EXHIBIT B-2

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REPORT OF SUBSURFACE EXPLORATION AND
GEOTECHNICAL ENGINEERING EVALUATION
Clarkston Lake Dam Reconstruction
Clarkston, DeKalb County, Georgia

WILLMER ENGINEERING, INC.
Willmer Project No. 71.3983

Prepared For

AMEC Environment & Infrastructure, Inc.
Kennesaw, Georgia

Prepared By

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November 6, 2014

VIA EMAIL

Ron Huffman, ASLA, AICP
Principal
AMEC Environment & Infrastructure, Inc.
1075 Big Shanty Road, NW
Suite 100
Kennesaw, Georgia 30144

SUBJECT: **Report of Subsurface Exploration and Geotechnical Engineering Evaluation**
Clarkston Lake Dam Reconstruction
Clarkston, DeKalb County, Georgia
Willmer Project No. 71.3983

Dear Mr. Huffman:

Willmer Engineering Inc. (Willmer) is pleased to present this report of subsurface exploration and geotechnical engineering evaluation for the Clarkston Lake Dam Reconstruction project located on Norman Road near Milam Park in DeKalb County, Georgia. This work was performed in accordance with our subcontract agreement for professional services dated July 17, 2014 with AMEC Environment & Infrastructure, Inc. (AMEC). The results of our geotechnical exploration, analysis and evaluation, and our geotechnical assessment/recommendations are presented in this report.

We appreciate the opportunity to be of service to you on this project and look forward to a continuing relationship. Please contact us if you have any questions concerning the report or require further assistance.

Sincerely,

WILLMER ENGINEERING INC.

Bradford Drew, EIT
Staff Engineer

Sujit K. Bhowmik, PhD, PE
Chief Engineer

James L. Willmer, PE
Executive Vice President/Principal Consultant

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Executive Summary

The following summary highlights significant aspects of the project and our conclusions and recommendations. The reader is referred to the report text for detailed descriptions of our geotechnical exploration, analyses, and recommendations.

- The upstream slope of the dam is flatter than 3H:1V, stable, and vegetated with grass. The downstream slope of the dam varies from steeper than 1H:1V near the west end to about 1.7H:1V near the east end of the dam. The middle section of the dam has a downstream slope of about 2.7H:1V to provide maintenance access.
- The dam embankment is comprised of fill soils consisting of very loose to loose silty/clayey sand and very soft sandy silt/sandy clay/fat clay. The embankment fill is underlain by alluvial and residual soils. Alluvial soils consisted of very loose to medium dense sand and silty/clayey sand and residual soils consisted of very loose to very dense silty sand and sandy silt.
- The downstream slope of the dam has a factor of safety of approximately 1.0, which indicates that the slope is possibly on the verge of failure or has already undergone movement along a slip surface. The observed distresses on the dam including sloughing, slough repair, and excessive settlement and cracking of the pavement on Norman road confirms that the safety factor for slope stability is close to 1.0.
- We recommend that two options be considered for repair/reconstruction of the dam. Option 1 consists of reconstructing the entire dam using suitable soils such that a minimum safety factor of 1.5 can be achieved under steady state seepage conditions. Where adequate space is available, we recommend a downstream slope of 2.5H:1V or flatter. With a slope of 2.5H:1V, the slope stability safety factor was determined to be about 1.8 under steady state seepage conditions.
- The existing slope is steeper than 1H:1V near the west end of the dam, and the existing pipe culvert under the driveway of the adjacent house and other site features limit flattening the slope of the dam in this area. Therefore, we recommend that a cantilever retaining wall be constructed to retain the embankment in the western portion of the dam. The slope stability safety factor for the dam with the retaining wall is about 1.6 under steady state seepage conditions.
- An alternative to constructing a retaining wall (as recommended above) would be to extend the existing culvert pipe along the toe of the reconstructed dam. Fill can then be placed and compacted around the extended pipe to reconstruct a downstream slope of 2.5H:1V or flatter.
- The second option (Option 2) for repair is to reconstruct the portion of the dam embankment south of the Norman Road centerline. In this option, the entire embankment starting from the downstream toe to the Norman Road centerline will be removed and replaced with properly compacted soil fill. The requirements of downstream slope, toe drain, and retaining wall/extended pipe culvert for this option would be the same as those for Option 1. If Option 2 is chosen, additional future maintenance of Norman Road may be required to repair any cracks or other pavement distresses.

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1.0 Project Information

1.1 Project Introduction

This project consists of a subsurface exploration and geotechnical engineering evaluation of Clarkston Lake Dam located in the City of Clarkston, DeKalb County, Georgia. This evaluation of the dam was performed as part of the City of Clarkston Streetscape and Pedestrian Enhancements project. The Clarkston Lake Dam is located on Norman Road near Milam Park in DeKalb County, Georgia, as shown in Figure 1. The dam is classified as a Category II dam.

1.2 Site Observations

The following observations were made during a site visit to the dam in August 2014. Photographs of the dam and some of the observed features listed below are shown in Figure 2 and Appendix III.

- The dam is approximately 350 feet long with a maximum height of about 13 feet.
- The upstream slope of the dam is flatter than 3H:1V and is vegetated with grass. The downstream slope of the dam varies from steeper than 1H:1V near the west end to about 1.7H:1V near the east end of the dam. The middle section of the dam has a downstream slope of about 2.7H:1V to provide maintenance access.
- The downstream slope is vegetated with shrubs near the west end and grass in the middle and the east end.
- The crest of the dam is approximately 35 feet wide with an active roadway (Norman Road) on top. The eastbound lane of Norman Road appears to have settled, forming cracks along the center of the lane (see Appendix III, Sheet 2).
- The dam includes a spillway that appears to be a combined principal and emergency spillway located near the east end of the dam. The spillway consists of a 60-inch diameter corrugated metal pipe that crosses under Norman Road (see Appendix III, Sheet 3) and discharges into a riprap-lined channel that flows west along the toe of the dam (see Figure 2). The inlet structure is connected to the lake through a concrete flume (see Appendix III, Sheets 3 and 4); however, no flow was observed through this inlet flume during our site visit.
- In addition to the inlet flume, a concrete pipe (approximately 18-inches in diameter based on visual estimate; the structure is located inside a fence and was not accessible during our site visit) connected to the inlet structure was observed discharging steadily into the structure. The upstream end of this pipe could not be located.
- In addition to the spillway structure, a concrete-lined flume extending from the crest down to the toe of the downstream slope of the dam appears to serve as an emergency spillway (see Appendix III, Sheet 4). This emergency spillway will route the water to the downstream toe ditch in case water from the lake overflows the dam during a heavy rainstorm.
- A 60-inch diameter corrugated metal pipe located near the toe of the dam carries water from the principal and emergency spillways and routes the flow beneath the ball fields at Milam Park (see Appendix III, Sheet 5).

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- A 60-inch diameter corrugated metal pipe culvert is located at the west end of the dam near the toe (see Appendix III, Sheet 5). The pipe runs to the west beneath the adjacent property; the upstream end of this pipe could not be located. No flow was observed in the pipe at the time of our visit.
- Sloughing was observed on the slope near the toe of the dam (see Appendix III, Sheet 6).
- Riprap has been placed at two locations on the downstream slope of the dam. It appears that the riprap was placed to repair previous sloughs on the downstream slope (see Appendix III, Sheets 6).
- A sewer line is exposed on the downstream slope of the dam (see Appendix III, Sheet 6).
- A corrugated metal pipe was observed on the downstream slope near the toe, but no water was observed flowing from the pipe.
- A partially damaged retaining wall about 5 feet wide was observed at the west end of the dam (see Appendix III, Sheet 6). The downstream slope adjacent to the wall is very steep (estimated to be 0.7H:1V).

1.3 Structure History

A history of the dam was documented in a report by Golder Associates Inc. titled *Report on Clarkston Lake & Crystal Pond Hydrologic & Environmental Evaluation, Clarkston, Georgia* dated May 30, 2007. Pertinent information from that report are noted below:

- The structure was constructed in 1926 as a lake for a dairy farm. The lake was originally known as Prather Lake, since it was constructed by Mr. Prather.
- At a later date, the area was sold to Mr. Clark and the lake was renamed as Clark's Lake.
- Once in the 1930's and again in the 1940's the lake was drained and sediment was moved from the lower lake to the upper lake. The upper lake (Crystal Pond) was created as part of this work.
- The lake property was purchased in 1954 as part of the Clark Estates development.
- Land immediately around the lake was deeded in 1970 to Clarkston Shores Corporation, creating the Clarkston Shores Lake Association.
- In 1971, the lakes were dredged and the spillways repaired.

Based on the descriptions of the dam provided in the above-referenced report, it appears that the current spillway structure was constructed after 2007.

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1.4 Objectives and Scope of Present Work

The primary objectives of the study reported herein were to obtain geotechnical information and provide recommendations for the proposed dam and drainage channel reconstruction. To achieve these objectives, Willmer performed the following major tasks:

- Review and compilation of available geotechnical data, topographic maps, aerial photographs, and geologic literature pertaining to the subject site.

- Planning and performance of a field exploration program consisting of: (i) visual inspection of the site to document topography and land use, above-ground utilities, accessibility for drilling equipment, and other features relevant to the field exploration work, (ii) coordination with Georgia Utilities Protection Center for subsurface utility clearance at boring locations, (iii) drilling five Standard Penetration Test (SPT) borings on the crest and toe of the dam, (iv) performing 3 hand-auger and Dynamic Cone Penetrometer (DCP) borings on the mid-slope and toe of the dam, (v) installing temporary piezometers in the borings located on the mid-slope and toe of the dam, (vi) obtaining undisturbed and bulk samples from selected soil layers for use in laboratory testing, and (vii) surveying boring elevations and piezometer water levels.

- Performance of a laboratory testing program consisting of classification and engineering property tests on representative soil samples.

- Compilation and evaluation of the collected field and laboratory test data and selection of engineering properties for use in geotechnical analyses.

- Performance of geotechnical analyses including estimation of settlement due dam reconstruction and slope stability analyses.

- Preparation of this report summarizing all relevant field and laboratory test data, the results of our analyses and evaluation, and our recommendations for reconstruction of the dam and drainage channels.

This engineering report is divided into five sections. The present section (Section 1) contains the project background information and provides a summary of the objectives and scope of our work. Summaries of the field exploration and laboratory testing programs are provided in Sections 2 and 3, respectively. Section 4 presents a description of the site and regional geologic conditions based on available geologic literature, and a description of the subsurface conditions based on the results of the field exploration and laboratory testing programs. The results of our geotechnical engineering evaluations and our recommendations are provided in Section 5.

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2.0 Field Exploration

2.1 Standard Penetration Test Borings

The subsurface exploration consisted of drilling three Standard Penetration Test (SPT) borings (B-1, B-4, and B-7) at the crest of the dam and two SPT borings (B-6 and B-9) at the toe of the dam. The locations of the SPT borings are shown in Figure 3. All of the boring locations were selected by Willmer. Ground surface elevations at each boring location were surveyed by Willmer based on existing site feature elevations shown on a topographic drawing provided to us by AMEC. Appendix I contains the Soil Boring Records presenting the information which was obtained from the subsurface exploration.

Drilling of the soil test borings was accomplished using a CME 45 rotary drill rig to advance continuous hollow-stem augers. The SPT borings were performed in general accordance with ASTM Standard D1586. In this process, a 2-foot long, 2-inch outside-diameter split-barrel sampler attached to the end of a string of drilling rods is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The blows required for the first 6 inches of penetration are allowed for seating the sampler into any loose cuttings, and the sum of the blows required for penetration of the second and third 6-inch increments constitutes the penetration resistance or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties including consistency, relative density, strength, compressibility and potential for difficult excavation. Correlations between the N-value and the relative density of cohesionless soils (sands) and consistency of cohesive soils (clays/silts) are included in Appendix I.

Groundwater observations at borings B-1, B-4, and B-7 (located on Norman Road) were noted immediately upon the completion of each boring. The borings were then backfilled with grout. Groundwater observations at borings B-6 and B-9 were noted immediately upon boring completion and at 24 hours after boring completion. Temporary piezometers were installed in borings B-6 and B-9 upon boring completion. Further description of the piezometer installation is provided in Section 2.5.

Classification of the soil samples collected was performed in general accordance with the Unified Soil Classification System (USCS) using visual/manual methods. Detailed descriptions of the materials encountered in each soil test boring, along with graphic representations of the standard penetration test blow counts (N-values), are presented on the Soil Boring Logs included in Appendix I.

2.2 Hand-Auger Borings

Hand-auger borings were performed where the drill rig could not access the proposed boring location. Two hand-auger borings (B-5 and B-8) were performed at the mid-slope of the dam and one hand-auger boring (B-3) was performed at the toe of the dam, and one hand-auger boring (B-4A) was performed near the upstream crest of the dam. The borings were advanced by manually turning a pipe rod with a bucket sampler at the base. Continuous samples were obtained for each 6 to 8 inch advancement of the auger. Each sample was taken out of the bucket and stratified by the geotechnical engineer. The boring depths ranged between 6.5 and 10 feet below the existing ground surface.

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Several hand-auger boring attempts were made at the proposed B-2 location (located on the mid-slope of the dam at the western end) but the hand-auger could not penetrate asphalt debris and cobbles that were encountered just below the ground surface.

Groundwater levels in the hand-auger borings were noted upon boring completion and at 24 hours after boring completion. Temporary piezometers were installed in the hand-auger borings upon boring completion. Further description of the piezometer installation is provided in Section 2.5.

2.3 Dynamic Cone Penetrometer Tests

Dynamic Cone Penetrometer (DCP) tests were performed at designated intervals in the hand-auger borings to provide an index for estimating soil strength and density. The DCP test consists of dropping a 15-pound donut-shaped steel weight a distance of 20 inches to drive a steel rod with a cone point. The cone is first seated 2 inches below the subgrade, and then the number of blows required to advance the cone point three individual increments of 1 ¾ inches are recorded. This blow count can be correlated to the N-value obtained from conventional split spoon sampling with a drill rig (SPT) to provide a measure of the relative consistency or density of the soil. Logs containing the DCP test results are provided in Appendix I.

2.4 Soil Sampling

Soil samples (split-spoon samples, a bulk sample, and an undisturbed Shelby tube sample) obtained during the field exploration program were classified by our geotechnical engineer. The split-spoon samples were obtained from all borings and placed in glass jars. A bulk soil sample (approximately 50 pounds) was obtained from boring B-1 at a depth of about 1 to 3 feet. An undisturbed Shelby tube sample was obtained from boring B-1 at a depth of about 14.5 feet for use in laboratory one-dimensional consolidation testing. The samples were transported to our laboratory for further classification, characterization, and testing.

2.5 Piezometer Installation and Monitoring

Upon completion of SPT and hand-auger boring at the mid-slope and toe of the dam, a piezometer was installed in the bore hole. No piezometers were installed on the crest of the dam since it is an active roadway (Norman Road). The piezometers were constructed of one-inch diameter, schedule 40 polyvinyl chloride (PVC) pipe with 5 feet of 0.01-inch machine slotted PVC screen. The screened portion was constructed with a sand pack and was placed to 1 foot above the top of the slotted portion of the pipe. Soil cuttings were then placed above the sand pack and the top one foot of the hole annulus was sealed with bentonite chips. Each PVC pipe extended above the ground surface and a cap was secured to the top of the pipe. The top of piezometer elevations were surveyed by Willmer based on existing site feature elevations shown on a topographic drawing provided to us by AMEC. Groundwater levels in the piezometers were measured on August 8, 2014 and September 2, 2014. A summary of the piezometer data is provided in Table 3.

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3.0 Laboratory Testing

3.1 General

A laboratory testing program was conducted to determine the engineering properties of soils for use in our analyses and recommendations for the Clarkston Lake Dam. The laboratory testing program consisted of: (i) classification and index tests on selected soil samples, (ii) a standard Proctor compaction test, and (iii) a one-dimensional consolidation test on an undisturbed soil sample. All laboratory tests were performed in general accordance with appropriate ASTM standards.

3.2 Classification and Index Tests

Classification and index tests were performed to aid in the characterization of selected split spoon samples, the undisturbed soil sample, and the bulk soil sample. The tests included visual classification in the laboratory, fines content (i.e., percent by dry weight of materials passing the US #200 sieve) determination (ASTM D 1140), moisture content determination (ASTM D 2216), and Atterberg Limits (Liquid Limit, Plastic Limit, and Plasticity Index) determination (ASTM D 4318). Results of these tests are summarized in Tables 1 and 2.

3.3 Standard Proctor Compaction

A standard Proctor Compaction test was performed on a bulk soil sample obtained from boring B-1 at a depth of 1 to 3 feet to determine the compaction characteristics of on-site soils. Results of this test are summarized in Table 1, and the individual test results are included in Appendix II. The standard Proctor maximum dry density for the bulk soil sample was 115.9 pounds per cubic foot (pcf) and the optimum moisture content was 14.4%. The natural moisture content of the sample was 16.9%, about 2.5% higher than optimum.

3.4 Consolidation Test

A one-dimensional consolidation test (ASTM D 2435) was performed on an undisturbed Shelby tube soil sample obtained from boring B-1 at a depth of about 14.5 feet. The sample was obtained from the residual soil encountered below the dam embankment. The one-dimensional consolidation test was performed to assess the compressibility characteristics of the soil and to estimate settlement due to possible reconstruction of the dam.

Results of the consolidation test are summarized in Table 2, and the individual test results are presented in the form of void ratio and coefficient of consolidation versus effective vertical stress plot in Appendix II. As shown in Table 2, the sample has a compression index of 0.45 and a recompression index of 0.05. The preconsolidation pressure (i.e., the maximum past stress experienced by the soil sample) is about 3,500 pounds per square foot (psf). The coefficient of consolidation for the sample for the applicable stress level is about 5 ft^2/day.

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4.0 Site Geology and Subsurface Conditions

4.1 Area Geology

Based on geological maps and descriptions, the site is located in the Mica Schist/Gneiss Formation within the Northern Piedmont Physiographic Province of Georgia. The Northern Piedmont is composed of metamorphic rocks with localized igneous intrusions (mica schist/gneiss/amphibolite). The residual soils encountered in the Northern Piedmont are the product of in-situ chemical and physical weathering of the underlying parent rock. Typically, weathering is most advanced near the surface and decreases with depth.

Below the residual soils, partially weathered rock (PWR) is usually encountered as a transition zone to the underlying bedrock. Partially weathered rock is locally defined as a material with standard penetration resistance (N-value) in excess of 50 blows per 6 inches, to as low as 50 blows per 1 inch. Hollow-stem auger refusal or an SPT N-value of 50 blows for 0 inches of penetration generally defines the rock interface (weathered or hard rock conditions) where diamond rock coring techniques are required to further advance the boring. Rock coring was not in our scope of work.

