Report of Preliminary Geotechnical Exploration

Hancock County Flood Risk Reduction Program – Eagle Creek Dry Storage Basin Phase 1

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Executive Summary

As part of the Hanacock County Flood Risk Reduction Program, the Maumee Watershed Conservancy District (MWCD) is evaluating several potential dam alignments in order to refine the conceptual design of a dry storage basin on Eagle Creek near Findlay, Ohio. The proposed Eagle Creek Dry Storage Basin is intended to provide storage during flood events to reduce the peak flow rates in Eagle Creek and the Blanchard River, thereby reducing the water surface elevations and risk of flooding downstream of the proposed Project area. The desired outcome of the proposed Project would be the reduction of flood risk and flood damages for the community. Stantec Consulting Services Inc. (Stantec) was contracted by MWCD to perform engineering and design services for the program, including the geotechnical exploration for the proposed dry storage basin.

Eagle Creek runs south to north, flowing into the Blanchard River in the eastern portion of the City of Findlay. The proposed dry storage basin is located approximately 4 miles south of the City of Findlay.

Ten borings were advanced by Stantec to obtain geotechnical data along a proposed embankment alignment west of Eagle Creek. Disturbed and undisturbed soil samples were collected through the soil overburden. Upon encountering bedrock, approximately 10 feet of rock coring was performed. Soil and rock samples obtained from the borings were logged in the field by a geotechnical engineer, then returned to the laboratory for testing and storage. Laboratory testing included natural moisture content determinations, soil classifications including particle size analysis and Atterberg limits, standard Proctor, and unconfined compressive strength testing. In addition, water pressure testing was performed in the bedrock in five of the borings.

Soils encountered along the proposed alignment west of Eagle Creek consisted of alternating layers of fine- and coarse-grained materials. Laboratory testing classified the fine-grained soils as Sandy Lean Clay (CL), Lean Clay (CL), Sandy Silty Clay (CL-ML), Silt with Sand (ML). These soils were described as moist, medium stiff to very stiff, and having varying amounts of sand and gravel. Fine-grained soils were encountered near the ground surface, and again deeper in the profile between two layers of coarse-grained soils. The coarse-grained materials were visually described as poorly graded sand with some gravel or mechanically classified as Silty Sand with Gravel (SM), Silty, Clayey Gravel with Sand (GC-GM), and Clayey Sand (SC). These soils were described as moist and dense to very dense. The layers of coarse-grained materials were found generally near the water table and again above top of bedrock. The depth to bedrock ranged from 12.8 feet (El. 784.8 feet) in B-1.1 to 21.0 feet (El. 773.4 feet) in B-2.14a. The bedrock was described as gray dolomite, slightly weathered, fractured to moderately fractured, slightly rough, and thin to medium bedded.

Seepage at and below the base of an embankment can erode the foundation, weaken the materials, and lead to uncontrolled releases of a reservoir. This risk is especially pronounced in a structure that does not retain water on a routine basis, as inspections are not often feasible except during flood events. The design team should consider the potential seepage concerns related to the various dam alignment alternatives currently under evaluation. The conclusions and recommendations herein assume that the preferred dam alignment will either

1. Require significant excavation of the natural soils within the reservoir footprint (upstream of the constructed dam), removing the fine-grained, near-surface soils, or

2. Not require significant excavation of the natural soil and leave a minimum of three (3) feet of the fine-grained, near-surface soils within the reservoir footprint (upstream of the constructed dam).

The following recommendations should be considered as the project moves to detailed design:

1. Additional exploration, including but not limited to, drilling, sampling, instrumentation, in-situ testing, and laboratory testing should be performed to further define the borrow sources and foundation soil and rock near the preferred dam alignment, chosen as a result of the current phase of the project.

   a. Potential Embankment Borrow Source

      i. Typical specifications for dam embankment fill suitability require soils classifications of CL, CH, or CL-ML. The plasticity index should be a minimum of 12 percent, and the material should be free of rock, soil clods or gravel larger than three (3) inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Gravel content should be limited to 15 percent by weight.

      ii. Considering the typical specifications above, the preliminary findings as discussed in Section 4.0 indicate that approximately 10 to 15 feet of potentially suitable borrow soil would be available below the topsoil layer in the locations of the borings on the northern end of the exploration, with minor amounts of coarse-grained materials that would need to be separated. Generally, there is only about four to eight feet of suitable embankment fill material in the borings south of Township Road 49. The plasticity index of the classified samples was borderline for acceptability with regards to the specifications above.

      iii. A borrow source study should be performed to determine the available quantity of site-specific fill materials. The study should include laboratory testing to determine design parameters of potential borrow soil, including optimal compaction, potential dispersivity, and as-compacted shear strength, and saturated and unsaturated permeability.

   b. Exploration of Preferred Dam Alignment

      i. The current phase of the project includes a multi-disciplinary approach to determining the preferred dam alignment. It is possible that the chosen preferred alignment will differ from the alignment which was evaluated as part of this geotechnical exploration. If the preferred alignment is changed, additional borings should be conducted along the selected alignment to evaluate the subsurface conditions.

      ii. Conduct additional geotechnical borings, test pits, and/or other exploration methods at more closely, regularly spaced intervals to adequately characterize subsurface conditions. Explorations should include locations along the preferred dam alignment and at select cross sections, and should obtain information to support the design of foundation treatment and/or necessary seepage control measures for the site. Additional borings should also be conducted at regular intervals upstream (detention-side) of the proposed dam alignment to evaluate the continuity of the fine-grained near-surface soils and the ability of same soils to function as a natural upstream blanket. See Section 5.5 for additional discussion.

      iii. Explorations should include methods to further define characteristics of the dolomite bedrock, including faults, fractures, discontinuities, voids, etc. that could influence the seepage below the proposed dam. See additional recommendations regarding bedrock explorations in Section 5.4.

      iv. Should significant soil excavations be required, a hydrogeologist should be engaged to advise the design team regarding the overall geology of the site and specific exploration techniques that can further define potential geologic concerns.

v. Further identify the vertical and lateral extents of coarse-grained materials that may influence foundation treatment and seepage design.

c. Install temporary piezometers and/or groundwater wells to establish groundwater levels and boundary conditions appropriate for detailed seepage design models.

d. Perform in-situ hydraulic conductivity testing of foundation soils and bedrock to develop site specific parameters for seepage design models. Testing should include additional water pressure tests of targeted bedrock layers and slug testing of installed piezometers/groundwater wells.

e. Perform soil water characteristic curve (SWCC) laboratory testing on applicable foundation and potential borrow materials to refine unsaturated permeability parameters for use in design.

f. Perform dispersive clay laboratory testing to determine the dispersivity of foundation and potential borrow soils.

2. An internal drainage system (chimney/blanket drain, finger drains, outlet pipes, etc.) should be considered for final design. Without an internal drainage system, the preliminary stability analyses (Stantec 2018) resulted in low factors of safety for steady-state flood conditions. Additionally, the existing subsurface includes pervious zones of coarse-grained materials and fractured bedrock that will require considerations during design. The use of internal drainage features may reduce the scope of necessary foundation treatment.

3. Design of the principal outlet conduits through the dam should include design of a filter diaphragm to intercept and filter preferential seepage paths along the conduits. Design filter diaphragms according to USACE filter criteria (USACE 2003) and other applicable design guidance (FEMA 2005).

4. The proposed structure will likely be classified as a high hazard dam. According to the NRCS Technical Release Number 60 (TR-60), the project sites are in Seismic Zone 2, and will therefore require special investigations to determine liquefaction potential and the presence of nearby faults. These seismic analysis requirements should be considered when developing the detailed explorations prior to final design.

The geotechnical exploration results and observations should be considered by the design team during selection of the preferred dam alignment. The dam alignments with the smallest reservoir footprints will likely require extensive excavation of the overburden soils within the reservoir to provide adequate storage capacity to meet project goals. The dam alignments with larger reservoir footprints will require less excavation within the reservoir.

If a selected dam alignment will require excavation of the reservoir footprint the following geotechnical conclusions and recommendations should be considered:

- Excavation of the “Upper Fine Grained” and/or “Lower Fine Grained” materials will expose significant thicknesses of more permeable coarse-grained overburden soils, and potentially expose bedrock with significant flow potential.

- If these materials are exposed, flood waters stored within the reservoir could be hydraulically connected from the reservoir, through the foundation soils and rock, and to the downstream toe of the embankment. This condition could lead to heaving, piping, or other seepage related concerns at the downstream toe of the dam.

- To treat these seepage concerns, the dam typical cross section should consider a key into the bedrock to serve as a seepage cutoff, or the design of an excavation and bedrock grouting program. To sufficiently incorporate a key into bedrock, graded filter layers should also be provided between fine-grained embankment fill soil and the surface of the bedrock.

If a selected dam alignment will not require extensive excavations of the reservoir footprint, the following geotechnical conclusions and recommendations should be considered:

- The “Upper Fine Grained” and/or “Lower Fine Grained” soils would generally remain in place within the reservoir footprint, potentially serving as a natural upstream blanket and reducing the potential for direct hydraulic connection to the permeable overburden soils and bedrock.
- According to the United States Bureau of Reclamation (USBR, 1987), the following recommendations should be considered when relying on a natural upstream blanket:
    - Areas of the embankment foundation covered by natural low-permeability blankets should be stripped of vegetation, defective areas repaired, and rolled to seal root holes or other openings.
    - Excavation of the natural low-permeability blanket should be avoided within 200 to 400 feet of the upstream toe of the dam. It is usually necessary to compact the low-permeability layer with a heavy roller or other appropriate compaction equipment.
    - The natural blanket soil should meet filter criteria with the underlying coarse-grained soils.
    - An upstream blanket should not be the only method relied upon for reduction of seepage forces in the foundation. Horizontal drainage blankets, trench drains, relief wells, or other seepage control measures should be provided when a cutoff trench will not be extended below the embankment.
    - A minimum of three (3) feet of fine-grained soils should be left in place below and upstream of the embankment fill.
- Additional exploration and sampling should be conducted to evaluate the effectiveness of the “Upper Fine Grained” and “Lower Fine Grained” soils to serve as a natural upstream blanket. This exploration would include enough borings to evaluate the continuity of the layers within approximately 400 feet of the upstream toe of the dam. Laboratory and field permeability testing and dispersivity testing should be conducted on the layers to evaluate the in-situ effectiveness as an upstream blanket. The fine-grained materials should be evaluated for filter compatibility with the underlying coarse-grained materials.

In general, less foundation improvement, including excavation, treatment, and grouting of underlying bedrock will be required for the larger footprints that do not require excavations from within the reservoir. It is likely that internal and downstream drainage features would be required for the typical cross-section of the dam, regardless of the selected alignment. Therefore, a significant cost savings would be expected for a larger reservoir footprint, reducing costs for overburden and bedrock excavation, bedrock surface treatments, and bedrock grouting programs.

1.0 INTRODUCTION

As part of the Hancock County Flood Risk Reduction (HCFRR) Program, the Maumee Watershed Conservancy District (MWCD) is evaluating several potential dam alignments in order to refine the conceptual design of a dry storage basin on Eagle Creek near Findlay, Ohio. The proposed Eagle Creek Dry Storage Basin is intended to provide storage during flood events to reduce the peak flow rates in Eagle Creek and the Blanchard River, thereby reducing the water surface elevations and risk of flooding downstream of the proposed Project area. The desired outcome of the proposed Project would be the reduction of flood risk and flood damages for the community. Stantec Consulting Services Inc. (Stantec) was contracted by MWCD to perform engineering and design services for the program, including the preliminary geotechnical exploration for the proposed dry storage basin. Stantec's efforts and recommendations to support the Program have included data review, gap analyses, plan and alternatives review, and proof-of-concept development for a dry storage basin on Eagle Creek.

Figure 1 shows the site vicinity and conceptual layouts for the Eagle Creek Dry Storage Basin. Eagle Creek runs south to north, flowing into the Blanchard River in the eastern portion of the City of Findlay. The proposed dry storage basin is located approximately 4 miles south of the City of Findlay. The current phase of design is focused on identifying the preferred alignment of the dam, considering the concerns of the local shareholders group. Several alternative dam alignments being evaluated are shown in Figure 1.

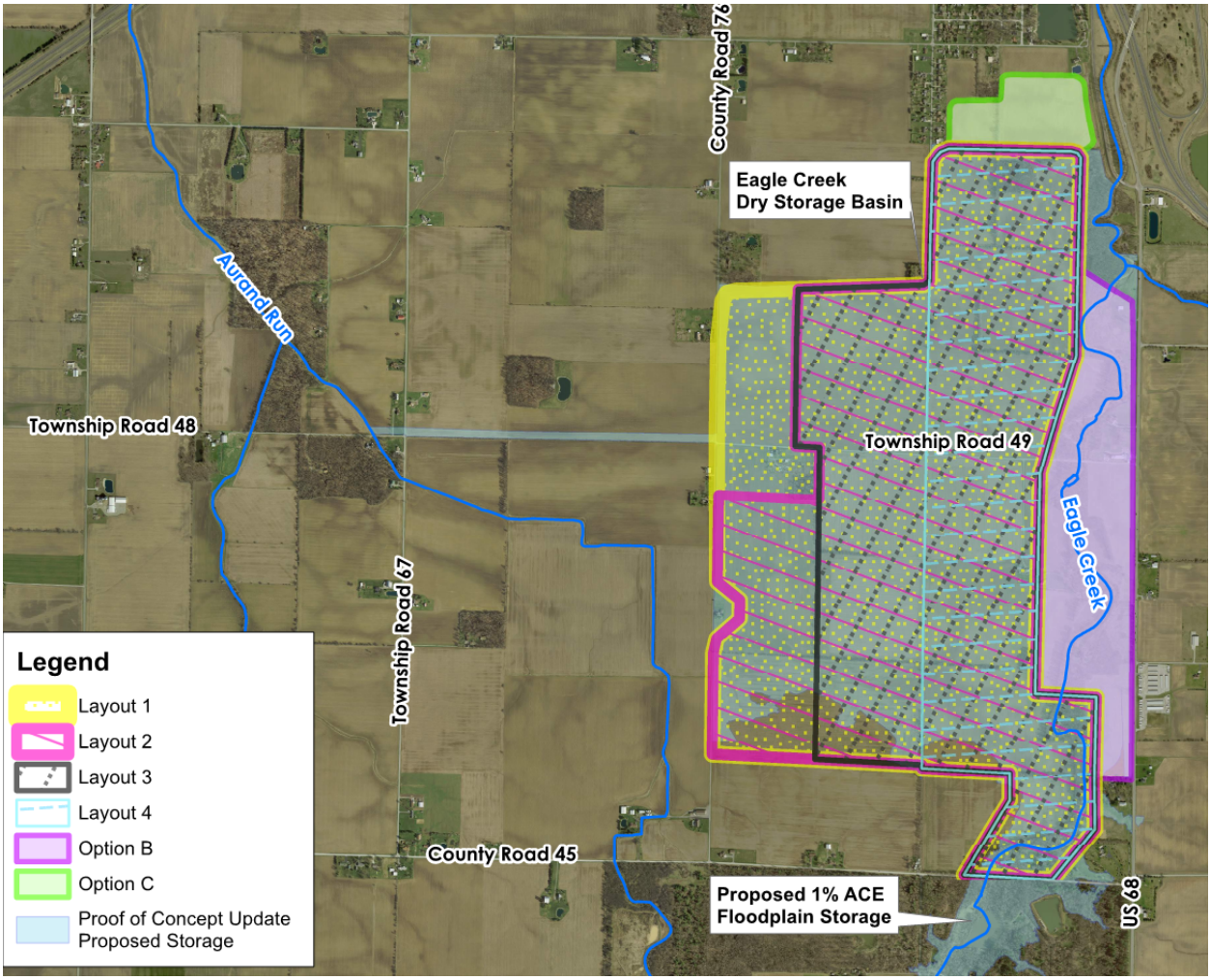

Figure 1. Site Vicinity Map

2.0 SITE GEOLOGY

2.1 GENERAL

The *Physiographic Regions of Ohio* map (Ohio Department of Natural Resources (ODNR), 1998) indicates that the proposed dry storage basin site is located in the Central Ohio Clayey Till Plain. The Central Ohio Clayey Till Plain has a surface of clayey till, and contains well-defined moraines with intervening flat-lying ground moraine and intermorainal lake basins. This region contains a few large streams and has moderate relief (100 feet) with elevations of 700 to 1,150 feet. According to the map, the Columbus Escarpment is approximately one to two miles north of the proposed Eagle Creek Dry Storage Basin site.

2.2 SOIL GEOLOGY

According to the *Quaternary Geology of Ohio* map (ODNR, 1999), the project site is predominantly underlain by clayey till deposited during the Late Wisconsinan Age. The clayey till originated as flat to gently undulating ground moraine.

The soil survey (*Web Soil Survey of Hancock County, Ohio*, United States Department of Agriculture (USDA), 2017) indicates that the site is underlain predominantly by Blount silt loam. These soils consist of silt loam, silty clay, and clay loam with low to moderately high capacities to transmit water.

The *Drift Thickness Map of Ohio* (ODNR, 2004) suggests a range of soil cover near the project site between 0 and 50 feet.

2.3 BEDROCK GEOLOGY

Bedrock mapping *(Reconnaissance Bedrock Geology of the Arlington, Ohio Quadrangle*, ODNR, 1999 and *Reconnaissance Bedrock Geology of the Blanchard, Ohio Quadrangle*, ODNR, 1998) and Descriptions of Geologic Map Units (ODNR, 2000) indicate that overburden soils in the vicinity of the project site are underlain by sedimentary bedrock from the Tymochtee Dolomite Formation of the Silurian System. The Tymochtee Dolomite Formation is composed of olive gray to yellowish brown dolomite with shale laminae. This bedrock is described as thin to massively bedded, with thicknesses ranging from 0 to 140 feet.

According to the Abandoned Underground Mine Locator (ODNR, 2015), mapped underground mines have not been identified in the project vicinity.

The *Ohio Karst Areas* map (ODNR, 2007) does not indicate known karst areas in the vicinity of the sites. Probable karst areas are located east of the project sites in Wyandot and Seneca Counties.

3.0 EXPLORATION

3.1 HISTORICAL EXPLORATION PROGRAMS

The ODOT Transportation Information Management System (TIMS) indicates that several geotechnical explorations have been performed in the vicinity of the potential dam site. An exploration was performed in 1962 for the existing alignment of US-68/SR-15, which is approximately 0.5 miles north of the proposed Eagle Creek Dam site. The majority of the soils encountered were classified as silt and clay (ODOT Classification A-6a) or silty clay (A-4a). Bedrock encountered was described as hard gray dolomite. The top of bedrock elevation was reported at approximately 780 feet near the intersection of US-68/SR-15 with Eagle Creek.

A search of the ODNR Ohio Oil & Gas Well Locator (2017) indicates that no wells have been drilled within the footprints of the proposed dam sites. Several wells have been drilled in the vicinity of the project sites, but the well reports include limited information to define subsurface conditions.

A search was also performed using the ODNR Ohio Water Wells Map (2017). According to the map, several wells have been drilled in the vicinity of the project sites. The water wells indicate that the overburden materials are typically clay, and bedrock was usually encountered at depths between 15 and 25 feet.

3.2 PRELIMINARY EXPLORATIONS

A geotechnical exploration was performed in 2012 by URS/Baird to obtain subsurface information in support of a flood prevention alternatives analysis in Hancock County (URS/Baird, 2013). The possible flood prevention measures included diversion channels, levees in downtown Findlay, and a detention dam on Eagle Creek. A total of forty-eight borings were advanced for this exploration. One boring (F-39-2012) was advanced within the area of the current study. The overburden soil consisted of lean clay (CL) and silty clay (CL-ML). Groundwater was found at a depth of eight feet below the ground surface. Bedrock was encountered at 18 feet below the ground surface (Elevation 783.2 feet). Bedrock was described as brownish-gray dolomite, slightly weathered and very strong. RQD was 87 percent. Additional information on this exploration is found in URS/Baird, 2013.

Stantec performed a geotechnical exploration in 2016 to evaluate subsurface conditions along a proposed diversion channel (Stantec 2016). One boring (B-11) from that exploration was advanced within the footprint of the current study area. The overburden soil consisted of silty clay in the upper 14.5 feet, with a 3.5-foot thick layer of gravel and sand above the top of bedrock. Groundwater was found at a depth of 15 feet below the ground surface. Bedrock was encountered at 18 feet below the ground surface (Elevation 781.7 feet).

In November 2017, two borings (B-101 and B-102) were advanced in the vicinity of the proposed Eagle Creek Dry Storage Basin in order to gather preliminary geotechnical data (Stantec 2018). B-101 was advanced adjacent to CR-77, west of Eagle Creek and B-102 was advanced through US-68, east of Eagle Creek.

Below the surface materials, an 8.5- to 9.8-foot layer of fine-grained material was encountered in the borings above the water table. This soil classified as Lean Clay with Sand (CL) and was described as moist, medium stiff to stiff, and having varying amounts of sand and gravel.

A thin layer of coarse-grained material was encountered below the upper fine-grained layer. Thin sand seams (1 to 2 inches thick) were encountered in B-101 between approximate elevations 787 feet and 788 feet. A 1.9-foot layer of moist, dense, poorly graded sand with some gravel was visually classified in B-102 between elevations 782.2 feet and 784.1 feet. The elevations correspond to similar locations (relative to the top of bedrock) within the profile of the two borings. The depth of this coarse-grained material generally corresponded to the location of the groundwater table as measured within the boreholes during drilling. The groundwater table was encountered at a depth of 11.5 feet (El. 788.0 feet) in B-101 and 11.4 feet (El. 784.1 feet) in B-102.

A lower layer of fine-grained material was encountered in the borings below the coarse-grained layer. This layer was 4.9 to 5.5 feet thick and classified as Sandy Lean Clay (CL) or Silty Clay with Sand (CL-ML). These soils were encountered between elevations 783.5 and 789.0 feet in B-101 and between elevations 777.3 and 782.2 feet in B-102. The material was described as moist and medium stiff to very stiff.

The final soil layer encountered above top of bedrock was a 3.8- to 3.9-foot layer of coarse-grained material. This material classified as Poorly Graded Gravel with Clay and Sand (GP-GC). The GP-GC soils were encountered between elevations 779.7 and 783.5 feet in B-101 and between elevations 773.4 and 777.3 feet in B-102. This material was described as moist and dense to very dense, with a fairly strong hydro-carbon odor noted in B-102.

Bedrock was encountered at a depth of 19.8 feet (El. 779.7 feet) in B-101 and 22.1 feet (El. 773.4 feet) in B-102. The bedrock was described as gray dolomite, slightly weathered, fractured to moderately fractured, slightly rough, and thin to medium bedded. Recovery of the rock core runs ranged from 90 to 100 percent with RQD ranging from 33 to 87 percent. More details from the 2017 Exploration including boring logs and laboratory test results can be found in the Report of Geotechnical Exploration submitted by Stantec on April 2, 2018 [Stantec (2018)].

3.3 EAGLE CREEK DRY STORAGE BASIN DESIGN PHASE I EXPLORATION

Ten borings were advanced by Stantec to obtain geotechnical data along a proposed embankment alignment west of Eagle Creek. In addition, water pressure testing was performed on the bedrock within five of the borings. A summary of the borings advanced for this project is shown in Table 1. A boring layout and boring logs are provided in Appendix A. The multi-disciplinary design team is currently evaluating four potential embankment layouts (1-4), with consideration of two options (B and C). The technical memorandum prepared by the design team for the conceptual design refinement (Phase 1) will contain detailed descriptions of the considered alternatives. The alternatives are shown in Figure 2 in order to provide context to the boring locations.

Prior to award of this phase of work, Stantec developed a proposal for two phases of geotechnical exploration. The first phase included three boring locations (B-1.X), while the second phase included 18 boring locations (B-2.X). The Phase 2 borings were originally intended to be flexible in location in order to explore along the preferred alternative alignment. To account for this flexibility, some Phase 2 boring locations were designated as “alternates” (B-2.Xa). Prior to mobilization for the Phase 1 geotechnical exploration, MWCD requested that Stantec increase the scope of exploration to include several Phase 2 borings, including several alternate locations. The borings conducted as part of this Phase 1 mobilization are shown in Figure 2. The locations of the borings may not align with the preferred alternative, depending on the results of the conceptual design refinement.

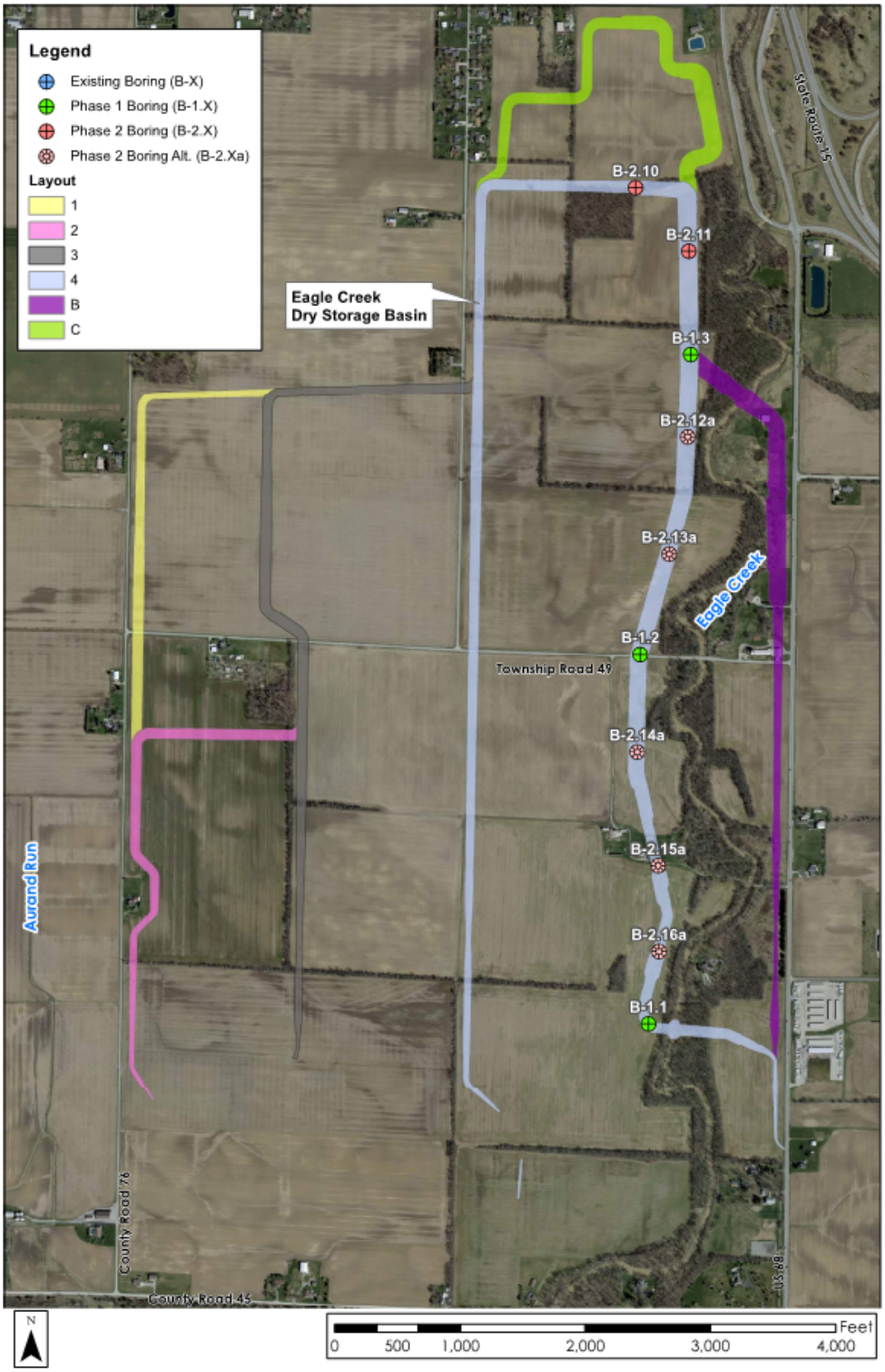

Figure 2. Boring Layout

Table 1. Boring Summary

Boring No.	Northing	Easting	Ground Surface Elevation (ft)	Thickness of Overburden (ft)	Top of Bedrock Elevation (ft)	Bottom of Boring Elevation (ft)
B-1.1[1]	477,356.00[2]	1,649,680.97[2]	797.6	12.8	784.8	772.8
B-1.2[1]	480,304.76[3]	1,649,614.28[3]	793.1	16.5	776.6	765.9
B-1.3	482,698.92	1,650,019.06	792.0	17.7	774.3	761.8
B-2.10[1]	484,031.73[4]	1,649,578.76[4]	796.3	17.9	778.4	767.5
B-2.11	483,523.70	1,650,003.24	790.7	14.5	776.2	764.6
B-2.12a[1]	482,040.46	1,649,993.92	791.5	15.6	775.9	765.1
B-2.13a	481,106.46	1,649,845.53	794.9	18.5	776.4	765.2
B-2.14a	479,527.22	1,649,589.97	794.4	21.0	773.4	763.0
B-2.15a[1]	478,618.14	1,649,758.81	797.4	16.0	781.4	769.8
B-2.16a	477,934.31[2]	1,649,764.46[2]	796.9	13.0	783.9	765.7

[1] An offset boring was drilled near these locations in order to collect undisturbed Shelby tube samples.
[2] Boring was relocated approximately 3 feet from reported coordinates to avoid potential conflict with drainage tile.
[3] Boring was relocated approximately 3 feet north to avoid potential conflict with storm sewer
[4] Boring was relocated approximately 4 feet south to avoid disturbance to farm field.

Note: Elevations are recorded in NAVD 88, Northing/Easting are Ohio State Plane NAD 83

The borings were completed with a CME 45 track-mounted drill rig using 3¼-inch inside diameter (ID) hollow stem augers to advance through soil. Standard penetration test (SPT) sampling was performed at select intervals until bedrock was encountered in the borings. Undisturbed Shelby tube (ST) samples were collected in offset borings drilled approximately four feet away from the parent borings indicated in Table 1. The energy ratio (ER) of the drill rigs' automatic hammer and drill rod systems was measured on a previous project. The average ER value for the equipment used on this project is 86.2 percent.

The SPT sampling was performed in accordance with ASTM D1586, without the use of liners. The SPT samples were driven with an automatic hammer and consisted of repeatedly dropping a 140-pound hammer from a height of 30 inches to drive a split-spoon sampler a distance of 18-inches. The number of hammer blows needed to advance the sampler was recorded over three 6-inch increments. The blow count from the first 6-inch increment was discarded due to ground disturbance at the bottom of the borehole. The sum of the blow counts from the second and third 6-inch increments is called the field N-value (N_{field}). The field N-value is corrected to an equivalent rod energy ratio of 60 percent (N_{60}) according to the equation below.

$$N_{60} = N_{field}\left(\frac{ER}{60}\right)$$

The depths/elevations of the SPTs with the corresponding field blow counts are shown on the boring logs in Appendix A.

Upon encountering bedrock, rock coring was performed in the borings using NQ-size equipment. Recovery length and rock quality designation (RQD) percentage were recorded for the core runs. The recovery is a measurement of the core sample obtained from a core run. The RQD is measured by dividing the sum of intact rock core segments longer than four inches by the total length of the core run. These values are shown on the boring logs in Appendix A.

The materials encountered were logged by a geotechnical engineer, with particular attention given to soil/rock type, consistency, and moisture content. The borings were checked for the presence of groundwater during and after drilling with the depth of water recorded on the boring logs.

Hydraulic pressure testing in rock was performed in five borings. The pressure testing was conducted using a single-packer system. The Lugeon method of pressure testing was used to correlate the test results to hydraulic conductivity and condition of discontinuities within the rock mass. Details and results of the pressure testing are discussed in Section 4.1.

Borings were backfilled using cement/bentonite grout. A tremie pipe was lowered to the bottom of the borehole and grout was injected as the drilling tools were removed to displace water and remaining soil cuttings, providing a seal within the boring.

The soil samples obtained from the borings were transported to Stantec's Geotechnical Laboratories. Engineering classification testing was performed on selected disturbed SPT and bulk samples reflecting the main soil horizons. The engineering classification tests included sieve and hydrometer analysis (ASTM D 422) and Atterberg limits (ASTM D 4318). Unconfined compressive strength testing (ASTM D 2166) was performed on select Shelby tube samples. The remaining Shelby tube samples are being stored to allow additional testing, if needed, to support the next phase of design. Details and results of laboratory testing are further discussed in Section 4.2. The laboratory test reports are provided in Appendix B.

4.0 FINDINGS

4.1 ROCK PRESSURE TESTING

Water pressure testing was performed in five borings. The pressure testing was conducted to assist in estimating permeability and flow regimes through the bedrock. These tests were conducted with a single packer configuration following completion of rock coring. Testing was conducted using a five-stage Lugeon method. A maximum pressure of 15 psi was applied within borings on this project. The pressure was incrementally increased to the maximum, and then decreased again in five total stages to complete the test.

Prior to testing at each location, the nitrogen pressure in the inflatable packer was allowed to stabilize for up to 10 minutes after inflation to develop an adequate seal. Following stabilization, the bypass valve was adjusted to apply the target pressure for each stage and the gauge was maintained at a constant pressure for the duration of the stage. The quantity of flow at each stage was measured on one-minute intervals during a five-minute pressure stage. The top and bottom of the testing interval, test pressure, and meter readings were recorded on field data forms. The average flow over each timed period was used to calculate the Lugeon value.

The Lugeon value is empirically defined as the hydraulic conductivity required to achieve a flow rate of 1 liter/minute per meter of test interval under a reference water pressure equal to 1 MPa (Equation 1).

$$Lugeon\ Value = \alpha \times \frac{q}{L} \times \frac{P_0}{P} \qquad \textbf{Equation 1}$$

Where: α = 12.42 (dimensionless factor for English units)
q = flow rate (gal/min)
L = Length (ft)
P_0 = 145 psi (reference pressure)
P = water pressure (psi)

Under ideal conditions (i.e., homogeneous and isotropic), one Lugeon is equivalent to 1.3×10^{-5} cm/sec (Quinones-Rozo, 2015). The published relationships provided in Quinones-Rozo (2015) were used to interpret the Lugeon values. Results of this interpretation are summarized in Table 2 below. Pressure testing calculation sheets are provided in Appendix C.

Table 2. Summary of Pressure Testing Results

Boring No.	Test Interval (ft)	Lugeon Value	Flow Potential Classification	Approximate Hydraulic Conductivity (cm/sec)	Condition of Rock Mass Discontinuities based on Lugeon value
B-1.1	17.5 – 24.8	186	Very High	>1 x 10^{-3}	Open closely spaced or voids
B-2.14a	22.0 – 31.4	142	Very High	>1 x 10^{-3}	Open closely spaced or voids
B-2.13a	21.9 – 29.7	58	High	7 x 10^{-4}	Many open
B-1.3	22.5 – 30.2	16	Medium	2 x 10^{-4}	Some open
B-2.10	21.5 – 28.8	1	Low	1 x 10^{-5}	Tight

Note: Classification, hydraulic conductivity, and condition of rock mass discontinuities are based on Table 2 provided in Camilo Quinones-Rozo, P.E. (2015)

In general, the Lugeon value and approximate hydraulic conductivity of the bedrock was lower moving north along the explored alignment, indicating lower flow potential in the northern reaches of the proposed reservoir.

4.2 LABORATORY TESTING

4.2.1 Overview

Geotechnical laboratory tests were assigned to select soil samples. Soil samples were tested for soil classification, moisture content, unconfined compressive strength, and standard Proctor compaction parameters. Laboratory testing performed during this phase is summarized in Table 3. Results of laboratory testing are provided in Appendix B.

