



**SUBSURFACE INVESTIGATION
REPORT**

**CITY OF CUMMING, GEORGIA
6.0-MGD WATER TREATMENT PLANT EXPANSION
CUMMING, FORSYTH COUNTY, GEORGIA**

Prepared for:

**CITY OF CUMMING, GEORGIA
C/O CIVIL ENGINEERING CONSULTANTS, INC.
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**GeoSystems Project No. 06-1899
November 14, 2006**

GEOSYSTEMS

ENGINEERING, INC.

November 14, 2006

City of Cumming, Georgia
c/o Nolan L. (Butch) Johnson, Jr., P.E.
Civil Engineering Consultants, Inc.
1225 Johnson Ferry Road, Suite 855
Marietta, Ga. 30068

Re: Subsurface Investigation
City of Cumming - Water Treatment Plant Expansion
Cumming, Forsyth County, Georgia
GeoSystems Project No. 06-1899

Dear Mr. Johnson:

In October 2006, GeoSystems Engineering, Inc. (GeoSystems) was contracted by the City of Cumming to provide a subsurface investigation for the planned 6.0-MGD expansion to the City's existing water treatment plant. The primary purpose of this study was to determine subsurface conditions in areas planned for the expansion and provide recommendations for foundation design and construction. The attached report describes the investigative procedures and presents the findings along with our evaluations and conclusions.

Thank you for giving us the opportunity to conduct the soil investigation for this project. We look forward to assisting you during the construction phase of the project. Please call us if we can be of any other help or if you have any questions.

Sincerely,

GeoSystems Engineering, Inc.



Phillip T. Jackson, E.I.T.
Staff Engineer

Copies Submitted: Addressee - 3



Larry D. Mullins, P.E.
Principal Engineer

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EXECUTIVE SUMMARY

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized subsurface investigation for the planned 6.0-MGD Water Treatment Plant (WTP) expansion for the City of Cumming. The purpose of this study was to investigate subsurface conditions in areas planned for the expansion and provide recommendations for foundation design and construction. The following briefly summarizes the essential findings of the investigation and our recommendations:

1. The subsurface conditions encountered during this investigation include fill materials, alluvial deposits, residual soils, partially weathered rock and refusal material. Within the proposed clearwell expansion area, the borings typically encountered an upper layer of fill overlying some alluvium, residual soils, partially weathered rock and refusal material. Residual soils, partially weathered rock, and refusal material underlie the proposed package plant location. Subsurface conditions at the two alternative pump station locations consist of fill overlying either residual soils or alluvium and then residual soils. The residuum is generally typical of that found in the Piedmont Physiographic Province in which the site is located. Groundwater was encountered in all of the borings drilled in the clearwell and pump station portions of the site. Groundwater was not encountered at the time of boring at the package plant location.
2. On completion of effective site dewatering, excavation to planned grade, and stabilization of the exposed soils, the clearwell may be supported by the planned conventional shallow slab foundation bearing on the prepared subgrade. We recommend that a maximum allowable soil bearing capacity of 2,000 psf be used for design of the clearwell individual column or continuous wall footings.
3. We recommend the package plant foundations be designed to bear on the relatively strong residuum encountered in the borings for a maximum allowable soil bearing capacity of 5,000 psf. Floor or grade slabs may be soil supported subject to site preparation and earthwork recommendations contained in this report.
4. We recommend the new pump station be sited at the location of boring B-15, where shallow foundation support on the existing fill soils may be accomplished. We recommend the foundation design be based on a maximum allowable bearing capacity of 2,000 pounds per square foot for the fill soils at the location of boring B-15. Foundation support at the alternative location (B-14 and B-14A) would require either difficult dewatering and excavation and replacement of unsuitable materials, or a deep foundation system.
5. Positive groundwater control must be performed during construction in order to allow shallow support of the clearwell. If groundwater control measures are inadequate, deep foundation support may become necessary as the only means of repairing water damage to the subgrade. Even with positive dewatering, localized undercutting of water-softened soils and replacement with crushed stone will be necessary. Either vacuum well points or a deep well system are expected to be required to adequately lower and maintain the groundwater at required levels until construction is complete. Temporary observation wells should be installed at the site to confirm groundwater levels prior to excavation and to monitor drawdown at the location of the adjacent 2.0-MG clearwell. The contractor should be responsible for design of the dewatering system,

considering the effect of groundwater lowering on the adjacent 2.0-MG clearwell. It is likely that settlement of the existing structure will occur as a result of the mass dewatering required for the new clearwell. Groundwater recharge and/or positive cutoff measures may be necessary to avoid lowering the groundwater underneath the existing clearwell.

6. Within the new clearwell area, partially weathered rock was encountered near the planned excavation level at the locations of borings B-1 and B-2. At the package plant location, layers of partially weathered rock were found within the residual soil stratum at depths of 3 feet in boring B-11 and 8 feet in B-12. Very dense or very hard soils were also encountered at various depths in a majority of the package plant borings. Based upon this information, we expect that some difficult excavation techniques during foundation and/or utility construction within the package plant area and possibly during mass site grading operations for the clearwell may be required for the removal of partially weathered rock, very dense or very hard soils, or possibly rock that could occur between our boring locations.

These and supplementary recommendations relative to pavements, retaining walls, slopes, site preparation, and foundation construction are discussed in detail in the following report. This summary should not be used as a separate document or in lieu of the entire report, including the appendices.

INTRODUCTION

Background

GeoSystems Engineering, Inc. (GeoSystems) was contracted by the City of Cumming in October 2006 to provide a subsurface investigation for the planned 6.0-MGD expansion to the City's existing water treatment plant. Civil Engineering Consultants, Inc. (CEC) of Marietta, Georgia provided site plans and design information required for the investigation.

The existing water treatment plant is located on Dahlonega Road/Georgia Highway 9, about 2 miles north of downtown Cumming. The site is just north of Sawnee Drive at Sawnee Creek. The planned expansion will include a 6.0-MGD package plant with a backwash clearwell, a 3.0-MG clearwell, and a new pump station. The planned expansion areas are situated respectively in existing ball fields located at the southwest corner of the plant, in a filled area generally west of the existing 2.0-MG clearwell, and at the existing sludge lagoons located on the eastern side of Dahlonega Road.

Purpose

The purpose of the study was to investigate subsurface conditions in the areas planned for the expansion and to provide recommendations for the foundation design and construction.

Scope of Work

The scope of work for the geotechnical exploration consisted of visual reconnaissances of the site, sixteen soil test borings, collection of soil samples, field and laboratory soil permeability testing, laboratory soil classification analyses, evaluation of the field and laboratory data, and preparation of this report.

Authorization

Formal written authorization for the investigation was provided by Mr. Jonathon W. Heard, Director of Utilities, on October 5, 2006. At that time, Mr. Heard signed our standard "Agreement for Limited Professional Services" contract form on behalf of the City.

METHODOLOGY

Subsurface conditions at the site were investigated by drilling sixteen soil test borings (B-1 through B-15 and B-14A) at the approximate locations shown on the enclosed boring location plans (Figure 1 through Figure 3). The boring location plans were produced from an electronic copy of the topographic site plan that CEC provided to us. GeoSystems personnel established the boring locations in the field by measuring distances and estimating right angles from existing site features. Boring elevations in the package plant and the pump station areas were estimated to the nearest 1.0 foot by interpolating between contours shown on the provided site plan. Elevations of the borings in the new clearwell area were determined to the nearest 1 foot by an approximate engineering level survey. These elevations were referenced to a datum of 1144.5 feet for the pump pad located on the

southeastern edge of the existing 2.0-MG clearwell. Since our measurements were not precise, the referenced boring locations and elevations should be considered approximate.

The soil test borings were advanced, utilizing continuous flight hollow-stem augers, to termination or refusal depths varying approximately from 13 to 63 feet below the existing ground surface. Standard penetration testing and split-barrel sampling of the soils were conducted in the borings at regular intervals to evaluate relative density or consistency of the soils and obtain samples for classification. One undisturbed Shelby-tube sample was also recovered from each boring B-4 and B-5 to obtain representative samples for laboratory classification and hydraulic conductivity (permeability) testing.

Temporary piezometers (observation wells) were constructed at the locations of borings B-4 and B-5 to obtain stabilized groundwater levels and allow field permeability (slug) testing. The wells were constructed of 2-inch diameter solid PVC riser pipe with a 10-foot screened section at each location. The annular space around the screen was backfilled to 2 feet above the top of the screen with a clean, well-graded sand filter pack. A 2-foot bentonite clay seal was placed on top of the sand filter pack. The annulus around the riser pipe was filled to the ground surface with the soil cuttings from the borehole. Field permeability tests were performed in each well on November 3, 2006. These were rising head seepage tests performed by bailing water from the wells. The rate of rise of water in each well was recorded over time, and the soil permeability (horizontal) was calculated from the data in accordance with NAVFAC Design Manual (DM-7.01), 1987.

The split-barrel samples from the borings were classified in the field and preliminary boring records were prepared by the driller. In the laboratory, each sample was examined by a geotechnical engineer, and final detailed logs of the borings were prepared showing visual soil descriptions and unified classifications, standard penetration values, and groundwater levels (if encountered). In addition, laboratory grain size analyses and saturated hydraulic conductivity tests were conducted on representative split-barrel samples collected from boring B-1 and the Shelby-tube samples collected from borings B-4 and B-5. The laboratory soil grain size distribution analyses consisted of four tests in accordance with procedures described by ASTM D 422 for gradation, which refers to the grain size distribution in a soil plotted as a function of the percent by weight passing a given sieve size. Saturated hydraulic conductivity (vertical) testing consisted of flexible-wall permeability tests on relatively undisturbed soil samples extruded from the Shelby tubes.

Brief descriptions of the field and laboratory procedures are presented in Appendix A. The boring location plans and the soil test boring logs are included in Appendix B. Laboratory test data are attached in Appendix C.

SITE CONDITIONS

Clearwell

As noted previously, the new 3.0-MG clearwell will be located in a previously filled area to the west of the existing 2.0-MG clearwell. This location is currently undeveloped and overgrown with high grasses, weeds and pine seedlings/saplings. Site topography varies from nearly level to moderately sloping down to the east and south. Indicated relief from our level survey data is about 20 feet,

varying from a high elevation near 1162 feet over the western three-fourths of the clearwell footprint to a low elevation of 1142 at the southeast corner. The topography shown on the provided site plan appears to be in error in this area, as the higher portions of the footprint are indicated to be at elevations 1172 to 1177.

Package Plant

The planned package plant location is in an area currently occupied by the northernmost of four baseball fields. This area is at the southwest corner of the existing WTP. Within the package plant area, site topography is nearly level to very gently sloping down to the north. Indicated elevations are 1206 to 1204 feet. Ground cover is a sparse cover of grass and weeds with large areas of bare earth. A chain link fence surrounds most of the field.

Pump Station

There are two alternate locations being considered for the proposed pump station. Both locations are situated in the existing sludge lagoon area, on the east side of Dahlonge Road. One site is in the western end of Lagoon 1, which was in the process of being filled-in with dry settled solids waste from the existing plant at the time of the field investigation. The second site is at the eastern end of lagoon 1 on the grassed containment dike. The ground surface elevation at both pump station locations appears to be about 1145 feet.

AREA AND SITE GEOLOGY

The Cumming WTP is located within the northern Piedmont Physiographic Province, an area underlain by ancient igneous and metamorphic rocks of Paleozoic age. Published geologic mapping indicates that the site is underlain by metamorphic rocks of the Powers Ferry formation which includes undifferentiated biotite-quartz-plagioclase gneiss (metagraywacke), mica schist, and amphibolite.

The origin of the Paleozoic rocks, as sediments, has been obscured, due to their age and repeated cycles of weathering, metamorphism, folding, faulting, and injection with younger Paleozoic granites and Triassic diabase dikes. All of these rocks have weathered in place and are covered by a mantle of residual soils of varying thickness. Residual soils are formed insitu by chemical alteration of the underlying rocks. Normally, the weathering is most advanced near the ground surface and decreases with depth until unweathered parent rock is encountered. A transition from clay to silt to silty sand to partially weathered rock to hard rock is typical; however, this order of weathering is not always present. It is not uncommon to find layers or zones of partially weathered rock (PWR) or relatively unaltered rock within the soil mantle or weathered rock layers within the underlying parent rock mass. The naturally developed soil profile may be changed by erosion and/or man's grading activities, so that the upper more weathered zones may be completely stripped away. Also, residual soils may be covered by washed-in alluvial soils or manmade fill, or both.

The deeper residual materials retain the relict structure of the original rock. Partially weathered rock materials have the appearance of sands in which the sand grains are individual mineral crystals that occupy the same positions as in the unaltered rock. Individual crystal breakdown occurs with further

weathering and sandy silts or silty sands are formed. The original structures within the parent rock are preserved in these soils; however, the crystalline structure is altered or destroyed. Residual soils characterized by preservation of relict structures that were present in the unweathered rock are termed saprolites.

Groundwater in the Piedmont generally occurs under water table conditions as a result of infiltration of surface waters through the somewhat permeable overburden. Fractures and other discontinuities in the underlying rock can affect groundwater conditions. In this geologic setting, the configuration of the groundwater table is generally expected to be a slightly subdued replica of the ground surface. Localized groundwater flow roughly follows the flow of surface water. Although hydraulically connected to the water table aquifer, groundwater at depth in the rock is found in water-bearing fractures.

SUBSURFACE CONDITIONS

Clearwell

Within the proposed clearwell expansion area, the borings typically encountered an upper layer of fill overlying some alluvium, residual soils, partially weathered rock and refusal materials. Fill is any material that has been placed by man. Alluvium is material that has been transported and deposited by flowing water. Residual is a term used to define soils formed in-place by the chemical weathering process of the underlying rocks. Residual material that can be penetrated by power augers and exhibits standard penetration resistances of at least 100 blows per foot is termed partially weathered rock. Refusal is a designation applied to any material which cannot be further penetrated by the soil drilling process, and is normally indicative of a very hard or very dense material, such as boulders, rock lenses, or the upper surface of bedrock.

Fill was encountered at all boring locations from the ground surface to depths ranging approximately from a minimum of 6 feet in boring B-8 to a maximum of 26 feet in B-6. The fill was sampled generally as silty sand (SM) and sandy or clayey silt (ML-MH) with some clay (CL-CH) layers. Scattered throughout the fill are various quantities of gravel, rocks, wood and other organic matter at random depths and locations. Relative density or consistency of the fill soils varies appreciably as indicated by standard penetration resistances ranging from a minimum of 2 blows per foot (bpf) to 20 bpf. A 2.5 to 5-foot layer of alluvium or possible alluvial soils underlies 6 to 8.5 feet of fill at the locations of borings B-8 and B-3, respectively. The alluvium was sampled as firm gray silty clay (CL) in boring B-3.

Below the fill and alluvium layers, a relatively thick stratum of residual soils was encountered in the borings. The residual soils extend to the top of partially weathered rock at depths of 36 to 41 feet in borings B-1, B-2, B-3, and B-8. At the remaining locations, the residual soil stratum extended to boring termination or refusal depths varying from 50 to 63 feet below ground. The residual soils were visually classified as either micaceous silty sands (SM) or micaceous sandy silts (ML). The laboratory grain size analyses show the residual soil classification is predominantly silty sand (SM) with approximately 64 to 70 percent sand content. Relative density of the sandy residuum was typically loose to medium dense, but varied from very loose to dense. Consistency of the silts was

generally firm to stiff, but varied from soft to very stiff. Standard penetration resistances in these soils ranged from a minimum of 2 to a maximum of 32 bpf.

Saturated hydraulic conductivity of the residual soils was measured vertically by the laboratory tests on undisturbed samples and horizontally by the field seepage tests conducted in the observation wells. The laboratory tests were conducted on sections of undisturbed samples recovered from a depth interval of 42 to 44 feet below ground. Average permeability of a section of soil from 40 to 50 in depth (approximate) was measured in the wells. The test results are as follows:

LOCATION	METHOD	DEPTH (feet)	PERMEABILITY (K_v) (cm/sec)	PERMEABILITY (K_h) (cm/sec)
B-4	Laboratory	42 - 44	5.6E-05	
B-4	Field	40 - 50		1.34E-04
B-5	Laboratory	42 - 44	2.8E-05	
B-5	Field	40 - 50		1.88E-04

At the locations of borings B-1, B-2, B-3, and B-8, 4 to 16 feet of continuous partially weathered rock was encountered in advance of auger refusal. The partially weathered rock materials were sampled as either very dense silty sand (SM) or very hard sandy silt (ML). Auger refusal materials were also encountered in borings B-4 and B-6 below the residual soil strata. Refusal depths in the borings varied approximately from 42 to 63 feet below the ground surface. Refusal encountered in the borings appears to be the top of bedrock within the clearwell location. However, rock coring procedures, which were beyond the scope of this investigation, would be required to determine the actual character and continuity of the refusal materials.

Stabilized groundwater levels were measured in borings B-1, B-4, B-5, B-6, and B-7 at a depth of approximately 23 feet below the existing ground surface. Time of boring groundwater levels were detected in the remaining borings at depths varying approximately from 5 to 25 feet below ground. In general, the groundwater level measurements correlate to a water table elevation in the range of 137 to 1140 feet. Groundwater levels are subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than those reported during this study.

Package Plant

The borings show that residual soils, partially weathered rock, and refusal materials underlie the proposed package plant location. These soils, described mainly as medium dense to very dense silty sand (SM) and very stiff to very hard sandy silt (ML), were encountered at or near the ground surface at all boring locations. Within the residual soils, standard penetration resistances varied from a minimum of 15 to a maximum of 69 bpf. Except at the location of B-11, the residual soil stratum continued to boring termination depths of 15 and 25 feet. Continuous partially weathered rock was encountered in boring B-11 from below the residual soils at a depth of 31 feet to auger refusal at 37 feet. Layers of PWR were also penetrated within the residual soil stratum from 3 to 11 feet in B-11 and from 8 to 11 feet in boring B-12. Refusal, which appears to be the upper surface of bedrock, occurred only at the location of boring B-11.

No groundwater was encountered in any of the package plant borings at the time of our field investigation. Again, we note that groundwater conditions at other locations or at other times may be different than those reported during this study.

Pump Station

Subsurface conditions at the two alternative pump station locations consist of fill overlying either residual soils or alluvium and then residual soils. An upper layer of fill was initially encountered to depths varying approximately from 13 feet at the location of boring B-14A to 6 feet at B-15. Boring B-14 encountered fill materials to auger refusal at a depth of 13 feet. At the location of borings B-14 and B-14A, the fill appears to be settled solids waste from the plant overlying wood debris. Refusal in boring B-14 appeared to be a tree trunk or stump. The settled solids waste, classified as soft clayey silt (MH), is currently being used to backfill the old lagoons. The fill in boring B-15, described as loose silty sand (SM), is associated with material previously placed during construction of the lagoon dike. Penetration resistances in the fill were 1 and 2 bpf in the settled solids waste and 7 and 9 bpf in the dike soils.

Below the fill in boring B-15, an approximate 10-foot layer of alluvium was encountered. The upper 5 feet of alluvium appears to be a soft sandy silt (ML). The lower 5 feet was described as a medium dense clayey sand (SC) with organic matter. Standard penetration resistances in these soils were 3 and 4 bpf in the silt and 15 bpf in the sand.

Residual soils were encountered below the fill in boring B-14A and below the alluvium in B-15. The residuum consisted of a dense silty sand (SM) that extended to boring termination depths of 15 and 20 feet, respectively. Standard penetration resistances in the residual soils were 39 and 28 bpf.

Groundwater levels at the time of boring were at depths of 4 feet in borings B-14 and B-14A and 9 feet in boring B-15.

PROJECT INFORMATION

Our understanding of this project is based on previous discussions with Mr. Butch Johnson and Mr. To Nguyen of Civil Engineering Consultants, review of the provided topographic site layout plan, and our field observations of the expansion areas. The expansion will include a 3.0-MG clearwell, a 6.0-MGD package plant with a backwash clearwell, and a pump station.

The new 3.0-MG clearwell will be located in the northwest corner of the site, immediately west of the existing 2.0-MG clearwell. We understand the new clearwell will be a rectangular, 142-foot by 296-foot, reinforced concrete structure. The top of the clearwell will be at elevation 1144.5 and the bottom slab at 1130.0 feet. Plans are to use an 18-inch thick bottom slab underlain by 3 feet of Class "C" concrete. The completed structure will be buried under 3 to 4 feet of soil backfill. Structural loading conditions have not been provided for the clearwell; however, the design indicates a foundation contact pressure for the base slab on the order of 1,500 to 2,000 psf. Significantly higher loads under the exterior walls and interior columns are expected. Based upon existing grades from

our field survey, cuts varying approximately from a maximum of 37 to a minimum of 17 feet are indicated to be required to achieve the planned clearwell bottom elevation.

The new package plant will be located in the baseball field area, southwest of the existing WTP plant. The plant building will be a rectangular, 83-foot by 136-foot, one-story metal structure with a soil supported (slab-on-grade) floor slab. A 28-foot square backwash clearwell will be located outside the northeast corner and a 10,000-gallon lime storage tank outside the southwest corner. Three treatment tanks, each 15 feet wide by 48 feet long by 10 feet high and weighing 456 kips, will be located in the plant building. These will be supported on approximately 24-inch thick slabs at the finish floor elevation. The planned finish floor elevation is 1206.0 feet, roughly zero to 2 feet above the indicated existing site grades. The bottom of the backwash clearwell will be at elevation 1189.5, which will require an excavation of about 15 or 16 feet.

Foundation loading conditions for the new building are expected to be light, not exceeding 100 kips for individual footings and 2 to 3 kips per linear foot for walls. Floor loading underneath the treatment tanks will be on the order of 600 to 700 psf.

Two alternate locations for the new pump station are being considered in the existing sludge lagoon area, on the eastern side of Highway 9. The station will generally be a relatively light slab-on-grade structure containing three pumps. The slab will be placed near the existing site grade.

DESIGN RECOMMENDATIONS

Seismic Design Criteria

The International Building Code (IBC) includes provisions for categorizing the upper 100 feet of the subsurface profile for use in evaluating potential seismic forces resulting from an earthquake. Although subsurface conditions to a depth of 100 feet were not investigated at this site, the available subsurface information and our previous experience indicate the average standard penetration resistance to this depth would generally be in the range of 15 to 50 blows per foot. Based on this information and the IBC definitions (Table 1615.1.1), the site is categorized as Site Class D (stiff soil profile).

Foundations/Floor Slab Support

In general, the undisturbed residual materials encountered in the planned clearwell and package plant locations should provide adequate long-term foundation support for the range of structural loads anticipated. Subject to recommendations in this report, the proposed clearwell and package plant structures may, therefore, be designed for conventional shallow slab-on-grade foundations, continuous footings or individual column footings bearing in existing undisturbed residual soils or partially weathered rock. Available bearing capacities in the residuum vary considerably from a low of about 2,000 psf in the weak soils found in the clearwell location to a high of 10 ksf or more in the partially weathered rock materials found in both the clearwell and package plant areas.

We recommend the new pump station be sited at the location of boring B-15, where shallow foundation support on the existing fill soils may be accomplished. Foundation support at the

alternative location (B-14 and B-14A) would require either difficult dewatering and excavation and replacement of unsuitable materials, or a deep foundation system.

Clearwell. Foundation support of the clearwell will be influenced by construction below the water table and areas of relatively weak residual soils at the planned foundation bearing level. The micaceous silts and sands encountered at the clearwell location are extremely sensitive to moisture and are subject to “quick” soil conditions or loss of strength in excavations below the water table. Therefore, positive groundwater control, as subsequently discussed in this report, must be performed during construction in order to allow shallow support of the clearwell. If the groundwater control measures are inadequate, deep foundation support may become necessary as the only means of repairing water damage to the subgrade. Even with positive dewatering, localized undercutting of water softened soils and replacement with crushed stone will be necessary.

On completion of effective site dewatering, excavation to planned grade, and stabilization of the exposed soils, the clearwell may be supported by the planned conventional shallow slab foundation bearing on the prepared subgrade. We recommend that a maximum allowable soil bearing capacity of 2,000 psf be used for design of the clearwell individual column or continuous wall footings.

Package Plant. Based on the relatively strong residuum encountered in the borings, we recommend the package plant foundations be designed for a maximum allowable soil bearing capacity of 5,000 psf for static loading conditions. Minimum widths of 24 inches for any individual column footings and 18 inches for continuous wall footings should be used for practical construction considerations and to reduce the possibility of localized foundation shear failures. Exterior footings should be placed at least 12 inches below final exterior grades to assure that foundations bear below the possible frost penetration depth.

Floor or grade slabs may be soil supported subject to site preparation and earthwork recommendations contained in this report. Building grade slabs should be jointed around columns and along footing-supported walls to minimize cracking due to possible differential movements. As an alternative to flat grade slabs and conventional spread footings, monolithic turned-down slabs-on-grade may be used. Turned-down slabs should be thickened underneath columns and load bearing walls and have adequate reinforcement in order to minimize cracking between the thickened and flat portions of the slab.

Pump Station. Based upon the boring data, we conclude that the expected light foundation load imposed by the planned pump station foundation slab can be supported on the existing fill soils at the location of boring B-15. We recommend the foundation design be based on a maximum allowable soil bearing capacity of 2,000 pounds per square foot for the existing fill conditions. The slab should bear at least 12 inches below finish grade. Shallow foundation support of the pump station slab is subject to the subsequent construction recommendations in this report.

Retaining/Below Grade Walls

Earth pressures on walls below grade are influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as free-standing walls, where some movement and rotation may occur to mobilize soil shear strength. Walls that are rigidly restrained, such as basement, pit and tunnel walls, should be designed for the at-rest condition. A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Since significant wall movements are required to develop the passive pressure, the total calculated passive pressure should be reduced by one-half to two-thirds for design purposes.

Based on previous experience with similar soils and construction, we recommend the following earth pressure coefficients and equivalent fluid pressures for design of retaining or below grade walls:

EARTH PRESSURE CONDITIONS	COEFFICIENT	RECOMMENDED EQUIVALENT FLUID PRESSURE (PCF)
Active (K_A)	0.33	40
At-Rest (K_O)	0.50	60
Passive (K_P)	3.00	---

A moist soil unit weight of 120 pounds per cubic foot should be used for design calculations. Our recommendations assume that the finish ground surface outside the walls will be level and that silty sand or other granular backfill will be utilized. A surcharge should be added to the earth pressure if the ground surface slopes up from the top of the wall. To calculate resistance to sliding, a value of 0.35 (includes a factor of safety of 1.5) should be used as the coefficient of friction between wall foundations and the underlying soil.

The recommended equivalent fluid pressures assume that constantly functioning drainage systems are installed between walls and soil backfill to prevent the accidental buildup of hydrostatic pressures and lateral stresses in excess of those stated. If a functioning drainage system is not installed, then lateral earth pressures should be determined using the buoyant weight of the soil (57.6 pcf). Hydrostatic pressures calculated with the unit weight of water (62.4 pcf) should be added to these earth pressures to obtain the total stresses for design.

Tractors and other heavy equipment should not operate within 10 feet of below grade walls to prevent lateral pressures in excess of those cited. If footings or other surcharge loadings are located a short distance outside below grade walls, they may also exert appreciable additional lateral pressures. If an imaginary line projected downward at a 45-degree angle from the bottom near edge of the surcharge load does not intersect the wall, the effect of the load on the wall may be neglected.

Whenever this line intersects the wall, the effect of the surcharge loads should be added to the recommended earth pressures to determine total lateral stresses. Foundation bearing levels may also be lowered to eliminate increased stresses on adjacent retaining walls.

Pavements

Strength testing of subgrades was not performed during this study; however, local experience with similar soils indicate typical CBR values in the range of 3 to 5. Based on these subgrade strength values and AASTHO design guidelines, we recommend the following minimum flexible asphalt pavement alternatives:

1. For parking lots and drives restricted to automobile traffic, a light-duty section consisting of 6 inches of crushed stone base course overlain by 2 inches of asphaltic surface course.
2. For parking lots and drives subject to both automobile and occasional truck traffic, a heavy-duty section consisting of 8 inches of crushed stone base course overlain by 1.5 inches of asphaltic binder course and 1.5 inches of asphaltic surface course.

The recommended pavement design sections are subject to successful completion of the site and subgrade preparation and fill placement operations as recommended in this report. We note that the compaction quality and gradation of the crushed stone base will directly affect the quality and life of the flexible pavement section. Consequently, we recommend a minimum compaction of 100 percent of the maximum dry density for the crushed stone material as determined by the modified Proctor compaction test (ASTM D-1557, Method D). A qualified soils engineering technician working under the direction of a geotechnical engineer should observe placement and compaction of the base coarse material and perform field density tests to confirm that the material has been placed in accordance with our recommendations. The crushed stone aggregate utilized in the base should conform with section 815 of the State of Georgia, Department of Transportation Standard Specifications for Road and Bridge Construction. In addition, all pavement materials and paving operations should meet applicable specifications of the Georgia Department of Transportation.

Slope Stability

Our exploration did not include a detailed analysis of slope stability for any temporary or permanent condition. However, within building, pavement and landscaped areas, we recommend temporary slopes no steeper than 1.5(H):1.0(V), and permanent slopes no steeper than 2.0(H):1.0(V) for construction in undisturbed residual soils or structural fill placed in accordance with our recommendations. A minimum setback from the top of all slopes of 10 feet is recommended for structures and 5 feet for pavements.

CONSTRUCTION RECOMMENDATIONS

Site Preparation

Prior to proceeding with construction operations, all vegetation, root systems, topsoil, and other deleterious non-soil materials should be stripped from the proposed construction areas. Clean topsoil

may be stockpiled and used to top dress slopes and other disturbed areas prior to permanent seeding and or stabilization. On completion of the stripping and rough grading, the areas intended to support floor slabs or pavements, new fill, and foundations should be carefully inspected by a qualified geotechnical engineer. Except for the new clearwell and pump station locations, engineering inspection should include observation of proofrolling of the subgrade utilizing a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proofrolling is to locate any soft, weak, or excessively wet soils which may be present at the time of construction. If unstable or unsuitable soils are found, some stabilization measures and/or undercutting and replacement with structural fill will likely be required in order to provide adequate subgrade and foundation support conditions.

Groundwater Control

As noted previously, no groundwater was detected in the borings drilled within the package plant location at the site. In the clearwell and pump station areas, groundwater was observed at all of the boring locations at depths varying approximately from 4 to 25 feet below ground. In general, the groundwater levels correlate to water table elevations ranging approximately from 1137 to 1140 feet within the clearwell and 1136 to 1141 at the two alternate pump station sites.

Construction Dewatering. Based on the indicated groundwater levels, temporary dewatering will be required at the clearwell location prior to excavation. Dewatering will be necessary in order to stabilize the excavation, achieve suitable working conditions, and prevent the loss of soil strength or “quick” soil conditions.

Groundwater control at this location will require a positive system of dewatering such as vacuum well points or a deep well system to adequately lower and maintain the groundwater at required levels until construction is complete. The dewatering system should be monitored and maintained around the clock to assure proper continuous operation and control. The system must also be supplemented with standby equipment to provide emergency dewatering in the event of failure of the primary method of groundwater control. Temporary observation wells must be installed at the site to confirm groundwater levels prior to excavation and monitor drawdown at the location of the adjacent 2.0-MG clearwell. To prevent possible costly construction delays, the required dewatering must be conducted well in advance of the excavation in order to lower and maintain groundwater levels at least 5 feet below the deepest excavation level at all times.

The dewatering system should be designed by the contractor, considering the effect of groundwater lowering on the adjacent 2.0-MG clearwell. It is likely that settlement of the existing clearwell will occur as a result of the mass dewatering required for the new clearwell. Groundwater recharge and/or positive cutoff measures may be necessary between the planned excavation and the existing clearwell to avoid lowering the groundwater underneath the structure. Water levels in observation wells adjacent to the existing clearwell and settlement of the structure should be monitored during construction to evaluate the effects of the dewatering and warn of possible distress to the structure.

Once the groundwater has been lowered to about elevation 1118 or lower, mass excavation of the new clearwell area may proceed. We recommend the mass excavation extend no deeper than 2 feet above the design subgrade elevation of 1125.5. Final excavation and stabilization of the subgrade

should then be performed in small, controlled areas. As small sections of the subgrade are exposed, each area should be inspected by the geotechnical engineer and then immediately protected by backfilling with a layer of crushed stone. Even with successful dewatering, we expect it will be necessary to undercut at least 2 feet of the subgrade soils and replace them with crushed stone. Equipment traffic on the prepared subgrade should be prohibited prior to placement of the Class C concrete.

Permanent Underdrains/Hydrostatic Pressure Relief. Structures constructed below the water table are subject to hydrostatic pressures, and provisions must be included in the design to protect grade slabs and below grade walls from the build-up of excessive uplift and lateral water pressures. Measures must also be included to reduce the likelihood of water seepage into structures, except when necessary to balance any excessive buoyant forces. Structures may be designed to either structurally resist any unbalanced water pressures or permanent underdrain systems and foundation drains must be provided. Pressure relief valves may also be installed within structures to prevent excessive buoyant pressures from occurring.

We understand that the new clearwell will be designed to provide sufficient uplift resistance by anchoring to the 3-foot thick concrete slab under the floor and by backfilling over the top. At the package plant location, a subdrainage system below the floor slab is not required. However, we recommend that a 4-inch layer of clean crushed stone or gravel covered with an impermeable membrane be placed beneath the building slab to provide a vapor barrier.

Difficult Excavation

Within the new clearwell area, partially weathered rock was encountered near the planned excavation level at the locations of borings B-1 and B-2. At the package plant location, layers of partially weathered rock were found within the residual soil stratum at depths of 3 feet in boring B-11 and 8 feet in B-12. Very dense or very hard soils were also encountered at various depths in a majority of the package plant borings. Based upon this information, we expect that some difficult excavation techniques during foundation and/or utility construction within the package plant area and possibly during mass site grading operations for the clearwell may be required for the removal of partially weathered rock, very dense or very hard soils, or possibly rock that could occur between our boring locations.

In mass excavations for general sitework, very hard or very dense soils and weathered rock can usually be removed by ripping with a single-tooth ripper attached to a large crawler tractor or by breaking the material out with a large front-end loader. In confined excavations, such as foundations and utility trenches, removal of weathered rock typically requires use of large backhoes, pneumatic spades, or light blasting. Refusal materials (apparent rock) usually require blasting for removal in both mass and confined excavations. Any blasting within structure subgrade areas or in footing excavations must be done carefully to prevent damage to the bearing materials.

The definition of rock can be a source of conflict during construction. The following definitions have been incorporated into specifications on other projects and are provided for your general guidance:

1. General Excavation

- Rip Rock - Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.
- Blast Rock - Any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or by a Caterpillar 977 front-end loader or equivalent; and occupying an original volume of at least one (1) cubic yard.

2. Trench/Foundation Excavation

- Blast Rock - Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 33,000 pounds and a stick crowd of not less than 29,000 pounds (Caterpillar 325 or equivalent), and occupying an original volume of at least one-half ($\frac{1}{2}$) cubic yard.

Earthwork

Based upon our qualitative evaluation of the subsurface conditions at the site and previous experience with similar soils, we expect the majority of the native soils and clean fill soils from the clearwell area will be suitable for use as structural fill. Soils from near or below the water table, are expected to be excessively wet and would require spreading and drying prior to fill placement. Typically, the wet soils are considered to be unsuitable for reuse. All structural fill should have a plasticity index (PI) less than 30 and be clean soil free of deleterious materials and rocks larger than 3 inches in diameter. The maximum dry density of structural fill soils should be at least 90 pcf, in order to provide adequate strength. All fill materials should be evaluated by the geotechnical engineer, and soil classification and compaction characteristics (moisture-density relationships) should be determined in the laboratory in advance of the earthwork.

General site structural fill required to achieve site grades underneath pavements, buildings, and treatment structures, or to replace undercut areas should be placed in maximum 6 to 8-inch lifts, loose measure, and compacted to at least 95 percent of the maximum dry density as determined by the standard Proctor compaction test (ASTM D-698). Backfill in trenches or other confined spaces, where light portable compaction equipment is required, should be placed in maximum lift thicknesses of 3 to 4 inches, loose measure. In landscaped areas, where no structures are planned or anticipated in the future, the compaction criteria may be reduced to 90 percent of the standard Proctor maximum dry density. We note that moisture control is important with the native soils typical of this area in order to achieve adequate compaction, and equipment should be available on site during construction for both wetting and drying proposed fill soils. Except for soils excavated from below the water table, we do not anticipate significant problems in controlling moisture contents during dry weather; however, during winter months or during extended wet periods, moisture control problems will likely occur.

During fill placement, a sufficient number of field density tests should be conducted by a qualified soils technician working under the direction of a geotechnical engineer to determine the degree of compaction and compliance with the project specifications. We recommend at least one density test be conducted per 2,500 - 5,000 square feet of fill area for each 2-foot interval of compacted soil. Any areas that do not comply with the compaction requirements during the earthwork construction should be recompacted until compliance is met.

Inspection

We recommend that all base slab subgrades and foundation excavations be evaluated by a qualified geotechnical engineer to confirm that conditions are similar to those encountered in the borings and that the bearing soils are capable of supporting the design contact pressures. Foundation excavations should be free of all soft or loose soil, mud, disturbed materials, and other deleterious materials prior to placement of concrete. In addition, concrete should not be placed on a frozen subgrade. Any foundation bearing surfaces that have been disturbed due to construction activities or exposure to precipitation or run-off must be repaired prior to placement of concrete. We recommend that foundation excavations and slab subgrades be concreted as soon as practical after they are excavated and that water not be allowed to pond or infiltrate the bearing surface. If it is necessary to leave the excavations open for an extended period of time, we recommend that a thin mat of lean concrete be placed over the bottom for protection.

QUALIFICATION OF RECOMMENDATIONS

This report has been prepared for the exclusive use of the City of Cumming and Civil Engineering Consultants, Inc. for design and construction of the proposed 6-MGD WTP expansion. Conclusions and recommendations in this report were based on the site and subsurface information obtained and our understanding of the planned site development. The exploratory activities, testing procedures, and evaluation of the data were consistent with those normally used in geotechnical engineering practice for projects of this type. We have made recommendations based on our experience with similar subsurface conditions under similar loading conditions. Allowable soil bearing capacity was estimated from previous correlations of standard penetration resistances and bearing capacities of comparable soils. Should the project plans change substantially from those outlined in this report, we request the opportunity to review our recommendations in light of the changes. If conditions differing from those anticipated are encountered during construction, GeoSystems should review the changed conditions to formulate any required modifications to the recommendations presented herein.

APPENDIX A
FIELD AND LABORATORY PROCEDURES

GEOSYSTEMS ENGINEERING

STANDARD FIELD AND LABORATORY TESTING PROCEDURES

Soil Test Boring

Soil sampling and penetration testing are performed in general accordance with ASTM Designation D 1586. Borings are usually advanced either by mechanically twisting continuous steel hollow-stem auger flights into the ground or by wash boring using roller cone or Hawthorne bits. At regular intervals, soil samples are obtained with a standard 1.4-inch I.D., 2-inch O.D., split-spoon sampler. The sampler is first seated 6 inches into the bottom of the hole to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to achieve the final foot of penetration is recorded and is designated the "standard penetration resistance." Penetration resistance, when properly evaluated, is an index to the soil strength, density and ability to support foundations.

Groundwater levels are normally determined by the driller in conjunction with the field investigation and are noted on the drilling records. These levels indicate the approximate location of the hydrostatic water table at the time of observation. Generally, water levels are reported at the time of boring and at subsequent times. The time of boring water level is detected as the drilling tools are advanced by changes in the drilling rate, soil sample moisture conditions, water or mud on the drill rods, and moisture conditions of the borehole drill cuttings. Additional groundwater levels are typically obtained at various times after boring to minimize any disruption by the drilling operations and to allow the water table to stabilize. Normally, a time lag of at least 24 hours is required to permit stabilization of the water table. A longer time period may be required in low permeability (clayey) soils. Water table measurements are taken in open boreholes using a weighted measuring tape or electronic groundwater level indicator.

Representative portions of the soil samples, obtained from the split-spoon sampler, are sealed in containers and shipped or transported to the office. In the office, the samples are examined by an engineer to verify the driller's field classifications.

Auger Borings

Auger borings, wash borings, and air hammer drilling without standard penetration testing are practical when the depth to rock is of primary concern. Auger and wash borings may also be used to obtain undisturbed samples at pre-selected depths. The borings may be advanced by hollow-stem augers, wash boring techniques using roller cone or Hawthorne bits, or pneumatic hammer drills to termination or refusal depths. The soils and rock materials encountered are roughly identified by the driller from cuttings brought to the surface during the drilling process. Crude estimates of the soil consistency or relative density and rock quality may also be made from the difficulty of the drilling process in advancing the borehole.

Undisturbed Sampling

Split tube samples are suitable for visual examination and classification tests but are not sufficiently intact for quantitative laboratory testing. Relatively undisturbed samples are obtained by pushing sections of 3 inch O.D., 16-gauge, steel "Shelby" tubing into the soil at the desired sampling levels. This procedure is described by ASTM Standard D-1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight, and transported to the laboratory. Locations and depths of undisturbed samples are shown on the Test Pit or Boring Records.

Soil Identification and Description

Soils are normally classified using the Unified Soil Classification System (ASTM D 2487). This is useful for grouping them for a particular purpose, but may be misleading in other applications. In addition to standard classification, soils are identified in accordance with the important soil properties to provide a complete description and assist with predicting behavior. Soil properties significant to most earthwork/foundation problems include consistency (cohesive fine grained soils) or relative density (cohesionless granular soils), color, and texture or composition. Consistency and relative density are fundamental properties in evaluating soil strength and are typically estimated based on standard penetration test results. The engineer's examination of soil samples recovered during the field investigation is primarily a qualitative visual process. Detailed soil classification requires basic laboratory grain size analyses and Atterberg limits (plasticity) tests.

Grain Size/Gradation

Grain size tests are performed to determine the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D-421 (dry preparation) or ASTM D-2217 (wet preparation). The grain size distribution of soils coarser than a number 200 sieve (0.074 mm opening) is determined by passing the samples through a standard set of nested sieves. A sample of known weight is passed through the sequence of sieves with decreasing size of openings and the portions retained on each sieve weighed. Materials passing the number 200 sieve are suspended in water and the grain size distributing calculated from the measured settlement rate (hydrometer analysis). Hydrometer analysis determines the density of a suspension of soil at various times after agitation. Using Stokes's law, the particle size remaining suspended at each particular time is calculated and the corresponding density is a measure of the quantity of soil smaller than the computed size. Procedures for the grain size analysis of soils is described by ASTM D-422.

Permeability/Hydraulic Conductivity

The permeability test is used to measure the ease with which water will flow through the soil, such as seepage under dams, percolation from land application, the squeezing out of water from the soil by the application of load, and drainage of subgrades, dams and backfills.

Hydraulic conductivity testing by the flexible wall permeameter method is performed on undisturbed or remolded samples according to ASTM D 5084. Constant head (Method A), falling head (Methods B & C), or constant rate of flow (Method D) systems may be utilized. Generally, the constant head method is used for granular soils and the falling head method for fine grained soils. Once the samples are prepared, each test specimen is trimmed, porous plates are placed on the ends, and encased in a rubber membrane. The encased test specimens are placed in permeameter cells and saturated, usually with back pressure. After saturation, a differential pressure head of water is applied across the sample and changes in pressure head with time are measured and recorded. Permeability or hydraulic conductivity of each soil sample is calculated from the test data.

APPENDIX B

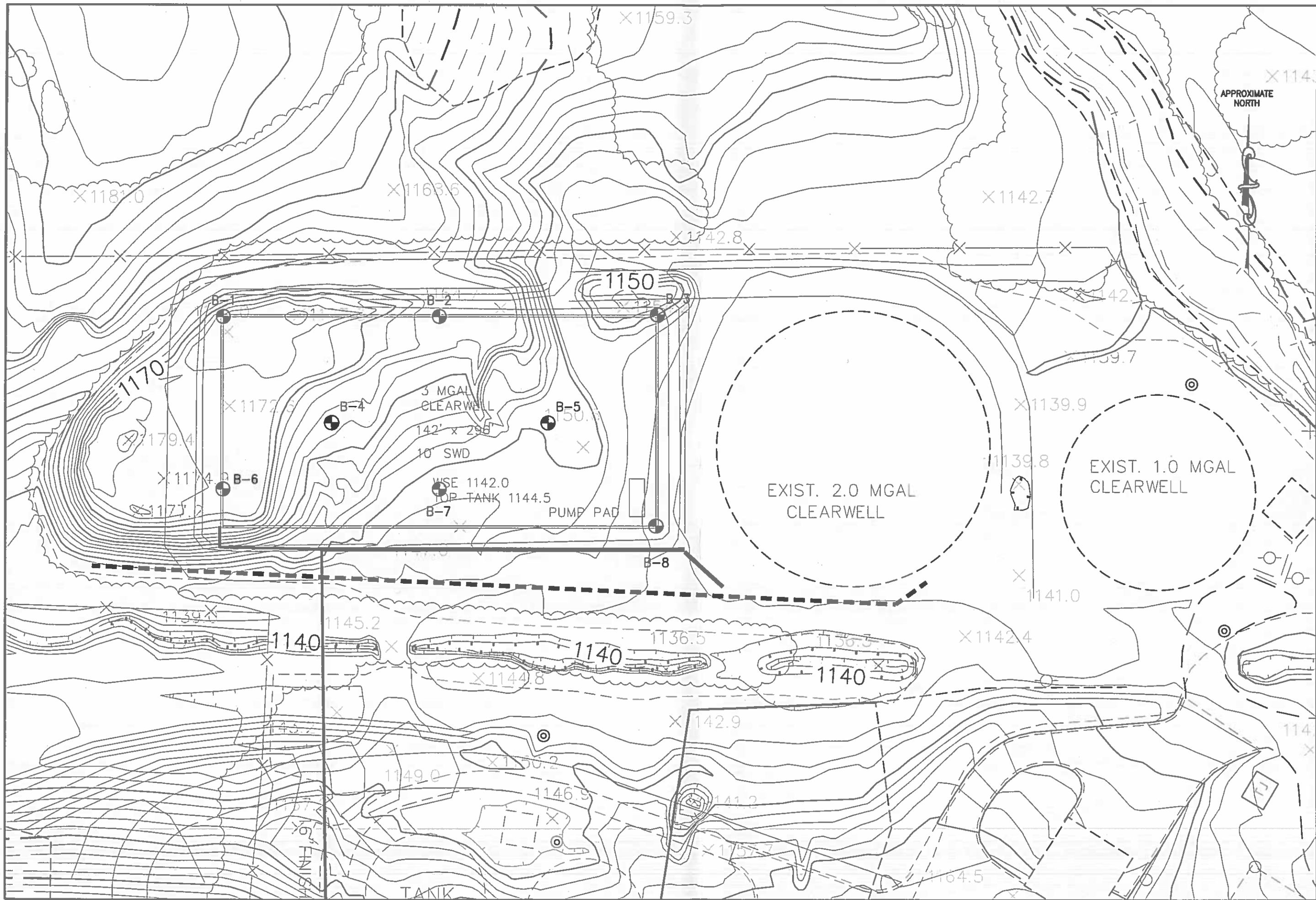
FIGURE 1 – BORING LOCATION PLAN

FIGURE 2 – BORING LOCATION PLAN

FIGURE 3 – BORING LOCATION PLAN

KEY TO SYMBOLS AND CLASSIFICATIONS

BORING LOGS – 24 PAGES



BORING LOCATION PLAN

PREPARED BY: ARC
 DATE: 10/13/2006
 PROJECT: CITY OF CUMMING WTP EXPANSION
 Clearwell, Package Plant, and Pump Stations
 Cumming, Forsyth County, Georgia
 GeoSystems Project Number: 06-1899
 REVIEWED BY: LDM
 DATE: 10/13/2006
 FIGURE: **1**

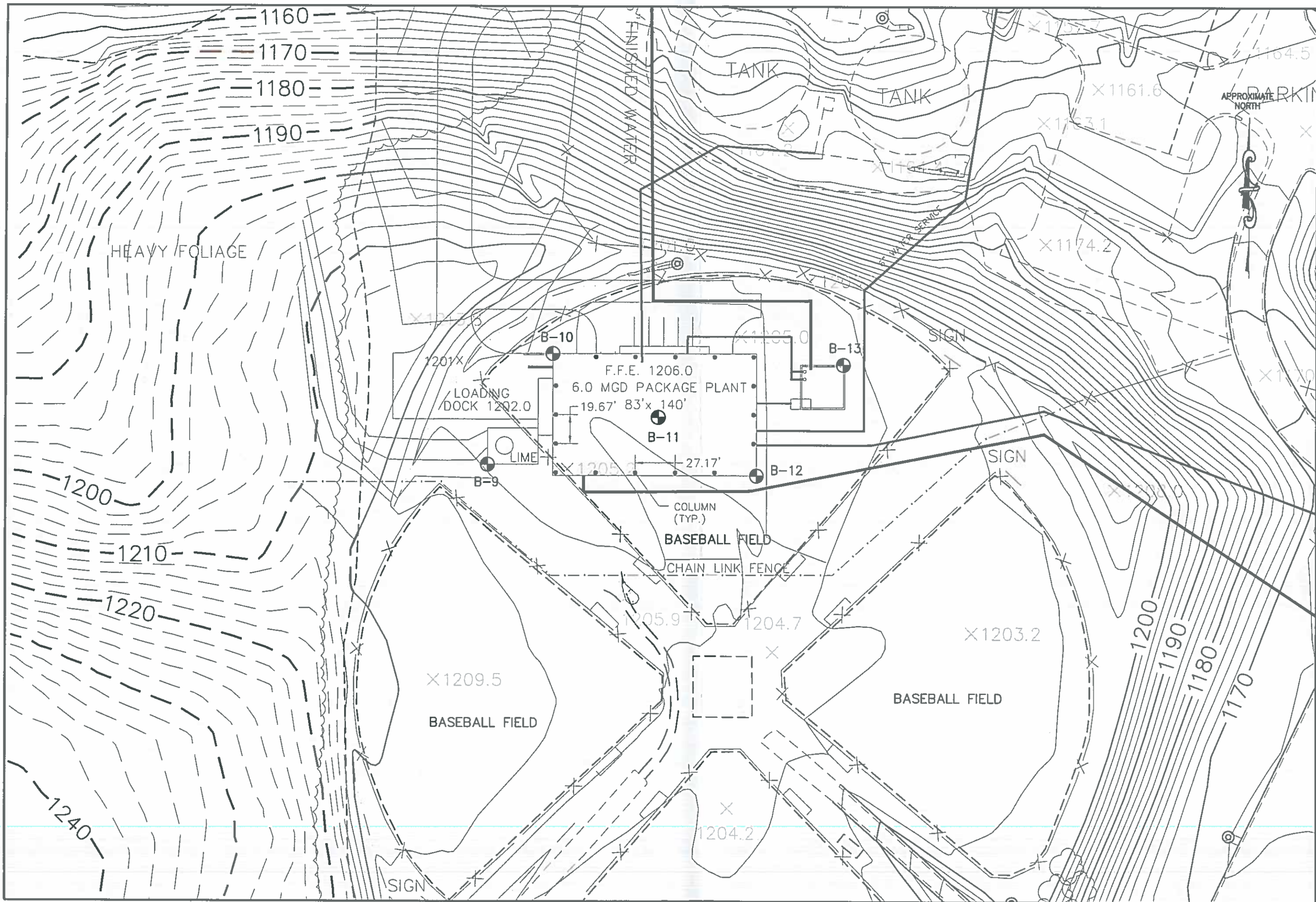
GEOSYSTEMS
ENGINEERING, INC.

REFERENCE: 06-1899 City of Cumming WTP Expansion PLAN

LEGEND

- - SOIL TEST BORING
 0 30 60
 GRAPHIC SCALE (FEET)

SCALE: 1" = 60' (APPROXIMATELY)



BORING LOCATION PLAN

PREPARED BY: ARC
 DATE: 10/13/2006
 PROJECT: CITY OF CUMMING WTP EXPANSION
 Clearwell, Package Plant, and Pump Stations
 Cumming, Forsyth County, Georgia
 REVIEWED BY: LDM
 DATE: 10/13/2006
 Geosystems Project Number: 06-1899

FIGURE 2

GEOSYSTEMS ENGINEERING, INC.

REFERENCE: 06-1899 City of Cumming WTP Expansion Plan

LEGEND

SOIL TEST BORING
 GRAPHIC SCALE (FEET)
 0 30 60

SCALE: 1" = 60' (APPROXIMATELY)

























































BORING LOCATION PLAN

PREPARED BY: ARC
 DATE: 10/13/2006
 PROJECT: CITY OF CUMMING WTP EXPANSION
 Clearwell, Package Plant, and Pump Stations
 Cumming, Forsyth County, Georgia
 GeoSystems Project Number: 06-1899

GEOSYSTEMS
ENGINEERING, INC.
 REFERENCE: 06-1899 City of Cumming WTP Expansion PLAN

LEGEND
 - SOIL TEST BORING
 0 30 60
 GRAPHIC SCALE (FEET)
 SCALE: 1" = 60' (APPROXIMATELY)

KEY TO SYMBOLS AND CLASSIFICATIONS

<table border="0" style="width: 100%;"> <tr> <td style="text-align: center;"></td> <td>FILL</td> </tr> <tr> <td style="text-align: center;"></td> <td>TOPSOIL</td> </tr> <tr> <td style="text-align: center;"></td> <td>PAVEMENT</td> </tr> <tr> <td style="text-align: center;"></td> <td>PARTIALLY WEATHERED ROCK</td> </tr> <tr> <td style="text-align: center;"></td> <td>CL: Low plasticity inorganic clays</td> </tr> <tr> <td style="text-align: center;"></td> <td>CH: High plasticity inorganic clays</td> </tr> <tr> <td style="text-align: center;"></td> <td>ML: Low plasticity inorganic silts</td> </tr> <tr> <td style="text-align: center;"></td> <td>MH: High plasticity inorganic silts</td> </tr> <tr> <td style="text-align: center;"></td> <td>SP: Poorly graded sands</td> </tr> </table>		FILL		TOPSOIL		PAVEMENT		PARTIALLY WEATHERED ROCK		CL: Low plasticity inorganic clays		CH: High plasticity inorganic clays		ML: Low plasticity inorganic silts		MH: High plasticity inorganic silts		SP: Poorly graded sands	<table border="0" style="width: 100%;"> <tr> <td style="text-align: center;"></td> <td>SW: Well graded sands</td> </tr> <tr> <td style="text-align: center;"></td> <td>GP: Poorly graded gravels</td> </tr> <tr> <td style="text-align: center;"></td> <td>GW: Well graded gravels</td> </tr> <tr> <td style="text-align: center;"></td> <td>OL: Low plasticity organic silts and clays</td> </tr> <tr> <td style="text-align: center;"></td> <td>OH: High plasticity organic silts and clay</td> </tr> <tr> <td style="text-align: center;"></td> <td>SM: Silty sands</td> </tr> <tr> <td style="text-align: center;"></td> <td>GM: Silty gravels</td> </tr> <tr> <td style="text-align: center;"></td> <td>SC: Clayey sands</td> </tr> <tr> <td style="text-align: center;"></td> <td>GC: Clayey gravels</td> </tr> </table>		SW: Well graded sands		GP: Poorly graded gravels		GW: Well graded gravels		OL: Low plasticity organic silts and clays		OH: High plasticity organic silts and clay		SM: Silty sands		GM: Silty gravels		SC: Clayey sands		GC: Clayey gravels
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CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

SANDS	N - VALUE BLOWS PER FOOT	APPROXIMATE RELATIVE DENSITY
		0 - 4
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
SILTS AND CLAYS	APPROXIMATE CONSISTENCY	
	0 - 1	Very Soft
	2 - 4	Soft
	5 - 8	Firm
	9 - 15	Stiff
	16 - 30	Very Stiff
	31 - 50	Hard
OVER 50	Very Hard	

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-1

GEOLOGIST: N/A

ELEVATION: 1162 Feet

NOTES: Water level at time of boring (▽) was measured at 41 Feet. The 24 hour water level (▽) was measured at 23 Feet.

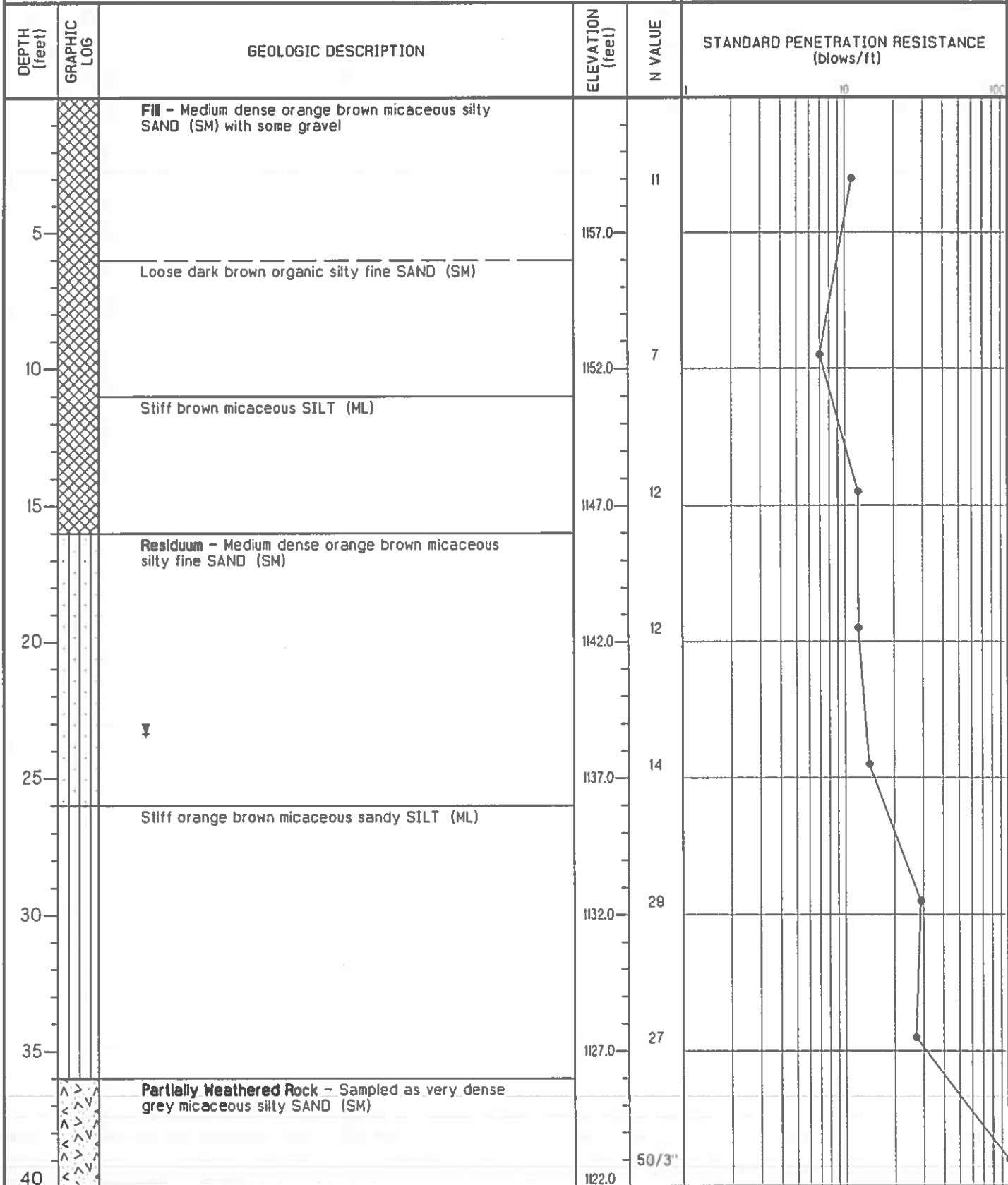
DATE DRILLED: 10/16/06

BORING DEPTH: 53 Feet

DRILLER: GABLE DRILLING CO.


WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-1

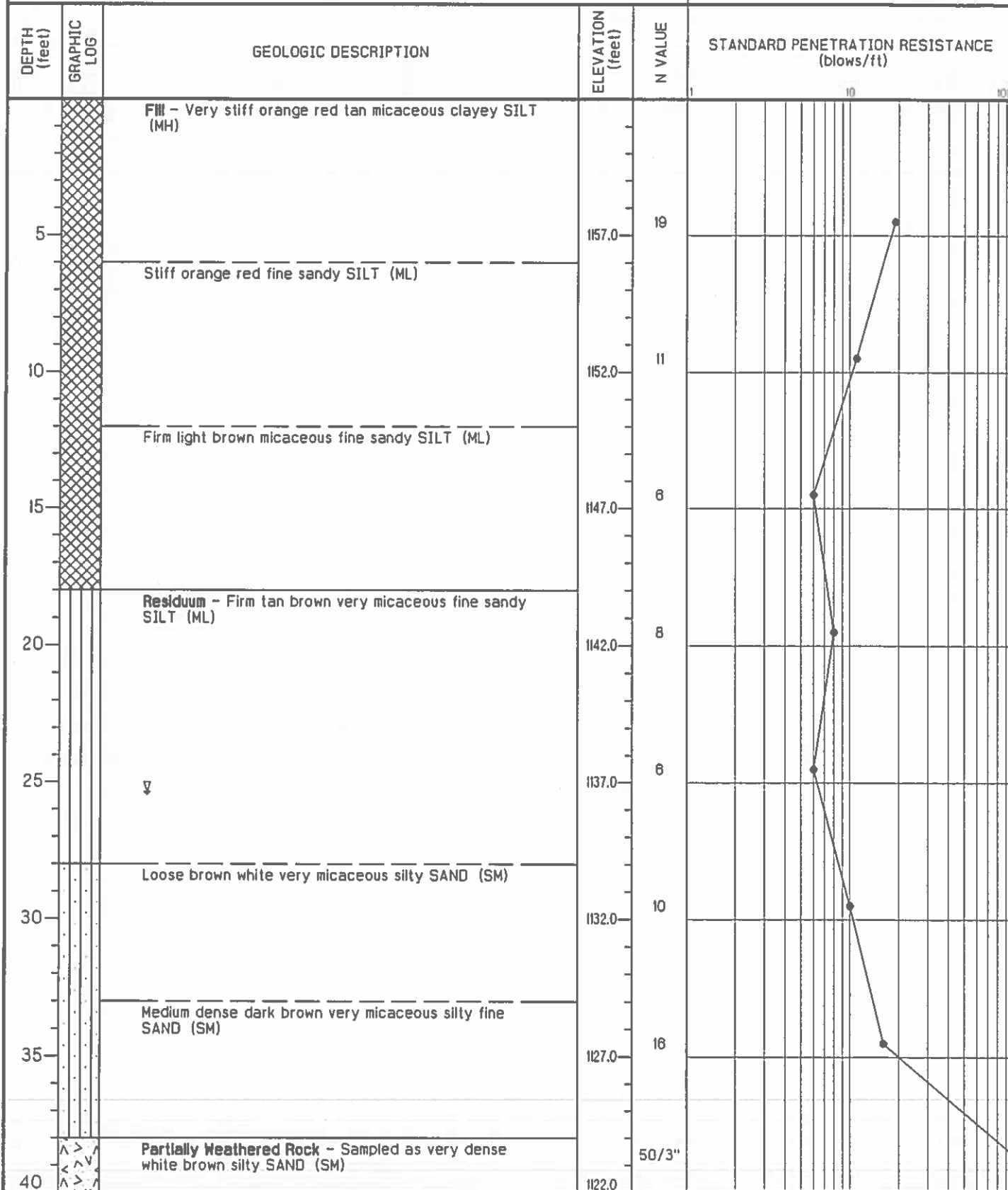
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)		
					1	10	40C
45		Partially Weathered Rock - Sampled as very hard grey brown sandy SILT (ML) ▽	1117.0	50/5"			
50			1112.0	50/4"			
55		Auger Refusal at 53 Feet	1107.0				
60			1102.0				
65			1097.0				
70			1092.0				
75			1087.0				
80			1082.0				
85			1077.0				

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-2

GEOLOGIST: N/A	ELEVATION: 1162 Feet
DATE DRILLED: 10/20/06	BORING DEPTH: 43 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: 25 Feet
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: Water level at time of boring (▽) was measured at 25 Feet.