An important aspect of the Northern Piedmont subsurface profile is that highly variable conditions can exist over relatively short horizontal distances. This is caused by variation in mineral composition of the parent rock and the intensity of fractures and joints within the rock. Zones of partially weathered rock can be encountered in residual soils, and lenses of soil can occur in the rock mass. This profile may be altered by excavating or filling, or by effects of water through the process of erosion or alluvial deposition.

4.2 Subsurface Conditions

The generalized soil stratigraphy discussed in the following paragraphs and those presented in the Soil Boring Records in Appendix II represent an estimate of the soil conditions based on interpretation of the boring data using generally accepted geotechnical engineering practice. The lines which are used to denote strata breaks on the Soil Boring Records are approximate because the actual subsurface strata changes are typically more gradual than the abrupt changes shown. In the absence of foreign substances, it is also difficult to distinguish between clean soil fill and virgin soils. *Although individual test borings are representative of the subsurface conditions at the precise boring locations on the dates shown, they are not necessarily indicative of the subsurface conditions at other locations or at other times.*

Based on borings B-1, B-4, and B-7, the dam embankment is composed of fill soils consisting of very loose to loose silty/clayey sand and very soft sandy silt/sandy clay/fat clay. The depth of fill ranged between 12 and 13.5 feet below the existing ground surface. SPT N-values for this stratum ranged between 1 blow for 18 inches of penetration to 9 blows per foot (bpf). The very loose to loose relative density and very soft to soft consistency of the fill soils indicates that very little or no compaction efforts were used in construction of the dam.

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The embankment fill is underlain by alluvial and/or residual soils. Alluvial soils were encountered in borings B-3, B-5, B-6, B-8, and B-9 at depths ranging between 3 and 8 feet, and consisted of very loose to medium dense sand and silty/clayey sand. SPT N-values for this stratum ranged between 1 and 18 bpf. The thickness of the alluvial stratum ranged between 2 and 4.5 feet.

Residual soils were encountered in all borings at depths ranging between 5 and 13.5 feet below the existing ground surface, and consisted of very loose to very dense silty sand and sandy silt. SPT N-values for this stratum ranged between 2 and 36 bpf. The top of partially weathered rock (PWR) was encountered in boring B-1 at the termination depth of 23.5 feet below the existing ground surface.

Groundwater was encountered at each boring location at the time of drilling, and the groundwater elevations are shown on the individual boring logs in Appendix I, on the subsurface profiles in Figures 4A through 4C, and in Table 3. As shown in Figures 4A through 4C, the groundwater elevations across the dam range between 941.5 and 930.8 feet.

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5.0 Geotechnical Conclusions and Recommendations

5.1 General

The geotechnical engineering evaluation and recommendations presented herein are based on the soil boring data gathered during this investigation, our understanding of the proposed design, and our experience with similar site and subsurface conditions. These recommendations were prepared in accordance with generally accepted geotechnical engineering practice for the exclusive use of AMEC and their designated consultants for the design of the proposed Clarkston Lake Dam Reconstruction in DeKalb County, Georgia. No other warranty, expressed or implied, is made.

We request that we be advised of any significant changes in the proposed development from that described in this report so that we may amend our recommendations accordingly. In addition, we request the opportunity to review the portions of the project specifications that relate to geotechnical engineering to ensure that our recommendations are properly incorporated.

5.2 Embankment Stability

As indicated in Section 1.2, the downstream slope of the dam ranges from near vertical at the west end to about 1.7H:1V near the east end of the dam. Existing sloughs and riprap used to repair previous sloughs were observed at a number of locations on the downstream slope. Also, numerous cracks and depressions in the right half of the eastbound lane of Norman Road indicates significant settlement and/or movement of the downstream slope of the dam. Soil test borings advanced through the dam (i.e., B-1, B-4, B-5, B-7, and B-8) indicate that the dam fill material consists of loose to very loose silty/clayey sand and very soft sandy silt/sandy clay/fat clay. The SPT N-value ranges from one blow for 18 inches of penetration to about 9 blows per foot; this consistency/density of soils confirm the marginal condition of this dam. Based on the observed slope conditions and subsurface profile obtained from the borings, we assess that the downstream slope of the dam is unstable, and the embankment has experienced significant settlement.

Subsurface profiles under the dam along three cross sections (A-A’, B-B’, C-C’, as shown in Figure 3) are presented on Figures 4A through 4C along with projected phreatic lines based on measured groundwater elevations. These cross sections were used to evaluate the stability of the downstream slope of the dam. The stability analyses were performed using the computer program SLIDE Version 5.0. The soil properties used in the analysis are based on field and laboratory test data and empirical correlations that are commonly used in geotechnical engineering. The results of the analyses are summarized in the table below, and individual output sheets from SLIDE are presented in Figures 5A through 5C.

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Dam Cross Section	Downstream Slope	Slope Stability Global Minimum Safety Factor
A-A	1.3H:1V	1.02
B-B	2.7H:1V (across access ramp)	1.79
C-C	1.7H:1V	0.95

As shown in the above table, most the downstream slope of the dam has a static condition factor of safety of approximately 1.0 (cross section B-B' has a higher safety factor because it is across the existing access ramp) which indicates that the slope is possibly on the verge of failure or has already undergone movement along a slip surface. The observed distresses on the dam including sloughing, slough repair, and excessive settlement and cracking of the pavement on Norman road confirm that the safety factor for slope stability is close to 1.0. Georgia Safe Dams requirements specify a static condition safety factor of at least 1.5.

5.3 Recommendations for Dam Repair/Reconstruction

Based on the results of the observation and slope stability evaluation, we recommend that the flowing options be considered for repair/reconstruction of the dam:

5.3.1 Option 1: Reconstruction of Entire Dam

In this option, the entire dam will be reconstructed using suitable soils such that the minimum safety factors required by Georgia Safe Dams are achieved. Where adequate space is available, we recommend a downstream slope of 2.5H:1V or flatter. The upstream slope of the dam should be 3H:1V or flatter. The downstream slope should also be provided with a toe drain and drainage ditch. With a slope of 2.5H:1V containing a 10-foot wide drainage blanket at the toe, the following slope stability safety factors were obtained:

Stability Condition	Georgia Safe Dams Required Safety Factor	Computed Safety Factor for 2.5H:1V Slope
End of Construction	1.3	1.95
Steady State Seepage	1.5	1.77
Steady State Seepage with Seismic Loading	1.1	1.34[1]
Rapid Drawdown (Upstream Slope)	1.3	1.36

1. A peak horizontal acceleration of 0.1g, corresponding to a 2% exceedance in 50 years, was used in the seismic evaluation, as required by Georgia Safe Dams.

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The individual SLIDE output sheets for the above analyses are presented in Figures 6A through 6D.
As described earlier, the existing slope is steeper than 1H:1V near the west end of the dam, and because of the existing culvert under the driveway of the adjacent house and other site features, the slope of the dam cannot be flattened in this area. Therefore, we recommend that a cantilever retaining wall be constructed to retain the embankment in the western portion of the dam. The retaining wall should be provided with a vertical drainage mat (i.e., a geocomposite drain made with geonet and filter fabric) placed against the stem of the wall. A perforated drain pipe encased in drainage stone should be provided at the bottom of the drainage mat to carry the flow along the wall and discharge into the toe ditch. The drainage stone should extend along the entire heel width of the cantilever wall. The retaining wall should also be provided with weep holes for proper drainage and to prevent water pressure build-up behind the wall. Assuming an 11-foot tall retaining wall with a drainage blanket provided at the stem and heel of the wall, the following slope stability safety factors were obtained:

Stability Condition	Georgia Safe Dams Required Safety Factor	Computed Safety Factor for Retaining Wall
End of Construction	1.3	1.69
Steady State Seepage	1.5	1.56
Steady State Seepage with Seismic Loading	1.1	1.34[1]

1. A peak horizontal acceleration of 0.1g, corresponding to a 2% exceedance in 50 years, was used in the seismic evaluation, as required by Georgia Safe Dams.

The individual SLIDE output sheets for the above analyses are presented in Figures 7A through 7C.

An alternative to constructing a retaining wall would be to extend the existing pipe culvert along the toe of the reconstructed dam. Fill can then be placed and compacted around the extended pipe to reconstruct a downstream slope of 2.5H:1V or flatter. A perforated drain pipe encased in drainage stone should be provided on the upstream side of the culvert pipe. Seepage from the dam will enter the drain pipe and flow to the inlet of the pipe that runs beneath the Milam Park ball fields. If this alternative is chosen, we recommend that two manholes be installed at each end of the extended culvert pipe to allow for visual inspection and future maintenance.

5.3.2 Option 2: Reconstruction of Eastbound Lane

As indicated earlier, the observed distresses on top of the dam (i.e., cracks in the pavement and excessive settlement) were in the east-bound lane. Although some cracks were observed on the westbound lane, these cracks did not appear to be related to any movement of the downstream slope. Therefore, a stable dam configuration can be obtained by reconstructing the portion of the dam embankment south of the Norman Road centerline. In this option, the entire embankment starting from the downstream toe to the Norman Road centerline will be removed and replaced with properly compacted soil fill. The portion of the embankment starting from the upstream slope and extending to the centerline of Norman road will be left in place; however, the pavement and the upper one foot of subgrade will be removed and reconstructed. The requirements for downstream slope, toe drain, and retaining wall/extended pipe culvert for this option would be the same as those for Option 1. If Option 2 is chosen, additional future maintenance of Norman Road may be required to repair any cracks or other pavement distresses.

5.4 Suitability of On-Site Soils

The majority of on-site soils are suitable for re-use to reconstruct the dam. However, the sandy fat clay encountered in borings B-7 and B-8 is not suitable for use in reconstruction of the dam. This material is expected to be saturated and it will be very difficult to dry it because of its low permeability. This material will also be difficult to compact in place for construction of the dam. It should be noted that all existing embankment materials obtained from below the phreatic line will need to be dried prior to placement and compaction for reconstruction of the dam. We recommend that the various layers of suitable soils from the existing embankment be mixed together prior to placement to form a homogenous material for construction of the dam. The homogenous material should be such that a friction angle of at least 30 degrees can be achieved when the material is compacted in place.

5.5 Acceptable Soil Fill Materials

Any offsite borrow material needed for the dam reconstruction should be tested by the geotechnical engineer for acceptance prior to the material being hauled to the site. Fill must be free of significant organic matter or debris and rock fragments greater than 3 inches in diameter and have a uniform composition. We recommend that the borrow material consist of sandy silt, silty sand, or clayey sand with a permeability less than 1.0×10^{-4} cm/sec. The liquid limit of the borrow material should be less than 50 percent and the plasticity index should be less than 30 percent. The minimum friction angle of the material should be 30 degrees when compacted in place.

5.6 Placement Procedures

The fill must be brought up to the proposed elevations by placing and compacting approved fill materials upon a prepared surface approved by the project geotechnical engineer. Fill material must not be placed over frozen or saturated materials, either natural or filled. All new fill material must be placed in horizontal lifts.

The maximum allowable lift thickness depends upon the soil type, moisture content, specified compaction, and compaction equipment. It is recommended that uniform lifts with a maximum loose thickness of 8 inches be used for fill placement. In confined areas, such as utility trenches and behind retaining walls where large compaction equipment cannot be used, a thinner lift (i.e., 4 inches of loose thickness) may be required to achieve the specified level of compaction.

5.7 Compaction Requirements

The fill must be placed by mechanically compacting each horizontal lift of fill material to a minimum dry density corresponding to 95 percent of the standard Proctor (ASTM D 698) maximum dry density. The upper 12 inches of fill beneath Norman Road should be compacted to at least 98 percent of the standard Proctor maximum dry density. Scarification and re-compaction of the upper fill soils immediately prior to pavement construction should be specified to account for disturbance due to inclement weather and/or construction traffic since fill completion. The backfill placed in excavations for

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new or removed utility lines should also be uniformly compacted to at least 95 percent of the Standard Proctor maximum dry density.

In addition to meeting the minimum dry density requirements specified above, fill must be placed at a moisture content equal to the standard Proctor optimum moisture content plus or minus 3 percent. In general, during wet/rainy periods, aeration may be necessary to adjust the fill materials to the required moisture condition. During dry periods, water may need to be added to achieve the required moisture content for compaction. Consideration should be given to creating a staging area for ‘wet’ soils to be moisture conditioned, i.e., ‘dried’ prior to their placement.

Care must be exercised by the contractor after fill soils have been placed and compacted. If water is allowed to stand on the surface, these soils will become saturated. Movement of construction traffic on saturated subgrades causes rutting that can destroy the compaction integrity of the fill. Once the integrity of the subgrade is affected, mobility of construction traffic becomes difficult or impossible. Therefore, the fill surface should be sloped to achieve positive drainage and to minimize water from ponding on the fill surface. If the surface of the fill becomes excessively wet, filling operations should be halted and the project geotechnical engineer consulted for guidance.

5.8 Monitoring

Fill placement and compaction operations must be monitored by the project geotechnical engineer or his representative. We strongly recommend that the placement and compaction of fill be monitored on a full-time basis by a NICET-certified Soil Technician working under the supervision of the project geotechnical engineer. The technician should observe each lift of fill placed and compacted to confirm that the project specifications are met.

5.9 Settlement of Reconstructed Dam Embankment

The settlement of the very loose to loose residual soils due to fill placement during dam reconstruction is estimated to be about 6 inches. However, since the residual soils consist of silty sand with a relatively high coefficient of consolidation of about 5 ft^2/day, no waiting period is required between completion of dam embankment reconstruction and the beginning of Norman Road pavement construction and/or installation of underground utilities.

5.10 Reconstruction of Drainage Channels and Pipes

We recommend that a filter fabric and graded rip-rap be placed on the bottom of the reconstructed drainage channels to decrease the water flow velocity and reduce erosion of the channel. All drainage channels should have a maximum side slope of 2.5H:1V and lined with filter fabric and riprap or grass, as applicable, to protect against stream erosion. All soil used for pipe backfill should conform to the acceptable fill criteria outlined in Section 5.4 above.

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5.11 Retaining Walls

As indicated earlier, a retaining wall will be required near the west end of the dam where 2.5H:1V downstream slope cannot be accommodated. We recommend an allowable bearing pressure of 2,000 pounds per square foot (psf) for use in preliminary design. Additional investigation within the specific area of the retaining wall is recommended prior to final design of the wall.

For silty/clayey sand fill soils compacted to at least 95 percent of the Standard Proctor (ASTM D 698) maximum dry density, the following soil design parameters may be used for retaining wall evaluation/design:

- Friction Angle for Backfill — 30 degrees
- Cohesion Intercept — 0 psf
- Active Earth Pressure Coefficient (Ka) — 0.33
- At-rest Pressure Coefficient (K_0) — 0.50
- Passive Earth Pressure Coefficient (Kp) — 3.00*
- Unit Weight of Soil as Placed — 120 pcf
- Equivalent Active Fluid Pressure — 40 pcf
- Equivalent At-rest Fluid Pressure — 60 pcf
- Equivalent Passive Fluid Pressure — 360 pcf*
- Coefficient of Sliding Friction — 0.35*

*In the design calculations, the resisting forces computed using the above recommended passive earth pressure coefficient, equivalent passive fluid pressure, and coefficient of sliding friction should be reduced using a safety factor of 1.5. In addition, since a drainage ditch will be located on the downstream side of the wall, we recommend that the passive pressure resistance be ignored.

The most common conditions assumed for earth retaining structure design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as freestanding walls, where some movement and rotation is expected. Since the top of these retaining walls will have no lateral support, active earth pressure conditions are likely to develop in the soil backfill behind the walls. Therefore, we recommend that active pressures be used in design of these walls.

The drainage measure behind the wall should be as recommended in Section 5.3.1.

5.12 Excavation Slope/Support

Temporary construction slopes should be designed in compliance with the most recent local, state, and federal governing regulations, including OSHA (29 CFR Part 1926) trench excavation safety standards. Temporary slopes should be cut to a stable slope or be temporarily braced, depending upon the excavation depth and encountered subsurface conditions. A trench box may also be used for excavation support. Stockpiles should be placed well away from the edge of the excavation and their height should be controlled so they do not surcharge the sides of the excavation. The responsibility for excavation safety and stability of temporary construction slopes should lie solely with the contractor.