Table 3. Summary of Laboratory Testing

Laboratory Test	Method	Number of Tests
Natural Moisture Content	ASTM D 2216	82
Sieve and Hydrometer Analysis	ASTM D 422	17
Atterberg Limits	ASTM D 4318	17
Soil Classifications	ASTM D 2487	17
Standard Proctor	ASTM D 1557	2
Unconfined Compressive Strength	ASTM D 2166	6

4.2.2 Natural Moisture Content

Selected SPT samples were subjected to natural moisture content testing in accordance with ASTM D 2216. Moisture contents ranged from 6.3 percent to 47.2 percent with an average of 19.8 percent. The test results are provided in Appendix B.

4.2.3 Soil Classification

Selected SPT samples were subjected to soil classification testing in accordance with ASTM D 2487 which included sieve and hydrometer analysis in accordance with ASTM D 422 and Atterberg limits in accordance with ASTM D 4318. Classification results are presented in Table 4. Forty-seven percent of the samples tested classified as CL, 21 percent classified as SM, 11 percent classified as SC, and the remaining samples classified as ML, GC-GM, SW-SM, and CL-ML (approximately 5 percent each).

Table 4. Results of Soil Classification Testing

Boring No.	Sample Type	Depth (ft)	LL (%)	PL (%)	PI (%)	Classification
B-1.1	Bulk	0.0 – 5.5	25	15	10	SC
B-1.1	SPT	10.0 – 11.5	17	14	3	SM
B-2.14a	SPT	7.5 – 9.0	42	28	14	ML
B-2.14a	SPT	12.5 – 14.0	NP	NP	NP	SM
B-2.14a	SPT Composite	17.5 – 21.2	21	13	8	CL
B-2.15a	SPT	12.5 – 14.0	NP	NP	NP	SM
B-2.16a	Bulk	0.0 – 5.0	33	18	15	CL
B-2.16a	SPT	10.0 – 11.5	22	16	6	GC-GM
B-1.2	SPT Composite	1.5 – 4.0	36	20	16	CL
B-1.2	SPT	5.0 – 6.5	24	16	8	SC
B-1.2	SPT	12.5 – 14.0	NP	NP	NP	SW-SM
B-1.3	SPT	12.5 – 14.0	36	22	14	CL
B-2.10	SPT	5.0 – 6.5	28	17	11	CL
B-2.10	SPT	12.5 – 14.0	24	15	9	CL
B-2.11	SPT	10.0 – 11.5	24	15	9	CL
B-2.12a	SPT	10.0 – 11.5	36	23	13	CL
B-2.12a	SPT	12.5 – 14.0	33	18	15	CL
B-2.13a	SPT	7.5 – 9.0	22	15	7	CL-ML
B-2.13a	SPT	15.0 – 16.5	NP	NP	NP	SM

4.2.4 Standard Proctor

Two Standard Proctor tests were performed per ASTM D698 on bulk samples obtained from borings B-1.1 and B-2.16a. Method A was followed, which uses a 4-inch diameter Proctor mold, with three layers of material (screened to pass the No. 4 sieve) compacted by 25 blows (5.50-lbf hammer dropped at a height of 12 inches) per layer. The results of the two tests are summarized in Table 5.

Table 5. Results of Standard Proctor Testing

Boring No.	Sample Type	Depth (ft)	Classification	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)
B-1.1	Bulk	0.0 – 5.5	SC	127.9	9.6
B-2.16a	Bulk	0.0 – 5.0	CL	121.0	12.3

4.2.5 Unconfined Compressive Strength

Selected ST samples were subjected to unconfined compressive strength testing in accordance with ASTM D 2166. Unconfined compressive strength results are presented in Table 6. The unconfined compressive strength of the samples tested ranged from 1.0 tons per square foot (tsf) to 4.5 tsf with an average of 2.5 tsf.

Table 6. Results of Unconfined Compressive Strength Testing

Boring No.	Depth (ft)	Unconfined Compressive Strength (tsf)	Undrained Shear Strength (tsf)
B-1.1B	2.7 – 3.2	1.0	0.5
B-1.1B	9.3 – 9.8	4.0	2.0
B-1.2B	0.8 – 1.3	1.9	1.0
B-2.10A	3.0 – 3.5	2.0	1.0
B-2.10A	11.0 – 11.5	1.3	0.6
B-2.10A	13.4 – 13.9	4.5	2.3

4.3 SUBSURFACE CONDITIONS

Ten borings were advanced along one of the proposed dam alignment alternatives, along the west side of Eagle Creek, in order to further define the subsurface conditions at the project site. The following sections discuss the subsurface conditions encountered in these borings. A soil profile diagram illustrating the subsurface materials encountered is provided in Appendix D.

4.3.1 Soil

Surface materials encountered consisted of 0.1 to 0.5 feet of topsoil. Below the surface materials, a 4.0- to 11.5-foot layer of generally fine-grained material was encountered in the borings. This fine-grained soil extended down to approximate elevations 792.1 feet (maximum at Boring B-1.1) and 779.0 feet (minimum at Boring B-2.12a). This soil classified as Sandy Lean Clay (CL) in three samples, Sandy Silty Clay (CL-ML) in one sample, and Clayey Sand (SC) in one sample. The Clayey Sand sample had a fines content of 48 percent and a plasticity index of 10. Other samples tested in this layer had fines content ranging from 60 to 70 percent and plasticity indexes ranging from 7 to 16 percent. The Clayey Sand (SC) sample was judged to be similar to the other fine-grained soil below the surface materials. The soils encountered in this layer are described as moist, medium stiff to stiff, and having varying amounts of sand and gravel. In general, this layer is thicker north of Township Road 49. This layer is referred to herein as “Upper Fine-Grained” material.

Coarse-grained material was typically encountered below the “Upper Fine-Grained” material. When observed, this layer ranged in thickness from 0.1 feet (thin sand seam at elevation 785.8 in B-2.10) to 3.5 feet (between elevations 789.1 and 785.6 in boring B-1.2). This soil generally classified as Clayey Sand (SC) with varying amounts of gravel, and was described as moist to wet, medium dense, and medium to coarse grained. The depth of this coarse-grained material generally corresponds with the location of the groundwater table as measured within the boreholes during drilling. The thickness of this layer varies across the site. In general, the layer starts as a thin seam at the north end of the site (B-2.10) and is thickest near Township Road 49 (B-1.2). The layer was not encountered in B-2.16a, B-2.15a, or B-2.12a. This material is referred to herein as “Upper Coarse-Grained” material.

A lower layer of fine-grained material was generally encountered below the “Upper Coarse-Grained” material. This layer was 0.5 to 6.5 feet thick and classified as Lean Clay (CL), Sandy Lean Clay (CL), or Silt with Sand (ML). The material was described as moist and medium stiff to very stiff. This layer was more prevalent in the northern reaches of the exploration, as it was not encountered in Borings B-1.2, B-2.15a, and B-2.16a. This material is referred to herein as “Lower Fine-Grained” material.

Below the “Lower Fine-Grained” material, a 0.6- to 9.8-foot layer of coarse-grained material was generally encountered above the top of bedrock. This material was not observed in Boring B-2.11. This layer mostly classified as Silty Sand (SM) with one sample classifying as Well-Graded Sand with Silt (SW-SM), and one sample classifying as Silty, Clayey Gravel with Sand (GC-GM). This material was described as moist to wet, medium dense to dense, fine to coarse grained, and containing varying amounts of gravel. In general, this layer is thicker near Township Road 49 and to the south. This material is referred to herein as “Lower Coarse-Grained” material.

The “Lower Fine-Grained” layer was encountered below the “Lower Coarse-Grained” material in Borings B-1.3, B-2.12a, B-2.13a, and B-2.14a above the top of bedrock. This layer ranged in thickness from 0.4 feet in borings B-2.12a and B-2.13a to 7.3 feet in B-2.14a. The material classified as Sandy Lean Clay (CL) and was described as being moist, stiff to very stiff, and having varying amounts of sand.

4.3.2 Bedrock

The depth to bedrock ranged from 12.8 feet (El. 784.8 feet) in B-1.1 to 21.0 feet (El. 773.4 feet) in B-2.14a. A summary of the encountered bedrock depths and elevations is provided in Table 1. The bedrock was described as

gray dolomite, slightly weathered, fractured to moderately fractured, slightly rough, and thin to medium bedded. A hydro-carbon odor was noted in borings B-2.10 and B-2.14a. Recovery of the rock core runs ranged from 60 to 100 percent with RQD ranging from 0 to 100 percent. Fractured zones and water loss were noted in the bedrock until the termination depths. In general, the bedrock recovery and RQD increased from south to north. Rock core photos are included in Appendix E.

4.3.3 Groundwater

The depth to groundwater at the time of drilling was noted on the boring logs. No observation wells or piezometers were installed as a part of this project, so long term water level monitoring was not performed. Groundwater levels may fluctuate due to seasonal climate changes and rain events. A summary of the groundwater elevations observed during the drilling program is provided in Table 7.

Table 7. Summary of Groundwater Elevations

Boring No.	Depth to Groundwater (ft)	Groundwater Elevation (ft)
B-1.1	5.5	792.1
B-1.2	4.0	789.1
B-1.3	7.5	784.5
B-2.10	7.5	788.8
B-2.11	7.5	783.2
B-2.12a	10.0	781.5
B-2.13a	10.0	784.9
B-2.14a	6.0	788.4
B-2.15a	7.9	789.5
B-2.16a	8.0	788.9

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

The recommendations that follow are based on the information discussed in this report and the interpretation of the subsurface conditions encountered at the site during fieldwork. If future design changes are made, Stantec should be notified so that such changes can be reviewed, and the recommendations amended as necessary.

These conclusions and recommendations are based on data and subsurface conditions from the borings advanced during this exploration using the degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions.

Seepage at and below the base of an embankment can erode the foundation, weaken the materials, and lead to uncontrolled releases of a reservoir. This risk is especially pronounced in a structure that does not retain water on a routine basis, as inspections are not often feasible except during flood events. The design team should consider the potential seepage concerns related to the various dam alignment alternatives currently under evaluation. The conclusions and recommendations herein assume that the preferred dam alignment will either

1. Require significant excavation of the natural soils within the reservoir footprint (upstream of the constructed dam), removing the fine-grained, near-surface soils, or

2. Not require significant excavation of the natural soil and leave a minimum of three (3) feet of the fine-grained, near-surface soils within the reservoir footprint (upstream of the constructed dam).

5.2 PRELIMINARY DAM DESIGN

1. Additional exploration, including but not limited to, drilling, sampling, instrumentation, in-situ testing, and laboratory testing should be performed to further define the borrow sources and foundation soil and rock near the preferred dam alignment, chosen as a result of the current phase of the project.

    a. Potential Embankment Borrow Source

        i. Typical specifications for dam embankment fill suitability require soils classifications of CL, CH, or CL-ML. The plasticity index should be a minimum of 12 percent, and the material should be free of rock, soil clods or gravel larger than three (3) inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Gravel content should be limited to 15 percent by weight.

        ii. Considering the typical specifications above, the preliminary findings as discussed in Section 4.0 indicate that approximately 10 to 15 feet of potentially suitable borrow soil would be available below the topsoil layer in the locations of the borings on the northern end of the exploration, with minor amounts of coarse-grained materials that would need to be separated. Generally, there is only about four to eight feet of suitable embankment fill material in the borings south of Township Road 49. The plasticity index of the classified samples was borderline for acceptability with regards to the specifications above.

iii. A borrow source study should be performed to determine the available quantity of site-specific fill materials. The study should include laboratory testing to determine design parameters of potential borrow soil, including optimal compaction, potential dispersivity, and as-compacted shear strength, and saturated and unsaturated permeability.

b. Exploration of Preferred Dam Alignment

i. The current phase of the project includes a multi-disciplinary approach to determining the preferred dam alignment. It is possible that the chosen preferred alignment will differ from the alignment which was evaluated as part of this geotechnical exploration. If the preferred alignment is changed, additional borings should be conducted along the selected alignment to evaluate the subsurface conditions.

ii. Conduct additional geotechnical borings, test pits, and/or other exploration methods at more closely, regularly spaced intervals to adequately characterize subsurface conditions. Explorations should include locations along the preferred dam alignment and at select cross sections, and should obtain information to support the design of foundation treatment and/or necessary seepage control measures for the site. Additional borings should also be conducted at regular intervals upstream (detention-side) of the proposed dam alignment to evaluate the continuity of the fine-grained near-surface soils and the ability of same soils to function as a natural upstream blanket. See Section 5.5 for additional discussion.

iii. Explorations should include methods to further define characteristics of the dolomite bedrock, including faults, fractures, discontinuities, voids, etc. that could influence the seepage below the proposed dam. See additional recommendations regarding bedrock explorations in Section 5.4.

iv. Should significant soil excavations be required (Section 5.1), a hydrogeologist should be engaged to advise the design team regarding the overall geology of the site and specific exploration techniques that can further define potential geologic concerns.

v. Further identify the vertical and lateral extents of coarse-grained materials that may influence foundation treatment and seepage design.

c. Install temporary piezometers and/or groundwater wells to establish groundwater levels and boundary conditions appropriate for detailed seepage design models.

d. Perform in-situ hydraulic conductivity testing of foundation soils and bedrock to develop site specific parameters for seepage design models. Testing should include additional water pressure tests of targeted bedrock layers and slug testing of installed piezometers/groundwater wells.

e. Perform soil water characteristic curve (SWCC) laboratory testing on applicable foundation and potential borrow materials to refine unsaturated permeability parameters for use in design.

f. Perform dispersive clay laboratory testing to determine the dispersivity of foundation and potential borrow soils.

2. An internal drainage system (chimney/blanket drain, finger drains, outlet pipes, etc.) should be considered for final design. Without an internal drainage system, the preliminary stability analyses (Stantec 2018) resulted in

low factors of safety for steady-state flood conditions. Additionally, the existing subsurface includes pervious zones of coarse-grained materials and fractured bedrock that will require considerations during design. The use of internal drainage features may reduce the scope of necessary foundation treatment. See Section 5.5 for additional discussion.

3. Design of the principal outlet conduits through the dam should include design of a filter diaphragm to intercept and filter preferential seepage paths along the conduits. Design filter diaphragms according to USACE filter criteria (USACE 2003) and other applicable design guidance (FEMA 2005).

4. The proposed structure will likely be classified as a high hazard dam. According to the NRCS Technical Release Number 60 (TR-60), the project sites are in Seismic Zone 2, and will therefore require special investigations to determine liquefaction potential and the presence of nearby faults. These seismic analysis requirements should be considered when developing the detailed explorations prior to final design.

5.3 EXCAVATABILITY

The design team assumes that excavations within the footprint of the basin will be limited to elevation 788 feet. Based on the bedrock elevations identified in borings within the study area, the top of rock is below elevation 788. Therefore, excavation of the bedrock should not be a concern unless an unknown knob or pinnacle is encountered during excavation. If excavations result in a condition where reservoir water will be in direct contact with the top of bedrock, care should be taken to seal fractures, bedding planes, discontinuities, etc. that could result in a direct hydraulic connection from the reservoir to the protected side of the embankment. In the event that bedrock is encountered in an area that requires excavation, several historical project documents included guidance, and are summarized below.

The descriptions of the bedrock encountered in the Stantec explorations were similar to those in the Blanchard River Watershed Study (URS/Baird, 2013). According to URS/Baird (2013), local quarry operators are generally able to remove the upper 4 to 5 feet of bedrock with minimal to no blasting. Blasting is considered the most efficient and cost-effective method for bedrock below 5 feet in depth. The bedrock encountered during the Stantec explorations complements this description, as lower RQD values and more fracturing were noted near the top of bedrock.

URS/Baird, 2013 provides the following recommendations for excavation of the bedrock:

> “Based on local quarry experience, available rock core data, and existing rock excavatability charts (Tsiambaos and Saroglou, 2010), we conclude that dolomite excavation will require techniques ranging from hard to very hard ripping (e.g., CAT D8-D9) to extremely hard ripping (e.g., CAT D11 or CAT D9+hydraulic breaking) to blasting depending upon the dolomite strength, joint/fracture frequency, and joint/fracture surface roughness and weathering. Dolomite that is moderately strong with closely spaced fractures that are moderately weathered typically will require hard ripping, whereas dolomite that is strong to very strong with widely spaced fractures that are slightly weathered or fresh will require blasting.”

5.4 BEDROCK SEEPAGE

Should the footprint of the reservoir be excavated extensively to expose (or nearly expose) bedrock, seepage beneath the constructed embankments is a concern. Based on the results of the preliminary bedrock pressure testing, a majority of the currently explored site demonstrates significant flow potential within the bedrock. While the

testing conducted simulated a maximum water head pressure of approximately 34 feet, flow was noted at each pressure stage.

Should the selected alignment require extensive excavations within the reservoir footprint, two primary options could be considered to mitigate potential seepage flow through the bedrock under the embankment. One option is to conduct mechanical excavation (including ripping and excavation of approximately 5 feet of bedrock), cleaning of the bedrock surface, and concrete capping as needed. This method would treat identified voids and fractures observed at the bedrock surface. The second option is to conduct bedrock grouting operations prior to excavation. The grouting would serve to fill the voids and fractures within the bedrock and be able to treat a wider and deeper area with less labor input. Following the grouting operation, excavation of soil overburden and compaction of a cutoff trench to the top of rock (above the grout curtain) would be necessary. Preliminary estimates indicate that mechanical excavation and compaction of a cutoff trench into the top of rock will be a more economical solution than a grouting program.

To address the concerns related to seepage through the foundation, additional pressure testing should be completed in the subsequent phases of exploration to provide more information concerning flow losses and their approximate depth. Down-hole imaging can also provide a quantitative view of the number and size of fractures present.

The additional exploratory drilling and pressure testing should be planned to adequately characterize the lateral extent of areas with greater flow potential (currently understood to be in the southern reaches of the proposed reservoir). It should also consider pressure testing of shorter intervals moving downward from the top of rock and extending deeper into bedrock at select locations. Based on the rock coring observations and historical information regarding bedrock excavation in the region (Section 5.3), significant amounts of the measured flow may have occurred within the upper approximately five feet of the bedrock. Pressure testing of smaller intervals could identify if this is consistent, which would aid in determining an economical combination of excavation and grouting.

5.5 DAM ALIGNMENT SELECTION

The geotechnical exploration results and observations should be considered by the design team during selection of the preferred dam alignment. The dam alignments with the smallest reservoir footprints will likely require extensive excavation of the overburden soils within the reservoir to provide adequate storage capacity to meet project goals. The dam alignments with larger reservoir footprints will require less excavation within the reservoir.

If a selected dam alignment will require excavation of the reservoir footprint the following geotechnical conclusions and recommendations should be considered:

- Excavation of the “Upper Fine Grained” and/or “Lower Fine Grained” materials will expose significant thicknesses of more permeable coarse-grained overburden soils, and potentially expose bedrock with significant flow potential.

- If these materials are exposed, flood waters stored within the reservoir could be hydraulically connected from the reservoir, through the foundation soils and rock, and to the downstream toe of the embankment. This condition could lead to heaving, piping, or other seepage related concerns at the downstream toe of the dam.

- To treat these seepage concerns, the dam typical cross section should consider a key into the bedrock to serve as a seepage cutoff, or the design of an excavation and bedrock grouting program. See Section 5.4 for

additional discussion. To sufficiently incorporate a key into bedrock, graded filter layers should also be provided between fine-grained embankment fill soil and the surface of the bedrock.

If a selected dam alignment will not require extensive excavations of the reservoir footprint, the following geotechnical conclusions and recommendations should be considered:

- The “Upper Fine Grained” and/or “Lower Fine Grained” soils would generally remain in place within the reservoir footprint, potentially serving as a natural upstream blanket and reducing the potential for direct hydraulic connection to the permeable overburden soils and bedrock.
- According to the United States Bureau of Reclamation (USBR, 1987), the following recommendations should be considered when relying on a natural upstream blanket:
    - Areas of the embankment foundation covered by natural low-permeability blankets should be stripped of vegetation, defective areas repaired, and rolled to seal root holes or other openings.
    - Excavation of the natural low-permeability blanket should be avoided within 200 to 400 feet of the upstream toe of the dam. It is usually necessary to compact the low-permeability layer with a heavy roller or other appropriate compaction equipment.
    - The natural blanket soil should meet filter criteria with the underlying coarse-grained soils.
    - An upstream blanket should not be the only method relied upon for reduction of seepage forces in the foundation. Horizontal drainage blankets, trench drains, relief wells, or other seepage control measures should be provided when a cutoff trench will not be extended below the embankment.
    - A minimum of three (3) feet of fine-grained soils should be left in place below and upstream of the embankment fill.
- Additional exploration and sampling should be conducted to evaluate the effectiveness of the “Upper Fine Grained” and “Lower Fine Grained” soils to serve as a natural upstream blanket. This exploration would include enough borings to evaluate the continuity of the layers within approximately 400 feet of the upstream toe of the dam. Laboratory and field permeability testing and dispersivity testing should be conducted on the layers to evaluate the in-situ effectiveness as an upstream blanket. The fine-grained materials should be evaluated for filter compatibility with the underlying coarse-grained materials.

In general, less foundation improvement, including excavation, treatment, and grouting of underlying bedrock will be required for the larger footprints that do not require excavations from within the reservoir. It is likely that internal and downstream drainage features would be required for the typical cross-section of the dam, regardless of the selected alignment. Therefore, a significant cost savings would be expected for a larger reservoir footprint, reducing costs for overburden and bedrock excavation, bedrock surface treatments, and bedrock grouting programs.

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APPENDIX A
BORING LAYOUT AND BORING LOGS

Legend

- Existing Boring (B-X)
- Phase 1 Boring (B-1.X)
- Phase 2 Boring (B-2.X)
- Phase 2 Boring Alt. (B-2.Xa)

Layout

- 1
- 2
- 3
- 4
- B
- C

Eagle Creek
Dry Storage Basin

B-2.10
B-2.11
B-1.3
B-2.12a
B-2.13a
B-1.2
B-2.14a
B-2.15a
B-2.16a
B-1.1

State Route 15
Eagle Creek
Township Road 49
Aurand Run
County Road 76
County Road 45
US 68

N

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

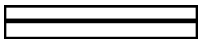
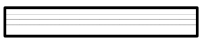
Strata Graphics

Symbol	Soil
	Fill
	Topsoil
	Gravel
	ML Soil
	CL Soil
	MH Soil
	CH Soil
	CLML Soil
	SW Soil
	SP Soil
	SM Soil
	SC Soil
	SCSM Soil
	GW Soil
	GP Soil
	GM Soil
	GC Soil
	GPGM Soil
	Fly Ash
	Bottom Ash
	Gypsum
	Non-Durable Shale
	Durable Shale
	Coal
	Limestone
	Sandstone

Water Level Graphics

Symbol	Description
	Measured in standpipe, piezometer, or well
	Inferred

Sampler Graphics

Symbol	Sampler	
	SPT	Split Spoon (2" dia.)
	S3	Split Spoon (3" dia.)
	ST	Shelby Tube
	U	Undisturbed Piston
	RC	Rock Core

Consistency of Fine-Grained Soils

Condition	N-Value (blows/ft)
Very Soft	<2
Soft	2 – 4
Medium Stiff	4 – 8
Stiff	8 – 15
Very Stiff	>15

Density of Coarse-Grained Soils

Condition	N-Value (blows/ft)
Very Loose	<4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	>50

Common Abbreviations

WH	Weight of Hammer
WR	Weight of Rod
HSA	Hollow Stem Auger
RQD	Rock Quality Designation
HAF	High Angle Fracture
LAF	Low Angle Fracture
HF	Horizontal Fracture
VF	Vertical Fracture
MF	Mechanical Fracture
HAJ	High Angle Joint
LAJ	Low Angle Joint
HJ	Horizontal Joint

SUBSURFACE LOG

Stantec Boring No. **B-1.1**

Client	MWCD	Boring Location	477,356.0 N; 1,649,681.0 E
Project Number	174316204	Surface Elevation	797.6 ft
Project Name	HCFRRP - Dry Storage Basin Design	Elevation Datum	NAVD88
Project Location	Hancock County, Ohio	Date Started	8/21/19
Inspector	Stantec - E. Holcombe	Completed	8/22/19
Drilling Contractor	Stantec - D. Clements	Depth to Water	5.5 ft
		Date/Time	8/21/19
		Depth to Water	N/A
		Date/Time	N/A
		Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size) NQ

Sampler Hammer Type Automatic Weight 140 lb Drop 30 in Efficiency 86.2

Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	797.6					ft		
0	797.4	Topsoil						
1		Clayey Sand (SC), brown, damp to wet, loose, trace fine river gravel		SPT	01	0.4	2-3-3	
		sand increases 0.2'-4.5'						
2		*soft, moist at 2.0'*		SPT	02	0.7	3-3-4	
		bulk sample 0.0'-5.5'						
3		*wet 3.0'-5.5'*						
4				SPT	03	1.2	3-3-3	
5	792.1			SPT	04A	0.7	2-25-8	
6		Clayey Sand with Gravel, gray, wet, dense, very fine to medium grained sand, rounded medium gravel		SPT	04B			
		wet stone fragment seam 5.5'-5.6'						
7	790.1							
8		Sandy Lean Clay, brown, moist to wet, stiff, low to medium plasticity		SPT	05	0.5	2-6-7	
9	788.1							
10								

UNDRAINED SHEAR STRENGTH - tsf ▲ (1, 2, 3, 4)

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ● (10 20 30 40 50 60 70 80 90)

Stantec Boring No. **B-1.1**

Client MWCD

Boring Location 477,356.0 N; 1,649,681.0 E

Project Number 174316204

Surface Elevation 797.6 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10	787.1	Lean Clay, gray, moist to wet, soft, trace sand and gravel (till) - (Continued)		SPT	06A	1.0	3-12-11	
11				SPT	06B			
12		Silty Sand with Gravel (SM), gray, wet, dense, very fine to medium sand, angular gravel, some clay						
	784.8	*clay seam 12.5'-12.8'*						
13		Dolomite, gray, slightly weathered, very-fine grained, highly to severely fractured, very strong, slightly rough, flat to vertical fractures		SPT	07	0.7	4-20-50+/.4	
14		*severely fractured 14.3'-15.0'*						
15		*laminated 15.0'-16.4'* *HF at 15.1', 15.3', 15.4', 15.5'*		RC	01	1.3	0	
16	781.0	*highly fractured 16.4'-16.6'*						
17		Dolomite with shale laminations, gray, slightly weathered, very fine grained, moderately to high highly fractured, soft to moderately hard, smooth, laminated, flat bedded, fractures along bedding planes (0°-10°) most fractures in shale laminations		RC	02	3.7	43	
18		*natural fractures 16.9', 17.1', 17.2', 17.3', 17.7', 18.5'* *MFs 18.1'-20.1'* *highly fractured 20.5'-20.8'*						
19		*highly fractured 21.3'-21.6'*						
20		*highly fractured 22.0'-22.1'*		RC	03	4.7	11	
21								
22								
23								

UNDRAINED SHEAR STRENGTH - tsf ▲

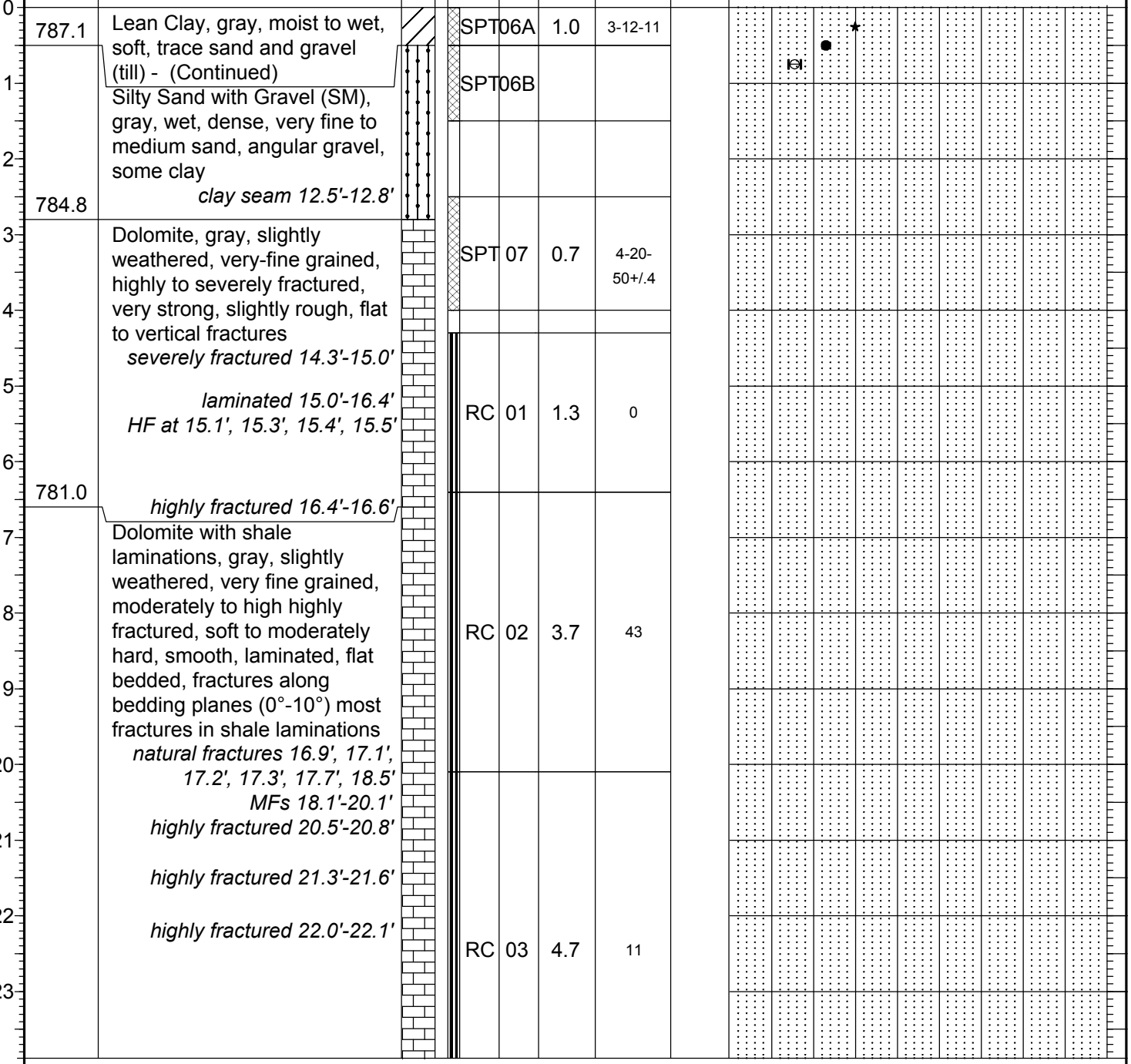
1 2 3 4

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ●

10 20 30 40 50 60 70 80 90



Stantec Boring No. **B-1.1**

Client MWCD

Boring Location 477,356.0 N; 1,649,681.0 E

Project Number 174316204

Surface Elevation 797.6 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf (1 2 3 4) / WATER CONTENT & ATTERBERG LIMITS (W_P W W_L) / Pocket Penetrometer/Torvane (tsf) / STANDARD PENETRATION TEST, BLOWS/FOOT (10 20 30 40 50 60 70 80 90)
						ft			
24	772.8	*severely fractured 23.9'-24.5'* *VF 24.0'-24.2'*							
25		*Boring terminated and backfilled with cement bentonite grout.*							
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									

Stantec

SUBSURFACE LOG

Stantec Boring No. **B-1.1a**

Client	MWCD	Boring Location	477,356.0 N; 1,649,681.0 E
Project Number	174316204	Surface Elevation	797.6 ft
Elevation Datum	NAVD88		
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/22/19
Completed	8/22/19		
Project Location	Hancock County, Ohio	Depth to Water	N/A
Date/Time	N/A		
Inspector	Stantec - E. Holcombe	Depth to Water	N/A
Date/Time	N/A		
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 3" ST

Rock Drilling and Sampling Tools (Type and Size) N/A

Sampler Hammer Type Automatic Weight N/A Drop N/A Efficiency N/A

Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical

UNDRAINED SHEAR STRENGTH - tsf ▲ (1, 2, 3, 4)

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ● (10 20 30 40 50 60 70 80 90)

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY ft	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
0	797.6							
0		Overburden. See B-1.1 boring log for detailed soil descriptions.		ST	01	1.0	300	
2				ST	02	1.2	400	
4				ST	03	1.4	400	
6		*sand in bottom of ST-03*						
8				ST	04	1.1	400-550	
9	788.1	*gravel and sand bottom of ST-04*						
10		*Boring terminated and backfilled with cement bentonite grout.*						

SUBSURFACE LOG

Stantec Boring No. **B-1.2**

Client	MWCD	Boring Location	480,304.8 N; 1,649,614.3 E
Project Number	174316204	Surface Elevation	793.1 ft (Elevation Datum: NAVD88)
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/26/19 (Completed: 8/26/19)
Project Location	Hancock County, Ohio	Depth to Water	4.0 ft (Date/Time: 8/26/19)
Inspector	Stantec - E. Holcombe	Depth to Water	N/A (Date/Time: N/A)
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size): NQ

Sampler Hammer Type: Automatic | Weight: 140 lb | Drop: 30 in | Efficiency: 86.2

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	793.1					ft		
0	792.9	Topsoil						
1		Sandy Silty Clay, brown, dry to damp, stiff		SPT	01	0.4	3-5-6	
	791.6							
2		Sandy Lean Clay (CL), brown and gray mottled, damp to moist, medium stiff, low to medium plasticity		SPT	02	0.8	2-2-3	
3				SPT	03A	1.5	3-3-3	
4	789.1			SPT	03B			
		Clayey Sand with Gravel (SC), gray and brown, moist to wet, medium dense, fine to medium grained						
5				SPT	04	0.9	1-4-8	
6								
7	785.6							
		Well-Graded Sand with Silt (SW-SM), gray, wet, loose to medium dense, very fine to medium grained, little clay		SPT	05	1.2	4-4-5	
8								
9								
10								

UNDRAINED SHEAR STRENGTH - tsf (1, 2, 3, 4)

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)

Pocket Penetrometer/Torvane (tsf)

STANDARD PENETRATION TEST, BLOWS/FOOT (10, 20, 30, 40, 50, 60, 70, 80, 90)

Stantec Boring No. **B-1.2**

Client MWCD

Boring Location 480,304.8 N; 1,649,614.3 E

Project Number 174316204

Surface Elevation 793.1 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10		Well-Graded Sand with Silt (SW-SM), gray, wet, loose to medium dense, very fine to medium grained, little clay - (Continued)		SPT	06	1.2	10-10-12	
		trace angular gravel at 11.3'						
12								
13		*little medium grained gravel 13.0'-16.5'*		SPT	07	1.5	6-5-18	
		rock fragment at 13.8', flat bedded						
15		*sand becomes fine to medium grained at 16.0'*		SPT	08	1.5	13-11-12	
16	776.6	*rock fragment at 16.3'*						
17		Dolomite, gray, slightly weathered, very fine grained, slightly to highly fractured, moderately hard to hard, flat to 40° fractures, flat bedded		RC	01	4.0	26	
		highly fractured 16.9'-18.0'						
19		*HAJ (40°) 18.2'-18.3', slightly rough, weathered*						
		LAF (10°) 18.9'-19.0', slightly rough						
20		*LAJ (30°) 19.2'-19.3', rough, weathered*						
21		*LAJ (20°) rough, weathered at 19.5'*						
		HF 20.3'-20.5', slightly rough						
22		*VF 20.8'-21.0', smooth*						
		HJ 21.2'-21.4'						
23		*HAF (80°) 21.7'-22.0', smooth*						