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-2

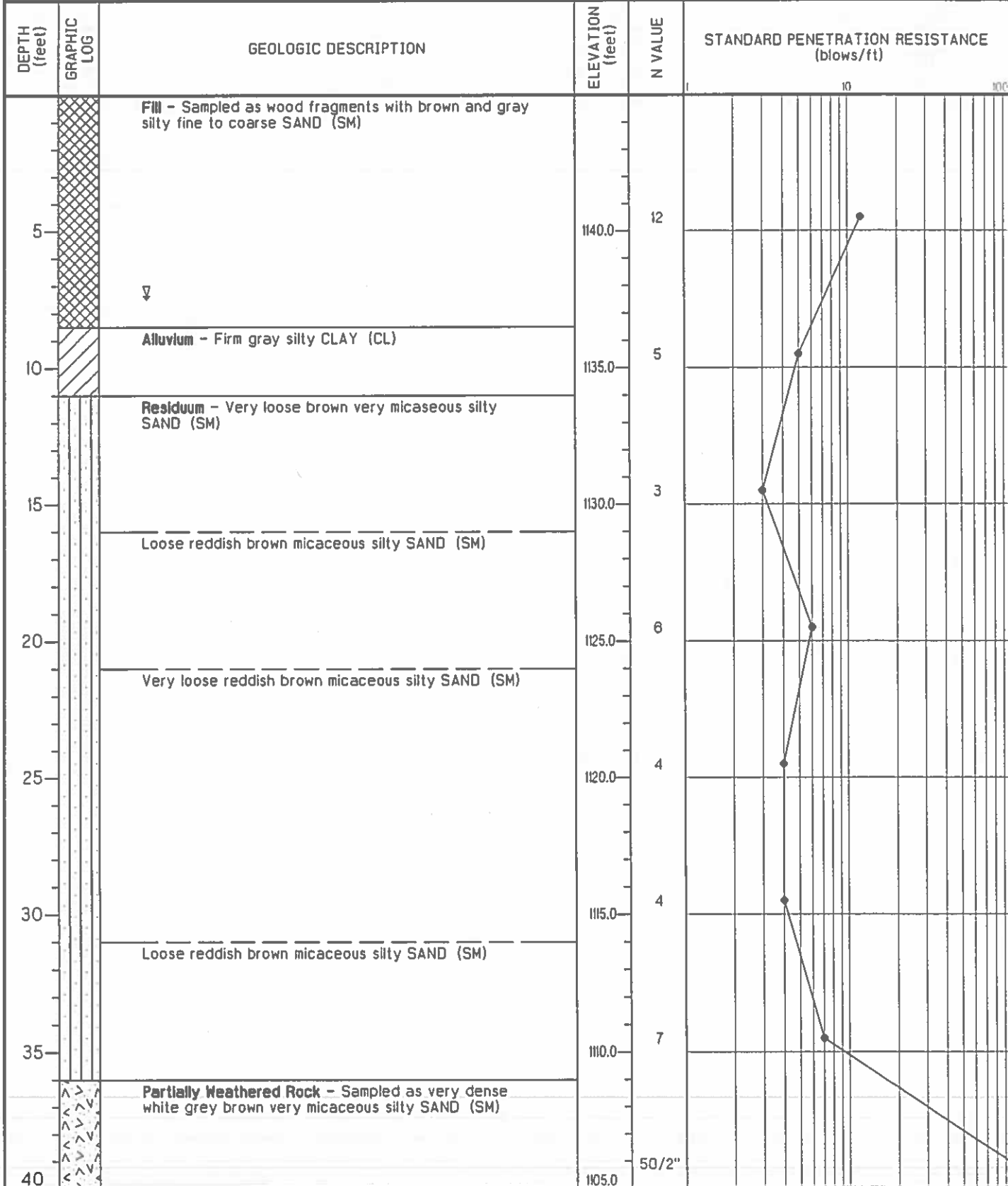
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					1	2	3	4	5	6	7	8	9	10						
		Partially Weathered Rock - Samples as very dense white brown silty SAND (SM)																		
45		Auger Refusal at 43 Feet	1117.0																	
50			1112.0																	
55			1107.0																	
60			1102.0																	
65			1097.0																	
70			1092.0																	
75			1087.0																	
80			1082.0																	
85			1077.0																	

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-3


GEOLOGIST: N/A	ELEVATION: 1145 Feet
DATE DRILLED: 10/18/06	BORING DEPTH: 42 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: 7 Feet
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: Water level at time of boring (▽) was measured at 7 Feet.



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-3

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					1	2	3	4	5	6	7	8	9	10	100						
		Partially Weathered Rock- Sampled as very dense white grey brown very micaceous silty SAND (SM)																			
		Augar Refusal at 42 Feet																			
45			1100.0																		
50			1095.0																		
55			1090.0																		
60			1085.0																		
65			1080.0																		
70			1075.0																		
75			1070.0																		
80			1065.0																		
85			1060.0																		

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-4

GEOLOGIST: N/A

ELEVATION: 1162 Feet

NOTES: Water level at time of boring (▽) was measured at 30 Feet. The 24 hour water level (▽) was measured at 23 Feet.

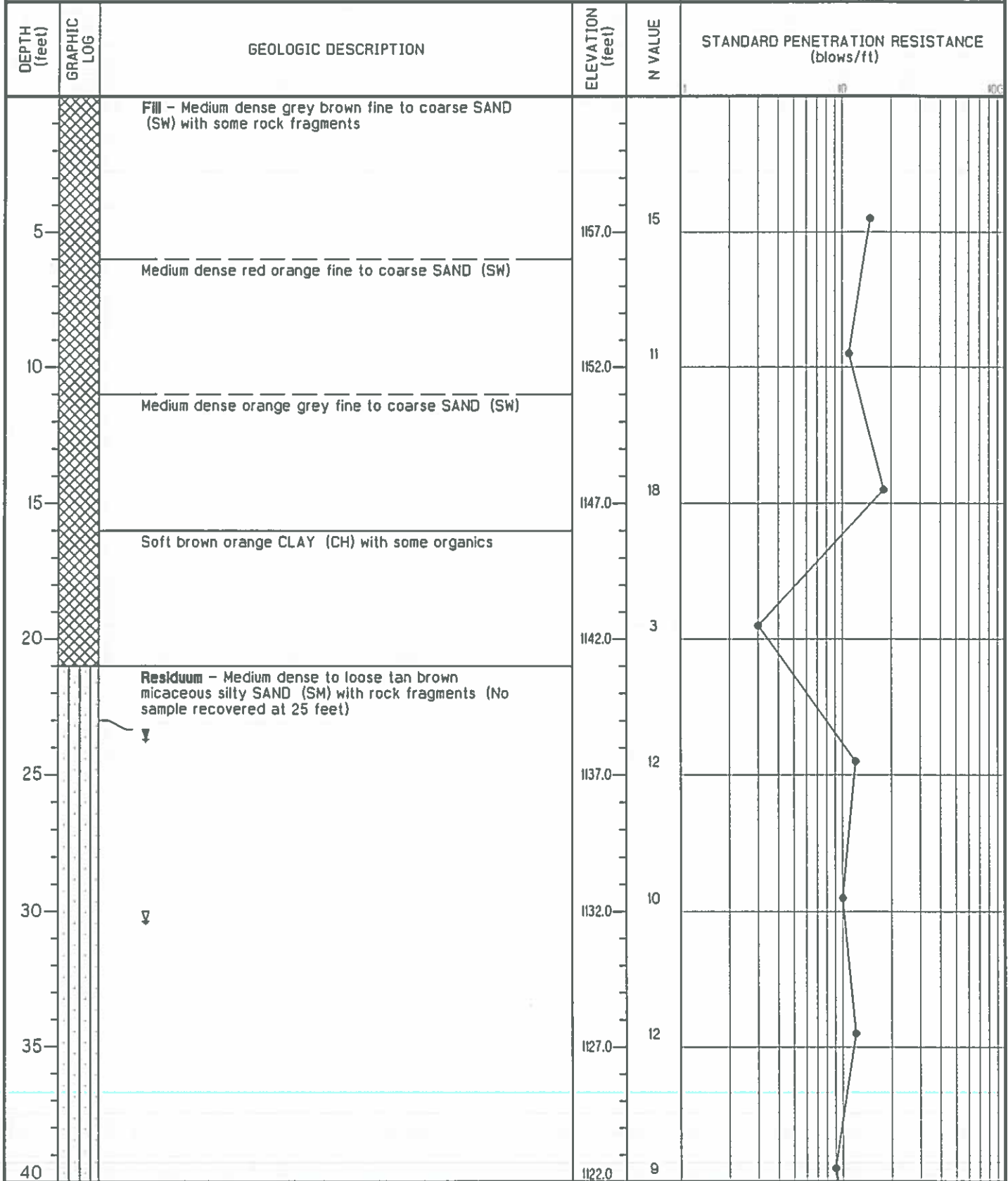
DATE DRILLED: 10/19/06

BORING DEPTH: 53 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-4

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)	
					1	100
45		Medium dense to loose tan brown micaceous silty SAND (SM) with rock fragments	1117.0	12		
50		Medium dense brown to grey brown silty SAND (SM)	1112.0	14		
55		Auger Refusal at 53 Feet	1107.0			
60			1102.0			
65			1097.0			
70			1092.0			
75			1087.0			
80			1082.0			
85			1077.0			

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-5

GEOLOGIST: N/A

ELEVATION: 1161 Feet

NOTES: Water level at time of boring (▽) was measured at 23 Feet. The 24 hour water level (▽) was measured at 23 Feet.

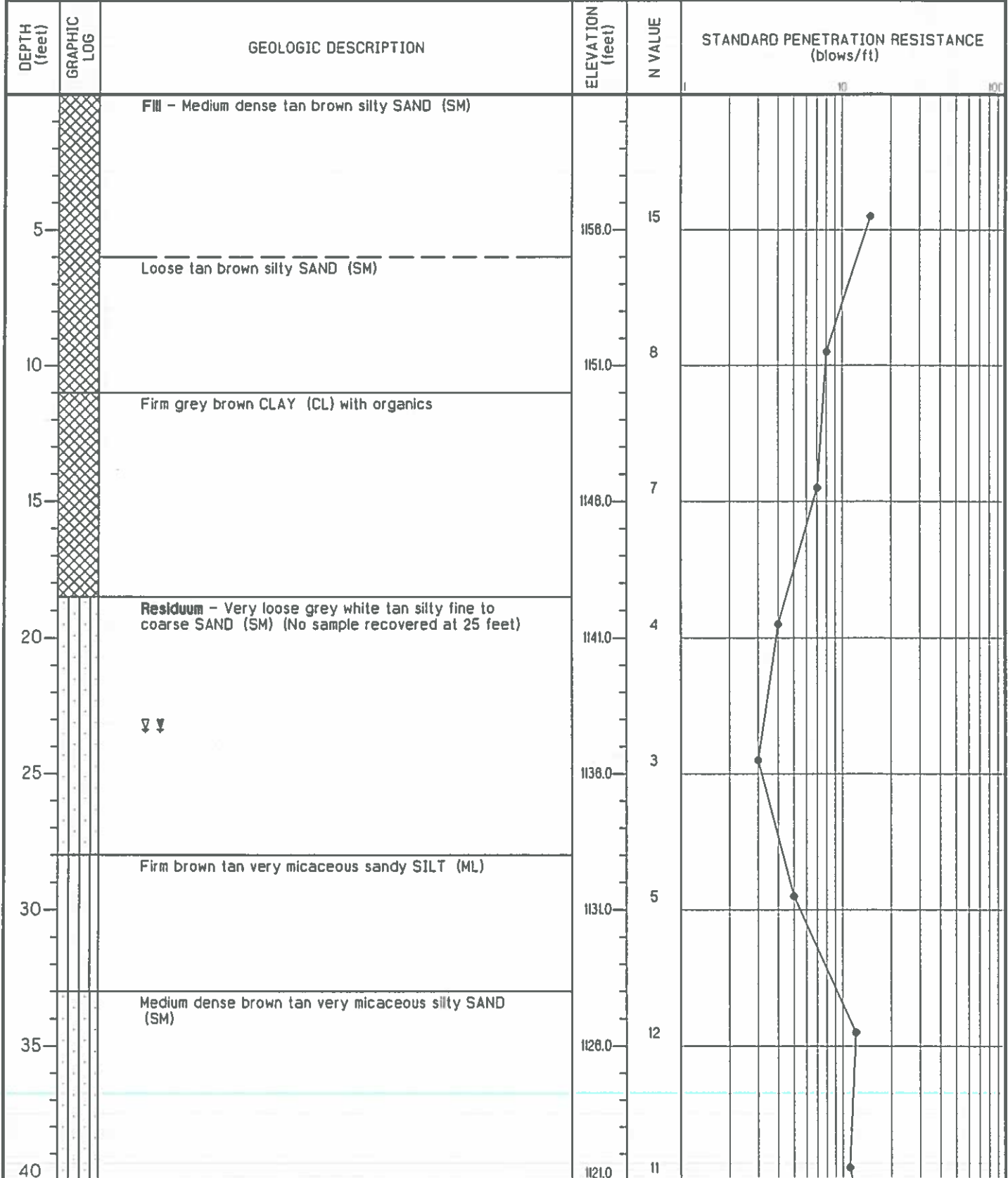
DATE DRILLED: 10/16/06

BORING DEPTH: 50 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-5

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)		
					1	10	100
45		Medium dense brown tan very micaceous silty SAND (SM)	1118.0	16			
50		Boring Terminated at 50 Feet	1111.0	16			
55			1108.0				
60			1101.0				
65			1098.0				
70			1091.0				
75			1088.0				
80			1081.0				
85			1076.0				

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-6

GEOLOGIST: N/A

ELEVATION: 1163 Feet

NOTES: Water level at time of boring (▽) was measured at 27 Feet. The 24 hour ground water level (▽) was measured at 23 Feet.

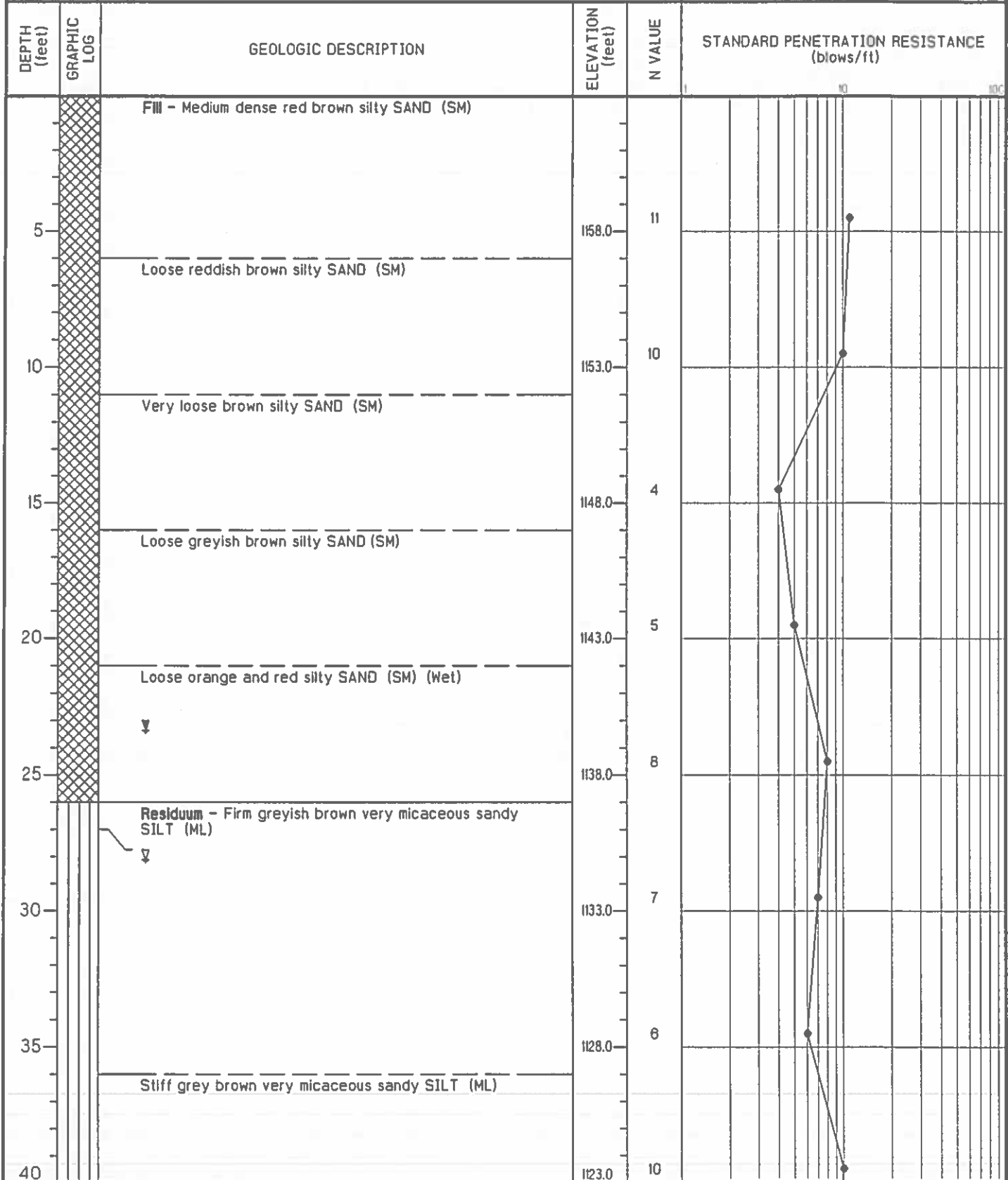
DATE DRILLED: 10/16/06

BORING DEPTH: 63 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
 CITY OF CUMMING
 CUMMING, GEORGIA

LOG OF BORING B-6

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)		
					1	10	30
45		Stiff grey brown very micaceous sandy SILT (ML)	1118.0	9			
50			1113.0	9			
55			1108.0	12			
60			1103.0	15			
65		Auger Refusal at 63 Feet	1098.0				
70			1093.0				
75			1088.0				
80			1083.0				
85			1078.0				

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-7

GEOLOGIST: N/A

ELEVATION: 1161 Feet

NOTES: Water level at time of boring (▽) was measured at 24 Feet. The 24 hour ground water level (▽) was measured at 23 Feet.

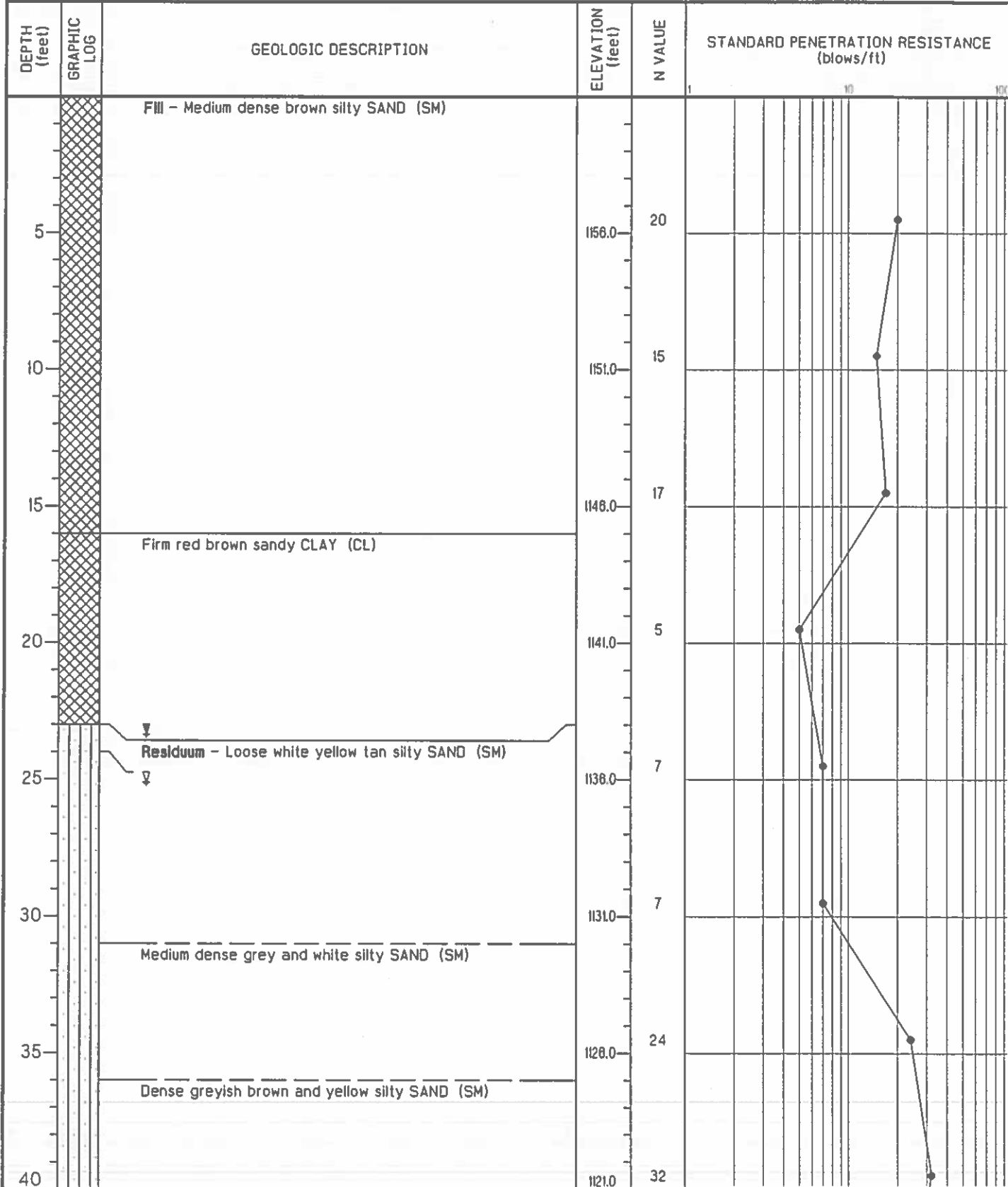
DATE DRILLED: 10/19/06

BORING DEPTH: 50 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-7

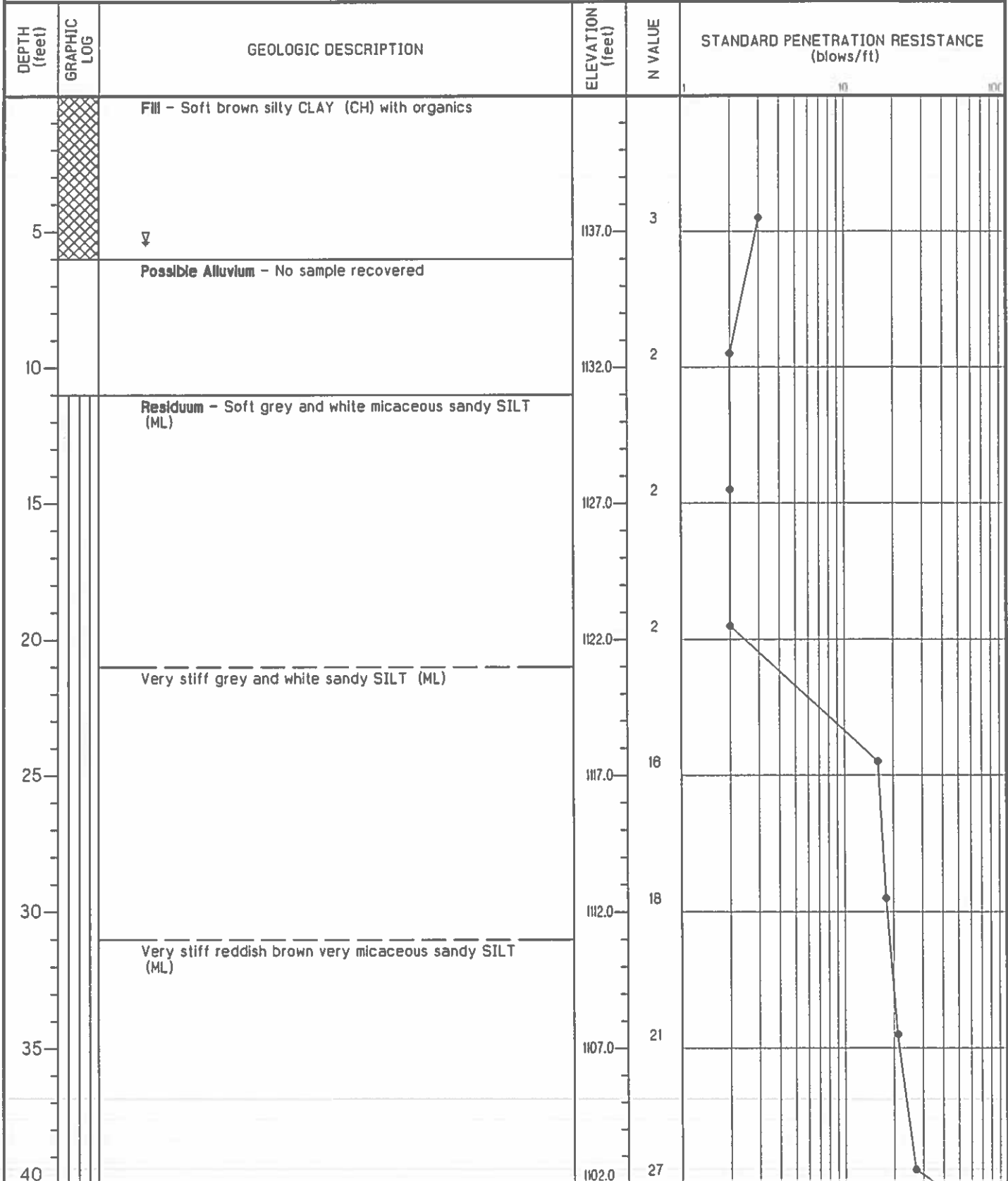
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																			
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
45		Dense greyish brown and yellow silty SAND (SM)	1118.0	22																				
		Medium dense orange and dark brown silty SAND (SM)																						
50		Boring Terminated at 50 Feet	1111.0	28																				
55			1108.0																					
60			1101.0																					
65			1098.0																					
70			1091.0																					
75			1086.0																					
80			1081.0																					
85			1076.0																					

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-8


GEOLOGIST: N/A	ELEVATION: 1142 Feet
DATE DRILLED: 10/18/06	BORING DEPTH: 45 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: 5 Feet
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: Water level at time of boring (▽) was measured at 5 Feet.



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-8

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					1	2	3	4	5	6	7	8	9	10	100					
45		Very stiff reddish brown very micaceous sandy SILT (ML) Partially Weathered Rock - Sampled as very dense dark brown micaceous silty fine SAND (SM)	1097.0	50/4"																
		Boring Terminated at 45 Feet																		
50			1092.0																	
55			1087.0																	
60			1082.0																	
65			1077.0																	
70			1072.0																	
75			1067.0																	
80			1062.0																	
85			1057.0																	

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-9

GEOLOGIST: <i>N/A</i>	ELEVATION: <i>1206 Feet</i>
DATE DRILLED: <i>10/20/06</i>	BORING DEPTH: <i>25 Feet</i>
DRILLER: <i>GABLE DRILLING CO.</i>	WATER LEVEL: <i>NGW@TOB *</i>
DRILLING METHOD: <i>HOLLOW STEM AUGER</i>	

NOTES: * - No ground water encountered at time of boring.

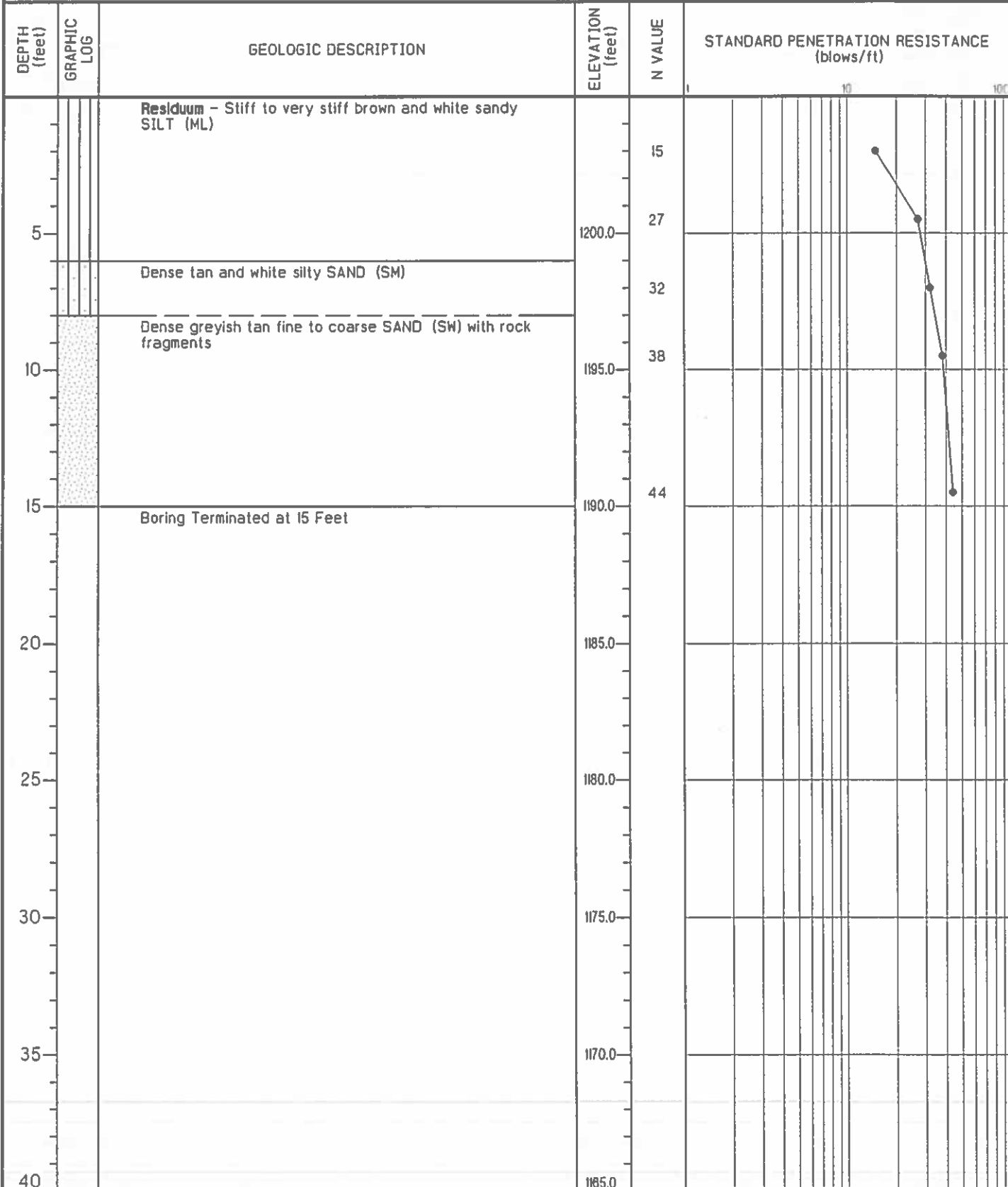
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)	
					1	100
0		Residuum - Medium dense light brown slightly micaceous silty fine SAND (SM)	1201.0	19		
5		Dense light tan brown micaceous silty fine SAND (SM)	1198.0	49		
10		Very dense light orange brown micaceous silty fine SAND (SM)	1191.0	51		
15		Very stiff light brown micaceous fine sandy SILT (ML)	1186.0	27		
20		Boring Terminated at 25 Feet	1181.0	28		
25			1176.0			
30			1171.0			
35			1166.0			
40						

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-10

GEOLOGIST: <i>N/A</i>	ELEVATION: <i>1205 Feet</i>
DATE DRILLED: <i>10/20/06</i>	BORING DEPTH: <i>15 Feet</i>
DRILLER: <i>GABLE DRILLING CO.</i>	WATER LEVEL: <i>NGW@TOB *</i>
DRILLING METHOD: <i>HOLLOW STEM AUGER</i>	

NOTES: * - No ground water encountered at time of boring.

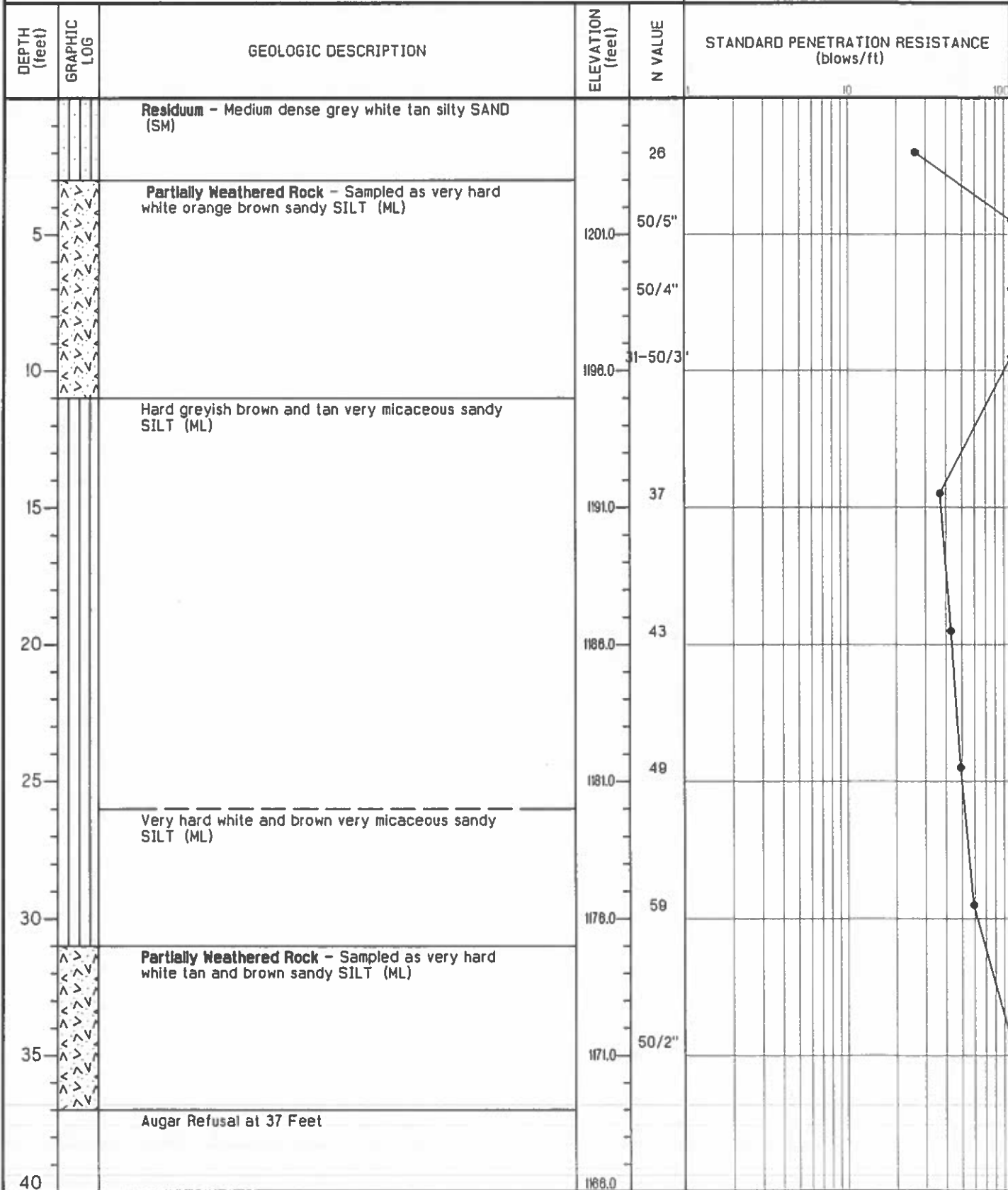


WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-11

GEOLOGIST: N/A	ELEVATION: 1206 Feet
DATE DRILLED: 10/20/06	BORING DEPTH: 37 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: NGW@TOB *
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: * - No ground water encountered at the time of boring.

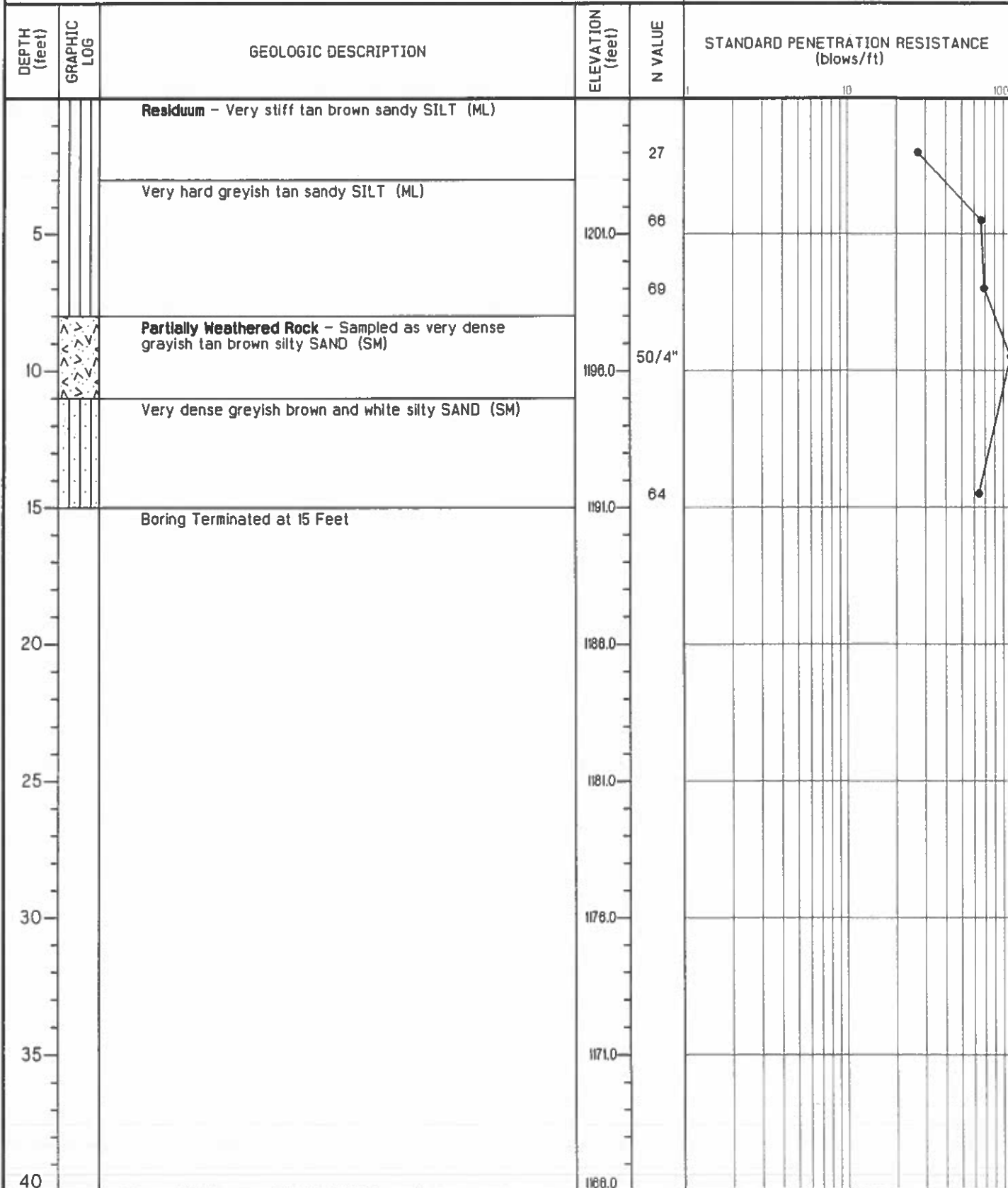


WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-12

GEOLOGIST: N/A	ELEVATION: 1206 Feet
DATE DRILLED: 10/20/06	BORING DEPTH: 15 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: NGW@TOB *
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: No ground water encountered at time of boring.

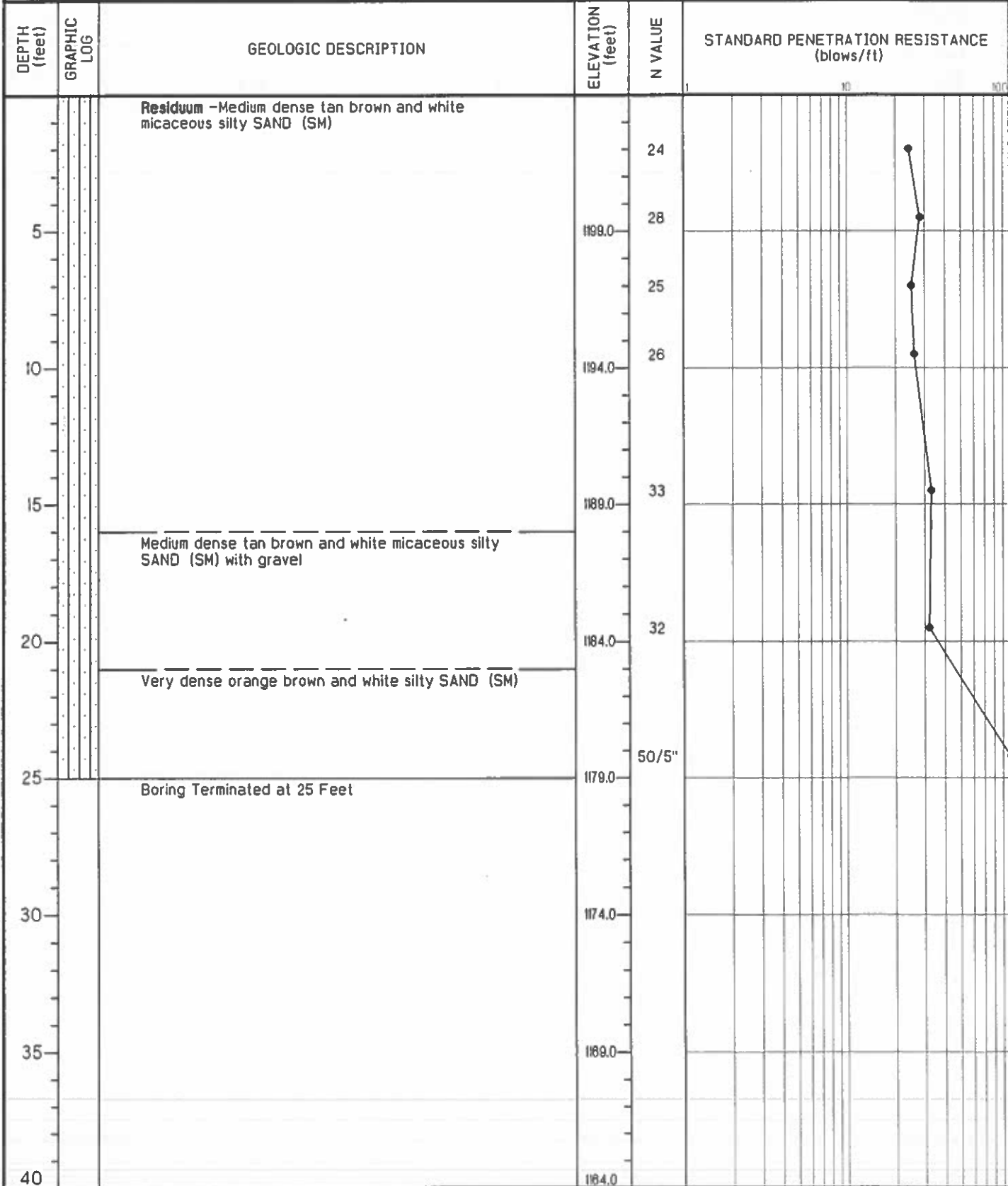


WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-13

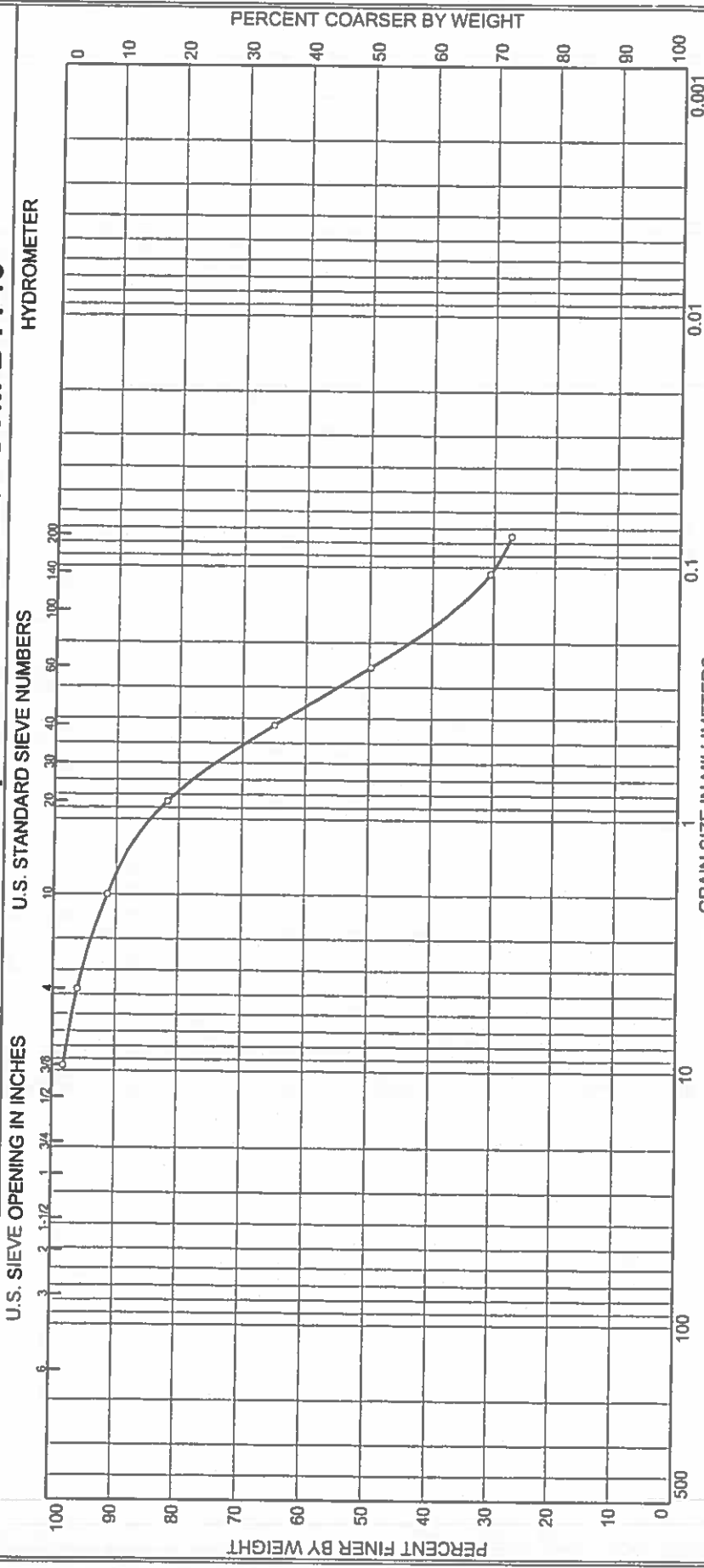
GEOLOGIST: <i>N/A</i>	ELEVATION: <i>1204 Feet</i>
DATE DRILLED: <i>10/20/06</i>	BORING DEPTH: <i>25 Feet</i>
DRILLER: <i>GABLE DRILLING CO.</i>	WATER LEVEL: <i>NGW@TOB *</i>
DRILLING METHOD: <i>HOLLOW STEM AUGER</i>	

NOTES: No ground water encountered at time of boring.



APPENDIX C
LABORATORY TEST REPORTS

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% SAND	% CLAY
0	69.0	27.1

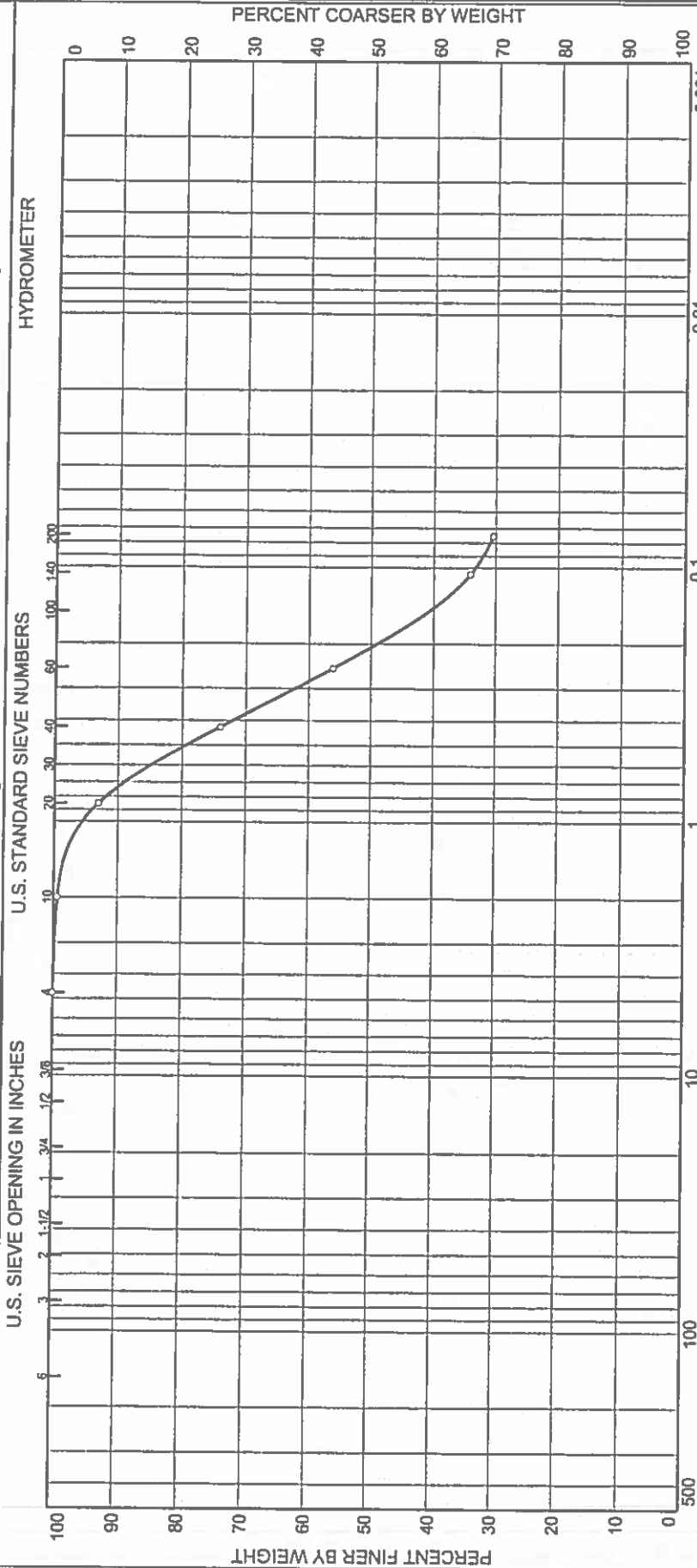
SOURCE	SAMPLE #	DEPTH/LEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-1	5	2.5'	10/27/06	SM	Orange and Green Micaceous Silty sand	21.8		

Client Geosystems Engineering
 Project City of Cumming WTP Expansion
 Project No. GTX-G1151 Lab no. _____

Tested By: CNA
 Reviewed By: JW

GeoTesting Express Inc.

Particle Size Distribution Report ASTM D422/ASTM D1140



<input type="checkbox"/> % COBBLES	0.0	<input type="checkbox"/> % GRAVEL	0.0
<input type="checkbox"/> % SAND	69.6	<input type="checkbox"/> % SILT	30.4
<input type="checkbox"/> % CLAY			

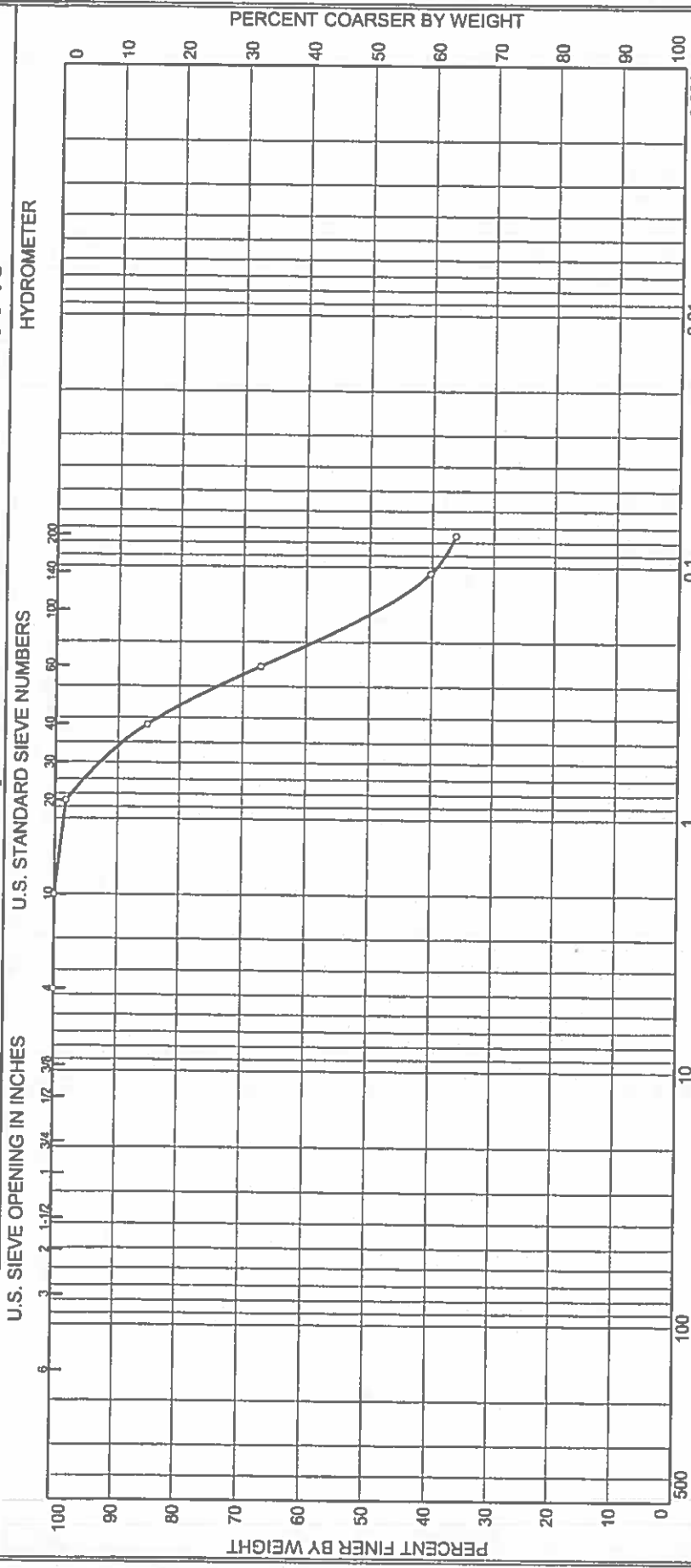
SOURCE	SAMPLE #	DEPTH/LEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-1	7	35'	10/27/06	SM	Black and White Micaceous Silty sand	18.8		

Client Geosystems Engineering
 Project City of Cumming WTP Expansion
 Project No. GTX-G1151 Lab no. _____

Tested By: CNA
 Reviewed By: JW



Particle Size Distribution Report ASTM D422/ASTM D1140



<input type="checkbox"/> % COBBLES	0.0	<input type="checkbox"/> % GRAVEL	0.0
<input type="checkbox"/> % SAND	63.9	<input type="checkbox"/> % SILT	36.1
<input type="checkbox"/> % CLAY			

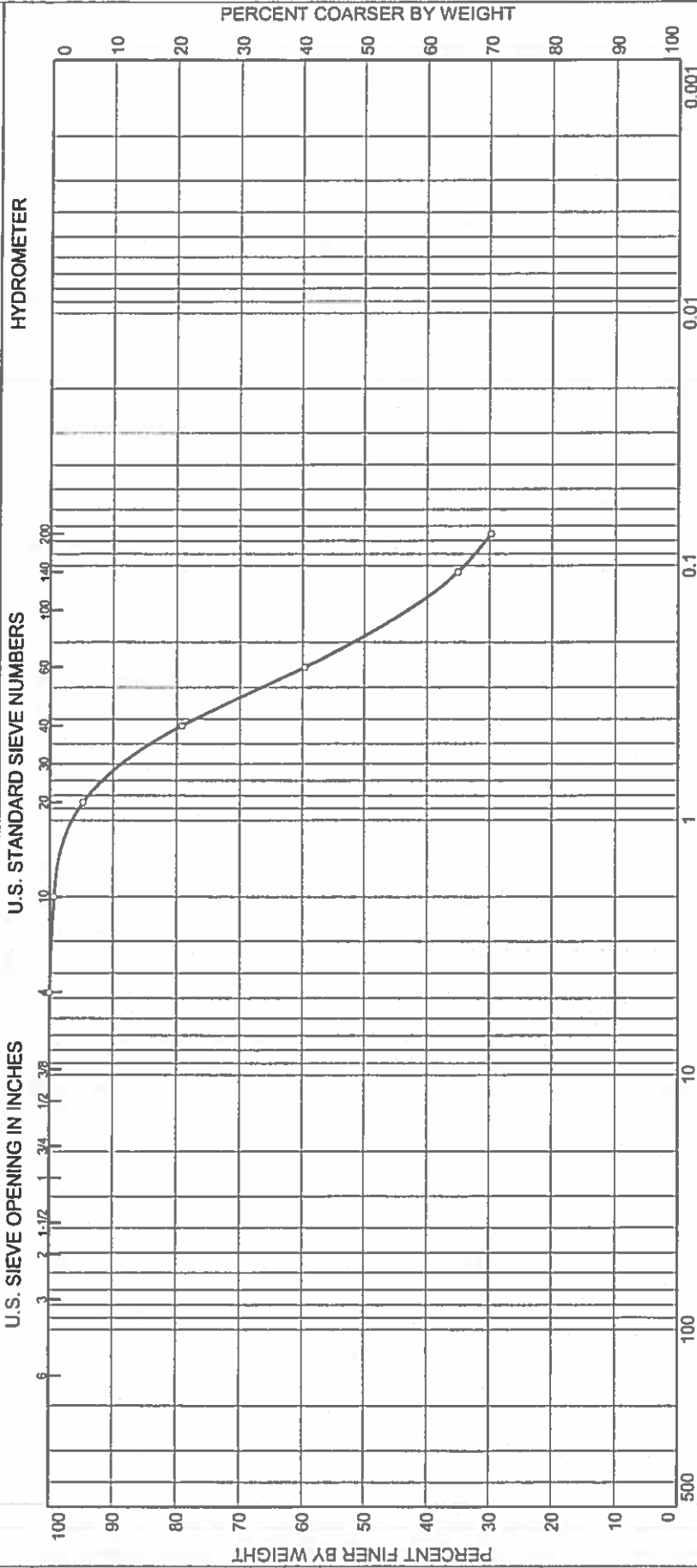
SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-4	UDS	42-44'	10/27/06	SM	Brown and White Micaceous Silty sand	31.6		

Client: Geosystems Engineering
 Project: City of Cumming WTP Expansion
 Project No. GTX-G1151 Lab no. _____

Tested By: CNA
 Reviewed By: JW

GeoTesting Express Inc.

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	70.3	29.7	

SOURCE	SAMPLE #	DEPTH/LEVEL	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-5	UDs	42-44'	10/27/06	SM	Brown Micaceous Silty sand	45.0		

Client **Geosystems Engineering**
 Project **City of Cumming WTP Expansion**
 Project No. **GTX-G1151** Lab no. _____

Tested By: CNA
 Reviewed By: JW

GeoTesting Express Inc.



