR Rule Assessment Monitoring Program was initiated (initial CCR Rule Appendix III and IV sampling event) for the LAP following placement of the statistically significant increase notification in the operating record on December 25, 2017, consistent with the CCR Rule. The initial assessment monitoring event for the LAP was completed in February 2018, followed by the first semi-annual assessment monitoring event completed in May 2018.

Based on the evaluation of the 2018 groundwater monitoring program data, there were confirmed federal Groundwater Protection Standard (GWPS) exceedances during the 2018 first semi-annual sampling event for arsenic, cobalt, and total radium at MW-27.

Due to these exceedances, Dominion Energy initiated an Assessment of Corrective Measures (ACM) consistent with the CCR Rule requirements. The ACM Report, completed on May 17, 2019, summarized the results of the assessment of remedial alternatives for addressing the reported federal GWPS exceedances based on the results of the field investigation and Commonwealth of Virginia statutory requirements promulgated during the 2019 General Assembly for CCR source removal from unlined impoundments.

The LAP will be closed by removal with removal activities commencing in the spring of 2023. The CCR material will be excavated and beneficially reused to the extent practical with some material disposed of in a solid waste landfill designed and permitted to accept CCR materials.

2.3.2 Upper Ash Pond Site History

The UAP was formerly operated by Lone Star Industries, Inc. as a sand and gravel pit. The UAP property was originally leased by VEPCO for construction and operation of the UAP *circa* 1983. Subsequently, Dominion Energy acquired the UAP property and annexed it to the Station. The UAP was constructed within earthen perimeter embankments with a crest elevation of approximately 42 feet AMSL. Available design information for the UAP indicates that the base of the impoundment is located at an approximate elevation of 2.5 feet AMSL. Available site records indicate that the UAP received CCR and associated coal combustion process waste.

In October 2016, following the installation of additional monitoring wells around the perimeter of the active UAP, background sampling activities under the CCR Rule were initiated. The background sampling activities for the UAP under the CCR Rule were completed in August 2017 and the initial CCR Rule Detection Monitoring Program event was completed in September 2017. Based on the results from the initial CCR Rule Detection Monitoring Program sampling event, a CCR Rule Assessment Monitoring Program was initiated (initial CCR Rule Appendix III and IV

sampling event) for the UAP following placement of the statistically significant increase notification in the operating record on February 6, 2018, consistent with the CCR Rule. The initial assessment monitoring event for the UAP was completed in March 2018, followed by the first semi-annual assessment monitoring event completed in July 2018.

Based on the evaluation of the 2018 groundwater monitoring program data, there were confirmed federal GWPS exceedances during the 2018 first semi-annual sampling event for arsenic, cobalt, lithium, and total radium.

Due to these exceedances, Dominion Energy initiated an ACM consistent with the CCR Rule requirements. The ACM Report, completed on May 17, 2019, summarized the results of the assessment of remedial alternatives for addressing the reported GWPS exceedances based on the results of the field investigation and Commonwealth of Virginia statutory requirements promulgated during the 2019 General Assembly for CCR source removal from unlined impoundments.

The UAP will be closed by removal with removal actions commencing in 2023. The CCR material will be excavated and beneficially resulted offsite or disposed of in an offsite permitted industrial waste landfill.

3.0 GEOLOGY AND HYDROGEOLOGY

A number of water quality and hydrogeological investigations have been completed for the Station and surrounding area. A list of the investigations and reports that have been used to prepare the Site Conceptual Model that is presented herein is presented as follows:

- *Water Quality Impact Evaluation from Proposed Ash Tailings Impoundment at VEPCO's Chesterfield Power Station, Farrar Island, Virginia*. Prepared by Dames and Moore, Bethesda, Maryland, July 15, 1983.
- *Late Mesozoic and Cenozoic Stratigraphic and Structural Framework near Hopewell, Virginia*. Dischinger, Jr., J.B., 1987. U.S. Geological Survey Bulletin 1567.
- *Ground-Water Resources of the York-James Peninsula of Virginia*. Laczniak, R.J., and A.A. Meng III, 1988. U.S. Geological Survey, Water-Resources Investigation Report No. 88-4059.
- *Hydrogeology and Analysis of the Ground-Water Flow System in the Coastal Plain of Southeastern Virginia*. Hamilton, P.A., and Larson, J.D., 1988. Virginia State Water Control Board: U.S. Geological Survey.
- *Geologic Map and Generalized Cross Sections of the Coastal Plain and Adjacent Parts of the Piedmont, Virginia.* Mixon, R.B., C.R. Berquist, Jr., W.L. Newell, G.H. Johnson, D.S. Powars, J.S. Schindler, and R.K. Radar, 1989. United States Department of the Interior, U.S. Geological Survey. Miscellaneous Investigation Series. MAP I-2033. 1:250,000 scale.
- *Oil Discharge Contingency Plan, Groundwater Characterization Study, Virginia Power, Chesterfield Power Station*. Prepared by Environmental Service and Technology Corporation, May 1, 1993.
- *Supplemental Investigation of Groundwater Conditions at the Bellwood Extrusion Plant, Chesterfield County*, Virginia. Environmental Resource Management (ERM), September 2001.
- *The Virginia Coastal Plain Hydrogeologic Framework*, Professional Paper No. 1731. McFarland, E.R., and T.S. Bruce, 2006. U.S. Department of Interior, U.S. Geological Survey.
- *Hydrogeologic and Geotechnical Report for the Dominion Chesterfield Power Station Fossil Fuel Combustion Products Management Facility, Chesterfield County, Virginia.* Golder Associates Inc., July 2010.

- *Revised Groundwater Quality and Risk Assessment Report, Chesterfield Power Station – Old Ash Pond, VPDES Permit No. VA0004146, 500 Coxendale Road, Chesterfield County, Virginia*. URS Corporation, Richmond, Virginia, March 22, 2012.

- *Facility Background Concentration Report for Groundwater Analytes, Chesterfield Power Station Fossil Fuel Combustion Products Management Facility*. Golder Associates Inc., May 2012.

- *Report, Lower and Upper Ash Ponds, Chesterfield Power Station*. Haley and Aldrich. May 2019.

Based on review of the information presented in these investigations, a summary of the regional and site hydrogeology information comprising the Site Conceptual Model is presented in the following sections.

3.1 Site Soil Units

The United States Department of Agriculture (USDA) has mapped a variety of soils in the vicinity of the LAP and UAP, including Ochrepts and Udults soils, Fluvaquent soils, Chewacla loam, Toccoa fine sandy loam, Buncombe loamy fine sand, Chastin loam, and the Pamunkey loam (USDA, 2006). The Fluvaquent soils are classified as hydric soils and the remaining soils as upland soils. The distribution of Fluvaquent soils, as mapped by the USDA, correlates well with the surveyed site-specific wetland delineation limits.

3.2 Regional Geology

The Station is located approximately 2.5 miles east of the Fall Line in the western part of the Virginia Coastal Plain physiographic province. The surrounding area is characterized by gently rolling topography incised by a number of dendritically patterned, well established stream channels flowing in a general easterly direction towards the James River. The Coastal Plain physiographic province is composed of an extensive complex of interlayered, unconsolidated to semi-consolidated strata deposited between the Quaternary and Cretaceous Periods. The thickness of the strata is variable within the Coastal Plain, varying from a “feather’s edge” where the sediments overlap the Piedmont physiographic province rocks and saprolitic sediment, to massively bedded formations near the continental shelf.

A geologic map for the Station is presented as Drawing 3 (Mixon *et al.*, 1989). As presented, structurally, the Station is located within the easterly dipping Coastal Plain physiographic province, with the northern limits of the inactive, steep-angled, reverse Dutch Gap Fault (reactivated normal fault with a west footwall) mapped immediately southeast of the Station and extending beneath the UAP along the south bank of the James River (Old Channel).

The uppermost sediments at the Station are mapped as Quaternary alluvium associated with the present-day James River. The Quaternary sediments are underlain by Tertiary and Cretaceous sedimentary deposits of variable thickness. The Cretaceous sediments overlie the Petersburg Granite (mapped to the west) and other

undifferentiated basement rock that varies in texture from a relatively uniform aphanitic to phaneritic textured rock to a heterogeneous gneissic texture. The Petersburg Granite is variously described as a Paleozoic crystalline basement rock composed primarily of quartz, sodic plagioclase, potassium feldspar, biotite, and hornblende, with minor amounts of ilmenite, magnetite, pyrite, zircon, apatite, titanite, muscovite, and fluorite (VDMR, 1993). Locally (site investigations in 2016), the lower basement bedrock is overlain by consolidated sediments (mudstone, arkose, and conglomerate) that are believed to date to the Triassic. The basement bedrock surface in the vicinity of the Station is interpreted to be inclined to the east.

3.2.1 Site Geology

Numerous soil borings have been drilled in the vicinity of the LAP and UAP as part of the various site investigations that have been completed for the units. Construction details for selected soil borings, observation wells, and monitoring wells are summarized in Table 1 and presented on the soil boring and well construction logs in Appendix A. The locations for some of these boreholes along with key geological contact elevation data are presented on Drawing 4. Information from these soil borings, including visual descriptions and geophysical logs, have been compiled and evaluated to formalize the Site Conceptual Model for the area of the Station surrounding the LAP and UAP. The Site Conceptual Model is illustrated on Drawings 4 through 10, with the cross section locations shown on Drawings 4 and 5. This information supplements published literature and was used herein in the design of the groundwater monitoring systems for the LAP and UAP.

3.2.1.1 Basement Bedrock

Drawing 4 shows the locations of selected soil borings, monitoring wells, and observation wells that have been advanced in the vicinity of the LAP and UAP. Using surveyed elevation data and recorded geologic information from the soil borings, a structural contour map for the top of basement bedrock was developed and is presented as an overlay on Drawing 4. The top of bedrock surface reflects the unconformable contact between overlying sediments and the underlying basement bedrock, including saprolite, partially weathered rock, and the competent parent rock. For this Station, basement bedrock is defined as igneous and metamorphic rocks that underlie the general sequence of sedimentary rocks and sediments of the Coastal Plain physiographic province in Virginia.

Core samples and other drill cuttings for the basement rock at this Station yield bedrock descriptions that range from homogenous fine-grained phaneritic granite (correlated with the Petersburg Granite) to aphanitic massive to gneissic-textured metamorphic rocks. In general, the basement bedrock types on the southern and western sides of the LAP were granitic in texture, and the rocks to the north and east exhibited more of a fine-grained homogeneous or coarse-grained banded gneissic texture. Minimal saprolite overburden (generally less than 10 feet) was observed in areas where granitic-textured rocks were observed, with significant (up to 50 feet or more) saprolite observed over basement bedrock that is described as gneissic in texture. The saprolite ranges in grade from fully decomposed rock with no relic rock fabric to partially weathered rock with significant relic rock fabric. The

competent basement bedrock (Rock Quality Designation of 75% or higher) was observed to be fractured with some healed fractures observed in the core sections. Fracture patterns were generally observed to be shallow dipping oblique in nature. Significant fractures were not observed in the gneissic-textured rocks that were recovered during the investigation.

Groundwater movement within the basement bedrock is expected to occur within the secondary porosity that is developed in the bedrock. For granitic rock, the secondary porosity is primarily comprised of joints and other discontinuities. For the gneissic-textured rocks, the secondary porosity is expected to be primarily comprised of weathered rock zones with some discontinuity contributions. Additional groundwater movement is expected to occur within the northerly trending fault zones.

As presented on Drawing 4 and cross sections A-A' through H-H' (Drawings 6 through 10), the basement bedrock elevation at the Station ranges from -40 feet MSL beneath the western side of the LAP to lower than -210 feet MSL beneath the eastern portion of the UAP. The variable depth is currently interpreted as a function of en echelon faulting that is inferred to be associated with a buried rift basin from the Triassic Period. Specifically, available structural data for basement bedrock elevations suggest that a series of northerly trending en echelon normal faults (interpreted) is present to the west of the northernmost mapped extent of the reactivated Dutch Gap Fault (see Drawing 4). These interpreted faults are believed to be associated with basin rifting activities during the Mesozoic Era and are interpreted to be associated with the buried rift basin that has been identified beneath the easternmost portion of the UAP.

As interpreted, a normal fault bounded horst is believed to be present beneath the central area of the LAP. Based on elevation data, the throw on the western fault is estimated at 90 feet and the throw on the eastern fault is estimated at 60 feet. The horst appears to be bounded by an easterly dipping graben fault block to the west and a westerly dipping graben block to the east. A fourth easterly dipping fault block appears to be present on the west side of the Dutch Gap Fault, and basement bedrock elevations fall off with a steep gradient to the east of the delineated Dutch Gap Fault zone.

3.2.1.2 Newark Supergroup (Triassic inferred) Rocks

Also presented on Drawing 4 are contours for the top of interpreted Newark Supergroup (Triassic) sediments. Locally, the Triassic sediments are weathered to saprolite with increasing competence observed with depth, and a maximum observed thickness of approximately 180 feet near borehole O on the eastern side of the UAP (see Drawing 4 and cross section E-E' on Drawing 8). The rocks encountered on the east side of the Dutch Gap Fault were generally described as varying from red to reddish-brown to brown mudstone to arkose to conglomerate. The conglomerate materials appeared to be primarily comprised of rounded boulders and cobbles of silica-rich igneous origin with trace amounts of diabase.

As illustrated on Drawing 4 and cross sections F-F' (Drawing 9) and H-H' (Drawing 10), a smaller area of isolated Triassic sediment appears to be present beneath the west-central area of the UAP on the eastern flank of the horst. These rocks were highly weathered and consisted of conglomeratic materials. Locally, mudstone and arkose comprised the majority of the Newark Supergroup sediments that were encountered.

Groundwater movement within the Newark Supergroup sediment is expected to be controlled by the texture of the original rock and the degree of weathering. In general, the highly weathered sections of mudstone and arkose exhibit lower hydraulic conductivity values than less weathered or coarser grained rocks.

3.2.1.3 Potomac Formation

Drawing 5 presents a structural contour map for the top of the Cretaceous Potomac Formation as delineated beneath the Station. The Potomac Formation sediments at the site are generally described as green to grayish green to gray compacted fine sand interbedded with lenses of sandy gravel, and dense clayey silt and clayey sand. The gravels are generally comprised of well-rounded quartz gravel. The formation generally exhibits a fining upward sequence with the deposit capped by a dark gray clayey member over most of the Station (locally the clayey member is absent).

As shown on Drawing 5 and the cross sections on Drawings 6 through 10, the elevation for the top of the Potomac Formation is variable, ranging from several feet above MSL on the eastern side of the Dutch Gap Fault to less than -50 feet MSL beneath the paleo easterly trending James River channel that passes north of the UAP and beneath the southern portion of the LAP. The undulating nature of the Potomac Formation is believed to reflect a combination of post-deposition erosion and displacement by the Dutch Gap Fault.

The Potomac Formation sediments are fully saturated, and groundwater movement within the Potomac Formation sediment is expected to primarily be controlled by primary porosity and hydraulic gradients. The hydraulic conductivity of the clayey sediments is generally low relative to the sand units, with the greatest hydraulic conductivity expected within the gravel units.

3.2.1.4 Tertiary and Quaternary Sediments

The Tertiary and Quaternary sediments overlie the lower Potomac Formation and generally are not differentiated at the Station. In general, the surficial sediments are mapped as Quaternary sediments. The upper Quaternary sediments are generally described as tan to gray fine-grained materials (clay, clayey silt, clayey fine sand, and dense mica-rich silt) with a basal gravel or coarse sand, and organic materials within the upper sections of the unit interbedded with lenses of organic orange-brown medium to fine sand. Clay-rich deposits tend to be mottled with black coloration. Locally, organic materials are present in the form of roots, wood fragments, peaty materials, and charcoal-type layers. The deposits beneath the LAP are generally fine-grained with a dense clay unit (possible over-bank deposits) mapped beneath the entire LAP. The clayey unit thins out to the south of the buried easterly

trending paleo-channel, and the deposits in the vicinity of the UAP are generally coarser grained with more variability, presumably due to channeling and reworking by the current-day James River. Thickness of the upper Quaternary deposits is variable across the Station with the maximum thickness observed on the southwestern side of the UAP and the southern side of the LAP (*e.g.*, area of infilled river channel).

The lower Tertiary deposits are generally described as yellow to orange to orange brown sand and sandy gravel to clayey gravel, with blue and greenish-gray dense clayey silt and silt zones. The sediments general fine upward and the gravels are well rounded to sub-rounded with zones of cobbles and boulders. Locally, the lower Tertiary deposits appear to have been eroded with interpreted organic-rich Quaternary deposits directly in contact with the lower Cretaceous sediments.

The uppermost aquifer beneath the Station is an unconfined aquifer and is found within the Quaternary-Tertiary sediments. Groundwater movement within the uppermost aquifer is expected to primarily be controlled by primary porosity and hydraulic gradients relative to recharge and discharge areas. The hydraulic conductivity of the clayey sediments is generally low relative to the sand and gravel units, with the greatest hydraulic conductivity expected within the sandy gravel units.

3.3 Site Hydrogeology

The groundwater surface generally mimics area topography with groundwater movement from topographically high areas to topographically low areas (*i.e.*, James River channel). The uppermost aquifer beneath the Station is unconfined and found in the exposed surficial overburden, and is comprised of Quaternary and upper Tertiary sediments, hereafter referred to as the Columbia Aquifer (the water table aquifer system, which includes unconfined sections of the Yorktown Formation). The Columbia Aquifer is an unconfined water table aquifer that is underlain by various undifferentiated Tertiary sedimentary units and the Cretaceous Potomac Formation. Regionally, the Potomac Formation is a confined aquifer, and a fine-grained confining unit is present at the top of the formation across most of the Station (locally the fine-grained confining unit appears to have been eroded). The Potomac Aquifer overlies the fractured bedrock aquifer associated with the Petersburg Granite and other undifferentiated basement bedrock. The Triassic sediments are considered to be part of the bedrock aquifer system, with groundwater expected to flow vertically and laterally across geologic boundaries based on the hydraulic properties of the aquifer matrix. Locally, the highly weathered fine-grained sediments of the Triassic deposits serve as confining layers for water-bearing zones within the unit.

3.3.1 Description of the Uppermost Columbia Aquifer

As presented on Drawings 5 through 10, the uppermost aquifer for this Station is the Columbia Aquifer, herein defined as being comprised of Quaternary and Tertiary sediments, and locally, some of the lower hydraulically connected Potomac Formation sediments where they are unconfined. The uppermost aquifer is a water table

aquifer (unconfined), lower sections of which are locally semi-confined. In the vicinity of the site, the Columbia Aquifer thickness ranges from approximately 60 feet to less than 20 feet, with an estimated average saturated thickness of approximately 40 to 50 feet around the perimeter of the LAP and UAP.

Available published on-line information (https://tides.mobilegeographics.com) indicates that the tidal range for the James River in the vicinity of the Station (latitude 37.3833 North and longitude 77.3783 West) is variable and averages approximately 3 feet, with a typical river elevation range of 0.35 feet AMSL at low tide to 3.35 feet AMSL at high tide. The tidal range is observed to influence the groundwater table within the Columbia Aquifer for those areas that are located at elevations that are less than 3 to 5 feet AMSL. Specifically, site data document a hydraulic connection between the uppermost aquifer and the James River, with lagging tidal fluctuations (upward of 2 feet) observed in observation and monitoring well water level data. Based on site conditions, the gradient reversal associated with the tidal fluctuation is not significant in lateral extent (observed along the fringe of the ponds where they abut tidal surface water bodies), with the most significant impact of the gradient reversal being a mixing zone along the western side of the LAP and the western and southern sides of the UAP.

Beneath the LAP, the average thickness of the Columbia Aquifer is approximately 35 to 45 feet, and the water-bearing portion of the Columbia Aquifer is semi-confined (fully saturated) due to the presence of a sandy clay confining unit that underlies the LAP. Beneath the UAP, the average thickness of the Columbia Aquifer has been reduced by pre-pond sand and gravel mining activities that are believed to have resulted in the removal of the upper confining layer and a significant portion of the underlying sand and gravel material. The average observed thickness is approximately 20 to 25 feet, with the unit fully saturated except beneath the eastern area of the UAP due to uplift on the east side of the Dutch Gap Fault.

The depth to groundwater in the Columbia Aquifer is variable depending on topographic elevation. In the immediate vicinity of the LAP and UAP, the groundwater elevation ranges from sea level along the banks of the James River up to approximately 10 to 15 feet AMSL where the LAP and UAP abut, with higher groundwater elevations documented in the western portion of the Station to the west of the LAP.

Depth-to-water measurements have been obtained periodically from site wells since the 1980's. These measurements indicate that the regional water table is present at an elevation near MSL, with some mounding beneath the LAP and UAP. The mounding is believed to be associated with the infiltration of residual impounded process water and impounded precipitation. As shown on Drawing 11, the groundwater flow within the Columbia Aquifer beneath the LAP and UAP is radial in nature for both ponds, with flow originating from beneath the impoundments (recharge area) and discharging to nearby receiving surface water bodies (James River and associated systems).

3.3.1.1 Artificially Induced UAP Uppermost Aquifer Stresses

In addition to the natural recharge and discharge cycles associated with precipitation infiltration and vertical recharge to stratigraphically lower water-bearing units and gradient controlling discharges towards the James River, the water table surface in the Columbia Aquifer beneath the UAP is influenced by a perimeter toe drain that was installed around the outside of the UAP berm when it was constructed in the 1980s. The approximate location of the perimeter toe drain is shown on Drawings 2 and 13. The toe drain was installed as an engineering control during construction of the UAP to remove collected water from the impoundment berm to maintain and protect the berm's structural integrity. The toe drain is constructed in the Columbia Aquifer. Based on review of the design drawings for the toe drain, approximate invert elevations for the toe drain are indicated on Drawings 2, 11, 12, and 13 every 500 feet (approximate). These invert elevations, where they are lower than the inferred groundwater surface, indicate that the toe drain will influence the water table elevation when the toe drain is being pumped. The toe drain is currently in operation and is scheduled for removal as part of the UAP closure activities.

3.3.1.2 Artificially Induced LAP Uppermost Aquifer Stresses

As with the UAP, in addition to the natural recharge and discharge cycles associated with precipitation infiltration and vertical recharge to stratigraphically lower water-bearing units and gradient controlling discharges towards the James River, the water table surface in the Columbia Aquifer beneath the LAP will be influenced by the hydraulic barrier control system that will be installed to facilitate the closure by removal activities for the LAP. The hydraulic barrier control system will be comprised of interlocking sheet piles, a Trench-cutting Remixing Deep (TRD) wall, and a series of deep dewatering wells coupled with excavation dewatering sumps installed around the eastern, southern, and western perimeter of the LAP. Details for the hydraulic barrier control system are presented in Appendix C (Haley and Aldrich, June 2022) and discussed in detail in Section 4.1.1.1.

Specifically, following construction of the hydraulic barrier control system and initiation of dewatering activities, a steep inward gradient is expected to develop across the hydraulic barrier wall in proximity of dewatering locations. The gradient will be inward towards the LAP dewatered excavation.

Due to the low permeability of the TRD wall and associated sheet piles, a relatively insignificant amount of drawdown is expected outside of the wall within the uppermost aquifer from groundwater leakage through the hydraulic barrier wall where it is installed, as the hydraulic barrier wall is expected to have an average permeability that is three (3) or more orders of magnitude less than that of the uppermost water table aquifer. The relative difference in permeability will more than offset the increased gradient across the hydraulic barrier wall, such that the amount of groundwater available to flow through the hydraulic barrier wall will greatly exceed the amount of groundwater flux through the hydraulic barrier wall. Leakage along backfilled areas or unmined areas will be less, depending on the gradient across the hydraulic barrier wall at those locations.

Minor drawdown within the uppermost aquifer outside of the hydraulic barrier wall is expected from operations of the deep Columbia Aquifer extraction wells. It is noted that in areas where the deep wells extend to depths that are greater than the installed hydraulic barrier wall, the impacts from the dewatering activities could extend outside of the hydraulic barrier wall perimeter, resulting in greater than expected drawdown outside of the hydraulic barrier wall. Depending on the final design of the deep dewatering wells (depth and pumping rates) the dewatering activities are expected to invert the normal upward potentiometric head gradient that is typically observed within the Columbia Aquifer sediments in the vicinity of the LAP, such that a downward gradient within the Columba Aquifer within vicinity of the hydraulic barrier wall is expected to develop proximal to pumping wells. The interim monitoring network presented herein is designed to monitor for these potential hydraulic impacts.

Based on the proposed design of the hydraulic barrier control system, the collective hydraulic impacts to the uppermost aquifer outside of the hydraulic barrier wall on the eastern, southern, and western perimeters are expected to be minimal with a slight inward gradient developing between the adjacent recharge areas to the uppermost aquifer (ditches on the perimeter road to the east and adjacent surface water bodies to the east, west, and south) and the LAP excavation. While it is expected to be measurable, the gradient is expected to be minimal in nature due to variations in the hydraulic conductivity of the various sediments comprising the uppermost aquifer, such that no significant changes (*i.e.*, a decrease of less than 1 foot) in the potentiometric surface elevation within the shallow water-bearing sediments of the uppermost aquifer are expected to occur in close proximity to the hydraulic barrier wall (*i.e.*, greater than 10 feet from the wall). The interim groundwater monitoring network presented herein has been designed based on this understanding.

On the northern side of the LAP and the southeastern corner of the LAP, more significant drawdown is expected. The interim groundwater monitoring network has been designed to account for this expected drawdown consistent with DEQ's guidance for fully submerged well screens.

Additionally, as discussed, an upward gradient exists between the lower Potomac Formation sediments and upper Columbia Aquifer. Within the Columbia aquifer however, a downward gradient is expected to develop within the vicinity of the LAP due to pumping of the deep extraction wells that are proposed. This inversion is not expected to result in leakage from the water table aquifer to the lower confined Potomac Aquifer, rather the upward gradient will be expected to increase, resulting in additional upward flows that will require management by the dewatering system. Therefore, monitoring of the lower Potomac Aquifer during the interim excavation period is not required. The interim monitoring network has been designed to demonstrate the upward gradient from the Potomac Aquifer to the Columbia Aquifer.

3.3.1.3 Uppermost Aquifer Hydraulic Properties

Available hydraulic testing data (slug test and drawdown and recovery test) for various observation and monitoring wells in the area of the LAP and UAP, and generally within the Station boundary, are summarized in Table 2 by screened aquifer unit. As presented, the data indicate that the hydraulic conductivity of the sediments comprising the uppermost Columbia Aquifer range over approximately six (6) orders of magnitude as expected based on the variability of the depositional environments and sediments, with a geometric average of 1.24E-03 centimeters per second (cm/s), or 3.5 feet per day. Based on review of the materials that comprise the uppermost aquifer, the average effective porosity of the unconfined aquifer is estimated at 20% (Saunders, 1998).

3.3.1.4 Horizontal Component of Flow

Using the interpreted potentiometric surface information shown on Drawing 11, the average hydraulic gradient along the ideal flow line beneath both the LAP and UAP was calculated using the following equation:

$$i = {}^{h_L}/_{L}$$

Where: i = hydraulic gradient (unitless)
h_L = head loss (elevation difference in feet)
L = length (horizontal distance in feet)

The groundwater flow rate for the LAP and UAP was then calculated using the following formula:

$$V = {}^{ki}/_{\theta}$$

Where: V= Groundwater Velocity (cm/s)
k = hydraulic conductivity (cm/s)
i = hydraulic gradient (unitless)
θ = assumed porosity (unitless)

Using the estimated average effective porosity value of 20% for the sediments comprising the uppermost aquifer (Sanders, 1998), the estimated average hydraulic conductivity value for the uppermost aquifer (Columbia), and the calculated gradient, the average rate of groundwater flow (*Vgw*) in the uppermost aquifer beneath the LAP and UAP were calculated as follows:

Lower Ash Pond Calculations

Groundwater Flow	Hydraulic Conductivity (k, cm/s)	Contour lines (feet amsl)	Flow Length (feet)	Calculated Gradient (i)	Geometric Average Gradient (i)	Assumed Porosity (Ø)	Estimated Groundwater Velocity	
							(cm/s)	(feet/year)
2nd Semi-Annual Assessment Monitoring Program Event (October 2021)								
Unit -Columbia Vgw1	1.39E-03	5-1	181	2.2E-02	1.2E-02	0.20	8.3E-05	86
Unit -Columbia Vgw2		9.9-5.0	786	6.2E-03				

As presented, the estimated average groundwater flow rate in the uppermost aquifer beneath the LAP (*Vgw*) is approximately 86 feet per year. The calculated flow rate velocity for the events conducted in 2021 is reduced compared to historical data prior to 2019. The reduced and variable flow rate velocity observed from second semi-annual 2019 event to current is associated with the installation of the rain cover at the LAP. Specifically, the reduced gradient and associated reduction in the groundwater flow rate was expected due to the reduction in recharge to the uppermost aquifer.

Upper Ash Pond Calculations

Groundwater Flow	Hydraulic Conductivity (k, cm/s)	Contour lines (feet amsl)	Flow Length (feet)	Calculated Gradient (i)	Average Gradient (i)	Assumed Porosity (Ø)	Estimated Groundwater Velocity	
							(cm/s)	(feet/year)
2nd Semi-Annual Assessment Monitoring Program Event (October 2021)								
Unit -Columbia Vgw	1.39E-03	10-2.5	241	3.1E-02	3.2E-02	0.20	2.2E-04	230
		10-2.5	234	3.2E-02				
Unit - Potomac Vgw	2.78E-03	8.0-2.0	2,607	2.3E-03	2.3E-03	0.20	3.2E-05	33

As presented, the estimated average groundwater flow rate in the uppermost Columbia Aquifer beneath the UAP is variable depending on the gradient evaluation location and is approximately 230 feet per year for 2021. The estimated average groundwater flow rate in the lower Potomac Aquifer beneath the Unit is variable depending on the gradient evaluation location and ranges from approximately 33 to 47 feet per year for 2021. The calculated flow rates for the events conducted in 2021 are consistent with previous calculations for the UAP.

3.3.1.5 Vertical Component of Flow

Using depth-to-water and elevation data (October 2021) from nested wells screened between the Columbia Aquifer and the underlying Potomac Aquifer, the vertical component of flow within the water-bearing formations beneath the Station were evaluated. Calculations for the vertical gradient between the upper Columbia Aquifer and the lower Potomac Aquifer are summarized in the following table based on well construction information (see Table 1)

and measured groundwater elevation data. Gradient results that are negative indicate an upward flow. The calculations were performed using the following algorithm:

$$i_{gw} = \left({}^{h_L}/_{L}\right)$$

Where: i_{gw} = groundwater potentiometric surface gradient

h_L = head loss (elevation difference)

L = length (vertical distance – midpoint of the well screens)

Columbia			Potomac			Head Loss	Head Loss Length	Hydraulic Gradient
Well	Screen (ft MSL)	GW Elev. (ft MSL)	Well	Screen (ft MSL)	GW Elev. (ft MSL)			
MW-1	20-30	3.16	MW-1D	45-55	2.89	0.27	25	1.08E-02
MW-6	49-59	5.70	MW-6D	70-90	6.91	-1.21	26	-4.65E-02
MW-16	24-34	2.65	MW-16D	60-70	1.40	1.25	36	3.47E-02
MW-29U	8-18	0.35	MW-30U	44-54	2.45	-2.10	36	-5.83E-02
MW-35S	54-64	8.77	MW-35D	89-99	2.81	5.96	35	1.70E-01

The gradient results indicate that both downward and upward flow conditions are present at the Station and that these variable conditions likely relate to the degree of confining between the well screens. Wells pairs with significant confining units between the screened intervals appear to have upward gradients. Well pairs with no significant confining units have a downward gradient.

Based on the depositional environment, the vertical hydraulic conductivity value for the Columbia Aquifer is estimated at 0.35 ft/day (estimated at 10% of the horizontal hydraulic conductivity). The effective porosity as discussed previously is estimated at 20% on average. Using the following algorithm, the vertical groundwater velocity for the upper Columbia Aquifer was estimated in the following table.

$$V_{gw} = Kv\, i \left({}^{1}/_{n_e}\right)$$

Where: V_{gw} = Groundwater velocity

K_v = Vertical Hydraulic conductivity

i = Hydraulic gradient

n_e = Effective porosity

Well Pair		Hydraulic Gradient	Effective Porosity	Hydraulic Conductivity (ft/d)	Velocity (ft/year)
MW-1	MW-1D	1.08E-02	0.20	0.35	6.9
MW-6	MW-6D	-4.65E-02			-29
MW-16	MW-16D	3.47E-02			22
MW-29U	MW-30U	-5.83E-02			-37
MW-35S	MW-35D	1.70E-01			110

As presented, the vertical flow rates are expected to be variable, ranging from 110 feet per year downward to 37 feet per year upward.

3.3.2 Description of the Confined Potomac Aquifer

As presented on Drawings 5 through 10, the uppermost Columbia Aquifer is underlain by the confined Potomac Aquifer. The Potomac Aquifer is found within the Cretaceous Potomac Formation sediments and is largely comprised of sand and sandy gravel beds with thin beds and lenses of finer grained materials. For the purposes of this Site Conceptual Model, the Potomac Aquifer is confined to semi-confined with thickness ranges from more than 160 feet in some of the infilled grabens to less than 10 feet on the footwall side of the graben faults.

Except where it is unconfined and hydraulically connected to the upper Columbia Aquifer (primarily along the southern side of the UAP), the Potomac Aquifer does not exhibit any significant tidal impacts. In areas where the Potomac Aquifer is hydraulically connected to the upper Columbia Aquifer, the tidal effects are similar to those observed for the Columbia Aquifer.

Recharge to the lower Potomac Aquifer is expected via vertical recharge from the overlying Columbia Aquifer where the two units are hydraulically connected, and from up-dip horizontal recharge where the Potomac Formation sediments are exposed at grade.

Using depth to water measurements that have been obtained from site wells, a potentiometric surface map was prepared for the Potomac Aquifer. The map is presented as an overlay on Drawing 12. As presented, the

potentiometric surface elevation ranges from 2 to 8 feet above MSL. The highest elevations are observed beneath the eastern limits of the UAP where the Potomac Formation sediments are confined and have been uplifted by the Dutch Gap Fault. Lower elevations are observed along the southern side of the LAP and UAP where the Potomac Aquifer is hydraulically connected to the upper Columbia Aquifer along the gradient-controlling discharge boundary associated with the James River. As presented on Drawing 12, the groundwater flow direction within the Potomac Aquifer beneath the LAP and UAP is towards the south and south-southwest.

3.3.2.1 Potomac Hydraulic properties

Available slug test data for various observation and monitoring wells in the area of the LAP and UAP, and generally within the Station boundary, are summarized in Table 2 by screened aquifer unit. As presented, slug testing data indicate that the hydraulic conductivity of the sediments comprising the Potomac Aquifer range over approximately four (4) orders of magnitude as expected based on the variability of the depositional environments and sediments, with a geometric average of 2.78E-03 cm/s, or 7.89 feet per day. Based on review of the materials that comprise the uppermost aquifer, the average effective porosity of the unconfined aquifer is estimated at 20% (Saunders, 1998).

3.3.2.2 Potomac Horizontal Flow

Using the interpreted potentiometric surface information shown on Drawing 12, the average hydraulic gradient along the ideal flow line beneath both the UAP was calculated using the following equation:

$$i = {}^{h_L}/_{L}$$

Where: i = hydraulic gradient (unitless)
h_L = head loss (elevation difference in feet)
L = length (horizontal distance in feet)

The groundwater flow rate for the Potomac Aquifer beneath the UAP was then calculated using the following formula:

$$V = {}^{ki}/_{\theta}$$

Where: V= Groundwater Velocity (cm/s)
k = hydraulic conductivity (cm/s)
i = hydraulic gradient (unitless)
θ = assumed porosity (unitless)

Using the estimated average effective porosity value of 20% for the sediments comprising the uppermost aquifer (Sanders, 1998), the estimated average hydraulic conductivity value for the uppermost aquifer (Potomac), and the

calculated gradient, the average rate of groundwater flow (*Vgw*) in the uppermost aquifer beneath the UAP was calculated as follows:

Groundwater Flow	Hydraulic Conductivity (k, cm/s)	Contour lines (feet amsl)	Flow Length (feet)	Calculated Gradient (i)	Average Gradient (i)	Assumed Porosity (Ø)	Estimated Groundwater Velocity	
							(cm/s)	(feet/year)
2nd Semi-Annual Assessment Monitoring Program Event (October 2021)								
Unit - Potomac Vgw	2.78E-03	8.0-2.0	2,607	2.3E-03	2.3E-03	0.20	3.2E-05	33

As presented, the estimated average groundwater flow rate in the lower Potomac Aquifer beneath the Unit is variable depending on the gradient evaluation location and averages approximately 33 feet per year for 2021. The calculated flow rates for the events conducted in 2021 are consistent with previous calculations for the UAP.

3.3.2.3 Potomac Vertical Flow

Using October 2021 depth-to-water and elevation data from nested wells screened between the Potomac Aquifer and the underlying bedrock aquifer, the vertical component of flow between these two units was evaluated. Calculations for the vertical gradient between the Potomac Aquifer and the lower bedrock aquifer are summarized in the following table based on well construction information (see Table 1) and measured groundwater elevation data. Gradient results that are negative indicate an upward flow.

Potomac			Bedrock			Head Loss	Head Loss Length	Hydraulic Gradient
Well	Screen (ft MSL)	GW Elev. (ft MSL)	Well	Screen (ft MSL)	GW Elev. (ft MSL)			
MW-1D	45-55	2.89	MW-1DD	171-181	3.26	-0.37	126	-2.9E-03
MW-6D	70-90	6.91	MW-6DD	220-230	4.97	1.94	140	1.4E-02
MW-16D	60-70	1.40	MW-16DD	150-160	5.90	4.50	90	-5.0E-02
MW-30U	44-54	2.45	MW-31U	120-140	4.58	-2.13	81	-2.6E-02
MW-35D	89-99	2.81	MW-35B	165-175	3.39	-0.58	76	-7.6E-03

The gradient results indicate that both downward and upward flow conditions are present at the Station between the Potomac Aquifer and the lower bedrock aquifer.

Based on the depositional environment, the vertical hydraulic conductivity value for the Potomac Aquifer is estimated at 0.789 ft/day (estimated at 10% of the horizontal hydraulic conductivity). The effective porosity as

discussed previously is estimated at 20% on average. Using the following algorithm, the vertical groundwater velocity (negative values indicate upward flow) for the Potomac Aquifer was estimated in the following table.

$$V_{gw} = Kv\, i \left(1/n_e\right)$$

Where: V_{gw} = Groundwater velocity

K_v = Vertical Hydraulic conductivity

i = Hydraulic gradient

n_e = Effective porosity

Well Pair		Hydraulic Gradient	Effective Porosity	Hydraulic Conductivity (ft/d)	Velocity (ft/year)
MW-1D	MW-1DD	-2.9E-03	0.20	0.789	-4.2
MW-6D	MW-6DD	1.4E-02			20
MW-16D	MW-16DD	-5.0E-02			-72
MW-30U	MW-31U	-2.6E-02			-37
MW-35D	MW-35B	-7.6E-03			-11

As presented, the vertical flow rates are expected to be variable, ranging from 20 feet per year downward to 72 feet per year upward.

3.3.3 Description of the Confined Bedrock Aquifer

As presented on Drawings 5 through 10, the Potomac Aquifer is underlain by bedrock associated with the Triassic Basin (eastern area beneath the UAP) or the continental basement bedrock (igneous and metamorphic rocks). For the purposes of this Site Conceptual Model, the Triassic sedimentary rocks and basement bedrock are considered one aquifer system. The bedrock aquifer is considered to be confined beneath the entire study area. Recharge to the bedrock aquifer system is expected via vertical recharge from the overlying water-bearing units where downward potentiometric gradients exist, and from up-dip horizontal recharge where the bedrock (and/or associated saprolite) is exposed at grade.

Using depth-to-water measurements that have been obtained from site wells, a potentiometric surface map was prepared for the bedrock aquifer. The map is presented as an overlay on Drawing 13. As presented, the

potentiometric surface elevation within the study area ranges from 0 feet MSL to approximately 6 feet AMSL. The highest elevations are observed to the south of the LAP and UAP with flow towards the north and northeast. Elevational differences between the Triassic bedrock and basement bedrock suggest that the hydraulic connection between the two (2) bedrock systems is restricted (*i.e.*, the hydraulic conductivity of the two bedrock units is different) and/or that the conductivity of the Dutch Gap Fault zone is higher than that of either bedrock system. Specifically, groundwater elevations in the Triassic bedrock are higher than expected based on their spatial location relative to elevations observed in the adjacent basement bedrock wells, with evidence for gradient convergence on the Dutch Gap Fault zone.

3.3.3.1 Bedrock Hydraulic Properties

Available slug test data for various observation and monitoring wells in the area of the LAP and UAP, and generally within the Station boundary, are summarized in Table 2 by screened aquifer unit. As presented, slug testing data for one well are available (MW-35B). The results from this well suggest a hydraulic conductivity of 2.6E-07 cm/s, or 7.4E-04 foot per day. The hydraulic conductivity of the bedrock system within the basement bedrock suite is expected to be a function of secondary porosity, such that the conductivity is primarily a function of the presence and density of discontinuities (*e.g.*, fractures, joints, faults) within the rock. Based on experience with similar basement bedrock systems in central Virginia, the hydraulic conductivity value reported for MW-35B is believed to be on the low range of expected conductivity values for the similar basement bedrock systems. Based on experience, the effective porosity of the basement bedrock system is expected to range from 0.1% (whole rock average) to 50% for open joints in the basement bedrock. Based on available geological information and gradient observations, the hydraulic conductivity of the Triassic bedrock system is expected to be around 1.0E-04 ft/day, with an effective porosity of approximately 10% to 15% depending on the degree of weathering and the sediment characteristics (clays, silts, sands, gravels, *etc.*).

3.3.3.2 Bedrock Horizontal Flow

Using the groundwater contours presented as an overlay on Drawing 13 from October 2021, the average hydraulic gradient for the bedrock aquifer in the vicinity of the LAP was calculated at 2.0E-03 (unitless) as shown below.

$$i_{gw} = \left({}^{h_L}/_{L}\right)$$

Where: i_{gw} = groundwater potentiometric surface gradient

h_L = head loss (elevation difference)

L = length (horizontal distance)

$i_{gw} = h_L/L$ = (6.0 ft AMSL – 2.0 ft AMSL) / 2035 feet = 2.0E-03

Similarly, using the groundwater contours presented as an overlay on Drawing 13, the average hydraulic gradient for the bedrock aquifer in the vicinity of the UAP was calculated at 4.7E-03 (unitless) as follows:

$I_{gw} = h_L/L$ = (6.0 ft AMSL – 2.0 ft AMSL) / 857 feet = 4.7E-03

Using the estimated effective porosity value of 1%, an estimated average hydraulic conductivity value of 10 ft/day (3.5E-03 cm/s), and the calculated gradient, the average rate of groundwater flow (*Vgw*) in the bedrock aquifer beneath the LAP was calculated using the algorithm below.

$$V_{gw} = K\, i\, (1/n_e)$$

Where: V_{gw} = Groundwater velocity

K = Hydraulic conductivity

i = Hydraulic gradient

n_e = Effective porosity

V_{gw}= [(10 ft per day) x (2.0E-03)] / 0.01

V_{gw}= 2.0 ft per day, or 7.3E+02 ft per year (730 ft per year)

Similarly, the average rate of groundwater flow (*Vgw*) in the bedrock aquifer beneath the UAP was calculated as follows:

V_{gw}= [(10 ft per day) x (4.7E-03)] / 0.01

V_{gw}= 4.7 ft per day, or 1.7E+03 ft per year (1,700 ft per year)

As presented above, the estimated horizontal rate of groundwater flow in the bedrock aquifer beneath the LAP is expected to average approximately 730 feet per year, and beneath the UAP it is expected to average approximately 1,700 feet per year due to the steeper gradient in that area.

3.3.3.3 Water Supply Wells

There are no known drinking water supply wells located downgradient from the LAP or UAP (*i.e.*, between the units and the groundwater discharge divide associated with the James River). There are no known water supply wells

within the immediate vicinity of the LAP or UAP that could impact the compliance monitoring network or that could be impacted by a release from the units.

4.0 DESIGN OF THE GROUNDWATER MONITORING SYSTEM

The monitoring wells for the compliance monitoring network are located and constructed with a sufficient number of wells to yield groundwater samples representative of the conditions in the uppermost unconfined aquifer beneath the Station that:

- Accurately represent the quality of background groundwater that has not been affected by leakage from the waste management unit (CCR unit), and
- Accurately represent the quality of groundwater passing the waste boundary of the waste management unit (CCR unit). The downgradient monitoring system installed at the waste boundary will ensure detection of groundwater contamination in the uppermost aquifer. Dominion Energy will monitor potential contaminant pathways related to the waste management unit (CCR unit).

Dominion Energy obtained a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of the CCR Rule [§257.91(f)] as adopted under the VSWMR on October 16, 2017. The existing certification has been placed in the Station operating record in accordance with the recordkeeping requirements of §257.105 as adopted by the VSWMR. In addition, the certification has been placed on Dominion Energy's publicly accessible internet site. Following completion of background sampling activities for the new compliance wells proposed herein, the groundwater monitoring network for the LAP will be recertified by a qualified professional engineer in accordance with the CCR Rule requirements.

Well placement, construction, development, and decommissioning procedures are discussed in the following sections. Recommended monitoring well construction, development, and decommissioning procedures are included in Appendix B.

4.1 Special Conditions

Special conditions are site conditions that can affect the design of a groundwater monitoring system. These conditions may include:

- Waste management units, including CCR units, located above mounded groundwater table;
- Waste management units, including CCR units, located above aquifers with seasonally variable groundwater flow directions;
- Waste management units, including CCR units, located in areas where nearby surface water features or proximity to tidally influenced surface water bodies may influence groundwater levels or expected flow directions;

- Waste management units, including CCR units, located near intermittently or continuously used groundwater production wells; and/or
- Waste management units, including CCR units, located in karst (carbonate bedrock) or faulted areas where subsurface geologic features may modify expected groundwater flow paths.

4.1.1 Special Conditions And Groundwater Monitoring Network Design

Based on the available hydrogeologic information for the Station and the pending closure by removal activities for the LAP and UAP, other than the considerations listed below, Dominion Energy is not aware of any special conditions, including those listed above, that would affect the design of a downgradient groundwater monitoring network that can effectively monitor the uppermost aquifer:

- Due to the surrounding low-lying topography, recharge characteristics, the design of the ponds, and gradient-controlling discharges to the James River, a natural radial flow regime is indicated in the Columbia Aquifer (uppermost aquifer system) beneath both the LAP and UAP.
- A perimeter toe drain system that intersects the uppermost water table aquifer, and which may influence the uppermost water table aquifer is present around the northern, western, and southern limits of the UAP.
- Other than a mixing zone along the fringe of the LAP and UAP, the tidal fluctuations observed in the Columbia Aquifer and the lower hydraulically connected sections of the Potomac Aquifer along the James River do not appear to exhibit any significant impacts in terms of elevation range or gradient reversal within the Columbia Aquifer. This observation is not expected to have any adverse impact on the ability to monitor the downgradient boundary of the LAP and UAP using a conventional groundwater monitoring network.
- Due to the location of the LAP and UAP, both of which are generally bounded by the James River and a former channel of the James River, and the radial-like flow systems observed in the Columbia Aquifer beneath the UAP and LAP a suitable upgradient well location(s) that reflects upgradient groundwater quality that could not potentially be impacted by the LAP or UAP is not available. Therefore, the background wells for the LAP and UAP are not located in areas that are hydraulically upgradient of either the LAP or UAP. Additional details on the background wells are presented in the following sections.
- Based on available hydraulic information and interpolated potentiometric surface maps for the study area, the Dutch Gap Fault zone and associated Triassic faults interpreted to the west of the Dutch Gap Fault are not expected to impact the groundwater flow direction within the uppermost aquifer. Additionally, it is not clear at this time whether these interpreted fault zones exhibit any significant impact on groundwater flow in the lower bedrock system. Rather, the data suggest that the difference in hydraulic properties between the sedimentary bedrock and the igneous/metamorphic basement bedrock is responsible for gradient variations in the bedrock aquifer system.

- A hydraulic barrier control system, comprised of interlocking sheet piles, a TRD wall, and a series of deep dewatering wells coupled with excavation dewatering sumps is being installed around the eastern, southern, and western perimeter of the LAP in the 2022 timeframe to facilitate the removal of CCR from the LAP. Details for the hydraulic barrier system are presented in the following Section.
    - These systems combined with expected variable (location and time) dewatering activities and excavation backfill as required to support the CCR removal activities are expected to create an interim inward gradient condition for the LAP. The interim inward gradient could potentially impact the water level in some of the perimeter compliance wells for the LAP and the groundwater monitoring network design presented in this document was developed to account for the expected impacts from the hydraulic barrier control system.

4.1.1.1 LAP Hydraulic Barrier Control System Design Details

A hydraulic barrier control system is being installed around the perimeter of the LAP beginning in 2022 to support the closure of the LAP via removal of accumulated CCR materials. Construction of the hydraulic barrier control system, which required the decommissioning of wells MW-B40A, and MW-B41A, is required to control the influx of groundwater to the excavation area. The monitoring wells that were decommissioned for the project were decommissioned in a manner consistent with the provisions presented in Appendix B. Details for the hydraulic barrier control system are presented in the *Chesterfield Power Station TRD Wall Construction Plans* (Haley & Aldrich, June 2022) presented in Appendix C and the approximate location of the barrier system is shown on Drawing 2.

As presented in Appendix C, as part of the hydraulic barrier control system Dominion Energy will have approximately 5,566 linear feet of TRD wall installed around the eastern, southern, and western perimeter areas of the LAP to help mitigate the inflow of groundwater to the excavation that will be created during the closure by removal activities for the LAP. The TRD wall is designed to mitigate the inflow of shallow groundwater from the uppermost aquifer and will be supplemented by an existing sheet pile wall on the southwest corner (collectively referred to as the hydraulic barrier wall). The TRD wall will be constructed with a mixture of cement and native soils and is expected to have a permeability that is significantly less than the high-yield sections of the uppermost aquifer (Columbia Aquifer) beneath the LAP. The sheet pile section is constructed of steel piles and some leakage is expected along the slip joints between the piles, although such leakage is expected to be less than the leakage that would be observed from the natural formation sans piles.

The average permeability of the uppermost aquifer is estimated at approximately 1.39E03 centimeters per second (cm/s) and the average hydraulic barrier permeability is expected to be less than 1E06 cm/s, or approximately three (3) or more orders of magnitude lower than the uppermost aquifer permeability. The design plans indicate that the TRD wall will be approximately 1.5 feet thick and will extend to a variable depth elevation ranging from -30 feet MSL to -60 feet MSL depending on the location of water-bearing sediment zones within the uppermost aquifer. Of note,

the as shown in Appendix C and on Drawing 2, the hydraulic barrier wall will not be installed along the northern perimeter of the LAP, a perimeter distance of approximately 2,150 linear feet.

In addition to the hydraulic barrier wall, a series of deep dewatering wells will be installed within the lower section of the Columbia Aquifer sediments across the footprint of the excavation area to control the upward gradient to the excavation from the underlying water-bearing sediments. The Columbia Aquifer sediments are generally isolated from the underlying Potomac Formation sediments in the vicinity of the LAP by variable thickness fine-grained sediments that comprise an aquitard. The dewatering activities for project will be conducted as needed using a combination of open sumps, shallow well points, and dewatering wells.

4.2 Monitoring Well Placement

The monitoring network described herein is designed to meet the performance standards specified in the VSWMR consistent with the CCR Final Rule, and to ensure protection of human health and the environment. Accordingly, the monitoring network is designed so that adequate monitoring coverage is provided to represent the quality of groundwater downgradient of the waste management unit (CCR unit), and in areas of the Station where groundwater has not been impacted by the waste management unit (CCR unit). Consistent with Dominion Energy's policy, the monitoring wells are installed on property that is owned by Dominion Energy.

4.2.1 Background Wells

Based on site conditions, the Site Conceptual Model, our understanding of the vertical and lateral presence of subsurface confining units, and groundwater flow directions, the background compliance wells for the uppermost aquifer beneath the LAP (Columbia Aquifer only) and the UAP (Columbia and Potomac Aquifer) are presented as follows:

Lower Ash Pond Background Compliance Wells		
Well	**Aquifer**	**Use**
MW-29U	Columbia	Background Compliance
MW-35S	Columbia	Background Compliance

Upper Ash Pond Background Compliance Wells		
Well	**Aquifer**	**Use**
MW-29U	Columbia	Background Compliance
MW-30U	Potomac	Background Compliance
MW-35S	Columbia	Background Compliance
MW-35D	Potomac	Background Compliance

A summary of the well construction information for the existing wells, including nearby observation wells, is provided in Table 1.

Due to the hydraulic flow regime and property ownership limitations, it is not feasible at this time to install a background well(s) for the Triassic aquifer beneath the eastern side of the Upper Ash Pond. Therefore, the consolidated background concentrations for the Columbia and Potomac Aquifers is used for background concentrations with wells that are screened within the Triassic aquifer. This approach is justified on the basis that sediments of the Columbia and Potomac Formations are present above the Triassic aquifer and therefore, vertical recharge to the Triassic aquifer is expected to infiltrate through these sediments imparting a matrix-representative geochemical signature to the recharge water. This approach does not account for geochemical changes that may occur within the Triassic aquifer once the recharge passes through the Triassic aquifer matrix. As such, modifications to the background network for the Triassic aquifer may be warranted in the future if spatial variability between the consolidated Columbia/Potomac Aquifers and the Triassic aquifer is significant.

4.2.2 Lower Ash Pond Compliance Wells

The LAP is underlain by a confining unit that separates the upper Columbia and lower Potomac Aquifers. Therefore, the downgradient compliance monitoring network for the uppermost aquifer (Columbia Aquifer) beneath the LAP, considering the special conditions that will be encountered with construction and operation of the hydraulic barrier control system, is as follows:

Lower Ash Pond Modified CCR Rule Compliance Monitoring Wells				
MW-25	MW-28	MW-20	MW-21R	MW-22R
MW-26	MW-27	MW-32SR	MW-23R	MW-33R
MW-34	MW-36(S)	--	--	--

A summary of the well construction information for the existing wells, including nearby observation wells, is provided in Table 1. Former compliance wells MW-21, MW-22, MW-23, MW-32S, and MW-33 were replaced with MW-21R, MW-22R, MW-23R, MW-32SR, and MW-33R in the spring of 2021 as part of the closure by removal project. Former observation wells MW-B40A (former VPDES well) and MW-B41A (former VPDES well) were decommissioned in August 2022 as part of the CCR removal project.

4.2.3 Upper Ash Pond Compliance Wells

Due to the removal of the natural confining layer between the upper Columbia Aquifer and the lower Potomac Aquifer by historical mining activities and/or natural depositional processes, the downgradient monitoring system for the UAP monitors the upper Columbia (C), the lower Potomac (P) Aquifer systems, and beneath the eastern side of the Station, the Triassic (T) aquifer system. Specifically, the downgradient compliance monitoring network for the uppermost aquifer beneath the UAP and the associated aquifer [indicated with postscripts (C), (P), and (T)] is as follows:

Upper Ash Pond Downgradient Compliance Wells				
MW-1 (C)	MW-1D (P)	MW-2 (C)	MW-3S (C)	MW-3D (T)
MW-4 (P)	MW-5 (C)	MW-6 (P)	MW-6D (T)	MW-7 (P)
MW-8R (C)	MW-9R (C)	MW-10 (P)	MW-11 (C)	MW-12 (C)
MW-13 (C)	MW-14 (P)	MW-15 (C)	MW-16 (C)	MW-16D (P)
MW-17S (C)	MW-B31 (C)	MW-B32 (C)	--	--

A summary of the well construction information for the existing wells, including nearby observation wells, is provided in Table 1.

4.2.4 Station Observation Wells

In addition to the background wells and downgradient wells for the compliance network, Dominion Energy maintains several observation wells that are used for periodic water level gauging and water quality assessments.

4.3 Monitoring Well Construction

Historical logs for MW-B31 and MW-B32 are not readily available. Based on historical tabulated information and downhole video logging, which indicates that these two wells are constructed with 10 feet of 2-inch inner diameter (ID) polyvinyl chloride (PVC) screen located within the upper portion of the Columbia Aquifer, well construction logs for the two (2) wells were prepared and are presented in Appendix A. Historical soil boring and well construction logs for the remaining monitoring wells and some of the observation wells that have been installed at the Station are also presented in Appendix A, along with geophysical logs for MW-1DD, MW-6DD, MW-16DD, and MW-31U.

As summarized in Table 1, the monitoring wells are generally constructed with 10 feet (some of the deep wells have 20 feet) of 2-inch ID PVC casing and 0.010-inch factory slotted, flush-threaded well screen. The bottom of the wells are equipped with a flush-threaded end cap and the well casings are extended to approximately 30 inches above grade (for wells that are not located in the 100-year floodplain). The wells were constructed so that the top of the screened interval is at least 5 feet below the seasonal low water table surface or the bottom of the adjacent pond, whichever is lower. Additionally, based on the Site Conceptual Model, the top of the well screens for wells MW-1 through MW-17 were located to extend from at least 5 feet below the invert elevation of the adjoining toe drain (where it intersects the water table).

Monitoring wells that are located above the 100-year floodplain elevation are completed with a locking protective standpipe, a concrete apron for surface protection, and concrete-filled bollards that were strategically located to protect the well head from vehicular traffic.

Monitoring wells that were installed in areas that are below the 100-year floodplain elevation are finished with a water-tight casing equipped with a self-vented, self-sealing air release value. The casings were equipped with a water-tight clean-out that allows access to the well head for sampling. The normally open air-release valve allows the well casing to breathe as the water level in the well fluctuates and will automatically close (via flotation) in the event that floodwaters begin to encroach upon the well casing. Wells equipped with the water-tight casings are secured in locking fiberglass construction utility cabinets that are secured to a concrete pad centered on the well casing. As with the stick-up well constructions, the floodplain well heads were finished with concrete-filled bollards that were strategically located to protect the well head from vehicular traffic and possible floating debris.

Details for the water-tight well casings are presented on Figure 1 in Appendix B. The design was selected to prevent surface water from entering the wells in the event of a flood, and to protect the wells from floating debris, while providing access to the wells for sampling with dedicated equipment during normal site conditions (*i.e.*, non-flood conditions).

If additional wells are required in the future, construction will be performed in general accordance with the specifications presented in Appendix B. Monitoring wells will be maintained such that they perform to design

specifications throughout the life of the monitoring program. Dominion Energy will document and include in the Station operating record the design, installation, and development of any monitoring wells, piezometers, and other measurement, sampling, and analytical devices as required by §257.91(e)(1) and in accordance with the recordkeeping requirements of §257.105 as adopted in the VSWMR.

4.3.1 Drilling Methods

Drilling of new monitoring wells will be performed in general accordance with the specifications presented in Appendix B. It is anticipated that a number of different drilling technologies may be used at this Station based on the geologic conditions that have been encountered. A qualified groundwater scientist will prepare and certify a boring and well construction log for each new well within 30 days of installation. Dominion Energy will transmit the boring logs, well construction logs, and appropriate maps for any wells to be included in the permitted network to the DEQ within 14 days of certification by the qualified groundwater scientist in accordance with the VSWMR. Available boring logs and well construction diagrams for current monitoring wells are provided in Appendix A.

4.3.2 Well Screens

Monitoring well screens should, in most circumstances, be a maximum of 10 feet in length. The design of new monitoring wells should take into consideration the hydrogeologic conditions at the site, the fate and transport considerations of the potential contaminants being monitored, and the procedure(s) being used to sample the monitoring well(s). Ideally, to preserve the geochemical integrity of the water samples, well screens should be designed and placed (vertically) in a manner that prevents a change in the well screen exposure during sampling (relative to the exposure between sampling events) so that conditions during the sampling event do not change from the conditions that are present between sampling events. For CCR facilities, DEQ requires that all monitoring wells be screened solely within the saturated zone of the uppermost aquifer (no portion of the screen should be exposed above the zone of saturation). In addition, wells shall be screened in naturally occurring geologic formations, not in manmade deposits (*e.g.,* fill, mine spoil).

4.3.3 Wellhead Completions

Wells will be completed with a locking protective standpipe and a concrete apron for surface protection. Construction of new monitoring wells will be performed in general accordance with the specifications presented in Appendix B. Protective bollards for monitoring wells will be installed at the time of well construction as needed for wells located adjacent to high traffic areas or the 100-year floodplain, or later if it is determined that protective bollards are warranted. Bollards will generally be painted with high-visibility paint to assist with wellhead protection.

4.3.4 Well Development

The existing wells have been developed. If new wells are installed, the new wells will be developed prior to sampling to remove particulates that are present in the well casing, filter pack, and adjacent aquifer matrix due to construction

activities. Development of new monitoring wells will be performed at least 24 hours after well construction. Wells may be developed with disposable bailers, a well development pump, or other approved method. Well development procedures are presented in Appendix B.

Samples withdrawn from the Station's monitoring wells should be clay- and silt-free; therefore, wells may require redevelopment from time to time based upon observed turbidity levels during sampling activities. If redevelopment of a monitoring well is required, it will be performed and documented in a manner similar to that used for a new well.

4.3.5 Pump Installations

Wells designated for use in the compliance monitoring network have dedicated bladder pumps, or similar pumps, installed to facilitate micropurge sampling activities. The pumps and associated tubing are constructed of environment-inert materials suitable for use in compliance and corrective action monitoring programs. Each pump should be placed within the middle portion of the well screen, and no closer than 2 feet from the bottom of the well.

4.3.6 Documentation

Documentation of future well construction activities will be in accordance with the VSWMR and CCR Final Rule. New wells will be surveyed by a licensed surveyor to within ±0.05 foot on the horizontal plane and ±0.01 foot vertically in reference to mean sea level. A boring log, well construction log, groundwater monitoring network map, and installation certification will be submitted to the DEQ within 14 days of certification by the qualified groundwater scientist in accordance with the VSWMR. Separately, a copy of the boring log, well construction log, groundwater monitoring network map, and installation certification will be incorporated into the Station operating record as required under §257.105 of the CCR Final Rule as adopted in the VSWMR. The certification shall occur within 30 days of well construction (including the licensed well survey).

4.4 Monitoring Well Decommissioning Procedures

If a monitoring well becomes unusable during the life of the monitoring program, Dominion Energy will make reasonable attempts to decommission the monitoring well in accordance with procedures presented in Appendix B.

4.4.1 Documentation

DEQ approval will be obtained prior to decommissioning any monitoring wells that are in the Station's compliance monitoring network. A report describing the decommissioning procedures will be transmitted to DEQ following completion of the decommissioning activities. Separately, a copy of the report will be included in the Station operating record in accordance with the recordkeeping requirements of §257.105 as adopted in the VSWMR.

4.5 Monitoring Well Replacement

Any monitoring well that fails to perform as designed shall be replaced prior to the next regularly scheduled groundwater sampling event, or as warranted. Non-performance of permitted groundwater monitoring wells should be reported to DEQ within 30 days of recognition.

If a monitoring well becomes unusable during the life of the monitoring program, Dominion Energy will make reasonable attempts to decommission the monitoring well in accordance with the procedures presented in Appendix B.

4.5.1 Documentation

DEQ approval will be obtained prior to decommissioning any monitoring wells that are in the compliance monitoring networks. A report describing the decommissioning procedures will be transmitted to DEQ following completion of the decommissioning activities. The report will be prepared in accordance with the provisions in Appendix B.

4.6 Well Operations and Maintenance

In accordance with the VSWMR and §257.91(e)(2), the compliance monitoring wells will be operated and maintained so they perform to their design specifications throughout the life of the monitoring program. Maintenance activities for the compliance wells are as follows:

Activity	Schedule
Lock Inspection	Each Monitoring Event
Protective Casing Inspection	Annually
Pump Inspection & Cleaning	Annually
Depth to Well Bottom	Annually
Fully Submerged Screen	Each Monitoring Event
Concrete Pad Inspection	Annually
Surface Water Infiltration Evaluation	Annually
Grass Mowing	Semi-Annually as needed
Air Vent Testing (floodplain wells)	Annually

The results from the well inspections will be recorded on a Well Inspection Log or similar during the routine semi-annual sampling events. Samples of typical well inspection logs are presented in Appendix B.

4.6.1 Floodplain Wells

Existing compliance wells located in the 100-year floodplain are installed with a floodplain resistant wellhead similar in design to the specification detailed in Figure 1 of Appendix B. This well head is designed to allow the well to breath under normal conditions (atmospheric pressure) and will close to prevent well flooding if the surrounding water level overtakes the vent housing. Additionally, the compliance wells in the floodplain are protected from rafted debris with bollards on the four corners of the surface pad.

Wells with this or similar floodplain protection designs should be inspected after every flooding event to ensure that there is no surficial damage from the flood that could impact the integrity of the well or future groundwater samples. If damage is observed, Dominion Energy will affect repairs before the next sampling event and will document the damage and completed repairs for the operating record.

For observation wells that are not constructed with the floodplain well housing, Dominion Energy will coordinate for removal and/or sealing of the wells with watertight compression caps as feasible prior to flooding events. Such measures will prevent surface water from entering the well and impacting the uppermost aquifer. After the highwater has passed, each well will be accessed to determine if surficial damage that could impact the integrity of the well or future groundwater samples has occurred. If damage is observed, Dominion Energy will affect repairs before the next sampling event and will document the damage and completed repairs for the operating record.

If Dominion Energy is not able to seal one or more wells prior to a flooding event, the well will be assessed after the flood event is over to determine the extent of impacts, if any. If available data indicates that the well head was submerged, the well will be re-developed to remove silt and other materials that may have entered the well. The goal of the redevelopment activities will be silt removal and to flush the well and surrounding aquifer with aquifer water. Development activities will be conducted until such time as the pH and specific conductance of the water recovered from the well is measured to be to be similar (within the bound of) to the upper and lower confidence limits for the targeted parameters based on measurements collected during any previously conducted sampling events. If development activities are not able to restore the water quality, the DEQ will be contacted at that time to discuss alternative solutions.

As of the date of this revision, the following wells have a flood-resistant wellhead:

Monitoring Wells		
MW-1	MW-13	MW-21I
MW-1D	MW-14	MW-22R
MW-1DD	MW-15	MW-23R
MW-2	MW-B32	MW-25
MW-2I	MW-17S	MW-26
MW-B31	MW-29U	MW-27
MW-3S	MW-30U	MW-32SR
MW-3D	MW-31U	MW-33R
MW-4	MW-20I	MW-34
MW-5	MW-21R	MW-36S
MW-36I		

5.0 GROUNDWATER MONITORING PROGRAM

This GMP is intended to provide a framework for consistent sampling and analysis procedures (as provided in Section 6.0) that are designed to ensure monitoring results from the detection and assessment monitoring programs provide an accurate representation of groundwater quality at the background and downgradient wells.

Groundwater monitoring activities for LAP and UAP have historically been performed in compliance with two (2) regulatory programs:

1. Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0004146 – Groundwater monitoring and reporting activities are currently being conducted in accordance with the conditions in the Chesterfield Power Station VPDES Permit and the affiliated VPDES GWP.

2. CCR Rule – Groundwater monitoring for the began in October 2016 under the Detection Monitoring Program which included eight (8) background sampling events and the initial Detection Monitoring Program event which was conducted in September 2017. Evaluation of Detection Monitoring Program data identified statistically significant increases (SSIs) over background for several CCR Rule Appendix III constituents. The SSI determination was completed in December 2017 for the LAP and February 2018 for the UAP. Based on the SSI findings, Dominion Energy initiated the CCR Rule Assessment Monitoring Program with the initial Assessment Monitoring Program sampling event for the LAP conducted in February 2018 and the UAP in March 2018.

In order to comply with the requirements of the CCR Rule, as well as the pending Solid Waste Facility Permit, Dominion Energy has prepared this GMP which presents a “modified” Assessment Monitoring Program modeled on the requirements of the CCR Rule, the VPDES permit requirements, and the expected solid waste permit (SWP) requirements. The modified Assessment Monitoring Program is designed to meet the requirements of VSWMR’s Phase II Monitoring Program and CCR’s Assessment Monitoring Program. To the extent a conflict exists between the requirements of the CCR Rule and VSWMR, this GMP utilizes the more stringent of requirements. Current monitoring programs for the LAP and UAP are conducted pursuant to the CCR Rule Assessment Monitoring Program and the VPDES permit requirements.

5.1 Groundwater Monitoring Program Data Management

Records of the background groundwater quality data and subsequent measurements, including concentration data, are (will be) kept in the operating record (reference the annual groundwater monitoring reports), provided to DEQ, and placed on the publicly available website in accordance with the recordkeeping and notification requirements of §257.105, §257.106, and §257.107 as adopted in the VSWMR. These records will be maintained throughout the active lives and post-closure care periods for the impoundments.

For each parameter, the laboratory certificates-of-analysis will identify the analytical Limit of Quantitation (LOQ), the analytical Limit of Detection (LOD), the reported concentration, and applicable laboratory quality assurance/quality control (QA/QC) data on surrogate and standards analyses. Statistical evaluations of the analytical data (if completed), federal GWPS and Virginia Groundwater Protection Standard (GPS) comparisons, static water level determinations and evaluations, and use of other measurement, sampling, and analytical devices, will be retained throughout the active lives and post-closure care periods for the impoundments.

5.2 Modified Assessment Monitoring Program

The modified Assessment Monitoring Program is designed to identify the presence and concentration of targeted potential solid waste constituents in the uppermost aquifer beneath the LAP and UAP, and to determine if those constituents are derived from the CCR units at concentrations that would require groundwater corrective action. Components of the modified Assessment Monitoring Program, including analytical requirements, sampling frequency, and data evaluation, are discussed in the following sections. The LAP and UAP are currently monitored under the provisions of the CCR Rule Assessment Monitoring Program and the Station's VPDES Permit. The modified Assessment Monitoring Program will be implemented following issuance of the Virginia SWP.

In accordance with the CCR Final Rule as adopted in the VSWMR, a notification must be prepared and placed within the operating record for each impoundment and on the publicly available website stating that an Assessment Monitoring Program has been established. Pursuant to §257.106 as adopted in the VSWMR, the DEQ must be notified when the notice has been placed. The required notification has been placed in the Station's operating record.

As requested by the DEQ, Dominion Energy will establish a background concentration for the constituents in the modified Assessment Monitoring Program. The background concentrations will be submitted to the DEQ as a *Facility Background Determination Report* consistent with the timeframes in the VSWMR.

Components of the modified Assessment Monitoring Program, including analytical requirements, sampling frequency, and data evaluation, are discussed in the following sections.

5.3 Constituents

The modified Assessment Monitoring Program will consist of the following constituents:

- CCR Rule Appendix III constituents;
- CCR Rule Appendix IV constituents (annual event with semi-annual events for detected constituents);
- VSWMR Table 3.1 Column B metals not included in the CCR Rule;

- Inorganic constituents listed in VPDES Permit VA0004146 (not included in CCR Rule Appendix III, CCR Rule Appendix IV, and VSWMR Table 3.1 Column B metals); and
- Speciation of chromium (total and hexavalent).

Samples will be analyzed using the appropriate analytical method from the latest edition of USEPA *Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846,* if available. The suggested analytical methods and LOQ for the proposed modified Assessment Monitoring Program constituents are presented in Table 4. Final laboratory results will be reported in parts per billion for all metals constituents

5.4 Sampling Schedule

Sampling under the modified Assessment Monitoring Program will occur semi-annually (180 days plus or minus 30 days) with the sample analyses completed within the calendar year semi-annual period consistent with the CCR Rule.

5.5 Verification Sampling Events

If verification sampling events are undertaken to verify suspect analytical results, the verification sampling activities, including laboratory analyses, must be completed within the combined 30-day determination and 14-day reporting window for SWP GPS exceedances (total of 44 days from the date of receipt of the laboratory certificates of analysis for the sampling event).

5.6 Establishing Groundwater Protection Standards

The federal GWPS were established for the LAP and UAP consistent with the timeframe in the CCR Rule.

Following implementation of the modified Assessment Monitoring Program, impoundment- and aquifer-specific SWP GPS will be calculated using the background well data for CCR Appendix IV constituents, VSWMR Table 3.1 Column B metals, and boron. The SWP GPS will be established in accordance with §257.95(h) as adopted in the VSWMR. The proposed SWP GPS will be developed based on the following requirements unless the requirements for establishing SWP GPS are revised by the USEPA or the DEQ with future revisions to the CCR Rule/VSWMR, in which case the more stringent provisions will apply:

- For constituents for which a USEPA Maximum Contaminant Level (MCL) has been established, the MCL for that constituent will be used as SWP GPS;
- For constituents for which MCLs have not been established, the impoundment- and aquifer-specific background concentration established from the background wells will be used as SWP GPS; or

- For constituents for which the impoundment- and aquifer-specific background level is higher than the MCL, the background concentration established from the background wells will be used as SWP GPS, as approved by the DEQ.

The established federal GWPS and SWP GPS will be included in the annual monitoring report required by §257.90(e) as adopted by the VSWMR and the corrective action report (if required). The MCL-based federal GWPS and SWP GPS will be updated upon USEPA's promulgation of new or revised MCLs. Following approval of the SWP GPS by the DEQ, the background-based SWP GPS will be updated every 2 years such that the eight (8) most recent background well sampling results will replace the oldest eight (8) background well sampling results.

Following initiation of the modified Assessment Monitoring Program and the establishment of background concentrations for the Table 4 constituents to be presented to the DEQ in a *Facility Background Determination Report*, proposed SWP GPS for the applicable constituents (CCR Rule Appendix IV constituents, boron, and VSWMR Table 3.1 Column B metals) will be submitted to the DEQ consistent with the VSWMR and the CCR Rule. Following issuance of the SWP, the SWP GPS based on MCLs will become effective immediately upon proposal. The SWP GPS based on background concentrations will become effective upon written DEQ approval.

The federal GWPS will be submitted to the operating record after completing the initial modified Assessment Monitoring Program event and no later than 30 days after establishing background concentrations for required monitoring constituents. The existing federal GWPS are presented in Appendix D and have been placed in the Station's operating record.

5.7 Analytical Data Evaluation

Groundwater data will be evaluated statistically as described in Section 7.0 of this GMP. The results of the statistical analyses will then be evaluated as follows:

- If the concentration of any monitored constituent is present in the groundwater at a concentration that is above the impoundment-specific background concentration, but below the current federal GWPS / SWP GPS, Dominion Energy shall continue the modified Assessment Monitoring Program.
- If any monitored constituent is present at a concentration that exceeds the impoundment-specific background concentration and/or the most current established federal GWPS or SWP GPS, Dominion Energy may:
  - Prepare an ASD certified by a qualified professional engineer within 90 days of determining the exceedance of federal GWPS / SWP GPS; or
  - Begin the initial steps toward groundwater Corrective Action. The Corrective Action Program will be consistent with both VSWMR 9VAC20-81-260 and §257.96, §257.97, and §257.98 of the CCR Rule.

5.8 Data Validation

In accordance with 9VAC20-81-250.A.4.j, voluntary third-party data validation of laboratory data may be completed during the 30-day statistical determination period.

5.9 Modified Assessment Monitoring Program Reporting Requirements

Reports required under the modified Assessment Monitoring Program include a federal GWPS / SWP GPS exceedance notification (if required), a semi-annual report, and an annual report. Consistent with the CCR Rule reporting requirements, required reports will be provided to the DEQ Regional Office upon posting in the Station's operating record and publicly-accessible internet site.

The minimum required information for each report and submittal timeframes for the reports are discussed in the following sections.

5.9.1 Facility Background Determination Report

A *Facility Background Determination Report* will be prepared for the LAP and UAP within 30 days of initially establishing background or re-establishing background. The *Facility Background Determination Report* will present the impoundment's established background concentrations for the constituents listed in Table 4. The *Facility Background Determination Report* will be placed in the operating record within 30 days of completion.

5.9.2 Groundwater Protection Standard Exceedance Notifications

Consistent with 9VAC20-81-250.C.3.e(3)(a) of the VSWMR, Dominion Energy will submit a SWP GPS exceedance notification for Table 4 constituents that have established SWP GPS to the DEQ within 14 days of identifying a statistical exceedance of a SWP GPS (no more than 44 days from issuance of the laboratory report).

Similarly, under the CCR Rule Dominion Energy will post a GWPS exceedance notification to the Facility's operating record for CCR Rule Appendix IV constituents that have established GWPS within 30 days of determining the statistical exceedance of a GWPS.

For the LAP, based on the evaluation of the 2018 groundwater monitoring program data there were confirmed federal GWPS exceedances. As a result of these findings, Dominion Energy initiated an ACM within the required timeframe pursuant to 40 CFR Part 257.96. The ACM was completed with a copy placed in the Station's operating record on May 17, 2019.

Similarly, for the UAP, based on the evaluation of the 2018 groundwater monitoring program data there were confirmed federal GWPS exceedances. As a result of these findings, Dominion Energy initiated an ACM within the required timeframe pursuant to 40 CFR Part 257.96. The ACM was completed with a copy placed in the Station's operating record on March 1, 2019.

5.9.3 Semi-Annual Report

No later than 120 days of completing the first semi-annual event of each year (*i.e.*, after receiving the laboratory analytical results), Dominion Energy will submit a semi-annual report for each impoundment to DEQ. Each semi-annual report will include the following:

- Signature page signed by a professional geologist or qualified groundwater scientist;
- Impoundment name and permit number;
- Statement noting whether or not all monitoring points within the permitted network installed to meet the requirements of the VSWMR were sampled as required during the event;
- Calculated rate of groundwater flow during the sampling period;
- The groundwater flow direction as determined during the sampling period presented as either plain text or graphically as a potentiometric surface map;
- Statement noting whether or not there were SSIs over background during the sampling period, the supporting statistical calculations, and reference to the date the director was notified of the increase pursuant to timeframes in the VSWMR, if applicable;
- Copy of the full Laboratory Analytical Report including dated signature page (laboratory manager or representative) to demonstrate compliance with the VSWMR timeframes. The DEQ will accept the lab report in CD-ROM format; and
- A brief discussion of the sampling and analysis activities.

5.9.4 Annual Report

Annual reports for each impoundment will be prepared and submitted to DEQ no later than 120 days after completing the second semi-annual event of each year (*i.e.*, after receiving the laboratory analytical results) or no later than January 31st of the following calendar year. The annual reports will include the following:

- A signature page;
- A completed QA/QC DEQ Form ARSC-01.
- The impoundment's name, type, permit number, current owner or operator, and location keyed to a United States Geological Survey (USGS) topographic map;
- Summary of the design type, operational history (*i.e.*, trench fill versus area fill), and size (acres) of the impoundment including key dates such as beginning, and termination of waste disposal actions and dates different groundwater monitoring phases were entered;

- Description of the surrounding land use noting whether any adjoining landowners utilize private wells as a potable water source;
- A discussion of the topographic, geologic, and hydrologic setting of the impoundment including a discussion on the nature of the uppermost aquifer (*i.e.*, confined versus unconfined) and proximity to surface waters;
- A discussion of the monitoring wells network noting any modifications that were made to the network during the year or any nonperformance issues and a statement noting that the monitoring well network meets (or did not meet) the VSWMR performance requirements;
- A listing of the groundwater sampling events undertaken during the previous calendar year;
- A historical table listing the detected constituents, and their concentrations identified in each well during the sampling period; and
- Evaluations of and appropriate responses to the groundwater elevation data; groundwater flow rate as calculated using the prior year's elevation data; groundwater flow direction (as illustrated on a potentiometric surface map); and sampling and analytical data obtained during the past calendar year.

In addition to the above requirements, Dominion Energy must comply with the CCR Rule recordkeeping requirements specified in §257.105(h)(1), the notification requirements specified in §257.106(h)(1), and the internet requirements specified in §257.107(h)(1).

5.9.5 Alternate Source Demonstrations

Alternate Source Demonstrations (ASDs) may be required under the VSWMR and/or the CCR Rule. Provisions for ASDs are as follows.

5.9.5.1 VSWMR ASDs

Consistent with the VSWMR, Dominion Energy may demonstrate that a source other than the impoundment caused a statistically significant detection of one or more monitored constituents or statistical exceedances of a SWP GPS, or that the statistical increase resulted from an error in sampling procedures, analysis, statistical procedures, or natural variation in groundwater quality. The ASD must be submitted to the DEQ within 90 days of identifying the exceedance.

If an ASD associated with a SWP GPS exceedance is approved by the DEQ, Dominion Energy may continue with the modified Assessment Monitoring Program. If such an ASD is not approved by the DEQ, Dominion Energy must initiate an ACM and a Corrective Action Program.

5.9.5.2 CCR Rule ASDs

Consistent with the CCR Rule Dominion Energy may demonstrate that a source other than the impoundment caused a statistically significant detection of one or more monitored constituents or statistical exceedances of a federal GWPS, or that the statistical increase resulted from an error in sampling procedures, analysis, statistical procedures, or natural variation in groundwater quality. The successful ASD must be completed within 90 days of detecting the exceedance and must be certified by a professional engineer with a copy provided in the next annual groundwater monitoring and corrective action report.

5.9.6 Well Installation Report

Well installation reports (for new wells) as may be required shall be submitted to the DEQ within 44 days of well completion (including the licensed survey). The well installation reports shall include permit-required information and shall be certified by a qualified groundwater scientist. If the well is a new compliance well, eight background samples will be collected following installation. If the well is a replacement compliance well being installed in the same formation within the same general area, background sampling may be completed, but is not required.

5.9.7 Well Decommissioning Report

Following issuance of a SWP by the DEQ, well decommissioning reports as may be required shall be submitted to the DEQ within 44 days of completing the physical well decommissioning activities. The well decommissioning reports shall include permit-required information and shall be certified by a qualified groundwater scientist.

5.9.8 Well Non-performance Notification

Following issuance of a SWP by the DEQ, well non-performance reports as may be required shall be submitted to the DEQ within 30 days of recognizing the non-performance issue. Well non-performance reports for compliance wells with screens that are determined to be exposed to the aquifer vadose zone will be accompanied by a plan of action for replacing the well prior to the next semi-annual compliance event as needed to ensure that the well screens for the compliance wells remain submerged consistent with DEQ guidance on the matter.

5.9.9 Groundwater Protection Standard Update Notifications

Notifications for federal GWPS / SWP GPS updates due to changes in USEPA MCLs and/or impoundment-and aquifer-specific background concentrations shall be submitted to the DEQ within 30 days of the update.

5.9.10 Off-site Plume Notification

In the event that a groundwater plume (concentrations above the federal GWPS and/or the SWP GPS) is determined to extend off site onto adjacent downgradient property, Dominion Energy will notify the DEQ and the affected landowner within 15 days of the determination consistent with provisions in the VSWMR.

6.0 SAMPLE AND ANALYSIS PROGRAM

Proper sampling procedures are an important and fundamental aspect in an effective monitoring program. The following sections, which are consistent with USEPA guidance, the requirements of the CCR Final Rule, and the VSWMR, outline the proposed sample collection procedures.

6.1 Sampling Order

The compliance wells are/will be equipped with dedicated purging and sampling equipment; therefore, the likelihood of cross-contamination is minimized. Accordingly, the anticipated sampling order will follow a sequence based on consideration of field conditions at the time of sampling.

6.2 Water Level Gauging

Prior to purging each monitoring well, the static water level will be gauged using an electronic water level indicator accurate to 0.01 foot. The measurement will be obtained from the surveyed measuring point on each well.

Prior to initial use and between wells, the portion of the water level indicator that comes in contact with the groundwater in the well will be decontaminated to avoid cross-contamination between monitoring wells. In addition to decontaminating the downhole equipment, sampling personnel will don new gloves between wells, and more frequently as needed, to avoid cross-contamination between monitoring wells. The compliance monitoring well network will be gauged within a 24-hour period during each compliance sampling event.

6.3 Purging Procedure

The monitoring wells in the monitoring network will be sampled using a micropurge technique. Micropurge sampling can greatly reduce the volume of water that must be purged from a well before representative samples can be collected, and typically provides for the collection of more representative samples than do other purge methods, as well as consistency in analytical results between sampling events. Micropurging is accomplished through the use of dedicated low-flow sampling devices. Bailers and portable pumps are not recommended because they cause mixing of the standing water column within the well (Robin and Gilham, 1987). This mixing action requires the removal of the traditional large purge volumes before sampling. Introducing any device into the well prior to sampling causes a surging effect that may increase turbidity and interfere with the normal flow of water through the well screen. This disturbance may remain in effect for as long as 24 to 48 hours (Kearl *et al.*, 1992).

For monitoring wells with dedicated bladder pumps equipped with check values that hold stagnant water in the discharge tubing between sampling events, the discharge tubing shall be purged prior to commencing micropurge activities to ensure that fresh formation water is sampled following the completion of micropurging. The discharge tube purge volume will be determined using the following equation:

Discharge Tube Volume (milliliters) = DTP * V_F

Where: DTP = Depth to the top of the pump to the nearest 0.1 foot

V_F = Volume Factor as follows:

10 = 1/4-inch diameter tubing

22 = 3/8-inch diameter tubing

39 = 1/2-inch diameter tubing

If discharge tube purging is required, the purge should be conducted at a rate equal to the well yield to avoid drawing stagnant well column water into the pump (*i.e.*, between 100 and 500 milliliters per minute). During the discharge tubing purge, the flow rate and the depth to groundwater should be monitored on regular intervals (every 3 to 5 minutes) to verify that the purge activities are not removing stagnant water from the water column in the monitoring well.

After completing the discharge tubing purge, if required, water quality parameters (pH, temperature, conductivity) will be monitored during the micropurge consistent with USEPA guidance on micropurging. The stabilization of these parameters (generally 10% for three consecutive readings) indicates when the discharge water is representative of formation water and samples can be collected for analysis. Measurements of turbidity may also be collected for the purpose of evaluating the purging technique. Water quality measurements will be collected on approximate 3- to 5-minute intervals and will be recorded on a Field Log or in the Field Book to document purge stabilization.

In addition to the water quality parameters, the flow rate may be monitored on regular intervals during the micropurge to verify that the micropurge activities are not removing stagnant water from the water column in the monitoring wells. In general, purge rates when using micropurge sampling procedures should not exceed 500 milliliters per minute. Any measurements taken should be recorded on a Field Log or in the Field Book to document steady-state flow conditions during the purge. The purge water will be managed in accordance with regulatory requirements.

On rare occasions, the yield of a monitoring well will be insufficient to keep up with the micropurge. In cases where the yield of the monitoring well is less than 50 milliliters per minute as documented by the recorded flow rate and continually decreasing head level as the well is purged, the required samples may be collected prior to stabilization of the water column provided the water quality parameters have stabilized within the required 10% range.

In the event that dedicated pumping equipment malfunctions during a sampling event, non-dedicated equipment may be used to micropurge the affected well(s) provided the pump can be decontaminated prior to use in each well.

The pump and associated discharge hoses must be decontaminated using a non-phosphate-based detergent and water mixture followed by a deionized water rinse to avoid cross-contamination between monitoring wells.

6.4 Sample Collection

Once the water quality data indicate that the micropurge activities have been completed, required samples should be collected directly from the discharge hose on the pump into laboratory-provided, pre-preserved sample containers selected for the required parameters or compatible parameters. Samples collected for the compliance program will not be filtered in the field or at the laboratory. Sample collection should be performed at the same rate (or lower) that was used during the micropurge. Following collection, samples will be placed in a cooler on ice under chain-of-custody control. Samples will be kept at no more than 6°C from collection to laboratory delivery.

Anticipated sample container, minimum volume, chemical preservative, and holding times for each analysis type are provided in Table 5. These standards may change depending on laboratory requirements. Sample preservation methods will be used to retard biological action, retard hydrolysis, and reduce sorption effects. These methods include chemical addition, refrigeration, and protection from light.

6.5 Sample Documentation

Chain-of-custody control is critical for documenting the integrity of the samples following collection, during transport to the laboratory, and at the laboratory. Consequently, the label for each sample container shall be completed to document the sample collection activities. An example sample container label is presented in Appendix E.

The chain-of-custody form should be signed by the sampling personnel and the receiving agent, with the date and time of transfer noted. In the event that the samples are being shipped to a laboratory, the signature of the receiving agent is not required; however, it is recommended that the tracking number for the shipping label be recorded on the chain-of-custody form. After completing the chain-of-custody form, it should be maintained with the samples. An example chain-of-custody form is presented in Appendix E.

6.6 Sample Seals

It is recommended that the shipping container be sealed to ensure that the samples have not been disturbed during transport to the laboratory. If sample seals are used, the tape should be labeled with instructions to notify the shipper if the seal is broken prior to receipt at the laboratory. An example chain-of-custody seal is presented in Appendix E.

6.7 Sample Event Documentation

The sampling event field notes should document the field activities such that they, along with the chain-of-custody form(s), are sufficient to allow for reconstruction of the sampling event by a third party.

6.8 Field Quality Assurance/Quality Control Procedures

Trip blanks, equipment blanks, and field blanks provide QA/QC measures for the monitoring program. The QA/QC measures are discussed in the following sections.

6.8.1 Trip Blanks

Trip blanks are a required part of the field sampling QA/QC program only whenever analytical parameters include volatile organic compounds (VOCs). Trip blanks are not required for this groundwater monitoring program.

6.8.2 Field Blanks

Field blanks may also be collected as part of the field sampling QA/QC program. The purpose of the field blank is to detect any contamination that might be introduced into the groundwater samples through the air or through sampling activities. For sampling programs involving VOCs, at least one field blank is recommended to be collected and analyzed for the same parameters as those for which groundwater samples are analyzed.

Field blanks must be prepared in the field (at the sampling site) using laboratory-supplied bottles and deionized or laboratory reagent-quality water. Each field blank is prepared by pouring the deionized water into the sample bottles at the location of one of the wells in the sampling program. Preservatives are added to specific sample bottles as required. The well at which the field blank is prepared must be identified on the Field Log along with any observations that may help explain anomalous results (*e.g.*, prevailing wind direction, up-wind potential sources of contamination). Once a field blank is collected, it is handled and shipped in the same manner as the rest of the samples.

6.8.3 Equipment Blanks

For wells that must be sampled with non-dedicated equipment, decontamination procedures consist of rinsing the equipment once with deionized or laboratory reagent-quality water, brushing the equipment using laboratory-quality soap, and triple rinsing the equipment with deionized or laboratory reagent-quality water. One equipment blank may be collected during each sampling event and analyzed for the same parameters as those for which groundwater samples are analyzed. Equipment blanks are collected by pouring deionized or laboratory reagent-quality water into or over the sampling device (*e.g.*, the water level indicator), and then filling a set of sample bottles.