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TABLES

Table 1

Summary of Laboratory Test Results
Clarkston Lake Dam Reconstruction
Clarkston, DeKalb County, Georgia
Willmer Project No. 71.3983

Boring No.	Sample Depth (feet)	Soil Description	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Fines Content (%)	Standard Proctor Compaction Test	
							Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-1	1 – 3	Brown and red silty medium to fine SAND	16.9	NP	NP	41.6	115.9	14.4
B-1	11 – 13	Gray silty medium to fine SAND	31.3	NP	NP	33.9	--	--
B-4	8.5 – 10	Brown clayey medium to fine SAND	19.9	29	10	35.3	--	--
B-5	6.5	Grayish brown clayey medium to fine SAND	26.4	30	13	44.5	--	--
B-7	6 – 7.5	Gray and brown medium to fine sandy fat CLAY	27.3	--	--	--	--	--
B-7	8.5 – 10	Gray and brown medium to fine sandy fat CLAY	26.2	52	28	59.8	--	--
B-8	6	Gray clayey medium to fine SAND	--	33	17	47.3	--	--

NP = Non-Plastic

Table 2

Summary of Consolidation Test Results
Clarkston Lake Dam Reconstruction
Clarkston, DeKalb County, Georgia
Willmer Project No. 71.3983

Sample No.	Sample Depth (feet)	Soil Description	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Fines Content (%)	Dry Unit Weight (pcf)	Void Ratio	σ_p' (psf)	C_c	C_r	C_v (ft^2/day)
B-1	14.5	Brown and tan silty medium to fine SAND (SM)	23.8	NP	NP	21.7	81.0	1.07	3,500	0.45	0.05	5

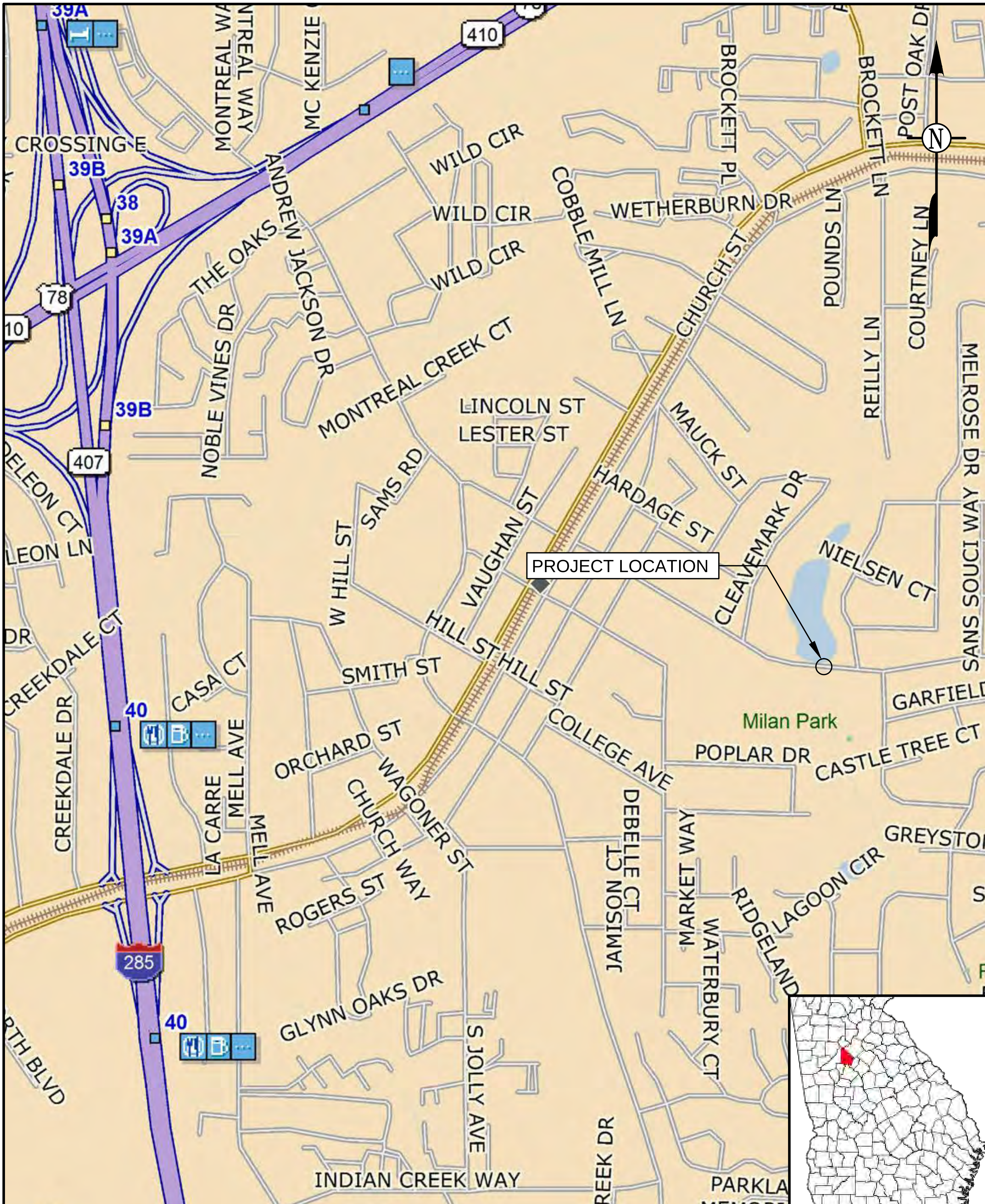
Abbreviations: NP – Non-Plastic
σ_p' - Preconsolidation Pressure
C_c - Compression Index
C_r - Recompression Index
C_v - Coefficient of Consolidation

Table 3

Summary of Piezometer Data
Clarkston Lake Dam Reconstruction
Clarkston, DeKalb County, Georgia
Willmer Project No. 71.3983

Boring No.	Ground Surface Elevation (feet)	Measured Groundwater Elevation (feet)	
		08/06/2014	09/02/2014
B-3	936.2	931.3	931.1
B-5	938.3	931.0	931.0
B-6	935.3	930.8	930.8
B-8	937.6	933.1	933.2
B-9	937.4	931.2	931.2

FIGURES



SOURCE: DELORME STREET ATLAS USA 2014

SCALE: 1" = 1000'	WILLMER ENGINEERING INC. WE GEOTECHNICAL ENGINEERING CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 1 PROJECT LOCATION MAP CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983
DATE: 10/29/2014		
DRAWN BY: AC		
REVIEWED BY: BD		

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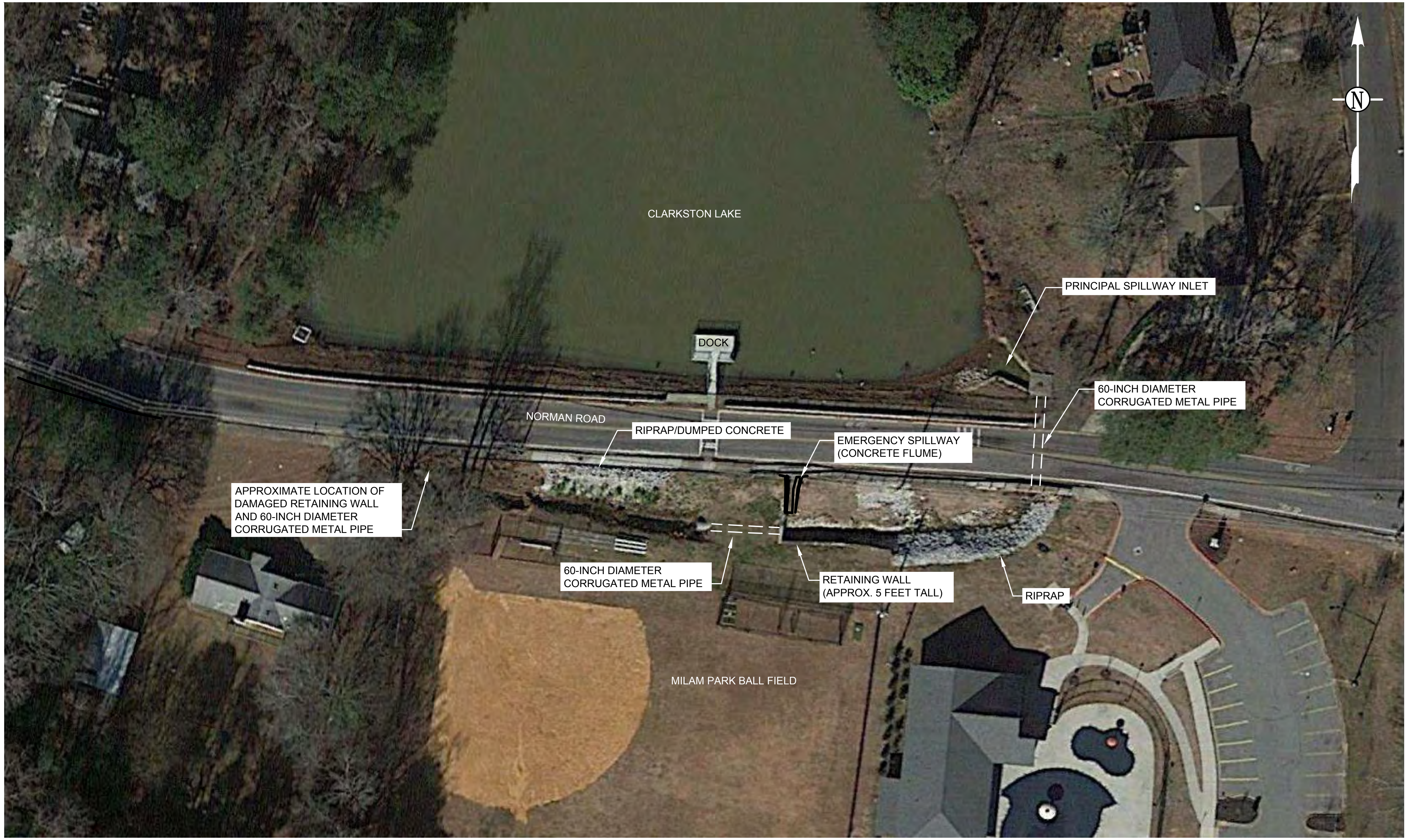

BASE IMAGE FROM GOOGLE EARTH AERIALS (JANUARY 2014)

SCALE: NTS DATE: 10/29/2014 DRAWN BY: AC REVIEWED BY: BD	WILLMER ENGINEERING INC. WE	GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 2 EXISTING SITE FEATURES CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY , GEORGIA WILLMER PROJECT No. 71.3983

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LEGEND:

- APPROXIMATE SPT BORING LOCATION (B - 1)
- APPROXIMATE HAND AUGER/DCP BORING LOCATION (B - 3)

BASE IMAGE FROM GOOGLE EARTH AERIALS (JANUARY 2014)
TOPOGRAPHIC SURVEY PROVIDED BY AMEC.

SCALE: 1" = 30' DATE: 10/29/2014 DRAWN BY: AC REVIEWED BY: BD	WILLMER ENGINEERING INC.	GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 3 BORING LOCATION PLAN CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983

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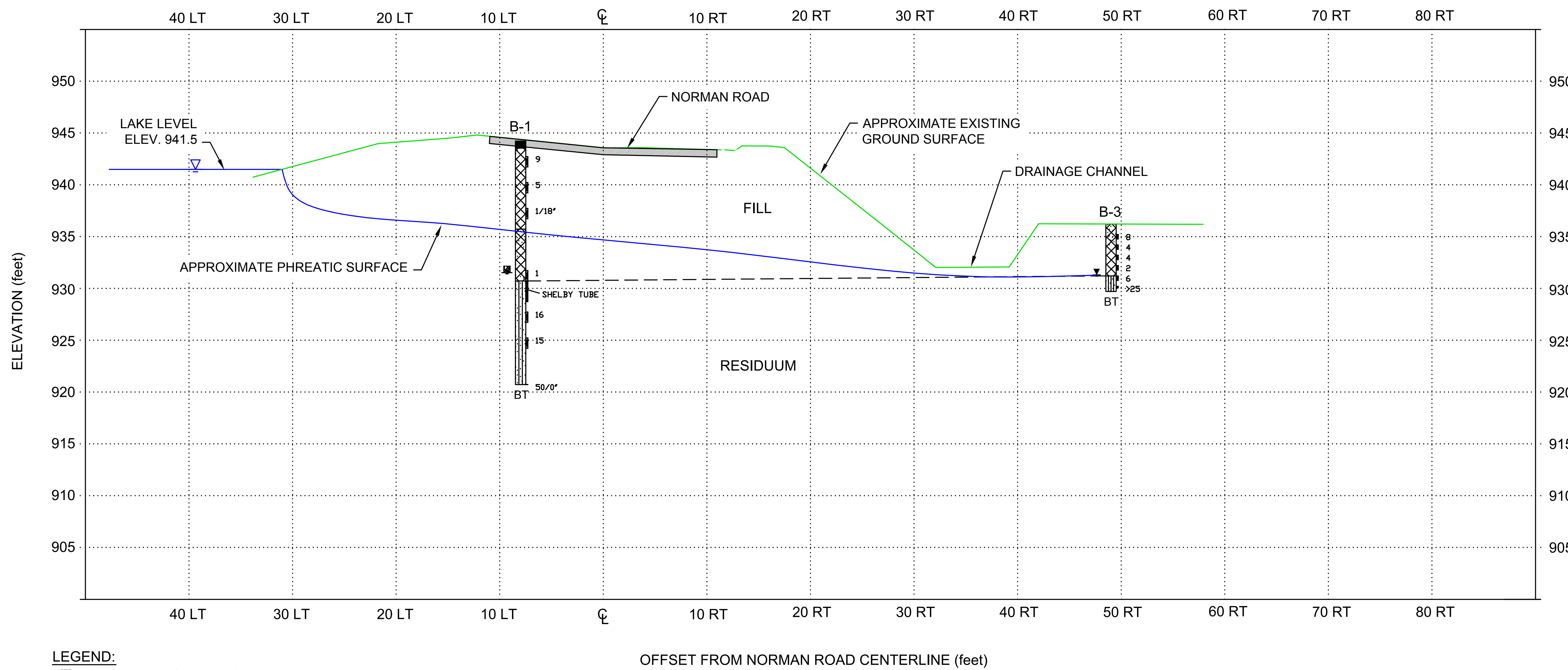
GENERALIZED SUBSURFACE PROFILE A-A'



LEGEND:

- Caved Level @ Time of Boring
- Groundwater Level on 09/02/2014

BT - Boring Terminated

NOTE: GROUND SURFACE ELEVATIONS ARE APPROXIMATE.

SCALE: 1" = 10'
DATE: 10/31/2014
DRAWN BY: ZMH
REVIEWED BY: BD

WILLMER ENGINEERING INC. WE

GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES
ENVIRONMENTAL SERVICES AND ENGINEERING
3772 PLEASANTDALE ROAD - SUITE 165
ATLANTA, GA 30340-4270

FIGURE 4A

GENERALIZED SUBSURFACE PROFILE A-A'
CLARKSTON LAKE DAM RECONSTRUCTION
CLARKSTON, DEKALB COUNTY, GEORGIA
WILLMER PROJECT No. 71.3983

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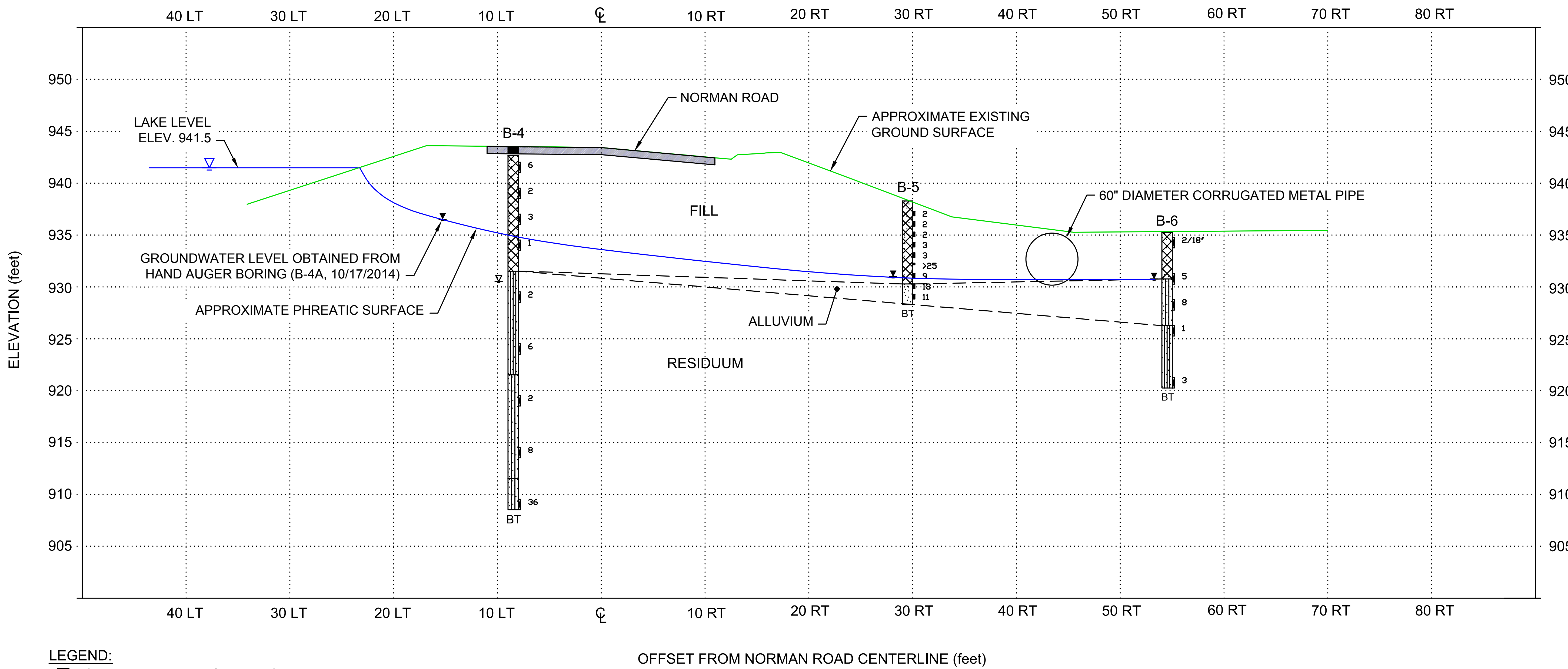
GENERALIZED SUBSURFACE PROFILE B-B'



LEGEND:

- Groundwater Level @ Time of Boring
- Groundwater Level on 09/02/2014

BT - Boring Terminated

NOTE: GROUND SURFACE ELEVATIONS ARE APPROXIMATE.

SCALE: 1" = 10' DATE: 10/31/2014 DRAWN BY: BD REVIEWED BY: SKB	WILLMER ENGINEERING INC. WE	GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 4B GENERALIZED SUBSURFACE PROFILE B-B' CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983

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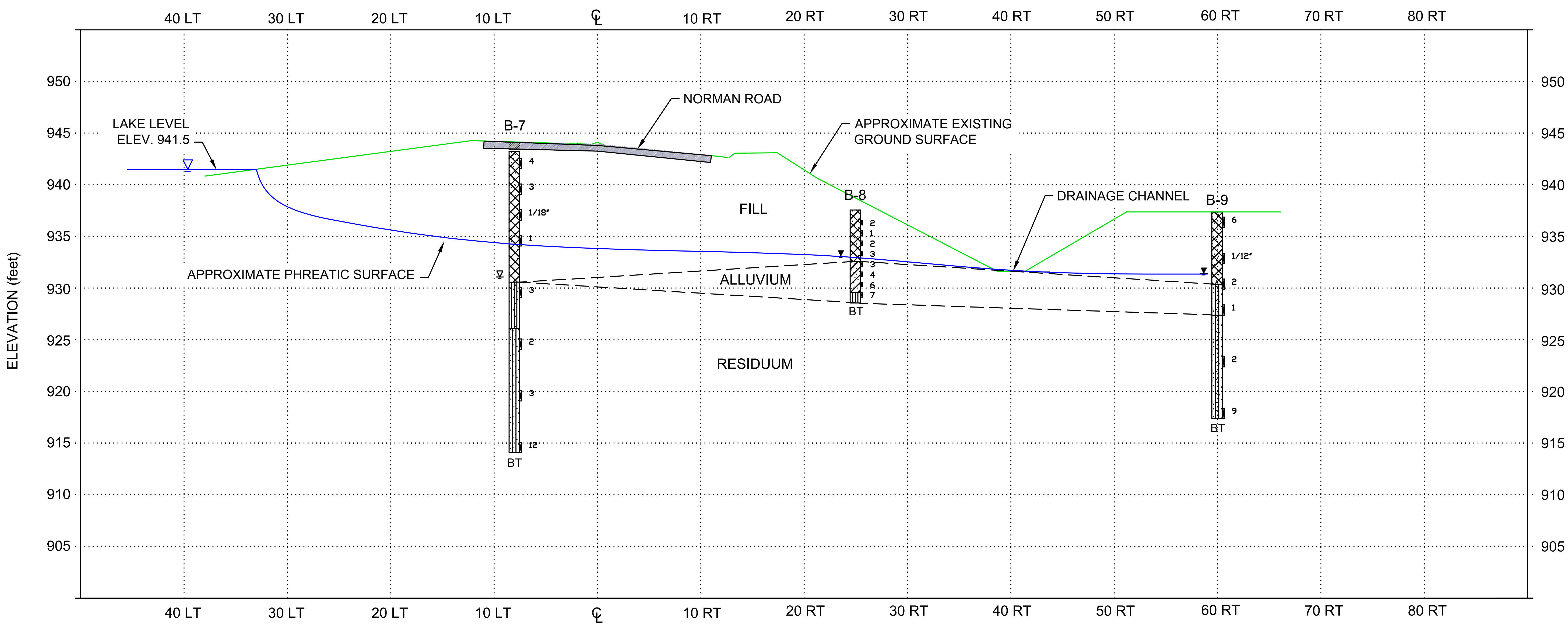
GENERALIZED SUBSURFACE PROFILE C-C'



LEGEND:

∇ - Groundwater Level @ Time of Boring

▼ - Groundwater Level on 09/02/2014

BT - Boring Terminated

NOTE: GROUND SURFACE ELEVATIONS ARE APPROXIMATE.