HYDRAULIC CONDUCTIVITY

Project No. *GTX-G1151* Tested By *JW*
Project Name *City of Cumming WTP Expansion* Test Date *10/26/2006*
Boring No. *B-4* Reviewed By *CA*
Sample No. *UDS* Review Date *10/30/2006*
Sample Depth *42-44 ft* Lab No. *20835*
Sample Description *Brown and white micaceous silty sand*

ASTM D5084 - Falling Head (Method C RisingTail)

Sample Type:	<i>UD</i>
Sample Orientation:	<i>Vertical</i>
Initial Water Content, %:	<i>34.5</i>
Wet Unit Weight, pcf:	<i>111.1</i>
Dry Unit Weight, pcf:	<i>82.6</i>
Compaction, %:	<i>N/A</i>
Hydraulic Conductivity, cm/sec. @20 °C	<i>5.6E-05</i>

Remarks: _____



HYDRAULIC CONDUCTIVITY

Project No. **GTX-G1151** Tested By **JW**
Project Name **City of Cumming WTP Expansion** Test Date **10/26/2006**
Boring No. **B-5** Reviewed By **CA**
Sample No. **UDS** Review Date **10/30/2006**
Sample Depth **42-44 ft** Lab No. **20836**
Sample Description **Brown micaceous silty sand**

ASTM D5084 - Falling Head (Method C Rising Tail)

Sample Type:	<i>UD</i>
Sample Orientation:	<i>Vertical</i>
Initial Water Content, %:	<i>40.4</i>
Wet Unit Weight, pcf:	<i>109.9</i>
Dry Unit Weight, pcf:	<i>78.3</i>
Compaction, %:	<i>N/A</i>
Hydraulic Conductivity, cm/sec. @20 °C	<i>2.8E-05</i>

Remarks:

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-14

GEOLOGIST: N/A

ELEVATION: 1145 Feet

NOTES: Water level at time of boring (▽) was measured at 4 Feet.

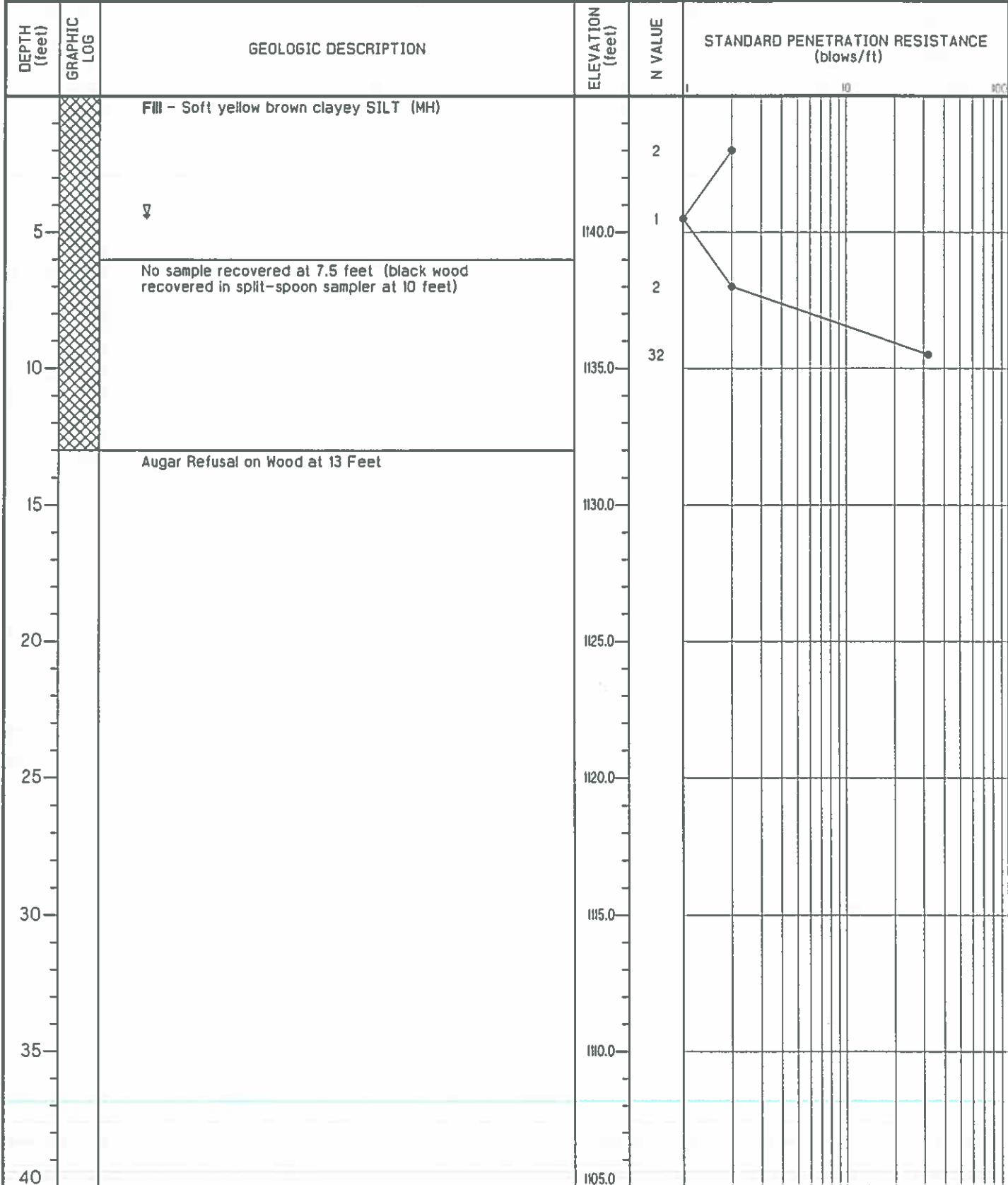
DATE DRILLED: 10/16/06

BORING DEPTH: 13 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 4 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-14A

GEOLOGIST: N/A

ELEVATION: 1145 Feet

NOTES: (1) Water level at time of boring (g) was measured at 4 Feet. (2) Boring located approximately 5 feet northwest of B-14.

DATE DRILLED: 10/16/06

BORING DEPTH: 15 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 4 Feet

DRILLING METHOD: HOLLOW STEM AUGER

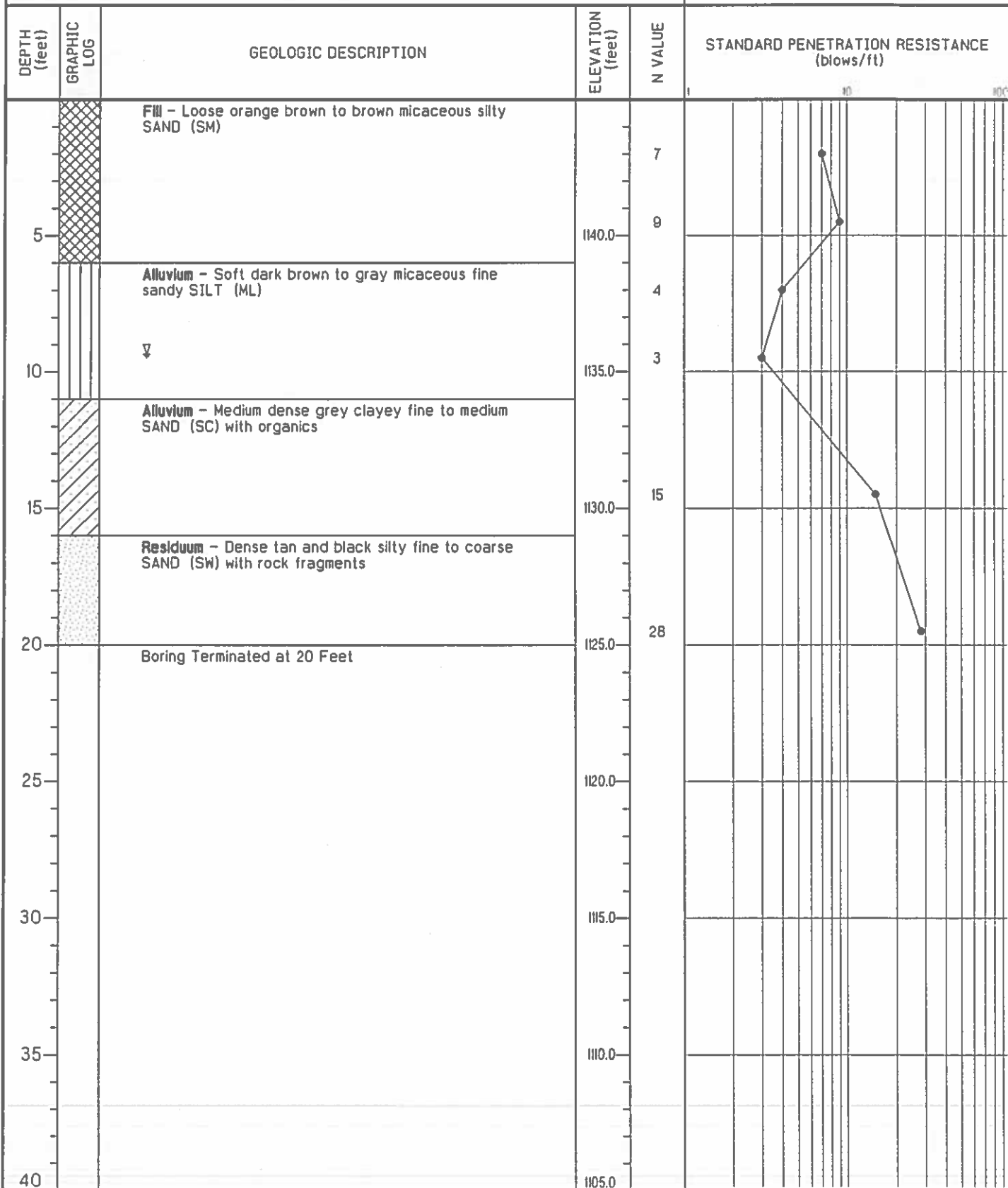
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					1	2	3	4	5	6	7	8	9	10						
5		Auger Boring - No split-spoon sampling performed (See log of Boring B-14 for soils description)	1140.0																	
10			1135.0																	
15		Residuum - Dense brown micaceous silty fine to medium SAND (SM)	1130.0	39																
		Boring Terminated at 15 Feet																		
20			1125.0																	
25			1120.0																	
30			1115.0																	
35			1110.0																	
40			1105.0																	

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-15

GEOLOGIST: N/A	ELEVATION: 1145 Feet
DATE DRILLED: 10/16/06	BORING DEPTH: 20 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: 9 Feet
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: Water level at time of boring (▽) was measured at 9 Feet.





GEOTECHNICAL EXPLORATION REPORT

**CITY OF CUMMING
PROPOSED PWWF CLEARWELL IMPROVEMENTS
FORSYTH COUNTY, GEORGIA**

Prepared for:

**CITY OF CUMMING UTILITIES
100 MAIN STREET, SUITE 401
CUMMING, GEORGIA 30040**

**GEOSYSTEMS PROJECT NO. 25-3003
JANUARY 29, 2026**

January 29, 2026

Ms. Christa Hopkins
City Engineer
Cumming Utilities
100 Main Street, Suite 401
Cumming, Georgia 30040

Re: Geotechnical Exploration Report
City of Cumming
PWPF Clearwell Improvements
Forsyth County, Georgia
GeoSystems Proposal No. 25-3003


Dear Ms. Hopkins:

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized geotechnical exploration for the proposed City of Cumming PWPF Clearwell Improvements. The primary purpose of the exploration was to characterize subsurface conditions at the site and provide recommendations for foundation design and construction of the new structures. The enclosed report describes our field investigation and engineering evaluation procedures and presents the site and subsurface conditions encountered along with our recommendations.

Thank you for giving us the opportunity to conduct this geotechnical exploration. We look forward to assisting you with any additional geotechnical evaluations that may be required in the future. If you have any questions concerning this report or need anything further, please call us.

Sincerely,

GeoSystems Engineering, Inc.


Larry D. Mullins, P.E.
Principal Engineer



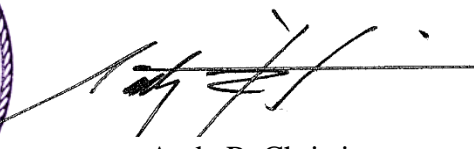

Andy R. Christian
Staff Engineer

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	BORING LOGS (17)
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INTRODUCTION

Background

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized geotechnical exploration for the planned clearwell improvements to the City's existing potable water production facility (PWPF). The project includes two 160-foot diameter, 6.0-million gallon (MG) clearwells (Phase 2 and future Phase 4), a high service pump station and an electrical building. Phase 2 and Phase 2B construction includes one clearwell, the electrical building, and the high service pump station. The second clearwell will be added in the future Phase 4 construction.

The existing PWPF is located on the west side of Dahlenega Road (Georgia Highway 9) at Sawnee Creek. The facility is 1½ to 2 miles northeast of downtown Cumming and about ½-mile north of Sawnee Drive. The planned clearwell improvement structures will be constructed in an undeveloped wooded area in the northwest corner of the existing PWPF immediately west of an existing 2.0-MG clearwell. The Phase 2 clearwell and electrical building are partially located within an old undocumented fill area that was previously addressed as part of subsurface investigation conducted by Geosystems in 2006 (Geosystems Project No. 06-1899). In addition to our current geotechnical exploration data, we have relied on the subsurface conditions indicated by the previous investigation soil test borings in evaluating geotechnical design and construction measures for this project.

Purpose

The primary purpose of this exploration was to characterize subsurface conditions at the clearwell improvements site and provide foundation design and construction recommendations for the new structures.

Scope of Work

The scope of work for the geotechnical exploration included visual inspections of the site, clearing of trees and underbrush to provide drill rig access to the boring locations, drilling seventeen soil test borings in the field, standard penetration testing and collection of split-spoon soil samples in the borings, evaluation of the boring data, and preparation of this report. The City of Cumming Utilities staked the boring locations in the field and determined the ground surface elevation at each boring location for our exploration prior to the site clearing. We have also reviewed available geologic information, historic aerial photographs, and on-line site specific soil survey data for the clearwell improvements site from the NRCS website.

Authorization

Formal written authorization for the exploration was provided by Mr. Jonathon W. Heard, Director of Utilities, on October 22, 2025. At that time, Mr. Heard signed our standard "Agreement for Limited Professional Services" contract form on behalf of the City.

EXPLORATION PROCEDURES

The soil test borings for this project (B-1 through B-17) were drilled at the approximate locations shown on the enclosed boring location plan (Figure 1). Locations of borings previously completed for Geosystems Project No. 06-1899 in 2006 (B-1 through B-8) are also included on Figure 1 using a different symbol for the borings. The boring location plan was produced from an electronic copy of the *Master Plan Option 2* that was provided to us. Site topography in the Phase 4 clearwell area was plotted on the plan using available Forsyth County GIS data.

Current exploration borings were drilled at the locations staked in the field by the City of Cumming Utilities. Ten soil test borings (B-1 through B-10), four on the perimeter and one at the center of each clearwell, were completed to auger refusal depths varying from 25 to 67 feet below ground surface (bgs). These relatively deep borings were required to determine the total thickness of compressible soils required for evaluation of the clearwell settlement. Four soil test borings (B-11 through B-14) at the corners of the high service pump station and three (B-15 through B-17) at the corners of the electrical building were also completed. The pump station borings were drilled to auger refusal depths varying from 16 to 26 feet bgs and the electrical building borings were extended to planned termination depths of 40 feet. Elevations of these borings were rounded to the nearest 1.0-foot elevation increment from the ground elevations that were labeled on the survey stakes. In some cases, the survey boring elevations diverge significantly from the contour elevations included on the provided *Master Plan Option 2*.

The borings were advanced by mechanically rotating hollow-stem augers into the ground to the boring termination or refusal depths noted above. Soil samples were obtained in the borings by conducting standard penetration tests (SPTs) at regular intervals using a standard 1.4-inch I.D., 2-inch O.D. split-spoon sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final foot was recorded and is designated the "standard penetration resistance" or the "N" value. Penetration resistance, when properly evaluated, is an indication of the soil's strength and support capability.

The split-spoon soil samples collected from the borings were initially classified, groundwater levels were recorded and logs of the borings were initially prepared by the driller at the time of the field investigation. On completion of the field investigation all borings were closed by backfilling the open boreholes with the drill soil cuttings.

In the laboratory, the field logs were reviewed, all split-spoon soil samples were visually classified by a geotechnical engineer, and final detailed logs of the borings and subsurface profiles were prepared. The soil test boring logs and subsurface profiles represent our interpretation of the field subsurface conditions. Included on the boring logs are visual soil descriptions, unified classifications, graphical plots of the standard penetration resistances, and groundwater conditions encountered at the time of the field investigation. The lines on the boring logs designating the interfaces between various strata represent approximate boundaries only, as transitions between materials may be gradual.

All drilling and sampling operations were conducted in general accordance with ASTM standards. Further descriptions of the field testing procedures are enclosed in Appendix A of this report. The boring location plan (Figure 1), subsurface profiles (Figures 2, 3 & 4) and soil test boring records are attached to Appendix B. Our previous subsurface investigation report (Project No. 06-1899) is included in Appendix C.

SITE CONDITIONS

As noted previously, the planned locations of the clearwell improvements structures are in an undeveloped wooded area in the northwest corner of the PWPF site, immediately west of an existing 2.0-MG clearwell. The Phase 2 clearwell and electrical building are partially located within an old undocumented fill area. The remainder of the site appears to be undisturbed with no existing fill. Site topography varies from nearly level to moderately sloping up generally to the north. Based on the provided *Master Plan Option 2* and available GIS topography, indicated total relief in the development area is in excess of 30 feet, varying from a low elevation of about 1150 feet along the south edge to a high elevation over 1180 feet in the northwest corner. There appears to be errors in the topography shown on *Master Plan Option 2*, as the indicated elevations of the boring locations are somewhat different from the surveyed elevations in some cases.

AREA AND SITE GEOLOGY

Geologically, the Cumming PWPF site is located in the Upland Georgia Subsection of the Piedmont Physiographic Province of Georgia. The location appears to be in an area along the convergence of the Central Uplands District to the northwest and the Gainesville Ridges District to the southeast. Both of these districts are characterized generally by low linear ridges; however, linearity of the ridges in the southwestern part of the Central Uplands District is not so prominent. Maximum elevations of the ridges occur in the northeastern areas of the districts and top out at 1300 to 1500 feet in the Central Uplands and 1500 to 1600 feet in the Gainesville Ridges. Elevations in the southwestern parts decrease to around 1100 and 700 feet, respectively.

The southern boundary of the Gainesville Ridges District is along a relatively continuous ridge that forms the drainage divide between streams flowing to the southwest and those flowing to the south. The boundary is generally along the Brevard fault zone, which extends across Georgia from northeast of Montgomery, Alabama to near Mount Airy, North Carolina.

The Piedmont Physiographic Province is an area bounded by the Ridge and Valley, and Blue Ridge provinces on the north and the Coastal Plain on the south. The Upland Georgia Subsection of the Piedmont consists of rocks northwest of the Brevard fault zone. The Piedmont is underlain by ancient igneous and metamorphic rocks of Paleozoic age (230 to 600 million years). The origin of the Paleozoic rocks, as sediments, has been obscured, due to their age and repeated cycles of weathering, metamorphism, folding, faulting, and injection with younger Paleozoic granites and Triassic diabase dikes. The rocks are crystalline in structure, having been cooled from a remolded molten mass, and are composed primarily of quartz, feldspar, mica and a number of dark minerals such as hornblende. Their chemical decomposition occurs first as a breakdown along the boundaries of the individual mineral crystals.

Review of the *Geology of the Greater Atlanta Region*, McConnell and Abrams, 1984, shows the PWPF site is underlain by metamorphic rocks of the Powers Ferry Formation (pfu), which includes undifferentiated biotite-quartz-plagioclase gneiss (metagraywacke), mica schist, and amphibolite. Gneiss is a foliated, biotite, quartz feldspar rock formed by regional metamorphism. Schist is a strongly foliated crystalline rock formed by dynamic metamorphism. It has well developed parallelism or banding of more than 50 percent of the minerals present in the rock, particularly mica and hornblende. Schist is similar to gneiss but with higher amounts of mica and hornblende. Amphibolite is a dark-colored, non-foliated crystalline rock formed through recrystallization, under conditions of high viscosity and direct pressure. It is composed of mainly amphibole and plagioclase minerals with little or no quartz. As the quartz content increases, amphibolite grades into a hornblende-plagioclase gneiss.

All of these rocks have weathered in place and are covered by a mantle of residual soils of varying thickness. Residual soils are formed insitu by chemical weathering of the underlying rocks. Due to their crystalline structure, chemical weathering occurs first as decomposition along the boundaries of individual mineral crystals and slightly weathered rock materials are formed having the appearance of very dense sands. Sand crystals in the slightly weathered rock are in the same positions originally occupied in the parent rock. Further chemical weathering results in disintegration of individual crystals and the formation, typically, of micaceous silty sand or micaceous sandy silt in which the original crystalline structure is obscured but banding of the parent rock is apparent. Due to more advanced weathering, the silty sand or sandy silt materials are changed into red or reddish brown silty clay or clayey silt and both the original crystalline structure, and the layered rock appearance are lost. The red soil coloration is produced primarily by oxidation of iron in the feldspars, micas and dark minerals.

Normally, weathering of the rock is most advanced near the ground surface and decreases with depth until unweathered parent rock is encountered. A transition from clay to silt to silty sand to partially weathered rock (PWR) to hard rock is typical; however, this order of weathering is not always followed and it is not uncommon to find seams or areas of PWR or relatively unaltered rock within the soil mantle or weathered rock layers within the underlying parent rock mass. The naturally developed soil profile may also be changed by erosion and/or man's grading activities, so that the upper more weathered zones may be completely stripped away or covered by washed-in alluvial soils or manmade fill, or both.

Groundwater in the Piedmont generally occurs under water table conditions as a result of infiltration of surface waters through the somewhat permeable overburden. Fractures and other discontinuities in the underlying rock can affect groundwater conditions; however, localized groundwater flow roughly follows the flow of surface water. Although hydraulically connected to the water table aquifer, groundwater at depth in the rock is found in water-bearing fractures. In this geologic setting, the configuration of the groundwater table is generally expected to be a slightly subdued replica of the ground surface.

SUBSURFACE CONDITIONS

Phase 2 Clearwell Improvements

At the planned clearwell and electrical building locations, previous 2006 borings B-1, B-2, and B-4 through B-7 and all current borings, except B-9, encountered an upper layer of fill overlying residual soils. A deeper layer of partially weathered rock and then auger refusal materials were encountered below the fill in most of these borings. Fill is any material that has been placed by man. Residual is a term used to define soils formed in-place by the chemical weathering process of the underlying rocks. Residual material that can be penetrated by power augers and exhibits standard penetration resistances of at least 100 blows per foot is termed partially weathered rock. Refusal is a designation applied to any condition which cannot be further penetrated by the soil drilling process and is normally indicative of a very hard or very dense material, such as boulders, rock lenses, or the upper surface of bedrock.

Fill. At the boring locations noted above, fill was encountered from near the ground surface to depths ranging approximately from a minimum of 3 or 4 feet in current boring B-8 to a maximum of 33 feet in current boring B-7. The fill was sampled generally as silty sand (SM) and sandy silt (ML) with some well graded sand (SW), clayey silt (MH) and clay (CL-CH) layers. The split-spoon samples also typically contained rock fragments. Scattered throughout the fill are variable quantities of rocks, wood and other organic matter at random depths and locations. Relative density or consistency of the fill soils varies appreciably as indicated by standard penetration resistances ranging from a minimum of 2 blows per foot (bpf) to a maximum of 53 bpf. The higher penetration values appear to be due to rocks or other hard objects encountered in the fill.

Residual Soils/Partially Weathered Rock. Residual soils and then partially weathered rock were typically found below the fill and below a thin topsoil layer at the location of boring B-9. Current borings B-15 and B-17 were terminated in the residuum at a depth of 40 feet. Also, previous borings B-5 and B-7 were terminated in residual soils at a depth of 50 feet and previous borings B-4 and B-6 encountered residual soils to auger refusal at depths of 53 and 63 feet bgs, respectively. Residual soils extended to the top of partially weathered rock at depths varying from 29 to 53 or 54 feet in the remaining borings. The residual soils were classified as either sandy silt (ML) or silty sand (SM). A single layer of sandy clay (CL) was also identified to a depth of 3 feet in boring B-9. Standard penetration resistances in the residual soils ranged from a minimum of 2 to a maximum of 38 bpf in this area. Penetration values indicate generally firm to very stiff consistency of the silt and clay and medium dense relative density of the sand.

All current and previous borings, except those noted above that were terminated in residual soils, encountered 2 to 16 feet of continuous partially weathered rock to auger refusal or boring termination depths. The partially weathered rock materials were sampled as either very dense silty sand (SM) or very hard sandy silt (ML) with some rock fragments.

Auger Refusal Conditions. Hollow stem auger refusal conditions were encountered at depths varying from 36 to 67 feet in all borings, except those noted above that were terminated in the residuum at depths of 40 and 50 feet. Rock core drilling or other exploration methods are required

to determine the nature and continuity of refusal material; however, refusal conditions at the boring locations appear to be the upper surface of bedrock.

Groundwater. Stabilized groundwater levels were measured in the current exploration borings at depths varying approximately from 20 or 21 to 34 feet below the existing ground surface. In general, the groundwater level measurements correlate to a water table elevation between 1137 and 1142 feet and northwest to southeast flow direction. Groundwater is subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than reported during this study.

Phase 2B High Service Pump Station & Future Phase 4 Clearwell

Subsurface conditions within the proposed high service pump station & future clearwell area were investigated by current soil test borings B-11 through B-14 and B-1 through B-5, respectively. Conditions encountered in these borings consist of undisturbed residual soils overlying partially weathered rock and then auger refusal conditions below a thin layer of topsoil at the ground surface. Groundwater was encountered in three of these borings at the time of the field investigation.

Residual Soils/Partially Weathered Rock. Residual soils were encountered from near the ground surface to the top of partially weathered rock varying from 13 or 14 feet to 30 feet at all boring locations in this area. As described in the previous Phase 2 section, the residual soils are classified mainly as sandy silt (ML) and silty sand (SM). Layers of sandy clay (CL) were also initially encountered in most of the borings to depths varying from 3 feet to 8 or 9 feet below ground. Penetration values in these soils varied from a minimum of 5 to a maximum of 53 bpf, but most ranged between 8 or 9 blows and 30 blows, again indicating firm to very stiff consistency for silt and clay and medium dense relative density for the sand.

A continuous partially weathered rock stratum, varying in thickness from 2 to 17 feet approximately, was encountered in the borings from below the residual soils to hollow-stem auger refusal depths. Partially weathered rock within the pump station and future clearwell locations was sampled entirely as very dense silty sand (SM) with frequent rock fragments.

Auger Refusal Conditions. In this area, hollow stem auger refusal conditions were encountered at all boring locations at depths varying from 16 to 45 feet below ground. As noted previously, the refusal conditions appear to be the upper surface of bedrock.

Groundwater. Stabilized groundwater levels were measured at depths of 33 to 34 feet in borings B-1 and B-2 and at 16.5 feet in B-13. The groundwater level measurements correlate to water table elevations ranging approximately from 1148 or 1149 at borings B-1 and B-2 to 1137 or 1138 feet at the location of boring B-13. The groundwater data in this area also indicates a northwest to southeast flow direction.

PROJECT INFORMATION

Our understanding of this project is based on our previous discussions and the information in the provided *Geotechnical Loading Information, Revised Concept Site Plan*, dated 10/15/25. The project includes two 160-foot diameter, 6.0-million gallon (MG) clearwells (Phase 2 and future Phase 4), a high service pump station and an electrical building. Phase 2 and Phase 2B construction includes one clearwell, the electrical building, and the high service pump station. The second clearwell will be added in the future Phase 4 construction.

The planned clearwell improvement structures will be constructed in an undeveloped wooded area in the northwest corner of the existing PWPF immediately west of an existing 2.0-MG clearwell. The clearwell structures will be 160-foot diameter 40-foot tall, prestressed concrete ground storage tanks. A bottom elevation at 1160 feet is proposed for the Phase 2 clearwell. No bottom elevation for the Phase 4 clearwell was provided but we assume the bottom elevation will also be 1160 feet.. Approximate excavations varying from 2 to 17 feet for the Phase 2 clearwell and 9 to 24 feet for Phase 4 are estimated to achieve the planned bottom elevation.

The typical foundation system for prestressed concrete, ground storage tanks, based on our previous experience and information provided by *ASI 372R* and *AWWA D110*, consists of a thin (6-inch minimum) reinforced monolithic, turndown concrete slab overlying a 6-inch thick crushed stone base. A turndown edge footing is usually included along the entire circumference of the slab to support the exterior perimeter tank wall. We understand that prestressed concrete storage tanks, such as planned for the clearwells in this project, can tolerate up to about 6 inches of uniform total settlement; however, angular distortion of the membrane floor, expressed in terms of the slope of the settlement profile, is typically the controlling factor. The ACI document, *Design and Construction of Prestressed Concrete Structures (ACI 372R)* recommends a maximum limit of 1/4-inch differential settlement in a 10-foot distance. The clearwell information provided notes a total uniform contact pressure of 3,000 pounds per square foot underneath the circular base foundation slab and a perimeter wall load of 10,000 pounds per linear foot. The continuous turndown perimeter wall footing is typically designed using a contact pressure equivalent to the circular base foundation loading.

We understand the proposed electrical and pump station buildings will be conventional CMU type construction. A finished floor elevation of 1158 feet is planned for both structures. The existing topography indicates that cuts of 2 to 10 feet for the electrical building and about 8 feet of fill and 17 feet of cut for the high service pump station will be required to achieve the finished floor elevation. Foundation loading conditions of 2.2 kips per linear foot (klf) for the electrical building and 3.5 klf for the pump station continuous load bearing exterior perimeter walls and 250 psf for both structure slabs were provided. A maximum interior wall load of 6.0 klf was also noted for the pump station.

DESIGN & CONSTRUCTION RECOMMENDATIONS

Seismic Site Classification

Site classification for seismic design of the proposed clearwell improvements project was determined in accordance with ASCE/SEI 7-22. Subsurface conditions to a depth of 100 feet were not investigated at the site and site-specific determination of the shear wave velocity profile to a depth of 100 feet below the ground surface was not performed to confirm the seismic site classification. Where site-specific data (measured shear wave velocities or other geotechnical data that can be used to estimate shear wave velocity) are not known in sufficient detail to determine the site class, the most critical site conditions of Site Class C, Site Class CD and Site Class D shall be used unless the geotechnical data determine that Site Class DE, E, or F soils are present at the site. Based on the limited available boring data and our previous experience with similar subsurface conditions, Site Class D (Medium dense sand or stiff clay), per the ASCE/SEI 7-22 definitions provided in Table 20.2-1, is recommended for design of the PWPF clearwell improvement structures.

Site Preparation

Initially, the site needs to be cleared of trees and all weeds, vines, grass and topsoil stripped from the ground surface in the proposed structure locations. The topsoil and other stripped materials should either be wasted from the site or stockpiled for later top dressing of disturbed areas prior to permanent seeding and or stabilization. On completion of the clearing and stripping operations, the construction area should be carefully inspected by the project geotechnical engineer. At that time, the engineer should observe areas near finished grade that are intended to support the structures or new structural fill and observe proofrolling of the subgrade utilizing a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. Inspection and proofrolling of the structure subgrade areas is to confirm the subgrades have been properly prepared and to identify any soft, weak, or excessively wet soils that may be present. Depending on the weather and observed conditions, some stabilization measures and/or undercutting and replacement of weak or wet soils with structural fill and/or crushed stone may be required to provide adequate subgrade support conditions. The extent of any stabilization measures or undercutting required should be determined at the time of construction by the geotechnical engineer.

Earthwork

All fill required to achieve site grades, backfill excavations around structures or replace undercut areas should be clean soil, free of organic matter and deleterious material. Material containing rocks or stones greater than 3 inches in diameter should not be used. Structural fill soils should also have a plasticity index (PI) typically less than 30 and a maximum dry density of at least 100 pcf as determined by the standard Proctor compaction test (ASTM D-698).

General site structural fill should be placed in maximum 6 to 8-inch lifts, loose measure, and compacted to at least 95 percent of the standard Proctor maximum dry density. Backfill in trenches or other confined spaces, where light portable compaction equipment is required, should be placed in maximum lift thicknesses of 3 to 4 inches, loose measure. In landscaped areas, where no structures are planned or anticipated in the future, the compaction criteria may be reduced to 90 percent standard Proctor. All fill material should be placed in horizontal lifts and adequately keyed into the existing subgrade.

Moisture control of the fill soils is essential in achieving specified densities and soil moisture contents within ± 3 percent of the optimum moisture content (OMC) should be maintained during placement and compaction. We recommend that the grading contractor have equipment on site during fill placement for both drying and wetting the soils to control moisture contents within the required range for compaction.

During fill placement, an adequate number of density tests should be performed by a soils technician working under the direction of the project geotechnical engineer to determine the degree of compaction and compliance with the project specifications. Tests should be performed for each 2-foot thick layer of compacted fill. Any areas that do not meet compaction requirements should be reworked to achieve compliance.

Foundation Support

Phase 2 Clearwell & Electrical Building. At these structure locations an upper layer of undocumented fill was initially encountered over a majority of the construction area. The fill is undocumented in terms of there being no previous records on the nature of the fill materials and compaction during placement. The soil test boring data show the fill is an inconsistent mixture of soil and rocks or boulders with wood debris and other unidentified organic matter. The wood debris was identified in the split-spoon samples as wood fragments and relatively intact, large pieces of apparent tree limbs.

The consistency or relative density of the existing fill soils encountered in the borings is erratic with significant zones of soil exhibiting low standard penetration values generally ranging from 4 to 9 bpf. The low penetration values indicate these soils were likely placed with little or no compaction effort, resulting in relatively weak and compressible support conditions. In our opinion, higher penetration values in the fill are likely exaggerated due to encountering rocks and other obstructions buried within the fill soil matrix. Due to inadequate soil compaction, the fill is susceptible to excessive settlement under increased loading conditions. Long term settlement is also likely from natural decomposition of wood and other organic matter buried in the fill. Settlement will likely be aggravated if the fill contains any voids, which usually occur within uncontrolled rocky/boulder fills.

The existing undocumented fill conditions in this area makes it very difficult and impractical to evaluate soil bearing capacity and settlement. However, our previous experience with similar conditions shows that excessive differential settlement of the clearwell and electrical building will likely occur. Due to excessive settlement and likely other issues with foundation support in these

difficult subsurface conditions, we recommend the clearwell and electrical building be moved to locations where support can be provided in undisturbed residual soil conditions. If the clearwell can be moved approximately 100 feet north of the current proposed location, it appears adequate foundation support can be achieved in undisturbed residual soil conditions with soil bearing capacities of at least 4 ksf. If the structures cannot be relocated, we recommend stone columns or aggregate piers, rigid inclusions, or other ground improvement measures be implemented for foundation support.

Stone columns or aggregate piers are columns of compacted crushed stone installed in groups to increase bearing capacity, mitigate settlement and allow the use of conventional shallow foundations. Also referred to as rammed or vibro column/piers that are constructed by compacting lifts of granular material (typically No. 57 crushed stone) into the ground, laterally displace weak soil and create individual columns. At this site, either a hollow mandrel tamper or a high-frequency vibratory probe should be used for placing and compacting of the crushed stone in the columns to prevent possible caving. This installation method requires the crushed stone be tremied to the tip of the tamper or probe at the bottom of the column and then the aggregate column is compacted as the probe is withdrawn to the ground surface. Once installation is complete, foundations can be constructed directly over the aggregate columns and no structural connection is required. Generally, a shallow foundation allowable soil bearing capacity on the order 5 to 6 ksf can be developed for aggregate column support.

Improvement of the subsurface conditions with rigid inclusions consists of installing unreinforced, cement grouted columns similar to piles into the ground to control settlement. Rigid inclusions will also allow the use of higher bearing capacities than those available before improvement for shallow foundation support. Rigid inclusions are installed by laterally displacing the soil using generally vibrating probes or reverse flight rotating augers. Once the probe or auger is advanced to the design bearing stratum, the tools are withdrawn, and grout is pumped into the bottom of the void during withdrawal to fill each column. The columns are not connected directly to the foundation, as piles would be, but they are designed to take advantage of the surrounding soil resistance and act together with the soils to provide the ground improvement. A load transfer platform (LTP), consisting of a 12 to 18-inch thick layer of compacted granular fill is usually required on top of the rigid inclusions as a bridge between the foundation and the rigid inclusions. The LTP will distribute the foundation loads to the rigid columns and surrounding soils and reduce stress concentrations from the columns on the foundation.

Many factors are considered in determining feasible ground improvement measures and designs are best carried out by specialized geotechnical contractors utilizing their previous experience and adapting their specialized products, equipment and construction methods to the site-specific conditions. A company with knowledge and experience in the design and construction of aggregate columns and other ground improvement measures can also provide engineering support in the design stages of the project and help determine the most feasible and economical foundation solution. We recommend that specialty geotechnical contractors such as Keller, Geopier, Menard USA, Nicholson Construction or others be consulted during the planning and design phase of the project to help in determining the most feasible and cost-effective type of ground improvement measure for the clearwell and electrical building structures in the undocumented fill area. Proposal

or bid requests for design and installation of the proposed ground improvement measures should include a performance specification assuring the proposed foundation support system complies with the load resistance capacity and settlement tolerance provisions for the structures.

Phase 2B High Service Pump Station & Future Phase 4 Clearwell. The boring data for these structures shows the undisturbed residual soil conditions should provide adequate long-term foundation support for the range of structural loads anticipated. At the anticipated foundation bearing elevations, the available foundation design soil bearing capacity in undisturbed residual soils is at least 4 ksf. We understand the actual contact pressure beneath the circular clearwell bottom is 3 ksf. Since the southeast portion of the high service pump station will be supported in new structural fill, allowable soil bearing capacity for foundation design is limited to 3 ksf in the fill soil area.

Subject to the site preparation and inspection recommendations in this report; the Phase 4 clearwell may be designed using the conventional monolithic slab-on-grade foundation system. The foundation should be of sufficient thickness and have adequate reinforcement to prevent cracking between the flat and thickened portions of the slab. The thickened portion of the foundation, underneath the perimeter wall of the tank, should bear at a depth of at least 12 inches below finish grade, which is the maximum frost penetration depth in the Atlanta area. A minimum of 6 inches of compacted crushed stone or sand is recommended to be installed on the foundation subgrade prior to concrete placement to provide uniform support conditions. Angular distortion of the standard tank foundation slab, expressed in terms of the slope of the settlement profile between the center and edge of the tank, is anticipated to be less than the tolerable limit of ¼-inch differential settlement in a 10-foot distance.

The high service pump station may be designed for conventional shallow slab-on-grade foundations or continuous footings bearing in existing undisturbed residual soils or new structural fill. Available bearing capacities in the residuum vary from 4 ksf in the residual soils to 10 ksf or more in partially weathered rock anticipated in the northwest corner of the structure. As noted above, foundations should be designed for a maximum allowable soil bearing capacity of 3 ksf in new structural fill required in the southeast portion of the pump station. A minimum width of 18 inches for continuous wall footings should be used for practical construction considerations and to reduce the possibility of localized foundation shear failures. Exterior footings should be placed at least 12 inches below final exterior grades to assure that foundations bear below the possible frost penetration depth.

Floor or grade slabs may be soil supported subject to site preparation and earthwork recommendations contained in this report. Building grade slabs should be jointed around any individual equipment foundations and along footing-supported walls to minimize cracking due to possible differential movements. As an alternative to flat slab-on-grade floors and conventional spread footings, monolithic turned-down slab-on-grade floors be used. Turned-down slabs should be thickened underneath heavy equipment and load bearing walls and have adequate reinforcement in order to minimize cracking between the thickened and flat portions of the slab.

Foundation Inspection

We recommend that all foundation excavations be evaluated at the time of construction by the project geotechnical engineer to confirm that conditions are similar to those encountered in the borings and that the bearing soils are capable of supporting the design contact pressure. Some stabilization measures and/or undercutting and replacement of weak or wet soils with crushed stone may be required in order to provide adequate foundation support. The extent of any stabilization measures or undercutting required should be determined at the time of construction by the inspecting geotechnical engineer.

Foundation excavations should be free of all soft or loose soil, mud, disturbed materials, or other deleterious materials prior to placement of concrete. In addition, foundation concrete should not be placed on a frozen subgrade. Any foundation bearing surfaces that have been disturbed due to construction activities or exposure to precipitation or run-off must be repaired prior to construction of the footings or foundation slabs. We recommend that foundation excavations be concreted as soon as practical after they are excavated and storm water or runoff should be prevented from ponding on or infiltrating the bearing surface. If it is necessary to leave foundation excavations open for an extended period of time, we recommend that a thin mat of lean concrete be placed over the bottom for protection.

Slope Stability

Our exploration did not include analysis of slope stability for any temporary or permanent condition. However, based on conditions at this site and OSHA requirements, we recommend that simple temporary slopes for properly dewatered excavations or excavations above the water table not exceed 1.5(H):1.0(V). Exposed slope faces should be protected from precipitation with an impermeable cover until the work is completed. Also, slope conditions should be inspected daily for any signs of instability such as tension cracks, bulging, or deterioration of the embankment soils.

Permanent slopes no steeper than 2.0(H):1.0(V) are recommended for construction in undisturbed residual soils above the water table or structural fill placed in accordance with our recommendations. Minimum setback distances from the top of slope of 10 feet for structures and 5 feet for pavements is also recommended. Appropriate groundcover provisions should be made for protection of permanent slopes from erosion.

Retaining/Below Grade Walls

Earth pressures on walls below grade are influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as free-standing walls, where some movement and rotation may occur to mobilize soil shear strength. Development of the full active earth pressure case requires a magnitude of horizontal wall movement that often cannot be tolerated or cannot occur due to the rigidity of the

wall or other design restrictions such as the impact on adjacent structures. In such cases, walls are often designed for either the at-rest condition or a condition intermediate of the active and at-rest conditions, depending on the amount of permissible wall movement. Walls that are rigidly restrained, such as basement, pit and tunnel walls, should be designed for the at-rest condition.

A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Passive conditions are typically assumed for portions of walls buried beneath the wall toe elevation. Since significant wall movements are required to develop passive resistance, the total calculated passive pressure should be reduced by at least 50 percent for design purposes.

Based on the boring information and our previous experience with similar soils, we recommend effective soil strength parameters of 0 psf for cohesion (c) and angles of internal friction (ϕ) of 25 and 28 degrees be used in determining lateral earth pressures for design of required temporary excavation shoring and the below grade structure walls. The angle of internal friction value of 25 degrees applies to structural fill compacted to 95 percent standard Proctor or undisturbed residual soils with standard penetration resistances generally less than 10 bpf. The 28-degree friction angle value may be used in structural fill compacted to 98 percent standard Proctor or undisturbed residual soils with penetration values greater than 10 bpf. An in-situ moist soil unit weight of 120 pcf is also recommended for design calculations. If any excavations or walls extend below the water table, lateral earth pressures should be determined using the buoyant weight of the soil. Hydrostatic pressures calculated with the unit weight of water (62.4 pcf) should be added to these earth pressures to obtain the total stresses for design.

Using ϕ -angles of 25 and 28 degrees results in the following earth pressure coefficients for design of the proposed lift station and grit structure below grade walls and any temporary shoring that may be required for installation:

Earth Pressure Conditions	Coefficient	
	25°	28°
Active (K_A)	0.41	0.36
At-Rest (K_O)	0.58	0.53
Passive (K_P)	2.46	2.80

Tractors and other heavy equipment should not operate within 10 feet of below grade walls to prevent lateral pressures in excess of those cited. If footings or other surcharge loadings are located a short distance outside below grade walls, they may also exert appreciable additional lateral pressures. If an imaginary line projected downward at a 45-degree angle from the bottom near edge of the surcharge load does not intersect the wall, the effect of the load on the wall may be neglected. Whenever this line intersects the wall, the effect of the surcharge loads should be added to the recommended earth pressures to determine total lateral stresses. Foundation bearing levels may also be lowered to eliminate increased stresses on adjacent below grade structures or retaining walls.

QUALIFICATION OF RECOMMENDATIONS

This report has been prepared for the exclusive use of the City of Cumming for design and construction of the proposed PWWF clearwell improvements. Conclusions and recommendations in this report were based on the site and subsurface information obtained and our understanding of the planned site development. The exploratory activities, testing procedures, and evaluation of the data were consistent with the skill and care ordinarily provided by professional geotechnical engineering practice in the Piedmont geologic setting under the same or similar circumstances for projects of this type and at the time of these services. We have made recommendations based on our experience with similar subsurface conditions under similar loading conditions. Allowable soil bearing capacity was estimated from previous correlations of standard penetration resistances and bearing capacities of comparable soils. We make no warranties or guarantees, either expressed or implied. GeoSystems is not responsible for the conclusions, opinions or recommendations of others based on our findings and evaluations.

We note that regardless of the thoroughness of a geotechnical exploration there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. If conditions differing from those anticipated are encountered during construction, GeoSystems should review the conditions to address any issues. Should the project plans change substantially from those outlined in this report, we also request the opportunity to review our recommendations in light of any changes.

APPENDIX A

FIELD AND LABORATORY PROCEDURES

GEOSYSTEMS ENGINEERING

STANDARD FIELD AND LABORATORY TESTING PROCEDURES

Soil Test Boring

Soil sampling and penetration testing are performed in general accordance with ASTM Designation D 1586. Borings are usually advanced either by mechanically twisting continuous steel hollow-stem auger flights into the ground or by wash boring using roller cone or Hawthorne bits. At regular intervals, soil samples are obtained with a standard 1.4-inch I.D., 2-inch O.D., split-spoon sampler. The sampler is first seated 6 inches into the bottom of the hole to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to achieve the final foot of penetration is recorded and is designated the "standard penetration resistance." Penetration resistance, when properly evaluated, is an index to the soil strength, density and ability to support foundations.

Groundwater levels are normally determined by the driller in conjunction with the field investigation and are noted on the drilling records. These levels indicate the approximate location of the hydrostatic water table at the time of observation. Generally, water levels are reported at the time of boring and at subsequent times. The time of boring water level is detected as the drilling tools are advanced by changes in the drilling rate, soil sample moisture conditions, water or mud on the drill rods, and moisture conditions of the borehole drill cuttings. Additional groundwater levels are typically obtained at various times after boring to minimize any disruption by the drilling operations and to allow the water table to stabilize. Normally, a time lag of at least 24 hours is required to permit stabilization of the water table. A longer time period may be required in low permeability (clayey) soils. Water table measurements are taken in open boreholes using a weighted measuring tape or electronic groundwater level indicator.

Representative portions of the soil samples, obtained from the split-spoon sampler, are sealed in containers and shipped or transported to the office. In the office, the samples are examined by an engineer to verify the driller's field classifications.

Soil Identification and Description

Soils are normally classified using the Unified Soil Classification System (ASTM D 2487). In addition to standard classification, soils are identified in accordance with the important soil properties to provide a complete description and assist with predicting behavior. Soil properties significant to most earthwork/foundation problems include consistency (cohesive fine grained soils) or relative density (cohesionless granular soils), color, and texture or composition. Consistency and relative density are fundamental properties in evaluating soil strength and are typically estimated based on standard penetration test results. The engineer's examination of soil samples recovered during the field investigation is primarily a qualitative visual process. Detailed soil classification requires basic laboratory grain size analyses and Atterberg limits (plasticity) tests.

APPENDIX B

FIGURE 1 – SITE LOCATION PLAN

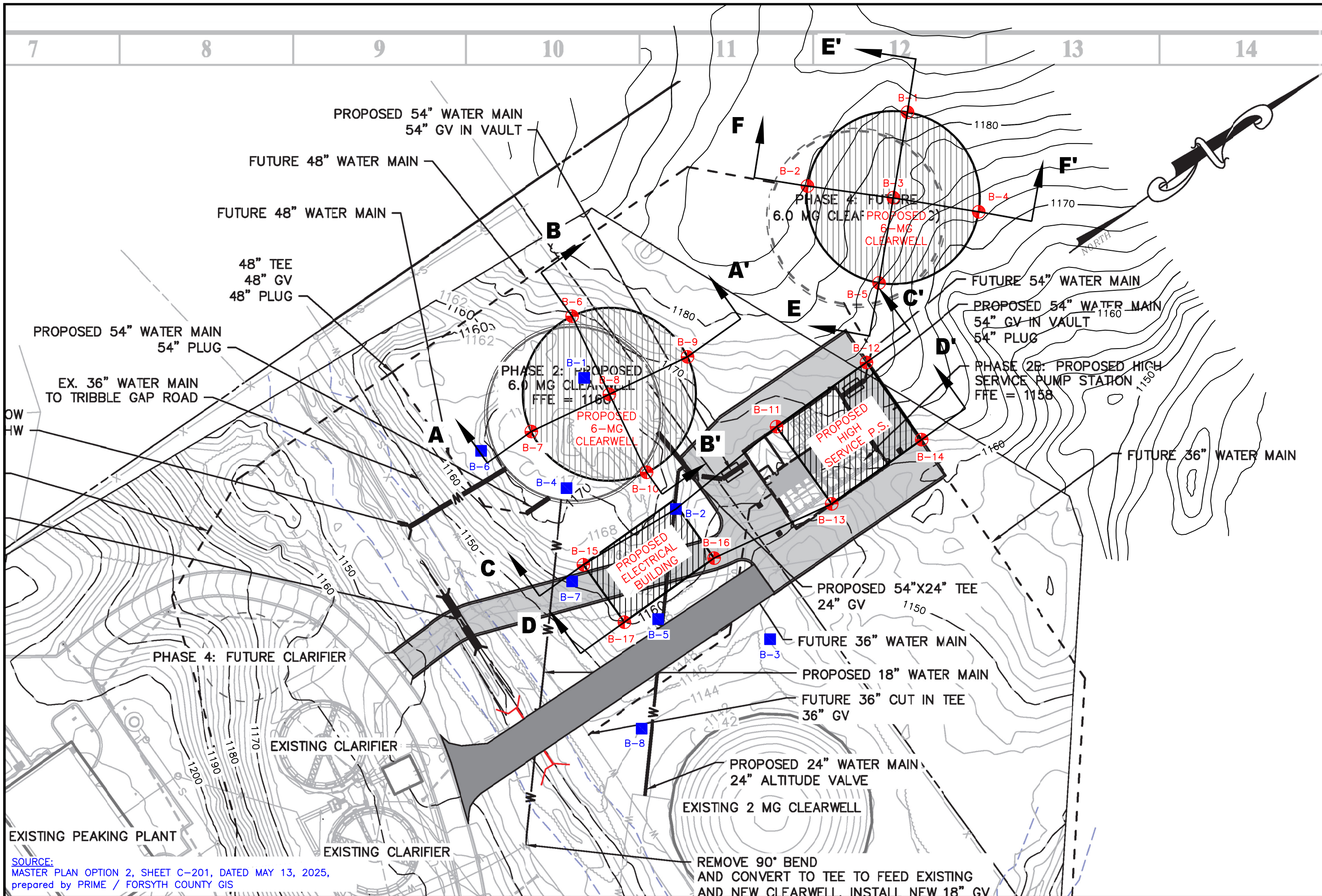
FIGURE 2 – SUBSURFACE PROFILES

FIGURE 3 – SUBSURFACE PROFILES

FIGURE 4 – SUBSURFACE PROFILES

KEY TO SYMBOLS AND CLASSIFICATIONS

SOIL TEST BORING LOGS (17)



BORING LOCATION PLAN

FIGURE: **1**
 PREPARED BY: ARC
 DATE: 1/12/2026
 REVIEWED BY: LDM
 DATE: 1/12/2026

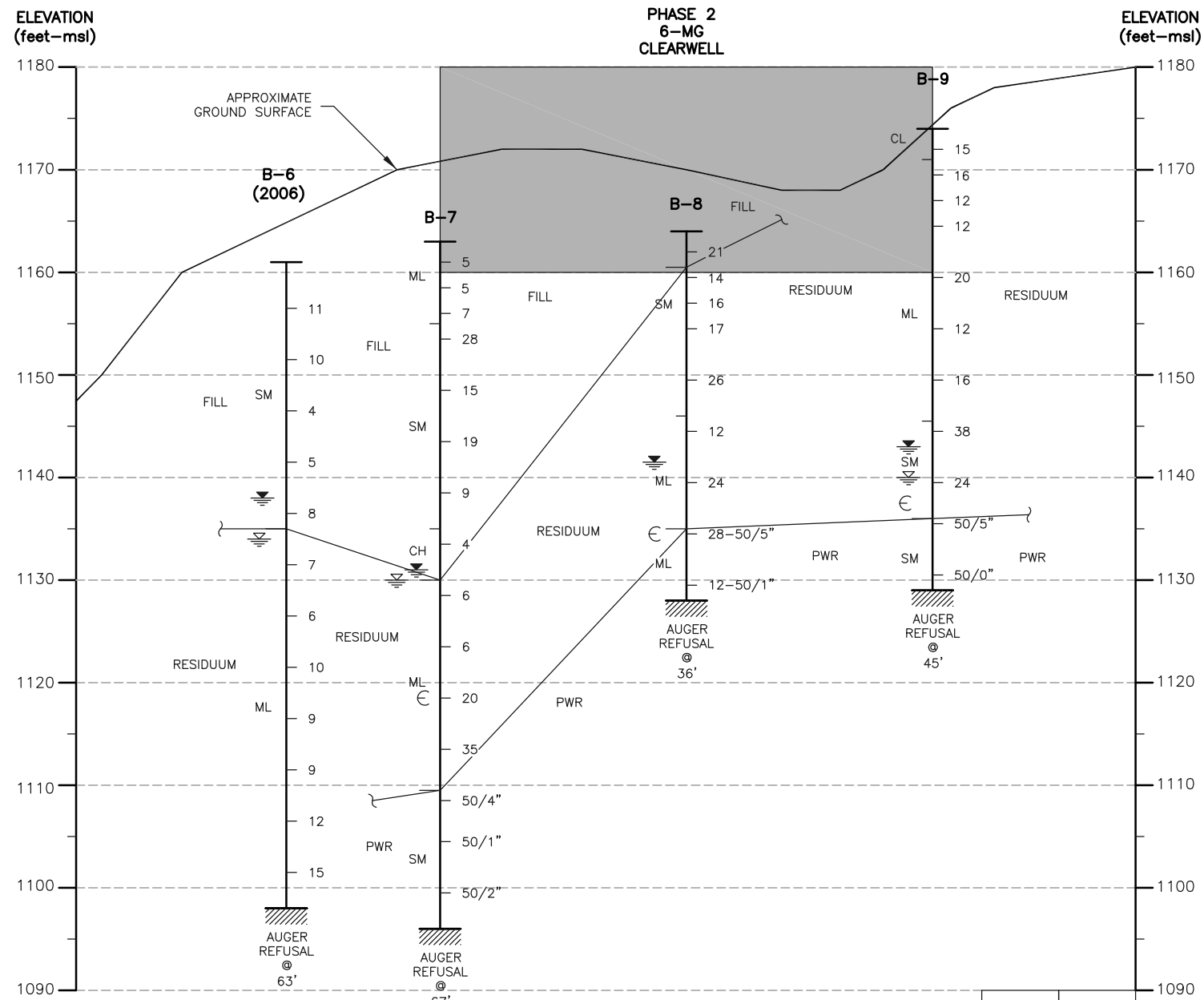
PROJECT: CITY OF CUMMING, GEORGIA
 PWWF PHASE II CLEARWELL IMPROVEMENTS
 935 DAHLONEGA, FORSYTH COUNTY, GA
 GEOSYSTEMS PROJECT NUMBER: 25-3003

GEOSYSTEMS
 ENGINEERING, INC.
 LEGEND

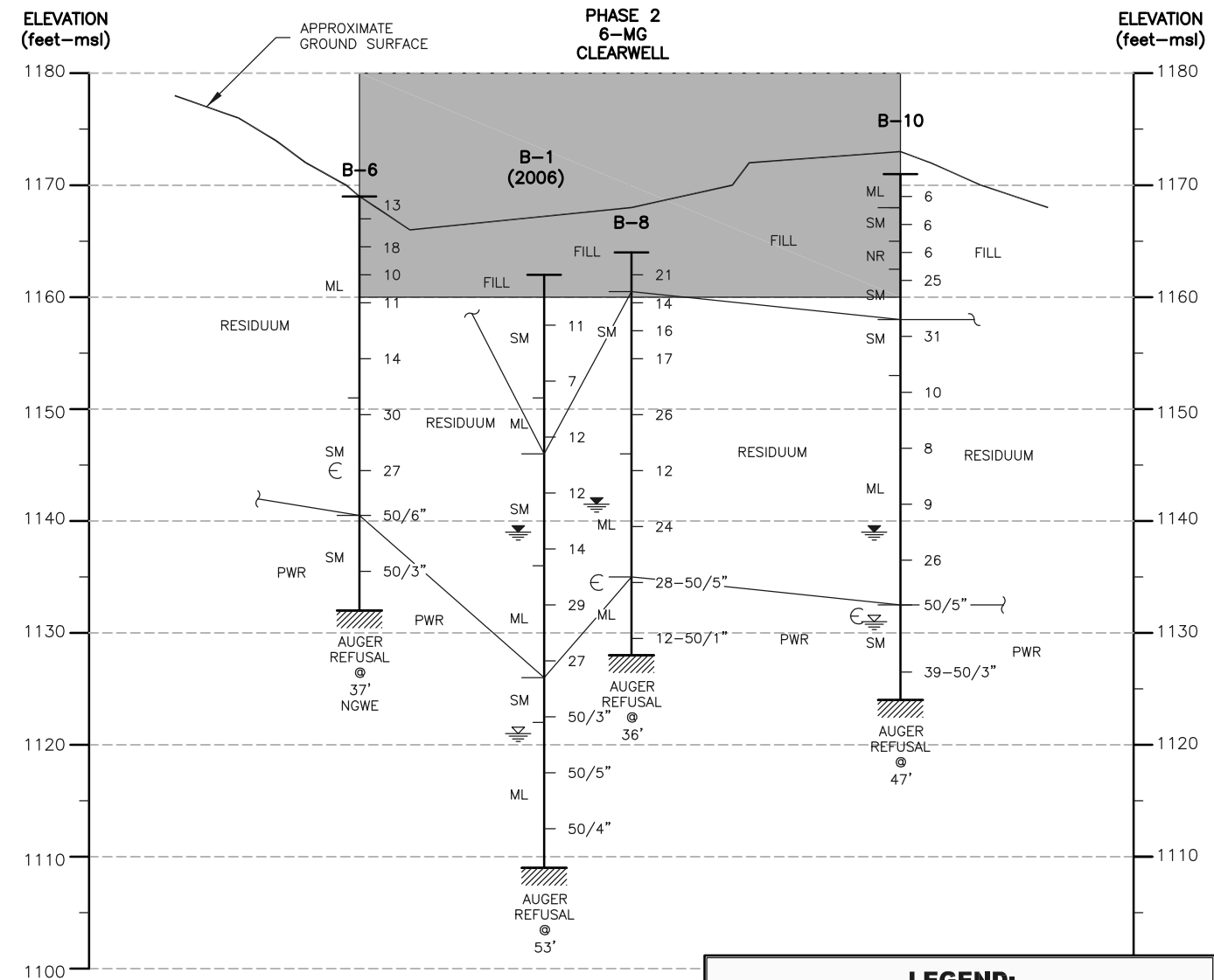
LEGEND
 - SOIL TEST BORING (THIS INVESTIGATION)
 - SOIL TEST BORING (2006 INVESTIGATION)
 SCALE: 1" = 80' (APPROXIMATELY)

SOURCE:
 MASTER PLAN OPTION 2, SHEET C-201, DATED MAY 13, 2025,
 prepared by PRIME / FORSYTH COUNTY GIS

REMOVE 90° BEND
 AND CONVERT TO TEE TO FEED EXISTING
 AND NEW CLEARWELL. INSTALL NEW 18" GV



SUBSURFACE PROFILE A-A'
SCALE: 1" = 50'(HORIZONTAL), 1"=15'(VERTICAL)



SUBSURFACE PROFILE B-B'
SCALE: 1" = 50'(HORIZONTAL), 1"=15'(VERTICAL)

**LEGEND:
TYPICAL SOIL TEST BORING PROFILE
NOT TO SCALE**

BORING NUMBER

UNIFIED SOIL CLASSIFICATIONS

OH - HIGH PLASTICITY ORGANICS	SPT - STANDARD PENETRATION RESISTANCE - BLOWS PER FOOT (BPF)
ML - LOW PLASTICITY SILT	WOH - STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
SM - SILTY SAND	NR - NO RECOVERY
SP - POORLY GRADED SAND	PWR - PARTIALLY WEATHERED ROCK
SW - WELL GRADED SAND	NGWE - NO GROUNDWATER ENCOUNTERED
CL - LOW PLASTICITY CLAY	
CH - HIGH PLASTICITY CLAY	

- NOTES:**
1. Approximate ground surface is plotted from the provided Master Plan Option 2 and available Forsyth County GIS data.
 2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
 3. Previous 2006 soil test borings are plotted at elevations listed in the subsurface investigation report, dated November 14, 2006.