If the analytes for the equipment blank would normally be filtered, this water should be placed into a pre-filtration bottle and subsequently filtered. Whether or not it is filtered, this water is placed into the equipment blank bottles, and the proper preservative added (as required).

6.8.4 Field Duplicates

Duplicate samples are generally collected to demonstrate the reproducibility of the sampling technique. Duplicate samples may be collected on a 5% (1 in 20) frequency. This is a separate duplicate from the duplicates a laboratory

must run and cannot be replaced by a laboratory-generated duplicate. Duplicates are representative of field sampling precision, whereas laboratory duplicates are a measure of analytical precision. Both pieces of information are essential to determining the quality of data generated for a project.

For the purpose of determining compliance with Facility background concentrations or groundwater protection standards (GPS/GWPS), field duplicate sample results should be averaged with the original event sample result, with the average event concentration for each constituent/parameter used to determine compliance.

6.9 Laboratory Quality Control Procedures

The quality assurance program for the selected Virginia Environmental Laboratory Accreditation Program (VELAP)-accredited analytical laboratory will be documented in their Quality Assurance Program Plan (QAPP). This document describes mechanisms employed by the VELAP-accredited laboratory to ensure that reported data meet or exceed applicable USEPA and Virginia requirements. The QAPP describes the laboratory's experience, its organizational structure, and procedures in place to ensure quality of the analytical data. The QAPP outlines the sampling, analysis, and reporting procedures used by the laboratory. The laboratory is responsible for the implementation of and adherence to the QA/QC requirements outlined in the QAPP. A copy of the laboratory's QAPP will be available to the DEQ or Station personnel upon request.

Audits are an important component of the quality assurance program at the laboratory. Audits are conducted by the laboratory. Internal system and performance audits are conducted periodically to ensure adherence by all laboratory departments to the QAPP. External audits are conducted by accrediting agencies or states. These reports are transmitted to department managers for review and response. Corrective measures must be taken for any finding or deficiency found in an audit.

Data Quality Reviews (DQRs), or equivalent, are requests submitted to the laboratory to formally review results that differ from historical results, or that exceed certain permit requirements or quality control criteria. The laboratory prepares a formal written response to DQRs explaining discrepancies. The DQR is the first line of investigation following any anomalous result.

6.9.1 Laboratory Documentation

Upon receipt of the samples at the laboratory, the following activities are recommended:

- The date, time of sample collection, and analysis to be performed will be provided to the VELAP-accredited laboratory.

- The samples will be examined upon receipt to ensure collection in USEPA-approved containers for the requested analysis. The sample collection data and time will also be reviewed to ensure the USEPA-required sample holding time has not expired or will not expire before the analysis can be performed.
- The information concerning transportation mode and manner will be reported on the form. Samples must be transported on ice or under refrigeration, and the inside temperature of the cooler recorded upon opening.
- The pH of each sample as well as the sample appearance will be recorded if required by the analytical method. Also, preservative adjustments, filtration, and sample splitting must also occur as required prior to distribution. Sample adjustments will be fully documented.

During analysis of the samples, it is recommended that the laboratory agent maintain the integrity of the samples as follows:

- During the sample analysis period, the samples will remain refrigerated.
- If at any point during the analysis process, the results are considered technically inaccurate, the analysis must be performed again if holding times have not been exceeded.

Documentation activities should be completed with permanent ink in a legible manner with mistakes crossed out with a single line.

6.9.2 Laboratory Analyses

Analytical procedures for constituents listed in Table 3.1 of the VSWMR and Appendix IV of the CCR Rule will be performed in accordance with USEPA *Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846,* as updated. Analytical methods for the remaining constituents and parameters required for the monitoring programs will be performed pursuant to procedures in USEPA *Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846,* as updated or if an SW-846 Method is not available, other USEPA-approved methods (*e.g.*, published drinking water methods, clean water act method, Standard Methods). The modified Detection Monitoring Program and modified Assessment Monitoring Program constituents, along with recommended test methods and LOQs, are listed in Tables 3 and 4. Laboratory analytical results for groundwater compliance samples will be reported on a total sample basis.

Alternate methods may be used if they have the same or lower LOQ. Methods with higher LOQs will be considered if the concentration of the parameter is such that an alternate test method with a higher LOQ will provide the same result.

6.9.3 Limits of Quantitation (LOQs)

Laboratory-specific LOQs will be used as the reporting limits for quantified detections of required monitoring constituents. Laboratory LOQs should be reported with the sample results.

6.9.4 Limits of Detection (LODs)

Laboratory-specific LODs will be used as the reporting limits for estimated detections of required monitoring constituents. Constituents detected at concentrations above the LOD but below the LOQ will be reported as estimated with a qualifying "J" flag on the laboratory certificates of analysis. It is noted that estimated detections are not considered statistically significant and cannot trigger the Corrective Action Program. Laboratory LODs should be reported with the sample results.

6.9.5 Method Blanks

Laboratory method blanks are used during the analytical process to detect any laboratory-introduced contamination that may occur during analysis. A minimum of one method blank should be analyzed by the laboratory per sample batch.

6.9.6 Matrix Spike and Matrix Spike Duplicate Samples

A matrix spike/matrix spike duplicate sample will be run with every sample batch. The relative percent difference between the spike and the spike duplicate sample should be less than 20 percent. Higher values may indicate matrix interference.

6.10 Data Validation

The laboratory is responsible for verifying that the reported analytical results are correct. The QA/QC data provided by the laboratory will be reviewed to ensure that the analytical results meet the project's data quality objectives. The review process is performed in general accordance with the procedures outlined in the National Functional Guidelines for Inorganic Superfund Methods Data Review, January 2017 (USEPA, 2017), or most updated version.

7.0 DATA EVALUATION

Statistical analysis of the data will be completed as discussed in the following subsections. These criteria represent a conservative approach to groundwater analysis and incorporate appropriate statistical and other evaluation methodologies.

7.1 Groundwater Data Evaluation

This section outlines the inter-well statistical evaluation methodologies that may be used to detect a release from the LAP and the UAP by comparing downgradient well results to statistically calculated background concentrations.

During background sample collection, it will be necessary to examine the data for outliers, anomalies, and trends that might be an indication of a sampling or analytical error. Outliers and anomalies are inconsistently large or small values that can occur due to sampling, laboratory, transportation, or transcription errors, or even by chance alone. Significant trends indicate a source of systematic error, or an actual contamination occurrence, that must be evaluated and corrected before valid inter-well statistical evaluations can be implemented. The inclusion of such values in the historical database used for temporal water quality evaluations or in the Station's background database for inter-well statistical evaluations could cause misinterpretation of the data set, and result in high false positive (*i.e.*, an indication of a release when none exists) and/or false negative (*i.e.*, falsely concluding there is no release in the presence of an actual release) conclusions.

To prevent the inclusion of anomalous data in the inter-well database, background monitoring results will be evaluated during background development for any new wells constructed, once those well(s) have at least four measurements for a given constituent using time vs. concentration graphs. Parameter concentrations that appear anomalous (*i.e.*, that are 5 times or greater than the previous results) may be verified during the next sample collection event or after a reasonable period of time to ensure sample independence (*e.g.*, 3 months). If the anomalous result is not verified, the outlier may be removed from the database to maintain the accuracy of the evaluation method. Any detected systematic trends or verified outliers in the background database will be evaluated and reported to the DEQ in a timely manner.

7.1.1 Correcting for Linear Trends

If a data series exhibits a linear trend, the sample will exhibit temporal dependence when tested via the sample autocorrelation function (see Section 14.2.3 of the Unified Guidance; EPA, 2009), the rank von Neumann ratio (see Section 14.2.4 of the Unified Guidance; EPA, 2009), or similar procedure. These data can be de-trended, much like the data in the previous example were de-seasonalized. Typically, the easiest way to de-trend observations with a linear trend is to compute a linear regression on the data (see Section 17.3.1 of the Unified Guidance; EPA, 2009) and then use the regression *residuals* instead of the original measurements in subsequent statistical analysis.

7.1.2 Use of Duplicate Sample Results

As discussed in Section 6.8.4 (Field Duplicates), for the purpose of statistical evaluations and determining compliance with Facility background concentrations or groundwater protection standards (GPS/GWPS), field duplicate sample results should be averaged with the original event sample result, with the average event concentration for each constituent/parameter used to determine compliance.

7.2 Inter-Well Statistical Methodology

In accordance with CCR Final Rule §257.93(f)(6) as adopted in the VSWMR, Dominion Energy, as owner and operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. The certification will include a narrative description of the statistical method selected to evaluate the groundwater monitoring data. As adopted in the VSWMR, this certification is subject to the recordkeeping requirements specified in §257.105(h), the notification requirements specified in §257.106(h), and the internet requirements specified in §257.107(h).

Consistent with §257.93(h), the selected statistical method(s) used for evaluation of the compliance monitoring data shall be designed to determine if there is a statistical exceedance of background concentrations. Subsection §257.93(d) indicates that background concentrations shall be developed from upgradient wells or other background wells that have not been impacted by leakage from a CCR unit. Therefore, the CCR Final Rule required inter-well (upgradient to downgradient) statistical evaluations.

7.3 Intra-Well Statistical Evaluations

While not required by the CCR Final Rule, intra-well statistical evaluations are proposed to supplement the inter-well statistical evaluations during the active dewatering stage of the CCR removal project if an inward gradient is verified to have developed. The intra-well statistical evaluations will be used to help evaluate the downgradient compliance well data for evidence of impact from the associated CCR unit. Specifically, as discussed herein, the dewatering activities associated with the CCR removal at the LAP are expected to result in a temporary inward gradient, such that the downgradient compliance wells may temporarily become upgradient of the CCR unit. The use of intra-well statistical evaluations will assist in the identification of a water quality change at a downgradient compliance well that may be associated with the temporary change in hydraulic gradient. To minimize the potential for false negative outcomes, the background datasets for each well will be limited to historical data that pre-dates the pumping activities associated with the CCR removal.

If statistically significant intra-well exceedances are identified for one (1) or more AMP constituents (CCR Rule Appendix IV and any other DEQ-required AMP constituents), supplemental control chart evaluations will be completed for surface water impact indicator parameters pH, chloride, and boron (and potentially other to be

identified parameters/constituents) to assist with determining if the statistically significant changes are associated with the inflow of surface water from the adjacent surface water bodies or other sources. Boron, chloride, and pH are proposed as indicator parameters for potential of surface water impacts based on:

1. Evaluation of existing available water quality data from the uppermost aquifer groundwater and the James River (upgradient to the Station location). These evaluations indicate that the shallow groundwater is generally more acidic than the James River; that boron concentrations in groundwater are generally an order of magnitude higher than those in the James River; and similarly, chloride concentrations are expected to be higher in groundwater than in the James River (this expectation is to be validated with future surface water monitoring data).

2. The robust fate and transport nature of pH and the two (2) anions (chloride and boron) within the site-specific hydrogeologic environment, are such that significant changes in source concentrations for the parameters are not expected to develop from the source water's interaction with the aquifer matrix, rendering any observed significant changes in concentrations/values at a downgradient well as being indicative of a new source water impact.

Due to the spatial and temporal variability of the indicator parameter concentrations/value in groundwater and surface water, a determination of a new source water impact may be indicated if at least two (2) parameters are showing statistically significant changes on an intra-well control chart basis.

7.4 Statistical Methods

The statistical test(s) used to evaluate the groundwater monitoring data will be selected based on the size of the dataset, the data distribution, and statistical level of significance requirements as allowed by the VSWMR and the CCR Final Rule, and associated state and Federal guidance documents. Dominion Energy will ensure that an adequate number of independent samples for the chosen statistical method are collected within the compliance period such that the level of significance for individual well comparison will be no less than 0.01 and no less than 0.05 for multiple comparisons for any statistical test. Possible statistical test methods are:

- A parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method will include estimating and testing the contrasts between each compliance well's mean and the background mean levels for each constituent;
- An analysis of variance (ANOVA) based on ranks followed by multiple comparisons procedures to identify significant evidence of contamination. The method will include estimating and testing the contrasts between each compliance well's median and the background median levels for each constituent;

- A tolerance or 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 tolerance or prediction limit;
- A control chart approach that gives control limits for each constituent; or
- Another statistical test method that meets the performance standards specified by the DEQ. A justification for the alternate test method will be submitted for approval by the DEQ.

The statistical analysis chosen to evaluate the groundwater data will meet the following performance standards and will be consistent with the EPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 2009):

- The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of monitoring parameters or constituents. If the distribution is shown by Dominion Energy to be inappropriate for a normal theory test, then the data should be transformed or a distribution-free theory test should be used. If the distributions for the constituents differ, more than one statistical method may be needed.
- If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a GPS, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparisons procedure is used, the Type I experiment-wise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, predictions intervals, or control charts.
- If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be protective of human health and the environment. The parameters shall be determined after considering the number of samples in the background database, the data distribution, and the range of the concentration for each constituent of concern.
- If a tolerance interval or a prediction interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be protective of human health and the environment. These parameters shall be determined after considering the number of samples in the background database, the data distribution, and the range of the concentrations for each constituent of concern.
- The statistical method shall account for data below the LOD with one or more statistical procedures that shall be at least as effective as any other approach in this section for evaluating groundwater data. Any LOQ that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within

specified limits of precision and accuracy during routine laboratory operating conditions that are available to the Station.

- If necessary, the statistical method shall include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

7.4.1 Reporting of Low and Zero Values

Chemical constituents that are not present above the detection limit of the analytical procedure are reported as NOT DETECTED (ND), or less than the LOD, rather than as zero or not present, and the laboratory's LOD is provided on the analytical report. There are a several methods for dealing with data that include values below detection and the selected method should be consistent with the EPA's Unified Guidance (USEPA, 2009).

7.4.2 Normality Testing

The original data must be tested for normality using an appropriate method consistent with EPA's Unified Guidance (USEPA, 2009). The following generalized guidelines should be considered for decisions in normality testing:

- If the original data show that the data are not normally distributed, then the data must be natural log-transformed and tested for normality using the above methods.
- If the original or the natural log-transformed data confirm that the data are normally distributed, then a normal distribution test must be applied.
- If neither the original nor the natural log-transformed data fit a normal distribution, then a distribution-free test must be applied.

7.4.3 Missing Data Values

Missing data values may result in an incomplete measure of environmental variability and an increased likelihood of falsely detecting contamination. If data are missing, there is a danger that the full extent of contamination may not be characterized. Therefore, resampling will occur within 30 days to replace the missing data unless an alternative schedule is otherwise approved by DEQ.

7.4.4 Outliers

An outlier is a value that is much different from most other values in a data set for a given groundwater chemical constituent. The reasons for outliers may include:

- Sampling errors or field contamination;
- Analytical errors or laboratory contamination;
- Recording or transcription errors;

- Faulty sample preparation or preservation, or shelf-life exceedance; or
- Extreme, but accurately detected environmental conditions (*e.g.*, spills, migration from the Station).

Formal testing for outliers should be done only if an observation seems particularly high (by orders of magnitude) compared to the rest of the data set. If a sample value is suspect, one should run the outlier test described below, from USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance* (USEPA, 2009).

7.5 Verification Procedure

Once groundwater analysis results have been collected, checked for QA/QC consistency, and determined to be above the appropriate statistical level, the results must be verified in accordance with the objectives of the VSWMR for groundwater monitoring. Verification re-sampling is an integral part of the statistical methodology described by USEPA's *Addendum to Interim Final Guidance Document - Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities* (July 1992). Without verification re-sampling, much larger statistical limits would be required to achieve site-wide false positive rates of 5% or less. Furthermore, the resulting false negative rate would be greatly increased. Verification sampling should generally be performed for each constituent when it is initially determined to be present above its statistical limit. Consistent with the VSWMR, verification samples if collected must be obtained within the 30-day statistically significant increase determination period defined in 9VAC20-81-250.A.4.h.(2).

7.6 Comparison to Groundwater Protection Standards

As discussed herein, the Station has two types of groundwater protection standards. The federal GWPS that are established pursuant to the CCR Rule based on USEPA MCLs, impoundment- and aquifer-specific background concentrations and CCR Rule established risk-based alternative concentrations for cobalt, lithium, and molybdenum. The CCR Rule does not require a federal GWPS for boron.

Once the Virginia SWP is issued, Dominion Energy will submit proposed SWP GPS to the DEQ for approval. These SWP GPS will be established pursuant to the VSWMR and permit provisions based on USEPA MCLs and impoundment- and aquifer-specific background concentrations.

Following the establishment of federal GWPS under the CCR Rule Assessment Monitoring Program and separately for the SWP GPS under the modified Assessment Monitoring Program outlined herein, quantified detections of the modified Assessment Monitoring Program constituents will be statistically compared to the established federal GWPS and DEQ-approved SWP GPS using one of the methods discussed below.

7.6.1 Background-Based GWPS / GPS

If the federal GWPS / SWP GPS for a constituent is derived from the impoundment- and aquifer-specific background concentration, then the groundwater monitoring data must be compared directly to the federal GWPS / SWP GPS using a value-to-value comparison.

7.6.2 MCL- or Alternate Concentration-Based GWPS / GPS

If the established federal GWPS is derived from a MCL (or an alternate concentration), or the SWP GPS is derived from a MCL, then the groundwater monitoring data may be compared to the federal GWPS / SWP GPS statistically and/or using a value-to-value procedure.

7.6.3 GWPS / GPS Comparison Process

Based on the criteria presented herein, groundwater monitoring data will initially be compared to the established federal GWPS / SWP GPS via a value-to-value comparison. If a federal GWPS / SWP GPS is exceeded during the value-to-value comparison for any parameter, a verification sample may be collected. The results from the verification sample will be compared to the federal GWPS / SWP GPS via a value-to-value comparison.

If the comparison indicates a potential federal GWPS / SWP GPS exceedance, the source of the federal GWPS / SWP GPS will be determined. If the federal GWPS or SWP GPS is derived from a MCL or alternate concentration limit, two additional independent groundwater samples for the suspect constituent(s) may be collected to facilitate a statistical comparison to the federal GWPS / SWP GPS. It is noted that verification sampling and/or additional sampling required to perform a statistical evaluation must occur within the same compliance monitoring period that

the original samples were collected. The compliance monitoring period begins on the day of sampling and expires 6 months later, or the date of the next compliance sampling event, whichever occurs first.

To perform a statistical comparison, a minimum of four (4) independent samples must be collected within the compliance monitoring period. Once data have been received for the four samples, then the lower confidence interval can be calculated and compared to the federal GWPS / SWP GPS. The lower limit should be calculated initially by using a 95% confidence level. If the lower limit exceeds the federal GWPS / SWP GPS, the DEQ may be contacted regarding the use of a confidence level greater than 95%.

8.0 HYDROGEOLOGIC ASSESSMENT

After each sampling event, groundwater surface elevations will be evaluated to determine whether the requirements for locating the monitoring wells continue to be satisfied and the rate and direction of groundwater flow will be determined. Groundwater elevations in monitoring wells must be measured within a period of time short enough to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.

The rate and direction of groundwater flow will be determined each time groundwater is sampled by comparing the groundwater surface elevations among the monitoring wells, and at least annually, constructing a groundwater surface contour map. The groundwater flow rate shall be determined using the following equation:

$$V_{gw} = K\, i\, \left({}^{1}/_{n_e}\right)$$

Where:

V_{gw} = Groundwater velocity

K = Hydraulic conductivity

i = Hydraulic gradient

n_e = Effective porosity

If the evaluation shows that the groundwater monitoring system does not satisfy the requirements of the VSWMR, the monitoring system will be modified to comply with those regulations after obtaining approval from the DEQ. The operator will request the appropriate permit amendment action related to any revisions of the monitoring well network deemed necessary due to a change in groundwater flow pattern or functionality of any monitoring well. Proposed revisions will be submitted to the DEQ within 30 days of determining that the system does not satisfy the requirements of the VSWMR; the modifications may include a change in the number, location, or depth of the monitoring wells.

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LIST OF TABLES

Table 1
Summary of Existing Well Construction Information
Chesterfield Power Station Lower and Upper Ash Ponds
Chesterfield, Virginia

Boring Identification	Well Identification	Compliance Monitoring Network	Coordinates*		Ground Surface Elevation (feet)	Top of Casing Elevation (feet)	Well Surface Protection Type	Boring Depth (feet below grade)	Well Screen (feet below grade)	Screen Length (feet)	Screened Unit	Drilling Method	Installation Date	Engineering Firm	Drilling Firm	Well Borehole Diameter (inches)
			Northing (feet)	Easting (feet)												
MW-1	MW-1	UAP	3,659,452.91	11,811,819.04	9.73	11.58	Floodplain Wellhead	80	20.0-30.0	10	Columbia	HSA/Mud-Rotary	6/21/2016	Haley and Aldrich, Inc.	Fishburne	6
MW-1D	MW-1D	UAP	3,659,449.96	11,811,809.97	9.8	11.38	Floodplain Wellhead	55.3	45.3-55.3	10	Potomac	HSA	8/22/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-1DD	MW-1DD	Observation Well	3,659,451.76	11,811,833.19	9.46	11.1	Floodplain Wellhead	181	171.0-181.0	10	Basement Bedrock	Mud-Rotary	9/26/2016	Golder Associates Inc.	Water Well Solut. LLC	6 5/8
MW-2	MW-2	UAP	3,659,888.60	11,812,365.73	9.07	10.80	Floodplain Wellhead	68	25.0-35.0	10	Columbia	HSA	6/20/2016	Haley and Aldrich, Inc.	Fishburne	6
MW-3D	MW-3D	UAP	3,660,744.77	11,812,886.53	15.12	16.92	Floodplain Wellhead	90	79.5-89.5	10	Triassic	HSA	8/17/2016	Golder Associates Inc.	GZ & CAI	8 1/4
MW-3S	MW-3S	UAP	3,660,738.85	11,812,882.62	15.27	17.05	Floodplain Wellhead	30	19.0-29.0	10	Columbia	HSA	8/18/2016	Golder Associates Inc.	GZ & CAI	8 1/4
MW-4	MW-4	UAP	3,661,189.06	11,813,224.92	16.63	18.45	Floodplain Wellhead	35	23.6-33.6	10	Columbia/Potomac	HSA	8/18/2016	Golder Associates Inc.	GZ & CAI	8 1/4
MW-5	MW-5	UAP	3,661,405.67	11,813,401.53	20.30	22.11	Floodplain Wellhead	60	27.0-37.0	10	Columbia	Sonic	6/22/2016	Haley and Aldrich, Inc.	Cascade	6 7/8
MW-6	MW-6	UAP	3,661,834.37	11,813,189.15	36.78	39.24	Stickup	62	49.0-59.0	10	Potomac	HSA	8/27/2016	Golder Associates Inc.	Parratt Wolffe, Inc.	8 1/4
MW-6D	MW-6D	UAP	3,661,820.42	11,813,197.33	37.8	40.17	Stickup	92	70.0-90.0	20	Triassic	HSA	8/27/2016	Golder Associates Inc.	Parratt Wolffe, Inc.	8 1/4
MW-6DD	MW-6DD	Observation Well	3,661,789.31	11,813,221.56	40.03	42.69	Stickup	240	220.0-230.0	10	Triassic	Mud-Rotary	9/15/2016	Golder Associates Inc.	Water Well Solut. LLC	6 5/8
MW-7	MW-7	UAP	3,661,718.44	11,812,729.28	41	43.45	Stickup	53	42.5-52.5	10	Potomac	HSA	9/12/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-8	Decommissioned	Decommissioned	3,661,566.62	11,812,252.31	41.31	43.62	Stickup	53	42.5-52.5	10	Columbia	HSA	9/13/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-8R	MW-8R	UAP	3,661,572.56	11,812,278.37	41.21	44.10	Stickup	53	41.0-51.0	10	Columbia	HSA	1/5/2017	Golder Associates Inc.	GEOlogic Exploration	8 1/4
MW-9	Decommissioned	Decommissioned	3,661,408.62	11,811,813.33	41.7	44.25	Stickup	55	43.0-53.0	10	Columbia	HSA	9/12/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-9R	MW-9R	UAP	3,661,400.01	11,811,790.81	41.78	44.64	Stickup	54	43.0-53.0	10	Columbia	HSA	1/19/2017	Golder Associates Inc.	GEOlogic Exploration	8 1/4
MW-10	MW-10	UAP	3,661,177.84	11,811,227.10	41.07	43.6	Stickup	53	42.0-52.0	10	Columbia/Potomac	HSA	9/17/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-11	MW-11	UAP	3,661,020.14	11,810,778.85	40.94	43.87	Stickup	53	42.5-52.5	10	Columbia	HSA	9/12/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-12	MW-12	UAP	3,660,850.86	11,810,294.33	41.31	44.06	Stickup	52	42.5-52.5	10	Columbia	HSA	8/25/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-13	MW-13	UAP	3,660,477.31	11,809,299.07	10.95	12.68	Floodplain Wellhead	25	14.0-24.0	10	Columbia	HSA	7/12/2016	Golder Associates Inc.	Ground Zero	8 1/4
MW-14	MW-14	UAP	3,660,027.47	11,809,396.53	19.45	21.19	Floodplain Wellhead	45.2	35.2-45.2	10	Potomac	HSA	8/5/2016	Golder Associates Inc.	GZ & CAI	8 1/4
MW-15	MW-15	UAP	3,659,595.36	11,809,774.96	22.76	24.39	Floodplain Wellhead	40	30.0-40.0	10	Columbia	HSA	6/22/2016	Haley and Aldrich, Inc.	Fishburne	6
MW-16	MW-16	UAP	3,659,489.24	11,810,179.79	20.1	23.17	Stickup	34.4	24.4-34.4	10	Columbia	HSA	7/13/2016	Golder Associates Inc.	Ground Zero	8 1/4
MW-16D	MW-16D	UAP	3,659,491.31	11,810,173.48	20.35	23.09	Stickup	69.8	59.8-69.8	10	Potomac	HSA	7/13/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-16DD	MW-16DD	Observation Well	3,659,495.58	11,810,159.40	21.01	23.64	Stickup	175	150.0-160.0	10	Triassic/Bedrock	Mud-Rotary	9/28/2016	Golder Associates Inc.	Water Well Solut. LLC	6 5/8
MW-17S	MW-17S	UAP	3,659,391.73	11,811,284.32	11.14	13.01	Floodplain Wellhead	30.5	20.0-30.0	10	Columbia	Sonic	6/20/2016	Haley and Aldrich, Inc.	Cascade	6
MW-20	MW-20	LAP	3,663,340.91	11,808,794.84	19.16	21.3	Stickup	35	25.0-35.0	10	Columbia	HSA	8/2/2016	Golder Associates Inc.	GZ & CAI	8 1/4
MW-21	Decommissioned	Decommissioned	3,663,048.82	11,809,166.60	10.06	11.91	Floodplain Wellhead	81	15.0-25.0	10	Columbia	HSA	6/30/2016	Haley and Aldrich, Inc.	GEOlogic Exploration	6
MW-21R	MW-21R	LAP	3,663,010.11	11,809,147.01	19.21	20.88	Floodplain Wellhead	40	24.0-34.0	10	Columbia	Sonic	12/20/2020	Golder Associates Inc.	M&W Drilling	6
MW-22	Decommissioned	Decommissioned	3,662,650.43	11,809,438.06	10.43	12.33	Floodplain Wellhead	35	23.0-33.0	10	Columbia	HSA	7/8/2016	Golder Associates Inc.	GZ & CAI	8 1/4
MW-22R	MW-22R	LAP	3,662,646.40	11,809,396.22	18.64	19.99	Floodplain Wellhead	50	30.0-40.0	10	Columbia	Sonic	12/20/2020	Golder Associates Inc.	M&W Drilling	6
MW-23	Decommissioned	Decommissioned	3,661,610.03	11,809,607.63	6.50	8.37	Floodplain Wellhead	41	30.0-40.0	10	Columbia	HSA	6/29/2016	Haley and Aldrich, Inc.	GEOlogic Exploration	6
MW-23R	MW-23R	LAP	3,661,604.50	11,809,567.69	15.69	17.14	Floodplain Wellhead	50	40.0-50.0	10	Columbia	Sonic	12/23/2020	Golder Associates Inc.	M&W Drilling	6
MW-24	Decommissioned	Decommissioned	3,660,510.02	11,808,151.46	16.15	18.66	Stickup	35	25.0-35.0	10	Columbia	Mud-Rotary	9/19/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	6 5/8
MW-25	MW-25	LAP	3,661,281.36	11,807,565.35	10.78	12.64	Floodplain Wellhead	57	45.0-55.0	10	Columbia/Potomac	HSA	9/14/2016	Golder Associates Inc.	Parratt Wolffe, Inc.	8 1/4
MW-26	MW-26	LAP	3,661,811.49	11,807,505.17	7.85	9.71	Floodplain Wellhead	30	13.0-23.0	10	Columbia	HSA	8/24/2016	Golder Associates Inc.	Parratt Wolffe, Inc.	8 1/4
MW-27	MW-27	LAP	3,662,287.10	11,807,604.24	15.44	17.15	Floodplain Wellhead	30	19.0-29.0	10	Columbia	HSA	8/25/2016	Golder Associates Inc.	Parratt Wolffe, Inc.	8 1/4
MW-28	MW-28	LAP	3,663,025.11	11,808,370.03	19.67	22.01	Stickup	35	24.0-34.0	10	Columbia	HSA	8/3/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-29U	MW-29U	LAP/UAP	3,661,275.70	11,807,107.29	5.25	7.13	Floodplain Wellhead	40	8.0-18.0	10	Columbia	HSA	7/7/2016	Golder Associates Inc.	Ground Zero	8 1/4
MW-30U	MW-30U	UAP	3,661,266.44	11,807,111.93	5.14	6.94	Floodplain Wellhead	54	44.0-54.0	10	Potomac	HSA	8/23/2016	Golder Associates Inc.	GZ & PW	8 1/4
MW-31U	MW-31U	UAP	3,661,235.21	11,807,125.11	4.55	6.29	Floodplain Wellhead	200	120.0-140.0	20	Basement Bedrock	Mud-Rotary	9/21/2016	Golder Associates Inc.	Water Well Solut. LLC	6 5/8
MW-32	Decommissioned	Decommissioned	3,662,108.03	11,809,523.64	6.62	8.37	Floodplain Wellhead	31	20.0-30.0	10	Columbia	HSA	6/29/2016	Haley and Aldrich, Inc.	GEOlogic Exploration	6
MW-32SR	MW-32SR	LAP	3,662,086.73	11,809,482.33	16.30	17.88	Floodplain Wellhead	50	40.0-50.0	10	Columbia	Sonic	12/21/2020	Golder Associates Inc.	M&W Drilling	6
MW-33	Decommissioned	Decommissioned	3,661,029.44	11,809,704.77	11.09	12.73	Floodplain Wellhead	35.2	25.2-35.2	10	Columbia	HSA	7/11/2016	Golder Associates Inc.	Ground Zero	8 1/4

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Summary of Existing Well Construction Information
Chesterfield Power Station Lower and Upper Ash Ponds
Chesterfield, Virginia

Boring Identification	Well Identification	Compliance Monitoring Network	Coordinates*		Ground Surface Elevation (feet)	Top of Casing Elevation (feet)	Well Surface Protection Type	Boring Depth (feet below grade)	Well Screen (feet below grade)	Screen Length (feet)	Screened Unit	Drilling Method	Installation Date	Engineering Firm	Drilling Firm	Well Borehole Diameter (inches)
			Northing (feet)	Easting (feet)												
MW-33R	MW-33R	LAP	3,661,007.52	11,809,667.03	18.89	20.35	Floodplain Wellhead	45	35.0-45.0	10	Columbia	Sonic	12/22/2020	Golder Associates Inc.	M&W Drilling	6
MW-34	MW-34	LAP	3,660,827.15	11,807,767.32	8.10	9.70	Floodplain Wellhead	30	19-29	10	Columbia	HSA	9/12/2016	Golder Associates Inc.	Connelly & Assoc. Inc.	8 1/4
MW-35B	MW-35B	Observation Well	3,663,414.67	11,806,314.41	55.09	58.18	Stickup	175	165-175	10	Basement Bedrock	Sonic	1/26/2017	Haley and Aldrich, Inc.	Cascade	6
MW-35D	MW-35D	UAP	3,663,443.97	11,806,317.22	55.03	57.75	Stickup	99	89-99	10	Potomac	HSA	9/28/2016	Haley and Aldrich, Inc.	GEOlogic Exploration	6
MW-35S	MW-35S	LAP/UAP	3,663,435.66	11,806,316.70	55.16	57.81	Stickup	64	54-64	10	Columbia	HSA	9/29/2016	Haley and Aldrich, Inc.	GEOlogic Exploration	6
MW-36(S)	MW-36(S)	LAP	3,660,465.56	11,808,700.39	12.91	14.71	Floodplain Wellhead	25	15-25	10	Columbia	Sonic	8/25/2022	Haley and Aldrich, Inc.	Parratt Wolffe, Inc.	6
MW-36(I)	MW-36(I)	Observation Well	3,660,461.47	11,808,692.08	12.66	17.79	Floodplain Wellhead	60	49-59	10	Columbia	Sonic	8/25/2022	Haley and Aldrich, Inc.	Parratt Wolffe, Inc.	6
MW-B31	MW-B31	UAP	3,660,340.77	11,812,582.82	11.82	12.81	Floodplain Wellhead	24.5	19.5-24.5	5	Columbia	Unknown	Unknown	Unknown	Unknown	Unknown
MW-B32	MW-B32	UAP	3,659,332.19	11,810,654.15	12.63	13.58	Floodplain Wellhead	33	29.0-33.0	4	Columbia/Potomac	Unknown	Unknown	Unknown	Unknown	Unknown
MW-B40A	Decommissioned	Decommissioned	3,660,535.63	11,808,691.69	15.17	18.49	Stickup	15	5.0-15.0	10	Columbia	HSA	10/19/2001	Resource International, LTD.	Fishburne	Unknown
MW-B50	MW-B50	Observation Well	3,662,817.77	11,807,891.10	22.97	25.83	Stickup	30	20.0-30.0	10	Columbia	HSA	10/19/2001	Resource International, LTD.	Fishburne	Unknown

Notes:

UAP = Upper Ash Pond

LAP = Lower Ash Pond

Coordinate system is Virginia State Plane South Zone North American Datum 1983 (NAD 83)

Vertical Datum is North American Vertical Datum 1988 (NAVD 88) and referenced to mean sea level.

Table 2
Summary of Estimated Hydraulic Conductivity
Chesterfield Power Station
Upper and Lower Ash Ponds

Well Location	Water Bearing Unit	Test Type	Location	Analyst	Analysis Type	Analysis Method	Screened Interval	Date	Result (ft/sec)	Result (cm/sec)
MW-35B	Bedrock	Falling Head Slug	Lower Ash Pond	Golder	confined	H	165.0-175.0	1/12/2017	8.65E-09	2.64E-07
B-19	Columbia	Falling Head Slug	Lower Ash Pond	Dames & Moore	unconfined	Unknown	5.0-15.0	1983	2.84E-01	1.00E-04
B-19*	Columbia	Falling Head Slug	Lower Ash Pond	URS	unconfined	B&R	10.0-20.0	9/12/2006	2.25E-06	6.85E-05
B-19*	Columbia	Rising Head Slug	Lower Ash Pond	URS	unconfined	B&R	10.0-20.0	9/12/2006	1.25E-06	3.81E-05
B-21	Columbia	Falling Head Slug	Lower Ash Pond	Dames & Moore	unconfined	Unknown	5.0-15.0	1983	1.42E+00	5.00E-04
B-41A	Columbia	Falling Head Slug	Lower Ash Pond	URS	unconfined	B&R	41.0-51.0	9/12/2006	2.89E-06	8.82E-05
B-41A	Columbia	Rising Head Slug	Lower Ash Pond	URS	unconfined	B&R	41.0-51.0	9/12/2006	1.00E-08	3.06E-07
B-42A	Columbia	Falling Head Slug	Lower Ash Pond	URS	unconfined	B&R	26.0-31.0	9/12/2006	1.29E-05	3.94E-04
B-42A	Columbia	Rising Head Slug	Lower Ash Pond	URS	unconfined	B&R	26.0-31.0	9/12/2006	6.81E-06	2.08E-04
DM-11	Columbia	Falling Head Slug	Off-Site (upgradient)	Dames & Moore	unconfined	Unknown	10.0-20.0	1983	5.00E+02	1.76E-01
DM-2	Columbia	Falling Head Slug	Off-Site (upgradient)	Dames & Moore	unconfined	Unknown	14.7-24.7	1983	5.00E+02	1.76E-01
DM-3	Columbia	Falling Head Slug	Off-Site (upgradient)	Dames & Moore	confined	Unknown	73.7-83.7	1983	2.84E-01	1.00E-04
DM-5	Columbia	Falling Head Slug	Upper Ash Pond	Dames & Moore	unconfined	Unknown	15.0-25.0	1983	2.83E+02	1.00E-01
DM-7	Columbia	Falling Head Slug	Upper Ash Pond	Dames & Moore	confined	Unknown	49.0-54.0	1983	5.67E+00	2.00E-03
MW-1	Columbia	Falling Head Slug	Upper Ash Pond	Golder	unconfined	KGS	20.0-30.0	9/29/2016	3.22E-04	9.81E-03
MW-1	Columbia	Rising Head Slug	Upper Ash Pond	Golder	unconfined	KGS	20.0-30.0	9/29/2016	8.73E-05	2.66E-03
MW-15	Columbia	Falling Head Slug	Upper Ash Pond	Golder	confined	KGS with Skin	30.0-40.0	9/30/2016	7.48E-05	2.28E-03
MW-15	Columbia	Rising Head Slug	Upper Ash Pond	Golder	confined	KGS	30.0-40.0	9/30/2016	8.26E-05	2.52E-03
MW-16	Columbia	Falling Head Slug	Upper Ash Pond	Golder	unconfined	KGS	24.4-34.4	9/29/2016	8.37E-06	2.55E-04
MW-16	Columbia	Rising Head Slug	Upper Ash Pond	Golder	unconfined	KGS	24.4-34.4	9/29/2016	8.56E-06	2.61E-04
MW-17S	Columbia	Falling Head Slug	Upper Ash Pond	Golder	unconfined	KGS	20.0-30.0	9/29/2016	7.99E-05	2.44E-03
MW-17S	Columbia	Rising Head Slug	Upper Ash Pond	Golder	unconfined	KGS	20.0-30.0	9/29/2016	9.77E-05	2.98E-03
MW-2	Columbia	Falling Head Slug	Upper Ash Pond	Golder	unconfined	KGS	25.0-35.0	9/29/2016	5.04E-04	1.54E-02
MW-2	Columbia	Falling Head Slug	Oil Storage Tanks	ENSAT	unconfined	B&R	50.0-65.0	2/25/1993	7.78E-01	2.74E-04
MW-2	Columbia	Rising Head Slug	Upper Ash Pond	Golder	unconfined	KGS	25.0-35.0	9/29/2016	2.69E-04	8.20E-03
MW-20	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS	25.0-35.0	9/29/2016	8.53E-04	2.60E-02
MW-20	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	KGS	25.0-35.0	9/29/2016	7.48E-04	2.28E-02
MW-21	Columbia	Falling Head Slug	Lower Ash Pond	Golder	unconfined	KGS	15.0-25.0	9/28/2016	9.77E-05	2.98E-03
MW-21	Columbia	Rising Head Slug	Lower Ash Pond	Golder	unconfined	KGS	15.0-25.0	9/28/2016	4.86E-04	1.48E-02
MW-21R	Columbia	Falling Head Slug	Lower Ash Pond	Golder	unconfined	Springer-Gelhar	24.0-34.0	2/10/2021	1.00E-03	3.05E-02
MW-21R	Columbia	Rising Head Slug	Lower Ash Pond	Golder	unconfined	Springer-Gelhar	24.0-34.0	2/10/2021	2.16E-03	6.58E-02
MW-22	Columbia	Rising Head Slug	Lower Ash Pond	Golder	unconfined	KGS	23.0-33.0	9/28/2016	9.82E-05	2.99E-03
MW-22R	Columbia	Falling Head Slug	Lower Ash Pond	Golder	unconfined	KGS	30.0-40.0	2/10/2021	8.65E-05	2.64E-03
MW-22R	Columbia	Rising Head Slug	Lower Ash Pond	Golder	unconfined	KGS	30.0-40.0	2/10/2021	3.92E-05	1.19E-03

Table 2
Summary of Estimated Hydraulic Conductivity
Chesterfield Power Station
Upper and Lower Ash Ponds

Well Location	Water Bearing Unit	Test Type	Location	Analyst	Analysis Type	Analysis Method	Screened Interval	Date	Result (ft/sec)	Result (cm/sec)
MW-23	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS	30.0-40.0	9/26/2016	1.78E-05	5.43E-04
MW-23	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	KGS	30.0-40.0	9/26/2016	2.60E-05	7.92E-04
MW-23R	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS	40.0-50.0	2/10/2021	5.87E-07	1.79E-05
MW-23R	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	KGS	40.0-50.0	2/10/2021	1.45E-07	4.42E-06
MW-26	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	H	13.0-23.0	9/29/2016	6.36E-05	1.94E-03
MW-26	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	H	13.0-23.0	9/29/2016	6.12E-05	1.87E-03
MW-27	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS	19.0-29.0	9/29/2016	4.50E-04	1.37E-02
MW-27	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	H	19.0-29.0	9/29/2016	4.37E-04	1.33E-02
MW-28	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS with Skin	24.0-34.0	9/29/2016	1.25E-04	3.81E-03
MW-28	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	H	24.0-34.0	9/29/2016	1.01E-04	3.08E-03
MW-29U	Columbia	Falling Head Slug	Upper Ash Pond	Golder	unconfined	H	8.0-18.0	9/29/2016	1.82E-06	5.55E-05
MW-3	Columbia	Falling Head Slug	Upper Ash Pond	Golder	unconfined	H	19.0-29.0	9/29/2016	5.02E-04	1.53E-02
MW-3	Columbia	Rising Head Slug	Upper Ash Pond	Golder	unconfined	KGS	19.0-29.0	9/29/2016	5.84E-04	1.78E-02
MW-32	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	H	20.0-30.0	9/29/2016	4.43E-06	1.35E-04
MW-32	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	H	20.0-30.0	9/29/2016	2.92E-06	8.90E-05
MW-32R	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS	40.0-50.0	2/10/2021	1.68E-05	5.12E-04
MW-32R	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	KGS	40.0-50.0	2/10/2021	6.85E-06	2.09E-04
MW-33	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS	25.2-35.2	9/26/2016	3.42E-05	1.04E-03
MW-33	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	KGS	25.2-35.2	9/26/2016	3.50E-05	1.07E-03
MW-33R	Columbia	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS	35.0-45.0	2/10/2021	3.89E-05	1.19E-03
MW-33R	Columbia	Rising Head Slug	Lower Ash Pond	Golder	confined	KGS	35.0-45.0	2/10/2021	1.14E-05	3.47E-04
MW-35S	Columbia	Falling Head Slug	Lower Ash Pond	Golder	unconfined	KGS	54.0-64.0	1/12/2017	1.06E-04	3.23E-03
MW-35S	Columbia	Rising Head Slug	Lower Ash Pond	Golder	unconfined	KGS	54.0-64.0	1/12/2017	9.58E-05	2.92E-03
MW-5	Columbia	Falling Head Slug	Upper Ash Pond	Golder	unconfined	KGS with Skin	27.0-37.0	9/29/2016	1.27E-04	3.87E-03
MW-5	Columbia	Rising Head Slug	Upper Ash Pond	Golder	unconfined	KGS	27.0-37.0	9/29/2016	1.08E-04	3.29E-03
MW-8	Columbia	Falling Head Slug	Upper Ash Pond	Golder	unconfined	B&R	42.5-52.5	9/30/2016	3.48E-06	1.06E-04
MW-8	Columbia	Rising Head Slug	Upper Ash Pond	Golder	unconfined	KGS	42.5-52.5	9/30/2016	1.75E-06	5.33E-05
MW-25	Columbia/Potomac	Falling Head Slug	Lower Ash Pond	Golder	confined	KGS	45.0-55.0	9/29/2016	1.45E-04	4.42E-03
MW-25	Columbia/Potomac	Rising Head Slug	Lower Ash Pond	Golder	confined	KGS	45.0-55.0	9/29/2016	8.56E-05	2.61E-03
MW-4	Columbia/Potomac	Falling Head Slug	Upper Ash Pond	Golder	confined	KGS	23.6-33.6	9/29/2016	5.95E-03	1.81E-01
MW-4	Columbia/Potomac	Rising Head Slug	Upper Ash Pond	Golder	confined	KGS	23.6-33.6	9/29/2016	7.28E-03	2.22E-01
DM-6	Potomac	Falling Head Slug	Upper Ash Pond	Dames & Moore	confined	Unknown	82.5-92.5	1983	5.67E-01	2.00E-04
MW-16D	Potomac	Falling Head Slug	Upper Ash Pond	Golder	confined	KGS	59.8-69.8	9/29/2016	6.21E-05	1.89E-03
MW-16D	Potomac	Rising Head Slug	Upper Ash Pond	Golder	confined	KGS	59.8-69.8	9/29/2016	6.56E-05	2.00E-03

Table 2
Summary of Estimated Hydraulic Conductivity
Chesterfield Power Station
Upper and Lower Ash Ponds

Well Location	Water Bearing Unit	Test Type	Location	Analyst	Analysis Type	Analysis Method	Screened Interval	Date	Result (ft/sec)	Result (cm/sec)
MW-1D	Potomac	Falling Head Slug	Upper Ash Pond	Golder	confined	H	45.3-55.3	9/29/2016	4.35E-04	1.33E-02
MW-1D	Potomac	Rising Head Slug	Upper Ash Pond	Golder	confined	H	45.3-55.3	9/29/2016	3.94E-04	1.20E-02
MW-35D	Potomac	Falling Head Slug	Upper Ash Pond	Golder	confined	KGS	89.0-99.0	1/12/2017	1.35E-05	4.11E-04
MW-35D	Potomac	Rising Head Slug	Upper Ash Pond	Golder	confined	KGS	89.0-99.0	1/12/2017	1.57E-05	4.79E-04
MW-6	Potomac	Rising Head Slug	Upper Ash Pond	Golder	unconfined	H	49.0-59.0	9/28/2016	3.99E-04	1.22E-02
MW-7	Potomac	Falling Head Slug	Upper Ash Pond	Golder	confined	KGS	42.5-52.5	9/16/2016	3.25E-06	9.91E-05
MW-7	Potomac	Rising Head Slug	Upper Ash Pond	Golder	confined	KGS with Skin	42.5-52.5	9/16/2016	4.17E-06	1.27E-04

Note:

KGS = Hyder et al. (1994)

H = Hvorslev (1951)

B&R = Bouwer and Rice, 1976

* = B-19 replacement boring (2002)

Columbia/Potomac wells pooled with Potomac wells for evaluation

Parameter Estimate	Columbia	Potomac	Bedrock
Geometric Mean (cm/s):	1.24E-03	2.78E-03	2.64E-07
Maximum (cm/s):	1.76E-01	2.22E-01	2.64E-07
Minimum (cm/s):	3.06E-07	9.91E-05	2.64E-07

Table 3
Summary of Modified Detection Monitoring Program Constituents and Parameters
Chesterfield Power Station
Upper and Lower Ash Ponds

PARAMETER	CLASS	CAS RN	TYPICAL METHOD	TYPICAL LOQ (ug/L)
CCR Appendix III to Part 257				
Boron	metal	7440-42-8	6010/6020	50
Calcium	metal	7440-70-2	6010/6020	5,000
Chloride	anion	16887-00-6	9056	1,000
Fluoride	anion	16984-48-8	9056	100
pH	field parameter	NA	9040C	NA
Sulfate	anion	18785-72-3	9056	1,000
Total Dissolved Solids (TDS)	dissolved cations and anions	Total	SM2540	50,000
VSWMR Table 3.1 Column A Metals				
Antimony	metal	Total	6010/6020	5
Arsenic	metal	Total	6010/6020	1
Barium	metal	Total	6010/6020	5
Beryllium	metal	Total	6010/6020	1
Cadmium	metal	Total	6010/6020	1
Chromium	metal	Total	6010/6020	5
Cobalt	metal	Total	6010/6020	1
Copper	metal	Total	6010/6020	5
Lead	metal	Total	6010/6020	1
Nickel	metal	Total	6010/6020	5
Selenium	metal	Total	6010/6020	10
Silver	metal	Total	6010/6020	5
Thallium	metal	Total	6010/6020	1
Vanadium	metal	Total	6010/6020	5
Zinc	metal	Total	6010/6020	5

Table 3
Summary of Modified Detection Monitoring Program Constituents and Parameters
Chesterfield Power Station
Upper and Lower Ash Ponds

VPDES Permit Detection Montioring Constituents				
Ammonia	wet chemistry	Total	EPA 350.1	10
Copper	metal	Total	6010/6020	0.50
Chloride	anion	16887-00-6	9056	1,000
Conductivity	field parameter	NA	9050A	NA
Molybdenum	metal	Total	6010/6020	0.50
Nitrate	wet chemistry	Total	EPA 353.2	40
Iron	metal	Total	6010/6020	50
pH	field parameter	NA	9040C	NA
Sulfate	anion	18785-72-3	9056	1,000
Total Dissolved Solids (TDS)	dissolved cations and anions	Total	SM2540	50,000
Total Hardness	wet chemistry	Total	SM 2340	1
Zinc	metal	Total	6010/6020	5

Notes:
- Class: General type of compound
- CAS RN: Chemical Abstracts Service Registry Number. Where 'Total' is entered, all species that contain the element are included.
- Method: Analytical Method from EPA SW-846 Methods for Evaluating Solid Waste. Samples will be analyzed using the version of each method that is current at the time of sampling.
- LOQ: Limit of Quantitation
- ug/L: micrograms per liter
- NA: Not Available
- pCi/L: picocuries per liter
- VSWMR: Virginia Municipal Solid Waste Regulations
- VPDES:
- Acceptable alternatives to the analytical methods listed above include current SW-846 Methods with LOQs equal to or lower than the one specified and other laboratory methods as approved by the Virginia Department of Environmental Quality.

Table 4
Summary of Modified Detection Monitoring Program Constituents and Parameters
Chesterfield Power Station
Upper and Lower Ash Ponds

PARAMETER	CLASS	CAS RN	TYPICAL METHOD	TYPICAL LOQ (ug/L)
CCR Appendix III to Part 257				
Boron	metal	7440-42-8	6010/6020	50
Calcium	metal	7440-70-2	6010/6020	5,000
Chloride	anion	16887-00-6	9056	1,000
Fluoride	anion	16984-48-8	9056	100
pH	field parameter	NA	9040C	NA
Sulfate	anion	18785-72-3	9056	1,000
Total Dissolved Solids (TDS)	dissolved cations and anions	Total	SM2540	50,000
CCR Appendix IV to Part 257				
Antimony	metal	Total	6010/6020	5
Arsenic	metal	Total	6010/6020	1
Barium	metal	Total	6010/6020	5
Beryllium	metal	Total	6010/6020	1
Cadmium	metal	Total	6010/6020	1
Chromium	metal	Total	6010/6020	5
Cobalt	metal	Total	6010/6020	1
Fluoride	metal	Total	9056	300
Lead	metal	Total	6010/6020	1
Lithium	metal	Total	6010/6020	50
Mercury	metal	Total	7470	2
Molybdenum	metal	Total	6010/6020	10
Selenium	metal	Total	6010/6020	10
Thallium	metal	Total	6010/6020	1
Radium 226 and 228 combined	radionuclide	(226) - 13982-63-3 (228) - 15262-20-1	9315/9320 or other EPA-approved methods	1.00 pCi/L
VSWMR Table 3.1 Column B Metals				
Antimony	metal	Total	6010/6020	5
Arsenic	metal	Total	6010/6020	1
Barium	metal	Total	6010/6020	5
Beryllium	metal	Total	6010/6020	1
Cadmium	metal	Total	6010/6020	1
Chromium	metal	Total	6010/6020	5
Cobalt	metal	Total	6010/6020	1
Copper	metal	Total	6010/6020	5
Lead	metal	Total	6010/6020	1
Mercury	metal	Total	7470	2
Nickel	metal	Total	6010/6020	5
Selenium	metal	Total	6010/6020	10
Silver	metal	Total	6010/6020	5
Thallium	metal	Total	6010/6020	1
Tin	metal	Total	6010/6020	1
Vanadium	metal	Total	6010/6020	5
Zinc	metal	Total	6010/6020	5

Table 4
Summary of Modified Detection Monitoring Program Constituents and Parameters
Chesterfield Power Station
Upper and Lower Ash Ponds

PARAMETER	CLASS	CAS RN	TYPICAL METHOD	TYPICAL LOQ (ug/L)
VPDES Permit Extended Montioring Constituents				
Ammonia	wet chemistry	Total	EPA 350.1	10
Copper	metal	Total	6010/6020	0.50
Chloride	anion	16887-00-6	9056	1,000
Conductivity	field parameter	NA	9050A	NA
Molybdenum	metal	Total	6010/6020	0.50
Nitrate	wet chemistry	Total	EPA 353.2	40
Iron	metal	Total	6010/6020	50
pH	field parameter	NA	9040C	NA
Sulfate	anion	18785-72-3	9056	1,000
Total Dissolved Solids (TDS)	dissolved cations and anions	Total	SM2540	50,000
Total Hardness	wet chemistry	Total	SM 2340	1
Zinc	metal	Total	6010/6020	5
Arsenic	metal	Total	6010/6020	1
Barium	metal	Total	6010/6020	5
Cadmium	metal	Total	6010/6020	1
Chromium	metal	Total	6010/6020	5
Chromium, Hexavalent	metal	Total	7196	5
Lead	metal	Total	6010/6020	1
Manganese	metal	Total	6010/6020	10
Mercury	metal	Total	6010/6020	2
Selenium	metal	Total	6010/6020	10
Silver	metal	Total	6010/6020	5
Vanadium	metal	Total	6010/6020	5

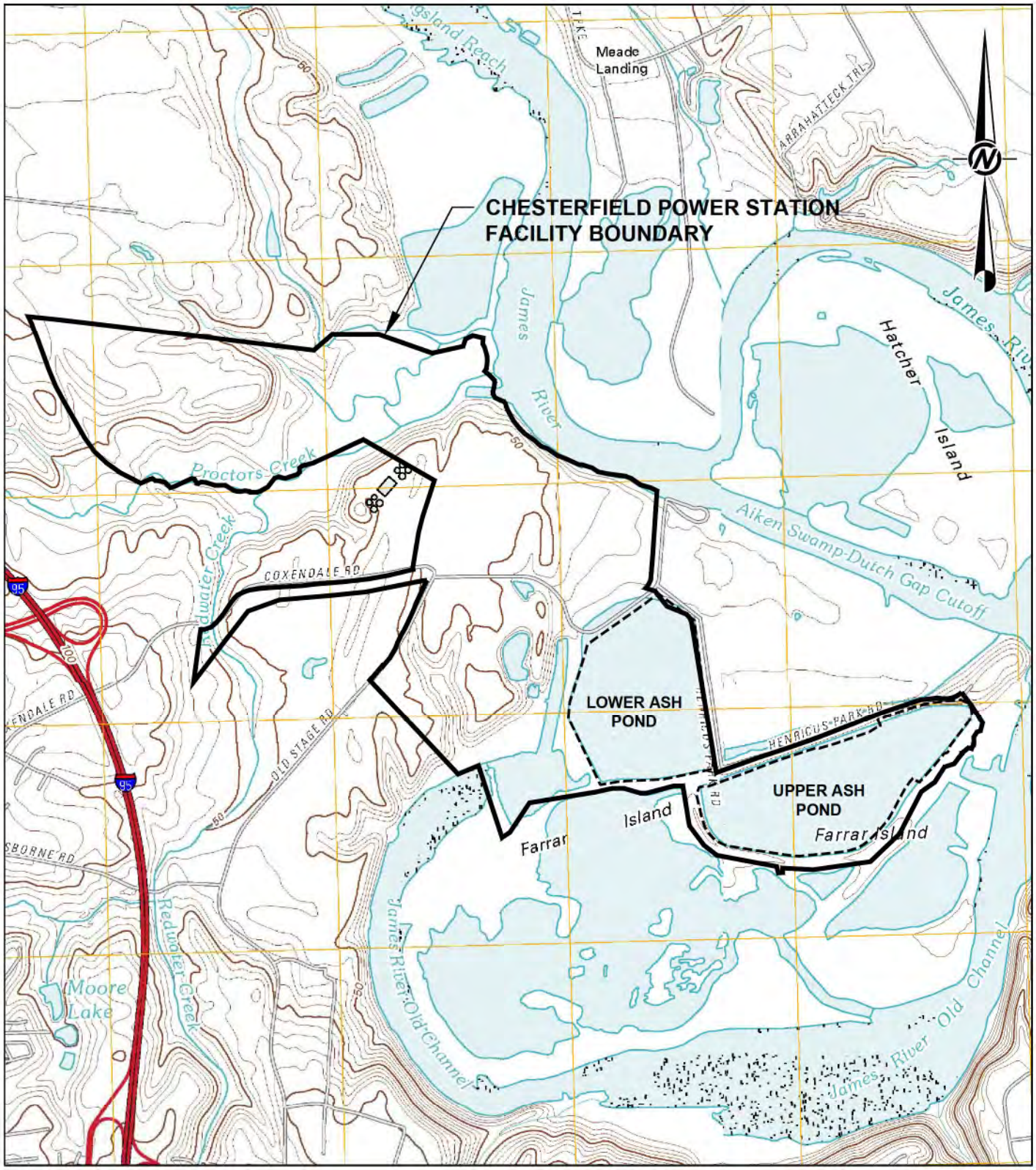
Notes:
- Class: General type of compound
- CAS RN: Chemical Abstracts Service Registry Number. Where 'Total' is entered, all species that contain the element are included.
- Method: Analytical Method from EPA SW-846 Methods for Evaluating Solid Waste. Samples will be analyzed using the version of each method that is current at the time of sampling.
- LOQ: Limit of Quantitation
- ug/L: micrograms per liter
- NA: Not Available
- pCi/L: picocuries per liter
- VSWMR: Virginia Municipal Solid Waste Regulations
- VPDES:
- Acceptable alternatives to the analytical methods listed above include current SW-846 Methods with LOQs equal to or lower than the one specified and other laboratory methods as approved by the Virginia Department of Environmental Quality.

Table 5
Summary of Sample Container Information and Hold Times
Chesterfield Power Station
Upper and Lower Ash Ponds

Parameter	Container & Volume	Preservative	Maximum Holding Time
pH	Flow-through cell or plastic, 500 mL	None	15 minutes (field analysis)
Specific Conductance	Flow-through cell or plastic, 500 mL	None	15 minutes (field analysis)
Temperature	Flow-through cell or plastic, 500 mL	None	15 minutes (field analysis)
Mercury (total)	Plastic; 250 mL	HNO_3 to pH<2	28 days
Metals (total) except mercury	Plastic, 250 mL	HNO_3 to pH<2	6 months
Total Dissolved Solids (TDS)	Plastic, 200 mL	None	7 days
Fluoride, Chloride, Sulfate	Plastic, 250 mL	None	28 days
Radium 226/228	Plastic, 1/2 gallon (2 L)	Preserved upon receipt at laboratory	6 months
Ammonia	Plastic, 250 mL	H_2SO_4 to pH<2	28 days
Chromium, Hexavalent	Plastic, 500 mL	None	24 hours
Nitrate	Plastic, 125 mL	None	48 hours
Total Hardness	Plastic, 500 mL	HNO_3 to pH<2	6 months

Notes:
mL= milliliter
VOA = Volatile Organic Analysis
L= Liter
HNO_3 = Nitric Acid
HCL = Hydrochloric Acid
H_2SO_4 = Sulfuric Acid

LIST OF DRAWINGS



SOURCE NOTE

Site Location Map consists of 7.5-minute USGS topographic quadrangles named Dutch Gap, Drewry's Bluff, Chester and Hopewell, all dated 2010.

2000 0 2000

SCALE FEET

CLIENT
DOMINION ENERGY

PROJECT
CHESTERFIELD POWER STATION

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2020-06-15
DESIGNED	-
PREPARED	BPG
REVIEWED	PKT
APPROVED	MGW

TITLE
SITE LOCATION MAP

PROJECT NO. 20-139767 | REV. 1 | DRAWING 1

802-665-4390
190 ACRES

805-666-2525
38 ACRES

CHESTERFIELD
POWER STATION

JAMES RIVER

806-664-8063
206.31 ACRES

MW-35S /
MW-35D

MP-1R

MW-35B

B52
(DECOMMISSIONED)

MW-20

MW-20I

OW-28D

OW-28B

MW-28

MW-21R

MW-21I

MW-B50

MW-22R

806-662-8465
53.204 ACRES

805-662-7764
59.276 ACRES

MW-27

MP-2

MW-32SR

MW-B42A

MP-3

APPROX. LIMITS
OF EX. RAIN COVER

807-660-1776
150.93 ACRES

MW-26

LVWWTS
BASIN

LOWER
ASH POND

MW-23R

MW-29U

MW-30U

MW-31U

MW-25

(DECOMMISSIONED) MW-B19

MW-33R

MW-34

MW-B41A

MW-24
(DECOMMISSIONED)

MW-B40A
(DECOMMISSIONED)

OW-24.5S

OW-24.5I

OW-24.5D

MW-36 (I)

MW-36 (S)

MW-13

MW-14

MW-15

MW-16
MW-16D
MW-16DD

MW-B32

POND

MW-DM5

MW-DM6

MW-DM7

MW-17S

MW-1
MW-1D
MW-1DD

MW-2

MW-B31

MW-3S
MW-3D

811-660-3332
144.1 ACRES

UPPER
ASH POND

MW-12

MW-11

MW-10

MW-9R

MW-8R

MW-7

MW-6
MW-6D
MW-6DD

MW-5

MW-4

LINED
STORMWATER
POND

TIDAL JAMES
RIVER
OLD CHANNEL

TIDAL JAMES
RIVER
OLD CHANNEL

LEGEND

- DOMINION PROPERTY BOUNDARY
- FACILITY BOUNDARY
- EXISTING TOPOGRAPHIC CONTOURS (2' INTERVALS)
- EXISTING TREELINE
- WASTE MANAGEMENT UNIT BOUNDARY (LIMITS OF PROPOSED CAP)
- EXISTING TOE DRAIN
- SURFACE WATER
- RESOURCE PROTECTION AREA BOUNDARY
- 10 — POTENTIOMETRIC SURFACE CONTOUR (OCTOBER 18, 2021)
- PROPOSED HYDRAULIC BARRIER WALL (APPROXIMATE LOCATION)
- MW-20 — EXISTING GROUNDWATER MONITORING WELL WITHIN GROUNDWATER MONITORING NETWORK
- MW-20I — EXISTING OBSERVATION WELL
- MW-24 — DECOMMISSIONED WELL

REFERENCE

1. EXISTING CONDITIONS COMPILED BY TUCK MAPPING SOLUTIONS USING PHOTOGRAMMETRIC METHODS, FROM AERIAL PHOTOGRAPHY DATED MAY 11, 2018.

REV.	MM/DD/YY	DESCRIPTION	DESIGN	CADD	CHECK	REVIEW
8	04/14/23	ADDED WELLS MW-36S/I	MGW	SIB	MGW	MGW
7	08/18/22	REVISIONS FOR LAP CLOSURE	MGW	SIB	MGW	MGW
6	09/24/21	MONITORING NETWORK REVISIONS	MGW	BPG	MGW	MGW
5	04/28/21	WELLS INSTALLED IN 2021 ADDED	MGW	SIB	MGW	MGW
4	10/05/20	PROPOSED NEW WELL LOCATIONS AND WELL DECOMMISSIONING	MGW	SIB	MGW	MGW
3	05/26/16	WELL LOCATION REVISIONS	MGW	BPG	MGW	MGW

SEAL

CLIENT
DOMINION ENERGY

CONSULTANT
WSP
2108 WEST LABURNUM AVENUE
SUITE 200
RICHMOND, VA 23227
(804) 358-7900

PROJECT
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VIRGINIA

TITLE
LOWER AND UPPER ASH POND
GROUNDWATER MONITORING PLAN

PROJECT NO.
31-406066

REV.
8

DRAWING
2

SCALE
350 0 350 700
FEET

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ARCH D
0 1 in

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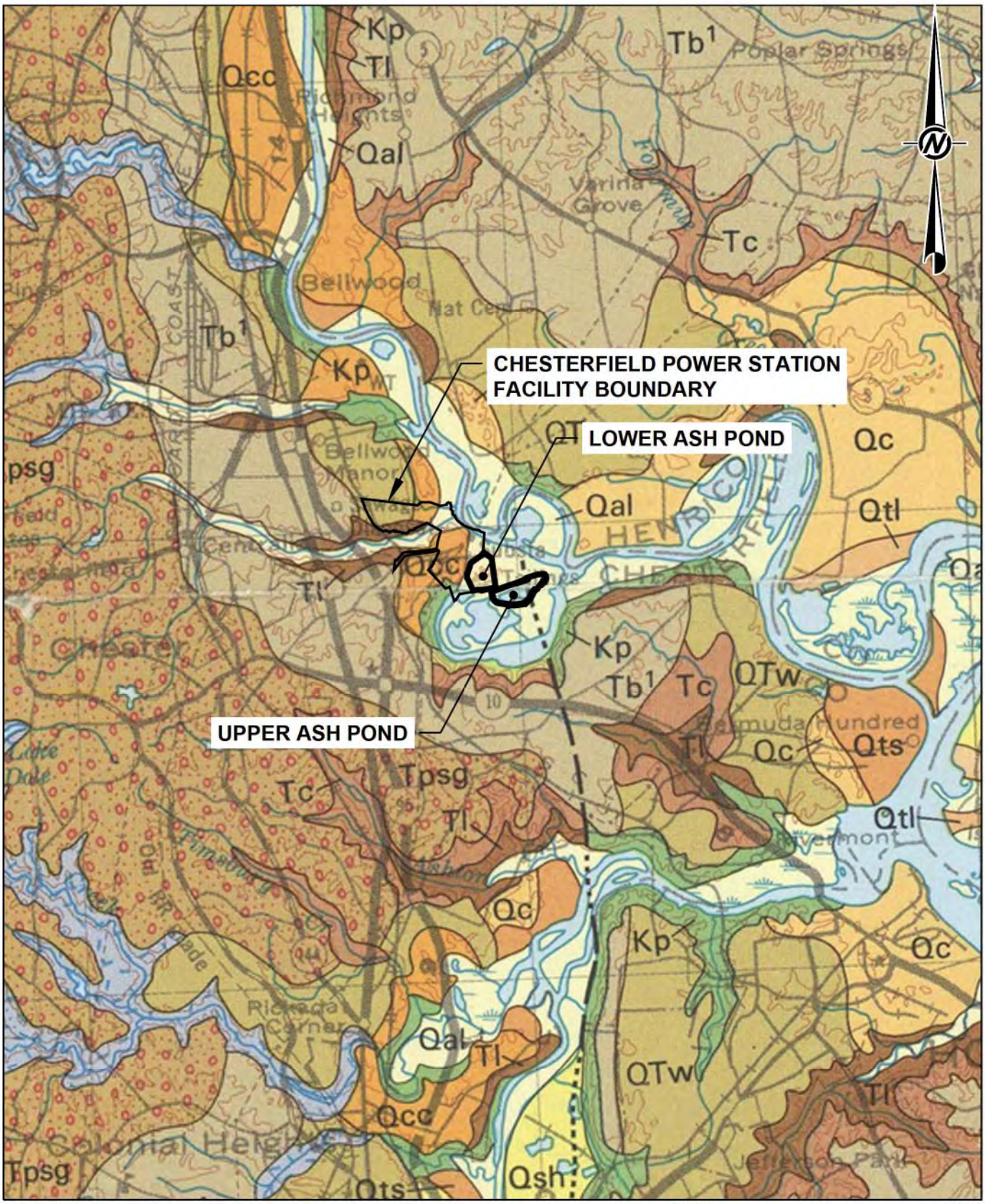


SOURCE NOTE

Geologic Map, 1989, by R.B. Mixon, C.R. Berquist, Jr., W.L. Newell, and G.H. Johnson

10000 0 10000

SCALE FEET

GOLDER
MEMBER OF WSP

DATE	07/27/17
DESIGN	MGW
CADD	ABR
CHECK	MGW
REVIEW	TCP

PROJECT No. 15-32864

SCALE AS SHOWN REV. 0

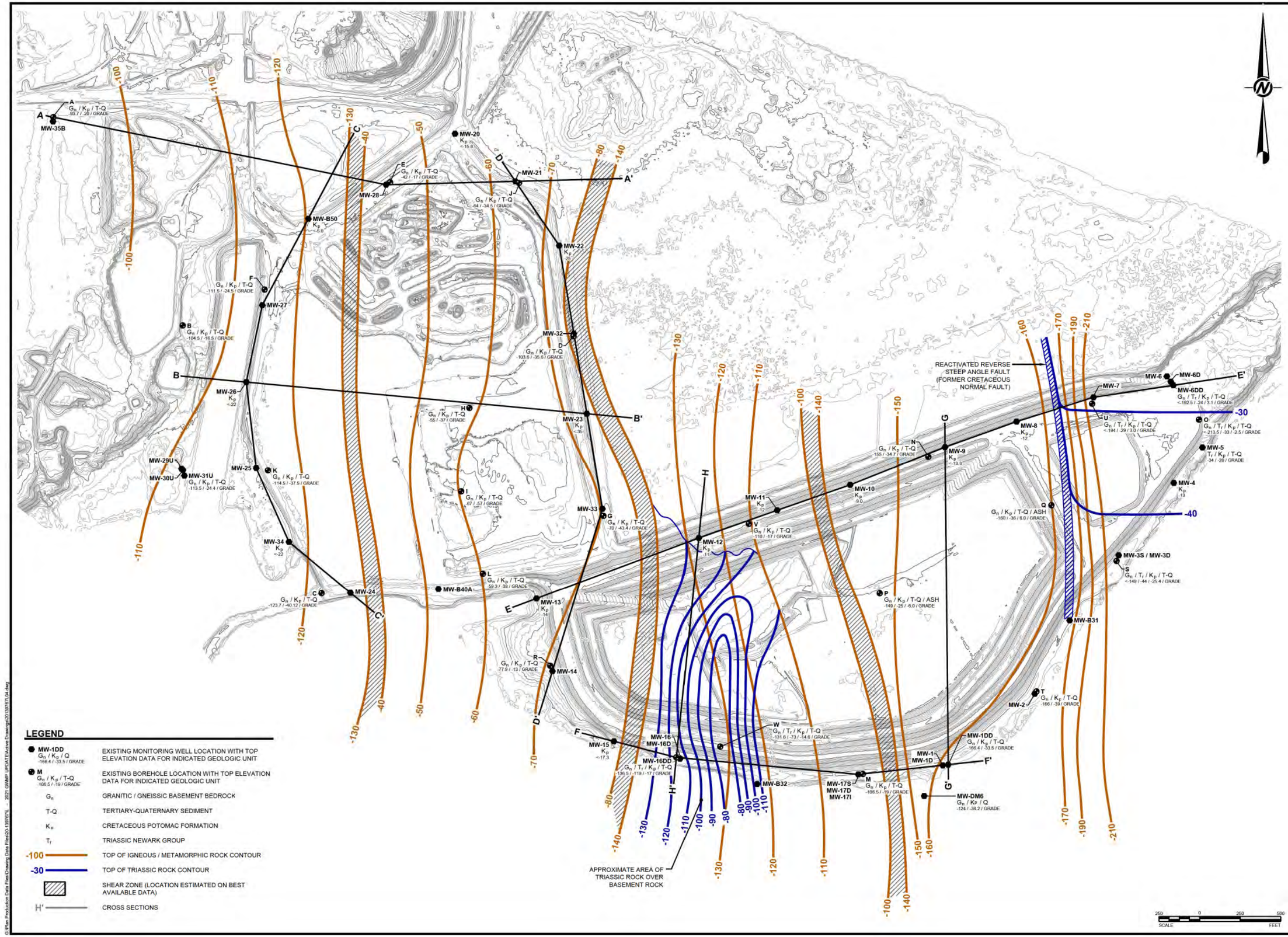
TITLE

GEOLOGIC MAP

DOMINION - CHESTERFIELD POWER STATION

DRAWING 3

G:\Plan Production Data Files\Drawing Data Files\20-139767\L - 2021 GWMP UPDATE\Active Drawings\20139767L03.dwg



LEGEND

MW-1DD G_n / K_p / Q -166.4 / -33.5 / GRADE	EXISTING MONITORING WELL LOCATION WITH TOP ELEVATION DATA FOR INDICATED GEOLOGIC UNIT
M G_n / K_p / T-Q -106.5 / -19 / GRADE	EXISTING BOREHOLE LOCATION WITH TOP ELEVATION DATA FOR INDICATED GEOLOGIC UNIT
G_n	GRANITIC / GNEISSIC BASEMENT BEDROCK
T-Q	TERTIARY-QUATERNARY SEDIMENT
K_{tt}	CRETACEOUS POTOMAC FORMATION
T_r	TRIASSIC NEWARK GROUP
-100	TOP OF IGNEOUS / METAMORPHIC ROCK CONTOUR
-30	TOP OF TRIASSIC ROCK CONTOUR
	SHEAR ZONE (LOCATION ESTIMATED ON BEST AVAILABLE DATA)
H'	CROSS SECTIONS

SCALE: 250 0 250 500 FEET

GOLDER
MEMBER OF WSP

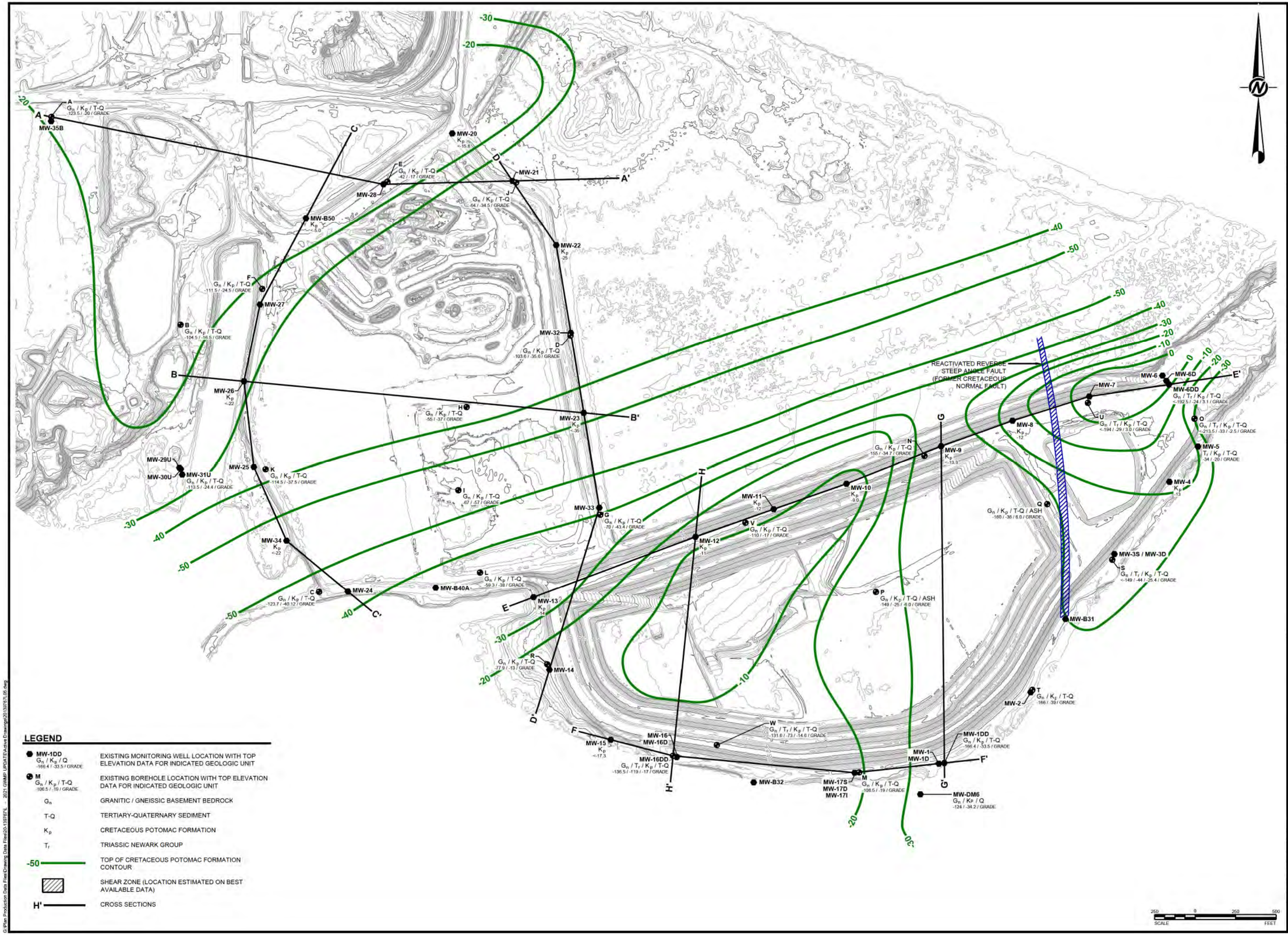
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
DOMINION
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VA

TITLE
STRUCTURAL CONTOUR MAP FOR BASEMENT BEDROCK

PROJECT No.		15-32864
FILE No.		20139767L04
REV. 0	SCALE	AS SHOWN
DESIGN	MGW	02/06/17
CADD	BPG	02/06/17
CHECK	MGW	07/27/17
REVIEW	TCP	07/27/17

DRAWING 4



G:\Plot Production Data Files\Drawing Data Files\20139767L - 2021 GWMP UPDATE\Active Drawings\20139767L05.dwg

GOLDER
MEMBER OF WSP

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

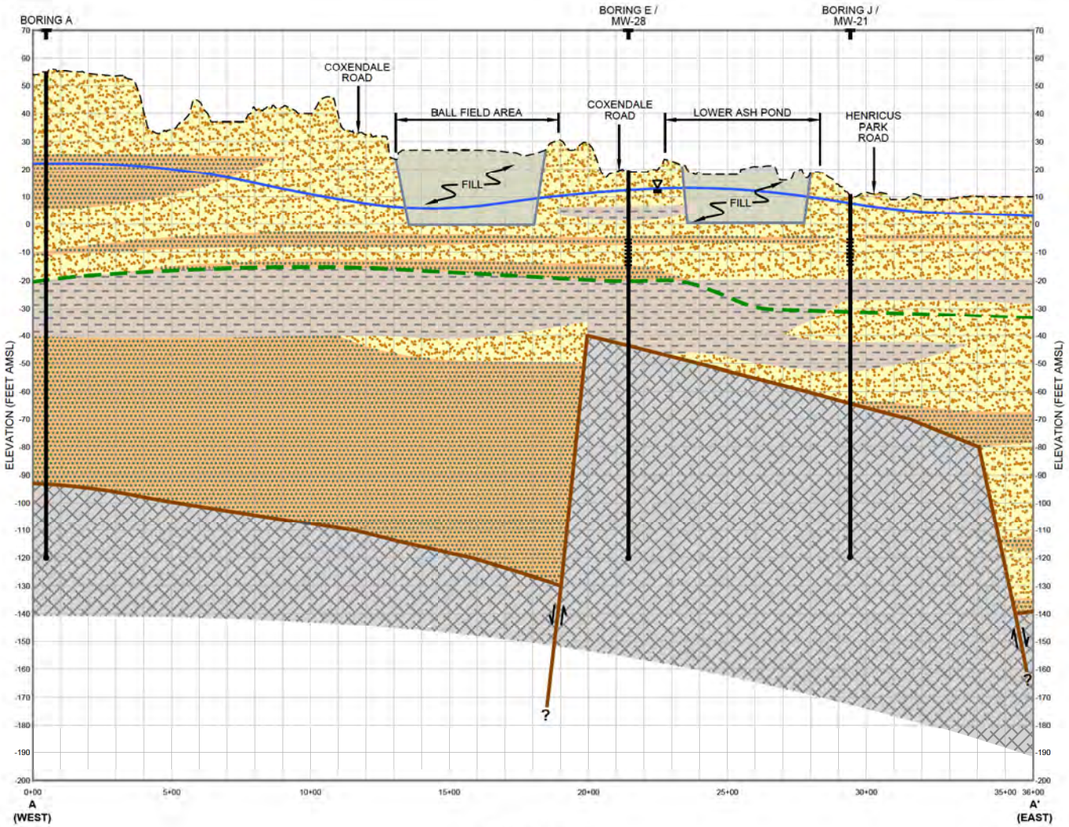
DOMINION
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VA

TITLE

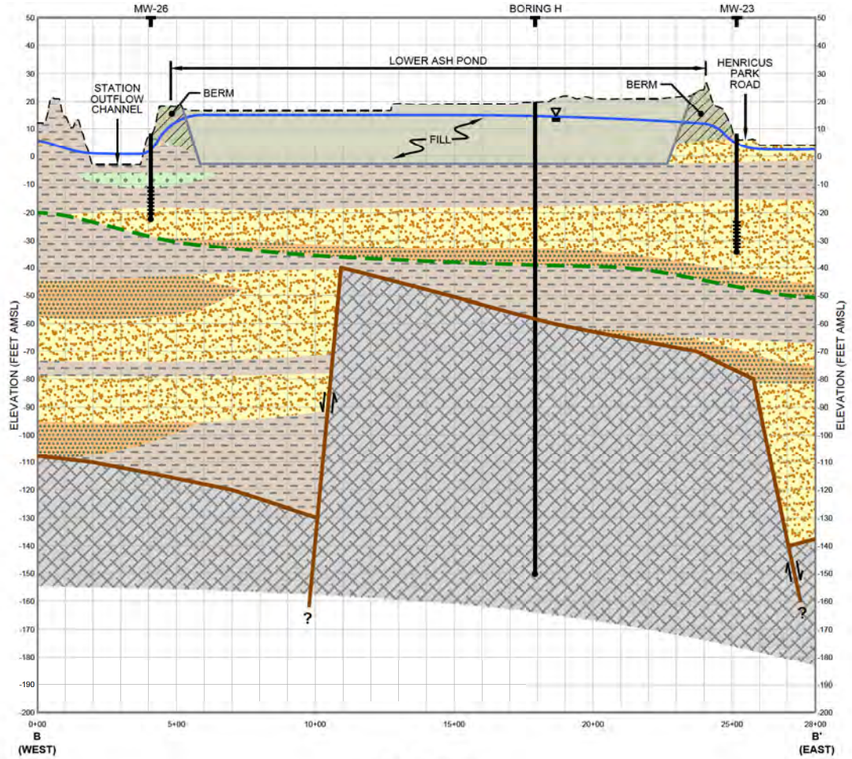
STRUCTURAL CONTOUR MAP FOR TOP OF CRETACEOUS POTOMAC FORMATION

PROJECT No.		15-32864
FILE No.		20139767L05
REV. 0	SCALE	AS SHOWN
DESIGN	MGW	02/06/17
CADD	BPG	02/06/17
CHECK	MGW	07/27/17
REVIEW	TCP	07/27/17

DRAWING 5



SECTION A - A'



SECTION B - B'

LEGEND

- EXISTING GROUND
- WATER TABLE
- TOP CRETACEOUS POTOMAC FORMATION
- TOP OF IGNEOUS / METAMORPHIC ROCK
- TOP OF TRIASSIC ROCK
- BOTTOM OF FILL
- SCREENED INTERVAL
- CLAY + SANDY CLAY + CLAYEY SILT
- SAND + GRAVEL
- SAND + SILT
- ORGANIC SILT + CLAY
- TRIASSIC CONGLOMERATE SILT STONE, SAND STONE, AND MUD STONE
- BEDROCK
- FILL MATERIAL
- ASH POND BERM FILL

SCALE: 50 25 0 25 FEET

SCALE: 250 0 250 500 FEET

GOLDER
MEMBER OF WSP

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

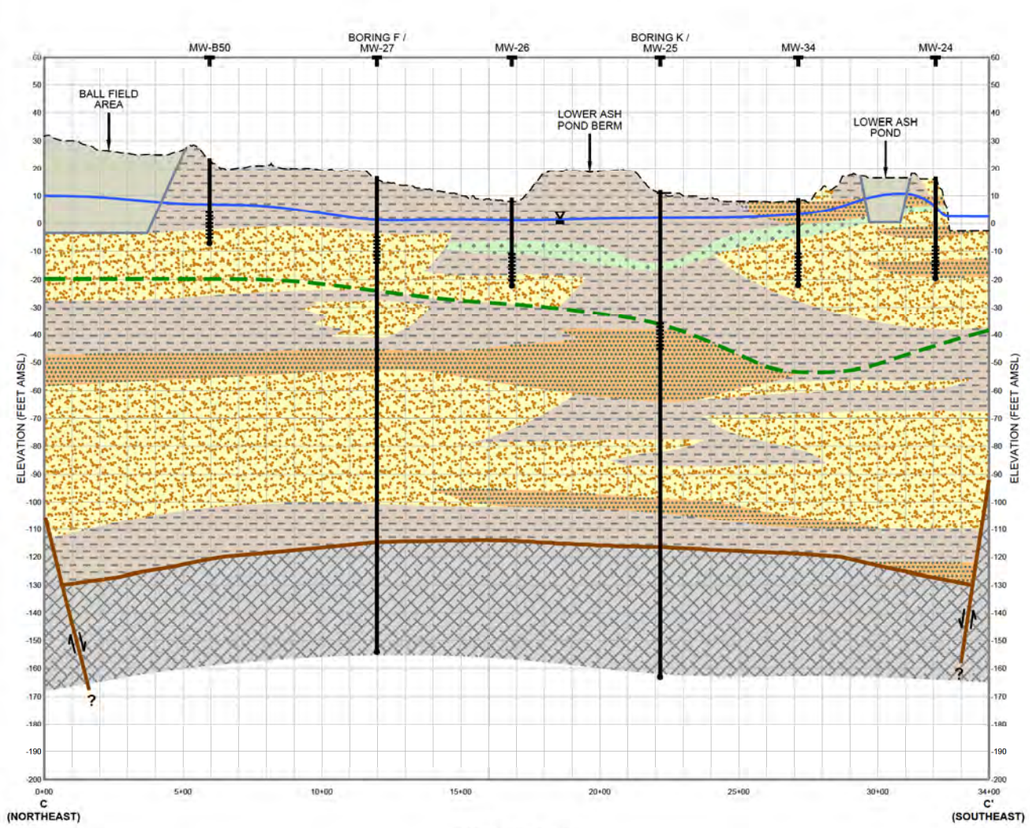
PROJECT
DOMINION
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VA

TITLE
CROSS SECTIONS
A-A' AND B-B'

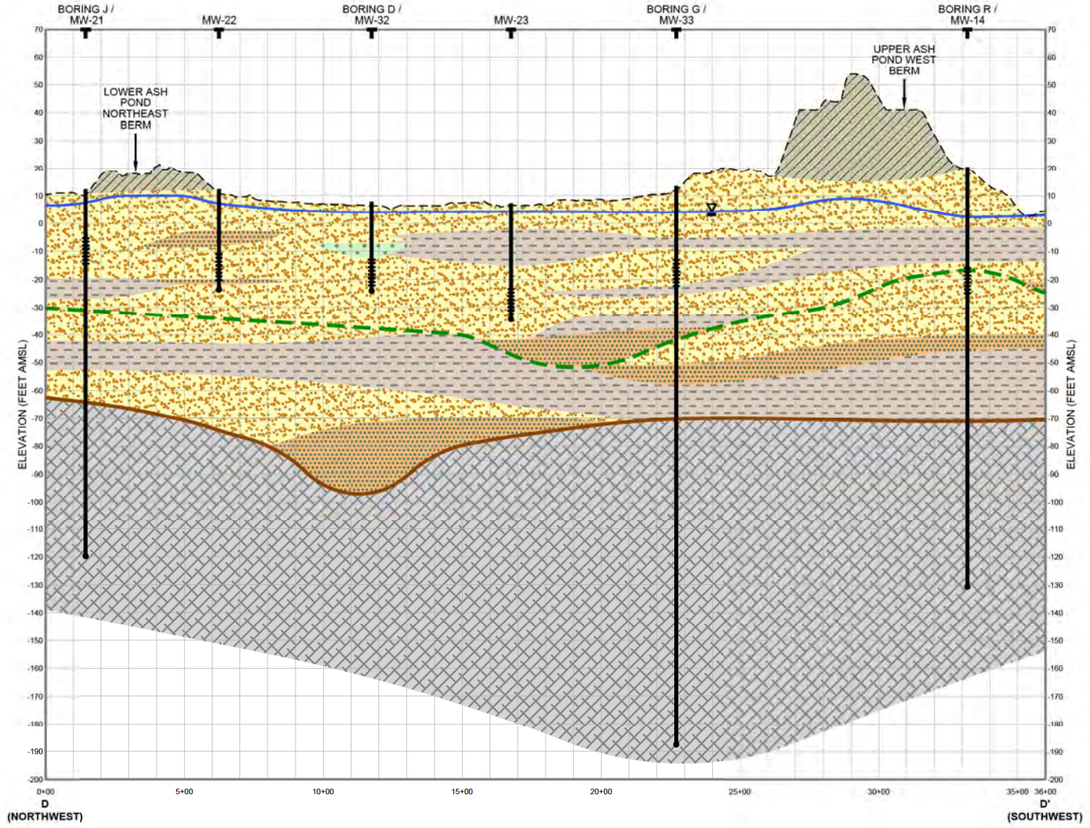
PROJECT No.		15-32864
FILE No.		20139767L06
REV. 0	SCALE	AS SHOWN
DESIGN	MGW	02/06/17
CADD	BPG	02/06/17
CHECK	MGW	07/27/17
REVIEW	TCP	07/27/17

DRAWING 6

G:\Plan Production Data Files\Drawing Data Files\20-139767\... 2021 GWMP UPDATE\Active Drawings\20139767L06.dwg



SECTION C - C'



SECTION D - D'

LEGEND

- EXISTING GROUND
- WATER TABLE
- TOP CRETACEOUS POTOMAC FORMATION
- TOP OF IGNEOUS / METAMORPHIC ROCK
- TOP OF TRIASSIC ROCK
- BOTTOM OF FILL
- SCREENED INTERVAL
- CLAY + SANDY CLAY + CLAYEY SILT
- SAND + GRAVEL
- SAND + SILT
- ORGANIC SILT + CLAY
- TRIASSIC CONGLOMERATE SILT STONE, SAND STONE, AND MUD STONE
- BEDROCK
- FILL MATERIAL
- ASH POND BERM FILL