SCALE: 1" = 10' DATE: 10/31/2014 DRAWN BY: BD REVIEWED BY: SKB	WILLMER ENGINEERING INC.	GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 4C GENERALIZED SUBSURFACE PROFILE C-C' CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983

P:\3983 Clarkston Lake Dam Reconstruction\CADD\Subsurface Profiles.dwg

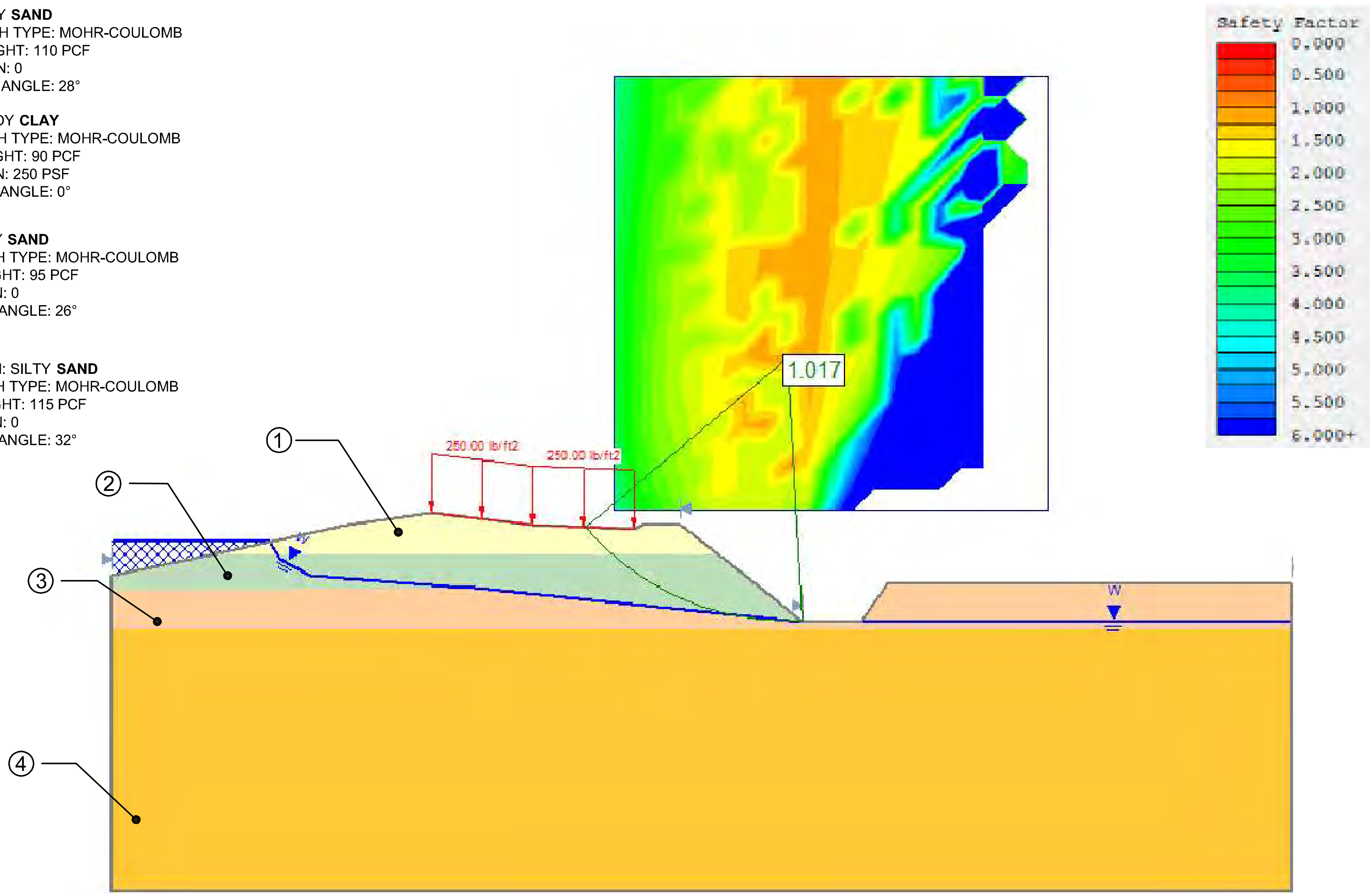
EXISTING SUBSURFACE PROFILE A-A'

① FILL: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 110 PCF
COHESION: 0
FRICTION ANGLE: 28°

② FILL: SANDY **CLAY**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 90 PCF
COHESION: 250 PSF
FRICTION ANGLE: 0°

③ FILL: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 95 PCF
COHESION: 0
FRICTION ANGLE: 26°

④ RESIDUUM: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 115 PCF
COHESION: 0
FRICTION ANGLE: 32°



SCALE: NTS	
DATE: 11/3/2014	
DRAWN BY: AC	
REVIEWED BY: BD	

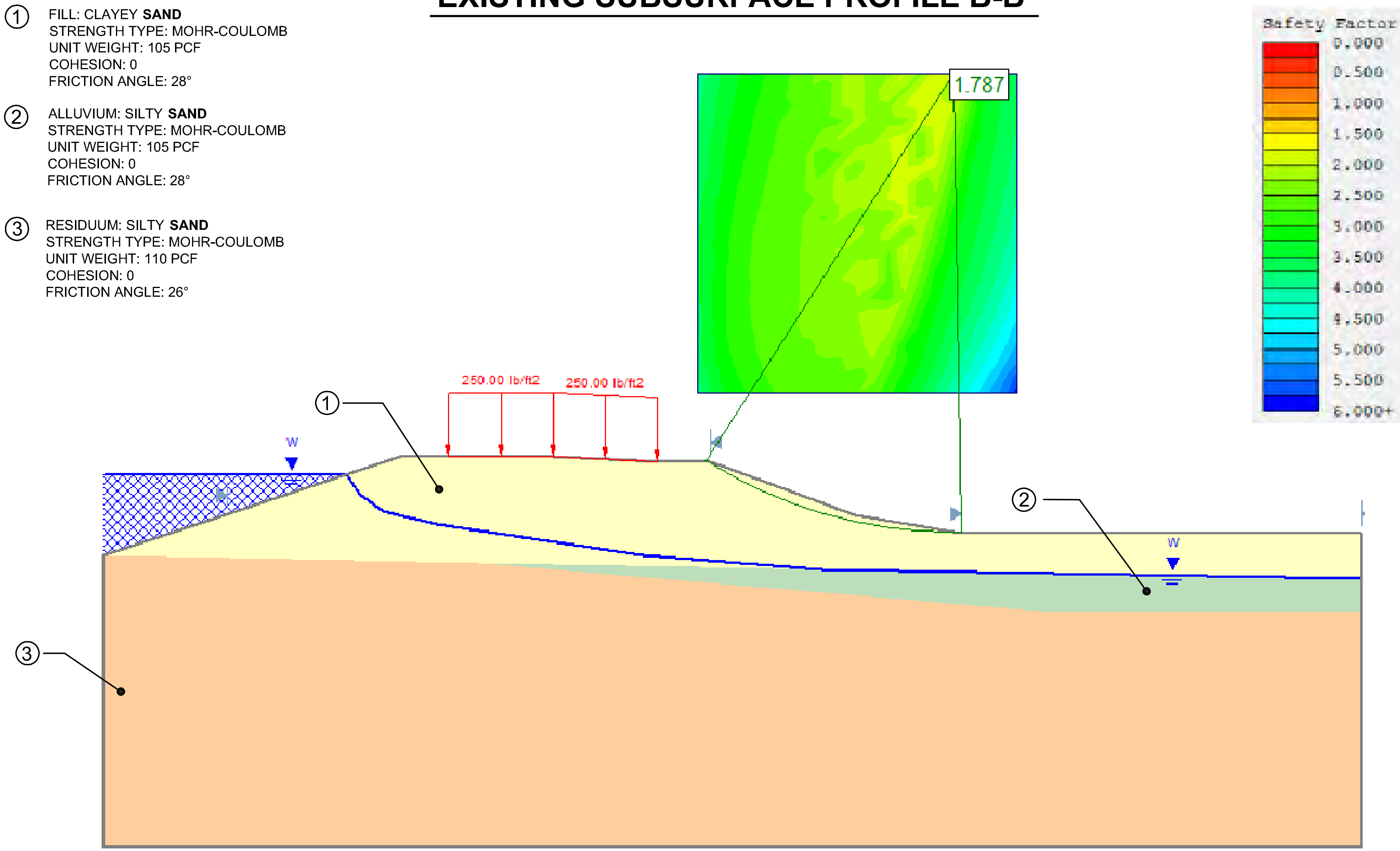
WILLMER ENGINEERING INC. | WE

GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES
ENVIRONMENTAL SERVICES AND ENGINEERING
3772 PLEASANTDALE ROAD - SUITE 165
ATLANTA, GA 30340-4270

FIGURE 5A
SUBSURFACE PROFILE A-A'
SLOPE STABILITY ANALYSIS
CLARKSTON LAKE DAM RECONSTRUCTION
CLARKSTON, DEKALB COUNTY, GEORGIA
WILLMER PROJECT No. 71.3983

P:\3983 Clarkston Lake Dam Reconstruction\CADD\Figure 5- Slope Stability.dwg

EXISTING SUBSURFACE PROFILE B-B'



SCALE: NTS DATE: 11/3/2014 DRAWN BY: AC REVIEWED BY: BD	WILLMER ENGINEERING INC. WE	GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 5B SUBSURFACE PROFILE B-B' SLOPE STABILITY ANALYSIS CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983

P:\3983 Clarkston Lake Dam Reconstruction\CADD\Figure 5- Slope Stability.dwg

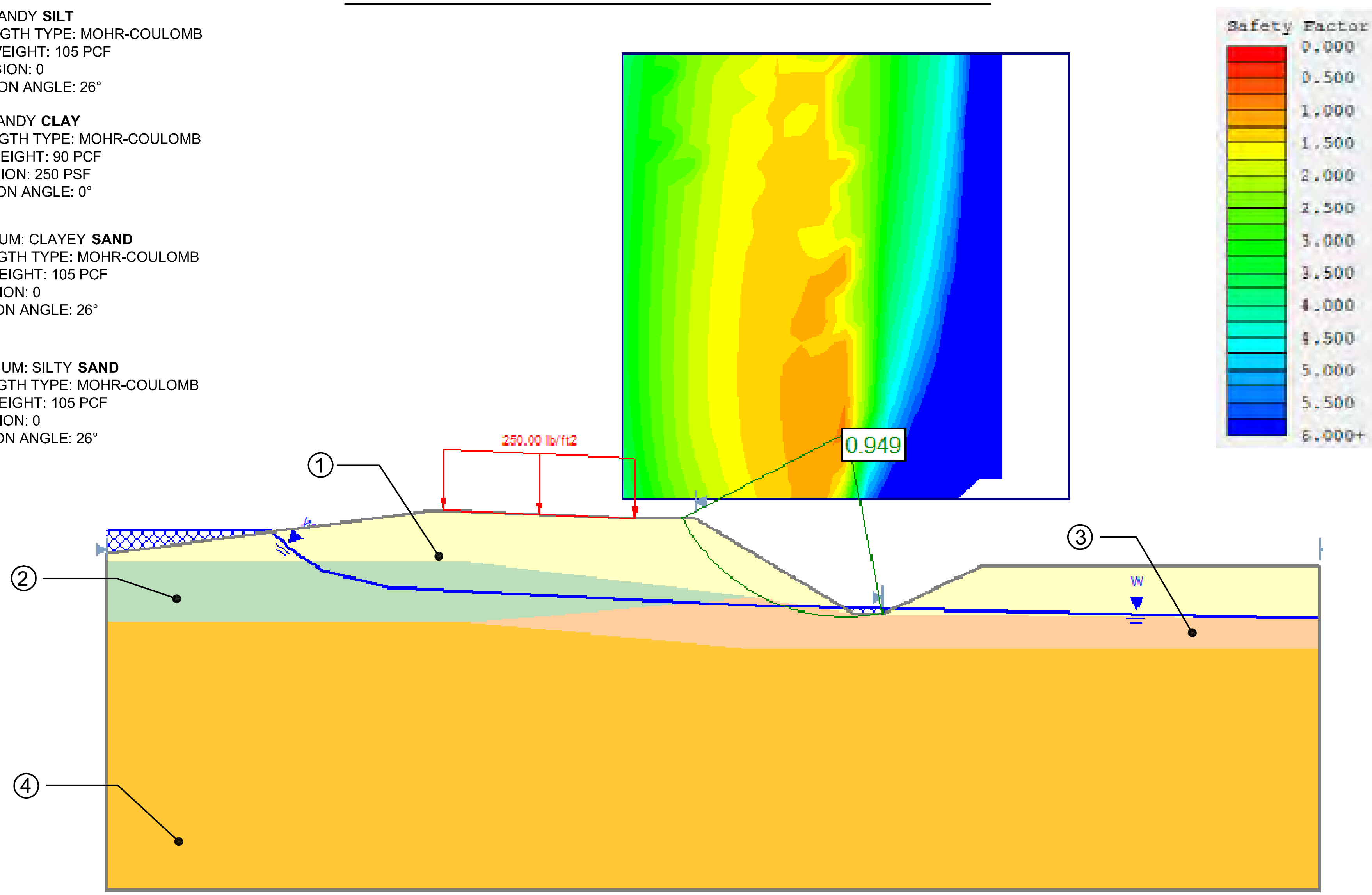
EXISTING SUBSURFACE PROFILE C-C'

① FILL: SANDY **SILT**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°

② FILL: SANDY **CLAY**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 90 PCF
COHESION: 250 PSF
FRICTION ANGLE: 0°

③ ALLUVIUM: CLAYEY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°

④ RESIDUUM: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°



SCALE: NTS	WILLMER ENGINEERING INC.
DATE: 11/3/2014	
DRAWN BY: AC	
REVIEWED BY: BD	

GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES
ENVIRONMENTAL SERVICES AND ENGINEERING
3772 PLEASANTDALE ROAD - SUITE 165
ATLANTA, GA 30340-4270

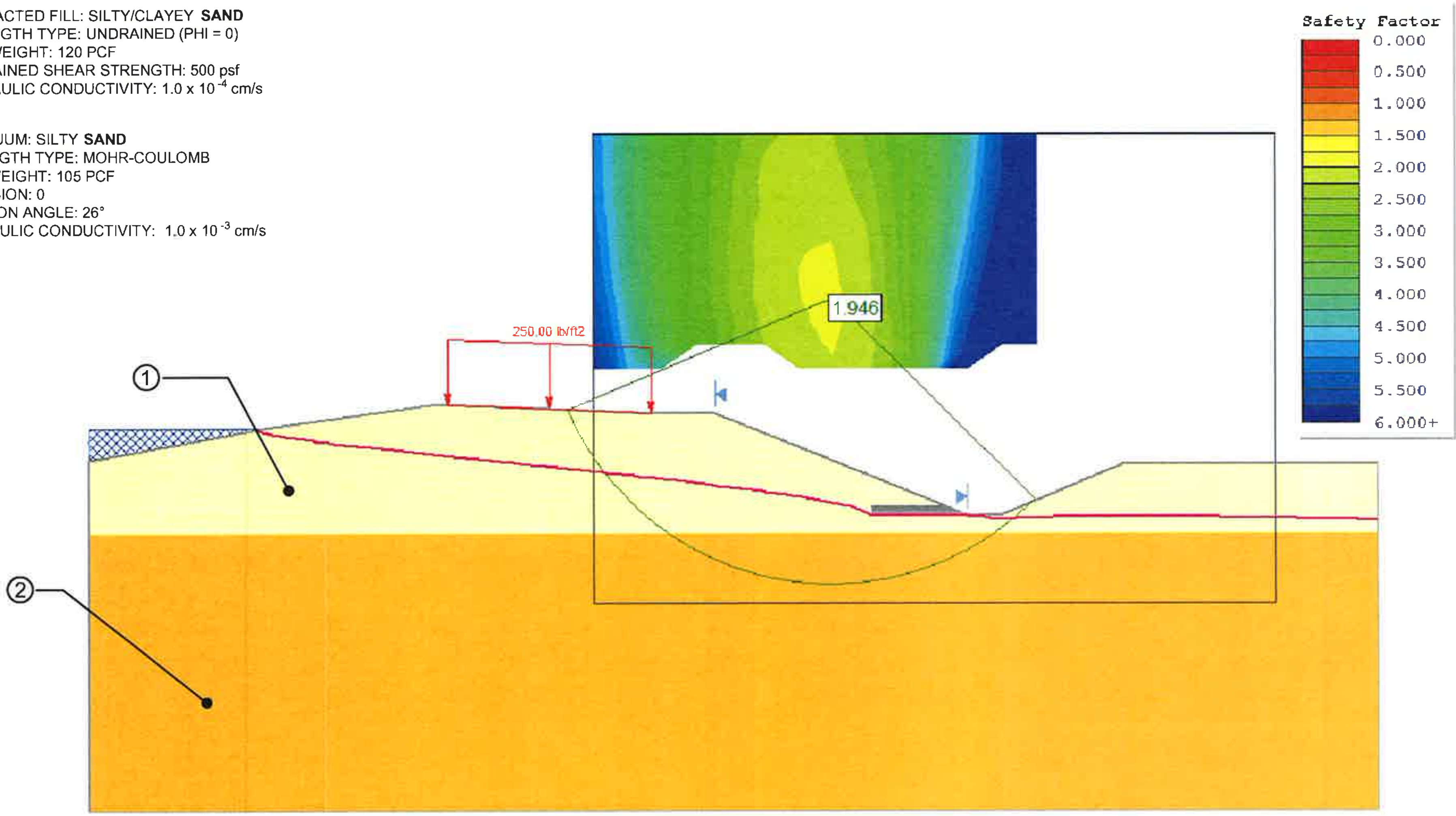
FIGURE 5C
SUBSURFACE PROFILE C-C'
SLOPE STABILITY ANALYSIS
CLARKSTON LAKE DAM RECONSTRUCTION
CLARKSTON, DEKALB COUNTY, GEORGIA
WILLMER PROJECT No. 71.3983