SOURCE:
MASTER PLAN OPTION 2, SHEET C-201, DATED MAY 13, 2025,
prepared by PRIME / FORSYTH COUNTY GIS

LEGEND

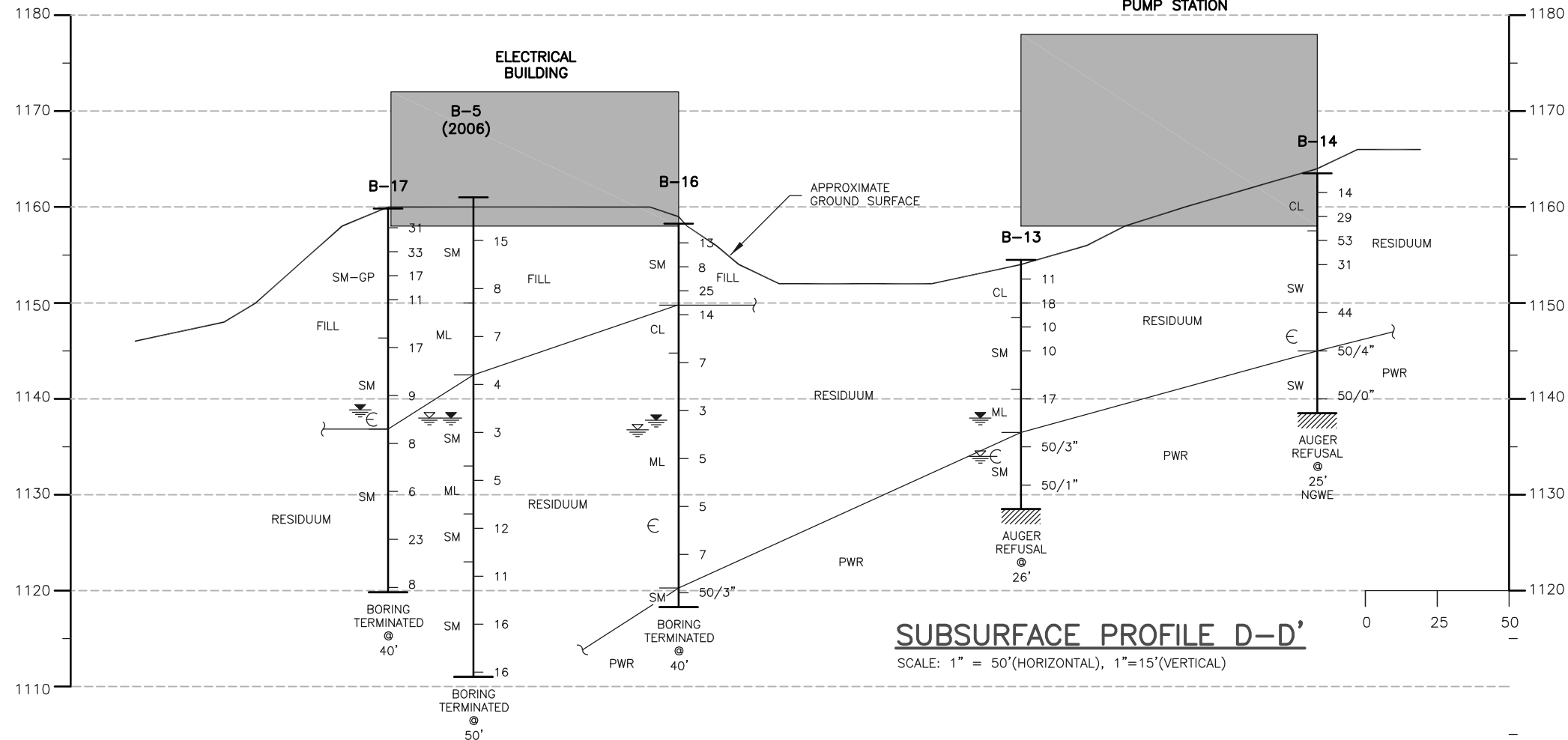
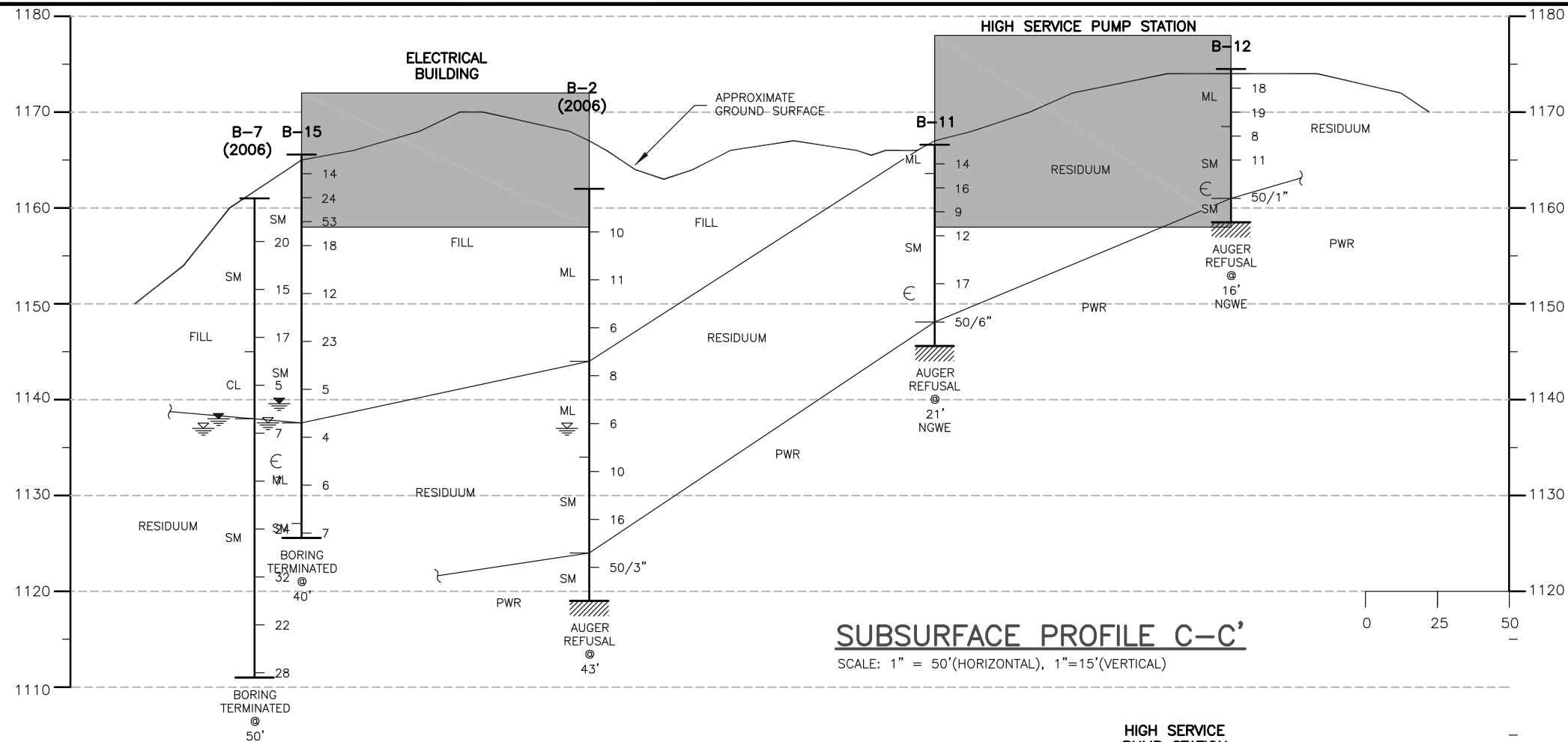
SCALE AS SHOWN (APPROXIMATE)

GEOSYSTEMS ENGINEERING, INC.

REFERENCE: BCW BLP.dwg

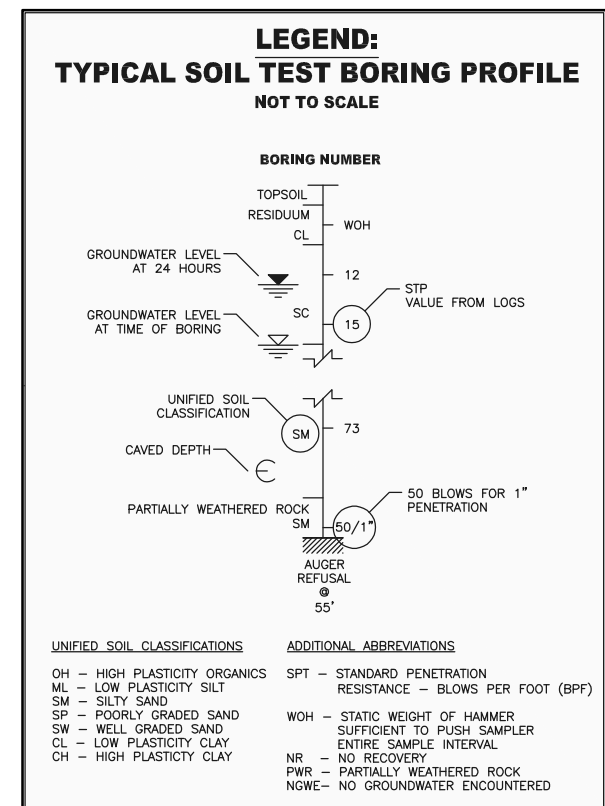
SUBSURFACE PROFILES

PROJECT:	CITY OF CUMMING, GEORGIA PWPF PHASE II CLEARWELL IMPROVEMENTS 935 DAHLONEGA, FORSYTH COUNTY, GA GEOSYSTEMS PROJECT NUMBER: 25-3003
PREPARED BY: ARC	DATE: 1/12/2026
REVIEWED BY: LDM	DATE: 1/12/2026
FIGURE:	2



NOTES:

1. Approximate ground surface is plotted from the provided Master Plan Option 2 and available Forsyth County GIS data.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the subsurface investigation report, dated November 14, 2006.



SOURCE:
MASTER PLAN OPTION 2, SHEET C-201, DATED MAY 13, 2025,
prepared by PRIME / FORSYTH COUNTY GIS

SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE II CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25-3003

PREPARED BY: ARC
DATE: 1/12/2026

REVIEWED BY: LDM
DATE: 1/12/2026

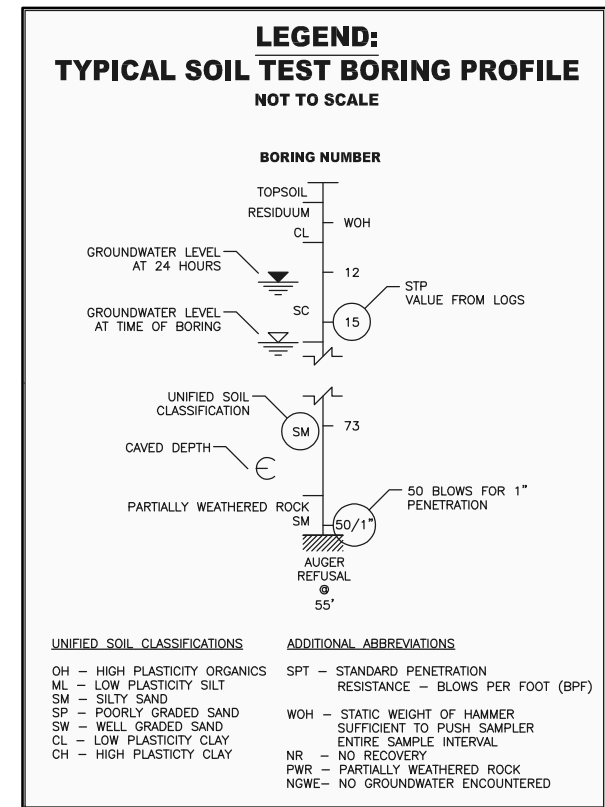
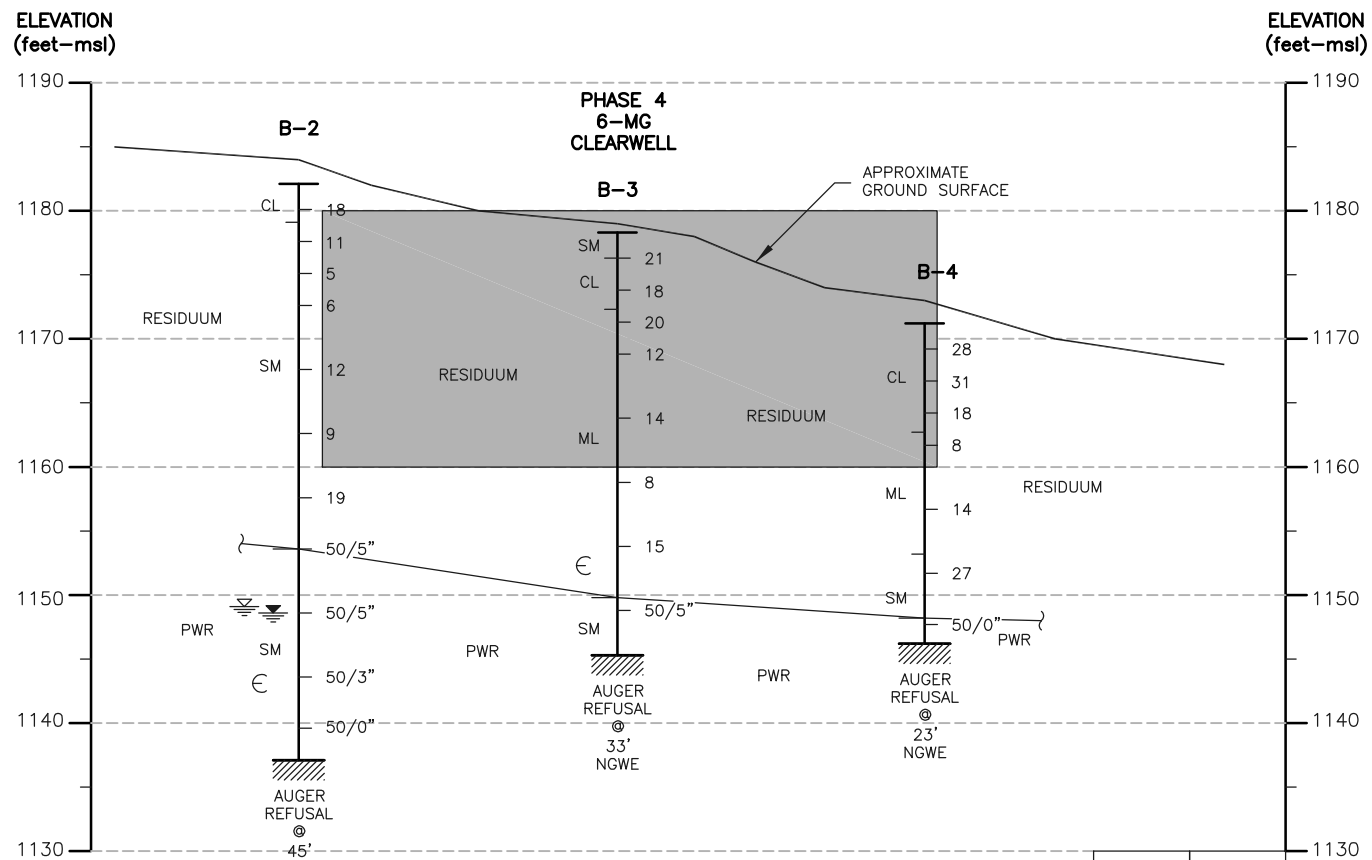
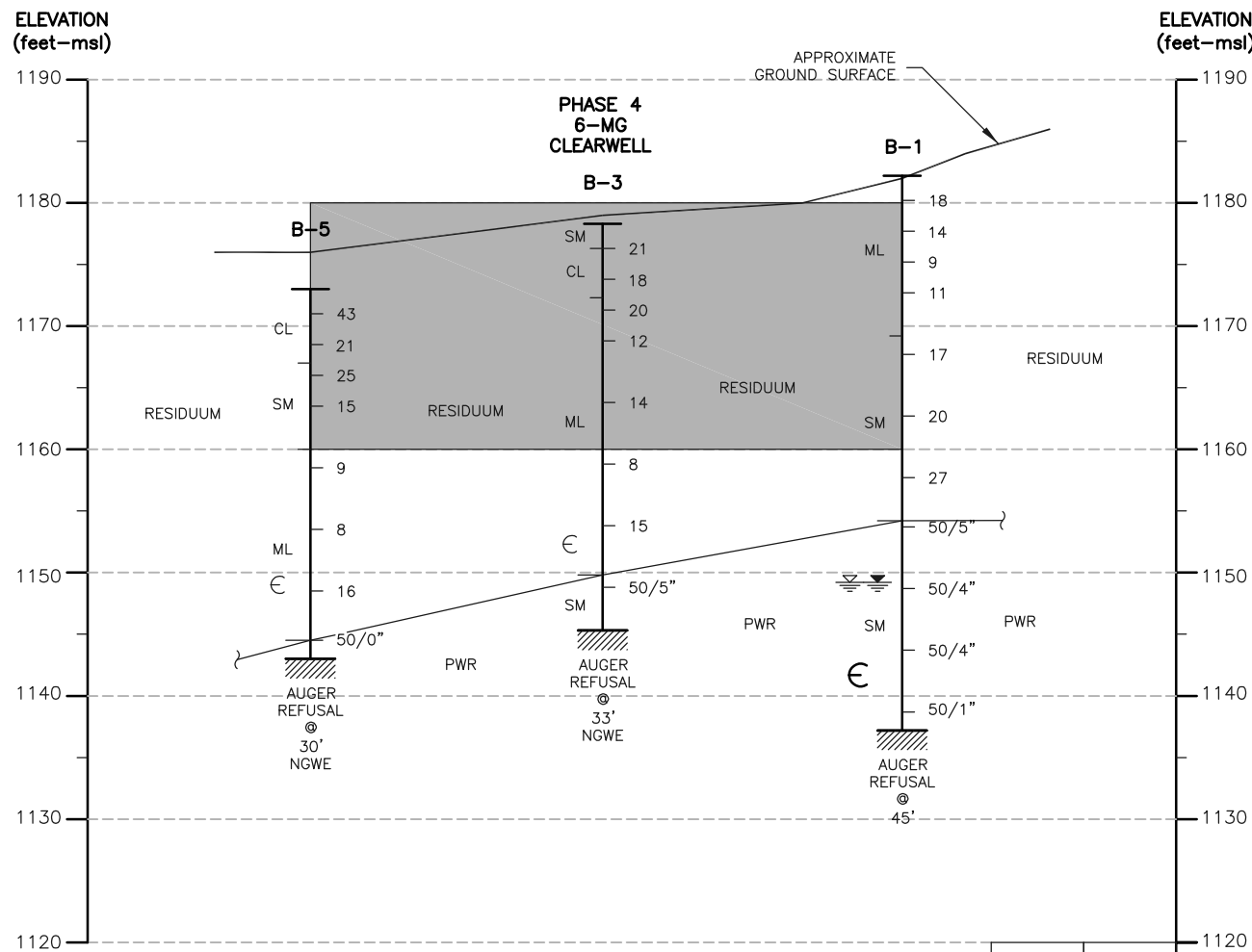
FIGURE: **3**

**GEOSYSTEMS
ENGINEERING, INC.**

REFERENCE: BCW BLP.dwg

LEGEND

SCALE AS SHOWN (APPROXIMATE)



NOTES:

1. Approximate ground surface is plotted from the provided Master Plan Option 2 and available Forsyth County GIS data.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the subsurface investigation report, dated November 14, 2006.

SOURCE:
MASTER PLAN OPTION 2, SHEET C-201, DATED MAY 13, 2025,
prepared by PRIME / FORSYTH COUNTY GIS

SUBSURFACE PROFILES

FIGURE: **4**

PREPARED BY: ARC
DATE: 1/12/2026

REVIEWED BY: LDM
DATE: 1/12/2026

PROJECT:
CITY OF CUMMING, GEORGIA
PWPF PHASE II CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25-3003



REFERENCE: BCW BLP.dwg

LEGEND

SCALE AS SHOWN (APPROXIMATE)

KEYS TO SYMBOLS AND CLASSIFICATIONS

SPECIAL STRATIGRAPHY IDENTIFIERS USED TO HIGHLIGHT SPECIFIC LAYERS	FILL TOPSOIL PAVEMENT	PARTIALLY WEATHERED ROCK ROCK (GENERAL) WATER ALLUVIUM
COARSE GRAINED SOIL - GRAVELS & SANDS (MORE THAN 50% OF MATERIAL IS RETAINED ON NO. 200 SIEVE)	CLEAN SANDS & GRAVELS (< 5% FINES CONTENT)	SP: Poorly graded sands SW: Well graded sands GP: Poorly graded gravels GW: Well graded gravels
FINE GRAINED SOIL - SILTS & CLAYS (MORE THAN 50% OF MATERIAL PASSES NO. 200 SEIVE)	SANDS & GRAVELS WITH HIGH FINES CONTENT (> 15% FINES CONTENT)	SM: Silty sands GM: Silty gravels SC: Clayey sands GC: Clayey gravels
SILTS	CLAYS	ML: Low plasticity inorganic silts MH: High plasticity inorganic silts CL: Low placticity inorganic clays CH: High plasticity inorganic clays
ORGANIC SILTS & CLAYS	ORGANIC SILTS & CLAYS	OL: Low plasticity organic silts and clays OH: High plasticity organic silts and clays

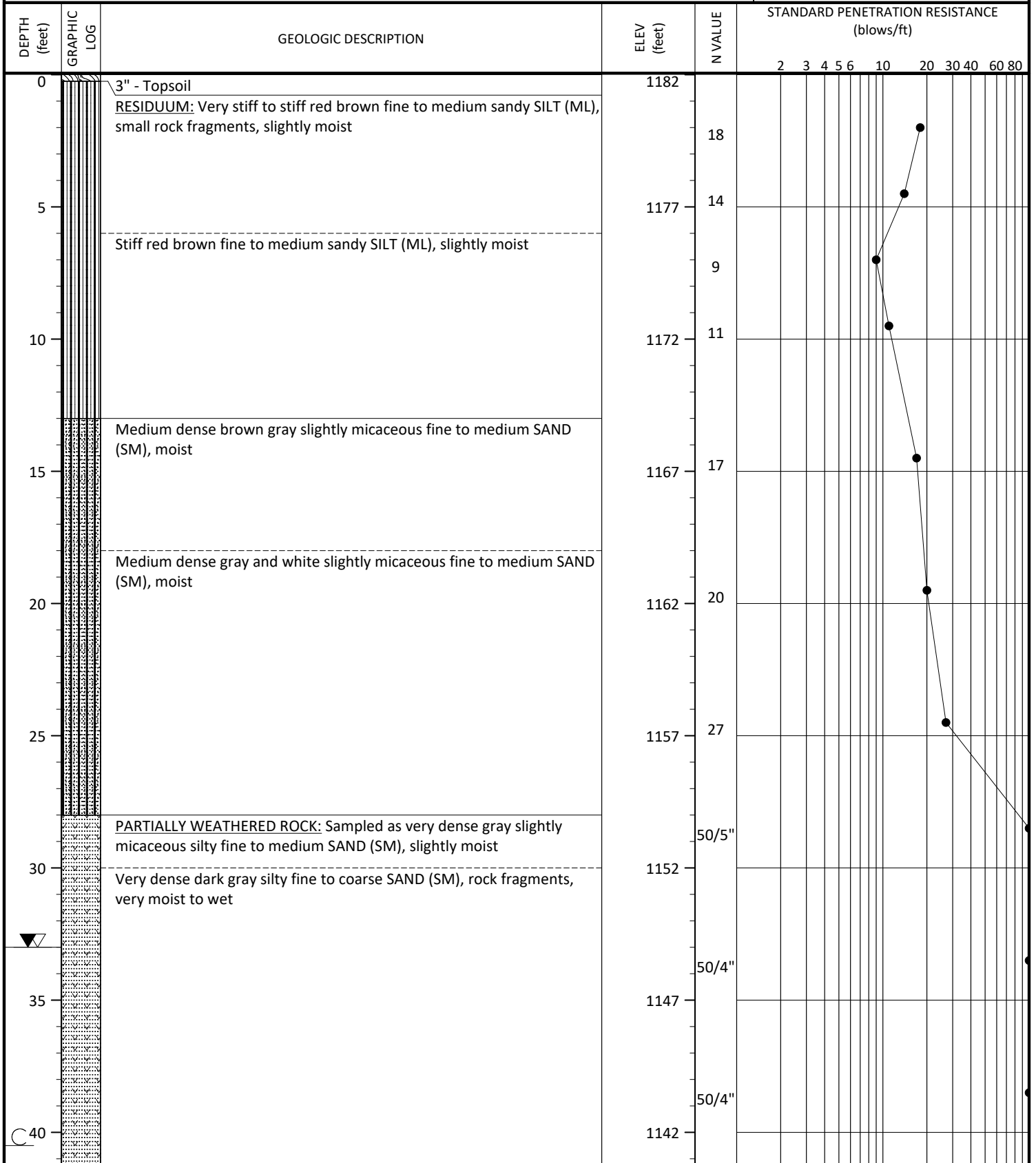
CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE DENSITY
SANDS AND GRAVELS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
	SILTS AND CLAYS	NUMBER OF BLOWS, N
0 - 1		Very Soft
2 - 4		Soft
5 - 8		Firm
9 - 15		Stiff
16 - 30		Very Stiff
31 - 50		Hard
OVER 50		Very Hard

**CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-1


GEOLOGIST: NA	ELEVATION (feet): 1182	NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Groundwater level measured at 33 feet about 2 hours after drilling. 3. Borehole caved to a depth of 40.5 feet.
DATE DRILLED: 11/14/2025	BORING DEPTH (feet): 45	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 33 \blacktriangledown 24HR (feet): 33	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-1

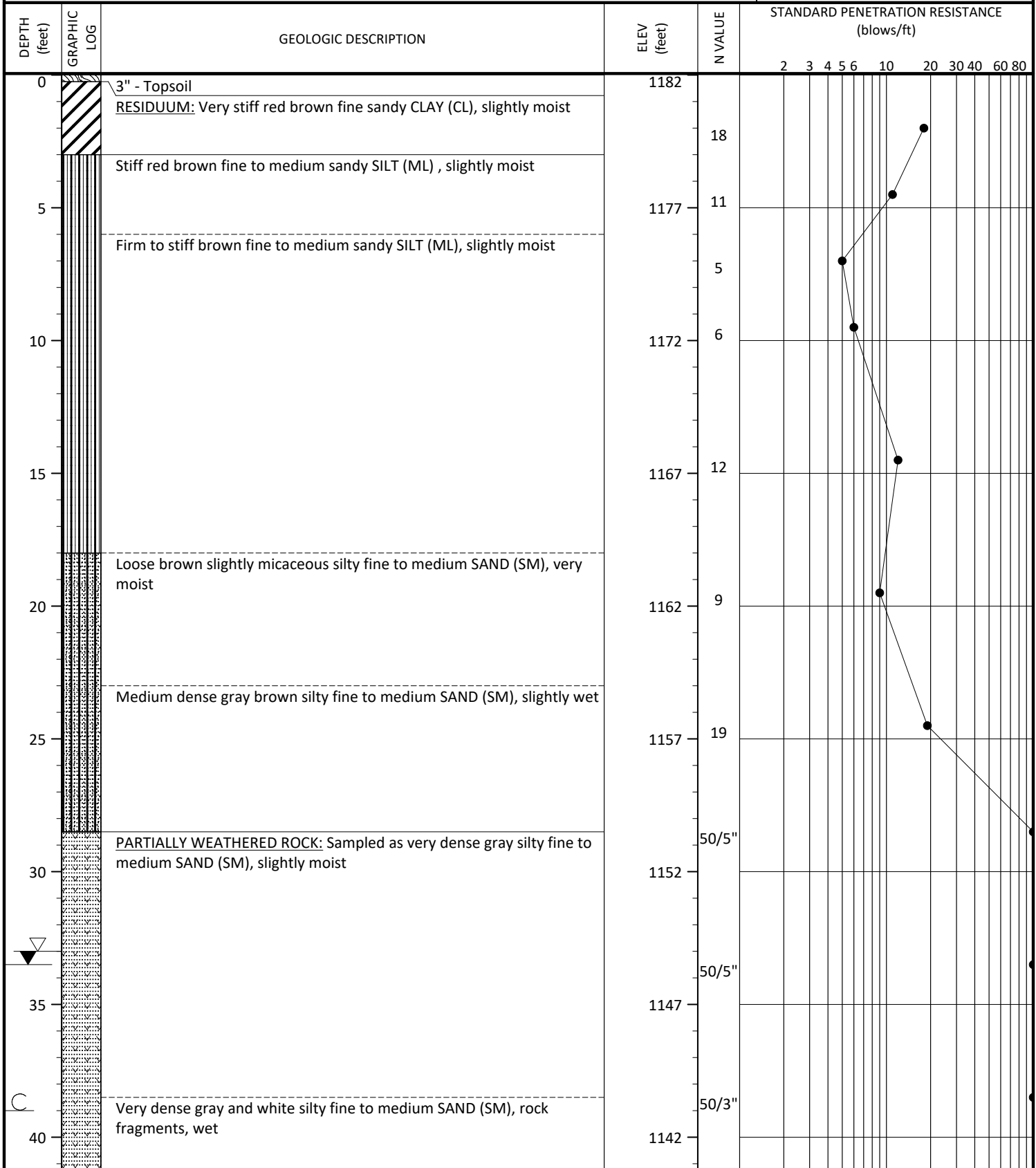
GEOLOGIST: <i>NA</i>		ELEVATION (feet): <i>1182</i>		NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Groundwater level measured at 33 feet about 2 hours after drilling. 3. Borehole caved to a depth of 40.5 feet.
DATE DRILLED: <i>11/14/2025</i>		BORING DEPTH (feet): <i>45</i>		
DRILLER: <i>GRINDSTONE DRILLING</i>		WATER LEVEL ∇ TOB (feet): <i>33</i> \blacktriangledown 24HR (feet): <i>33</i>		
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>				

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					2	3	4	5	6	10	20	30	40	60	80						
45		Very dense dark gray silty fine to coarse SAND (SM), rock fragments, very moist to wet	1137	50/1"																	
		Auger Refusal at 45 feet																			

**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**



LOG OF BORING B-2

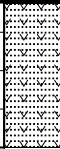
GEOLOGIST: NA	ELEVATION (feet): 1182	NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Groundwater level measured at 33.5 feet about 4 hours after drilling. 3. Borehole caved to a depth of 39 feet.
DATE DRILLED: 11/14/2025	BORING DEPTH (feet): 45	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 33 \blacktriangledown 24HR (feet): 33.5	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWWF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-2

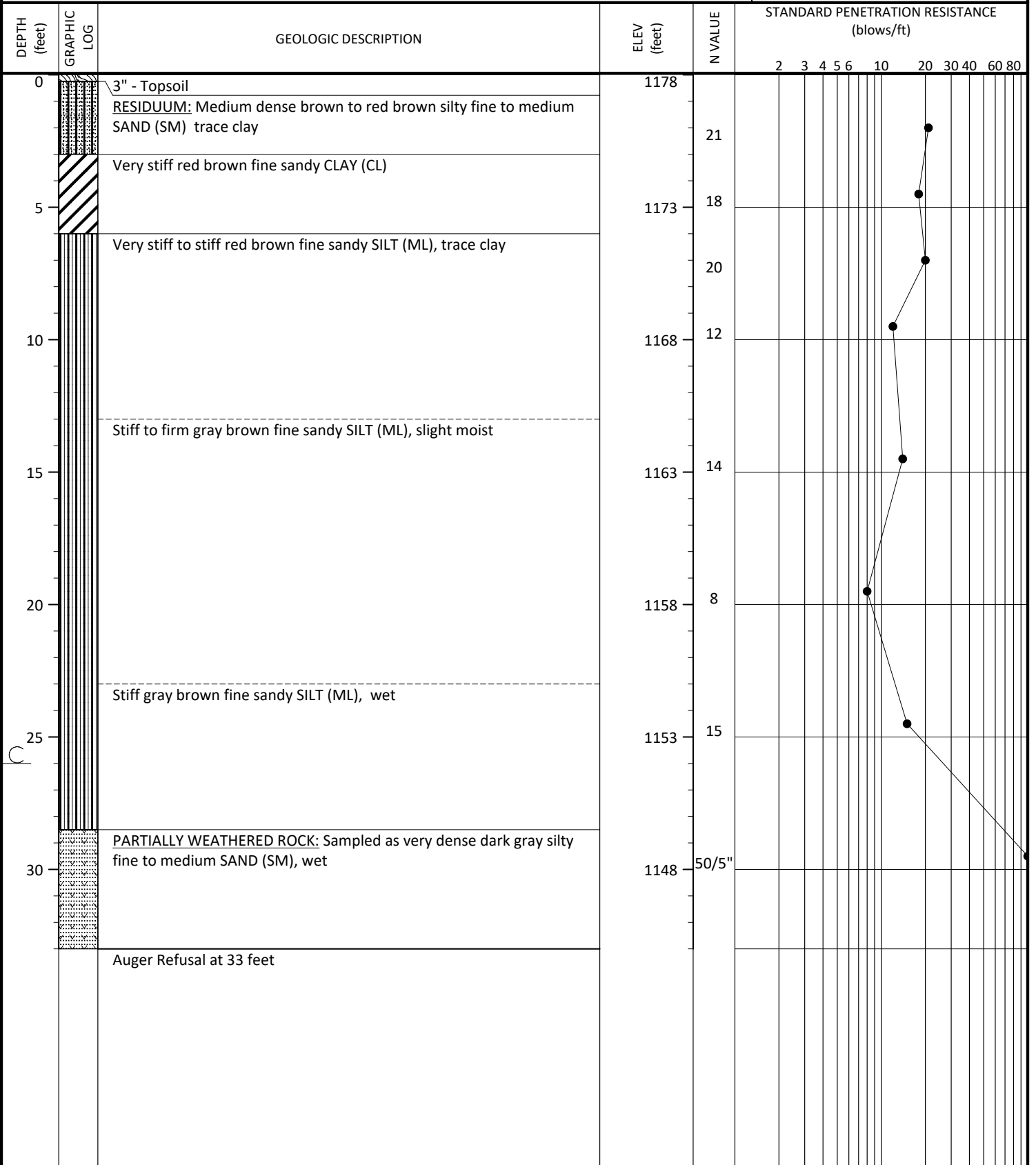
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1182</i>	NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Groundwater level measured at 33.5 feet about 4 hours after drilling. 3. Borehole caved to a depth of 39 feet.
DATE DRILLED: <i>11/14/2025</i>	BORING DEPTH (feet): <i>45</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL  TOB (feet): <i>33</i>  24HR (feet): <i>33.5</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					2	3	4	5	6	10	20	30	40	60	80						
45		Very dense gray and white silty fine to medium SAND (SM), rock fragments, wet	1137	50/0"																	
		Auger Refusal at 45 feet																			

**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-3

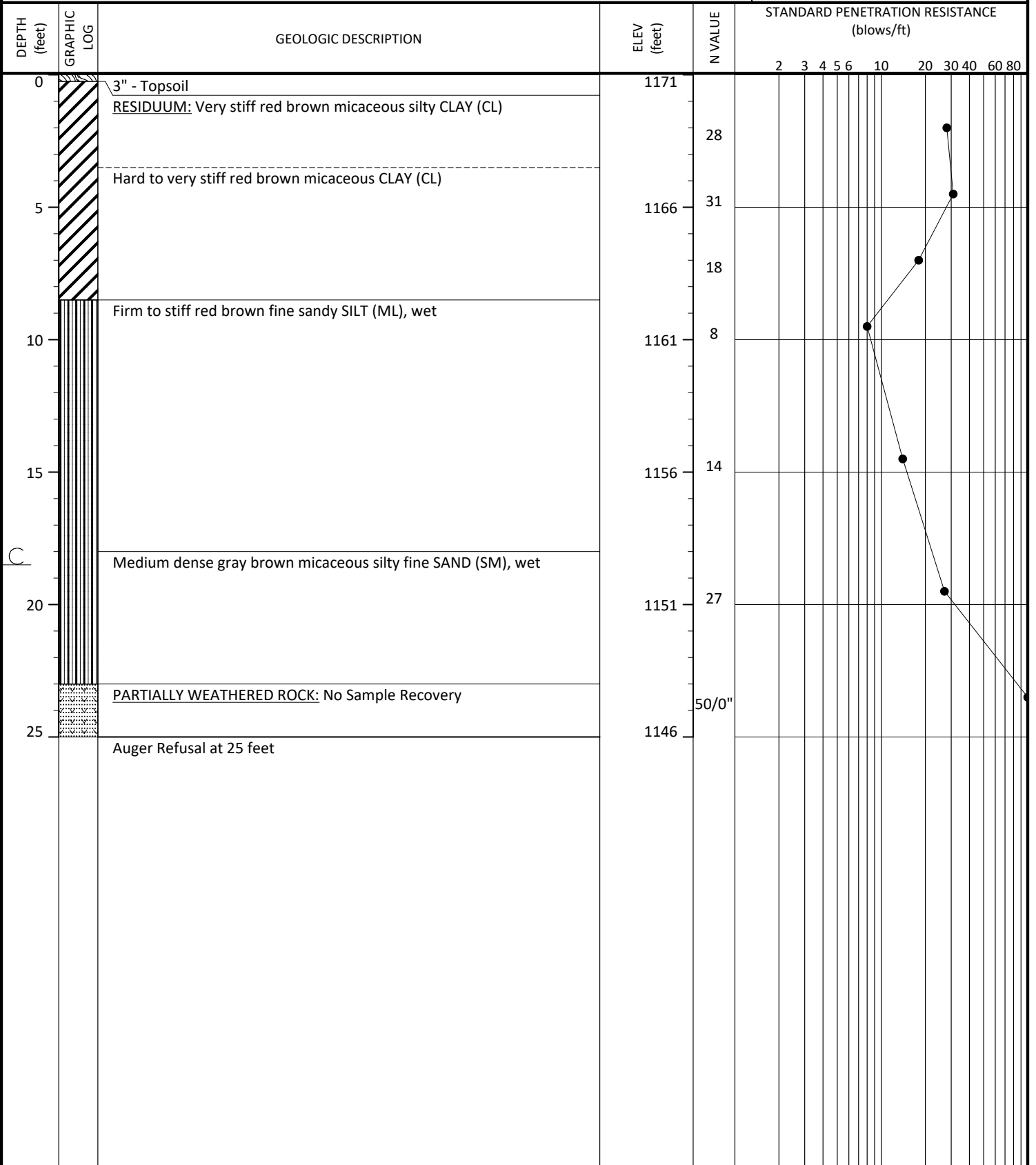
GEOLOGIST: <i>NA</i>		ELEVATION (feet): <i>1178</i>		NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. Groundwater level was not measured after 24 hours (NGWE). 3. Borehole caved to a depth of 26 feet.
DATE DRILLED: <i>11/14/2025</i>		BORING DEPTH (feet): <i>33</i>		
DRILLER: <i>GRINDSTONE DRILLING</i>		WATER LEVEL ∇ TOB (feet): <i>NGWE</i> \blacktriangledown 24HR (feet): <i>NGWE</i>		
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>				



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-4

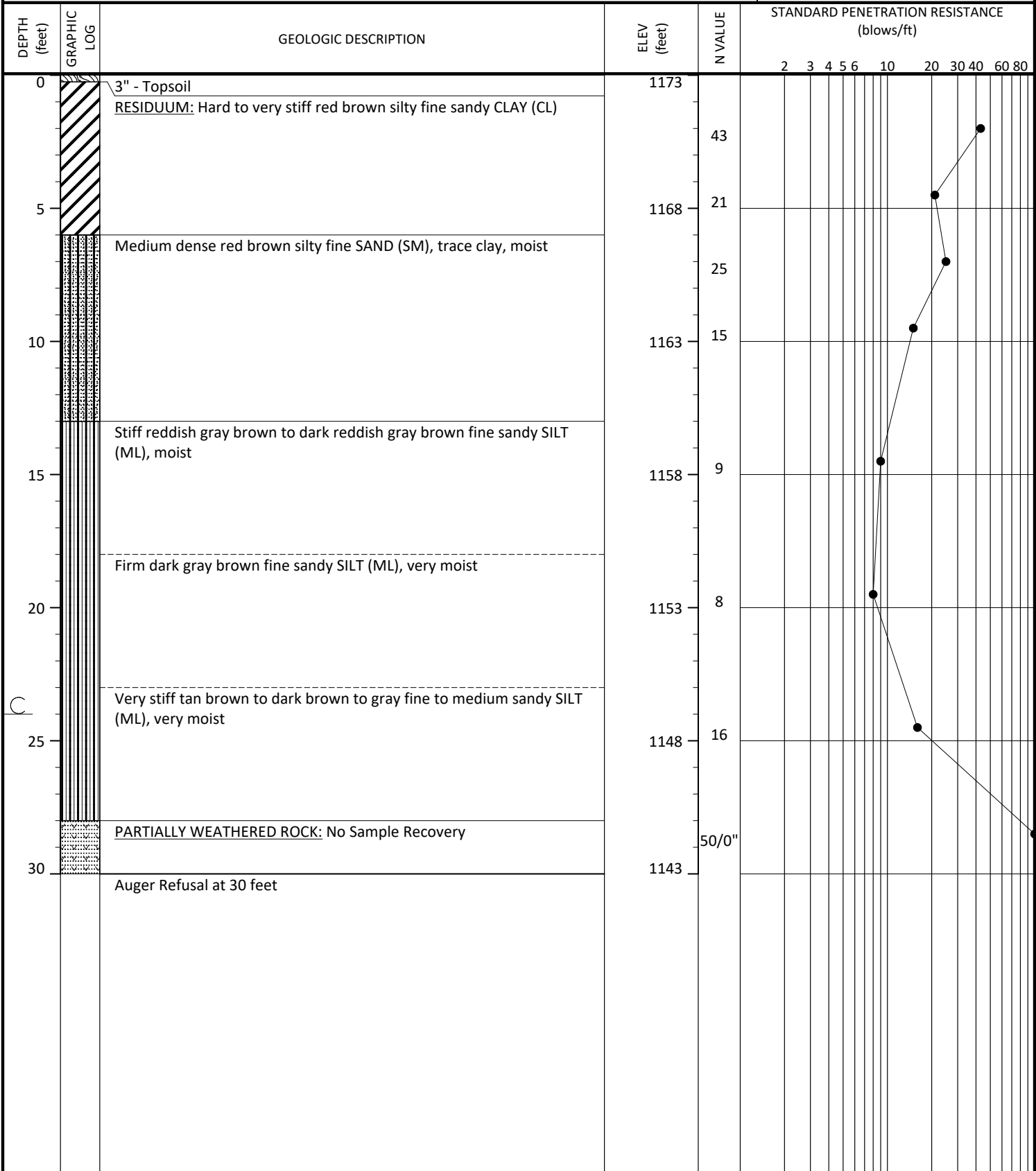
GEOLOGIST: NA	ELEVATION (feet): 1171	NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. Groundwater level was not measured after 24 hours (NGWE). 3. Borehole caved to a depth of 18.5 feet.
DATE DRILLED: 11/14/2025	BORING DEPTH (feet): 25	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): NGWE \blacktriangledown 24HR (feet): NGWE	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-5

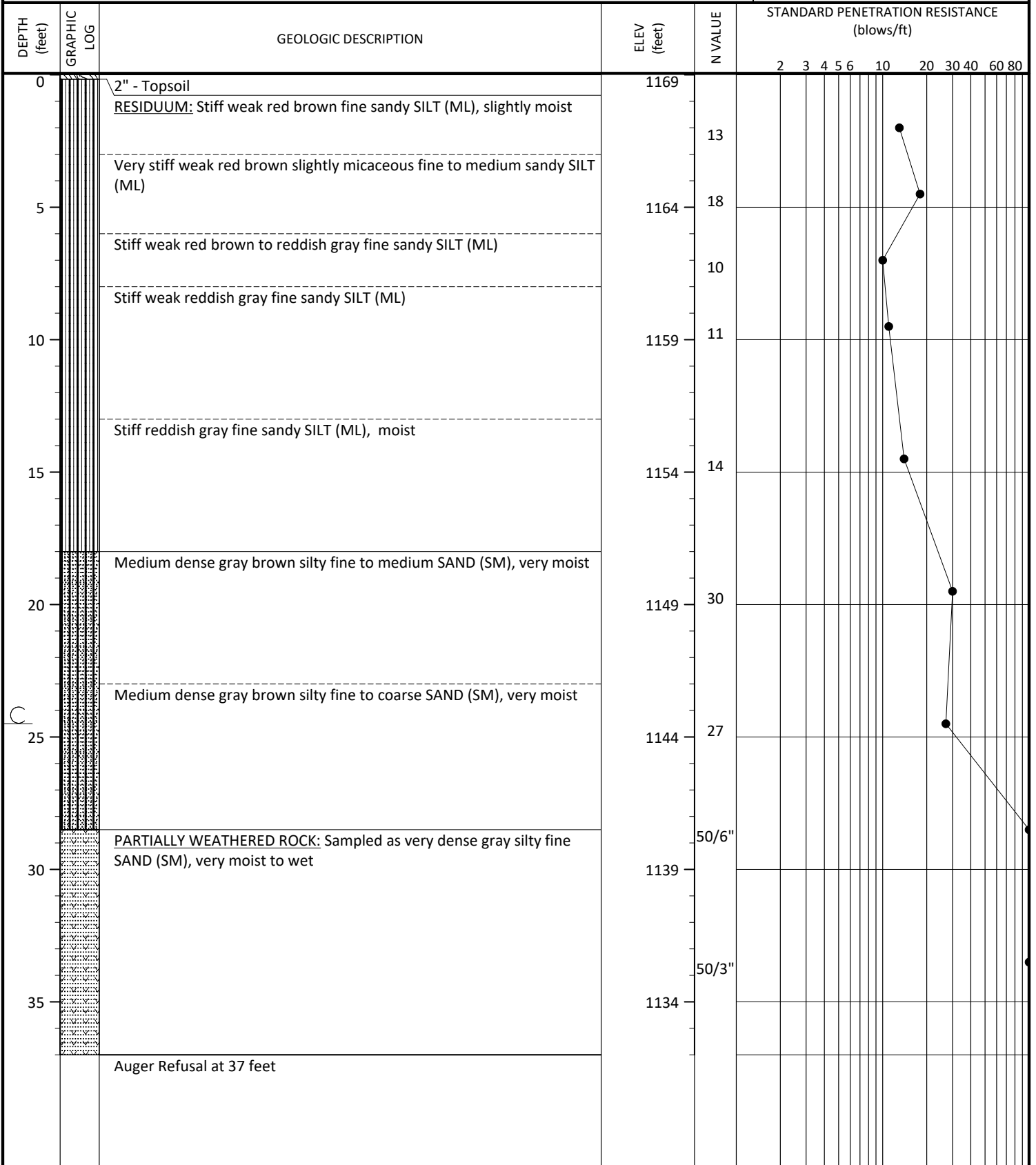
GEOLOGIST: NA	ELEVATION (feet): 1173	NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater was encountered after 24 hours.(NGWE). 3. Borehole caved to a depth of 24 feet.
DATE DRILLED: 11/12/2025	BORING DEPTH (feet): 30	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): NGWE \blacktriangledown 24HR (feet): NGWE	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-6

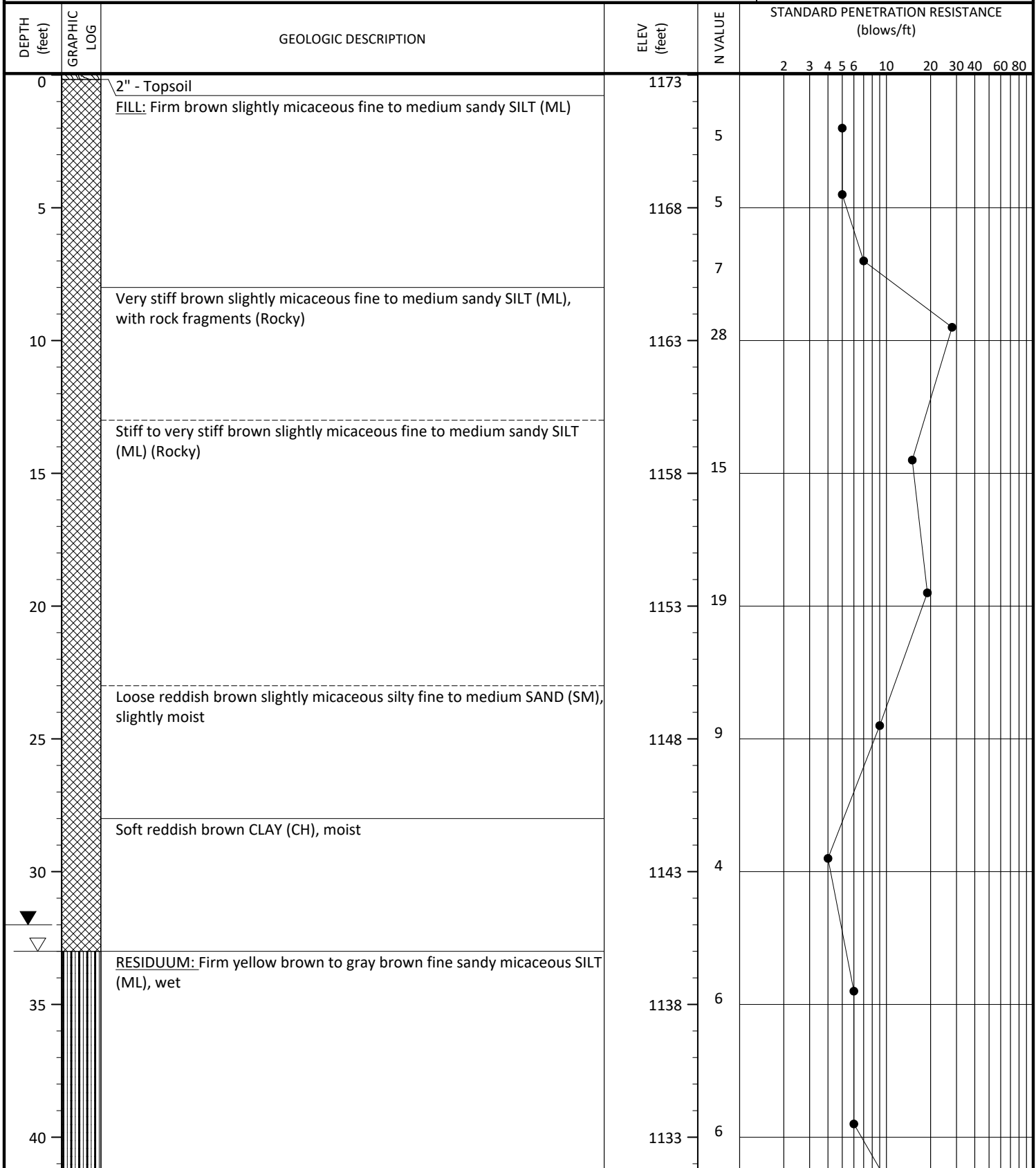
GEOLOGIST: NA	ELEVATION (feet): 1169	NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater was encountered after 24 hours(NGWE). 3. Borehole caved to a depth of 24.5 feet.
DATE DRILLED: 11/12/2025	BORING DEPTH (feet): 37	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ▽ TOB (feet): NGWE ▼ 24HR (feet): NGWE	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-7

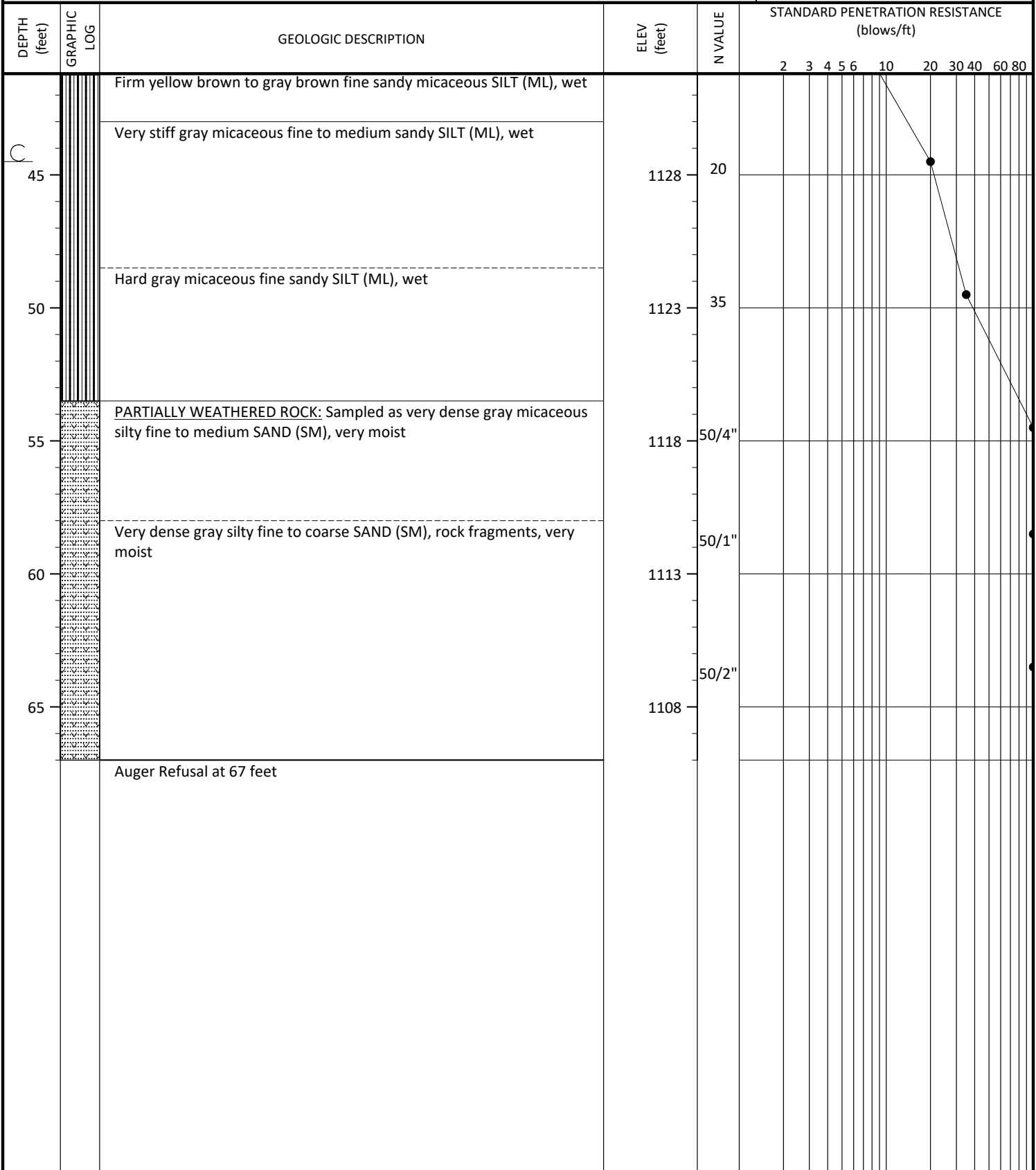
GEOLOGIST: NA	ELEVATION (feet): 1173	NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Stabilized groundwater level measured at 32 feet 24 hours after drilling. 3. Borehole caved to a depth of 44.5 feet.
DATE DRILLED: 11/11/2025	BORING DEPTH (feet): 67	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 33 \blacktriangledown 24HR (feet): 32	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-7

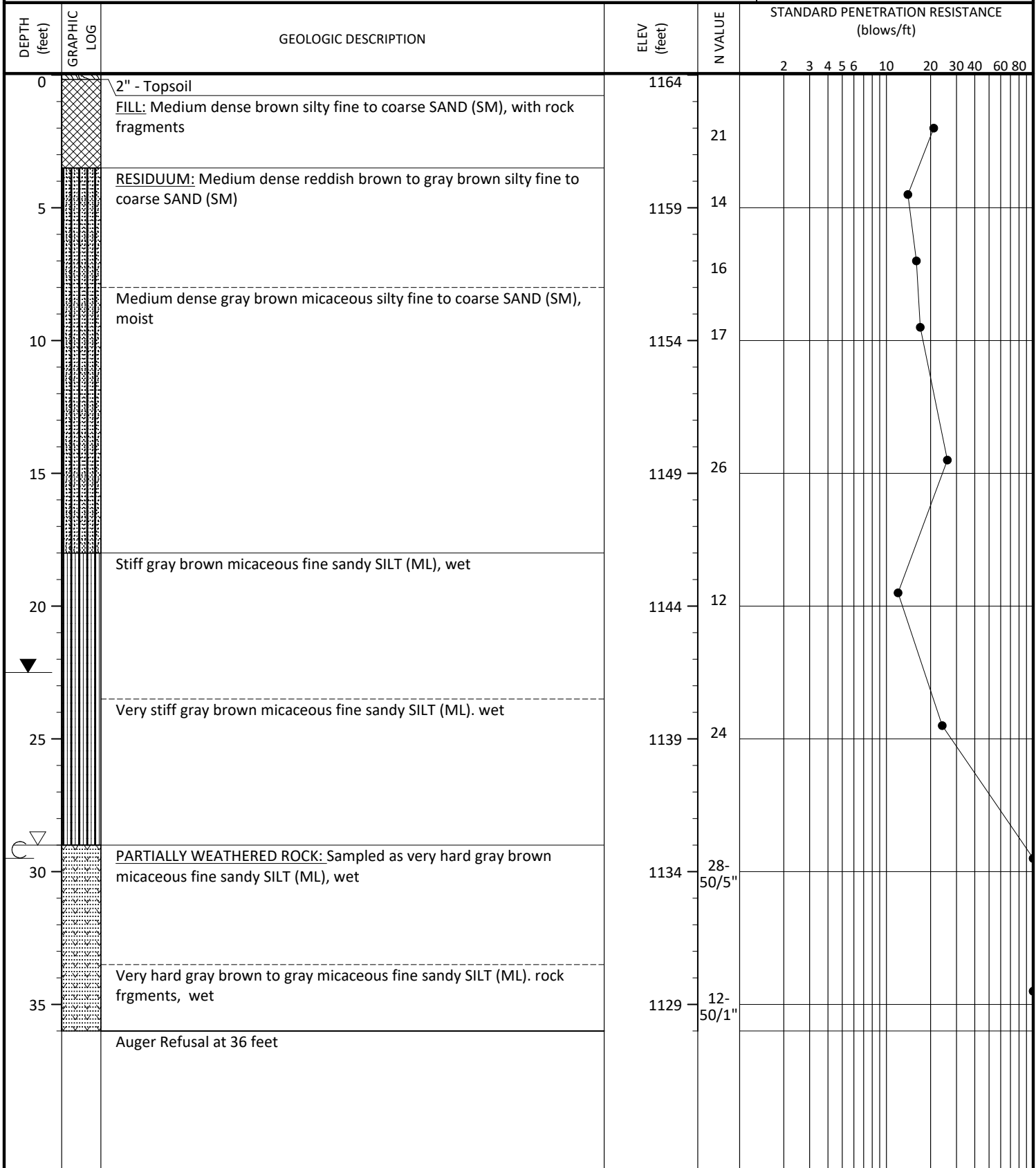
GEOLOGIST: <i>NA</i>		ELEVATION (feet): <i>1173</i>		NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Stabilized groundwater level measured at 32 feet 24 hours after drilling. 3. Borehole caved to a depth of 44.5 feet.
DATE DRILLED: <i>11/11/2025</i>		BORING DEPTH (feet): <i>67</i>		
DRILLER: <i>GRINDSTONE DRILLING</i>		WATER LEVEL ∇ TOB (feet): <i>33</i> \blacktriangledown 24HR (feet): <i>32</i>		
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>				



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-8

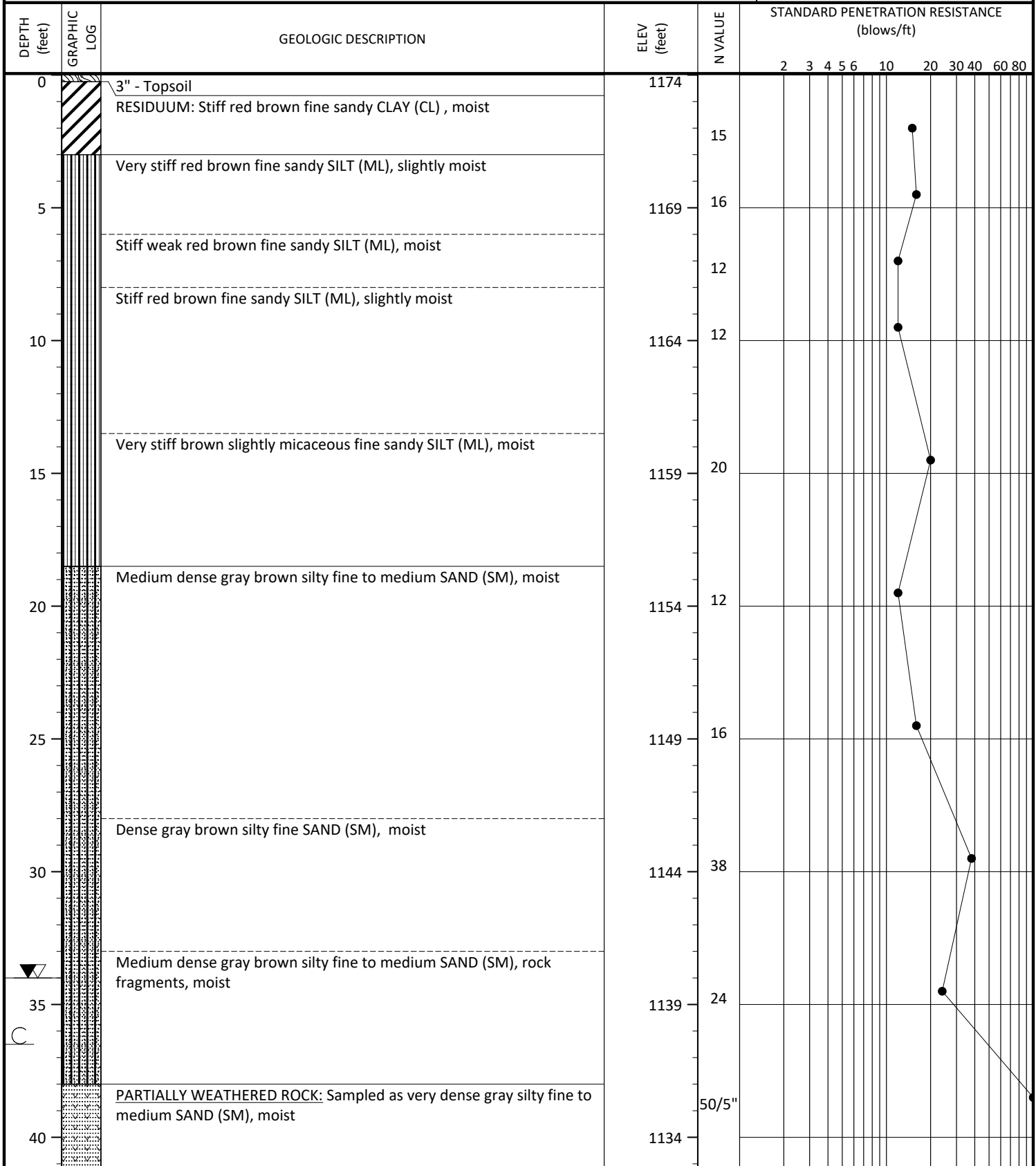
GEOLOGIST: NA	ELEVATION (feet): 1164	NOTES: 1. Groundwater detected at 29 feet at the time of boring. 2. Stabilized groundwater level measured at 22.5 feet 24 hours after drilling. 3. Borehole caved to a depth of 29.5 feet.
DATE DRILLED: 11/12/2025	BORING DEPTH (feet): 36	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 29 \blacktriangledown 24HR (feet): 22.5	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**



LOG OF BORING B-9

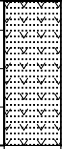
GEOLOGIST: NA	ELEVATION (feet): 1174	NOTES: 1. Groundwater detected at 34 feet at the time of boring. 2. Stabilized groundwater level measured at 34 feet 24 hours after drilling. 3. Borehole caved to a depth of 36.5 feet.
DATE DRILLED: 11/12/2025	BORING DEPTH (feet): 45	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 34 \blacktriangledown 24HR (feet): 34	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-9