SCALE: 50 FEET, 25, 0, 25

SCALE: 250, 0, 250, 500 FEET

GOLDER
MEMBER OF WSP

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
DOMINION
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VA

TITLE
CROSS SECTIONS
C-C' AND D-D'

PROJECT No.		15-32864
FILE No.		20139767L06
REV. 0	SCALE	AS SHOWN
DESIGN	MGW	02/06/17
CADD	BPG	02/06/17
CHECK	MGW	07/27/17
REVIEW	TCP	07/27/17

DRAWING 7

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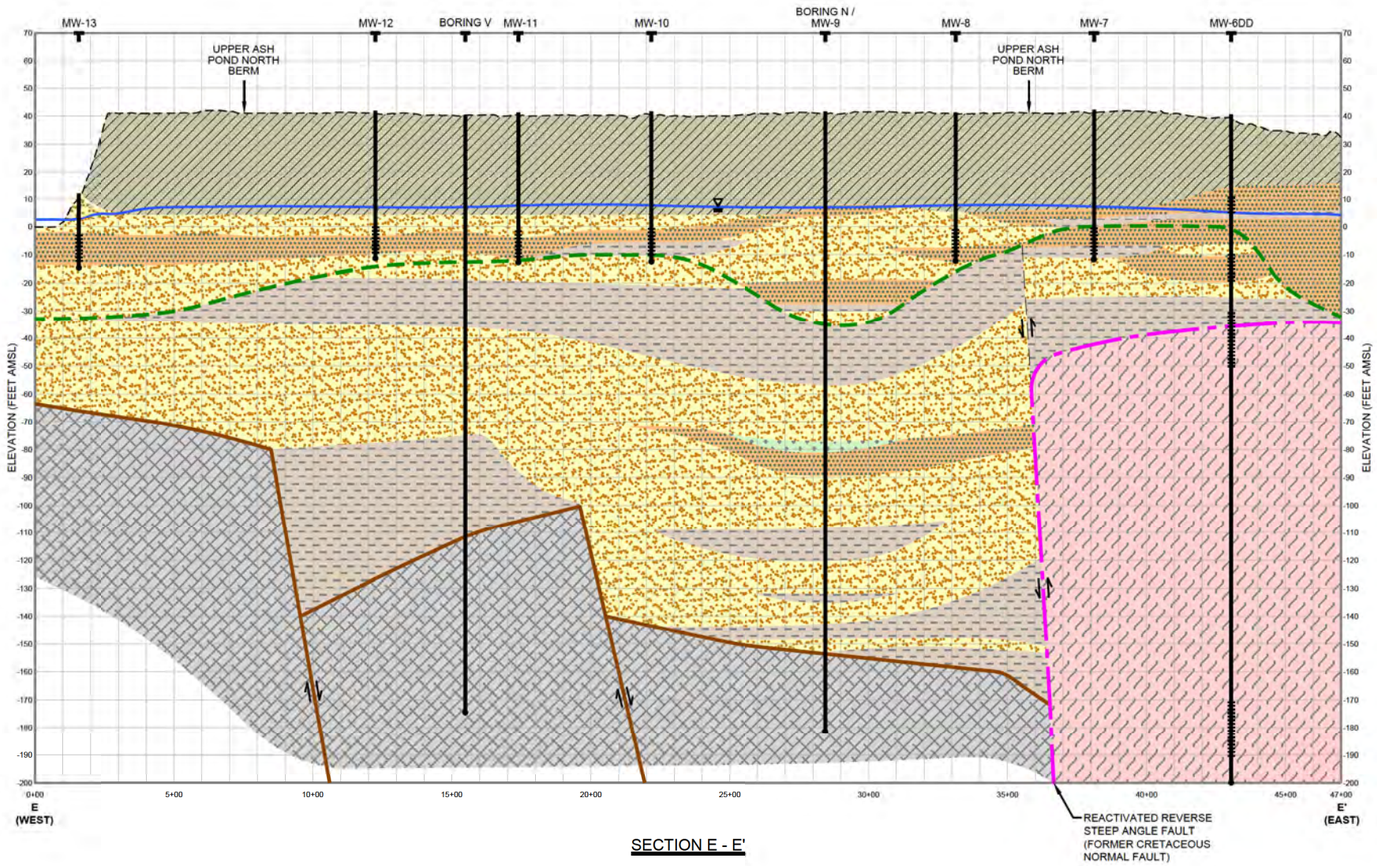


SECTION E - E'

LEGEND

- EXISTING GROUND
- WATER TABLE
- TOP CRETACEOUS POTOMAC FORMATION
- TOP OF IGNEOUS / METAMORPHIC ROCK
- TOP OF TRIASSIC ROCK
- BOTTOM OF FILL
- SCREENED INTERVAL
- CLAY + SANDY CLAY + CLAYEY SILT
- SAND + GRAVEL
- SAND + SILT
- ORGANIC SILT + CLAY
- TRIASSIC CONGLOMERATE SILT STONE, SAND STONE, AND MUD STONE
- BEDROCK
- FILL MATERIAL
- ASH POND BERM FILL

SCALE: 50 25 0 25 FEET

SCALE: 250 0 250 500 FEET

GOLDER
MEMBER OF WSP

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

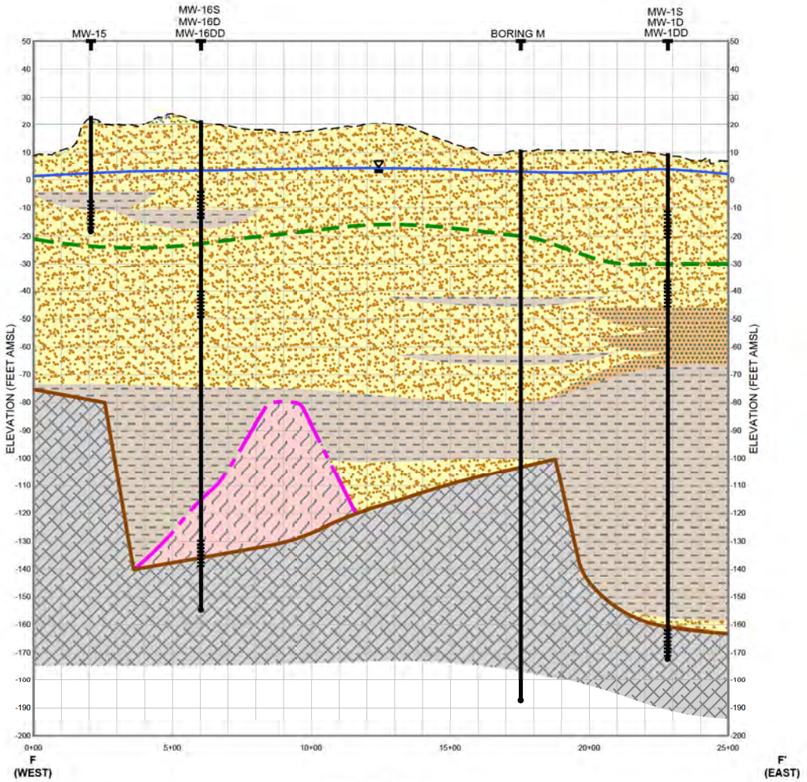
PROJECT
DOMINION
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VA

TITLE
CROSS SECTION
E-E'

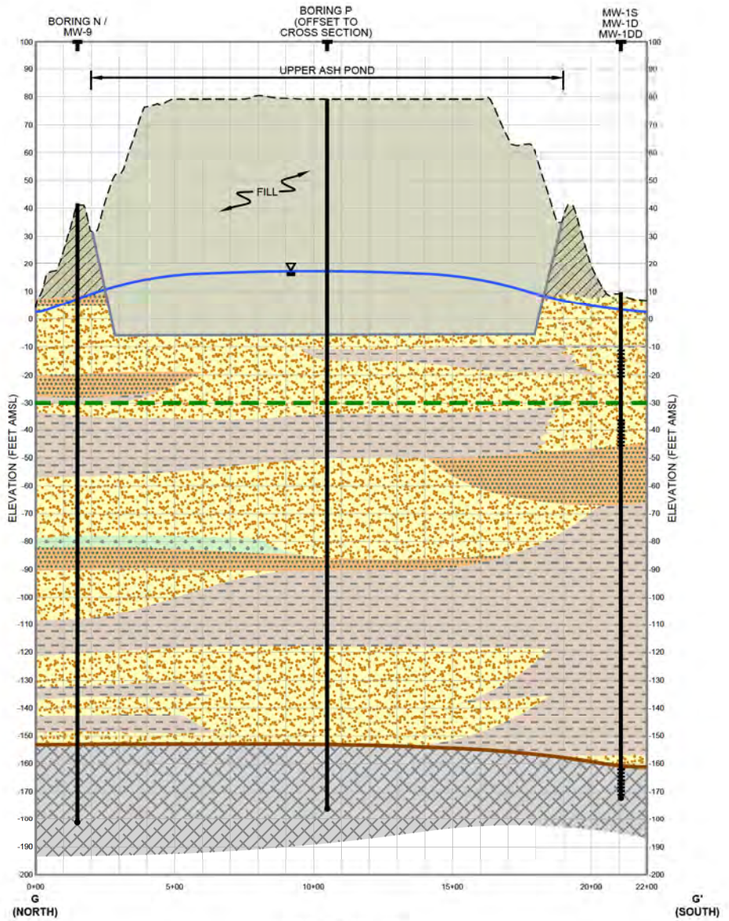
PROJECT No.		15-32864
FILE No.		20139767L06
REV. 0	SCALE	AS SHOWN
DESIGN	MGW	02/06/17
CADD	BPG	02/06/17
CHECK	MGW	07/27/17
REVIEW	TCP	07/27/17

DRAWING 8

G:\Plan Production Data Files\Drawing Data Files\20s-15976\... 2021 GWMP UPDATE\Active Drawings\20139767L06.dwg



SECTION F - F'



SECTION G - G'

LEGEND

- EXISTING GROUND
- WATER TABLE
- TOP CRETACEOUS POTOMAC FORMATION
- TOP OF IGNEOUS / METAMORPHIC ROCK
- TOP OF TRIASSIC ROCK
- BOTTOM OF FILL
- SCREENED INTERVAL
- CLAY + SANDY CLAY + CLAYEY SILT
- SAND + GRAVEL
- SAND + SILT
- ORGANIC SILT + CLAY
- TRIASSIC CONGLOMERATE SILT STONE, SAND STONE, AND MUD STONE
- BEDROCK
- FILL MATERIAL
- ASH POND BERM FILL

SCALE: 50 25 0 25 FEET

SCALE: 250 0 250 500 FEET

GOLDER
MEMBER OF WSP

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
DOMINION
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VA

TITLE
CROSS SECTIONS
F-F' AND G-G'

PROJECT No.		15-32864
FILE No.		20139767L06
REV. 0	SCALE	AS SHOWN
DESIGN	MGW	02/06/17
CADD	BPG	02/06/17
CHECK	MGW	07/27/17
REVIEW	TCP	07/27/17

DRAWING 9

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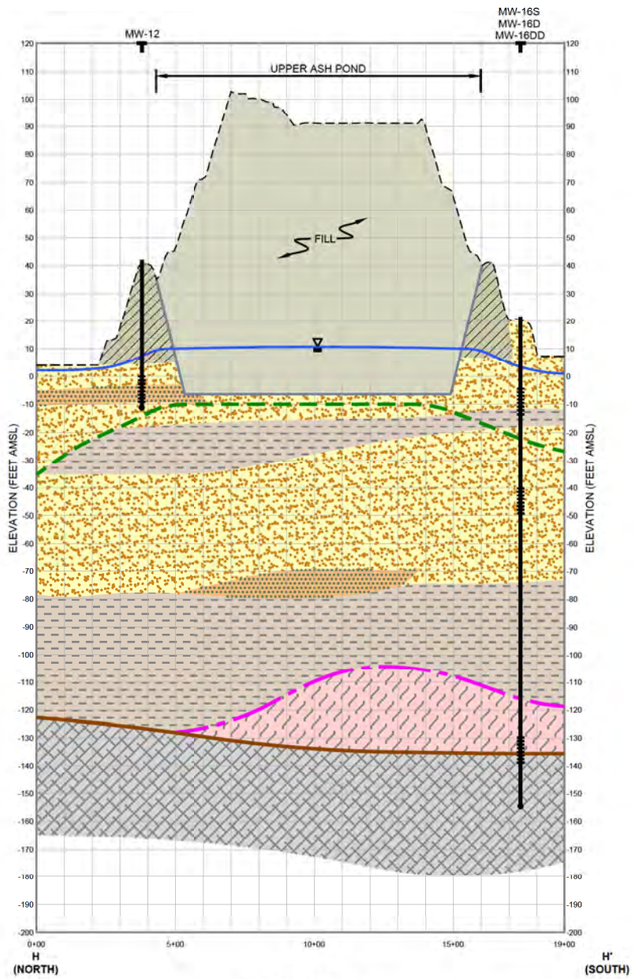

SECTION H - H'

LEGEND

- EXISTING GROUND
- WATER TABLE
- TOP CRETACEOUS POTOMAC FORMATION
- TOP OF IGNEOUS / METAMORPHIC ROCK
- TOP OF TRIASSIC ROCK
- BOTTOM OF FILL
- SCREENED INTERVAL
- CLAY + SANDY CLAY + CLAYEY SILT
- SAND + GRAVEL
- SAND + SILT
- ORGANIC SILT + CLAY
- TRIASSIC CONGLOMERATE SILT STONE, SAND STONE, AND MUD STONE
- BEDROCK
- FILL MATERIAL
- ASH POND BERM FILL

SCALE: 50 25 0 25 FEET

SCALE: 250 0 250 500 FEET

GOLDER
MEMBER OF WSP

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
DOMINION
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VA

TITLE
CROSS SECTION
H-H'

PROJECT No.		15-32864
FILE No.		20139767L06
REV. 0	SCALE	AS SHOWN
DESIGN	MGW	02/06/17
CADD	BPG	02/06/17
CHECK	MGW	07/27/17
REVIEW	TCP	07/27/17

DRAWING 10

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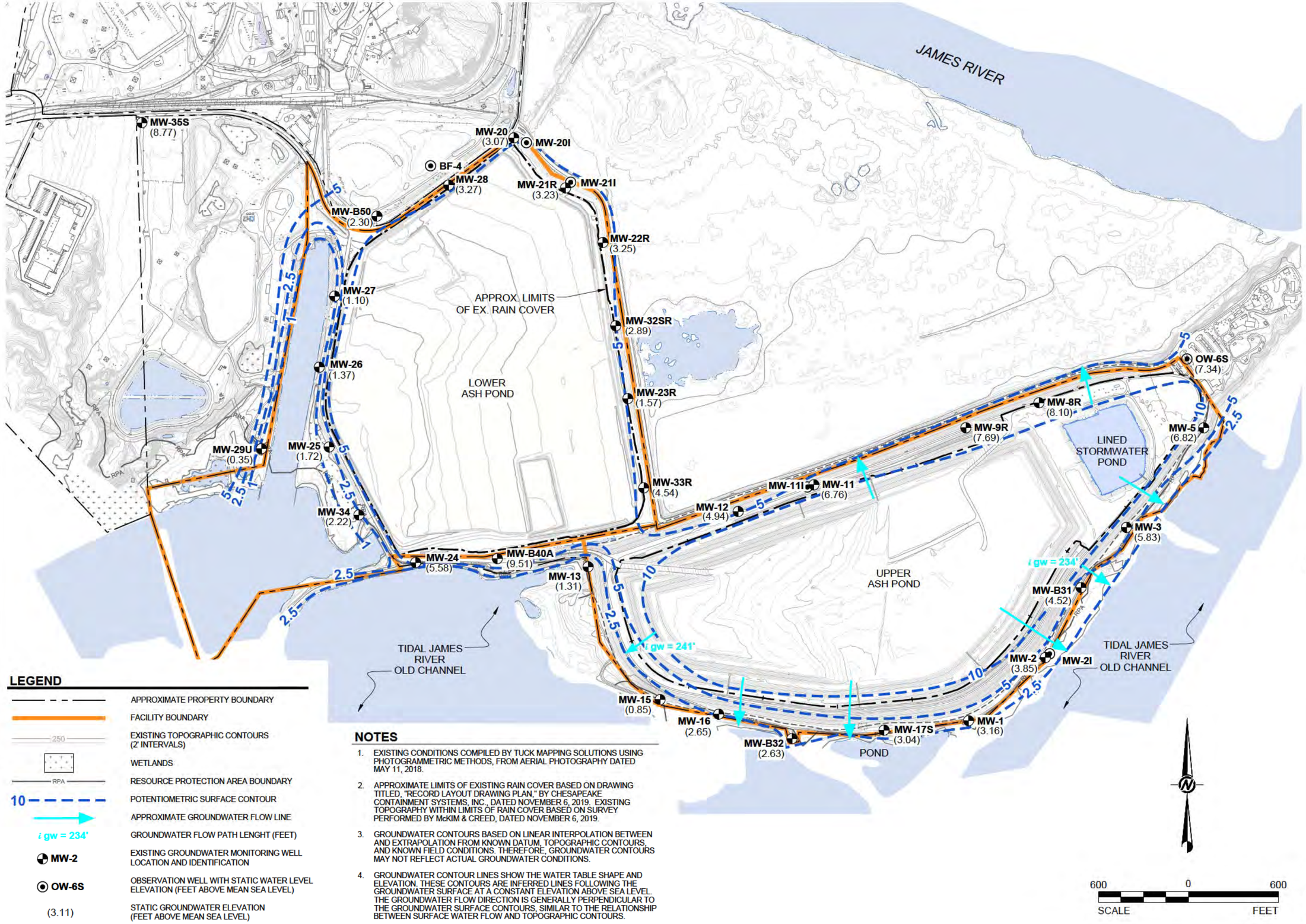


LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- FACILITY BOUNDARY
- 250 — EXISTING TOPOGRAPHIC CONTOURS (2' INTERVALS)
- WETLANDS
- RPA — RESOURCE PROTECTION AREA BOUNDARY
- 10 — POTENTIOMETRIC SURFACE CONTOUR
- APPROXIMATE GROUNDWATER FLOW LINE
- i gw = 234' — GROUNDWATER FLOW PATH LENGHT (FEET)
- MW-2 — EXISTING GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION
- OW-6S — OBSERVATION WELL WITH STATIC WATER LEVEL ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- (3.11) — STATIC GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)

NOTES

1. EXISTING CONDITIONS COMPILED BY TUCK MAPPING SOLUTIONS USING PHOTOGRAMMETRIC METHODS, FROM AERIAL PHOTOGRAPHY DATED MAY 11, 2018.
2. APPROXIMATE LIMITS OF EXISTING RAIN COVER BASED ON DRAWING TITLED, "RECORD LAYOUT DRAWING PLAN," BY CHESAPEAKE CONTAINMENT SYSTEMS, INC., DATED NOVEMBER 6, 2019. EXISTING TOPOGRAPHY WITHIN LIMITS OF RAIN COVER BASED ON SURVEY PERFORMED BY McKIM & CREED, DATED NOVEMBER 6, 2019.
3. GROUNDWATER CONTOURS BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATUM, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, GROUNDWATER CONTOURS MAY NOT REFLECT ACTUAL GROUNDWATER CONDITIONS.
4. GROUNDWATER CONTOUR LINES SHOW THE WATER TABLE SHAPE AND ELEVATION. THESE CONTOURS ARE INFERRED LINES FOLLOWING THE GROUNDWATER SURFACE AT A CONSTANT ELEVATION ABOVE SEA LEVEL. THE GROUNDWATER FLOW DIRECTION IS GENERALLY PERPENDICULAR TO THE GROUNDWATER SURFACE CONTOURS, SIMILAR TO THE RELATIONSHIP BETWEEN SURFACE WATER FLOW AND TOPOGRAPHIC CONTOURS.

YYYY-MM-DD 2022-07-05
DESIGNED ANG
PREPARED SIB
REVIEWED MGW
APPROVED MGW

CLIENT
DOMINION ENERGY

CONSULTANT
WSP GOLDER

PROJECT
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VIRGINIA
UPPER ASH POND

TITLE
GROUNDWATER POTENTIOMETRIC SURFACE MAP
COLUMBIA AQUIFER
OCTOBER 18, 2021

PROJECT NO.
20-13976722

REV. 0
DRAWING 11

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: G:\Plan Production Data Files\Drawing Data Files\20-13976722\20-13976722_040_11.dwg

JAMES RIVER

MW-35D
(2.81)

MW-30U
(2.45)

APPROX. LIMITS
OF EX. RAIN COVER

LOWER
ASH POND

i gw = 2,607'

LINED
STORMWATER
POND

MW-7
(8.38)

MW-6
(5.70)

MW-10
(7.11)

MW-11I

MW-4
(6.83)

UPPER
ASH POND

MW-14
(0.67)

TIDAL JAMES
RIVER
OLD CHANNEL

MW-2I

TIDAL JAMES
RIVER
OLD CHANNEL

MW-16D
(1.40)

OW-17I
(2.42)

MW-1D
(2.89)

POND

2.0
3.0
4.0
5.0
6.0
7.0
8.0

RPA

LEGEND

	APPROXIMATE PROPERTY BOUNDARY
	FACILITY BOUNDARY
250	EXISTING TOPOGRAPHIC CONTOURS (2' INTERVALS)
	WETLANDS
RPA	RESOURCE PROTECTION AREA BOUNDARY
5.0	POTENTIOMETRIC SURFACE CONTOUR
	APPROXIMATE GROUNDWATER FLOW LINE
i gw = 2,607'	GROUNDWATER FLOW PATH LENGHT (FEET)
MW-6	EXISTING GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION
OW-17I	OBSERVATION WELL WITH STATIC WATER LEVEL ELEVATION (FEET ABOVE MEAN SEA LEVEL)
(6.17)	STATIC GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)

NOTES

1. EXISTING CONDITIONS COMPILED BY TUCK MAPPING SOLUTIONS USING PHOTOGRAMMETRIC METHODS, FROM AERIAL PHOTOGRAPHY DATED MAY 11, 2018.
2. APPROXIMATE LIMITS OF EXISTING RAIN COVER BASED ON DRAWING TITLED, "RECORD LAYOUT DRAWING PLAN," BY CHESAPEAKE CONTAINMENT SYSTEMS, INC., DATED NOVEMBER 6, 2019. EXISTING TOPOGRAPHY WITHIN LIMITS OF RAIN COVER BASED ON SURVEY PERFORMED BY McKIM & CREED, DATED NOVEMBER 6, 2019.
3. GROUNDWATER CONTOURS BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATUM, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, GROUNDWATER CONTOURS MAY NOT REFLECT ACTUAL GROUNDWATER CONDITIONS.
4. GROUNDWATER CONTOUR LINES SHOW THE WATER TABLE SHAPE AND ELEVATION. THESE CONTOURS ARE INFERRED LINES FOLLOWING THE GROUNDWATER SURFACE AT A CONSTANT ELEVATION ABOVE SEA LEVEL. THE GROUNDWATER FLOW DIRECTION IS GENERALLY PERPENDICULAR TO THE GROUNDWATER SURFACE CONTOURS, SIMILAR TO THE RELATIONSHIP BETWEEN SURFACE WATER FLOW AND TOPOGRAPHIC CONTOURS.

600 0 600
SCALE FEET

CLIENT
DOMINION ENERGY

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-07-05
DESIGNED	ANG
PREPARED	SIB
REVIEWED	MGW
APPROVED	MGW

PROJECT
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VIRGINIA
UPPER ASH POND

TITLE
GROUNDWATER POTENTIOMETRIC SURFACE MAP
POTOMAC AQUIFER
OCTOBER 18, 2021

PROJECT NO.
20-13976722

REV. 0
DRAWING 12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

Path: G:\Plan Production Data Files\Drawing Data Files\203-13976722\040_GWA\Active Drawings\20139767 22_040_12.dwg

JAMES RIVER

LOWER ASH POND

UPPER ASH POND

LINED STORMWATER POND

POND

PROPOSED POND

PROPOSED POND

WATER LEVEL ELEVATION = 15' (ABOVE MEAN SEA LEVEL)

TIDAL JAMES RIVER OLD CHANNEL

TIDAL JAMES RIVER OLD CHANNEL

REACTIVATED REVERSE STEEP ANGLE FAULT (FORMER CRETACEOUS NORMAL FAULT)

MW-35S / MW-35D
MW-35B (3,39)
MW-20
MW-20I
BF-4
MW-28
MW-21R
MW-21I
MW-B50
MW-22R
MW-27
MW-32SR
MW-26
MW-23R
MW-29U
MW-30U (4,58) MW-31U
MW-25
MW-33R
MW-34
MW-12
MW-11
OW-24.5S
OW-24.5I
OW-24.5D
MW-24
MW-B40A
MW-13
MW-14
MW-15
MW-16
MW-16D
(5,90) MW-16DD
MW-B32
MW-17S
OW-17I
(2,05) OW-17D
MW-1
MW-1D
(3.55) MW-1DD
MW-2
MW-B31
MW-3S
MW-3D
MW-7
MW-8R
MW-9R
MW-10
OW-10
MW-4
MW-5
MW-6
OW-6S
MW-6D
MW-6DD (4,69)

LEGEND

- DOMINION PROPERTY BOUNDARY
- FACILITY BOUNDARY
- EXISTING TOPOGRAPHIC CONTOURS (2' INTERVALS)
- EXISTING TOPOGRAPHIC CONTOURS (APPROXIMATE)
- EXISTING TREELINE
- WASTE MANAGEMENT UNIT BOUNDARY (LIMITS OF PROPOSED CAP)
- MW-1 — GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION WITH STATIC WATER LEVEL ELEVATION (FEET ABOVE MEAN SEA LEVEL_
- OW-10 — OBSERVATION WELL WITH STATIC WATER LEVEL ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- SURFACE WATER
- RPA — RESOURCE PROTECTION AREA BOUNDARY
- EXISTING TOE DRAIN
- 5.0 — GROUNDWATER SURFACE CONTOUR WITH ELEVATION
- ESTIMATED GROUNDWATER FLOW DIRECTION
- SHEAR ZONE (LOCATION ESTIMATED ON BEST AVAILABLE DATA)

REV.	MM/DD/YY	DESCRIPTION	DESIGN	CADD	CHECK	REVIEW
0	07/05/22	-	MGW	BPG	MGW	MGW

SEAL

CLIENT
DOMINION ENERGY

CONSULTANT
GOLDER ASSOCIATES
2108 WEST LABURNUM AVENUE
SUITE 200
RICHMOND, VA 23227
(804) 358-7900
www.golder.com
GOLDER

PROJECT
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VIRGINIA

TITLE
GROUNDWATER SURFACE CONTOUR MAP
BEDROCK AQUIFER
OCTOBER 18, 2021

PROJECT NO
20-13976722

REV.
0

DRAWING
13

Path: G:\Plan Production\Data Files\Drawing Data Files\20139767222\MXD_GW\Active Drawings\20139767222_MXD_13.mxd

APPENDIX A

MONITORING WELL CONSTRUCTION LOGS
AVAILABLE GEOPHYSICAL LOGS

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. MW-1

Boring No. MW-1

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	J. Yonts
CONTRACTOR	Fishburne Drilling	**DATE INSTALLED**	6/20/2016
DRILLER	J. Raasio		

Ground El. - ft
El. Datum -

Location See plan

☑ **Guard Pipe**
☐ **Roadway Box**

SOIL/ROCK CONDITIONS

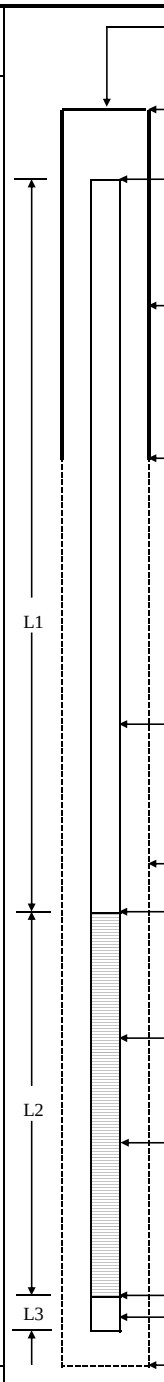
See boring log

BOREHOLE BACKFILL

0.0
Concrete
2.0
Bentonite
16.0
Bentonite Seal
18.0
Sand

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)



(Not to Scale)

Type of protective cover/lock

Height/Depth of top of guard pipe/roadway box above/below ground surface 3.0 ft

Height/Depth of top of riser pipe above/below ground surface 2.5 ft

Type of protective casing: Guard Pipe
Length 5.0 ft
Inside Diameter 4.000 in

Depth of bottom of guard pipe/roadway box 2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	14.0
Bentonite Seal	16.0	2.0
Filter Sand	18.0	12.5

Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe 2.1 in
Type of backfill around riser Sand, bentonite pellets, bentonite

Diameter of borehole 6.0 in

Depth to top of well screen 20.0 ft

Type of screen PVC
Screen gauge or size of openings 0.010 in
Diameter of screen 2.0 in
Type of backfill around screen #2 Filter Sand

Depth of bottom of well screen 30.0 ft

Bottom of Silt trap 0.5 ft

Depth of bottom of borehole 30.5 ft

20 ft	+	10 ft	+	0.5 ft	=	30.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

TEST BORING REPORT

Boring No. MW-1

Project	Dominion Power/Chesterfield, Chester, VA
Client	Dominion
Contractor	Fishburne Drilling Inc.

File No. 42735-001
Sheet No. 1 of 3
Start June 21, 2016
Finish June 21, 2016
Driller J. Raasio
H&A Rep. J. Yonts
Elevation 9.7
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel
Type	HSA	S	-
Inside Diameter (in.)	2.5	1 3/8	-
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures:
Rig Make & Model: Track mounted CME 55
Bit Type: Cutting Head/Roller Bit
Drill Mud: Bentonite
Casing: HSA Spun to 80.0 ft
Hoist/Hammer: Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	7 8 8 20	S1 18	0.0 2.0	9.5 0.3 8.7 1.0	GP	-TOPSOIL- White and black GRAVEL (GP), mps 1.0 in., no odor, dry										
					SM	Medium dense brown and tan silty SAND (SM), trace rounded gravel, mps 1.0 in., no odor, moist	5	5	--	10	50	30				
	4 6 9 7	S2 20	3.0 5.0		SM	Similar to S1, below 1.0 ft, except moist, less gravel	--	5	--	10	55	30				
5																
	1 1 1 2	S3 17	8.0 10.0		ML/ SM	Loose sandy SILT (ML) grading to silty SAND (SM), trace well rounded gravel, mps 1.1 in., no odor, wet	5	5	--	10	40	40				
10				-3.3												
	3 9 18 15	S4 24	13.0 15.0	13.0	SM	Medium dense brown to red-brown silty SAND with gravel (SM), subrounded gravel, mps 1.1 in., no odor, wet	10	20	10	5	25	30				
15				-8.3		-FILL-										
	18 27 52 50/3"	S5 24	18.0 19.8	18.0	SM	Very dense orange, tan, and white silty SAND with gravel (SM), mps 1.0 in., no odor, wet, gravel subrounded to rounded	5	10	10	25	20	30				
20						Note: Augering to 23.0 ft indicates cobbles/gravel present.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
Refer to groundwater level table					

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 80.0
Rock Cored (ft) -
Samples 17S

Boring No. MW-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-1
File No. 42735-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
	50/1"	S6 2	23.0 23.1	-13.3 23.0	SW-SM	Very dense well-graded SAND with silt (SW-SM), mps 0.8 in., wet	5	5	20	30	30	10				
25						Note: Augering to 28.0 ft indicates coarse material.											
	50/2"	S7 0	28.0 28.2			Very dense, no recovery										
30						Note: Augering indicates cobbles/gravel, coarse material to approximately 31 ft. Change in soil below 31.0 ft. Approximately 2 ft running sands in augers.											
	5 22 60 50/3"	S8 24	33.0 34.8		SW-SM	Very dense well-graded SAND with silt and gravel (SW-SM) grading to to brown, tan, and white silty SAND with gravel (SM), mps 1.2 in., wet, no odor	10	20	20	30	10	10				
35						Note: Augering to 38.0 ft indicates coarse material (gravel/cobbles).										
	12 50/3"	S9 8	38.0 38.8	-28.3 38.0	SP	Very dense brown, orange, and white poorly-graded SAND (SP), wet, no odor, rounded sand	--	--	15	60	15	10				
40																
	21 50/3"	S10 10	43.0 43.8		SM	Very dense gray-green silty SAND (SM), no odor, wet	--	--	20	30	20	30				
45																
	14 42 50/2"	S11 13	48.0 49.2		SM	Very dense gray-green silty SAND (SM), wet	--	--	30	30	15	15				
50						Note: Augers filled with approximately 6.0 to 8.0 ft of running sand and gravel after drilling to 53.0 ft. Washed out to attempt to remove material. Filled again with approximately 7.0 to 9.0 ft of running sand and gravel. Started using drilling mud below 53.0 ft. Switched to roller bit.											
	8 13 20 21	S12 24	53.0 55.0	-43.3 53.0	SP	Dense gray poorly-graded SAND (SP), no odor, wet, rounded sand and gravel, mostly quartz, trace fines	--	15	30	30	20	5				
55																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-1

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-1
File No. 42735-001
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
	50/2"	S13 0	58.0 58.2			No recovery, possibly on coarse gravel										
60																
	50/1"	S14 1	63.0 63.1			Recovered one piece of gravel approximately 1 in., well rounded										
65				-58.3												
	19 18 20 27	S15 16	68.0 70.0	68.0	SW-SM	Dense gray and white well-graded SAND with silt and gravel (SW-SM), no odor, wet, well rounded gravel	15	15	20	20	15	15				
				-59.3 69.0	CL	Hard gray to dark gray lean CLAY (CL), moist	--	--	--	--	10	90				
				-60.0 69.7	SW-SM	Dense gray and white well-graded SAND with silt and gravel (SW-SM), no odor, wet	10	20	20	20	15	15				
70																
				-63.3												
	34 48 26 13	S16 13	73.0 75.0	73.0	CL	Hard dark gray lean CLAY (CL), no odor, moist	--	--	--	--	5	95				
75																
				-68.3												
	12 12 20 27	S17 15	78.0 80.0	78.0	SP	Medium dense gray and white poorly-graded SAND (SP), no odor, wet	--	5	10	60	20	5				
80				-70.3 80.0		BOTTOM OF EXPLORATION 80.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-1

RECORD OF BOREHOLE MW-1D

SHEET 1 of 3

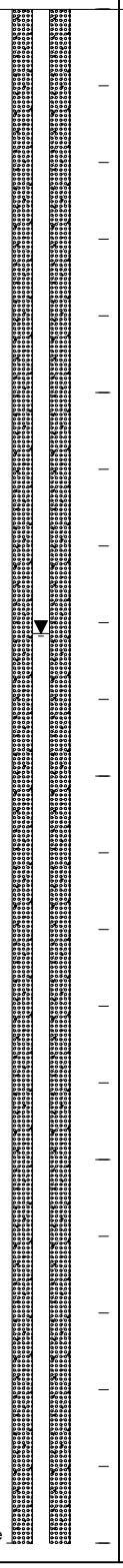
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 55.30 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 8/22/16
DATE COMPLETED: 8/22/16

NORTHING: 3,659,449.96
EASTING: 11,811,809.97
GS ELEVATION: 9.80 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.00 - 13.00 Sand, medium to fine-grained sand, trace silt, brown, light brown, no odor, dry, compact	SP								
							1	2 IN SS	6 -11 -10 -9	21	1.60 / 2.00
5	5										
							2	2 IN SS	1 -2 -1 -2	3	0.10 / 2.00
10	0				-3.20						
		13.00 - 19.00 Sand, fine to coarse-grained sand, trace silt, orange brown to brown, no odor, saturated, loose.	SW		13.00		3	2 IN SS	10 -3 -3 -3	6	0.90 / 2.00
15	-5										
					-9.20		4	2 IN SS	12 -25 -43 -47	>50	1.60 / 2.00
20	-10	19.00 - 28.00 Clayey sand, fine to medium-grained sand, trace coarse sand, gray to tan, no odor, wet, very dense.	SC		19.00						
		Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0 TO 45.3'
Material: PVC
Diameter: 2 inches
Joint Type: threaded

WELL COMPLETION
Pad: 3.0' by 3.0'
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0.5' to 40.0'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 40.0' to 43.0'
Type: Bentonite Chip

FILTER PACK
Interval: 43.0' TO 55.3'
Type: No. 2 DSI

WELL SCREEN
Interval: 45.3' TO 55.3'
Material: PVC
Diameter: 2 inches
Slot Size: 0.010-inch
End Cap: PVC

Well Notes:
Floodplain housing installed

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-1D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 55.30 ft
DRILL METHOD: 4.25-inch HSA

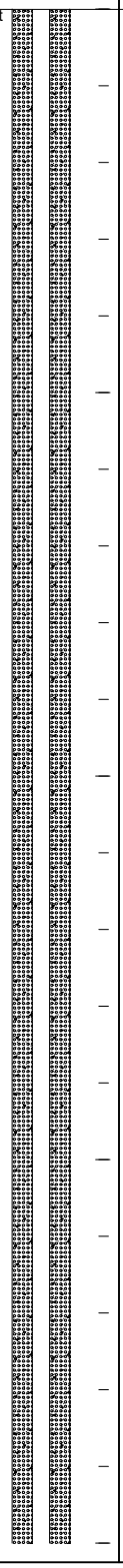
DRILL RIG: CME-55
DATE STARTED: 8/22/16
DATE COMPLETED: 8/22/16

NORTHING: 3,659,449.96
EASTING: 11,811,809.97
GS ELEVATION: 9.80 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20		19.00 - 28.00 Clayey sand, fine to medium-grained sand, trace coarse sand, gray to tan, no odor, wet, very dense. *(Continued)*	SC								
							5	2 IN SS	9 -14 -23 -28	37	0.90 / 2.00
25	-15										
					-18.20						
		28.00 - 33.00 Sand, fine to coarse-grained sand, trace fine to coarse gravel, some clay, gray to gray brown, no odor, saturated, very dense.			28.00		6	2 IN SS	14 -50	50	0.50 / 0.75
30	-20		SP								
					-23.20						
		33.00 - 38.00 Sand, fine to coarse-grained sand, trace fine gravel, trace clay, gray to gray brown, no odor, saturated, compact.			33.00		7	2 IN SS	7 -3 -22 -40	25	0.80 / 2.00
35	-25		SP								
					-28.20						
		38.00 - 43.00 Clayey sand, fine to medium-grained sand, some silt, trace fine gravel, gray brown to tan, no odor, moist, very dense.	SC		38.00		8	2 IN SS	22 -33 -50	>50	1.20 / 1.50
40	-30										

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0 TO 45.3'
Material: PVC
Diameter: 2 inches
Joint Type: threaded

WELL COMPLETION
Pad: 3.0' by 3.0'
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0.5' to 40.0'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 40.0' to 43.0'
Type: Bentonite Chip

FILTER PACK
Interval: 43.0' TO 55.3'
Type: No. 2 DSI

WELL SCREEN
Interval: 45.3' TO 55.3'
Material: PVC
Diameter: 2 inches
Slot Size: 0.010-inch
End Cap: PVC

Well Notes:
Floodplain housing installed

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-1D

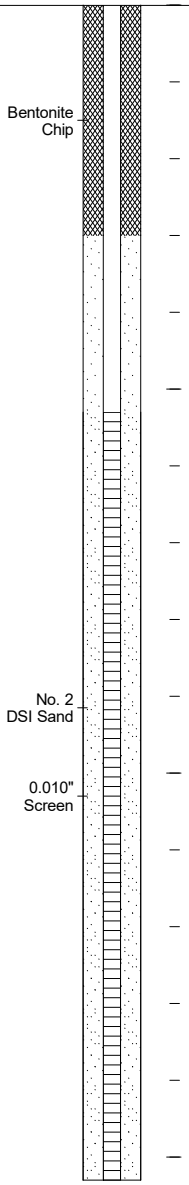
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 55.30 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 8/22/16
DATE COMPLETED: 8/22/16

NORTHING: 3,659,449.96
EASTING: 11,811,809.97
GS ELEVATION: 9.80 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40		38.00 - 43.00 Clayey sand, fine to medium-grained sand, some silt, trace fine gravel, gray brown to tan, no odor, moist, very dense. *(Continued)*	SC		-33.20						
		43.00 - 53.00 Sand, fine to medium-grained sand, some clay and silt, gray, no odor, moist to wet, very dense.			43.00		9	2 IN SS	7 -26 -49 -50	>50	1.80 / 1.75
45	-35										
			SP				10	2 IN SS	13 -30 -46 -40	>50	1.60 / 2.00
50	-40										
					-43.20						
		53.00 - 55.00 Sand, fine to coarse-grained sand, some silt and clay, gray, no odor, wet, compact.	SP		53.00		11	2 IN SS	5 -7 -20 -37	27	0.70 / 2.00
55	-45				-45.20						
		Boring completed at 55.30 ft			55.00						
60	-50										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0 TO 45.3'
Material: PVC
Diameter: 2 inches
Joint Type: threaded

WELL COMPLETION
Pad: 3.0' by 3.0'
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0.5' to 40.0'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 40.0' to 43.0'
Type: Bentonite Chip

FILTER PACK
Interval: 43.0' TO 55.3'
Type: No. 2 DSI

WELL SCREEN
Interval: 45.3' TO 55.3'
Material: PVC
Diameter: 2 inches
Slot Size: 0.010-inch
End Cap: PVC

Well Notes:
Floodplain housing installed

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 181.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/23/16
DATE COMPLETED: 9/26/16

NORTHING: 3,659,451.76
EASTING: 11,811,833.19
GS ELEVATION: 9.46 ft
TOC ELEVATION: 11.10 ft

DEPTH W.L.: 13.00 ft
ELEVATION W.L.: -3.54 ft
DATE W.L.: 9/26/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	5	0.00 - 13.00 Sand, medium to fine-grained sand, trace silt, brown, light brown, no odor, dry, compact	SP			1	2 IN SS	6-11-10-9	21	1.60 / 2.00
						2	2 IN SS	1-2-1-2	3	0.10 / 2.00
5	0				-3.54					
10	-5	13.00 - 19.00 Sand, fine to coarse-grained sand, trace silt, orange brown to brown, no odor, saturated, loose.	SW		13.00	3	2 IN SS	10-3-3-3	6	0.90 / 2.00
15	-10	19.00 - 28.00 Clayey sand, fine to medium-grained sand, trace coarse sand, gray to tan, no odor, wet, very dense.	SC		-9.54 19.00	4	2 IN SS	12-25-43-47	>50	1.60 / 2.00
20		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0 to 171'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3'
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0 to 164'
Type: bentonite grout

FILTER PACK SEAL
Interval: 0 to 164'
Type: Bentonite grout

FILTER PACK
Interval: 164' to 181'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 171' to 181'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 6 5/8 mud rotary roller bit
Notes:

WELL NOTES:
Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes.

SAMPLE NOTES:
Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 181.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/23/16
DATE COMPLETED: 9/26/16

NORTHING: 3,659,451.76
EASTING: 11,811,833.19
GS ELEVATION: 9.46 ft
TOC ELEVATION: 11.10 ft

DEPTH W.L.: 13.00 ft
ELEVATION W.L.: -3.54 ft
DATE W.L.: 9/26/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		19.00 - 28.00 Clayey sand, fine to medium-grained sand, trace coarse sand, gray to tan, no odor, wet, very dense. *(Continued)*	SC									
						5	2 IN SS	9-14-23-28	37	0.90 / 2.00		
	-15											
25					-18.54							
		28.00 - 33.00 Sand, fine to coarse-grained sand, trace fine to coarse gravel, some clay, gray to gray brown, no odor, saturated, very dense.	SP		28.00	6	2 IN SS	14-50	50	0.50 / 0.75		**WELL NOTES:** Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes. **SAMPLE NOTES:** Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.
	-20											
30					-23.54							
		33.00 - 38.00 Sand, fine to coarse-grained sand, trace fine gravel, trace clay, gray to gray brown, no odor, saturated, compact.	SP		33.00	7	2 IN SS	7-3-22-40	25	0.80 / 2.00		
	-25											
35					-28.54							
		38.00 - 43.00 Clayey sand, fine to medium-grained sand, some silt, trace fine gravel, gray brown to tan, no odor, moist, very dense.	SC		38.00	8	2 IN SS	22-33-50	>50	1.20 / 1.50		
	-30											
40		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 181.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/23/16
DATE COMPLETED: 9/26/16

NORTHING: 3,659,451.76
EASTING: 11,811,833.19
GS ELEVATION: 9.46 ft
TOC ELEVATION: 11.10 ft

DEPTH W.L.: 13.00 ft
ELEVATION W.L.: -3.54 ft
DATE W.L.: 9/26/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
40		38.00 - 43.00 Clayey sand, fine to medium-grained sand, some silt, trace fine gravel, gray brown to tan, no odor, moist, very dense. *(Continued)*	SC		-33.54							
	-35	43.00 - 53.00 Sand, fine to medium-grained sand, some clay and silt, gray, no odor, moist to wet, very dense.	SP		43.00	9	2 IN SS	7-26-49-50	>50	1.80 / 1.75		
45												
	-40					10	2 IN SS	13-30-46-40	>50	1.60 / 2.00		
50					-43.54							
	-45	53.00 - 55.00 Sand, fine to coarse-grained sand, some silt and clay, gray, no odor, wet, compact.	SP		53.00 -45.54	11	2 IN SS	5-7-20-37	27	0.70 / 2.00		
55		55.00 - 72.00 Sand and gravel.	SP-GW		55.00							
	-50											
60		Log continued on next page										

WELL NOTES:
Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes.

SAMPLE NOTES:
Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 181.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/23/16
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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
60		55.00 - 72.00 Sand and gravel. *(Continued)*										
	-55		SP-GW			12	CUT'G			10.00		
65												
	-60				-62.54							
70		72.00 - 73.00 Sand and gravel with some gray clay.	SP-GW		72.00 -63.54							
		73.00 - 75.00 Sand and gravel.	SP-GW		73.00							
	-65				-65.54							
75		75.00 - 83.00 Clay, some sand and gravel, dark gray clay, stringers of clayer sand, white, fine to medium-grained sand.	CH		75.00	13	CUT'G			8.00		
	-70										Bentonite Grout	
80		Log continued on next page										

WELL NOTES:
Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes.

SAMPLE NOTES:
Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 181.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/23/16
DATE COMPLETED: 9/26/16

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ELEVATION W.L.: -3.54 ft
DATE W.L.: 9/26/16
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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
80		75.00 - 83.00 Clay, some sand and gravel, dark gray clay, stringers of clayer sand, white, fine to medium-grained sand. *(Continued)*	CH		-73.54							
		83.00 - 85.00 Clay, some sand and gravel, dark gray clay, stringers of clayer sand, white, fine to medium-grained sand.	CH		83.00 -75.54	14	CUT'G			8.00		
85	-75	85.00 - 103.00 Sandy Clay, white to light gray, fine to coarse-grained sand with rounded gravel.			85.00							
	-80											**WELL NOTES:** Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes.
90			CH									**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.
	-85					15	CUT'G			12.00		
95												
	-90											
100		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 181.00 ft
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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
100		85.00 - 103.00 Sandy Clay, white to light gray, fine to coarse-grained sand with rounded gravel. *(Continued)*	CH		-93.54	16	CUT'G			6.00		
	-95	103.00 - 110.00 Clay, light green, large clay chips.			103.00							
105			CL			17	CUT'G			6.00		**WELL NOTES:** Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes. **SAMPLE NOTES:** Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.
	-100				-100.54							
110		110.00 - 128.00 Clay, reddish-brown, large clay chips.			110.00							
	-105											
115			CL			18	CUT'G			12.00		
	-110											
120		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
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DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
120		110.00 - 128.00 Clay, reddish-brown, large clay chips. *(Continued)*	CL			18	CUT'G			12.00		
	-115											
125												
					-118.54	19	CUT'G			8.00		
	-120	128.00 - 132.00 Clay, bluish-green and reddish-brown, large clay chips.	CL		128.00							**WELL NOTES:** Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes. **SAMPLE NOTES:** Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.
130					-122.54							
	-125	132.00 - 138.00 Clay, bluish-green and reddish-brown with lenses of light green clayey sand.	CL		132.00	20	CUT'G			10.00		
135					-128.54							
		138.00 - 156.00 Clay, dark gray, large clay chips.	CL		138.00							
	-130											
140		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
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140		138.00 - 156.00 Clay, dark gray, large clay chips. *(Continued)*	CL			20	CUT'G			10.00		
	-135					21	CUT'G			7.00		
145												
	-140					22	CUT'G			9.00		
150												
	-145				-146.54							
155		156.00 - 166.00 Sandy clay, light green, large clay chips.	CH		156.00	23	CUT'G			8.00		
	-150											
160		Log continued on next page										

WELL NOTES:
Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes.

SAMPLE NOTES:
Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
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DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
160		156.00 - 166.00 Sandy clay, light green, large clay chips. *(Continued)*	CH			23	CUT'G			8.00	Bentonite Grout	
	-155				-156.54							
165		166.00 - 177.50 Clayey sand, light green, clay chips small to absent.			166.00							
	-160					24	CUT'G			8.00		
170			SC								No. 2 DSI Sand	
	-165											
175											0.010" Screen	
					-168.04							
		177.50 - 181.00 Granite, sand cuttings.			177.50							
	-170		Rock									
180		Log continued on next page										

WELL NOTES:
Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes.

SAMPLE NOTES:
Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-1DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 181.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
180		177.50 - 181.00 Granite, sand cuttings. *(Continued)*	Rock		-171.54							
		Boring completed at 181.00 ft										
	-175											
185												
	-180											
190												
	-185											
195												
	-190											
200												

WELL NOTES:
Floodplain Cover installed. Sample descriptions to depth of 55 feet obtained from adjoining boreholes.

SAMPLE NOTES:
Split spoon data from adjacent borehole MW-1D. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

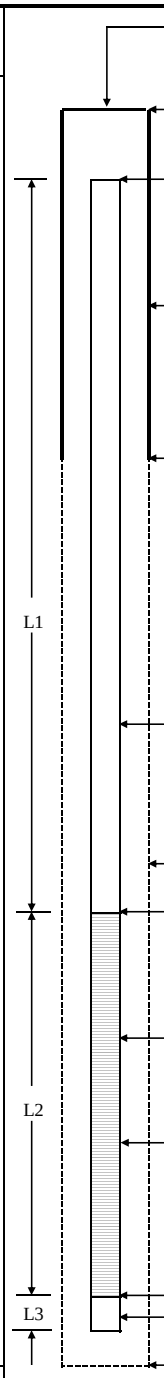
Well No.	Boring No.
MW-2	MW-2

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	J. Yonts
CONTRACTOR	Fishburne Drilling	**DATE INSTALLED**	6/20/2016
DRILLER	J. Raasio		

Ground El.	- ft	**Location**	See plan
El. Datum	-		

☑ **Guard Pipe**
☐ **Roadway Box**

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
See boring log	0.0 – 2.0: Concrete 2.0 – 21.0: Bentonite 21.0 – 23.0: Bentonite Seal 23.0 – 35.5: Sand



Type of protective cover/lock

Height/Depth of top of guard pipe/roadway box above/below ground surface 3.0 ft

Height/Depth of top of riser pipe above/below ground surface 2.5 ft

Type of protective casing: Guard Pipe
Length 5.0 ft
Inside Diameter 4.000 in

Depth of bottom of guard pipe/roadway box 2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	19.0
Bentonite Seal	21.0	2.0
Filter Sand	23.0	12.5

Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe 2.1 in
Type of backfill around riser Sand, bentonite pellets, bentonite

Diameter of borehole 6.0 in

Depth to top of well screen 25.00 ft

Type of screen PVC
Screen gauge or size of openings 0.010 in
Diameter of screen 2.0 in
Type of backfill around screen #2 Filter Sand

Depth of bottom of well screen 35.0 ft

Bottom of Silt trap 0.5 ft

Depth of bottom of borehole 35.5 ft

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)

(Not to Scale)

25 ft	+	10 ft	+	0.5 ft	=	35.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-2

Project	Dominion Power/Chesterfield, Chester, VA
Client	Dominion
Contractor	Fishburne Drilling Inc.

File No. 42735-001
Sheet No. 1 of 3
Start June 20, 2016
Finish June 20, 2016
Driller J. Raasio
H&A Rep. J. Yonts
Elevation 8.9
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	-	Rig Make & Model: Track mounted CME 55
Inside Diameter (in.)	4.5	1 3/8	-	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: HSA Spun to 68.0 ft
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	7 9 7 9	S1 20	0.0 2.0	8.7 0.3 8.4 0.5	SP ML	-TOPSOIL/GRASS- GRAVEL, mps 1.0 in. no odor Medium dense brown sandy SILT (ML), no odor, moist	--	--	--	10	30	60				
	2 4 3 2	S2 11	3.0 5.0		ML	Similar to S1, except loose, sandier, moist	--	--	--	--	50	50				
5				0.9		-FILL-										
	2/24"	S3 18	8.0 10.0	8.0	SM	Very loose gray-black silty SAND (SM), mps 0.2 in., no odor, wet, trace rounded gravel	--	5	--	20	55	20				
10				-4.1												
	21 13 52 50/1"	S4 19	13.0 15.0	13.0	SM	Very dense brown and white silty SAND with gravel (SM), mps 0.5 in., no odor, wet, rounded gravel	5	10	10	30	20	25				
15																
	4 21 31 40	S5 24	18.0 20.0		SM	Similar to S4, except mps 0.5 in., wet, rounded gravel	5	10	10	30	20	25				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
Refer to groundwater level table					

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 68.0
Rock Cored (ft) -
Samples 13S

Boring No. MW-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-2
File No. 42735-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	8 49 50/3"	S6 15	23.0 24.3	-15.1 24.0	SM	Very dense brown to white silty SAND with gravel (SM), mps 0.5 in., no odor, wet	--	5	10	10	40	35				
					SM	Very dense brown and white silty SAND with gravel (SM), mps 0.5 in., no odor, wet, few angular gray gravel pieces (limestone)	20	10	5	5	30	30				
25																
	18 29 29 25	S7 18	28.0 30.0		SM	Dense brown, white, and tan silty SAND with gravel (SM), mps 1.0 in, no odor, wet, rounded gravel	10	15	20	15	20	20				
30						Note: Running sands encountered after augering to 28.0 ft.										
	7 14 28 36	S8 17	33.0 35.0		SM	Dense white, gray, and tan silty SAND with gravel (SM), mps 0.75 in., moist, slighty more plastic than S7, well rounded gravel	10	10	10	20	20	30				
35																
	5 9 12 14	S9 24	38.0 40.0	-29.1 38.0	CL	Very stiff gray to dark gray lean CLAY (CL), moist, trace fine sand	--	--	--	--	10	90				
40																
	44 50/2"	S10 8	43.0 43.7	-34.1 43.0	SW-SM	Very dense tan to white well-graded SAND with silt, mps 0.5 in., no odor, moist	5	10	25	20	30	10				
45																
	5 50/3"	S11 24	48.0 48.8		SW-SM	Similar to S10	5	10	20	25	30	10				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-2

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

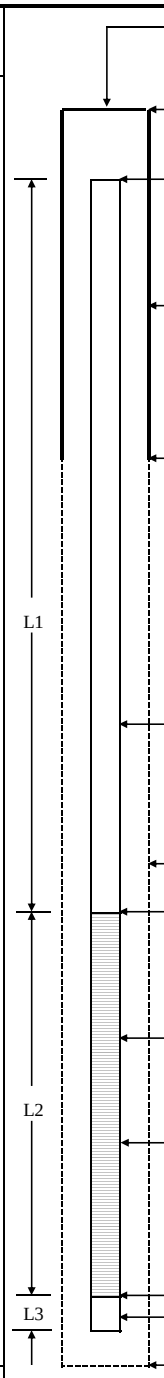
Well No.	Boring No.
MW-2	MW-2

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	J. Yonts
CONTRACTOR	Fishburne Drilling	**DATE INSTALLED**	6/20/2016
DRILLER	J. Raasio		

Ground El.	- ft	**Location**	See plan
El. Datum	-		

☑ **Guard Pipe**
☐ **Roadway Box**

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
See boring log	0.0 – 2.0: Concrete 2.0 – 21.0: Bentonite 21.0 – 23.0: Bentonite Seal 23.0 – 35.5: Sand



Type of protective cover/lock

Height/Depth of top of guard pipe/roadway box above/below ground surface 3.0 ft

Height/Depth of top of riser pipe above/below ground surface 2.5 ft

Type of protective casing: Guard Pipe
Length 5.0 ft
Inside Diameter 4.000 in

Depth of bottom of guard pipe/roadway box 2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	19.0
Bentonite Seal	21.0	2.0
Filter Sand	23.0	12.5

Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe 2.1 in
Type of backfill around riser Sand, bentonite pellets, bentonite

Diameter of borehole 6.0 in

Depth to top of well screen 25.00 ft

Type of screen PVC
Screen gauge or size of openings 0.010 in
Diameter of screen 2.0 in
Type of backfill around screen #2 Filter Sand

Depth of bottom of well screen 35.0 ft

Bottom of Silt trap 0.5 ft

Depth of bottom of borehole 35.5 ft

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)

(Not to Scale)

25 ft	+	10 ft	+	0.5 ft	=	35.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-2

Project	Dominion Power/Chesterfield, Chester, VA
Client	Dominion
Contractor	Fishburne Drilling Inc.

File No. 42735-001
Sheet No. 1 of 3
Start June 20, 2016
Finish June 20, 2016
Driller J. Raasio
H&A Rep. J. Yonts
Elevation 8.9
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	-	Rig Make & Model: Track mounted CME 55
Inside Diameter (in.)	4.5	1 3/8	-	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: HSA Spun to 68.0 ft
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	7 9 7 9	S1 20	0.0 2.0	8.7 0.3 8.4 0.5	SP ML	-TOPSOIL/GRASS- GRAVEL, mps 1.0 in. no odor Medium dense brown sandy SILT (ML), no odor, moist	--	--	--	10	30	60				
	2 4 3 2	S2 11	3.0 5.0		ML	Similar to S1, except loose, sandier, moist	--	--	--	--	50	50				
5				0.9		-FILL-										
	2/24"	S3 18	8.0 10.0	8.0	SM	Very loose gray-black silty SAND (SM), mps 0.2 in., no odor, wet, trace rounded gravel	--	5	--	20	55	20				
10				-4.1												
	21 13 52 50/1"	S4 19	13.0 15.0	13.0	SM	Very dense brown and white silty SAND with gravel (SM), mps 0.5 in., no odor, wet, rounded gravel	5	10	10	30	20	25				
15																
	4 21 31 40	S5 24	18.0 20.0		SM	Similar to S4, except mps 0.5 in., wet, rounded gravel	5	10	10	30	20	25				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
Refer to groundwater level table					

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 68.0
Rock Cored (ft) -
Samples 13S

Boring No. MW-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-2
File No. 42735-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	8 49 50/3"	S6 15	23.0 24.3	-15.1 24.0	SM	Very dense brown to white silty SAND with gravel (SM), mps 0.5 in., no odor, wet	--	5	10	10	40	35				
					SM	Very dense brown and white silty SAND with gravel (SM), mps 0.5 in., no odor, wet, few angular gray gravel pieces (limestone)	20	10	5	5	30	30				
25																
	18 29 29 25	S7 18	28.0 30.0		SM	Dense brown, white, and tan silty SAND with gravel (SM), mps 1.0 in, no odor, wet, rounded gravel	10	15	20	15	20	20				
30						Note: Running sands encountered after augering to 28.0 ft.										
	7 14 28 36	S8 17	33.0 35.0		SM	Dense white, gray, and tan silty SAND with gravel (SM), mps 0.75 in., moist, slighty more plastic than S7, well rounded gravel	10	10	10	20	20	30				
35																
	5 9 12 14	S9 24	38.0 40.0	-29.1 38.0	CL	Very stiff gray to dark gray lean CLAY (CL), moist, trace fine sand	--	--	--	--	10	90				
40																
	44 50/2"	S10 8	43.0 43.7	-34.1 43.0	SW-SM	Very dense tan to white well-graded SAND with silt, mps 0.5 in., no odor, moist	5	10	25	20	30	10				
45																
	5 50/3"	S11 24	48.0 48.8		SW-SM	Similar to S10	5	10	20	25	30	10				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-2

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-2
File No. 42735-001
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
	5 18 29 28	S12 12	53.0 55.0		SW-SM	Dense gray to white well-graded SAND with silt and gravel (SW-SM), mps 1.5 in., no odor, moist, well rounded gravel, coarsening with depth	15	20	20	20	15	10				
55																
	10 16 23 24	S13 24	58.0 60.0	-50.1 59.0	SW-SM	Similar to S12, except dark gray	10	20	25	25	10	10				
				-50.6 59.5	CL	Dark gray lean CLAY lense from 59.0 to 59.5 ft, less coarse gravel, wet, well rounded gravel										
60																
						Note: Did not obtain split spoon sample at 63.0 and 68.0 ft due to running sands. Borehole terminated at 68.0 ft.										
65																
				-59.1 68.0		BOTTOM OF EXPLORATION 68.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-2

RECORD OF BOREHOLE MW-3

SHEET 1 of 2

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 30.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 8/18/16
DATE COMPLETED: 8/18/16

NORTHING: 3,660,738.85
EASTING: 11,812,882.62
GS ELEVATION: 15.27 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	15	0.00 - 14.00 Sand, fine to coarse-grained, trace silt and clay, brown, no odor, dry, compact.	SP				1	MACRO CORE	N/A		3.00 / 5.00	Bentonite Grout	**WELL CASING** Interval: 0' to 11' Material: PVC Diameter: 2" Joint Type: threaded **WELL COMPLETION** Pad: 3' by 3' concrete Protective Casing: 6" PVC **ANNULUS SEAL** Interval: 0.5' to 11' Type: Bentonite grout **FILTER PACK SEAL** Interval: 11' to 14' Type: Bentonite Chips **FILTER PACK** Interval: 14' to 29' Type: No. 2 DSI Sand **WELL SCREEN** Interval: 19' to 29' Material: PVC Diameter: 2" Slot Size: 0.010" End Cap: 2"
5	10						2	MACRO CORE	N/A		3.00 / 5.00		
10	5						3	MACRO CORE	N/A		3.80 / 5.00	Bentonite Chip	
					1.27								
15	0	14.00 - 18.00 Sand, fine to coarse-grained, trace rounded gravel, trace silt and clay, brown, no odor, wet, dense.	SP		14.00		4	MACRO CORE	N/A		3.50 / 5.00		
					-2.73								
20		18.00 - 30.00 Sand and gravel, fine to coarse-grained, fine gravel some silt and clay, no odor, brown to orange brown, saturated, very dense.	SP-GW		18.00								

Log continued on next page

Well Notes:
Floodplain well head

Sample Notes:
Direct push and split spoon sampling

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-3

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 30.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 8/18/16
DATE COMPLETED: 8/18/16

NORTHING: 3,660,738.85
EASTING: 11,812,882.62
GS ELEVATION: 15.27 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
20	-5	18.00 - 30.00 Sand and gravel, fine to coarse-grained, fine gravel some silt and clay, no odor, brown to orange brown, saturated, very dense. *(Continued)*	SP-GW				5	2 IN SS	4 -18 -47 -37	>50	0.90 / 2.00	No. 2 DSI Sand	**WELL CASING** Interval: 0' to 11' Material: PVC Diameter: 2" Joint Type: threaded **WELL COMPLETION** Pad: 3' by 3' concrete Protective Casing: 6" PVC **ANNULUS SEAL** Interval: 0.5' to 11' Type: Bentonite grout **FILTER PACK SEAL** Interval: 11' to 14' Type: Bentonite Chips **FILTER PACK** Interval: 14' to 29' Type: No. 2 DSI Sand **WELL SCREEN** Interval: 19' to 29' Material: PVC Diameter: 2" Slot Size: 0.010" End Cap: 2"
25	-10											0.010" Screen	
30	-15				-14.73		6	2 IN SS	16 -24 -23 -24	47	1.20 / 2.00	No. 2 DSI Sand	**Well Notes:** Floodplain well head **Sample Notes:** Direct push and split spoon sampling
		Boring completed at 30.00 ft											
35	-20												
40													

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-3D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 90.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/14/16
DATE COMPLETED: 8/17/16

NORTHING: 3,660,744.77
EASTING: 11,812,886.53
GS ELEVATION: 15.12 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
0	15	0.00 - 14.00 Sand, fine to coarse-grained, trace silt and clay, brown, no odor, dry, compact.	SP				1	MACRO CORE	N/A		3.00 / 5.00	
5	10						2	MACRO CORE	N/A		3.00 / 5.00	
10	5						3	MACRO CORE	N/A		3.80 / 5.00	
					1.12							
		14.00 - 18.00 Sand, fine to coarse-grained, trace rounded gravel, trace silt and clay, brown, no odor, wet, dense.			14.00							
15	0		SP				4	MACRO CORE	N/A		3.50 / 5.00	
					-2.88							
		18.00 - 33.00 Sand and gravel, fine to coarse-grained sand, fine gravel some silt and clay, no odor, brown to orange brown, saturated, very dense.	SP-GW		18.00							
20		Log continued on next page										

WELL CASING
Interval: 0' to 79.5'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3'
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 72'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 72.0' to 75.0'
Type: Bentonite Chips

FILTER PACK
Interval: 75.0' to 89.5'
Type: DSI No. 2 Sand

WELL SCREEN
Interval: 79.5' to 89.5'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Well Notes:
Floodplain wellhead

Sample Notes:
Direct push and Split Spoon Sampling

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-3D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 90.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/14/16
DATE COMPLETED: 8/17/16

NORTHING: 3,660,744.77
EASTING: 11,812,886.53
GS ELEVATION: 15.12 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
20	-5	18.00 - 33.00 Sand and gravel, fine to coarse-grained sand, fine gravel some silt and clay, no odor, brown to orange brown, saturated, very dense. *(Continued)*	SP-GW				5	2 IN SS	4 -18 -47 -37	>50	0.90 / 2.00		
25	-10						6	2 IN SS	16 -24 -23 -24	47	1.20 / 2.00		
30	-15				-17.88		7	2 IN SS	21 -20 -20 -33	40	1.00 / 2.00		
		33.00 - 38.00 Silty sand, fine to medium-grained sand, trace coarse sand and fine gravel, some clay, no odor, gray, wet.	SM		33.00								
35	-20				-22.88		8	2 IN SS	6 -10 -12 -13	22	0.90 / 2.00	Bentonite Grout	
		38.00 - 43.00 Silty clay, dark gray, trace fine gravel, no odor, moist, firm.	CL		38.00								
40		Log continued on next page											

WELL CASING
Interval: 0' to 79.5'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3'
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 72'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 72.0' to 75.0'
Type: Bentonite Chips

FILTER PACK
Interval: 75.0' to 89.5'
Type: DSI No. 2 Sand

WELL SCREEN
Interval: 79.5' to 89.5'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Well Notes:
Floodplain wellhead

Sample Notes:
Direct push and Split Spoon Sampling

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-3D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 90.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/14/16
DATE COMPLETED: 8/17/16

NORTHING: 3,660,744.77
EASTING: 11,812,886.53
GS ELEVATION: 15.12 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
40	-25	38.00 - 43.00 Silty clay, dark gray, trace fine gravel, no odor, moist, firm. *(Continued)*	CL		-27.88								
		43.00 - 49.00 Clayey silt, green to dark green, no odor, moist, stiff.			43.00		9	2 IN SS	6 -8 -10 -13	18	1.80 / 2.00		
45	-30		ML										
		49.00 - 58.00 Clayey silt, some fine to medium-grained sand, light green, no odor, moist, stiff to very stiff.			-33.88 49.00		10	2 IN SS	6 -10 -12 -16	22	2.00 / 2.00		
50	-35												
			ML				11	2 IN SS	13 -17 -20 -29	37	2.00 / 2.00		
55	-40												
					-42.88								
		58.00 - 63.00 Clayey silt, some fine to medium-grained sand, reddish-brown, no odor, moist to dry, very stiff.	ML		58.00		12	2 IN SS	12 -16 -22 -34	38	2.00 / 2.00		
60		Log continued on next page											

WELL CASING
Interval: 0' to 79.5'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3'
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 72'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 72.0' to 75.0'
Type: Bentonite Chips

FILTER PACK
Interval: 75.0' to 89.5'
Type: DSI No. 2 Sand

WELL SCREEN
Interval: 79.5' to 89.5'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Well Notes:
Floodplain wellhead

Sample Notes:
Direct push and Split Spoon Sampling

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-3D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 90.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/14/16
DATE COMPLETED: 8/17/16

NORTHING: 3,660,744.77
EASTING: 11,812,886.53
GS ELEVATION: 15.12 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
60	-45	58.00 - 63.00 Clayey silt, some fine to medium-grained sand, reddish-brown, no odor, moist to dry, very stiff. *(Continued)*	ML		-47.88								
		63.00 - 68.00 Clayey silt, some fine to medium-grained sand, reddish-brown to greenish-gray, no odor, dry, very dense.			63.00		13	2 IN SS	17 -30 -40 -50	>50	2.00 / 2.00		
65	-50		ML		-52.88								
		68.00 - 78.00 Clayey silt, some fine-grained sand, reddish-brown, no odor, damp, very stiff.			68.00		14	2 IN SS	13 -17 -21 -30	38	2.00 / 2.00		
70	-55												
			ML				15	2 IN SS	12 -19 -30 -37	49	2.00 / 2.00	Bentonite Chip	
75	-60				-62.88								
		78.00 - 79.00 Clayey silt, some fine-grained sand, reddish-brown, no odor, damp, very stiff, small seams of gray clayey silt with fine sand.	ML		78.00 -63.88		16	2 IN SS	18 -19 -28 -36	47	2.00 / 2.00		
		79.00 - 83.00 Clayey silt, some fine-grained sand, reddish-brown, no odor, damp, very stiff.	ML		79.00								
80		Log continued on next page											

WELL CASING
Interval: 0' to 79.5'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3'
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 72'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 72.0' to 75.0'
Type: Bentonite Chips

FILTER PACK
Interval: 75.0' to 89.5'
Type: DSI No. 2 Sand

WELL SCREEN
Interval: 79.5' to 89.5'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Well Notes:
Floodplain wellhead

Sample Notes:
Direct push and Split Spoon Sampling

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-3D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 90.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/14/16
DATE COMPLETED: 8/17/16

NORTHING: 3,660,744.77
EASTING: 11,812,886.53
GS ELEVATION: 15.12 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
80	-65	79.00 - 83.00 Clayey silt, some fine-grained sand, reddish-brown, no odor, damp, very stiff. *(Continued)*	ML		-67.88							No. 2 DSI Sand	**WELL CASING** Interval: 0' to 79.5' Material: PVC Diameter: 2" Joint Type: threaded **WELL COMPLETION** Pad: 3' by 3' Protective Casing: 6" PVC **ANNULUS SEAL** Interval: 0' to 72' Type: Bentonite grout **FILTER PACK SEAL** Interval: 72.0' to 75.0' Type: Bentonite Chips **FILTER PACK** Interval: 75.0' to 89.5' Type: DSI No. 2 Sand **WELL SCREEN** Interval: 79.5' to 89.5' Material: PVC Diameter: 2" Slot Size: 0.010" End Cap: 2"
		83.00 - 84.00 Clayey silt with rock fragments (cobbles) some fine-grained sand, reddish-brown, no odor, damp, very stiff.	ML-GW		83.00 -68.88		17	2 IN SS	16 -22 -30 -50	>50	2.00 / 2.00	0.010" Screen	
85	-70	84.00 - 88.00 Clayey silt, some fine-grained sand, reddish-brown, no odor, damp, very stiff.	ML		84.00 -72.88								**Well Notes:** Floodplain wellhead **Sample Notes:** Direct push and Split Spoon Sampling
		88.00 - 90.00 Clayey silt, trace fine-grained sand, reddish-brown, no odor, damp to moist, very stiff.	ML		88.00 -74.88		18	2 IN SS	11 -22 -24 -32	46	2.00 / 2.00	No. 2 DSI Sand	
90	-75	Boring completed at 90.00 ft											
95	-80												
100													

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-4

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/14/16
DATE COMPLETED: 8/18/16

NORTHING: 3,661,189.06
EASTING: 11,813,224.92
GS ELEVATION: 16.63 ft
TOC ELEVATION: 18.45 ft

DEPTH W.L.: 11.51 ft
ELEVATION W.L.: 5.12 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
0		0.00 - 19.80 Sand, fine to coarse-grained sand, trace silt and clay, brown to light brown, no odor, dry compact.										
	15					1	MACRO CORE			3.00 / 5.00		
5												
	10					2	MACRO CORE			2.10 / 5.00		
10			SP								Bentonite Grout	
	5					3	MACRO CORE			3.50 / 5.00		
15												
	0					4	MACRO CORE			5.00 / 5.00		
					-3.17						Bentonite Chip	
20		Log continued on next page	CL									

WELL CASING
Interval: 0' to 23.6'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0.5' to 17.6'
Type: bentonite grout

FILTER PACK SEAL
Interval: 17.6' to 20.6'
Type: bentonite chip

FILTER PACK
Interval: 20.6' to 33.6'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 23.6' to 33.6'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: Direct Push, 4.25-inch HSA
Notes:

WELL NOTES:
floodplain wellhead

SAMPLE NOTES:
Direct push and split spoon sampling

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-4

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

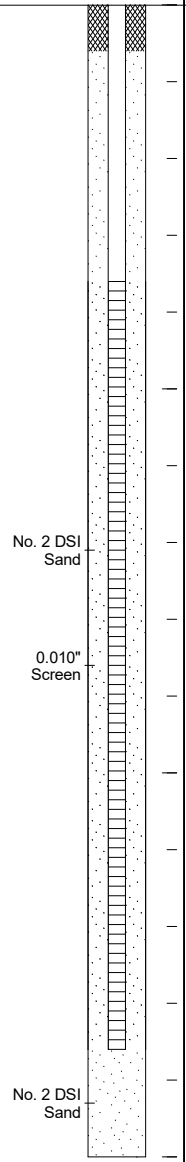
DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/14/16
DATE COMPLETED: 8/18/16

NORTHING: 3,661,189.06
EASTING: 11,813,224.92
GS ELEVATION: 16.63 ft
TOC ELEVATION: 18.45 ft

DEPTH W.L.: 11.51 ft
ELEVATION W.L.: 5.12 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20		19.80 - 28.70 Silty clay, brown to dark gray, moist, stiff. *(Continued)*			19.80					
	-5									
			CL			5	2 IN SS	4-5-9-13	14	1.50 / 2.00
25										
	-10									
					-12.07					
		28.70 - 29.80 Sand and fine gravel, fine to coarse-grained sand, some silt, brown, no odor, saturated, compact.	SP-SW		28.70 -13.17	6	2 IN SS	6-9-14-9	23	2.00 / 2.00
30		29.80 - 35.00 Silty clay, greenish gray, no odor, damp to moist, firm.			29.80					
	-15		CL							
						7	2 IN SS	4-7-8-8	15	2.00 / 2.00
					-18.37					
35		Boring completed at 35.00 ft								
	-20									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
floodplain wellhead

SAMPLE NOTES:
Direct push and split spoon sampling

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. MW-5

Boring No. MW-5

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	J. Yonts
CONTRACTOR	Fishburne Drilling	**DATE INSTALLED**	6/22/2016
DRILLER	J. Raasio		

Ground El. - ft
El. Datum -

Location See plan

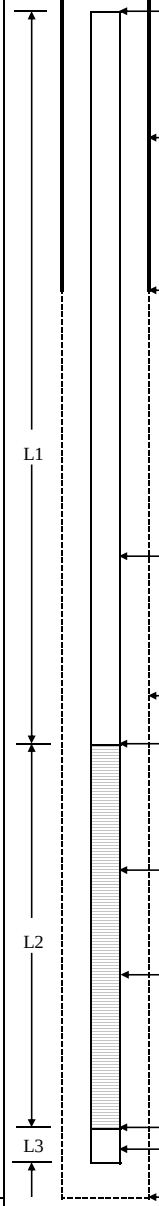
☑ **Guard Pipe**
☐ **Roadway Box**

SOIL/ROCK CONDITIONS

See boring log

BOREHOLE BACKFILL

0.0
Concrete
2.0
Bentonite
23.0
Bentonite Seal
25.0
Sand



Type of protective cover/lock

Height/Depth of top of guard pipe/roadway box above/below ground surface 3.0 ft

Height/Depth of top of riser pipe above/below ground surface 2.5 ft

Type of protective casing: Guard Pipe
Length 5.0 ft
Inside Diameter 4.000 in

Depth of bottom of guard pipe/roadway box 2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	21.0
Bentonite Seal	23.0	2.0
Filter Sand	25.0	12.5

Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe 2.1 in
Type of backfill around riser Sand, bentonite pellets, bentonite

Diameter of borehole 6.0 in

Depth to top of well screen 27.00 ft

Type of screen PVC
Screen gauge or size of openings 0.010 in
Diameter of screen 2.0 in
Type of backfill around screen #2 Filter Sand

Depth of bottom of well screen 37.0 ft

Bottom of Silt trap 0.5 ft

Depth of bottom of borehole 37.5 ft

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)

(Not to Scale)

27 ft	+	10 ft	+	0.5 ft	=	37.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-5

Project	Dominion Power/Chesterfield, Chester, VA
Client	Dominion
Contractor	Cascade Drilling

File No. 42735-001
Sheet No. 1 of 3
Start June 22, 2016
Finish June 22, 2016
Driller C. Ruffer
H&A Rep. H. Hollauer
Elevation 20.2
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	-	Rig Make & Model: Track mounted TS: 150 CE
Inside Diameter (in.)	6.875	-	-	Bit Type: 6-in. Sonic Core Barrel
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)	-	-	-	Casing: Override
				Hoist/Hammer: None
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		S1 7	0.0 10.0		SP	Orange-brown poorly-graded SAND (SP), mps 1.0 in., no structure, no odor, dry	-	5	5	5	80	5				
10		S2 10	10.0 20.0	7.2		-FILL-										
				13.0	SP-SM	Medium brown poorly-graded SAND with silt and gravel (SP-SM), mps 1.5 in., no structure, no odor, moist	5	10	15	15	45	10				
15				4.2 16.0	SM	Orange-brown silty SAND with gravel (SM), mps 1.5 in., no structure, no odor, moist, approximately 10 in. layer of dark brown silty from approximately 17.0 to 17.8 ft	5	10	15	15	35	20				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
Refer to groundwater level table					

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 60.0
Rock Cored (ft) -
Samples 6S

Boring No. MW-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-5
File No. 42735-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20		S3 8	20.0 30.0													
				-1.8 22.0	SM	Light gray-brown silty SAND (SM), mps 0.5 in., slight depositional structure, no odor, moist	-	5	10	25	40	20				
				-2.8 23.0	ML	Dark brown SILT (ML), mps less than 0.074 mm, depositional layering/structure, no odor, moist	-	-	-	-	-	100				
				-3.3 23.5	SM	Orange-brown silty SAND with gravel (SM), mps 1.5 in., no structure, no odor, moist Note: Gravel increases with depth.	10	10	15	15	35	15				
25																
30		S4 12	30.0 40.0		SM	Orange-brown silty SAND with gravel (SM), mps 2.0 in., no structure, no odor, moist	15	15	10	20	20	20				
35				-15.8 36.0	CL	Dark brown lean CLAY layer (CL)	-	-	-	-	-	100				
				-16.3 36.5												
40		S5 10	40.0 50.0	-19.8 40.0	ML	Dark gray sandy SILT (ML), mps less than 0.43 mm, trace clay, slight layering, no odor, moist	-	-	-	-	30	70				
				-21.8 42.0	ML	Dark gray SILT (ML), mps less than 0.43 mm, slight structure, no odor, moist	-	-	-	-	-	100				
45																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-5

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-5
File No. 42735-001
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				-29.8												
50		S6 12	50.0 60.0	50.0	SM	Medium gray silty SAND with gravel (SM), mps 2.0 in., no structure, no odor, moist	15	15	10	20	20	20				
				-33.8 54.0		Highly weathered/decomposed rock, gray with white granitic composition, able to cut with difficulty										
55																
				-39.8 60.0		BOTTOM OF EXPLORATION 60.0 FT										
60																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-5

RECORD OF BOREHOLE MW-6

SHEET 1 of 4

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 62.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

NORTHING: 3,661,834.37
EASTING: 11,813,189.15
GS ELEVATION: 36.78 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.00 - 8.00 Silty clay, trace fine-grained sand, micaceous, brown, no odor, firm, w<PL, trace rounded gravel up to 2 inch in diameter, cobbles.	CL		28.78		1	CUT'G	N/A		8.00 / 8.00
	35										
5											
	30										
		8.00 - 12.00 Silty clay, trace fine-grained sand, micaceous, brown with black mottling, no odor, w<PL, soft.	CL		8.00		2	2 IN SS	2 -6 -7 -7	13	1.60 / 2.00
10							3	2 IN SS	2 -8 -5 -7	13	1.30 / 2.00
	25				24.78						
		12.00 - 14.50 Silty clay with fine-grained sand, micaceous, light brown, moist, no odor, w<PL, soft.	CL		12.00		4	2 IN SS	2 -3 -4 -6	7	2.00 / 2.00
					22.28						
		14.50 - 17.00 Silty clay, some fine-grained sand, micaceous, light brown, no odor, W<PL, firm	CL		14.50		5	2 IN SS	2 -5 -7 -9	12	1.60 / 2.00
15											
	20				19.78		6	2 IN SS	2 -4 -5 -6	9	2.00 / 2.00
		17.00 - 22.00 Silty sand with clay, fine-grained sand, light brown, no odor, dry, loose.	SC		17.00		7	2 IN SS	3 -5 -5 -5	10	2.00 / 2.00
20		Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0.0' to 49.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" aluminum

ANNULUS SEAL
Interval: 0.0' to 41.0'
Type: bentonite grout

FILTER PACK SEAL
Interval: 41.0' to 44.0'
Type: bentonite chip

FILTER PACK
Interval: 44.0' to 59.0'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 49.0' to 59.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Sample Notes:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent soil boring MW-6D.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-6

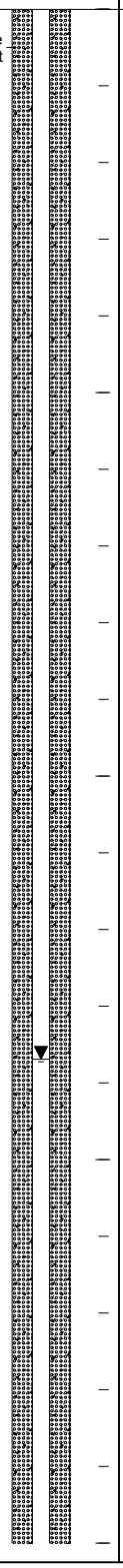
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 62.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

NORTHING: 3,661,834.37
EASTING: 11,813,189.15
GS ELEVATION: 36.78 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20		17.00 - 22.00 Silty sand with clay, fine-grained sand, light brown, no odor, dry, loose. *(Continued)*	SC		14.78		8	2 IN SS	3 -4 -5 -5	9	1.30 2.00
	15	22.00 - 25.00 Sand, fine to medium-grained sand, some silt and clay, light brown, loose, dry, micaceous.	SP		11.78		9	2 IN SS	3 -3 -3 -3	6	2.00 2.00
25		25.00 - 25.50 Sand, fine to medium-grained sand, some silt and clay, light brown, loose, moist, micaceous.	SP		25.00 11.28		10	2 IN SS	3 -4 -14 -26	18	2.00 2.00
	10	25.50 - 29.50 Sand and gravel, fine to coarse-grained sand, quartzite gravel up to 1 inch in diameter, sub-angular to rounded, moist, compact, light brown.	SP		25.50 7.28		11	2 IN SS	11 -28 -35 -30	>50	2.00 2.00
30		29.50 - 31.50 Sand and gravel, fine to coarse-grained sand, sub-rounded to well rounded gravel up to 1.5 inches in diameter, wet, compact.	SP		29.50 5.28		12	2 IN SS	27 -27 -28 -25	>50	2.00 2.00
	5	31.50 - 33.00 Sand and gravel, medium-grained sand, trace clay, sone fine and coarse-grained sand, some sub to well-rounded gravel up to 0.5 inch in diameter, wet, loose, light brown.	SP		31.50 3.78		13	2 IN SS	11 -20 -13 -18	33	2.00 2.00
		33.00 - 34.40 Sand, poorly sorted fine to coarse-grained sand, sub- to well-rounded 0.5-inch diameter gravel, orange to light brown, wet, loose, some silt and clay nodules.	SP		33.00 2.38		14	2 IN SS	4 -7 -12 -8	19	2.00 2.00
35		34.40 - 35.60 Silty clay, micaceous, brown, W<PL, very stiff.	CL		34.40 1.18		15	2 IN SS	6 -11 -30 -50	41	2.00 2.00
		35.60 - 36.00 Silty sandy clay with gravel, orange sand with gray, brown, and white clay lenses, W>PL, stiff, gravel is sub- to well rounded up to 0.5 inch in diameter.	CL GP		35.60 0.78 36.00		16	2 IN SS	11 -25 -13 -11	38	0.67 2.00
	0	36.00 - 36.92 Sandy gravel, light gray grading to yellowish-brown, loose, wet.			-0.14 36.92						
		36.92 - 45.00 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist. Water perched on top of clay.	CL				17	2 IN SS	2 -5 -9 -10	14	2.00 2.00
40		Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0.0' to 49.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" aluminum

ANNULUS SEAL
Interval: 0.0' to 41.0'
Type: bentonite grout

FILTER PACK SEAL
Interval: 41.0' to 44.0'
Type: bentonite chip

FILTER PACK
Interval: 44.0' to 59.0'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 49.0' to 59.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Sample Notes:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent soil boring MW-6D.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-6

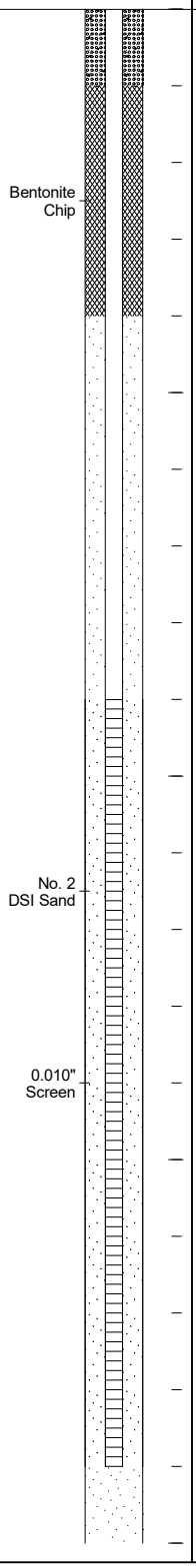
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 62.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

NORTHING: 3,661,834.37
EASTING: 11,813,189.15
GS ELEVATION: 36.78 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40		36.92 - 45.00 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist. Water perched on top of clay. *(Continued)*	CL		-8.22		18	2 IN SS	3 -9 -13 -14	22	2.00 / 2.00
	-5										
45		45.00 - 46.75 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist, trace wood fragments and small pebbles.	CL		45.00 -9.97						
	-10	46.75 - 50.00 Silty fine-grained sand, gray, moist.	SW		46.75 -13.22		19	2 IN SS	4 -9 -12 -15	21	2.00 / 2.00
50		50.00 - 50.50 Silty clay with trace fine-grained sand and mica flakes, dense, dark gray.	CL		50.00 -13.72						
	-15	50.50 - 55.00 Sandy gravel, light gray, small rounded quartz pebbles and rock fragments to coarse-grained sand.	GP		50.50 -18.22		20	2 IN SS	4 -19 -50/2"	>50	0.92 / 2.00
55		55.00 - 62.00 Sandy gravel with clay stringers, light gray to brown, rounded to subrounded 1 inch diameter broken gravel, saturated.	GP		55.00		21	2 IN SS	13 -25 -50/2"	>50	0.92 / 2.00
	-20										
60		Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0.0' to 49.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" aluminum

ANNULUS SEAL
Interval: 0.0' to 41.0'
Type: bentonite grout

FILTER PACK SEAL
Interval: 41.0' to 44.0'
Type: bentonite chip

FILTER PACK
Interval: 44.0' to 59.0'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 49.0' to 59.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Sample Notes:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent soil boring MW-6D.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-6

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 62.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

NORTHING: 3,661,834.37
EASTING: 11,813,189.15
GS ELEVATION: 36.78 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
60		55.00 - 62.00 Sandy gravel with clay stringers, light gray to brown, rounded to subrounded 1 inch diameter broken gravel, saturated. *(Continued)*	GP				22	2 IN SS	8 -12 -14 -18	26	2.00 / 2.00	No. 2 DSI Sand	
	-25				-25.22								
		Boring completed at 62.00 ft											
65													
	-30												
70													
	-35												
75													
	-40												
80													

WELL CASING
Interval: 0.0' to 49.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" aluminum

ANNULUS SEAL
Interval: 0.0' to 41.0'
Type: bentonite grout

FILTER PACK SEAL
Interval: 41.0' to 44.0'
Type: bentonite chip

FILTER PACK
Interval: 44.0' to 59.0'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 49.0' to 59.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Sample Notes:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent soil boring MW-6D.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-6D

SHEET 1 of 5

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 92.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

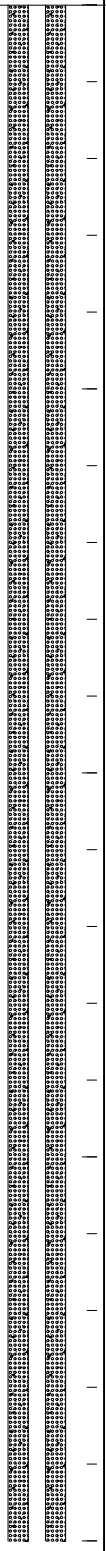
NORTHING: 3,661,820.42
EASTING: 11,813,197.33
GS ELEVATION: 37.80 ft
TOC ELEVATION: 40.17 ft