UNDRAINED SHEAR STRENGTH - tsf ▲

1 2 3 4

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ●

10 20 30 40 50 60 70 80 90

Stantec Boring No. **B-1.2**

Client MWCD

Boring Location 480,304.8 N; 1,649,614.3 E

Project Number 174316204

Surface Elevation 793.1 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
24		Dolomite, gray, slightly weathered, very fine grained, slightly to highly fractured, moderately hard to hard, flat to 40° fractures, flat bedded - (Continued)		RC	02	3.4	100	
25		*HJ at 21.9', weathered fractured 23.0'-23.3', some shale laminations*						
26		*HJ at 24.3', weathered*						
27	765.9	*HF at 24.7', smooth*						
28		*LAF (5°) at 25.3', rough*						
		LAF (5°) at 25.9', rough highly fractured 26.4'-26.7'						
29		*Boring terminated and backfilled with cement bentonite grout.*						
30								
31								
32								
33								
34								
35								
36								
37								

UNDRAINED SHEAR STRENGTH - tsf ▲

1 2 3 4

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ●

10 20 30 40 50 60 70 80 90

Stantec

SUBSURFACE LOG

Stantec Boring No. **B-1.2a**

Client	MWCD	Boring Location	480,304.8 N; 1,649,614.3 E
Project Number	174316204	Surface Elevation	793.1 ft (Elevation Datum: NAVD88)
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/27/19 (Completed: 8/27/19)
Project Location	Hancock County, Ohio	Depth to Water	N/A (Date/Time: N/A)
Inspector	Stantec - E. Holcombe	Depth to Water	N/A (Date/Time: N/A)
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 3" ST

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: N/A | Drop: N/A | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (ft)	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
0	793.1	Overburden. See B-1.2 boring log for detailed soil descriptions.		ST	01	1.4	400	
1								
2		*bulk sample 0.0'-4.0'*						
3				ST	02	1.0	450	
4	789.1	*Boring terminated and backfilled with cement bentonite grout.*						
5								
6								
7								
8								
9								
10								

UNDRAINED SHEAR STRENGTH - tsf: 1 2 3 4

WATER CONTENT & ATTERBERG LIMITS: W_P W W_L

Pocket Penetrometer/Torvane (tsf)

STANDARD PENETRATION TEST, BLOWS/FOOT: 10 20 30 40 50 60 70 80 90

Printed on 10/4/19

SUBSURFACE LOG

Stantec Boring No. **B-1.3**

Client	MWCD	Boring Location	482,698.9 N; 1,650,019.1 E
Project Number	174316204	Surface Elevation	792.0 ft (Elevation Datum: NAVD88)
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/29/19 (Completed: 8/30/19)
Project Location	Hancock County, Ohio	Depth to Water	7.5 ft (Date/Time: 8/29/19)
Inspector	Stantec - E. Holcombe	Depth to Water	N/A (Date/Time: N/A)
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size): NQ

Sampler Hammer Type: Automatic | Weight: 140 lb | Drop: 30 in | Efficiency: 86.2

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	792.0					ft		
0	791.9	Topsoil						
		Silty Clay, light brown, dry to damp, medium stiff		SPT	01	0.8	2-3-5	
1	790.5							
		Lean Clay, light and dark brown mottled, damp, medium stiff to stiff, little silt		SPT	02	1.0	3-5-7	
2		*bulk sample 0.0'-5.0'*						
3				SPT	03	1.0	3-3-6	
4		*fine sandy clay at bottom of SPT-03*						
5								
				SPT	04	0.2	3-2-3	
6								
7		*wood fragment at 7.7'*						
	784.2			SPT	05A	0.7	1-2-5	
8		Clayey Sand with Gravel, brown, gray and black, wet, loose, very fine to medium grained		SPT	05B			
9	782.5							
10								

UNDRAINED SHEAR STRENGTH - tsf (1, 2, 3, 4)

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)

Pocket Penetrometer/Torvane (tsf)

STANDARD PENETRATION TEST, BLOWS/FOOT (10, 20, 30, 40, 50, 60, 70, 80, 90)

Stantec Boring No. **B-1.3**

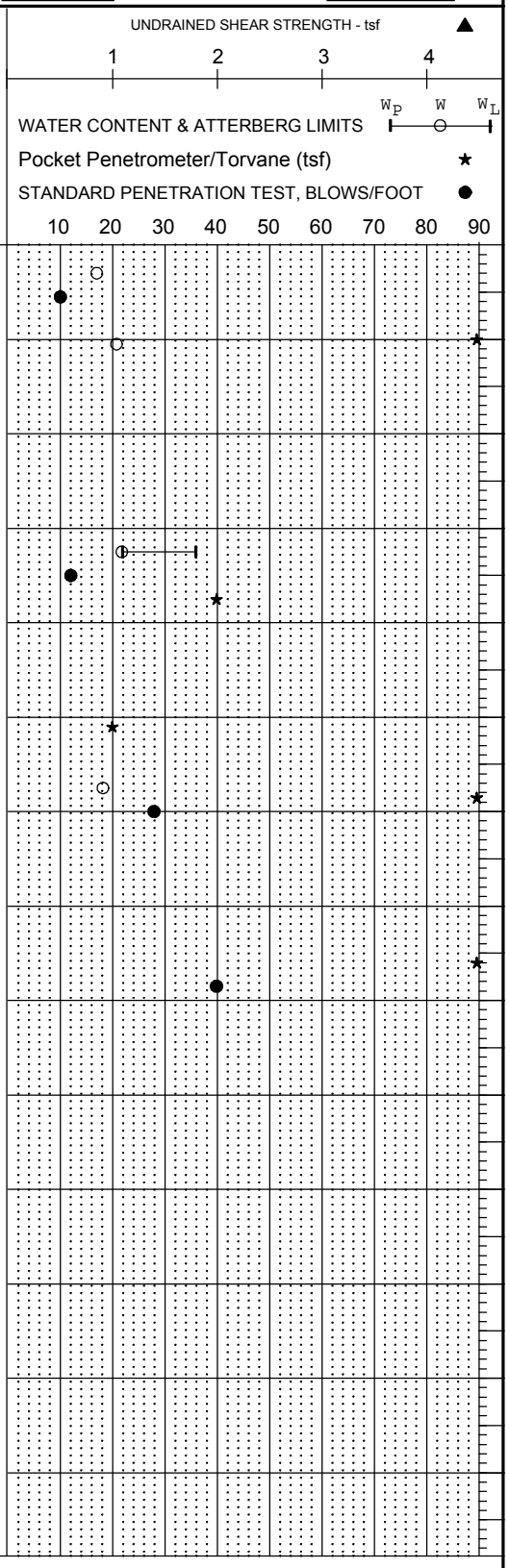
Client MWCD

Boring Location 482,698.9 N; 1,650,019.1 E

Project Number 174316204

Surface Elevation 792.0 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10	781.4	Poorly Graded Sand, gray, wet, medium dense, medium grained - (Continued)		SPT	06A	1.2	3-5-5	
11		Lean Clay (CL), gray, damp to moist, stiff (till)		SPT	06B			
12								
13				SPT	07	1.0	3-5-7	
14	777.6							
15	776.6	Clayey Sand, gray, wet, medium dense, medium to coarse grained						
16		Lean Clay, gray, moist, very stiff, some medium grained sand and gravel fragments		SPT	08	1.5	6-12-16	
17	774.3							
18		Dolomite, gray, slightly weathered, moderately fractured, tight fractures, very fine grained, flat to vertical fractures, flat bedded, laminated, hard		SPT	09A	1.5	15-19-21	
19				SPT	09B			
20		*rock fragments at 17.7'* *VF 20.0'-20.2'*		SPT	10	0.0	50+/0.1	
21		*HF at 20.3', 20.6', 20.7', 20.8', 21.0'*		RC	01	1.3	0	
22								
23								



Stantec Boring No. **B-1.3**

Client MWCD

Boring Location 482,698.9 N; 1,650,019.1 E

Project Number 174316204

Surface Elevation 792.0 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
24		Dolomite, gray, slightly weathered, moderately fractured, tight fractures, very fine grained, flat to vertical fractures, flat bedded, laminated, hard - (Continued)		RC	02	8.8	7	
25								
26								
27								
28								
29								
30	761.8							

Boring terminated and backfilled with cement bentonite grout.

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

SUBSURFACE LOG

Stantec Boring No. **B-2.10**

Client	MWCD	Boring Location	484,031.7 N; 1,649,578.8 E
Project Number	174316204	Surface Elevation	796.3 ft
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	9/4/19
Project Location	Hancock County, Ohio	Depth to Water	7.5 ft
Inspector	Stantec - E. Holcombe	Depth to Water	N/A
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Elevation Datum: NAVD88 | Completed: 9/4/19 | Date/Time: 9/4/19 | Date/Time: N/A

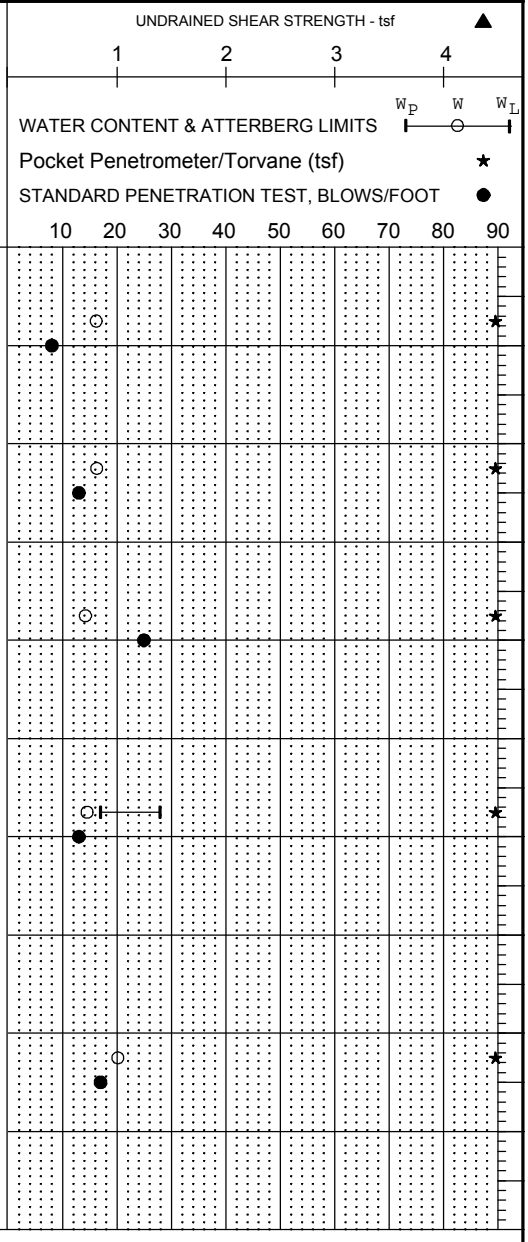
Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size): NQ

Sampler Hammer Type: Automatic | Weight: 140 lb | Drop: 30 in | Efficiency: 86.2

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	796.3					ft		
0	795.9	Topsoil						
1		Sandy Lean Clay (CL), brown and orange brown mottled, dry to damp, stiff to very stiff, trace organics		SPT	01	1.1	2-4-4	
2		*bulk sample 0.0'-5.0'*		SPT	02	1.1	7-5-8	
3		*trace rounded sand and gravel (till), more brown color 3.0'-4.5'*		SPT	03	1.4	12-12-13	
4		*pink quartz fragment (1/2") at 4.2'*						
5				SPT	04	1.5	3-6-7	
6								
7								
8		*grayish brown, less gravel 7.5'-9.0'*		SPT	05	1.5	3-7-10	
9								
10	786.3							



Stantec Boring No. **B-2.10**

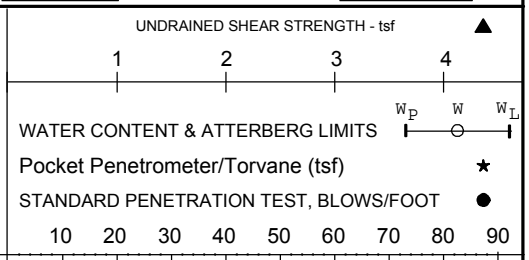
Client MWCD

Boring Location 484,031.7 N; 1,649,578.8 E

Project Number 174316204

Surface Elevation 796.3 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10		Sandy Lean Clay (CL), gray, damp, stiff, medium plasticity, trace fine gravel (till)		SPT	06	1.5	4-5-9	
11		*fine sand seam at 10.5'*						
12								
13				SPT	07	1.5	2-5-6	
14		*softer 13.5'-14.0'*						
15								
16				SPT	08	1.5	3-5-8	
17	779.3	*wet, sandy clay 16.0'-16.5'*						
	778.4	Poorly Graded Sand with Clay, gray, wet, loose, fine grained		SPT	09		50+/.4	
18		Dolomite, gray, slightly weathered, moderately to highly fractured, flat to vertical fractures, moderately hard to hard, smooth to rough fractures						
19		*VF 18.6'-18.8', slightly rough*		RC	01	2.3	0	
20		*VF 18.9'-19.3', smooth*						
21		*hydrocarbon odor at 19.0'*						
22		*highly fractured 19.0'-19.6'*						
23		*VF 20.0'-20.2', smooth*						
		HJ at 20.0, 20.1, open						
		LAF (30°) 20.4'-20.5', smooth						
		competent 21.4'-21.8'						
		flat, fractured, rough 21.8'-22.1'						
		VF 22.3'-22.7', smooth		RC	02	5.0	16	



Stantec Boring No. **B-2.10**

Client MWCD

Boring Location 484,031.7 N; 1,649,578.8 E

Project Number 174316204

Surface Elevation 796.3 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
24		Dolomite, gray, slightly weathered, moderately to highly fractured, flat to vertical fractures, moderately hard to hard, smooth to rough fractures - (Continued)						
25		*fractured 22.7'-22.8'*						
26		*HF at 23.1', tight*						
27		*highly fractured 23.4'-23.6', flat, slightly open*		RC	03	2.4	27	
28		*VF 24.4'-24.5', smooth* *highly fractured 24.7'-25.0'* *highly fractured 25.3'-25.4'* *VF 26.1'-26.2'*						
	767.5	*shale lamination at 26.5'* *LAF (10°) at 27.1', 27.2'* *moderately fractured 27.4'-27.8'*						
29								
30		*Boring terminated and backfilled with cement bentonite grout.*						
31								
32								
33								
34								
35								
36								
37								

UNDRAINED SHEAR STRENGTH - tsf ▲

1 2 3 4

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ●

10 20 30 40 50 60 70 80 90

SUBSURFACE LOG

Stantec Boring No. **B-2.10a**

Client	MWCD	Boring Location	484,031.7 N; 1,649,578.8 E
Project Number	174316204	Surface Elevation	796.3 ft
Elevation Datum	NAVD88		
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	9/5/19
Completed	9/5/19		
Project Location	Hancock County, Ohio	Depth to Water	N/A
Date/Time	N/A		
Inspector	Stantec - E. Holcombe	Depth to Water	N/A
Date/Time	N/A		
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 3" ST

Rock Drilling and Sampling Tools (Type and Size) N/A

Sampler Hammer Type Automatic Weight N/A Drop N/A Efficiency N/A

Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
0	796.3	Overburden. See B-2.10 boring log for detailed soil descriptions.						
3				ST	01	1.6	600	
6		ST-02 pushed 1.5', very stiff clay		ST	02	1.5	550	
10								

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

Stantec Boring No. **B-2.10a**

Client MWCD

Boring Location 484,031.7 N; 1,649,578.8 E

Project Number 174316204

Surface Elevation 796.3 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf (1 2 3 4) / WATER CONTENT & ATTERBERG LIMITS (W_P W W_L) / Pocket Penetrometer/Torvane (tsf) / STANDARD PENETRATION TEST, BLOWS/FOOT (10 20 30 40 50 60 70 80 90)
						ft			
10		Overburden. See B-2.10 boring log for detailed soil descriptions. - (Continued)							
11				ST	03	1.7	1000		
12									
13				ST	04	1.9	1000		
14									
15				ST	05	2.0	1000		
16	780.3								
		Boring terminated and backfilled with cement bentonite grout.							
17									
18									
19									
20									
21									
22									
23									

SUBSURFACE LOG

Stantec Boring No. **B-2.11**

Client	MWCD	Boring Location	483,523.7 N; 1,650,003.2 E
Project Number	174316204	Surface Elevation	790.7 ft
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	9/3/19
Project Location	Hancock County, Ohio	Depth to Water	7.5 ft
Inspector	Stantec - E. Holcombe	Depth to Water	N/A
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Elevation Datum: NAVD88 | Completed: 9/3/19 | Date/Time: 9/3/19 | Date/Time: N/A

Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size): NQ

Sampler Hammer Type: Automatic | Weight: 140 lb | Drop: 30 in | Efficiency: 86.2

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	790.7					ft		
0		Silty Clay, brown, dry to damp, stiff		SPT	01	0.4	3-4-5	
1								
2				SPT	02	0.4	4-6-6	
	787.7							
3		Lean Clay, brown and gray mottled, damp, very soft to stiff, low to med plasticity		SPT	03	1.2	6-7-8	
4								
5				SPT	04	0.1	2-1-1	
6								
7								
	783.2							
	782.6	Clayey Sand with Gravel, brown and gray, wet, medium dense, coarse grained		SPT	05A	1.2	5-5-6	
8		Sandy Lean Clay (CL), gray, damp, stiff to very stiff, trace rounded sand and gravel (till)		SPT	05B			
9								
10								

UNDRAINED SHEAR STRENGTH - tsf: 1 2 3 4

WATER CONTENT & ATTERBERG LIMITS: W_P W W_L

Pocket Penetrometer/Torvane (tsf)

STANDARD PENETRATION TEST, BLOWS/FOOT: 10 20 30 40 50 60 70 80 90

Stantec Boring No. **B-2.11**

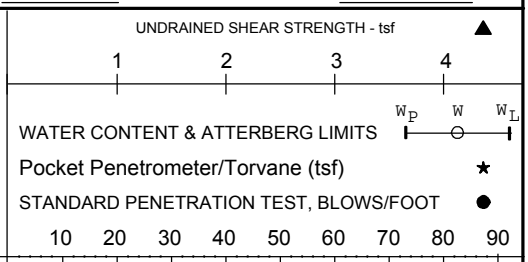
Client MWCD

Boring Location 483,523.7 N; 1,650,003.2 E

Project Number 174316204

Surface Elevation 790.7 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10		Sandy Lean Clay (CL), gray, damp, stiff to very stiff, trace rounded sand and gravel (till) - (Continued)		SPT	06	1.2	3-7-8	
11		*sand seam 10.0'-10.3'*						
12								
13				SPT	07	1.0	3-4-5	
14	776.2							
15		Dolomite, gray, slightly weathered, moderately to highly fractured, flat to vertical fractures, very fine grained, thin bedded		SPT	08	0.1	50/.1	
16		*severely fractured 15.7'-15.9', 16.1'-16.2*		RC	01	0.9	0	
17		*HJ at 16.5', smooth fractured shale lamination at 16.7'*						
18		*HAF (85°) 17.0'-17.5', smooth HF at 17.1'*						
19		*HJ at 17.5', smooth MF at 17.9'*		RC	02	5.0	28	
20		*LAF (20°) at 18.0', rough severely fractured 18.0'-18.3'*						
21		*HJ at 18.5', smooth LAJ (30°) at 18.6', smooth MF at 19.3', 19.7', 20.3', and 20.4'*						
22		*HJ at 19.5', slightly rough LAJ (10°) at 21.0', smooth HJ at 21.3', 21.4', 21.5'*						
23		*LAJ (10°) at 21.8' moderately fractured 22.3'-22.5'*		RC	03	4.8	18	



SUBSURFACE LOG

Stantec Boring No. **B-2.11**

Client MWCD

Boring Location 483,523.7 N; 1,650,003.2 E

Project Number 174316204

Surface Elevation 790.7 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY ft	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf; WATER CONTENT & ATTERBERG LIMITS; Pocket Penetrometer/Torvane (tsf); STANDARD PENETRATION TEST, BLOWS/FOOT
24		Dolomite, gray, slightly weathered, moderately to highly fractured, flat to vertical fractures, very fine grained, thin bedded - (Continued)							
25		*shale lamination 23.0'-23.2'*							
26	764.6	*highly fractured 23.3'-23.5'*							
27		*moderately fractured 23.7'-26.1'*							
28		*Boring terminated and backfilled with cement bentonite grout.*							
29									
30									
31									
32									
33									
34									
35									
36									
37									

UNDRAINED SHEAR STRENGTH - tsf: 1 2 3 4

WATER CONTENT & ATTERBERG LIMITS: W_P W W_L

Pocket Penetrometer/Torvane (tsf)

STANDARD PENETRATION TEST, BLOWS/FOOT: 10 20 30 40 50 60 70 80 90

SUBSURFACE LOG

Stantec Boring No. **B-2.12a**

Client	MWCD	Boring Location	482,040.5 N; 1,649,993.9 E
Project Number	174316204	Surface Elevation	791.5 ft (Elevation Datum: NAVD88)
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/28/19 — Completed: 8/29/19
Project Location	Hancock County, Ohio	Depth to Water	10.0 ft — Date/Time: 8/28/19
Inspector	Stantec - E. Holcombe	Depth to Water	N/A — Date/Time: N/A
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

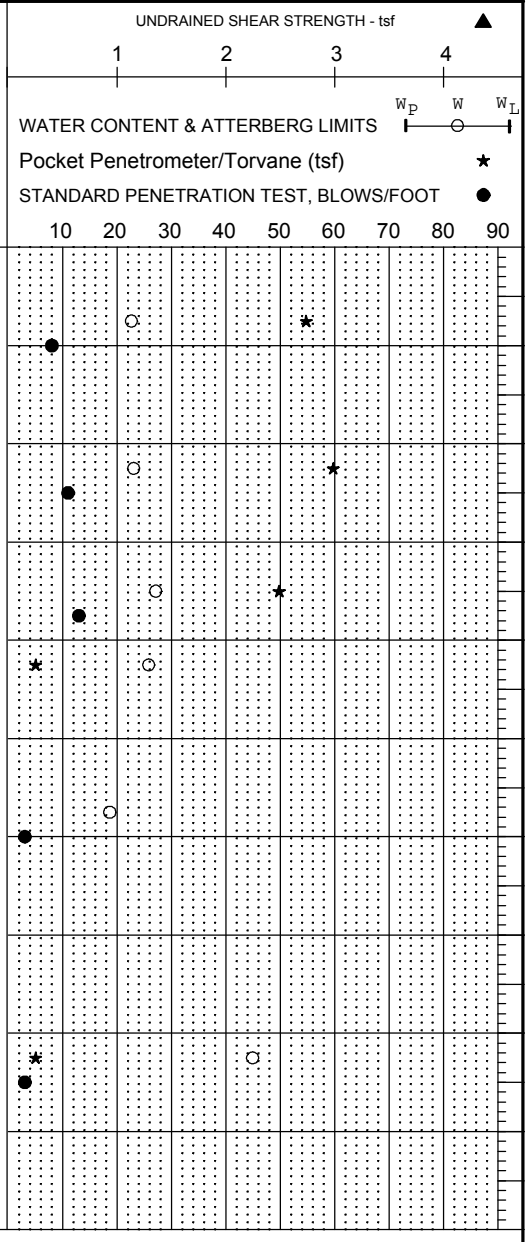
Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size): NQ

Sampler Hammer Type: Automatic — Weight: 140 lb — Drop: 30 in — Efficiency: 86.2

Borehole Azimuth: N/A (Vertical) — Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	791.5					ft		
0	791.2	Topsoil						
		Lean Clay, brown, dry to damp, stiff, some silt		SPT	01	0.6	2-3-5	
1								
		changes to light and dark brown mottled in SPT-02						
2		*bulk sample 0.0'-5.0'*		SPT	02	1.0	3-5-6	
3				SPT	03A	1.5	6-6-7	
	787.5							
4		Sandy Lean Clay (CL), brown to gray, moist, soft to stiff, trace organics		SPT	03B			
5								
				SPT	04	0.0	3-1-2	
6								
7								
8				SPT	05	0.3	1-1-2	
9								
10								



Stantec Boring No. **B-2.12a**

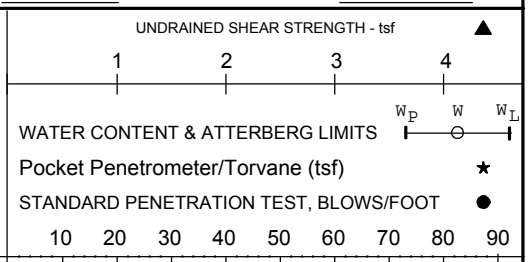
Client MWCD

Boring Location 482,040.5 N; 1,649,993.9 E

Project Number 174316204

Surface Elevation 791.5 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10		Sandy Lean Clay (CL), brown to gray, moist, soft to stiff, trace organics - (Continued)		SPT	06	1.4	WOH-1-3	
11								
12	779.0							
13		Lean Clay (CL), gray, moist, soft, medium plasticity		SPT	07	0.5	WOH-1-2	
14								
15	776.5							
	776.3	Clayey Sand with Gravel, gray, wet, medium dense		SPT	08A	1.4	7-20-50+/.4	
	775.9	Lean Clay, gray, wet, very stiff, little sand and gravel (till)		SPT	08B			
16		Dolomite, gray, slightly to moderately weathered, moderately to highly fractured, very fine grained, few shale laminations, flat to vertical fractures, tight to open fractures, flat, thin bedded, moderately hard to hard						
17		*highly fractured 16.4'-17.2'*						
18		*LAF (30°) at 17.5'*						
19		*HJ at 17.6', shale lamination, tight*		RC	01	4.5	14	
20		*LAJ (20°) at 17.7', open, rough*						
21		*highly fractured 18.0'-19.2'*						
22		*VF 18.1'-18.3'*						
23		*HJ at 19.4'*						
		fractured 19.6'-20.1'						
		VF 19.8'-20.0'						
		HJ at 20.5', open, slightly rough						
		fractured 21.8'-22.0'						



Stantec Boring No. **B-2.12a**

Client MWCD

Boring Location 482,040.5 N; 1,649,993.9 E

Project Number 174316204

Surface Elevation 791.5 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
24		*HF at 22.3'*		RC	02	5.0	46	
		HJ at 22.4', open, rough						
		HJ at 22.9', 23.1'						
25		*HAF (50°), 23.2'-23.4', tight*						
		highly fractured 23.6'-24.0',						
		25.9'-26.4'						
		HF at 24.4', tight						
26	765.1	*LAF (30°) at 24.5', tight*						
		HF at 24.7', 24.9', 25.0', tight						
27		*Boring terminated and backfilled with cement bentonite grout.*						
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								

UNDRAINED SHEAR STRENGTH - tsf ▲

1 2 3 4

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ●

10 20 30 40 50 60 70 80 90

SUBSURFACE LOG

Stantec Boring No. **B-2.12b**

Client	MWCD	Boring Location	482,040.5 N; 1,649,993.9 E
Project Number	174316204	Surface Elevation	791.5 ft
Elevation Datum	NAVD88		
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/28/19
Completed	8/28/19		
Project Location	Hancock County, Ohio	Depth to Water	N/A
Date/Time	N/A		
Inspector	Stantec - E. Holcombe	Depth to Water	N/A
Date/Time	N/A		
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 3" ST

Rock Drilling and Sampling Tools (Type and Size) N/A

Sampler Hammer Type Automatic Weight N/A Drop N/A Efficiency N/A

Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
0	791.5	Overburden. See B-2.12a boring log for detailed soil descriptions.		ST	01	1.3	NR	
1								
2				ST	02	1.3	NR	
3								
4								
5								
6				ST	03	1.2	500	
7								
8				ST	04	2.0	NR	
9								
10								

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

Stantec

SUBSURFACE LOG

Stantec Boring No. **B-2.12b**

Client MWCD

Boring Location 482,040.5 N; 1,649,993.9 E

Project Number 174316204

Surface Elevation 791.5 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf (1 2 3 4) / WATER CONTENT & ATTERBERG LIMITS (W_P W W_L) / Pocket Penetrometer/Torvane (tsf) / STANDARD PENETRATION TEST, BLOWS/FOOT (10 20 30 40 50 60 70 80 90)
						ft			
10		Overburden. See B-2.12a boring log for detailed soil descriptions. - (Continued)							
11				ST	05	2.0	NR		
12									
13				ST	06	2.0	NR		
14	777.5								
		Boring terminated and backfilled with cement bentonite grout.							
15									
16									
17									
18									
19									
20									
21									
22									
23									

SUBSURFACE LOG

Stantec Boring No. **B-2.13a**

Client	MWCD	Boring Location	481,106.5 N; 1,649,845.5 E
Project Number	174316204	Surface Elevation	794.9 ft
Project Name	HCFRRP - Dry Storage Basin Design	Elevation Datum	NAVD88
Project Location	Hancock County, Ohio	Date Started	8/27/19
Inspector	Stantec - E. Holcombe	Completed	8/27/19
Drilling Contractor	Stantec - D. Clements	Depth to Water	10.0 ft
		Date/Time	8/27/19
		Depth to Water	N/A
		Date/Time	N/A
		Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size) NQ

Sampler Hammer Type Automatic Weight 140 lb Drop 30 in Efficiency 86.2

Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	794.9					ft		
0		Silty Clay, brown, damp to moist, medium stiff, low plasticity, trace sand and gravel		SPT	01	0.9	1-5-3	
1								
2				SPT	02	0.6	3-4-3	
3		*mottled (till) 3.3'-5.0'*		SPT	03	1.1	2-4-3	
4								
5		*soft 5.0'-7.5'*		SPT	04	0.9	3-2-2	
6								
7	787.4	*clayey sand in bottom of SPT-04*						
8		Sandy Silty Clay (CL-ML), gray, dry to damp, stiff, trace sand (till)		SPT	05	1.0	3-4-7	
9		*quartz rock fragment (1") in bottom of SPT-05*						
10								

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

Stantec Boring No. **B-2.13a**

Client MWCD

Boring Location 481,106.5 N; 1,649,845.5 E

Project Number 174316204

Surface Elevation 794.9 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10	784.6			SPT	06A	1.5	5-10-14	
		Poorly Graded Sand, gray, wet, dense, very fine to fine grained		SPT	06B			
11								
12								
13	781.8			SPT	07A	1.5	6-14-16	
	781.3	Sandy Silt, gray, wet, very stiff, very fine grained sand		SPT	07B			
				SPT	07C			
14		Silty Sand with Gravel (SM), gray, wet, very dense, coarse grained sand, medium coarse gravel						
15								
		vertical brown clay seam 15.5'-16.0'		SPT	08	1.1	8-12-13	
16								
17								
18	776.8			SPT	09A	1.0	3-7-50+/.1	
	776.4	Lean Clay, gray, moist, very stiff, trace gravel (till)		SPT	09B			
19		Dolomite, gray, slightly to moderately weathered, moderately to highly fractured, flat bedded, flat to vertical fractures, few black laminations, moderately strong to strong, flat fractures are smooth, angled fractures are slightly rough to rough						
20				RC	01	2.4	0	
21								
22		*VF 18.9'-19.4' fractured 20.0'-20.4', 20.8'-21.3' LAF (20°) at 21.6' moderately fractured 21.3'-25.0', flat, tight*						
23								

UNDRAINED SHEAR STRENGTH - tsf

1 2 3 4

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf)

STANDARD PENETRATION TEST, BLOWS/FOOT

10 20 30 40 50 60 70 80 90

Stantec Boring No. **B-2.13a**

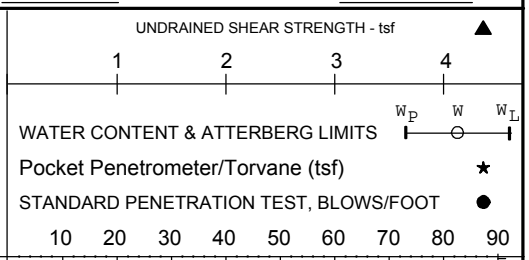
Client MWCD

Boring Location 481,106.5 N; 1,649,845.5 E

Project Number 174316204

Surface Elevation 794.9 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
24		Dolomite, gray, slightly to moderately weathered, moderately to highly fractured, flat bedded, flat to vertical fractures, few black laminations, moderately strong to strong, flat fractures are smooth, angled fractures are slightly rough to rough - (Continued)		RC	02	6.8	37	
25		*VF 24.6'-24.8'*						
26		*highly fractured 25.0'-25.2'*						
27		*moderately to highly fractured 27.0'-28.1'*						
28		*rough, open joint (35°) at 27.5'*						
29	765.2	*HAF (75°) at 27.7'* *flat, tight fractures 28.1'-29.7'*		RC	03	1.6	0	
30		*Boring terminated and backfilled with cement bentonite grout.*						
31								
32								
33								
34								
35								
36								
37								



SUBSURFACE LOG

Stantec Boring No. **B-2.14a**

Client	MWCD	Boring Location	479,527.2 N; 1,649,590.0 E
Project Number	174316204	Surface Elevation	794.4 ft (Elevation Datum: NAVD88)
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/22/19 (Completed: 8/23/19)
Project Location	Hancock County, Ohio	Depth to Water	6.0 ft (Date/Time: 8/22/19)
Inspector	Stantec - E. Holcombe	Depth to Water	N/A (Date/Time: N/A)
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size): NQ

Sampler Hammer Type: Automatic | Weight: 140 lb | Drop: 30 in | Efficiency: 86.2

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	794.4					ft		
0	794.3	Topsoil						
1		Lean Clay, brown, damp to moist, medium stiff to stiff, low plasticity, trace sand and silt		SPT	01	0.2	WOH-2-3	
2				SPT	02	0.8	4-5-4	
3	791.4	Sandy Lean Clay, brown and gray mottled, damp to moist, medium stiff, medium plasticity		SPT	03	1.5	3-3-3	
4								
5	789.4	Silty Clay, brown, damp, soft, low plasticity		SPT	04A	0.5	1-2-1	
6	788.4	Poorly Graded Sand, gray, wet, loose, very fine to fine grained		SPT	04B			
7	787.9	Silt with Sand (ML), gray, wet, very soft, very fine grained sand, trace clay						
8				SPT	05	1.5	WOH-WOH-1	
9								
10	784.4							

UNDRAINED SHEAR STRENGTH - tsf (1, 2, 3, 4)

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)

Pocket Penetrometer/Torvane (tsf)

STANDARD PENETRATION TEST, BLOWS/FOOT (10, 20, 30, 40, 50, 60, 70, 80, 90)

Stantec Boring No. **B-2.14a**

Client MWCD

Boring Location 479,527.2 N; 1,649,590.0 E

Project Number 174316204

Surface Elevation 794.4 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10		Clayey Sand, brown, wet, dense, medium grained sand		SPT	06	0.4	4-7-6	
11		*orange seashell (1/4") at 11.0'*						
12	781.9							
13		Silty Sand (SM), gray, wet, medium dense, medium coarse grained		SPT	07A	1.5	8-13-9	
	780.7	*Dolomite stone fragment 13.5'-13.7'*		SPT	07B			
14		Sandy Lean Clay (CL), gray, moist, stiff to very stiff, trace rounded medium grained sand (till)						
15		*white stone fragment (1/4") at 13.8'*		SPT	08	0.2	4-6-9	
16		*dolomite stone fragment in SPT-08*						
17		*brown mottled 17.5'-19.0'*						
18				SPT	09	0.7	10-12-12	
19								
20				SPT	10	1.1	5-5-50+/.2	
21	773.4							
		Dolomite, gray, few shale laminations, slightly weathered, moderately fractured, smooth to slightly rough laminations, flat thin bedded, fractures along bedding plane (mostly in shale laminations)		RC	01	0.2	0	
22								
23								