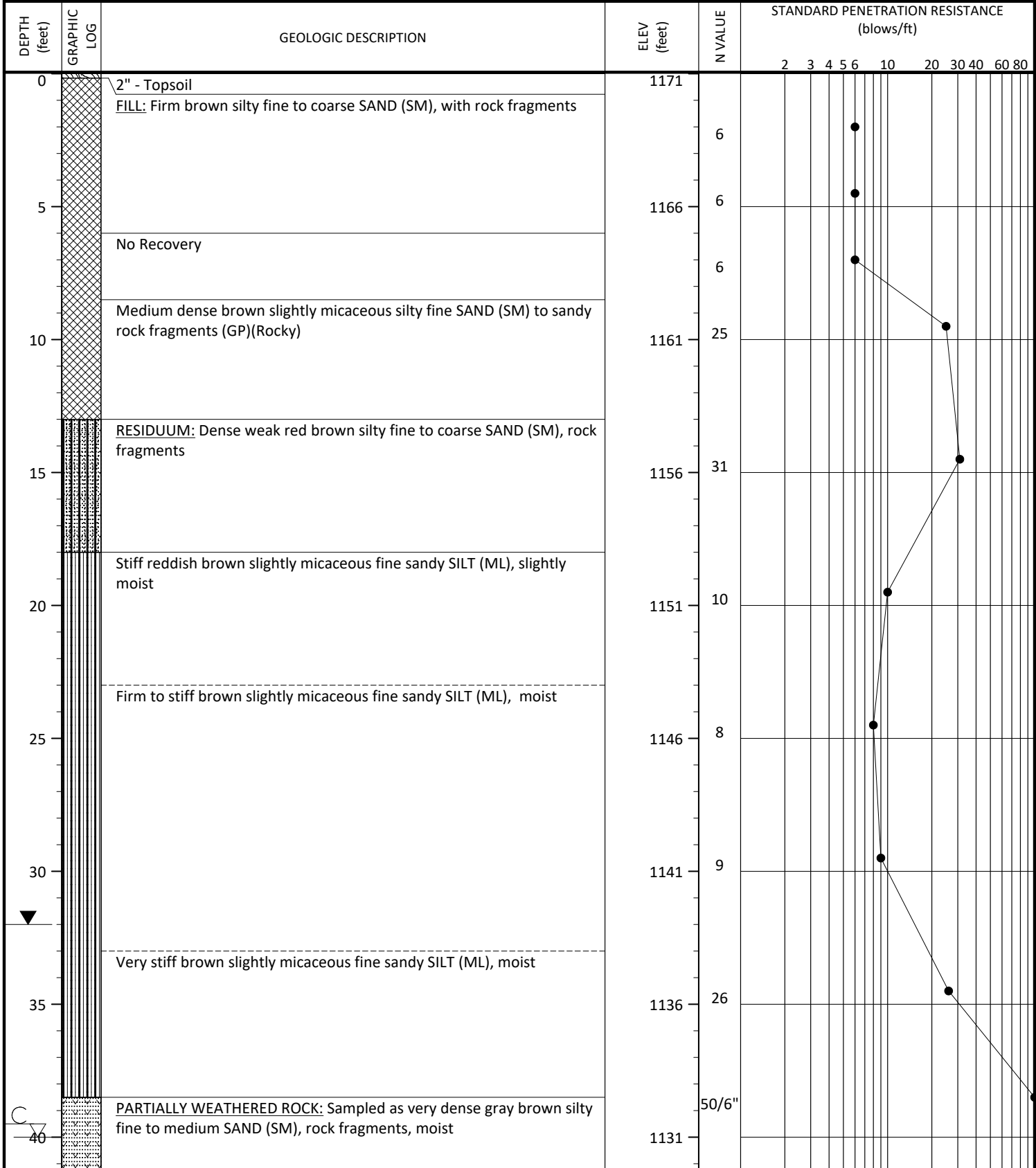
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1174</i>	NOTES: 1. Groundwater detected at 34 feet at the time of boring. 2. Stabilized groundwater level measured at 34 feet 24 hours after drilling. 3. Borehole caved to a depth of 36.5 feet.
DATE DRILLED: <i>11/12/2025</i>	BORING DEPTH (feet): <i>45</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL  TOB (feet): <i>34</i>  24HR (feet): <i>34</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					2	3	4	5	6	10	20	30	40	60	80						
45		<u>PARTIALLY WEATHERED ROCK</u> : Sampled as very dense gray silty fine to medium SAND (SM), moist	1129	50/0"																	
		Auger Refusal at 45 feet																			

**CITY OF CUMMING, GEORGIA
PWWF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-10


GEOLOGIST: NA	ELEVATION (feet): 1171	NOTES: 1. Groundwater detected at 40 feet at the time of boring. 2. Stabilized groundwater level measured at 32 feet 24 hours after drilling. 3. Borehole caved to a depth of 39.5 feet.
DATE DRILLED: 11/12/2025	BORING DEPTH (feet): 47	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 40 \blacktriangledown 24HR (feet): 32	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-10

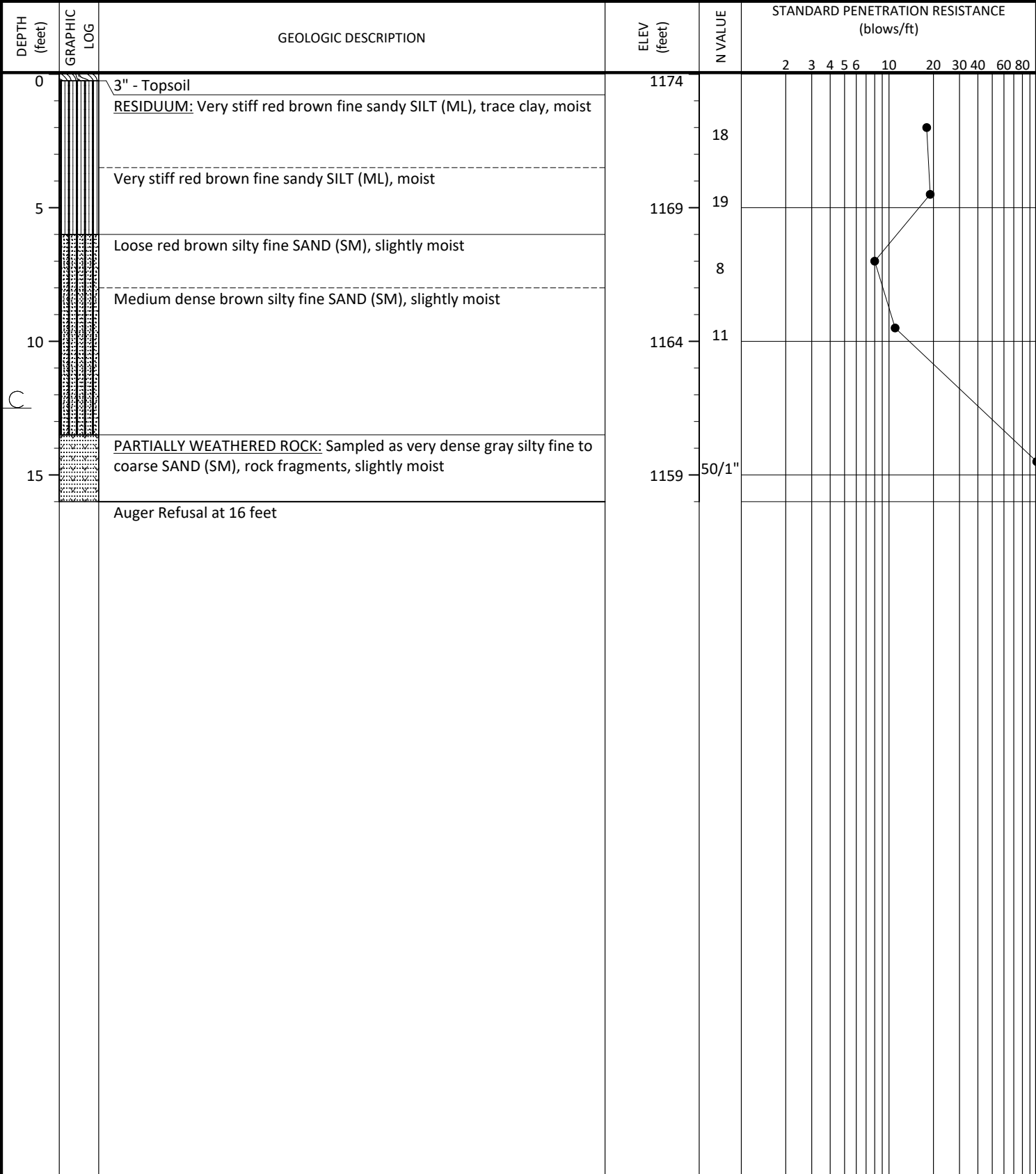
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1171</i>	NOTES: 1. Groundwater detected at 40 feet at the time of boring. 2. Stabilized groundwater level measured at 32 feet 24 hours after drilling. 3. Borehole caved to a depth of 39.5 feet.
DATE DRILLED: <i>11/12/2025</i>	BORING DEPTH (feet): <i>47</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL ∇ TOB (feet): <i>40</i> \blacktriangledown 24HR (feet): <i>32</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																	
					2	3	4	5	6	10	20	30	40	60	80							
45		PARTIALLY WEATHERED ROCK: Sampled as very dense gray brown silty fine to medium SAND (SM), rock fragments, moist	1126	39-50/3"																		
		Very dense gray brown silty fine to medium SAND (SM), moist																				
	Auger Refusal at 47 feet																					

**CITY OF CUMMING, GEORGIA
PWPf CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-12

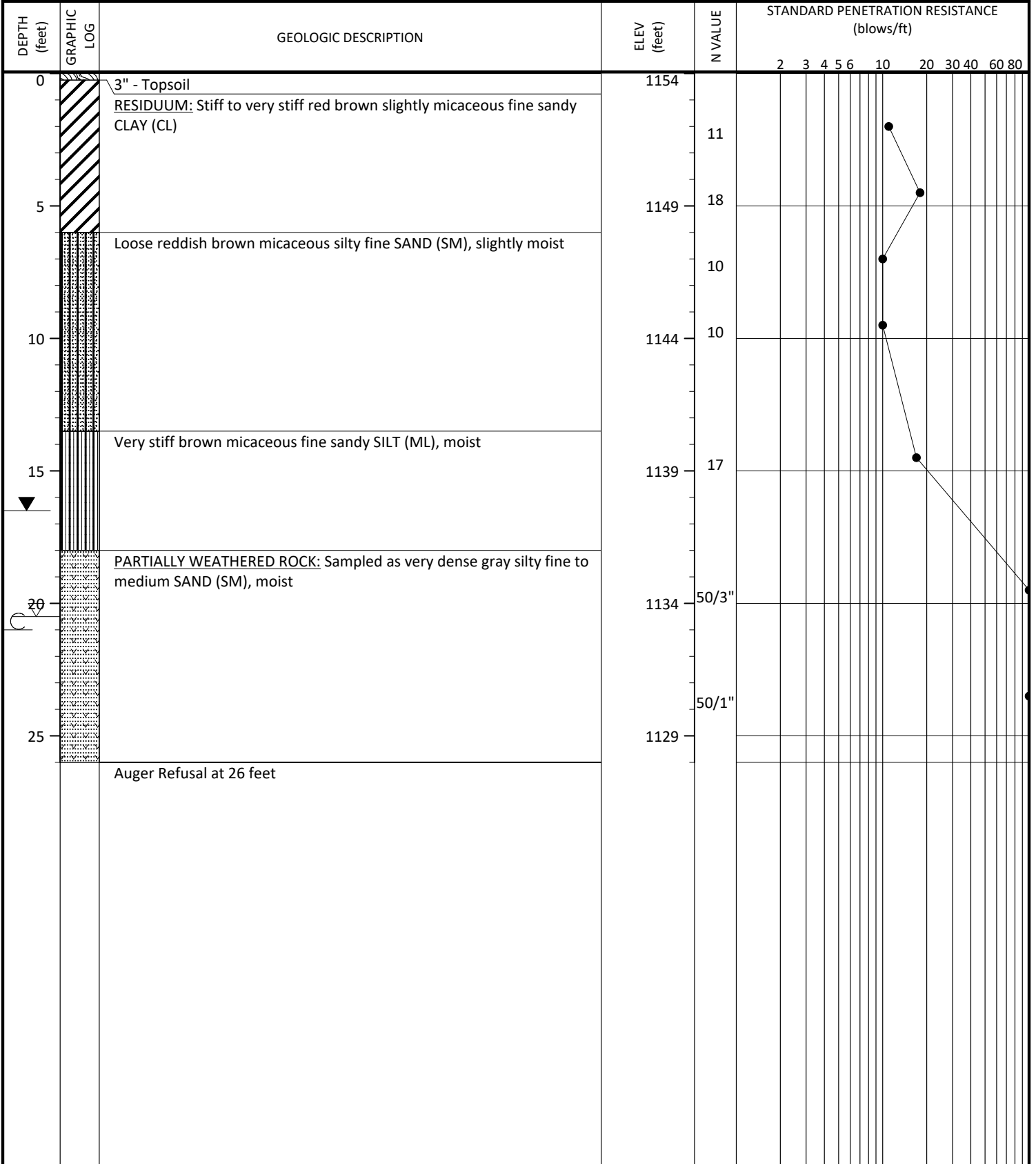
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1174</i>	NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater encountered after 24 hours (NGWE). 3. Borehole caved to a depth of 12.5 feet.
DATE DRILLED: <i>11/12/2025</i>	BORING DEPTH (feet): <i>16</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL ∇ TOB (feet): <i>NGWE</i> \blacktriangledown 24HR (feet): <i>NGWE</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		



**CITY OF CUMMING, GEORGIA
PWWP CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-13

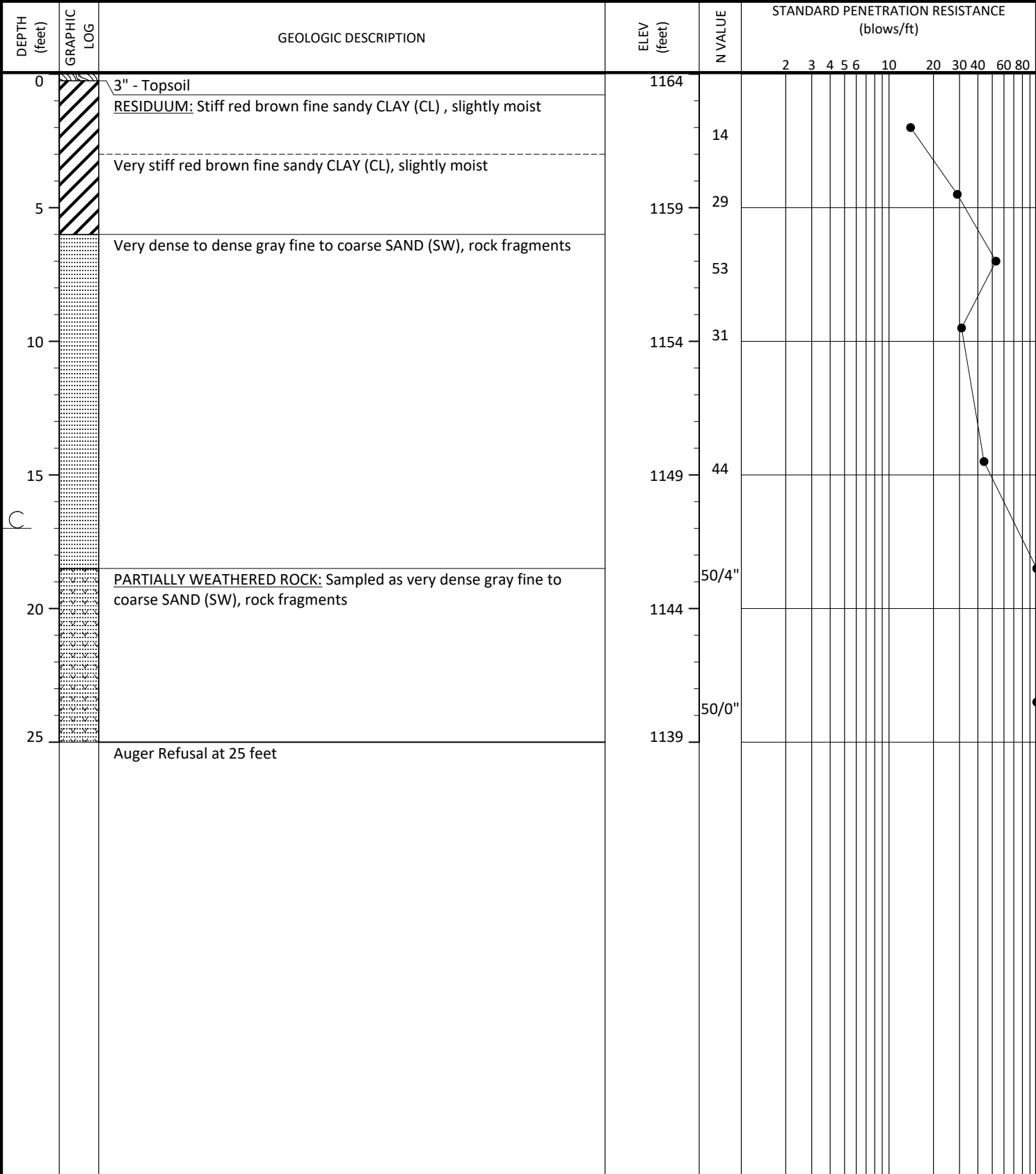
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1154</i>	NOTES: 1. Groundwater detected at 20.5 feet at the time of boring. 2. Groundwater level measured at 16.5 feet 24 hours after drilling. 3. Borehole caved to a depth of 20.5 feet.
DATE DRILLED: <i>11/12/2025</i>	BORING DEPTH (feet): <i>26</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL ∇ TOB (feet): <i>20.5</i> \blacktriangledown 24HR (feet): <i>16.5</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		



**CITY OF CUMMING, GEORGIA
PWPf CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-14

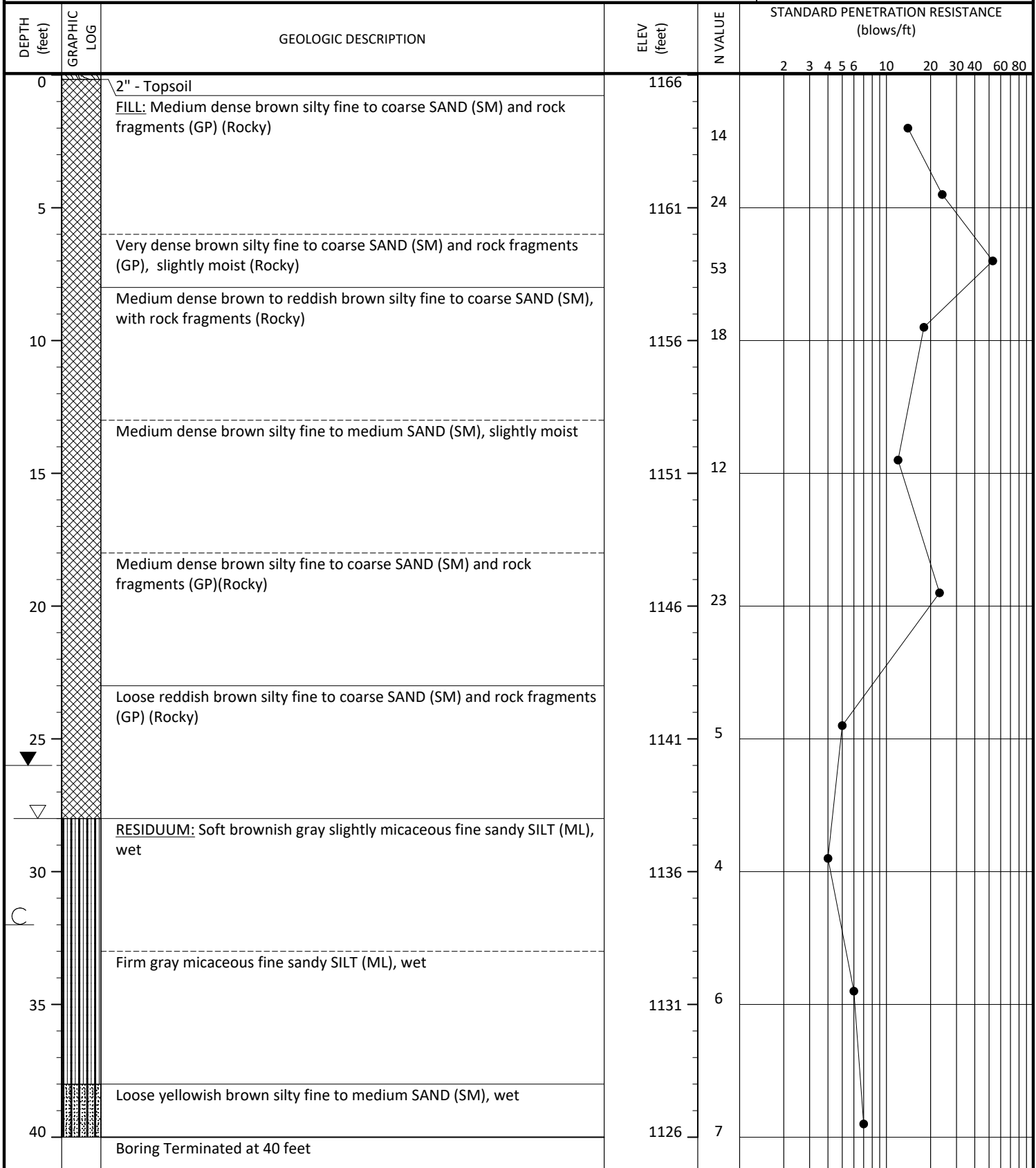
GEOLOGIST: NA	ELEVATION (feet): 1164	NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater encountered after 24 hours (NGWE). 3. Borehole caved to a depth of 17 feet.
DATE DRILLED: 11/12/2025	BORING DEPTH (feet): 25	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): NGWE \blacktriangledown 24HR (feet): NGWE	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWWF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-15

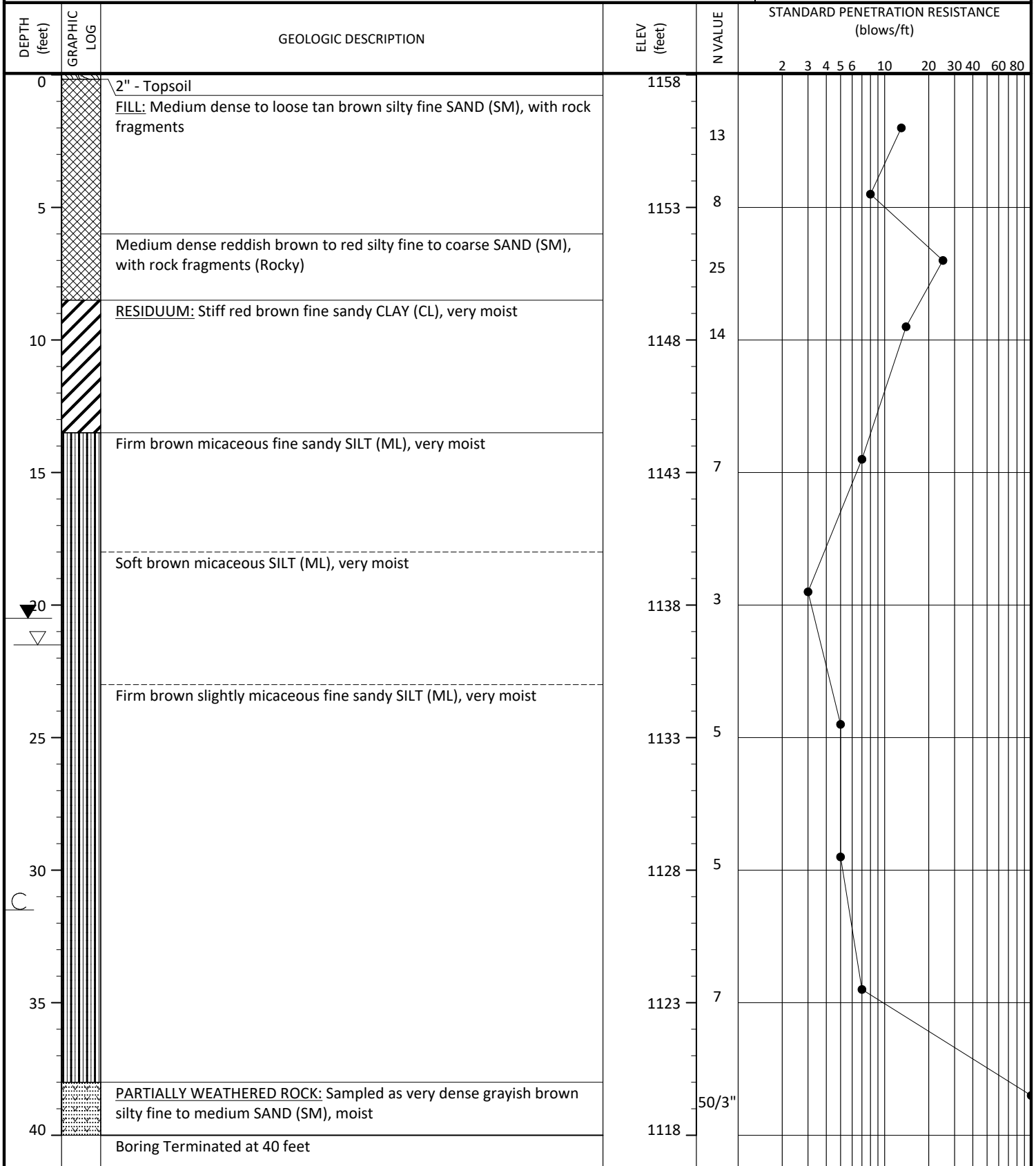
GEOLOGIST: <i>NA</i>		ELEVATION (feet): <i>1166</i>		NOTES: 1. Groundwater detected at 28 feet at the time of boring. 2. Groundwater level measured at 26 feet 24 hours after drilling. 3. Borehole caved to a depth of 32 feet.
DATE DRILLED: <i>11/11/2025</i>		BORING DEPTH (feet): <i>40</i>		
DRILLER: <i>GRINDSTONE DRILLING</i>		WATER LEVEL ∇ TOB (feet): <i>28</i> \blacktriangledown 24HR (feet): <i>26</i>		
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>				



CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-16

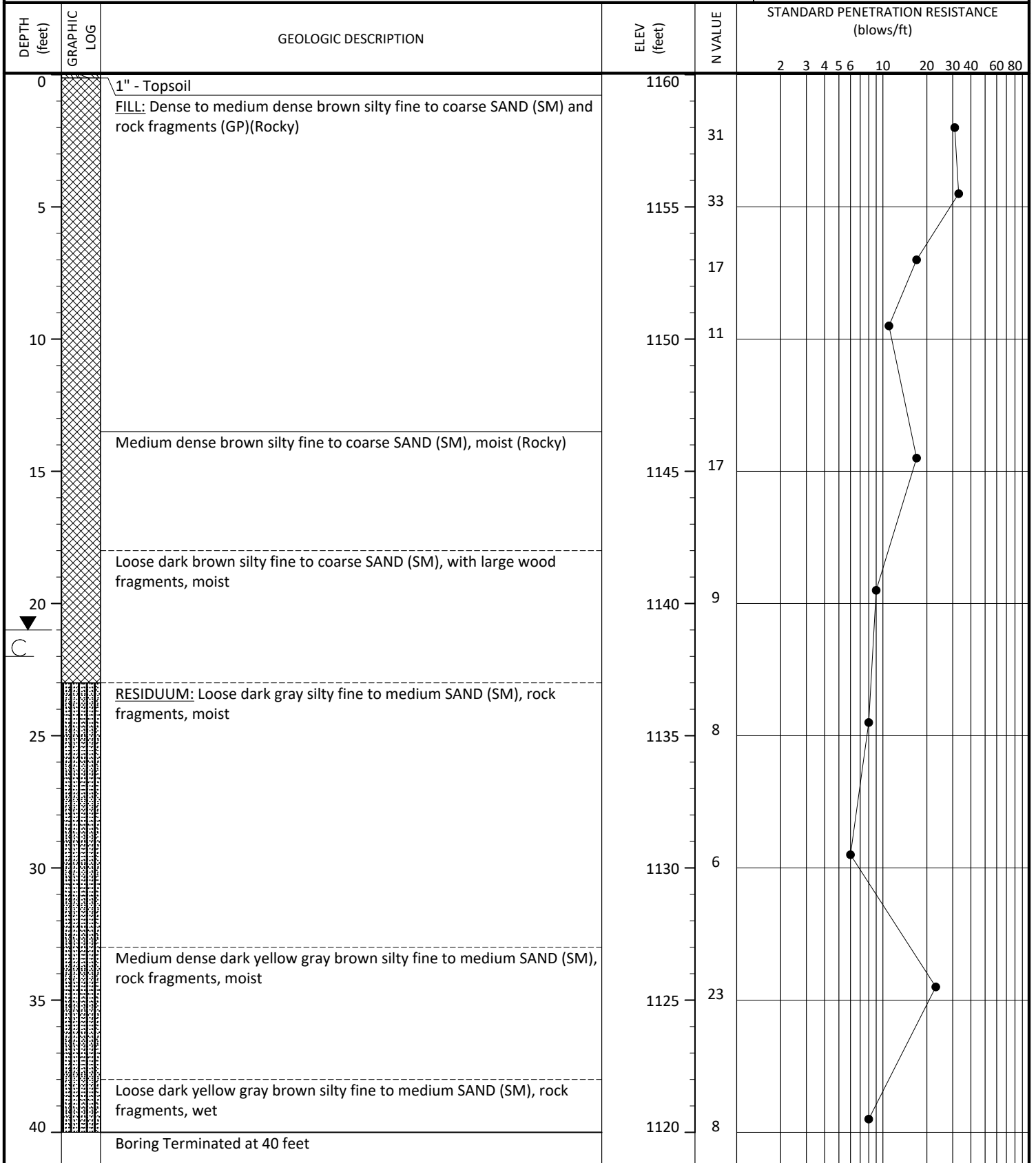
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1158</i>	NOTES: 1. Groundwater detected at 21.5 feet at the time of boring. 2. Groundwater level measured at 20.5 feet 24 hours after drilling. 3. Borehole caved to a depth of 31.5 feet.
DATE DRILLED: <i>11/11/2025</i>	BORING DEPTH (feet): <i>40</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL ∇ TOB (feet): <i>21.5</i> \blacktriangledown 24HR (feet): <i>20.5</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		



**CITY OF CUMMING, GEORGIA
PWWF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-17

GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1160</i>	NOTES: 1. No groundwater encountered at the time of boring (NGWE). 2. Stabilized groundwater level measured at 21 feet 24 hours after drilling. 3. Borehole caved to a depth of 22 feet.
DATE DRILLED: <i>11/11/2025</i>	BORING DEPTH (feet): <i>40</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL ∇ TOB (feet): <i>NGWE</i> \blacktriangledown 24HR (feet): <i>21</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		



APPENDIX C

2006 SUBSURFACE INVESTIGATION REPORT



**SUBSURFACE INVESTIGATION
REPORT**

**CITY OF CUMMING, GEORGIA
6.0-MGD WATER TREATMENT PLANT EXPANSION
CUMMING, FORSYTH COUNTY, GEORGIA**

Prepared for:

**CITY OF CUMMING, GEORGIA
C/O CIVIL ENGINEERING CONSULTANTS, INC.
1225 JOHNSON FERRY ROAD, SUITE 855
MARIETTA, GEORGIA 30068**

**GeoSystems Project No. 06-1899
November 14, 2006**

GEOSYSTEMS

ENGINEERING, INC.

November 14, 2006

City of Cumming, Georgia
c/o Nolan L. (Butch) Johnson, Jr., P.E.
Civil Engineering Consultants, Inc.
1225 Johnson Ferry Road, Suite 855
Marietta, Ga. 30068

Re: Subsurface Investigation
City of Cumming - Water Treatment Plant Expansion
Cumming, Forsyth County, Georgia
GeoSystems Project No. 06-1899

Dear Mr. Johnson:

In October 2006, GeoSystems Engineering, Inc. (GeoSystems) was contracted by the City of Cumming to provide a subsurface investigation for the planned 6.0-MGD expansion to the City's existing water treatment plant. The primary purpose of this study was to determine subsurface conditions in areas planned for the expansion and provide recommendations for foundation design and construction. The attached report describes the investigative procedures and presents the findings along with our evaluations and conclusions.

Thank you for giving us the opportunity to conduct the soil investigation for this project. We look forward to assisting you during the construction phase of the project. Please call us if we can be of any other help or if you have any questions.


Sincerely,

GeoSystems Engineering, Inc.



Phillip T. Jackson, E.I.T.
Staff Engineer

Copies Submitted: Addressee - 3



Larry D. Mullins, P.E.
Principal Engineer

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APPENDIX C: LABORATORY TEST REPORTS

EXECUTIVE SUMMARY

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized subsurface investigation for the planned 6.0-MGD Water Treatment Plant (WTP) expansion for the City of Cumming. The purpose of this study was to investigate subsurface conditions in areas planned for the expansion and provide recommendations for foundation design and construction. The following briefly summarizes the essential findings of the investigation and our recommendations:

1. The subsurface conditions encountered during this investigation include fill materials, alluvial deposits, residual soils, partially weathered rock and refusal material. Within the proposed clearwell expansion area, the borings typically encountered an upper layer of fill overlying some alluvium, residual soils, partially weathered rock and refusal material. Residual soils, partially weathered rock, and refusal material underlie the proposed package plant location. Subsurface conditions at the two alternative pump station locations consist of fill overlying either residual soils or alluvium and then residual soils. The residuum is generally typical of that found in the Piedmont Physiographic Province in which the site is located. Groundwater was encountered in all of the borings drilled in the clearwell and pump station portions of the site. Groundwater was not encountered at the time of boring at the package plant location.
2. On completion of effective site dewatering, excavation to planned grade, and stabilization of the exposed soils, the clearwell may be supported by the planned conventional shallow slab foundation bearing on the prepared subgrade. We recommend that a maximum allowable soil bearing capacity of 2,000 psf be used for design of the clearwell individual column or continuous wall footings.
3. We recommend the package plant foundations be designed to bear on the relatively strong residuum encountered in the borings for a maximum allowable soil bearing capacity of 5,000 psf. Floor or grade slabs may be soil supported subject to site preparation and earthwork recommendations contained in this report.
4. We recommend the new pump station be sited at the location of boring B-15, where shallow foundation support on the existing fill soils may be accomplished. We recommend the foundation design be based on a maximum allowable bearing capacity of 2,000 pounds per square foot for the fill soils at the location of boring B-15. Foundation support at the alternative location (B-14 and B-14A) would require either difficult dewatering and excavation and replacement of unsuitable materials, or a deep foundation system.
5. Positive groundwater control must be performed during construction in order to allow shallow support of the clearwell. If groundwater control measures are inadequate, deep foundation support may become necessary as the only means of repairing water damage to the subgrade. Even with positive dewatering, localized undercutting of water-softened soils and replacement with crushed stone will be necessary. Either vacuum well points or a deep well system are expected to be required to adequately lower and maintain the groundwater at required levels until construction is complete. Temporary observation wells should be installed at the site to confirm groundwater levels prior to excavation and to monitor drawdown at the location of the adjacent 2.0-MG clearwell. The contractor should be responsible for design of the dewatering system,

considering the effect of groundwater lowering on the adjacent 2.0-MG clearwell. It is likely that settlement of the existing structure will occur as a result of the mass dewatering required for the new clearwell. Groundwater recharge and/or positive cutoff measures may be necessary to avoid lowering the groundwater underneath the existing clearwell.

6. Within the new clearwell area, partially weathered rock was encountered near the planned excavation level at the locations of borings B-1 and B-2. At the package plant location, layers of partially weathered rock were found within the residual soil stratum at depths of 3 feet in boring B-11 and 8 feet in B-12. Very dense or very hard soils were also encountered at various depths in a majority of the package plant borings. Based upon this information, we expect that some difficult excavation techniques during foundation and/or utility construction within the package plant area and possibly during mass site grading operations for the clearwell may be required for the removal of partially weathered rock, very dense or very hard soils, or possibly rock that could occur between our boring locations.

These and supplementary recommendations relative to pavements, retaining walls, slopes, site preparation, and foundation construction are discussed in detail in the following report. This summary should not be used as a separate document or in lieu of the entire report, including the appendices.

INTRODUCTION

Background

GeoSystems Engineering, Inc. (GeoSystems) was contracted by the City of Cumming in October 2006 to provide a subsurface investigation for the planned 6.0-MGD expansion to the City's existing water treatment plant. Civil Engineering Consultants, Inc. (CEC) of Marietta, Georgia provided site plans and design information required for the investigation.

The existing water treatment plant is located on Dahlonega Road/Georgia Highway 9, about 2 miles north of downtown Cumming. The site is just north of Sawnee Drive at Sawnee Creek. The planned expansion will include a 6.0-MGD package plant with a backwash clearwell, a 3.0-MG clearwell, and a new pump station. The planned expansion areas are situated respectively in existing ball fields located at the southwest corner of the plant, in a filled area generally west of the existing 2.0-MG clearwell, and at the existing sludge lagoons located on the eastern side of Dahlonega Road.

Purpose

The purpose of the study was to investigate subsurface conditions in the areas planned for the expansion and to provide recommendations for the foundation design and construction.

Scope of Work

The scope of work for the geotechnical exploration consisted of visual reconnaissances of the site, sixteen soil test borings, collection of soil samples, field and laboratory soil permeability testing, laboratory soil classification analyses, evaluation of the field and laboratory data, and preparation of this report.

Authorization

Formal written authorization for the investigation was provided by Mr. Jonathon W. Heard, Director of Utilities, on October 5, 2006. At that time, Mr. Heard signed our standard "Agreement for Limited Professional Services" contract form on behalf of the City.

METHODOLOGY

Subsurface conditions at the site were investigated by drilling sixteen soil test borings (B-1 through B-15 and B-14A) at the approximate locations shown on the enclosed boring location plans (Figure 1 through Figure 3). The boring location plans were produced from an electronic copy of the topographic site plan that CEC provided to us. GeoSystems personnel established the boring locations in the field by measuring distances and estimating right angles from existing site features. Boring elevations in the package plant and the pump station areas were estimated to the nearest 1.0 foot by interpolating between contours shown on the provided site plan. Elevations of the borings in the new clearwell area were determined to the nearest 1 foot by an approximate engineering level survey. These elevations were referenced to a datum of 1144.5 feet for the pump pad located on the

southeastern edge of the existing 2.0-MG clearwell. Since our measurements were not precise, the referenced boring locations and elevations should be considered approximate.

The soil test borings were advanced, utilizing continuous flight hollow-stem augers, to termination or refusal depths varying approximately from 13 to 63 feet below the existing ground surface. Standard penetration testing and split-barrel sampling of the soils were conducted in the borings at regular intervals to evaluate relative density or consistency of the soils and obtain samples for classification. One undisturbed Shelby-tube sample was also recovered from each boring B-4 and B-5 to obtain representative samples for laboratory classification and hydraulic conductivity (permeability) testing.

Temporary piezometers (observation wells) were constructed at the locations of borings B-4 and B-5 to obtain stabilized groundwater levels and allow field permeability (slug) testing. The wells were constructed of 2-inch diameter solid PVC riser pipe with a 10-foot screened section at each location. The annular space around the screen was backfilled to 2 feet above the top of the screen with a clean, well-graded sand filter pack. A 2-foot bentonite clay seal was placed on top of the sand filter pack. The annulus around the riser pipe was filled to the ground surface with the soil cuttings from the borehole. Field permeability tests were performed in each well on November 3, 2006. These were rising head seepage tests performed by bailing water from the wells. The rate of rise of water in each well was recorded over time, and the soil permeability (horizontal) was calculated from the data in accordance with NAVFAC Design Manual (DM-7.01), 1987.

The split-barrel samples from the borings were classified in the field and preliminary boring records were prepared by the driller. In the laboratory, each sample was examined by a geotechnical engineer, and final detailed logs of the borings were prepared showing visual soil descriptions and unified classifications, standard penetration values, and groundwater levels (if encountered). In addition, laboratory grain size analyses and saturated hydraulic conductivity tests were conducted on representative split-barrel samples collected from boring B-1 and the Shelby-tube samples collected from borings B-4 and B-5. The laboratory soil grain size distribution analyses consisted of four tests in accordance with procedures described by ASTM D 422 for gradation, which refers to the grain size distribution in a soil plotted as a function of the percent by weight passing a given sieve size. Saturated hydraulic conductivity (vertical) testing consisted of flexible-wall permeability tests on relatively undisturbed soil samples extruded from the Shelby tubes.

Brief descriptions of the field and laboratory procedures are presented in Appendix A. The boring location plans and the soil test boring logs are included in Appendix B. Laboratory test data are attached in Appendix C.

SITE CONDITIONS

Clearwell

As noted previously, the new 3.0-MG clearwell will be located in a previously filled area to the west of the existing 2.0-MG clearwell. This location is currently undeveloped and overgrown with high grasses, weeds and pine seedlings/saplings. Site topography varies from nearly level to moderately sloping down to the east and south. Indicated relief from our level survey data is about 20 feet,

varying from a high elevation near 1162 feet over the western three-fourths of the clearwell footprint to a low elevation of 1142 at the southeast corner. The topography shown on the provided site plan appears to be in error in this area, as the higher portions of the footprint are indicated to be at elevations 1172 to 1177.

Package Plant

The planned package plant location is in an area currently occupied by the northernmost of four baseball fields. This area is at the southwest corner of the existing WTP. Within the package plant area, site topography is nearly level to very gently sloping down to the north. Indicated elevations are 1206 to 1204 feet. Ground cover is a sparse cover of grass and weeds with large areas of bare earth. A chain link fence surrounds most of the field.

Pump Station

There are two alternate locations being considered for the proposed pump station. Both locations are situated in the existing sludge lagoon area, on the east side of Dahlonge Road. One site is in the western end of Lagoon 1, which was in the process of being filled-in with dry settled solids waste from the existing plant at the time of the field investigation. The second site is at the eastern end of lagoon 1 on the grassed containment dike. The ground surface elevation at both pump station locations appears to be about 1145 feet.

AREA AND SITE GEOLOGY

The Cumming WTP is located within the northern Piedmont Physiographic Province, an area underlain by ancient igneous and metamorphic rocks of Paleozoic age. Published geologic mapping indicates that the site is underlain by metamorphic rocks of the Powers Ferry formation which includes undifferentiated biotite-quartz-plagioclase gneiss (metagraywacke), mica schist, and amphibolite.

The origin of the Paleozoic rocks, as sediments, has been obscured, due to their age and repeated cycles of weathering, metamorphism, folding, faulting, and injection with younger Paleozoic granites and Triassic diabase dikes. All of these rocks have weathered in place and are covered by a mantle of residual soils of varying thickness. Residual soils are formed insitu by chemical alteration of the underlying rocks. Normally, the weathering is most advanced near the ground surface and decreases with depth until unweathered parent rock is encountered. A transition from clay to silt to silty sand to partially weathered rock to hard rock is typical; however, this order of weathering is not always present. It is not uncommon to find layers or zones of partially weathered rock (PWR) or relatively unaltered rock within the soil mantle or weathered rock layers within the underlying parent rock mass. The naturally developed soil profile may be changed by erosion and/or man's grading activities, so that the upper more weathered zones may be completely stripped away. Also, residual soils may be covered by washed-in alluvial soils or manmade fill, or both.

The deeper residual materials retain the relict structure of the original rock. Partially weathered rock materials have the appearance of sands in which the sand grains are individual mineral crystals that occupy the same positions as in the unaltered rock. Individual crystal breakdown occurs with further

weathering and sandy silts or silty sands are formed. The original structures within the parent rock are preserved in these soils; however, the crystalline structure is altered or destroyed. Residual soils characterized by preservation of relict structures that were present in the unweathered rock are termed saprolites.

Groundwater in the Piedmont generally occurs under water table conditions as a result of infiltration of surface waters through the somewhat permeable overburden. Fractures and other discontinuities in the underlying rock can affect groundwater conditions. In this geologic setting, the configuration of the groundwater table is generally expected to be a slightly subdued replica of the ground surface. Localized groundwater flow roughly follows the flow of surface water. Although hydraulically connected to the water table aquifer, groundwater at depth in the rock is found in water-bearing fractures.

SUBSURFACE CONDITIONS

Clearwell

Within the proposed clearwell expansion area, the borings typically encountered an upper layer of fill overlying some alluvium, residual soils, partially weathered rock and refusal materials. Fill is any material that has been placed by man. Alluvium is material that has been transported and deposited by flowing water. Residual is a term used to define soils formed in-place by the chemical weathering process of the underlying rocks. Residual material that can be penetrated by power augers and exhibits standard penetration resistances of at least 100 blows per foot is termed partially weathered rock. Refusal is a designation applied to any material which cannot be further penetrated by the soil drilling process, and is normally indicative of a very hard or very dense material, such as boulders, rock lenses, or the upper surface of bedrock.

Fill was encountered at all boring locations from the ground surface to depths ranging approximately from a minimum of 6 feet in boring B-8 to a maximum of 26 feet in B-6. The fill was sampled generally as silty sand (SM) and sandy or clayey silt (ML-MH) with some clay (CL-CH) layers. Scattered throughout the fill are various quantities of gravel, rocks, wood and other organic matter at random depths and locations. Relative density or consistency of the fill soils varies appreciably as indicated by standard penetration resistances ranging from a minimum of 2 blows per foot (bpf) to 20 bpf. A 2.5 to 5-foot layer of alluvium or possible alluvial soils underlies 6 to 8.5 feet of fill at the locations of borings B-8 and B-3, respectively. The alluvium was sampled as firm gray silty clay (CL) in boring B-3.

Below the fill and alluvium layers, a relatively thick stratum of residual soils was encountered in the borings. The residual soils extend to the top of partially weathered rock at depths of 36 to 41 feet in borings B-1, B-2, B-3, and B-8. At the remaining locations, the residual soil stratum extended to boring termination or refusal depths varying from 50 to 63 feet below ground. The residual soils were visually classified as either micaceous silty sands (SM) or micaceous sandy silts (ML). The laboratory grain size analyses show the residual soil classification is predominantly silty sand (SM) with approximately 64 to 70 percent sand content. Relative density of the sandy residuum was typically loose to medium dense, but varied from very loose to dense. Consistency of the silts was

generally firm to stiff, but varied from soft to very stiff. Standard penetration resistances in these soils ranged from a minimum of 2 to a maximum of 32 bpf.

Saturated hydraulic conductivity of the residual soils was measured vertically by the laboratory tests on undisturbed samples and horizontally by the field seepage tests conducted in the observation wells. The laboratory tests were conducted on sections of undisturbed samples recovered from a depth interval of 42 to 44 feet below ground. Average permeability of a section of soil from 40 to 50 in depth (approximate) was measured in the wells. The test results are as follows:

LOCATION	METHOD	DEPTH (feet)	PERMEABILITY (K_v) (cm/sec)	PERMEABILITY (K_h) (cm/sec)
B-4	Laboratory	42 - 44	5.6E-05	
B-4	Field	40 - 50		1.34E-04
B-5	Laboratory	42 - 44	2.8E-05	
B-5	Field	40 - 50		1.88E-04

At the locations of borings B-1, B-2, B-3, and B-8, 4 to 16 feet of continuous partially weathered rock was encountered in advance of auger refusal. The partially weathered rock materials were sampled as either very dense silty sand (SM) or very hard sandy silt (ML). Auger refusal materials were also encountered in borings B-4 and B-6 below the residual soil strata. Refusal depths in the borings varied approximately from 42 to 63 feet below the ground surface. Refusal encountered in the borings appears to be the top of bedrock within the clearwell location. However, rock coring procedures, which were beyond the scope of this investigation, would be required to determine the actual character and continuity of the refusal materials.

Stabilized groundwater levels were measured in borings B-1, B-4, B-5, B-6, and B-7 at a depth of approximately 23 feet below the existing ground surface. Time of boring groundwater levels were detected in the remaining borings at depths varying approximately from 5 to 25 feet below ground. In general, the groundwater level measurements correlate to a water table elevation in the range of 137 to 1140 feet. Groundwater levels are subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than those reported during this study.

Package Plant

The borings show that residual soils, partially weathered rock, and refusal materials underlie the proposed package plant location. These soils, described mainly as medium dense to very dense silty sand (SM) and very stiff to very hard sandy silt (ML), were encountered at or near the ground surface at all boring locations. Within the residual soils, standard penetration resistances varied from a minimum of 15 to a maximum of 69 bpf. Except at the location of B-11, the residual soil stratum continued to boring termination depths of 15 and 25 feet. Continuous partially weathered rock was encountered in boring B-11 from below the residual soils at a depth of 31 feet to auger refusal at 37 feet. Layers of PWR were also penetrated within the residual soil stratum from 3 to 11 feet in B-11 and from 8 to 11 feet in boring B-12. Refusal, which appears to be the upper surface of bedrock, occurred only at the location of boring B-11.

No groundwater was encountered in any of the package plant borings at the time of our field investigation. Again, we note that groundwater conditions at other locations or at other times may be different than those reported during this study.

Pump Station

Subsurface conditions at the two alternative pump station locations consist of fill overlying either residual soils or alluvium and then residual soils. An upper layer of fill was initially encountered to depths varying approximately from 13 feet at the location of boring B-14A to 6 feet at B-15. Boring B-14 encountered fill materials to auger refusal at a depth of 13 feet. At the location of borings B-14 and B-14A, the fill appears to be settled solids waste from the plant overlying wood debris. Refusal in boring B-14 appeared to be a tree trunk or stump. The settled solids waste, classified as soft clayey silt (MH), is currently being used to backfill the old lagoons. The fill in boring B-15, described as loose silty sand (SM), is associated with material previously placed during construction of the lagoon dike. Penetration resistances in the fill were 1 and 2 bpf in the settled solids waste and 7 and 9 bpf in the dike soils.

Below the fill in boring B-15, an approximate 10-foot layer of alluvium was encountered. The upper 5 feet of alluvium appears to be a soft sandy silt (ML). The lower 5 feet was described as a medium dense clayey sand (SC) with organic matter. Standard penetration resistances in these soils were 3 and 4 bpf in the silt and 15 bpf in the sand.

Residual soils were encountered below the fill in boring B-14A and below the alluvium in B-15. The residuum consisted of a dense silty sand (SM) that extended to boring termination depths of 15 and 20 feet, respectively. Standard penetration resistances in the residual soils were 39 and 28 bpf.

Groundwater levels at the time of boring were at depths of 4 feet in borings B-14 and B-14A and 9 feet in boring B-15.

PROJECT INFORMATION

Our understanding of this project is based on previous discussions with Mr. Butch Johnson and Mr. To Nguyen of Civil Engineering Consultants, review of the provided topographic site layout plan, and our field observations of the expansion areas. The expansion will include a 3.0-MG clearwell, a 6.0-MGD package plant with a backwash clearwell, and a pump station.

The new 3.0-MG clearwell will be located in the northwest corner of the site, immediately west of the existing 2.0-MG clearwell. We understand the new clearwell will be a rectangular, 142-foot by 296-foot, reinforced concrete structure. The top of the clearwell will be at elevation 1144.5 and the bottom slab at 1130.0 feet. Plans are to use an 18-inch thick bottom slab underlain by 3 feet of Class "C" concrete. The completed structure will be buried under 3 to 4 feet of soil backfill. Structural loading conditions have not been provided for the clearwell; however, the design indicates a foundation contact pressure for the base slab on the order of 1,500 to 2,000 psf. Significantly higher loads under the exterior walls and interior columns are expected. Based upon existing grades from

our field survey, cuts varying approximately from a maximum of 37 to a minimum of 17 feet are indicated to be required to achieve the planned clearwell bottom elevation.

The new package plant will be located in the baseball field area, southwest of the existing WTP plant. The plant building will be a rectangular, 83-foot by 136-foot, one-story metal structure with a soil supported (slab-on-grade) floor slab. A 28-foot square backwash clearwell will be located outside the northeast corner and a 10,000-gallon lime storage tank outside the southwest corner. Three treatment tanks, each 15 feet wide by 48 feet long by 10 feet high and weighing 456 kips, will be located in the plant building. These will be supported on approximately 24-inch thick slabs at the finish floor elevation. The planned finish floor elevation is 1206.0 feet, roughly zero to 2 feet above the indicated existing site grades. The bottom of the backwash clearwell will be at elevation 1189.5, which will require an excavation of about 15 or 16 feet.

Foundation loading conditions for the new building are expected to be light, not exceeding 100 kips for individual footings and 2 to 3 kips per linear foot for walls. Floor loading underneath the treatment tanks will be on the order of 600 to 700 psf.

Two alternate locations for the new pump station are being considered in the existing sludge lagoon area, on the eastern side of Highway 9. The station will generally be a relatively light slab-on-grade structure containing three pumps. The slab will be placed near the existing site grade.

DESIGN RECOMMENDATIONS

Seismic Design Criteria

The International Building Code (IBC) includes provisions for categorizing the upper 100 feet of the subsurface profile for use in evaluating potential seismic forces resulting from an earthquake. Although subsurface conditions to a depth of 100 feet were not investigated at this site, the available subsurface information and our previous experience indicate the average standard penetration resistance to this depth would generally be in the range of 15 to 50 blows per foot. Based on this information and the IBC definitions (Table 1615.1.1), the site is categorized as Site Class D (stiff soil profile).

Foundations/Floor Slab Support

In general, the undisturbed residual materials encountered in the planned clearwell and package plant locations should provide adequate long-term foundation support for the range of structural loads anticipated. Subject to recommendations in this report, the proposed clearwell and package plant structures may, therefore, be designed for conventional shallow slab-on-grade foundations, continuous footings or individual column footings bearing in existing undisturbed residual soils or partially weathered rock. Available bearing capacities in the residuum vary considerably from a low of about 2,000 psf in the weak soils found in the clearwell location to a high of 10 ksf or more in the partially weathered rock materials found in both the clearwell and package plant areas.

We recommend the new pump station be sited at the location of boring B-15, where shallow foundation support on the existing fill soils may be accomplished. Foundation support at the

alternative location (B-14 and B-14A) would require either difficult dewatering and excavation and replacement of unsuitable materials, or a deep foundation system.

Clearwell. Foundation support of the clearwell will be influenced by construction below the water table and areas of relatively weak residual soils at the planned foundation bearing level. The micaceous silts and sands encountered at the clearwell location are extremely sensitive to moisture and are subject to “quick” soil conditions or loss of strength in excavations below the water table. Therefore, positive groundwater control, as subsequently discussed in this report, must be performed during construction in order to allow shallow support of the clearwell. If the groundwater control measures are inadequate, deep foundation support may become necessary as the only means of repairing water damage to the subgrade. Even with positive dewatering, localized undercutting of water softened soils and replacement with crushed stone will be necessary.

On completion of effective site dewatering, excavation to planned grade, and stabilization of the exposed soils, the clearwell may be supported by the planned conventional shallow slab foundation bearing on the prepared subgrade. We recommend that a maximum allowable soil bearing capacity of 2,000 psf be used for design of the clearwell individual column or continuous wall footings.

Package Plant. Based on the relatively strong residuum encountered in the borings, we recommend the package plant foundations be designed for a maximum allowable soil bearing capacity of 5,000 psf for static loading conditions. Minimum widths of 24 inches for any individual column footings and 18 inches for continuous wall footings should be used for practical construction considerations and to reduce the possibility of localized foundation shear failures. Exterior footings should be placed at least 12 inches below final exterior grades to assure that foundations bear below the possible frost penetration depth.

Floor or grade slabs may be soil supported subject to site preparation and earthwork recommendations contained in this report. Building grade slabs should be jointed around columns and along footing-supported walls to minimize cracking due to possible differential movements. As an alternative to flat grade slabs and conventional spread footings, monolithic turned-down slabs-on-grade may be used. Turned-down slabs should be thickened underneath columns and load bearing walls and have adequate reinforcement in order to minimize cracking between the thickened and flat portions of the slab.

Pump Station. Based upon the boring data, we conclude that the expected light foundation load imposed by the planned pump station foundation slab can be supported on the existing fill soils at the location of boring B-15. We recommend the foundation design be based on a maximum allowable soil bearing capacity of 2,000 pounds per square foot for the existing fill conditions. The slab should bear at least 12 inches below finish grade. Shallow foundation support of the pump station slab is subject to the subsequent construction recommendations in this report.

Retaining/Below Grade Walls

Earth pressures on walls below grade are influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as free-standing walls, where some movement and rotation may occur to mobilize soil shear strength. Walls that are rigidly restrained, such as basement, pit and tunnel walls, should be designed for the at-rest condition. A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Since significant wall movements are required to develop the passive pressure, the total calculated passive pressure should be reduced by one-half to two-thirds for design purposes.

Based on previous experience with similar soils and construction, we recommend the following earth pressure coefficients and equivalent fluid pressures for design of retaining or below grade walls:

EARTH PRESSURE CONDITIONS	COEFFICIENT	RECOMMENDED EQUIVALENT FLUID PRESSURE (PCF)
Active (K_A)	0.33	40
At-Rest (K_O)	0.50	60
Passive (K_p)	3.00	---

A moist soil unit weight of 120 pounds per cubic foot should be used for design calculations. Our recommendations assume that the finish ground surface outside the walls will be level and that silty sand or other granular backfill will be utilized. A surcharge should be added to the earth pressure if the ground surface slopes up from the top of the wall. To calculate resistance to sliding, a value of 0.35 (includes a factor of safety of 1.5) should be used as the coefficient of friction between wall foundations and the underlying soil.

The recommended equivalent fluid pressures assume that constantly functioning drainage systems are installed between walls and soil backfill to prevent the accidental buildup of hydrostatic pressures and lateral stresses in excess of those stated. If a functioning drainage system is not installed, then lateral earth pressures should be determined using the buoyant weight of the soil (57.6 pcf). Hydrostatic pressures calculated with the unit weight of water (62.4 pcf) should be added to these earth pressures to obtain the total stresses for design.

Tractors and other heavy equipment should not operate within 10 feet of below grade walls to prevent lateral pressures in excess of those cited. If footings or other surcharge loadings are located a short distance outside below grade walls, they may also exert appreciable additional lateral pressures. If an imaginary line projected downward at a 45-degree angle from the bottom near edge of the surcharge load does not intersect the wall, the effect of the load on the wall may be neglected.

Whenever this line intersects the wall, the effect of the surcharge loads should be added to the recommended earth pressures to determine total lateral stresses. Foundation bearing levels may also be lowered to eliminate increased stresses on adjacent retaining walls.

Pavements

Strength testing of subgrades was not performed during this study; however, local experience with similar soils indicate typical CBR values in the range of 3 to 5. Based on these subgrade strength values and AASTHO design guidelines, we recommend the following minimum flexible asphalt pavement alternatives:

1. For parking lots and drives restricted to automobile traffic, a light-duty section consisting of 6 inches of crushed stone base course overlain by 2 inches of asphaltic surface course.
2. For parking lots and drives subject to both automobile and occasional truck traffic, a heavy-duty section consisting of 8 inches of crushed stone base course overlain by 1.5 inches of asphaltic binder course and 1.5 inches of asphaltic surface course.

The recommended pavement design sections are subject to successful completion of the site and subgrade preparation and fill placement operations as recommended in this report. We note that the compaction quality and gradation of the crushed stone base will directly affect the quality and life of the flexible pavement section. Consequently, we recommend a minimum compaction of 100 percent of the maximum dry density for the crushed stone material as determined by the modified Proctor compaction test (ASTM D-1557, Method D). A qualified soils engineering technician working under the direction of a geotechnical engineer should observe placement and compaction of the base coarse material and perform field density tests to confirm that the material has been placed in accordance with our recommendations. The crushed stone aggregate utilized in the base should conform with section 815 of the State of Georgia, Department of Transportation Standard Specifications for Road and Bridge Construction. In addition, all pavement materials and paving operations should meet applicable specifications of the Georgia Department of Transportation.

Slope Stability

Our exploration did not include a detailed analysis of slope stability for any temporary or permanent condition. However, within building, pavement and landscaped areas, we recommend temporary slopes no steeper than 1.5(H):1.0(V), and permanent slopes no steeper than 2.0(H):1.0(V) for construction in undisturbed residual soils or structural fill placed in accordance with our recommendations. A minimum setback from the top of all slopes of 10 feet is recommended for structures and 5 feet for pavements.

CONSTRUCTION RECOMMENDATIONS

Site Preparation

Prior to proceeding with construction operations, all vegetation, root systems, topsoil, and other deleterious non-soil materials should be stripped from the proposed construction areas. Clean topsoil

may be stockpiled and used to top dress slopes and other disturbed areas prior to permanent seeding and or stabilization. On completion of the stripping and rough grading, the areas intended to support floor slabs or pavements, new fill, and foundations should be carefully inspected by a qualified geotechnical engineer. Except for the new clearwell and pump station locations, engineering inspection should include observation of proofrolling of the subgrade utilizing a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proofrolling is to locate any soft, weak, or excessively wet soils which may be present at the time of construction. If unstable or unsuitable soils are found, some stabilization measures and/or undercutting and replacement with structural fill will likely be required in order to provide adequate subgrade and foundation support conditions.

Groundwater Control

As noted previously, no groundwater was detected in the borings drilled within the package plant location at the site. In the clearwell and pump station areas, groundwater was observed at all of the boring locations at depths varying approximately from 4 to 25 feet below ground. In general, the groundwater levels correlate to water table elevations ranging approximately from 1137 to 1140 feet within the clearwell and 1136 to 1141 at the two alternate pump station sites.

Construction Dewatering. Based on the indicated groundwater levels, temporary dewatering will be required at the clearwell location prior to excavation. Dewatering will be necessary in order to stabilize the excavation, achieve suitable working conditions, and prevent the loss of soil strength or “quick” soil conditions.

Groundwater control at this location will require a positive system of dewatering such as vacuum well points or a deep well system to adequately lower and maintain the groundwater at required levels until construction is complete. The dewatering system should be monitored and maintained around the clock to assure proper continuous operation and control. The system must also be supplemented with standby equipment to provide emergency dewatering in the event of failure of the primary method of groundwater control. Temporary observation wells must be installed at the site to confirm groundwater levels prior to excavation and monitor drawdown at the location of the adjacent 2.0-MG clearwell. To prevent possible costly construction delays, the required dewatering must be conducted well in advance of the excavation in order to lower and maintain groundwater levels at least 5 feet below the deepest excavation level at all times.