DEPTH W.L.: 76.21 ft
ELEVATION W.L.: -38.41 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.00 - 8.00 Silty clay, trace fine-grained sand, micaceous, brown, no odor, firm, w<PL, trace rounded gravel up to 2 inch in diameter, cobbles.	CL		29.80	1	CUT'G			8.00 / 8.00
	35									
5										
	30	8.00 - 12.00 Silty clay, trace fine-grained sand, micaceous, brown with black mottling, no odor, w<PL, soft.	CL		8.00 25.80	2	2 IN SS	2-6-7-7	13	1.60 / 2.00
10						3	2 IN SS	2-8-5-7	13	1.30 / 2.00
	25	12.00 - 14.50 Silty clay with fine-grained sand, micaceous, light brown, moist, no odor, w<PL, soft.	CL		12.00 23.30	4	2 IN SS	2-3-4-6	7	2.00 / 2.00
15		14.50 - 17.00 Silty clay, some fine-grained sand, micaceous, light brown, no odor, W<PL, firm	CL		14.50 20.80	5	2 IN SS	2-5-7-9	12	1.60 / 2.00
	20	17.00 - 22.00 Silty sand with clay, fine-grained sand, light brown, no odor, dry, loose.	SC		17.00	6	2 IN SS	2-4-5-6	9	2.00 / 2.00
20						7	2 IN SS	3-5-5-5	10	2.00 / 2.00

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0' to 70'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4 y 4 aluminum

ANNULUS SEAL
Interval: 0.5' to 61'
Type: bentonite grout

FILTER PACK SEAL
Interval: 61' to 65'
Type: Bentonite chip

FILTER PACK
Interval: 65' to 90'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 70' to 90'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 4.25-inch HSA
Notes:

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse & M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 92.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

NORTHING: 3,661,820.42
EASTING: 11,813,197.33
GS ELEVATION: 37.80 ft
TOC ELEVATION: 40.17 ft

DEPTH W.L.: 76.21 ft
ELEVATION W.L.: -38.41 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		17.00 - 22.00 Silty sand with clay, fine-grained sand, light brown, no odor, dry, loose. *(Continued)*	SC		15.80	8	2 IN SS	3-4-5-5	9	1.30 / 2.00		
	15	22.00 - 25.00 Sand, fine to medium-grained sand, some silt and clay, light brown, loose, dry, micaceous.	SP		22.00 12.80	9	2 IN SS	3-3-3-3	6	2.00 / 2.00		
25		25.00 - 25.50 Sand, fine to medium-grained sand, some silt and clay, light brown, loose, moist, micaceous.	SP		25.00 12.30	10	2 IN SS	3-4-14-26	18	2.00 / 2.00		
		25.50 - 29.50 Sand and gravel, fine to coarse-grained sand, quartzite gravel up to 1 inch in diameter, sub-angular to rounded, moist, compact, light brown.	SP		25.50 8.30	11	2 IN SS	11-28-35-30	>50	2.00 / 2.00		
	10					12	2 IN SS	27-27-28-25	>50	2.00 / 2.00		**WELL NOTES:** Stick-up casing
30		29.50 - 31.50 Sand and gravel, fine to coarse-grained sand, sub-rounded to well rounded gravel up to 1.5 inches in diameter, wet, compact.	SP		29.50 6.30	13	2 IN SS	11-20-13-18	33	2.00 / 2.00	Bentonite Grout	**SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade.
		31.50 - 33.00 Sand and gravel, fine to coarse sand, trace clay, 0.5-inch diameter sub to well-rounded gravel, wet, loose, fines are light brown.	SP-SG		31.50 4.80	14	2 IN SS	4-7-12-8	19	2.00 / 2.00		
	5	33.00 - 34.40 Sand, fine to coarse sand, trace clay, trace 0.5-inch diameter sub to well-rounded gravel, small clay nodules, wet, loose, fines are orange to light brown.	SP		33.00 3.40							
		34.40 - 35.60 Silty clay, micaceous, brown, W<PL, very stiff.	CL		34.40 2.20	15	2 IN SS	6-11-30-50	41	2.00 / 2.00		
35		35.60 - 36.00 Silty clay with sand and gravel, orange sand with gray, brown, and white clay lenses, W>PL, stiff, gravel size up to 0.5-inch diameter, sub to well rounded.	CL GP		35.60 1.80 36.00 0.88							
		36.00 - 36.92 Sandy gravel, light gray grading to yellowish-brown, loose, wet.			36.92	16	2 IN SS	11-25-13-11	38	0.67 / 2.00		
	0	36.92 - 45.00 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist. Water perched on top of clay.	GP			17	2 IN SS	2-5-9-10	14	2.00 / 2.00		
40		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse & M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 92.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

NORTHING: 3,661,820.42
EASTING: 11,813,197.33
GS ELEVATION: 37.80 ft
TOC ELEVATION: 40.17 ft

DEPTH W.L.: 76.21 ft
ELEVATION W.L.: -38.41 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40		36.92 - 45.00 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist. Water perched on top of clay. *(Continued)*	GP			18	2 IN SS	3-9-13-14	22	2.00 / 2.00
	-5									
45		45.00 - 46.75 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist, trace wood fragments and small pebbles.	CL		-7.20 45.00 -8.95					
		46.75 - 50.00 Silty fine sand, gray, moist.	SM		46.75 -12.20	19	2 IN SS	4-9-12-15	21	2.00 / 2.00
50	-10	50.00 - 50.50 Silty clay with trace fine-grained sand and mica flakes, dense, dark gray.	CL		50.00 -12.70	20	2 IN SS	4-19-50	>50	0.92 / 2.00
		50.50 - 60.00 Sandy gravel with coarse sand, up to 1-inch diameter rounded to subrounded quartz gravel, light gray to brown, saturated.	GP		50.50					
	-15					21	2 IN SS	13-25-50	>50	0.92 / 2.00
55										
	-20									
60		Log continued on next page			-22.20					

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse & M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 92.00 ft
DRILL METHOD: 4.25-inch HSA

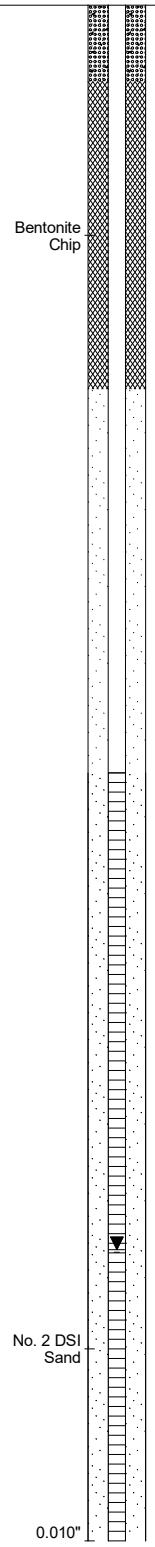
DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

NORTHING: 3,661,820.42
EASTING: 11,813,197.33
GS ELEVATION: 37.80 ft
TOC ELEVATION: 40.17 ft

DEPTH W.L.: 76.21 ft
ELEVATION W.L.: -38.41 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
60		60.00 - 65.00 Sand, medium to fine with trace clay and mica flakes, gray.	SW		60.00	22	2 IN SS	8-12-14-18	26	2.00 / 2.00
	-25				-27.20					
65		65.00 - 65.30 Silty clay, micaceous, gray, moist.	CL		-27.50					
		65.30 - 67.00 Silty clay, reddish-brown with gray mottling, micaceous, trace fine sand.	CL		65.30 -29.20	23	2 IN SS	14-10-20-20	30	1.25 / 2.00
	-30	67.00 - 80.00 Silty clay with trace fine sand, reddish-brown to dark reddish-brown, micaceous, moist.			67.00					
70						24	2 IN SS	5-8-15-19	23	2.00 / 2.00
	-35		CL							
75						25	2 IN SS	14-18-22-21	40	2.00 / 2.00
	-40									
80		Log continued on next page			-42.20					

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse & M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 92.00 ft
DRILL METHOD: 4.25-inch HSA

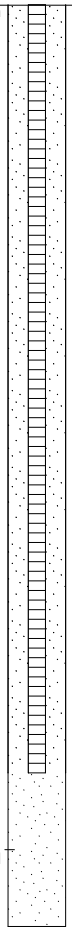
DRILL RIG: CME-850
DATE STARTED: 8/26/16
DATE COMPLETED: 8/27/16

NORTHING: 3,661,820.42
EASTING: 11,813,197.33
GS ELEVATION: 37.80 ft
TOC ELEVATION: 40.17 ft

DEPTH W.L.: 76.21 ft
ELEVATION W.L.: -38.41 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
80		80.00 - 85.00 Silty clay with trace fine sand, brown, micaceous, gray clay stringers (horizontal) at 80 to 82 feet below grade, dry.	CL		80.00	26	2 IN SS	10-15-21-29	36	2.00/2.00
	-45									
85					-47.20					
		85.00 - 89.00 Weathered granitic rock, black and white granite with biotite, feldspar, quartz, muscovite, dry, weathered cobbles.	GP		85.00	27	2 IN SS	50	50	0.42/2.00
	-50									
					-51.20					
		89.00 - 92.00 Silty clay with sand, micaceous, trave weathered rock fragments, dry, reddish-brown, dense.	CL		89.00	28	2 IN SS	10-18-22-27	40	1.08/2.00
90					-54.20					
		Boring completed at 92.00 ft								
	-55									
95										
	-60									
100										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse & M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 240.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/14/16
DATE COMPLETED: 9/15/16

NORTHING: 3,661,789.31
EASTING: 11,813,221.56
GS ELEVATION: 40.03 ft
TOC ELEVATION: 42.69 ft

DEPTH W.L.: 47.48 ft
ELEVATION W.L.: -7.45 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	40	0.00 - 8.00 Silty clay, trace fine-grained sand, micaceous, brown, no odor, firm, w<PL, trace rounded gravel up to 2 inch in diameter, cobbles.	CL		32.03	1	CUT'G			8.00 / 8.00
		8.00 - 12.00 Silty clay, trace fine-grained sand, micaceous, brown with black mottling, no odor, w<PL, soft.			8.00	2	2 IN SS	2-6-7-7	13	1.60 / 2.00
5	35		CL			3	2 IN SS	2-8-5-7	13	1.30 / 2.00
		12.00 - 14.50 Silty clay with fine-grained sand, micaceous, light brown, moist, no odor, w<PL, soft.			28.03 12.00	4	2 IN SS	2-3-4-6	7	2.00 / 2.00
10	30	14.50 - 17.00 Silty clay, some fine-grained sand, micaceous, light brown, no odor, W<PL, firm	CL		25.53 14.50	5	2 IN SS	2-5-7-9	12	1.60 / 2.00
		17.00 - 22.00 Silty sand with clay, fine-grained sand, light brown, no odor, dry, loose.	SC		23.03 17.00	6	2 IN SS	2-4-5-6	9	2.00 / 2.00
15	25					7	2 IN SS	3-5-5-5	10	2.00 / 2.00
20	20	Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0' to 220'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' concrete
Protective Casing: 4" by 4" aluminum

ANNULUS SEAL
Interval:
Type:

FILTER PACK SEAL
Interval: 210' to 0.5'
Type: bentonite grout

FILTER PACK
Interval: 210' to 230'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 220' to 230'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 6 5/8 mud rotary roller bit
Notes:

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 240.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/14/16
DATE COMPLETED: 9/15/16

NORTHING: 3,661,789.31
EASTING: 11,813,221.56
GS ELEVATION: 40.03 ft
TOC ELEVATION: 42.69 ft

DEPTH W.L.: 47.48 ft
ELEVATION W.L.: -7.45 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20	20	17.00 - 22.00 Silty sand with clay, fine-grained sand, light brown, no odor, dry, loose. *(Continued)*	SC		18.03	8	2 IN SS	3-4-5-5	9	1.30 / 2.00		
		22.00 - 25.00 Sand, fine to medium-grained sand, some silt and clay, light brown, loose, dry, micaceous.	SP		22.00 15.03	9	2 IN SS	3-3-3-3	6	2.00 / 2.00		
25	15	25.00 - 25.50 Sand, fine to medium-grained sand, some silt and clay, light brown, loose, moist, micaceous.	SP		25.00 14.53	10	2 IN SS	3-4-14-26	18	2.00 / 2.00		
		25.50 - 29.50 Sand and gravel, fine to coarse-grained sand, quartzite gravel up to 1 inch in diameter, sub-angular to rounded, moist, compact, light brown.	SP		25.50 10.53	11	2 IN SS	11-28-35-30	>50	2.00 / 2.00		
30	10	29.50 - 31.50 Sand and gravel, fine to coarse-grained sand, sub-rounded to well rounded gravel up to 1.5 inches in diameter, wet, compact.	SP		29.50 8.53	12	2 IN SS	27-27-28-25	>50	2.00 / 2.00		**WELL NOTES:** Stick-up casing
		31.50 - 33.00 Sand and gravel, fine to coarse sand, trace clay, 0.5-inch diameter sub to well-rounded gravel, wet, loose, fines are light brown.	SP-SG		31.50 7.03	13	2 IN SS	11-20-13-18	33	2.00 / 2.00		**SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.
		33.00 - 34.40 Sand, fine to coarse sand, trace clay, trace 0.5-inch diameter sub to well-rounded gravel, small clay nodules, wet, loose, fines are orange to light brown.	SP		33.00 5.63	14	2 IN SS	4-7-12-8	19	2.00 / 2.00		
35	5	34.40 - 35.60 Silty clay, micaceous, brown, W<PL, very stiff.	CL		34.40 4.43	15	2 IN SS	6-11-30-50	41	2.00 / 2.00		
		35.60 - 36.00 Silty clay with sand and gravel, orange sand with gray, brown, and white clay lenses, W>PL, stiff, gravel size up to 0.5-inch diameter, sub to well rounded.	CL GP		35.60 4.03 36.00 3.11							
		36.00 - 36.92 Sandy gravel, light gray grading to yellowish-brown, loose, wet.			36.92	16	2 IN SS	11-25-13-11	38	0.67 / 2.00		
40		36.92 - 45.00 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist. Water perched on top of clay.	GP			17	2 IN SS	2-5-9-10	14	2.00 / 2.00		

Log continued on next page

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 240.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/14/16
DATE COMPLETED: 9/15/16

NORTHING: 3,661,789.31
EASTING: 11,813,221.56
GS ELEVATION: 40.03 ft
TOC ELEVATION: 42.69 ft

DEPTH W.L.: 47.48 ft
ELEVATION W.L.: -7.45 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40	0	36.92 - 45.00 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist. Water perched on top of clay. *(Continued)*	GP		-4.97	18	2 IN SS	3-9-13-14	22	2.00 / 2.00
45	-5	45.00 - 45.75 Silty clay to clay with silt, trace mica flakes, dark gray, dense, moist, trace wood fragments and small pebbles.	CL		45.00 -5.72 45.75					
		45.75 - 50.00 Silty fine sand, gray, moist.	SM		-9.97	19	2 IN SS	4-9-12-15	21	2.00 / 2.00
50	-10	50.00 - 50.50 Silty clay with trace fine-grained sand and mica flakes, dense, dark gray.	CL		50.00 -10.47 50.50	20	2 IN SS	4-19-50	>50	0.92 / 2.00
		50.50 - 60.00 Sandy gravel with coarse sand, up to 1-inch diameter rounded to subrounded quartz gravel, light gray to brown, saturated.	GP			21	2 IN SS	13-25-50	>50	0.92 / 2.00
55	-15									
60		Log continued on next page			-19.97					

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
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DRILL METHOD: 6 5/8 mud rotary roller bit

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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
60	-20	60.00 - 65.00 Sand, medium to fine with trace clay and mica flakes, gray.	SW		60.00	22	2 IN SS	8-12-14-18	26	2.00 / 2.00		
65	-25	65.00 - 65.30 Silty clay, micaceous, gray, moist.	CL		-24.97 -25.27							
		65.30 - 67.00 Silty clay, reddish-brown with gray mottling, micaceous, trace fine sand.	CL		65.30 -26.97	23	2 IN SS	14-10-20-20	30	1.25 / 2.00		
		67.00 - 80.00 Silty clay with trace fine sand, reddish-brown to dark reddish-brown, micaceous, moist.	CL		67.00	24	2 IN SS	5-8-15-19	23	2.00 / 2.00		**WELL NOTES:** Stick-up casing **SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.
70	-30											
75	-35					25	2 IN SS	14-18-22-21	40	2.00 / 2.00		
80		Log continued on next page			-39.97							

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
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DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
80	-40	80.00 - 85.00 Silty clay with trace fine sand, brown, micaceous, gray clay stringers (horizontal) at 80 to 82 feet below grade, dry.	CL		80.00	26	2 IN SS	10-15-21-29	36	2.00 / 2.00		
					-44.97							
85	-45	85.00 - 89.00 Weathered granitic rock, black and white granite with biotite, feldspar, quartz, muscovite, dry, weathered cobbles.	GP		85.00	27	2 IN SS	50	50	0.42 / 2.00		
					-48.97							
		89.00 - 92.00 Silty clay with sand, micaceous, trave weathered rock fragments, dry, reddish-brown, dense.	CL		89.00	28	2 IN SS	10-18-22-27	40	1.08 / 2.00		**WELL NOTES:** Stick-up casing **SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.
90	-50				-51.97							
		92.00 - 109.00 Sandy clay, coarse rounded sand particles, reddish-brown, small clay chips, small quartz rock fragments, micaceous, moist.			92.00	29	CUT'G			3.00		
95	-55		CL			30	CUT'G			5.00		
100		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6DD

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100	-60	92.00 - 109.00 Sandy clay, coarse rounded sand particles, reddish-brown, small clay chips, small quartz rock fragments, micaceous, moist. *(Continued)*	CL			21	CUT'G			5.00	Bentonite Grout	
105	-65					32	CUT'G			5.00		
					-68.97							
		109.00 - 110.00 Clay, gray clay nodules in cuttings.	CL		109.00 -69.97							
110	-70	110.00 - 112.00 Sandy clay, coarse rounded sand particles, reddish-brown, small clay chips, small quartz and grayish-brown weathered rock fragments, micaceous.	CL		110.00 -71.97							
		112.00 - 115.00 Sandy clay, coarse rounded sand particles, reddish-brown, small clay chips, small quartz and hard grayish-brown weathered rock fragments, micaceous, moist.	CL		112.00 -74.97	33	CUT'G			5.00		
115	-75	115.00 - 139.00 Sandy clay, coarse rounded sand particles, small clay chips, brown, trace weathered rock fragments.	CL		115.00	34	CUT'G			5.00		
120		Log continued on next page										

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 240.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/14/16
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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
120	-80	115.00 - 139.00 Sandy clay, coarse rounded sand particles, small clay chips, brown, trace weathered rock fragments. *(Continued)*	CL			35	CUT'G			5.00		
125	-85					36	CUT'G			5.00		
130	-90					37	CUT'G			5.00		
135	-95					38	CUT'G			5.00		
					-98.97							
140		139.00 - 140.00 Sandy clay, coarse sand, large clay chips	CL		139.00 -99.97							
		Log continued on next page										

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
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Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6DD

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140	-100	140.00 - 142.00 Clayey gravel (cobbles), gray soft weathered rock fragments with red clay.	GC		140.00 -101.97							
		142.00 - 143.00 Clay, red.	CL		142.00 -102.97	39	CUT'G			5.00		
		143.00 - 144.00 Weathered rock fragments, soft, gray.	GC		143.00 -103.97							
		144.00 - 163.00 Sandy clay with trace soft gray rock fragments, reddish-brown clay.			144.00							
145	-105					40	CUT'G			5.00		
150	-110		CL			41	CUT'G			5.00		
155	-115					42	CUT'G			5.00		
160		Log continued on next page										

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 240.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/14/16
DATE COMPLETED: 9/15/16

NORTHING: 3,661,789.31
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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
160	-120	144.00 - 163.00 Sandy clay with trace soft gray rock fragments, reddish-brown clay. *(Continued)*	CL		-122.97	43	CUT'G		5.00		
		163.00 - 166.00 Weathered rock fragments, soft, gray, granitic looking rock fragments.	GC		163.00 -125.97						
165	-125	166.00 - 193.00 Sandy clay, coarse sand, red to reddish-brown clay, clay chips are small, trace weathered phaneritic rock fragments with quartz, feldpar, and mica minerals and others are aphanitic soft gray fragments.			166.00	44	CUT'G		5.00		
170	-130					45	CUT'G		5.00		
175	-135		CL			46	CUT'G		5.00		
180		Log continued on next page									

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
180	-140	166.00 - 193.00 Sandy clay, coarse sand, red to reddish-brown clay, clay chips are small, trace weathered phaneritic rock fragments with quartz, feldpar, and mica minerals and others are aphanitic soft gray fragments. *(Continued)*				47	CUT'G			5.00		
185	-145		CL			48	CUT'G			5.00		
190	-150					49	CUT'G			5.00		
					-152.97							
		193.00 - 194.00 Rock fragments (aphanitic gray rock fragments) with sand and reddish-brown clay.	GC		193.00 -153.97							
		194.00 - 218.00 Sandy clay, micaceous, hard clay small chips, reddish-brown, coarse sand.			194.00							
195	-155		CL			50	CUT'G			5.00		
200		Log continued on next page										

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6DD

PROJECT: CPS - LAP & UAP
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DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
200	-160	194.00 - 218.00 Sandy clay, micaceous, hard clay small chips, reddish-brown, coarse sand. *(Continued)*				51	CUT'G			5.00		
205	-165					52	CUT'G			5.00	Bentonite Chip	
210	-170		CL			53	CUT'G			5.00		**WELL NOTES:** Stick-up casing **SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.
215	-175					54	CUT'G			5.00		
					-177.97							
		218.00 - 220.00 Sand, coarse.	SM		218.00							
220		Log continued on next page			-179.97						No. 2 DSI	

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-6DD

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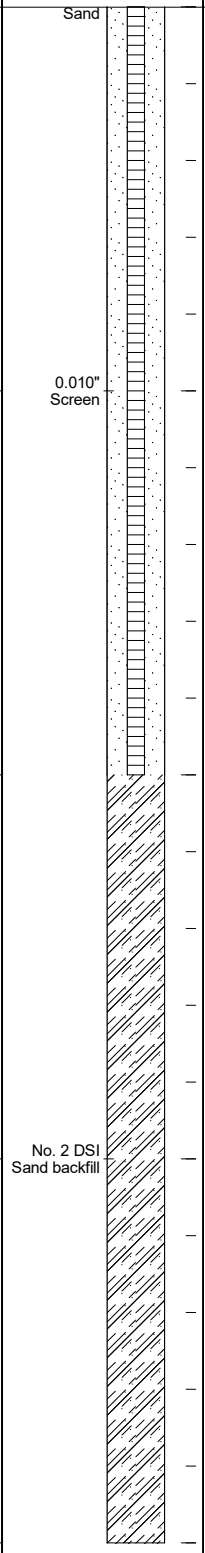
220	-180	220.00 - 224.50 Sandy clay, micaceous, hard clay small chips, reddish-brown, coarse sand.	CL		220.00	55	CUT'G			5.00
					-184.47					
225	-185	224.50 - 226.00 Rock fragments (aphanitic gray rock fragments) with sand and reddish-brown clay.	GC		224.50 -185.97					
		226.00 - 231.00 Sandy clay, micaceous, hard clay small chips, reddish-brown, coarse sand.	CL		226.00	56	CUT'G			5.00
230	-190				-190.97					
		231.00 - 237.00 Sandy clay with gray aphanitic saft rock fragments, micaceous, hard clay small chips, reddish-brown clay, coarse sand.	CL-GC		231.00	57	CUT'G			5.00
235	-195				-196.97					
		237.00 - 240.00 Sandy clay, micaceous, hard clay small chips, reddish-brown, coarse sand.	CL		237.00	58	CUT'G			5.00
240		Log continued on next page Boring completed at 240.00 ft			-199.97					

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
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DATE: 10/15/16

Golder Associates

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EASTING: 11,813,221.56
GS ELEVATION: 40.03 ft
TOC ELEVATION: 42.69 ft

DEPTH W.L.: 47.48 ft
ELEVATION W.L.: -7.45 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
240	-200											
						59	CUT'G			5.00		
245	-205											
250	-210											
255	-215											
260												

WELL NOTES:
Stick-up casing

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade. Split spoon data from adjacent borehole MW-6D. Run geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-7

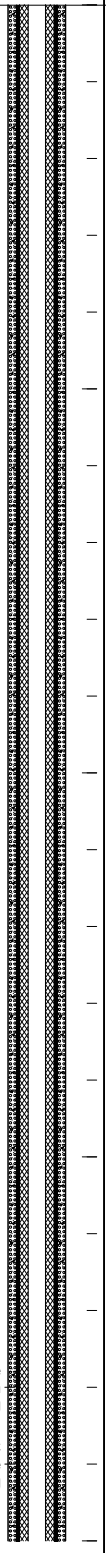
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 9/9/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,718.44
EASTING: 11,812,729.28
GS ELEVATION: 41.00 ft
TOC ELEVATION: 43.45 ft

DEPTH W.L.: 35.24 ft
ELEVATION W.L.: 5.76 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	40	0.00 - 5.00 Clayey sand with gravel, brown to orange brown, medium sand, gravel is rounded to subrounded, moist. FILL.	SC			1	CUT'G			3.00 / 3.00
						2	2 IN SS	2-3-5-5	8	1.50 / 2.00
5	35				36.00					
		5.00 - 10.00 Clayey sand with gravel, brown to orange brown, medium sand, gravel is rounded to subrounded, moist. FILL.	SC		5.00					
						3	2 IN SS	5-5-5-4	10	1.50 / 2.00
10	30				31.00					
		10.00 - 18.00 Clayey sand, medium to coarse-grained sand, brown, trace rounded gravel, wet. FILL.	SC		10.00	4	2 IN SS	4-4-4-3	8	1.00 / 2.00
15	25				23.00					
		18.00 - 23.00 Clayey sand, fine to medium-grained sand, micaceous, moist, loose. FILL.	SC		18.00	5	2 IN SS	3-4-1-3	5	1.50 / 2.00
20		Log continued on next page								



WELL CASING
Interval: 0' to 42.5'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 36.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 36.0' to 38.0'
Type: Bentonite chips

FILTER PACK
Interval: 38.0' to 52.5'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 42.5' to 52.5'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 8.25-inch HSA & 4.25-inch HSA
Notes:

WELL NOTES:
Surface cased borehole.

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. Giordano
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-7

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

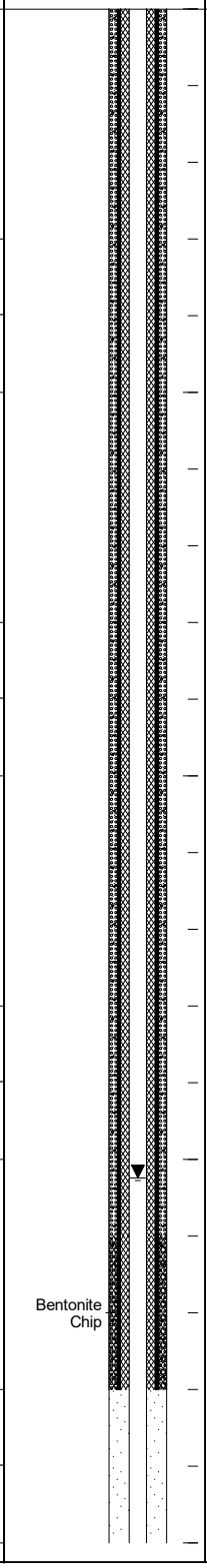
DRILL RIG: CME-55
DATE STARTED: 9/9/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,718.44
EASTING: 11,812,729.28
GS ELEVATION: 41.00 ft
TOC ELEVATION: 43.45 ft

DEPTH W.L.: 35.24 ft
ELEVATION W.L.: 5.76 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20	20	18.00 - 23.00 Clayey sand, fine to medium-grained sand, micaceous, moist, loose. FILL. *(Continued)*	SC		18.00					
		23.00 - 28.00 Clayey sand, fine to medium-grained sand, micaceous, moist, loose, large gravel. FILL.	SC		23.00	6	2 IN SS	5-4-3-3	7	1.00 / 2.00
25	15				13.00					
		28.00 - 33.00 Sand, fine to medium-grained, loose, moist, brown to orange brown, some plastic fines and subrounded gravel. FILL.	SP		28.00	7	2 IN SS	2-2-3-2	5	1.50 / 2.00
30	10				8.00					
		33.00 - 34.00 Sandy clay with gravel and root fragments, wet, dark brown to blackish-brown. FILL.	SC		33.00 7.00	8	2 IN SS	3-9-12-14	21	2.00 / 2.00
35	5	34.00 - 38.50 Sand and gravel, medium to coarse-grained sand, subrounded gravel and cobbles, wet, brown to light brown.	SP		34.00 2.50					
		38.50 - 40.00 Sand and clay, medium to coarse-grained sand, micaceous, wet, compact, tan colored.	SC		38.50 1.00	9	2 IN SS	2-3-4-5	7	2.00 / 2.00
40		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Surface cased borehole.

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. Giordano
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-7

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 9/9/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,718.44
EASTING: 11,812,729.28
GS ELEVATION: 41.00 ft
TOC ELEVATION: 43.45 ft

DEPTH W.L.: 35.24 ft
ELEVATION W.L.: 5.76 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
40	0	40.00 - 43.00 Sand and gravel, medium to coarse-grained sand, subrounded gravel and cobbles, wet, brown to light brown.	SC		40.00 -2.00							
45	-5	43.00 - 48.00 Clayey sand, medium-grained sand, trace silt and subangular gravel up to 1.5 inches in diameter, brown, wet.	SC		43.00 -7.00	10	2 IN SS	10-3-12-16	15	2.00/2.00	No. 2 DSI Sand 0.010" Screen	
50	-10	48.00 - 51.00 Silty clay, trace fine-grained sand, dark gray, W<PL, stiff, some fine sand seams up to 0.5-inch thick.	CL-ML		48.00 -10.00	11	2 IN SS	5-6-7-11	13	2.00/2.00		**WELL NOTES:** Surface cased borehole. **SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.
		51.00 - 53.00 Silty sand, fine-grained sand, gray, wet, compact.	SM		51.00 -12.00	12	2 IN SS	7-11-16-17	27	2.00/2.00	No. 2 DSI Sand	
55	-15	Boring completed at 53.00 ft										
60												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. Giordano
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-8

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 9/8/16
DATE COMPLETED: 9/13/16

NORTHING: 3,661,566.62
EASTING: 11,812,252.31
GS ELEVATION: 41.31 ft
TOC ELEVATION: 43.62 ft

DEPTH W.L.: 35.89 ft
ELEVATION W.L.: 5.42 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	40	0.00 - 5.00 Clayey sand with gravel, brown to orange brown, medium sand, gravel is rounded to subrounded, moist. FILL. .	SC		36.31					
5	35	5.00 - 10.00 Clayey sand with gravel, brown to orange brown, medium sand, gravel is rounded to subrounded, moist. FILL.	SC		5.00 31.31	1	CUT'G		28.00	28.00
10	30	10.00 - 18.00 Clayey sand, medium to coarse sand, brown, trace rounded gravel, wet. FILL.	SC		10.00 23.31					
15	25	18.00 - 23.00 Clayey sand, fine to medium sand, micaceous, moist, loose. FILL.	SC		18.00					
20		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

10-inch PVC surface casing
Bentonite grout in casing

WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0.0' to 41.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 38.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 38.0' to 41.0'
Type: Bentonite chip

FILTER PACK
Interval: 41.0' to 53.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 43.0' to 53.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 8.25-inch HSA & 4.25-inch HSA
Notes:

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. Giordano
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-8

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

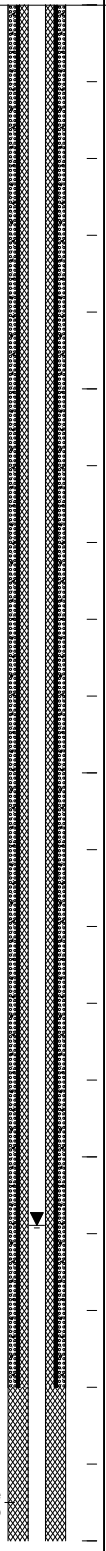
DRILL RIG: CME-55
DATE STARTED: 9/8/16
DATE COMPLETED: 9/13/16

NORTHING: 3,661,566.62
EASTING: 11,812,252.31
GS ELEVATION: 41.31 ft
TOC ELEVATION: 43.62 ft

DEPTH W.L.: 35.89 ft
ELEVATION W.L.: 5.42 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20		18.00 - 23.00 Clayey sand, fine to medium sand, micaceous, moist, loose. FILL. *(Continued)*	SC		18.31					
	20	23.00 - 28.00 Clayey sand, fine to medium sand, micaceous, moist, loose, large gravel. FILL.	SC		23.00	1	CUT'G			28.00 28.00
25					13.31					
	15	28.00 - 33.00 Clayey sand, medium to fine-grained well graded sand, brown, some plastic fines, come cobbles, some root materials, slightly moist, compact. FILL.	SC		28.00	2	2 IN SS	2-3-4-4	7	1.50 2.00
30										
	10				8.31					
		33.00 - 38.00 Clayey sand, medium-grained, well-graded sand, brown, moist.	SC		33.00	3	2 IN SS	WOH-WOH-1-1	0	0.50 2.00
35										
	5				3.31					
		38.00 - 48.00 Clayey sand, medium to fine-grained, well-graded sand, brown, wet.	SC		38.00	4	2 IN SS	WOH-WOH-WOH-1	0	2.00 2.00
40		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. Giordano
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-8

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

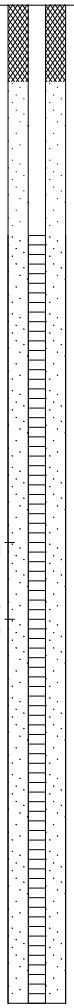
DRILL RIG: CME-55
DATE STARTED: 9/8/16
DATE COMPLETED: 9/13/16

NORTHING: 3,661,566.62
EASTING: 11,812,252.31
GS ELEVATION: 41.31 ft
TOC ELEVATION: 43.62 ft

DEPTH W.L.: 35.89 ft
ELEVATION W.L.: 5.42 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40		38.00 - 48.00 Clayey sand, medium to fine-grained, well-graded sand, brown, wet. *(Continued)*								
	0									
			SC			5	2 IN SS	3-2-1-2	3	0.50 / 2.00
45					-6.69					
	-5									
		48.00 - 49.00 Sand, coarse-grained, well graded, tan-brown, wet.	SW		48.00 -7.69	6	2 IN SS	7-11-14-13	25	1.00 / 2.00
		49.00 - 51.00 Gravel and sand, coarse-grained well-graded sand, brown to tan-brown, some reddish-purple clay lens, wet.	GW/SW		49.00 -9.69					
50										
	-10	51.00 - 53.00 Clayey sand, medium-grained, trace silt and subangular gravel up to 1.5 inches in diameter, brown, wet.	SC		51.00 -11.69	7	2 IN SS	2-1-2-1	3	0.00 / 2.00
		Boring completed at 53.00 ft								
55										
	-15									
60										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. Giordano
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-8R

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: Geoprobe 8040 DT
DATE STARTED: 1/3/17
DATE COMPLETED: 1/5/17

NORTHING: 3,661,572.56
EASTING: 11,812,278.37
GS ELEVATION: 41.21 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	40	0.00 - 5.00 Clayey sand with gravel, brown to orange brown, medium sand, gravel is rounded to subrounded, moist. FILL. .	SC		36.21								
5	35	5.00 - 10.00 Clayey sand with gravel, brown to orange brown, medium sand, gravel is rounded to subrounded, moist. FILL.	SC		5.00 31.21							Bentonite grout in casing	
10	30	10.00 - 18.00 Clayey sand, medium to coarse sand, brown, trace rounded gravel, wet. FILL.	SC		10.00		1	CUT'G	N/A		28.00 28.00		
15	25				23.21								
20		18.00 - 23.00 Clayey sand, fine to medium sand, micaceous, moist, loose. FILL. Log continued on next page	SC		18.00								

WELL CASING
Interval: 0.0' to 41.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 36.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 36.0' to 19.0'
Type: Bentonite chip

FILTER PACK
Interval: 36.0' to 51.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 41.0' to 51.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GEOlogic Exploration
DRILLER: Johnny Burr

PREPARED: C. LaCosse
REVIEWED:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-8R

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: Geoprobe 8040 DT
DATE STARTED: 1/3/17
DATE COMPLETED: 1/5/17

NORTHING: 3,661,572.56
EASTING: 11,812,278.37
GS ELEVATION: 41.21 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
20	20	18.00 - 23.00 Clayey sand, fine to medium sand, micaceous, moist, loose. FILL. *(Continued)*	SC		18.21								
25	15	23.00 - 28.00 Clayey sand, fine to medium sand, micaceous, moist, loose, large gravel. FILL.	SC		23.00 13.21		1	CUT'G	N/A		28.00 / 28.00	Bentonite Chip	
30	10	28.00 - 33.00 Clayey sand, medium to fine-grained well graded sand, brown, some plastic fines, come cobbles, some root materials, slightly moist, compact. FILL.	SC		28.00 8.21		2	2 IN SS	2 -3 -4 -4	7	1.50 / 2.00		
35	5	33.00 - 38.00 Clayey sand, medium-grained, well-graded sand, brown, moist.	SC		33.00 3.21		3	2 IN SS	WOH -WOH -1 -1	0	0.50 / 2.00		
40		38.00 - 48.00 Clayey sand, medium to fine-grained, well-graded sand, brown, wet.	SC		38.00		4	2 IN SS	WOH -WOH -WOH -1	0	2.00 / 2.00		

Log continued on next page

WELL CASING
Interval: 0.0' to 41.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 36.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 36.0' to 19.0'
Type: Bentonite chip

FILTER PACK
Interval: 36.0' to 51.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 41.0' to 51.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft
DRILLING COMPANY: GEOlogic Exploration
DRILLER: Johnny Burr
PREPARED: C. LaCosse
REVIEWED:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-8R

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: Geoprobe 8040 DT
DATE STARTED: 1/3/17
DATE COMPLETED: 1/5/17

NORTHING: 3,661,572.56
EASTING: 11,812,278.37
GS ELEVATION: 41.21 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
40		38.00 - 48.00 Clayey sand, medium to fine-grained, well-graded sand, brown, wet. *(Continued)*											
	0												
			SC				5	2 IN SS	3 -2 -1 -2	3	0.50 / 2.00	No. 2 DSI Sand	
45													
	-5											0.010" Screen	
					-6.79								
		48.00 - 49.00 Sand, coarse-grained, well graded, tan-brown, wet.	SW		48.00 -7.79		6	2 IN SS	7 -11 -14 -13	25	1.00 / 2.00		
		49.00 - 51.00 Gravel and sand, coarse-grained well-graded sand, brown to tan-brown, some reddish-purple clay lens, wet.	GW/SW		49.00 -9.79								
50													
	-10	51.00 - 53.00 Clayey sand, medium-grained, trace silt and subangular gravel up to 1.5 inches in diameter, brown, wet.	SC		51.00 -11.79		7	2 IN SS	2 -1 -2 -1	3	0.00 / 2.00	Formation Slough	
		Boring completed at 53.00 ft											
55													
	-15												
60													

WELL CASING
Interval: 0.0' to 41.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 36.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 36.0' to 19.0'
Type: Bentonite chip

FILTER PACK
Interval: 36.0' to 51.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 41.0' to 51.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GEOlogic Exploration
DRILLER: Johnny Burr

PREPARED: C. LaCosse
REVIEWED:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-9

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 55.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

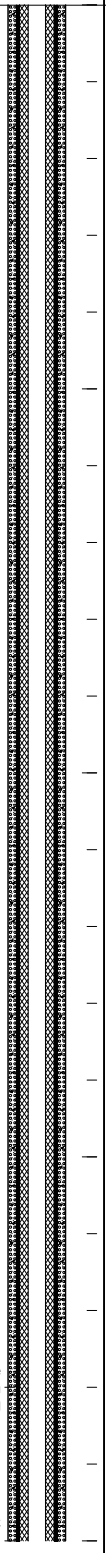
DRILL RIG: CME-55
DATE STARTED: 9/7/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,408.62
EASTING: 11,811,813.33
GS ELEVATION: 41.70 ft
TOC ELEVATION: 44.25 ft

DEPTH W.L.: 36.55 ft
ELEVATION W.L.: 5.15 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	40	0.00 - 4.00 Top soil and root mass, FILL.	OL		37.70	1	2 IN SS	3-2-2-3	4	1.70 / 2.00
5	35	4.00 - 9.00 Silty sand, poorly graded, medium-grained sand, dense, orange brown, no odor, dry. FILL.	SP-SM		4.00 32.70	2	2 IN SS	4-5-5-6	10	1.70 / 2.00
10	30	9.00 - 14.00 Silty sand, poorly graded, medium-grained sand, dense, orange brown, no odor, dry. FILL.	SP-SM		9.00 27.70	3	2 IN SS	4-8-9-11	17	1.70 / 2.00
15	25	14.00 - 19.00 Silty sand with angular gravel, poorly graded, medium-grained sand, dense, gray-brown, no odor, dry. FILL.	SP-SM		14.00 22.70	4	2 IN SS	3-5-6-9	11	1.80 / 2.00
20		19.00 - 24.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL. Log continued on next page	SM		19.00	5	2 IN SS	3-5-11-14	16	1.80 / 2.00

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0.0' to 43'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 36.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 36.0' to 38.0'
Type: Bentonite chips

FILTER PACK
Interval: 38.0' to 53.0'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 43.0' to 53.0`
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 8.25-inch HSA & 4.25-inch HSA
Notes:

WELL NOTES:
10-inch casing to 40.0'

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-9

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 55.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 9/7/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,408.62
EASTING: 11,811,813.33
GS ELEVATION: 41.70 ft
TOC ELEVATION: 44.25 ft

DEPTH W.L.: 36.55 ft
ELEVATION W.L.: 5.15 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		19.00 - 24.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL. *(Continued)*	SM		17.70	5	2 IN SS	3-5-11-14	16	1.80 / 2.00	surface casing	
	20											
		24.00 - 29.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL.			24.00	6	2 IN SS	8-12-14-16	26	0.30 / 2.00		
25			SM									
	15				12.70							
		29.00 - 33.00 Silty sand, medium dense, grayish-brown with decomposed wood fragments, organic odor, moist. FILL.			29.00	7	2 IN SS	9-9-10-10	19	1.70 / 2.00		**WELL NOTES:** 10-inch casing to 40.0' **SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.
30			SM									
	10				8.70							
		33.00 - 34.00 Cobbles, FILL.	GP		33.00 7.70							
		34.00 - 39.00 Sandy silt, very soft, grayish-brown grading to orangish-brown, trace roots, no odor, moist.			34.00	8	2 IN SS	2-1-2-1	3	1.80 / 2.00		
35												
	5		ML								Bentonite Chip	
					2.70							
		39.00 - 40.90 Silty sand, decomposed organic material, loose, orangish-brown, very loose.	SM		39.00	9	2 IN SS	1-1-2-5	3	1.70 / 2.00		
40		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-9

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 55.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 9/7/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,408.62
EASTING: 11,811,813.33
GS ELEVATION: 41.70 ft
TOC ELEVATION: 44.25 ft

DEPTH W.L.: 36.55 ft
ELEVATION W.L.: 5.15 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
40		39.00 - 40.90 Silty sand, decomposed organic material, loose, orangish-brown, very loose. *(Continued)*	SM		0.80	9	2 IN SS	1-1-2-5	3	1.70 / 2.00		
		40.90 - 53.00 Silty sand, fine-grained sand, some clay, brown to gray, wet, loose.			40.90							
	0					10	2 IN SS	8-10-3-5	13	1.00 / 2.00		
45											No. 2 DSI Sand	
	-5		SM									
											0.010" Screen	
						11	2 IN SS	1-1-1-2	2	1.40 / 2.00		**WELL NOTES:** 10-inch casing to 40.0'
50												**SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction.
	-10				-11.30							
		53.00 - 55.00 Clayey sand, fine-grained sand, gray, wet, loose.	SC		53.00	12	2 IN SS	3-4-7-5	11	1.10 / 2.00	No. 2 DSI Sand	
55		Boring completed at 55.00 ft			-13.30							
	-15											
60												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-9R

SHEET 1 of 3

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 54.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: Geoprobe 8040 DT
DATE STARTED: 1/18/17
DATE COMPLETED: 1/19/17

NORTHING: 3,661,400.01
EASTING: 11,811,790.81
GS ELEVATION: 41.78 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
0	40	0.00 - 4.00 Top soil and root mass, FILL.	OL		37.78		1	2 IN SS	3 -2 -2 -3	4	1.70 / 2.00	
5	35	4.00 - 9.00 Silty sand, poorly graded, medium-grained sand, dense, orange brown, no odor, dry. FILL.	SP-SM		4.00 32.78		2	2 IN SS	4 -5 -5 -6	10	1.70 / 2.00	
10	30	9.00 - 14.00 Silty sand, poorly graded, medium-grained sand, dense, orange brown, no odor, dry. FILL.	SP-SM		9.00 27.78		3	2 IN SS	4 -8 -9 -11	17	1.70 / 2.00	Bentonite grout in casing
15	25	14.00 - 19.00 Silty sand with angular gravel, poorly graded, medium-grained sand, dense, gray-brown, no odor, dry. FILL.	SP-SM		14.00 22.78		4	2 IN SS	3 -5 -6 -9	11	1.80 / 2.00	
20		19.00 - 24.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL.	SM		19.00		5	2 IN SS	3 -5 -11 -14	16	1.80 / 2.00	

Log continued on next page

WELL CASING
Interval: 0.0' to 43'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 20.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 20.0' to 38.0'
Type: Bentonite chips

FILTER PACK
Interval: 38.0' to 53.0'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 43.0' to 53.0`
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft
DRILLING COMPANY: GEOlogic Exploration
DRILLER: Johnny Burr
PREPARED: C. LaCosse
REVIEWED:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-9R

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 54.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: Geoprobe 8040 DT
DATE STARTED: 1/18/17
DATE COMPLETED: 1/19/17

NORTHING: 3,661,400.01
EASTING: 11,811,790.81
GS ELEVATION: 41.78 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
20		19.00 - 24.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL. *(Continued)*	SM				5	2 IN SS	3 -5 -11 -14	16	1.80 / 2.00		
	20				17.78								
		24.00 - 29.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL.	SM		24.00		6	2 IN SS	8 -12 -14 -16	26	0.30 / 2.00		
25													
	15				12.78							Bentonite Chip	
		29.00 - 33.00 Silty sand, medium dense, grayish-brown with decomposed wood fragments, organic odor, moist. FILL.	SM		29.00		7	2 IN SS	9 -9 -10 -10	19	1.70 / 2.00		
30													
	10				8.78								
		33.00 - 34.00 Cobbles, FILL.	GP		33.00 7.78								
		34.00 - 39.00 Sandy silt, very soft, grayish-brown grading to orangish-brown, trace roots, no odor, moist.	ML		34.00		8	2 IN SS	2 -1 -2 -1	3	1.80 / 2.00		
35													
	5				2.78								
		39.00 - 40.90 Silty sand, decomposed organic material, loose, orangish-brown, very loose.	SM		39.00		9	2 IN SS	1 -1 -2 -5	3	1.70 / 2.00		
40		Log continued on next page											

WELL CASING
Interval: 0.0' to 43'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 20.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 20.0' to 38.0'
Type: Bentonite chips

FILTER PACK
Interval: 38.0' to 53.0'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 43.0' to 53.0`
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GEOlogic Exploration
DRILLER: Johnny Burr

PREPARED: C. LaCosse
REVIEWED:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-9R

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 54.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: Geoprobe 8040 DT
DATE STARTED: 1/18/17
DATE COMPLETED: 1/19/17

NORTHING: 3,661,400.01
EASTING: 11,811,790.81
GS ELEVATION: 41.78 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
40		39.00 - 40.90 Silty sand, decomposed organic material, loose, orangish-brown, very loose. *(Continued)*	SM		0.88		9	2 IN SS	1 -1 -2 -5	3	1.70 / 2.00		
		40.90 - 53.00 Silty sand, fine-grained sand, some clay, brown to gray, wet, loose.			40.90								
	0						10	2 IN SS	8 -10 -3 -5	13	1.00 / 2.00		
45												No. 2 DSI Sand	
	-5		SM										
							11	2 IN SS	1 -1 -1 -2	2	1.40 / 2.00	0.010" Screen	
50													
	-10				-11.22								
		53.00 - 55.00 Clayey sand, fine-grained sand, gray, wet, loose.	SC		53.00		12	2 IN SS	3 -4 -7 -5	11	1.10 / 2.00		
55					-13.22								
		Boring completed at 54.00 ft			55.00								
	-15												
60													

WELL CASING
Interval: 0.0' to 43'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 20.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 20.0' to 38.0'
Type: Bentonite chips

FILTER PACK
Interval: 38.0' to 53.0'
Type: No. 2 DSI sand

WELL SCREEN
Interval: 43.0' to 53.0`
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GEOlogic Exploration
DRILLER: Johnny Burr

PREPARED: C. LaCosse
REVIEWED:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-10

SHEET 1 of 3

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 52.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 9/16/16
DATE COMPLETED: 9/17/16

NORTHING: 3,661,177.84
EASTING: 11,811,227.10
GS ELEVATION: 41.07 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	41	0.00 - 4.00 Top soil and root mass, FILL.	OL		37.07								
	40												
		4.00 - 9.00 Silty sand, poorly-graded, medium-grained sand, dense, orange brown, no odor, dry. FILL.	SP-SM		4.00		1	CUT'G	N/A		8.00 / 8.00		
5	35												
					32.07		2	2 IN SS	4 -8 -9 -11	17	1.83 / 2.00		
		9.00 - 14.00 Silty sand, poorly-graded, medium-grained sand, dense, orange brown, no odor, dry. FILL.	SP-SM		9.00								
10	30												
					27.07								
		14.00 - 19.00 Silty sand with angular gravel, poorly-graded, medium-grained sand, dense, gray-brown, no odor, dry. FILL.-	SP-SM		14.00		3	2 IN SS	3 -5 -6 -9	11	1.92 / 2.00		
15	25												
					22.07							Bentonite grout in 10-inch PVC casing 10-inch PVC surface casing cemented in	
		19.00 - 24.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL.	SM		19.00		4	2 IN SS	3 -5 -11 -14	16	1.75 / 2.00		
20		Log continued on next page											

WELL CASING
Interval: 0.0' to 42.0'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 35.0'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 35.0' to 37.0'
Type: Bentonite Chip

FILTER PACK
Interval: 37.0' to 52.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 42.0' to 52.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Sample Notes:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction. Geology descriptions from 0 to 40 feet from adjacent soil boring OW-10.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-10

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 52.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

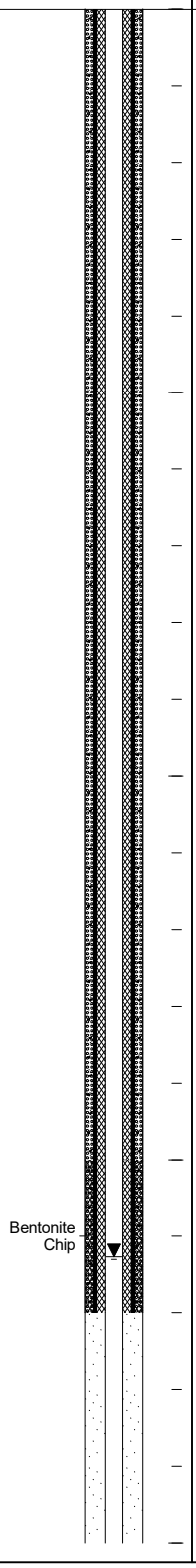
DRILL RIG: CME-55
DATE STARTED: 9/16/16
DATE COMPLETED: 9/17/16

NORTHING: 3,661,177.84
EASTING: 11,811,227.10
GS ELEVATION: 41.07 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20	20	19.00 - 24.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL. *(Continued)*	SM		17.07		4	2 IN SS	3 -5 -11 -14	16	1.75 / 2.00
25	15	24.00 - 29.00 Silty sand, grayish-brown grading to orangish-brown, no odor, moist, dense. FILL.	SM		24.00 12.07		5	2 IN SS	8 -12 -14 -16	26	2.00 / 2.00
30	10	29.00 - 43.00 Silty sand, medium dense, grayish-brown with decomposed wood fragments, organic (rotting wood) odor, moist. FILL.	SM		29.00		6	2 IN SS	9 -9 -10 -10	19	1.83 / 2.00
35	5						7	2 IN SS	2 -1 -1 -2	2	1.92 / 2.00
40							8	2 IN SS	1 -1 -2 -5	3	1.83 / 2.00

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0.0' to 42.0'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 35.0'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 35.0' to 37.0'
Type: Bentonite Chip

FILTER PACK
Interval: 37.0' to 52.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 42.0' to 52.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Sample Notes:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction. Geology descriptions from 0 to 40 feet from adjacent soil boring OW-10.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-10

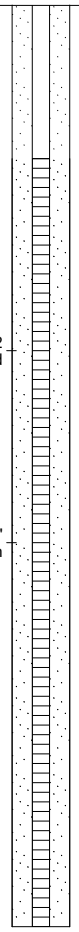
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 52.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 9/16/16
DATE COMPLETED: 9/17/16

NORTHING: 3,661,177.84
EASTING: 11,811,227.10
GS ELEVATION: 41.07 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40		29.00 - 43.00 Silty sand, medium dense, grayish-brown with decomposed wood fragments, organic (rotting wood) odor, moist. FILL. *(Continued)*	SM		-1.93		8	2 IN SS	1 -1 -2 -5	3	1.83 / 2.00
	0										
		43.00 - 45.00 Cobbles, FILL.	GP		43.00 -3.93		9	2 IN SS	4 -6 -3 -6	9	0.00 / 2.00
45		45.00 - 50.00 Silty clay, trace fine-grained sand, gray, with light brown to reddish-brown clayey sand lenses (upto 4" thick), W>PL,soft.	CL		45.00		10	2 IN SS	2 -2 -4 -8	6	2.00 / 2.00
	-5										
50					-8.93						
		50.00 - 52.00 Clayey Sand, fine-grained sand, with gray silty clay lenses (up to 3 inches thick), wet, loose.	SC		50.00 -10.93		11	2 IN SS	5 -4 -10 -12	14	1.70 / 2.00
	-10	Boring completed at 52.00 ft									
55											
	-15										
60											

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0.0' to 42.0'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 35.0'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 35.0' to 37.0'
Type: Bentonite Chip

FILTER PACK
Interval: 37.0' to 52.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 42.0' to 52.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Sample Notes:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. Borehole advanced and reamed out with HSAs for surface casing and well construction. Geology descriptions from 0 to 40 feet from adjacent soil boring OW-10.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-11

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

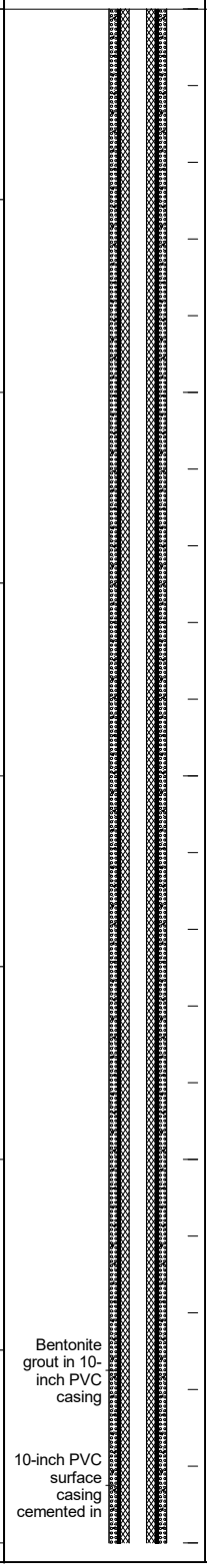
DRILL RIG: CME-55
DATE STARTED: 7/18/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,020.14
EASTING: 11,810,778.85
GS ELEVATION: 40.94 ft
TOC ELEVATION: 43.87 ft

DEPTH W.L.: 36.85 ft
ELEVATION W.L.: 4.09 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	40	0.00 - 5.00 Sand, fine to medium-grained sand, some clay and silt, brown to dark brown, no odor, dry, compact. FILL.	SP		35.94	1	MACRO CORE			1.50 / 5.00
5	35	5.00 - 8.00 Sand, fine to medium-grained sand, some clay and silt, brown to dark brown, no odor, dry, compact. FILL.	SP		5.00 32.94	2	MACRO CORE			4.50 / 5.00
		8.00 - 10.00 Clayey sand, fine to medium-grained sand, some silt, brown, drak brown, and gray, no odor, dry, compact. FILL.	SC		8.00 30.94					
10	30	10.00 - 19.50 Sand, fine to medium-grained, some silt and clay, brown to gray brown, no odor, dry, compact. FILL.	SP		10.00	3	MACRO CORE			4.00 / 5.00
15	25					4	MACRO CORE			3.60 / 5.00
		19.50 - 20.00 Sand, coarse-grained sand. FILL.	SW		21.44 19.50 20.94					
20		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0.0' to 42.5'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.0' to 35.5'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 35.5 ' to 37.5'
Type: Bentonite Chip

FILTER PACK
Interval: 37.5 to 52.5'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 42.5' to 52.5'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 8.25-inch HSA & 4.25-inch HSA
Notes:

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. 2" diameter macrocore used for direct push. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo, C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-11

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/18/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,020.14
EASTING: 11,810,778.85
GS ELEVATION: 40.94 ft
TOC ELEVATION: 43.87 ft

DEPTH W.L.: 36.85 ft
ELEVATION W.L.: 4.09 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20	20	20.00 - 27.00 Sand, fine to medium-grained sand, some silt and clay, brown to gray brown, no odor, dry, compact. FILL.	SP		20.00	5	MACRO CORE			5.00 / 5.00		
25	15				13.94	6	MACRO CORE			4.70 / 5.00		
		27.00 - 28.00 Sand, coarse-grained sand. FILL.	SW		27.00 12.94							
30	10	28.00 - 38.00 Sand, fine to medium-grained sand, some silt and clay, brown to gray brown, no odor, saturated at 33.8 feet, compact. FILL.	SP		28.00	7	MACRO CORE			4.60 / 5.00		**SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade prior to drilling. 2" diameter macrocore used for direct push. Borehole advanced and reamed out with HSAs for surface casing and well construction.
35	5				2.94	8	MACRO CORE			2.10 / 5.00	Bentonite Chip	
		38.00 - 43.00 Silty sand, fine to medium, some clay, dark gray to grayish-brown, moist to saturated, no odor, dense, trace fine gravel.	SP		38.00							
40		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo, C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-11

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 53.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

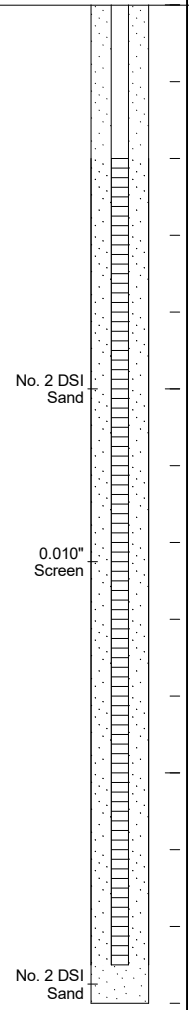
DRILL RIG: CME-55
DATE STARTED: 7/18/16
DATE COMPLETED: 9/12/16

NORTHING: 3,661,020.14
EASTING: 11,810,778.85
GS ELEVATION: 40.94 ft
TOC ELEVATION: 43.87 ft

DEPTH W.L.: 36.85 ft
ELEVATION W.L.: 4.09 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40	0	38.00 - 43.00 Silty sand, fine to medium, some clay, dark gray to grayish-brown, moist to saturated, no odor, dense, trace fine gravel. *(Continued)*	SP		-2.06					
		43.00 - 53.00 Sand, fine to medium with gravel up to 1 inch in diameter, sub to well rounded, light brown, wet, loose.	SP		43.00	9	2 IN SS	1-8-10-11	18	1.80 / 2.00
45	-5									
						10	2 IN SS	5-8-10-8	18	2.00 / 2.00
50	-10				-12.06					
		Boring completed at 53.00 ft								
55	-15									
60										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. 2" diameter macrocore used for direct push. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo, C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-11I

Project	Chesterfield Power Station, Chester, Virginia
Client	Dominion Energy
Contractor	Geologic Exploration

File No. 133249-004
Sheet No. 1 of 4
Start February 25, 2019
Finish February 26, 2019
Driller K. Sargent
H&A Rep. A. Gerringer
Elevation 41.1
Datum NAVD88
Location See Plan
N 3661011.54
E 11810757.49

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Override	Sonic	-	Rig Make & Model: Track-mounted Geoprobe 8150LS
Inside Diameter (in.)	6.0	4.0	-	Bit Type: None Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Sonic
Hammer Fall (in.)	-	-	-	Hoist/Hammer: None None PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Note: Hand augered to 5 ft. Cuttings consist of poorly-graded SAND with silt (SP-SM) from 0 to 4 ft, and lean CLAY with sand (CL) from 4 to 5 ft.										
5		CR1 36	5.0 9.0		36.1 5.0	SP-SM	Yellow-brown poorly-graded SAND with silt (SP-SM), mps 0.5 in., no odor, moist	-	5	-	20	65	10				
10		CR2 24	9.0 19.0			SP-SM	Similar to above, mps 2.0 in.	5	5	-	20	60	10				
15						SP-SM	Similar to above, mps 0.75 in.	-	10	-	20	60	10				
20		CR3 84	19.0 29.0			SP-SM	Similar to above, except darker brown and more gravel										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
2/26/19					

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 99.0
Rock Cored (ft) -
Samples 10CR

Boring No. MW-11I

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

HALEY ALDRICH

Boring No. MW-11I
File No. 133249-004
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
					18.6												
					22.5	SW	Red-yellow well-graded SAND (SW)										
					18.1	SP-SM	Brown poorly-graded SAND with silt and gravel (SP-SM), mps 1.0 in., no odor, subrounded gravel	5	15	-	60	10	10				
25					23.0												
		CR4 54	29.0 39.0			SP-SM	Similar to above, less gravel										
30																	
						SP-SM	Brown poorly-graded SAND with silt (SP-SM), mps 0.25 in., no odor	-	10	-	20	60	10				
35																	
		CR5 72	39.0 49.0			SP	Brown poorly-graded SAND with gravel (SP), mps 4.0 in., no odor, moist, rounded to subrounded gravel	15	10	10	50	10	5				
40					-1.9												
					43.0												
45																	
		CR6 108	49.0 59.0		-8.9												
50					50.0	ML	Yellow-brown SILT with sand (ML), mps 0.43 mm, no odor	-	-	-	-	15	85				
					-10.9												
					52.0	SP-SM	Brown poorly-graded SAND with silt and gravel (SP-SM), mps 4.0 in., no odor	-	15	-	5	70	10				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-11I

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-11I
File No. 133249-004
Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
55						SP-SM	Similar to above	10	15	5	50	10	10				
							Note: Color transitions to light tan.										
60		CR7 120	59.0 69.0		-19.9 61.0	CL	Gray lean CLAY (CL), mps 0.074 mm, no odor, moist	-	-	-	-	-	100				
65																	
70		CR8 120	69.0 79.0			CL	Similar to above	-	-	-	-	-	100				
75																	
80		CR9 120	79.0 89.0			CL	Similar to above	-	-	-	-	-	100				
85																	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-11I

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-11I

File No. 133249-004

Sheet No. 4 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
					-47.9												
		CR10 120	89.0 99.0		89.0	SC	Blue-gray clayey SAND with gravel (SC), mps 2.0 in., no odor	5	20	-	55	-	20				
90																	
95					-57.9												
					99.0		BOTTOM OF EXPLORATION 99.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-11I

RECORD OF BOREHOLE MW-12

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 52.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/18/16
DATE COMPLETED: 8/25/16

NORTHING: 3,660,850.86
EASTING: 11,810,294.33
GS ELEVATION: 41.31 ft
TOC ELEVATION: 44.06 ft

DEPTH W.L.: 38.40 ft
ELEVATION W.L.: 2.91 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	41	0.00 - 8.00 Fill, Sand, fine to medium-grained, some clay, some silt, brown to orange brown, no odor, dry, compact. FILL.	SP			1	MACRO CORE			2.30 5.00
5	36					2	MACRO CORE			5.00 5.00
					33.31					
		8.00 - 10.00 Clayey sand, fine to medium-grained sand, some silt, brown to orange brown, no odor, dry, compact. FILL.	SC		8.00					
10	31				31.31					
		10.00 - 12.50 Fill, Sand, fine to medium-grained sand, some clay and silt, brown to orange brown, no odor, dry, compact. FILL.	SC		10.00	3	MACRO CORE			4.70 5.00
					28.81					
		12.50 - 12.75 Piece of wood. FILL.	OH		28.56					
		12.75 - 25.00 Fill, Sand, fine to medium-grained sand, some clay and silt, brown to orange brown, no odor, dry, compact. FILL.	SC		12.75					
15	26					4	MACRO CORE			5.00 5.00
	25									
20		Log continued on next page								

Bentonite grout in 10-inch PVC casing
10-inch PVC

WELL CASING
Interval: 0.0' to 42.0
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0.5' to 38.5'
Type: bentonite grout

FILTER PACK SEAL
Interval: 38.5' to 41.0'
Type: Bentonite chip

FILTER PACK
Interval: 41.0' to 52.0
Type: No. 2 DSI sand

WELL SCREEN
Interval: 42.0' to 52.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 8.25-inch HSA & 4.25-inch HSA
Notes:

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. 2" macrocore used to collect direct push samples. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo, C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-12

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 52.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/18/16
DATE COMPLETED: 8/25/16

NORTHING: 3,660,850.86
EASTING: 11,810,294.33
GS ELEVATION: 41.31 ft
TOC ELEVATION: 44.06 ft

DEPTH W.L.: 38.40 ft
ELEVATION W.L.: 2.91 ft
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		12.75 - 25.00 Fill, Sand, fine to medium-grained sand, some clay and silt, brown to orange brown, no odor, dry, compact. FILL. *(Continued)*	SC		16.31	5	MACRO CORE			5.00 / 5.00	surface casing cemented in	
25	20	25.00 - 26.50 Clayey silt, trace fine to medium-grained sand, brown, no odor, dry to damp, stiff. FILL.	ML		25.00 14.81							
	15	26.50 - 29.50 Sand, fine to coarse-grained sand, trace silt and clay, no odor, brown to grayish-brown, dry, compact.	SP		26.50 11.81	6	MACRO CORE			5.00 / 5.00		
30		29.50 - 33.00 Sand, fine to medium-grained sand, trace silt and clay, no odor, brown to orangish-brown, dry, compact.	SP		29.50 8.31	7	MACRO CORE			3.40 / 5.00		**SAMPLE NOTES:** Soil boring vacuum extracted to 8 feet below grade prior to drilling. 2" macrocore used to collect direct push samples. Borehole advanced and reamed out with HSAs for surface casing and well construction.
	10	33.00 - 35.00 Sand, fine to medium-grained sand, trace silt and clay, no odor, brown to orangish-brown, dry, compact.	SP		33.00 6.31							
35		35.00 - 38.50 Sand, fine to medium-grained sand, some silt and clay, brown to orange brown, no odor, dry, compact.	SP		35.00 2.81	8	MACRO CORE			2.50 / 5.00		
	5	38.50 - 43.00 Clayey silt, trace fine-grained sand, brown, no odor, damp, firm.	ML		38.50						Bentonite Chip	
40		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo, C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-12

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 52.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/18/16
DATE COMPLETED: 8/25/16

NORTHING: 3,660,850.86
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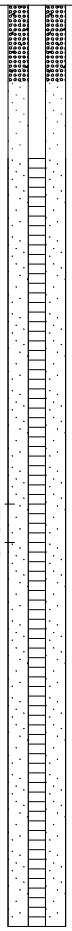
DATE W.L.: 10/5/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40		38.50 - 43.00 Clayey silt, trace fine-grained sand, brown, no odor, damp, firm. *(Continued)*	ML		-1.69					
	0				43.00	9	2 IN SS	10-9-7-6	16	0.50 / 2.00
45										
	-5		GP			10	2 IN SS	5-10-3-4	13	2.00 / 2.00
50					-9.69	11	2 IN SS	7-6-2-3	8	2.00 / 2.00
	-10	51.00 - 52.00 Sand, medium to fine-grained well graded sand, reddish-brown, wet.	SW		51.00					
		Boring completed at 52.00 ft			-10.69					
55	-15									
60										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

SAMPLE NOTES:
Soil boring vacuum extracted to 8 feet below grade prior to drilling. 2" macrocore used to collect direct push samples. Borehole advanced and reamed out with HSAs for surface casing and well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo, C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-13

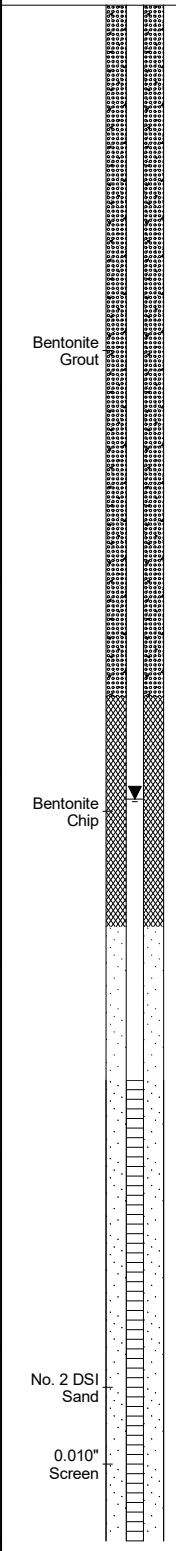
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 25.00 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/12/16
DATE COMPLETED: 7/12/16

NORTHING: 3,660,477.31
EASTING: 11,809,299.07
GS ELEVATION: 10.95 ft
TOC ELEVATION: 12.68 ft

DEPTH W.L.: 10.34 ft
ELEVATION W.L.: 0.61 ft
DATE W.L.: 10/7/06
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT
0	10	0.00 - 7.50 Sand, fine to coarse-grained sand, some silt, brown, no odor, dry, compact.	SP			2.00 5.00
5	5				3.45	3.70
		7.50 - 8.00 Clayey silt, brown, no odor, moist, firm.	MH		7.50 2.95	5.00
		8.00 - 9.50 Sand, fine to coarse-grained sand, some silt, brown, moist to wet, compact.	SP		8.00 1.45	
10	0	9.50 - 10.00 Clayey silt, moist, brown.	MH		9.50 0.95	
		10.00 - 13.50 Sand, fine to coarse-grained sand, some silt, brown, moist to wet, compact.	SP		10.00 -2.55	3.50 5.00
		13.50 - 14.50 Clayey silt, trace fine to coarse-grained sand, no odor, moist to wet, firm,	MH		13.50 -3.55	
15	-5	14.50 - 23.00 Sand, fine to coarse-grained sand, trace fine gravel, some silt, grayish-brown, no odor, saturated, compact to dense.	SP		14.50	2.50 5.00
20		Log continued on next page				



WELL CASING
Interval: 0' to 14'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' Concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 9'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 9' to 12'
Type: Bentonite Chip

FILTER PACK
Interval: 12' to 24'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 14' to 24'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 4.25 inch HSA and MacroCore Samples
Notes:

WELL NOTES:
Well completed with flood protection wellhead

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Ground Zero
DRILLER: Cory

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-13

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 25.00 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/12/16
DATE COMPLETED: 7/12/16

NORTHING: 3,660,477.31
EASTING: 11,809,299.07
GS ELEVATION: 10.95 ft
TOC ELEVATION: 12.68 ft

DEPTH W.L.: 10.34 ft
ELEVATION W.L.: 0.61 ft
DATE W.L.: 10/7/06
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		14.50 - 23.00 Sand, fine to coarse-grained sand, trace fine gravel, some silt, grayish-brown, no odor, saturated, compact to dense. *(Continued)*	SP			2.00 5.00		
	-10				-12.05			
		23.00 - 25.00 Sand, medium-grained sand with trace of coarse-sand and fine gravel, trace silt, brown, no odor, saturated, dense.	SP		23.00		No. 2 DSI Sand	
25		Boring completed at 25.00 ft			-14.05			
	-15							
30								**WELL NOTES:** Well completed with flood protection wellhead
	-20							
35								
	-25							
40								

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Ground Zero
DRILLER: Cory

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-14

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 45.20 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/12/16
DATE COMPLETED: 8/5/16

NORTHING: 3,660,027.47
EASTING: 11,809,396.53
GS ELEVATION: 19.45 ft
TOC ELEVATION: 21.19 ft

DEPTH W.L.: 18.25 ft
ELEVATION W.L.: 1.20 ft
DATE W.L.: 10/7/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
0	15	0.00 - 12.00 Silty sand, fine to coarse-grained sand, trace fine gravel, brown, no odor, dry, compact.	SM			1	MACRO CORE			2.00 / 5.00		**WELL CASING** Interval: 0' to 35.2' Material: PVC Diameter: 2" Joint Type: Threaded **WELL COMPLETION** Pad: 3' by 3' Concrete Protective Casing: 4" by 4" Aluminum **ANNULUS SEAL** Interval: 0' to 31' Type: Bentonite Grout **FILTER PACK SEAL** Interval: 31' to 33' Type: Bentonite Chip **FILTER PACK** Interval: 33.0' to 45.2' Type: No. 2 DSI Sand **WELL SCREEN** Interval: 35.2' to 45.2' Material: PVC Diameter: 2" Slot Size: 0.010" End Cap: 2"
5						2	MACRO CORE			2.00 / 5.00		
10	10				7.45	3	MACRO CORE			1.50 / 5.00		**DRILLING METHODS** Type: 4.25 inch HSA and MacroCore Samples Notes: **WELL NOTES:** Drilled with direct push and reamed out with 4.25-inch HSA for well construction.
		12.00 - 14.00 Silty sand, fine to coarse, trave fine gravel, brown, no odor, moist, compact.	SM		12.00 5.45							
	5	14.00 - 15.00 Silty sand, fine to coarse-grained sand, trave fine gravel, brown, wood fragments, no odor, moist, compact.	SM		14.00 4.45							
15		15.00 - 22.50 Sand, fine to coarse-grained, some silt, trace gravel, brown, no odor, saturated, dense.	SP		15.00	4	MACRO CORE			0.20 / 5.00	Bentonite Grout	
	0											
20		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-14

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 45.20 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/12/16
DATE COMPLETED: 8/5/16

NORTHING: 3,660,027.47
EASTING: 11,809,396.53
GS ELEVATION: 19.45 ft
TOC ELEVATION: 21.19 ft

DEPTH W.L.: 18.25 ft
ELEVATION W.L.: 1.20 ft
DATE W.L.: 10/7/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		15.00 - 22.50 Sand, fine to coarse-grained, some silt, trace gravel, brown, no odor, saturated, dense. *(Continued)*	SP		-3.05	5	MACRO CORE			3.00 / 3.00		
		22.50 - 23.00 Silty clay, trace fine-grained sand, bluish-gray, no odor, moist to dry, hard.	CH		22.50 -3.55							
		23.00 - 28.00 Clayey silt, some fine to medium-grained sand, bluish-green, no odor, dry, stiff.	ML		23.00	6	2 IN SS	14-10-14-15	24	2.00 / 2.00		
25	-5				-8.55							
		28.00 - 34.00 Clayey silt, some fine to medium-grained sand, bluish-green, no odor, damp to moist, stiff.	ML		28.00	7	2 IN SS	7-11-18-19	29	2.00 / 2.00		**WELL NOTES:** Drilled with direct push and reamed out with 4.25-inch HSA for well construction.
30	-10				-14.55	8	2 IN SS	5-7-11-15	18	2.00 / 2.00	Bentonite Chip	
		34.00 - 38.00 Silty sand, fine to medium-grained, some clay, grayish-green, no odor, moist, compact.	SM		34.00							
35	-15				-18.55							
		38.00 - 45.20 Silty sand, fine to medium-grained sand, some clay, grayish-green, no odor, wet, compact.	SM		38.00	9	2 IN SS	7-7-12-19	19	1.50 / 2.00	No. 2 DSI Sand	
40	-20	Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-14

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 45.20 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/12/16
DATE COMPLETED: 8/5/16

NORTHING: 3,660,027.47
EASTING: 11,809,396.53
GS ELEVATION: 19.45 ft
TOC ELEVATION: 21.19 ft

DEPTH W.L.: 18.25 ft
ELEVATION W.L.: 1.20 ft
DATE W.L.: 10/7/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
40		38.00 - 45.20 Silty sand, fine to medium-grained sand, some clay, grayish-green, no odor, wet, compact. *(Continued)*	SM								0.010" Screen	
	-25					10	2 IN SS	4-12-15-17	27	1.70 / 2.00		
45					-25.75							
		Boring completed at 45.20 ft										
	-30											**WELL NOTES:** Drilled with direct push and reamed out with 4.25-inch HSA for well construction.
50												
	-35											
55												
	-40											
60												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.	Boring No.
MW-15	MW-15

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	J. Yonts
CONTRACTOR	Fishburne Drilling	**DATE INSTALLED**	6/22/2016
DRILLER	J. Raasio		

Ground El. - ft
El. Datum -
Location See plan

☑ **Guard Pipe**
☐ **Roadway Box**

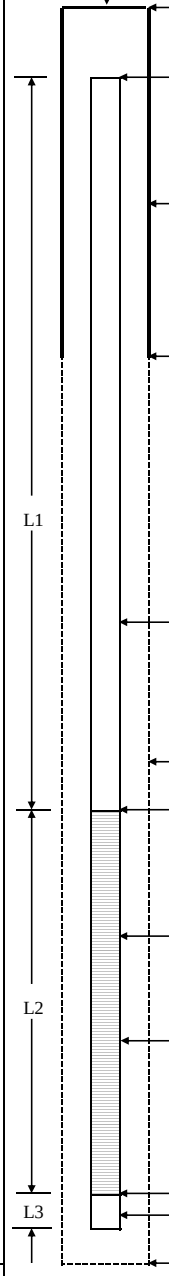
SOIL/ROCK CONDITIONS

See boring log

BOREHOLE BACKFILL

0.0
Concrete
2.0
Bentonite
26.0
Bentonite Seal
28.0
Sand
(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)



(Not to Scale)

Type of protective cover/lock	
Height/Depth of top of guard pipe/roadway box above/below ground surface	3.0 ft
Height/Depth of top of riser pipe above/below ground surface	2.5 ft
Type of protective casing:	Guard Pipe
Length	5.0 ft
Inside Diameter	4.000 in
Depth of bottom of guard pipe/roadway box	2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	24.0
Bentonite Seal	26.0	2.0
Filter Sand	28.0	12.5

Type of riser pipe:	Schedule 40 PVC
Inside diameter of riser pipe	2.1 in
Type of backfill around riser	Sand, bentonite pellets, bentonite
Diameter of borehole	6.0 in
Depth to top of well screen	30.00 ft
Type of screen	PVC
Screen gauge or size of openings	0.010 in
Diameter of screen	2.0 in
Type of backfill around screen	#2 Filter Sand
Depth of bottom of well screen	40.0 ft
Bottom of Silt trap	0.5 ft
Depth of bottom of borehole	40.5 ft

30 ft	+	10 ft	+	0.5 ft	=	40.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-15

Project	Dominion Power/Chesterfield, Chester, VA
Client	Dominion
Contractor	Fishburne Drilling, Inc.