UNDRAINED SHEAR STRENGTH - tsf ▲

1 2 3 4

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ●

10 20 30 40 50 60 70 80 90

Stantec Boring No. **B-2.14a**

Client MWCD

Boring Location 479,527.2 N; 1,649,590.0 E

Project Number 174316204

Surface Elevation 794.4 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY ft	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
24		Dolomite, gray, few shale laminations, slightly weathered, moderately fractured, smooth to slightly rough laminations, flat thin bedded, fractures along bedding plane (mostly in shale laminations) - (Continued)		RC	02	5.0	30	
25		*hydrocarbon odor at 21.0'*						
26		*LAF (20°) 21.2'-21.3'*						
27		*HF at 21.4', 21.5', 21.6', 22.0', 22.3', 22.4', 22.8'*						
28		*VF 22.6'-22.7'*						
29		*vug cavity at 23.2'*						
30		*severely fractured 23.6'-23.9'*		RC	03	5.0	10	
31		*HF at 24.1', 24.3', 24.4', 24.7', 25.3', 26.3'*						
	763.0	*LAF (10°) at 25.2', 25.6', 26.0'*						
32		*highly fractured 26.4'-26.7'*						
		LAF (10°) at 26.7'						
		HF at 27.1', 27.2', 27.4', 27.8'						
		LAF (10°) at 27.6', 28.1'						
		HF 28.3', 28.5' (rough), 29.0'						
		highly fractured with some vertical fractures 29.4'-30.3'						
		highly fractured 30.9'-31.4'						
33		*Boring terminated and backfilled with cement bentonite grout.*						
34								
35								
36								
37								

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

SUBSURFACE LOG

Stantec Boring No. **B-2.15a**

Client	MWCD	Boring Location	478,618.1 N; 1,649,758.8 E
Project Number	174316204	Surface Elevation	797.4 ft
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/21/19
Project Location	Hancock County, Ohio	Depth to Water	7.9 ft
Inspector	Stantec - E. Holcombe	Depth to Water	N/A
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Elevation Datum: NAVD88 | Completed: 8/21/19 | Date/Time: 8/21/19 | Date/Time: N/A

Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size): NQ

Sampler Hammer Type: Automatic | Weight: 140 lb | Drop: 30 in | Efficiency: 86.2

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	797.4					ft		
0	797.2	Topsoil						
		Silty Clay, brown, damp to moist, stiff, trace sand		SPT	01	0.7	2-4-5	
1	795.9							
		Sandy Silty Clay, light brown, dry, very stiff		SPT	02	0.9	4-6-9	
2	794.4							
		Lean Clay, brown and orange mottled, moist, very stiff, trace sand		SPT	03	0.7	6-8-8	
3								
4	792.4							
		Lean Clay, brown and gray mottled, damp to moist, very stiff, trace coarse sand (rounded)		SPT	04	1.2	3-7-8	
5								
6								
		quartz fragment (1/2") at 7.7'						
7	789.5			SPT	05A	0.8	2-6-9	
		Silty Sand with Gravel (SM), gray and brown, wet, dense, medium to coarse sand, medium to coarse gravel		SPT	05B			
8								
9								
10								

UNDRAINED SHEAR STRENGTH - tsf: 1 2 3 4

WATER CONTENT & ATTERBERG LIMITS: W_P W W_L

Pocket Penetrometer/Torvane (tsf)

STANDARD PENETRATION TEST, BLOWS/FOOT: 10 20 30 40 50 60 70 80 90

SUBSURFACE LOG

Stantec Boring No. **B-2.15a**

Client MWCD

Boring Location 478,618.1 N; 1,649,758.8 E

Project Number 174316204

Surface Elevation 797.4 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10		Silty Sand with Gravel (SM), gray and brown, wet, dense, medium to coarse sand, medium to coarse gravel - (Continued)		SPT	06	1.0	4-9-11	
11		*more gravel at 11.0'*						
12								
13		*brown clay seam 12.8'-13.4'*		SPT	07	1.5	8-13-16	
14		*less clay at 13.5'*						
15				SPT	08A	1.5	8-10-15	
16	781.4			SPT	08B			
17		Limestone with Shale Interbedded (60/40%), gray, slightly to moderately weathered, very fine grained, highly to moderately fractured, moderately hard, slightly rough, flat, thin bedding, most fractures along bedding planes		SPT	09	0.2	50+/.2	
18								
19		*highly weathered, wet shale seam 17.5'-17.6'*		RC	01	2.5	0	
20		*VF 17.7'-17.9'*						
21		*highly fractured 17.7'-18.8'*						
	775.9	*LAF (30°) 18.6'-18.8'*						
22		*shale laminations at 18.9', 19.8'*						
		HAF (45°) at 19.3'						
		highly fractured 19.5'-19.7'						
		HF at 21.2'						
		VF 21.4'-21.6'						
23		Dolomite (See next page for full description)		RC	02	4.5	22	

UNDRAINED SHEAR STRENGTH - tsf ▲

1 2 3 4

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

Pocket Penetrometer/Torvane (tsf) ★

STANDARD PENETRATION TEST, BLOWS/FOOT ●

10 20 30 40 50 60 70 80 90

Stantec Boring No. **B-2.15a**

Client MWCD

Boring Location 478,618.1 N; 1,649,758.8 E

Project Number 174316204

Surface Elevation 797.4 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
24		Dolomite, gray, slightly weathered, very fine grained, moderately to highly fractured, moderately hard to hard, slightly rough to rough, laminated, thin bedding, slightly micaceous - (Continued)						
25								
26								
27	769.8	*HF at 21.8', 21.9'* *moderately fractured 22.2'-22.7'* *highly fractured 22.7'-24.5'* *VF 24.9'-25.1'* *two VFs 27.1'-27.4'* *highly fractured 27.4'-27.7'*		RC	03	1.5	27	
28		*Boring terminated and backfilled with cement bentonite grout.*						
29								
30								
31								
32								
33								
34								
35								
36								
37								

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

Stantec

SUBSURFACE LOG

Stantec Boring No. **B-2.15b**

Client	MWCD	Boring Location	478,618.1 N; 1,649,758.8 E
Project Number	174316204	Surface Elevation	797.4 ft
Elevation Datum	NAVD88		
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/21/19
Completed	8/21/19		
Project Location	Hancock County, Ohio	Depth to Water	7.5 ft
Date/Time	8/21/19		
Inspector	Stantec - E. Holcombe	Depth to Water	N/A
Date/Time	N/A		
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 3" ST

Rock Drilling and Sampling Tools (Type and Size) N/A

Sampler Hammer Type Automatic Weight N/A Drop N/A Efficiency N/A

Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	797.4					ft		
0		Overburden. See B-2.15a boring log for detailed soil descriptions.		ST	01	2.0	500	
1								
2				ST	02	1.6	500	
3								
4				ST	03	1.3	500	
5								
6				ST	04	1.5	500	
7	789.4		▽					
8		*Boring terminated and backfilled with cement bentonite grout.*						
9								
10								

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

SUBSURFACE LOG

Stantec Boring No. **B-2.16a**

Client	MWCD	Boring Location	477,934.3 N; 1,649,764.5 E
Project Number	174316204	Surface Elevation	796.9 ft (Elevation Datum: NAVD88)
Project Name	HCFRRP - Dry Storage Basin Design	Date Started	8/20/19 (Completed: 8/20/19)
Project Location	Hancock County, Ohio	Depth to Water	8.0 ft (Date/Time: 8/20/19)
Inspector	Stantec - E. Holcombe	Depth to Water	4.0 ft (Date/Time: 8/21/19)
Drilling Contractor	Stantec - D. Clements	Drill Rig Type and ID	CME 45T (815)

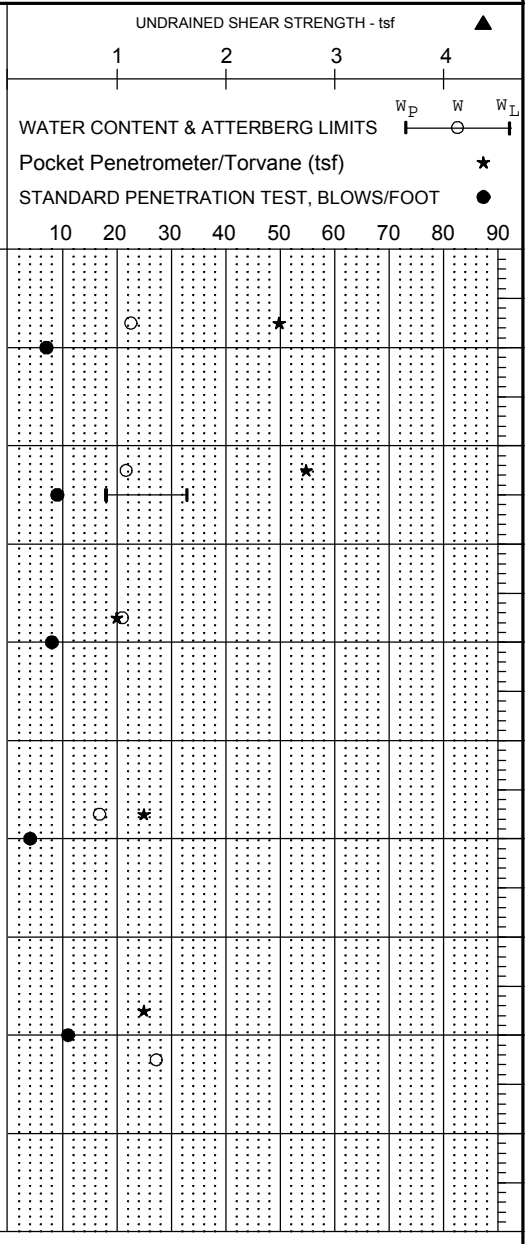
Overburden Drilling and Sampling Tools (Type and Size): 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size): NQ

Sampler Hammer Type: Automatic | Weight: 140 lb | Drop: 30 in | Efficiency: 86.2

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
	796.9					ft		
0	796.4	Topsoil						
1		Sandy Lean Clay (CL), brown, damp, medium stiff, low to medium plasticity		SPT	01	0.7	2-3-4	
2		*bulk sample 0.0'-5.0'*		SPT	02	1.2	2-4-5	
3		*brown and gray mottled after 3.0'*		SPT	03	1.4	3-4-4	
4								
5		*more silty at 5.0'*		SPT	04	0.3	1-1-3	
6								
7								
8	788.9			SPT	05A	0.6	4-5-6	
9		Silty, Clayey Gravel with Sand (GC-GM), gray and dark brown, wet, medium dense, medium to coarse sand, angular to rounded		SPT	05B			
10								



Stantec Boring No. **B-2.16a**

Client MWCD

Boring Location 477,934.3 N; 1,649,764.5 E

Project Number 174316204

Surface Elevation 796.9 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
						ft		
10		Silty, Clayey Gravel with Sand (GC-GM), gray and dark brown, wet, medium dense, medium to coarse sand, angular to rounded - (Continued)		SPT	06	1.0	10-10-10	
11		*more gravel 10.0'-11.5'*						
12		*white sandstone fragments 10.2'-10.3'*						
13	783.9			SPT	07A	1.2	4-27-43	
		Dolomite, gray, moderately hard to hard, very fine grained, highly fractured, flat to vertical fractures, laminated, flat bedding, slightly weathered, fractures are slightly rough		SPT	07B			
14		*dolomite rock fragment (1.5") in bottom of SPT-08*		SPT	08	0.1	50+/.1	
15				RC	01	1.1	0	
16								
17		*highly fractured 16.9'-20.2'*						
18				RC	02	1.8	15	
19								
20								
21		*VF 20.2'-20.5'* *moderately fractured 20.5'-23.1'* *fractured 20.6'-20.8'* *flat, slightly weathered joint at 21.2'* *MF at 21.8', 22.0'* *high fractured 22.3'-22.5'* *VF 22.5'-22.8'*						
22								
23				RC	03	4.5	35	

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

Stantec Boring No. **B-2.16a**

Client MWCD

Boring Location 477,934.3 N; 1,649,764.5 E

Project Number 174316204

Surface Elevation 796.9 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY ft	SAMPLES BLOWS / PRESS.(psi) / RQD (%)	MONITOR WELL / PIEZOMETER
24		Dolomite, gray, moderately hard to hard, very fine grained, highly fractured, flat to vertical fractures, laminated, flat bedding, slightly weathered, fractures are slightly rough - (Continued)						
25								
26								
27		*flat fractures 23.5'-24.2'*						
28		*VF 25.7'-26.2'*						
29		*flat shale seams (1/8") 26.8'-29.0'*		RC	04	4.4	0	
30		*highly fractured 29.3'-31.2'*						
31	765.7							
32		*Boring terminated and backfilled with bentonite pellets to seal rock core socket, then backfilled with cement bentonite grout to surface.*						
33								
34								
35								
36								
37								

UNDRAINED SHEAR STRENGTH - tsf ▲
1 2 3 4
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
Pocket Penetrometer/Torvane (tsf) ★
STANDARD PENETRATION TEST, BLOWS/FOOT ●
10 20 30 40 50 60 70 80 90

APPENDIX B
LABORATORY TEST RESULTS

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name HCFRRP - Eagle Creek DSB

Project Number 174316204

Tested By

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Test Method ASTM

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
B-1.1, 0.0'-1.5'	70	9/5/19	Dist	No. 4			No	30.54	137.20	120.14	19.0
B-1.1, 1.5'-3.0'	71	9/5/19	Hom	No. 10			Yes	32.31	103.17	90.78	21.2
B-1.1, 3.0'-4.5'	72	9/5/19	Hom	No. 10			Yes	31.89	134.91	117.95	19.7
B-1.1, 5.0'-6.5'	73	9/5/19	Hom	No. 10			Yes	31.56	113.31	99.71	20.0
B-1.1, 7.5'-9.0'	74	9/5/19	Hom	No. 10			Yes	30.78	109.50	95.83	21.0
B-1.1, 10.0'-11.5'	75	9/5/19	Dist	No. 4			No	32.09	110.57	100.06	15.5
B-2.14A, 0.0'-1.5'	77	9/5/19	Dist	No. 4			No	32.20	116.03	100.19	23.3
B-2.14A, 1.5'-3.0'	78	9/5/19	Hom	No. 10			Yes	30.73	99.84	86.01	25.0
B-2.14A, 3.0'-4.5'	79	9/5/19	Hom	No. 10			Yes	31.66	118.48	102.68	22.2
B-2.14A, 5.0'-6.5'	80	9/5/19	Dist	No. 4			No	30.62	112.20	95.11	26.5
B-2.14A, 7.5'-9.0'	81	9/5/19	Hom	No. 10			Yes	30.55	128.13	96.84	47.2
B-2.14A, 10.0'-11.5'	82	9/5/19	Dist	No. 4			No	31.75	102.29	86.06	29.9
B-2.14A, 12.5'-14.0'	83	9/5/19	Dist	No. 4			No	32.26	133.74	117.32	19.3
B-2.14A, 15.0'-16.5'	84	9/11/19	Dist	No. 4			No	30.93	70.61	65.02	16.4
B-2.14A, 17.5'-19.0'	86	9/11/19	Hom	No. 10			Yes	30.61	71.16	64.97	18.0
B-2.14A, 20.0'-21.2'	87	9/11/19	Hom	No. 10			Yes	32.02	102.39	98.25	6.3
B-2.15A, 0.0'-1.5'	88	9/5/19	Hom	No. 10			Yes	32.26	114.72	102.06	18.1
B-2.15A, 1.5'-3.0'	89	9/5/19	Hom	No. 10			Yes	32.23	117.60	104.65	17.9
B-2.15A, 3.0'-4.5'	90	9/5/19	Hom	No. 10			Yes	31.02	120.46	106.95	17.8
B-2.15A, 5.0'-6.5'	91	9/5/19	Hom	No. 10			Yes	30.88	110.23	97.81	18.6
B-2.15A, 7.9'-9.0'	93	9/5/19	Dist	No. 4			No	30.70	113.09	102.46	14.8
B-2.15A, 10.0'-11.5'	94	9/5/19	Dist	No. 4			No	30.70	134.58	125.73	9.3
B-2.15A, 12.5'-14.0'	95	9/5/19	Dist	No. 4			No	32.01	106.38	98.18	12.4
B-2.15A, 15.0'-16.0'	96	9/5/19	Dist	No. 4			No	31.88	130.10	118.22	13.8
B-2.16A, 0.0'-1.5'	97	9/5/19	Hom	No. 10			Yes	31.81	99.37	86.90	22.6
B-2.16A, 1.5'-3.0'	98	9/5/19	Hom	No. 10			Yes	32.05	96.06	84.64	21.7
B-2.16A, 3.0'-4.5'	99	9/5/19	Hom	No. 10			Yes	32.14	105.01	92.37	21.0
B-2.16A, 5.0'-6.5'	100	9/5/19	Dist	No. 4			No	32.16	80.54	73.58	16.8

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name HCFRRP - Eagle Creek DSB

Project Number 174316204

Tested By

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Test Method ASTM

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
B-2.16A, 8.0'-9.0'	102	9/5/19	Dist	No. 4			No	32.21	106.08	90.23	27.3
B-2.16A, 10.0'-11.5'	103	9/5/19	Dist	No. 4			No	31.80	105.15	99.83	7.8
B-2.16A, 12.5'-13.0'	104	9/5/19	Dist	No. 4			No	32.32	104.49	97.63	10.5

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name HCFRRP - Eagle Creek DSB

Project Number 174316204

Tested By

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Test Method ASTM

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
B-1.2, 0.0'-1.5'	105	9/11/19	Hom	No. 4			No	32.21	117.94	104.90	17.9
B-1.2, 1.5'-3.0'	107	9/11/19	Hom	No. 10			Yes	32.19	101.08	89.82	19.5
B-1.2, 3.0'-4.0'	108	9/11/19	Hom	No. 10			Yes	30.55	117.98	101.91	22.5
B-1.2, 4.0'-4.5'	109	9/11/19	Dist	No. 4			No	30.72	92.73	80.84	23.7
B-1.2, 5.0'-6.5'	110	9/11/19	Dist	No. 4			No	32.14	125.41	117.61	9.1
B-1.2, 7.5'-9.0'	111	9/11/19	Dist	No. 4			No	32.33	115.04	98.70	24.6
B-1.2, 10.0'-11.5'	112	9/11/19	Dist	No. 4			No	31.74	120.75	103.98	23.2
B-1.2, 12.5'-14.0'	113	9/11/19	Dist	No. 4			No	32.30	102.67	94.79	12.6
B-1.2, 15.0'-16.5'	114	9/11/19	Dist	No. 4			No	32.19	118.82	109.09	12.7
B-1.3, 0.0'-1.5'	115	9/11/19	Hom	No. 10			Yes	32.13	100.94	88.80	21.4
B-1.3, 1.5'-3.0'	116	9/11/19	Hom	No. 10			Yes	32.02	92.68	81.30	23.1
B-1.3, 3.0'-4.5'	117	9/11/19	Hom	No. 10			Yes	32.09	90.08	79.65	21.9
B-1.3, 5.0'-6.5'	118	9/11/19	Hom	No. 10			Yes	32.33	89.59	79.48	21.4
B-1.3, 7.8'-9.0'	120	9/11/19	Hom	No. 10			Yes	32.01	90.76	77.17	30.1
B-1.3, 10.0'-10.6'	121	9/11/19	Dist	No. 10			Yes	31.22	108.85	97.57	17.0
B-1.3, 10.6'-11.5'	122	9/11/19	Hom	No. 10			Yes	30.93	94.06	83.18	20.8
B-1.3, 12.5'-14.0'	123	9/11/19	Hom	No. 10			Yes	32.07	106.43	93.12	21.8
B-1.3, 15.0'-16.5'	124	9/11/19	Hom	No. 10			Yes	32.05	114.01	101.39	18.2
B-2.10, 0.0'-1.5'	127	9/11/19	Hom	No. 10			Yes	32.09	112.05	100.92	16.2
B-2.10, 1.5'-3.0'	128	9/11/19	Hom	No. 10			Yes	31.90	98.48	89.13	16.3
B-2.10, 3.0'-4.5'	129	9/11/19	Hom	No. 10			Yes	30.60	97.63	89.32	14.2
B-2.10, 5.0'-6.5'	130	9/11/19	Hom	No. 10			Yes	32.66	114.86	104.46	14.5
B-2.10, 7.5'-9.0'	131	9/11/19	Hom	No. 10			Yes	30.94	92.56	82.22	20.2
B-2.10, 10.0'-11.5'	132	9/11/19	Hom	No. 10			Yes	31.76	87.87	78.89	19.1
B-2.10, 12.5'-14.0'	133	9/11/19	Hom	No. 10			Yes	32.24	84.57	77.52	15.6
B-2.10, 15.0'-16.5'	134	9/11/19	Hom	No. 10			Yes	32.08	102.42	94.47	12.7
B-2.11, 0.0'-1.5'	136	9/11/19	Dist	No. 4			No	30.87	95.10	82.46	24.5
B-2.11, 1.5'-3.0'	137	9/11/19	Hom	No. 10			Yes	32.23	87.46	75.02	29.1

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Moisture Content of Soil

ASTM D 2216

Project Name HCFRRP - Eagle Creek DSB

Project Number 174316204

Tested By

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Test Method ASTM

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
B-2.11, 3.0'-4.5'	138	9/11/19	Hom	No. 10			Yes	30.78	108.11	91.23	27.9
B-2.11, 5.0'-6.5'	139	9/11/19	Hom	No. 4			No	31.88	71.50	64.10	23.0
B-2.11, 8.1'-9.0'	141	9/11/19	Hom	No. 10			Yes	32.11	112.73	104.03	12.1
B-2.11, 10.0'-11.5'	142	9/11/19	Hom	No. 10			Yes	31.68	106.98	98.19	13.2
B-2.11, 12.5'-14.0'	143	9/12/19	Hom	No. 10			Yes	31.00	100.95	92.37	14.0
B-2.12a, 0.0'-1.5'	144	9/12/19	Hom	No. 10			Yes	32.35	101.02	88.30	22.7
B-2.12a, 1.5'-3.0'	145	9/12/19	Hom	No. 10			Yes	32.26	89.23	78.53	23.1
B-2.12a, 3.0'-4.0'	146	9/12/19	Hom	No. 10			Yes	31.82	90.50	77.95	27.2
B-2.12a, 4.0'-4.5'	147	9/12/19	Hom	No. 10			Yes	30.71	93.48	80.58	25.9
B-2.12a, 5.0'-6.5'	148	9/12/19	Hom	No. 10			Yes	30.72	65.40	59.93	18.7
B-2.12a, 7.5'-9.0'	149	9/12/19	Hom	No. 10			Yes	32.00	114.56	88.89	45.1
B-2.12a, 10.0'-11.5'	150	9/11/19	Hom	No. 10			Yes	30.98	105.41	81.91	46.1
B-2.12a, 12.5'-14.0'	151	9/11/19	Hom	No. 10			Yes	31.89	87.37	76.61	24.1
B-2.12a, 15.2'-15.6'	152	9/12/19	Dist	No. 4			Yes	31.92	179.25	169.98	6.7
B-2.13a, 0.0'-1.5'	154	9/12/19	Hom	No. 10			Yes	30.62	92.70	83.66	17.0
B-2.13a, 1.5'-3.0'	155	9/12/19	Hom	No. 10			Yes	32.32	86.71	80.23	13.5
B-2.13a, 3.0'-4.5'	156	9/12/19	Hom	No. 10			Yes	31.65	83.44	73.78	22.9
B-2.13a, 5.0'-6.5'	157	9/12/19	Hom	No. 10			Yes	30.79	92.76	80.71	24.1
B-2.13a, 7.5'-9.0'	158	9/11/19	Hom	No. 10			Yes	31.91	116.24	107.11	12.1
B-2.13a, 10.0'-11.5'	159	9/12/19	Dist	No. 4			No	31.81	153.86	130.87	23.2
B-2.13a, 13.1'-13.6'	161	9/12/19	Hom	No. 10			Yes	31.57	91.16	81.70	18.9
B-2.13a, 15.0'-16.5'	163	9/11/19	Dist	No. 4			No	31.25	102.72	94.64	12.7
B-2.13a, 17.5'-18.6'	164	9/12/19	Hom	No. 10			Yes	32.21	93.85	89.05	8.4

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.1, 10.0'-11.5'	Lab ID	75
Sample Type	SPT	Date Received	9-5-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 15.5

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	79.9
No. 4	4.75	76.0
No. 10	2	71.9
No. 40	0.425	65.9
No. 200	0.075	43.4
	0.02	24.5
	0.005	14.2
	0.002	7.6
estimated	0.001	3.4

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	24.0	28.1
Coarse Sand	4.1	6.0
Medium Sand	6.0	---
Fine Sand	22.5	22.5
Silt	29.2	35.8
Clay	14.2	7.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	17
Plastic Limit:	14
Plasticity Index:	3
Activity Index:	0.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand with gravel

AASHTO Classification: A-4 (0)

Comments:

Reviewed By JES

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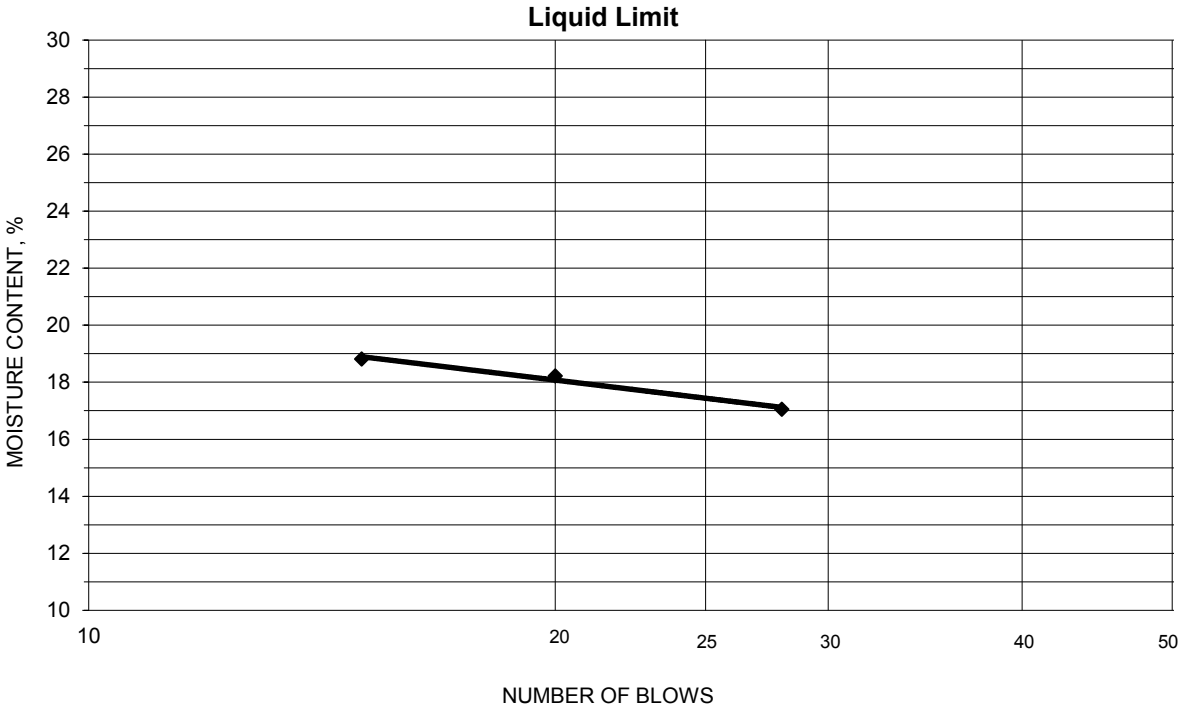
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-1.1, 10.0'-11.5'			Lab ID	75
				% + No. 40	34
Tested By	MF	Test Method	ASTM D 4318 Method A	Date Received	09-05-2019
Test Date	09-10-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
24.85	22.84	11.05	28	17.0	
24.35	22.30	11.05	20	18.2	
23.42	21.45	10.98	15	18.8	17



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.69	16.83	10.69	14.0	14	3
18.00	17.15	11.06	14.0		

Remarks: _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.1, 10.0'-11.5'	Lab ID	75

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-06-2019
Date Received	09-05-2019

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	79.9
No. 4	76.0
No. 10	71.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

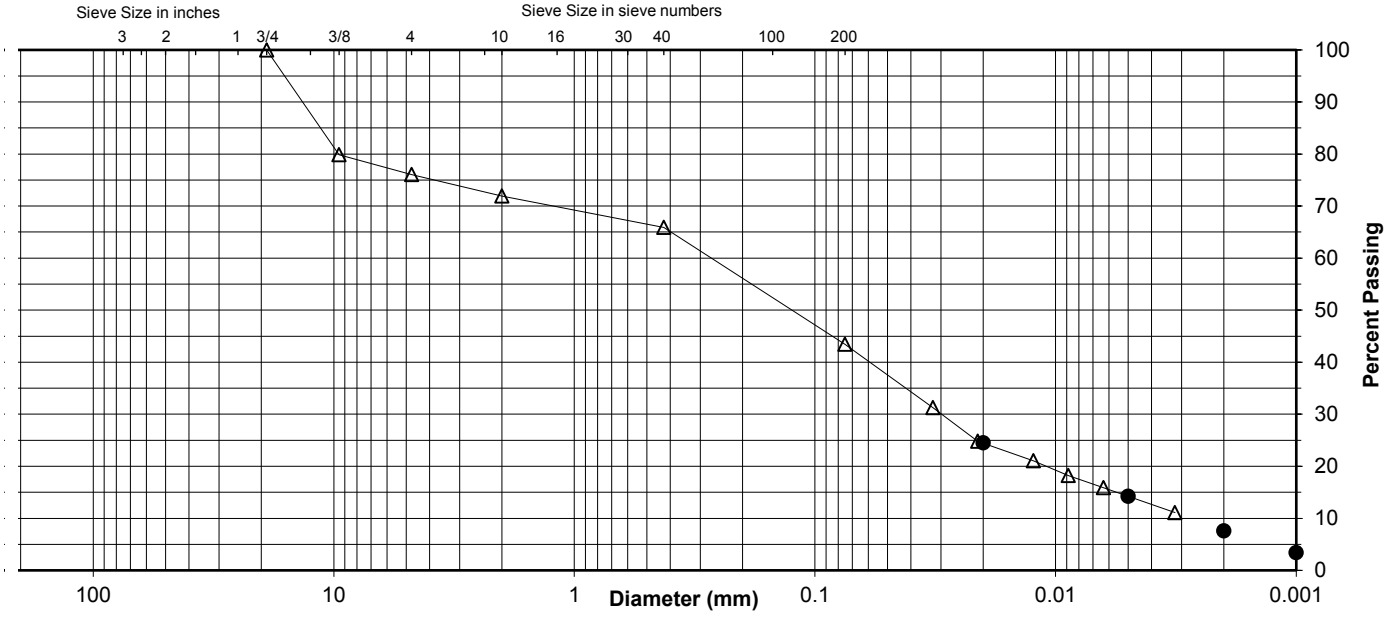
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	65.9
No. 200	43.4
0.02 mm	24.5
0.005 mm	14.2
0.002 mm	7.6
0.001 mm	3.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	24.0	4.1	6.0	22.5	29.2	14.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	28.1			6.0	22.5	35.8	7.6



Comments

Reviewed By JES

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.14A, 7.5'-9.0'	Lab ID	81
Sample Type	SPT	Date Received	9-5-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 47.2

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	97.1
No. 10	2	96.3
No. 40	0.425	94.4
No. 200	0.075	76.0
	0.02	47.7
	0.005	22.9
	0.002	9.6
estimated	0.001	0.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	2.9	3.7
Coarse Sand	0.8	1.9
Medium Sand	1.9	---
Fine Sand	18.4	18.4
Silt	53.1	66.4
Clay	22.9	9.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	42
Plastic Limit:	28
Plasticity Index:	14
Activity Index:	1.5

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	ML
Group Name:	Silt with sand
AASHTO Classification:	A-7-6 (11)

Comments:

Reviewed By JES

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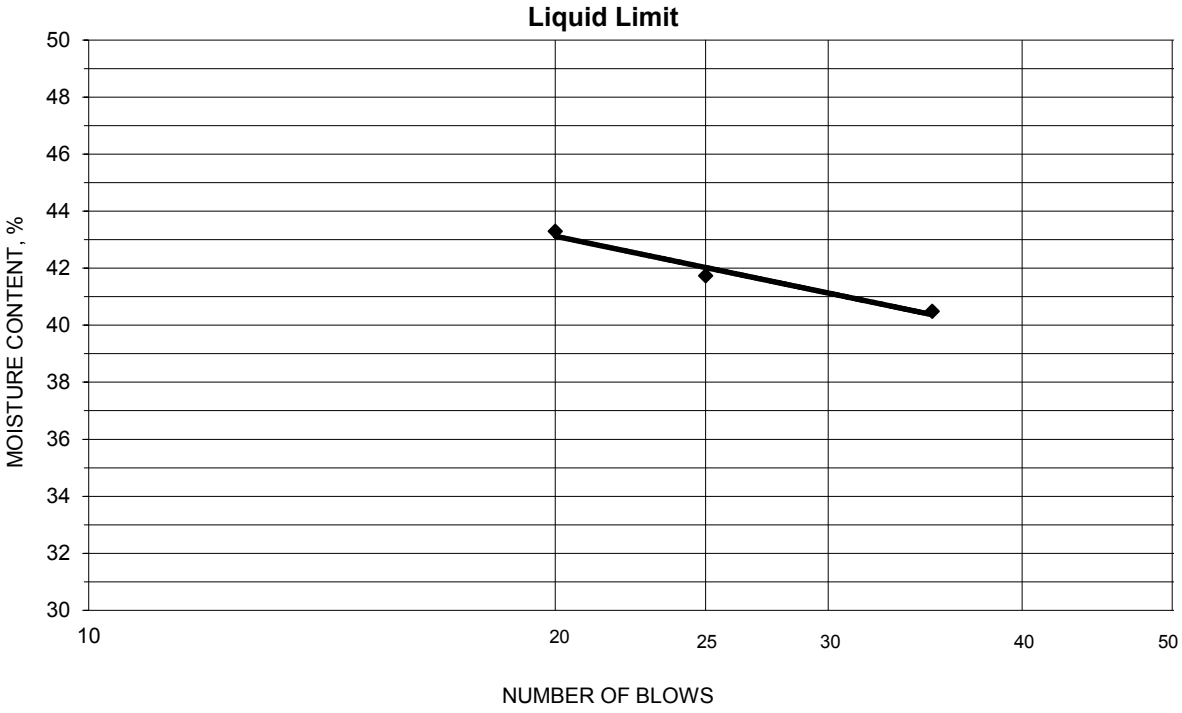
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.14A, 7.5'-9.0'			Lab ID	81
				% + No. 40	6
Tested By	MF	Test Method	ASTM D 4318 Method A	Date Received	09-05-2019
Test Date	09-10-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.57	19.25	11.05	35	40.5	
20.59	17.79	11.08	25	41.7	
21.70	18.47	11.01	20	43.3	42



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.34	18.27	11.01	28.5	28	14
20.82	18.71	11.15	27.9		

Remarks: _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.14A, 7.5'-9.0'	Lab ID	81

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-09-2019
Date Received	09-05-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	97.1
No. 10	96.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