P:\3983 Clarkston Lake Dam Reconstruction\CADD\Figure 5- Slope Stability.dwg

RECONSTRUCTED SLOPE – END OF CONSTRUCTION

(1) COMPACTED FILL: SILTY/CLAYEY **SAND**
STRENGTH TYPE: UNDRAINED (PHI = 0)
UNIT WEIGHT: 120 PCF
UNDRAINED SHEAR STRENGTH: 500 psf
HYDRAULIC CONDUCTIVITY: 1.0 x 10^{-4} cm/s

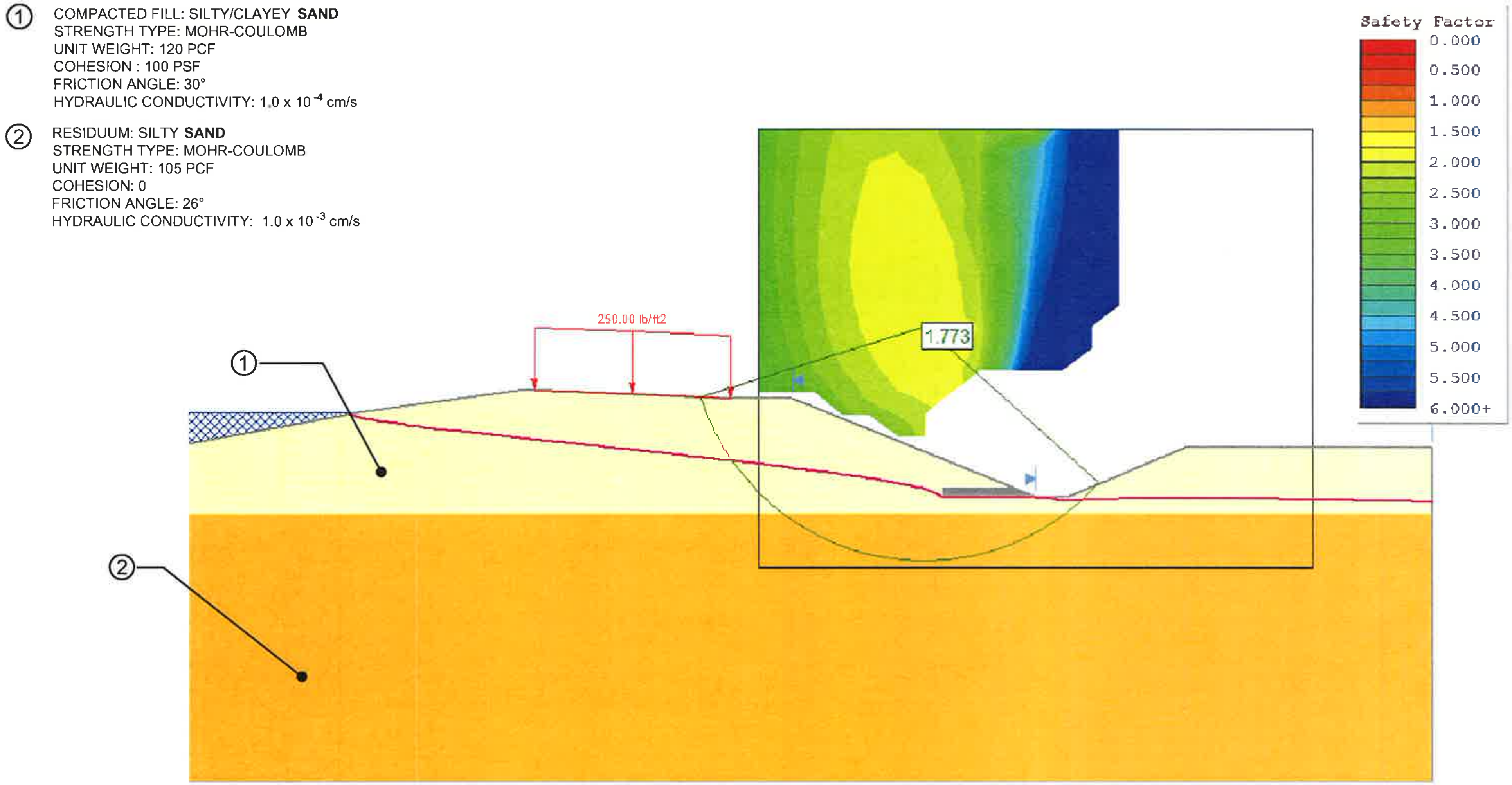
(2) RESIDUUM: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°
HYDRAULIC CONDUCTIVITY: 1.0 x 10^{-3} cm/s



SCALE: NTS DATE: 11/6/2014 DRAWN BY: AC REVIEWED BY: BD	WILLMER ENGINEERING INC. | WE	GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 6A END OF CONSTRUCTION SLOPE STABILITY ANALYSIS CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983

P:\13983 Clarkston Lake Dam Reconstruction\CADD\Figure 6 - Slope Stability Analysis.dwg

RECONSTRUCTED SLOPE – STEADY STATE SEEPAGE



SCALE: NTS	WILLMER ENGINEERING INC.	GEOTECHNICAL ENGINEERING ¤ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 6B STEADY STATE SEEPAGE SLOPE STABILITY ANALYSIS CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983
DATE: 11/6/2014			
DRAWN BY: AC			
REVIEWED BY: BD			

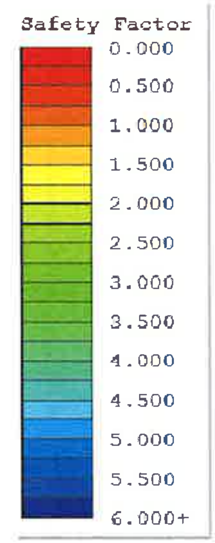
P:\3983 Clarkston Lake Dam Reconstruction\CADD\Figure 6 - Slope Stability Analysis.dwg

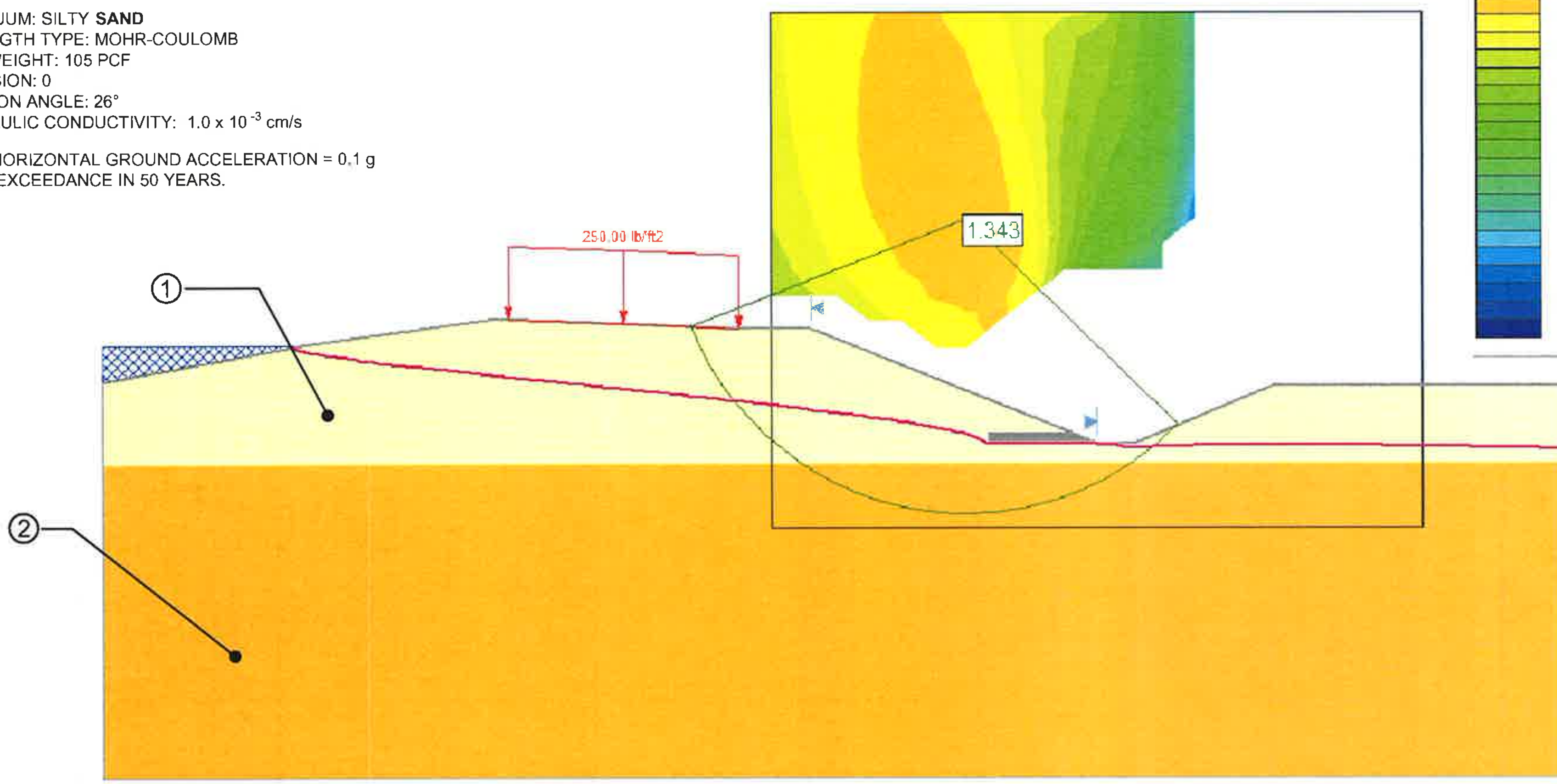
RECONSTRUCTED SLOPE – SEISMIC LOADING

(1) COMPACTED FILL: SILTY/CLAYEY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 120 PCF
COHESION : 100 PSF
FRICTION ANGLE: 30°
HYDRAULIC CONDUCTIVITY: 1.0×10^{-4} cm/s

(2) RESIDUUM: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°
HYDRAULIC CONDUCTIVITY: 1.0×10^{-3} cm/s

NOTE: PEAK HORIZONTAL GROUND ACCELERATION = 0.1 g for 2% EXCEEDANCE IN 50 YEARS.





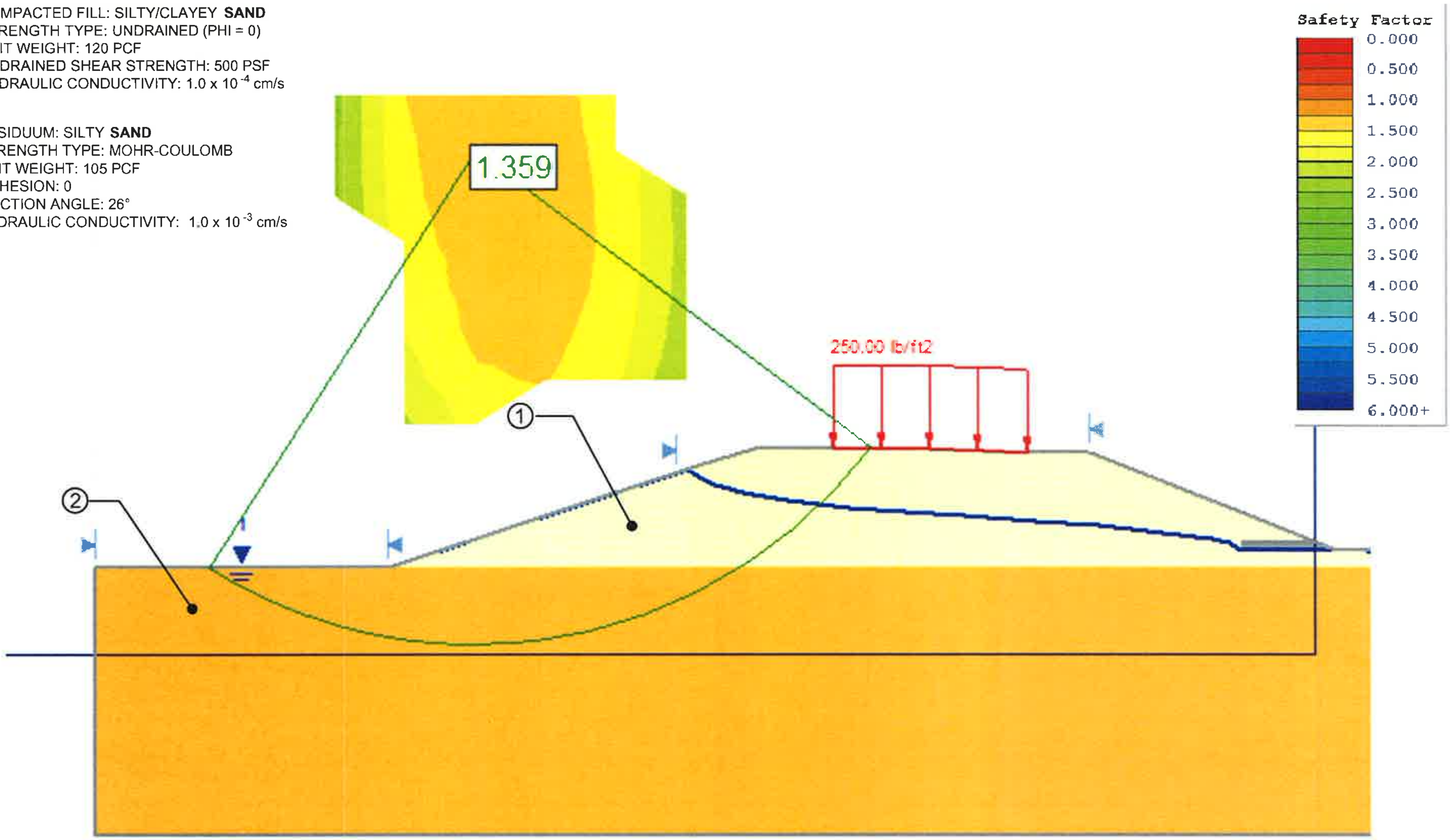
SCALE: NTS DATE: 11/6/2014 DRAWN BY: AC REVIEWED BY: BD	WILLMER ENGINEERING INC. WE	GEOTECHNICAL ENGINEERING ▫ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 6C SEISMIC LOADING SLOPE STABILITY ANALYSIS CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983

P:\13983 Clarkston Lake Dam Reconstruction\CADD\Figure 6 - Slope Stability Analysis.dwg

RECONSTRUCTED SLOPE – RAPID DRAWDOWN (UPSTREAM SLOPE)

① COMPACTED FILL: SILTY/CLAYEY **SAND**
STRENGTH TYPE: UNDRAINED (PHI = 0)
UNIT WEIGHT: 120 PCF
UNDRAINED SHEAR STRENGTH: 500 PSF
HYDRAULIC CONDUCTIVITY: 1.0 x 10^{-4} cm/s

② RESIDUUM: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°
HYDRAULIC CONDUCTIVITY: 1.0 x 10^{-3} cm/s



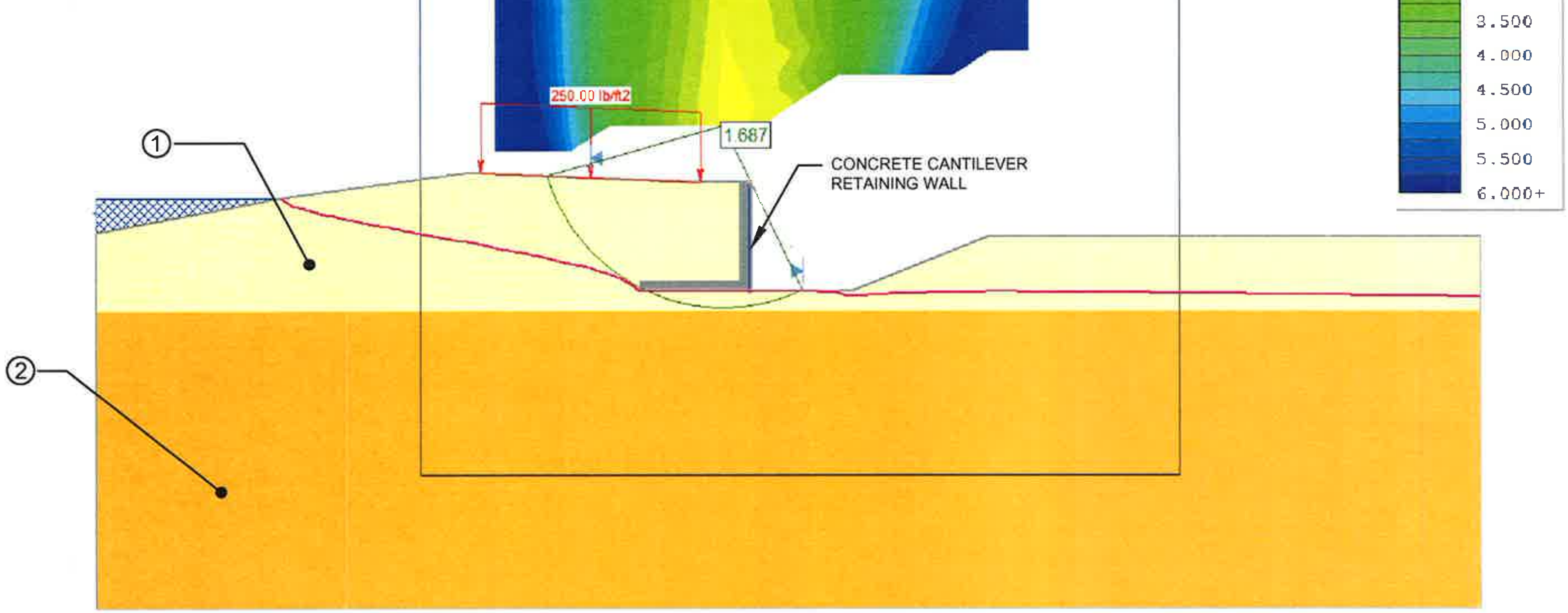
SCALE: NTS	WILLMER ENGINEERING INC. WE	GEOTECHNICAL ENGINEERING ▫ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 6D RAPID DRAWDOWN (UPSTREAM SLOPE) SLOPE STABILITY ANALYSIS CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983
DATE: 11/6/2014			
DRAWN BY: AC			
REVIEWED BY: BD			

P:\3983 Clarkston Lake Dam Reconstruction\CADD\Figure 6 - Slope Stability Analysis.dwg

RETAINING WALL – END OF CONSTRUCTION

① COMPACTED FILL: SILTY/CLAYEY **SAND**
STRENGTH TYPE: UNDRAINED (PHI=0)
UNIT WEIGHT: 120 PCF
UNDRAINED SHEAR STRENGTH: 500 PSF
HYDRAULIC CONDUCTIVITY: 1.0×10^{-4} cm/s

② RESIDUUM: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°
HYDRAULIC CONDUCTIVITY: 1.0×10^{-3} cm/s