File No. 42735-001
Sheet No. 1 of 2
Start June 22, 2016
Finish June 22, 2016
Driller J. Raasio
H&A Rep. J. Yonts
Elevation 22.7
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	-	Rig Make & Model: Track mounted CME 55
Inside Diameter (in.)	4.0	1 3/8	-	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: HSA Spun to 40.0
				Hoist/Hammer: Automatic Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				19.7		Note: Advanced HSA to 3.0 ft to begin sampling.										
	3 6 8 9	S1 15	3.0 5.0	3.0	SP	Medium dense brown to tan poorly-graded SAND (SP), mps 0.25 in., no odor, dry to moist	--	5	10	50	25	10				
5				14.7		-FILL-										
	2 2 3 3	S2 18	8.0 10.0	8.0	SP	Loose tan to brown poorly-graded SAND (SP), no odor, dry	--	--	--	5	80	15				
10																
	2 5 7 6	S3 12	13.0 15.0		SP	Similar to S2, except medium dense with coarser lenses	--	--	5	15	70	10				
15																
	1 2 2 2	S4 20	18.0 20.0		SP	Similar to S3, except very loose, moist to wet	--	5	5	10	60	20				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
Refer to groundwater level table					

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 40.0
Rock Cored (ft) -
Samples 8S

Boring No. MW-15

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-15
File No. 42735-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20				-0.3												
	1 7 10 11	S5 12	23.0 25.0	23.0	SM	Medium dense brown to gray silty SAND (SM), no odor, moist to wet	--	--	5	30	40	25				
25				-5.3												
	1 4 6 9	S6 24	28.0 30.0	28.0	CL	Stiff gray to brown sandy lean CLAY (CL), no odor, moist, plastic	--	--	--	20	40	40				
30				-10.3												
	5 14 19 21	S7 24	33.0 35.0	33.0	SM	Dense tan, white, and orange silty SAND with gravel (SM), mps 1.25 in., no odor, moist to wet, well rounded gravel	10	10	20	30	10	20				
35																
	5 12 31 50	S8 24	38.0 40.0		SM	Dense gray, white, and orange silty SAND with gravel (SM), mps 1.1 in., no odor, wet, well rounded gravel, coarsens with depth	10	10	20	30	20	10				
40				-17.3 40.0		BOTTOM OF EXPLORATION 40.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-15

RECORD OF BOREHOLE MW-16

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 34.40 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/13/16
DATE COMPLETED: 7/13/16

NORTHING: 3,659,489.24
EASTING: 11,810,179.79
GS ELEVATION: 20.10 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	20	0.00 - 10.00 Sand, fine to medium grained, trace silt and clay, brown, no odor, dry, compact.	SP					
5	15							
10	10				10.10		Bentonite Grout	
		10.00 - 20.00 Sand, fine to medium grained, trace silt and clay, brown, no odor, dry, compact to loose.	SP		10.00			
15	5							
20					0.10			
		Log continued on next page						

WELL CASING
Interval: 0' to 24.4'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0' to 19'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 19' to 22'
Type: Bentonite Chip

FILTER PACK
Interval: 22.0' to 34.4
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 24.4' to 34.4'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

Well Notes:
Drilled with direct push, reamed out with 4.25-inch HSA for well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Ground Zero
DRILLER: Cory Gamewell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-16

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 34.40 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/13/16
DATE COMPLETED: 7/13/16

NORTHING: 3,659,489.24
EASTING: 11,810,179.79
GS ELEVATION: 20.10 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
20	0	20.00 - 22.00 Sand, fine to medium grained, trace silt and clay, brown, no odor, damp to moist, compact to loose.	SP		20.00		Bentonite Chip	**WELL CASING** Interval: 0' to 24.4' Material: PVC Diameter: 2" Joint Type: threaded
					-1.90			**WELL COMPLETION** Pad: 3' by 3' concrete Protective Casing: 4" by 4" Aluminum
		22.00 - 24.00 Silty sand, fine to medium grained, trace clay, no odor, wet, compact to dense, grayish-brown.	SM		22.00			**ANNULUS SEAL** Interval: 0' to 19' Type: Bentonite Grout
					-3.90			**FILTER PACK SEAL** Interval: 19' to 22' Type: Bentonite Chip
		24.00 - 33.00 Sand, fine to coarse grained, some silt, trace fine gravel, no odor, saturated, dense, grayish-brown to brown.	SP		24.00			**FILTER PACK** Interval: 22.0' to 34.4 Type: No. 2 DSI Sand
25	-5							**WELL SCREEN** Interval: 24.4' to 34.4' Material: PVC Diameter: 2" Slot Size: 0.010" End Cap: 2"
							No. 2 DSI Sand	
							0.010" Screen	**Well Notes:** Drilled with direct push, reamed out with 4.25-inch HSA for well construction.
30	-10							
					-12.90			
		33.00 - 34.40 Silty clay, damp to moist, no odor, hard.	CH		33.00			
					-14.30			
		Boring completed at 34.40 ft						
35	-15							
40								

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Ground Zero
DRILLER: Cory Gamewell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-16D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 69.80 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/13/16
DATE COMPLETED: 7/13/16

NORTHING: 3,659,491.31
EASTING: 11,810,173.48
GS ELEVATION: 20.35 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	20	0.00 - 10.00 Sand, fine to medium-grained sand, trace silt and clay, brown, no odor, dry, compact.	SP				1	MACRO CORE	N/A		4.10 / 5.00		**WELL CASING** Interval: 0' to 60.0' Material: PVC Diameter: 2" Joint Type: threaded **WELL COMPLETION** Pad: 3' by 3' concrete Protective Casing: 4" by 4" Aluminum **ANNULUS SEAL** Interval: 0' to 53.5' Type: Bentonite Grout **FILTER PACK SEAL** Interval: 53.5' to 57.0' Type: Bentonite Chip **FILTER PACK** Interval: 57.0' to 60.0' Type: No. 2 DSI Sand **WELL SCREEN** Interval: 60.0' to 70.0' Material: PVC Diameter: 2" Slot Size: 0.010" End Cap: 2"
5	15						2	MACRO CORE	N/A		1.90 / 5.00		
10	10	10.00 - 20.00 Sand, fine to medium-grained sand, trace silt and clay, brown, no odor, dry, compact to loose.	SP		10.35 10.00		3	MACRO CORE	N/A		2.50 / 5.00		
15	5						4	MACRO CORE	N/A		1.30 / 5.00		
20		Log continued on next page			0.35								

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-16D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 69.80 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/13/16
DATE COMPLETED: 7/13/16

NORTHING: 3,659,491.31
EASTING: 11,810,173.48
GS ELEVATION: 20.35 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
20	0	20.00 - 22.00 Sand, fine to medium-grained sand, trace silt and clay, brown, no odor, damp to moist, compact to loose.	SP		20.00 -1.65								
		22.00 - 24.00 Silty sand, fine to medium-grained sand, trace clay, no odor, wet, compact to dense, grayish-brown.	SM		22.00 -3.65		5	MACRO CORE	N/A		3.00 / 5.00		
		24.00 - 33.00 Sand, fine to coarse-grained sand, some silt, trace fine gravel, no odor, saturated, dense, grayish-brown to brown.	SP		24.00		6	MACRO CORE	N/A		2.50 / 5.00	Bentonite Grout	
25	-5												
30	-10						7	MACRO CORE	N/A		3.50 / 4.00		
		33.00 - 38.00 Silty clay, damp to moist, no odor, hard.	CH		-12.65 33.00 -17.65								
		38.00 - 43.00 Sandy silt with clay, fine-grained sand, no odor, olive green, damp to dry, stiff.	ML		38.00		8	2 IN SS	7 -10 -14 -20	24	2.00 / 2.00		
35	-15												
40		Log continued on next page											

WELL CASING
Interval: 0' to 60.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0' to 53.5'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 53.5' to 57.0'
Type: Bentonite Chip

FILTER PACK
Interval: 57.0' to 60.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 60.0' to 70.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-16D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 69.80 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/13/16
DATE COMPLETED: 7/13/16

NORTHING: 3,659,491.31
EASTING: 11,810,173.48
GS ELEVATION: 20.35 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
40	-20	38.00 - 43.00 Sandy silt with clay, fine-grained sand, no odor, olive green, damp to dry, stiff. *(Continued)*	ML		-22.65								
		43.00 - 48.00 Sandy silt with clay, fine-grained sand, no odor, olive green, damp to moist, very stiff.			43.00		9	2 IN SS	13 -17 -17 -21	34	2.00 / 2.00		
45	-25		ML		-27.65								
		48.00 - 53.50 Sandy silt with clay, fine-grained sand, no odor, green to light green, damp to moist, stiff.			48.00		10	2 IN SS	8 -11 -12 -25	23	2.00 / 2.00		
50	-30		ML		-33.15								
		53.50 - 54.25 Silty sand, fine to medium-grained sand, greenish-gray.	SM		53.50 -33.90		11	2 IN SS	10 -13 -13 -18	26	2.00 / 2.00		
		54.25 - 58.00 Sandy silt with clay, fine-grained sand, no odor, green to light green, damp to moist, stiff.			54.25							Bentonite Chip	
55	-35		ML		-37.65								
		58.00 - 63.00 Silty sand, fine to coarse-grained sand, some clay, no odor, light green to grayish-green, moist to wet, very dense.	SM		58.00		12	2 IN SS	23 -26 -26 -50/5.5"	>50	1.50 / 2.00		
60		Log continued on next page											

WELL CASING
Interval: 0' to 60.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0' to 53.5'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 53.5' to 57.0'
Type: Bentonite Chip

FILTER PACK
Interval: 57.0' to 60.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 60.0' to 70.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-16D

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 69.80 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/13/16
DATE COMPLETED: 7/13/16

NORTHING: 3,659,491.31
EASTING: 11,810,173.48
GS ELEVATION: 20.35 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
60	-40	58.00 - 63.00 Silty sand, fine to coarse-grained sand, some clay, no odor, light green to grayish-green, moist to wet, very dense. *(Continued)*	SM		-42.65								
		63.00 - 68.00 Sand, fine to coarse-grained sand, trace gravel, some silt and clay, grayish-green, no odor, moist to wet, very dense.			63.00		13	2 IN SS	11 -23 -39 -50/5.5"	>50	1.40 / 2.00	No. 2 DSI Sand	
65	-45		SP		-47.65							0.010" Screen	
		68.00 - 70.00 Sand, fine to coarse-grained sand, trace gravel, some silt and clay, grayish-green, no odor, moist to wet, compact to dense.	SP		68.00 -49.65		14	2 IN SS	8 -15 -14 -26	29	1.40 / 2.00		
70	-50	Boring completed at 69.80 ft			70.00								
75	-55												
80													

WELL CASING
Interval: 0' to 60.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0' to 53.5'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 53.5' to 57.0'
Type: Bentonite Chip

FILTER PACK
Interval: 57.0' to 60.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 60.0' to 70.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-16DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
0	20	0.00 - 10.00 Sand, fine to medium grained, trace silt and clay, brown, no odor, dry, compact.	SP			1	MACRO CORE			4.10 / 5.00		**WELL CASING** Interval: 0' to 150.0' Material: PVC Diameter: 2" Joint Type: threaded **WELL COMPLETION** Pad: 3' by 3' concrete Protective Casing: 4" by 4" Aluminum **ANNULUS SEAL** Interval: 0' to 140.0' Type: Bentonite Grout **FILTER PACK SEAL** Interval: 140.0' to 146.0' Type: Bentonite **FILTER PACK** Interval: 146.0' to 160.0' Type: No. 2 DSI Sand **WELL SCREEN** Interval: 150.0' to 160.0' Material: PVC Diameter: 2" Slot Size: 0.010" End Cap: 2"
5	15					2	MACRO CORE			1.90 / 5.00		**DRILLING METHODS** Type: 6 5/8 mud rotary roller bit Notes:
10	10	10.00 - 20.00 Sand, fine to medium grained, trace silt and clay, brown, no odor, dry, compact to loose.	SP		11.01 10.00	3	MACRO CORE			2.50 / 5.00		**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.
15	5					4	MACRO CORE			1.30 / 5.00		
20		Log continued on next page			1.01							

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-16DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20	0	20.00 - 22.00 Sand, fine to medium grained, trace silt and clay, brown, no odor, damp to moist, compact to loose.	SP		20.00 -0.99							
		22.00 - 24.00 Silty sand, fine to medium grained, trace clay, no odor, wet, compact to dense, grayish-brown.	SM		22.00 -2.99	5	MACRO CORE			3.00 / 5.00		
25	-5	24.00 - 33.00 Sand, fine to coarse grained, some silt, trace fine gravel, no odor, saturated, dense, grayish-brown to brown.	SP		24.00	6	MACRO CORE			2.50 / 5.00		
30	-10					7	MACRO CORE			3.50 / 4.00		**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.
					-11.99							
		33.00 - 38.00 Silty clay, damp to moist, no odor, hard.	CH		33.00 -16.99							
35	-15	38.00 - 43.00 Sandy silt with clay, fine-grained sand, no odor, olive green, damp to dry, stiff.	ML		38.00	8	2 IN SS	7-10-14-20	24	2.00 / 2.00		
40		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-16DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
40		38.00 - 43.00 Sandy silt with clay, fine-grained sand, no odor, olive green, damp to dry, stiff. *(Continued)*	ML		-21.99							
	-20											
		43.00 - 48.00 Sandy silt with clay, fine-grained sand, no odor, olive green, damp to moist, very stiff.	ML		43.00	9	2 IN SS	13-17-17-21	34	2.00 / 2.00		
45					-26.99							
	-25											
		48.00 - 53.50 Sandy silt with clay, fine-grained sand, no odor, green to light green, damp to moist, stiff.	ML		48.00	10	2 IN SS	8-11-12-25	23	2.00 / 2.00		
50					-32.49							**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.
	-30											
		53.50 - 54.25 Silty sand, fine to medium-grained, greenish-gray.	SM		53.50 -33.24	11	2 IN SS	10-13-13-18	26	2.00 / 2.00		
		54.25 - 58.00 Sandy silt with clay, fine-grained sand, no odor, green to light green, damp to moist, stiff.	ML		54.25							
55	-35				-36.99							
		58.00 - 63.00 Silty sand, fine to coarse-grained, some clay, no odor, light green to grayish-green, moist to wet, very dense.	SM		58.00	12	2 IN SS	23-26-26-50	>50	1.50 / 2.00		
60		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-16DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N / REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
60	-40	58.00 - 63.00 Silty sand, fine to coarse-grained, some clay, no odor, light green to grayish-green, moist to wet, very dense. *(Continued)*	SM		-41.99						
		63.00 - 68.00 Sand, fine to coarse-grained, trace gravel, some silt and clay, grayish-green, no odor, moist to wet, very dense.	SP		63.00 -46.99	13	2 IN SS	11-23-39-50	>50 1.40/2.00		
65	-45										
		68.00 - 70.00 Sand, fine to coarse-grained, trace gravel, some silt and clay, grayish-green, no odor, moist to wet, compact to dense.	SP		68.00 -48.99	14	2 IN SS	8-15-14-26	29 1.40/2.00		
70	-50	70.00 - 95.00 Sand, fine to coarse-grained, some small sandy clay strips, light-gray to green.	SP		70.00	15	CUTTINGS		10.00	Bentonite Grout	**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.
75	-55										
80		Log continued on next page									

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-16DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
80		70.00 - 95.00 Sand, fine to coarse-grained, some small sandy clay strips, light-gray to green. *(Continued)*										
	-60											
85						16	CUTTINGS			10.00		
	-65											
			SP									
90												**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.
	-70											
					-73.99							
95		95.00 - 110.00 Clay, light green, some fine sand, trace coarse sand.			95.00	17	CUTTINGS			10.00		
	-75											
			CH									
100		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-16DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
100		95.00 - 110.00 Clay, light green, some fine sand, trace coarse sand. *(Continued)*										
	-80											
105			CH			18	CUTTINGS			10.00		
	-85											
110					-88.99							
		110.00 - 120.00 Clay, reddish-brown with large chips.			110.00							**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.
	-90											
115			CH			19	CUTTINGh			10.00		
	-95											
120					-98.99							
		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-16DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
120		120.00 - 130.00 Clay, light gray, large chips.			120.00							
	-100											
125			CH			20	CUTTINGS			10.00		
	-105											
					-108.99							
130		130.00 - 140.00 Sandy clay, fine to coarse-grained, green.			130.00							**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.
	-110											
135			CH			21	CUTTINGS			10.00		
	-115											
140					-118.99							
		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-16DD

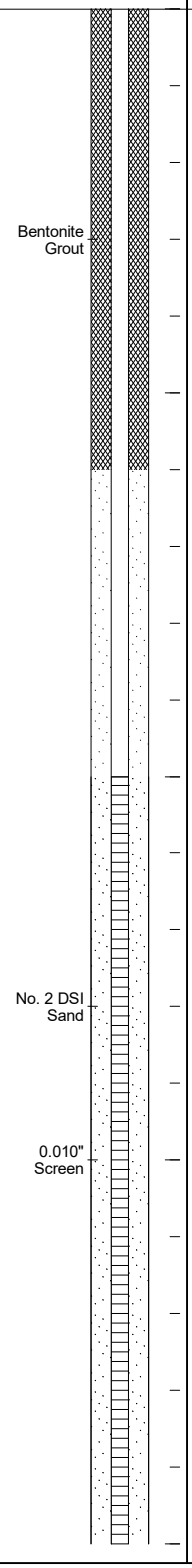
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
140		140.00 - 150.00 Dense thin siltstone lenses (fragments) interbedded with sandy clay, fine to coarse-grained, green.	CH		140.00					
	-120									
145										
	-125				-128.99					
150		150.00 - 155.00 Dense thin siltstone lenses (fragments) interbedded with clay with fine to coarse-grained sand, green.	CH		150.00					
	-130									
155					-133.99					
		155.00 - 156.00 Sand cuttings. Granitic bedrock or boulders.	Rock		155.00					
	-135				-134.99					
		156.00 - 157.50 No resistance on drill bit (soft clay or void).	Void		156.00					
					-136.49					
		157.50 - 175.00 Sand cuttings. Granitic bedrock.	Rock		157.50					
160		Log continued on next page								



SAMPLE NOTES:
Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-16DD

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 175.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/28/16
DATE COMPLETED: 9/28/16

NORTHING: 3,659,495.58
EASTING: 11,810,159.40
GS ELEVATION: 21.01 ft
TOC ELEVATION: 23.64 ft

DEPTH W.L.: 17.38 ft
ELEVATION W.L.: 3.63 ft
DATE W.L.: 10/6/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
160		157.50 - 175.00 Sand cuttings. Granitic bedrock. *(Continued)*										
	-140										No. 2 DSI Sand Backfill	
165											Bentonite Chip	
	-145		Rock									
170											No. 2 DSI Sand Backfill	**SAMPLE NOTES:** Split spoon data from adjacent borehole MW-16D. Ran geophysical log on open borehole.
	-150											
175					-153.99							
		Boring completed at 175.00 ft										
	-155											
180												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

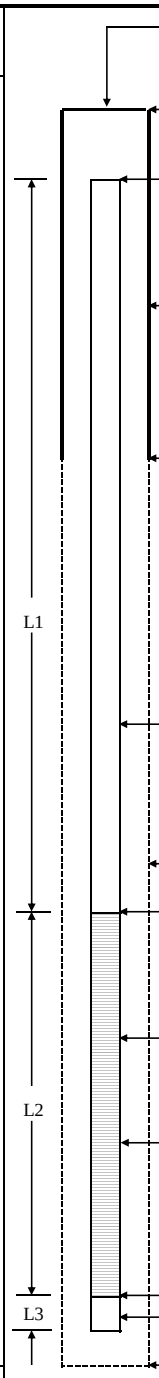
Well No.	Boring No.
MW-17S	MW-17S

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	H. Hollauer
CONTRACTOR	Cascade Drilling	**DATE INSTALLED**	6/20/2016
DRILLER	Chris Ruffer		

Ground El. - ft **Location** See plan ☑ **Guard Pipe** ☐ **Roadway Box**

El. Datum -

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
See boring log	0.0 Concrete 2.0 Bentonite 16.0 Bentonite Seal 18.0 Sand



Type of protective cover/lock

Height/Depth of top of guard pipe/roadway box above/below ground surface 3.0 ft

Height/Depth of top of riser pipe above/below ground surface 2.5 ft

Type of protective casing: Guard Pipe

Length 5.0 ft

Inside Diameter 4.000 in

Depth of bottom of guard pipe/roadway box 2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	14.0
Bentonite Seal	16.0	2.0
Filter Sand	18.0	12.5

Type of riser pipe: Schedule 40 PVC

Inside diameter of riser pipe 2.1 in

Type of backfill around riser Sand, bentonite pellets, bentonite

Diameter of borehole 6.0 in

Depth to top of well screen 20.0 ft

Type of screen PVC

Screen gauge or size of openings 0.010 in

Diameter of screen 2.0 in

Type of backfill around screen #2 Filter Sand

Depth of bottom of well screen 30.0 ft

Bottom of Silt trap 0.5 ft

Depth of bottom of borehole 30.5 ft

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)

(Not to Scale)

20 ft	+	10 ft	+	0.5 ft	=	30.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

Form 2007

HALEY ALDRICH

TEST BORING REPORT DRAFT

Boring No. MW-17S

Project	Dominion Power/Chesterfield, Chester, VA
Client	Dominion
Contractor	Cascade Drilling

File No. 42735-001
Sheet No. 1 of 2
Start June 20, 2016
Finish June 20, 2016
Driller C. Ruffer
H&A Rep. H. Hollauer
Elevation 9.0
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	-	Rig Make & Model: Track mounted TS: 150 CE
Inside Diameter (in.)	6.875	-	-	Bit Type:
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)	-	-	-	Casing: Override
				Hoist/Hammer: None
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		S1 10	0.0 10.0	SM		Orange-brown silty SAND (SM), mps less than 4.75 mm, no odor, no structure, slightly moist	--	--	5	5	70	20				
					1.0	-FILL/REWORKED NATIVE-										
					8.0											
10		S2 10	10.0 20.0	SM		Red-brown silty SAND (SM), mps 2.0 in., no odor, no structure, moist, gravel rounded	5	5	5	5	60	20				
					-6.0											
15				SM	15.0	Orange-brown to light gray silty SAND (SM), mps 1.0 in., no odor, no structure, gravel rounded, slightly bonded, slightly moist	5	5	15	15	30	30				
20		S3 10	20.0 30.0			Note: Gravel increasing with depth. -FLUVIAL DEPOSITS-										

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
Refer to groundwater level table					

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 30.5
Rock Cored (ft) -
Samples 3S
Boring No. MW-17S

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB10.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT Z:\42735\GINT\42735-001_TB.GPJ Nov 9, 16

HALEY ALDRICH

TEST BORING REPORT DRAFT

Boring No. MW-17S
File No. 42735-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																
						-FLUVIAL DEPOSITS-										
30				SM	-21.5	Orange-brown and light-gray slightly bonded silty SAND with gravel (SM), mps 0.5 in., no odor, no structure, slightly moist	--	20	10	10	35	25				
					30.5	BOTTOM OF EXPLORATION 30.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-17S

RECORD OF BOREHOLE MW-20

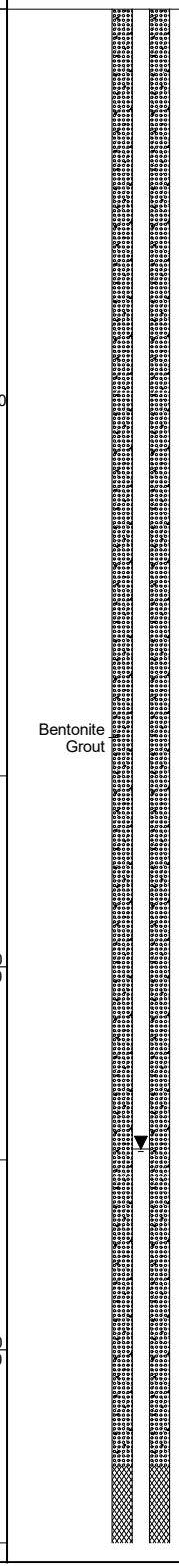
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/21/16
DATE COMPLETED: 8/2/16

NORTHING: 3,663,340.91
EASTING: 11,808,794.84
GS ELEVATION: 19.16 ft
TOC ELEVATION: 21.30 ft

DEPTH W.L.: 14.86 ft
ELEVATION W.L.: 4.30 ft
DATE W.L.: 10/7/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.00 - 11.00 Sand, fine to medium-grained sand, some silt and clay, trace cobbles, brown to orange brown, no odor, dry, compact.	SP			1	CUT'G			10.00
	15									
5										
	10									
10					8.16					
		11.00 - 12.50 Sand, fine to medium-grained, some silt and clay, trace cobbles, brown to orange brown, no odor, dry, compact.	SP		11.00 6.66	2	MACRO CORE			5.00 5.00
		12.50 - 14.00 Silt, some clay, grayish-brown, no odor, saturated, soft.	ML		12.50 5.16					
	5	14.00 - 18.00 Silty clay, trace of fine-grained sand, brown to orangish-brown, no odor, wet, stiff.	CL		14.00	3	MACRO CORE			5.00 5.00
15					1.16					
	0	18.00 - 24.00 Silty sand, some clay, fine to medium-grained sand, brown to orangish-brown, no odor, saturated, compact.	SM		18.00					
20		Log continued on next page								



WELL CASING
Interval: 0' to 22'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0' to 19'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 19' to 22'
Type: Bentonite Chips

FILTER PACK
Interval: 22' to 35'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 25' to 35'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 4.25-inch HSA
Notes:

SAMPLE NOTES:
Boring vacuum extracted to 8 feet before drilling. Refusal with direct push at 25 feet, boring finished and reamed with augers for well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-20

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 7/21/16
DATE COMPLETED: 8/2/16

NORTHING: 3,663,340.91
EASTING: 11,808,794.84
GS ELEVATION: 19.16 ft
TOC ELEVATION: 21.30 ft

DEPTH W.L.: 14.86 ft
ELEVATION W.L.: 4.30 ft
DATE W.L.: 10/7/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		18.00 - 24.00 Silty sand, some clay, fine to medium-grained sand, brown to orangish-brown, no odor, saturated, compact. *(Continued)*	SM			4	MACRO CORE			2.80 / 5.00	Bentonite Chip	
					-4.84							
	-5	24.00 - 28.50 Sand, fine to coarse-grained sand, some silt, trace fine gravel, brown to orangish-brown, saturated, dense.	SP		24.00							
25												
					-9.34							
		28.50 - 35.00 Clayey sand, fine to medium-grained sand, some silt, grayish-brown to light brown, no odor, wet, compact.	SC		28.50	5	2 IN SS	3-7-9	16	1.10 / 1.50	No. 2 DSI Sand	
30	-10										0.010" Screen	**SAMPLE NOTES:** Boring vacuum extracted to 8 feet before drilling. Refusal with direct push at 25 feet, boring finished and reamed with augers for well construction.
						6	2 IN SS	1-12-11	23	1.50 / 1.50		
	-15				-15.84							
35		Boring completed at 35.00 ft										
	-20											
40												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.	Boring No.
MW-21	MW-21

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	J. Yonts
CONTRACTOR	Fishburne Drilling	**DATE INSTALLED**	6/23/2016
DRILLER	J. Raasio		

Ground El. - ft
El. Datum -

Location See plan

☑ **Guard Pipe**
☐ **Roadway Box**

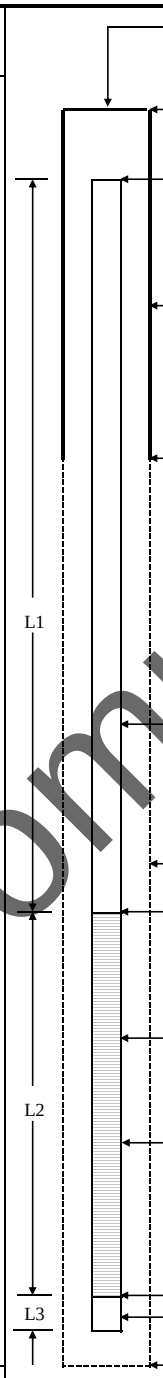
SOIL/ROCK CONDITIONS

See boring log

BOREHOLE BACKFILL

0.0
Concrete
2.0
Bentonite
11.0
Bentonite Seal
13.0
Sand

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)



(Not to Scale)

Type of protective cover/lock	
Height/Depth of top of guard pipe/roadway box above/below ground surface	3.0 ft
Height/Depth of top of riser pipe above/below ground surface	2.5 ft
Type of protective casing:	Guard Pipe
Length	5.0 ft
Inside Diameter	4.000 in
Depth of bottom of guard pipe/roadway box	2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	9.0
Bentonite Seal	11.0	2.0
Filter Sand	13.0	12.5

Type of riser pipe:	Schedule 40 PVC
Inside diameter of riser pipe	2.1 in
Type of backfill around riser	Sand, bentonite pellets, bentonite
Diameter of borehole	6.0 in
Depth to top of well screen	15.00 ft
Type of screen	PVC
Screen gauge or size of openings	0.010 in
Diameter of screen	2.0 in
Type of backfill around screen	#2 Filter Sand
Depth of bottom of well screen	25.0 ft
Bottom of Silt trap	0.5 ft
Depth of bottom of borehole	25.5 ft

15 ft	+	10 ft	+	0.5 ft	=	25.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

TEST BORING REPORT

Boring No. MW-21

Project	Dominion Power/Chesterfield, Chester, VA
Client	Dominion
Contractor	Geologic Exploration, Inc.

File No. 42735-001
Sheet No. 1 of 3
Start June 30, 2016
Finish June 30, 2016
Driller B. Thomas
H&A Rep. H. Hollauer
Elevation 10.0
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	-	Rig Make & Model: Track mounted Diedrich D-120
Inside Diameter (in.)	4.25	1 3/8	-	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: HSA
				Hoist/Hammer: Automatic Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	1 5 3 1	S1 14	0.0 2.0		SP	Loose gray-brown poorly-graded SAND (SP), mps 0.5 in., no odor, no structure, dry	--	5	--	10	80	5				
				7.0 3.0		-FILL-										
5	1 1 WOH WOH	S2 7	4.0 6.0		ML	Very soft gray-brown SILT with sand (ML), mps less than 0.43 mm, organic odor, no structure, moist, trace clay, trace roots	--	--	--	--	20	80				
10	4 4 3 3	S3 16	9.0 11.0		ML	Medium stiff gray and orange-brown SILT (ML), trace clay, mps less than 0.43 mm, no odor, mottled, moist	--	--	--	--	10	90				
15	3 3 3 2	S4 16	14.0 16.0		ML	Similar to S3, except fine sand increases slightly, orange-brown	--	--	--	--	20	80				
20	30 34 36 40	S5 22	19.0 21.0	-9.5 19.5	SW-SM	Very dense orange-brown well-graded SAND with silt and gravel (SW-SM), mps 1.0 in., no odor, no structure, wet	10	10	25	30	15	10				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
Refer to groundwater level table					

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 81.0
Rock Cored (ft) -
Samples 17S

Boring No. MW-21

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-21
File No. 42735-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	14 18 23 27	S6	24.0 26.0		SW-SM	Similar to S5, except dense	10	10	25	30	15	10				
				-18.0 28.0												
30	14 13 8 9	S7 14	29.0 31.0		SW-SM	Similar to S6, except medium dense	10	10	25	30	15	10				
				-20.5 30.5	SM	Dark gray silty CLAY on top of medium dense medium gray silty SAND (SM), trace clay, mps less than 40, no odor, depositional structure, moist to wet Note: Color change to orange-brown in spoon at approximately 30.9 ft.	--	--	--	--	70	30				
35	14 22 28 30	S8 0	34.0 36.0			No recovery										
				-27.0 37.0												
40	11 23 25 27	S9 16	39.0 41.0		SM	Dense gray to orange-brown silty SAND (SM), trace clay, mps 0.5 in., contains coarse gravel, no odor, no structure, moist to wet	5	5	--	--	60	30				
45	14 22 27 34	S10 16	44.0 46.0		SM	Similar to S9, except coarser sand, gray, wet	5	5	15	20	30	25				
50	15 36 50/5"	S11 8	49.0 50.4		SC	Very dense gray silty SAND with gravel (SC), mps 1.0 in., trace clay, no odor, no structure, wet	10	10	20	20	20	20				
55		S12 0	54.0 56.0			No recovery										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-21

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-21
File No. 42735-001
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				-47.5 57.5												
60	28 28 33 36	S13 12	59.0 61.0		ML	Hard green-gray clayey SILT (ML), mps less than 0.074 mm, no odor, no structure, wet, sample disturbed, possibly by plug at bottom	--	--	--	--	--	100				
65	11 11 12 14	S14 10	64.0 66.0		ML	Very stiff dark gray SILT (ML), mps less than 0.074 mm, no odor, no structure, moist	--	--	--	--	--	100				
70	9 9 33 40	S15 14	69.0 71.0		ML	Similar to S14, except gray-brown, hard	--	--	--	--	--	100				
75	38 42 44 50/6"	S16 18	74.0 76.0		ML	Hard dark gray sandy SILT (ML), mps less than 0.43 mm, no odor, no structure, damp to moist	--	--	--	--	70	30				
				-67.0 77.0												
80	23 33 38 41	S17 22	79.0 81.0			Hard/very dense red and light gray-green with red SAPROLITE										
				-71.0 81.0		BOTTOM OF EXPLORATION 81.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-21

RECORD OF BOREHOLE MW-21R

SHEET 1 of 2

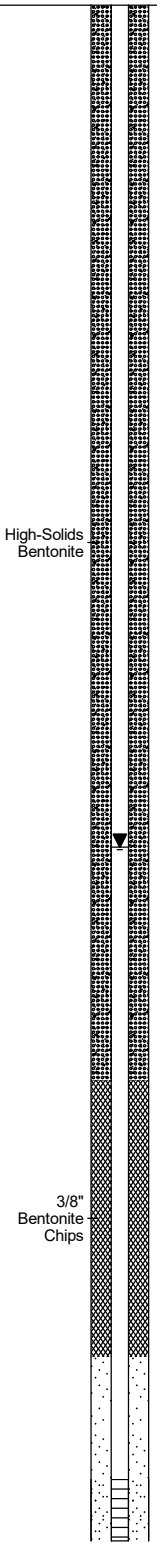
PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 40.00 ft
DRILL METHOD: Sonic

DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/18/20
DATE COMPLETED: 12/20/20

NORTHING: 3,663,010.11
EASTING: 11,809,147.01
GS ELEVATION: 19.21 ft
TOC ELEVATION: 20.88 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	ATT / REC
0		0.00 - 0.50 FILL, TOPSOIL. SM, silty SAND, fine to medium sand, grassy organics, dark brown, moist, compact.	SM	18.71 0.50	
		0.50 - 9.00 FILL, SM, gravelly silty SAND, medium sand, fine to coarse subrounded to well rounded gravel, brown, moist, compact.	SM		2.75 10.00
				10.21	
10		9.00 - 11.50 FILL, ML, sandy SILT, fine sand, light brown, micaceous, moist, compact.	ML	9.00 7.71	
		11.50 - 15.50 FILL, SW, gravelly well graded SAND, medium to coarse sand, fine to medium subrounded gravel, some silt, moist, compact.	SW	11.50 3.71	6.50 10.00
		15.50 - 19.00 SW, well graded SAND, fine to coarse sand, trace organics, gray and brown, micaceous, wet, loose.	SW	15.50 0.21	
20		19.00 - 21.00 SM, silty SAND, fine sand, brown, moist, dense.	SM	19.00 -1.79	
		21.00 - 27.00 SM, silty SAND, some fine subrounded gravel, brown and orange, wet, compact.	SM	21.00	10.00 10.00
25		Log continued on next page			

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0'-24'
Material: Sch. 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' x 4'
Protective Casing: Floodplain Box

ANNULUS SEAL
Interval: 0'-17.5'
Type: High-Solids Bentonite

FILTER PACK SEAL
Interval: 17.5'-22'
Type: 3/8" Bentonite Chips

FILTER PACK
Interval: 22'-35'
Type: No. 2 Sand

WELL SCREEN
Interval: 24'-34'
Material: Sch. 40 PVC
Diameter: 2"
Slot Size: 0.01"
End Cap: 2"

DRILLING METHODS
Type: Sonic

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

BOREHOLE RECORD 2020-12 CPS LAP WELL RELOCATE BORING LOGS.GPJ ENV_BORING.GDT 2/12/21

RECORD OF BOREHOLE MW-21R

PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 40.00 ft
DRILL METHOD: Sonic

DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/18/20
DATE COMPLETED: 12/20/20

NORTHING: 3,663,010.11
EASTING: 11,809,147.01
GS ELEVATION: 19.21 ft
TOC ELEVATION: 20.88 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	ATT / REC	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
25		21.00 - 27.00 SM, silty SAND, some fine subrounded gravel, brown and orange, wet, compact. *(Continued)*	SM		-7.79			
		27.00 - 35.00 SM/GM, silty SAND and GRAVEL, medium to coarse sand, fine to coarse subrounded gravel, brown and orange, loose, wet.	GM		27.00	10.00 10.00	No. 2 Sand 0.01" Screen	
30	-10							
	-15				-15.79	10.00	No. 2 Sand	
35		35.00 - 38.50 CL, sandy silty CLAY, fine sand, dark gray, very stiff, W~PL.	CL		35.00	10.00	Granular Bentonite	
	-20	38.50 - 39.00 SM, silty SAND, fine to medium sand, trace clay, moist, dense.	SM		-19.29 38.50 -19.79			
		39.00 - 40.00 SM, silty SAND, fine to coarse sand, some fine subrounded gravel, moist, compact.	SM		39.00 -20.79			
40		Boring completed at 40.00 ft						
	-25							
45								
	-30							
50								

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

BOREHOLE RECORD 2020-12 CPS LAP WELL RELOCATE BORING LOGS.GPJ ENV_BORING.GDT 2/12/21

RECORD OF BOREHOLE MW-22

SHEET 1 of 2

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

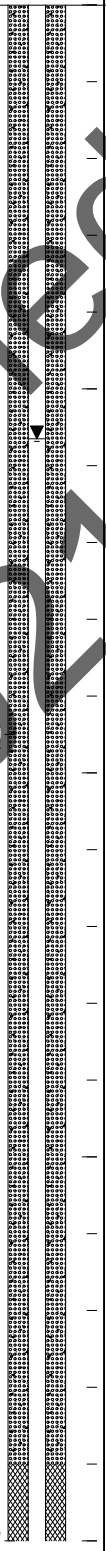
DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/7/16
DATE COMPLETED: 7/8/16

NORTHING: 3,662,650.43
EASTING: 11,809,438.06
GS ELEVATION: 10.43 ft
TOC ELEVATION: 12.33 ft

DEPTH W.L.: 5.65 ft
ELEVATION W.L.: 4.78 ft
DATE W.L.: 7/8/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT
0	10	0.00 - 8.00 No sample, soil boring vacuum extracted to 8 feet below grade per Digging, Drilling, Cutting permit.	Fill		2.43 8.00	8.00 8.00
5	5	8.00 - 10.50 Silty sand to well graded sand, dark gray to gray-brown.	SW		-0.07 10.50	2.00 2.00
10	0	10.50 - 14.00 Silty sand mottled dark gray and olive brown.	SW		-3.57 14.00	5.00 5.00
15	-5	14.00 - 19.00 Silty gravel, fines mottled gray and yellowish-brown.	GP		-8.57 19.00	3.50 5.00
20		19.00 - 32.00 Silty sand, well graded sand, mottled gray and reddish-brown. Log continued on next page	SW			

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0' to 21'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 19'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 19' to 21'
Type: Bentonite Chips

FILTER PACK
Interval: 21' to 33'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 23' to 33'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 4.25 inch HSA and MacroCore Samples
Notes:

WELL NOTES:
Floodplain well head

SAMPLE NOTES:
Fill, borehole vacuum extracted to 8 feet below grade.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: G. Morelli
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-22

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: 4.25 inch HSA and MacroCore Samples

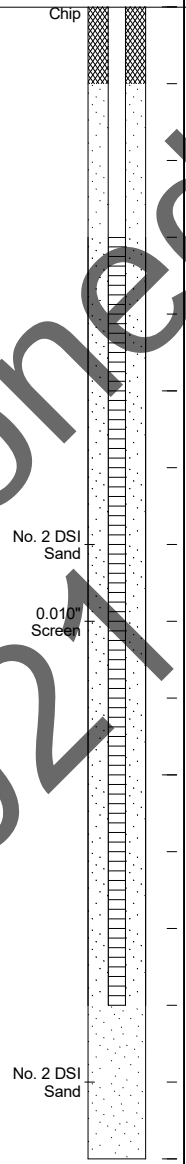
DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/7/16
DATE COMPLETED: 7/8/16

NORTHING: 3,662,650.43
EASTING: 11,809,438.06
GS ELEVATION: 10.43 ft
TOC ELEVATION: 12.33 ft

DEPTH W.L.: 5.65 ft
ELEVATION W.L.: 4.78 ft
DATE W.L.: 7/8/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT
20	-10	19.00 - 32.00 Silty sand, well graded sand, mottled gray and reddish-brown. *(Continued)*				3.00 5.00
25	-15		SW			
30	-20					3.00 5.00
		32.00 - 33.00 Sand and gravel, rounded gravel, reddish-brown fines.	GP		-21.57 32.00 -22.57	3.00 5.00
		33.00 - 35.00 Sandy silt, black.	ML		33.00	
35	-25	Boring completed at 35.00 ft			-24.57	
40						

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Floodplain well head

SAMPLE NOTES:
Fill, borehole vacuum extracted to 8 feet below grade.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & CAI
DRILLER: Cory, J. Leatherman

PREPARED: G. Morelli
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-22R

PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 50.00 ft
DRILL METHOD: Sonic

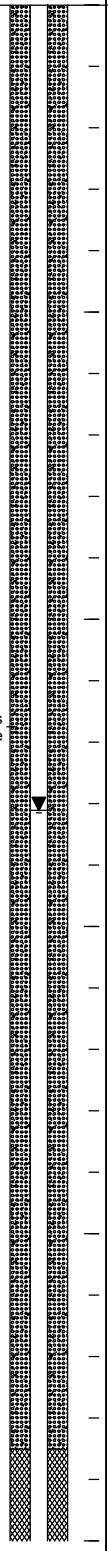
DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/18/20
DATE COMPLETED: 12/20/20

NORTHING: 3,662,646.40
EASTING: 11,809,396.22
GS ELEVATION: 18.64 ft
TOC ELEVATION: 19.99 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	ATT / REC
0	15	0.00 - 10.50 FILL, SM, gravelly silty SAND, medium sand, fine to medium subrounded to well rounded gravel, brown, moist, compact.	SM			2.00 10.00
10	5	10.50 - 14.00 FILL, SM, silty SAND, fine to medium sand, some fine to medium subrounded gravel, gray with some brown FILL mixed from above, micaceous, moist, compact.	SM		8.14 10.50 4.64	
15	0	14.00 - 18.00 SM, silty SAND, fine sand, some clay, dark gray and dark green, some mottling, micaceous, wet, compact.	SM		14.00 0.64	8.00 10.00
20	-5	18.00 - 21.00 SM, silty SAND, fine sand, some clay, olive green and black, wet, compact.	SM		18.00 -2.36	
25		21.00 - 27.00 SM, silty SAND, fine sand, some clay, darky gray, wet, compact.	SM		21.00	10.00 10.00

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0'-30'
Material: Sch. 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' x 4'
Protective Casing: Floodplain Box

ANNULUS SEAL
Interval: 0'-23.5'
Type: High-Solids Bentonite

FILTER PACK SEAL
Interval: 23.5'-27'
Type: 3/8" Bentonite Chips

FILTER PACK
Interval: 27'-40'
Type: No. 2 Sand

WELL SCREEN
Interval: 30'-40'
Material: Sch. 40 PVC
Diameter: 2"
Slot Size: 0.01"
End Cap: 2"

DRILLING METHODS
Type: Sonic

LOG SCALE: 1 in = 3.13 ft
DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

RECORD OF BOREHOLE MW-22R

PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 50.00 ft
DRILL METHOD: Sonic

DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/18/20
DATE COMPLETED: 12/20/20

NORTHING: 3,662,646.40
EASTING: 11,809,396.22
GS ELEVATION: 18.64 ft
TOC ELEVATION: 19.99 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	ATT / REC	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
25		21.00 - 27.00 SM, silty SAND, fine sand, some clay, darky gray, wet, compact. *(Continued)*	SM		-8.36		3/8" Bentonite Chips	
		27.00 - 34.00 SM, silty SAND, fine to medium sand, some clay, light gray and brown with orange mottling, wet, compact.	SM		27.00	10.00 10.00		
30	-10							
	-15				-15.36		No. 2 Sand	
		34.00 - 37.00 SM, silty SAND, fine to coarse sand, trace fine subrounded to well rounded gravel, orange and brown, wet, loose.	SM		34.00	10.00 10.00	0.01" Screen	
35					-18.36			
		37.00 - 40.00 SM/GM, silty SAND and GRAVEL, medium to coarse sand, fine to coarse subrounded to well rounded gravel (size increasing with depth), orange, wet, loose.	GM		37.00			
	-20				-21.36			
40		40.00 - 42.00 CL, sandy silty CLAY, brown, W>PL, very stiff.	CL		40.00		No. 2 Sand	
					-23.36			
		42.00 - 44.00 CL, silty CLAY, some fine sand, dark gray, micaceous, W>PL, very stiff.	CL		42.00			
	-25				-25.36			
		44.00 - 46.00 SW, well graded SAND, medium, light gray, micaceous, moist, dense.	SW		44.00	10.00 10.00	Granular Bentonite	
45					-27.36			
		46.00 - 48.00 SW, well graded SAND, medium, orange and white, micaceous, moist, dense.	SW		46.00			
					-29.36			
	-30	48.00 - 50.00 SW, well graded SAND, fine to medium, light tan, micaceous, moist, dense.	SW		48.00			
50					-31.36			
		Boring completed at 50.00 ft						

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.	Boring No.
MW-23	MW-23

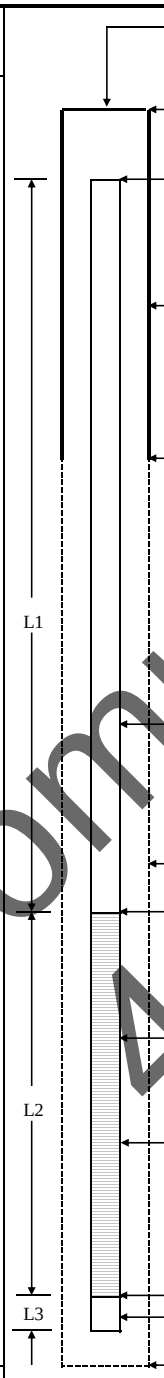
PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	H. Hollauer
CONTRACTOR	Geologic Exploration	**DATE INSTALLED**	6/29/2016
DRILLER	B. Thomas		

Ground El. - ft
El. Datum -

Location See plan

☑ **Guard Pipe**
☐ **Roadway Box**

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
See boring log	0.0 Concrete 2.0 / Bentonite / 26.0 Bentonite Seal / 28.0 Sand



Type of protective cover/lock

Height/Depth of top of guard pipe/roadway box above/below ground surface 3.0 ft

Height/Depth of top of riser pipe above/below ground surface 2.5 ft

Type of protective casing: Guard Pipe
Length 5.0 ft
Inside Diameter 4.000 in

Depth of bottom of guard pipe/roadway box 2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	24.0
Bentonite Seal	26.0	2.0
Filter Sand	28.0	12.5

Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe 2.1 in
Type of backfill around riser Sand, bentonite pellets, bentonite

Diameter of borehole 6.0 in

Depth to top of well screen 30.00 ft

Type of screen PVC
Screen gauge or size of openings 0.010 in
Diameter of screen 2.0 in
Type of backfill around screen #2 Filter Sand

Depth of bottom of well screen 40.0 ft

Bottom of Silt trap 0.5 ft

Depth of bottom of borehole 40.5 ft

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)

(Not to Scale)

30 ft	+	10 ft	+	0.5 ft	=	40.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

TEST BORING REPORT

Boring No. MW-23

Project	Dominion Power/Chesterfield, Chester, VA
Client	Dominion
Contractor	Fishburne Drilling Inc.

File No. 42735-001
Sheet No. 1 of 2
Start June 29, 2016
Finish June 29, 2016
Driller B. Thomas
H&A Rep. H. Hollauer
Elevation 6.3
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	-	Rig Make & Model: Track mounted Diedrich D-120
Inside Diameter (in.)	4.25	1 3/8	-	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: HSA
				Hoist/Hammer: Safety Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 3 4 4	S1 24	0.0 2.0		SM	Loose orange-brown and gray silty SAND (SM), mps less than 2.0 mm, no odor, no structure, damp to moist, coarser with depth	--	--	5	5	55	35				
				2.3		-FILL-										
	9 10 4 2	S2 18	4.0 6.0	4.0	SM	Medium dense gray-brown silty SAND (SM), mps less than 4.75 mm, no odor, slight depositional structure, moist to wet	--	5	5	10	50	30				
5				-1.7 8.0												
	1 1 1 1	S3 20	9.0 11.0		ML	Very soft dark gray clayey SILT (ML), mps less than 0.074 mm, depositional structure, slight organic odor, wet, trace decomposed wood	--	--	--	--	--	100				
10																
	4 1 1 2	S4 16	14.0 16.0		ML	Similar to S3	--	--	--	--	--	100				
15						-FLUVIAL DEPOSITS										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 41.0
Rock Cored (ft) -
Samples 9S

Boring No. MW-23

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-23
File No. 42735-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	3 2 3 4	S5 16	19.0 21.0		ML	Similar to S4, except one piece of gravel, soft	5	--	--	--	--	95				
				-16.7 23.0												
25	2 3 5 6	S6 20	24.0 26.0		SM	Loose dark gray silty SAND (SM), mps less than 0.43 mm, no odor, depositional structure, moist to wet, trace roots	--	--	--	--	60	40				
30	3 5 6 8	S7 18	29.0 31.0		ML	Stiff gray-brown sandy SILT (ML), mps less than 0.43 mm, no odor, slight depositional structure, moist	--	--	--	--	35	65				
35	2 6 5 6	S8 15	34.0 36.0	-29.2		-FLUVIAL DEPOSITS-										
				35.5	SM	Medium dense gray-brown silty SAND (SM), mps less than 0.43 mm, no odor, no structure, wet	--	--	--	--	85	15				
40	2 5 6 8	S9 15	39.0 41.0		SM	Similar to S8	--	--	--	--	85	15				
				-34.7 41.0		-NEED STRATA- BOTTOM OF EXPLORATION 41.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-23

RECORD OF BOREHOLE MW-23R

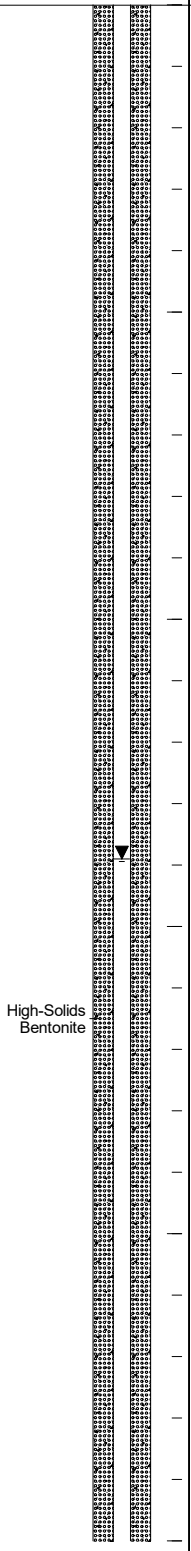
PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 50.00 ft
DRILL METHOD: Sonic

DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/23/20
DATE COMPLETED: 12/23/20

NORTHING: 3,661,604.50
EASTING: 11,809,567.69
GS ELEVATION: 15.69 ft
TOC ELEVATION: 17.14 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	ATT / REC
0	15	0.00 - 11.00 FILL, SM, silty SAND, fine to medium sand, some fine to medium subrounded to rounded gravel, some clay, light brown, moist, compact.	SM			2.00 10.00
10	5				4.69 11.00	
		11.00 - 17.00 ML, clayey SILT, some organics, dark gray, wet, soft.	ML			5.00 10.00
15	0				-1.31 17.00	
		17.00 - 21.00 ML, clayey SILT, some organics, gray and brown, micaceous, wet, soft.	ML			
20	-5				-5.31 21.00	
		21.00 - 27.00 ML, clayey SILT, some fine sand, dark gray, micaceous, wet, soft.	ML			10.00 10.00
25		Log continued on next page				

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0'-40'
Material: Sch. 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' x 4'
Protective Casing: Floodplain Box

ANNULUS SEAL
Interval: 0'-33'
Type: High-Solids Bentonite

FILTER PACK SEAL
Interval: 33'-37'
Type: 3/8" Bentonite Chips

FILTER PACK
Interval: 37'-50'
Type: No. 2 Sand

WELL SCREEN
Interval: 40'-50'
Material: Sch. 40 PVC
Diameter: 2"
Slot Size: 0.01"
End Cap: 2"

DRILLING METHODS
Type: Sonic

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

RECORD OF BOREHOLE MW-23R

PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 50.00 ft
DRILL METHOD: Sonic

DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/23/20
DATE COMPLETED: 12/23/20

NORTHING: 3,661,604.50
EASTING: 11,809,567.69
GS ELEVATION: 15.69 ft
TOC ELEVATION: 17.14 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	ATT / REC	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
25	-10	21.00 - 27.00 ML, clayey SILT, some fine sand, dark gray, micaceous, wet, soft. *(Continued)*	ML		-11.31			
		27.00 - 36.00 ML, sandy clayey SILT, fine sand, dark gray and brown, wet, compact.	ML		27.00	10.00 10.00		
30	-15							
35	-20				-20.31	8.00 10.00	3/8" Bentonite Chips	
		36.00 - 39.00 SM, silty SAND, fine sand, dark gray and brown, wet, compact.	SM		36.00			
					-23.31			
40	-25	39.00 - 50.00 SM, silty SAND, fine to coarse sand, dark gray and brown, wet, loose.	SM		39.00		No. 2 Sand	
45	-30					7.00 10.00	0.01" Screen	
50		Boring completed at 50.00 ft			-34.31			

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

BOREHOLE RECORD 2020-12 CPS LAP WELL RELOCATE BORING LOGS.GPJ ENV_BORING.GDT 2/11/21

RECORD OF BOREHOLE MW-24

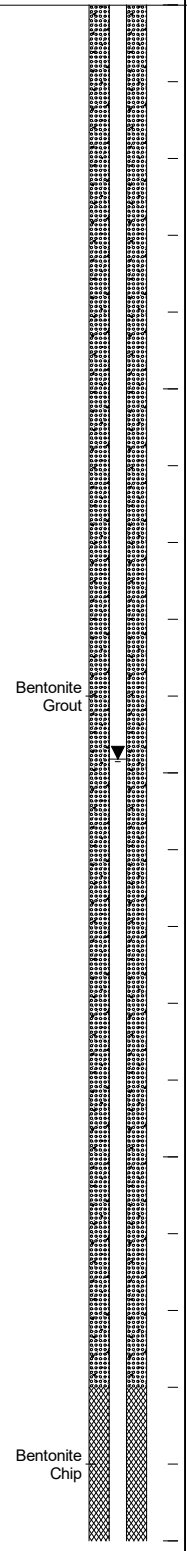
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: CME-55
DATE STARTED: 9/19/16
DATE COMPLETED: 9/19/16

NORTHING: 3,660,510.02
EASTING: 11,808,151.46
GS ELEVATION: 16.15 ft
TOC ELEVATION: 18.66 ft

DEPTH W.L.: 9.82 ft
ELEVATION W.L.: 6.33 ft
DATE W.L.: 9/19/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT
0	15	0.00 - 5.00 Sand, poorly sorted, brown.	SP		11.15	5.00 / 5.00
5	10	5.00 - 11.00 Silty sand with rounded gravel, brown.	SM		5.00 5.15	5.00 / 5.00
	5	11.00 - 12.00 Clayey sand, black.	SC		11.00 4.15	
		12.00 - 13.00 Sand and gravel. Rig chattering at 12 to 13 feet.	GP		12.00 3.15	5.00 / 5.00
10		13.00 - 17.00 Clayey sand, black.	SC		13.00 -0.85	
15	0	17.00 - 20.50 Sand with rounded gravel, trace clay, brownish-black.	SP		17.00	5.00 / 5.00
20		Log continued on next page				



WELL CASING
Interval: 0' to 20'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0' to 18'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 18' to 20'
Type: Bentonite Chips

FILTER PACK
Interval: 20' to 35'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 25' to 35'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 6 5/8 mud rotary roller bit
Notes:

SAMPLE NOTES:
Borehole drilled with mud rotary.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-24

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: CME-55
DATE STARTED: 9/19/16
DATE COMPLETED: 9/19/16

NORTHING: 3,660,510.02
EASTING: 11,808,151.46
GS ELEVATION: 16.15 ft
TOC ELEVATION: 18.66 ft

DEPTH W.L.: 9.82 ft
ELEVATION W.L.: 6.33 ft
DATE W.L.: 9/19/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20			SP		-4.35			
		20.50 - 21.50 Sand and gravel. Rig chattering at 21 feet.	GP		20.50 -5.35			
	-5	21.50 - 28.50 Clayey sand, mica flakes, trace organic material (degraded wood), brown.			21.50	5.00 5.00		
25			SC					
	-10					5.00 5.00	No. 2 DSI Sand	
					-12.35			
		28.50 - 29.50 Sand and gravel. Rig chattering at 29 feet.	GP		28.50 -13.35			
30		29.50 - 35.00 Sand with trace gravel, fine-grained sand, brown. Fast drilling 31 to 25 (loose sand).			29.50		0.010" Screen	**SAMPLE NOTES:** Borehole drilled with mud rotary.
	-15		SP			5.00 5.00		
35					-18.85			
		Boring completed at 35.00 ft						
	-20							
40								

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: M. Williams
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-25

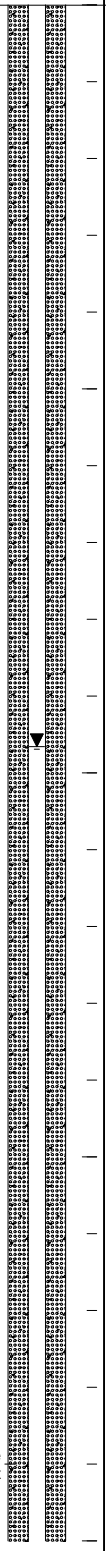
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 57.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 9/14/16
DATE COMPLETED: 9/14/16

NORTHING: 3,661,281.36
EASTING: 11,807,565.35
GS ELEVATION: 10.78 ft
TOC ELEVATION: 12.64 ft

DEPTH W.L.: 9.66 ft
ELEVATION W.L.: 1.12 ft
DATE W.L.: 10/12/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	10	0.00 - 3.75 Fill, silty sandy clay, fine-grained sand, some decayed organic plant material, slight organic (decayed material) odor, brown to light gray, W>PL, soft.	CL			1	2 IN SS	2-2-2-2	4	2.00 / 2.00
						2	2 IN SS	3-2-3-3	5	2.00 / 2.00
					7.03					
		3.75 - 5.50 Silty clay, decayed fiberous organic plant material, light brown to gray, W>PL, no odor.	CL		3.75	3	2 IN SS	2-2-2-3	4	2.00 / 2.00
5					5.28					
	5	5.50 - 10.25 Silty clay, trace fine-grained sand and sub-rounded gravel, some decayed fiberous plant material, W>PL, no odor, soft.	CL		5.50	4	2 IN SS	WOH-12-4-8	16	2.00 / 2.00
						5	2 IN SS	4-4-7-9	11	0.80 / 2.00
10					0.53					
	0	10.25 - 14.00 Silty clay, some fine-grained sand, trace sub-rounded gravel up to 1 inch in diameter, light brown, W~PL, no odor, wet at 10 feet, soft.	CL		10.25	6	2 IN SS	3-4-5-7	9	1.60 / 2.00
						7	2 IN SS	2-4-3-5	7	1.30 / 2.00
					-3.22					
		14.00 - 23.00 Silty clay, some fine-grained sand, trace sub-rounded gravel up to 1 inch in diameter, gray, W>PL, no odor, very soft.			14.00					
15	-5		CL			8	2 IN SS	1-1-1-1	2	2.00 / 2.00
						9	2 IN SS	1-1-1-1	2	0.20 / 2.00
						10	2 IN SS	WOH-1-1-1	2	0.40 / 2.00
20		Log continued on next page								



WELL CASING
Interval: 0' to 45'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 38'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 38' to 40'
Type: Bentonite Chips

FILTER PACK
Interval: 40' to 55'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 45' to 55'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 4.25-inch HSA
Notes:

WELL NOTES:
Floodplain well head

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-25

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 57.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 9/14/16
DATE COMPLETED: 9/14/16

NORTHING: 3,661,281.36
EASTING: 11,807,565.35
GS ELEVATION: 10.78 ft
TOC ELEVATION: 12.64 ft

DEPTH W.L.: 9.66 ft
ELEVATION W.L.: 1.12 ft
DATE W.L.: 10/12/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20	-10	14.00 - 23.00 Silty clay, some fine-grained sand, trace sub-rounded gravel up to 1 inch in diameter, gray, W>PL, no odor, very soft. *(Continued)*	CL			11	2 IN SS	WOH-WOH-18-2	0	2.00/2.00		
					-12.22 / 23.00	12	2 IN SS	WOH-WOH-18-3	0	2.00/2.00		
		23.00 - 26.50 Silty clay, some fine-grained sand, trace sub-rounded gravel up to 1 inch in diameter, lenses of decayed fiberous plant material, gray, W>PL, no odor, wet at 24 feet below grade, very soft.	CL			13	2 IN SS	WOH-12-2-4	14	2.00/2.00		
25	-15				-15.72 / 26.50	14	2 IN SS	2-2-2-3	4	2.00/2.00		
		26.50 - 27.50 Organic material, woody decayed fiberous material with silty clay.	OH		-16.72 / 27.50							
		27.50 - 33.00 Silty clay, some fine-grained sand, gray, W>PL, no odor, very soft.	CL			15	2 IN SS	WOH-WOH-18-3	0	2.00/2.00		**WELL NOTES:** Floodplain well head
30	-20					16	2 IN SS	WOH-WOH-18-6	0	2.00/2.00		
					-22.22 / 33.00	17	2 IN SS	12-4-5-5	9	2.00/2.00		
		33.00 - 41.00 Silty clay, trace fine sand, W>PL, gray. soft.	CL			18	2 IN SS	WOH-12-5-7	17	2.00/2.00		
35	-25					19	2 IN SS	WOH-12-3-5	15	2.00/2.00		
						20	2 IN SS	4-5-4-5	9	2.00/2.00	Bentonite Chip	
40		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-25

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 57.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 9/14/16
DATE COMPLETED: 9/14/16

NORTHING: 3,661,281.36
EASTING: 11,807,565.35
GS ELEVATION: 10.78 ft
TOC ELEVATION: 12.64 ft

DEPTH W.L.: 9.66 ft
ELEVATION W.L.: 1.12 ft
DATE W.L.: 10/12/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
40		33.00 - 41.00 Silty clay, trace fine sand, W>PL, gray. soft. *(Continued)*	CL									
	-30				-30.22	21	2 IN SS	2-4-6-6	10	2.00 / 2.00		
		41.00 - 50.00 Silty clay, trace fine-grained sand, W>PL, gray to brown, soft.			41.00							
						22	2 IN SS	4-5-5-6	10	2.00 / 2.00		
45						23	2 IN SS	WOH-12-3-4	15	2.00 / 2.00		
	-35		CL									
											No. 2 DSI Sand	
					-39.22							**WELL NOTES:** Floodplain well head
50		50.00 - 51.00 Clayey sand, fine-grained sand, gray, wet, loose.	SC		50.00						0.010" Screen	
	-40				-40.22	24	2 IN SS	3-7-7-9	14	2.00 / 2.00		
		51.00 - 55.00 Sand and gravel, fine-grained sand, gravel is sub- to well-rounded up to 1 inch in diameter, fines are brown, wet, loose.			51.00							
			GP									
					-44.22							
55		55.00 - 57.00 Silty clayey sand, fine to medium-grained sand with some sub- to well-rounded gravel up to 1 inch in diameter, fines are light gray, wet, compact.			55.00							
	-45		SC			25	2 IN SS	2-11-7-12	18	1.20 / 2.00	No. 2 DSI Sand	
					-46.22							
		Boring completed at 57.00 ft										
60												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-26

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 30.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/24/16
DATE COMPLETED: 8/24/16

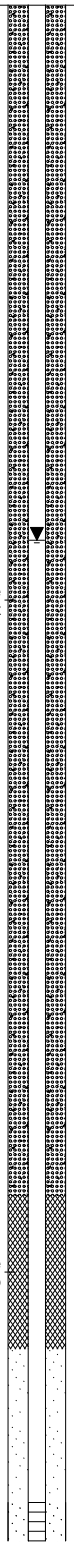
NORTHING: 3,661,811.49
EASTING: 11,807,505.17
GS ELEVATION: 7.85 ft
TOC ELEVATION: 9.71 ft

DEPTH W.L.: 6.97 ft
ELEVATION W.L.: 0.88 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.00 - 4.00 FILL. Silty sandy clay with gravel, fine sub-rounded gravel up to 1 inch in diameter, W<PL, brown, firm, no odor.	CL		3.85	1	2 IN SS	5-4-4-5	8	0.80 / 2.00
	5					2	2 IN SS	5-7-8-9	15	1.60 / 2.00
		4.00 - 7.50 Silty clay, some sub-rounded gravel up to 1 inch in diameter, gray-brown, no odor, W~PL, firm.	CL		4.00	3	2 IN SS	5-4-6-5	10	1.10 / 2.00
5					0.35	4	2 IN SS	3-4-6-11	10	1.30 / 2.00
	0	7.50 - 8.20 Sand, fine to medium-grained sand, some silt, gray, moist, compact.	SP		7.50 -0.35					
		8.20 - 11.50 Silty clay, some fine-grained sand, some rounded gravel up to 0.5-inch diameter, brown, W>PL, soft.	CL		8.20	5	2 IN SS	2-3-3-5	6	1.40 / 2.00
10						6	2 IN SS	2-2-3-3	5	1.00 / 2.00
					-3.65					
	-5	11.50 - 13.50 Silty clay, trace fine-grained sand, gray, no odor, W>PL, soft, root fragments present.	CL		11.50	7	2 IN SS	WOH-WOH-WOH-WOH	0	2.00 / 2.00
					-5.65					
		13.50 - 13.70 Sand, fine-grained.	SW		13.70					
		13.70 - 14.50 Silty clay, trace fine-grained sand, gray, no odor, W>PL, soft, root fragments present.	CL		-6.65 14.50					
15		14.50 - 19.50 Silty clay with decayed wood fibers up to 1-inch thick, dark brown, W>PL, soft.	OH			8	2 IN SS	WOH-12-2-1	14	2.00 / 2.00
	-10					9	2 IN SS	WOH-8-2--	10	2.00 / 2.00
					-11.65	10	2 IN SS	WOH-WOH-WOH-WOH	0	1.60 / 2.00
20			CL		19.50					

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0' to 19.5'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0.0' to 15.5'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 15.5' to 17.5'
Type: Bentonite Chips

FILTER PACK
Interval: 17.5' to 29.5'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 19.5' to 29.5'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 4.25-inch HSA
Notes:

WELL NOTES:
Floodplain well head

SAMPLE NOTES:
140#/30-inch drop auto hammer used.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-26

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 30.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/24/16
DATE COMPLETED: 8/24/16

NORTHING: 3,661,811.49
EASTING: 11,807,505.17
GS ELEVATION: 7.85 ft
TOC ELEVATION: 9.71 ft

DEPTH W.L.: 6.97 ft
ELEVATION W.L.: 0.88 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		19.50 - 22.00 Silty clay, trace fine-grained sand, trace root fragments, gray to brown, no odor, soft. *(Continued)*	CL		-14.15	11	2 IN SS	WOH-18-4--	22	2.00 / 2.00		
	-15	22.00 - 26.00 Silty clay, trace fine-grained sand, trace sub-angular to sub-rounded gravel up to 1-inch diameter, brownish-gray to brown, W>PL, soft.	CL		22.00	12	2 IN SS	2-3-3-4	6	- / 2.00	No. 2 DSI Sand	
25						13	2 IN SS	3-3-8-27	11	- / 2.00	0.010" Screen	
					-18.15							
	-20	26.00 - 30.00 Silty clayey sand and gravel, fine to medium-grained sand, sub-rounded gravel up to 2-inch diameter, brown, wet, loose.	SP		26.00	14	2 IN SS	4-11-14-7	25	- / 2.00		
						15	2 IN SS	4-7-9-13	16	- / 2.00	No. 2 DSI Sand	**WELL NOTES:** Floodplain well head
30		Boring completed at 30.00 ft			-22.15							**SAMPLE NOTES:** 140#/30-inch drop auto hammer used.
	-25											
35												
	-30											
40												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/8/16

RECORD OF BOREHOLE MW-27

SHEET 1 of 2

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 30.00 ft
DRILL METHOD: 4.25-inch HSA

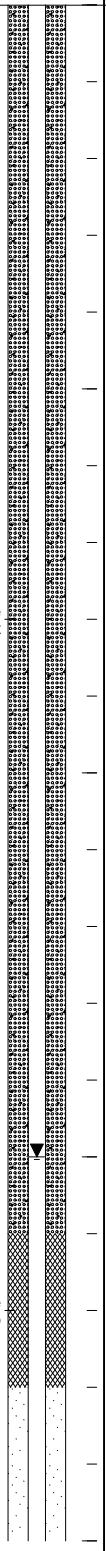
DRILL RIG: CME-850
DATE STARTED: 8/25/16
DATE COMPLETED: 8/25/16

NORTHING: 3,662,287.10
EASTING: 11,807,604.24
GS ELEVATION: 15.44 ft
TOC ELEVATION: 17.15 ft

DEPTH W.L.: 15.00 ft
ELEVATION W.L.: 0.44 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	15	0.00 - 4.00 FILL, silty clay and gravel, trace fine-grained sand, brown, no odor, W<PL, firm, quartzite gravel up to 2-inch diameter, sub- to well-rounded.	CL			1	2 IN SS	4-6-7-11	13	1.70 / 2.00
						2	2 IN SS	10-21-34-21	>50	1.10 / 2.00
					11.44 / 4.00					
5	10	4.00 - 10.00 Silty clay,some gravel, trace fine-grained sand, gray to brown, no odor, W<PL, firm, gravel up to 1-inch diameter.	CL			3	2 IN SS	18-10-8-7	18	1.80 / 2.00
						4	2 IN SS	9-22-13-17	35	1.80 / 2.00
						5	2 IN SS	14-14-10-12	24	1.70 / 2.00
10	5	10.00 - 14.50 Silty clay, trace fine-grained sand, gray, no odor, W>PL, soft.	CL		5.44 / 10.00	6	2 IN SS	3-3-2-2	5	0.50 / 2.00
						7	2 IN SS	WOH-WOH-WOH-24	0	2.00 / 2.00
					0.94 / 14.50	8	2 IN SS	WOH-WOH-4-4	0	1.50 / 2.00
15	0	14.50 - 16.50 Silty clay, trace fine-grained sand, gray, no odor, W>PL, soft to firm.	CL							
		16.50 - 18.50 Gravelly sandy clay, fine to medium-grained sand, sub-rounded gravel up to 1.5-inch diameter, brown to tan, W>PL, soft.	CL		-1.06 / 16.50	9	2 IN SS	2-5-7-8	12	0.70 / 2.00
		18.50 - 25.00 Silty sand and gravel, some clay, fine to coarse-grained sand, gravel rounded to sub-rounded up to 1.5-inch diameter, brown to dark brown, wet, compact.	SP		-3.06 / 18.50	10	2 IN SS	7-8-34-25	42	1.50 / 2.00
20		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0' to 20.'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 16.0
Type: Bentonite grout

FILTER PACK SEAL
Interval: 16.0 to 18.0'
Type: Bentonite Chips

FILTER PACK
Interval: 18.0' to 3.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 20.0' to 30.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 4.25-inch HSA
Notes:

WELL NOTES:
Floodplain well head

SAMPLE NOTES:
140#/30-inch drop auto hammer used.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-27

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 30.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-850
DATE STARTED: 8/25/16
DATE COMPLETED: 8/25/16

NORTHING: 3,662,287.10
EASTING: 11,807,604.24
GS ELEVATION: 15.44 ft
TOC ELEVATION: 17.15 ft

DEPTH W.L.: 15.00 ft
ELEVATION W.L.: 0.44 ft
DATE W.L.: 10/4/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20	-5	18.50 - 25.00 Silty sand and gravel, some clay, fine to coarse-grained sand, gravel rounded to sub-rounded up to 1.5-inch diameter, brown to dark brown, wet, compact. *(Continued)*	SP			11	2 IN SS	13-13-17-16	30	1.80 / 2.00		
						12	2 IN SS	9-1-2-16	3	1.30 / 2.00	No. 2 DSI Sand	
25	-10	25.00 - 30.00 Sand and gravel, fine to coarse-grained sand, rounded to sub-rounded gravel up to 1.0-inch diameter, light brown, wet, compact.	SP		-9.56 / 25.00	13	2 IN SS	6-17-24-31	41	1.90 / 2.00	0.010" Screen	
						14	2 IN SS	4-15-22-21	37	2.00 / 2.00		
						15	2 IN SS	5-12-19-19	31	- / 2.00		**WELL NOTES:** Floodplain well head
30	-15	Boring completed at 30.00 ft			-14.56							**SAMPLE NOTES:** 140#/30-inch drop auto hammer used.
35	-20											
40												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Parratt Wolffe, Inc.
DRILLER: P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-28

SHEET 1 of 2

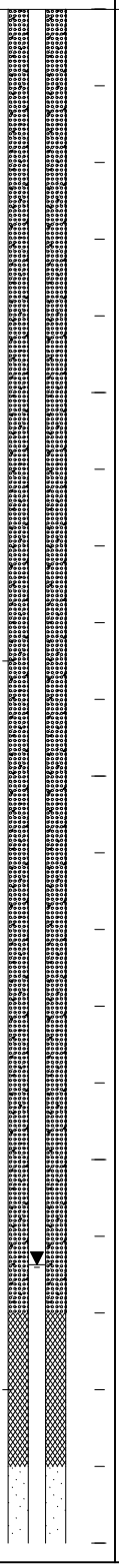
PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 8/3/16
DATE COMPLETED: 8/3/16

NORTHING: 3,663,025.11
EASTING: 11,808,370.03
GS ELEVATION: 19.67 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.00 - 8.00 Fill, silty sand, fine to medium-grained sand, some clay, brown to orangish-brown, no odor, compact, saturated at 1 foot below grade.	SM		11.67 8.00		1	CUT-TINGS	N/A		8.00 8.00
5	15	8.00 - 13.00 Clayey silt, some fine-grained sand with root fragments, brown to gray, no odor, soft, wet.	ML		6.67 13.00		2	2 IN SS	2 -2 -3 -4	5	1.80 2.00
10	10	13.00 - 18.00 Silty clay, trace fine-grained sand and root fragments, gray to brown, no odor, very soft, wet.	CL		1.67 18.00		3	2 IN SS	WOH -WOH -WOH -WOH	0	0.80 2.00
15	5	18.00 - 24.00 Silty sand, fine to medium-grained sand, some clay, brown to grayish-brown, no odor, loose, saturated.	SM				4	2 IN SS	2 -2 -3 -3	5	1.80 2.00
20	0	Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' to 24.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0' to 17.0
Type: Bentonite grout

FILTER PACK SEAL
Interval: 17.0 to 19.0'
Type: Bentonite Chips

FILTER PACK
Interval: 19.0' to 34.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 24.0' to 34.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: Nadal

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

AA BOREHOLE RECORD CPS LOGS.GPJ ENVIRONMENTAL DATA TEMPLATE.GDT 2/2/17

RECORD OF BOREHOLE MW-28

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 8/3/16
DATE COMPLETED: 8/3/16

NORTHING: 3,663,025.11
EASTING: 11,808,370.03
GS ELEVATION: 19.67 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
20		18.00 - 24.00 Silty sand, fine to medium-grained sand, some clay, brown to grayish-brown, no odor, loose, saturated. *(Continued)*	SM		-4.33								
							5	2 IN SS	3 -3 -19 -30	22	1.00 / 2.00		
	-5	24.00 - 27.00 Gravelly sand, fine to coarse-grained sand, fine gravel, trace silt, no odor, compact, saturated.	SP		24.00								
25					-7.33							No. 2 DSI Sand	
		27.00 - 33.00 Silty sand, fine to medium-grained sand, some clay, light brown to greenish-yellow, no odor, wet with some dry seams, compact.			27.00								
							6	2 IN SS	6 -7 -12 -15	19	1.80 / 2.00	0.010" Screen	
30	-10		SM										
							7	2 IN SS	18 -18 -19 -20	37	1.20 / 2.00		
					-13.33								
		33.00 - 35.00 Silty sand, fine to medium-grained sand, some clay, grayish-green.	SM		33.00								
	-15											No. 2 DSI Sand	
35		Boring completed at 35.00 ft			-15.33								
	-20												
40													

WELL CASING
Interval: 0' to 24.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 4" by 4" Aluminum

ANNULUS SEAL
Interval: 0' to 17.0
Type: Bentonite grout

FILTER PACK SEAL
Interval: 17.0 to 19.0'
Type: Bentonite Chips

FILTER PACK
Interval: 19.0' to 34.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 24.0' to 34.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: Nadal

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-29U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 40.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

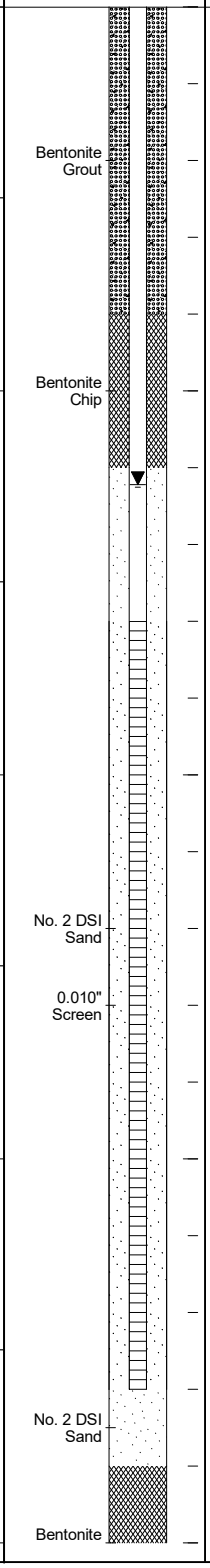
DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/7/16
DATE COMPLETED: 7/7/16

NORTHING: 3,661,275.70
EASTING: 11,807,107.29
GS ELEVATION: 5.25 ft
TOC ELEVATION: 7.13 ft

DEPTH W.L.: 6.22 ft
ELEVATION W.L.: -0.97 ft
DATE W.L.: 10/7/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT
0	5	0.00 - 2.00 FILL, sand and gravel, medium-grained sand, angular gravel (crushed stone).	Fill		3.25	
		2.00 - 7.00 Silty sand, brown to yellow.	SP		2.00	3.00 / 5.00
5	0				-1.75	
		7.00 - 8.50 Silty sand, mottled brown and gray.	SP		7.00 -3.25	3.00 / 5.00
		8.50 - 10.00 Silty sand, brown.	SP		8.50 -4.75	
10	-5	10.00 - 29.00 Clayey silt, dark brownish-gray, decaying woody material.	MH		10.00	2.00 / 5.00
15	-10					3.50 / 5.00
20		Log continued on next page				

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0' to 8.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 4.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 4.0 to 6.0'
Type: Bentonite Chips

FILTER PACK
Interval: 6.0' to 18.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 8.0' to 18.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: Direct Push, 4.25-inch HSA
Notes:

WELL NOTES:
Floodplain wellhead installed.

SAMPLE NOTES:
2-inch OD Macrocore sampler. Borehole reamed to 18 feet with 4.25-inch HSAs for well construction.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Ground Zero
DRILLER: Cory

PREPARED: G. Morelli
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-29U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 40.00 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/7/16
DATE COMPLETED: 7/7/16

NORTHING: 3,661,275.70
EASTING: 11,807,107.29
GS ELEVATION: 5.25 ft
TOC ELEVATION: 7.13 ft

DEPTH W.L.: 6.22 ft
ELEVATION W.L.: -0.97 ft
DATE W.L.: 10/7/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20	-15	10.00 - 29.00 Clayey silt, dark brownish-gray, decaying woody material. *(Continued)*	MH			2.50 5.00	Chip	
25	-20					3.00 5.00		
					-23.75			**WELL NOTES:** Floodplain wellhead installed.
		29.00 - 39.00 Clay, dark gray.	CL		29.00		No. 2 DSI Sand	**SAMPLE NOTES:** 2-inch OD Macrocore sampler. Borehole reamed to 18 feet with 4.25-inch HSAs for well construction.
30	-25					3.00 5.00		
35	-30					5.00 5.00		
					-33.75			
		39.00 - 40.00 Silty sand, dark gray.	SP		39.00			
40		Boring completed at 40.00 ft			-34.75			

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Ground Zero
DRILLER: Cory

PREPARED: G. Morelli
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-30U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 54.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/7/16
DATE COMPLETED: 8/23/16

NORTHING: 3,661,266.44
EASTING: 11,807,111.93
GS ELEVATION: 5.14 ft
TOC ELEVATION: 6.94 ft

DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	5	0.00 - 2.00 FILL, sand and gravel, medium-grained sand, angular gravel (crushed stone).	Fill		3.14					
		2.00 - 7.00 Silty sand, brown to yellow.	SP		2.00	1	MACRO CORE			3.00 / 5.00
5	0				-1.86					
		7.00 - 8.50 Silty sand, mottled brown and gray.	SP		7.00	2	MACRO CORE			3.00 / 5.00
		8.50 - 10.00 Silty sand, brown.	SP		8.50					
10	-5				-4.86					
		10.00 - 29.00 Clayey silt, dark brownish-gray, decaying woody material.	MH		10.00	3	MACRO CORE			2.00 / 5.00
15	-10					4	MACRO CORE			3.50 / 5.00
20		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Bentonite

WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0' to 44.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0' to 40.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 40.0 to 42.0'
Type: Bentonite Chips

FILTER PACK
Interval: 42.0' to 54.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 44.0' to 54.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 8.25-inch HSA & 4.25-inch HSA
Notes:

WELL NOTES:
Floodplain wellhead installed.

SAMPLE NOTES:
2-inch OD Macrocore sampler for direct push to 40 feet. Borehole advanced with 4.25-inch HSAs for well construction. Sample descriptions to 35 feet from adjacent well MW-29U.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & PW
DRILLER: Cory, P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-30U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 54.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/7/16
DATE COMPLETED: 8/23/16

NORTHING: 3,661,266.44
EASTING: 11,807,111.93
GS ELEVATION: 5.14 ft
TOC ELEVATION: 6.94 ft

DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20	-15	10.00 - 29.00 Clayey silt, dark brownish-gray, decaying woody material. *(Continued)*	MH			5	MACRO CORE			2.50 / 5.00
25	-20					6	MACRO CORE			3.00 / 5.00
					-23.86					
		29.00 - 39.00 Clay, dark gray.	CL		29.00	7	MACRO CORE			3.00 / 5.00
30	-25									
35	-30					8	MACRO CORE			5.00 / 5.00
					-33.86					
		39.00 - 40.00 Silty sand, dark gray.	SP		39.00					
40					-34.86					
		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES: Grout

WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Floodplain wellhead installed.

SAMPLE NOTES:
2-inch OD Macrocore sampler for direct push to 40 feet. Borehole advanced with 4.25-inch HSAs for well construction. Sample descriptions to 35 feet from adjacent well MW-29U.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & PW
DRILLER: Cory, P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-30U

SHEET 3 of 3

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 54.00 ft
DRILL METHOD: 8.25-inch HSA & 4.25-inch HSA

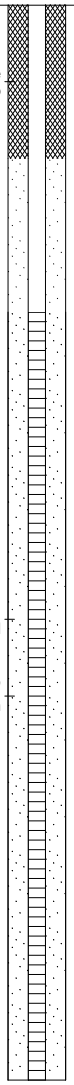
DRILL RIG: Geoprobe 7822 DT/CME-55
DATE STARTED: 7/7/16
DATE COMPLETED: 8/23/16

NORTHING: 3,661,266.44
EASTING: 11,807,111.93
GS ELEVATION: 5.14 ft
TOC ELEVATION: 6.94 ft

DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40	-35	40.00 - 42.00 Silty clay, trace fine-grained sand, micaceous, gray, no oodor, W>PL, soft	CL		40.00 -36.86	9	2 IN SS	2-3-3-3	6	1.30 / 2.00
		42.00 - 43.50 Silty clayey sand, fine-grained sand, micaceous, gray, no odor, wet, very loose.	SC		42.00 -38.36	10	2 IN SS	WOH-WOH-WOH-WOH	0	2.00 / 2.00
		43.50 - 45.50 Sandy silty clay, fine-grained sand, micaceous, gray, no odor, W>PL, soft.	CL		43.50 -40.36	11	2 IN SS	5-6-1-14	7	2.00 / 2.00
45	-40	45.50 - 45.80 Gravel lense, thinly bedded sub-rounded gravel up to 1.5-inch diameter.	GP		-40.66					
		45.80 - 47.00 Silty clay, some fine-grained sand, micaceous, gray, no odor, W<PL, firm.	CL		45.80 -41.86	12	2 IN SS	9-15-16-18	31	1.60 / 2.00
		47.00 - 48.00 Silty sand, fine-grained sand, gray, wet, no odor, compact.	SM		47.00 -42.86					
		48.00 - 54.00 Silty clay, micaceous, gray, no odor, W<PL, firm.	CL		48.00	13	2 IN SS	8-11-11-15	22	1.80 / 2.00
50	-45					14	2 IN SS	WOH-WOH-8-11	0	1.70 / 2.00
						15	2 IN SS	2-10-16-19	26	- / 2.00
					-48.86					
		Boring completed at 54.00 ft								
55	-50									
60										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Floodplain wellhead installed.

SAMPLE NOTES:
2-inch OD Macrocore sampler for direct push to 40 feet. Borehole advanced with 4.25-inch HSAs for well construction. Sample descriptions to 35 feet from adjacent well MW-29U.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: GZ & PW
DRILLER: Cory, P. Poyner

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
EASTING: 11,807,125.11
GS ELEVATION: 4.55 ft
TOC ELEVATION: 6.29 ft

DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.00 - 2.00 FILL, sand and gravel, medium-grained sand, angular gravel (crushed stone).	Fill		2.55					
		2.00 - 7.00 Silty sand, brown to yellow.			2.00	1	MACRO CORE			3.00 / 5.00
	0		SP							
5					-2.45					
		7.00 - 8.50 Silty sand, mottled brown and gray.	SP		7.00 -3.95	2	MACRO CORE			3.00 / 5.00
		8.50 - 10.00 Silty sand, brown.	SP		8.50 -5.45					
	-5									
10		10.00 - 29.00 Clayey silt, dark brownish-gray, decaying woody material.			10.00	3	MACRO CORE			2.00 / 5.00
	-10									
15			MH			4	MACRO CORE			3.50 / 5.00
	-15									
20		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0' to 120.0'
Material: PVC
Diameter: 2"
Joint Type: threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0.0' to 110.0'
Type: Bentonite grout

FILTER PACK SEAL
Interval: 110.0 to 115.0'
Type: Bentonite Chips

FILTER PACK
Interval: 115.0' to 140.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 120.0' to 140.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 6 5/8 mud rotary roller bit
Notes:

WELL NOTES:
Floodplain wellhead installed.

SAMPLE NOTES:
Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

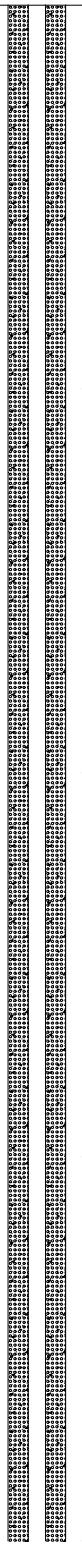
DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
EASTING: 11,807,125.11
GS ELEVATION: 4.55 ft
TOC ELEVATION: 6.29 ft

DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20		10.00 - 29.00 Clayey silt, dark brownish-gray, decaying woody material. *(Continued)*				5	MACRO CORE			2.50 5.00
	-20		MH							
25						6	MACRO CORE			3.00 5.00
					-24.45					
		29.00 - 39.00 Clay, dark gray.			29.00					
	-25									
30						7	MACRO CORE			3.00 5.00
	-30		CL							
35						8	MACRO CORE			5.00 5.00
					-34.45					
		39.00 - 40.00 Silty sand, dark gray.	SP		39.00					
	-35				-35.45					
40		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Floodplain wellhead installed.

SAMPLE NOTES:
Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
EASTING: 11,807,125.11
GS ELEVATION: 4.55 ft
TOC ELEVATION: 6.29 ft

DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
40		40.00 - 42.00 Silty clay, trace fine-grained sand, micaceous, gray, no oodor, W>PL, soft	CL		40.00 -37.45	9	2 IN SS	2-3-3-3	6	1.30/2.00		
		42.00 - 43.50 Silty clayey sand, fine-grained sand, micaceous, gray, no odor, wet, very loose.	SC		42.00 -38.95	10	2 IN SS	WOH-WOH-WOH-WOH	0	2.00/2.00		
	-40	43.50 - 45.50 Sandy silty clay, fine-grained sand, micaceous, gray, no odor, W>PL, soft.	CL		43.50 -40.95	11	2 IN SS	5-6-1-14	7	2.00/2.00		
45		45.50 - 45.80 Gravel lense, thinly bedded sub-rounded gravel up to 1.5-inch diameter.	GP		-41.25							
		45.80 - 47.00 Silty clay, some fine-grained sand, micaceous, gray, no odor, W<PL, firm.	CL		45.80 -42.45	12	2 IN SS	9-15-16-18	31	1.60/2.00		
		47.00 - 48.00 Silty sand, fine-grained sand, gray, wet, no odor, compact.	SM		47.00 -43.45							
	-45	48.00 - 54.00 Silty clay, micaceous, gray, no odor, W<PL, firm.	CL		48.00	13	2 IN SS	8-11-11-15	22	1.80/2.00		**WELL NOTES:** Floodplain wellhead installed.
50						14	2 IN SS	WOH-WOH-8-11	0	1.70/2.00		**SAMPLE NOTES:** Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.
						15	2 IN SS	2-10-16-19	26	-/2.00		
					-49.45							
	-50	54.00 - 74.00 Clay, large chips, light gray.			54.00							
55											Bentonite Grout	
			CL									
	-55											
60		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
EASTING: 11,807,125.11
GS ELEVATION: 4.55 ft
TOC ELEVATION: 6.29 ft

DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
60		54.00 - 74.00 Clay, large chips, light gray. *(Continued)*										
	-60											
65												
			CL			16	CUT'G			14.00 14.00		
	-65											**WELL NOTES:** Floodplain wellhead installed.
70												**SAMPLE NOTES:** Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.
					-69.45							
	-70	74.00 - 76.00 Clay, large chips, light gray, some dark-gray hard laminar chunks of clay.	CL		74.00 -71.45							
75		76.00 - 77.00 Clay, large chips, light gray, some small white sandy clay chips.	CL		76.00 -72.45							
						17	CUT'G			10.00		
		77.00 - 85.00 Sandy clay, fine-grained sand, large chips, light gray.	SC		77.00					10.00		
	-75											
80		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
EASTING: 11,807,125.11
GS ELEVATION: 4.55 ft
TOC ELEVATION: 6.29 ft

DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
80		77.00 - 85.00 Sandy clay, fine-grained sand, large chips, light gray. *(Continued)*	SC			17	CUT'G			10.00 10.00		
	-80				-80.45							
85		85.00 - 94.00 Sand, fine to medium-grained sand, white, with some quartz rock fragments.	SC		85.00							
	-85											**WELL NOTES:** Floodplain wellhead installed.
90						18	CUT'G			12.00 12.00		**SAMPLE NOTES:** Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.
	-90				-89.45							
		94.00 - 107.00 Sand and gravel, medium to coarse-grained sand, small quartzite pebbles, and siltstone fragments.			94.00							
95			GP			19	CUT'G			10.00 10.00		
	-95											
100		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
EASTING: 11,807,125.11
GS ELEVATION: 4.55 ft
TOC ELEVATION: 6.29 ft

DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
100		94.00 - 107.00 Sand and gravel, medium to coarse-grained sand, small quartzite pebbles, and siltstone fragments. *(Continued)*	GP			19	CUT'G			10.00 10.00		
105	-100				-102.45							
		107.00 - 114.00 Silty clay with trace of sand, light green, large clay chip cuttings.	CL		107.00	20	CUT'G			10.00 10.00	Bentonite Grout	**WELL NOTES:** Floodplain wellhead installed. **SAMPLE NOTES:** Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.
110	-105				-109.45							
		114.00 - 118.00 Silty sandy clay, light green, small clay chip cuttings.	ML		114.00							
115	-110				-113.45	21	CUT'G			10.00 10.00		
		118.00 - 125.00 Granite, sand cuttings, changed from drag bit to tri-cone bit.	Rock		118.00							
120	-115	Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
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GS ELEVATION: 4.55 ft
TOC ELEVATION: 6.29 ft

DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
120		118.00 - 125.00 Granite, sand cuttings, changed from drag bit to tri-cone bit. *(Continued)*	Rock			21	CUT'G			10.00 10.00		
	-120				-120.45							
125		125.00 - 134.00 Granite, sand cuttings, changed from tri-cone bit to button bit.			125.00						No. 2 DSI Sand	
	-125		Rock									**WELL NOTES:** Floodplain wellhead installed.
130											0.010" Screen	
						22	CUT'G			10.00 10.00		**SAMPLE NOTES:** Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.
	-129.45											
	-130	134.00 - 140.00 Granite, sand cuttings, 26 minutes from 134 to 140 feet.			134.00							
135												
			Rock			23	CUT'G			10.00 10.00		
	-135				-135.45							
140		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
EASTING: 11,807,125.11
GS ELEVATION: 4.55 ft
TOC ELEVATION: 6.29 ft

DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
140		140.00 - 145.00 Granite, sand cuttings, 45 minutes from 140 to 145 feet.	Rock		140.00						No. 2 DSI Sand Backfill	
	-140				-140.45	23	CUT'G			10.00 10.00		
145		145.00 - 150.00 Granite, sand cuttings, 36 minutes from 145 to 150 feet.	Rock		145.00						Bentonite Chip	
	-145				-145.45							**WELL NOTES:** Floodplain wellhead installed.
150		150.00 - 155.00 Granite, sand cuttings, 39 minutes from 150 to 155 feet.	Rock		150.00	24	CUT'G			10.00 10.00		**SAMPLE NOTES:** Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.
	-150				-150.45							
155		155.00 - 160.00 Granite, sand cuttings, 52 minutes from 155 to 160 feet.	Rock		155.00	25	CUT'G			10.00 10.00		
	-155				-155.45							
160		Log continued on next page										

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

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DATE STARTED: 9/19/16
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TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
160		160.00 - 168.00 Granite, sand cuttings, 34 minutes from 160 to 168 feet.	Rock		160.00	25	CUT'G			10.00 10.00		
	-160				-163.45							
165		168.00 - 175.00 Granite, sand cuttings, 85 minutes from 168 to 175 feet.	Rock		168.00	26	CUT'G			10.00 10.00		**WELL NOTES:** Floodplain wellhead installed. **SAMPLE NOTES:** Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.
	-165											
170												
	-170				-170.45						No. 2 DSI Sand Backfill	
175		175.00 - 178.00 Granite, sand cuttings, 28 minutes from 175 to 178 feet.	Rock		175.00	27	CUT'G			10.00 10.00		
	-175	178.00 - 180.00 Granite, sand cuttings, 15 minutes from 178 to 180 feet.	Rock		-173.45 178.00							
180		Log continued on next page			-175.45							

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-31U

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 200.00 ft
DRILL METHOD: 6 5/8 mud rotary roller bit

DRILL RIG: Custom
DATE STARTED: 9/19/16
DATE COMPLETED: 9/21/16

NORTHING: 3,661,235.21
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GS ELEVATION: 4.55 ft
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DEPTH W.L.: 3.24 ft
ELEVATION W.L.: 1.31 ft
DATE W.L.: 5/22/77
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
180		180.00 - 188.00 Granite, sand cuttings, 15 minutes from 178 to 180 feet.	Rock		180.00	27	CUT'G			10.00 10.00
	-180				-183.45					
185		188.00 - 190.00 Granite, sand cuttings, 13 minutes from 188 to 190 feet.	Rock		188.00					
	-185				-185.45					
190		190.00 - 195.00 Granite, sand cuttings, 40 minutes from 190 to 195 feet.	Rock		190.00	28	CUT'G			10.00 10.00
	-190				-190.45					
195		195.00 - 200.00 Granite, sand cuttings, 43 minutes from 195 to 200 feet. Run geophysical log on borehole after tripping tools.	Rock		195.00	28	CUT'G			10.00 4.00
	-195				-195.45					
200		Boring completed at 200.00 ft								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Floodplain wellhead installed.

SAMPLE NOTES:
Sample descriptions from 0 to 52 feet from adjacent wells MW-29U and MW-30U. Ran geophysical log on open borehole.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Water Well Solut. LLC
DRILLER: R. O'dell

PREPARED: R. Mongillo
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.	Boring No.
MW-32S	MW-32S

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-001
LOCATION	Chester, VA	**PROJECT MGR.**	J. Kingston
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	H. Hollauer
CONTRACTOR	Geologic Exploration	**DATE INSTALLED**	6/29/2016
DRILLER	B. Thomas		

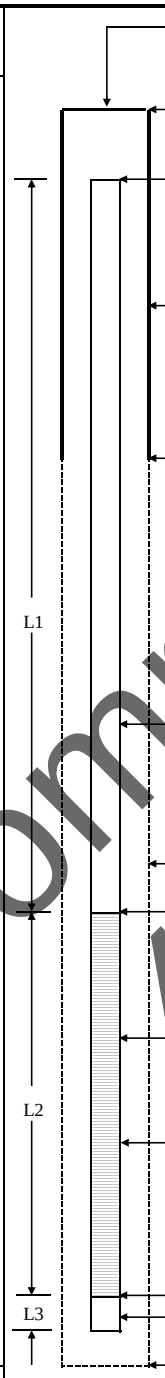
Ground El. - ft
El. Datum -

Location See plan

☑ **Guard Pipe**
☐ **Roadway Box**

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
	0.0
	Concrete
	2.0
	Bentonite
See boring log	
	16.0
	Bentonite Seal
	18.0
	Sand
	(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)



Type of protective cover/lock

Height/Depth of top of guard pipe/roadway box above/below ground surface 3.0 ft

Height/Depth of top of riser pipe above/below ground surface 2.5 ft

Type of protective casing: Guard Pipe
Length 5.0 ft
Inside Diameter 4.000 in

Depth of bottom of guard pipe/roadway box 2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	14.0
Bentonite Seal	16.0	2.0
Filter Sand	18.0	12.5

Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe 2.1 in
Type of backfill around riser Sand, bentonite pellets, bentonite

Diameter of borehole 6.0 in

Depth to top of well screen 20.0 ft

Type of screen PVC
Screen gauge or size of openings 0.010 in
Diameter of screen 2.0 in
Type of backfill around screen #2 Filter Sand

Depth of bottom of well screen 30.0 ft

Bottom of Silt trap 0.5 ft

Depth of bottom of borehole 30.5 ft

(Not to Scale)

20 ft	+	10 ft	+	0.5 ft	=	30.5 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

HALEY ALDRICH

TEST BORING REPORT DRAFT

Boring No. MW-32S

Project Dominion Power/Chesterfield, Chester, VA
Client Dominion
Contractor Geological Exploration, Inc.