The dewatering system should be designed by the contractor, considering the effect of groundwater lowering on the adjacent 2.0-MG clearwell. It is likely that settlement of the existing clearwell will occur as a result of the mass dewatering required for the new clearwell. Groundwater recharge and/or positive cutoff measures may be necessary between the planned excavation and the existing clearwell to avoid lowering the groundwater underneath the structure. Water levels in observation wells adjacent to the existing clearwell and settlement of the structure should be monitored during construction to evaluate the effects of the dewatering and warn of possible distress to the structure.

Once the groundwater has been lowered to about elevation 1118 or lower, mass excavation of the new clearwell area may proceed. We recommend the mass excavation extend no deeper than 2 feet above the design subgrade elevation of 1125.5. Final excavation and stabilization of the subgrade

should then be performed in small, controlled areas. As small sections of the subgrade are exposed, each area should be inspected by the geotechnical engineer and then immediately protected by backfilling with a layer of crushed stone. Even with successful dewatering, we expect it will be necessary to undercut at least 2 feet of the subgrade soils and replace them with crushed stone. Equipment traffic on the prepared subgrade should be prohibited prior to placement of the Class C concrete.

Permanent Underdrains/Hydrostatic Pressure Relief. Structures constructed below the water table are subject to hydrostatic pressures, and provisions must be included in the design to protect grade slabs and below grade walls from the build-up of excessive uplift and lateral water pressures. Measures must also be included to reduce the likelihood of water seepage into structures, except when necessary to balance any excessive buoyant forces. Structures may be designed to either structurally resist any unbalanced water pressures or permanent underdrain systems and foundation drains must be provided. Pressure relief valves may also be installed within structures to prevent excessive buoyant pressures from occurring.

We understand that the new clearwell will be designed to provide sufficient uplift resistance by anchoring to the 3-foot thick concrete slab under the floor and by backfilling over the top. At the package plant location, a subdrainage system below the floor slab is not required. However, we recommend that a 4-inch layer of clean crushed stone or gravel covered with an impermeable membrane be placed beneath the building slab to provide a vapor barrier.

Difficult Excavation

Within the new clearwell area, partially weathered rock was encountered near the planned excavation level at the locations of borings B-1 and B-2. At the package plant location, layers of partially weathered rock were found within the residual soil stratum at depths of 3 feet in boring B-11 and 8 feet in B-12. Very dense or very hard soils were also encountered at various depths in a majority of the package plant borings. Based upon this information, we expect that some difficult excavation techniques during foundation and/or utility construction within the package plant area and possibly during mass site grading operations for the clearwell may be required for the removal of partially weathered rock, very dense or very hard soils, or possibly rock that could occur between our boring locations.

In mass excavations for general sitework, very hard or very dense soils and weathered rock can usually be removed by ripping with a single-tooth ripper attached to a large crawler tractor or by breaking the material out with a large front-end loader. In confined excavations, such as foundations and utility trenches, removal of weathered rock typically requires use of large backhoes, pneumatic spades, or light blasting. Refusal materials (apparent rock) usually require blasting for removal in both mass and confined excavations. Any blasting within structure subgrade areas or in footing excavations must be done carefully to prevent damage to the bearing materials.

The definition of rock can be a source of conflict during construction. The following definitions have been incorporated into specifications on other projects and are provided for your general guidance:

1. General Excavation

- Rip Rock - Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.
- Blast Rock - Any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or by a Caterpillar 977 front-end loader or equivalent; and occupying an original volume of at least one (1) cubic yard.

2. Trench/Foundation Excavation

- Blast Rock - Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 33,000 pounds and a stick crowd of not less than 29,000 pounds (Caterpillar 325 or equivalent), and occupying an original volume of at least one-half ($\frac{1}{2}$) cubic yard.

Earthwork

Based upon our qualitative evaluation of the subsurface conditions at the site and previous experience with similar soils, we expect the majority of the native soils and clean fill soils from the clearwell area will be suitable for use as structural fill. Soils from near or below the water table, are expected to be excessively wet and would require spreading and drying prior to fill placement. Typically, the wet soils are considered to be unsuitable for reuse. All structural fill should have a plasticity index (PI) less than 30 and be clean soil free of deleterious materials and rocks larger than 3 inches in diameter. The maximum dry density of structural fill soils should be at least 90 pcf, in order to provide adequate strength. All fill materials should be evaluated by the geotechnical engineer, and soil classification and compaction characteristics (moisture-density relationships) should be determined in the laboratory in advance of the earthwork.

General site structural fill required to achieve site grades underneath pavements, buildings, and treatment structures, or to replace undercut areas should be placed in maximum 6 to 8-inch lifts, loose measure, and compacted to at least 95 percent of the maximum dry density as determined by the standard Proctor compaction test (ASTM D-698). Backfill in trenches or other confined spaces, where light portable compaction equipment is required, should be placed in maximum lift thicknesses of 3 to 4 inches, loose measure. In landscaped areas, where no structures are planned or anticipated in the future, the compaction criteria may be reduced to 90 percent of the standard Proctor maximum dry density. We note that moisture control is important with the native soils typical of this area in order to achieve adequate compaction, and equipment should be available on site during construction for both wetting and drying proposed fill soils. Except for soils excavated from below the water table, we do not anticipate significant problems in controlling moisture contents during dry weather; however, during winter months or during extended wet periods, moisture control problems will likely occur.

During fill placement, a sufficient number of field density tests should be conducted by a qualified soils technician working under the direction of a geotechnical engineer to determine the degree of compaction and compliance with the project specifications. We recommend at least one density test be conducted per 2,500 - 5,000 square feet of fill area for each 2-foot interval of compacted soil. Any areas that do not comply with the compaction requirements during the earthwork construction should be recompacted until compliance is met.

Inspection

We recommend that all base slab subgrades and foundation excavations be evaluated by a qualified geotechnical engineer to confirm that conditions are similar to those encountered in the borings and that the bearing soils are capable of supporting the design contact pressures. Foundation excavations should be free of all soft or loose soil, mud, disturbed materials, and other deleterious materials prior to placement of concrete. In addition, concrete should not be placed on a frozen subgrade. Any foundation bearing surfaces that have been disturbed due to construction activities or exposure to precipitation or run-off must be repaired prior to placement of concrete. We recommend that foundation excavations and slab subgrades be concreted as soon as practical after they are excavated and that water not be allowed to pond or infiltrate the bearing surface. If it is necessary to leave the excavations open for an extended period of time, we recommend that a thin mat of lean concrete be placed over the bottom for protection.

QUALIFICATION OF RECOMMENDATIONS

This report has been prepared for the exclusive use of the City of Cumming and Civil Engineering Consultants, Inc. for design and construction of the proposed 6-MGD WTP expansion. Conclusions and recommendations in this report were based on the site and subsurface information obtained and our understanding of the planned site development. The exploratory activities, testing procedures, and evaluation of the data were consistent with those normally used in geotechnical engineering practice for projects of this type. We have made recommendations based on our experience with similar subsurface conditions under similar loading conditions. Allowable soil bearing capacity was estimated from previous correlations of standard penetration resistances and bearing capacities of comparable soils. Should the project plans change substantially from those outlined in this report, we request the opportunity to review our recommendations in light of the changes. If conditions differing from those anticipated are encountered during construction, GeoSystems should review the changed conditions to formulate any required modifications to the recommendations presented herein.

APPENDIX A
FIELD AND LABORATORY PROCEDURES

GEOSYSTEMS ENGINEERING

STANDARD FIELD AND LABORATORY TESTING PROCEDURES

Soil Test Boring

Soil sampling and penetration testing are performed in general accordance with ASTM Designation D 1586. Borings are usually advanced either by mechanically twisting continuous steel hollow-stem auger flights into the ground or by wash boring using roller cone or Hawthorne bits. At regular intervals, soil samples are obtained with a standard 1.4-inch I.D., 2-inch O.D., split-spoon sampler. The sampler is first seated 6 inches into the bottom of the hole to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to achieve the final foot of penetration is recorded and is designated the "standard penetration resistance." Penetration resistance, when properly evaluated, is an index to the soil strength, density and ability to support foundations.

Groundwater levels are normally determined by the driller in conjunction with the field investigation and are noted on the drilling records. These levels indicate the approximate location of the hydrostatic water table at the time of observation. Generally, water levels are reported at the time of boring and at subsequent times. The time of boring water level is detected as the drilling tools are advanced by changes in the drilling rate, soil sample moisture conditions, water or mud on the drill rods, and moisture conditions of the borehole drill cuttings. Additional groundwater levels are typically obtained at various times after boring to minimize any disruption by the drilling operations and to allow the water table to stabilize. Normally, a time lag of at least 24 hours is required to permit stabilization of the water table. A longer time period may be required in low permeability (clayey) soils. Water table measurements are taken in open boreholes using a weighted measuring tape or electronic groundwater level indicator.

Representative portions of the soil samples, obtained from the split-spoon sampler, are sealed in containers and shipped or transported to the office. In the office, the samples are examined by an engineer to verify the driller's field classifications.

Auger Borings

Auger borings, wash borings, and air hammer drilling without standard penetration testing are practical when the depth to rock is of primary concern. Auger and wash borings may also be used to obtain undisturbed samples at pre-selected depths. The borings may be advanced by hollow-stem augers, wash boring techniques using roller cone or Hawthorne bits, or pneumatic hammer drills to termination or refusal depths. The soils and rock materials encountered are roughly identified by the driller from cuttings brought to the surface during the drilling process. Crude estimates of the soil consistency or relative density and rock quality may also be made from the difficulty of the drilling process in advancing the borehole.

Undisturbed Sampling

Split tube samples are suitable for visual examination and classification tests but are not sufficiently intact for quantitative laboratory testing. Relatively undisturbed samples are obtained by pushing sections of 3 inch O.D., 16-gauge, steel "Shelby" tubing into the soil at the desired sampling levels. This procedure is described by ASTM Standard D-1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight, and transported to the laboratory. Locations and depths of undisturbed samples are shown on the Test Pit or Boring Records.

Soil Identification and Description

Soils are normally classified using the Unified Soil Classification System (ASTM D 2487). This is useful for grouping them for a particular purpose, but may be misleading in other applications. In addition to standard classification, soils are identified in accordance with the important soil properties to provide a complete description and assist with predicting behavior. Soil properties significant to most earthwork/foundation problems include consistency (cohesive fine grained soils) or relative density (cohesionless granular soils), color, and texture or composition. Consistency and relative density are fundamental properties in evaluating soil strength and are typically estimated based on standard penetration test results. The engineer's examination of soil samples recovered during the field investigation is primarily a qualitative visual process. Detailed soil classification requires basic laboratory grain size analyses and Atterberg limits (plasticity) tests.

Grain Size/Gradation

Grain size tests are performed to determine the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D-421 (dry preparation) or ASTM D-2217 (wet preparation). The grain size distribution of soils coarser than a number 200 sieve (0.074 mm opening) is determined by passing the samples through a standard set of nested sieves. A sample of known weight is passed through the sequence of sieves with decreasing size of openings and the portions retained on each sieve weighed. Materials passing the number 200 sieve are suspended in water and the grain size distributing calculated from the measured settlement rate (hydrometer analysis). Hydrometer analysis determines the density of a suspension of soil at various times after agitation. Using Stokes's law, the particle size remaining suspended at each particular time is calculated and the corresponding density is a measure of the quantity of soil smaller than the computed size. Procedures for the grain size analysis of soils is described by ASTM D-422.

Permeability/Hydraulic Conductivity

The permeability test is used to measure the ease with which water will flow through the soil, such as seepage under dams, percolation from land application, the squeezing out of water from the soil by the application of load, and drainage of subgrades, dams and backfills.

Hydraulic conductivity testing by the flexible wall permeameter method is performed on undisturbed or remolded samples according to ASTM D 5084. Constant head (Method A), falling head (Methods B & C), or constant rate of flow (Method D) systems may be utilized. Generally, the constant head method is used for granular soils and the falling head method for fine grained soils. Once the samples are prepared, each test specimen is trimmed, porous plates are placed on the ends, and encased in a rubber membrane. The encased test specimens are placed in permeameter cells and saturated, usually with back pressure. After saturation, a differential pressure head of water is applied across the sample and changes in pressure head with time are measured and recorded. Permeability or hydraulic conductivity of each soil sample is calculated from the test data.

APPENDIX B

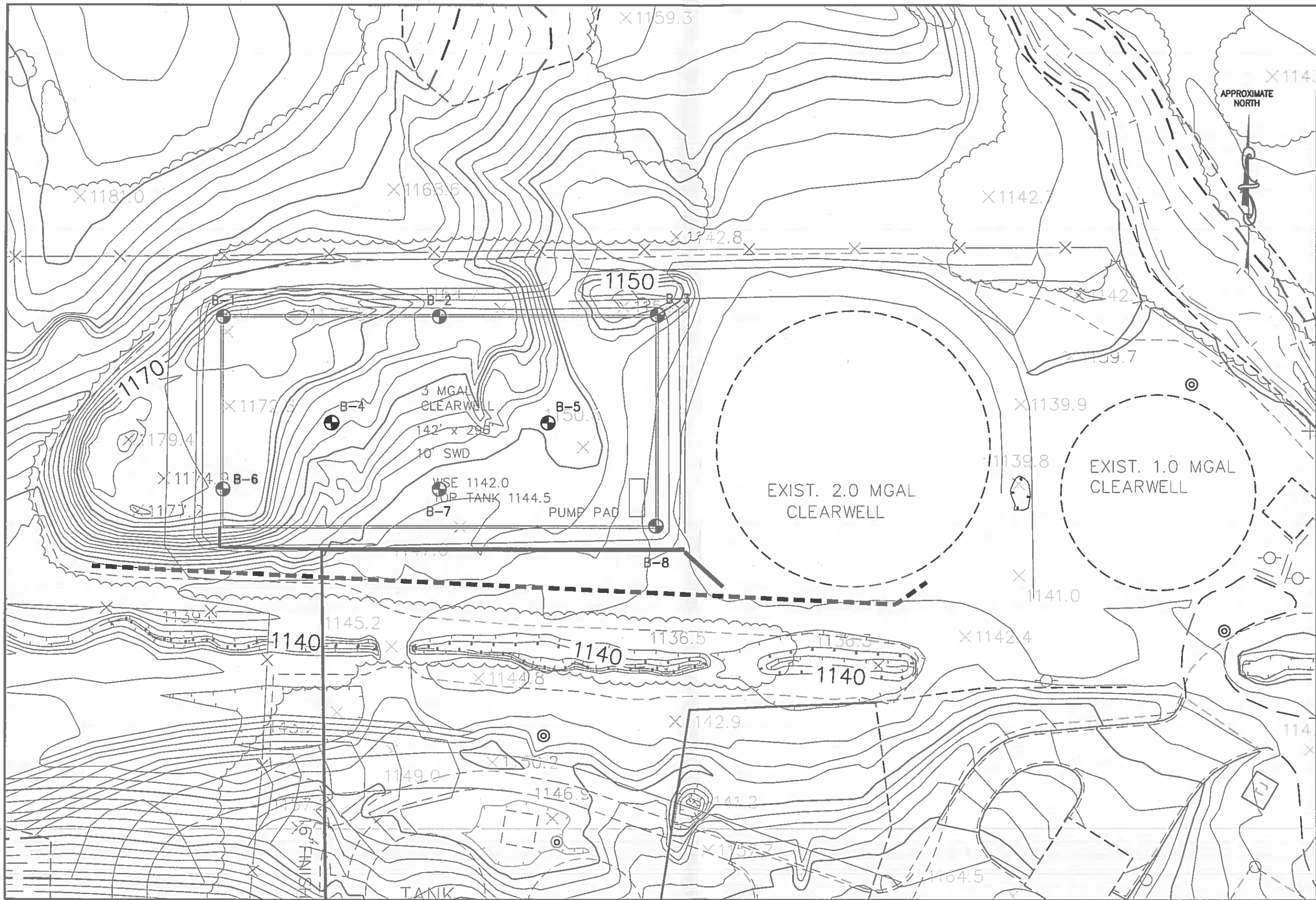
FIGURE 1 – BORING LOCATION PLAN

FIGURE 2 – BORING LOCATION PLAN

FIGURE 3 – BORING LOCATION PLAN

KEY TO SYMBOLS AND CLASSIFICATIONS

BORING LOGS – 24 PAGES



BORING LOCATION PLAN

PROJECT: CITY OF CUMMING WTP EXPANSION
 Clearwell, Package Plant, and Pump Stations
 Cumming, Forsyth County, Georgia
 GeoSystems Project Number: 06-1899

PREPARED BY: ARC
 DATE: 10/13/2006

REVIEWED BY: LDM
 DATE: 10/13/2006

FIGURE: **1**

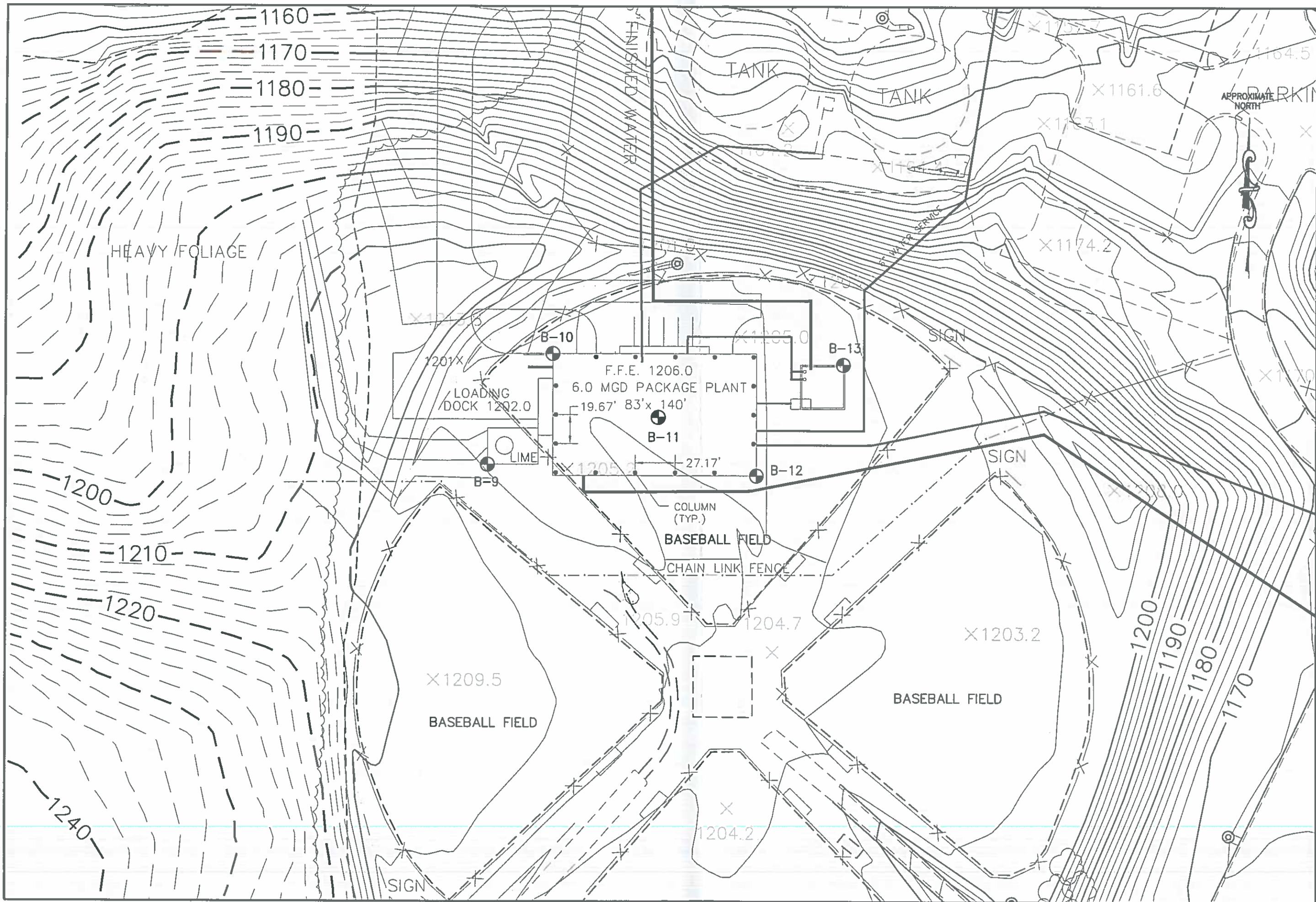
GEOSYSTEMS
 ENGINEERING, INC.

REFERENCE: 06-1899 City of Cumming WTP Expansion PLAN

LEGEND
 - - SOIL TEST BORING



SCALE: 1" = 60' (APPROXIMATELY)



BORING LOCATION PLAN

PREPARED BY: ARC
 DATE: 10/13/2006
 PROJECT: CITY OF CUMMING WTP EXPANSION
 Clearwell, Package Plant, and Pump Stations
 Cumming, Forsyth County, Georgia
 REVIEWED BY: LDM
 DATE: 10/13/2006
 Geosystems Project Number: 06-1899

FIGURE **2**

GEOSYSTEMS ENGINEERING, INC.

REFERENCE: 06-1899 City of Cumming WTP Expansion PLAN

LEGEND

SOIL TEST BORING
 GRAPHIC SCALE (FEET)
 0 30 60

SCALE: 1" = 60' (APPROXIMATELY)



BORING LOCATION PLAN

PREPARED BY: ARC
 DATE: 10/13/2006
 PROJECT: CITY OF CUMMING WTP EXPANSION
 Clearwell, Package Plant, and Pump Stations
 Cumming, Forsyth County, Georgia
 GeoSystems Project Number: 06-1899
 REVIEWED BY: LDM
 DATE: 10/13/2006
 FIGURE **3**

GEOSYSTEMS ENGINEERING, INC.

REFERENCE: 06-1899 City of Cumming WTP Expansion PLAN



















LEGEND

SOIL TEST BORING



SCALE: 1" = 60' (APPROXIMATELY)

KEY TO SYMBOLS AND CLASSIFICATIONS

 FILL  TOPSOIL  PAVEMENT  PARTIALLY WEATHERED ROCK  CL: Low plasticity inorganic clays  CH: High plasticity inorganic clays  ML: Low plasticity inorganic silts  MH: High plasticity inorganic silts  SP: Poorly graded sands	 SW: Well graded sands  GP: Poorly graded gravels  GW: Well graded gravels  OL: Low plasticity organic silts and clays  OH: High plasticity organic silts and clay  SM: Silty sands  GM: Silty gravels  SC: Clayey sands  GC: Clayey gravels
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CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

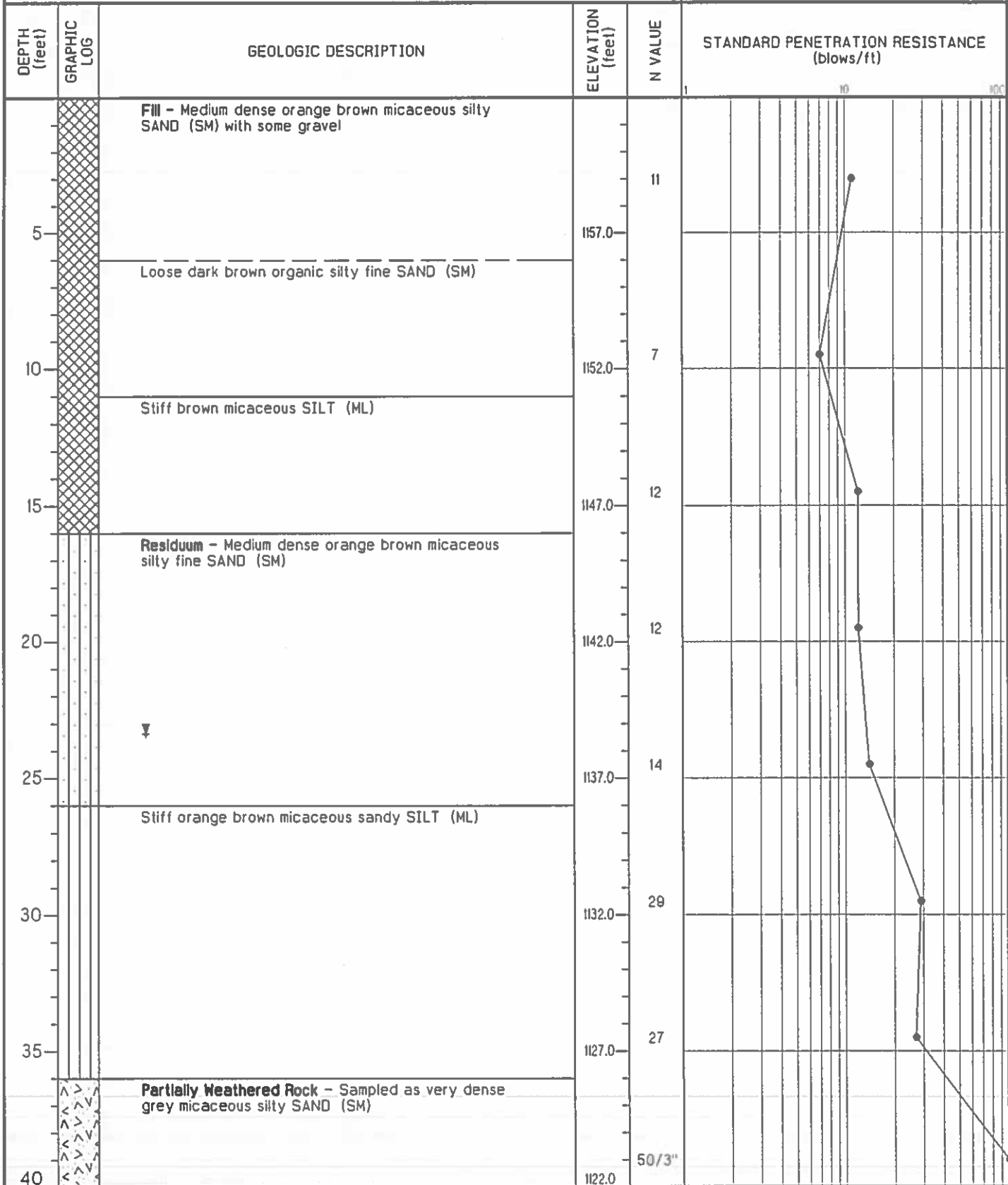
SANDS	N - VALUE BLOWS PER FOOT	APPROXIMATE RELATIVE DENSITY
		0 - 4
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
SILTS AND CLAYS	APPROXIMATE CONSISTENCY	
	0 - 1	Very Soft
	2 - 4	Soft
	5 - 8	Firm
	9 - 15	Stiff
	16 - 30	Very Stiff
	31 - 50	Hard
OVER 50	Very Hard	

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-1


GEOLOGIST: N/A	ELEVATION: 1162 Feet
DATE DRILLED: 10/16/06	BORING DEPTH: 53 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: 23 Feet
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: Water level at time of boring (▽) was measured at 41 Feet. The 24 hour water level (▽) was measured at 23 Feet.



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-1

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)		
					1	10	40C
45		Partially Weathered Rock - Sampled as very hard grey brown sandy SILT (ML) ▽	1117.0	50/5"			
50			1112.0	50/4"			
55		Auger Refusal at 53 Feet	1107.0				
60			1102.0				
65			1097.0				
70			1092.0				
75			1087.0				
80			1082.0				
85			1077.0				

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-2

GEOLOGIST: N/A

ELEVATION: 1162 Feet

NOTES: Water level at time of boring (▽) was measured at 25 Feet.

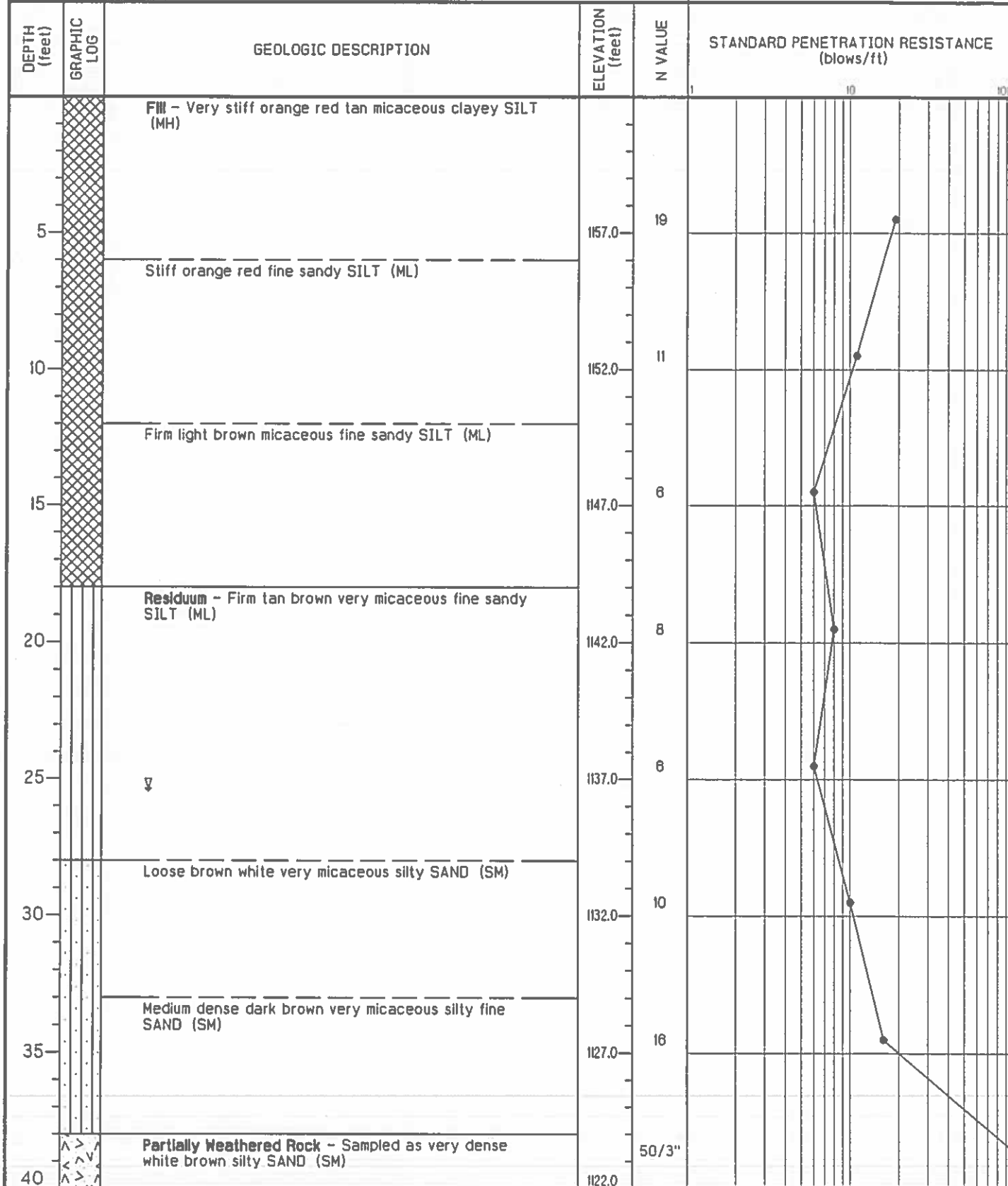
DATE DRILLED: 10/20/06

BORING DEPTH: 43 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 25 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-2

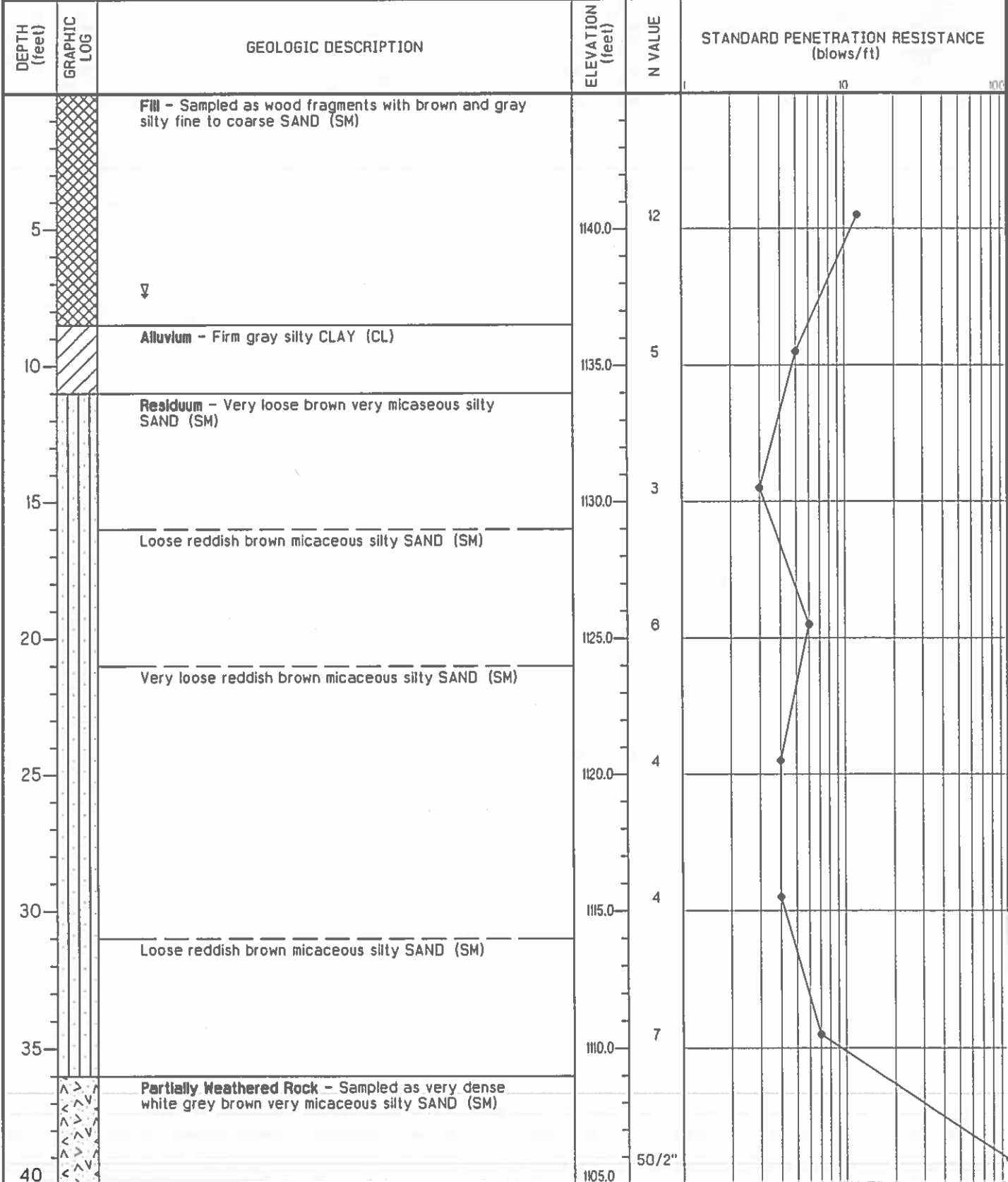
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					1	2	3	4	5	6	7	8	9	10						
		Partially Weathered Rock - Samples as very dense white brown silty SAND (SM)																		
45		Auger Refusal at 43 Feet	1117.0																	
50			1112.0																	
55			1107.0																	
60			1102.0																	
65			1097.0																	
70			1092.0																	
75			1087.0																	
80			1082.0																	
85			1077.0																	

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-3


GEOLOGIST: N/A	ELEVATION: 1145 Feet
DATE DRILLED: 10/18/06	BORING DEPTH: 42 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: 7 Feet
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: Water level at time of boring (▽) was measured at 7 Feet.



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-3

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					1	2	3	4	5	6	7	8	9	10	100						
		Partially Weathered Rock- Sampled as very dense white grey brown very micaceous silty SAND (SM)																			
45		Augar Refusal at 42 Feet	1100.0																		
50			1095.0																		
55			1090.0																		
60			1085.0																		
65			1080.0																		
70			1075.0																		
75			1070.0																		
80			1065.0																		
85			1060.0																		

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-4

GEOLOGIST: N/A

ELEVATION: 1162 Feet

NOTES: Water level at time of boring (▽) was measured at 30 Feet. The 24 hour water level (▽) was measured at 23 Feet.

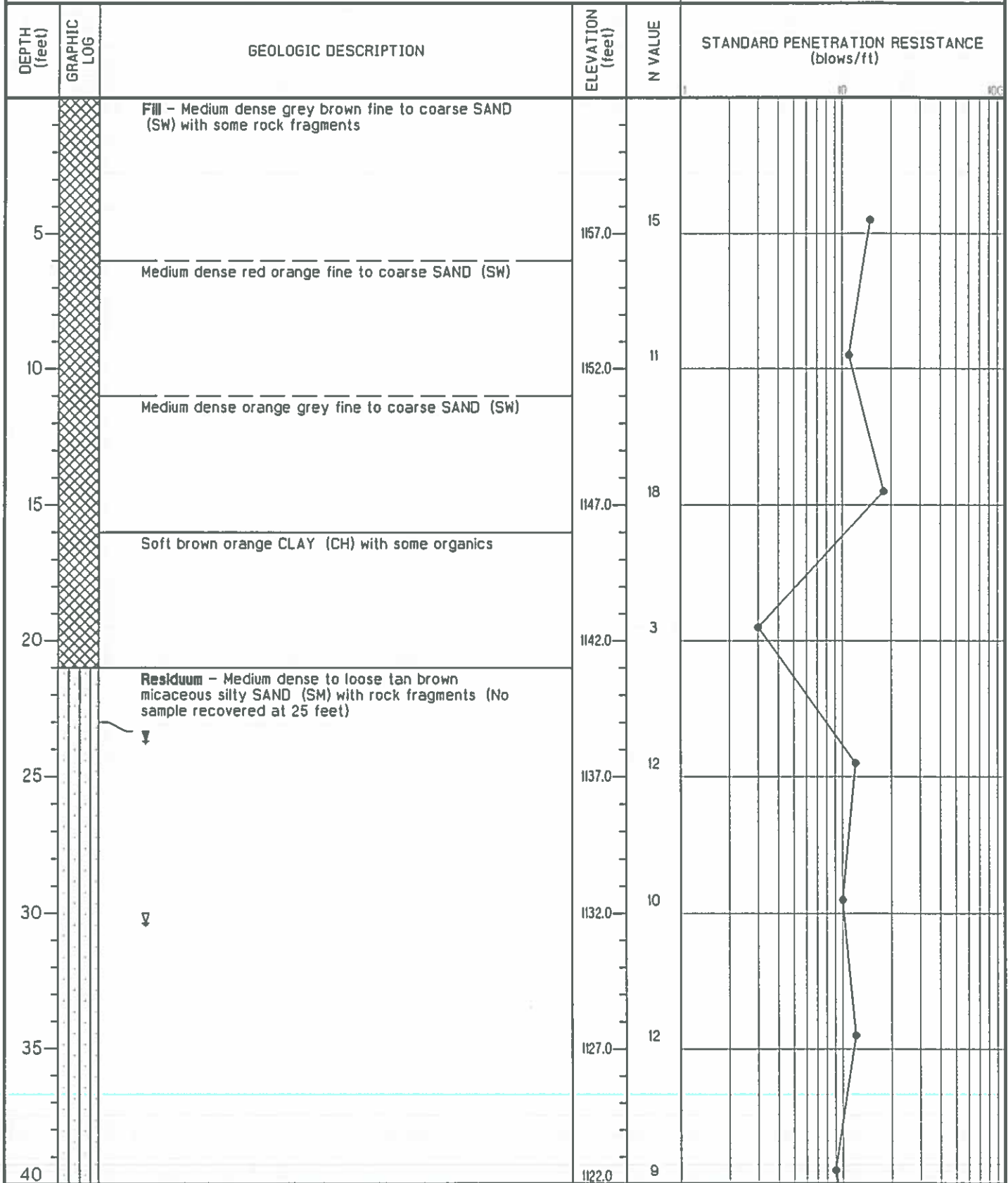
DATE DRILLED: 10/19/06

BORING DEPTH: 53 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-4

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)	
					1	100
45		Medium dense to loose tan brown micaceous silty SAND (SM) with rock fragments	1117.0	12		
		Medium dense brown to grey brown silty SAND (SM)				
50			1112.0	14		
55		Auger Refusal at 53 Feet	1107.0			
60			1102.0			
65			1097.0			
70			1092.0			
75			1087.0			
80			1082.0			
85			1077.0			

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-5

GEOLOGIST: N/A

ELEVATION: 1161 Feet

NOTES: Water level at time of boring (▽) was measured at 23 Feet. The 24 hour water level (▽) was measured at 23 Feet.

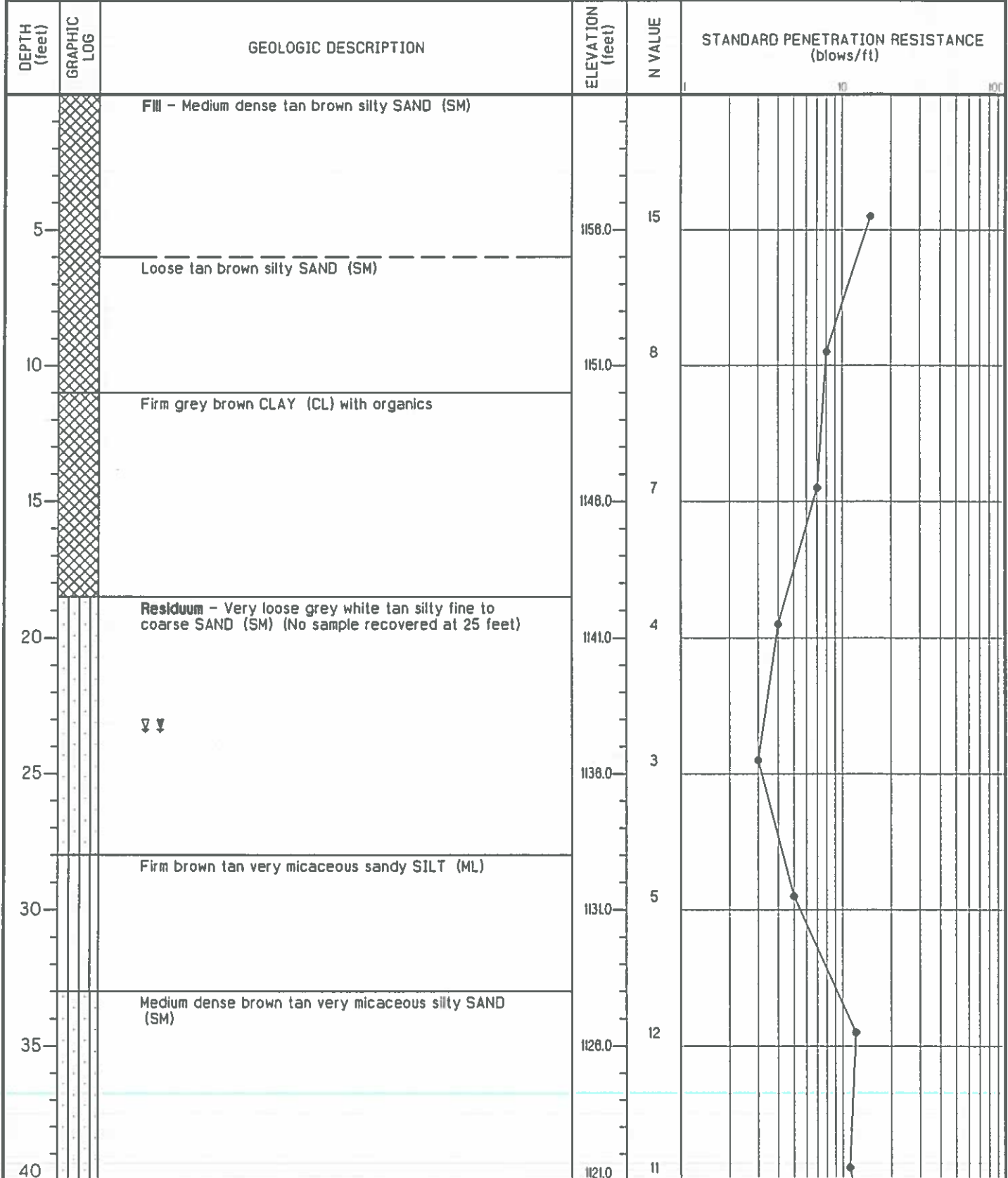
DATE DRILLED: 10/16/06

BORING DEPTH: 50 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-5

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)		
					1	10	100
45		Medium dense brown tan very micaceous silty SAND (SM)	1118.0	16			
50		Boring Terminated at 50 Feet	1111.0	16			
55			1108.0				
60			1101.0				
65			1098.0				
70			1091.0				
75			1088.0				
80			1081.0				
85			1076.0				

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-6

GEOLOGIST: N/A

ELEVATION: 1163 Feet

NOTES: Water level at time of boring (▽) was measured at 27 Feet. The 24 hour ground water level (▽) was measured at 23 Feet.

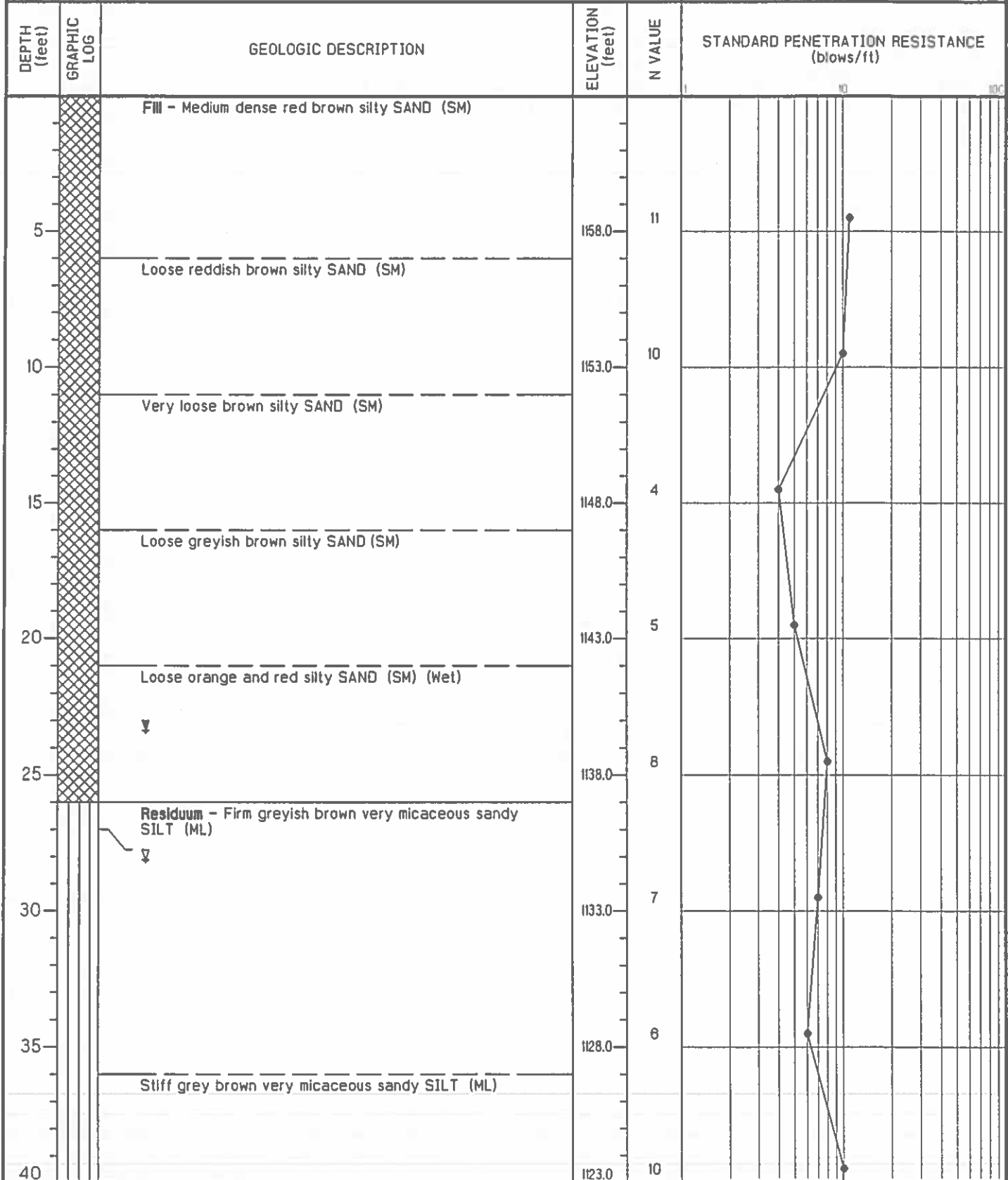
DATE DRILLED: 10/16/06

BORING DEPTH: 63 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
 CITY OF CUMMING
 CUMMING, GEORGIA

LOG OF BORING B-6

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)		
					1	10	30
45		Stiff grey brown very micaceous sandy SILT (ML)	1118.0	9			
50			1113.0	9			
55			1108.0	12			
60			1103.0	15			
65		Auger Refusal at 63 Feet	1098.0				
70			1093.0				
75			1088.0				
80			1083.0				
85			1078.0				

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-7

GEOLOGIST: N/A

ELEVATION: 1161 Feet

NOTES: Water level at time of boring (▽) was measured at 24 Feet. The 24 hour ground water level (▽) was measured at 23 Feet.

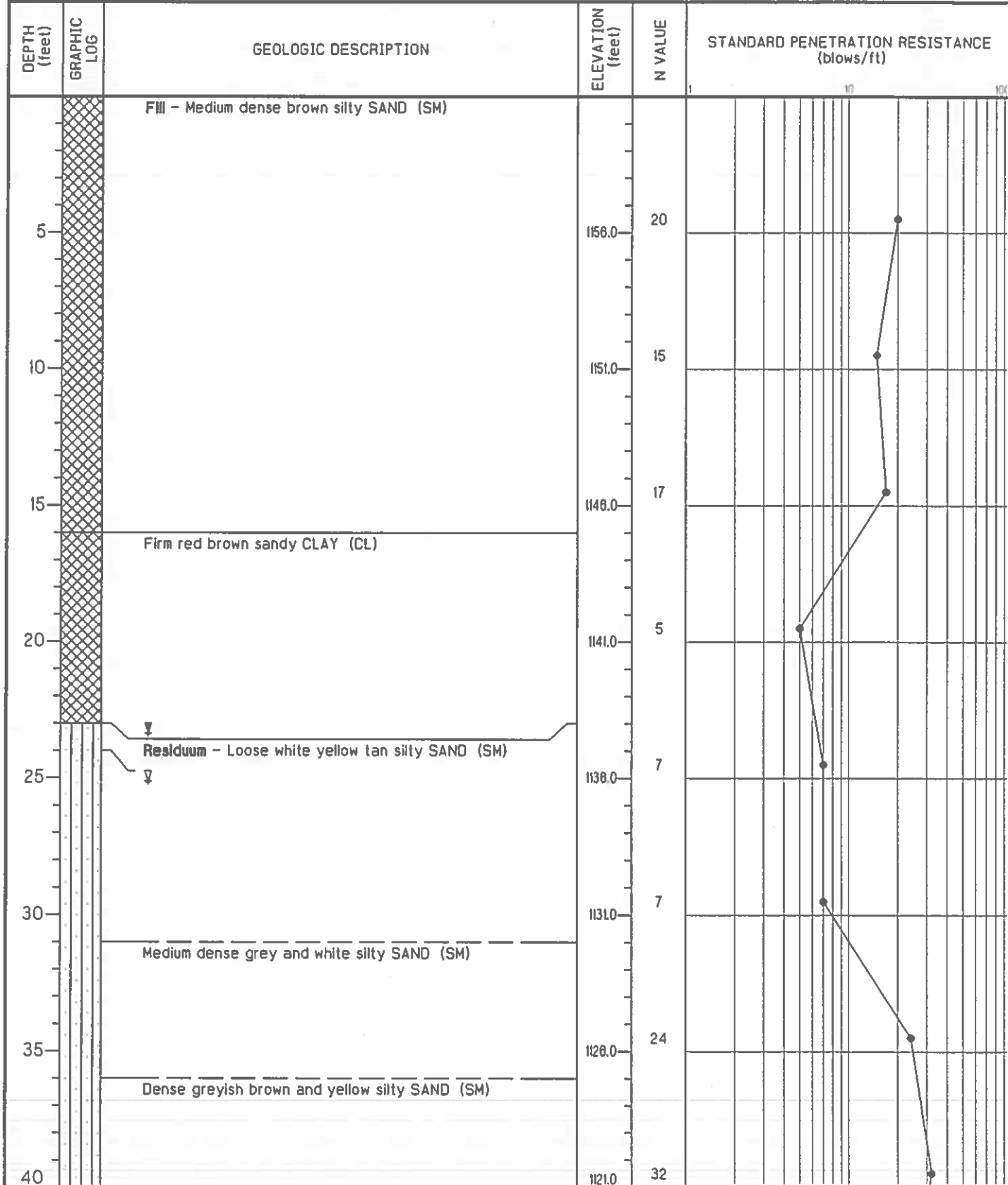
DATE DRILLED: 10/19/06

BORING DEPTH: 50 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 23 Feet

DRILLING METHOD: HOLLOW STEM AUGER

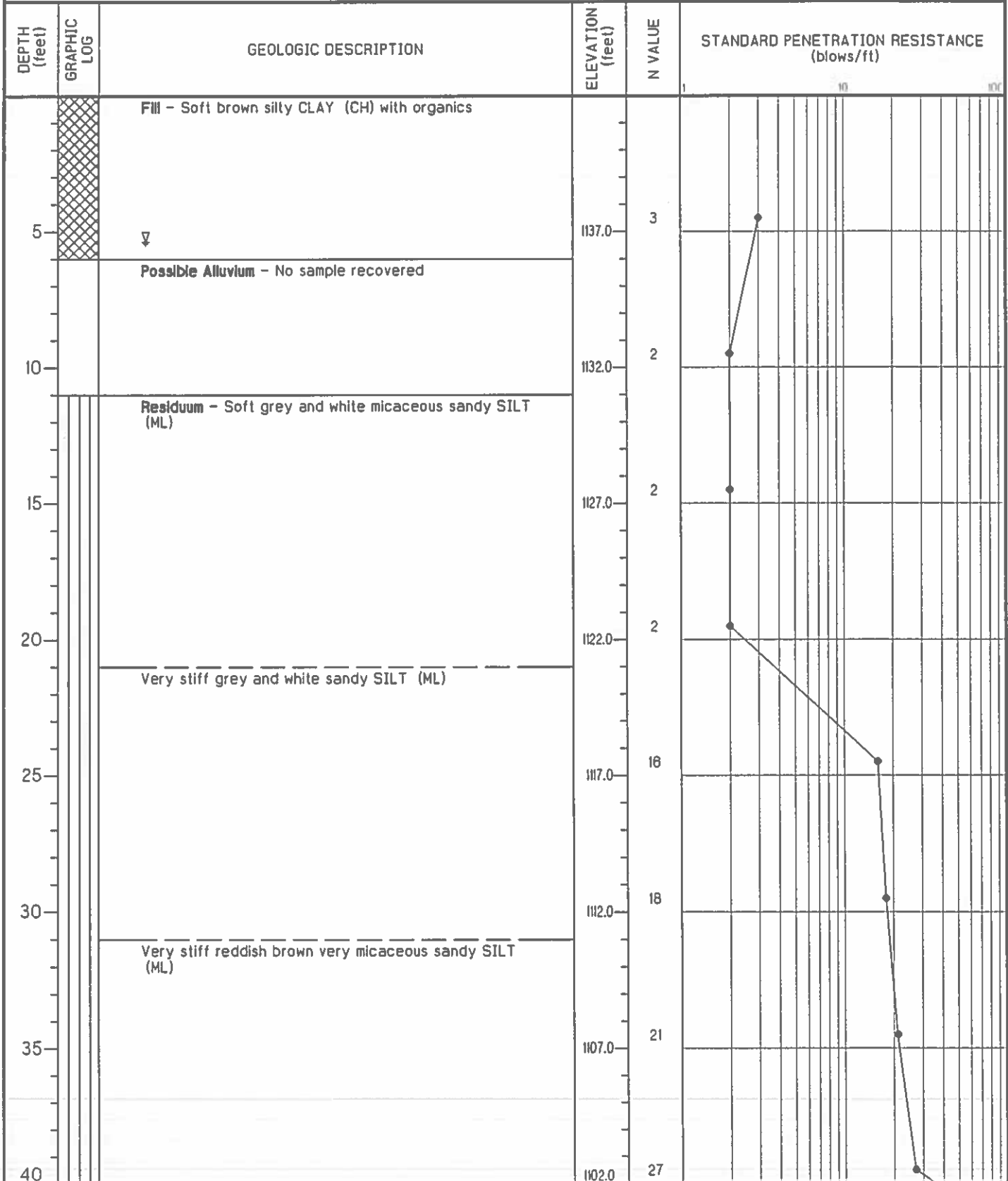


WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-8


GEOLOGIST: N/A	ELEVATION: 1142 Feet
DATE DRILLED: 10/18/06	BORING DEPTH: 45 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: 5 Feet
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: Water level at time of boring (▽) was measured at 5 Feet.



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-8

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					1	2	3	4	5	6	7	8	9	10	100					
45		Very stiff reddish brown very micaceous sandy SILT (ML) Partially Weathered Rock - Sampled as very dense dark brown micaceous silty fine SAND (SM)	1097.0	50/4"																
		Boring Terminated at 45 Feet																		
50			1092.0																	
55			1087.0																	
60			1082.0																	
65			1077.0																	
70			1072.0																	
75			1067.0																	
80			1062.0																	
85			1057.0																	

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-9

GEOLOGIST: <i>N/A</i>	ELEVATION: <i>1206 Feet</i>
DATE DRILLED: <i>10/20/06</i>	BORING DEPTH: <i>25 Feet</i>
DRILLER: <i>GABLE DRILLING CO.</i>	WATER LEVEL: <i>NGW@TOB *</i>
DRILLING METHOD: <i>HOLLOW STEM AUGER</i>	

NOTES: * - No ground water encountered at time of boring.

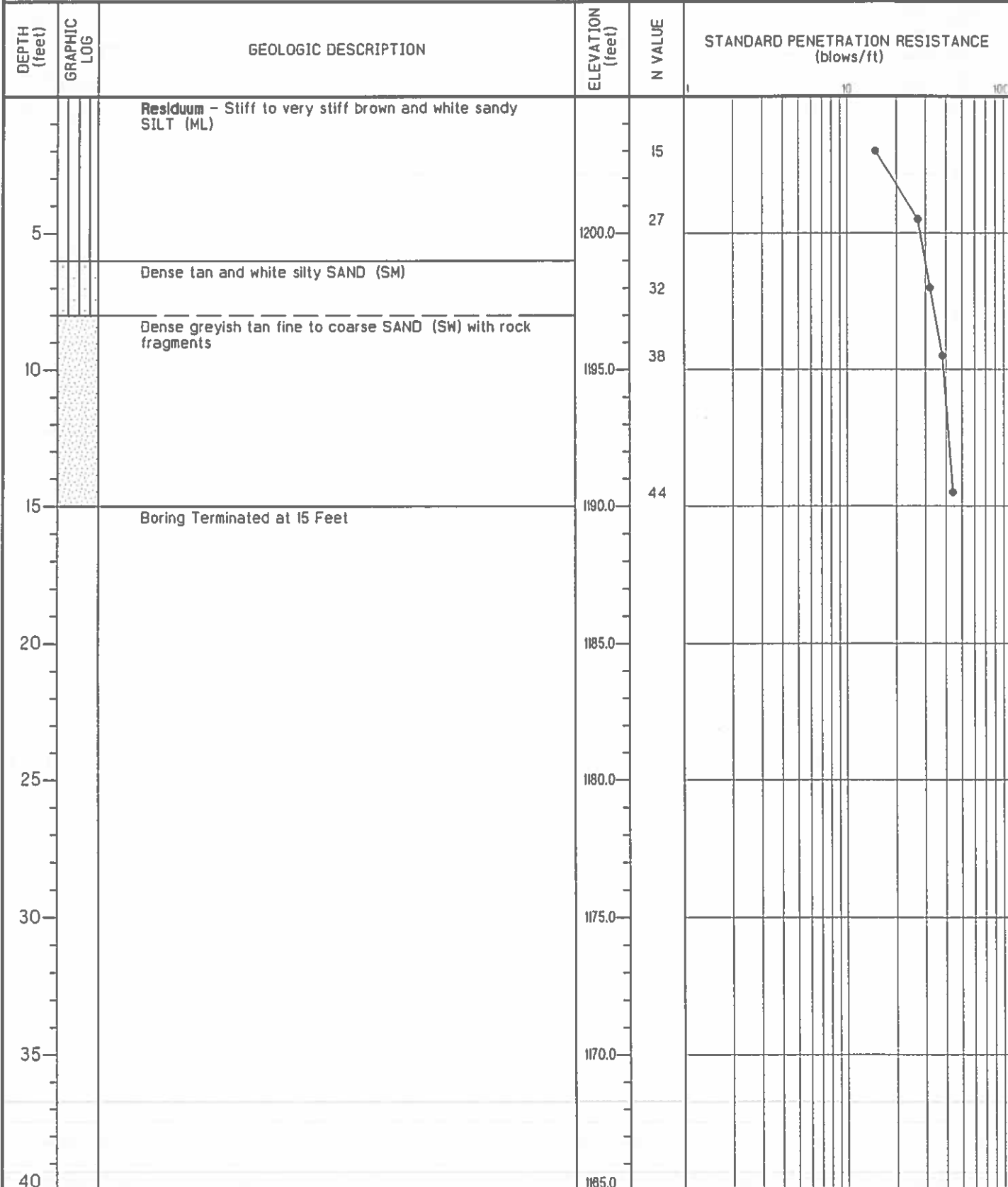
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)	
					1	10
0		Residuum - Medium dense light brown slightly micaceous silty fine SAND (SM)	1201.0	19		
5		Dense light tan brown micaceous silty fine SAND (SM)	1198.0	49		
10		Very dense light orange brown micaceous silty fine SAND (SM)	1191.0	51		
15		Very stiff light brown micaceous fine sandy SILT (ML)	1186.0	27		
20			1181.0	28		
25		Boring Terminated at 25 Feet	1176.0			
30			1171.0			
35			1166.0			
40						

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-10

GEOLOGIST: N/A	ELEVATION: 1205 Feet
DATE DRILLED: 10/20/06	BORING DEPTH: 15 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: NGW@TOB *
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: * - No ground water encountered at time of boring.