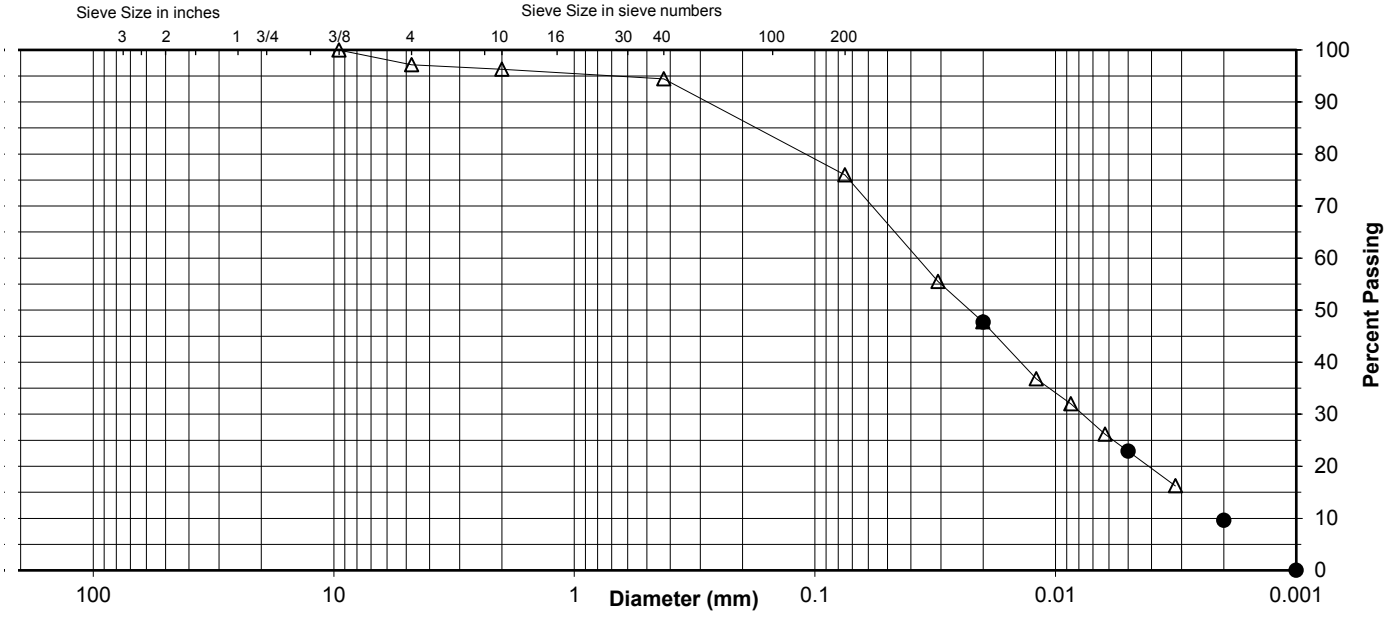
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	94.4
No. 200	76.0
0.02 mm	47.7
0.005 mm	22.9
0.002 mm	9.6
0.001 mm	0.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.9	0.8	1.9	18.4	53.1	22.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	3.7			1.9	18.4	66.4	9.6



Comments

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.14A, 12.5'-14.0'	Lab ID	83
Sample Type	SPT	Date Received	9-5-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 19.3

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	97.8
No. 10	2	90.5
No. 40	0.425	31.7
No. 200	0.075	12.3
	0.02	6.1
	0.005	3.3
	0.002	1.9
estimated	0.001	1.2

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	2.2	9.5
Coarse Sand	7.3	58.8
Medium Sand	58.8	---
Fine Sand	19.4	19.4
Silt	9.0	10.4
Clay	3.3	1.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty sand
AASHTO Classification:	A-1-b (0)

Comments:

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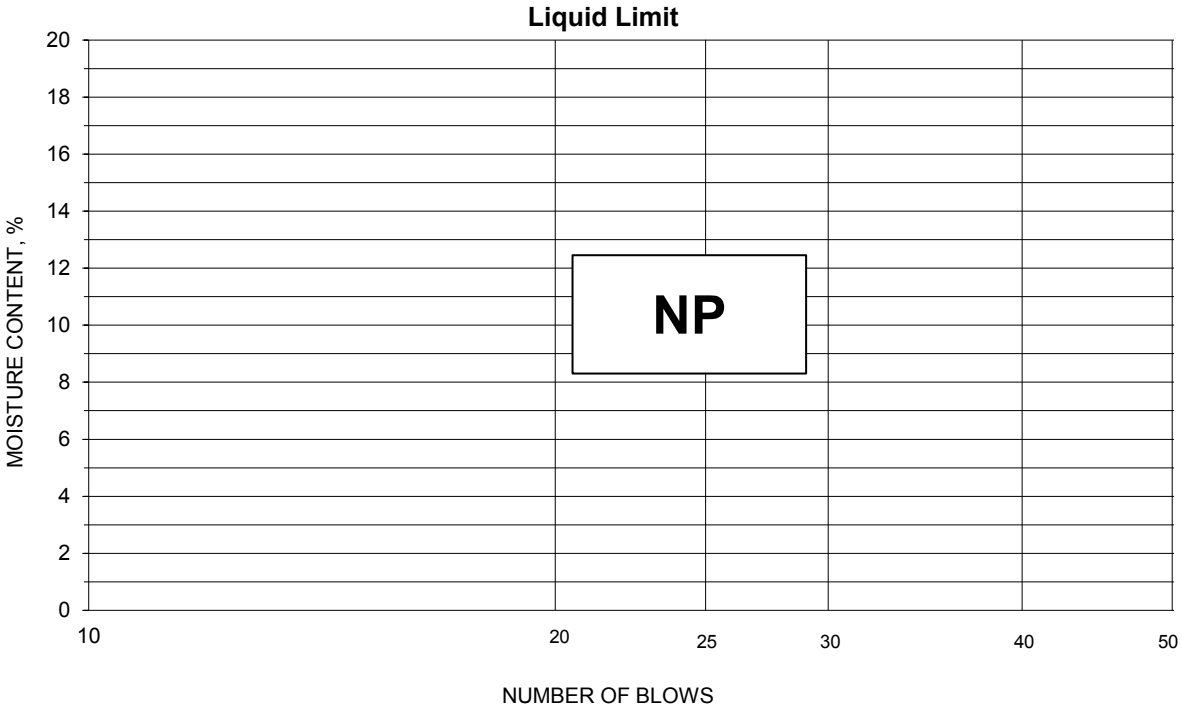
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.14A, 12.5'-14.0'			Lab ID	83
				% + No. 40	68
Tested By	MF	Test Method	ASTM D 4318 Method A	Date Received	09-05-2019
Test Date	09-10-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.14A, 12.5'-14.0'	Lab ID	83

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-06-2019
Date Received	09-05-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	97.8
No. 10	90.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

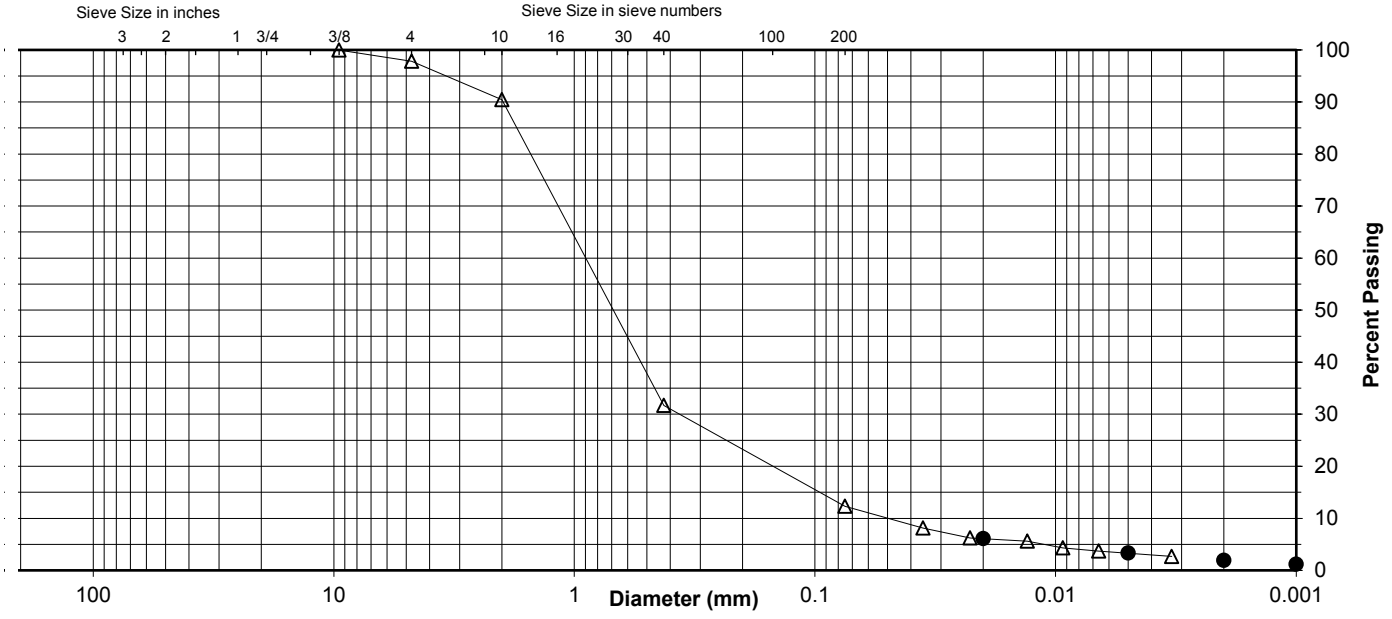
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	31.7
No. 200	12.3
0.02 mm	6.1
0.005 mm	3.3
0.002 mm	1.9
0.001 mm	1.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.2	7.3	58.8	19.4	9.0	3.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	9.5			58.8	19.4	10.4	1.9



Comments

Reviewed By

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.14A, 17.5'-19.0', 20.0'-21.2'	Lab ID	85
Sample Type	SPT Composite	Date Received	9-5-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): 12.2

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	92.9
No. 10	2	85.1
No. 40	0.425	71.5
No. 200	0.075	53.8
	0.02	42.6
	0.005	23.4
	0.002	13.5
estimated	0.001	6.5

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	7.1	14.9
Coarse Sand	7.8	13.6
Medium Sand	13.6	---
Fine Sand	17.7	17.7
Silt	30.4	40.3
Clay	23.4	13.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	21
Plastic Limit:	13
Plasticity Index:	8
Activity Index:	0.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: CL

Group Name: Sandy lean clay

AASHTO Classification: A-4 (1)

Comments:

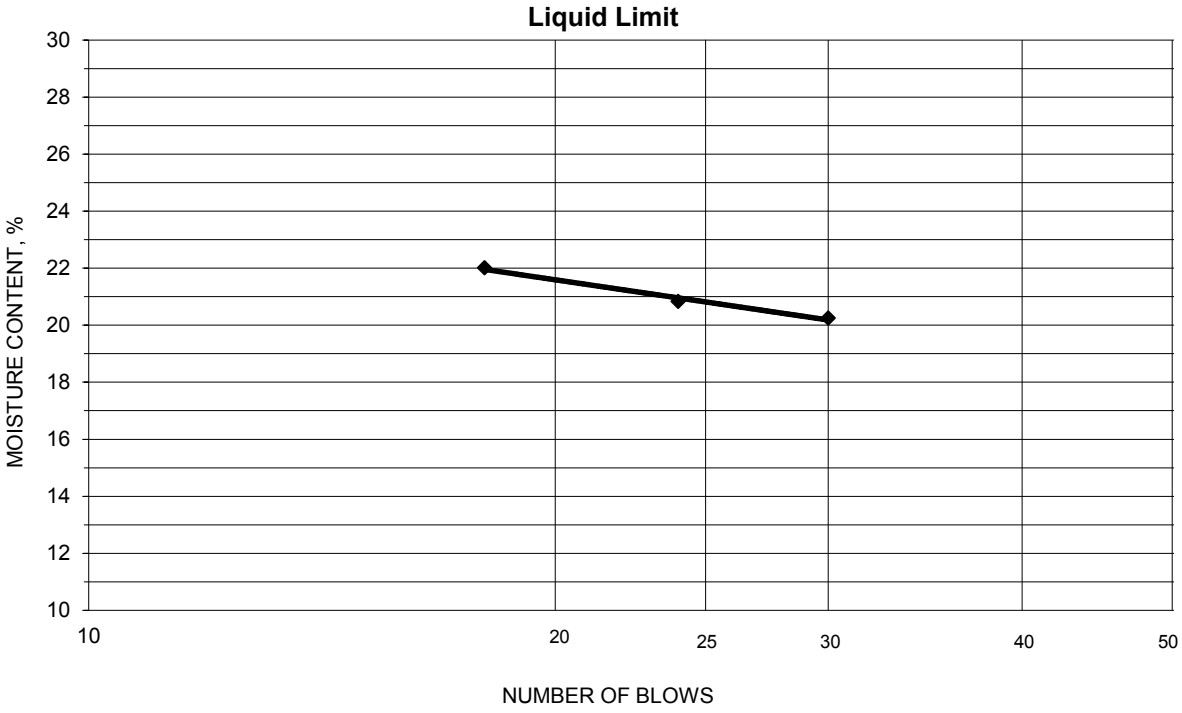
Reviewed By

Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.14A, 17.5'-19.0', 20.0'-21.2'			Lab ID	85
				% + No. 40	28
Tested By	JP	Test Method	ASTM D 4318 Method A	Date Received	09-05-2019
Test Date	09-12-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
25.39	22.96	10.96	30	20.3	
26.02	23.44	11.06	24	20.8	
25.70	23.05	11.01	18	22.0	21



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
19.58	18.53	10.47	13.0	13	8
20.54	19.43	11.04	13.2		

Remarks: _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.14A, 17.5'-19.0', 20.0'-21.2'	Lab ID	85

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-11-2019
Date Received	09-05-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	92.9
No. 10	85.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

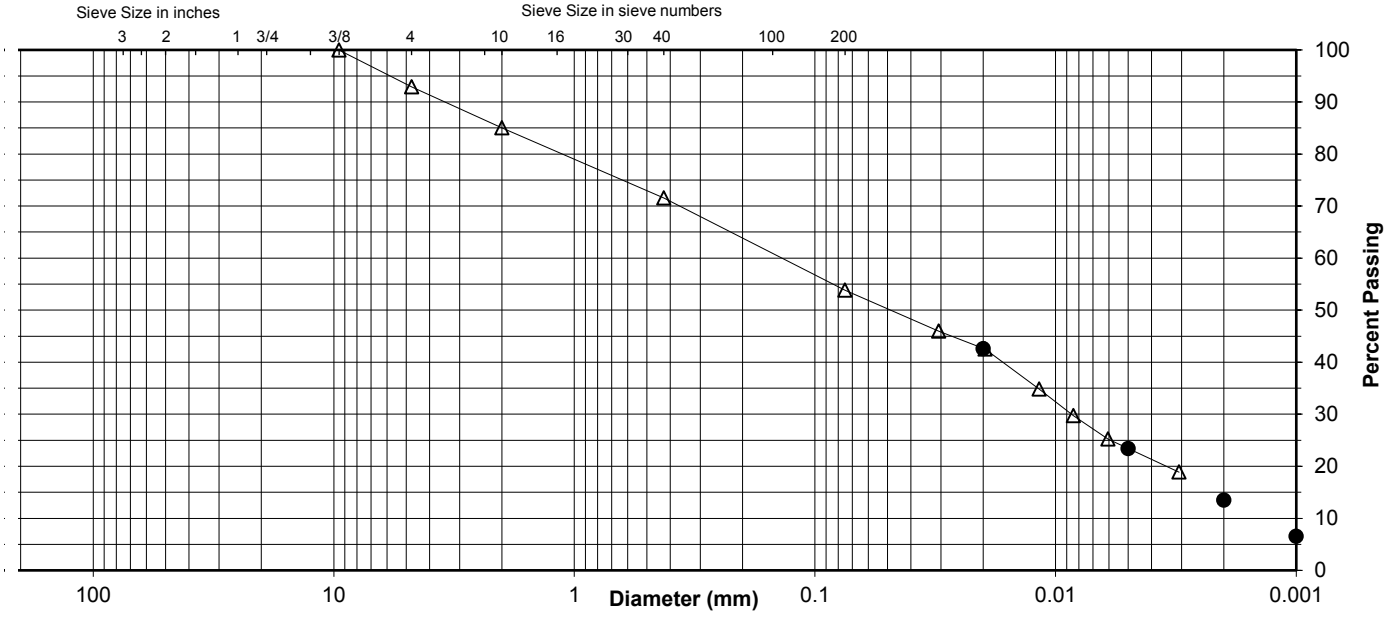
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	71.5
No. 200	53.8
0.02 mm	42.6
0.005 mm	23.4
0.002 mm	13.5
0.001 mm	6.5

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	7.1	7.8	13.6	17.7	30.4	23.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	14.9			13.6	17.7	40.3	13.5



Comments

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.15A, 12.5'-14.0'	Lab ID	95
Sample Type	SPT	Date Received	9-5-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 12.4

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	89.3
No. 4	4.75	77.6
No. 10	2	56.1
No. 40	0.425	22.3
No. 200	0.075	12.7
	0.02	7.0
	0.005	3.4
	0.002	1.6
estimated	0.001	0.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	22.4	43.9
Coarse Sand	21.5	33.8
Medium Sand	33.8	---
Fine Sand	9.6	9.6
Silt	9.3	11.1
Clay	3.4	1.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand with gravel

AASHTO Classification: A-1-b (0)

Comments:

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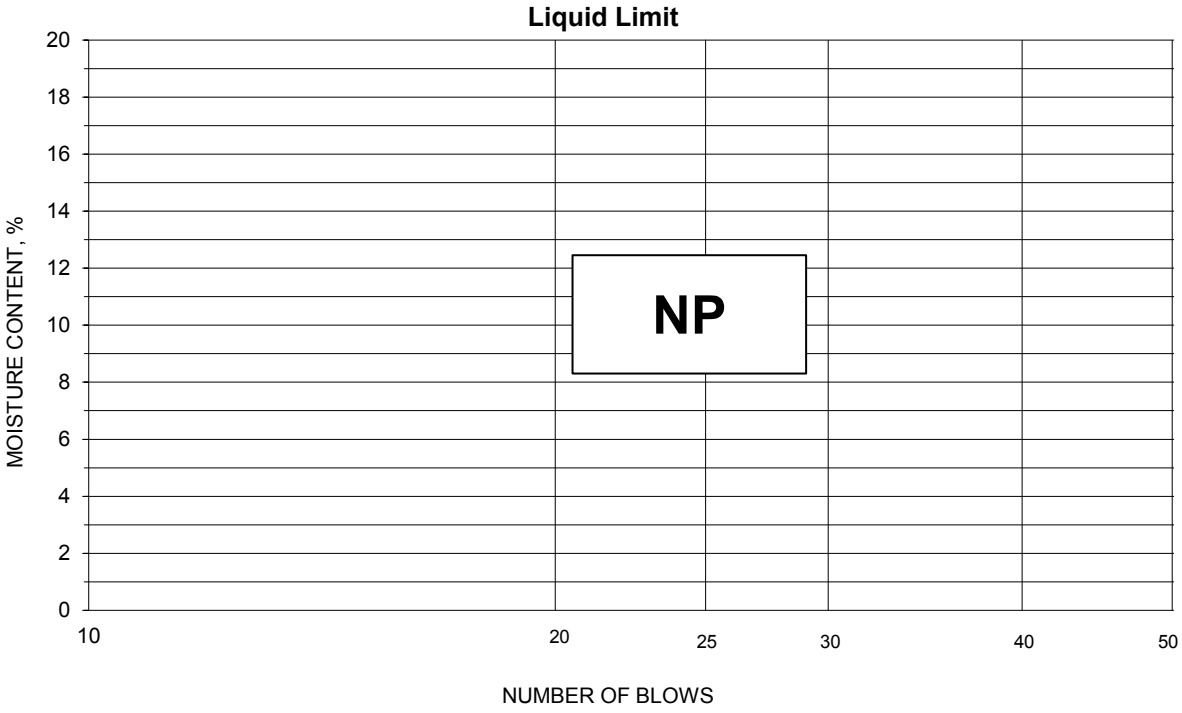
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.15A, 12.5'-14.0'			Lab ID	95
				% + No. 40	78
Tested By	MF	Test Method	ASTM D 4318 Method A	Date Received	09-05-2019
Test Date	09-10-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.15A, 12.5'-14.0'	Lab ID	95

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	9/
Date Received	09-05-2019

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	89.3
No. 4	77.6
No. 10	56.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

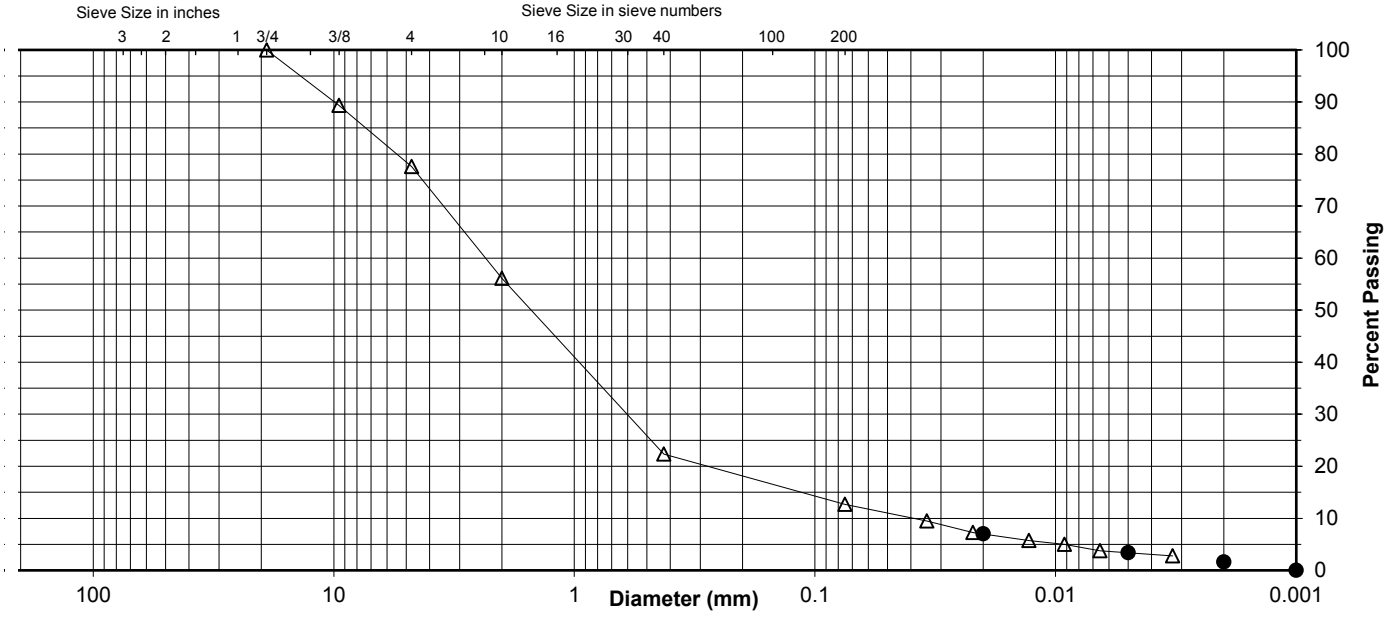
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	22.3
No. 200	12.7
0.02 mm	7.0
0.005 mm	3.4
0.002 mm	1.6
0.001 mm	0.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	22.4	21.5	33.8	9.6	9.3	3.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	43.9			33.8	9.6	11.1	1.6



Comments

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.16A, 10.0'-11.5'	Lab ID	103
Sample Type	SPT	Date Received	9-5-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.8

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	67.7
No. 4	4.75	52.8
No. 10	2	36.3
No. 40	0.425	22.9
No. 200	0.075	14.9
	0.02	8.1
	0.005	3.7
	0.002	1.6
estimated	0.001	0.7

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	47.2	63.7
Coarse Sand	16.5	13.4
Medium Sand	13.4	---
Fine Sand	8.0	8.0
Silt	11.2	13.3
Clay	3.7	1.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	22
Plastic Limit:	16
Plasticity Index:	6
Activity Index:	3.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: GC-GM

Group Name: Silty, clayey gravel with sand

AASHTO Classification: A-1-a (0)

Comments:

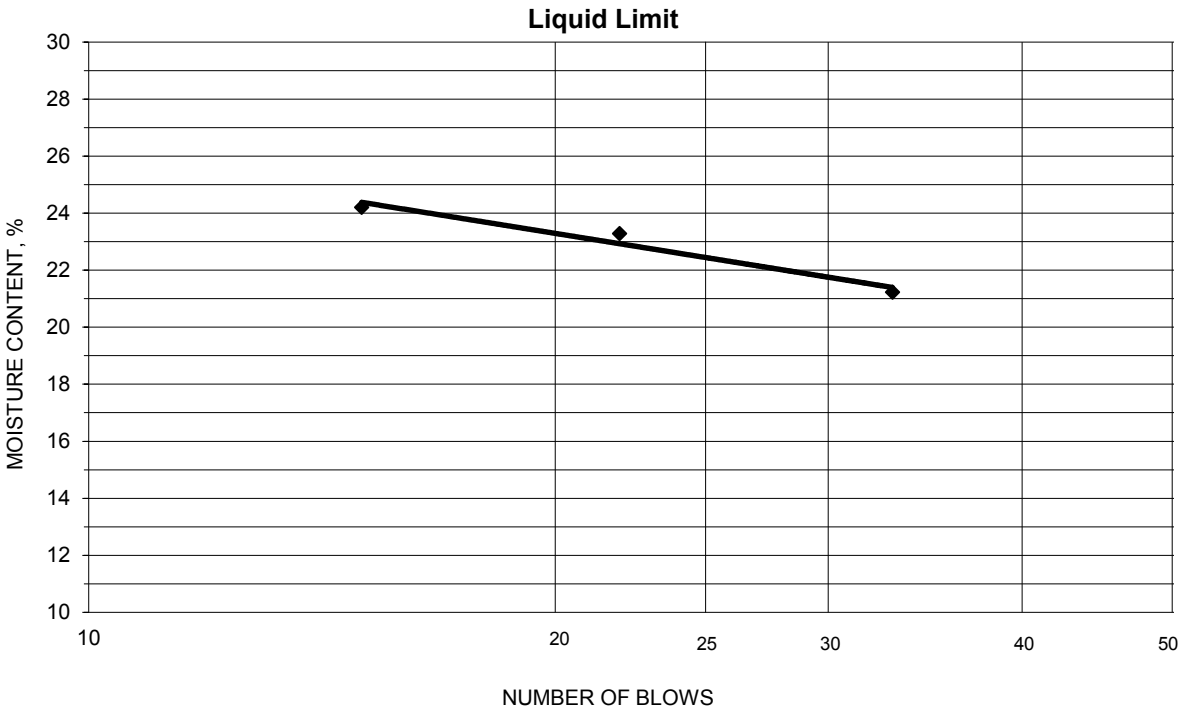
Reviewed By JES

Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.16A, 10.0'-11.5'			Lab ID	103
				% + No. 40	77
Tested By	JP	Test Method	ASTM D 4318 Method A	Date Received	09-05-2019
Test Date	09-12-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
28.33	25.31	11.08	33	21.2	
26.06	23.15	10.65	22	23.3	
26.62	23.52	10.71	15	24.2	22



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
19.81	18.57	11.07	16.5	16	6
20.07	18.80	10.93	16.1		

Remarks: _____

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Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.16A, 10.0'-11.5'	Lab ID	103

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-06-2019
Date Received	09-05-2019

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	67.7
No. 4	52.8
No. 10	36.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

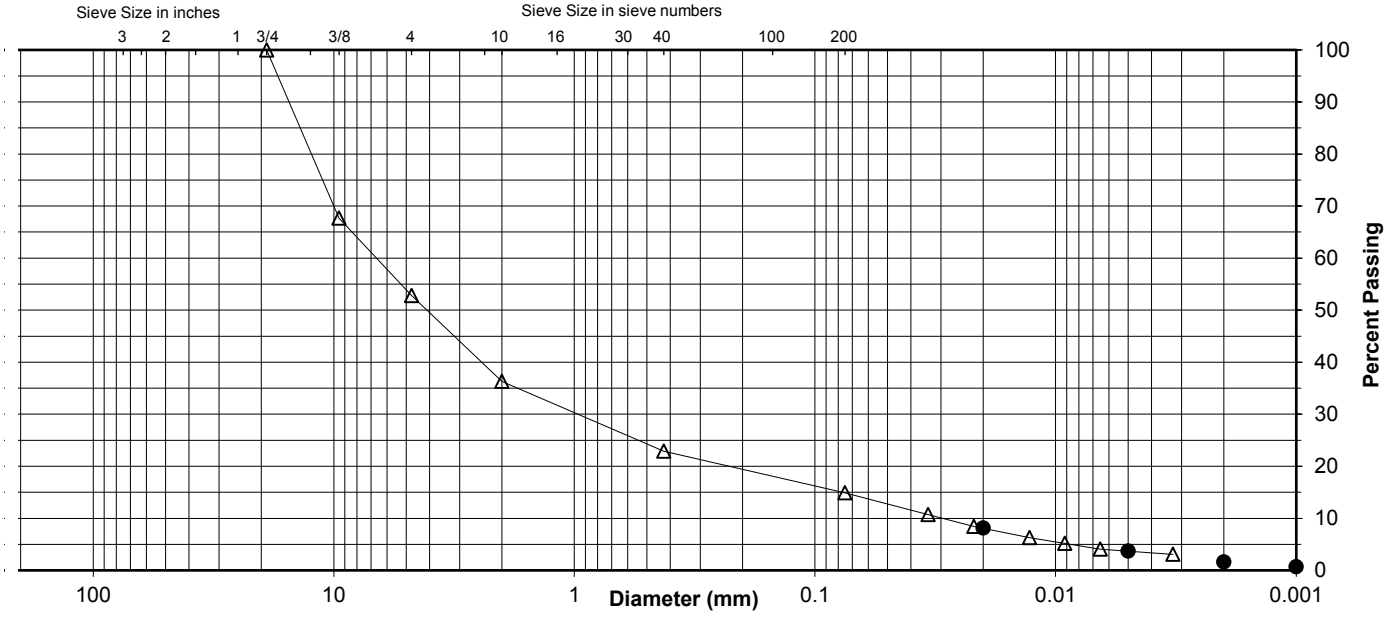
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	22.9
No. 200	14.9
0.02 mm	8.1
0.005 mm	3.7
0.002 mm	1.6
0.001 mm	0.7

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	47.2	16.5	13.4	8.0	11.2	3.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	63.7			13.4	8.0	13.3	1.6



Comments

Reviewed By JES

Stantec

Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.2, 1.5'-3.0', 3.0'-4.0'	Lab ID	106
Sample Type	SPT Composite	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): 21.0

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	94.5
No. 40	0.425	87.2
No. 200	0.075	62.4
	0.02	51.9
	0.005	34.1
	0.002	23.7
estimated	0.001	16.3

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	5.5
Coarse Sand	5.5	7.3
Medium Sand	7.3	---
Fine Sand	24.8	24.8
Silt	28.3	38.7
Clay	34.1	23.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	36
Plastic Limit:	20
Plasticity Index:	16
Activity Index:	0.7

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL
Group Name:	Sandy lean clay
AASHTO Classification:	A-6 (8)

Comments:

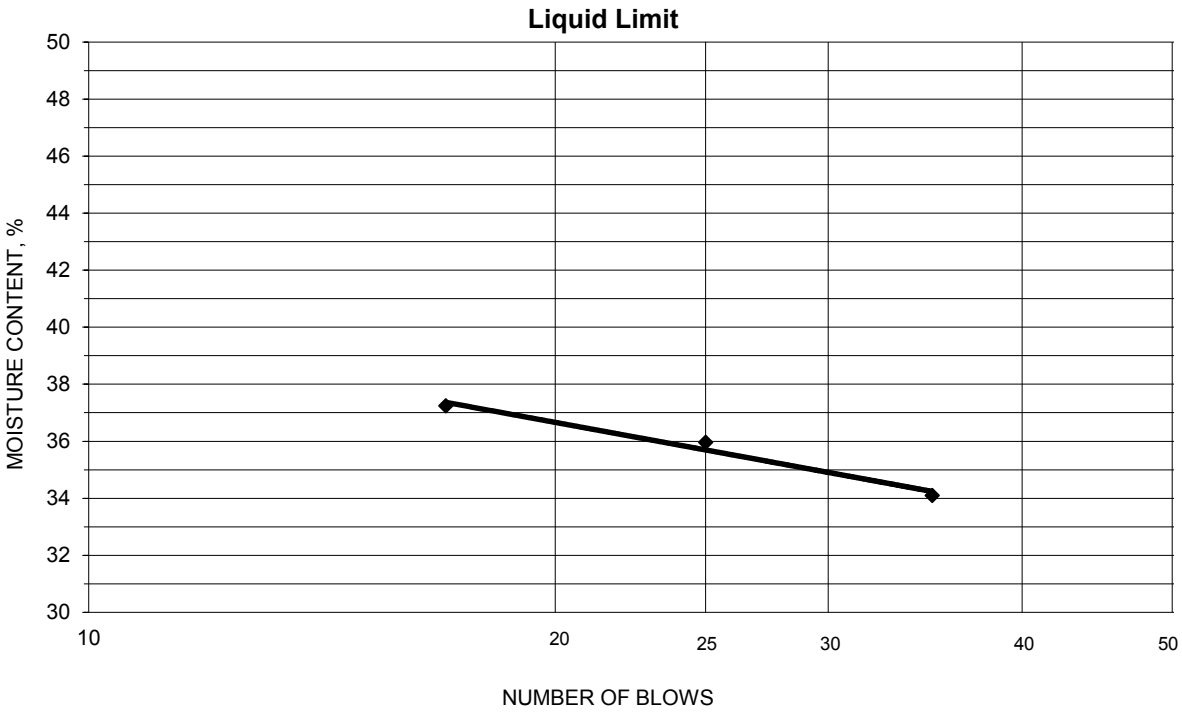
Reviewed By JES

Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-1.2, 1.5'-3.0', 3.0'-4.0'			Lab ID	106
				% + No. 40	13
Tested By	MP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-17-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.86	19.75	10.63	35	34.1	
24.64	21.03	10.99	25	36.0	
22.39	19.31	11.04	17	37.2	36



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.98	19.32	11.02	20.0	20	16
21.05	19.40	11.08	19.8		

Remarks: _____

Reviewed By JRS

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Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.2, 1.5'-3.0', 3.0'-4.0'	Lab ID	106

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	94.5

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: MP
Test Date: 09-12-2019
Date Received: 09-11-2019

Maximum Particle size: No. 4 Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

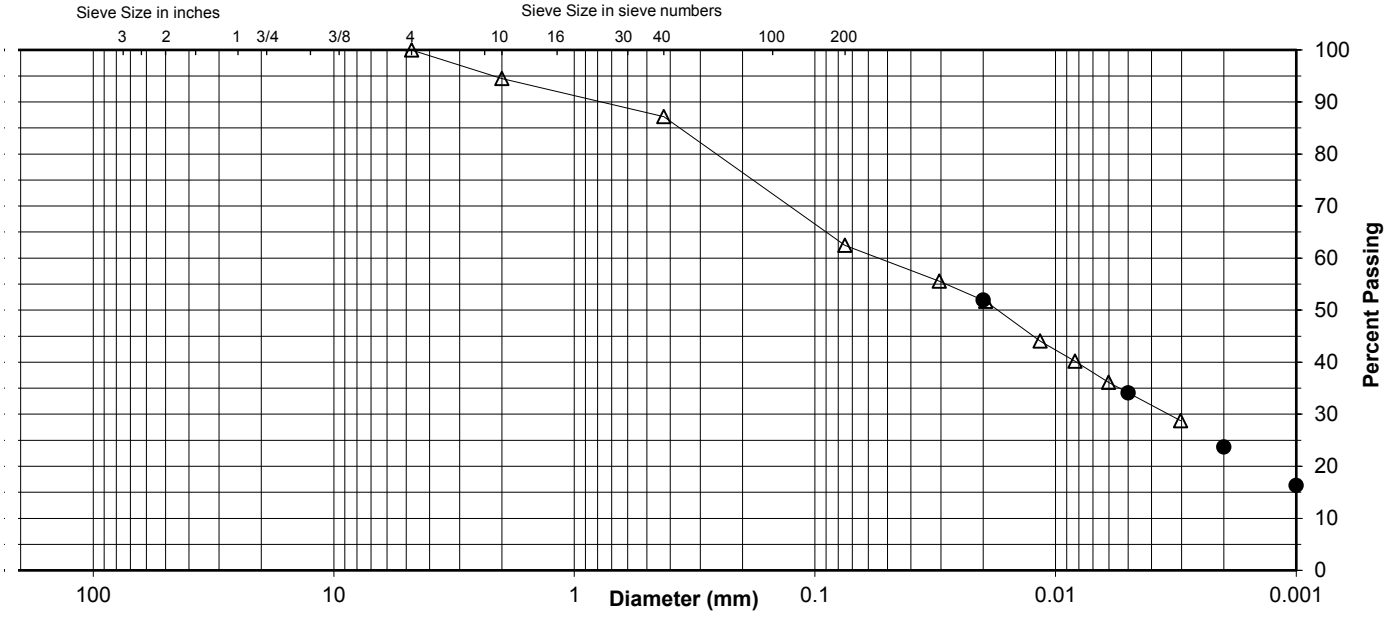
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	87.2
No. 200	62.4
0.02 mm	51.9
0.005 mm	34.1
0.002 mm	23.7
0.001 mm	16.3