File No. 42735-001
Sheet No. 1 of 2
Start June 29, 2016
Finish June 29, 2016
Driller B. Thomas
H&A Rep. H. Hollauer
Elevation 10.8
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: Track
Inside Diameter (in.)	4.25	1 3/8	--	Bit Type:
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: HSA 4.25
				Hoist/Hammer: Automatic Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 2 5 6	S1 24	0.0 2.0	ML	10.6 0.2	0.0 - 0.2 ft: Topsoil and Root Mat 0.2 - 0.5 ft: Loose orange brown silty fine yellow sandy SILT (ML), mps < 0.42 mm, no structure, no odor, slightly mottled, becomes denser with depth, slightly moist				5	35	60				
						-FILL-										
	5 5 4 4	S2 24	4.0 6.0	SM SM	6.8 4.0	Loose orange brown silty fine SAND (SM), mps < 0.42 mm, slight structure, no odor, slightly moist, trace roots Gray loose silty fine SAND (SM), mps < 2.0 mm, no structure, organic odor (swampy), moist, trace organics (roots)				5 10	70 55	30 30				
5				ML	4.8 6.0	Loose orange brown sandy SILT (ML), mps < 0.42 mm, no structure, no odor, moist, trace roots (same as 0.2 - 5.0 ft)				5	35	60				
	2 1 2 1	S3 18	9.0 11.0													
10				SM	0.8 10.0	Loose dark gray silty SAND (SM), mps < 2.0 mm, no structure, no odor, wet										
	1 1 WOH 1	S4 20	14.0 16.0													
15				ML	-4.2 15.0	Grades to very soft dark gray SILT (ML), mps <0.42 mm, no structure, organic odor, trace organics (decomposed wood), wet						100				
					-8.2											
	2 1	S5 20	19.0 21.0	ML	19.0	Grading to soft orange brown and gray brown sandy SILT (ML), mps < 0.42 mm, no structure, no odor, wet, trace roots					30	70				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 31.0
Rock Cored (ft) -
Samples 7S

Boring No. MW-32S

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB10.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT Z:\42735\GINT\42735-001_TB.GPJ Nov 9, 16

HALEY ALDRICH

TEST BORING REPORT DRAFT

Boring No. MW-32S
File No. 42735-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	2 2					Grading to…										
					-12.2 23.0											
	1 2 3 4	S6 20	24.0 26.0	SM		Loose gray brown silty SAND (SM), mps < 2.0 mm, no structure, organic odor, wet, few layers of fine SAND				5	60	35				
25																
	1 1 2 3	S7 20	29.0 31.0													
30					-20.2 31.0	BOTTOM OF EXPLORATION 31 FT Note: No refusal.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-32S

RECORD OF BOREHOLE MW-32SR

PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 50.00 ft
DRILL METHOD: Sonic

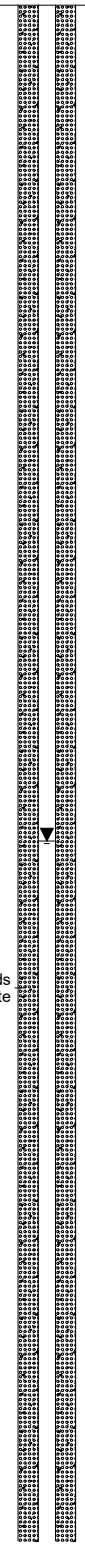
DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/19/20
DATE COMPLETED: 12/21/20

NORTHING: 3,662,086.73
EASTING: 11,809,482.33
GS ELEVATION: 16.30 ft
TOC ELEVATION: 17.88 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	ATT / REC
0	15	0.00 - 11.00 FILL, SM, silty SAND, fine to medium sand, some fine subrounded gravel, some organics, some clay, brown, moist, compact.	SM		5.30	2.50 10.00
10	5	11.00 - 14.00 SM, silty SAND, medium sand, trace fine subrounded gravel, some organics, some clay, brown and orange, moist, compact.	SM		11.00 2.30	
15	0	14.00 - 17.50 SM, silty SAND, fine sand, some clay, dark gray, micaceous, wet, compact.	SM		14.00 -1.20	4.50 10.00
20	-5	17.50 - 21.00 SM, silty SAND, fine to medium sand, some fine subrounded to rounded gravel, some clay, olive green and brown, wet, dense.	SM		17.50 -4.70	
25		21.00 - 26.00 ML, SILT, some fine sand, some decomposing wood, dark gray, wet, soft.	ML		21.00	10.00 10.00

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0'-40'
Material: Sch. 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' x 4'
Protective Casing: Floodplain Box

ANNULUS SEAL
Interval: 0'-32'
Type: High-Solids Bentonite

FILTER PACK SEAL
Interval: 32'-37'
Type: 3/8" Bentonite Chips

FILTER PACK
Interval: 37'-50'
Type: No. 2 Sand

WELL SCREEN
Interval: 40'-50'
Material: Sch. 40 PVC
Diameter: 2"
Slot Size: 0.01"
End Cap: 2"

DRILLING METHODS
Type: Sonic

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

RECORD OF BOREHOLE MW-32SR

PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 50.00 ft
DRILL METHOD: Sonic

DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/19/20
DATE COMPLETED: 12/21/20

NORTHING: 3,662,086.73
EASTING: 11,809,482.33
GS ELEVATION: 16.30 ft
TOC ELEVATION: 17.88 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	ATT / REC	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
25		21.00 - 26.00 ML, SILT, some fine sand, some decomposing wood, dark gray, wet, soft. *(Continued)*	ML		-9.70			
	-10	26.00 - 30.00 ML, sandy SILT, fine to medium sand, some decomposing wood, brown and gray, wet, soft.	ML		26.00 -13.70	10.00 10.00		
30		30.00 - 35.00 ML, sandy SILTY, fine to medium sand, brown and gray, wet, soft.	ML		30.00 -18.70	7.00	3/8" Bentonite Chips	
35	-15	35.00 - 40.00 SM, silty SAND, fine to medium sand, trace organics, brown and gray, wet, compact.	SM		35.00 -23.70	10.00		
40	-20	40.00 - 45.00 SM, silty SAND, fine to medium sand, brown and gray, wet, loose.	SM		40.00 -28.70	10.00	No. 2 Sand	
45	-25	45.00 - 50.00 SM/GM, silty SAND and GRAVEL, medium to coarse sand, fine to coarse well rounded gravel, brown and gray, wet, loose.	GM		45.00 -33.70	10.00	0.01" Screen	
50	-30	Boring completed at 50.00 ft						

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

RECORD OF BOREHOLE MW-33

SHEET 1 of 2

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.20 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/8/16
DATE COMPLETED: 7/11/16

NORTHING: 3,661,029.44
EASTING: 11,809,704.77
GS ELEVATION: 11.09 ft
TOC ELEVATION: 12.73 ft

DEPTH W.L.: 8.88 ft
ELEVATION W.L.: 2.21 ft
DATE W.L.: 10/3/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT
0	10	0.00 - 8.00 FILL, soil boring vacuum extracted to 8 feet below grade per Digging, Drilling, Cutting Permit requirements.	Fill		3.09 8.00	8.00 8.00
5	5	8.00 - 13.00 Sand, fine-grained sand, brown.	SP		-1.91 13.00	2.00 2.00 5.00 5.00
10	0	13.00 - 15.00 Sand, fine-grained sand, small angular gravel, trace silt, brown.	SP		-3.91 15.00	
15	-5	15.00 - 18.00 Sand, fine-grained sand, trace silt, brown.	SP		-6.91 18.00	3.50 5.00
20		18.00 - 24.50 Sandy silt, dark grayish-brown.	ML			

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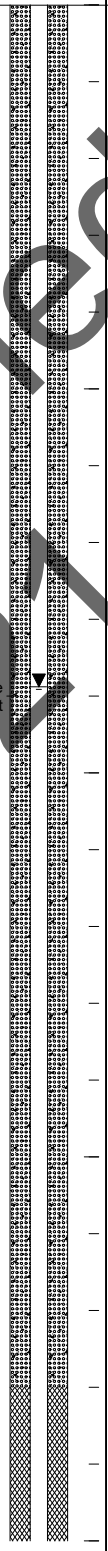
MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0.0' to 25.2'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0.0' to 18.0'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 18.0' to 23.0'
Type: Bentonite Chip

FILTER PACK
Interval: 23.0' to 35.2'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 25.2' to 35.2'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: Direct Push, 4.25-inch HSA
Notes:

WELL NOTES:
Floodplain wellhead

SAMPLE NOTES:
Vacuum extracted drill cuttings.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Ground Zero
DRILLER: Cory

PREPARED: G. Morelli
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-33

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 35.20 ft
DRILL METHOD: Direct Push, 4.25-inch HSA

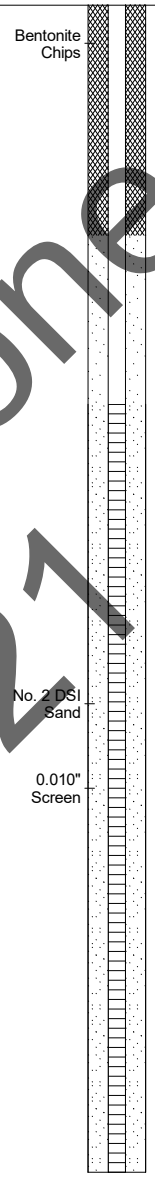
DRILL RIG: Geoprobe 7822 DT
DATE STARTED: 7/8/16
DATE COMPLETED: 7/11/16

NORTHING: 3,661,029.44
EASTING: 11,809,704.77
GS ELEVATION: 11.09 ft
TOC ELEVATION: 12.73 ft

DEPTH W.L.: 8.88 ft
ELEVATION W.L.: 2.21 ft
DATE W.L.: 10/3/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT
20		18.00 - 24.50 Sandy silt, dark grayish-brown. *(Continued)*	ML			4.00 5.00
	-10				-13.41 24.50	
		24.50 - 25.00 Sand, fine-grained sand, trace silt, dark grayish-brown.	SW		-13.91 25.00	
25		25.00 - 30.00 No recovery, loose material.				
	-15		SW			0.00 5.00
					-18.91 30.00	
30		30.00 - 35.20 Sand, well graded dark grayish-brown.				
	-20		SW			2.00 5.20
35		Boring completed at 35.20 ft			-24.11	
	-25					
40						

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL NOTES:
Floodplain wellhead

SAMPLE NOTES:
Vacuum extracted drill cuttings.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Ground Zero
DRILLER: Cory

PREPARED: G. Morelli
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

RECORD OF BOREHOLE MW-33R

PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 45.00 ft
DRILL METHOD: Sonic

DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/20/20
DATE COMPLETED: 12/22/20

NORTHING: 3,661,007.52
EASTING: 11,809,667.03
GS ELEVATION: 18.89 ft
TOC ELEVATION: 20.35 ft

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	ATT / REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
0	15	0.00 - 12.00 FILL, SM, silty SAND, some fine subrounded gravel, light brown, moist, compact.	SM		6.89	2.00 10.00		**WELL CASING** Interval: 0'-35' Material: Sch. 40 PVC Diameter: 2" Joint Type: Threaded **WELL COMPLETION** Pad: 3' x 4' Protective Casing: Floodplain Box **ANNULUS SEAL** Interval: 0'-26' Type: High-Solids Bentonite **FILTER PACK SEAL** Interval: 26'-31' Type: 3/8" Bentonite Chips **FILTER PACK** Interval: 31'-45' Type: No. 2 Sand **WELL SCREEN** Interval: 35'-45' Material: Sch. 40 PVC Diameter: 2" Slot Size: 0.01" End Cap: 2" **DRILLING METHODS** Type: Sonic
5	10							
10	5	12.00 - 15.00 SM, silty SAND, trace fine subrounded gravel, light brown, moist, compact.	SM		12.00 3.89	3.00	High-Solids Bentonite	
15	0	15.00 - 22.00 ML, sandy SILT, fine sand, dark gray, micaceous, wet, very soft.	ML		15.00 -3.11	10.00		
20	-5	22.00 - 28.00 ML, sandy SILT, fine sand, trace fine subrounded gravel, dark gray, micaceous, wet, very soft.	ML		22.00	10.00 10.00		
25		Log continued on next page						

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

BOREHOLE RECORD 2020-12 CPS LAP WELL RELOCATE BORING LOGS.GPJ ENV_BORING.GDT 2/11/21

RECORD OF BOREHOLE MW-33R

PROJECT: Chesterfield Power Station - LAP
PROJECT NUMBER: 20139767.400
DRILLED DEPTH: 45.00 ft
DRILL METHOD: Sonic

DRILL RIG: Geoprobe 8140LS
DATE STARTED: 12/20/20
DATE COMPLETED: 12/22/20

NORTHING: 3,661,007.52
EASTING: 11,809,667.03
GS ELEVATION: 18.89 ft
TOC ELEVATION: 20.35 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	ATT / REC	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
25		22.00 - 28.00 ML, sandy SILT, fine sand, trace fine subrounded gravel, dark gray, micaceous, wet, very soft. *(Continued)*	ML		-9.11	10.00 10.00		
		28.00 - 40.00 SM, silty SAND, fine to medium sand, dark gray, micaceous, homogenous, wet, compact.	SM		28.00		3/8" Bentonite Chips	
30	-10							
35	-15					10.00 10.00	No. 2 Sand	
40	-20				-21.11		0.01" Screen	
	-25	40.00 - 45.00 SM, silty SAND, medium sand, dark gray and brown, wet, compact.	SM		40.00			
45	-30	Boring completed at 45.00 ft			-26.11			
50								

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: M&W Drilling
DRILLER: Chad White

PREPARED: C. Joyner
REVIEWED: MGW
DATE: 2/11/21

GOLDER

BOREHOLE RECORD 2020-12 CPS LAP WELL RELOCATE BORING LOGS.GPJ ENV_BORING.GDT 2/11/21

RECORD OF BOREHOLE MW-34

SHEET 1 of 2

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 30.00 ft
DRILL METHOD: 4.25-inch HSA

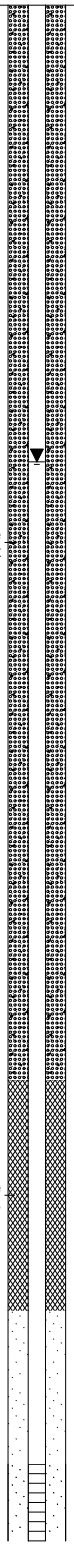
DRILL RIG: CME-55
DATE STARTED: 9/9/16
DATE COMPLETED: 9/12/16

NORTHING: 3,660,827.15
EASTING: 11,807,767.32
GS ELEVATION: 8.10 ft
TOC ELEVATION: 9.70 ft

DEPTH W.L.: 5.95 ft
ELEVATION W.L.: 2.15 ft
DATE W.L.: 10/12/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.00 - 3.50 Sand with silt, micaceous fine-grained sand with gravel, gravel is subrounded, fines are orangish-brown to tan with reddish-brown concretions, compact, dry.	SM		4.60	1	2 IN SS	2-2-2-5	4	2.00/2.00
	5					2	2 IN SS	3-4-5-5	9	2.00/2.00
		3.50 - 5.00 Sand with silt, micaceous fine-grained sand with gravel, gravel is subrounded, fines are orangish-brown to tan with reddish-brown concretions, soft, dry.	SM		3.50 3.10	3	2 IN SS	8-2-2-3	4	2.00/2.00
5		5.00 - 5.50 Sandy clay, bluish-gray with brown, moist, micaceous.	CL		5.00 2.60					
		5.50 - 10.00 Sandy clay, some gravel, dark brown, moist, medium to coarse-grained sand.	CL		5.50	4	2 IN SS	3-2-2-3	4	1.00/2.00
	0					5	2 IN SS	WOH-WOH-WOH-WOH	0	0.25/2.00
10		10.00 - 12.00 Silt, bluish-brown, micaceous, moist to wet, soft, contains leaf and root matter.	ML		-1.90 10.00 -3.90	6	2 IN SS	1-1-1-1	2	2.00/2.00
		12.00 - 14.00 Silt, bluish-brown, micaceous, wet, soft, contains leaf and root matter.	ML		12.00 -5.90	7	2 IN SS	WOH-WOH-1-1	0	2.00/2.00
	-5	14.00 - 15.50 Silt, brown, micaceous, wet, soft, contains leaf and root matter.	ML		14.00 -7.40	8	2 IN SS	WOH-WOH-1-1	0	2.00/2.00
15		15.50 - 15.75 Sand lense with some silt, dark brown.	SP		-7.65 15.75					
		15.75 - 22.00 Sand, fine to medium-grained sand, micaceous, wet, well graded, dark brown.	SW			9	2 IN SS	WOH-WOH-2-3	0	2.00/2.00
	-10					10	2 IN SS	WOH-WOH-WOH-WOH	0	0.25/2.00
20		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS / COMMENTS

WELL CASING
Interval: 0.0' to 19.0'
Material: PVC
Diameter: 2"
Joint Type: Threaded

WELL COMPLETION
Pad: 3' by 3' concrete
Protective Casing: 6" PVC

ANNULUS SEAL
Interval: 0.0' to 14.0'
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 14.0' to 17.0'
Type: Bentonite Chip

FILTER PACK
Interval: 17.0' to 29.0'
Type: No. 2 DSI Sand

WELL SCREEN
Interval: 19.0' to 29.0'
Material: PVC
Diameter: 2"
Slot Size: 0.010"
End Cap: 2"

DRILLING METHODS
Type: 4.25-inch HSA
Notes:

WELL NOTES:
Floodplain wellhead

SAMPLE NOTES:
Boring advanced to 30 feet below grade.

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. Giordano
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

RECORD OF BOREHOLE MW-34

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 30.00 ft
DRILL METHOD: 4.25-inch HSA

DRILL RIG: CME-55
DATE STARTED: 9/9/16
DATE COMPLETED: 9/12/16

NORTHING: 3,660,827.15
EASTING: 11,807,767.32
GS ELEVATION: 8.10 ft
TOC ELEVATION: 9.70 ft

DEPTH W.L.: 5.95 ft
ELEVATION W.L.: 2.15 ft
DATE W.L.: 10/12/16
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		15.75 - 22.00 Sand, fine to medium-grained sand, micaceous, wet, well graded, dark brown. *(Continued)*	SW		-13.90	11	2 IN SS	WOH-WOH- WOH-WOH	0	0.50 / 2.00		
	-15	22.00 - 30.00 Sand, fine to medium-grained sand, micaceous, wet, dark brown.	SP		22.00	12	2 IN SS	WOH-1-18-3	19	2.00 / 2.00	No. 2 DSI Sand	
25						13	2 IN SS	WOH-15-5-9	20	2.00 / 2.00	0.010" Screen	
						14	2 IN SS	4-3-5-2	8	2.00 / 2.00		
	-20					15	2 IN SS	1-1-4-3	5	2.00 / 2.00	No. 2 DSI Sand	**WELL NOTES:** Floodplain wellhead
30		Boring completed at 30.00 ft			-21.90							**SAMPLE NOTES:** Boring advanced to 30 feet below grade.
	-25											
35												
	-30											
40												

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Connelly & Assoc. Inc.
DRILLER: J. Leatherman

PREPARED: C. Giordano
REVIEWED: M. Williams
DATE: 10/15/16

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 11/9/16

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.
OW-35S
Boring No.
OW-35S

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-804
LOCATION	Chester, VA	**PROJECT MGR.**	M. Groseclose
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	H. Hollauer
CONTRACTOR	Geologic Exploration, Inc.	**DATE INSTALLED**	9/29/2016
DRILLER	M. Ireland		

Ground El.	**55.25**	ft	**Location**	See plan	☑ **Guard Pipe**
El. Datum	**-**				☐ **Roadway Box**

SOIL/ROCK CONDITIONS

See boring log

BOREHOLE BACKFILL

0.0

Grout

47.0

Bentonite Seal

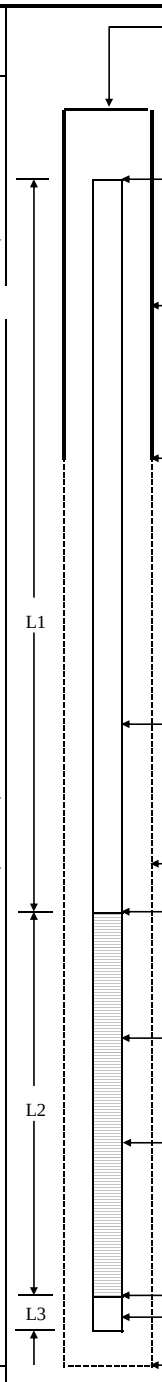
50.0

Sand

64.0

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)



(Not to Scale)

Type of protective cover/lock	Protective Cover with Padlock
Height of top of riser pipe above ground surface	3.09 ft
Type of protective casing:	Guard Pipe
Length	5.0 ft
Inside Diameter	4.0 in
Depth of bottom of guard pipe/roadway box	2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite Slurry	2.0	45.0
Bentonite Chipes	47.0	3.0

Type of riser pipe:	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in
Type of backfill around riser	Sand, Bentonite, Concrete
Diameter of borehole	6.0 in
Depth to top of well screen	54.0 ft
Type of screen	Machine Slotted Sch. 40 PVC
Screen gauge or size of openings	0.010 in
Diameter of screen	2.0 in
Type of backfill around screen	#2 Filter Sand
Depth of bottom of well screen	64.0 ft
Bottom of Silt trap	64.0 ft
Depth of bottom of borehole	64.0 ft

57.09 ft	+	10 ft	+	0 ft	=	67.09 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.
OW-35D
Boring No.
OW-35D

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	42735-804
LOCATION	Chester, VA	**PROJECT MGR.**	M. Groseclose
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	H. Hollauer
CONTRACTOR	Geologic Exploration, Inc.	**DATE INSTALLED**	9/28/2016
DRILLER	M. Ireland		

Ground El.	**55.23**	ft	**Location**	See plan	☑ **Guard Pipe**
El. Datum	**-**				☐ **Roadway Box**

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL		
		Type of protective cover/lock	Protective Cover with Padlock
		Height of top of riser pipe above ground surface	3.03 ft
	0.0	**Type of protective casing:**	Guard Pipe
		Length	5.0 ft
		Inside Diameter	4.0 in
		Depth of bottom of guard pipe/roadway box	2.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite Slurry	2.0	81.0
Bentonite Chips	83.0	3.0

Grout	L1	**Type of riser pipe:**	Schedule 40 PVC
		Inside diameter of riser pipe	2.0 in
See boring log		**Type of backfill around riser**	Sand, bentonite, concrete
	83.0		
Bentonite Seal			
	86.0	**Diameter of borehole**	6.0 in
		Depth to top of sand filter pack	86.0 ft
		Depth to top of well screen	89.0 ft
		Type of screen	Machine Slotted Sch. 40 PVC
		Screen gauge or size of openings	0.010 in
Sand	L2	**Diameter of screen**	2.0 in
		Type of backfill around screen	#2 Filter Sand
		Depth of bottom of well screen	99.0 ft
	L3	**Bottom of Silt trap**	99.0 ft
	99.0	**Depth of bottom of borehole**	99.0 ft

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)

(Not to Scale)

93.03 ft	+	10 ft	+	0 ft	=	103.03 ft
Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length

COMMENTS:

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.	Boring No.
MW-35B	MW-35B

PROJECT	Chesterfield Power Station	**H&A FILE NO.**	129732-002
LOCATION	Chester, VA	**PROJECT MGR.**	M. Groseclose
CLIENT	Dominion Resources Services, Inc.	**FIELD REP.**	C. Mitiguy
CONTRACTOR	Geologic Exploration, Inc.	**DATE INSTALLED**	1/26/2017
DRILLER	A. Gloege		

Ground El.	**55.09** ft	**Location**	See plan	☑	**Guard Pipe**
El. Datum	**NVGD29**			☐	**Roadway Box**

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL		
			Type of protective cover/lock — Protective Cover with Padlock
			Height of top of riser pipe above ground surface — 3.09 ft
	0.0		
			Type of protective casing: — Guard Pipe
			Length — 5.0 ft
			Inside Diameter — 4.0 in
	Grout		**Depth of bottom of guard pipe/roadway box** — 2.0 ft
		L1	
See boring log	138.0		
	Aqua Guard		**Type of riser pipe:** — Schedule 40 PVC
			Inside diameter of riser pipe — 2.0 in
	158.0		**Type of backfill around riser** — Sand, bentonite, Aqua Guard, grout
	Bentonite Seal		
	162.0		**Diameter of borehole** — 6.0 in
			Depth to top of sand filter pack — 162.0 ft
			Depth to top of well screen — 165.0 ft
			Type of screen — Machine Slotted Sch. 40 PVC
			Screen gauge or size of openings — 0.010 in
	Sand	L2	**Diameter of screen** — 2.0 in
			Type of backfill around screen — #3 Filter Sand
			Depth of bottom of well screen — 175.0 ft
		L3	**Bottom of Silt trap** — 175.0 ft
	175.0		**Depth of bottom of borehole** — 175.0 ft

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)

(Not to Scale)

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite Slurry	2.0	136.0
Aqua Guard	138.0	20.0
Bentonite Chips	158.0	4.0

Riser Pay Length (L1)	+	Length of screen (L2)	+	Length of silt trap (L3)	=	Pay length
168.09 ft	+	10 ft	+	0 ft	=	178.09 ft

COMMENTS:

TEST BORING REPORT

Boring No. MW-35B

Project	Dominion/Chesterfield Power Station, Chester, VA
Client	Dominion
Contractor	Cascade Drilling

File No. 129732-002
Sheet No. 1 of 7
Start 25 January 2017
Finish 26 January 2017
Driller A. Gloege
H&A Rep. C. Mitiguy
Elevation 55.1
Datum NGVD29
Location See Plan
N 3663416.56
E 11806314.55

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	Sonic	Sonic	Rig Make & Model: Geoprobe 8150LS
Inside Diameter (in.)	6.0/7.0	4.0	4.0	Bit Type: None
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)	-	-	-	Casing: Sonic
				Hoist/Hammer: - -
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		C1 60	0.0 5.0			ML	Note: Boring advanced with airknife from 0.0 ft to 8.0 ft. Orange-brown sandy SILT (ML), trace clay, mps 0.425 mm, no structure, no odor, slightly moist	-	-	-	-	30	70				
5		C2 120	5.0 15.0														
10					45.1		-FILL-										
					10.0	ML	Brown SILT (ML), with roots, mps 0.425 mm, no structure, no odor,	-	-	-	-	10	90				
					44.7	ML	moist, (native topsoil surface)	-	-	-	-	40	60				
					10.4		Orange-brown sandy SILT (ML), mps 0.425 mm, no odor, slightly moist, mottled, bonded color, (native)										
15		C3 240	15.0 35.0		40.1 15.0	SP	Orange-brown poorly-graded SAND (SP), mps 0.425 mm, no structure, no odor, dry	-	-	-	-	95	5				
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 160.0
Rock Cored (ft) 15.0
Samples 12C

Boring No. MW-35B

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

HALEY ALDRICH

Boring No. MW-35B
File No. 129732-002
Sheet No. 2 of 7

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						SP	Orange-brown poorly-graded SAND with silt and trace clay (SP), mps 0.425 mm, no odor, mottled, dry to slightly moist	-	-	-	-	90	10				
25																	
30							Note: Gravel and cobbles appear at 30.0 ft, mps 4.0 in., dry.										
					22.1												
					33.0	SW-SM	Light to brown well-graded SAND with silt and gravel (SW-SM), trace cobbles, mps 88.9 mm, no structure, slightly moist to dry, gravel rounded	5	10	20	15	20	10				
35		C4 120	35.0 45.0														
40																	
45		C5 180	45.0 55.0														
					6.1												
50					49.0	SP-SW	Light tan poorly-graded SAND with silt (SP-SM), mps 1.0 in., trace clay, slightly bonded, no structure, gravel rounded, no odor, slightly moist	5	5	5	50	25	10				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-35B

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-35B
File No. 129732-002
Sheet No. 3 of 7

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
55		C6 132	55.0 65.0				Note: Installed well screen from 54.0 to 64.0 ft at OW-35S.										
60																	
65		C7 96	65.0 75.0		-9.9 65.0	CL	Medium-gray CLAY (CL), mps 25.4mm, trace rounded gravel, no structure	5	-	-	-	-	95				
					-11.9 67.0		Note: Weathered cobbles and quartzite gravel.										
					-12.4 67.5	SP-SM	Tan to orange-brown poorly-graded SAND with silt (SP-SM), mps 38.1mm, slightly bonded, trace clay, no structure, gravel rounded, no odor, slightly moist	5	5	5	50	25	10				
70							Note: CLAY layer from approximately 71.5 ft to 72.0 ft.										
75		C8 216	75.0 95.0		-19.9 75.0	CL	Dark gray-green CLAY (CL), mps <0.425mm, relatively dense, no structure, no odor, slightly moist	-	-	-	-	10	90				
80						CL	Note: Similar to C8, except dark brown, trace mica flakes.	-	-	-	-	10	90				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-35B

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-35B
File No. 129732-002
Sheet No. 4 of 7

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						CL	Note: Similar to above, except medium gray.	-	-	-	-	10	90				
85						CL	Note: Similar to above, except dark brown.	-	-	-	-	10	90				
						CL	Note: Similar to above, except gray.	-	-	-	-	10	90				
							Note: Installed well screen from 89.0 to 99.0 at OW-35D.										
90																	
					-38.9 94.0	CL	Light gray sandy CLAY (CL), trace mica flakes, no odor, slightly moist to dry	-	5	-	-	40	55				
95					-39.9 95.0	SC	Gray clayey SAND with gravel (SC), mps 76.2mm, no structure, no odor, moist, gravel rounded	5	10	5	10	50	20				
		C9 240	95.0 115.0														
100							Note: Soil becomes denser with depth.										
105																	
110																	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-35B

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-35B
File No. 129732-002
Sheet No. 5 of 7

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
115		C10 300	115.0 135.0			SM	Gray silty SAND with gravel (SM),mps 88.9mm, no structure, rounded gravel and cobbles, no odor, slightly moist, relatively dense	10	10	5	10	45	20				
120																	
125																	
130																	
135		C11 120	135.0 155.0			SC	Similar to C10	10	10	5	10	45	20				
140																	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-35B

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-35B
File No. 129732-002
Sheet No. 6 of 7

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
145																	
					-93.9												
					149.0		Gray-green highly weathered GNEISS, rock structure, mica flakes										
150																	
							Note: Rock becomes more competent with depth.										
155		C12 240	155.0 175.0														
							-WEATHERED BEDROCK-										
					-104.9												
160					160.0		Hard, fresh to slightly weathered, gray, black and white, fine to coarse grained GNEISS, moderately fractured. Few fracture surfaces with slight iron staining. Primary joints dipping horizontal with secondary joints dipping moderately. Joints spaced close, undulating and smooth, trace garnets. RQD 50%										
165							Note: Installed well screen from 165.0 to175.0 at OW-35B.										
							-COMPETENT BEDROCK-										
170																	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-35B

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-35B
File No. 129732-002
Sheet No. 7 of 7

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
					-119.9		-COMPETENT BEDROCK-										
175					175.0		BOTTOM OF EXPLORATION 175.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-35B

RECORD OF BOREHOLE MW-B31

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 24.50 ft
DRILL METHOD: Unknown

DRILL RIG: Unknown
DATE STARTED:
DATE COMPLETED:

NORTHING: 3,660,340.77
EASTING: 11,812,582.82
GS ELEVATION: 11.82 ft
TOC ELEVATION: 12.81 ft

DEPTH W.L.: 6.85 ft
ELEVATION W.L.: 4.97 ft
DATE W.L.: 1/9/17
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
0	10	0.00 - 24.50						**WELL CASING** Interval: 0' to 24.5' Material: PVC Diameter: 2" Joint Type: Unknown **WELL COMPLETION** Pad: 3' by 3' Protective Casing: 6" PVC **ANNULUS SEAL** Interval: Unknown Type: Unknown **FILTER PACK SEAL** Interval: Unknown Type: Unknown **FILTER PACK** Interval: Unknown Type: Unknown **WELL SCREEN** Interval: 19.5' to 24.5' Material: PVC Diameter: 2" Slot Size: Unknown End Cap: 2"
5	5						▼	
10	0							**DRILLING METHODS** Type: Unknown Notes: **WELL NOTES:** Floodplain wellhead
15	-5							
20		Log continued on next page						

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Unknown
DRILLER: Unknown

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 2/9/17

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 2/13/17

RECORD OF BOREHOLE MW-B31

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 24.50 ft
DRILL METHOD: Unknown

DRILL RIG: Unknown
DATE STARTED:
DATE COMPLETED:

NORTHING: 3,660,340.77
EASTING: 11,812,582.82
GS ELEVATION: 11.82 ft
TOC ELEVATION: 12.81 ft

DEPTH W.L.: 6.85 ft
ELEVATION W.L.: 4.97 ft
DATE W.L.: 1/9/17
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		0.00 - 24.50 *(Continued)*						
	-10						Unknown	
					-12.68			
		Boring completed at 24.50 ft						
25								
	-15							
								WELL NOTES: Floodplain wellhead
30								
	-20							
35								
	-25							
40								

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Unknown
DRILLER: Unknown

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 2/9/17

Golder Associates

BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 2/13/17

RECORD OF BOREHOLE MW-B32

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 33.00 ft
DRILL METHOD: Unknown

DRILL RIG: Unknown
DATE STARTED:
DATE COMPLETED:

NORTHING: 3,659,332.19
EASTING: 11,810,654.15
GS ELEVATION: 12.63 ft
TOC ELEVATION: 13.58 ft

DEPTH W.L.: 12.15 ft
ELEVATION W.L.: 0.48 ft
DATE W.L.: 1/9/17
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
0		0.00 - 33.00						**WELL CASING** Interval: 0' to 33' Material: PVC Diameter: 2" Joint Type: Unknown **WELL COMPLETION** Pad: 3' by 3' Protective Casing: 6" PVC **ANNULUS SEAL** Interval: Unknown Type: Unknown **FILTER PACK SEAL** Interval: Unknown Type: Unknown **FILTER PACK** Interval: Unknown Type: Unknown **WELL SCREEN** Interval: 29.0' to 33.0' Material: PVC Diameter: 2" Slot Size: Unknown End Cap: 2"
5	10							
10	5							**DRILLING METHODS** Type: Unknown Notes: **WELL NOTES:** Floodplain wellhead
15	0						▼	
20	-5	Log continued on next page						

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Unknown
DRILLER: Unknown

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 2/9/17

Golder Associates

RECORD OF BOREHOLE MW-B32

PROJECT: CPS - LAP & UAP
PROJECT NUMBER: 1532-864
DRILLED DEPTH: 33.00 ft
DRILL METHOD: Unknown

DRILL RIG: Unknown
DATE STARTED:
DATE COMPLETED:

NORTHING: 3,659,332.19
EASTING: 11,810,654.15
GS ELEVATION: 12.63 ft
TOC ELEVATION: 13.58 ft

DEPTH W.L.: 12.15 ft
ELEVATION W.L.: 0.48 ft
DATE W.L.: 1/9/17
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS / COMMENTS
20		0.00 - 33.00 *(Continued)*						
	-10							
25								
	-15							
30							Unknown	**WELL NOTES:** Floodplain wellhead
	-20				-20.37			
		Boring completed at 33.00 ft						
35								
	-25							
40								

LOG SCALE: 1 in = 2.5 ft

DRILLING COMPANY: Unknown
DRILLER: Unknown

PREPARED: C. LaCosse
REVIEWED: M. Williams
DATE: 2/9/17

Golder Associates

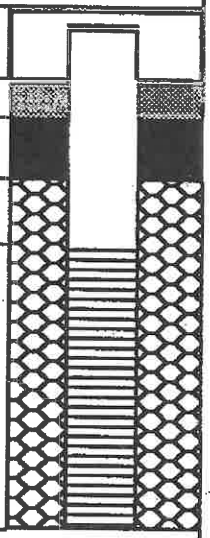
BOREHOLE RECORD CPS LOGS.GPJ ENV_BORING.GDT 2/13/17

BORING LOG

Identification:	B-40A	Location:	Chesterfield Power Station	Project No.	95058.62
Drilling Contractor	Fishburne Drilling Inc.	Name of Logger:	Julius Balzac	Date:	19 October, 2001
Type: HSA	Total Depth: ~15.0'	Screen/Casing Type:	0.010" Slot 2" PVC	Screened Interval:	15'-5'

Depth (feet)	Sample No. (Depth, ft)	Blow Counts	Recovery (inches)	Description of Material
0				
4	3-5	1-1-2-1	0"	Olive gray clayey medium SAND.
8				
	8-10	2-2-3-1	14"	Dark gray soft CLAY, moist.
12				
	13-15	2-2-2-3	16"	Dark gray to gray fine clayey SAND.
16				

Well Construction Details



NOTES:
1. PVC Well Riser set in locked metal cover in 2' x 2' x 4" concrete pad.

2. Water level is ~ 13.0'.

WELL LEGEND

- PVC Riser
- PVC Screen
- Bentonite
- Cement Grout
- No. 2 Morie Sand

RESOURCE INTERNATIONAL, LTD.

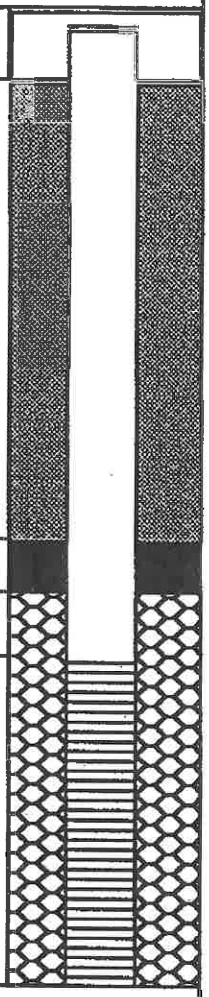
ENGINEERS • SCIENTISTS • SURVEYORS • PLANNERS
9560 KINGS CHARTER DRIVE • P.O. BOX 6160 • ASHLAND, VA 23005
(804) 550-9200 • FAX (804) 550-9259

BORING LOG

Identification:	B-50	Location:	Chesterfield Power Station	Project No.	95058.62
Drilling Contractor	Fishburne Drilling Inc.	Name of Logger:	Anthony W. Creech, P.G.	Date:	18 October, 2001
Type: HSA	Total Depth: ~30.0'	Screen/Casing Type:	0.010" Slot 2" PVC	Screened Interval:	30'-20'

Depth (feet)	Sample No. (Depth, ft)	Blow Counts	Recovery (inches)	Description of Material
0				
4	3-5	4-4-4-3	15"	Light brown soft inorganic SILT.
8				
	8-10	2-1-1-1	21"	Dark gray inorganic soft SILT.
12				
	13-15	weight of rod	6"	Dark gray SILT, soft.
16				
20	18-20	1-3-4-5	24"	Olive gray CLAY with SAND, soft.
24				
	23-25	3-2-5-23	14"	Yellowish orange fine SAND.
28				
	28-30	3-22-18-16	16"	Light brown coarse SAND and white GRAVEL, medium dense.
32				

Well Construction Details



NOTES:
1. PVC Well Riser set in locked metal cover in 2' x 2' x 4" concrete pad.

2. Water level is ~ 23.0'.

WELL LEGEND

- PVC Riser
- PVC Screen
- Bentonite
- Cement Grout
- No. 2 Morie Sand

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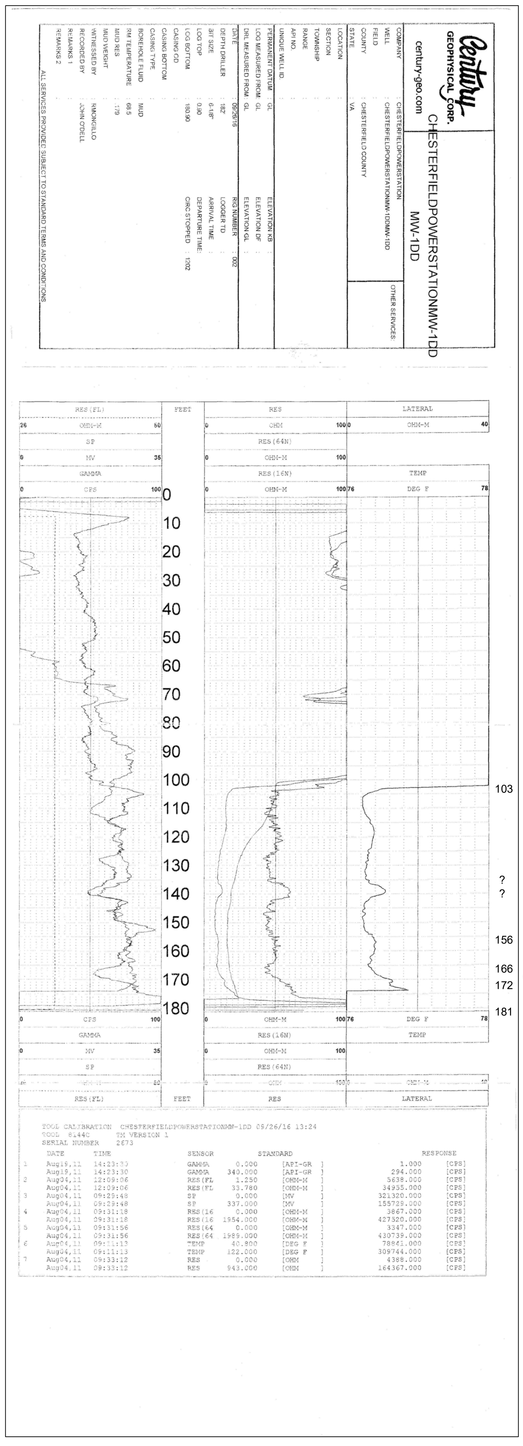
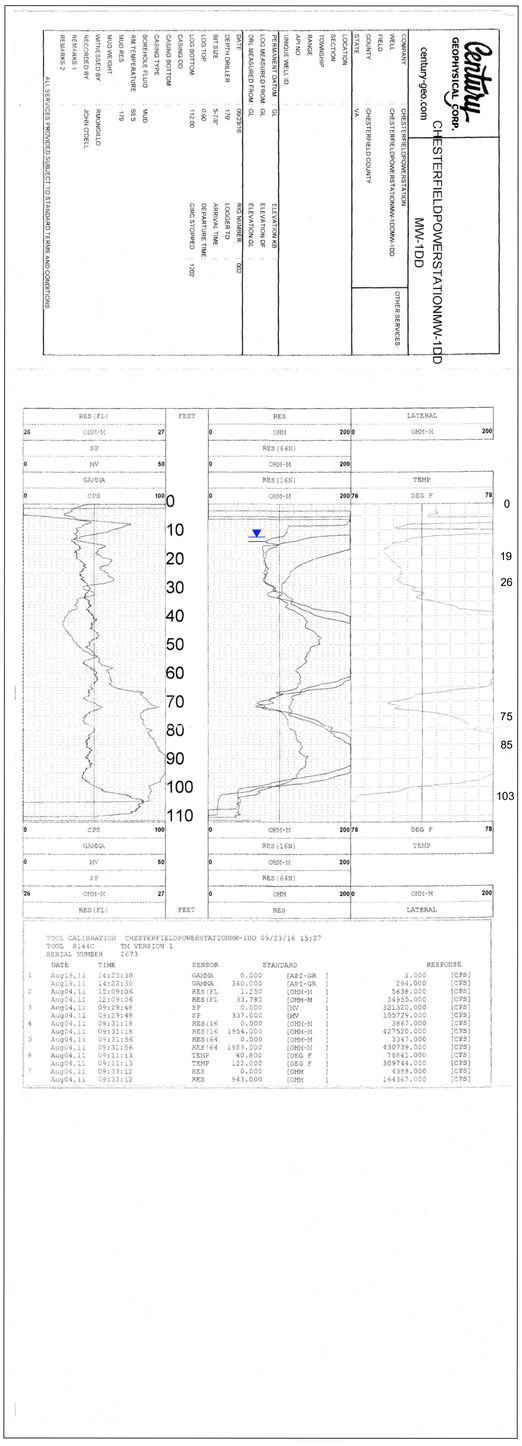




REV. 1

PROJECT
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VIRGINIA

CLIENT
DOMINION ENERGY

SEAL

TITLE
GEOPHYSICAL LOGS
MW-1DD

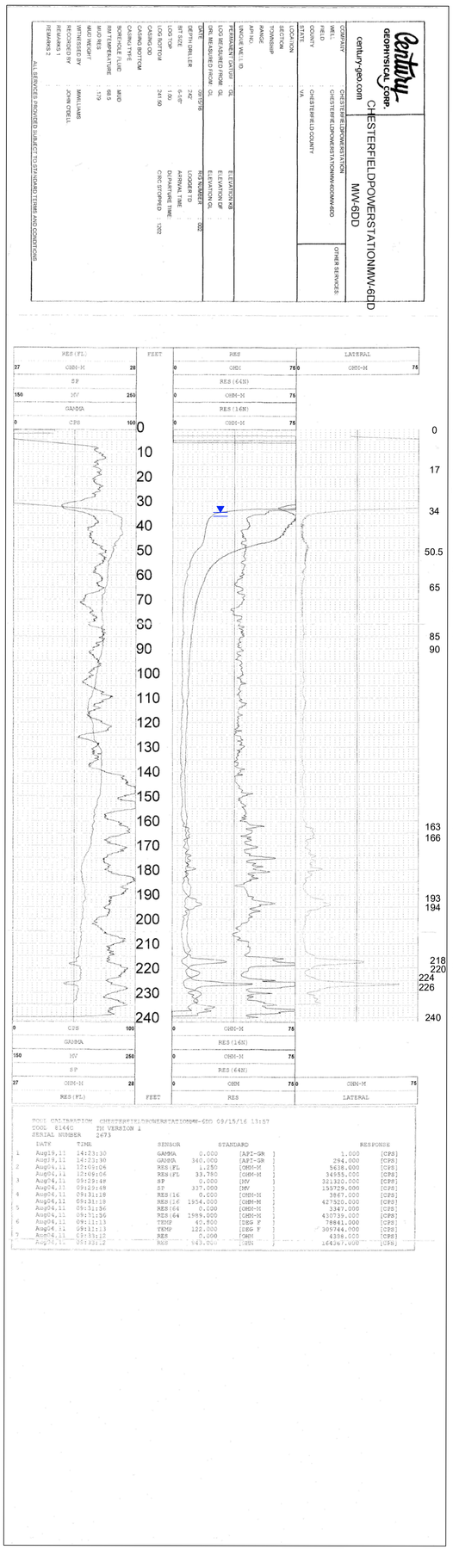
CONSULTANT
GOLDER ASSOCIATES
2108 WEST LABURNUM AVENUE
SUITE 200
RICHMOND, VA 23227
(804) 358-7900
www.golder.com

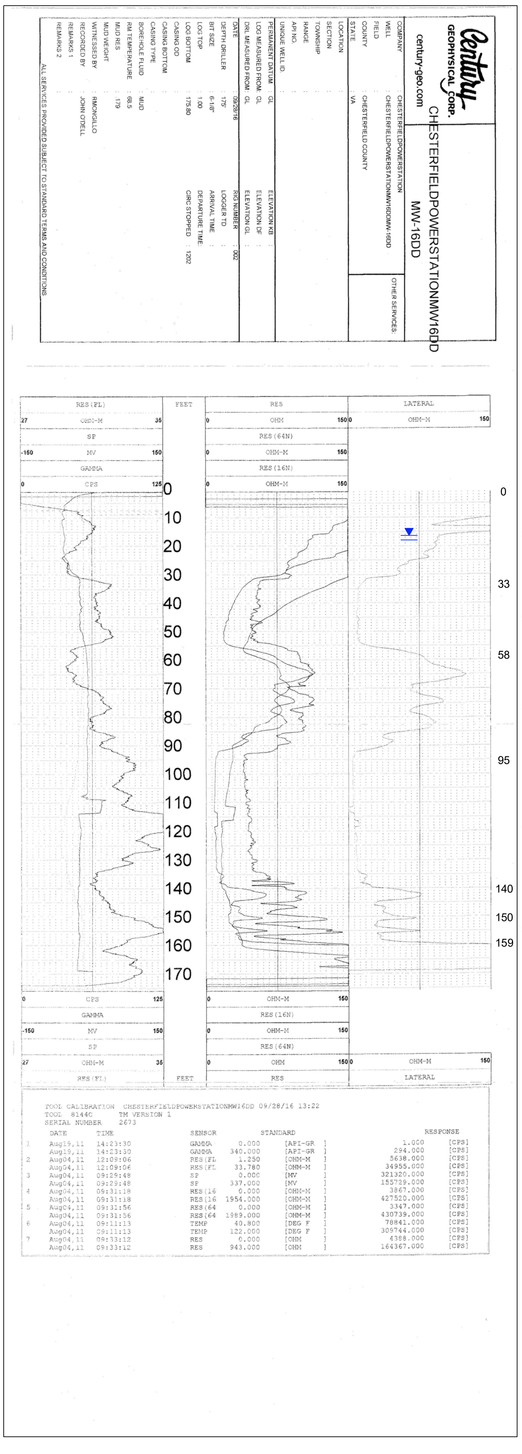
PROJECT NO.
20-139767

PLATE 1

REV.	MM/DD/YY	DESCRIPTION	DESIGN	CADD	CHECK	REVIEW
1	06/15/20	UPDATED TITLEBLOCK	MGW	BPG	MGW	MGW

0 1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ARCH D





REV.	DATE	DESCRIPTION	DESIGN	CADD	CHECK	REVIEW
1	06/15/20	UPDATED TITLEBLOCK	MGW	BPG	MGW	MGW

PROJECT
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VIRGINIA

CLIENT
DOMINION ENERGY

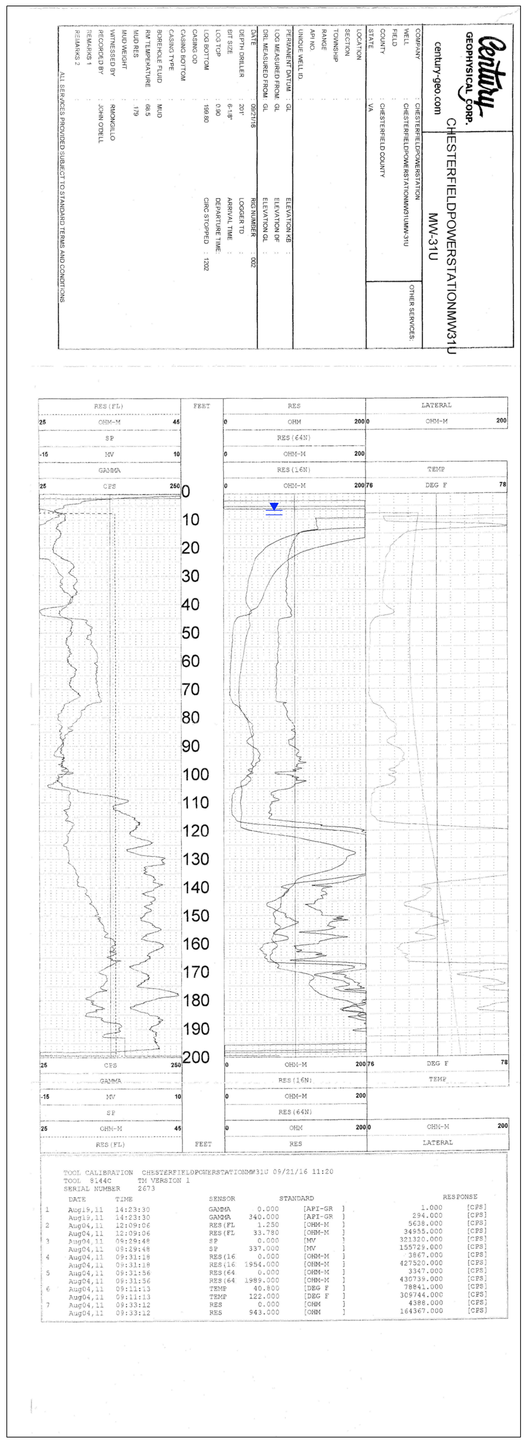
SEAL

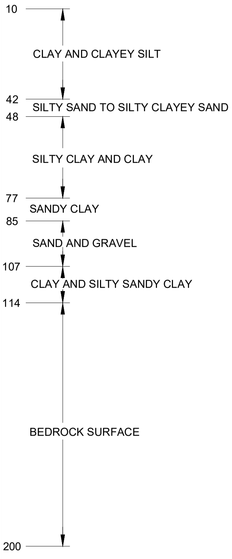
TITLE
GEOPHYSICAL LOGS
MW-6DD & MW-16DD

CONSULTANT
GOLDER ASSOCIATES
2108 WEST LABURNUM AVENUE
SUITE 200
RICHMOND, VA 23227
(804) 358-7900
www.golder.com

PROJECT NO.
20-139767

REV. 1
PLATE 2





REV. 1

PROJECT
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VIRGINIA

CLIENT
DOMINION ENERGY

SEAL

TITLE
GEOPHYSICAL LOGS
MW-31U

CONSULTANT
GOLDER

GOLDER ASSOCIATES
2108 WEST LABURNUM AVENUE
SUITE 200
RICHMOND, VA 23227
(804) 358-7900
www.golder.com

PROJECT NO.
20-139767

PLATE 3

REV.	MM/DD/YY	DESCRIPTION	DESIGN	CADD	CHECK	REVIEW
1	06/15/20	UPDATED TITLEBLOCK	MGW	BPG	MGW	MGW

TEST BORING REPORT

Boring No. MW-36 (I)

Project	Well Installs, LAP
Client	Saiia
Contractor	Parratt Wolff

File No.	0135342-001-017
Sheet No.	1 of 3
Start	August 17, 2022
Finish	August 25, 2022
Driller	A. Convery
H&A Rep.	A. Dodson
Elevation Datum	NAD 83
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	-	-	Rig Make & Model: Boart Longyear LS 205 Mini Sonic
Inside Diameter (in.)	6	4	-	Bit Type: Sonic Drill Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun
Hammer Fall (in.)	-	-	-	Hoist/Hammer: Winch/ Automatic Hammer PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		S1 33	0.0 5.0			Trace ash -TOPSOIL-										
				SP-SM	1.5	Gray poorly-graded SAND with silt (SP-SM), no structure, no odor, moist				15	70	15				
				SM	3.8	Red-brown silty SAND (SM), no structure, no odor, moist to wet, trace gravel					20	80				
5		S2 12	5.0 10.0													
10		S3 7	10.0 15.0	SM	10.0	Light-brown silty SAND with gravel (SM), no structure, no odor, wet	5			30	50	15				
15		S4 57	15.0 20.0	SM		Similar to S3										
				CL	18.3	Gray lean CLAY (CL), no structure, no odor, moist						100				
				SP-	19.3	Light-brown poorly-graded SAND with silt and gravel (SP-SM), no structure, no odor, moist	5	5	10	35	30	15				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	60.0
Rock Cored (ft)	-
Samples	S9

Boring No. MW-36 (I)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-36 (I)
File No. 0135342-001-017
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20		S5 50	20.0 25.0	SM / GW	20.0	Gray well-graded GRAVEL with sand (GW), no structure, no odor, wet	50	30	10	10						
				SM	21.3	Gray silty SAND with gravel (SM), no structure, no odor, wet	5	5	10	25	35	20				
				SM	24.0	Red-brown silty SAND (SM), no structure, no odor, moist to wet, trace gravel					20	80				
				SP-SM		Gray poorly-graded SAND with silt and gravel (SP-SM), no structure, no odor, moist	10	5	15	25	30	15				
25		S6 60	25.0 30.0	CL	25.0	Gray lean CLAY with sand (CL), no structure, no odor, mois:					10	90				
30		S7 60	30.0 35.0	CL		Similar to S6										
35		S8 60	35.0 40.0													
				SC	38.0	Gray clayey SAND (SC), no structure, no odor, moist				35	45	20				
				SC	39.0	Orange clayey SAND (SC), no structure, no odor, moist			10	40	40	10				
40		S9 54	40.0 50.0	SC-SM	40.0	Tan and red-brown silty clayey SAND with gravel (SC-SM), no structure, no odor, wet	5	10		20	35	30				
45																
				SM	49.0	Tan silty SAND with gravel (SM), no structure, no odor, wet	5	15		10	40	30				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-36 (I)

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-36 (I)
File No. 0135342-001-017
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
55																
				CL	59.0	Gray lean CLAY (CL), no structure, no odor, moist						100				
60					60.0	BOTTOM OF EXPLORATION 60.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-36 (I)

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-36 (S)

Project	Well Installs, LAP
Client	Saiia
Contractor	Parratt Wolff

File No.	0135342-001-017
Sheet No.	1 of 2
Start	August 23, 2022
Finish	August 25, 2022
Driller	A. Convery
H&A Rep.	A. Dodson
Elevation	
Datum	NAD 83
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	-	-	Rig Make & Model: Boart Longyear LS 205 Mini Sonic
Inside Diameter (in.)	6	4	-	Bit Type: Sonic Drill Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun
Hammer Fall (in.)	-	-	-	Hoist/Hammer: Winch/ Automatic Hammer PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		S1 24	0.0 5.0			Trace ash -TOPSOIL-										
				SP-SM	1.3	Gray poorly-graded SAND with silt (SP-SM), no structure, no odor, moist, trace gravel				15	70	15				
				SM	3.3	Red-brown silty SAND (SM), no structure, no odor, moist, trace gravel					20	80				
5		S2 42	5.0 15.0	SM		Gray and light-brown silty SAND with gravel (SM), no structure, no odor, moist to wet	5			30	50	15				
10																
15		S3 17	15.0 20.0	SP-SM	15.0	Gray-brown poorly-graded SAND with silt and gravel (SP-SM), no structure, no odor, wet	15	15	20	20	15	15				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	25.0
Rock Cored (ft)	-
Samples	S4
Boring No.	**MW-36 (S)**

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. MW-36 (S)
File No. 0135342-001-017
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20		S4 18	20.0 25.0	SP-SM		Red-brown poorly-graded SAND with silt (SP-SM), no structure, no odor, moist to wet, trace gravel				20	60	20				
25					25.0	BOTTOM OF EXPLORATION 25.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. MW-36 (S)

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. MW-36 (I)

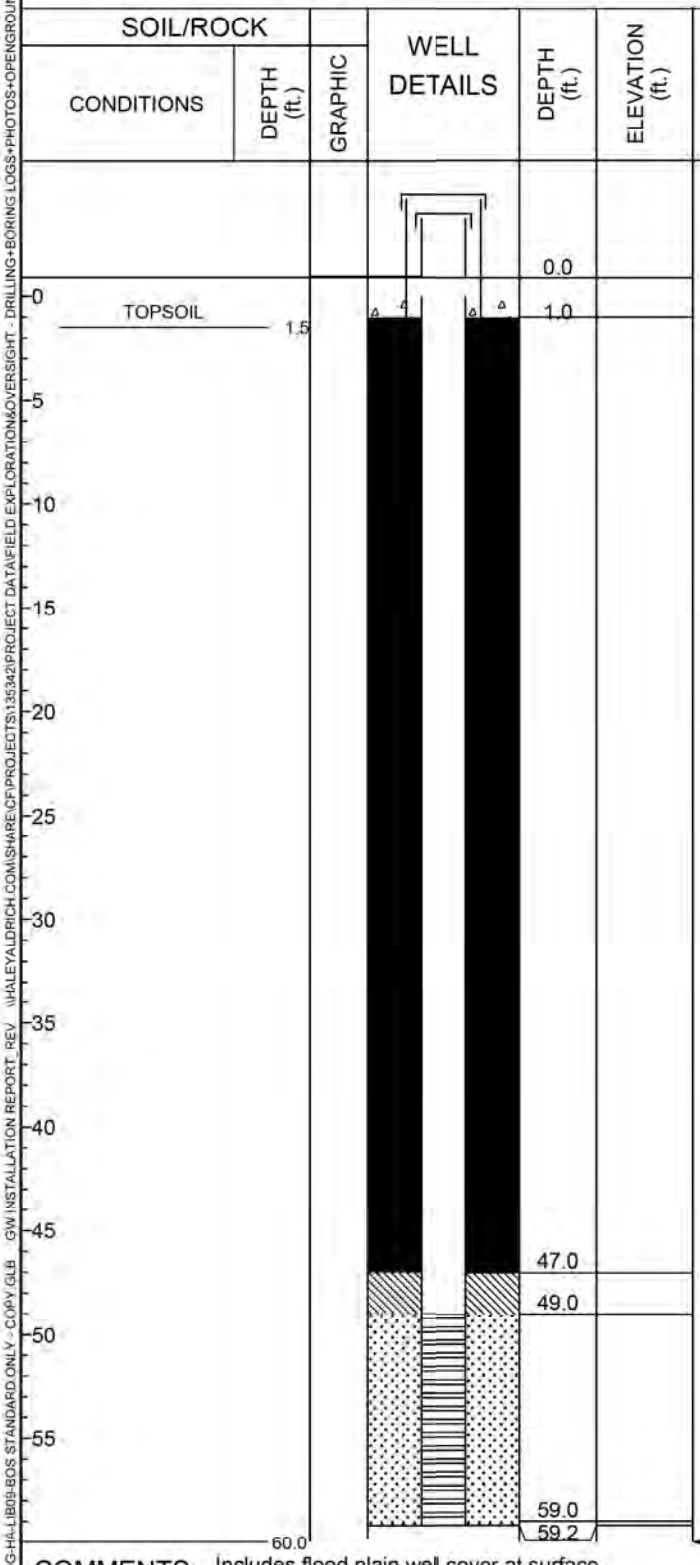
Project Well Installs
Location LAP
Client Saiia
Contractor Parratt Wolff
Driller A. Convery

Initial Water Level (depth bgs) ft

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 0135342-001-017
Date Installed 25 Aug 2022
H&A Rep. A. Dodson
Location See Plan

Ground El.
Datum NAD 83



WELL CONSTRUCTION DETAILS

Type of protective cover: Padlock

Depth of Guard Pipe below ground surface: 49.0 ft

Depth of top of riser below ground surface: 0.0 ft

Type of protective casing:

Length:

Inside diameter:

Depth of bottom of Guard Pipe:

Type of riser pipe: Schedule 40 PVC

Inside diameter of riser pipe: 2.0 in.

Depth of bottom of riser pipe: 49.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	1.0
Grout	1.0	47.0
Bentonite	47.0	2.0
	-	-

Diameter of borehole:

Depth to top of well screen: 49.0 ft

Type of screen: Machine slotted Sch 40 PVC

Screen gauge or size of openings: 20 Slot

Diameter of screen: 2.0 in.

Type of Backfill around Screen: No 2 Sand

Depth to bottom of well screen: 59 ft

Bottom of silt trap: 59.2 ft

Depth of bottom of well: 59.2 ft

Depth of bottom of borehole: 59.0 ft

COMMENTS: Includes flood plain well cover at surface.

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

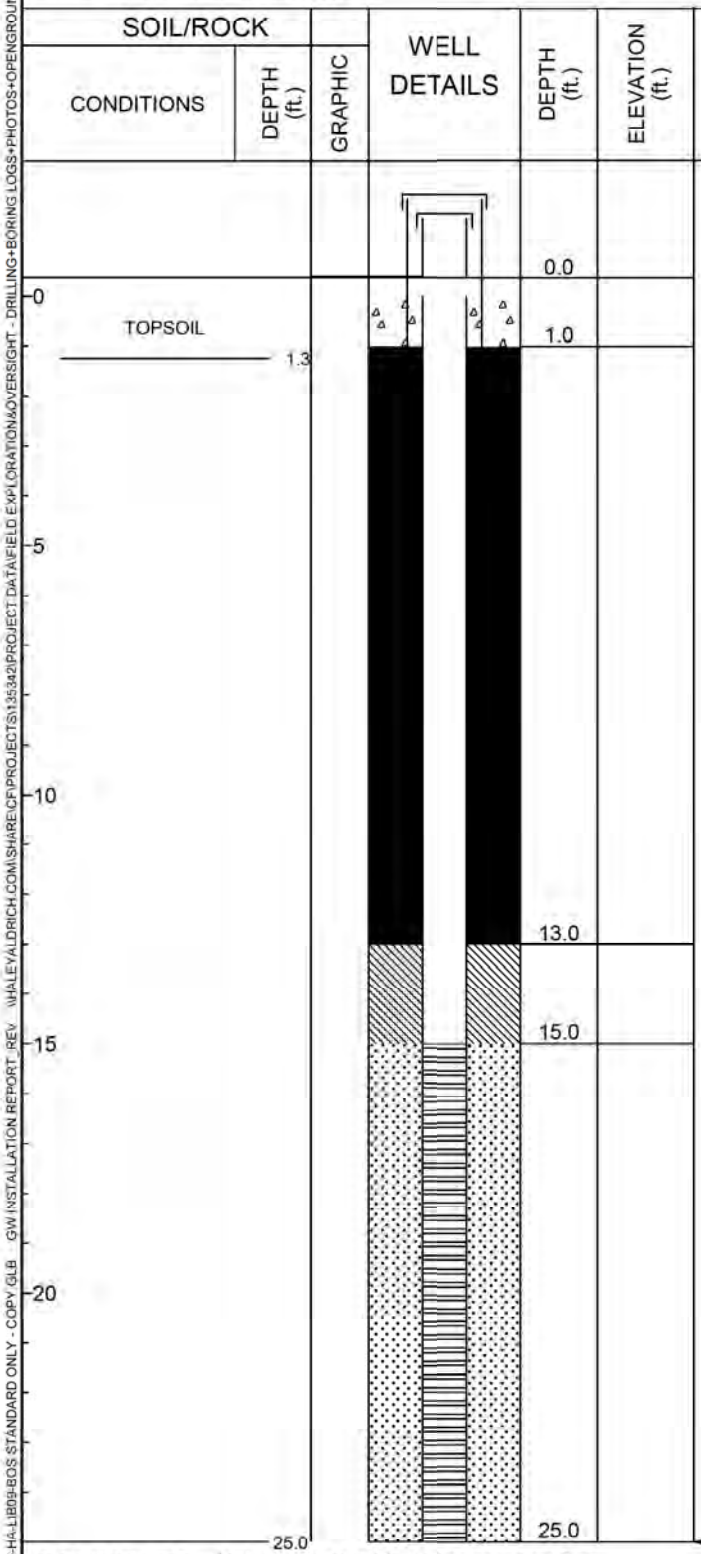
HALEY ALDRICH

Well No. MW-36 (S)

Project	Well Installs
Location	LAP
Client	Saiia
Contractor	Parratt Wolff
Driller	A. Convery
Initial Water Level (depth bgs)	ft

Well Diagram: Riser Pipe; Screen; Filter Sand; Cuttings; Grout; Concrete; Bentonite Seal

File No.	0135342-001-017
Date Installed	25 Aug 2022
H&A Rep.	A. Dodson
Location	See Plan
Ground El.	
Datum	NAD 83



WELL CONSTRUCTION DETAILS

Type of protective cover	Padlock
Depth of Guard Pipe below ground surface	25.0 ft
Depth of top of riser below ground surface	0.0 ft
Type of protective casing	
Length	
Inside diameter	
Depth of bottom of Guard Pipe	
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	15.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	1.0
Grout	1.0	13.0
Bentonite	13.0	2.0
	-	-

Diameter of borehole	
Depth to top of well screen	15.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	20 Slot
Diameter of screen	2.0 in.
Type of Backfill around Screen	No 2 Sand
Depth to bottom of well screen	25 ft
Bottom of silt trap	25.2 ft
Depth of bottom of well	25.2 ft
Depth of bottom of borehole	25.2 ft

COMMENTS: Includes flood plain well cover at surface.

APPENDIX B

GROUNDWATER MONITORING WELL CONSTRUCTION SPECIFICATIONS
WELL DEVELOPMENT GUIDANCE
WELL DECOMMISSIONING GUIDANCE
FIGURE 1 – MONITORING WELL DETAILS

GROUNDWATER MONITORING WELL CONSTRUCTION SPECIFICATIONS

1.0 DRILLING

1.1 Nominal Boring Diameter

In all cases where the diameter of the well pipe will be 2 inches, the minimum nominal borehole diameter of borings advanced through soil materials will be 6 inches in order to help ensure that the minimum width of the annulus around the well pipe will be 2 inches.

1.2 Drilling Methods

Boring should be advanced with drilling technology appropriate for the subsurface conditions at the site.

1.3 Cuttings

Drilling will be performed in a manner that minimizes the spreading of soil cuttings. Disposition of cuttings upon project completion will be the responsibility of Owner/Operator or the Owner/Operator's designated representative. Cuttings will be disposed of in accordance with the DEQ's Investigative Derived Waste Disposal Policy.

2.0 SOIL SAMPLING

2.1 Cuttings

During borehole drilling, the driller will attempt to sample the soil cuttings by providing samples of the cuttings at intervals specified by the Owner/Operator or the Owner/Operator's representative. The driller will keep cuttings clear of the borehole.

2.3 Sample Disposition

Disposition of sample material upon completion of the project will be the responsibility of the Owner/Operator or the Owner/Operator's designated representative.

3.0 WELL CONSTRUCTION

3.1 Well Pipe and Screen

Each monitoring well will be constructed of pre-cleaned Schedule 40 PVC pipe having an inner diameter of 2 inches.

The base of each well will terminate with a screen 10 feet in length unless otherwise requested by the client or regulatory agency or dictated by geologic conditions. Screens will be factory-slotted. Slots will be 0.01 inch in width.

The driller will wear clean surgical-type gloves whenever handling PVC well pipe, and the pipe will be maintained in a clean manner.

In order to provide a clean cut, a PVC pipe cutter will be used whenever it is necessary to shorten sections of the PVC well pipe; a hacksaw will not be used.

3.3 Sand Pack

Filter sand will be a clean sand of proper size in relation to the screen slots to prevent its passage into the well, with no fraction coarser than 0.25-inch nominal diameter.

Filter sand will be placed in the annulus around the well riser and to a point approximately 2 feet above the top of the screen. A tremie pipe will be used as feasible.

3.4 Bentonite Seal

The annulus around the well pipe will be sealed with a layer of bentonite pellets, to be placed directly above the sand filter pack. The minimum thickness of the bentonite layer will be approximately two feet. The bentonite pellets should ideally be allowed 24 hours for hydration prior to continuing with well construction. A tremie pipe will be used as feasible

3.5 Grout

Following hydration of the bentonite seal, each boring will be sealed with a Portland Type I bentonite/cement slurry, using the tremie pipe method or a bentonite slurry grout if required by the project.

Bentonite content in the cement slurry will be 2 to 5 percent by weight to help reduce shrinkage.

3.6 Surface Completion

The driller will be prepared for either manhole or stickup surface completions.

In the case of manhole installations, suitable surface completion will consist of capped PVC riser and steel manhole.

The PVC riser will be provided with a lockable, watertight, expansion cap. The driller will provide a lock for each cap. All locks will be keyed identically and all keys relinquished to the owner.

The manhole will be placed in a manner that permits surface water to runoff and drain away from the manhole cover.

In the case of stickup installations, suitable surface completion will consist of a concrete apron, capped PVC well riser, and outer protective casing. The apron will be constructed in such a manner that surface water will not return to it.

The concrete apron will have the following minimum dimensions: 3 feet x 3 feet x 3.5 inches, and will be centered with respects to the riser. A form will be used in constructing the apron. The form will be centered with respect to the PVC riser. The upper surface of the apron will be graded to provide drainage away from the PVC riser. A spike will be set into the pad for surveying purposes.

The inner PVC riser (well pipe) will extend to an approximate height of 1.75 feet above the top of the concrete pad. A vent hole having a diameter of 0.25 inches will be drilled through the PVC riser at a point 2 inches below its top. Shavings generated by drilling the PVC riser will be prevented from falling into the well. The PVC riser will be provided with a slip on PVC cap.

The outer protective casing will be constructed of steel pipe having a diameter, or diagonal, of not less than 8 inches. The top of the outer protective casing, when uncovered, will be placed at a point between 0.5-inch above the top of the PVC well pipe and 0.5-inch below the top of the PVC pipe. A drain hole having a diameter of 0.5-inch will be drilled through the outer protective casing near the top of the concrete apron. Shavings generated by drilling the steel casing will be prevented from falling into the well. The casing will be marked for surveying purposes.

The outer protective casing will be lockable. The driller will provide a lock for each protective casing cap. All locks will be keyed identically.

4.0 SURVEYING

A licensed surveyor will survey well elevation. Survey point(s) will include:

- concrete pad (marked with a spike);
- outer protective steel casing, when open (engraved mark);
- inner PVC well pipe (engraved mark);
- ground surface (not marked);
- well location to within $\pm$ 0.5 foot in horizontal plane;
- ground surface elevation to within $\pm$ 0.01 foot;

- surveyor's pin elevation on concrete apron within ± 0.01 foot;
- top of monitoring well casing elevation to within ± 0.01 foot; and,
- top of protective steel casing elevation to within ± 0.01 foot.

5.0 WELL DEVELOPMENT AND INSPECTION

The driller will develop each well until sediment free water with stabilized field constituents (i.e., temperature, pH and specific conductance) is obtained.

Development will be conducted using a surge block followed by pumping or bailing. The surge block may be used as a means of assessing the integrity of the well screen and riser.

In the event a pump is employed, the design of the pump will be such that any groundwater that has come into contact with air is not allowed to drain back into the well. Air surging will not be used.

All well development equipment (bailers, pumps, surge blocks) and any additional equipment that contacts subsurface formations will be decontaminated prior to on site use, between consecutive on site uses, and/or between consecutive well installations, as directed by Owner/Operator or Owner/Operator's designated representative.

6.0 ANCILLARY REQUIREMENTS

6.1 Extraneous Material

The driller will take all reasonable care to ensure that each boring is free from all materials other than those required for well construction. Materials required for well construction is here defined to include polyvinyl chloride (PVC), sand, bentonite, Portland cement and natural soil materials. All other materials accidentally or purposely placed in the hole will be removed by driller prior to well completion.

6.2 Decontamination

All drilling equipment (drill steel, bits, casing materials) and any additional equipment, that contacts subsurface formations will be decontaminated prior to on site use, between consecutive on site uses, and/or between consecutive well installations, as directed by Owner/Operator or Owner/Operator's designated representative.

Appropriate decontamination procedure will consist of steam cleaning with potable water and biodegradable detergent (e.g., Liquinox) approved by Owner/Operator

or Owner/Operator's designated representative. Steam cleaning will be conducted in a manner that minimizes over-spray and runoff.

6.3 Disposition of Waste Water

If drilling fluids are used or monitoring wells constructed in an area of suspected contamination, well development wastewater will be placed in 55-gallon drums at the well site and subsequently transported to a publicly operated treatment works (POTW) or the sites leachate collection system for disposal.

6.4 Site Safety Plan

The driller is responsible for maintaining the personal safety of his employees while on site. The driller will keep a fire extinguisher (in good working condition) and first aid kit at the site at all times during which his employees occupy the site.

The driller will be responsible for providing any personal protective equipment that might be required by state and federal occupational safety and health agencies, including, but not necessarily limited to, hard hats, hearing protection and steel-toed boots, for all personnel employed by the driller.

6.5 Cleanup

The driller will be responsible for removing all refuse from each well site. Such refuse typically includes, but is not limited to, PVC pipe wrappers, sand bags, bentonite bags, cement bags, beverage containers, food wrappers and other forms of litter. Smoking on site will not be permitted.

The driller will be responsible for providing the following information to the Owner/Operator's designated representative after well installation has been performed:

- date and time of construction;
- drilling method and fluid used (if applicable);
- boring diameter;
- well pipe (inner casing) specifications;
- well depth (+/-0.01 ft.);
- drilling/lithologic logs;
- specifications for other casing materials (if applicable);
- screen specifications;
- well pipe/screen joint type;
- filter pack specifications (material, size);
- filter pack volume and calculations;
- filter pack placement methods;

- bentonite seal specifications;
- bentonite seal volume;
- bentonite seal placement method;
- grout specifications;
- grout volume;
- grout placement method;
- surface completion specifications; and
- well development procedure

7.0 WELL CONSTRUCTION AND SOIL BORING LOGS

In accordance with 9VAC-20-81-250-A.3.g of the Virginia Solid Waste Management Regulations or other applicable regulations, certified copies of well construction and soil boring logs will be forwarded to the DEQ following completion of well construction activities.

g:\projects\dominion\chesterfield power stn\1532-864 uap and lap groundwater\uap groundwater monitoring plan\2016-04 submittal - rtc deq ltr 2016-02-26\appendices\appendix iia monitoring well construction specifications - golder vswmr amendment 7 update.docx

WELL DEVELOPMENT PROCEDURES

- Record the static water level in the well.
- If a pump is present in the well, remove the pump from the well and measure the total depth of the well.
- Calculate saturated volume of the well and filter pack.
- Using a disposable bailer, collect a water sample from the top of the water column and record field measurements of water quality parameters (Water Quality Parameters (WQP): turbidity, pH, temperature, and specific conductance).
- Surge the well with the teflon surge block or large diameter weighted bailer for three to five minutes.
- Remove the surging device and purge the well with a pneumatic well development pump at a rate that is greater than the natural recharge rate of the well.
- Containerize all purge water for disposal at the location designated by the site.
- Record measurements of WQP on development logs following the removal of each consecutive well and filter pack volume.
- Continue purging until the turbidity level stabilizes or is reduced to less than 5 NTU, then repeat surging with surge block. Surging and purging are to be continued for a minimum of 4 hours, or until turbidity levels following a surging event are less than 10 NTU.
- If the well purges dry, record the rate of recharge and continue purging and surging activities after the well has recovered. Reduce the purge rate to slightly less than the natural recharge rate of the well.
- All non-disposable equipment that will be placed inside of the well during the development process will be decontaminated prior to each day's use using a phosphate-free detergent followed by a deionized water rinse.
- Purge water should be disposed of in a manner that is consistent with the Virginia Department of Environmental Quality's Investigative Derived Waste Disposal Policy.

g:\projects\dominion\chesterfield power stn\073-6607 dominion reymet rd lf\environmental\groundwater monitoring plan 2012\attachments\app iib well development standard operating guidance.docx

1.0 STANDARD OVERVIEW

This Standard represents recommended procedures for decommissioning monitoring wells at solid waste facilities. All wells (monitor wells, water supply wells, etc.) and piezometers not actively being used for their intended purpose and with no future plan for utilization should be decommissioned. Wells and piezometers represent potential conduits for cross-contamination through annulus transfer, improper construction, corrosion, accidents and vandalism. Proper decommissioning eliminates the potential for cross-contamination. In addition to the threat of cross-contamination, improperly decommissioned wells can pose a threat to the integrity of future baseliners. In expansion areas over unconsolidated material, unless the well casing is removed and replaced with a flexible grout, the casing can damage the baseliner in the event of differential settlement or subsidence. The weight of the overlying waste mass often causes a limited amount of subsidence, especially in fine-grained deposits. Since future expansions can occur in areas not currently foreseen, all unused wells within the vicinity of a solid waste disposal facility should be abandoned in accordance with this Standard.

The following well decommissioning procedures are designed to ensure that well materials (including cement grout) will not cause damage to liner materials in the event of subsidence and to minimize the potential for contaminant migration through annular materials. Where regulatory requirements conflict with the procedures described herein, approval should be sought to adhere to this Standard. The procedures described in this Standard generally meet or exceed most regulatory requirements. Possible reasons for variation to this Standard include, but are not limited to, unusual site hydrogeologic conditions, deep wells (>100 feet), multiple cased monitor wells or larger diameter wells (>4”), driven casing wells and State-specific well decommissioning requirements that differ from this Standard.

The goal of well decommissioning is to remove all borehole components including the existing grout and gravel pack and replace the borehole contents with a suitable grout mixture. Removal of all borehole components is best accomplished by overdrilling the well using an auger of a diameter 1.25 times that of the original borehole coupled with a centering device.

This standard was developed in consideration of the following reference materials:

- ASTM D 5299-99, 2005. Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities. ASTM 1993 Annual Book of Standards, vol. 04.08, pp. 1318-1333.
- AWWA/ANSI A100-06, 2006. AWWA Standard for Water Wells, American Water Works Association, Denver Colorado. Appendix G.
- Lutenegger, A.J. and DeGroot, D.J. 1993, Hydrologic properties of contaminant transport barriers as borehole sealants. Hydraulic conductivity and Waste Contaminant Transport in Soils, ASTM STP 1142, D.E. Daniel and S.J. Trautwein, eds., ASTM Philadelphia, Pennsylvania.
- NWWA, 1975 (National Water Well Association Committee on Water Well Standards, 1975) Manual of Water Well Construction Practices, EPA –570/9-75-001. Office of Water Supply, Washington D.C.
- Smith, S.A., 1994, Well & Borehole Sealing, S.A. Smith Consulting Services, Ada, Ohio with Wisconsin Water Well Association for Groundwater publishing Co., Dublin, Ohio, 69p.

2.0 SURVEY CONTROL

Unless detailed survey information exists, each well shall be surveyed for both horizontal and vertical control, prior to decommissioning. The location of the well shall be surveyed to the nearest 0.5 feet. The ground surface elevation and top of well casing shall also be surveyed to the nearest 0.1 feet and 0.1 feet, respectively, relative to mean sea level. A State-licensed surveyor shall perform surveying.

3.0 GROUT SPECIFICATIONS

The following are specifications for three grout mixtures commonly used in well decommissioning and referenced throughout this Standard:

1. Neat cement grout - a mixture in the proportion of 94 pounds of Portland cement and not more than six gallons of water. Used to decommission wells completed in competent bedrock formations.
2. Neat Bentonite grout - a mixture in the proportion of 94 pounds of Portland cement and not more than six gallons of water, with bentonite up to five percent by weight of cement (between 3 and 4.7 pounds of bentonite per 94 pounds of Portland cement). Used to decommission wells completed in competent bedrock formations.
3. High solids bentonite grout - a mixture of water and a minimum of 30 percent by weight of bentonite (see discussion below), with no additives (minimum of 2.5 pounds of bentonite per gallon of water). Used to decommission wells completed in unconsolidated materials and competent rock, where appropriate.

Typically, a high solids grout can be prepared using granular bentonite and pumped at a relatively low-viscosity state if done quickly (within 15 minutes). This is due to the slower hydration of the granular bentonite as compared to powdered bentonite. However, if these timeframes cannot be achieved or if it is desirable to have a slower "set," an alternative is to use what has been termed the "Ohio mix". The "Ohio mix" involves preparing a low-solids bentonite grout slurry (30 to 50lbs/100 gallons of water) using API 200-mesh bentonite (e.g., Natural Gel, Gold Seal), into which 125 lb. of granular bentonite (8 to 20-mesh) is added and mixed (stirred). The hydrated bentonite in the slurry delays hydration of the granular bentonite without the addition of polymers or other agents. The result is a high solids bentonite grout at a viscosity that is feasible to pump with reasonable working time (Eidil et al. 1992 from Smith, 1994).

3.1 Cement

The cement shall be Portland Cement® Type 1 in accordance with ASTM C150, Type 1 or API-10A, Class A.

3.2 Water

Water shall be obtained from an approved source. Water used for down-hole purposes shall have a Total Dissolved Solids (TDS) concentration of less than 500 mg/L (Smith, 1994) and be certified free from contaminants, or sampled for volatile organic compounds by EPA method 8260.

3.3 Bentonite

Bentonite shall be an additive free granular sodium bentonite (Benseal, Enviroplug, PDS Granular, Volclay Crumbles or equivalent) generally 8 to 20 mesh particle size. Use of granular bentonite *in lieu* of powdered bentonite allows the placement of a high-solids grout with relatively low viscosity, if mixing and pumping are done quickly. If following the "Ohio mix" discussed above, additive free API 200-mesh bentonite is used for the initial slurry (e.g., Natural Gel, Gold Seal) into which granular bentonite (8 to 20 mesh) is added and mixed.

3.4 Grouting Equipment

Grout mixers shall be paddle or blade type capable of thoroughly mixing grout. All grouting lines (i.e., hoses, pipes, drill rods, etc.) shall have an inside diameter of at least 0.50 inches to prevent clogging. Grout pumps shall be of a positive displacement or progressive cavity type (Moyno) capable of delivering a minimum pressure of 20 psi. Venturi mixing and centrifugal pumps are less desirable alternatives due to clay particle shearing and clogging problems, respectively.

4.0 DECOMMISSIONING PROCEDURES

Decommissioning procedures must be tailored to each well type and geologic environment. The broad range of suitable decommissioning methods for different situations is covered in detail in ASTM D5299-99 and the above referenced standards and literature. The purpose of this standard is to establish minimum requirements for the most common well construction types at our facilities. For landfill facilities, the most common type of well installation consists of single cased wells installed in unconsolidated material at relatively shallow depths (i.e., < 100 feet). The procedures described herein can be used to decommission two-inch or four-inch diameter single cased PVC or steel wells installed at depths generally less than 100 feet. Other less common well types requiring specialized procedures and materials include large diameter wells, multiple cased wells and driven casing wells.

The goal of decommissioning is to completely remove all well materials either through overdrilling or pulling of the well or casing. Once all well materials have been removed, the resulting borehole can be properly sealed with a suitable grout mixture.

In general, a high solids bentonite grout mixture (30% by weight) is preferred for most well decommissioning projects. State regulations often stipulate that for wells installed in bedrock, non-flexible grout mixtures must be used, such as neat cement grout or neat bentonite grout. Non-flexible grout mixtures more closely match the physical characteristics of competent bedrock. For all wells or portions of wells completed in unconsolidated material a high solids bentonite grout as defined above is the requisite grouting material. For wells of portions of wells completed in competent bedrock grouting materials can be either of the three grout types specified above with preference given to high solids bentonite grout.

The following are specific decommissioning procedures. These steps shall generally be completed in the order listed below.

1. Ensure that adequate survey control exists for each well and obtain a copy of the original well construction log.
2. Well decommissioning drilling equipment, augers, water level marker, and other tools must be decontaminated before being brought to the site.
3. The depth of the well shall be measured and compared to the anticipated well depth to determine if any obstructions are in the well. If the well is obstructed, the obstruction will be removed prior to sealing the well, if possible.
4. Expected grout volume calculations shall be completed using the depth information derived from Steps 1 and 3. The expected volume shall be recorded for reconciliation with the final grout volumes used.
5. Remove the protective casing. Position the drill rig directly over the well and attach a chain to the outer protective casing. Pull directly upward on the protective casing. Often for shallow wells this procedure will also pull up the inner-casing and annular materials. If this occurs, continue to pull all well materials out, as practicable.

6. Remove the well casing and associated annular materials. Typically, removal is accomplished through overdrilling using a Hollow Stem Auger (HSA) drill rig equipped with an auger bit that exceeds the diameter of the original bit (1.25 times the original auger diameter) used to construct the well. The key to successful overdrilling is insuring the auger bit remains centered on the well for the duration of overdrilling. For wells constructed of PVC, either employ a pilot bit to insure centering is maintained or place A-rod (steel rod) throughout the length of the well to act as a guide during overdrilling. A pilot bit consists of an elongate pointed pin with a maximum diameter slightly less than that of the inner well casing. For wells constructed of steel materials, the steel casing itself can be used to maintain centering during overdrilling. Essentially, an auger is selected with an inner diameter slightly larger than the diameter of the steel casing. During overdrilling the auger follows the steel casing to the target depth. Centering must be assured through use of one of the above-described centering methods. The overdrilling shall progress slowly to insure that the drilling operation remains centered over the well/boring. Once the base of the well is reached the auger or drilling equipment shall be left in place, to prevent cave in of materials, while proceeding to Step 6.

   For unconsolidated wells installed using driven casing or equivalent methods (i.e., no annular materials), it may be possible to pull the outer casing or well *in lieu* of overdrilling. If this procedure is used, grouting must be completed concurrently with the pulling of casing with grout level maintained within 5 feet of ground surface while the casing is pulled. The grout shall be introduced into the well from the base using a tremie line through the innermost casing (with the base of the well removed). The grout mixtures and procedures shall be as described in Step 6.

   Driven casing wells completed entirely in competent bedrock may be decommissioned without removing the casing by tremie grouting according to the procedures described in Step 6.

7. Upon removal of the casing, well screen and annular materials, the resulting boring shall be tremie grouted. The grout shall be a high solids bentonite grout as defined above. Essentially, the grout mixture shall contain as high a bentonite content as can be reasonably pumped (30% bentonite by weight). For wells installed in competent bedrock state regulations often mandate use of a neat cement grout mixture. It is preferable in cases where the borehole intersects both competent bedrock and unconsolidated materials that the unconsolidated interval shall be abandoned using a high solids bentonite grout. Grout shall be mixed to a uniform consistency. The grout shall be pumped into the boring through a tremie pipe placed at the bottom of the boring. The auger flights shall be left in place until the tremie line is situated at the bottom of the boring. Grouting shall proceed in a continuous and expeditious manner by concurrently pulling the auger flights and pumping grout until the grout level is within two feet of the ground surface. Both the bottom of the tremie pipe and the base of the auger flights must remain submerged in grout while the well is grouted.

   After the grout has settled for 24 hours, the borehole must be checked for grout settlement, and if necessary, topped off with the appropriate grout mixture. The final level of the grout shall be within two feet of the ground surface. The top two feet of the borehole shall be abandoned by adding and compacting native soils.

8. Equipment used for well decommissioning shall be cleaned and decontaminated between decommissioning locations.

9. Upon completion of decommissioning activities, well decommissioning materials and equipment will be removed from the site and the site will be restored. Over-drilled well materials and cuttings shall be properly disposed.

10. After the well has been decommissioned, a record must be prepared. The record must contain the following information, at a minimum:
    - Name and address of property owner;
    - Name, license or registration number of the contractor doing the work, name of the driller performing the work, and the signature of the representative;
    - Date work was completed;
    - Survey information including the county, township, range, section, and three quartiles, and the street address or fire number of the well or boring (for unincorporated areas);
    - A description of the geological material penetrated by the well (i.e., copy of the original boring log);
    - The original well or boring depth, and current well or boring depth;
    - The approximate date of construction;
    - The grout or sealing materials, type, quantities, and intervals;
    - The casing type, diameter, and depth, if present;
    - The screen or open hole depth interval, if present;
    - A description of any obstruction, if present;
    - A description of any deviations from the above procedures, or other unusual conditions encountered or actions taken; and
    - A statement as to whether or not all well materials were removed and if not a detailed explanation of the type of materials left in place and their approximate elevation, type, condition, etc.
11. Copies of the decommissioning record are to be forwarded to the site and the State agency if required.

4.1 Failure to remove all well materials

If for any reason the above decommissioning procedures fail to remove all well casing and screen materials, the well shall be permanently marked with a steel post and attached name plate containing the well identification. The name plate and/or site records shall contain, at a minimum, the following:

- Well Identification;
- Date of installation;
- Date of decommissioning;
- Survey coordinates; and
- Approximate elevation interval of in place well materials.