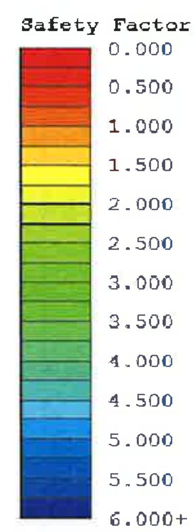
SCALE: NTS	WILLMER ENGINEERING INC. WE	FIGURE 7A
DATE: 11/6/2014	GEOTECHNICAL ENGINEERING ▫ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	END OF CONSTRUCTION SLOPE STABILITY ANALYSIS CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA
DRAWN BY: AC		WILLMER PROJECT No. 71.3983
REVIEWED BY: BD		

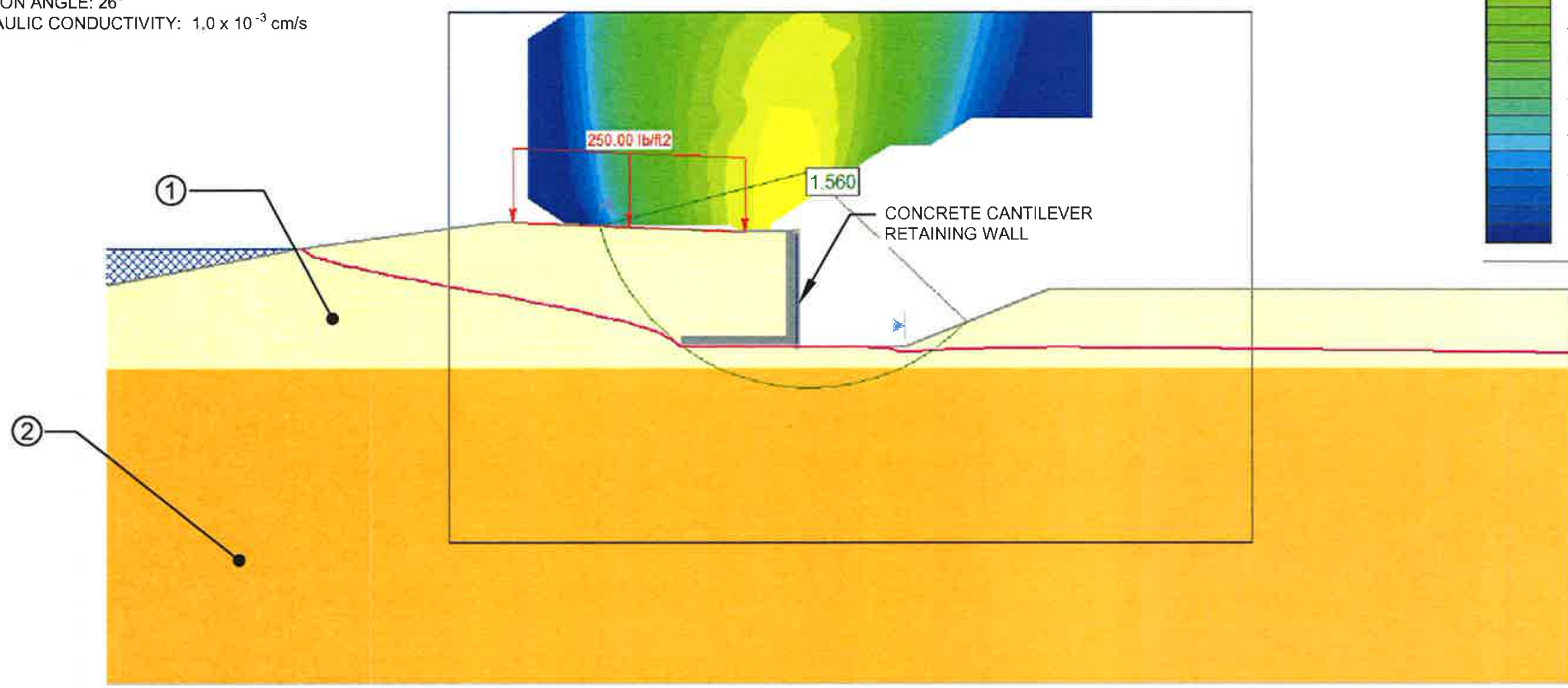
P:\3983 Clarkston Lake Dam Reconstruction\CADD\Figure 7 - Slope Stability Analysis.dwg

RETAINING WALL – STEADY STATE SEEPAGE

① COMPACTED FILL: SILTY/CLAYEY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 120 PCF
COHESION : 100 PSF
FRICTION ANGLE: 30°
HYDRAULIC CONDUCTIVITY: 1.0 x 10^{-4} cm/s

② RESIDUUM: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°
HYDRAULIC CONDUCTIVITY: 1.0 x 10^{-3} cm/s





SCALE: NTS DATE: 11/6/2014 DRAWN BY: AC REVIEWED BY: BD	WILLMER ENGINEERING INC. WE	GEOTECHNICAL ENGINEERING ▫ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 7B STEADY STATE SEEPAGE SLOPE STABILITY ANALYSIS CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983

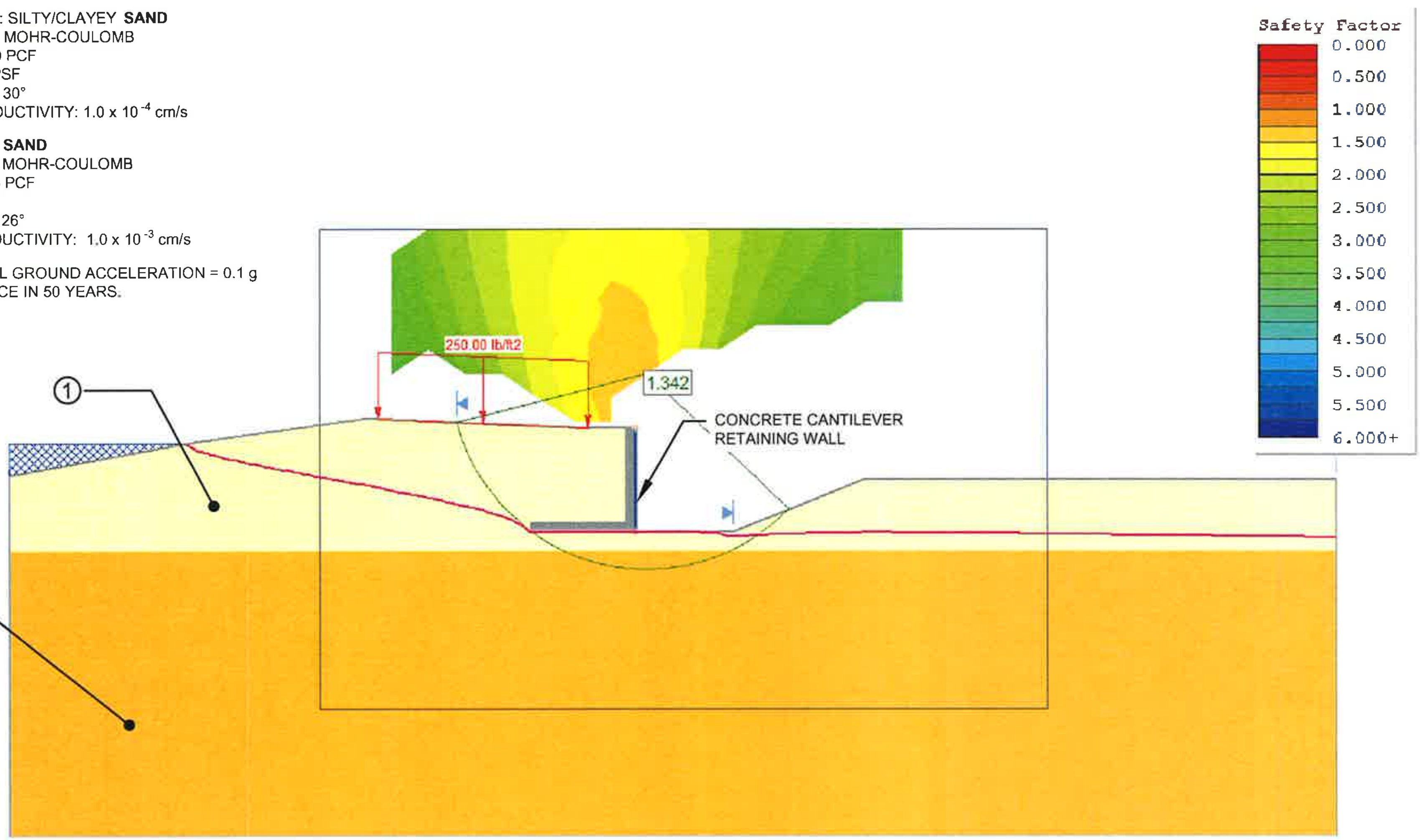
P:\3983 Clarkston Lake Dam Reconstruction\CADD\Figure 7 - Slope Stability Analysis.dwg

RETAINING WALL – SEISMIC LOADING

1. COMPACTED FILL: SILTY/CLAYEY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 120 PCF
COHESION : 100 PSF
FRICTION ANGLE: 30°
HYDRAULIC CONDUCTIVITY: 1.0×10^{-4} cm/s

2. RESIDUUM: SILTY **SAND**
STRENGTH TYPE: MOHR-COULOMB
UNIT WEIGHT: 105 PCF
COHESION: 0
FRICTION ANGLE: 26°
HYDRAULIC CONDUCTIVITY: 1.0×10^{-3} cm/s

NOTE: PEAK HORIZONTAL GROUND ACCELERATION = 0.1 g for 2% EXCEEDANCE IN 50 YEARS.



SCALE: NTS	WILLMER ENGINEERING INC.	GEOTECHNICAL ENGINEERING ▫ CONSTRUCTION SERVICES ENVIRONMENTAL SERVICES AND ENGINEERING 3772 PLEASANTDALE ROAD - SUITE 165 ATLANTA, GA 30340-4270	FIGURE 7C SEISMIC LOADING SLOPE STABILITY ANALYSIS CLARKSTON LAKE DAM RECONSTRUCTION CLARKSTON, DEKALB COUNTY, GEORGIA WILLMER PROJECT No. 71.3983
DATE: 11/6/2014			
DRAWN BY: AC			
REVIEWED BY: BD			

P:\3983 Clarkston Lake Dam Reconstruction\CADD\Figure 7 - Slope Stability Analysis.dwg

APPENDIX I

WILLMER ENGINEERING INC. | WE

BORING RECORD LEGEND

SM, CL, etc: - GROUP SYMBOL based on Unified Soil Classification System.
(Refer to ASTM D-2488 and Table 1 of D-2487)

N-VALUE: BLOWS PER FOOT- Standard Penetration Resistance (SPT) blow count , the sum of the second and third 6-inch increments of the SPT test.
(Refer to ASTM D-1586)

<u>CONSISTENCY / RELATIVE DENSITY Correlated with SPT Blow Count, N:</u>

SILTS AND CLAYS

N (blows per foot)	Consistency
0 - 2	Very Soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very Stiff
31 - 50	Hard
> 50	Very Hard

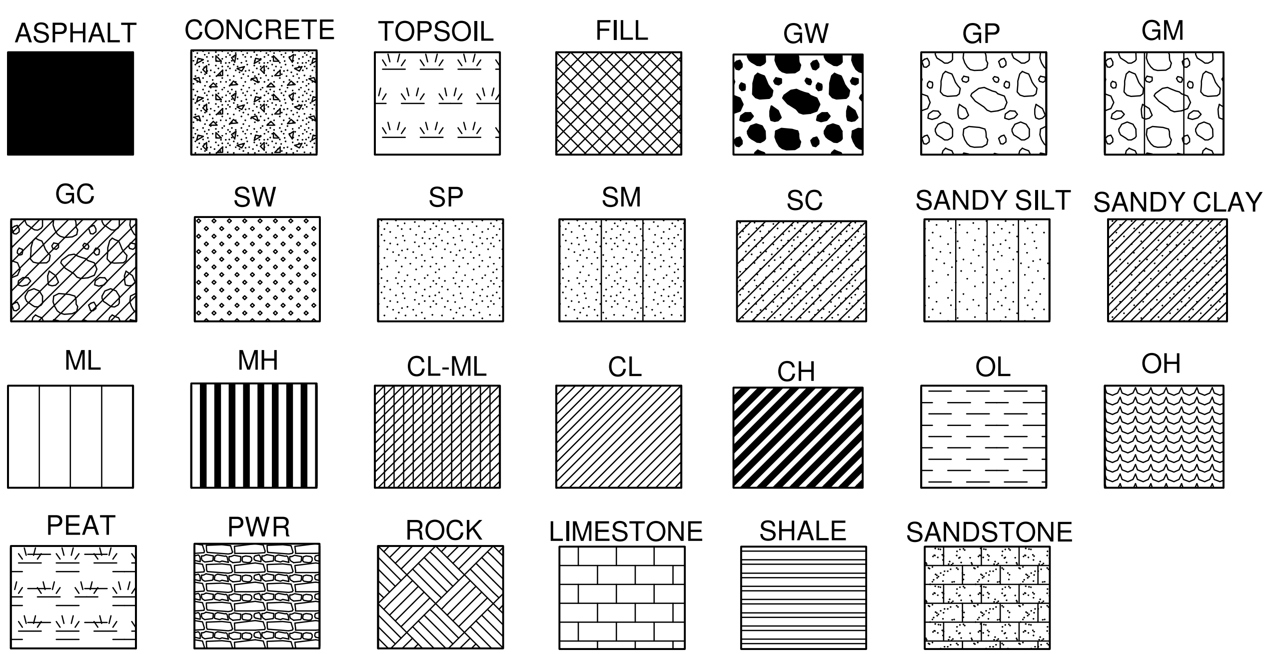
SANDS

N (blows per foot)	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
> 50	Very Dense

<u>NOTES:</u>

Groundwater Measurements:

- ▼ Water level at 24 hours
- ▽ Water level at time of boring
- Caved level at 24 hours



WILLMER ENGINEERING INC. | WE

Willmer Engineering Inc.
3772 Pleasantdale Road, Suite 165
Atlanta, Georgia 30340

UNIFIED SOIL CLASSIFICATION SYSTEM REFERENCE SHEET

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN #200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED #4 SIEVE	CLEAN GRAVELS LITTLE OR NO FINES	**(GW)**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			(GP)	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES APPRECIABLE AMOUNT OF FINES	**(GM)**	SILTY GRAVELS and GRAVEL-SAND-SILT MIXTURES
			(GC)	CLAYEY GRAVELS and GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING #4 SIEVE	CLEAN SAND LITTLE OR NO FINES	**(SW)**	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			(SP)	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES APPRECIABLE AMOUNT OF FINES	**(SM)**	SILTY SANDS and SAND-SILT MIXTURES
			(SC)	CLAYEY SANDS and SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		**(ML)**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR VERY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			(CL)	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			(OL)	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		**(MH)**	INORGANIC ELASTIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS
			(CH)	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			(OH)	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			**(PT)**	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

WILLMER ENGINEERING INC. WE

Project: **Clarkston Lake Dam Reconstruction**	**HOLE No. B-1**
Location: **Clarkston, DeKalb County, Georgia**	Sheet 1 of 1
Project Number: **71.3983**	Location: **See Figure 3**

Azimuth: **--** Angle from Horizontal: **90** Surface Elevation (ft): **944.23** Station: **520+38, 8' LT**

Drilling Equipment: **CME 45** Drilling Method: **HSA- Automatic Hammer**

Core Boxes: **N/A** Samples: **9** Overburden (ft): **N/A** Rock (ft): **N/A** Total Depth (ft): **23.5**

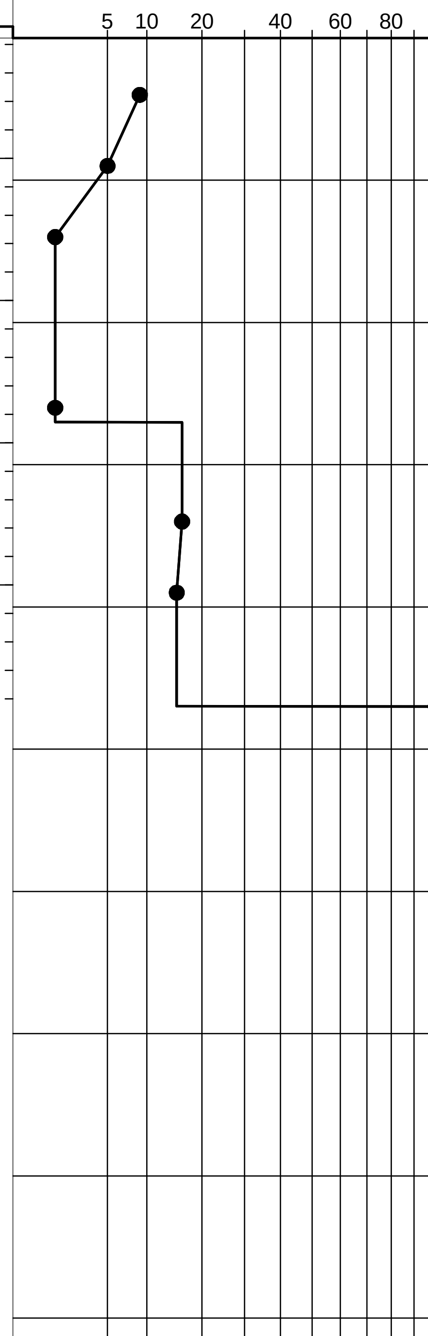
Logged By: **BD** Date Drilled: **8/4/14**

VERTICAL DEPTH (ft)	SAMPLE TYPE	REC%	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N-VALUE
0				ASPHALT PAVEMENT = 8 inches		944.2	
	SS			FILL: Loose brown and red silty medium to fine **SAND**	FILL		9
5	SS			Very soft red **SILT** (very moist)	FILL	940	5
				Very soft gray medium to fine sandy **CLAY**	FILL		
	SS						1/18"
10				Very loose gray silty medium to fine **SAND**	FILL	935	
	SS						1
15	ST			RESIDUUM: Medium dense brown and tan silty medium to fine **SAND**	SM	930	
	SS						16
20	SS					925	15
	SS						50/0"

Boring was terminated at 23.5 feet below the existing ground surface.

The hole caved at 13 feet below the existing ground surface at the time of boring completion.