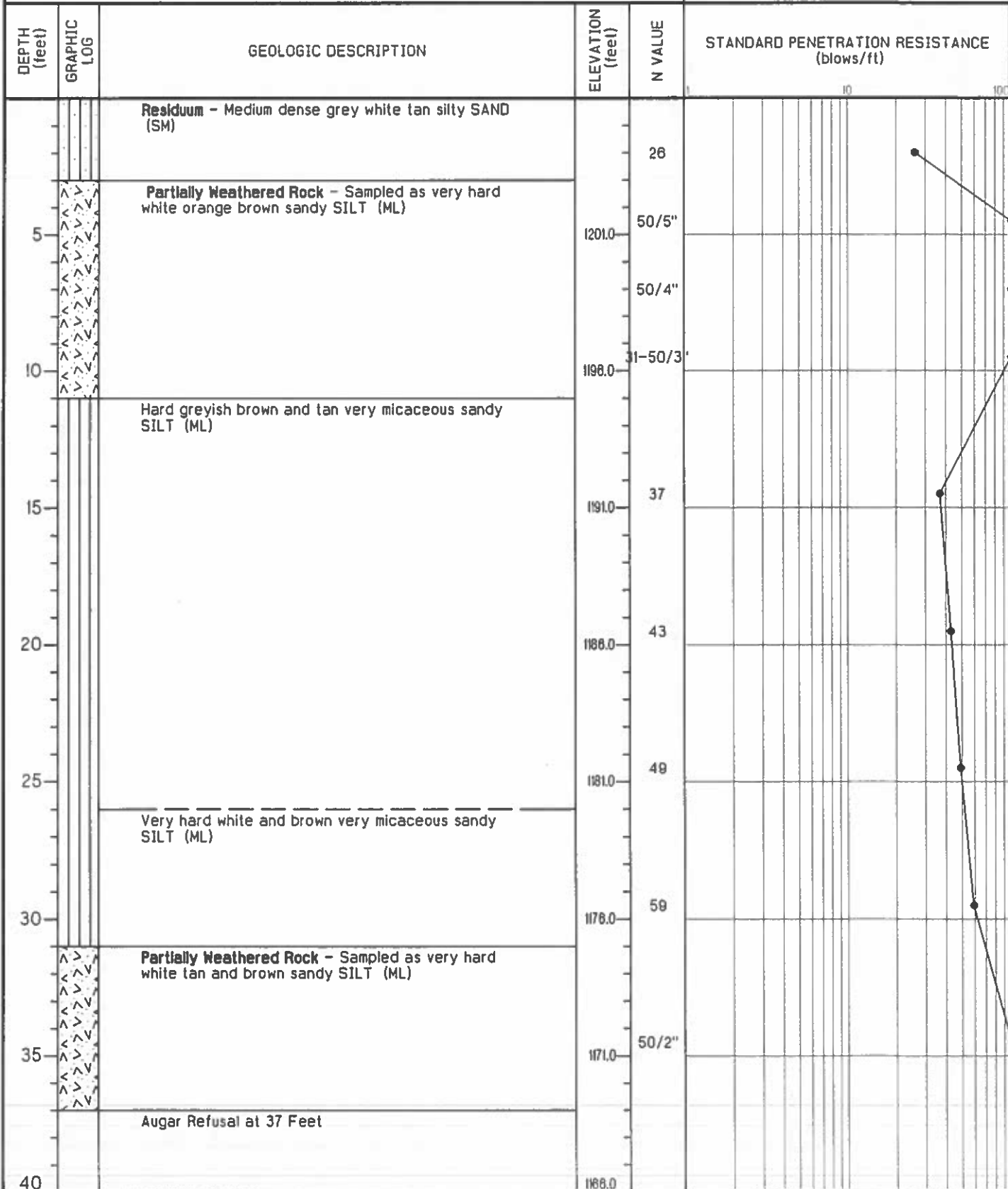


WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-11

GEOLOGIST: N/A	ELEVATION: 1206 Feet
DATE DRILLED: 10/20/06	BORING DEPTH: 37 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: NGW@TOB *
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: * - No ground water encountered at the time of boring.



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-12

GEOLOGIST: N/A

ELEVATION: 1206 Feet

NOTES: No ground water encountered at time of boring.

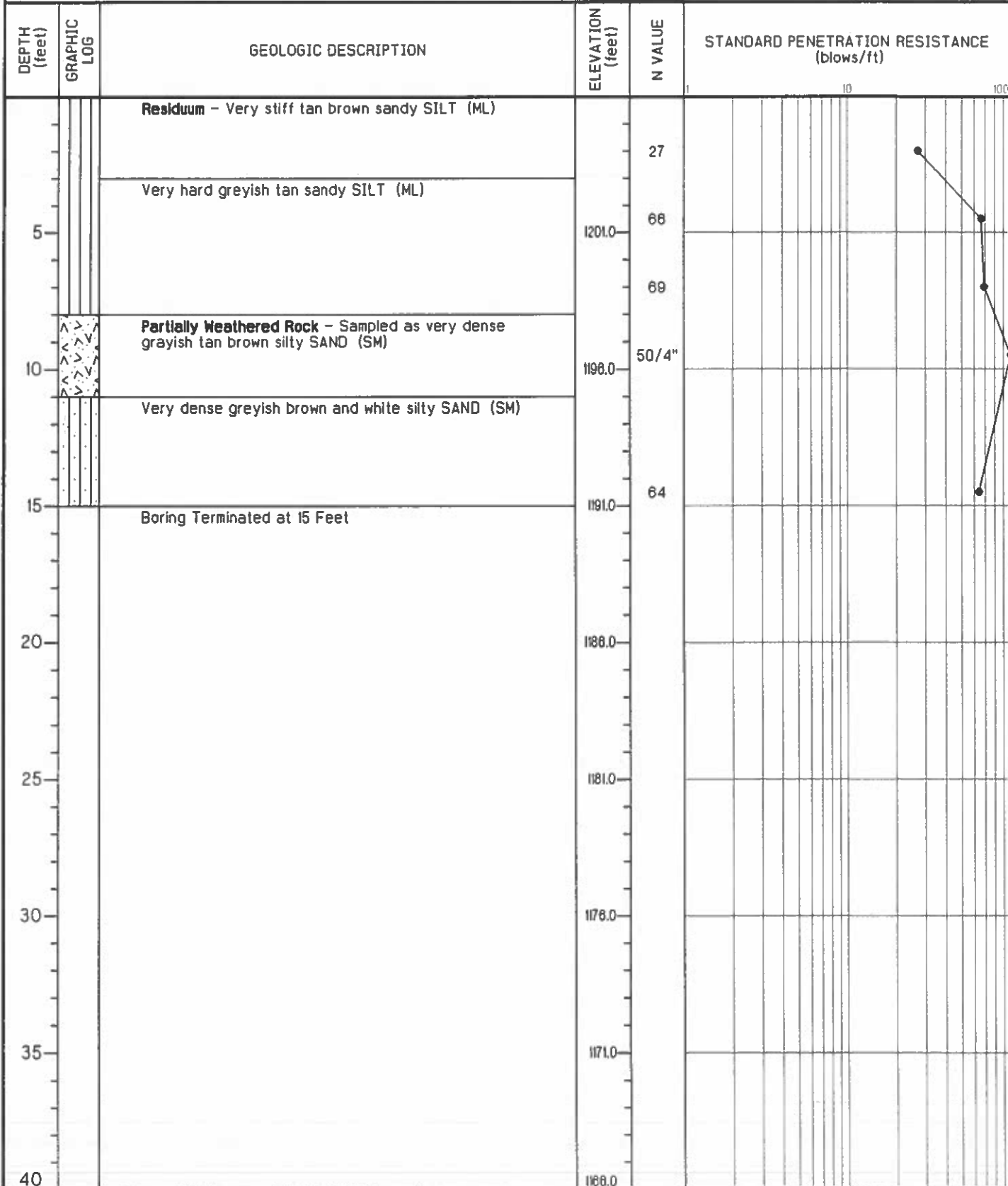
DATE DRILLED: 10/20/06

BORING DEPTH: 15 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: NGW@TOB *

DRILLING METHOD: HOLLOW STEM AUGER

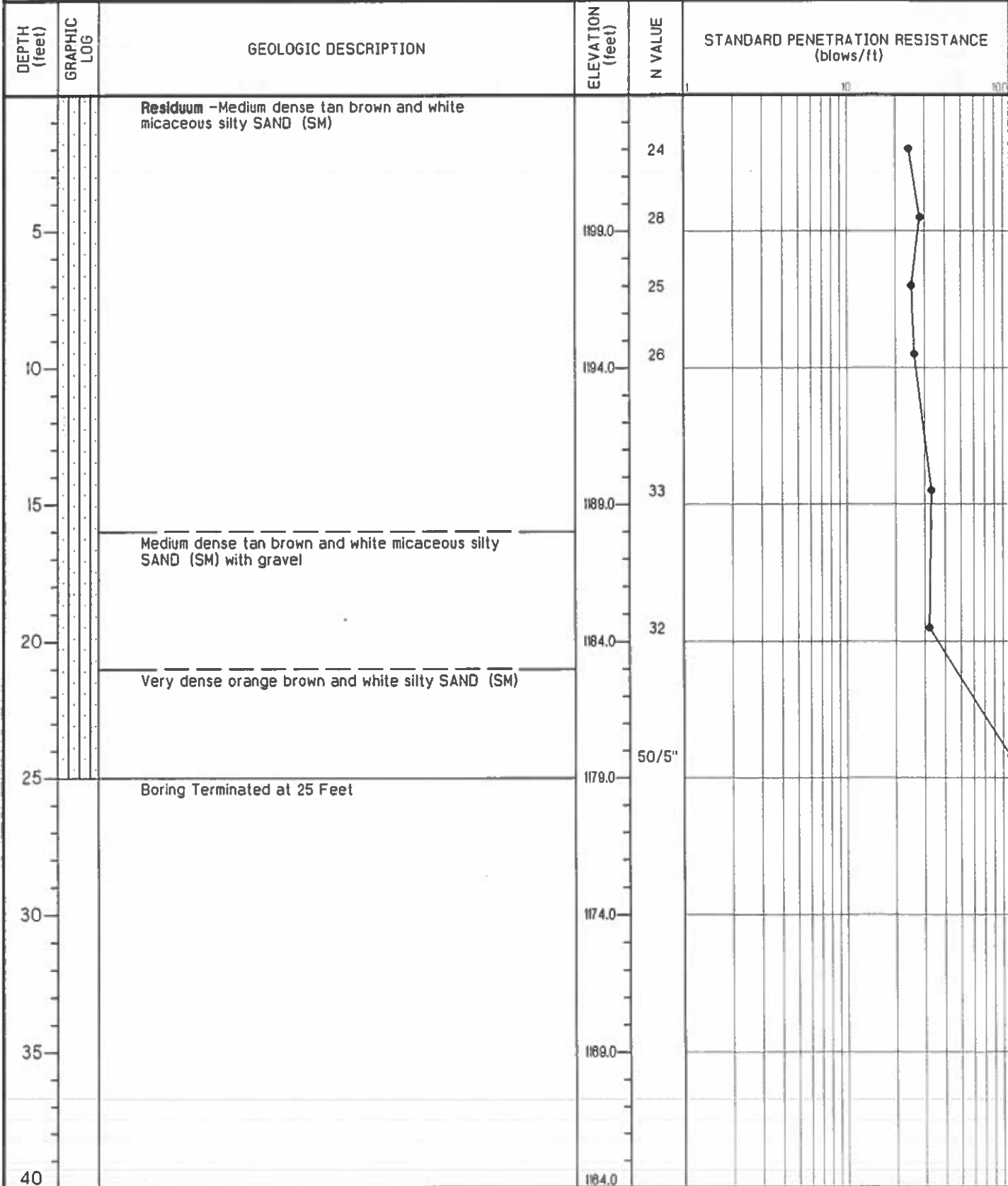


WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-13

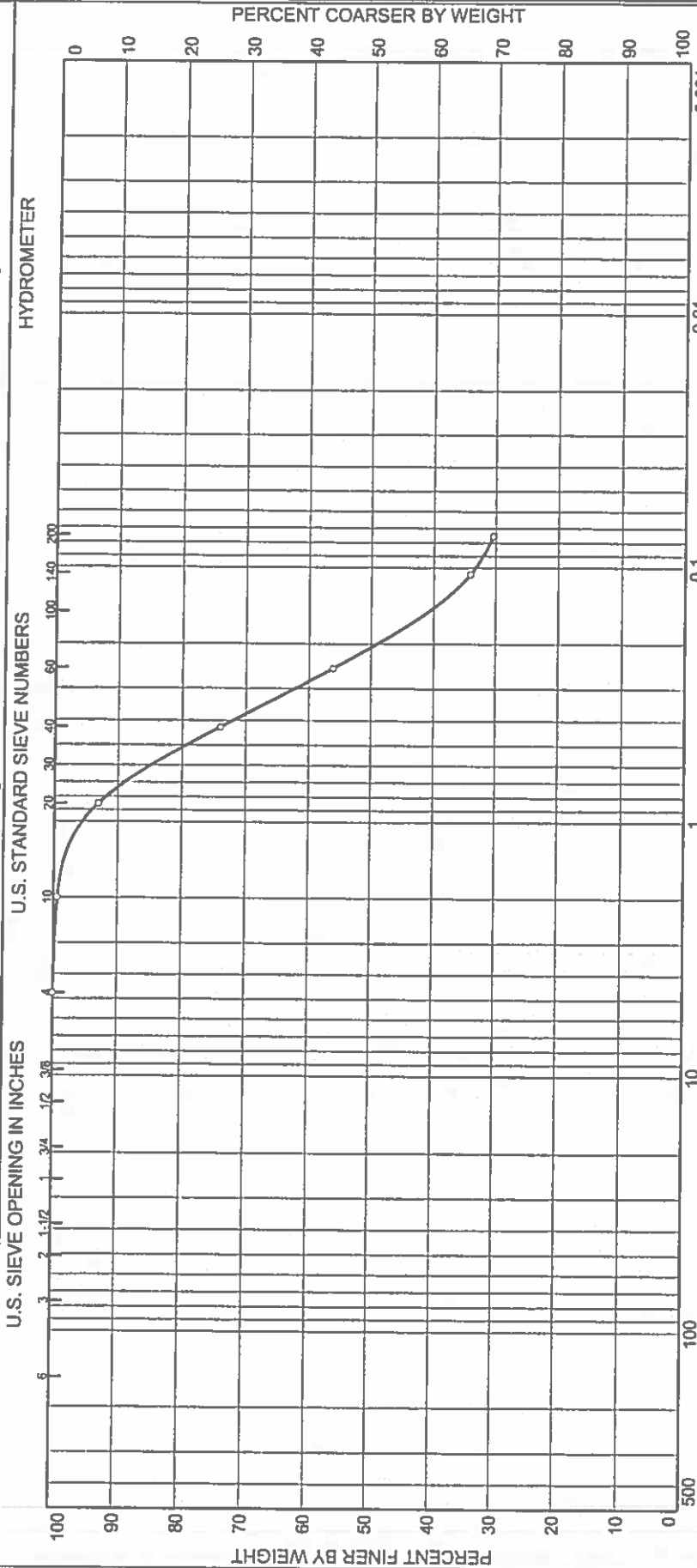
GEOLOGIST: N/A	ELEVATION: 1204 Feet
DATE DRILLED: 10/20/06	BORING DEPTH: 25 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: NGW@TOB *
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: No ground water encountered at time of boring.

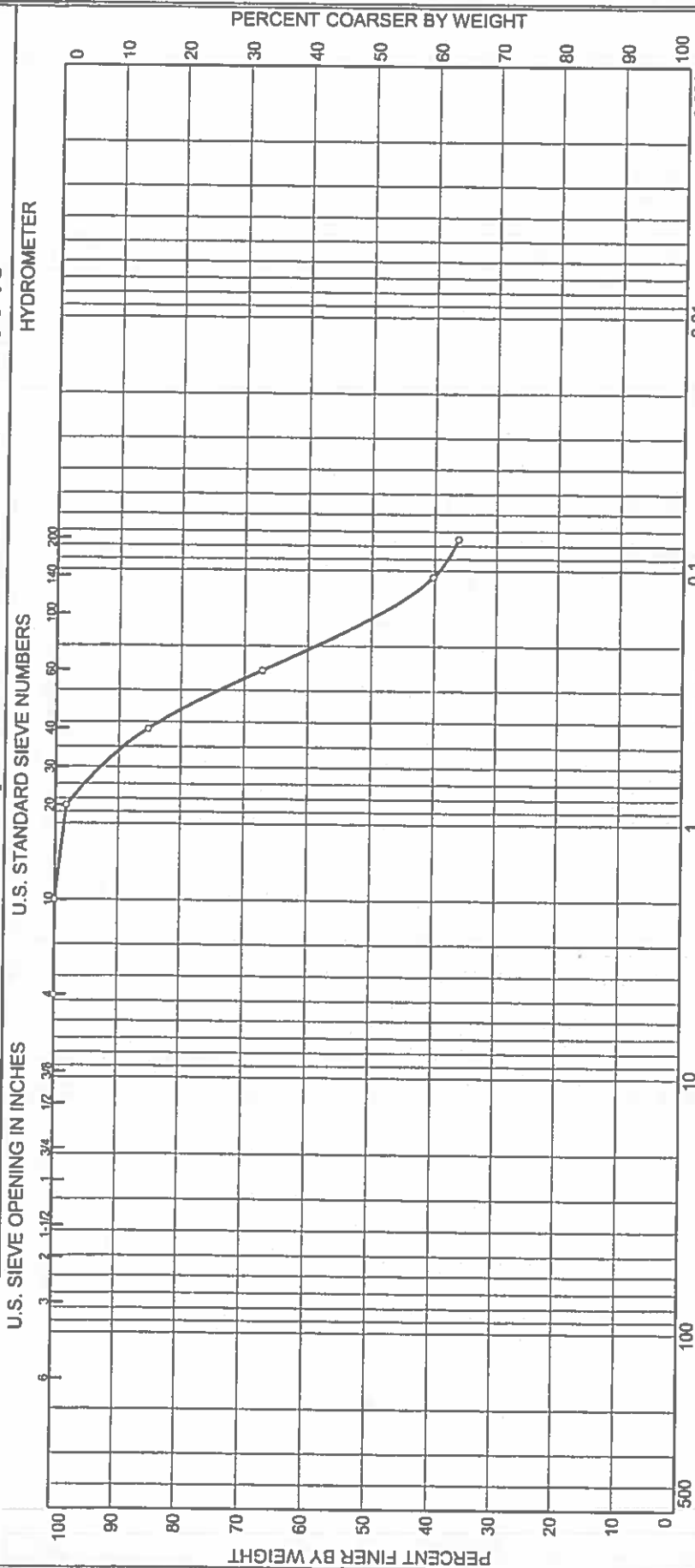


APPENDIX C
LABORATORY TEST REPORTS

Particle Size Distribution Report ASTM D422/ASTM D1140



Particle Size Distribution Report ASTM D422/ASTM D1140



<input type="checkbox"/> % COBBLES	0.0	<input type="checkbox"/> % GRAVEL	0.0
<input type="checkbox"/> % SAND	63.9	<input type="checkbox"/> % SILT	36.1
<input type="checkbox"/> % CLAY			

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-4	UDS	42-44'	10/27/06	SM	Brown and White Micaceous Silty sand	31.6		

Client: Geosystems Engineering
 Project: City of Cumming WTP Expansion
 Project No. GTX-G1151 Lab no. _____

Tested By: CNA
 Reviewed By: JW

GeoTesting Express Inc.



HYDRAULIC CONDUCTIVITY

Project No. *GTX-G1151* Tested By *JW*
Project Name *City of Cumming WTP Expansion* Test Date *10/26/2006*
Boring No. *B-4* Reviewed By *CA*
Sample No. *UDS* Review Date *10/30/2006*
Sample Depth *42-44 ft* Lab No. *20835*
Sample Description *Brown and white micaceous silty sand*

ASTM D5084 - Falling Head (Method C RisingTail)

Sample Type:	<i>UD</i>
Sample Orientation:	<i>Vertical</i>
Initial Water Content, %:	<i>34.5</i>
Wet Unit Weight, pcf:	<i>111.1</i>
Dry Unit Weight, pcf:	<i>82.6</i>
Compaction, %:	<i>N/A</i>
Hydraulic Conductivity, cm/sec. @20 °C	<i>5.6E-05</i>

Remarks: _____



HYDRAULIC CONDUCTIVITY

Project No. **GTX-G1151** Tested By **JW**
Project Name **City of Cumming WTP Expansion** Test Date **10/26/2006**
Boring No. **B-5** Reviewed By **CA**
Sample No. **UDS** Review Date **10/30/2006**
Sample Depth **42-44 ft** Lab No. **20836**
Sample Description **Brown micaceous silty sand**

ASTM D5084 - Falling Head (Method C Rising Tail)

Sample Type:	<i>UD</i>
Sample Orientation:	<i>Vertical</i>
Initial Water Content, %:	<i>40.4</i>
Wet Unit Weight, pcf:	<i>109.9</i>
Dry Unit Weight, pcf:	<i>78.3</i>
Compaction, %:	<i>N/A</i>
Hydraulic Conductivity, cm/sec. @20 °C	<i>2.8E-05</i>

Remarks:

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-14

GEOLOGIST: N/A

ELEVATION: 1145 Feet

NOTES: Water level at time of boring (▽) was measured at 4 Feet.

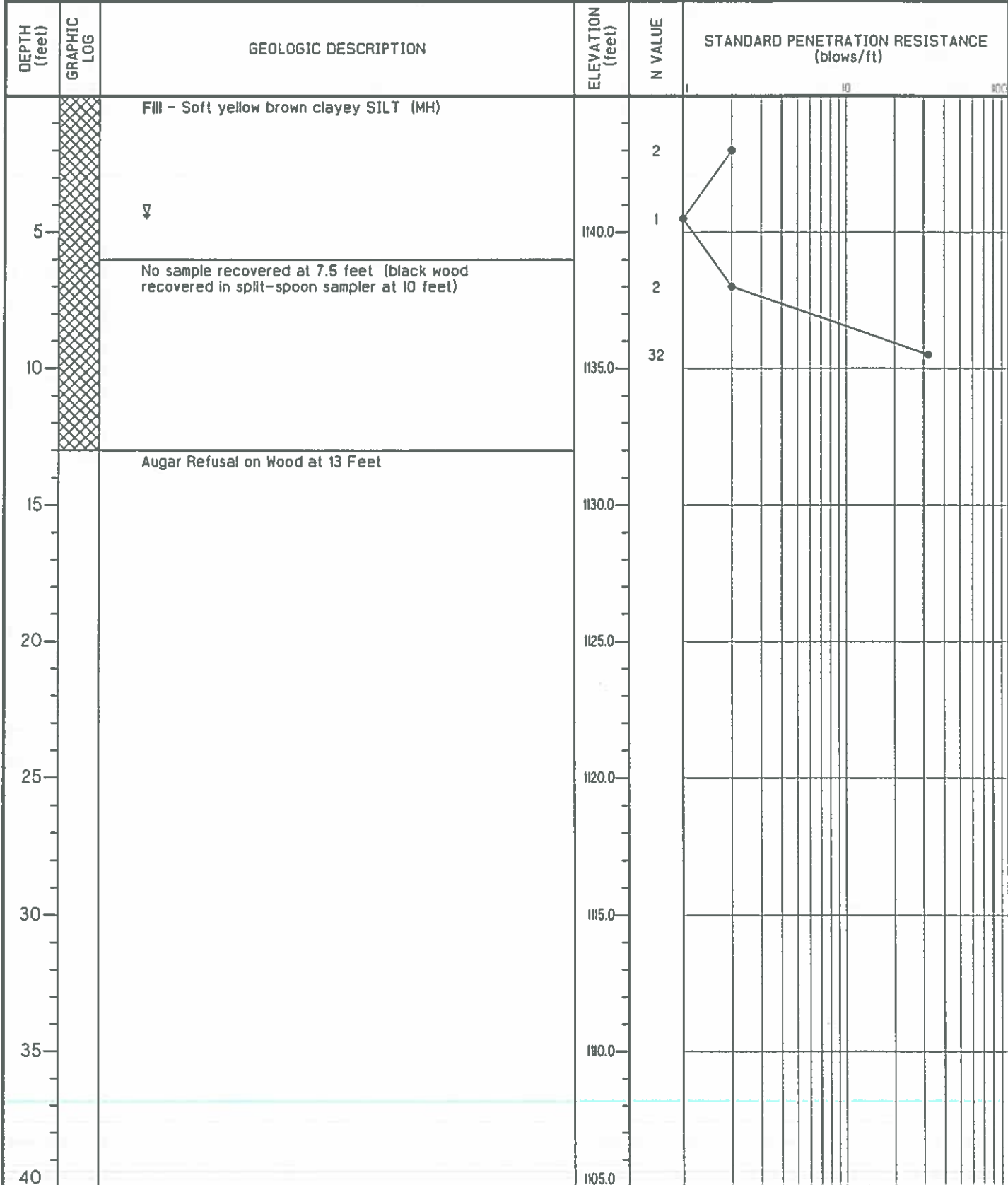
DATE DRILLED: 10/16/06

BORING DEPTH: 13 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 4 Feet

DRILLING METHOD: HOLLOW STEM AUGER



WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-14A

GEOLOGIST: N/A

ELEVATION: 1145 Feet

NOTES: (1) Water level at time of boring (g) was measured at 4 Feet. (2) Boring located approximately 5 feet northwest of B-14.

DATE DRILLED: 10/16/06

BORING DEPTH: 15 Feet

DRILLER: GABLE DRILLING CO.

WATER LEVEL: 4 Feet

DRILLING METHOD: HOLLOW STEM AUGER

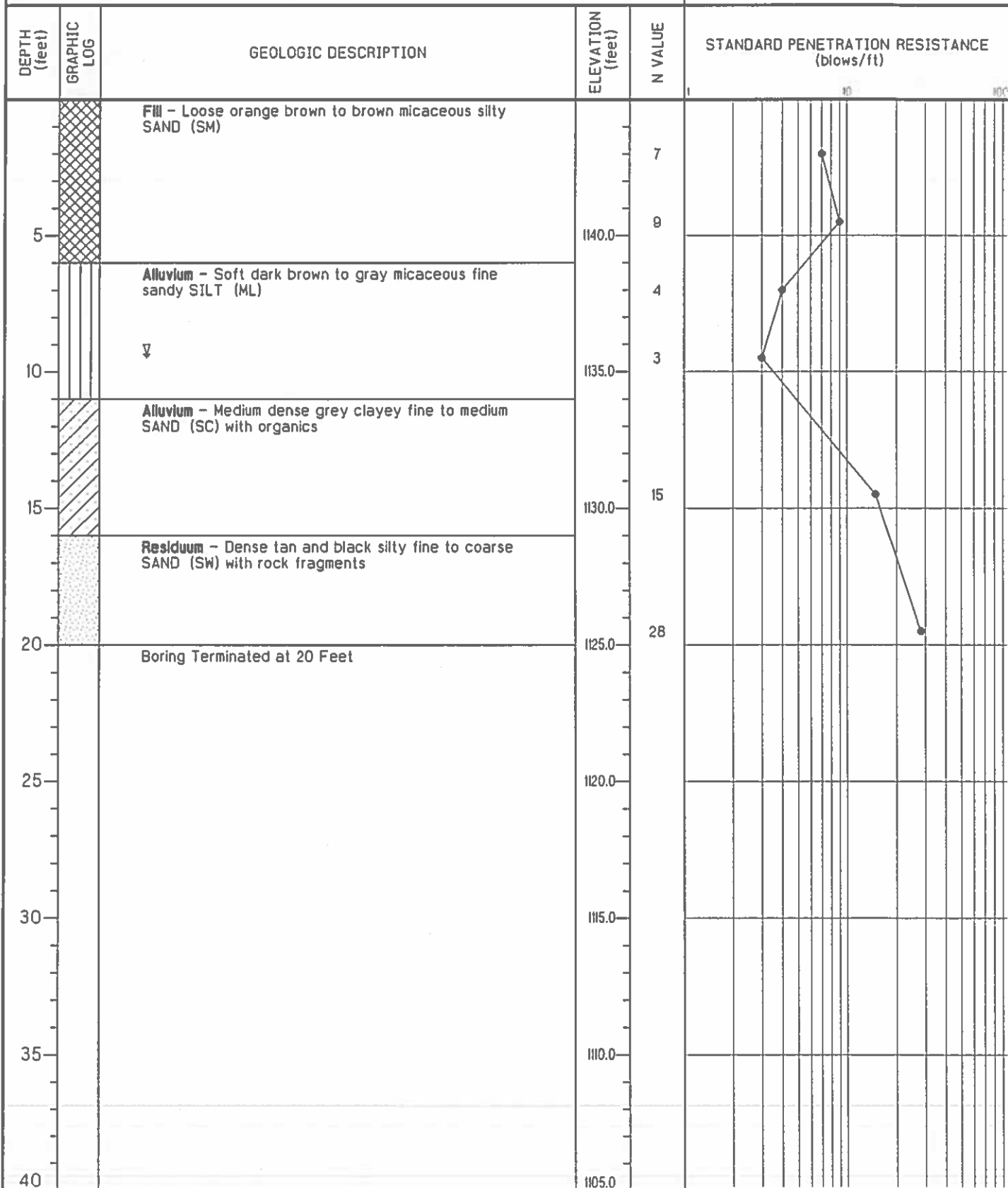
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					1	2	3	4	5	6	7	8	9	10						
5		Auger Boring - No split-spoon sampling performed (See log of Boring B-14 for soils description)	1140.0	39																
10			1135.0																	
15		Residuum - Dense brown micaceous silty fine to medium SAND (SM)	1130.0																	
		Boring Terminated at 15 Feet																		
20			1125.0																	
25			1120.0																	
30			1115.0																	
35			1110.0																	
40			1105.0																	

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-15

GEOLOGIST: N/A	ELEVATION: 1145 Feet
DATE DRILLED: 10/16/06	BORING DEPTH: 20 Feet
DRILLER: GABLE DRILLING CO.	WATER LEVEL: 9 Feet
DRILLING METHOD: HOLLOW STEM AUGER	

NOTES: Water level at time of boring (▽) was measured at 9 Feet.



March 7, 2026

Ms. Christa Hopkins
City Engineer
Cumming Utilities
100 Main Street, Suite 401
Cumming, Georgia 30040

Re: Supplementary Geotechnical Exploration Report
City of Cumming
PWPF Clearwell Improvements
Forsyth County, Georgia
GeoSystems Proposal No. 25-3003

Dear Ms. Hopkins:

GeoSystems Engineering, Inc. (GeoSystems) has completed a supplementary geotechnical exploration for the proposed City of Cumming PWPF Clearwell Improvements project. The purpose of this supplementary exploration was to further characterize subsurface conditions at the project site as a result of revisions to the structure locations and elevations. Our previous *Geotechnical Exploration Report* was submitted on January 29, 2026. This supplementary report updates our previous foundation support recommendations and addresses groundwater issues prompted by the revisions to the project. All other conclusions and recommendations in our previous report remain applicable.

REVISED PROJECT INFORMATION

The following summarizes our understanding of the revised design conditions for the project as discussed in our Microsoft Teams Meeting with Ted Turner and David Clark of Stratus on February 18, 2026, and the provided *2026-02-17 Civil Excerpts for Geotech* pdf drawings. This supplementary geotechnical exploration report addresses the structures included in Phase 2 and Phase 3 developments of the site. Except for proposed emergency generators, which were not included previously, these structures were typically relocated at various distances south of the locations referenced in our January 29 report.

Phase 2 Development

A 160-foot diameter, 6.0-million gallon (MG) clearwell, electrical building and emergency generators are included in the Phase 2 development. The clearwell and electrical building construction conditions are as described in our previous report, except the top of slab elevation for the clearwell was lowered 5 feet to 1155.00 feet and the electrical building finished floor elevation is now 8 feet lower at 1150.00 feet.

No details have been provided concerning the emergency generators; however, we expect that foundation support will consist of a shallow mat type foundation on grade. Planned site grade at the location of the generators is shown at 1149 to 1150 feet elevation, which will require about 8 feet of cut below existing site grade in the northwest corner and a maximum of 6 feet of new fill in the southwest corner.

Phase 3 Development

Phase 3 development consists of a future high service pump station (HSPS). As noted in our previous geotechnical exploration report, the HSPS will be conventional CMU type construction. A revised finished floor elevation of 1150 feet is currently planned with a lower top of slab elevation of 1137 feet for an approximate 20-foot wide pipe vault along the west side of the structure. Based on the proposed Phase 2 finished site grades, a maximum cut of 5 or 6 feet will be necessary in the western portion of the structure at the time of construction to achieve the upper floor slab elevation. In the lower pipe vault area, a 17 to 20-foot deep excavation is indicated.

EXPLORATION PROCEDURES

Our supplementary geotechnical exploration included three soil test borings (B-23, B-24 and B-25) in the clearwell location, two borings (B-20 and B-21) in the electrical building, and three (B-18, B-19 and B-22) in the future HSPS location. The boring locations are shown on the enclosed Supplementary Boring Location Plan (Figure 1) prepared from the Detailed Grading Plan, Sheet C-203A, included in the excerpt drawings provided to us. The City of Cumming Utilities staked the boring locations at the site and provided existing grade elevations at the locations prior to the field work. Elevations of the borings in this report were rounded to the nearest 1.0-foot elevation increment from the ground elevations provided by the city. Borings B-18, B-19 and B-23 through B-25 in the clearwell and future HSPS structures were completed to auger refusal depths varying from 31 to 52 feet below ground surface (bgs). Borings B-20, B-21 and B-22, at the corners of the electrical building and HSPS structure along the south side, were terminated at depths of 40 and 50 feet.

Soil test boring, soil sampling operations and preparation of soil test boring logs and subsurface profiles were as described in our previous report. The Supplementary Boring Location Plan, subsurface profiles (Figures 2 through 5) and supplementary soil test boring records, which represent our interpretation of the field subsurface conditions are included as attachments to this report.

SUBSURFACE CONDITIONS

Except at the locations of borings B-18 and B-19, the supplementary borings initially encountered undocumented fill overlying residual soils. The fill is undocumented in terms of there being no previous records on the nature of the fill materials and compaction during placement. Residual soils were found near the ground surface in borings B-18 and B-19. Below the residual soils, partially weathered rock (PWR) and then auger refusal conditions were typically found. Groundwater was encountered in all of the supplementary boring locations at the time of investigation.

Fill

Undocumented fill was initially encountered from near the ground surface to depths of 18 to 23 feet at the boring locations noted above. The fill materials are similar to those previously encountered at the site and consist mainly of silty sand (SM), clayey sand (SC) and low plasticity clay (CL) with rock fragments, asphalt fragments, wood fragments, and other organic matter. Standard penetration resistances in the fill ranged from weight of hammer (WOH) to a maximum of 18 blows per foot (bpf). Weight of hammer is a term used to describe at least 18 inches of penetration by the split-spoon sampler into the soil formation solely under the weight of the 140-pound test hammer.

Residual Soils/Partially Weathered Rock

Residual soils and then partially weathered rock were typically found below the fill and below topsoil in borings B-18 and B-19. Borings B-20 and B-22 were terminated in residual soils at a depth of 40 feet. Residual soils extended to the top of partially weathered rock at depths varying from 28 to 48 feet in the remaining borings. The residual soils encountered in this supplementary exploration were classified predominantly as silty sand (SM) and sandy silt (ML). An upper 6 to 8-foot thick layer of sandy clay (CL) was also penetrated at the locations of borings B-18 and B-19. Standard penetration resistances in the residual soils ranged from a minimum of 2 to a maximum of 77 bpf.

Except for borings B-20 and B-22, continuous 3 to 7-foot thick layers of partially weathered rock were encountered to auger refusal or termination depths in the supplementary borings. The partially weathered rock materials were typically sampled as very dense silty sand (SM).

Auger Refusal Conditions

Hollow stem auger refusal conditions were encountered at depths varying from 31 to 52 feet in all borings, except B-20, B-21 and B-22, that were terminated in the residuum at depths of 40 and 50 feet. Rock core drilling or other exploration methods are required to determine the nature and continuity of refusal material; however, refusal conditions at the boring locations appear to be the upper surface of bedrock.

Groundwater

Groundwater levels were measured at the time of the supplementary field investigation at depths varying approximately from 5 to 27 feet below the existing ground surface. The groundwater level measurements correlate to a water table elevation between 1137 and 1142 feet, as noted in our previous geotechnical exploration. Groundwater is subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than reported during this study.

DESIGN & CONSTRUCTION RECOMMENDATIONS

Foundation Support

Our supplementary geotechnical exploration shows the Phase 2 and Phase 3 clearwell improvement structures at the revised locations will be mostly underlain by 10 to 18 feet of undocumented fill at proposed foundation bearing elevations. At a finished floor elevation of 1150 feet, foundation support conditions for the electrical building will include 4 to 6 feet of new structural fill along the east end overlying 10 to 18 feet of existing fill and some alluvium. Boring data from our 2006 investigation shows that 12 to 18 feet of fill and alluvium will underlie the emergency generators area. At the east end of the generators, 5 to 6 feet of new structural fill will also be required. The residual soils below the existing fill and alluvium are also indicated to be relatively weak and compressible at a number of locations.

Due to the difficult subsurface conditions at this site, we recommend that ground improvement measures, as described in our previous exploration report, be implemented to provide uniform support conditions and reliable long-term foundation performance for the clearwell improvement structures. It appears that minor portions of the clearwell in the northwest quadrant and the HSPS along the west side of the structure will bear in undisturbed residual soils and ground improvement measures in these areas may not be necessary. Further coordination with specialty geotechnical contractors is recommended to evaluate if reducing the treatment areas is feasible.

Groundwater Control

In order to achieve the 1137 top of slab elevation for the pipe vault along the west side of the Phase 3 HSPS structure, a deep excavation on the order of 17 to 20 feet below the planned Phase 2 finished grade is anticipated. The excavation is expected to extend below the water table in unconsolidated soils, as indicated by the conditions encountered at the locations of 2025/2026 exploration borings B-10 and B-18, and 2006 boring B-4. We expect that a combination of sloping and temporarily bracing or shoring will be used for excavation protection during the vault installation and proper dewatering of the excavation must be performed to improve excavation conditions and prevent the loss of soil strength or “quick” soil conditions in the unconsolidated soils. Once the entire excavation area has been adequately dewatered, temporary excavation slopes constructed within the upper existing fill soils should be no steeper than 1.5(H):1.0(V). A temporary excavation shoring system to support the deeper excavation should be designed to support earth pressures as subsequently outlined in this report.

Dewatering by pumping from sumps located within the vault excavation is not recommended. This excavation in soil below the water table will require a positive system of dewatering such as staged vacuum well points or deep wells to adequately lower and maintain the groundwater at the required level during construction.

We note that groundwater levels could change considerably based on seasonal and climatic variations and more extensive dewatering may be required if water levels are significantly higher during construction than those indicated during this investigation. The necessity and extent of any dewatering required should be determined in advance of construction to allow sufficient time to lower and maintain groundwater levels at least 3 feet below excavation levels at all times.

QUALIFICATION OF RECOMMENDATIONS

This supplementary geotechnical exploration report has been prepared for the exclusive use of the City of Cumming for design and construction of the proposed PWPF clearwell improvements. Conclusions and recommendations in this report were based on the site and subsurface information obtained and our understanding of the planned site development. The exploratory activities, testing procedures, and evaluation of the data were consistent with the skill and care ordinarily provided by professional geotechnical engineering practice in the Piedmont geologic setting under the same or similar circumstances for projects of this type and at the time of these services. We have made recommendations based on our experience with similar subsurface conditions under similar loading conditions.


Other than the foundation support and groundwater control measures noted, there are no significant changes to the evaluations and conclusions presented in our January 29 report. Seismic site classification, site preparation, earthwork, slope stability, foundation support, lateral earth pressure and inspection recommendations previously presented remain applicable for the revised clearwell improvements structure locations and elevations. Our previous report and this supplementary report should be used together to provide a complete understanding of the project and our geotechnical services. We make no warranties or guarantees, either expressed or implied. GeoSystems is not responsible for the conclusions, opinions or recommendations of others based on our findings and evaluations.

We note that regardless of the thoroughness of a geotechnical exploration there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. If conditions differing from those anticipated are encountered during construction, GeoSystems should review the conditions to address any issues. Should the project plans change substantially from those outlined in this report, we also request the opportunity to review our recommendations in light of any changes.

We appreciate the opportunity to continue working with you on this project. If you have any questions concerning this report or need anything further, please call me.

Sincerely,

GeoSystems Engineering, Inc.

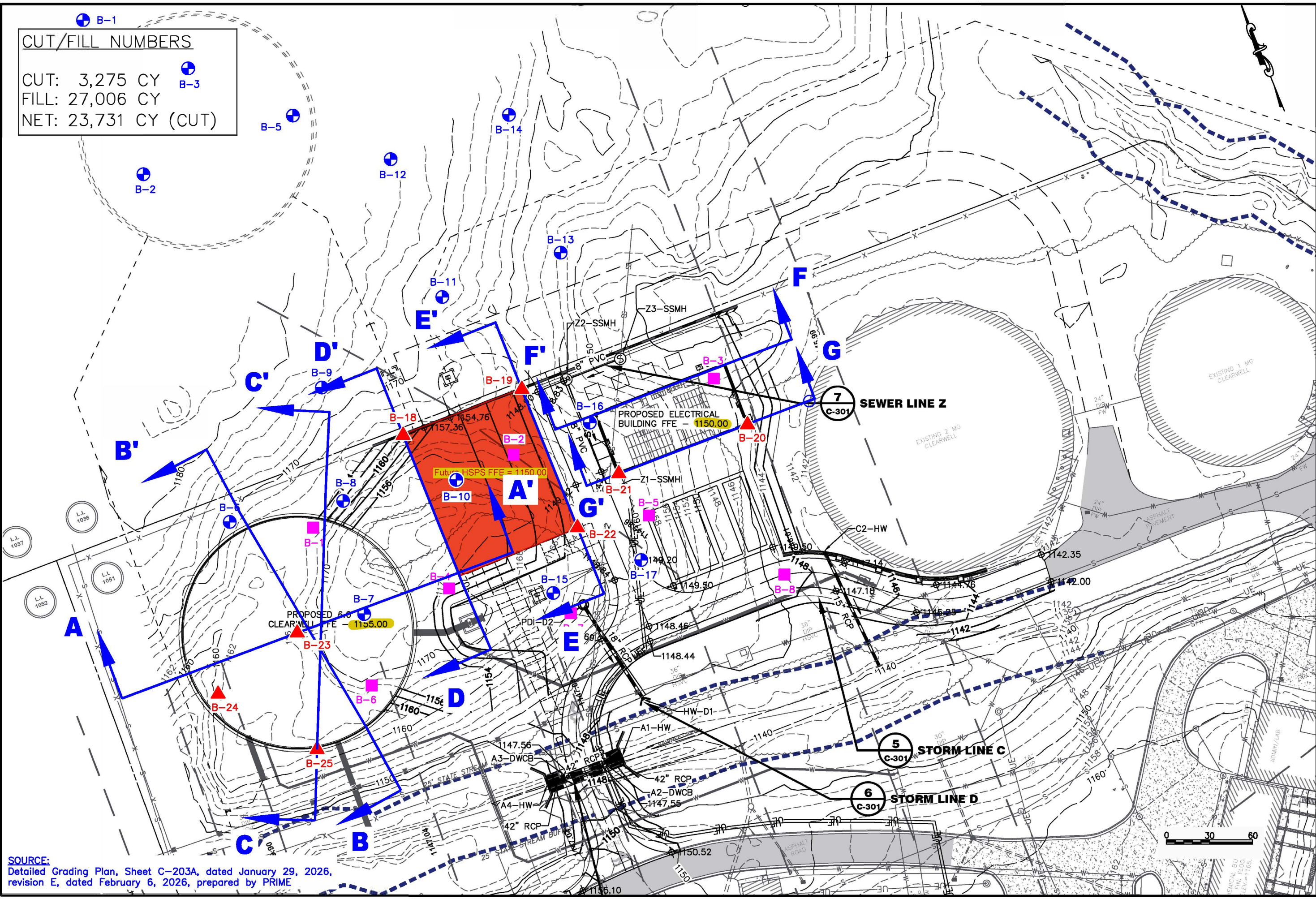

Larry D. Mullins, P.E.
Principal Engineer



Attachments: Supplementary Boring Location Plan (Figure 1)
Subsurface Profiles (Figures 2 through 5)
Keys to Symbols and Classifications
Soil Test Boring Logs (10 pages)

CUT/FILL NUMBERS

CUT: 3,275 CY
 FILL: 27,006 CY
 NET: 23,731 CY (CUT)



SOURCE:
 Detailed Grading Plan, Sheet C-203A, dated January 29, 2026,
 revision E, dated February 6, 2026, prepared by PRIME

SUPPLEMENTARY BORING LOCATION PLAN

PROJECT: CITY OF CUMMING, GEORGIA
 PWPF PHASE 2 CLEARWELL IMPROVEMENTS
 935 DAHLONGEA, FORSYTH COUNTY, GA
 GEOSYSTEMS PROJECT NUMBER: 25-3003

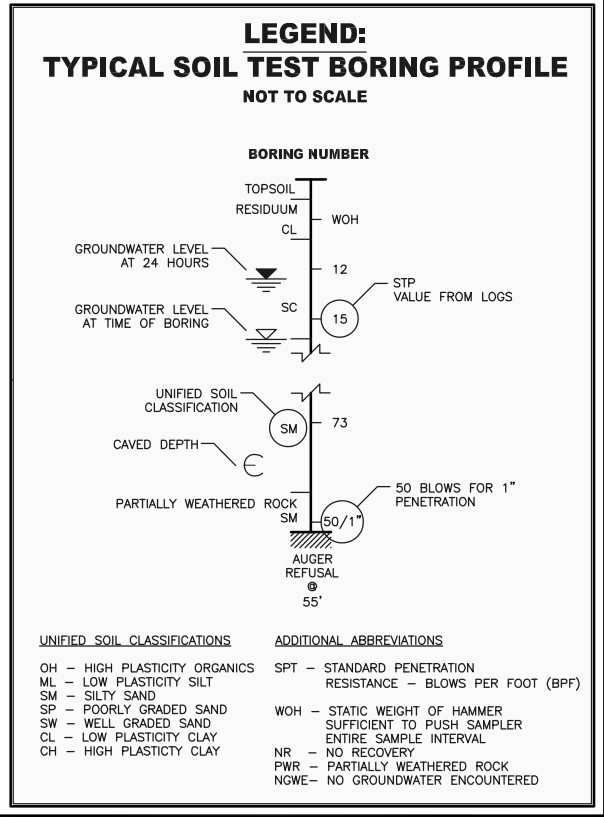
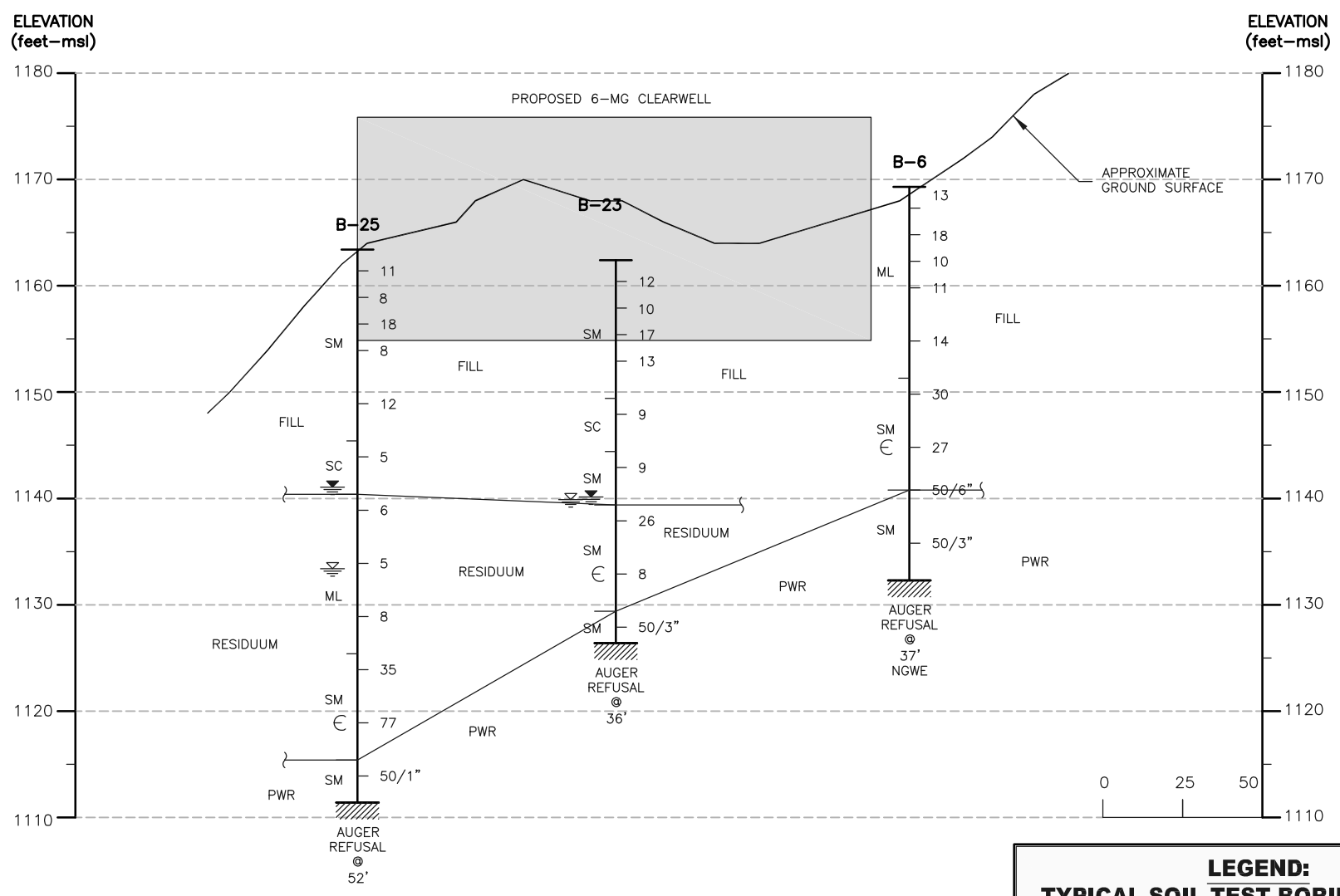
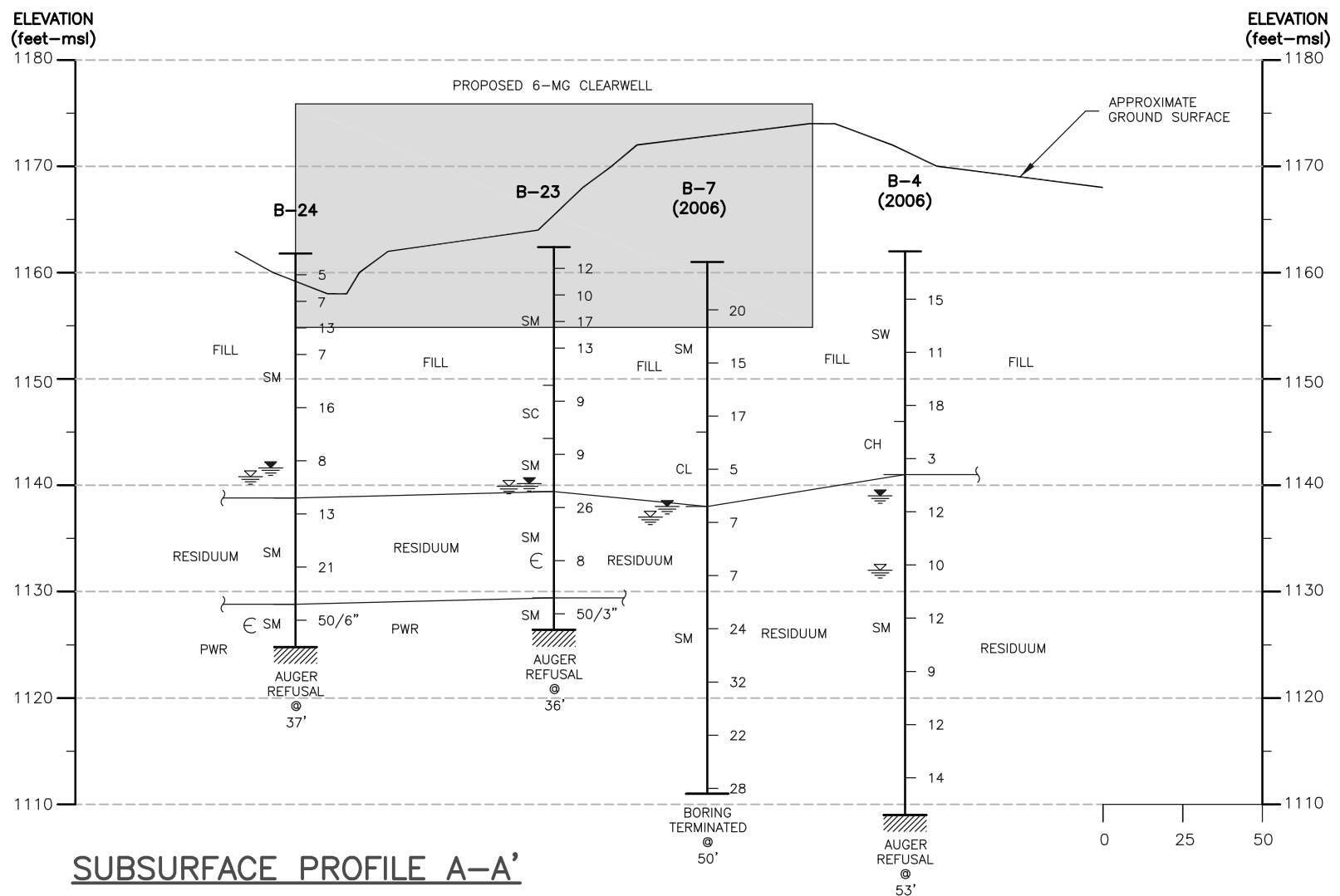
PREPARED BY: ARC
 DATE: 3/4/2026
 REVIEWED BY: LDM
 DATE: 3/4/2026

FIGURE
1

GEOSYSTEMS
 ENGINEERING, INC.

REFERENCE: C_PWPF P2 (V2).dwg

- LEGEND**
- SUPPLEMENTARY SOIL TEST BORING (2026 EXPLORATION)
 - SOIL TEST BORING (2025)
 - SOIL TEST BORING (2006)
- SCALE: 1" = 60' (APPROXIMATELY)



- NOTES:**
1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C-203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
 2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
 3. Previous 2006 soil test borings are plotted at elevations listed in the subsurface investigation report, dated November 14, 2006.

LEGEND



SUBSURFACE PROFILES

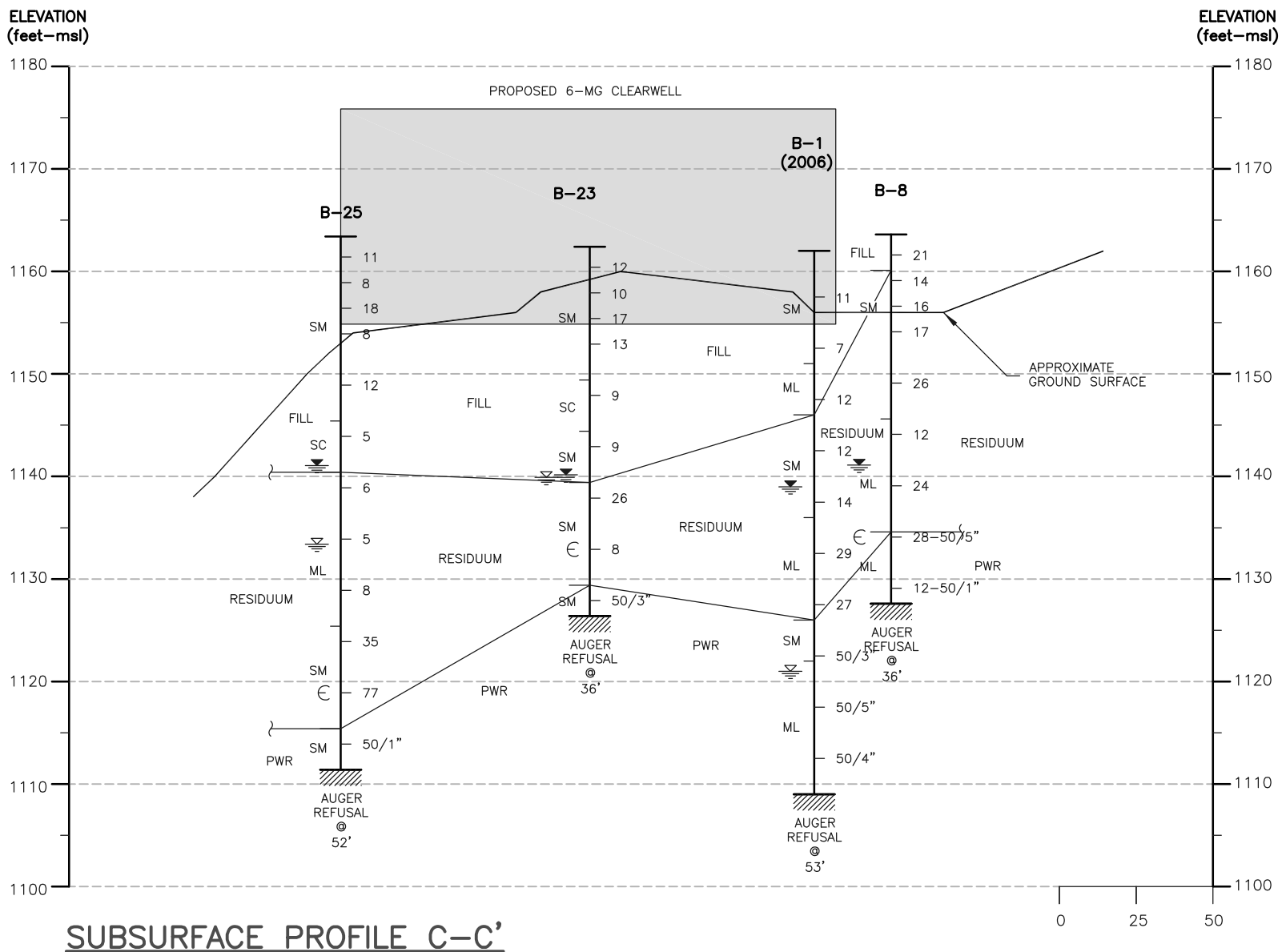
SCALE AS SHOWN (APPROXIMATE)

REFERENCE: BCW BLP.dwg

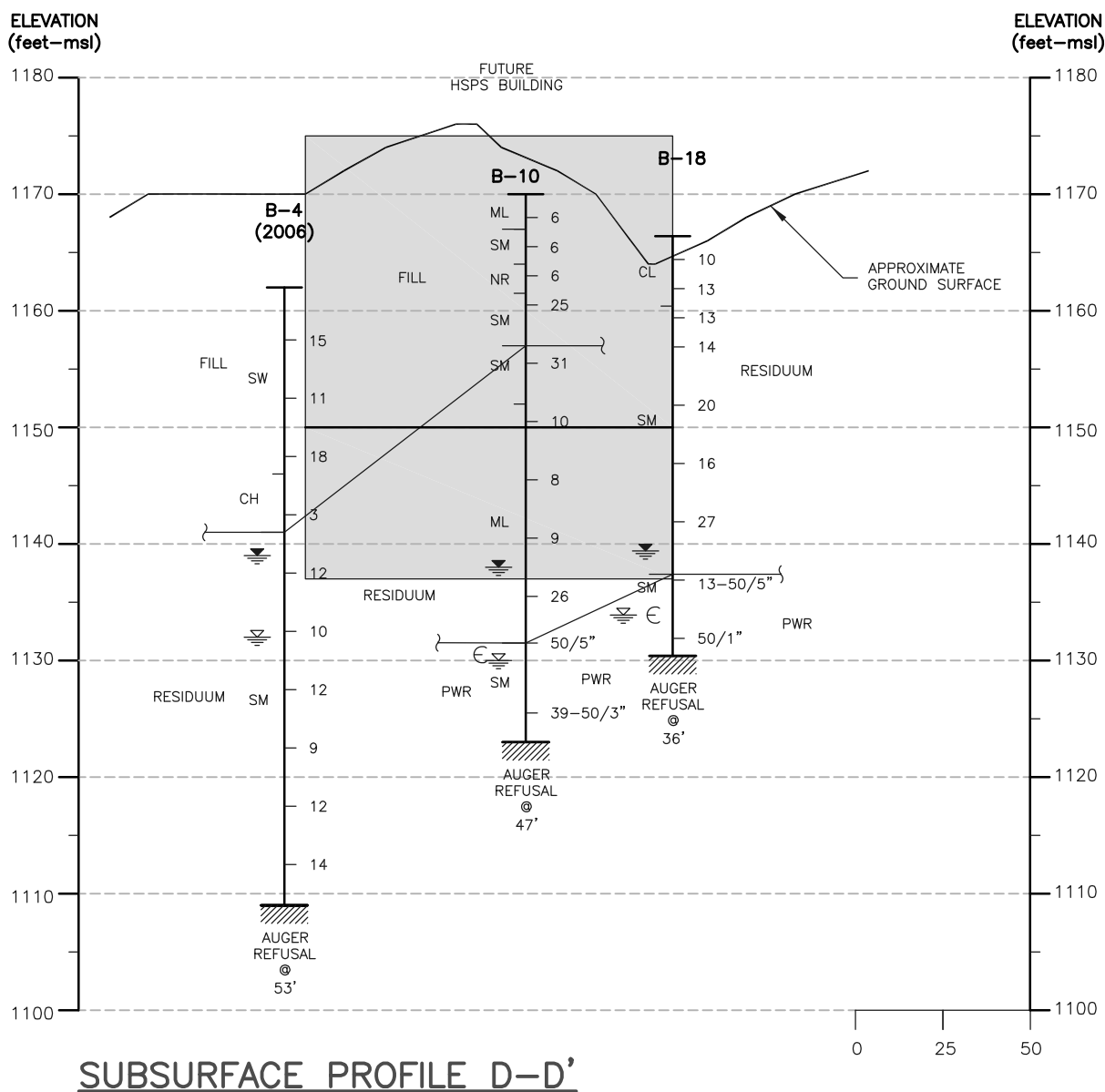
PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25-3003

PREPARED BY: ARC
DATE: 3/3/2026
REVIEWED BY: LDM
DATE: 3/3/2026

FIGURE:
2



SUBSURFACE PROFILE C-C'



SUBSURFACE PROFILE D-D'

NOTES:

1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C-203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the subsurface investigation report, dated November 14, 2006.