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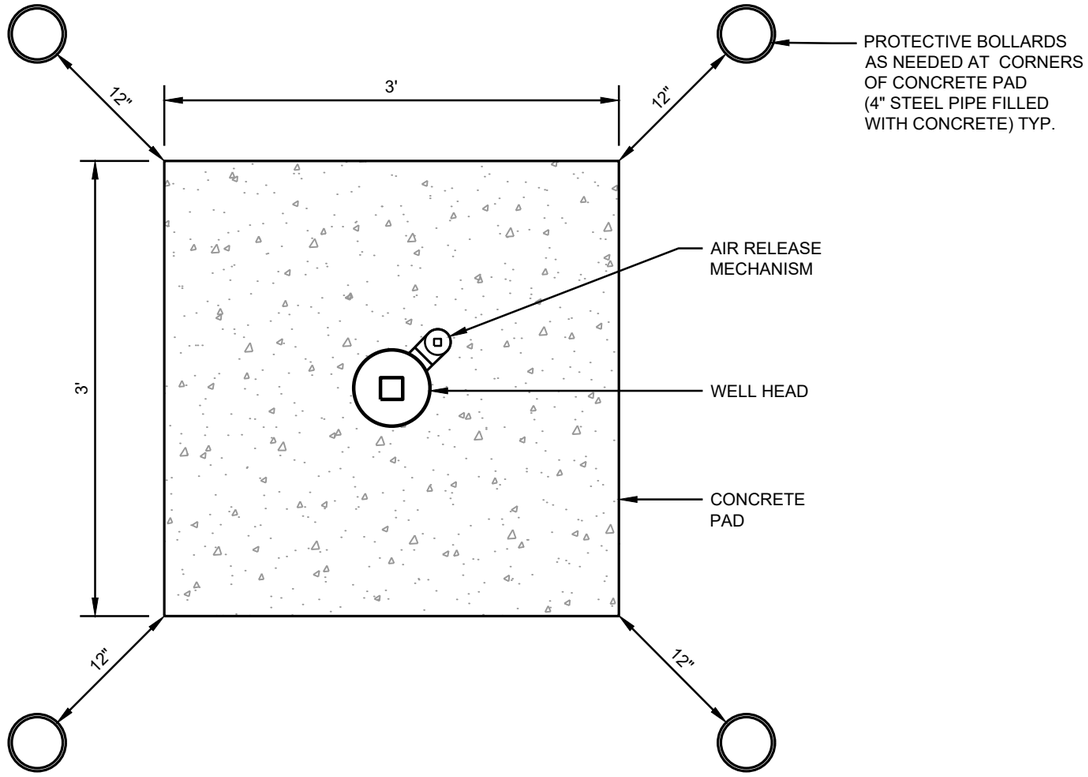
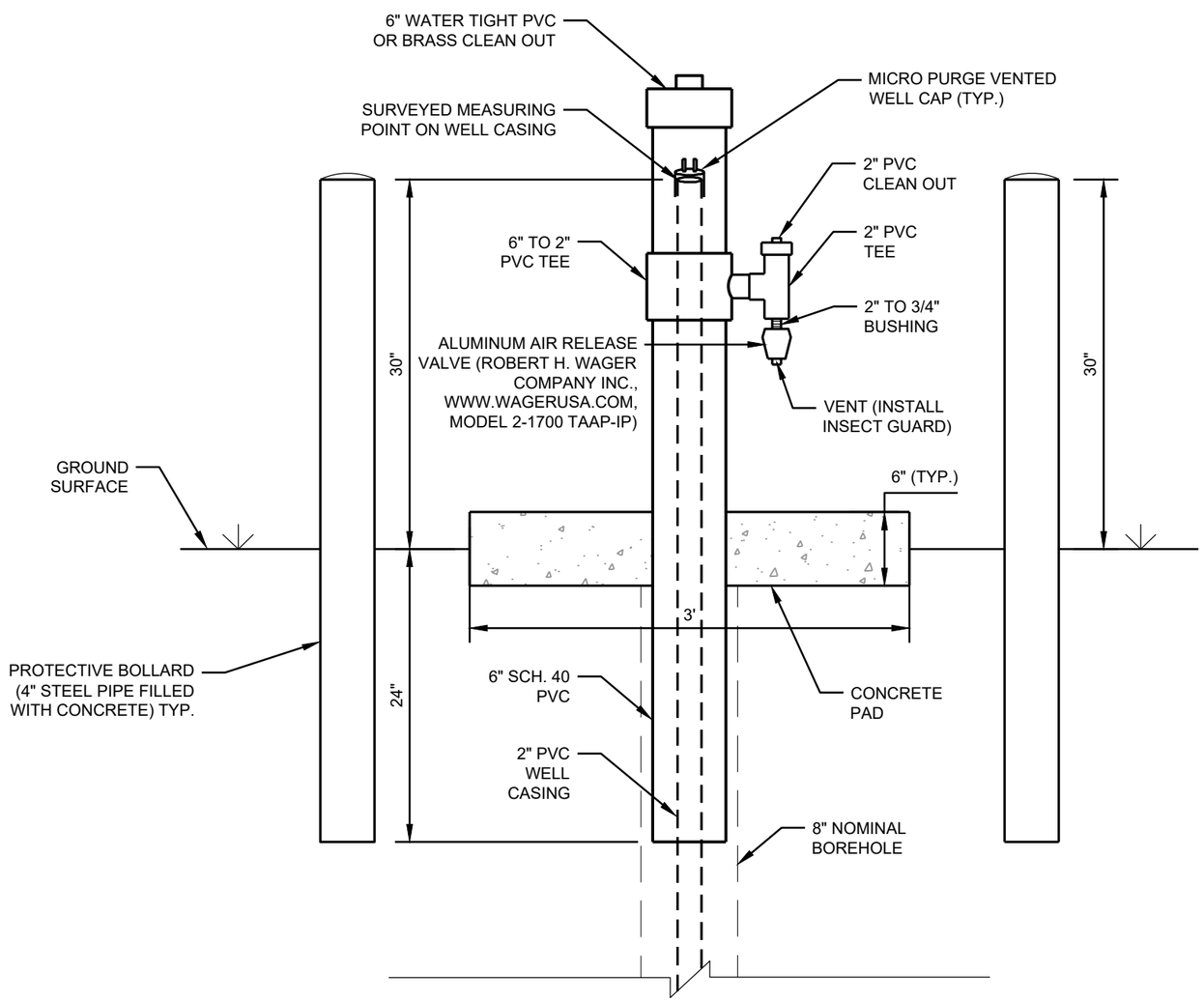


PLAN VIEW

SCALE: 1" = 1'

NOTE: PROTECTIVE BOLLARDS TO BE INSTALLED AS NEEDED BASED ON SITE CONDITIONS TO PROTECT WELLHEAD INTEGRITY (AS DETERMINED BY DOMINION).



CROSS-SECTION VIEW

SCALE: 1" = 1'

Golder Associates
Richmond, Virginia

PROJECT
DOMINION
CHESTERFIELD POWER STATION
CHESTERFIELD COUNTY, VA

TITLE
MONITORING WELL DETAILS

PROJECT No.		15-32864
FILE No.		1532864A05
REV. 0	SCALE	AS SHOWN
DESIGN	MGW	06/29/16
CADD	BPG	06/29/16
CHECK		
REVIEW		

FIGURE 1

G:\Plan Production Data Files\Drawing Data Files\15-32864A - Groundwater Map (UAP)\Active Drawings\1532864A05.dwg

Golder Associates

WELL CONDITION SUMMARY

DATE:________

Project Name______________________ Project No./Task No.______________________

Personnel ________________________ Page______ of _______

Well ID	Protective Casing	Well Casing	Label	Lock	Pad Condition	Depth of Well (Feet)	General Turbidity	Comments/ Observations*
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No	☐ OK ☐ Damaged		☐ Clear ☐ Turbid	

* Note ponding water, weep holes, condition of surrounding area, including any disturbance of the ground since last inspection, evidence of contamination.

Signature:________________________________ Date:_______________________________

WELL INSPECTION REPORT

FACILITY INFORMATION

Owner: _____ **Permit No.** _____

Location: _____ **Project No.** _____

INSPECTION

Inspection Date: _____ **Inspector Name:** _____

Time: _____ **Weather Conditions:** _____

MONITORING WELL CONDITIONS

Well ID: _____

Lock Condition: _____

Protective Casing Condition: _____

Pad Condition: _____

Pump Type: _____

Pump Serial No.: _____

Pump Condition: _____

Tubing Condition: _____

Sediment Accumulation in Well (describe): _____

Depth to Water (feet): _____

Depth to Bottom (feet): _____

Comments: _____

_____

Signature: _____ **Date:** _____

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APPENDIX C

HYDRAULIC BARRIER SYSTEM CONSTRUCTION PLANS

CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

DCR INVENTORY # 041031

JUNE 2022 (REV1)

BERMUDA DISTRICT
CHESTER, VIRGINIA

VSMP COMPLIANCE:

WATER QUALITY COMPLIANCE IN ACCORDANCE WITH 9VAC25-870-65 IS ACHIEVED THROUGH THE CCR REMOVAL PROJECT VSMP VAR10G662. THE TRD WALL PROJECT IS RELATED WORK FOR THE CLEAN CLOSURE OF THE LOWER ASH POND.

THIS PROJECT IS COVERED UNDER THE UMBRELLA VSMP VAR10G662.

CBPA COMPLIANCE:

A. TIDAL WETLANDS NOT IMPACTED

B. NON-TIDAL WETLANDS PERMITTED VIA USACE JD #NAO-2007-02441

C. TIDAL SHORES NOT IMPACTED

D. VEGETATED CONSERVATION AREA WITHIN 100 FEET OF PROPERTY LINE NOT IMPACTED

E. 100-YEAR FLOODPLAIN NOT FILLED

F. HIGHLY ERODIBLE SOILS OR STEEP SLOPES SHOWN ON PLANS AND PROTECTED BY EROSION AND SEDIMENT CONTROL MEASURES SHOWN IN THIS SITE PLAN

G. NO HIGHLY PERMEABLE SOILS

H. THE PURPOSE OF THE PROJECT IS TO INSTALL A BELOW-GRADE HYDRAULIC CUTOFF WALL AND THEN RESTORE THE SURFACE TO PRE-CONSTRUCTION CONDITIONS. WATER QUALITY COMPLIANCE IN ACCORDANCE WITH 9 VAC 25-870-65 IS OBTAINED FOR THE CHESTERFIELD CCR PROJECT BY A REDUCTION IN POST-DEVELOPED IMPERVIOUS AREA.

THIS PROJECT WILL HAVE A LAND DISTURBANCE GREATER THAN 2,500 S.F.; THEREFORE THE VSMP REGULATIONS FOR STORMWATER ARE APPLICABLE AND ADMINISTERED BY THE COUNTY.

GENERAL SITE DATA:

ADDRESS:	451 COXENDALE ROAD
LATITUDE & LONGITUDE:	37.3702°N / 77.3698°W
TAX ID:	811-660-3332-00000
MAGISTERIAL DISTRICT:	BERMUDA
ZONING:	I-3 (HEAVY-INDUSTRIAL)
PREVIOUS CASES:	10SN0114, 19SN0554, 15SN0647
SITE AREA:	144.1 ACRES
TOTAL IMPERVIOUS AREA:	16.10 +/- ACRES
DISTURBED AREA:	NOT APPLICABLE
PERMANENT RPA IMPACTS:	NOT APPLICABLE
DEVELOPMENT DISTRICT:	NOT APPLICABLE
EXISTING USE:	STEAM GENERATION POWER PLANT
UTILITIES:	PUBLIC WATER & SEWER
OFFSITE LAND DISTURBANCE:	ANY OFFSITE LAND DISTURBANCE ACTIVITY ASSOCIATED WITH THIS PROJECT MUST HAVE AN APPROVED EROSION AND SEDIMENT CONTROL PLAN.
COUNTY LAND DISTURBANCE	A CHESTERFIELD COUNTY LAND DISTURBANCE PERMIT IS REQUIRED FOR THIS PROJECT. ALL LAND DISTURBANCE OCCURS WITHIN THE LOD ESTABLISHED UNDER 21PR0206.
VIRGINIA STORMWATER MANAGEMENT PROGRAM PERMIT (VSMP VAR10G662):	REQUIRED PRIOR TO ISSUANCE OF LAND DISTURBANCE PERMIT, APPROVED UMBRELLA VSMP VAR10G662 IS ALREADY IN PLACE.
FLOODPLAIN:	FLOOD ZONE X AS DEFINED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY, FIRM PANELS 51041C0335D AND 51041C0351D, EFFECTIVE DATE:26 APRIL 2017.
NAME OF RECEIVING WATERS:	JAMES RIVER
VA HU6 TWELVE DIGIT WATERSHED CODE:	VA HU6: JL06 HUC12: 020802060106 NAME: JAMES RIVER- CURLES CREEK
WETLANDS:	USACOE JD # NAO-2007-02441 WETLANDS AND RPA FIELD DELINEATED BY GOLDER ASSOCIATES MARCH 2015. WATERS OF THE U.S. HAVE NOT BEEN DETERMINED BY THE USACOE.

SITE LOCUS

TOPO SOURCE: USGS TOPOGRAPHIC MAP, PETERSBURG, VIRGINIA, QUADRANGLE 1984.

DRAWING INDEX

SHEET NO.	SHEET TITLE	DESCRIPTION
01	G-100	TITLE SHEET
02	C-100	EXISTING CONDITIONS PLAN
03	C-101	TRD WALL PLAN AND SHEET INDEX
04	C-102	TRAFFIC PLAN
05	C-103	INSTRUMENTATION PLAN
06	C-200	PLAN AND PROFILE STA. 0+00 TO 7+00
07	C-201	PLAN AND PROFILE STA. 7+00 TO 14+50
08	C-202	PLAN AND PROFILE STA. 14+50 TO 21+50
09	C-203	PLAN AND PROFILE STA. 21+50 TO 29+50
10	C-204	PLAN AND PROFILE STA. 29+50 TO 37+50
11	C-205	PLAN AND PROFILE STA. 37+50 TO 45+50
12	C-206	PLAN AND PROFILE STA. 45+50 TO 53+50
13	C-207	PLAN AND PROFILE STA. 53+50 TO 60+85
14	C-211	GROUT PLANT
15	C-300	FINAL STABILIZATION PLANS
16	C-301	FINAL STABILIZATION PLANS
17	C-302	FINAL STABILIZATION PLANS
18	C-303	FINAL STABILIZATION PLANS
19	C-500	DETAILS

OWNER INFO:

OWNER: VIRGINIA ELECTRIC & POWER COMPANY, d.b.a. DOMINION ENERGY
GINGER PHELPS
500 COXENDALE ROAD
CHESTER, VIRGINIA 23836
PHONE: (804) 241-3459
FAX: (804) 273-2876
EMAIL: GINGER.Y.PHELPS@DOMINIONENERGY.COM

ENGINEER: HALEY & ALDRICH
DANIEL MC GRATH, P.E.
1 PARK WEST CIRCLE, SUITE 208
MIDLOTHIAN, VA 23114
PHONE: (804) 419-0016
EMAIL: DMCGRATH@HALEYALDRICH.COM

PROJECT GENERAL NOTES:

1. ANY SIGN IN EXCESS OF EIGHT (8) FEET REQUIRES A PERMIT. PERMIT MUST BE OBTAINED THROUGH BUILDING INSPECTION DEPARTMENT. ANY SIGNAGE PROPOSED ON THE PLAN IS CONTINGENT UPON APPROVAL THROUGH SIGN PERMIT REVIEW PROCESS.
2. ALL PROPOSED UTILITIES ARE TO BE INSTALLED UNDERGROUND INCLUDING ELECTRIC, TELEPHONE AND CATV.
3. NO IMPACT TO PUBLIC UTILITIES. CONTACT FOR CHESTERFIELD COUNTY UTILITIES IS DANA SONG, 804-748-1356, SONGD@CHESTERFIELD.GOV.
4. RPA IMPACTS ARE NOT ANTICIPATED AS PART OF THIS PROJECT.
5. EXISTING FIRE HYDRANT LOCATIONS ARE SUFFICIENT FOR THIS PROJECT.
6. ALL CONSTRUCTION AND MATERIALS SHALL CONFORM WITH THE LATEST EDITION OF THE VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT) ROAD AND BRIDGE STANDARDS AND ROAD AND BRIDGE SPECIFICATIONS EXCEPT WHERE LOCAL JURISDICTION STANDARDS ARE APPLICABLE AS NOTED HEREIN.
7. THE CONTRACTOR SHALL NOTIFY THE OWNER AT LEAST 48 HOURS PRIOR TO STARTING WORK ON THE PROJECT.
8. THE LOCATION OF ALL EXISTING UTILITIES MAY OR MAY NOT BE SHOWN. THE CONTRACTOR SHALL INVESTIGATE THROUGH CONDUCTING HAND EXCAVATION TO LOCATE SERVICE UTILITIES INCLUDING IRRIGATION LINES PRIOR TO ANY MASS EXCAVATION.
9. ALL DISTURBED AREAS ARE TO BE STABILIZED AND ACCEPTED.
10. FLY ASH SHALL NOT BE USED IN CONCRETE.
11. SILT FENCE OR OTHER SUITABLE CONTROL MUST BE PROVIDED AROUND THE PERIMETER OF ANY SOIL STOCKPILE AREA.

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Birmingham, AL 35207

ISSUED FOR PERMIT

Project No.:	135342-012
Scale:	SHOWN
Date:	JUNE 2022
Drawn By:	HA
Designed By:	HA
Checked By:	HA
Approved By:	HA

Stamp:

COMMONWEALTH OF VIRGINIA
DANIEL F. McGRATH
Lic. No. 040703
6/7/2022
PROFESSIONAL ENGINEER

Rev.	Description	By	Date
1	GENERAL UPDATES	MPG	06/07/22

CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

TITLE SHEET

G-100

Sheet: 01 of 19

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LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING RPA BOUNDARY
- EXISTING PAVED ROAD
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING CULVERT OR STORM PIPE
- EXISTING TREE LINE
- EXISTING GRAVEL LINED CHANNEL OR CHECK DAM
- EXISTING CONCRETE LINED CHANNEL

NOTES

1. BASE TOPOGRAPHY FROM AERIAL SURVEY PERFORMED BY DRAPER ADEN ASSOCIATES, INC. ON 12/23/2020, PROJECT NO. 20021424-010508, DATED 02/26/2021.
2. HORIZONTAL DATUM NAD83, VERTICAL DATUM NAVD88.

JAMES RIVER
(FARRAR GUT)

EXISTING GRAVEL ROAD
EXISTING PROPERTY LINE
ELECTRICAL POLES (TYP.)
EXISTING FENCE
HIKING TRAIL
EXISTING ROAD
EXISTING WELL
EXISTING CULVERT
EDGE OF EXISTING GEOMEMBRANE COVER
EXISTING TRUCK WASH SYSTEM
EXISTING CONCRETE

THERMAL CHANNEL
CHESTERFIELD POWER STATION
COXENDALE ROAD
EXISTING LOWER ASH POND
EXISTING UPPER ASH POND
HENRICUS PARK ROAD
DIRT ROAD
GRAVEL ROAD

0 150 300 450 600
SCALE IN FEET

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

EXISTING CONDITIONS PLAN

C-100

Sheet: 02 of 19

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LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING RPA BOUNDARY
- EXISTING PAVED ROAD
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING CULVERT OR STORM PIPE
- EXISTING TREE LINE
- EXISTING SHEET PILE WALL
- PROPOSED TRD WALL (NON-STRUCTURAL)
- PROPOSED STRUCTURAL TRD WALL **SEE NOTE 3**
- PROPOSED MICROPILE-SUPPORTED SECTION **SEE NOTE 4**

NOTES

1. BASE TOPOGRAPHY FROM AERIAL SURVEY PERFORMED BY DRAPER ADEN ASSOCIATES, INC. ON 12/23/2020, PROJECT NO. 20021424-010508, DATED 02/26/2021.
2. HORIZONTAL DATUM NAD83, VERTICAL DATUM NAVD88.
3. PROPOSED STRUCTURAL TRD WALL SECTION (STA. 29+12 TO STA. 37+80) IS THE SUBJECT OF A PREVIOUS ALTERATION PERMIT SUBMITTED ON MARCH 2, 2022
4. MICROPILE SUPPORTS FROM STA. 37+80 TO STA. 44+00 ARE PROPOSED FOR THE SUPPORT OF THE TRD MACHINE DURING WALL INSTALLATION.

C-206
C-205
C-207
C-204
C-203
C-202
C-201
C-200
HENRICUS PARK ROAD
CONC. DITCH
STORM PIPE

0 150 300 450 600
SCALE IN FEET

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

TRD WALL PLAN AND SHEET INDEX

C-101

Sheet: 03 of 19

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LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING RPA BOUNDARY
- EXISTING PAVED ROAD
- EXISTING GRAVEL ROAD
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- EXISTING TREE LINE
- EXISTING CONTROL POINT
- EXISTING GRAVEL LINED CHANNEL OR CHECK DAM
- EXISTING CONCRETE LINED CHANNEL

NOTES

GENERAL:

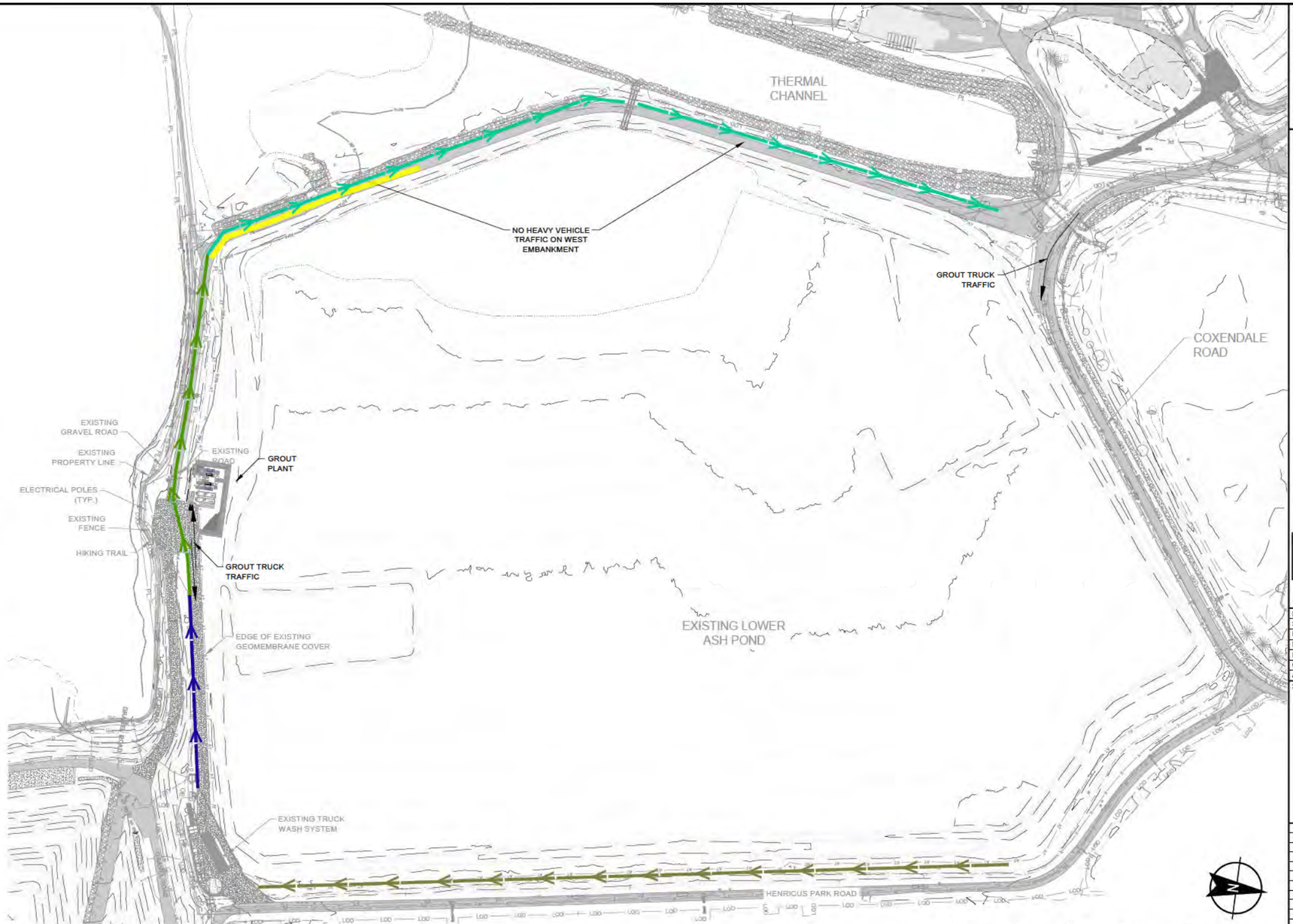
1. BASE TOPOGRAPHY FROM AERIAL SURVEY PERFORMED BY DRAPER ADEN ASSOCIATES, INC. ON 12/23/2020, PROJECT NO. 20021424-010508, DATED 02/26/2021.
2. HORIZONTAL DATUM NAD83, VERTICAL DATUM NAVD88.

KAYAK LAUNCH TRAFFIC:

3. CHESTERFIELD COUNTY ACCESS FOR THE FARRAR GUT KAYAK LAUNCH SHALL BE PROVIDED AT ALL POSSIBLE TIMES THROUGH USE OF THE WESTERN (COXENDALE RD) AND EASTERN (HENRICUS PARK RD) ACCESS POINTS.
4. WALKING TRAIL ACCESS ALONG THE SOUTHERN EMBANKMENT WILL BE MARKED WITH SIGNS AND/OR BARRICADES DURING PERIODS OF CONSTRUCTION WHEN THE TRAIL MUST BE CLOSED.
5. REFER TO THE DETAILED COORDINATION SCHEDULE FOR SPECIFIC CLOSURE AND/OR ROUTING DATES.

GROUT TRUCK AND TRD TRAFFIC:

6. FOR THE MARKED TRD AND MICROPILE SEGMENTS SHOWN, THAT SECTION OF THE ROAD WILL BE CLOSED FOR GENERAL TRAFFIC DURING TRD WALL OR MICROPILE INSTALLATION.
7. GROUT TRUCKS SHALL TAKE THE DESIGNATED ROUTE ONLY AND WILL NOT TRAVEL ON THE WESTERN EMBANKMENT.
8. SPOILS HANDLING FROM THE TRD MACHINE IS ANTICIPATED TO BE IN FRONT OF THE DIRECTION OF TRAVEL.



OVERALL TRD WALL CONSTRUCTION SEQUENCE

SEQUENCE #	MARKER	FROM	TO	LENGTH (FT)	NOTES
1		29+12	37+80	868	INCLUDES STRUCTURAL WALL
2		0+00	19+77	1,977	TIE TO EXISTING SHEET PILE WALL
3		37+80	44+00	620	MICROPILES - SIMULTANEOUS WITH SEQUENCE 2
4		23+73	29+12	539	TIE TO EXISTING SHEET PILE WALL
5		44+00	60+00	1,600	GAP FOR OUTLET STRUCTURE

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

TRAFFIC PLAN

C-102

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LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING RPA BOUNDARY
- EXISTING PAVED ROAD
- EXISTING GRAVEL ROAD
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- EXISTING OVERHEAD ELECTRIC LINE
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- EXISTING CULVERT OR STORM PIPE
- EXISTING TREE LINE
- EXISTING CONTROL POINT
- EXISTING GRAVEL LINED CHANNEL OR CHECK DAM
- EXISTING CONCRETE LINED CHANNEL
- LAP-HA-TRD-INC08 PROPOSED INCLINOMETER

NOTES

1. BASE TOPOGRAPHY FROM AERIAL SURVEY PERFORMED BY DRAPER ADEN ASSOCIATES, INC. ON 12/23/2020, PROJECT NO. 20021424-010508, DATED 02/26/2021.
2. HORIZONTAL DATUM NAD83, VERTICAL DATUM NAVD88.
3. REFER TO THE INSTRUMENTATION PLAN TEXT FOR MONITORING THRESHOLDS AND ALARM POINTS.

INCLINOMETER TABLE

INSTRUMENT	NORTHING	EASTING
LAP-HA-TRD-01	3662180.44	11807585.19
LAP-HA-TRD-02	3661884.74	11807535.63
LAP-HA-TRD-03	3661551.18	11807495.02
LAP-HA-TRD-04	3660696.48	11807901.69
LAP-HA-TRD-05	3660563.19	11807970.17
LAP-HA-TRD-06	3660516.19	11808181.37
LAP-HA-TRD-07	3660518.14	11808444.25
LAP-HA-TRD-08	3660563.62	11808835.21
LAP-HA-TRD-09	3661099.33	11809653.62
LAP-HA-TRD-10	3661594.12	11809569.22
LAP-HA-TRD-11	3662090.46	11809486.28
LAP-HA-TRD-12	3662580.92	11809403.65
LAP-HA-TRD-13	3661128.12	11807679.54
LAP-HA-TRD-14	3660792.60	11807847.58

NOTE: INCLINOMETER LOCATIONS MAY BE SHIFTED UP TO 50 FEET LATERALLY ALONG THE TRD WALL ALIGNMENT TO EITHER SIDE OF THE PROPOSED LOCATION TO ASSIST WITH INSTALLATION OR TO AVOID LOCAL OBSTACLES.

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

INSTRUMENTATION PLAN

C-103

Sheet: 05 of 19

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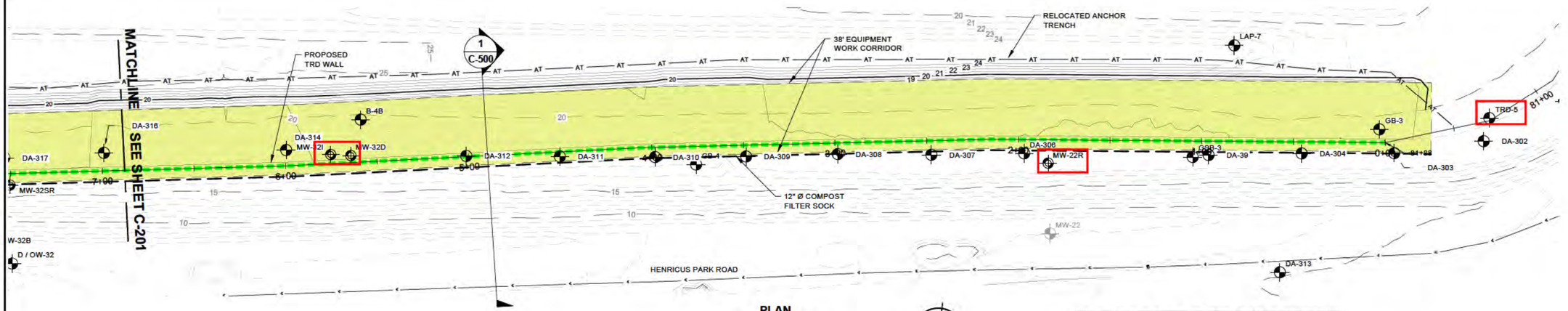
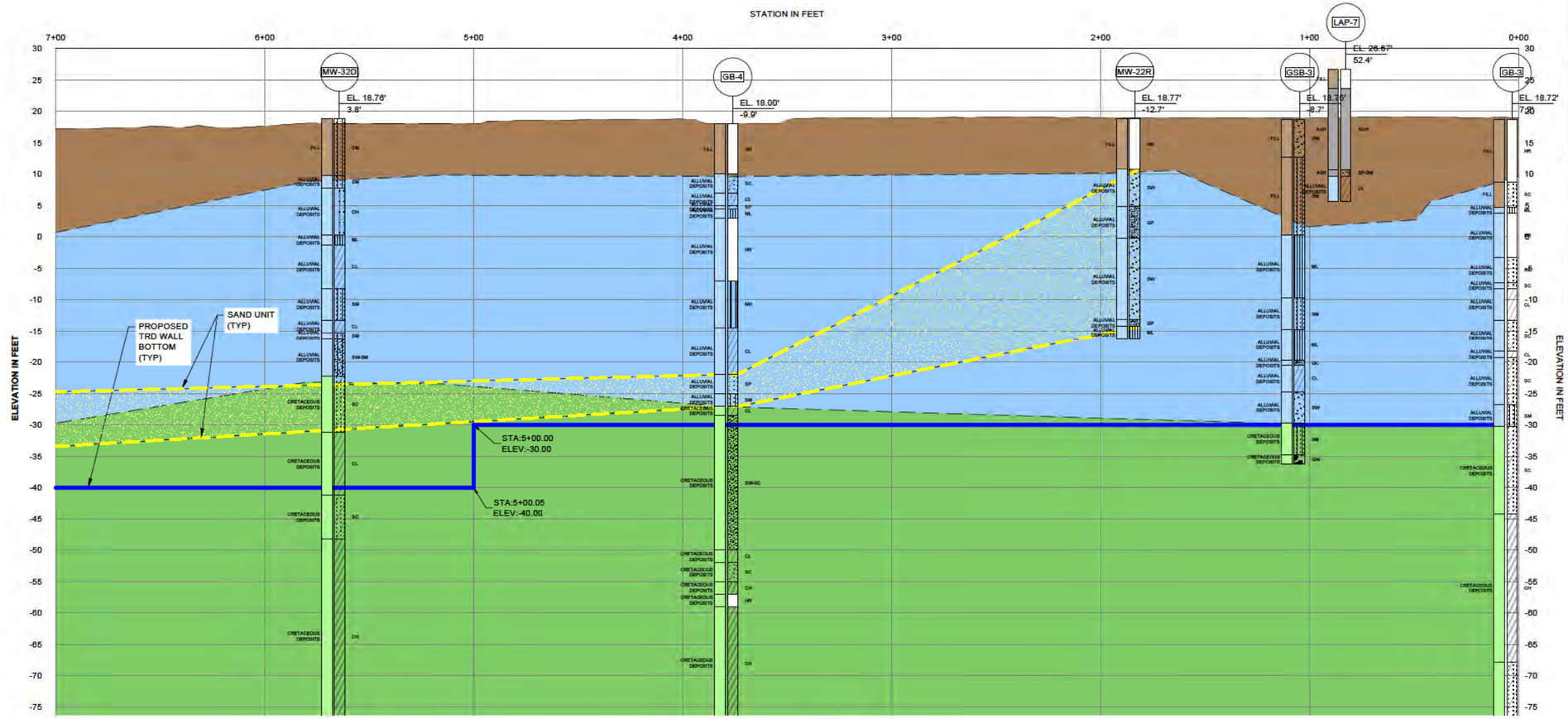


PLAN
STA. 0+00 TO 7+00

0 30 60 90 120
SCALE IN FEET

Wells	Monitoring Program	Direct Work Path*	Hydraulically Cut Off**
TRD-5	NA	No	-
MW-22R	CCR/VSWMR	No	Yes
MW-32I	NA	Yes	Yes
MW-32D	NA	Yes	No

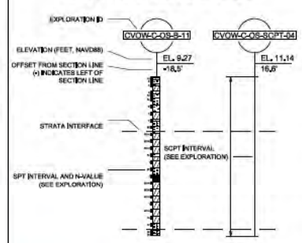


PROFILE
STA. 0+00 TO 7+00

HORIZ. 0 30 60 90 120
VERT. 0 10 30 45 60
SCALE IN FEET

LEGEND
(FOR C-200 TO C-207)

BORING STICK DETAILS



MW-22R WELLS LISTED IN TABLE
FILL
SAND UNIT
ALLUVIAL DEPOSITS
CRETACEOUS DEPOSITS

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

PLAN AND PROFILE
STA. 0+00 TO 7+00

C-200

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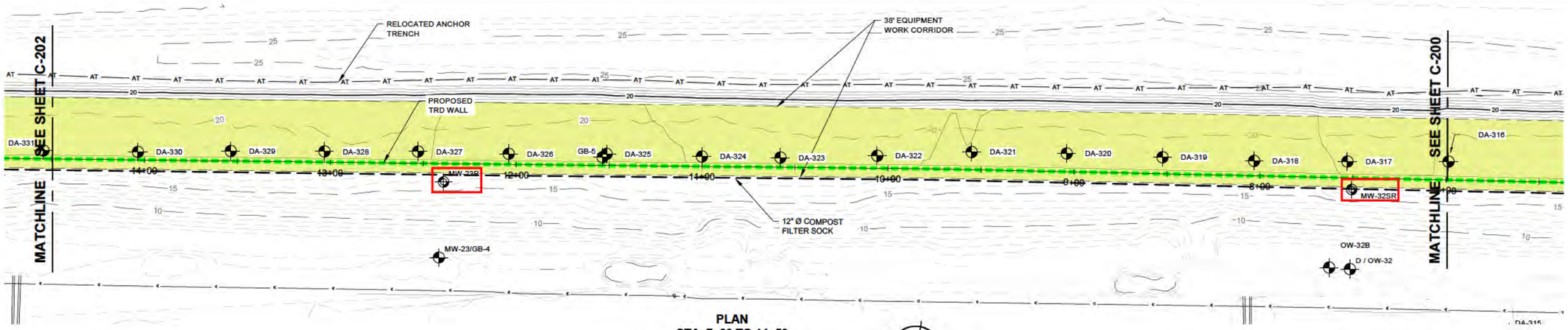
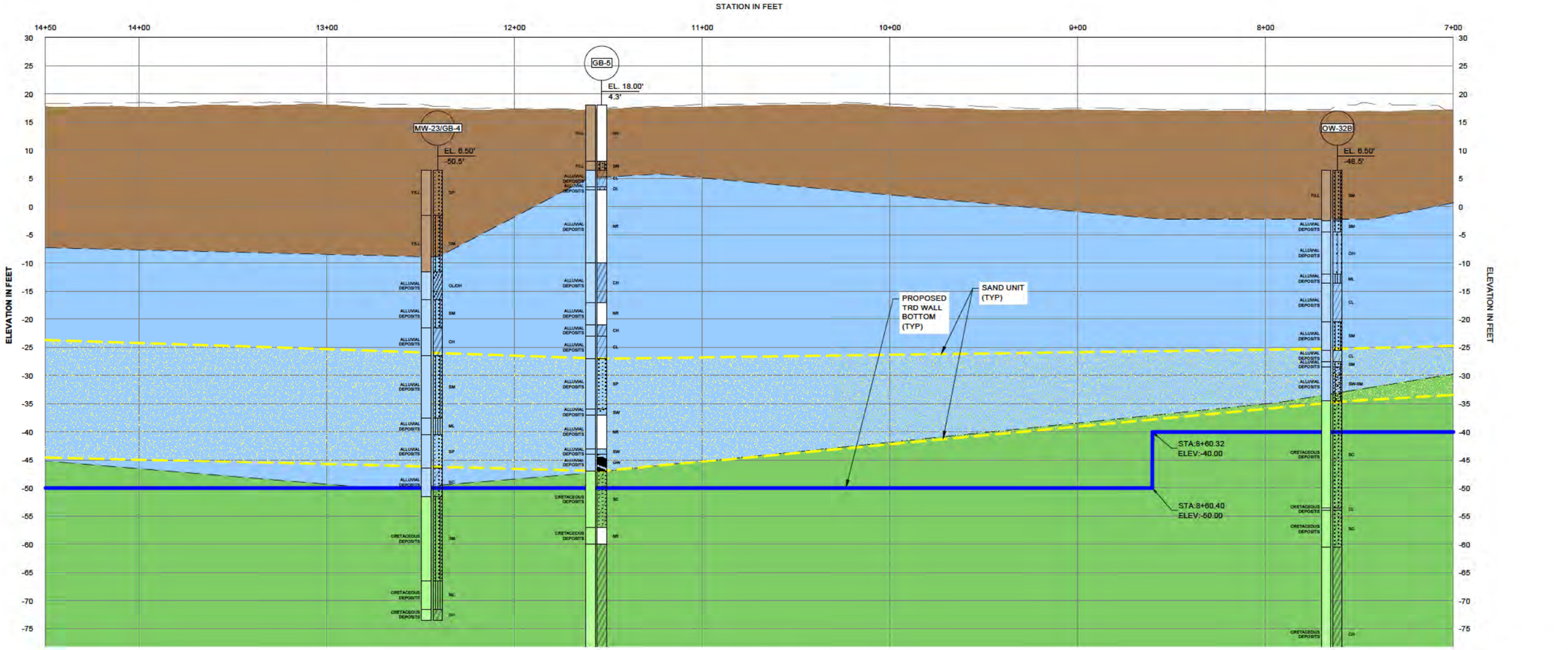


PLAN
STA. 7+00 TO 14+50

0 30 60 90 120
SCALE IN FEET

Wells	Monitoring Program	Direct Work Path*	Hydraulically Cut Off**
MW-32SR	CCR/VSWMR	No	Yes
MW-23R	CCR/VSWMR	No	Yes



PROFILE
STA. 7+00 TO 14+50

HORIZ. 0 30 60 90 120
VERT. 0 10 20 30 40
SCALE IN FEET

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

PLAN AND PROFILE
STA. 7+00 TO 14+50

C-201

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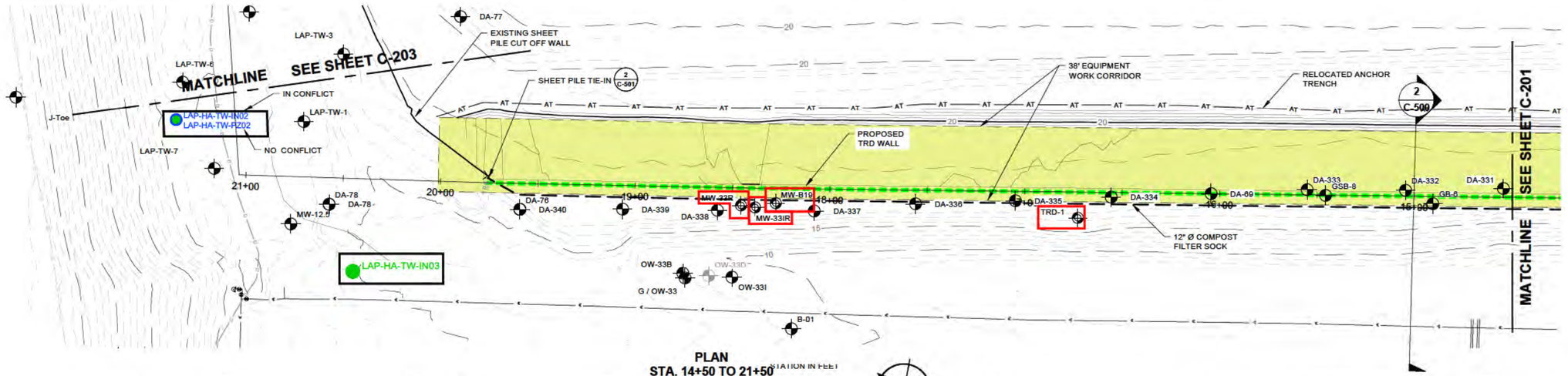
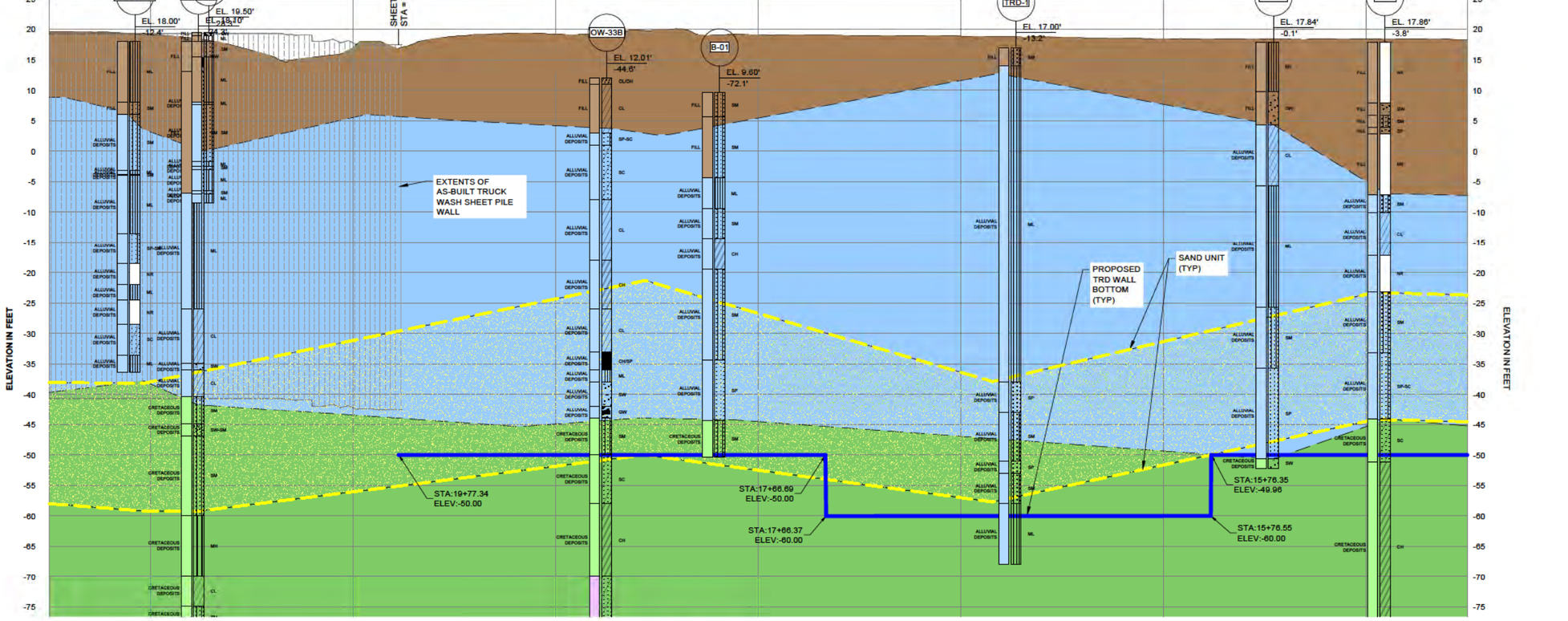


PLAN
STA. 14+50 TO 21+50

SCALE IN FEET

Wells	Monitoring Program	Direct Work Path*	Hydraulically Cut Off**
TRD-1	NA	Yes	Yes
MW-33R	CCR/VSWMR	Yes	Yes
MW-33IR	CCR/VSWMR	Yes	Yes
MW-B19	VPDES	Yes	-



PROFILE
STA. 14+50 TO 21+50

HORIZ. 0 30 60 90 120
VERT. 0 10 20 30 40
SCALE IN FEET

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

PLAN AND PROFILE
STA. 14+50 TO 21+50

C-202

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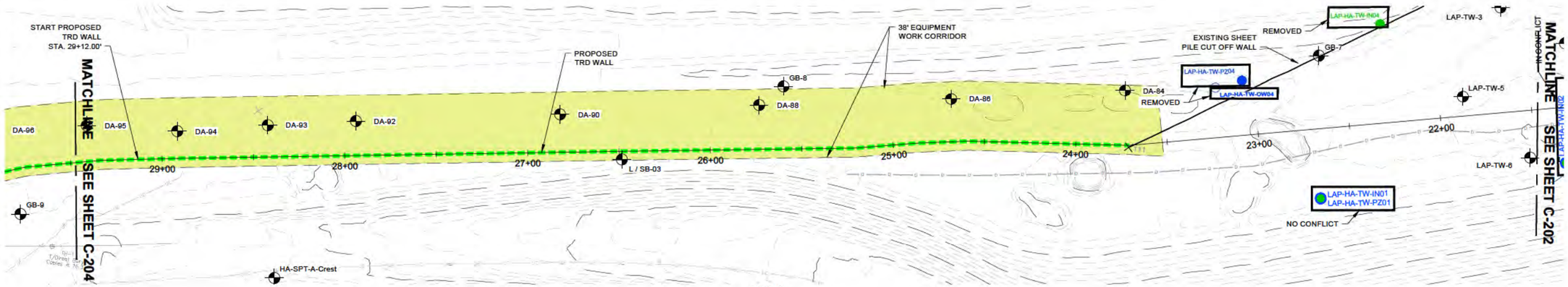
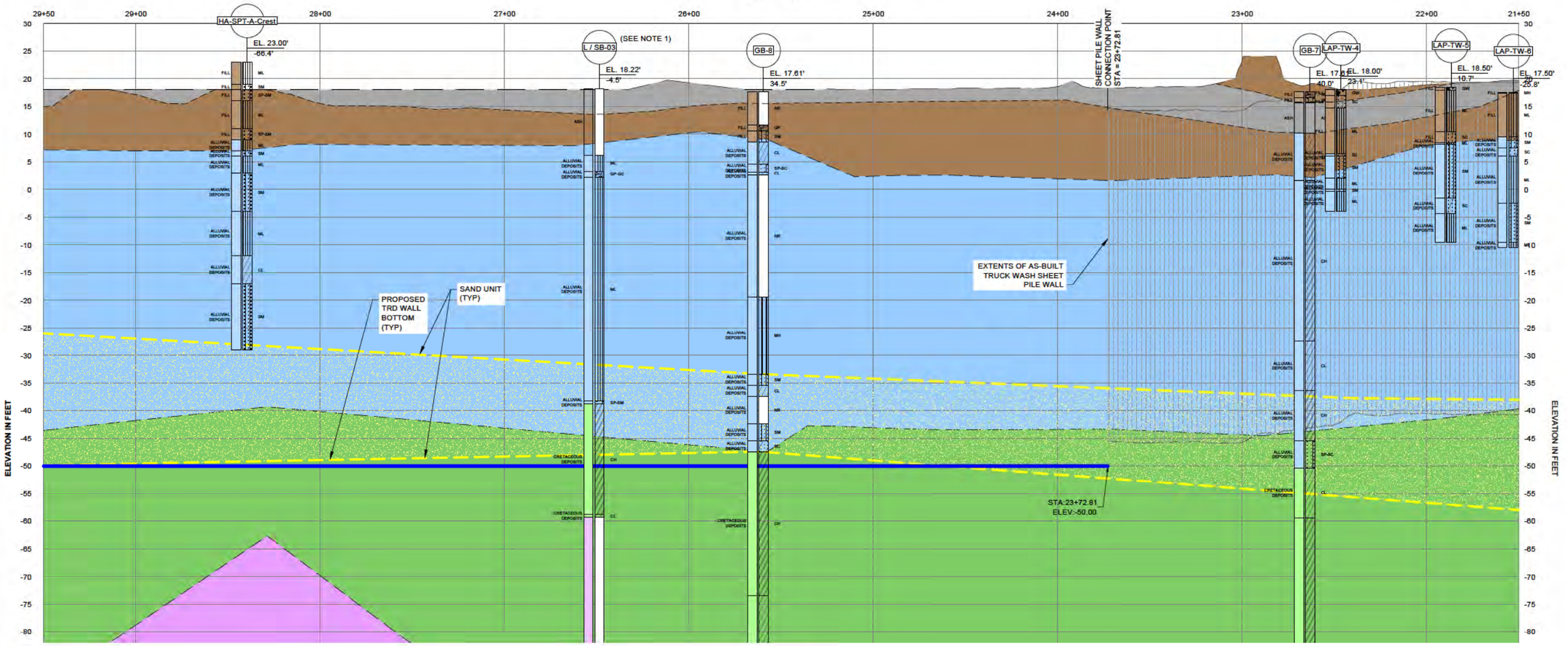


PLAN
STA. 21+50 TO 29+50

0 30 60 90 120
SCALE IN FEET
STATION IN FEET

NOTE:
1. ASH DEPTH RANGES FROM 4' TO 7' BASED ON HISTORICAL RECORD



PROFILE
STA. 21+50 TO 29+50

HORIZ. 0 30 60 90 120
VERT. 0 10 20 30 40
SCALE IN FEET

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Saiia Construction Company, LLC
4400 Lewisburg Road
Birmingham, AL 35207

ISSUED FOR PERMIT

Project No.:	135342-012
Scale:	SHOWN
Date:	JUNE 2022
Drawn By:	HA
Designed By:	HA
Checked By:	HA
Approved By:	HA

Stamp:

COMMONWEALTH OF VIRGINIA
DANIEL P. McGRATH
Lic. No. 040703
6/7/2022
PROFESSIONAL ENGINEER

Rev.	Description	By	Date
1	GENERAL UPDATES	MPG	06/07/22

CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

PLAN AND PROFILE
STA. 21+50 TO 29+50

C-203

Sheet: 09 of 19

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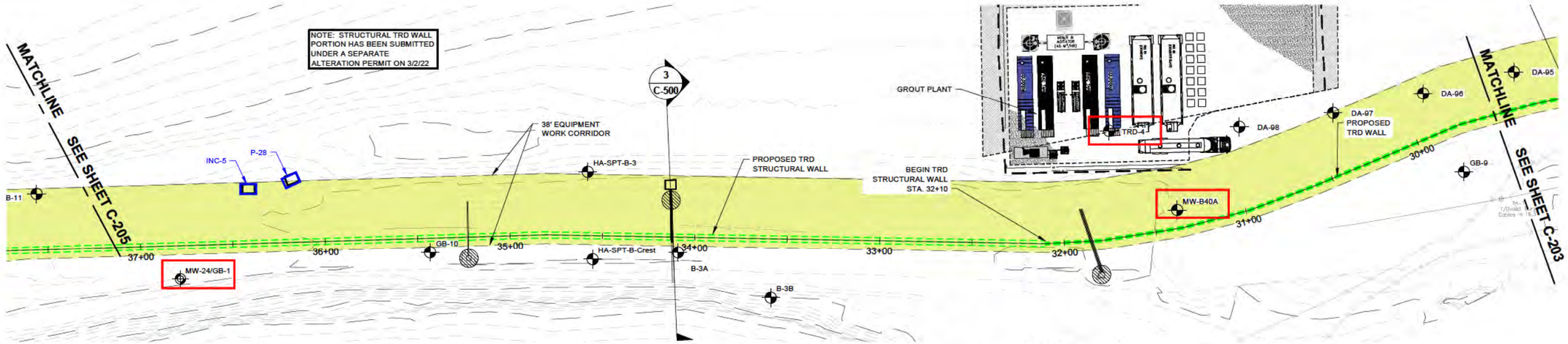
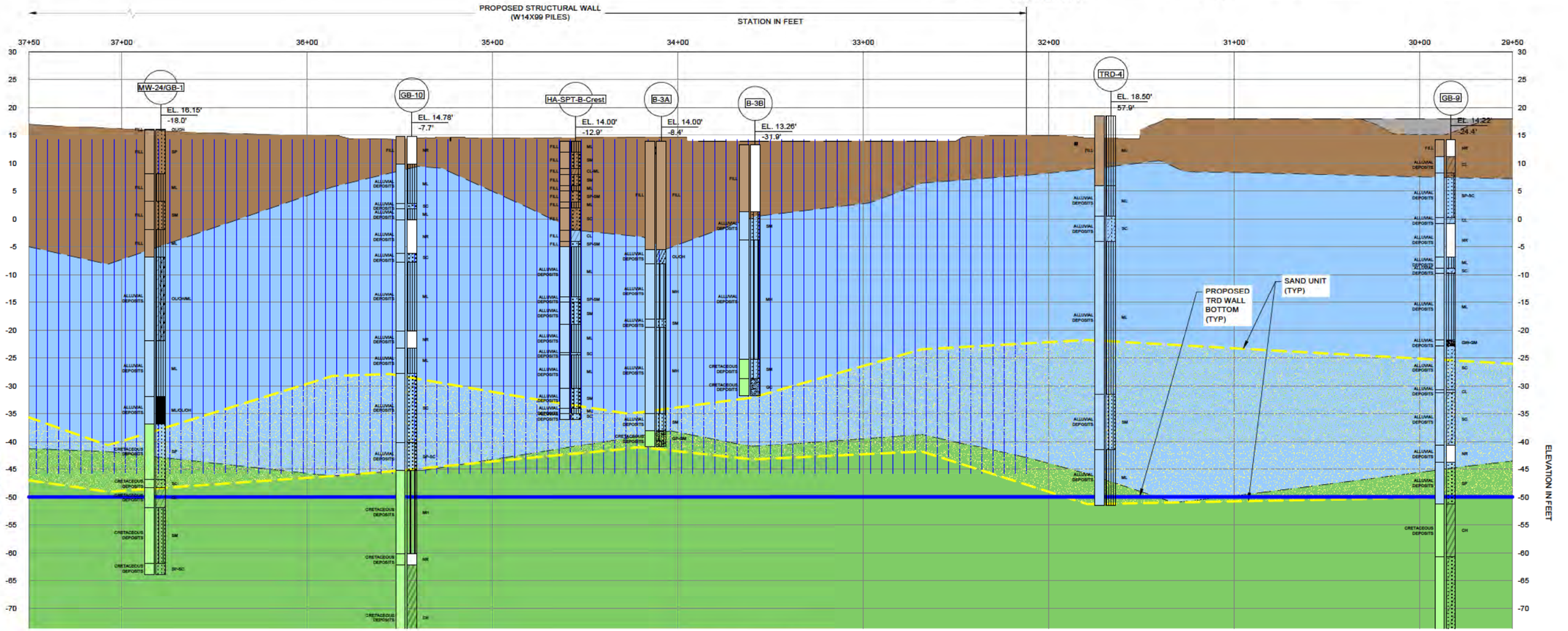


PLAN
STA. 29+50 TO 37+50

0 30 60 90 120
SCALE IN FEET

Wells	Monitoring Program	Direct Work Path*	Hydraulically Cut Off**
MW-24	CCR/VSWMR	No	Yes
TRD-4	NA	No	Yes
MW-B40A	VPDES	Yes	Yes



PROFILE
STA. 29+50 TO 37+50

HORIZ. 0 30 60 90 120
VERT. 0 10 20 30 40
SCALE IN FEET

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1	GENERAL UPDATES	MPG	06/07/22

CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

PLAN AND PROFILE
STA. 29+50 TO 37+50

C-204

Sheet: 10 of 19

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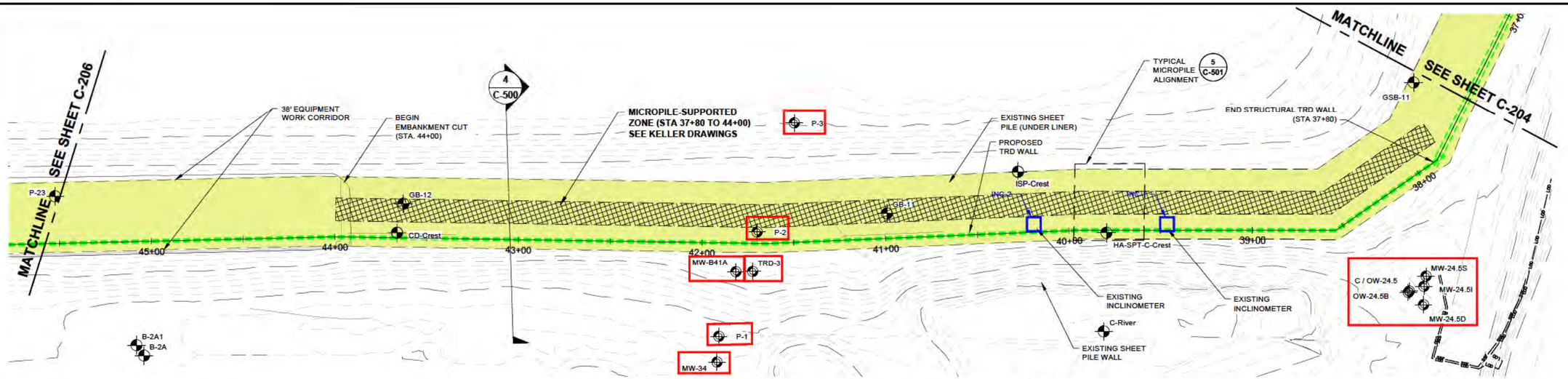
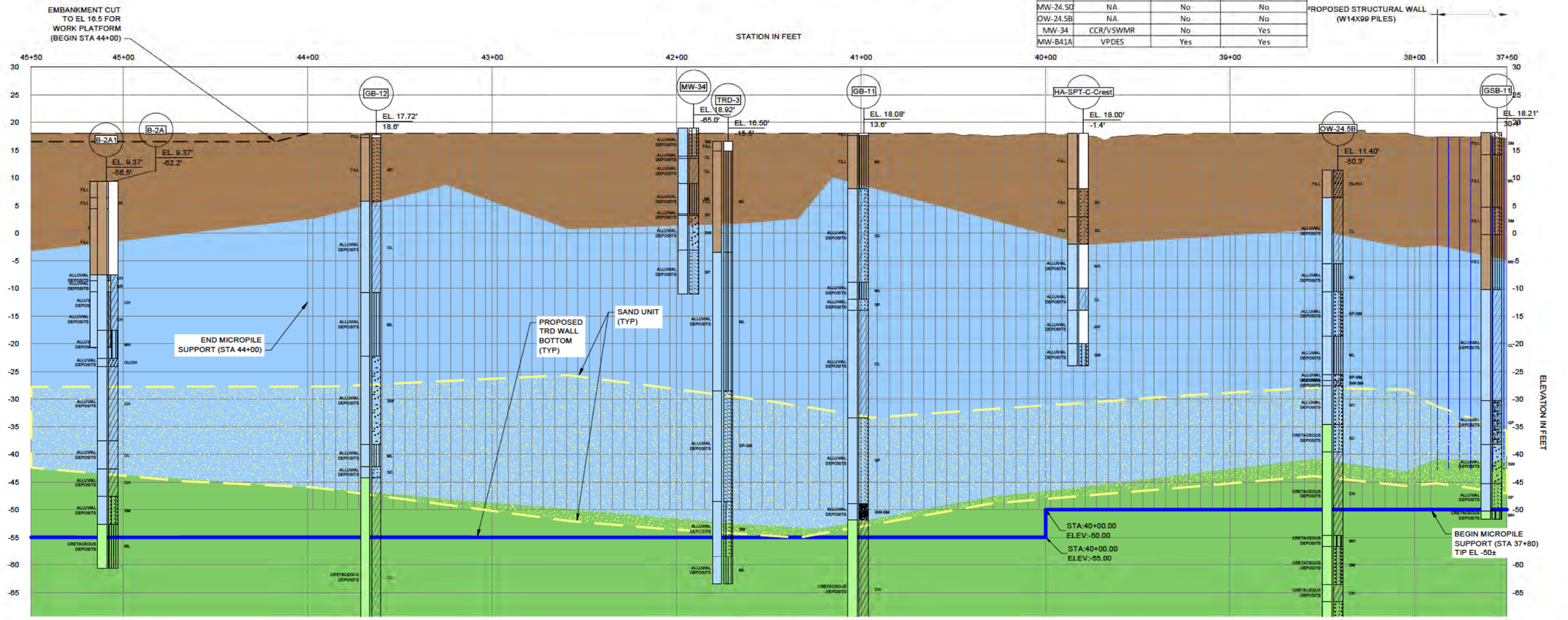
Sheet: C-204



PLAN
STA. 37+50 TO 45+50

0 30 60 90 120
SCALE IN FEET

Wells	Monitoring Program	Direct Work Path*	Hydraulically Cut Off**
P-1	NA	No	-
P-2	NA	Yes	Yes
P-3	NA	No	Yes
TRD-3	NA	Yes	-
MW-24.5S	NA	No	Yes
MW-24.5I	NA	No	No
MW-24.5D	NA	No	No
OW-24.5B	NA	No	No
MW-34	CCR/VSWMR	No	Yes
MW-B41A	VPDES	Yes	Yes



PROFILE
STA. 37+50 TO 45+50

HORIZ. 0 30 60 90 120
VERT. 0 10 20 30 40
SCALE IN FEET

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

PLAN AND PROFILE
STA. 37+50 TO 45+50

C-205

Sheet: 11 of 19

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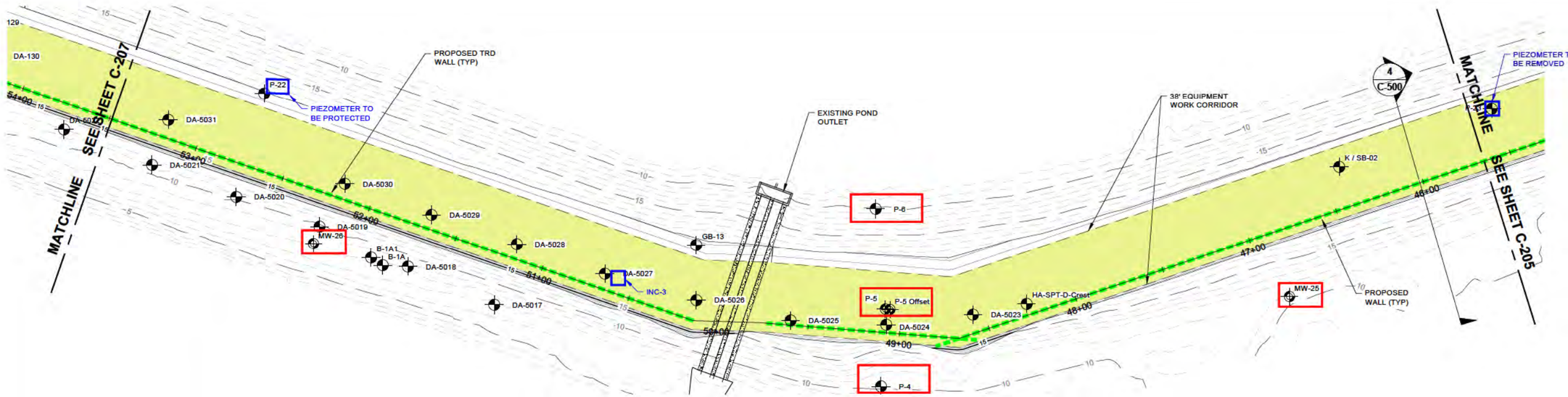
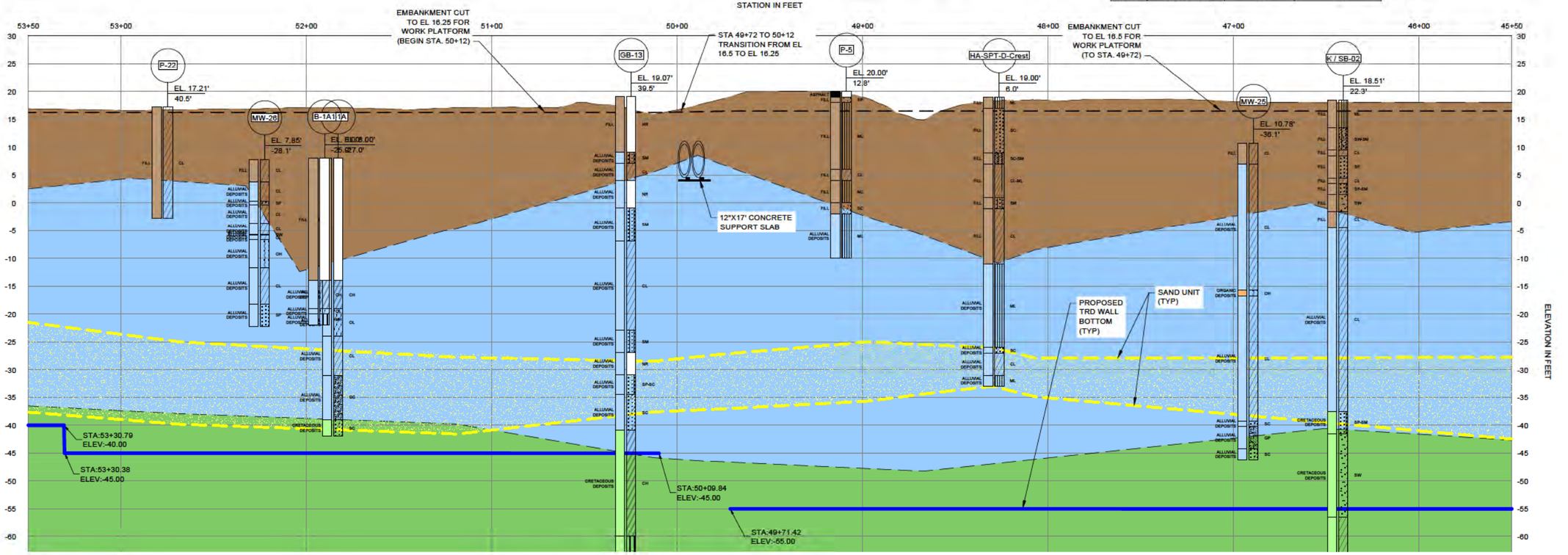


PLAN
STA. 45+50 TO 53+50

0 30 60 90 120
SCALE IN FEET

Wells	Monitoring Program	Direct Work Path*	Hydraulically Cut Off**
P-4	NA	No	-
P-5	NA	Yes	Yes
P-6	NA	Yes	Yes
MW-25	CCR/VSWMR	No	Yes
MW-26	CCR/VSWMR	Yes	Yes

STATION IN FEET



PROFILE
STA. 45+50 TO 53+50

HORIZ. 0 30 60 90 120
VERT. 0 10 20 30 40
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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

PLAN AND PROFILE
STA. 45+50 TO 53+50

C-206

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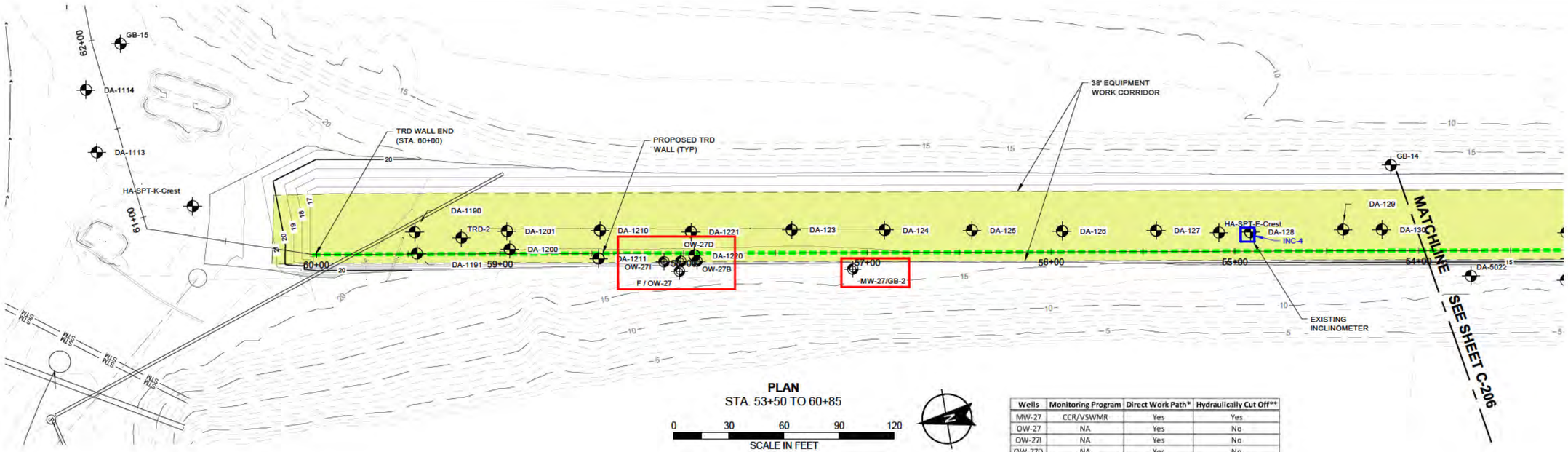
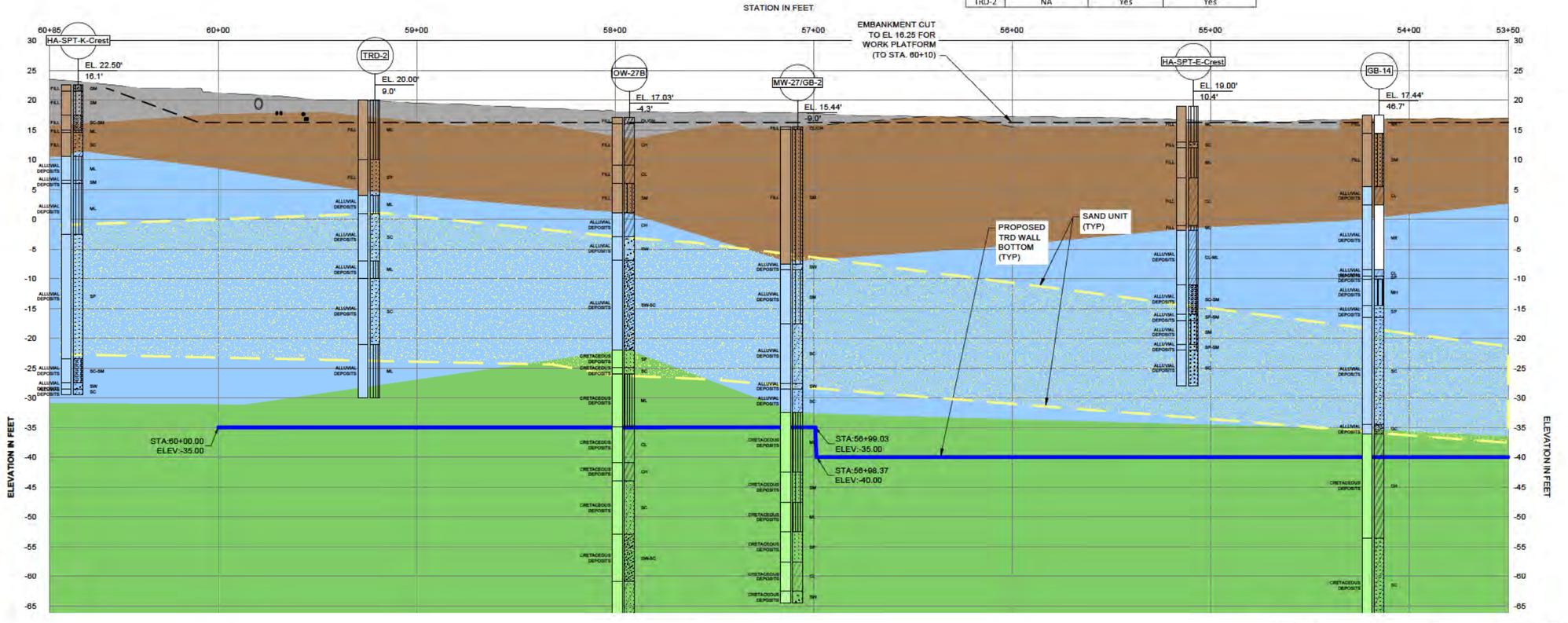


PLAN
STA. 53+50 TO 60+85

0 30 60 90 120
SCALE IN FEET

Wells	Monitoring Program	Direct Work Path*	Hydraulically Cut Off**
MW-27	CCR/VSWMR	Yes	Yes
OW-27	NA	Yes	No
OW-27I	NA	Yes	No
OW-27D	NA	Yes	No
OW-27B	NA	Yes	No
TRD-2	NA	Yes	Yes



PROFILE
STA. 53+50 TO 60+85

HORIZ. 0 30 60 90 120
VERT. 0 10 20 30 40
SCALE IN FEET

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

PLAN AND PROFILE
STA. 53+50 TO 60+85

C-207

Sheet: 13 of 19

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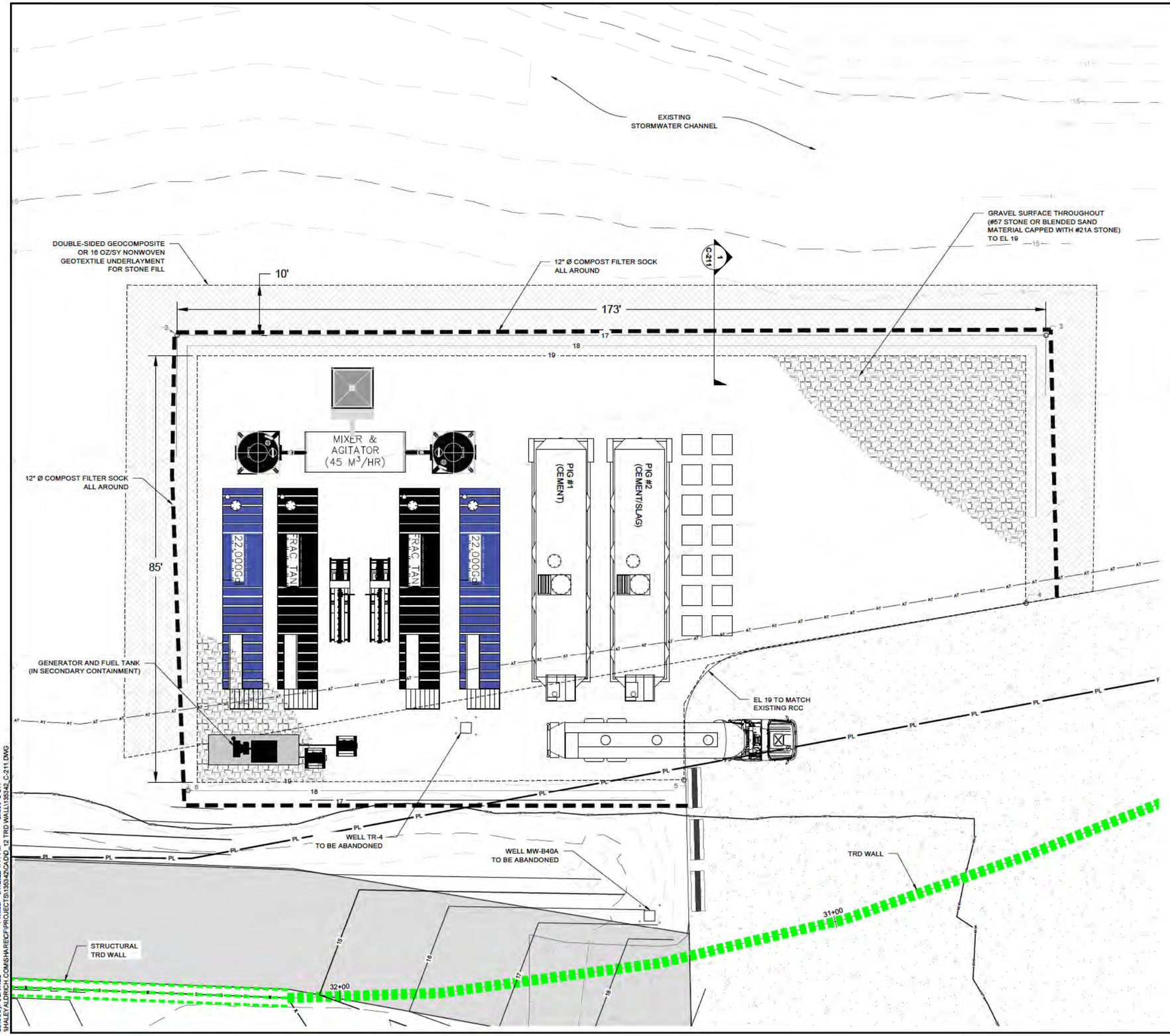


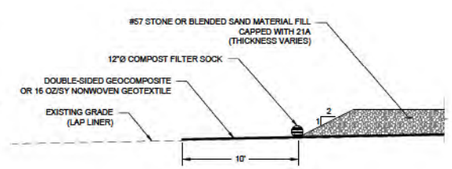
LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING LINER ANCHOR TRENCH
- 100 YEAR FLOODPLAIN

GROUT PLANT NOTES

1. LAYOUT OF GROUT PLANT EQUIPMENT IS PROVIDED BY KELLER AND MAY VARY.

Point #	Easting	Northing	Point Elevation	Raw Description
2	11808597.6655'	3660650.9907'	17.000'	NWCorner
3	11808770.6649'	3660650.9907'	17.000'	NECorner
4	11808766.6649'	3660597.6758'	19.000'	SECorner at RCC
5	11808698.5848'	3660562.5113'	19.000'	SECorner at RCC
6	11808599.8495'	3660560.3520'	18.000'	SWCorner



1 **PAD SECTION**
NOT TO SCALE

N

0 10 20 30 40
SCALE IN FEET

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

GROUT PLANT

C-211

Sheet: 14 of 19

Sheet: C-211
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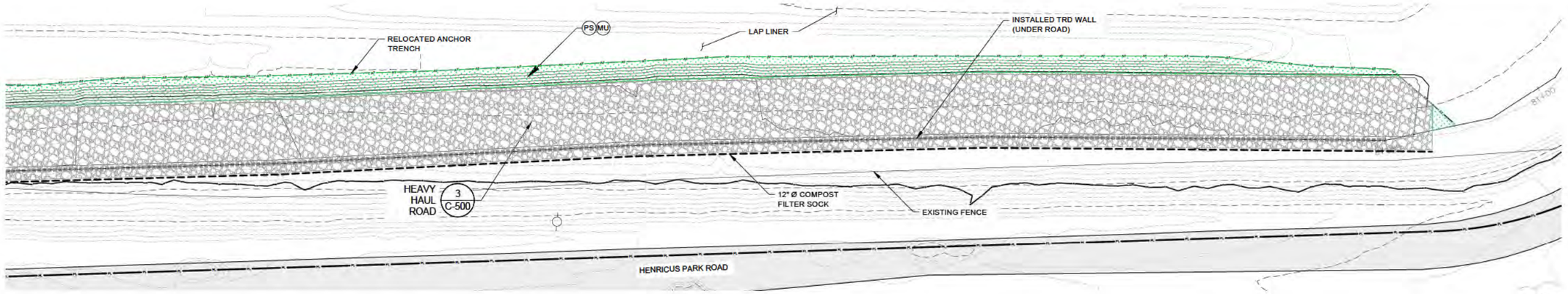
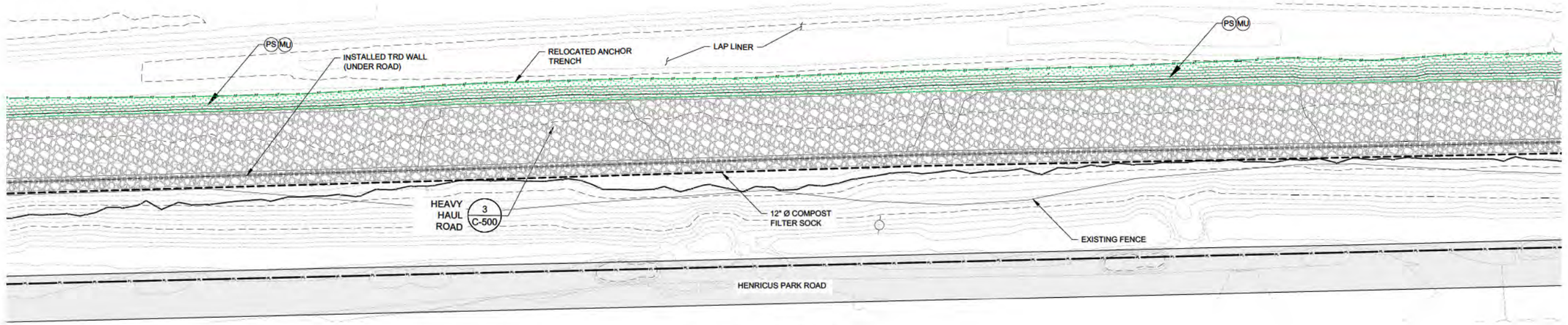


STATION 0+00 TO 07+00

SCALE: AS SHOWN

0 30 60 90 120

SCALE IN FEET



STATION 07+00 TO 14+50

SCALE: AS SHOWN

0 30 60 90 120

SCALE IN FEET

LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING RPA BOUNDARY
- EXISTING PAVED ROAD
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR
- PROPOSED PERMANENT SEEDING AND MULCH (PS)(MU)
- PROPOSED GRAVEL ROAD
- PROPOSED COMPOST FILTER SOCK

NOTES

1. BASE TOPOGRAPHY FROM AERIAL SURVEY PERFORMED BY DRAPER ADEN ASSOCIATES, INC. ON 12/23/2020, PROJECT NO. 20021424-010508, DATED 02/26/2021.
2. HORIZONTAL DATUM NAD83, VERTICAL DATUM NAVD88.