STANDARD PENETRATION TEST DATA (blows/foot)



SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
NQ - Rock Core, 1-7/8"	CT - Continuous Tube	DC - Driving Casing		**B-1**

WILLMER ENGINEERING INC. | WE

Project: **Clarkston Lake Dam Reconstruction**	**HOLE No. B-4**
Location: **Clarkston, DeKalb County, Georgia**	Sheet 1 of 1
Project Number: **71.3983**	Location: **See Figure 3**

Azimuth: **--** Angle from Horizontal: **90** Surface Elevation (ft): **943.53** Station: **521+51, 8' LT**

Drilling Equipment: **CME 45** Drilling Method: **HSA- Automatic Hammer**

Core Boxes: **N/A** Samples: **10** Overburden (ft): **N/A** Rock (ft): **N/A** Total Depth (ft): **35.0**

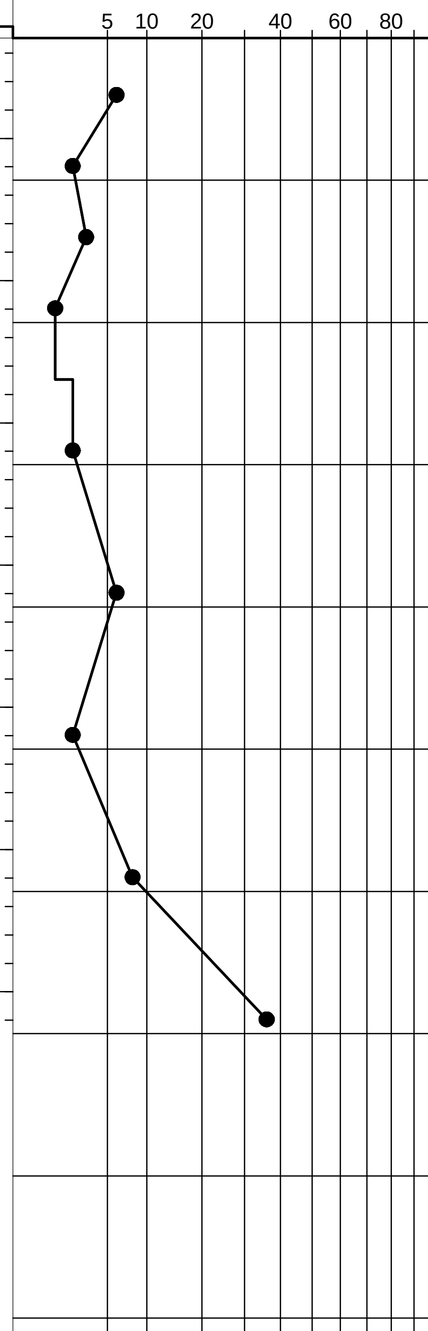
Logged By: **BD** Date Drilled: **8/4/14**

VERTICAL DEPTH (ft)	SAMPLE TYPE	REC%	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N-VALUE
0				ASPHALT PAVEMENT = 8 inches		943.5	
	SS			FILL: Loose to very loose brown, red, and gray clayey medium to fine **SAND**	**FILL**		6
5	SS					940	2
	SS						3
10	SS					935	1
	ST						
	SS			RESIDUUM: Very loose to loose brown, tan, and gray medium to fine sandy **SILT** (micaceous)	**ML**	930	2
15							
20	SS					925	6
25	SS			Very loose to loose red and tan (mottled black) silty medium to fine **SAND** (very micaceous)	**SM**	920	2
30	SS					915	8
35	SS			Dense brown, tan, and gray silty medium to fine **SAND** (slightly micaceous)	**SM**	910	36

Boring was terminated at 35 feet below the existing ground surface.

Groundwater was encountered at 13 feet below the existing ground surface at the time of boring completion.

STANDARD PENETRATION TEST DATA (blows/foot)



SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
NQ - Rock Core, 1-7/8"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-4**

WILLMER ENGINEERING INC. | WE

Project: **Clarkston Lake Dam Reconstruction**
Location: **Clarkston, DeKalb County, Georgia**
Project Number: **71.3983**

HOLE No. B-6

Sheet 1 of 1

Location: **See Figure 3**

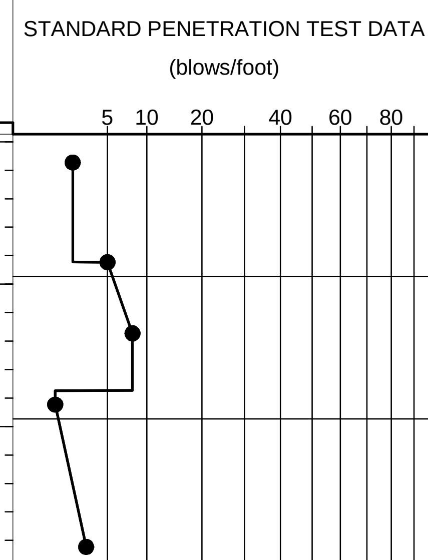
Azimuth: **--** | Angle from Horizontal: **90** | Surface Elevation (ft): **935.27** | Station: **521+60, 55' RT**

Drilling Equipment: **CME 45** | Drilling Method: **HSA- Automatic Hammer**

Core Boxes: **N/A** | Samples: **5** | Overburden (ft): **N/A** | Rock (ft): **N/A** | Total Depth (ft): **15.0**

Logged By: **BD** | Date Drilled: **8/4/14**

VERTICAL DEPTH (ft)	SAMPLE TYPE	REC%	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N-VALUE
	SS			FILL: Very soft reddish brown medium to fine sandy **SILT**	**FILL**	935.3 / 935	2/18"
5	SS			ALLUVIUM: Loose gray silty coarse to fine **SAND**	**SM**	930	5
	SS						8
10	SS			RESIDUUM: Very soft to soft red, tan, and gray medium to fine sandy **SILT** (very micaceous)	**ML**	925	1
15	SS						3



Boring was terminated at 15 feet below the existing ground surface.

A temporary 1" PVC piezometer was installed after boring completion.

Groundwater was encountered at 4.5 feet below the existing ground surface at 24 hours after boring completion.

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
NQ - Rock Core, 1-7/8"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-6**

WILLMER ENGINEERING INC. | WE

Project: **Clarkston Lake Dam Reconstruction**
Location: **Clarkston, DeKalb County, Georgia**
Project Number: **71.3983**

HOLE No. B-7

Sheet 1 of 1

Location: **See Figure 3**

Azimuth: **--** Angle from Horizontal: **90** Surface Elevation (ft): **944.07** Station: **522+52, 8' LT**

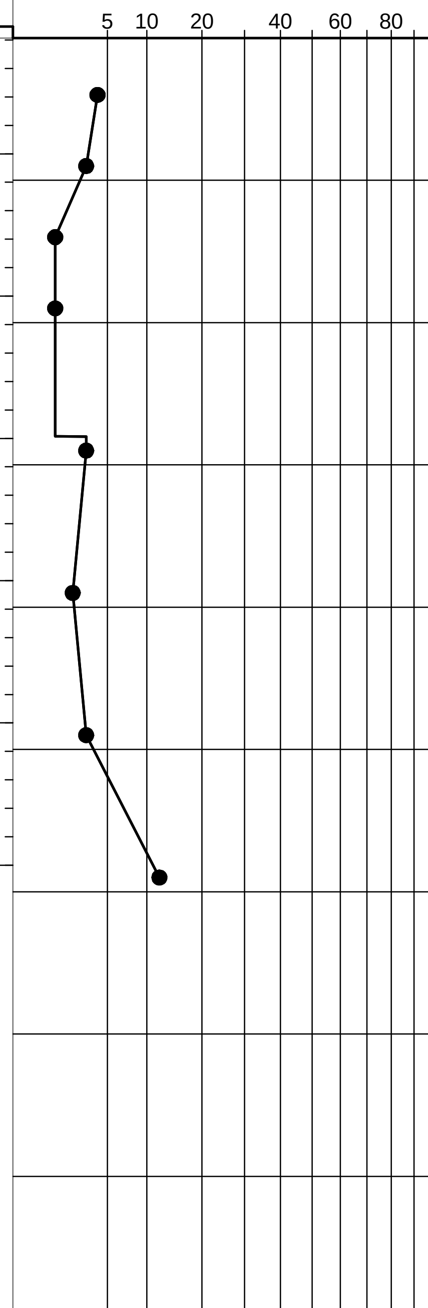
Drilling Equipment: **CME 45** Drilling Method: **HSA- Automatic Hammer**

Core Boxes: **N/A** Samples: **9** Overburden (ft): **N/A** Rock (ft): **N/A** Total Depth (ft): **30.0**

Logged By: **BD** Date Drilled: **8/4/14**

VERTICAL DEPTH (ft)	SAMPLE TYPE	REC%	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N-VALUE
0				ASPHALT PAVEMENT = 8 inches		944.1	
	SS			FILL: Soft red and tan medium to fine sandy **SILT**	FILL		4
5	SS					940	3
	SS			Very soft gray and brown medium to fine sandy fat **CLAY**	FILL		1/18"
10	SS					935	1
15	SS			RESIDUUM: Soft brown and tan medium to fine sandy **SILT** with rock fragments	ML	930	3
20	SS			Very loose to medium dense gray. white, and tan silty medium to fine **SAND** (micaceous)	SM	925	2
25	SS					920	3
30	SS					915	12

STANDARD PENETRATION TEST DATA (blows/foot)



Boring was terminated at 30 feet below the existing ground surface.

Groundwater was encountered at 13 feet below the existing ground surface at the time of boring completion.

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
NQ - Rock Core, 1-7/8"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-7**

WILLMER ENGINEERING INC. | WE

Project: **Clarkston Lake Dam Reconstruction**
Location: **Clarkston, DeKalb County, Georgia**
Project Number: **71.3983**

HOLE No. B-9

Sheet 1 of 1

Location: **See Figure 3**

Azimuth: **--** Angle from Horizontal: **90** Surface Elevation (ft): **937.38** Station: **522+57, 60' RT**

Drilling Equipment: **CME 45** Drilling Method: **HSA- Automatic Hammer**

Core Boxes: **N/A** Samples: **7** Overburden (ft): **N/A** Rock (ft): **N/A** Total Depth (ft): **20.0**

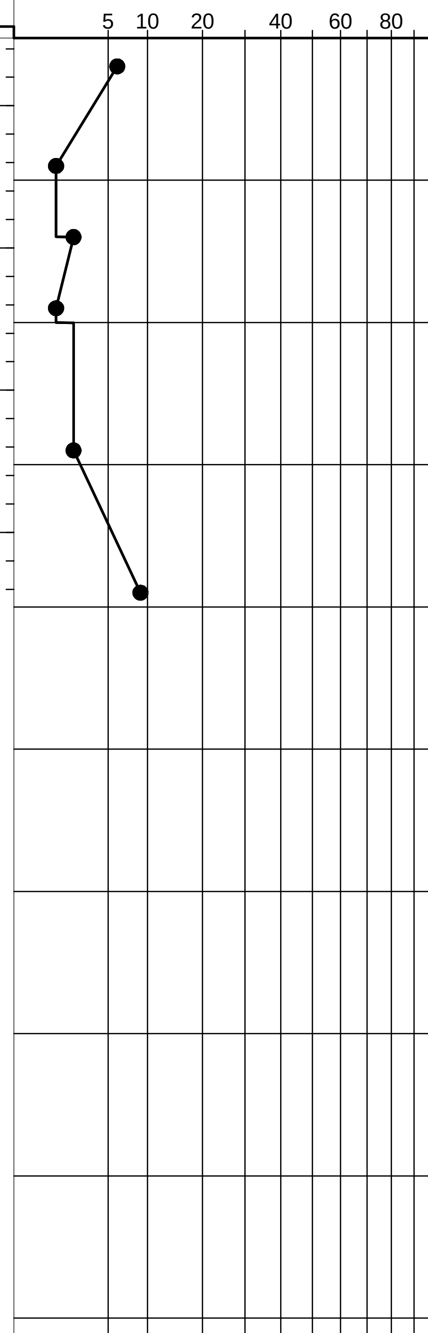
Logged By: **BD** Date Drilled: **8/4/14**

VERTICAL DEPTH (ft)	SAMPLE TYPE	REC%	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N-VALUE
0	SS			FILL: Firm to very soft reddish brown medium to fine sandy **SILT**	**FILL**	937.4	6
	SS						1/12"
	SS			ALLUVIUM: Very loose gray and yellow silty coarse to fine **SAND**	**SM**		2
	SS						1
10	ST			RESIDUUM: Very loose to loose brown, tan, and white silty medium to fine **SAND** (very micaceous)	**SM**		
	SS						2
	SS						9
20				Boring was terminated at 20 feet below the existing ground surface.			

Groundwater was encountered at 6 feet below the existing ground surface at 24 hours after boring completion.

A temporary 1" PVC piezometer was installed after boring completion.

STANDARD PENETRATION TEST DATA (blows/foot)



SAMPLER TYPE

SS - Split Spoon
ST - Shelby Tube
NQ - Rock Core, 1-7/8"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD

HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-9**

SPTN BORING LOGS.GPJ 10/29/14

WILLMER ENGINEERING INC.

Project: **Clarkston Lake Dam Reconstruction**
Location: **Clarkston, DeKalb County, Georgia**
Project Number: **71.3983**

HOLE No. B-3

Sheet 1 of 1

Location: **See Figure 3**

Azimuth: **--** | Angle from Horizontal: **90** | Surface Elevation (ft): **936.22** | Station: **520+50, 49' RT**

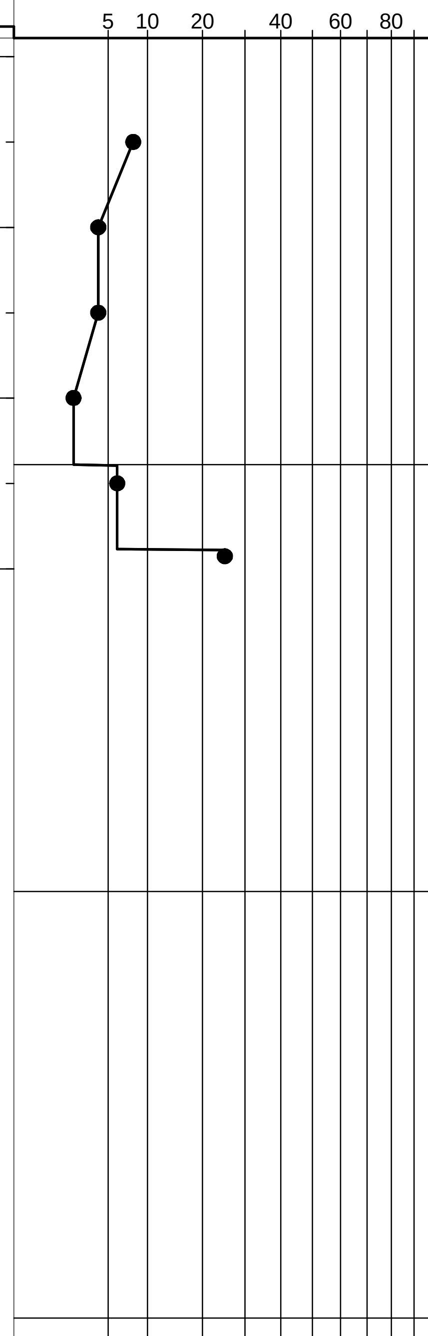
Drilling Equipment: **Hand Auger/DCP** | Drilling Method: **Auger and Penetrometer**

Core Boxes: **N/A** | Samples: **6** | Overburden: **N/A** | Rock: **N/A** | Total Depth (ft): **6.5**

Logged By: **BD** | Date Logged: **8/5/14**

VERTICAL DEPTH	SAMPLE TYPE	RCD%	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	BLOWS/1.75 IN.
0				FILL: Loose brown and tan silty medium to fine **SAND** with root fragments		936.2	
1	DCP						8
2	DCP					934	4
3	DCP			ALLUVIUM: Very loose to loose grayish brown clayey medium to fine **SAND**	SC		4
4	DCP					932	2
5	DCP			RESIDUUM: Loose to medium dense brown, tan, and gray medium to fine sandy **SILT** (very micaceous)	ML		6
6	DCP					930	>25

DYNAMIC CONE PENETRATION TEST DATA (blows/1.75 inch increment)



Hand auger refusal was encountered at 6.5 feet below the existing ground surface.

A 1" PVC piezometer was installed after boring completion.

Groundwater was encountered at 4.9 feet below the existing ground surface at 24 hours after boring completion.

A&PLOG BORING LOGS.GPJ 10/29/14

SAMPLER TYPE

SS - Split Spoon
ST - Shelby Tube
NQ - Rock Core, 1-7/8"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD

HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-3**

WILLMER ENGINEERING INC. WE

Project: **Clarkston Lake Dam Reconstruction**	**HOLE No. B-5**
Location: **Clarkston, DeKalb County, Georgia**	Sheet 1 of 1
Project Number: **71.3983**	Location: **See Figure 3**

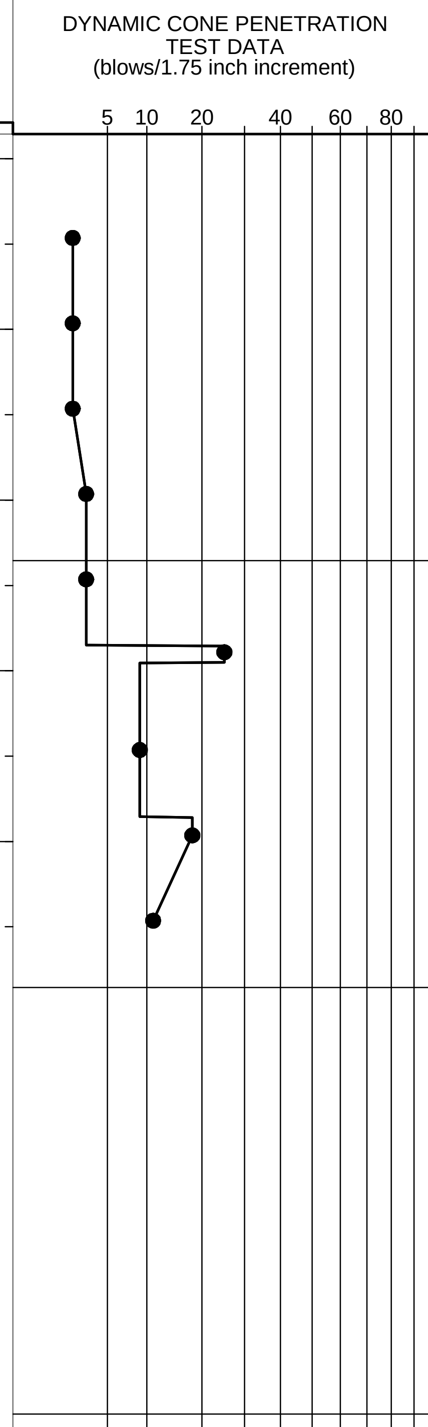
Azimuth: **--** Angle from Horizontal: **90** Surface Elevation (ft): **938.29** Station: **521+56, 30' RT**

Drilling Equipment: **Hand Auger/DCP** Drilling Method: **Auger and Penetrometer**

Core Boxes: **N/A** Samples: **9** Overburden: **N/A** Rock: **N/A** Total Depth (ft): **10.0**

Logged By: **BD** Date Logged: **8/5/14**

VERTICAL DEPTH	SAMPLE TYPE	RCD%	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	BLOWS/1.75 IN.
0				FILL: Very soft reddish brown medium to fine sandy **SILT (slightly micaceous)**	938.3	
1	DCP					2
2	DCP				936	2
3	DCP					2
4	DCP				934	3
5	DCP			Very loose to loose grayish brown clayey medium to fine **SAND** with root fragments and asphalt fragments		3
6	DCP			- blow count amplified possibly due to debris in fill	932	>25
7	DCP					9
8	DCP			ALLUVIUM: Medium dense to loose gray **SAND** with pebbles and gravel (SP)	930	18
9	DCP					11
10				Boring was terminated at 10 feet below the existing ground surface.		