LEGEND

GEOSYSTEMS
ENGINEERING, INC.

REFERENCE: BCW BLP.dwg

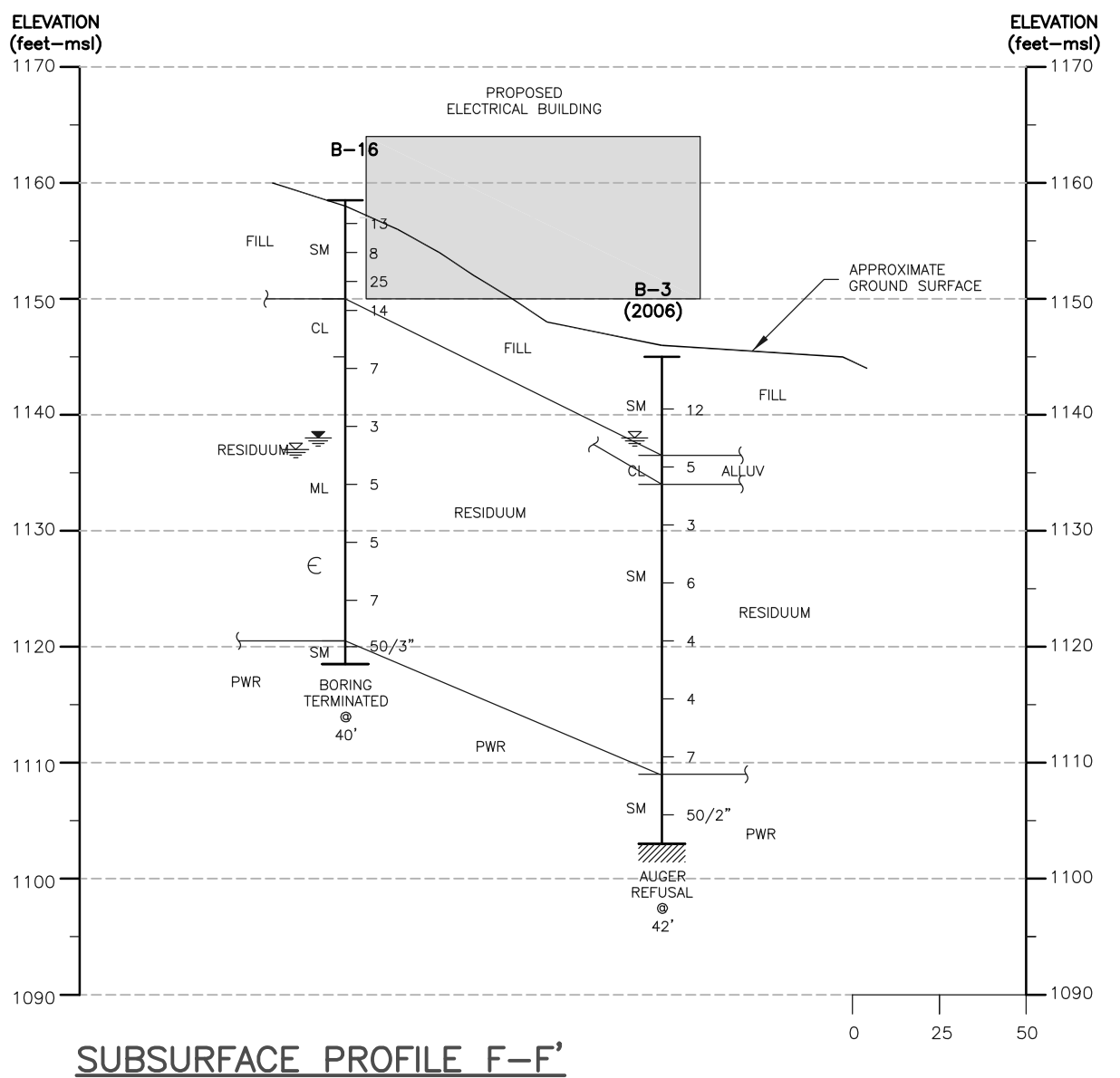
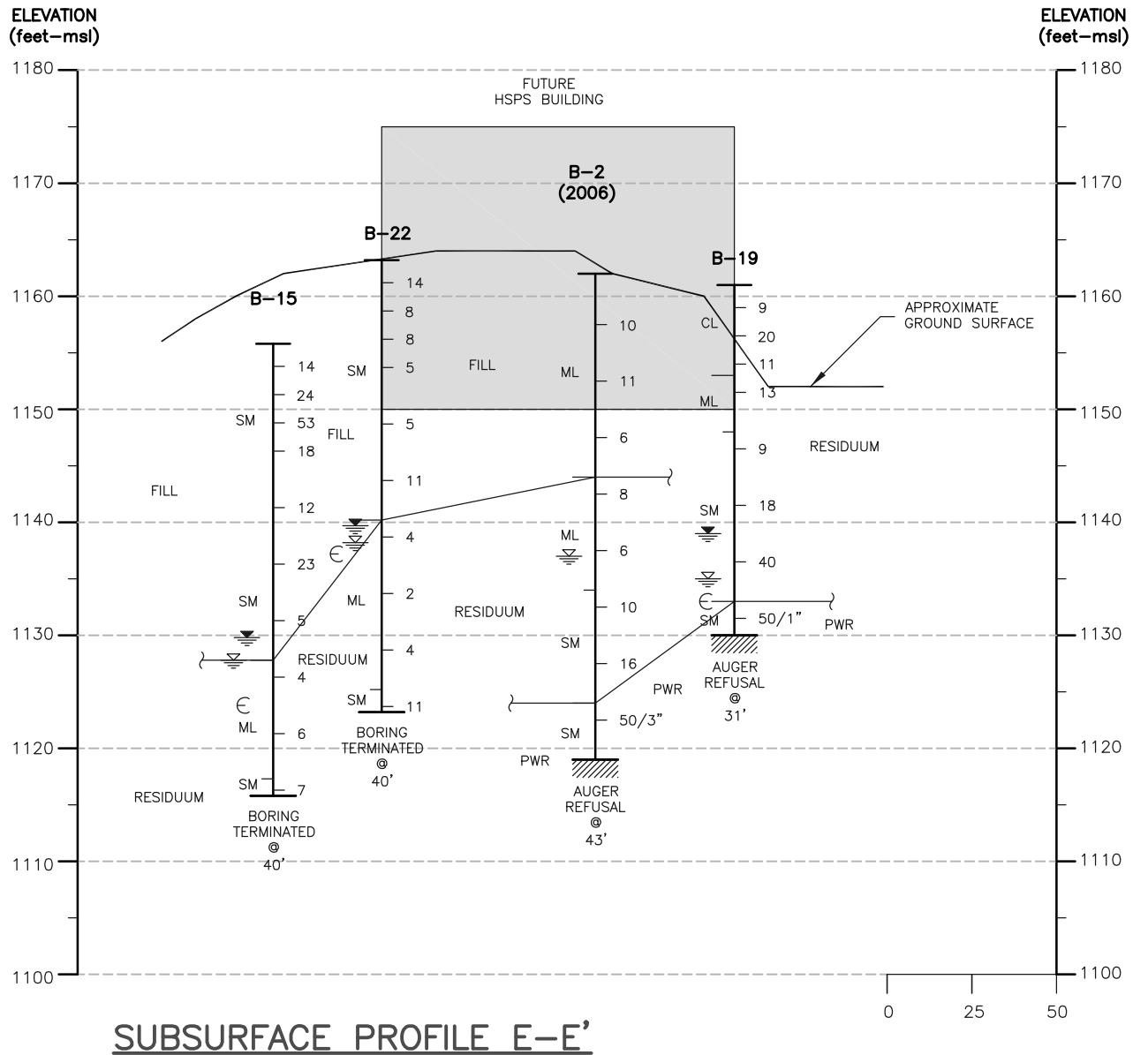
SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWWP PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25-3003

PREPARED BY: ARC
DATE: 3/3/2026
REVIEWED BY: LDM
DATE: 3/3/2026

FIGURE:
3

SCALE AS SHOWN (APPROXIMATE)



LEGEND:
TYPICAL SOIL TEST BORING PROFILE
NOT TO SCALE

BORING NUMBER

TOPSOIL
RESIDUUM
CL
WOH

GROUNDWATER LEVEL AT 24 HOURS

GROUNDWATER LEVEL AT TIME OF BORING

UNIFIED SOIL CLASSIFICATION

CAVED DEPTH

PARTIALLY WEATHERED ROCK

SM

50/1" PWR

AUGER REFUSAL @ 55'

STP VALUE FROM LOGS

50 BLOWS FOR 1" PENETRATION

UNIFIED SOIL CLASSIFICATIONS

OH - HIGH PLASTICITY ORGANICS
ML - LOW PLASTICITY SILT
SM - SILTY SAND
SP - POORLY GRADED SAND
SW - WELL GRADED SAND
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

ADDITIONAL ABBREVIATIONS

SPT - STANDARD PENETRATION RESISTANCE - BLOWS PER FOOT (BPF)
WOH - STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
NR - NO RECOVERY
PWR - PARTIALLY WEATHERED ROCK
NGWE - NO GROUNDWATER ENCOUNTERED

- NOTES:**
1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C-203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
 2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
 3. Previous 2006 soil test borings are plotted at elevations listed in the subsurface investigation report, dated November 14, 2006.

LEGEND

GEOSYSTEMS
ENGINEERING, INC.

REFERENCE: BCW BLP.dwg

SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25-3003

PREPARED BY: ARC
DATE: 3/3/2026
REVIEWED BY: LDM
DATE: 3/3/2026

FIGURE:
4

SCALE AS SHOWN (APPROXIMATE)

KEYS TO SYMBOLS AND CLASSIFICATIONS

SPECIAL STRATIGRAPHY IDENTIFIERS USED TO HIGHLIGHT SPECIFIC LAYERS	FILL TOPSOIL PAVEMENT	PARTIALLY WEATHERED ROCK ROCK (GENERAL) WATER ALLUVIUM
COARSE GRAINED SOIL - GRAVELS & SANDS (MORE THAN 50% OF MATERIAL IS RETAINED ON NO. 200 SIEVE)	CLEAN SANDS & GRAVELS (< 5% FINES CONTENT)	SP: Poorly graded sands SW: Well graded sands GP: Poorly graded gravels GW: Well graded gravels
FINE GRAINED SOIL - SILTS & CLAYS (MORE THAN 50% OF MATERIAL PASSES NO. 200 SEIVE)	SANDS & GRAVELS WITH HIGH FINES CONTENT (> 15% FINES CONTENT)	SM: Silty sands GM: Silty gravels SC: Clayey sands GC: Clayey gravels
SILTS	CLAYS	ML: Low plasticity inorganic silts MH: High plasticity inorganic silts CL: Low placticity inorganic clays CH: High plasticity inorganic clays
ORGANIC SILTS & CLAYS	ORGANIC SILTS & CLAYS	OL: Low plasticity organic silts and clays OH: High plasticity organic silts and clays

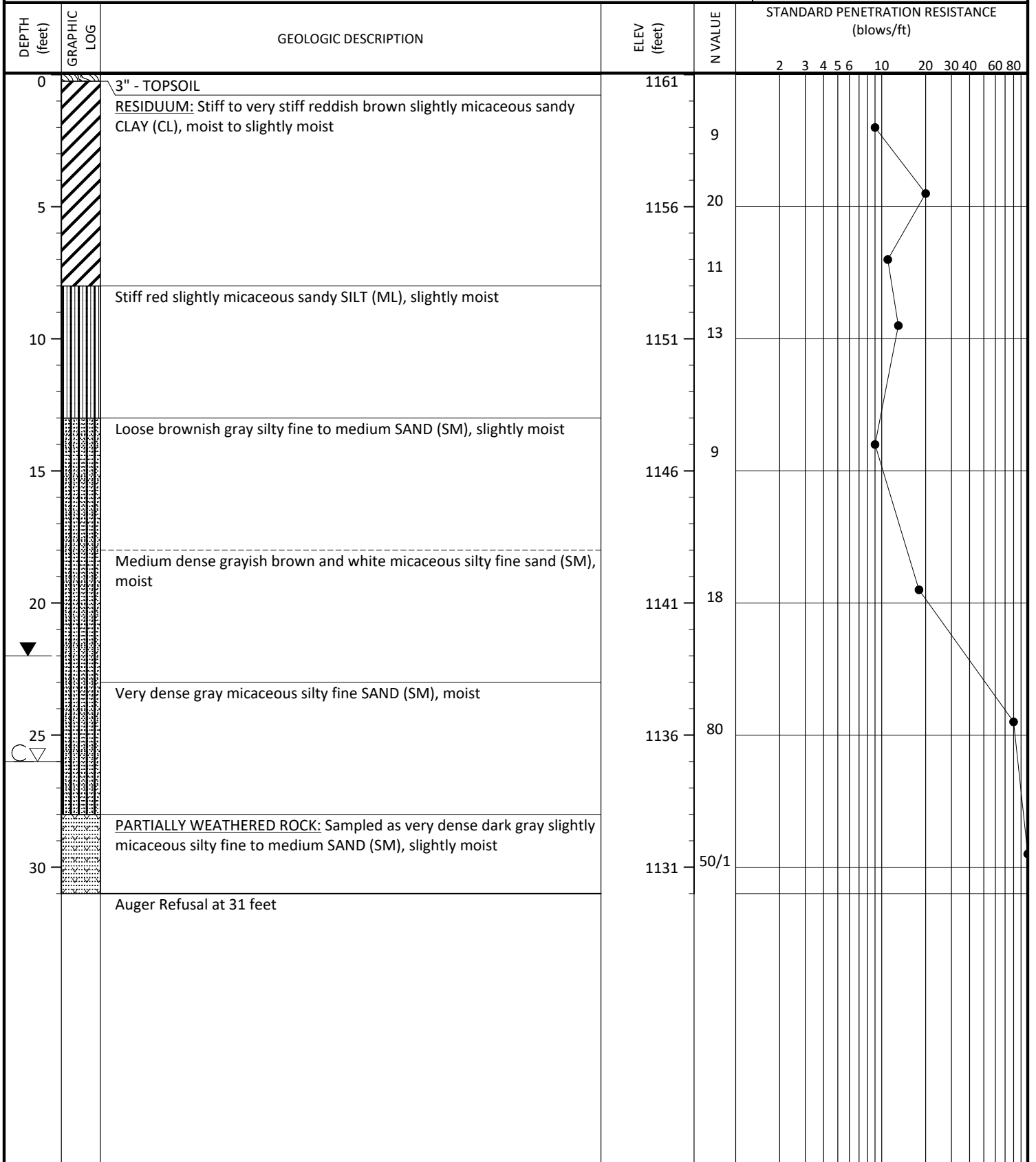
CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE DENSITY
SANDS AND GRAVELS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
	SILTS AND CLAYS	NUMBER OF BLOWS, N
0 - 1		Very Soft
2 - 4		Soft
5 - 8		Firm
9 - 15		Stiff
16 - 30		Very Stiff
31 - 50		Hard
OVER 50		Very Hard

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-19

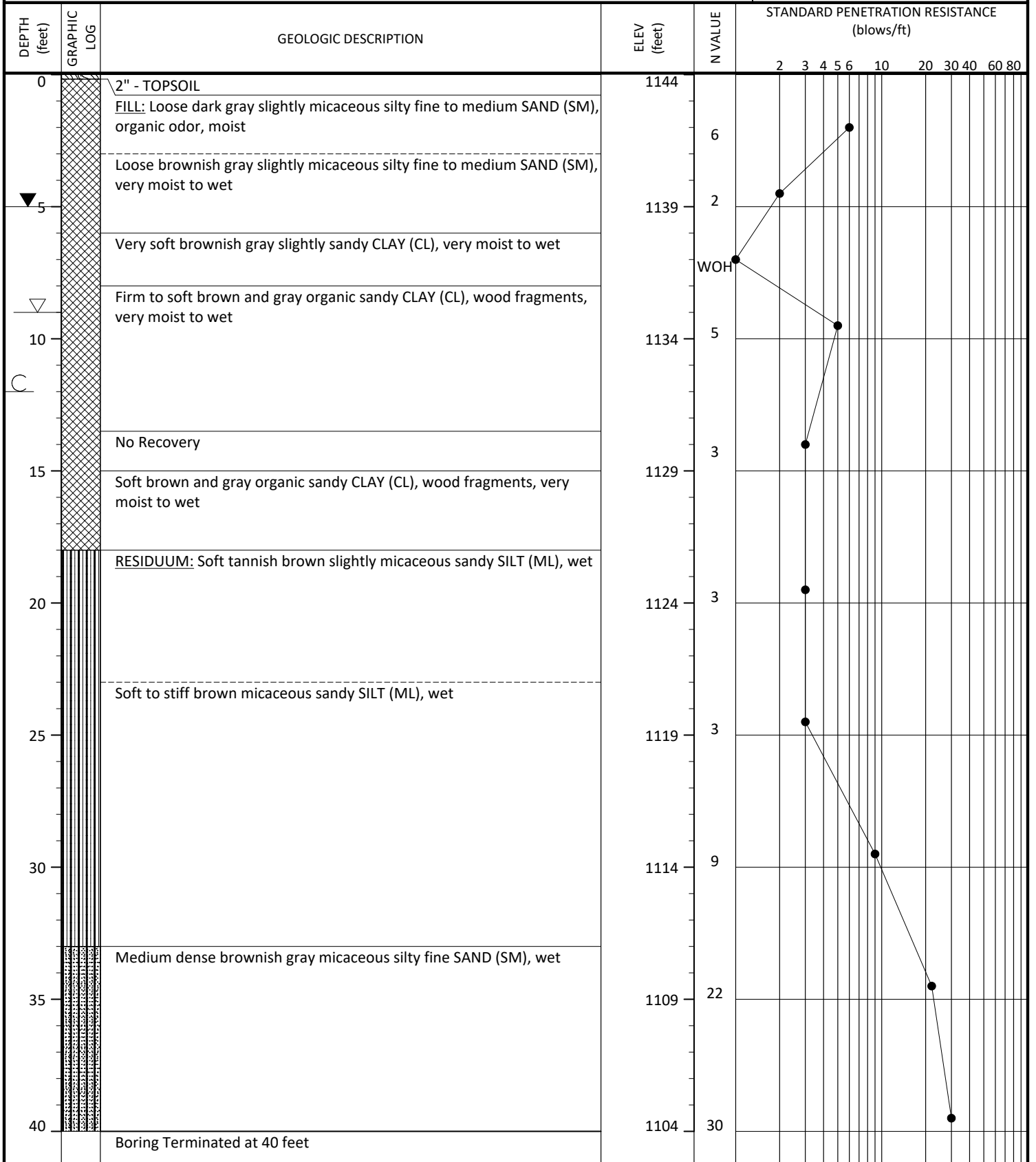
GEOLOGIST: NA	ELEVATION (feet): 1161	NOTES: 1. Groundwater detected at 26 feet at the time of boring. 2. Groundwater level measured at 22 feet approximately 5 hours after drilling. 3. Borehole caved to a depth of 26 feet.
DATE DRILLED: 2/25/2026	BORING DEPTH (feet): 31	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 26 \blacktriangledown 24HR (feet): 22	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-20

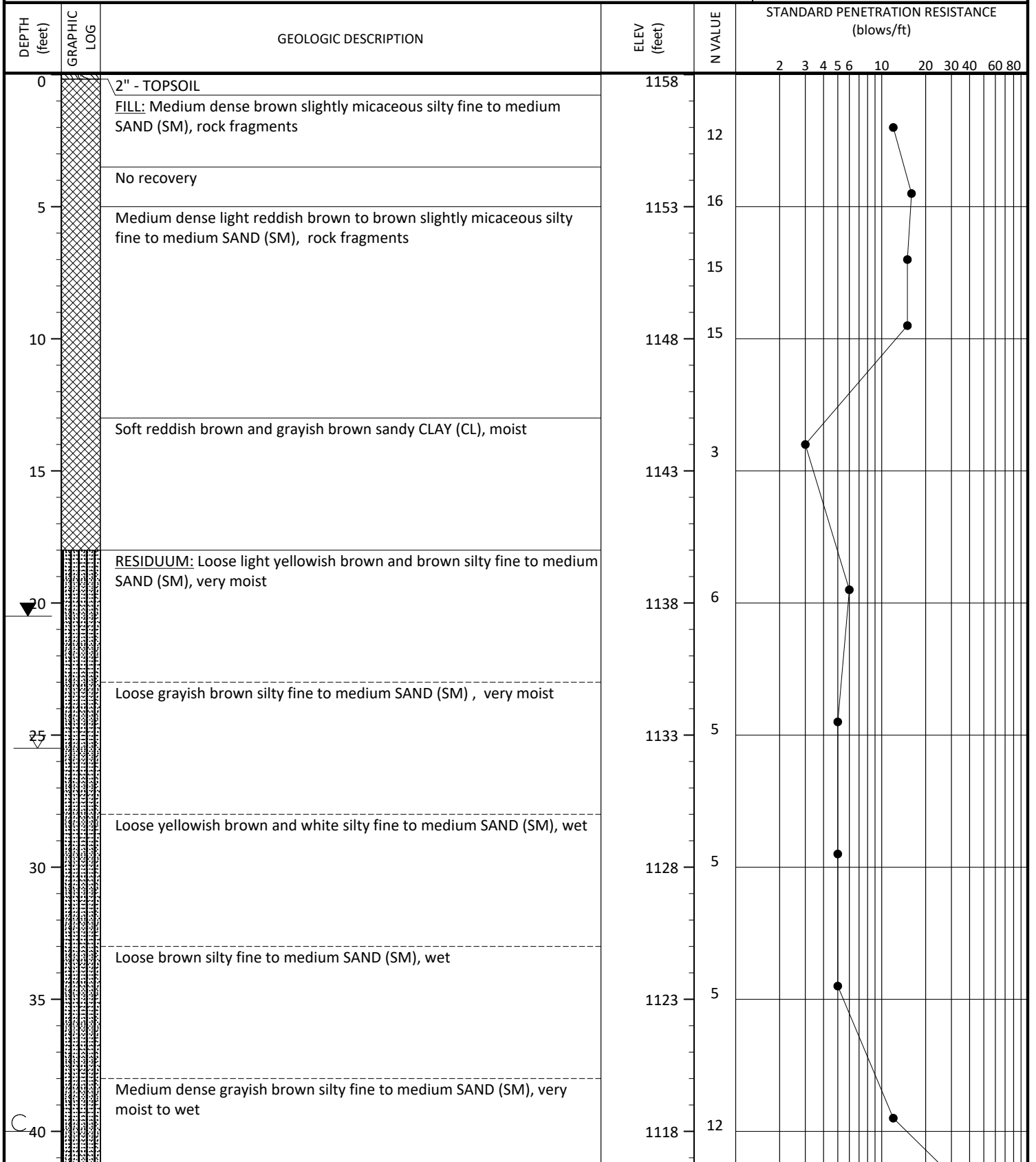
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1144</i>	NOTES: 1. Groundwater detected at 9 feet at the time of boring. 2. Groundwater level measured at 5 feet approximately 4 hours after drilling. 3. Borehole caved to a depth of 12 feet. 4. Weight of hammer (WOH).
DATE DRILLED: <i>2/24/2026</i>	BORING DEPTH (feet): <i>40</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL ∇ TOB (feet): <i>9</i> \blacktriangledown 24HR (feet): <i>5</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-21




GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1158</i>	NOTES: 1. Groundwater detected at 25.5 feet at the time of boring. 2. Groundwater level measured at 20.5 feet approximately 19 hours after drilling. 3. Borehole caved to a depth of 40 feet.
DATE DRILLED: <i>2/24/2026</i>	BORING DEPTH (feet): <i>50</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL ∇ TOB (feet): <i>25.5</i> \blacktriangledown 24HR (feet): <i>20.5</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		



**CITY OF CUMMING, GEORGIA
PWWP CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-21

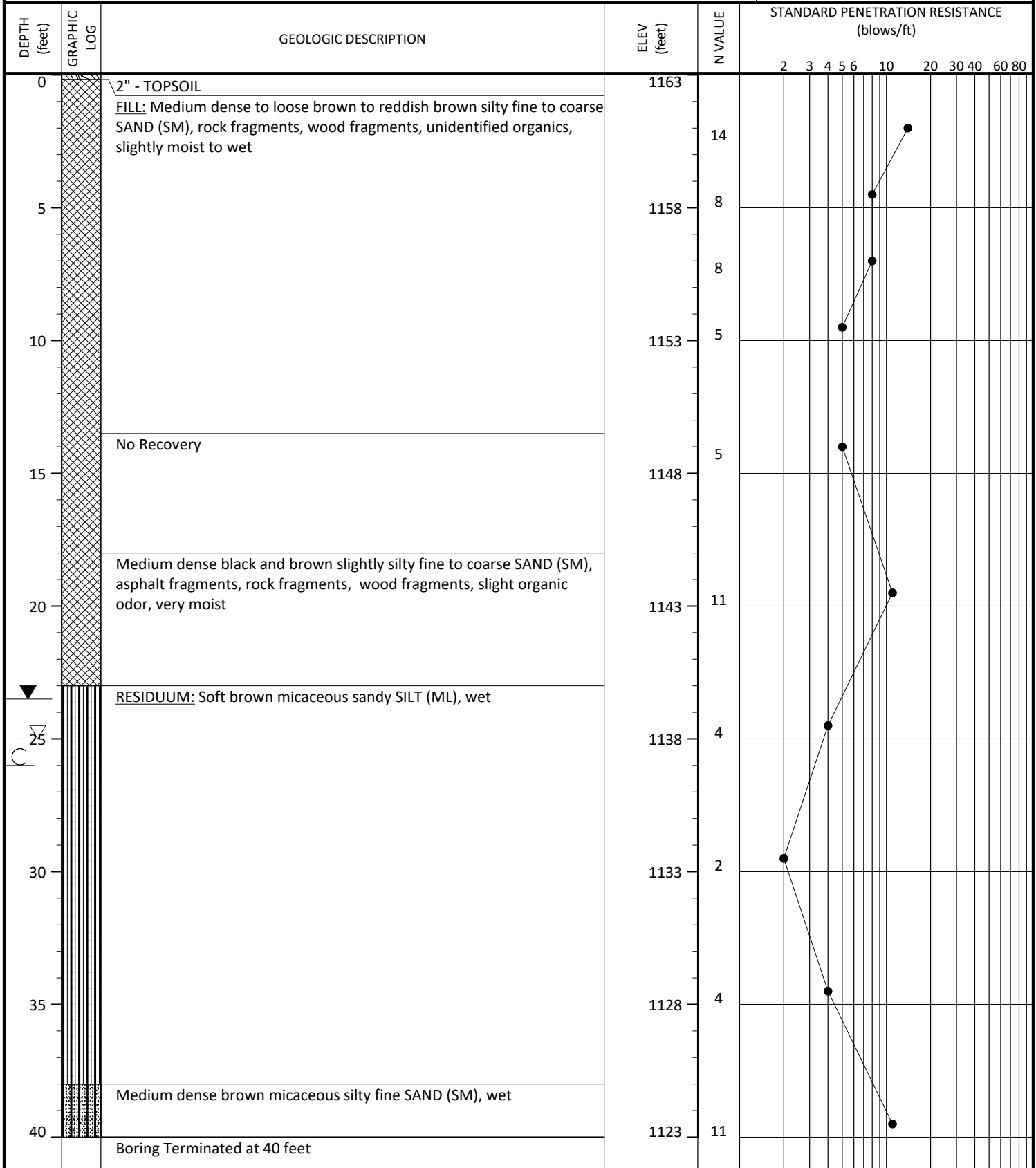
GEOLOGIST: <i>NA</i>		ELEVATION (feet): <i>1158</i>		NOTES: 1. Groundwater detected at 25.5 feet at the time of boring. 2. Groundwater level measured at 20.5 feet approximately 19 hours after drilling. 3. Borehole caved to a depth of 40 feet.
DATE DRILLED: <i>2/24/2026</i>		BORING DEPTH (feet): <i>50</i>		
DRILLER: <i>GRINDSTONE DRILLING</i>		WATER LEVEL ∇ TOB (feet): <i>25.5</i> \blacktriangledown 24HR (feet): <i>20.5</i>		
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>				

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					2	3	4	5	6	10	20	30	40	60	80						
		Medium dense grayish brown silty fine to medium SAND (SM), very moist to wet																			
45		PARTIALLY WEATHERED ROCK: Sampled as very dense grayish brown micaceous silty fine SAND (SM), very moist	1113	43-50/4"																	
50		Sampled as very dense dark gray micaceous silty fine SAND (SM), very moist	1108	50/4"																	
		Boring Terminated at 50 feet																			

**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-22

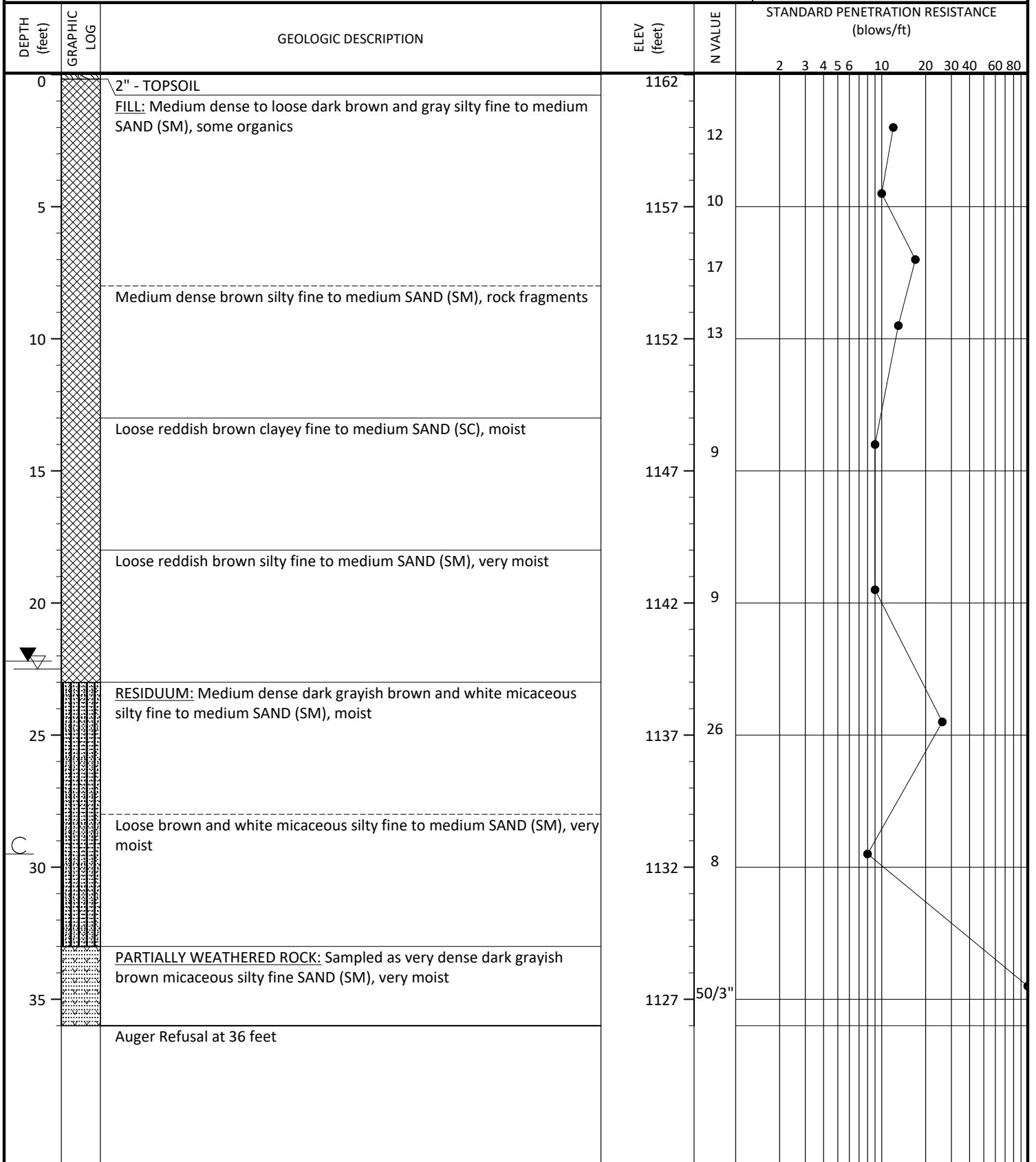
GEOLOGIST: NA	ELEVATION (feet): 1163	NOTES: 1. Groundwater detected at 25 feet at the time of boring. 2. Groundwater level measured at 23.5 feet approximately 16 hours after drilling. 3. Borehole caved to a depth of 26 feet.
DATE DRILLED: 2/24/2026	BORING DEPTH (feet): 40	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 25 \blacktriangledown 24HR (feet): 23.5	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-23

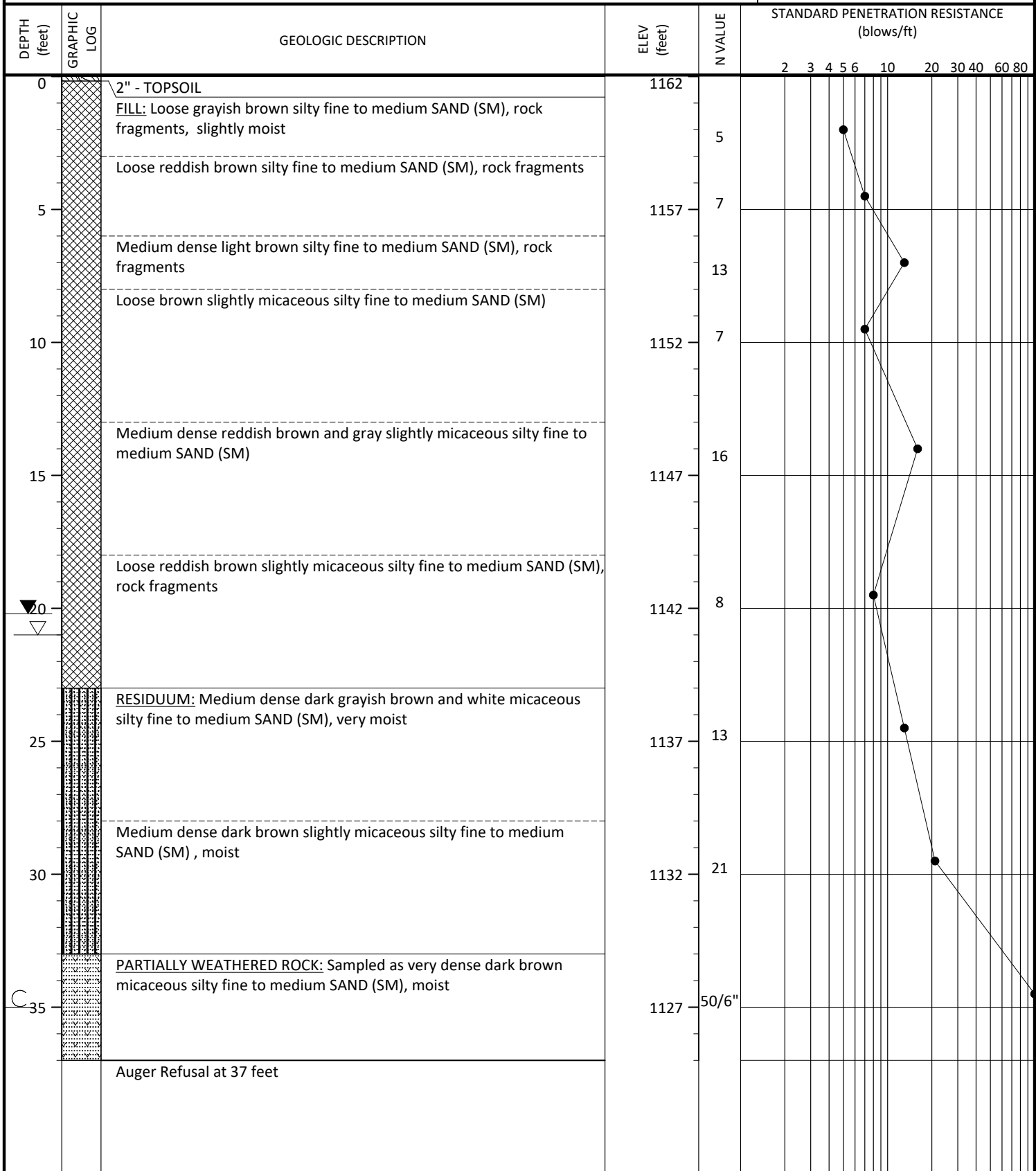
GEOLOGIST: NA	ELEVATION (feet): 1162	NOTES: 1. Groundwater detected at 22.5 feet at the time of boring. 2. Groundwater level measured at 22.2 feet approximately 24 hours after drilling. 3. Borehole caved to a depth of 29.5 feet.
DATE DRILLED: 2/25/2026	BORING DEPTH (feet): 36	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 22.5 \blacktriangledown 24HR (feet): 22.2	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-24

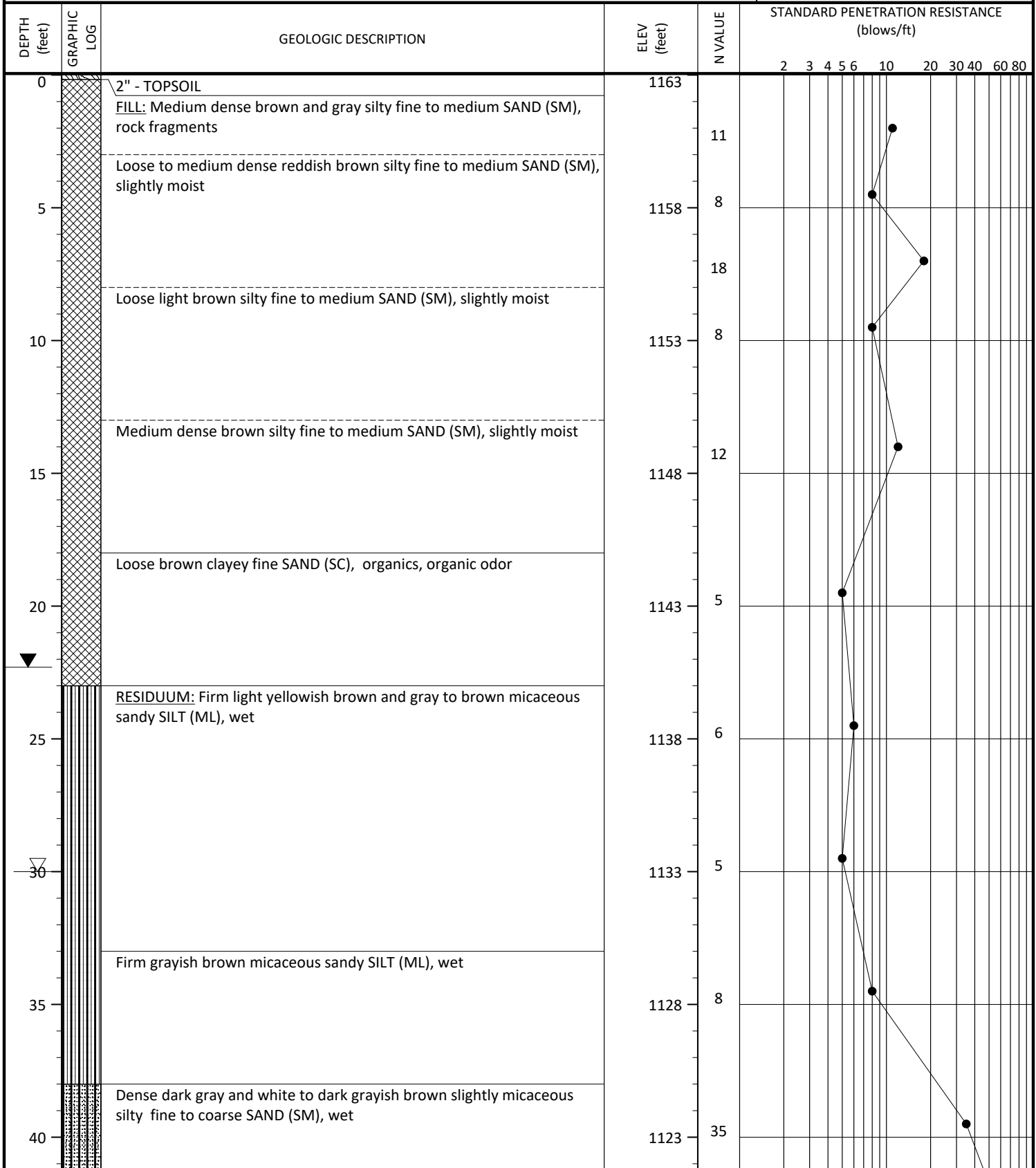
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>1162</i>	NOTES: 1. Groundwater detected at 21 feet at the time of boring. 2. Groundwater level measured at 20.2 feet approximately 24 hours after drilling. 3. Borehole caved to a depth of 35 feet.
DATE DRILLED: <i>2/25/2026</i>	BORING DEPTH (feet): <i>37</i>	
DRILLER: <i>GRINDSTONE DRILLING</i>	WATER LEVEL ∇ TOB (feet): <i>21</i> \blacktriangledown 24HR (feet): <i>20.2</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		



**CITY OF CUMMING, GEORGIA
PWP CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-25

GEOLOGIST: NA	ELEVATION (feet): 1163	NOTES: 1. Groundwater detected at 30 feet at the time of boring. 2. Groundwater level measured at 22.3 feet approximately 24 hours after drilling. 3. Borehole caved to a depth of 44.5 feet.
DATE DRILLED: 2/25/2026	BORING DEPTH (feet): 52	
DRILLER: GRINDSTONE DRILLING	WATER LEVEL ∇ TOB (feet): 30 \blacktriangledown 24HR (feet): 22.3	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		

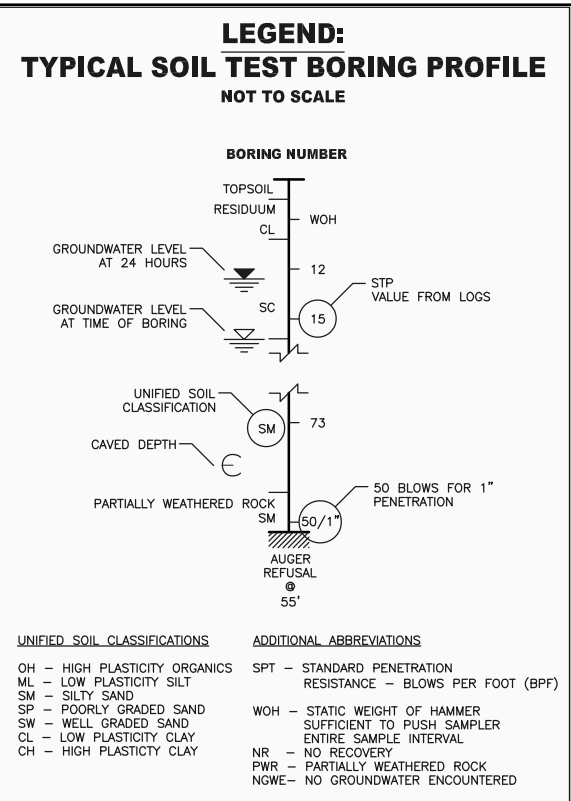
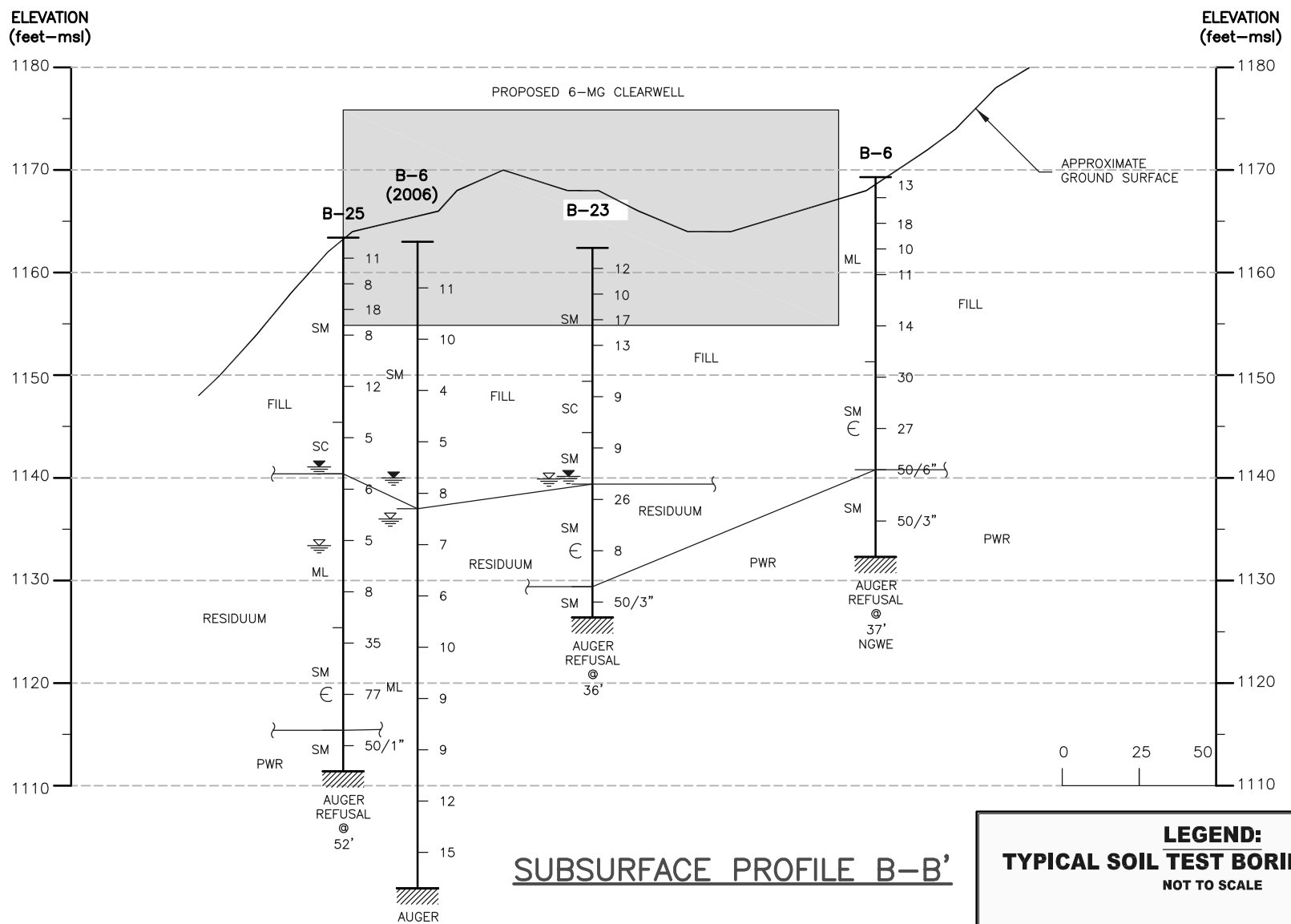
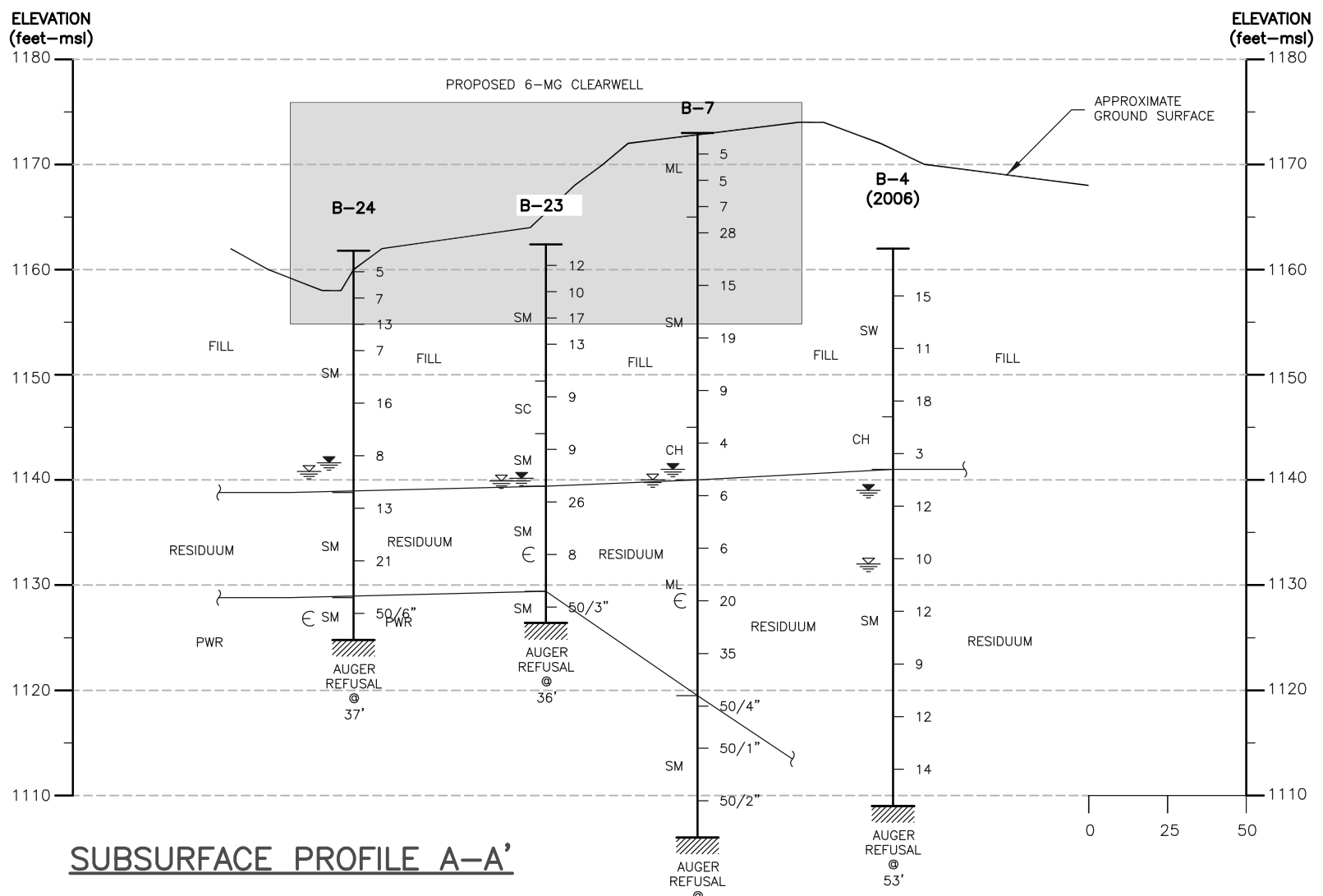


**CITY OF CUMMING, GEORGIA
 PWPF CLEARWELL IMPROVEMENTS - PHASE 2
 FORSYTH COUNTY, GEORGIA**

LOG OF BORING B-25

GEOLOGIST: <i>NA</i>		ELEVATION (feet): <i>1163</i>		NOTES: 1. Groundwater detected at 30 feet at the time of boring. 2. Groundwater level measured at 22.3 feet approximately 24 hours after drilling. 3. Borehole caved to a depth of 44.5 feet.
DATE DRILLED: <i>2/25/2026</i>		BORING DEPTH (feet): <i>52</i>		
DRILLER: <i>GRINDSTONE DRILLING</i>		WATER LEVEL ∇ TOB (feet): <i>30</i> \blacktriangledown 24HR (feet): <i>22.3</i>		
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>				

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)										
					2	3	4	5	6	10	20	30	40	60	80
45		Dense dark gray and white to dark grayish brown slightly micaceous silty fine to coarse SAND (SM), wet	1118	77											
		Very dense dark grayish brown slightly micaceous silty fine to coarse SAND (SM), rock fragments, wet													
50		PARTIALLY WEATHERED ROCK: Sampled as very dense dark gray slightly micaceous silty fine SAND (SM), wet	1113	50/1"											
		Auger Refusal at 52 feet													



- NOTES:**
1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C-203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
 2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
 3. Previous 2006 soil test borings are plotted at elevations listed in the subsurface investigation report, dated November 14, 2006.

REVISED
1:06 pm, Jun 12, 2026

LEGEND

GEOSYSTEMS
ENGINEERING, INC.

REFERENCE: BCW BLP.dwg

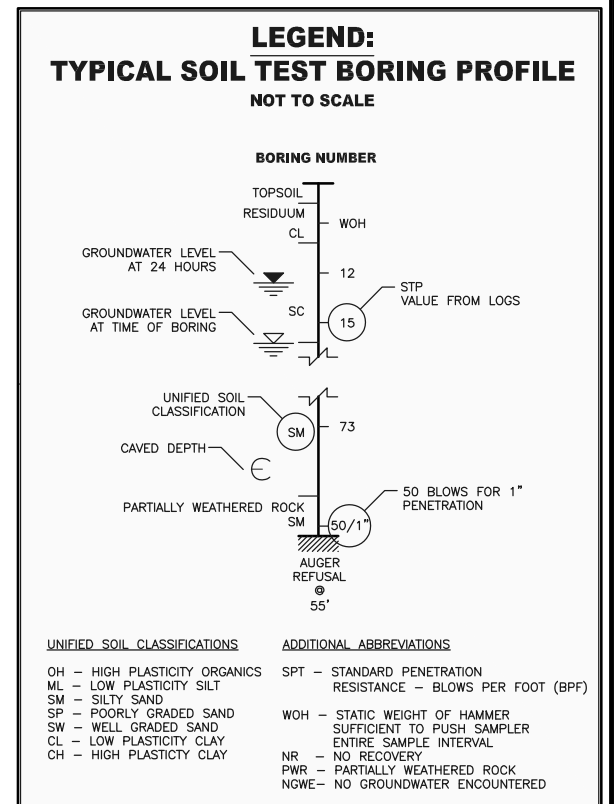
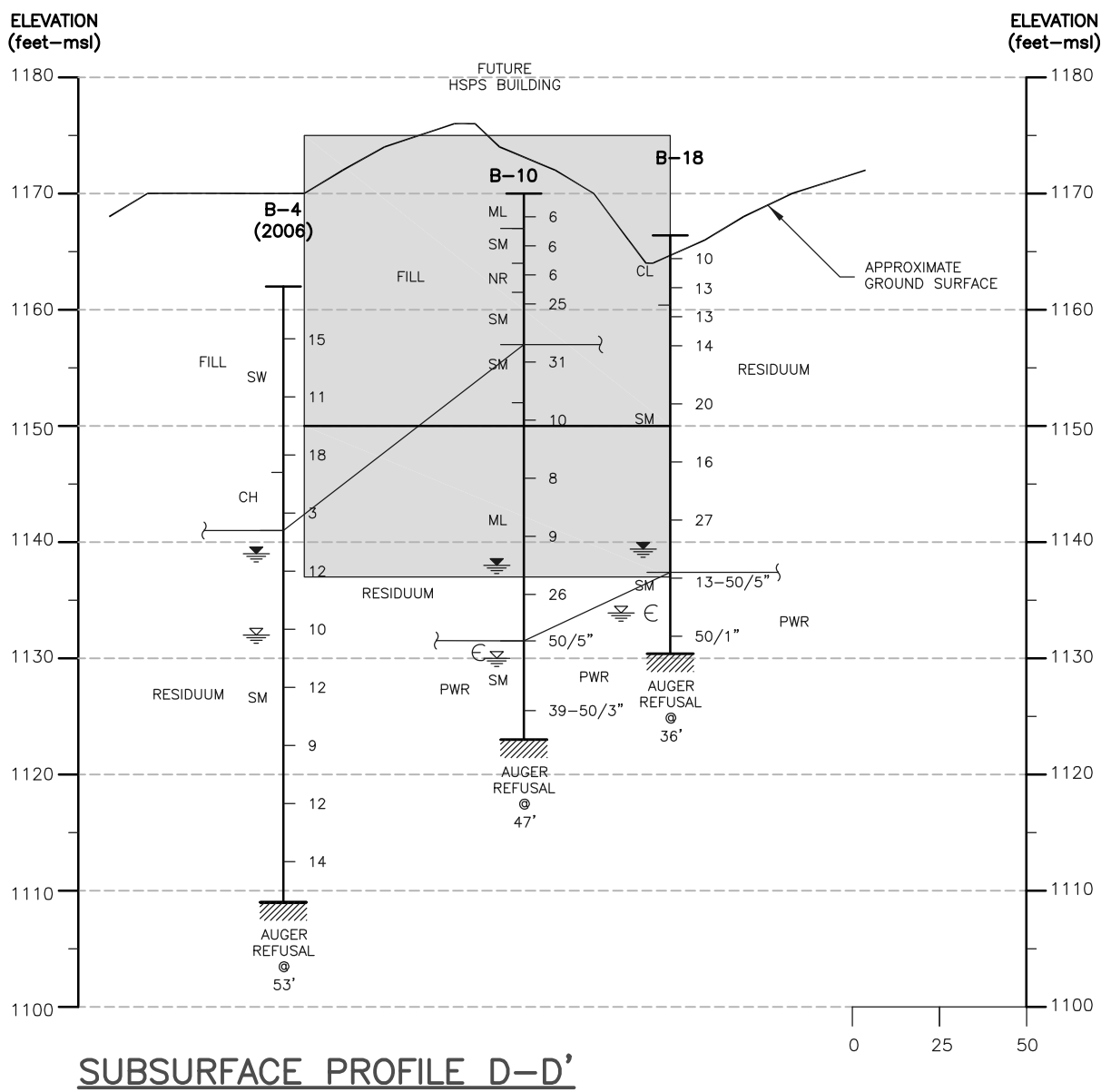
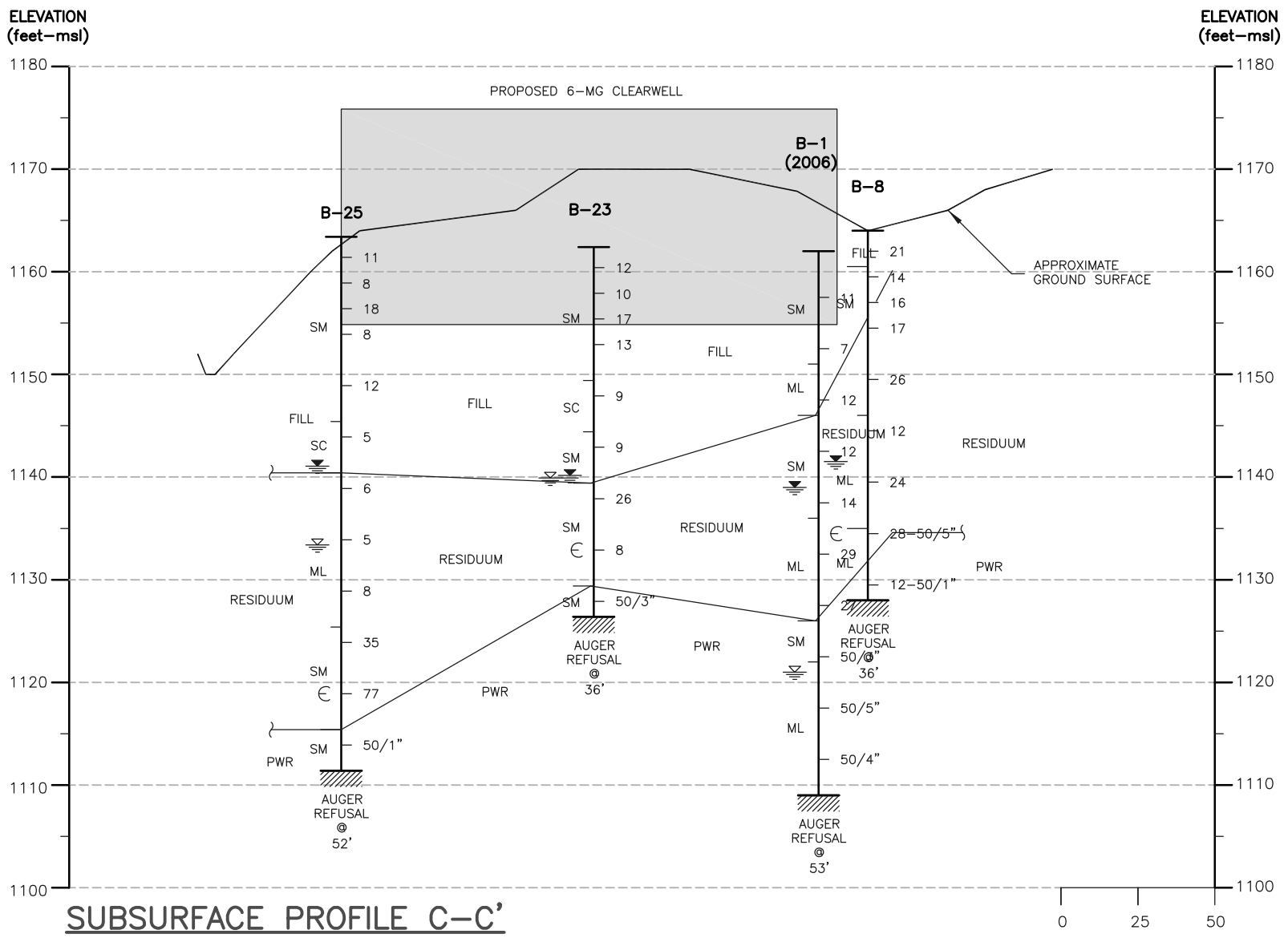
SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25-3003

PREPARED BY: ARC
DATE: 3/3/2026
REVIEWED BY: LDM
DATE: 3/3/2026

FIGURE:
2

SCALE AS SHOWN (APPROXIMATE)



NOTES:

1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C-203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
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REVISED
1:07 pm, Jun 12, 2026

LEGEND

GEOSYSTEMS
ENGINEERING, INC.

SUBSURFACE PROFILES

SCALE AS SHOWN (APPROXIMATE)

REFERENCE: BCW BLP.dwg

PROJECT: CITY OF CUMMING, GEORGIA
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FIGURE:
3