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

FINAL STABILIZATION PLANS

C-300

Sheet: 15 of 19

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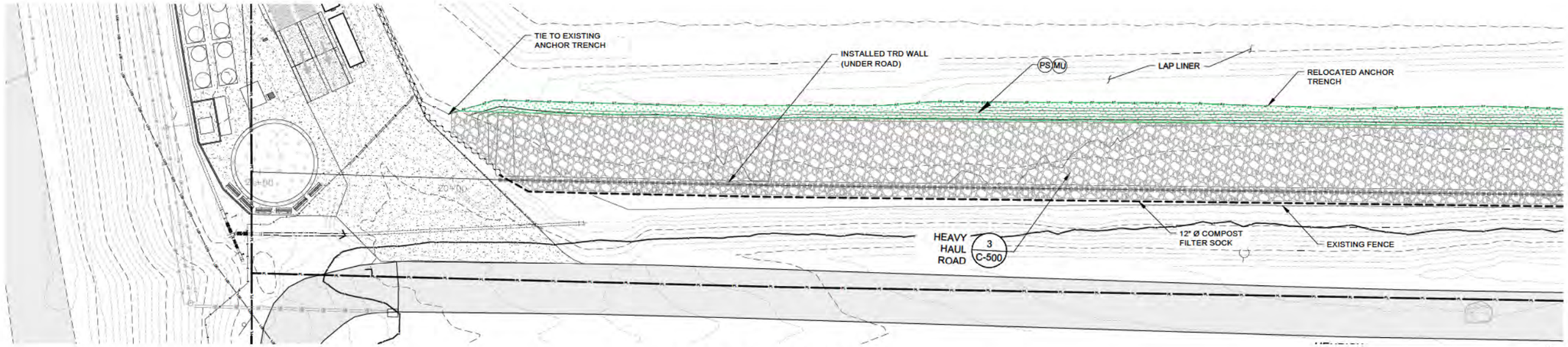
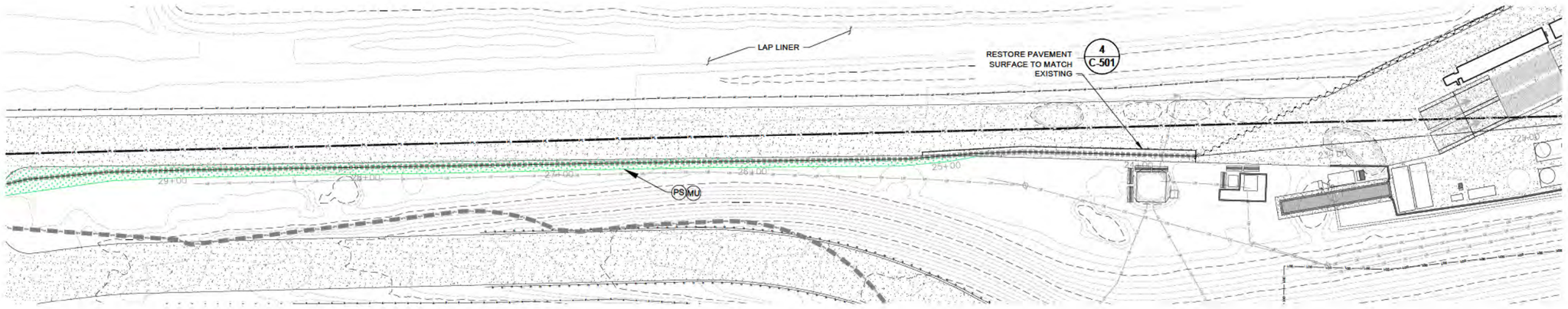


STATION 14+50 TO 19+77

SCALE: AS SHOWN

0 30 60 90 120

SCALE IN FEET



STATION 23+73 TO 29+50

SCALE: AS SHOWN

0 30 60 90 120

SCALE IN FEET

LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING RPA BOUNDARY
- EXISTING PAVED ROAD
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR
- PROPOSED PERMANENT SEEDING AND MULCH (PS MU)
- PROPOSED GRAVEL ROAD
- PROPOSED COMPOST FILTER SOCK

NOTES

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

FINAL STABILIZATION PLANS

C-301

Sheet: 16 of 19

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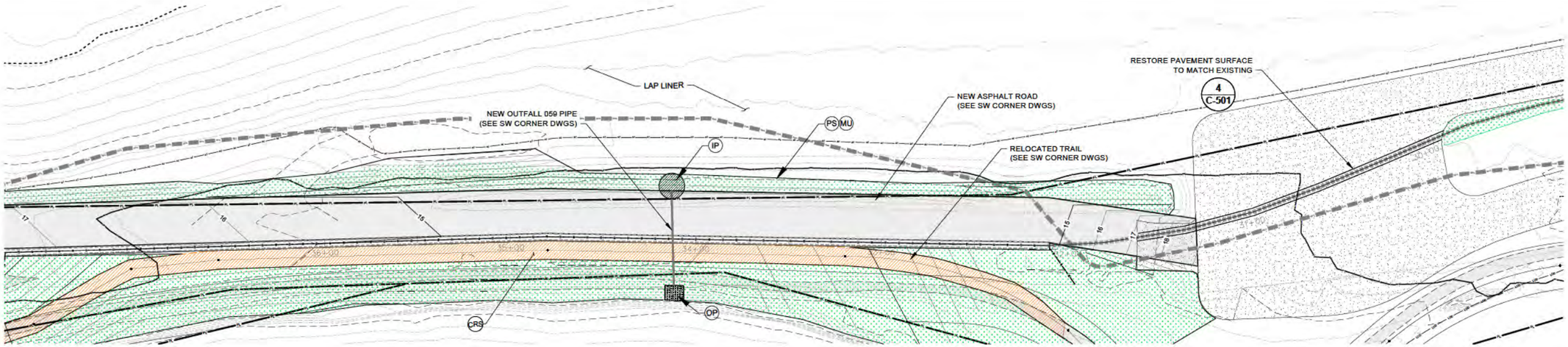
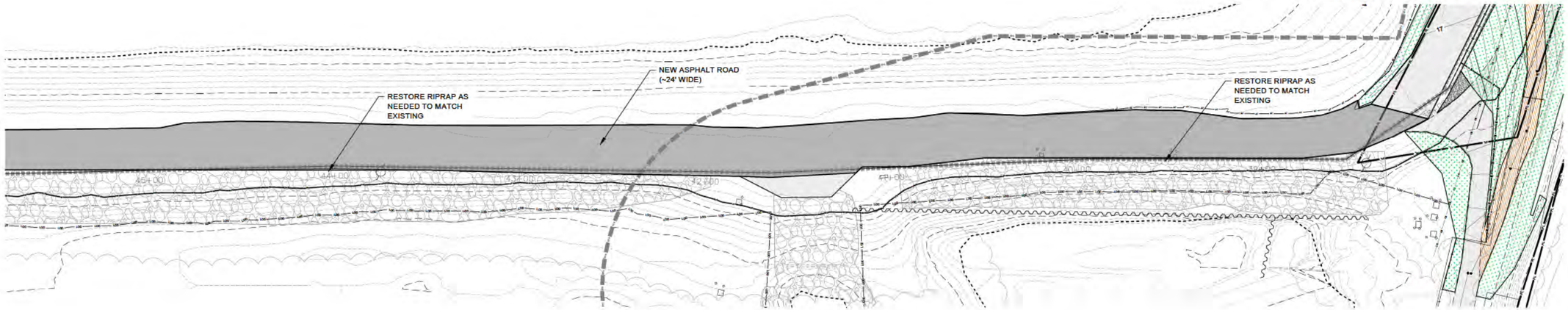


STATION 29+50 TO 37+50

SCALE: AS SHOWN

0 30 60 90 120

SCALE IN FEET



STATION 37+50 TO 45+50

SCALE: AS SHOWN

0 30 60 90 120

SCALE IN FEET

LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING RPA BOUNDARY
- EXISTING PAVED ROAD
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR
- PROPOSED PERMANENT SEEDING AND MULCH (PS)(MU)
- PROPOSED GRAVEL ROAD
- PROPOSED COMPOST FILTER SOCK

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CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

FINAL STABILIZATION PLANS

C-302

Sheet: 17 of 19

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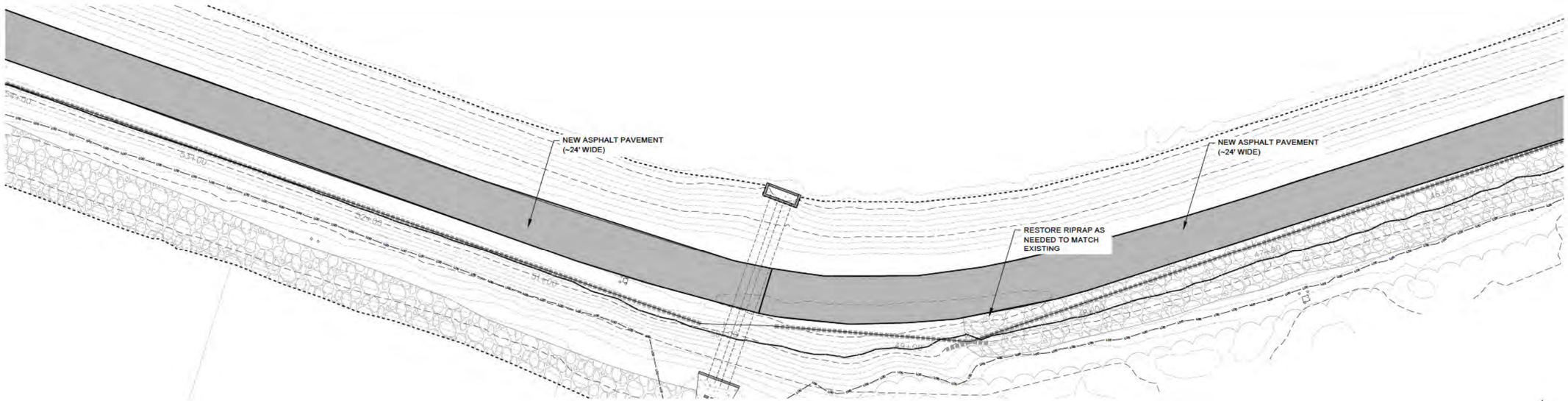

STATION 45+50 TO 53+50

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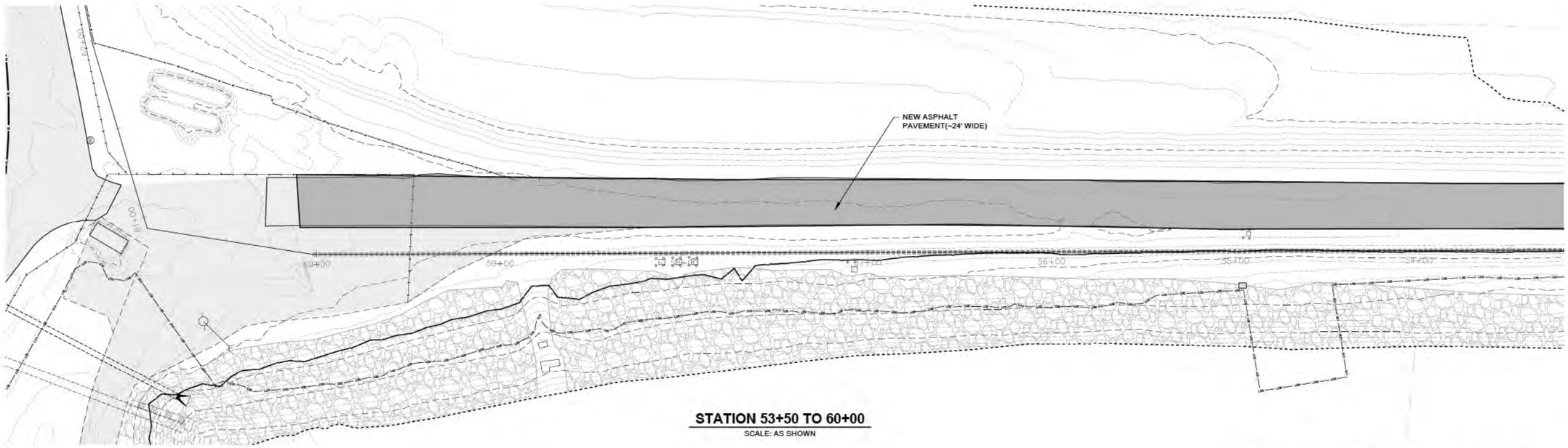

STATION 53+50 TO 60+00

SCALE: AS SHOWN

0 30 60 90 120

SCALE IN FEET

LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING PROPERTY LINE
- EXISTING RPA BOUNDARY
- EXISTING PAVED ROAD
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- PROPOSED CONTOUR MAJOR
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PROFESSIONAL ENGINEER

Rev.	Description	By	Date
1	GENERAL UPDATES	MPG	06/07/22

CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

FINAL STABILIZATION PLANS

C-303

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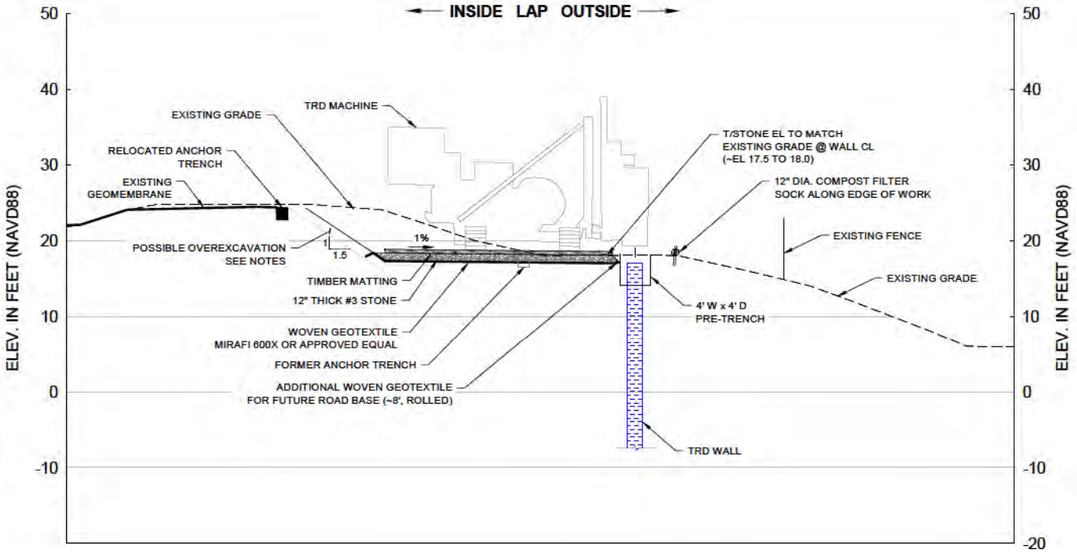
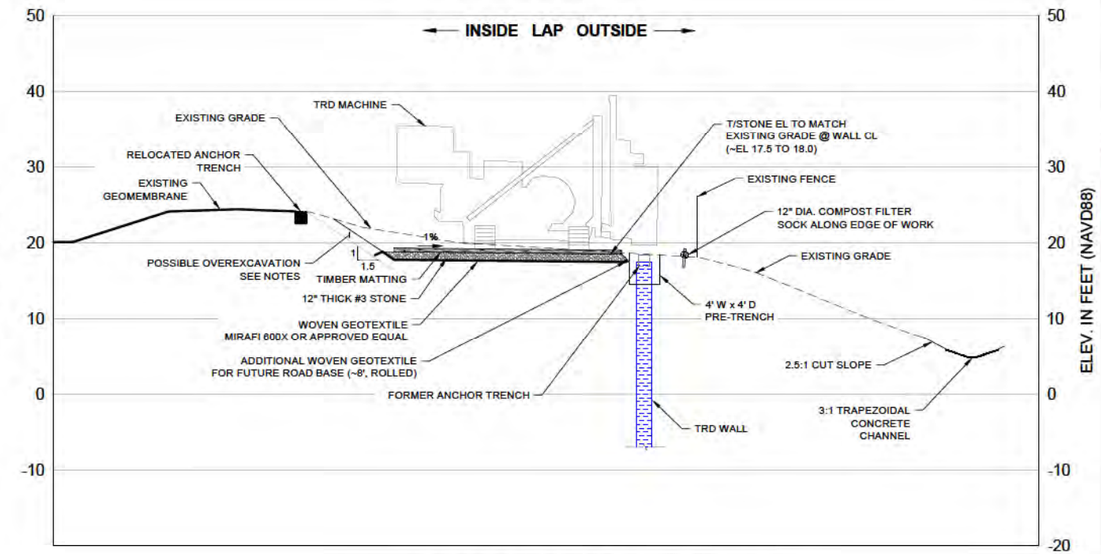
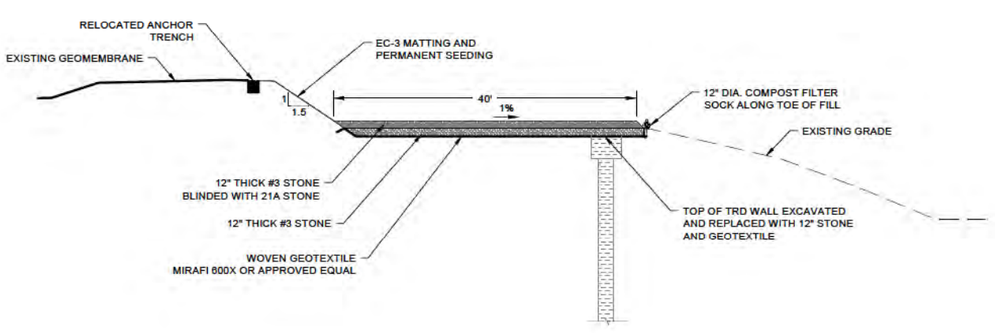


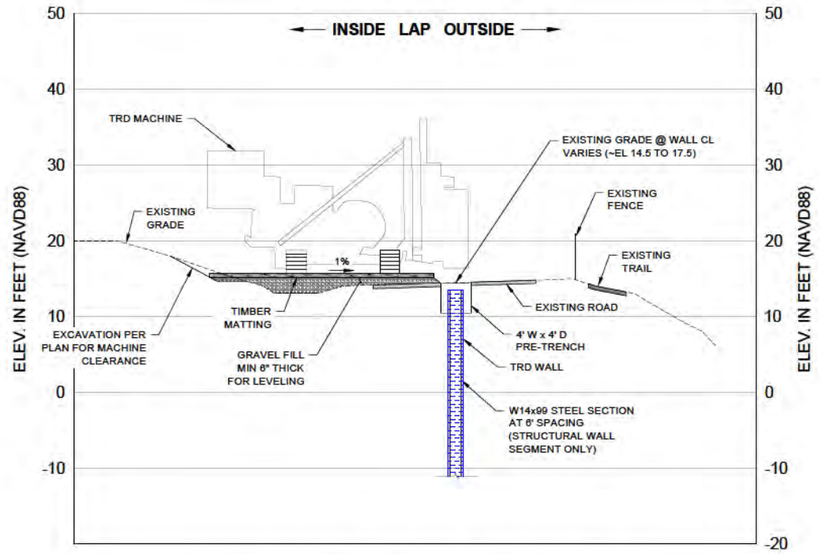
1 TYPICAL TRD WALL WORK PLATFORM FROM STA 0+00 TO 10+00
SCALE: 1" = 10'



2 TYPICAL TRD WALL WORK PLATFORM FROM STA 10+00 TO 19+72
SCALE: 1" = 10'



3 HAUL ROAD CONVERSION STA. 0+00 TO 19+50 (TYP)
SCALE: 1" = 10'



4 TYPICAL TRD WALL WORK PLATFORM FROM STA 31+50 TO 37+80
SCALE: 1" = 10'

SECTIONS NOTES

1. IF CCR IS ENCOUNTERED DURING THE EXCAVATION FOR THE TRD WORK PLATFORM, IT SHALL BE REMOVED TO A DEPTH OF AT LEAST ONE FOOT BELOW THE FINISHED GRADE SURFACE AND REPLACED WITH AT LEAST ONE FOOT OF SOIL, STONE, ETC. OF COVER MATERIAL.
2. IF CCR MATERIAL IS ENCOUNTERED IN THE 4' x 4' PRE-EXCAVATION TRENCH, EXCAVATION SHALL CONTINUE UNTIL VERIFIED VISUALLY CLEAN SOIL IS REACHED OR UNTIL A DEPTH OF 10 FEET IS REACHED, WHICHEVER COMES FIRST. CONSULT THE PROJECT ENGINEER FOR PRE-EXCAVATION DEPTHS GREATER THAN 10 FEET.
3. ENCOUNTERED CCR MATERIAL SHALL BE TAKEN TO THE ON-SITE LANDFILL.
4. ALTERNATE COVER MATERIALS MAY BE USED AS DESCRIBED IN THE LAP OPERATIONS PLAN, IF SUITABLE FOR THE LOCATION.
5. EXPOSED CCR SHALL BE PROTECTED FROM PRECIPITATION AND WIND, AND SHALL BE COVERED IN ACCORDANCE WITH NOTES 1 AND 2 AT THE END OF EACH WORKING DAY.
6. MAINTAIN POSITIVE DRAINAGE TOWARDS THE OUTSIDE OF THE LAP UNLESS OTHERWISE EXPLICITLY SHOWN IN THE DRAWINGS.
7. THE MAXIMUM ALLOWABLE SLOPES OF THE WORK PLATFORM ARE 3% PERPENDICULAR TO THE TRD TRENCH AND 4% ALONG THE AXIS OF THE TRENCH.

HALEY ALDRICH

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Midlothian, VA 23114
Tel: 804.419.0199
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Saiia®
Saiia Construction Company, LLC
4400 Lewisburg Road
Birmingham, AL 35207

ISSUED FOR PERMIT

Project No.:	135342-012
Scale:	SHOWN
Date:	JUNE 2022
Drawn By:	HA
Designed By:	HA
Checked By:	HA
Approved By:	HA

Stamp:

COMMONWEALTH OF VIRGINIA
DANIEL P. McGRATH
Lic. No. 040703
6/7/2022
PROFESSIONAL ENGINEER

Rev.	Description	By	Date
1	GENERAL UPDATES	MPG	06/07/22

CHESTERFIELD POWER STATION
TRD WALL CONSTRUCTION

BERMUDA DISTRICT
CHESTER, VIRGINIA

DETAILS

C-500

Sheet: 19 of 19

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APPENDIX D

GROUNDWATER PROTECTION STANDARDS

Groundwater Protection Standard Establishment
40 CFR Part 257 Subpart D

Chesterfield Power Station – Lower Ash Pond
Chester, Virginia

EPA's "*Disposal of Coal Combustion Residuals from Electric Utilities*" Final Rule, 40 CFR §257.95(d)(2), requires the owner or operator of an existing Coal Combustion Residuals (CCR) unit monitoring groundwater under the Assessment Monitoring Program to establish groundwater protection standards (GWPS) for all constituents detected pursuant to 40 CFR §257.95(b) or 40 CFR §257.95(d).

Initial Assessment Monitoring Program Appendix IV groundwater sampling and analysis was completed on March 23, 2018 in accordance with 40 CFR §257.95(b). Detected Appendix IV constituents included: arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, molybdenum, thallium, and radium 226 & 228 (combined). GWPS have been established for those detected Appendix IV constituents using the following methodology in accordance with 40 CFR §257.95(h):

1. For constituents for which a Maximum Contaminant Level (MCL) has been established, the MCL was used.
2. For constituents for which a health-based GWPS has been adopted under the August 29, 2018 Phase 1, Part 1 amendment to the CCR Rule, the health-based GWPS was used.
    a. The Commonwealth of Virginia adopted by reference the October 4, 2016 version of 40 CFR §257 into 9VAC20-81-800 of the Virginia Solid Waste Management Regulations. Amendments to 40 CFR Part 257 Subpart D after October 4, 2016 have not been incorporated into 9VAC20-81-800. Therefore, the health-based GWPS is not applicable to the Virginia CCR Rule under 9VAC20-81-800.
3. Under 9VAC20-81-800, for constituents for which an MCL has not been established, the background concentration for the constituent was used for GWPS.
4. For constituents for which the background level is higher than the MCL or health-based GWPS, the background concentration was used for GWPS.

Supporting data and calculations are included as an attachment to this memo. The following Table 1 summarizes groundwater protection standards for Chesterfield Power Station's Lower Ash Pond.

Attachments: Table 1 – CCR Rule Groundwater Protection Standards
Golder September 5, 2018 Proposed Groundwater Protection Standards

Table 1 – CCR Rule Groundwater Protection Standards – Chesterfield Power Station Lower Ash Pond

Detected Appendix IV Constituent	Units	Site-Specific Background Value	EPA MCL	CCR Rule Health-Based GWPS	CCR Rule GWPS	CCR Rule GWPS Source	Virginia CCR GWPS	Virginia CCR GWPS Source
Arsenic	µg/L	19.8	10	--	19.8	BKG	19.8	BKG
Barium	µg/L	318	2000	--	2000	MCL	2000	MCL
Beryllium	µg/L	QL (1)	4	--	4	MCL	4	MCL
Cadmium	µg/L	QL (1)	5	--	5	MCL	5	MCL
Chromium	µg/L	QL (5)	100	--	100	MCL	100	MCL
Cobalt	µg/L	7.40	--	6	7.40	BKG	7.40	BKG
Fluoride	µg/L	281	4000	--	4000	MCL	4000	MCL
Lead	µg/L	QL (1)	15*	15	15	CCR GWPS	QL (1)	BKG
Lithium	µg/L	QL (50)	--	40	40	CCR GWPS	QL (50)	BKG
Molybdenum	µg/L	QL (10)	--	100	100	CCR GWPS	QL (10)	BKG
Thallium	µg/L	QL (1)	2	--	2	MCL	2	MCL
Radium 226 & 228	pCi/L	1.55	5	--	5	MCL	5	MCL

Notes:

µg/L = Micrograms per liter
BKG = Site-Specific Background Value
CCR GWPS = Coal Combustion Residuals Rule health-based GWPS adopted under the Phase 1, Part 1 Amendment.
EPA = United States Environmental Protection Agency
GWPS = Groundwater Protection Standard
MCL = Maximum Contaminant Level
pCi/L = picocuries per liter
QL = Quantitation Limit; values in parentheses (1) represent highest laboratory QL for the constituent based on background data. Future QL values are subject to change; however, GWPS cannot be less than values in parentheses.
* = Listed MCL represents an EPA MCL action level

GOLDER

September 5, 2018

Reference No. 178975418.401

Kelly Hicks, P.G. Project Manager III
Dominion Energy
5000 Dominion Boulevard
Glen Allen, VA 23060

Via Email: kelly.a.hicks@dominionenergy.com

RE: PROPOSED GROUNDWATER PROTECTION STANDARDS
CHESTERFIELD POWER STATION LOWER ASH POND
CHESTERFIELD COUNTY, VIRGINIA

Dear Kelly:

Consistent with the provisions of Title 40 Code of Federal Regulations (CFR) Subpart 257.95(d)(2) of the Coal Combustion Residuals (CCR) Rule, Golder Associates Inc. (Golder) is providing the enclosed proposed Groundwater Protection Standard (GPS) for the Lower Ash Pond at the Dominion Chesterfield Power Station. The proposed GPS are for the Lower Ash Pond and are proposed for the Appendix IV constituents listed in 40 CFR 257 that were detected during the initial Assessment Monitoring Program Appendix IV sampling event. A summary of the proposed GPS is provided in Table 1. As presented, the proposed GPS are based on:

- Federal Maximum Contaminant Levels (MCLs) – for constituents for which an MCL has been established; or;
- Site-specific background values – for constituents for which an MCL has not been established or for constituents for which the site-specific background value is higher than the MCL; or;
- United States Environmental Protection Agency (EPA) risk-based Regional Screening Levels (RSLs) for Tapwater – for constituents for which an MCL has not been established, an RSL may be used.

The results of the supporting statistical evaluations are summarized in Table 2.

The selection of a statistical method was previously certified pursuant to the CCR rule [257.93(f)(6)] and posted the Certification in the Facility's operating record on October 17, 2017, pursuant to the CCR Rule [257.105(h)(4)]. Golder recommends that the MCL-based GPS be updated upon the EPA's promulgation of new or revised MCLs. The site-specific background-based GPS should be updated as needed based on changes in background water quality.

Golder Associates Inc.
2108 West Laburnum Ave., Suite 200
Richmond, Virginia, USA 23227

T: +1 804 358-7900 | F: +1 804 358-2900

If you have any questions regarding the information presented herein, please do not hesitate to contact us.

Sincerely,

Golder Associates Inc.

Craig J. LaCosse
Senior Project Geologist

Michael G. Williams, C.P.G.
Principal and Senior Consultant

Cc: Martha Smith (Golder)

Attachments:

Table 1:	Proposed CCR Groundwater Protection Standards, CCR Rule Appendix IV Constituents, Lower Ash Pond, Chesterfield Power Station
Table 2:	Summary of Appendix IV Statistical Evaluations, Lower Ash Pond, Chesterfield Power Station
Attachment 1	Background Statistic Worksheets

https://golderassociates.sharepoint.com/sites/22463g/reports/cps - lap-uap-metals 2018/cps lap 2018/proposed gps/draft final/2018-09-05 cps lap ccr gps proposal.docx

Tables

Table 1
Proposed CCR Groundwater Protection Standards
CCR Rule Appendix IV Constituents
Lower Ash Pond
Chesterfield Power Station

CCR Appendix IV Consituent	Class	CAS RN	Units	Site-Specific Background Value	EPA MCL/RSL	Proposed CCR GPS	GPS Source
Arsenic	Metal	7440-38-2	µg/L	19.8	10	19.8	BKG
Barium	Metal	7440-39-3	µg/L	318	2,000	2,000	MCL
Beryllium	Metal	7440-41-7	µg/L	QL (1)	4	4	MCL
Cadmium	Metal	7440-43-9	µg/L	QL (1)	5	5	MCL
Chromium	Metal	7440-47-3	µg/L	QL (5)	100	100	MCL
Cobalt	Metal	7440-48-4	µg/L	7.4	[6]	7.4	BKG
Fluoride	Metal	16984-48-8	µg/L	281.4	4,000	4,000	MCL
Lead	Metal	7439-92-1	µg/L	QL (1)	15*	15*	MCL*
Lithium	Metal	7439-93-2	µg/L	QL (50)	[40]	50	BKG
Molybdenum	Metal	7439-98-7	µg/L	QL (10)	[100]	100	RSL
Thallium	Metal	7440-28-0	µg/L	QL (1)	2	2	MCL
Radium 226 & 228	Radionuclide	13982-63-3 / 15262-20-1	pCi/L	1.55	5	5	MCL

Notes:
µg/L = Microgram per liter
BKG = Site-specific Background Value
CAS RN = Chemical Abstracts Service Registry Number
CCR = Coal Combustion Residuals
EPA = United States Environmental Protection Agency
GPS = Groundwater Protection Standard
MCL = Maximum Contaminant Level
RSL = Regional Screening Level; RSLs are presented in brackets
pCi/L = picoCurie per liter
MDC = Minimum Detectable Concentration (sample specific)
QL = Laboratory quantitation limit (value shown in parentheses is a recent QL and is subject to change)
Note that quantitiation limit is subject to change with updated method detection limit studies
(1) = Indicated value represents recent quantitation limit
* = Listed MCL represents an EPA action level

Table 2
Summary of Appendix IV Statistical Evaluations
Lower Ash Pond
Chesterfield Power Station

Sample Identity	Date	Arsenic, Appendix IV ug/L	Barium, Appendix IV ug/L	Beryllium, Appendix IV ug/L	Cadmium, Appendix IV ug/L	Chromium, Appendix IV ug/L	Cobalt, Appendix IV ug/L	Fluoride, Appendix III & IV ug/L
MW-29U	10/07/2016	2.1 J	200	< 1.0 U	< 1.0 U	2.0 B	3.4	79 J
	11/16/2016	9.3	270	< 1.0 U	< 1.0 U	1.6 J	3.9	160 J
	01/09/2017	3.7 J	180	< 1.0 U	0.43 J	0.57 B	2.7	120
	02/20/2017	7.2	240	< 1.0 U	< 1.0 U	0.75 J	4.1	130
	04/03/2017	9.1	210	< 1.0 U	< 1.0 U	0.84 J+	6.9 J+	230 J+
	05/15/2017	13	280	< 1.0 U	0.33 J	< 2.0 U	4.4	190
	06/19/2017	17.8	318	< 1.0 U	0.90	1.4	3.8	220
	07/24/2017	14.6	275	< 1.0 U	< 0.80 U	1.8 J+	3.6	140
MW-35S	01/12/2017	< 5.0 U	48	< 1.0 U	0.34 J	1.3 B	5.4	24 B
	02/23/2017	< 5.0 U	42	< 1.0 U	< 1.0 U	0.34 B	3.8	29 B
	03/16/2017	0.41 J	42	< 1.0 U	< 1.0 U	< 2.0 U	3.6	42 B
	04/07/2017	0.51 J	41	< 1.0 U	< 1.0 U	0.38 J	3.0	27 J
	05/03/2017	< 5.0 U	28	< 1.0 U	< 1.0 U	< 2.0 U	1.7	< 50 U
	06/06/2017	< 5.0 U	40	< 1.0 U	< 1.0 U	< 2.0 U	1.9	28 J
	07/05/2017	< 1.0 U	43.0	< 1.0 U	< 0.80 U	1.2 J	0.94 J	< 100 U
	08/10/2017	< 1.0 U	38.4	< 1.0 U	< 0.80 U	< 5.0 U	0.82 J	< 100 U
Minimum		0.41	28	1.0	0.33	0.34	0.8	24
Maximum		17.80	318	1.0	1.00	5.00	6.9	230
n		16	16	16	16	16	16	16
Count Detects		10	16	0	4	11	16	13
Count Non-Detects		6	0	16	12	5	0	3
Mean of Data Set		6.23	143.46	1.0	0.84	1.57	3.37	104
Standard Deviation of Data Set		5.29	111.37	0.0	0.25	1.10	1.57	70
% Truncated		38%	0%	100%	75%	31%	0%	19%
Outliers		No	No	No	No	No	No	No
n (Outliers Removed)		16	16	16	16	16	16	16
% Truncated (Outliers Removed)		38%	0%	100%	75%	31%	0%	19%
Normality		Normal	Non-Normal	Non-Normal	Non-Normal	Normal	Normal	Normal
Mean & Std Adjustment		Kaplan Meier	Not Applicable	Not Applicable	Not Applicable	Kaplan Meier	Not Applicable	Kaplan Meier
Adjusted Mean of Data Set		5.233	Not Applicable	Not Applicable	Not Applicable	1.083	Not Applicable	95.19
Adjusted Standard Deviation of Data Set		5.665	Not Applicable	Not Applicable	Not Applicable	0.531	Not Applicable	72.54
Background Limit Type		UPL	NPTL	NPTL	NPTL	UPL	UPL	UPL
Parametric Critical Value		2.49	Not Applicable	Not Applicable	Not Applicable	2.49	2.49	2.49
Calculated Background Concentration		19.8	318	1 (QL)	1 (QL)	2.447	7.4	281.4
Level of Confidence		95%	95%	95%	95%	95%	95%	95%
Percent Coverage		95%	82.9%	82.9%	82.9%	95%	95%	95%
Is Calculated Background > QL		Yes	Yes	No --> will use QL (1.0)	No --> will use QL (1.0)	No --> will use QL (5.0)	Yes	Yes

Notes:

n - Number of Observations
ug/L - micrograms per liter
pCi/L - picocuries per liter
B - result is blank qualified
J+ - Estimated/bias high concentration
ND - Not Detected
Non-Parametric Percent Coverage for Data Sets - Table 17-4 in Appendix D of Unified Guidance
NTPL - Non-Parametric Tolerance Limit
Parametric Prediction Limit Critical Value (t-quantile)- Table 16-1 in Appendix D of Unified Guidance
Parametric Tolerance Limit Critical Value (tolerance factor)- Table 17-3 in Appendix D of Unified Guidance
QL = Laboratory quantitation limit = Reporting limit
U - Result below method detection limit / minimum detectable concentration
UPL - Upper Prediction Limit using K=4
NTPL - Non-Parametric Tolerance Limit

Check: CJL 9/4/18

Review: MGW 9/4/18

Table 2
Summary of Appendix IV Statistical Evaluations
Lower Ash Pond
Chesterfield Power Station

Sample Identity	Date	Lead, Appendix IV ug/L	Lithium, Appendix IV ug/L	Molybdenum, Appendix IV ug/L	Thallium, Appendix IV ug/L	Total Radium pCi/L
MW-29U	10/07/2016	0.51 B	< 50 U	1.0 J	< 1.0 U	0.909
	11/16/2016	0.79 J	< 50 U	1.1 J	< 1.0 U	1.00
	01/09/2017	< 1.0 U	0.48 B	0.74 J	< 1.0 U	0.709
	02/20/2017	0.19 B	0.51 J	1.2 B	< 1.0 U	1.24
	04/03/2017	0.28 J+	1.0 J+	1.1 J	< 1.0 U	0.476
	05/15/2017	0.47 J	< 8.0 U	1.9 J	< 1.0 U	0.693
	06/19/2017	< 0.10 U	0.41 J	6.4	< 0.10 U	0.542 U
	07/24/2017	< 1.0 U	< 25.0 U	5.0 J	< 1.0 U	1.53
MW-35S	01/12/2017	0.46 B	1.5 J	< 10 U	< 1.0 U	0.841
	02/23/2017	0.18 B	1.7 B	< 10 U	< 1.0 U	0.615
	03/16/2017	0.31 B	1.6 J	0.58 J	< 1.0 U	0.658
	04/07/2017	0.37 J	1.9 J	0.68 J	< 1.0 U	0.358
	05/03/2017	< 1.0 U	2.1 J	< 10 U	< 1.0 U	0.554
	06/06/2017	< 1.0 U	2.4 J	< 10 U	< 1.0 U	0.282 U
	07/05/2017	< 1.0 U	1.5 J	< 5.0 U	< 1.0 U	0.908 U
	08/10/2017	< 1.0 U	2.4 J	< 5.0 U	< 1.0 U	0.934 U
Minimum		0.10	0.41	0.58	0.1	0.282
Maximum		1.00	50	10.00	1.0	1.530
n		16	16	16	16	16
Count Detects		9	12	10	0	12
Count Non-Detects		7	4	6	16	4
Mean of Data Set		0.60	9.41	4.356	0.944	0.766
Standard Deviation of Data Set		0.35	16.94	3.848	0.225	0.323
% Truncated		44%	25%	38%	100%	25%
Outliers		No	Yes	No	No	No
n (Outliers Removed)		16	14	16	16	16
% Truncated (Outliers Removed)		44%	14%	38%	100%	25%
Normality		Normal	Normal	Log-Normal	Non-Normal	Normal
Mean & Std Adjustment		Kaplan Meier	Kaplan Meier	Kaplan Meier	Not Applicable	Kaplan Meier
Adjusted Mean of Data Set		0.366	1.458	0.266 (LN)	Not Applicable	0.711
Adjusted Standard Deviation of Data Set		0.192	0.685	0.732 (LN)	Not Applicable	0.328
Background Limit Type		UPL	UPL	UTL	NPTL	UPL
Parametric Critical Value		2.49	2.533	2.524	Not Applicable	2.49
Calculated Background Concentration		0.858	3.254	8.28	1 (QL)	1.552
Level of Confidence		95%	95%	95%	95%	95%
Percent Coverage		95%	95%	95%	82.9%	95%
Is Calculated Background > QL		No --> will use QL (1.0)	No --> will use QL (50.0)	No --> will use QL (10.0)	No --> will use QL (1.0)	Yes

Notes:

n - Number of Observations
ug/L - micrograms per liter
pCi/L - picocuries per liter
B - result is blank qualified
J+ - Estimated/bias high concentration
ND - Not Detected
Non-Parametric Percent Coverage for Data Sets - Table 17-4 in Appendix D of Unified Guidance
NTPL - Non-Parametric Tolerance Limit
Parametric Prediction Limit Critical Value (t-quantile)- Table 16-1 in Appendix D of Unified Guidance
Parametric Tolerance Limit Critical Value (tolerance factor)- Table 17-3 in Appendix D of Unified Guidance
QL = Laboratory quantitation limit = Reporting limit
U - Result below method detection limit / minimum detectable concentration
UPL - Upper Prediction Limit using K=4
NTPL - Non-Parametric Tolerance Limit

Check: CJL 9/4/18

Review: MGW 9/4/18

Attachment 1

Background Statistic Worksheets

Arsenic, Appendix IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	12		
Number of Detects	10	Number of Non-Detects	6
Number of Distinct Detects	10	Number of Distinct Non-Detects	2
Minimum Detect	0.41	Minimum Non-Detect	1
Maximum Detect	17.8	Maximum Non-Detect	5
Variance Detected	37.18	Percent Non-Detects	37.5%
Mean Detected	7.772	SD Detected	6.098
Mean of Detected Logged Data	1.502	SD of Detected Logged Data	1.364

Dixon's Outlier Test for Arsenic, Appendix IV

Total N = 16
Number NDs = 6
Number Detects = 10
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 17.8 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.277

For 10% significance level, 17.8 is not an outlier.
For 5% significance level, 17.8 is not an outlier.
For 1% significance level, 17.8 is not an outlier.

2. Data Value 0.41 is a Potential Outlier (Lower Tail)?

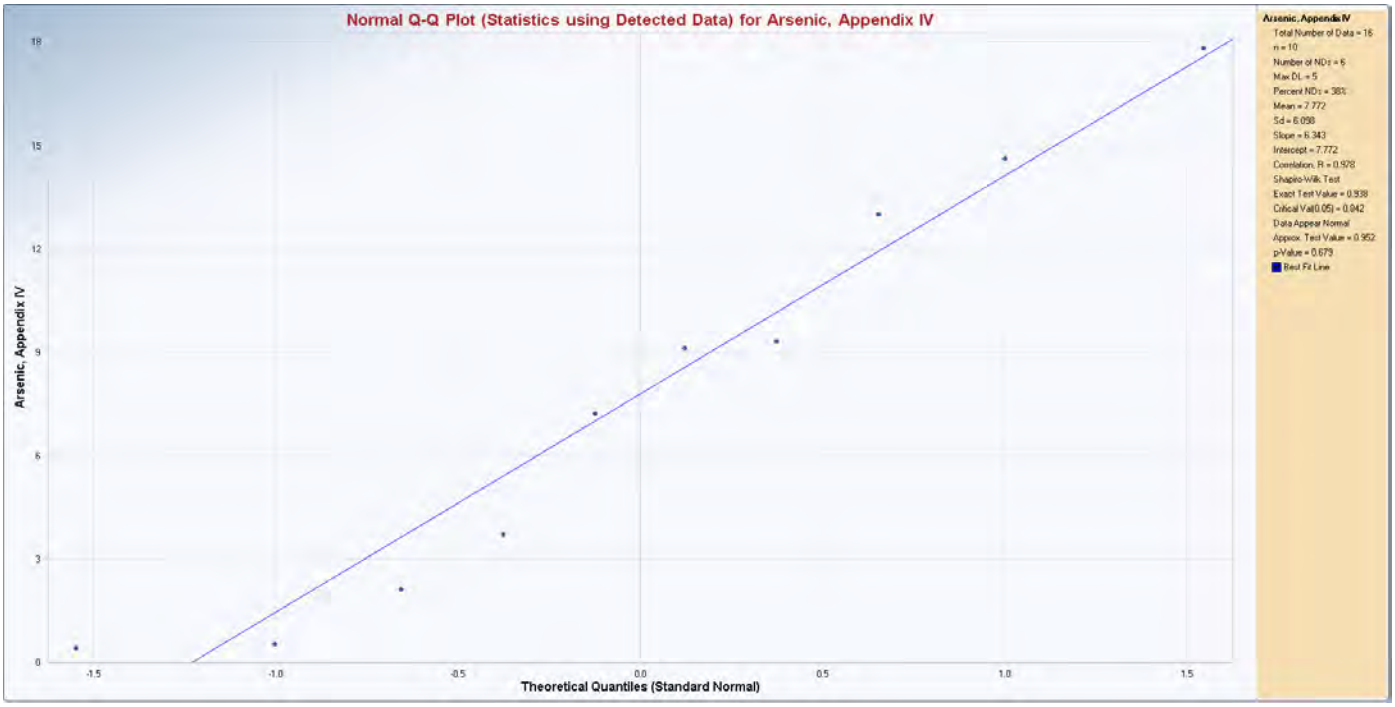
Test Statistic: 0.007

For 10% significance level, 0.41 is not an outlier.
For 5% significance level, 0.41 is not an outlier.
For 1% significance level, 0.41 is not an outlier.

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.524	d2max (for USL)	2.443

Arsenic, Appendix IV



Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

Mean	5.233	SD	5.665
95% UTL95% Coverage	19.53	95% KM UPL (t)	15.47
95% KM UPL for Next 4 Observations	19.77	95% KM UPL for Mean of Next 4 Observations	10.79

Barium, Appendix IV

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
Minimum	28	First Quartile	41.75
Second Largest	280	Median	114
Maximum	318	Third Quartile	247.5
Mean	143.5	SD	111.4
Coefficient of Variation	0.776	Skewness	0.261
Mean of logged Data	4.589	SD of logged Data	0.948

Dixon's Outlier Test for Barium, Appendix IV

Total N = 16
Number NDs = 0
Number Detects = 16
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 318 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.155

For 10% significance level, 318 is not an outlier.
For 5% significance level, 318 is not an outlier.
For 1% significance level, 318 is not an outlier.

2. Data Value 28 is a Potential Outlier (Lower Tail)?

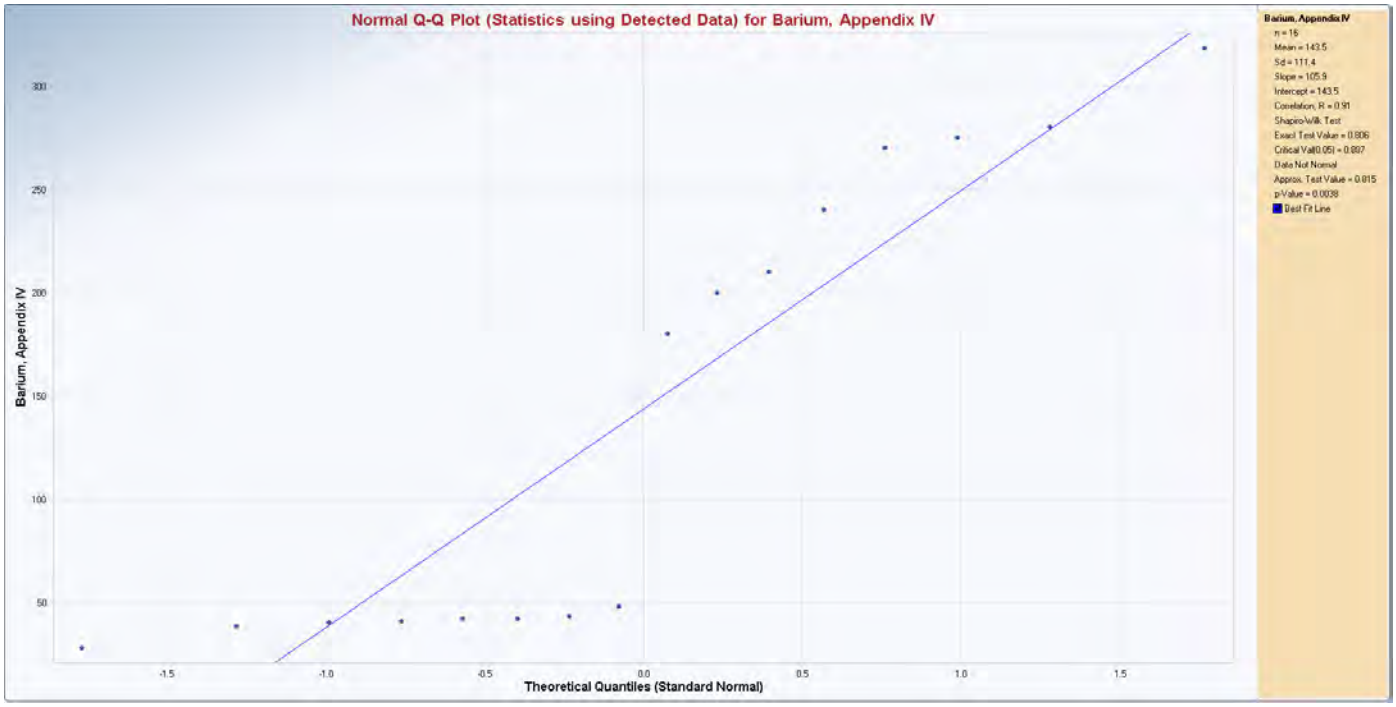
Test Statistic: 0.049

For 10% significance level, 28 is not an outlier.
For 5% significance level, 28 is not an outlier.
For 1% significance level, 28 is not an outlier.

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.524	d2max (for USL)	2.443

Barium, Appendix IV

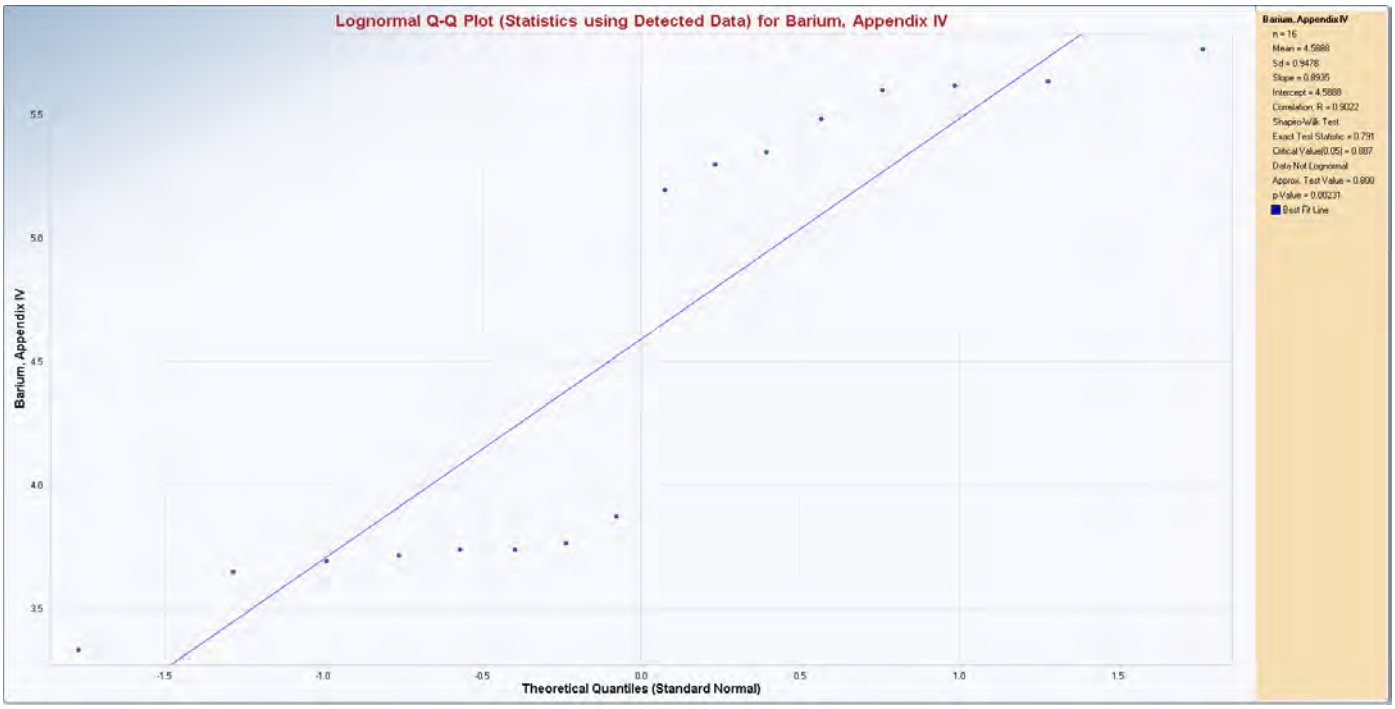


Normal GOF Test

Shapiro Wilk Test Statistic	0.806	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Barium, Appendix IV



Lognormal GOF Test

Shapiro Wilk Test Statistic	0.791	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

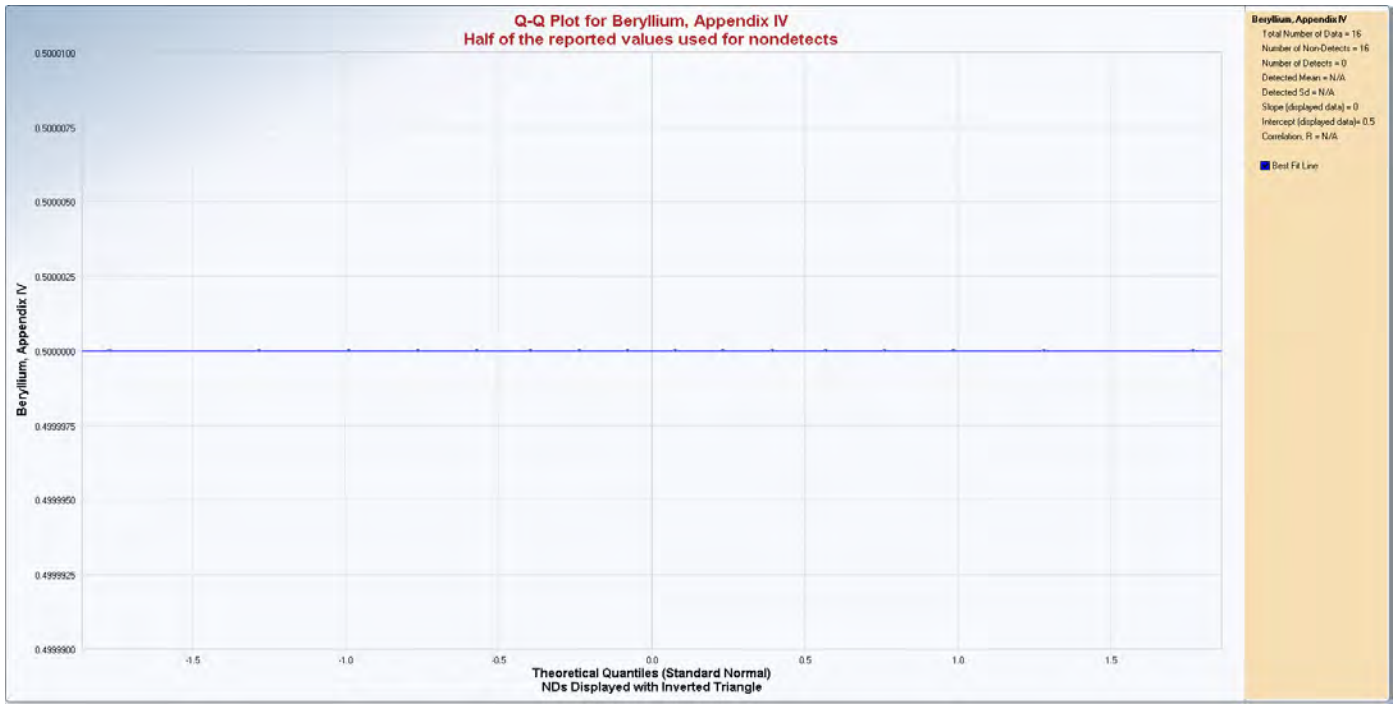
Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	16	95% UTL with 95% Coverage	318
Approximate f	0.842	Confidence Coefficient (CC) achieved by UTL	0.56
95% Percentile Bootstrap UTL with 95% Coverage	318	95% BCA Bootstrap UTL with 95% Coverage	318

Beryllium, Appendix IV

General Statistics

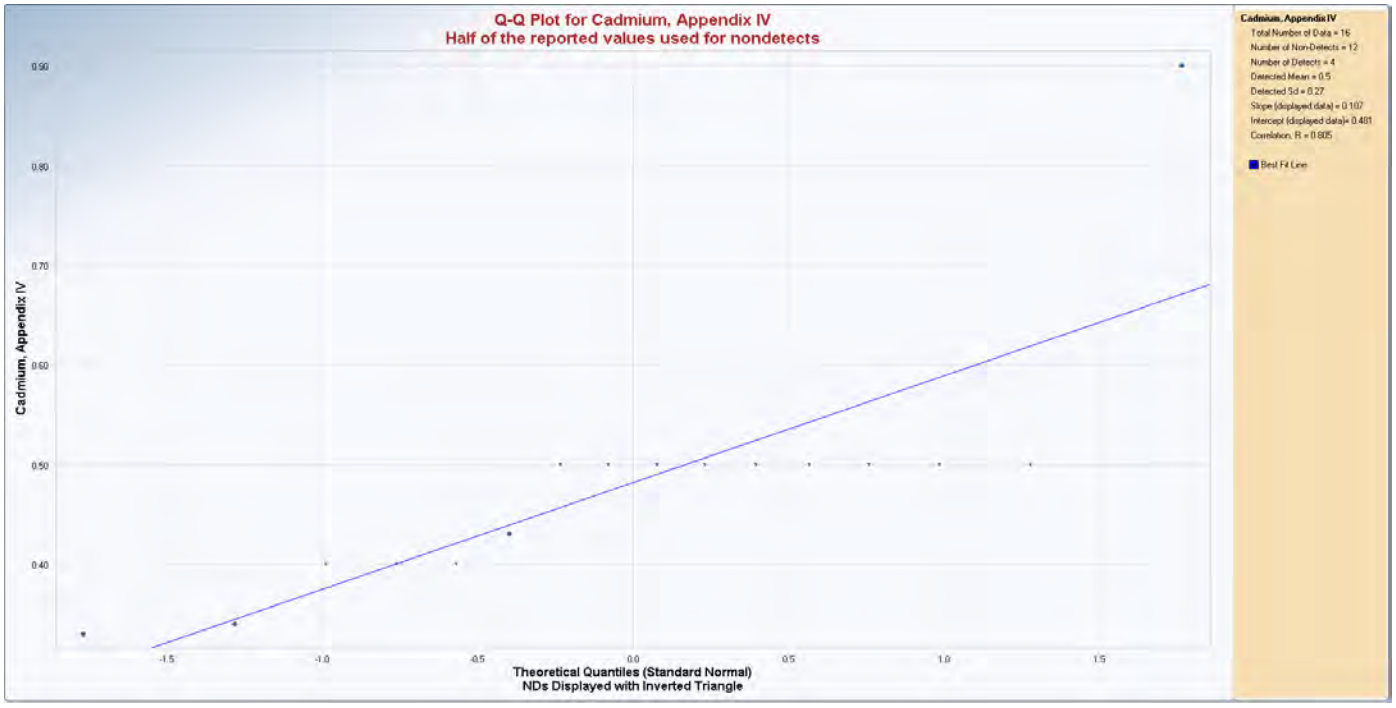
Total Number of Observations	16		
Number of Distinct Observations	1		
Number of Detects	0	Number of Non-Detects	16
Number of Distinct Detects	0	Number of Distinct Non-Detects	1
Minimum Detect	N/A	Minimum Non-Detect	1
Maximum Detect	N/A	Maximum Non-Detect	1
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A



Cadmium, Appendix IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	6		
Number of Detects	4	Number of Non-Detects	12
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	0.33	Minimum Non-Detect	0.8
Maximum Detect	0.9	Maximum Non-Detect	1
Variance Detected	0.0731	Percent Non-Detects	75%
Mean Detected	0.5	SD Detected	0.27
Mean of Detected Logged Data	-0.784	SD of Detected Logged Data	0.468



Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	16	95% UTL with95% Coverage	1
Approximate f	0.842	Confidence Coefficient (CC) achieved by UTL	0.56
95% UPL	1	95% USL	1

Chromium, Appendix IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	12		
Number of Detects	11	Number of Non-Detects	5
Number of Distinct Detects	11	Number of Distinct Non-Detects	2
Minimum Detect	0.34	Minimum Non-Detect	2
Maximum Detect	2	Maximum Non-Detect	5
Variance Detected	0.326	Percent Non-Detects	31.25%
Mean Detected	1.107	SD Detected	0.571
Mean of Detected Logged Data	-0.049	SD of Detected Logged Data	0.614

Dixon's Outlier Test for Chromium, Appendix IV

Total N = 16
Number NDs = 5
Number Detects = 11
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 2.5 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.363

For 10% significance level, 2.5 is not an outlier.
For 5% significance level, 2.5 is not an outlier.
For 1% significance level, 2.5 is not an outlier.

2. Data Value 0.34 is a Potential Outlier (Lower Tail)?

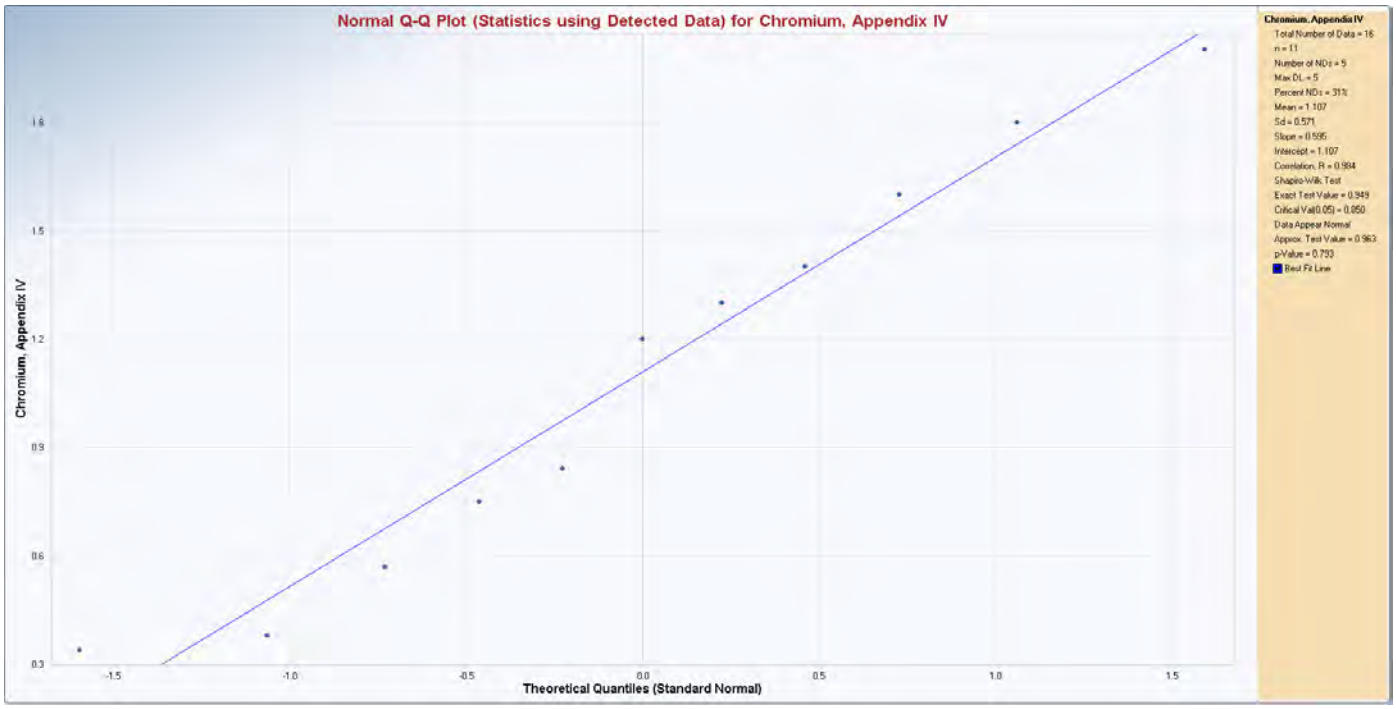
Test Statistic: 0.158

For 10% significance level, 0.34 is not an outlier.
For 5% significance level, 0.34 is not an outlier.
For 1% significance level, 0.34 is not an outlier.

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.524	d2max (for USL)	2.443

Chromium, Appendix IV



Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

Mean	1.083	SD	0.531
95% UTL95% Coverage	2.424	95% KM UPL (t)	2.043
95% KM UPL for Next 4 Observations	2.447	95% KM UPL for Mean of Next 4 Observations	1.604

Cobalt, Appendix IV

General Statistics

Total Number of Observations	16	Number of Distinct Observations	14
Minimum	0.82	First Quartile	2.5
Second Largest	5.4	Median	3.6
Maximum	6.9	Third Quartile	3.95
Mean	3.373	SD	1.568
Coefficient of Variation	0.465	Skewness	0.292
Mean of logged Data	1.083	SD of logged Data	0.584

Dixon's Outlier Test for Cobalt, Appendix IV

Total N = 16
Number NDs = 0
Number Detects = 16
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 6.9 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.481

For 10% significance level, 6.9 is an outlier.
For 5% significance level, 6.9 is not an outlier.
For 1% significance level, 6.9 is not an outlier.

2. Data Value 0.82 is a Potential Outlier (Lower Tail)?

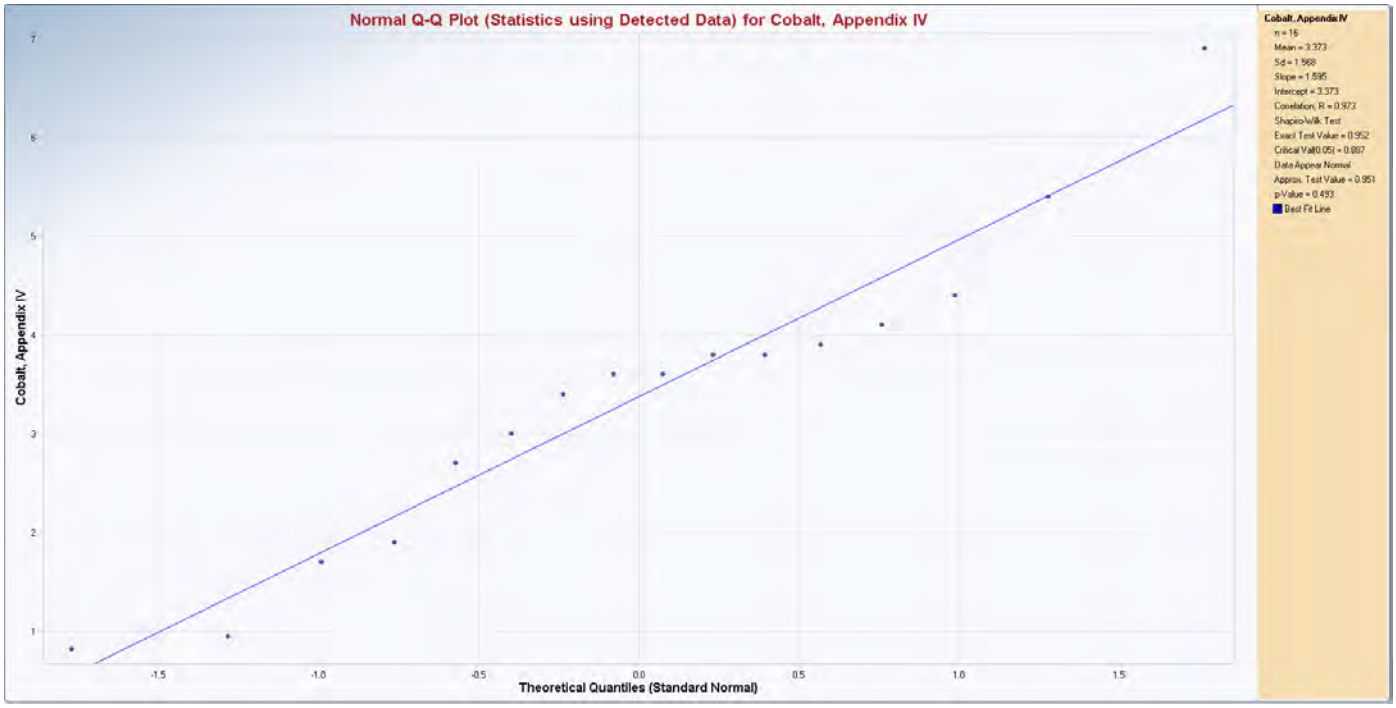
Test Statistic: 0.246

For 10% significance level, 0.82 is not an outlier.
For 5% significance level, 0.82 is not an outlier.
For 1% significance level, 0.82 is not an outlier.

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.524	d2max (for USL)	2.443

Cobalt, Appendix IV



Normal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data Normal at 5% Significance Level	

Data Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with	95% Coverage	7.33	90% Percentile (z)	5.382
	95% UPL (t)	6.206	95% Percentile (z)	5.952
95% UPL for Next 4 Observations		7.397	99% Percentile (z)	7.02
95% UPL for Mean of 4 Observations		4.909	95% USL	7.203

Fluoride, Appendix III & IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	15		
Number of Detects	13	Number of Non-Detects	3
Number of Distinct Detects	13	Number of Distinct Non-Detects	2
Minimum Detect	24	Minimum Non-Detect	50
Maximum Detect	230	Maximum Non-Detect	100
Variance Detected	5829	Percent Non-Detects	18.75%
Mean Detected	109.2	SD Detected	76.35
Mean of Detected Logged Data	4.387	SD of Detected Logged Data	0.878

Dixon's Outlier Test for Fluoride, Appendix III & IV

Total N = 16
Number NDs = 3
Number Detects = 13
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 230 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.197

For 10% significance level, 230 is not an outlier.
For 5% significance level, 230 is not an outlier.
For 1% significance level, 230 is not an outlier.

2. Data Value 24 is a Potential Outlier (Lower Tail)?

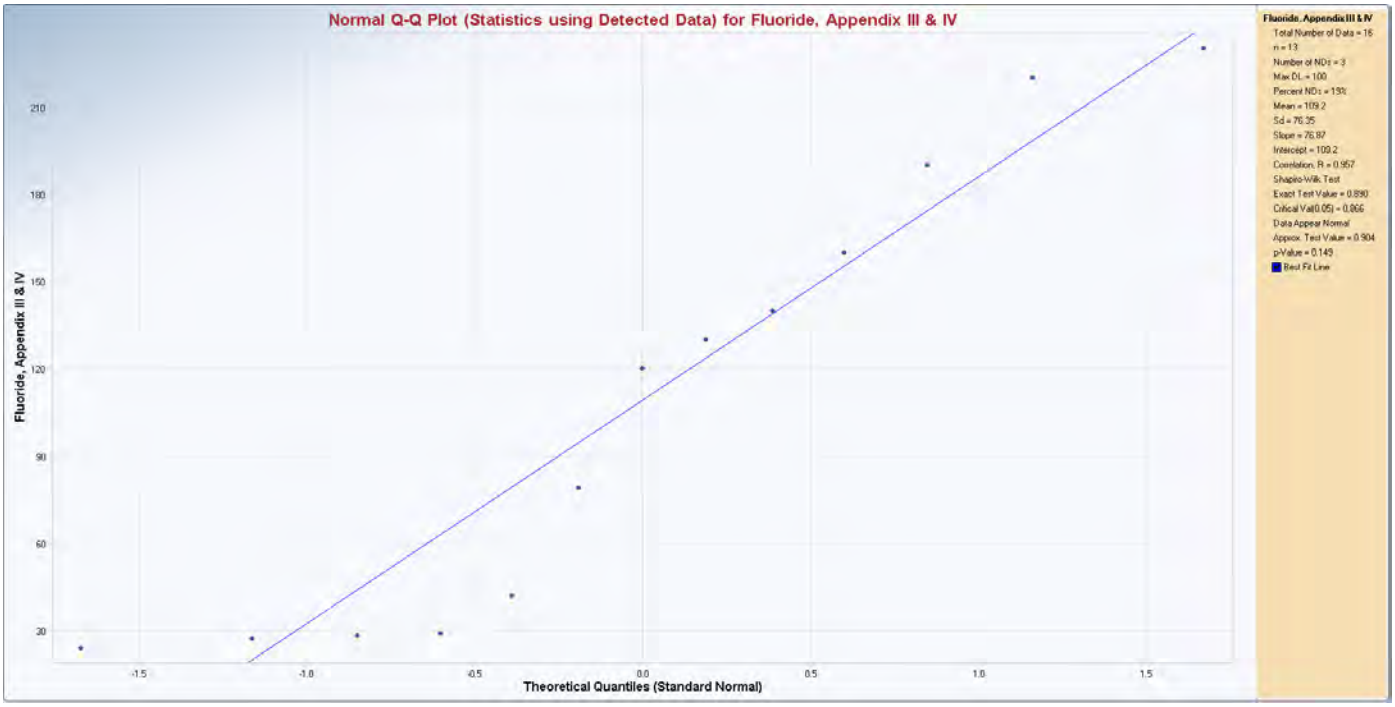
Test Statistic: 0.018

For 10% significance level, 24 is not an outlier.
For 5% significance level, 24 is not an outlier.
For 1% significance level, 24 is not an outlier.

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.524	d2max (for USL)	2.443

Fluoride, Appendix III & IV



Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.89	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

Mean	95.19	SD	72.54
95% UTL95% Coverage	278.3	95% KM UPL (t)	226.3
95% KM UPL for Next 4 Observations	281.4	95% KM UPL for Mean of Next 4 Observations	166.3

Lead, Appendix IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	11		
Number of Detects	9	Number of Non-Detects	7
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.18	Minimum Non-Detect	0.1
Maximum Detect	0.79	Maximum Non-Detect	1
Variance Detected	0.0361	Percent Non-Detects	43.75%
Mean Detected	0.396	SD Detected	0.19
Mean of Detected Logged Data	-1.028	SD of Detected Logged Data	0.48

Dixon's Outlier Test for Lead, Appendix IV

Total N = 16
Number NDs = 7
Number Detects = 9
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 0.79 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.483

For 10% significance level, 0.79 is an outlier.
For 5% significance level, 0.79 is not an outlier.
For 1% significance level, 0.79 is not an outlier.

2. Data Value 0.05 is a Potential Outlier (Lower Tail)?

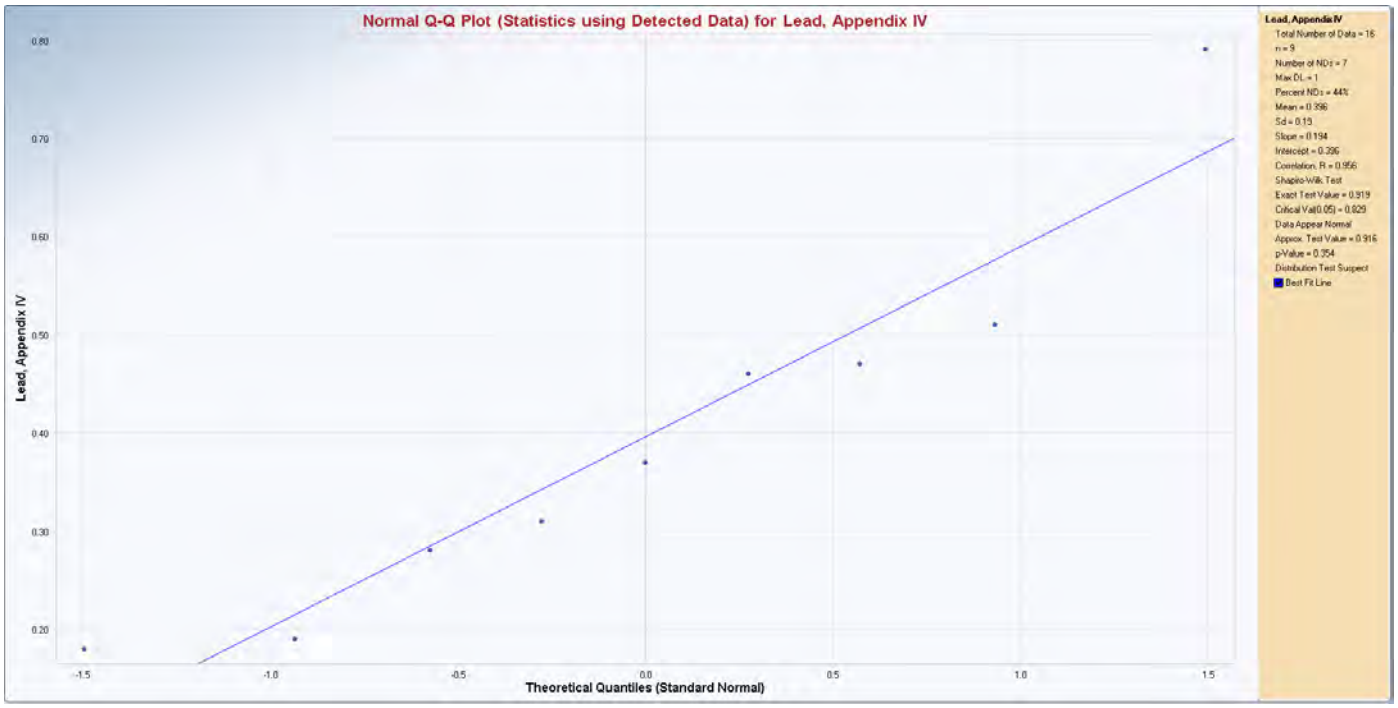
Test Statistic: 0.311

For 10% significance level, 0.05 is not an outlier.
For 5% significance level, 0.05 is not an outlier.
For 1% significance level, 0.05 is not an outlier.

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.524	d2max (for USL)	2.443

Lead, Appendix IV



Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.919	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

Mean	0.366	SD	0.192
95% UTL95% Coverage	0.85	95% KM UPL (t)	0.712
95% KM UPL for Next 4 Observations	0.858	95% KM UPL for Mean of Next 4 Observations	0.554

Lithium, Appendix IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	13		
Number of Detects	12	Number of Non-Detects	4
Number of Distinct Detects	10	Number of Distinct Non-Detects	3
Minimum Detect	0.41	Minimum Non-Detect	8
Maximum Detect	2.4	Maximum Non-Detect	50
Variance Detected	0.512	Percent Non-Detects	25%
Mean Detected	1.458	SD Detected	0.715
Mean of Detected Logged Data	0.221	SD of Detected Logged Data	0.642

Dixon's Outlier Test for Lithium, Appendix IV

Total N = 16
Number NDs = 4
Number Detects = 12
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 25 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.510

For 10% significance level, 25 is an outlier.
For 5% significance level, 25 is an outlier.
For 1% significance level, 25 is not an outlier.

2. Data Value 0.41 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.008

For 10% significance level, 0.41 is not an outlier.
For 5% significance level, 0.41 is not an outlier.
For 1% significance level, 0.41 is not an outlier.

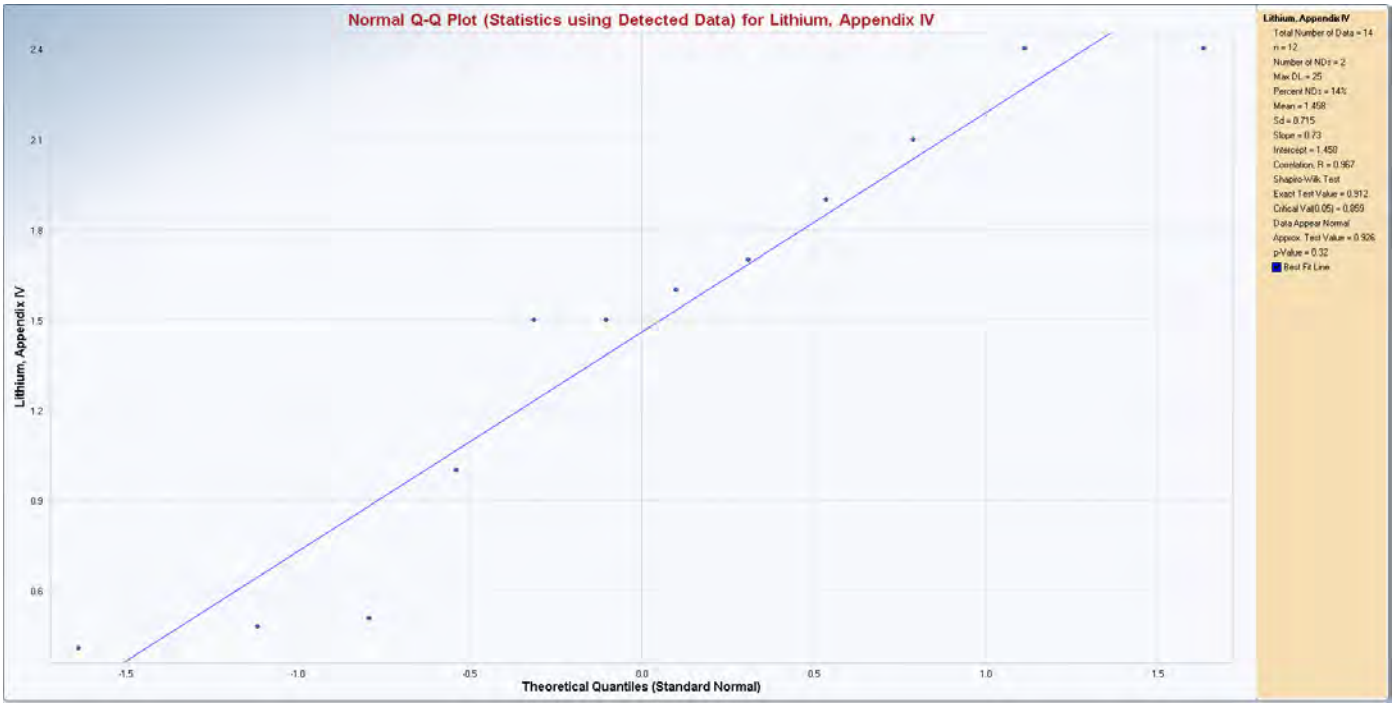
Lithium, Appendix IV

General Statistics - Outliers Removed

Total Number of Observations	14		
Number of Distinct Observations	12		
Number of Detects	12	Number of Non-Detects	2
Number of Distinct Detects	10	Number of Distinct Non-Detects	2
Minimum Detect	0.41	Minimum Non-Detect	8
Maximum Detect	2.4	Maximum Non-Detect	25
Variance Detected	0.512	Percent Non-Detects	14.29%
Mean Detected	1.458	SD Detected	0.715
Mean of Detected Logged Data	0.221	SD of Detected Logged Data	0.642

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.614	d2max (for USL)	2.372



Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

Mean	1.458	SD	0.685
95% UTL95% Coverage	3.248	95% KM UPL (t)	2.714
95% KM UPL for Next 4 Observations	3.254	95% KM UPL for Mean of Next 4 Observations	2.146

Molybdenum, Appendix IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	10		
Number of Detects	10	Number of Non-Detects	6
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.58	Minimum Non-Detect	5
Maximum Detect	6.4	Maximum Non-Detect	10
Variance Detected	4.107	Percent Non-Detects	37.5%
Mean Detected	1.97	SD Detected	2.027
Mean of Detected Logged Data	0.325	SD of Detected Logged Data	0.815

Dixon's Outlier Test for Molybdenum, Appendix IV

Total N = 16
Number NDs = 6
Number Detects = 10
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 6.4 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.247

For 10% significance level, 6.4 is not an outlier.
For 5% significance level, 6.4 is not an outlier.
For 1% significance level, 6.4 is not an outlier.

2. Data Value 0.58 is a Potential Outlier (Lower Tail)?

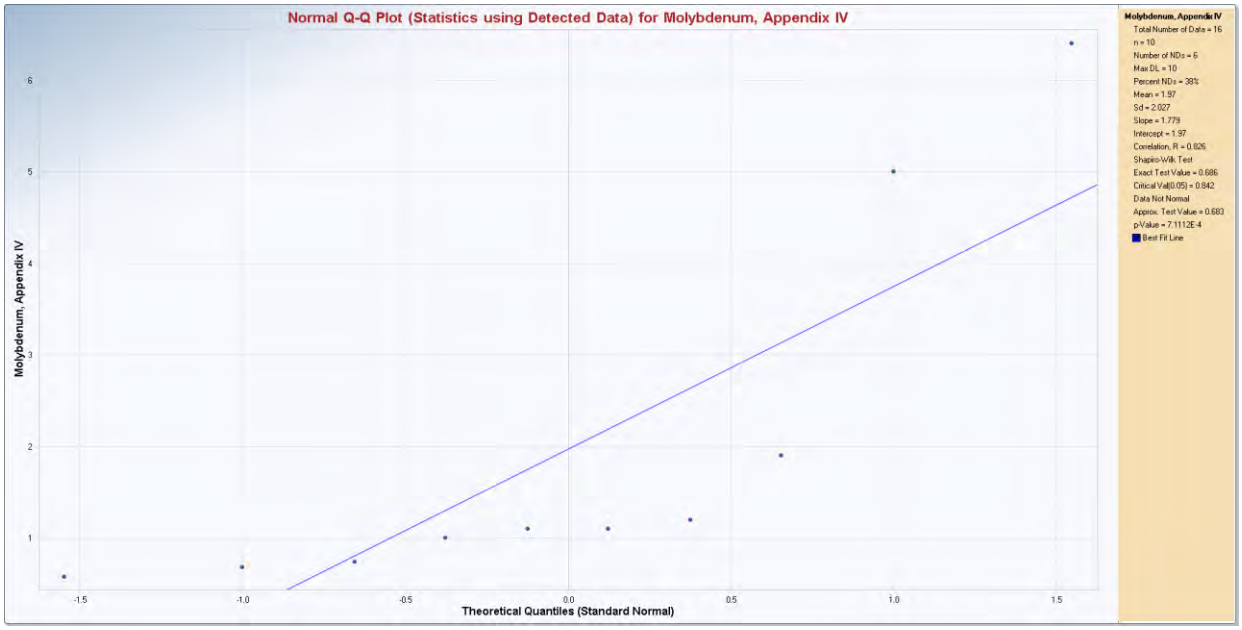
Test Statistic: 0.036

For 10% significance level, 0.58 is not an outlier.
For 5% significance level, 0.58 is not an outlier.
For 1% significance level, 0.58 is not an outlier.

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.524	d2max (for USL)	2.443

Molybdenum, Appendix IV

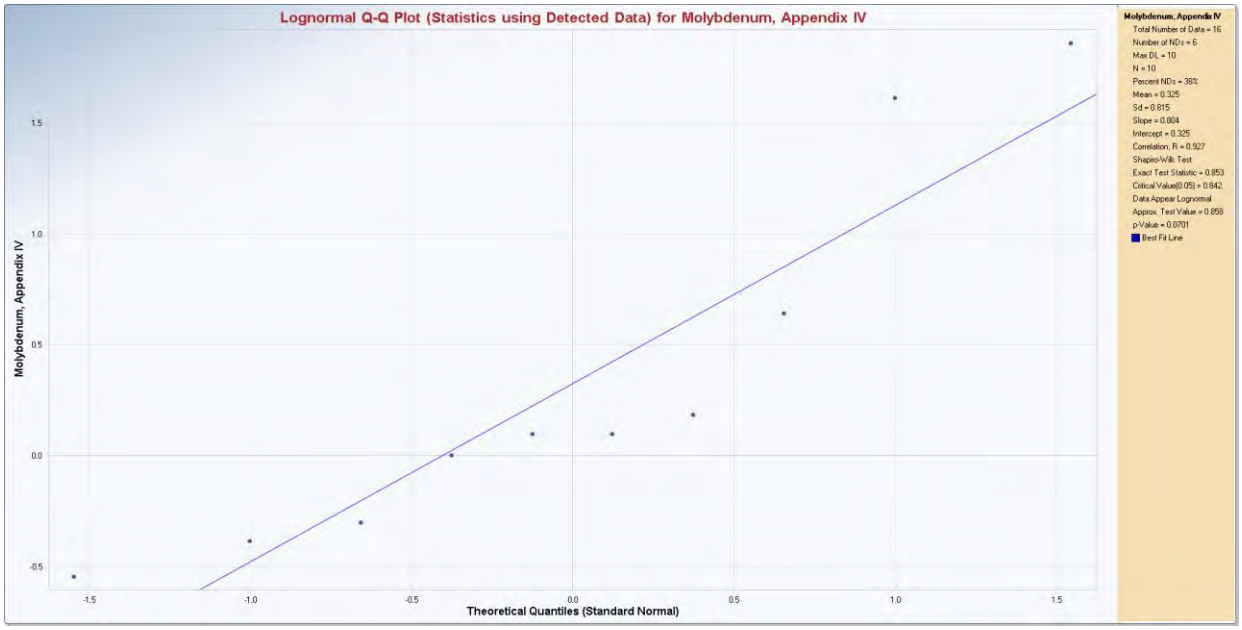


Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.686	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Molybdenum, Appendix IV



Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.853	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

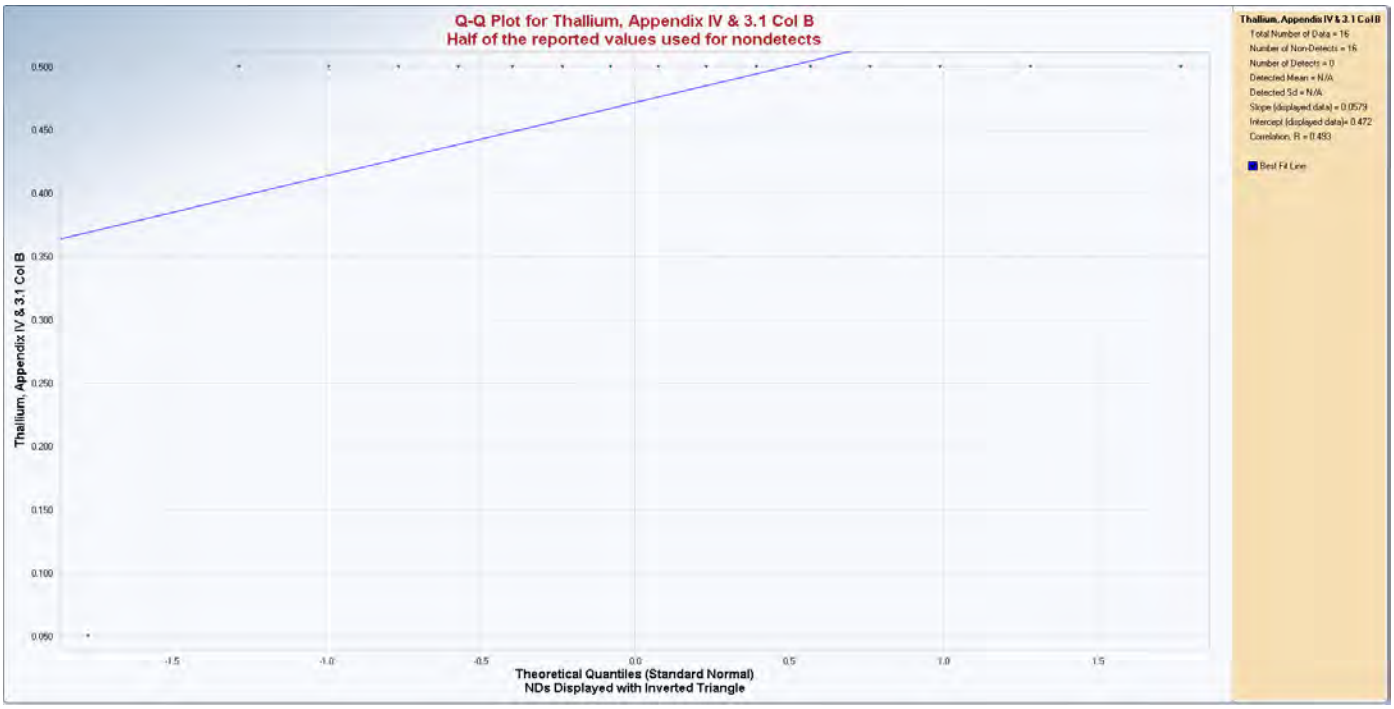
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	0.266 (LN)	95% KM UTL (Lognormal)95% Coverage	8.286 ug/L
KM SD of Logged Data	0.732 (LN)	95% KM UPL (Lognormal)	4.901
95% KM Percentile Lognormal (z)	4.352	95% KM USL (Lognormal)	7.81

Thallium, Appendix IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	2		
Number of Detects	0	Number of Non-Detects	16
Number of Distinct Detects	0	Number of Distinct Non-Detects	2
Minimum Detect	N/A	Minimum Non-Detect	0.1
Maximum Detect	N/A	Maximum Non-Detect	1
Variance Detected	N/A	Percent Non-Detects	100%
Mean Detected	N/A	SD Detected	N/A
Mean of Detected Logged Data	N/A	SD of Detected Logged Data	N/A



Total Radium, Appendix IV

General Statistics

Total Number of Observations	16		
Number of Distinct Observations	16		
Number of Detects	12	Number of Non-Detects	4
Number of Distinct Detects	12	Number of Distinct Non-Detects	4
Minimum Detect	0.358	Minimum Non-Detect	0.282
Maximum Detect	1.53	Maximum Non-Detect	0.934
Variance Detected	0.11	Percent Non-Detects	25%
Mean Detected	0.799	SD Detected	0.332
Mean of Detected Logged Data	-0.3	SD of Detected Logged Data	0.405

Dixon's Outlier Test for Radium 226 + 228

Total N = 16
Number NDs = 4
Number Detects = 12
Number Data (n) = 16
10% critical value: 0.454
5% critical value: 0.507
1% critical value: 0.595
Note: NDs replaced by DL/2 in Outlier Test

1. Data Value 1.53 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.452

For 10% significance level, 1.53 is not an outlier.
For 5% significance level, 1.53 is not an outlier.
For 1% significance level, 1.53 is not an outlier.

2. Data Value 0.141 is a Potential Outlier (Lower Tail)?

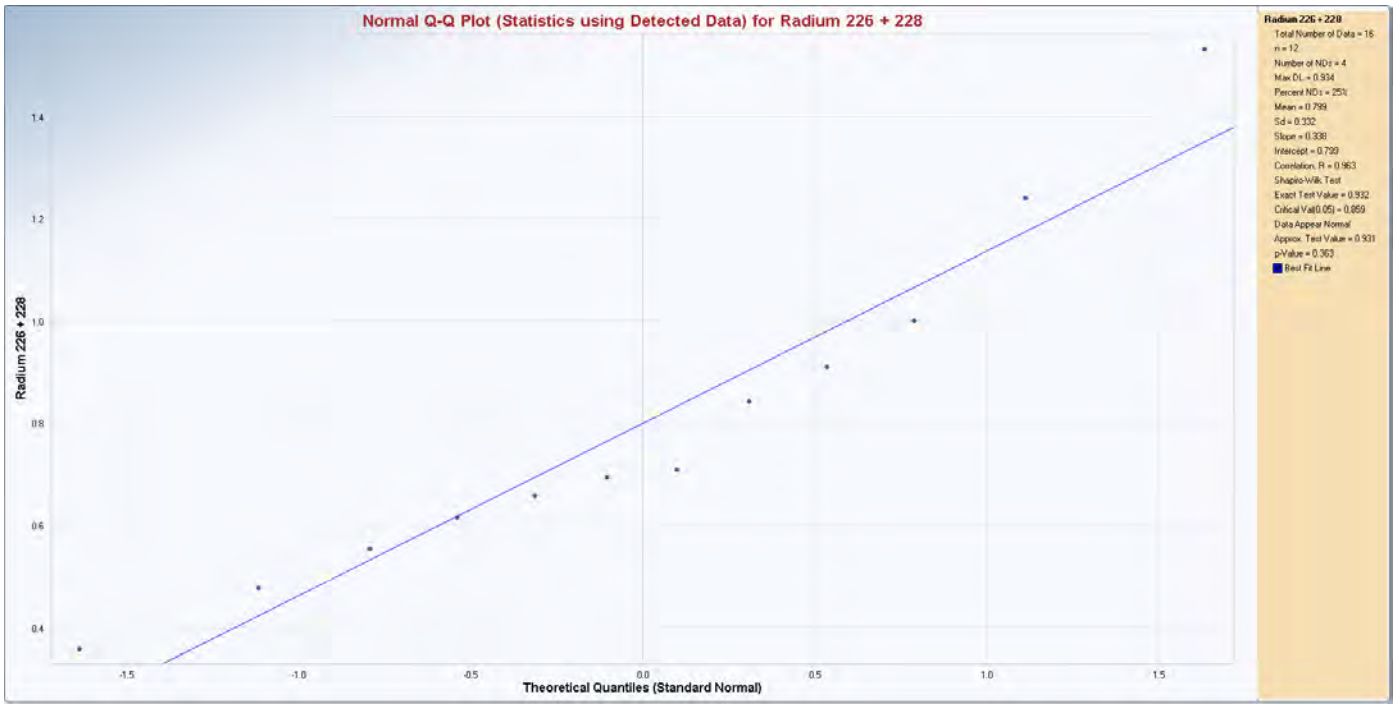
Test Statistic: 0.253

For 10% significance level, 0.141 is not an outlier.
For 5% significance level, 0.141 is not an outlier.
For 1% significance level, 0.141 is not an outlier.

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.524	d2max (for USL)	2.443

Total Radium, Appendix IV



Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Detected Data appear Normal at 5% Significance Level	

Data Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.711	KM SD	0.328
95% UTL95% Coverage	1.538	95% KM UPL (t)	1.303
95% KM UPL for Next 4 Observations	1.552	95% KM UPL for Mean of Next 4 Observations	1.032

APPENDIX E

EXAMPLE CHAIN-OF-CUSTODY FORM
EXAMPLE SAMPLE LABEL
EXAMPLE CHAIN-OF-CUSTODY SEAL

ENVIRONMENTAL SAMPLING SUPPLY

LOT#

SAMPLE ID

SAMPLED BY	DATE
	TIME
LOCATION	PRESERVATIVE
ANALYSIS	CLIENT

Oakland, CA • Houston, TX • Chicago, IL • Richmond, VA
(510) 562-4988 www.essvial.com (800) 233-8425

ENVIRONMENTAL SAMPLING SUPPLY

LOT#

SAMPLE ID

SAMPLED BY	DATE
	TIME
LOCATION	PRESERVATIVE
ANALYSIS	CLIENT

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ENVIRONMENTAL SAMPLING SUPPLY

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LOCATION	PRESERVATIVE
ANALYSIS	CLIENT

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ENCO

CUSTODY SEAL

Date: ______________________________

Signature: ___________________________

ENCO

ENVIRONMENTAL CONSERVATION LABORATORIES, INC.
4810 Executive Park Ct., Ste 211 • Jacksonville, FL 32216-6069 • (904) 296-3007
10775 Central Port Drive • Orlando, FL 32824 • (407) 826-5314
102-A Woodwinds Industrial Court • Cary, NC 27511 • (919) 467-3090

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	TIME
LOCATION	PRESERVATIVE
ANALYSIS	CLIENT

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ENVIRONMENTAL SAMPLING SUPPLY

LOT#

SAMPLE ID

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	TIME
LOCATION	PRESERVATIVE
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ENVIRONMENTAL SAMPLING SUPPLY

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SAMPLE ID

SAMPLED BY	DATE
	TIME
LOCATION	PRESERVATIVE
ANALYSIS	CLIENT

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CUSTODY SEAL

Date: ______________________________

Signature: ___________________________

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10775 Central Port Drive • Orlando, FL 32824 • (407) 826-5314
102-A Woodwinds Industrial Court • Cary, NC 27511 • (919) 467-3090

CHAIN OF CUSTODY

PAGE _____OF _____

CLIENT NAME:	PROJECT NAME:
CLIENT CONTACT:	SITE NAME:
CLIENT ADDRESS:	PROJECT NUMBER:
CLIENT PHONE NUMBER:	P.O. NUMBER:
CLIENT FAX NUMBER:	REGULATORY AUTHORITY:

Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS#
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	**Turn Around Time:** **Day(s)**

							MATRIX						ANALYSIS							COMMENTS
CLIENT SAMPLE I.D.	Date Sampled	Time Sampled	Number of Containers	Grab	Composite	Field Filtered	Groundwater	Wastewater	Drinking Water	Soil	Solids	Other _____								PLEASE NOTE PRESERVATIVE(S)
1)																				
2)																				
3)																				
4)																				
5)																				
6)																				
7)																				
8)																				
9)																				
10)																				

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME	**LAB USE ONLY** **COOLER TEMP ℃** _____
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME	
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME	

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