A temporary 1" PVC piezometer was installed after boring completion.

Groundwater was encountered at 7.3 feet below the existing ground surface at 24 hours after boring completion.

A&PLOG BORING LOGS.GPJ 10/29/14

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
NQ - Rock Core, 1-7/8"	CT - Continuous Tube	DC - Driving Casing		**B-5**

WILLMER ENGINEERING INC. | WE

Project: **Clarkston Lake Dam Reconstruction**
Location: **Clarkston, DeKalb County, Georgia**
Project Number: **71.3983**

HOLE No. B-8

Sheet 1 of 1

Location: **See Figure 3**

Azimuth: **--** Angle from Horizontal: **90** Surface Elevation (ft): **937.56** Station: **522+54, 25' RT**

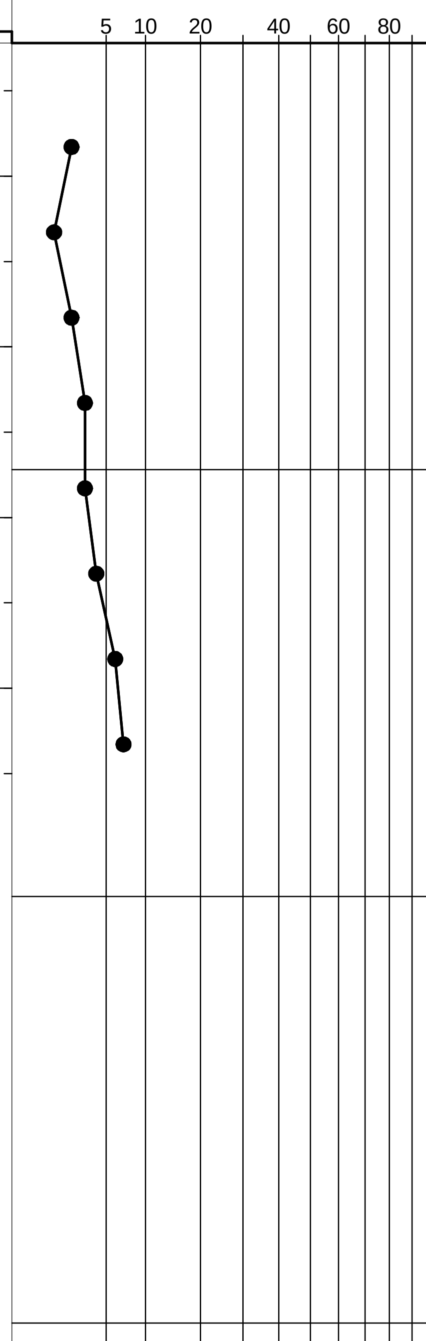
Drilling Equipment: **Hand Auger/DCP** Drilling Method: **Auger and Penetrometer**

Core Boxes: **N/A** Samples: **8** Overburden: **N/A** Rock: **N/A** Total Depth (ft): **9.0**

Logged By: **BD** Date Logged: **8/5/14**

VERTICAL DEPTH	SAMPLE TYPE	RCD%	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	BLOWS/1.75 IN.
0				FILL: Very soft reddish brown medium to fine sandy **SILT** (slightly micaceous)	937.6	
1	DCP					2
2	DCP				936	1
3	DCP					2
3.5				Soft grayish brown medium to fine sandy **CLAY**	934	
4	DCP					3
5	DCP			ALLUVIUM: Very loose to loose gray clayey medium to fine **SAND** (SC)	932	3
6	DCP					4
7	DCP				930	6
8	DCP			Firm light gray medium to fine sandy **SILT** (slightly micaceous) (ML)		7
9						

DYNAMIC CONE PENETRATION TEST DATA (blows/1.75 inch increment)



Boring was terminated at 9 feet below the existing ground surface.

A temporary 1" PVC piezometer was installed after boring completion.

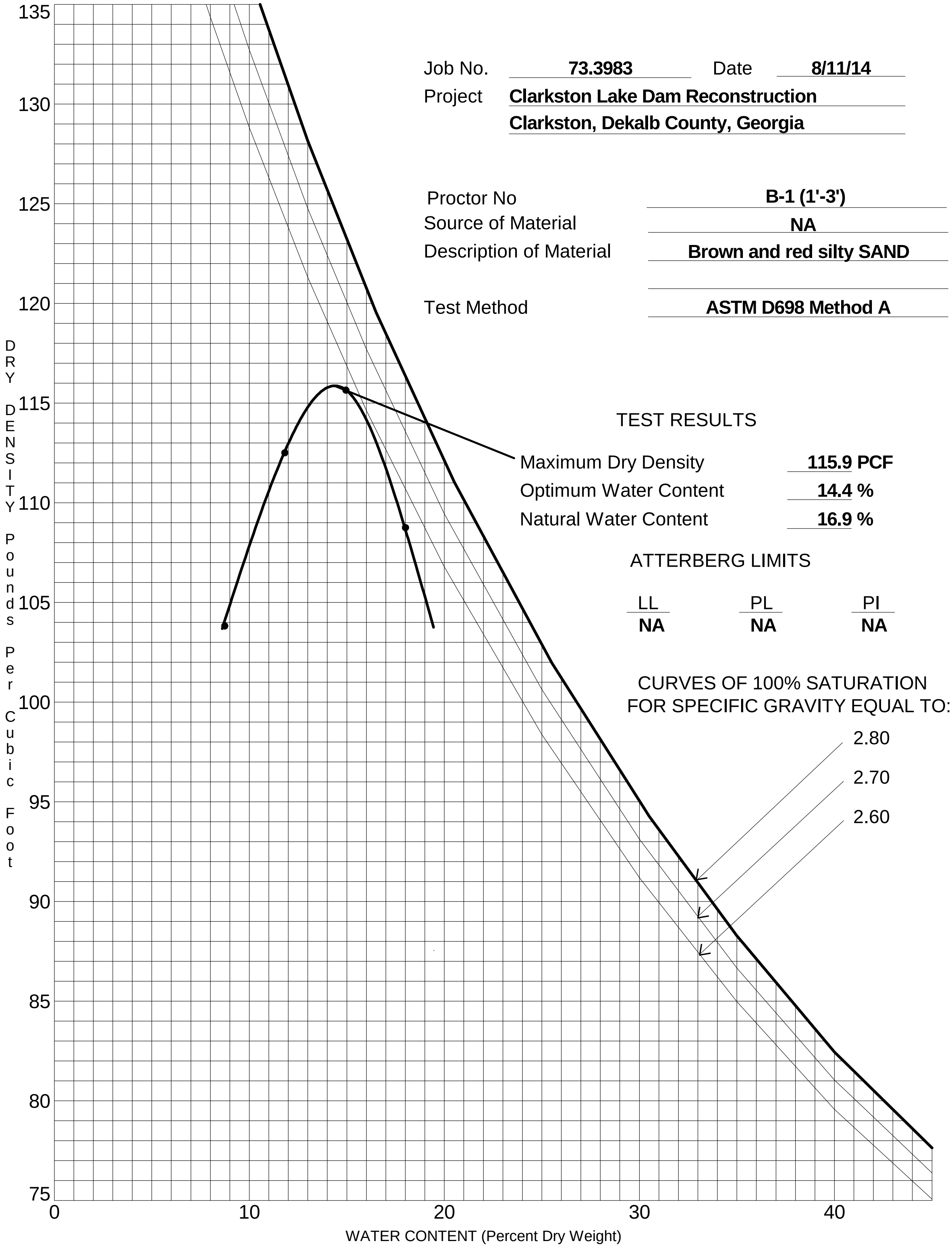
Groundwater was encountered at 4.5 feet below the existing ground surface at 24 hours after boring completion.

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
NQ - Rock Core, 1-7/8"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-8**

APPENDIX II



Job No. **73.3983** Date **8/11/14**

Project **Clarkston Lake Dam Reconstruction**
Clarkston, Dekalb County, Georgia

Proctor No **B-1 (1'-3')**

Source of Material **NA**

Description of Material **Brown and red silty SAND**

Test Method **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density **115.9 PCF**

Optimum Water Content **14.4 %**

Natural Water Content **16.9 %**

ATTERBERG LIMITS

LL	PL	PI
NA	**NA**	**NA**

Willmer Engineering Inc. WE

MOISTURE-DENSITY RELATIONSHIP

WILLMER ENGINEERING INC. | WE

Consolidation Test Worksheet	
Project Name	Clarkston Lake Dam
Project Location	Clarkston, DeKalb County, Georgia
Project No.	71.3983
Boring No.	B-1
Depth	14.5 feet
Soil Description	brown and tan silty SAND
Test Run By	BD
Date	10/7/2014
Test Method	ASTM D2435

Ring Dimensions:	
Ring Height	1.00 in
Ring Diameter	2.50 in

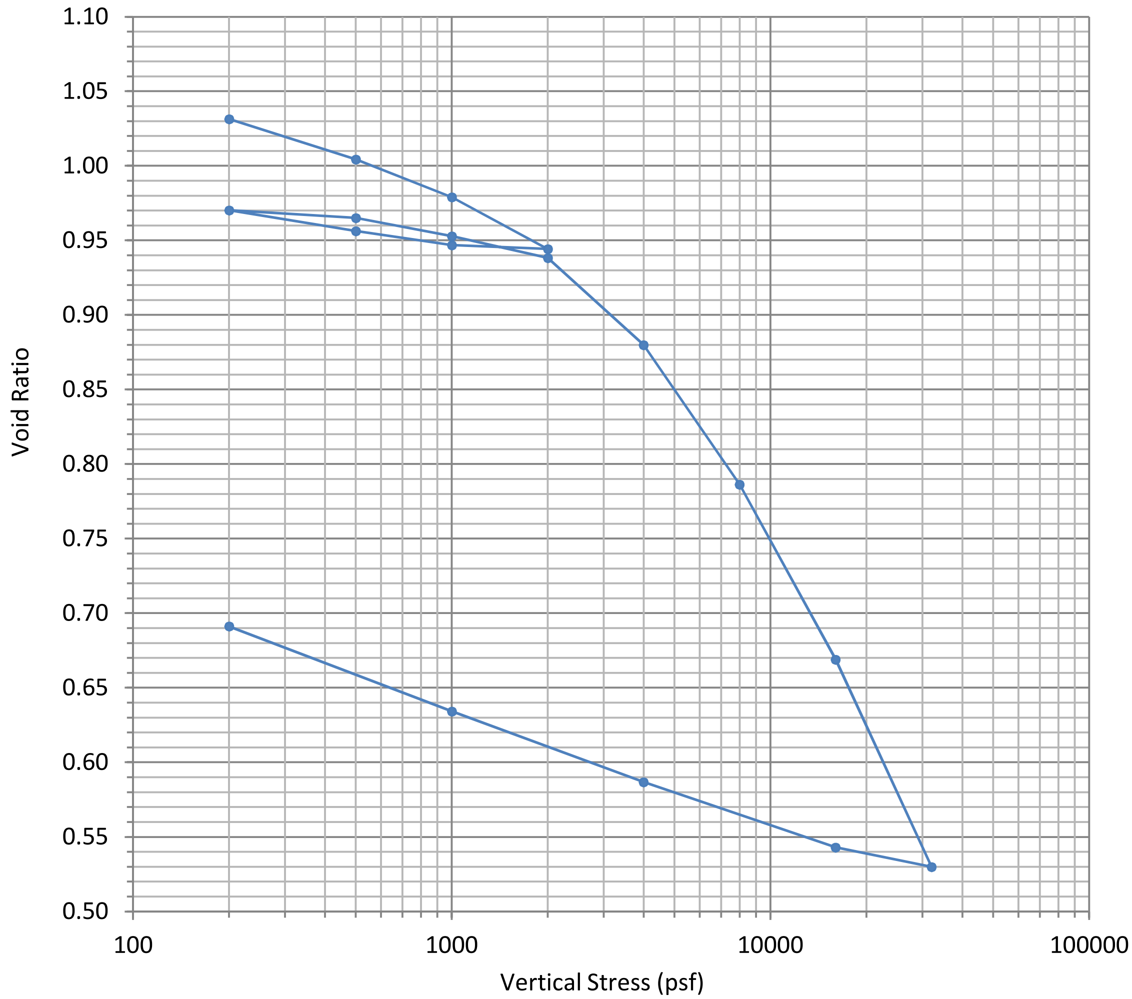
Before Test:		After Test:	
Wt of Ring	111.57 grams	Wt of Ring	111.58 grams
Wt of Ring + Specimen	240.76 grams	Wt of Ring + Specimen	240.34 grams
Wt of Specimen	129.19 grams	Wt of Specimen	128.76 grams
Moisture Content:		**Moisture Content:**	
Tare No.	ER-2	Tare No.	CPJ
Tare Wt	8.36 grams	Tare Wt	8.07 grams
Wet Wt + Tare	146.7 grams	Wet Wt + Tare	133.58 grams
Dry Wt + Tare	120.14 grams	Dry Wt + Tare	100.32 grams
Moisture Content	23.8 %	Moisture Content	36.1 %
Dry Wt of Specimen	104.4 grams	Dry Wt of Specimen	94.6 grams

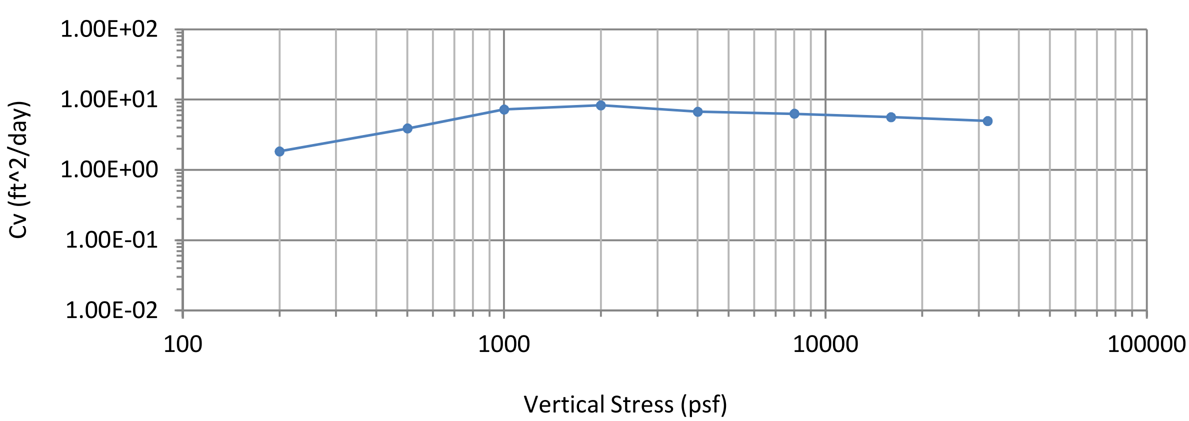
Soil Information:	
LL	NP
PL	NP
PI	NP
GS	2.69
σ'p	3,500 psf
Cc	0.43
Cr	0.05

Consolidation Test Results			
Before Test:		**After Test:**	
Specimen Height	1.000 in	Specimen Height	0.816 in
Water Content	23.8 %	Water Content	36.1 %
Dry Unit Weight	81.0 pcf	Dry Unit Weight	90.0 pcf
Saturation	59.6 %	Saturation	112.1 %
Void Ratio	1.07	Void Ratio	0.87

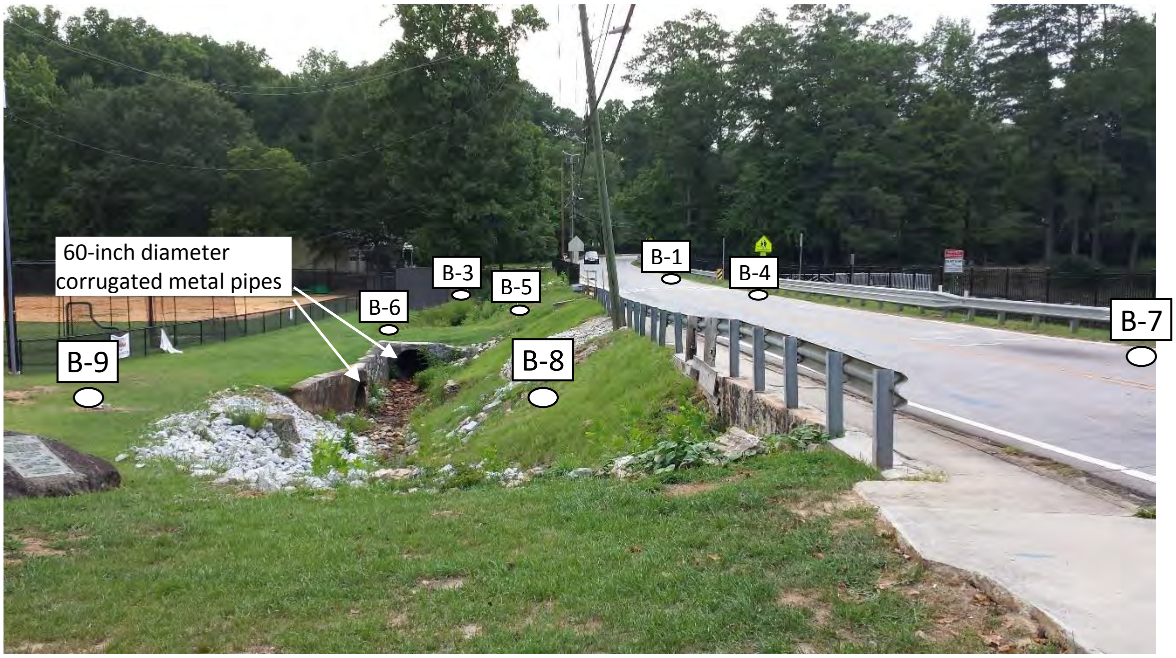
Consolidation Test
Clarkston Lake Dam Reconstruction
Clarkston, DeKalb County, Georgia
Willmer Project No. 71.3983

B-1 @ 14.5 feet





APPENDIX III



East End of Dam (Station 523+40±); Facing West

Station 522+70±; Facing West

Norman Road – Facing West: Settlement and Cracking

Norman Road – Facing West: Settlement and Cracking

Principal spillway channel through corrugated metal pipe; Facing North

Location of Inlet Structure; Facing East

Inlet Structure and Concrete Flume; Facing North

Emergency Spillway Flume; Facing Northeast

Inlet pipe under Milam Park; Facing Southeast

Drainage Channel at the West End of Dam; Facing West

Sloughing of Downstream Slope; Facing Northwest

Damaged Retaining Wall, Steep Slope, and Sloughing at West End of Dam; Facing North