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	5.5	7.3	24.8	28.3	34.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	5.5			7.3	24.8	38.7	23.7



Comments

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Stantec

Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.2, 5.0'-6.5'	Lab ID	110
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 9.1

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	83.7
No. 4	4.75	64.4
No. 10	2	50.4
No. 40	0.425	31.6
No. 200	0.075	18.4
	0.02	12.1
	0.005	5.2
	0.002	2.6
estimated	0.001	1.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	35.6	49.6
Coarse Sand	14.0	18.8
Medium Sand	18.8	---
Fine Sand	13.2	13.2
Silt	13.2	15.8
Clay	5.2	2.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	24
Plastic Limit:	16
Plasticity Index:	8
Activity Index:	3.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SC

Group Name: Clayey sand with gravel

AASHTO Classification: A-2-4 (0)

Comments:

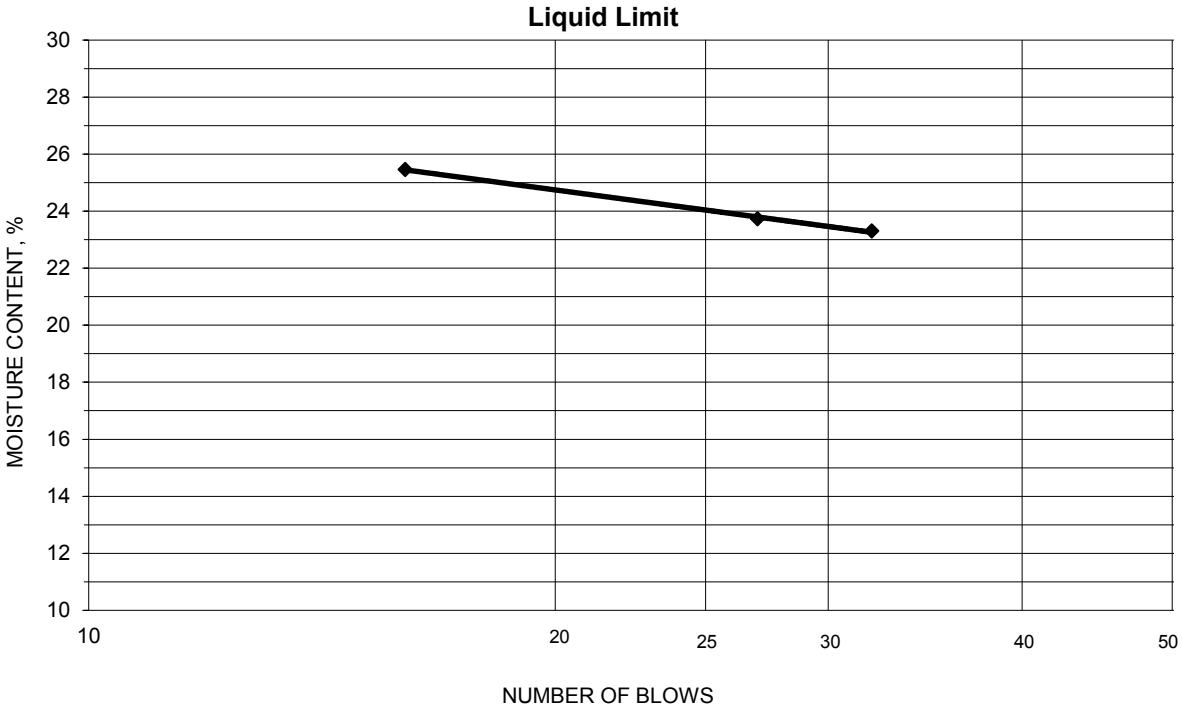
Reviewed By

Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-1.2, 5.0'-6.5'			Lab ID	110
				% + No. 40	68
Tested By	JP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-18-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
23.30	20.96	10.92	32	23.3	
24.98	22.31	11.06	27	23.7	
24.49	21.75	10.99	16	25.5	24



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.65	17.51	10.66	16.6	16	8
18.95	17.87	11.00	15.7		

Remarks: _____

Reviewed By JES

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Version: 20170217
Approved By: RJ

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.2, 5.0'-6.5'	Lab ID	110

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	JP
Test Date	09-12-2019
Date Received	09-11-2019

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	83.7
No. 4	64.4
No. 10	50.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

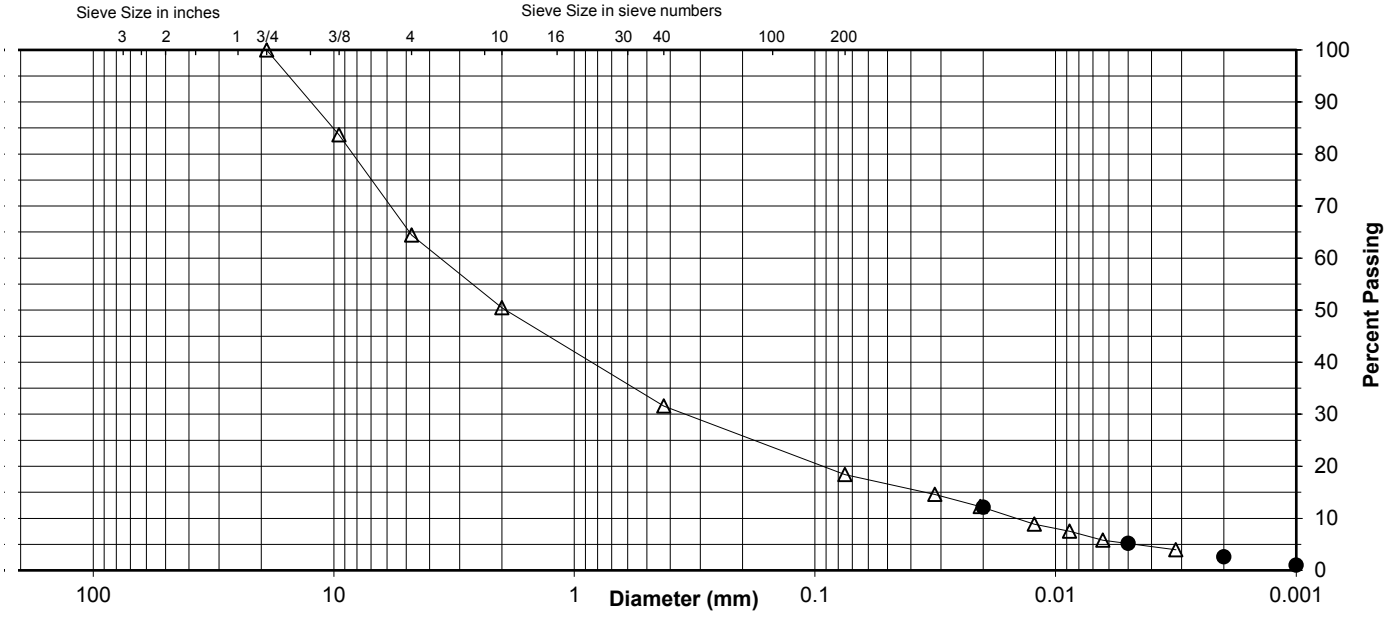
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	31.6
No. 200	18.4
0.02 mm	12.1
0.005 mm	5.2
0.002 mm	2.6
0.001 mm	1.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	35.6	14.0	18.8	13.2	13.2	5.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	49.6			18.8	13.2	15.8	2.6



Comments

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Approved By: RJ

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.2, 12.5'-14.0'	Lab ID	113
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 12.6

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	86.3
No. 10	2	71.2
No. 40	0.425	40.6
No. 200	0.075	11.9
	0.02	7.7
	0.005	4.0
	0.002	1.7
estimated	0.001	1.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	13.7	28.8
Coarse Sand	15.1	30.6
Medium Sand	30.6	---
Fine Sand	28.7	28.7
Silt	7.9	10.2
Clay	4.0	1.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SW-SM

Group Name: Well-graded sand with silt

AASHTO Classification: A-1-b (0)

Comments:

Reviewed By JES

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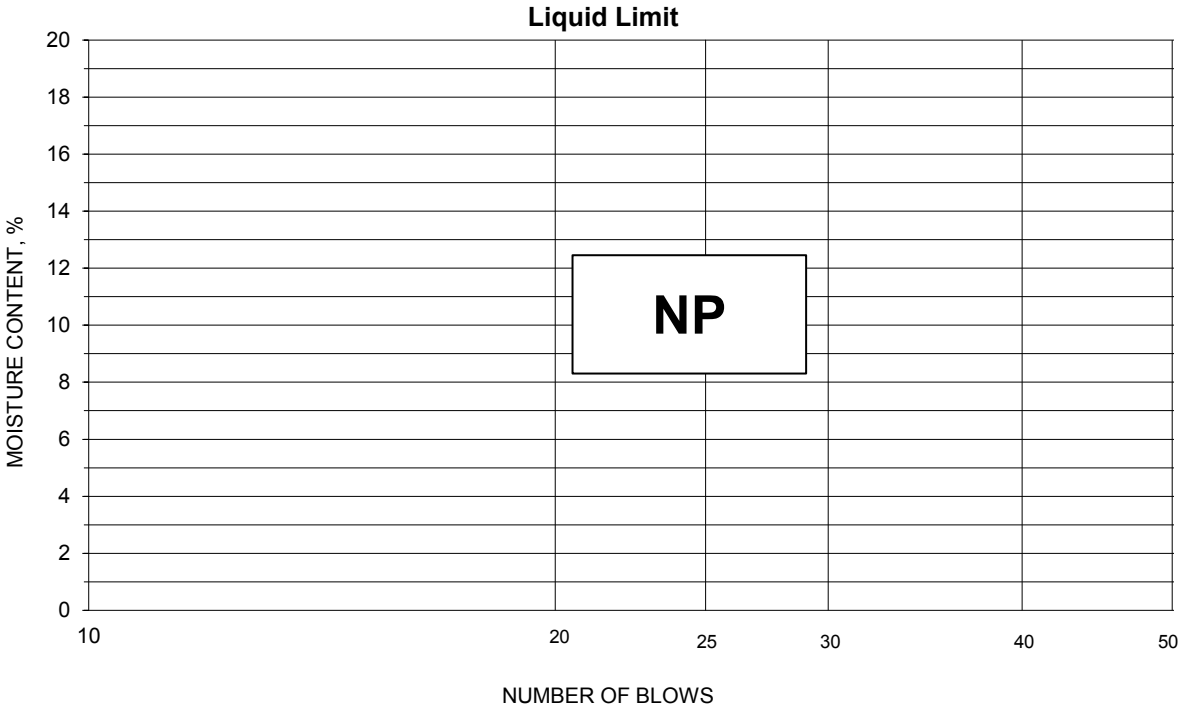
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-1.2, 12.5'-14.0'			Lab ID	113
				% + No. 40	59
Tested By	JP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-18-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.2, 12.5'-14.0'	Lab ID	113

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-12-2019
Date Received	09-11-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	86.3
No. 10	71.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

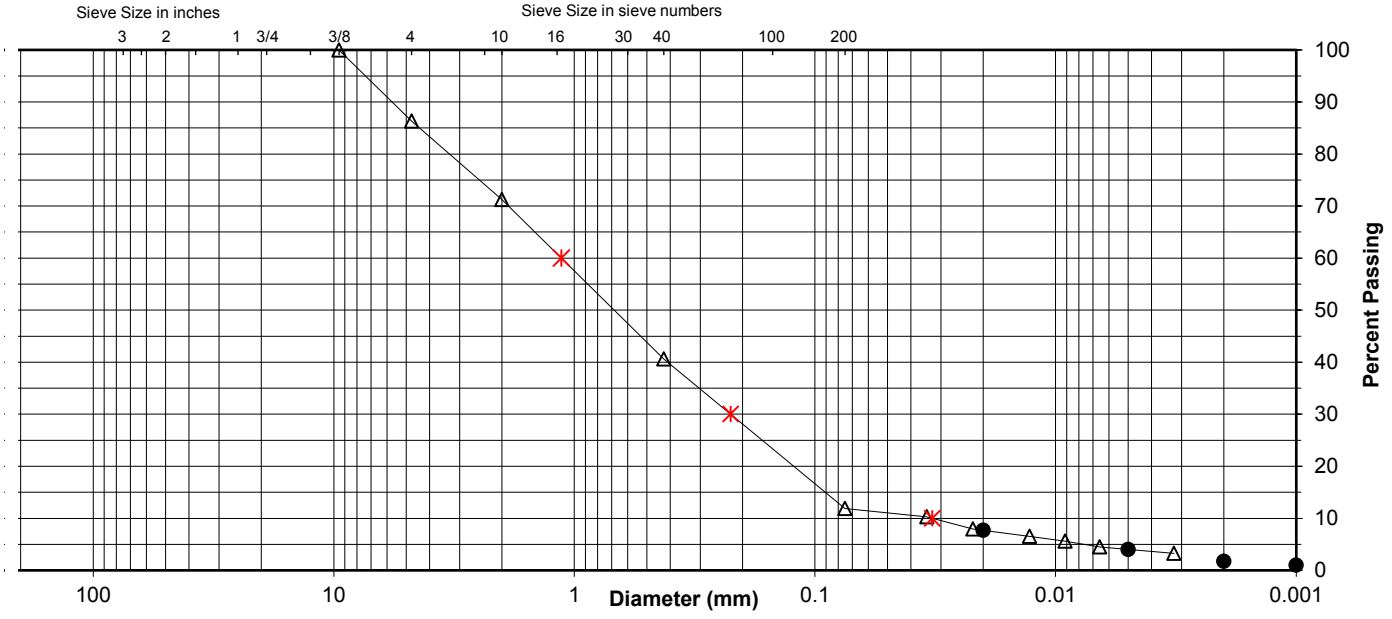
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	40.6
No. 200	11.9
0.02 mm	7.7
0.005 mm	4.0
0.002 mm	1.7
0.001 mm	1.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	13.7	15.1	30.6	28.7	7.9	4.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	28.8			30.6	28.7	10.2	1.7



Comments

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.3, 12.5'-14.0'	Lab ID	123
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 21.8

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	98.7
No. 200	0.075	96.0
	0.02	90.5
	0.005	66.6
	0.002	44.5
estimated	0.001	27.1

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.3
Medium Sand	1.3	---
Fine Sand	2.7	2.7
Silt	29.4	51.5
Clay	66.6	44.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	36
Plastic Limit:	22
Plasticity Index:	14
Activity Index:	0.3

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL
Group Name:	Lean clay
AASHTO Classification:	A-6 (14)

Comments:

Reviewed By JES

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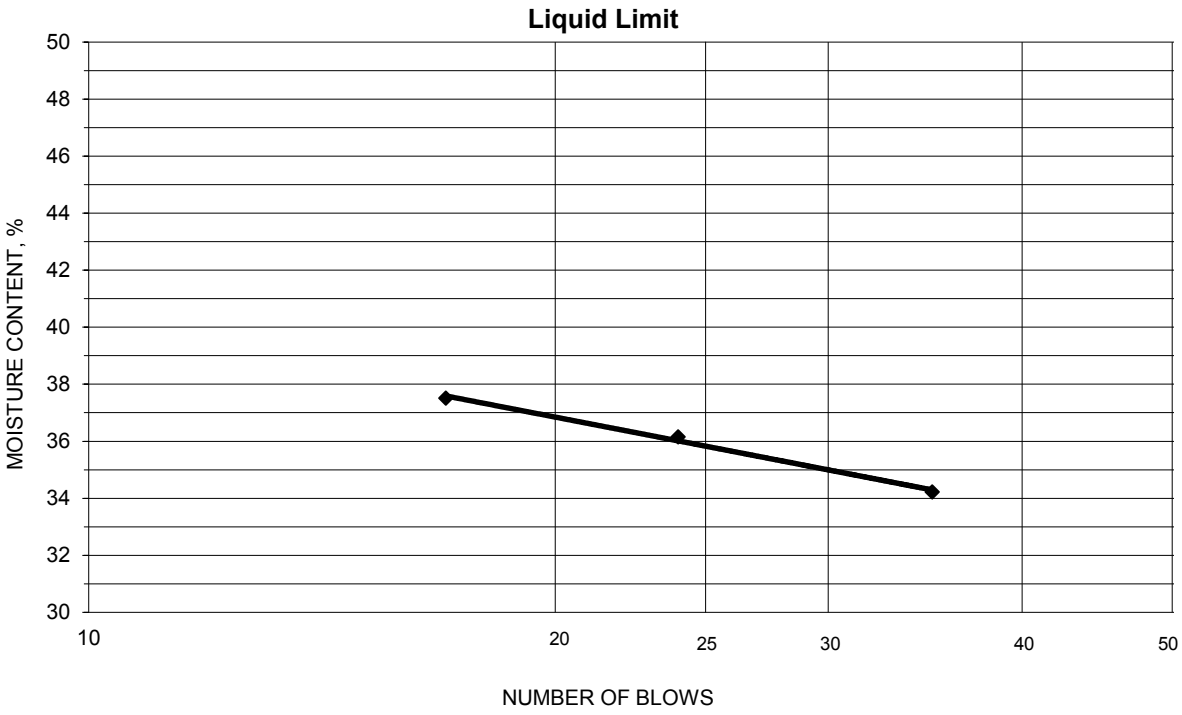
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-1.3, 12.5'-14.0'			Lab ID	123
				% + No. 40	1
Tested By	MP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-16-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
23.07	20.00	11.03	35	34.2	
23.58	20.25	11.04	24	36.2	
22.54	19.40	11.03	17	37.5	36



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.26	18.53	10.57	21.7	22	14
19.69	18.15	11.07	21.8		

Remarks: _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.3, 12.5'-14.0'	Lab ID	123

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	MP
Test Date	09-12-2019
Date Received	09-11-2019

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity 2.7

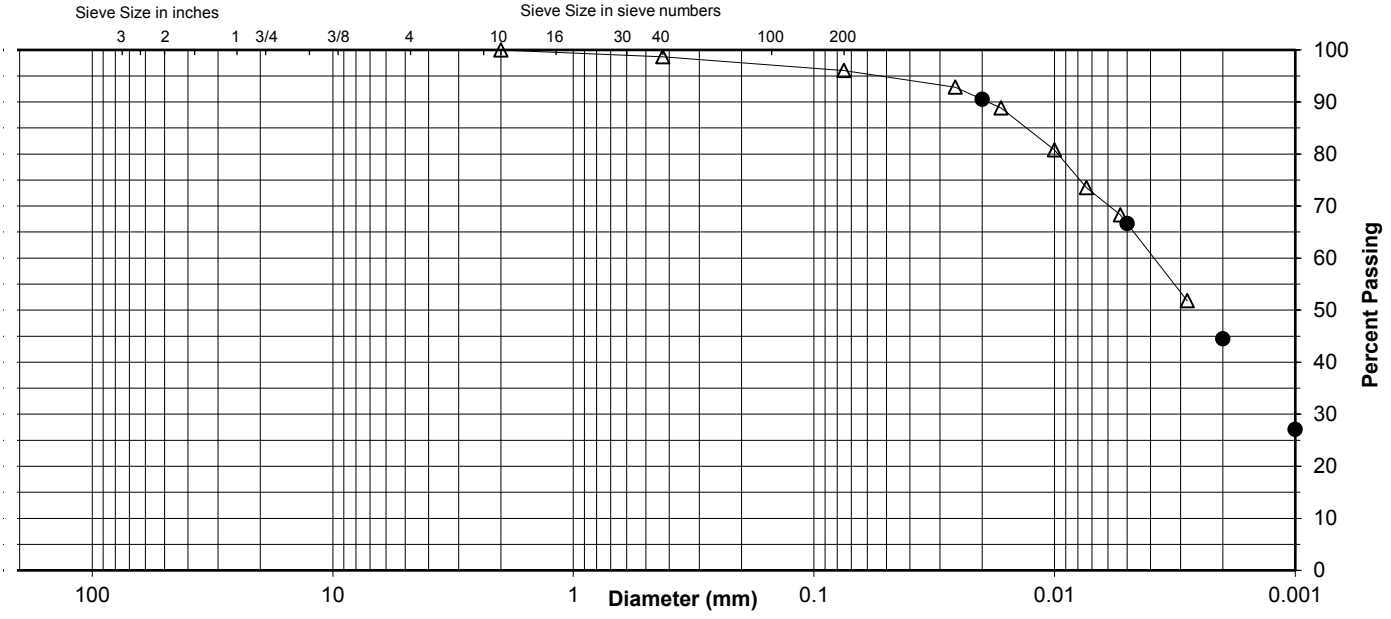
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	98.7
No. 200	96.0
0.02 mm	90.5
0.005 mm	66.6
0.002 mm	44.5
0.001 mm	27.1

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	1.3	2.7	29.4	66.6

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	1.3	2.7	51.5	44.5



Comments

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.10, 5.0'-6.5'	Lab ID	130
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 14.5

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	97.0
No. 10	2	93.3
No. 40	0.425	85.6
No. 200	0.075	69.5
	0.02	59.0
	0.005	37.6
	0.002	25.1
estimated	0.001	14.9

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	3.0	6.7
Coarse Sand	3.7	7.7
Medium Sand	7.7	---
Fine Sand	16.1	16.1
Silt	31.9	44.4
Clay	37.6	25.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	28
Plastic Limit:	17
Plasticity Index:	11
Activity Index:	0.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL
Group Name:	Sandy lean clay
AASHTO Classification:	A-6 (5)

Comments:

Reviewed By JES

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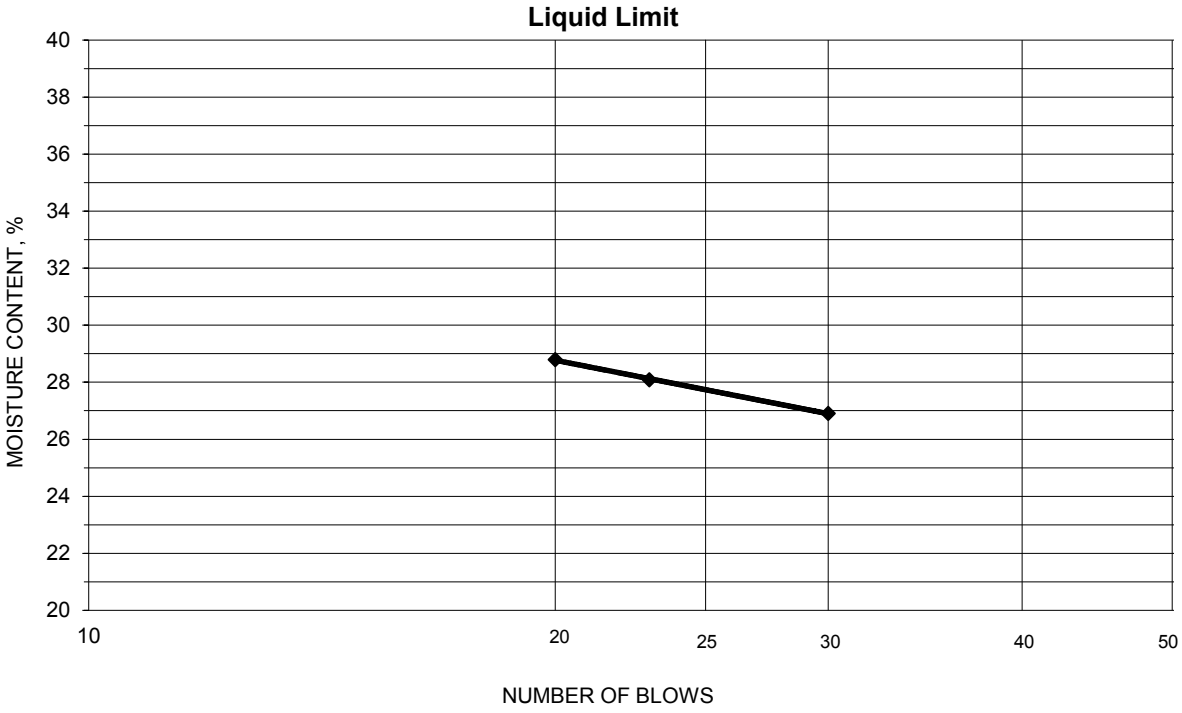
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.10, 5.0'-6.5'			Lab ID	130
				% + No. 40	14
Tested By	JP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-16-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
26.16	22.95	11.02	30	26.9	
24.69	21.62	10.69	23	28.1	
25.07	21.94	11.07	20	28.8	28



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.45	17.37	11.04	17.1	17	11
17.78	16.80	11.05	17.0		

Remarks: _____

Reviewed By _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.10, 5.0'-6.5'	Lab ID	130

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	JP
Test Date	09-12-2019
Date Received	09-11-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	97.0
No. 10	93.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

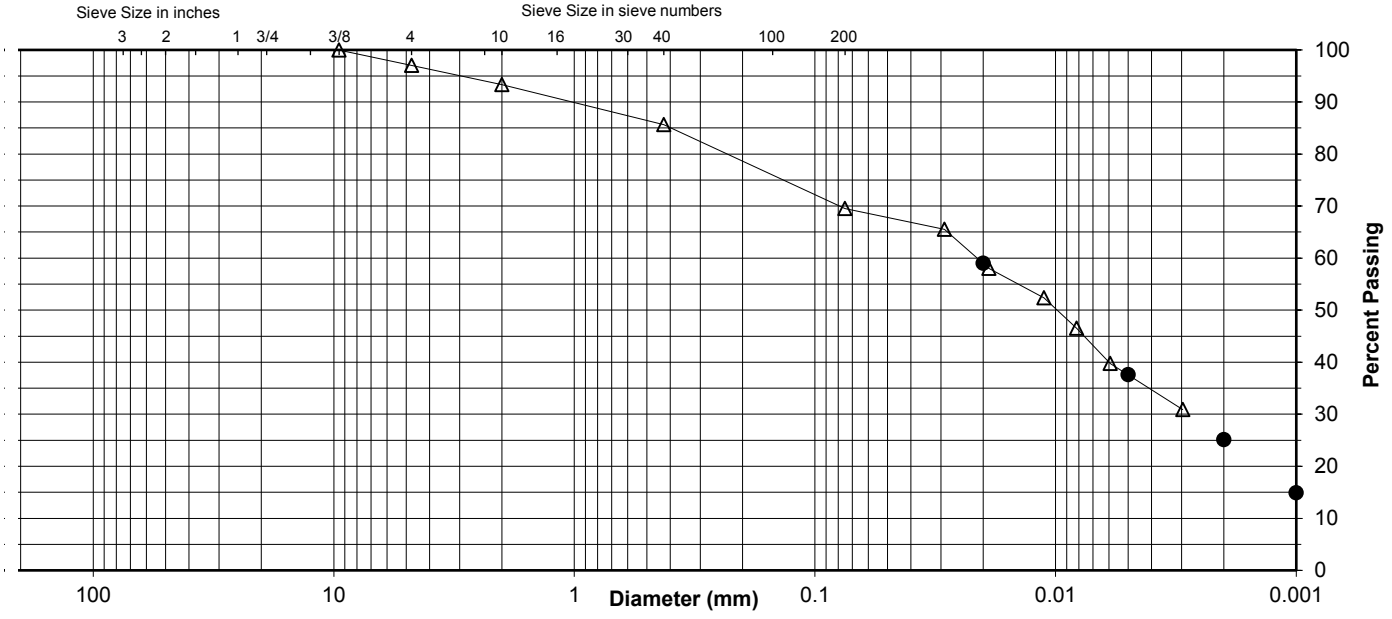
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	85.6
No. 200	69.5
0.02 mm	59.0
0.005 mm	37.6
0.002 mm	25.1
0.001 mm	14.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	3.0	3.7	7.7	16.1	31.9	37.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	6.7			7.7	16.1	44.4	25.1



Comments

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.10, 12.5'-14.0'	Lab ID	133
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 15.6

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	94.7
No. 10	2	86.5
No. 40	0.425	78.5
No. 200	0.075	62.0
	0.02	46.8
	0.005	28.5
	0.002	18.1
estimated	0.001	10.1

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	5.3	13.5
Coarse Sand	8.2	8.0
Medium Sand	8.0	---
Fine Sand	16.5	16.5
Silt	33.5	43.9
Clay	28.5	18.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	24
Plastic Limit:	15
Plasticity Index:	9
Activity Index:	0.5

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: CL

Group Name: Sandy lean clay

AASHTO Classification: A-4 (3)

Comments:

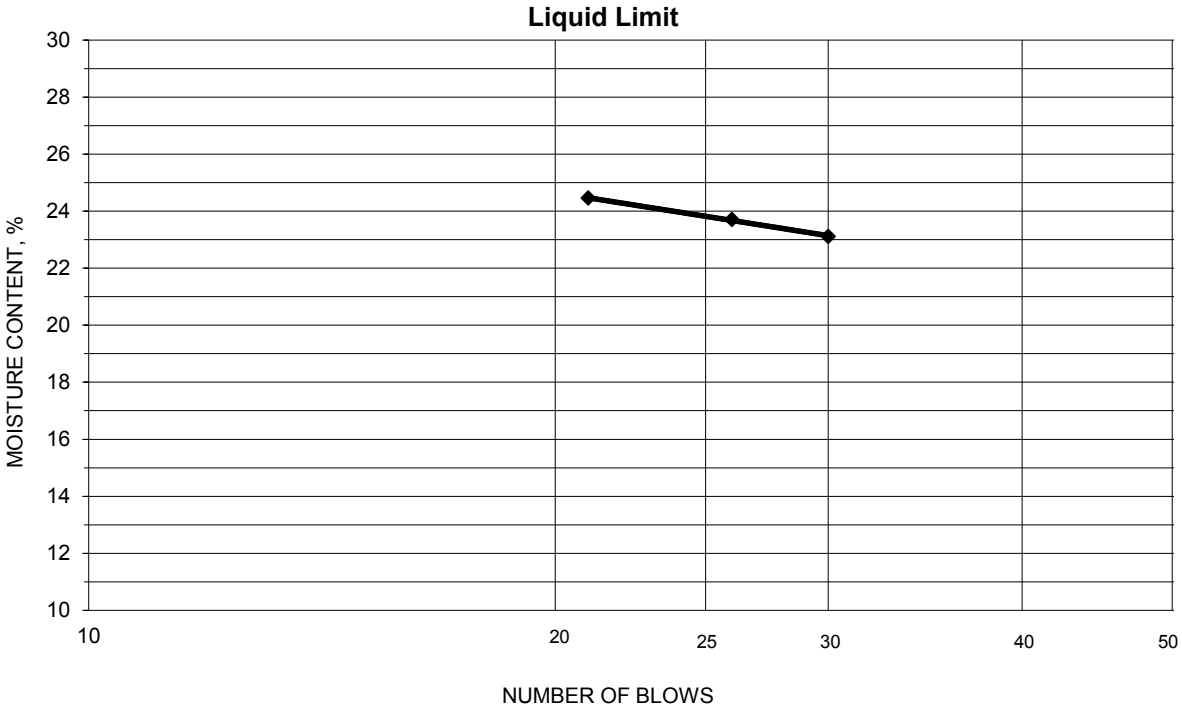
Reviewed By JES

Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.10, 12.5'-14.0'			Lab ID	133
				% + No. 40	22
Tested By	JP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-16-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
24.70	22.12	10.96	30	23.1	
24.97	22.31	11.09	26	23.7	
25.22	22.41	10.92	21	24.5	24



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.95	16.97	10.48	15.1	15	9
21.34	20.00	11.01	14.9		

Remarks: _____

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Particle-Size Analysis of Soils

ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.10, 12.5'-14.0'	Lab ID	133

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-12-2019
Date Received	09-11-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	94.7
No. 10	86.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

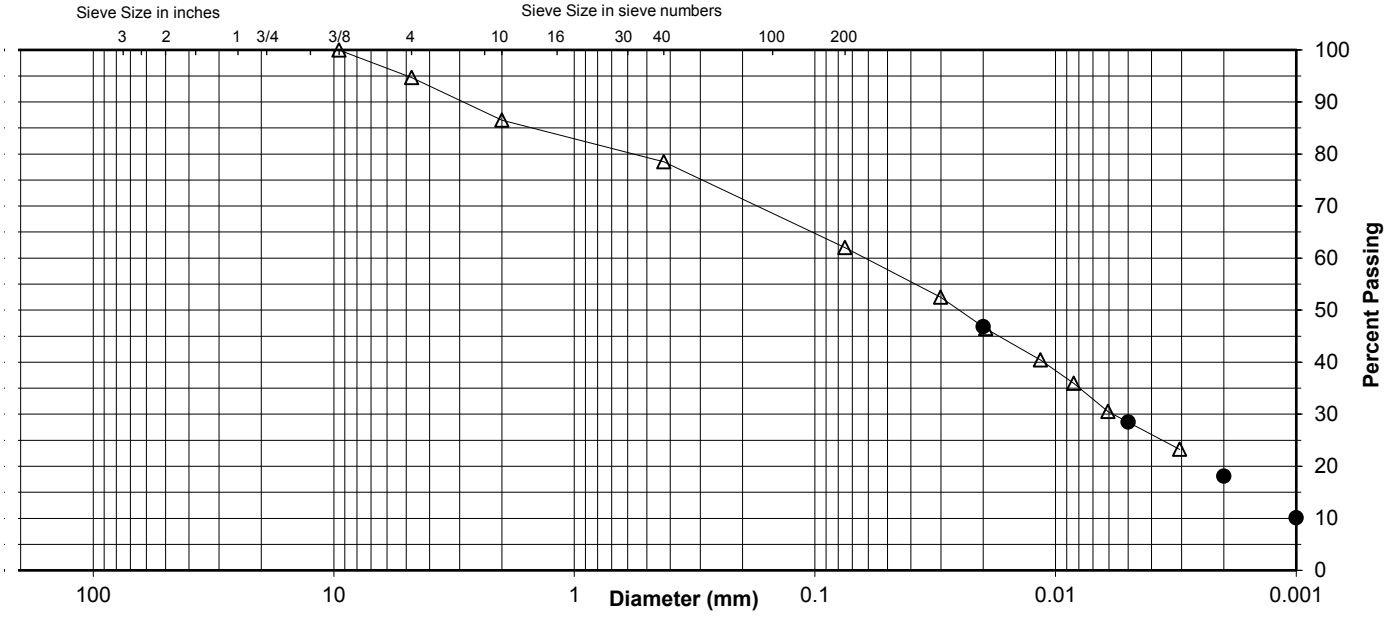
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	78.5
No. 200	62.0
0.02 mm	46.8
0.005 mm	28.5
0.002 mm	18.1
0.001 mm	10.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	5.3	8.2	8.0	16.5	33.5	28.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	13.5			8.0	16.5	43.9	18.1



Comments

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Approved By: RJ

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.11, 10.0'-11.5'	Lab ID	142
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 13.2

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	96.9
No. 10	2	90.1
No. 40	0.425	82.8
No. 200	0.075	67.3
	0.02	51.5
	0.005	32.1
	0.002	20.9
estimated	0.001	10.7

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	3.1	9.9
Coarse Sand	6.8	7.3
Medium Sand	7.3	---
Fine Sand	15.5	15.5
Silt	35.2	46.4
Clay	32.1	20.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	24
Plastic Limit:	15
Plasticity Index:	9
Activity Index:	0.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL
Group Name:	Sandy lean clay
AASHTO Classification:	A-4 (3)

Comments:

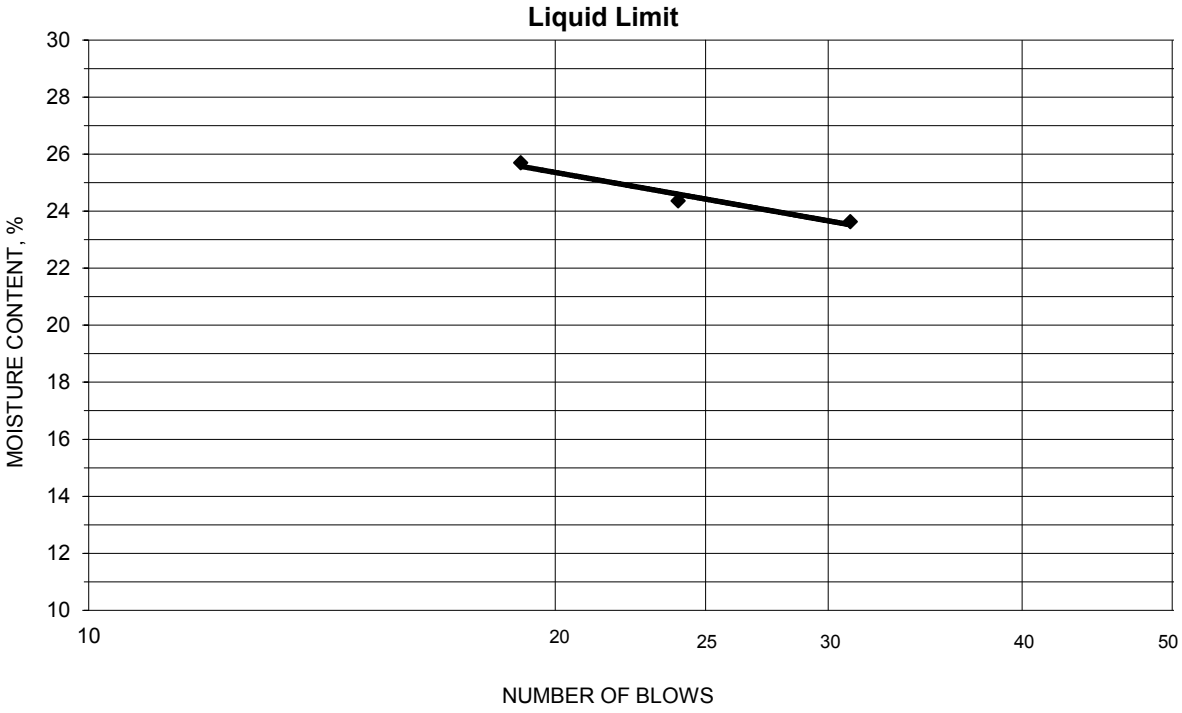
Reviewed By JES

Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.11, 10.0'-11.5'			Lab ID	142
				% + No. 40	17
Tested By	MP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-17-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
23.72	21.30	11.06	31	23.6	
24.27	21.68	11.05	24	24.4	
22.77	20.36	10.98	19	25.7	24



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.03	18.82	10.62	14.8	15	9
22.35	20.85	10.93	15.1		

Remarks: _____

Reviewed By _____

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Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.11, 10.0'-11.5'	Lab ID	142

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-12-2019
Date Received	09-11-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	96.9
No. 10	90.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

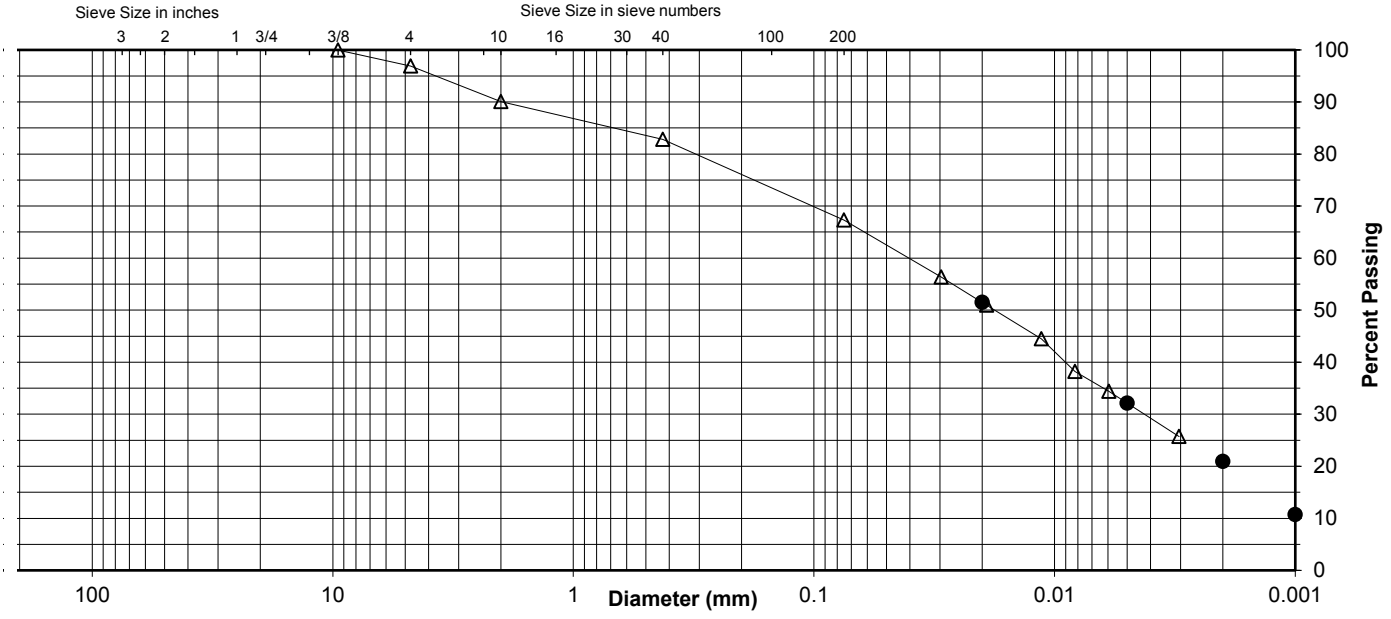
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	82.8
No. 200	67.3
0.02 mm	51.5
0.005 mm	32.1
0.002 mm	20.9
0.001 mm	10.7

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	3.1	6.8	7.3	15.5	35.2	32.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	9.9			7.3	15.5	46.4	20.9



Comments

Reviewed By

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.12a, 10.0'-11.5'	Lab ID	150
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 46.1

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	97.4
No. 10	2	94.4
No. 40	0.425	90.4
No. 200	0.075	69.8
	0.02	52.8
	0.005	31.5
	0.002	19.7
estimated	0.001	10.4

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	2.6	5.6
Coarse Sand	3.0	4.0
Medium Sand	4.0	---
Fine Sand	20.6	20.6
Silt	38.3	50.1
Clay	31.5	19.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	36
Plastic Limit:	23
Plasticity Index:	13
Activity Index:	0.7

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL
Group Name:	Sandy lean clay
AASHTO Classification:	A-6 (8)

Comments:

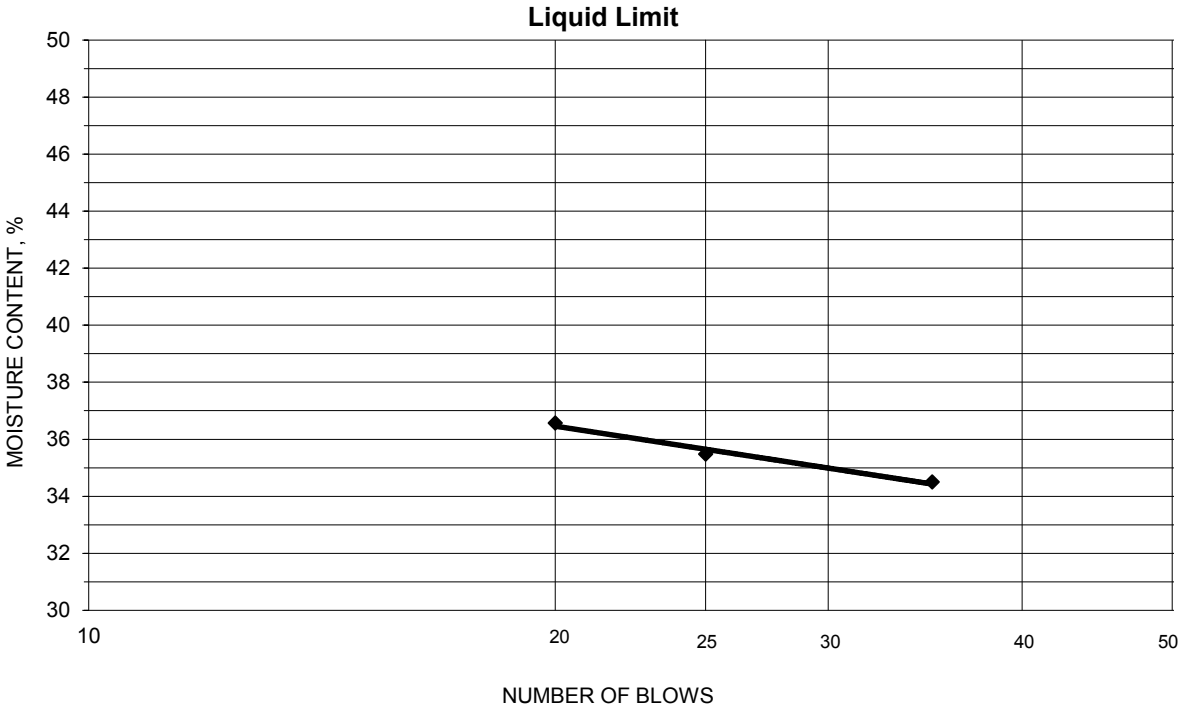
Reviewed By JES

Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.12a, 10.0'-11.5'			Lab ID	150
				% + No. 40	10
Tested By	MP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-13-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
25.14	21.49	10.91	35	34.5	
23.58	20.27	10.94	25	35.5	
23.61	20.10	10.50	20	36.6	36



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.72	19.73	11.05	22.9	23	13
19.20	17.68	11.01	22.8		

Remarks: _____

Reviewed By _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.12a, 10.0'-11.5'	Lab ID	150

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	MP
Test Date	09-12-2019
Date Received	09-11-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	97.4
No. 10	94.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

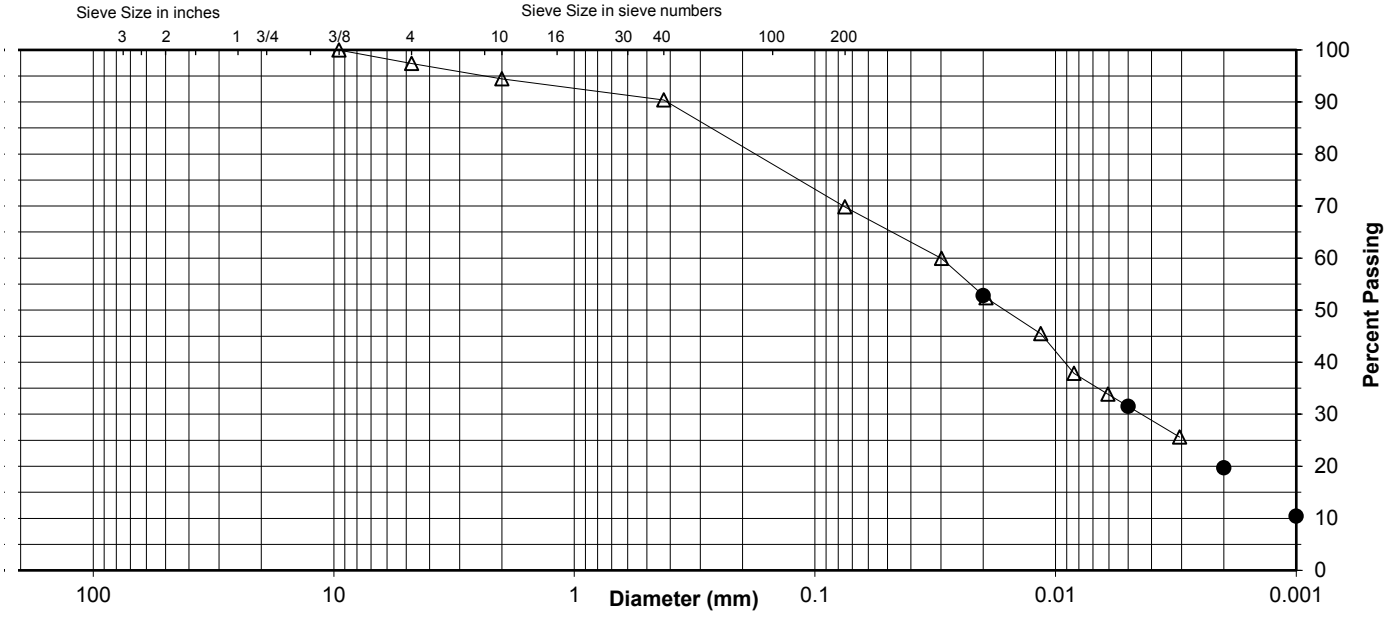
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	90.4
No. 200	69.8
0.02 mm	52.8
0.005 mm	31.5
0.002 mm	19.7
0.001 mm	10.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.6	3.0	4.0	20.6	38.3	31.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	5.6			4.0	20.6	50.1	19.7



Comments

Reviewed By JES

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.12a, 12.5'-14.0'	Lab ID	151
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 24.1

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	99.7
No. 200	0.075	98.3
	0.02	81.4
	0.005	51.9
	0.002	32.1
estimated	0.001	19.3

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.3
Medium Sand	0.3	---
Fine Sand	1.4	1.4
Silt	46.4	66.2
Clay	51.9	32.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	33
Plastic Limit:	18
Plasticity Index:	15
Activity Index:	0.5

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL
Group Name:	Lean clay
AASHTO Classification:	A-6 (15)

Comments:

Reviewed By

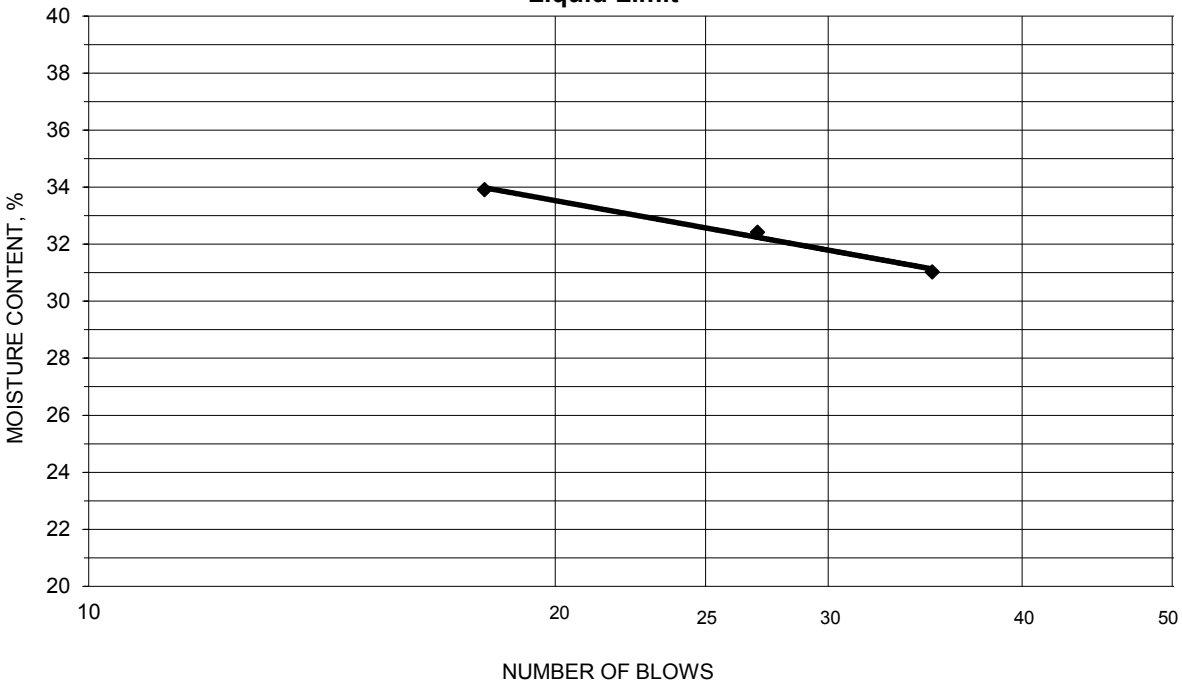
Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB	Project No.	174316204
Source	B-2.12a, 12.5'-14.0'	Lab ID	151
		% + No. 40	0
Tested By	JP	Test Method	ASTM D 4318 Method A
Test Date	09-18-2019	Prepared	Dry
		Date Received	09-11-2019

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
24.20	20.98	10.60	35	31.0	
24.29	20.97	10.73	27	32.4	
23.84	20.50	10.65	18	33.9	33

Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.84	16.76	10.75	18.0	18	15
17.33	16.39	11.04	17.6		

Remarks: _____

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Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.12a, 12.5'-14.0'	Lab ID	151

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	JP
Test Date	09-13-2019
Date Received	09-11-2019

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity 2.7

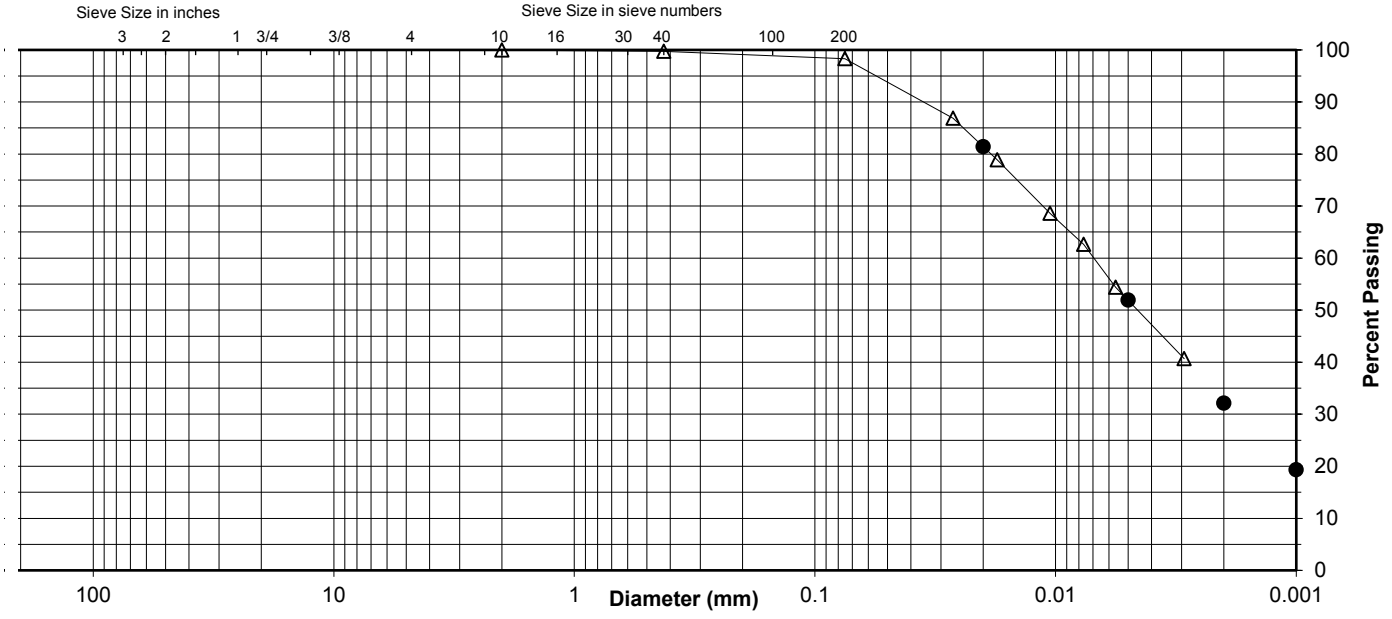
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	98.3
0.02 mm	81.4
0.005 mm	51.9
0.002 mm	32.1
0.001 mm	19.3

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.3	1.4	46.4	51.9

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.3	1.4	66.2	32.1



Comments

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.13a, 7.5'-9.0'	Lab ID	158
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 12.1

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	92.7
No. 40	0.425	83.8
No. 200	0.075	59.9
	0.02	45.1
	0.005	26.5
	0.002	14.6
estimated	0.001	6.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	7.3
Coarse Sand	7.3	8.9
Medium Sand	8.9	---
Fine Sand	23.9	23.9
Silt	33.4	45.3
Clay	26.5	14.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	22
Plastic Limit:	15
Plasticity Index:	7
Activity Index:	0.5

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: CL-ML

Group Name: Sandy silty clay

AASHTO Classification: A-4 (1)

Comments:

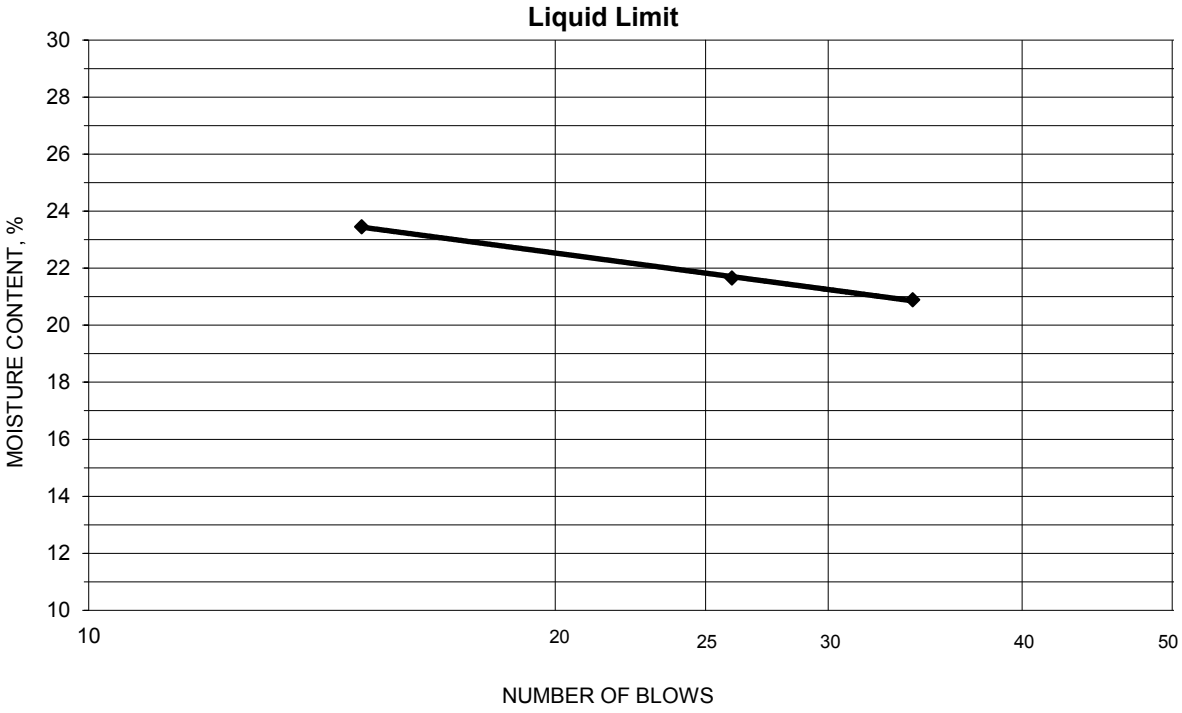
Reviewed By JES

Stantec

ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.13a, 7.5'-9.0'			Lab ID	158
				% + No. 40	16
Tested By	MP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-16-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
26.99	24.17	10.67	34	20.9	
25.23	22.64	10.68	26	21.7	
23.73	21.34	11.15	15	23.5	22



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.55	20.18	11.09	15.1	15	7
21.22	19.86	11.02	15.4		

Remarks: _____

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Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.13a, 7.5'-9.0'	Lab ID	158

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	JP
Test Date	09-13-2019
Date Received	09-11-2019

Maximum Particle size: No. 4 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	92.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity 2.7

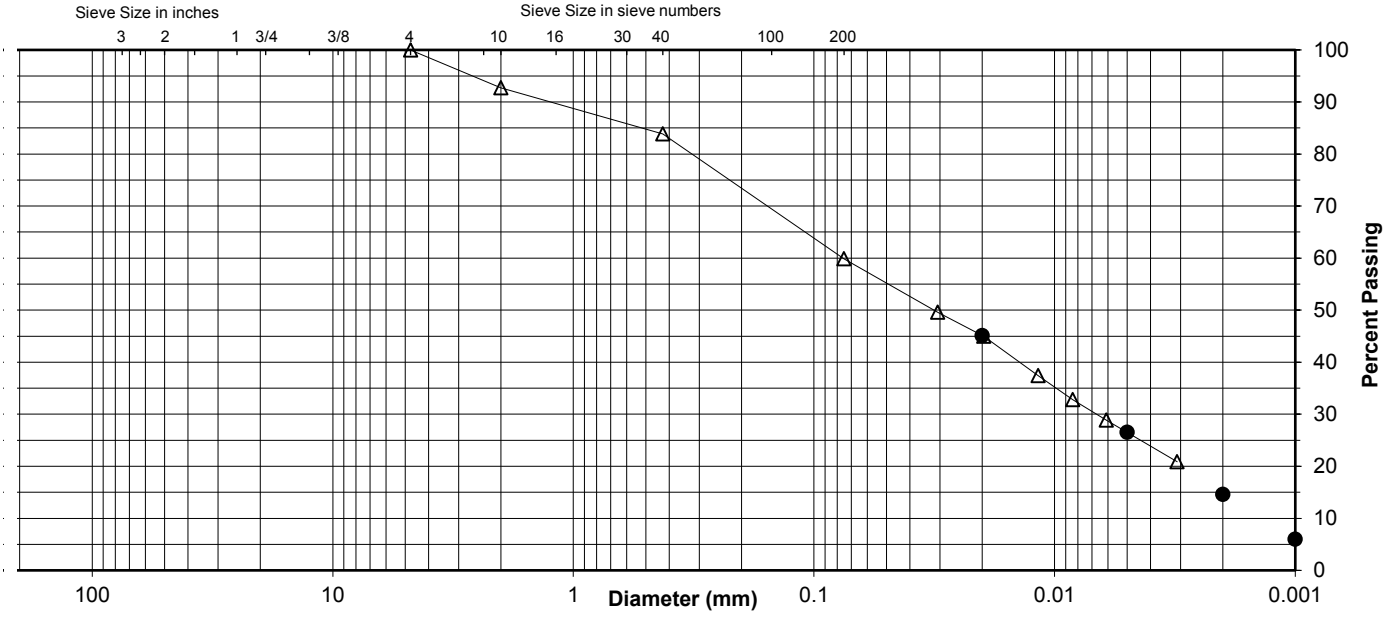
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	83.8
No. 200	59.9
0.02 mm	45.1
0.005 mm	26.5
0.002 mm	14.6
0.001 mm	6.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	7.3	8.9	23.9	33.4	26.5

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	7.3	8.9	23.9	45.3	14.6



Comments

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Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.13a, 15.0'-16.5'	Lab ID	163
Sample Type	SPT	Date Received	9-11-19
		Date Reported	9-18-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 12.7

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	93.1
No. 4	4.75	78.5
No. 10	2	57.9
No. 40	0.425	23.7
No. 200	0.075	12.8
	0.02	6.9
	0.005	3.5
	0.002	1.6
estimated	0.001	1.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	21.5	42.1
Coarse Sand	20.6	34.2
Medium Sand	34.2	---
Fine Sand	10.9	10.9
Silt	9.3	11.2
Clay	3.5	1.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand with gravel

AASHTO Classification: A-1-b (0)

Comments:

Reviewed By JRS

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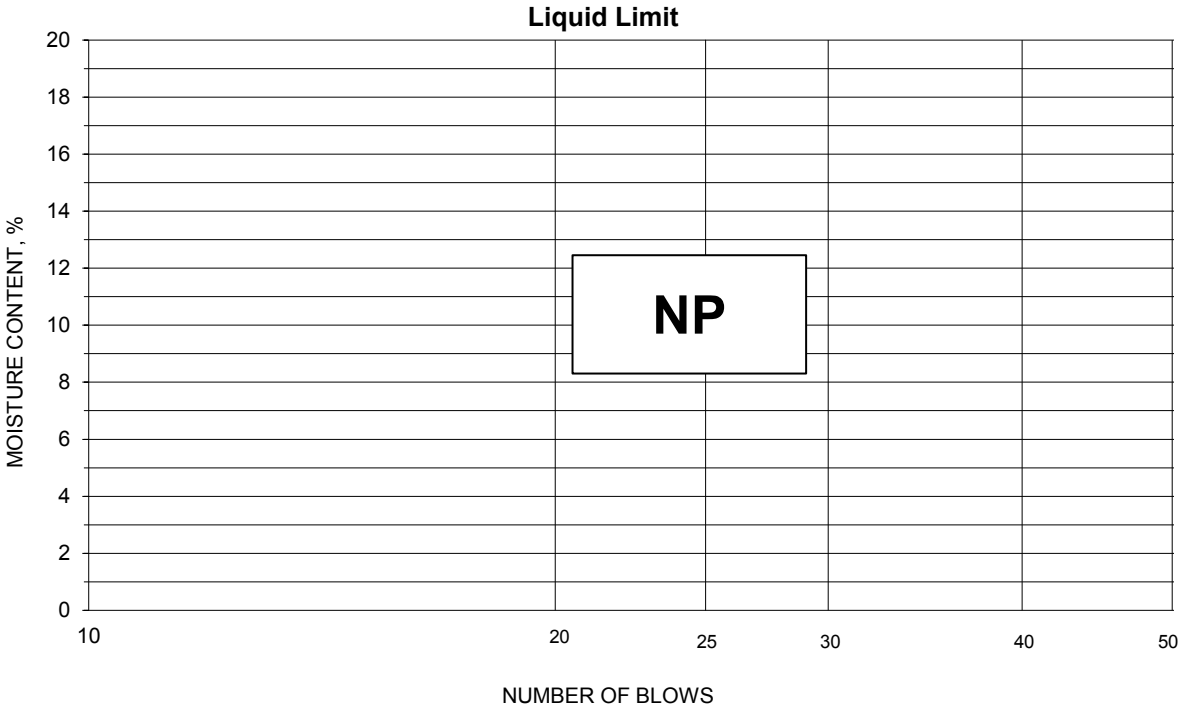
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.13a, 15.0'-16.5'			Lab ID	163
				% + No. 40	76
Tested By	JP	Test Method	ASTM D 4318 Method A	Date Received	09-11-2019
Test Date	09-17-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By _____

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Approved By: RJ

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.13a, 15.0'-16.5'	Lab ID	163

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	JP
Test Date	09-13-2019
Date Received	09-11-2019

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	93.1
No. 4	78.5
No. 10	57.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

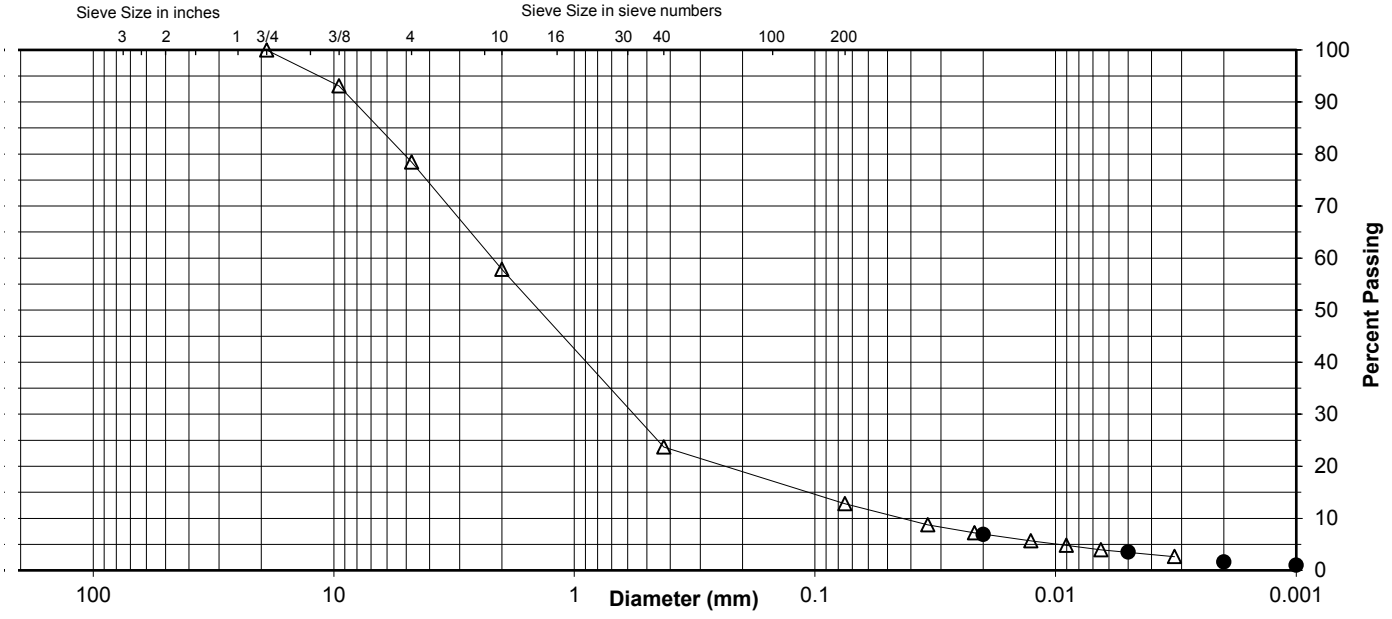
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	23.7
No. 200	12.8
0.02 mm	6.9
0.005 mm	3.5
0.002 mm	1.6
0.001 mm	1.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	21.5	20.6	34.2	10.9	9.3	3.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	42.1			34.2	10.9	11.2	1.6



Comments

Reviewed By JRS

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Version: 20170217
Approved By: RJ

Stantec

Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.1, 0.0'-5.5'	Lab ID	176
Sample Type	SPT	Date Received	9-5-19
		Date Reported	10-1-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 6.2

Particle Size Analysis

Preparation Method: ASTM D 421

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	98.1
No. 4	4.75	95.6
No. 10	2	91.1
No. 40	0.425	83.0
No. 200	0.075	47.6
	0.02	30.9
	0.005	20.2
	0.002	14.3
estimated	0.001	10.8

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	4.4	8.9
Coarse Sand	4.5	8.1
Medium Sand	8.1	---
Fine Sand	35.4	35.4
Silt	27.4	33.3
Clay	20.2	14.3

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Dry

Liquid Limit:	25
Plastic Limit:	15
Plasticity Index:	10
Activity Index:	0.7

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854

Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SC

Group Name: Clayey sand

AASHTO Classification: A-4 (2)

Comments:

Reviewed By JES

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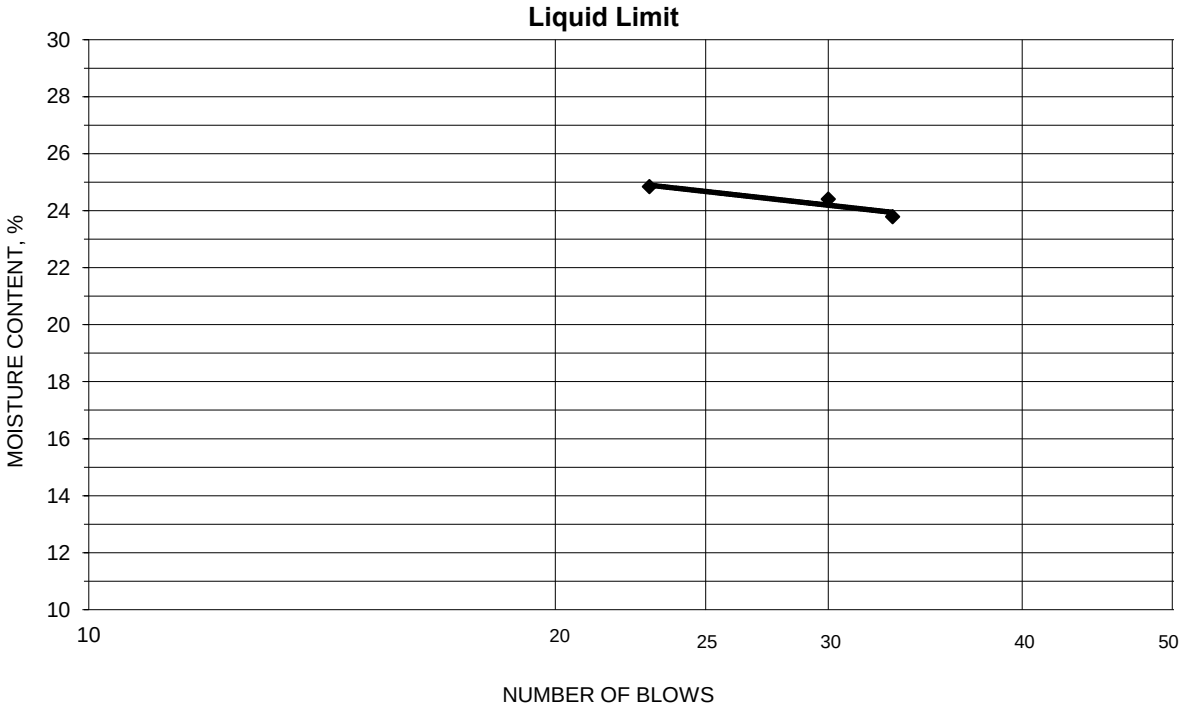
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-1.1, 0.0'-5.5'			Lab ID	176
				% + No. 40	17
Tested By	JP	Test Method	ASTM D 4318 Method A	Date Received	09-05-2019
Test Date	09-25-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
26.53	23.55	11.02	33	23.8	
26.83	23.74	11.08	30	24.4	
26.47	23.39	10.99	23	24.8	25



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.31	19.08	10.60	14.5	15	10
20.29	19.03	10.74	15.2		

Remarks:

Reviewed By JES

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Particle-Size Analysis of Soils

ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.1, 0.0'-5.5'	Lab ID	176

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	JP
Test Date	09-25-2019
Date Received	09-05-2019

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	98.1
No. 4	95.6
No. 10	91.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

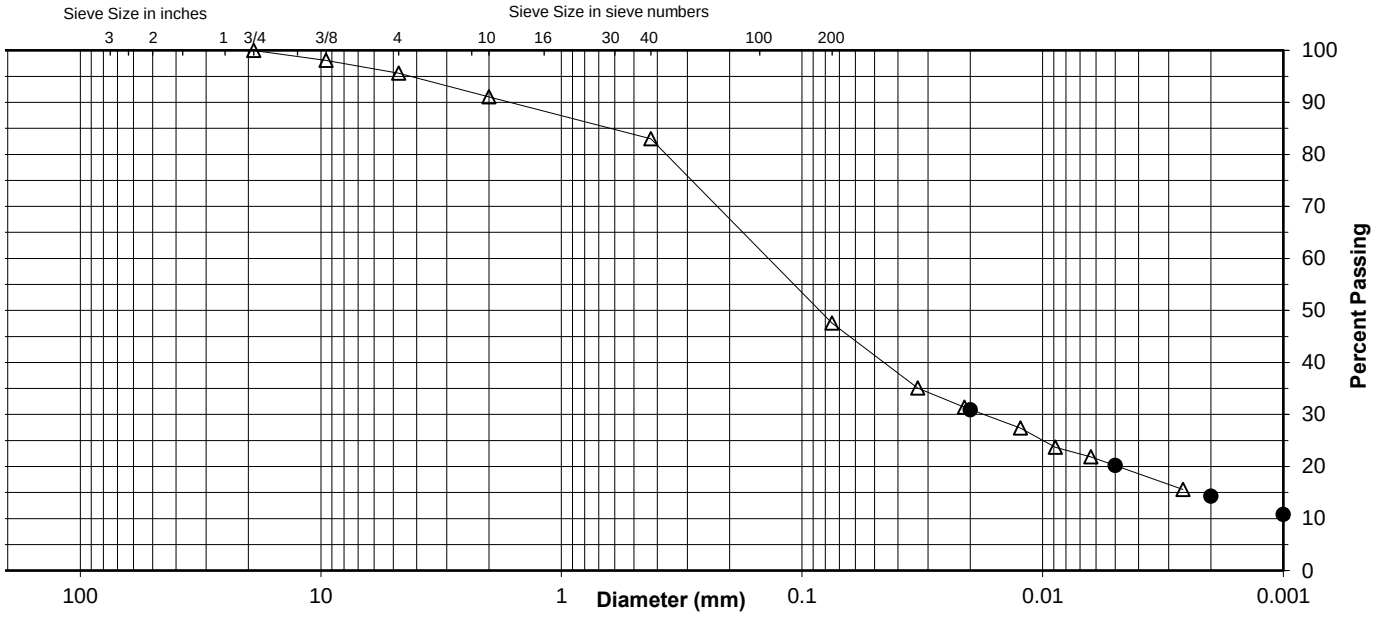
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	83.0
No. 200	47.6
0.02 mm	30.9
0.005 mm	20.2
0.002 mm	14.3
0.001 mm	10.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	4.4	4.5	8.1	35.4	27.4	20.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	8.9			8.1	35.4	33.3	14.3



Comments

Reviewed By

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Approved By: RJ

Stantec

Summary of Soil Tests

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.16A, 0.0'-5.0'	Lab ID	177
Sample Type	SPT	Date Received	9-5-19
		Date Reported	10-1-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.5

Particle Size Analysis

Preparation Method: ASTM D 421

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	98.5
No. 40	0.425	96.7
No. 200	0.075	66.8
	0.02	53.1
	0.005	35.4
	0.002	25.8
estimated	0.001	17.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	1.5
Coarse Sand	1.5	1.8
Medium Sand	1.8	---
Fine Sand	29.9	29.9
Silt	31.4	41.0
Clay	35.4	25.8

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Dry

Liquid Limit:	33
Plastic Limit:	18
Plasticity Index:	15
Activity Index:	0.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Test Method: ASTM D 854

Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: CL

Group Name: Sandy lean clay

AASHTO Classification: A-6 (8)

Comments:

Reviewed By

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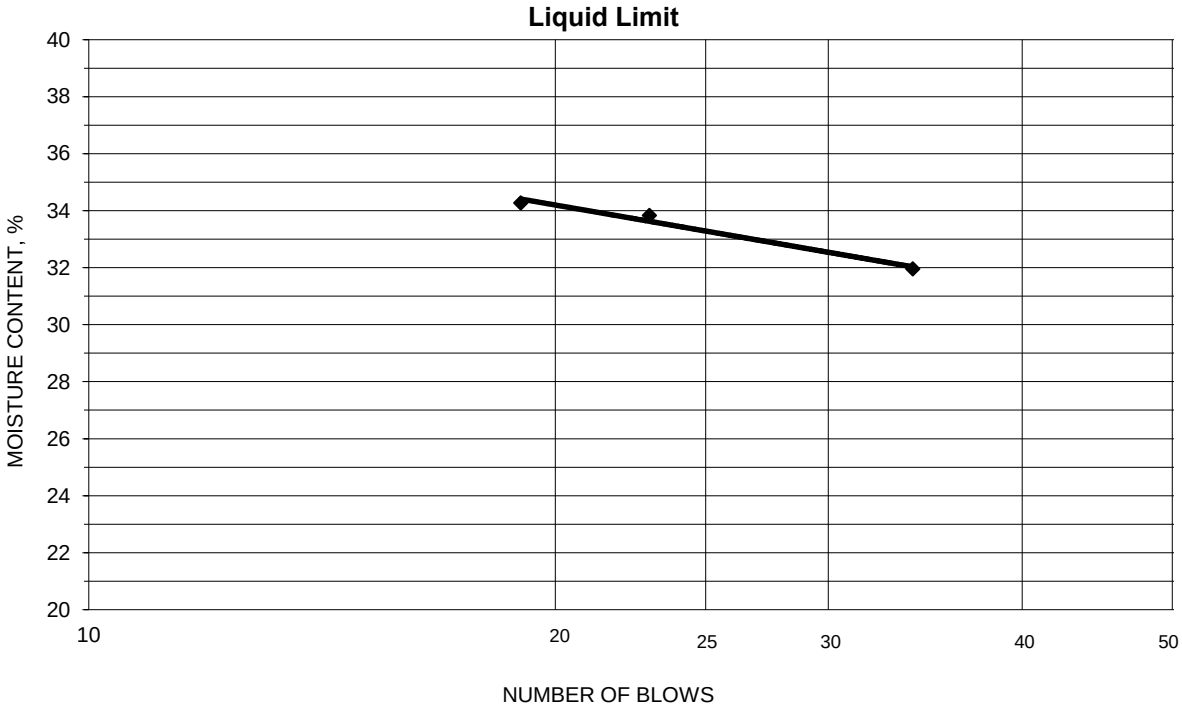
ATTERBERG LIMITS

Project	HCFRRP - Eagle Creek DSB			Project No.	174316204
Source	B-2.16A, 0.0'-5.0'			Lab ID	177
				% + No. 40	3
Tested By	MP	Test Method	ASTM D 4318 Method A	Date Received	09-05-2019
Test Date	09-26-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
23.69	20.51	10.56	34	32.0	
25.08	21.50	10.92	23	33.8	
23.93	20.63	11.00	19	34.3	33



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.10	21.22	10.58	17.7	18	15
24.22	22.24	11.06	17.7		

Remarks: _____

Reviewed By JES

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Approved By: RJ

Particle-Size Analysis of Soils

ASTM D 422

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.16A, 0.0'-5.0'	Lab ID	177

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 421
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	JP
Test Date	09-25-2019
Date Received	09-05-2019

Maximum Particle size: No. 4 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	98.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

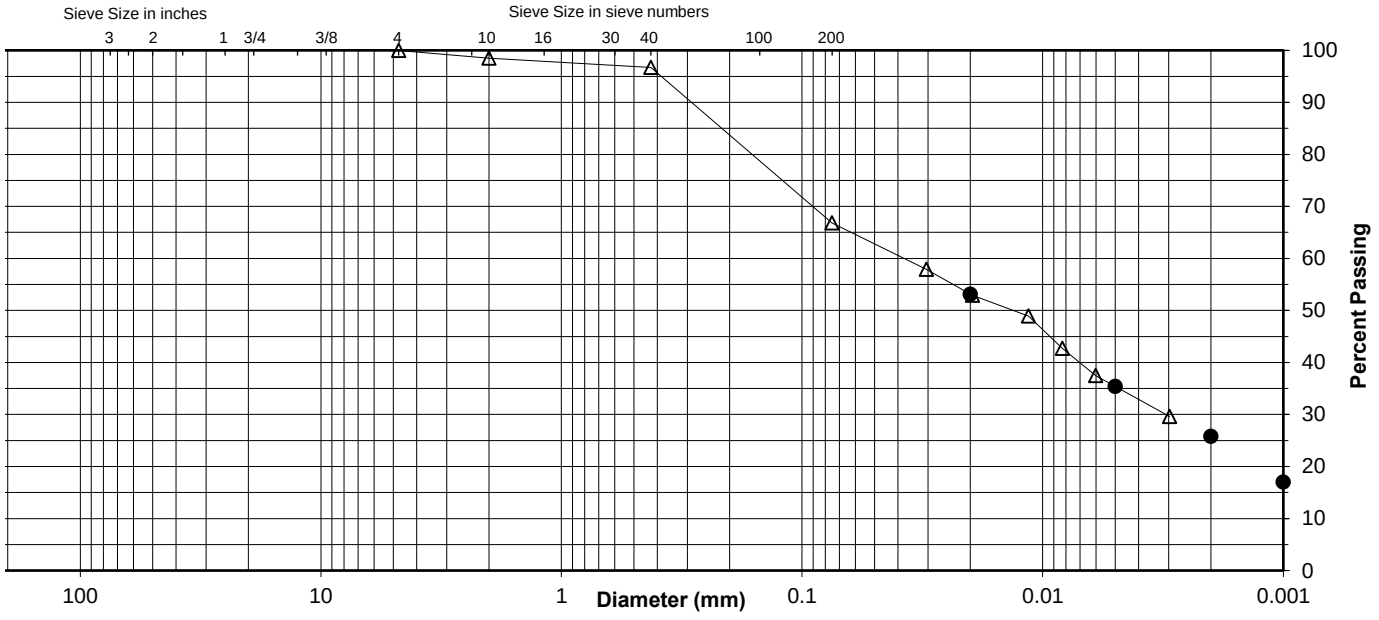
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	96.7
No. 200	66.8
0.02 mm	53.1
0.005 mm	35.4
0.002 mm	25.8
0.001 mm	17.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	1.5	1.8	29.9	31.4	35.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	1.5			1.8	29.9	41.0	25.8



Comments

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Compaction Characteristics of Soil Using Standard Effort

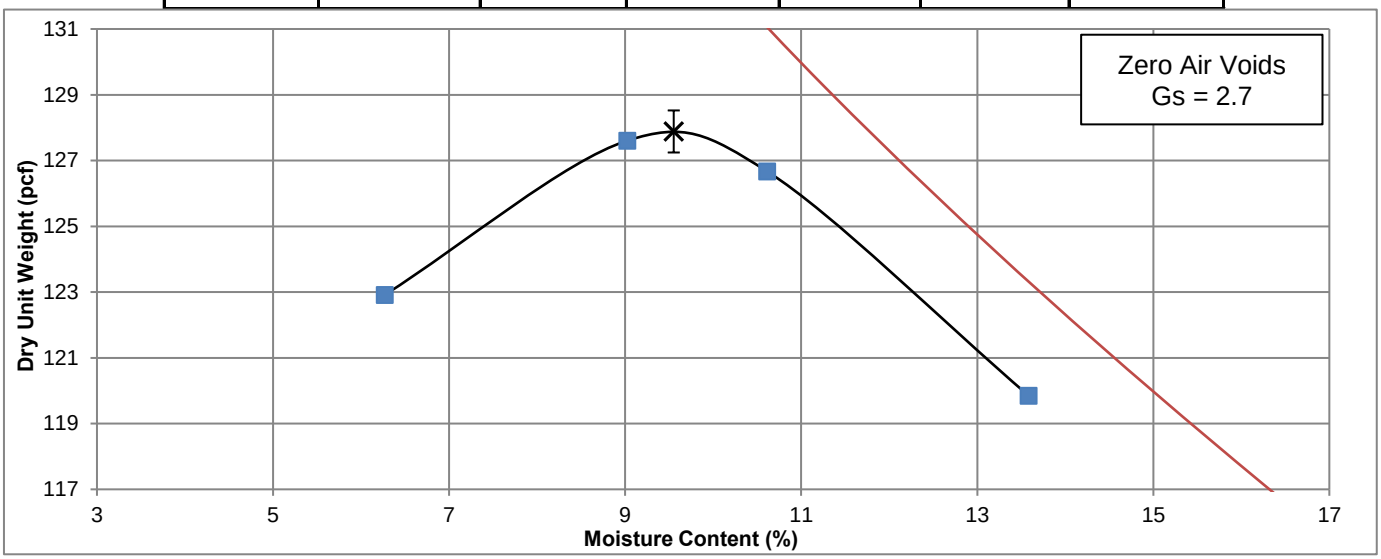
ASTM D 698 - Method A

Project	HCFRRP - Eagle Creek DSB	Project No.	174316204
Source	B-1.1, 0.0'-5.5'	Sample ID	176
Description	clayey sand	Date Received	09/05/2019
Visual Notes		Date Tested	09/25/2019

Test Fraction (%)	95.4		Oversized Fraction (%)	4.6	
Gs of Test Fraction	2.7	Assumed	Gs of Oversized Fraction	N/A	
Oversized Fraction Sieve	No. 4		MC of Oversized Fraction (%)	0.8	

Mold Weight (g)	4125	Preparation Method	Moist	Rammer Type	Manual

Wet Soil & Mold Weight (g)	Wet Soil Weight (g)	Moisture Content Determination: Wet Soil & Tare (g)	Dry Soil & Tare (g)	Tare (g)	Water Content (%)	Dry Unit Weight (pcf)
6092	1967	412.93	391.77	54.21	6.3	122.9
6220	2095	395.26	368.69	74.23	9.0	127.6
6235	2110	387.15	356.94	72.32	10.6	126.7
6175	2050	315.28	286.68	76.14	13.6	119.8



Maximum Dry Unit Weight (pcf)	**127.9**
Optimum Moisture Content (%)	**9.6**
Corrected Maximum Dry Unit Weight (pcf)	**N/A**
Corrected Optimum Moisture Content (%)	**N/A**

Reviewed By JES

Comments

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Version: 20170216
Approved By: RJ

Stantec

Compaction Characteristics of Soil Using Standard Effort

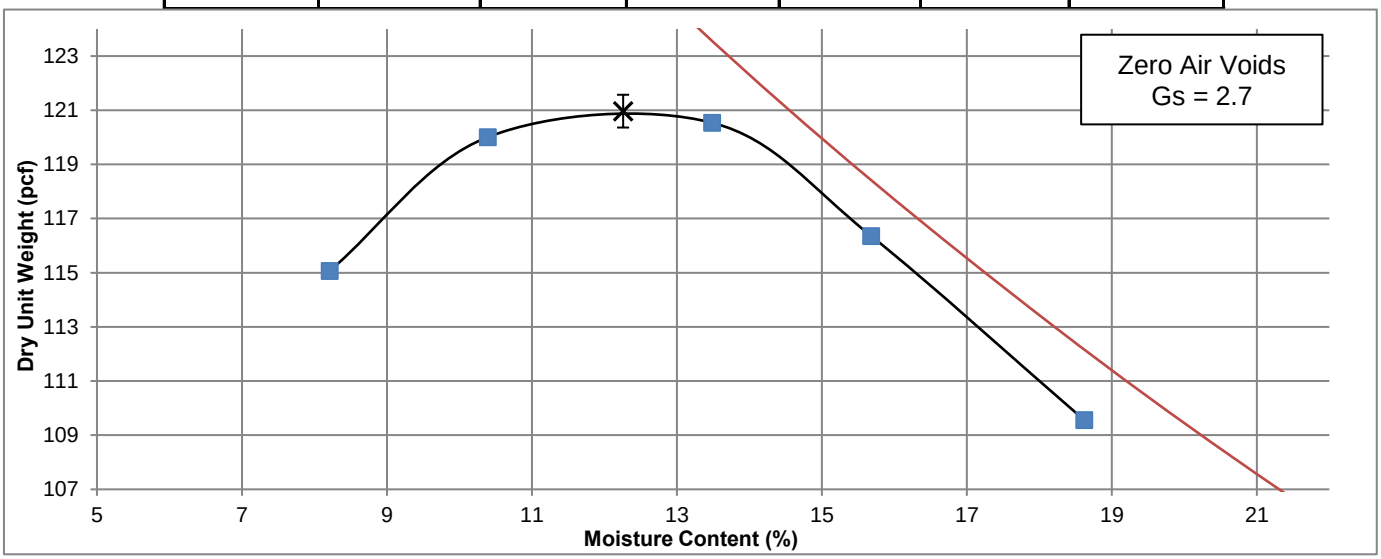
ASTM D 698 - Method A

Project	HCFRRP - Eagle Creek DSB	Project No.	174316204
Source	B-2.16A, 0.0'-5.0'	Sample ID	177
Description	sandy lean clay	Date Received	09/05/2019
Visual Notes		Date Tested	09/26/2019

Test Fraction (%)	99.9		Oversized Fraction (%)	0.1	
Gs of Test Fraction	2.7	Assumed	Gs of Oversized Fraction	N/A	
Oversized Fraction Sieve	No. 4		MC of Oversized Fraction (%)	2.5	

Mold Weight (g)	4100	Preparation Method	Moist	Rammer Type	Manual

Wet Soil & Mold Weight (g)	Wet Soil Weight (g)	Moisture Content Determination: Wet Soil & Tare (g)	Dry Soil & Tare (g)	Tare (g)	Water Content (%)	Dry Unit Weight (pcf)
5975	1875	531.97	497.11	72.43	8.2	115.1
6095	1995	453.83	418.13	74.56	10.4	120.0
6160	2060	495.71	443.44	55.89	13.5	120.5
6127	2027	311.55	279.64	76.10	15.7	116.4
6057	1957	351.29	307.49	72.27	18.6	109.6



Maximum Dry Unit Weight (pcf)	**121.0**
Optimum Moisture Content (%)	**12.3**
Corrected Maximum Dry Unit Weight (pcf)	**N/A**
Corrected Optimum Moisture Content (%)	**N/A**

Reviewed By JES

Comments

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Version: 20170216
Approved By: RJ

Stantec

Unconfined Compressive Strength of Cohesive Soil

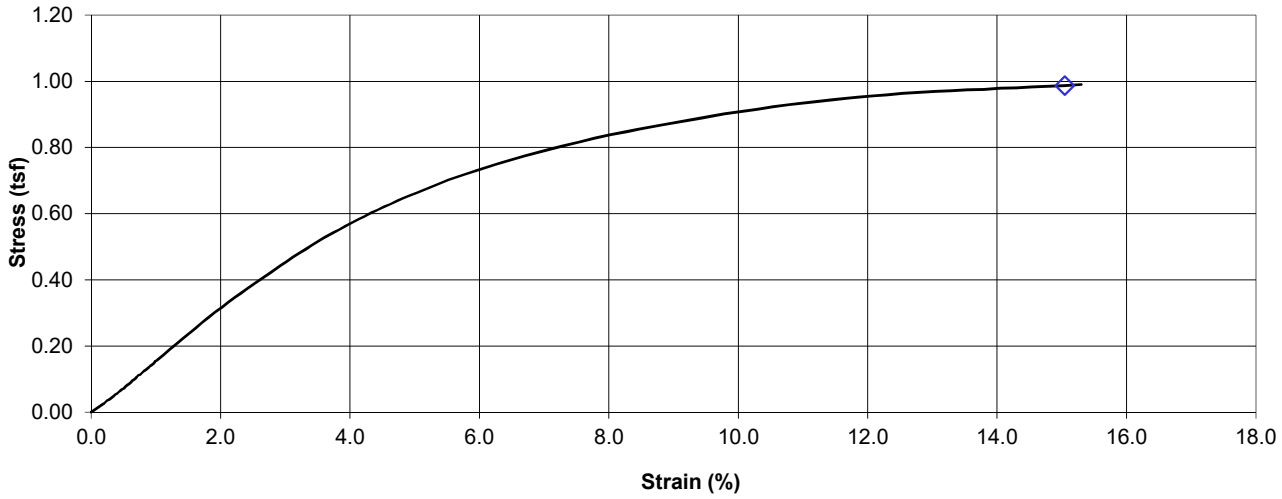
ASTM D 2166

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-1.1b, 2.0'-4.0'	Lab ID	166
Visual Description	Lean Clay (CL), brown, moist, firm		
		Recovered	1.2'
		Test Interval	2.7' - 3.2'

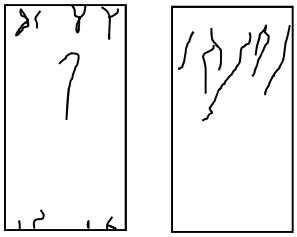
Specimen Type:	Undisturbed	LL	N/A	PL	N/A
				PI	N/A

Date Extruded	09/23/2019		
Date Tested	09/23/2019		
Initial Wet Density (pcf)	128.6	Initial MC Taken	After Test, From Center of Specimen
Initial Moisture Content (%)	23.6		
Initial Dry Density (pcf)	104.1		
At Test Moisture Content (%)	N/A	At Test MC Taken	N/A
At Test Dry Density (pcf)	N/A		
Specific Gravity	N/A		
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	0.99
Average Height (in)	6.195	Undrained Shear Strength (tsf)	0.49
Average Diameter (in)	2.808	Strain at Maximum Stress (%)	15.0
Height to Diameter Ratio	2.2	Strain rate to failure (% / min.)	1.00

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) N/A

Torvane Reading (kg/cm^2) N/A

Comments

2.0'-2.6' - Saved in tube

Reviewed By RJ

Stantec

Unconfined Compressive Strength of Cohesive Soil

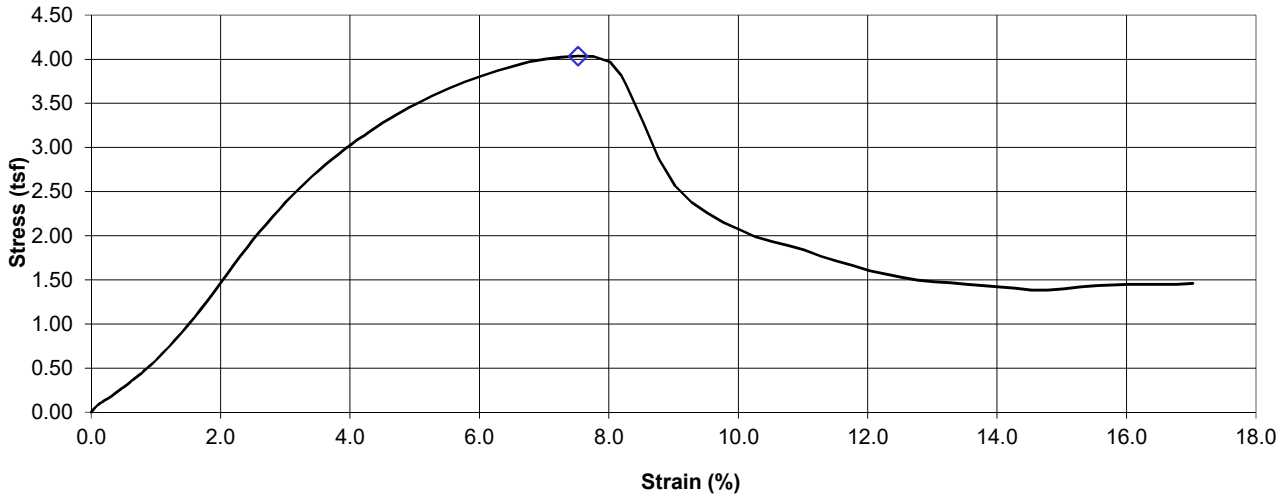
ASTM D 2166

Project Name HCFRRP - Eagle Creek DSB | Project Number 174316204
Source B-1.1b, 7.5'-9.5' | Lab ID 168
Visual Description Lean Clay (CL), gray, moist, firm, gravel
Recovered 2.3'
Test Interval 9.3' - 9.8'

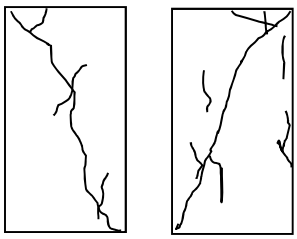
Specimen Type: Undisturbed | LL N/A | PL N/A | PI N/A
Date Extruded 09/23/2019
Date Tested 09/23/2019

Initial Wet Density (pcf)	144.4	Initial MC Taken	After Test, From Whole Specimen
Initial Moisture Content (%)	11.6		
Initial Dry Density (pcf)	129.4		
At Test Moisture Content (%)	N/A	At Test MC Taken	N/A
At Test Dry Density (pcf)	N/A		
Specific Gravity	N/A		
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	4.04
Average Height (in)	6.098	Undrained Shear Strength (tsf)	2.02
Average Diameter (in)	2.837	Strain at Maximum Stress (%)	7.5
Height to Diameter Ratio	2.1	Strain rate to failure (% / min.)	1.00

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) N/A
Torvane Reading (kg/cm^2) N/A

Comments
7.5'-9.3' - Saved in tube

Reviewed By RJ

Stantec

Unconfined Compressive Strength of Cohesive Soil

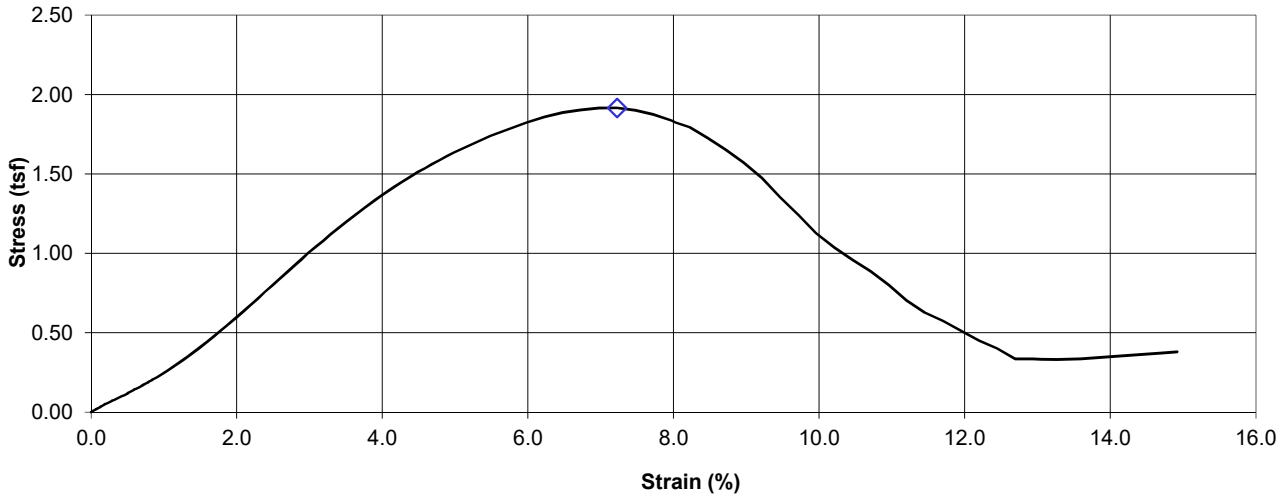
ASTM D 2166

Project Name HCFRRP - Eagle Creek DSB | Project Number 174316204
Source B-1.2b, 0.0'-2.0' | Lab ID 169
Visual Description Lean Clay (CL), brown, moist, firm
Recovered 1.3'
Test Interval 0.8' - 1.3'

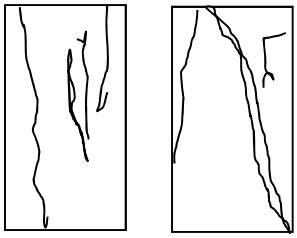
Specimen Type: Undisturbed | LL N/A | PL N/A | PI N/A
Date Extruded 09/23/2019
Date Tested 09/23/2019

Initial Wet Density (pcf)	123.7		
Initial Moisture Content (%)	23.2	Initial MC Taken	After Test, From Whole Specimen
Initial Dry Density (pcf)	100.4		
At Test Moisture Content (%)	N/A	At Test MC Taken	N/A
At Test Dry Density (pcf)	N/A		
Specific Gravity	N/A		
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	1.92
Average Height (in)	6.145	Undrained Shear Strength (tsf)	0.96
Average Diameter (in)	2.859	Strain at Maximum Stress (%)	7.2
Height to Diameter Ratio	2.1	Strain rate to failure (% / min.)	0.99

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) N/A
Torvane Reading (kg/cm^2) N/A

Comments
0.0'-0.8' - Saved in tube

Reviewed By RJ

Stantec

Unconfined Compressive Strength of Cohesive Soil

ASTM D 2166

Project Name	HCFRRP - Eagle Creek DSB	Project Number	174316204
Source	B-2.10a, 2.0'-4.0'	Lab ID	171
Visual Description	Lean Clay (CL), brown, moist, firm, gravel		
		Recovered	1.5'
		Test Interval	3.0' - 3.5'

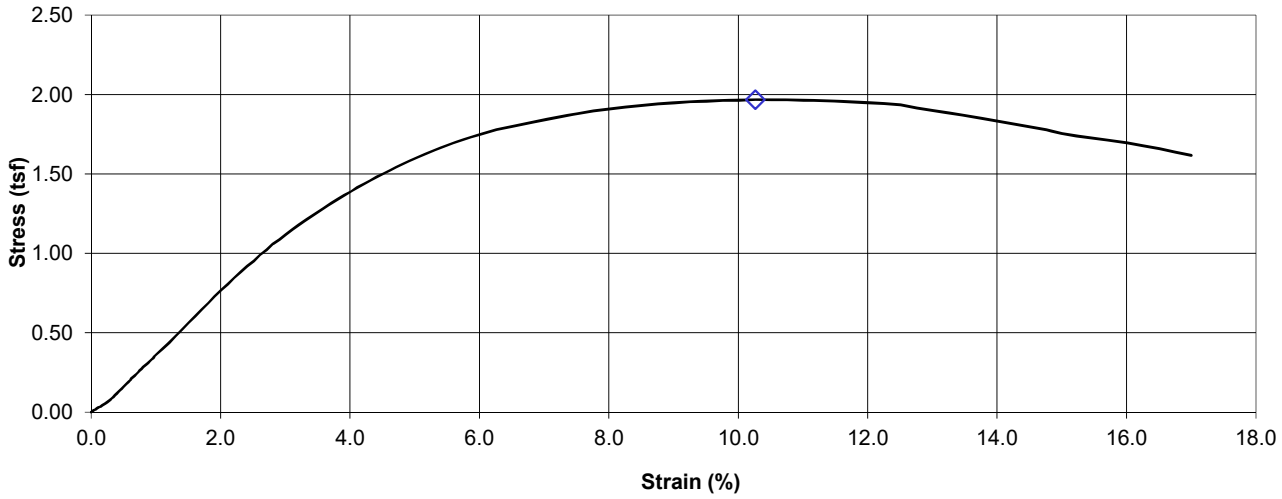
Specimen Type:	Undisturbed	LL	N/A	PL	N/A
				PI	N/A

Date Extruded 09/24/2019

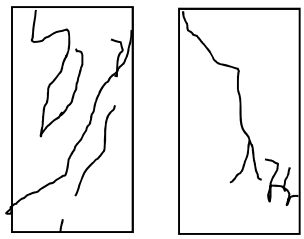
Date Tested 09/23/2019

Initial Wet Density (pcf)	131.4		
Initial Moisture Content (%)	18.6	Initial MC Taken	After Test, From Whole Specimen
Initial Dry Density (pcf)	110.8		
At Test Moisture Content (%)	N/A	At Test MC Taken	N/A
At Test Dry Density (pcf)	N/A		
Specific Gravity	N/A		
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	1.97
Average Height (in)	6.008	Undrained Shear Strength (tsf)	0.98
Average Diameter (in)	2.877	Strain at Maximum Stress (%)	10.3
Height to Diameter Ratio	2.1	Strain rate to failure (% / min.)	1.00

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) N/A

Torvane Reading (kg/cm^2) N/A

Comments

2.0'-3.0' - Saved in tube

Reviewed By RJ

Stantec

Unconfined Compressive Strength of Cohesive Soil

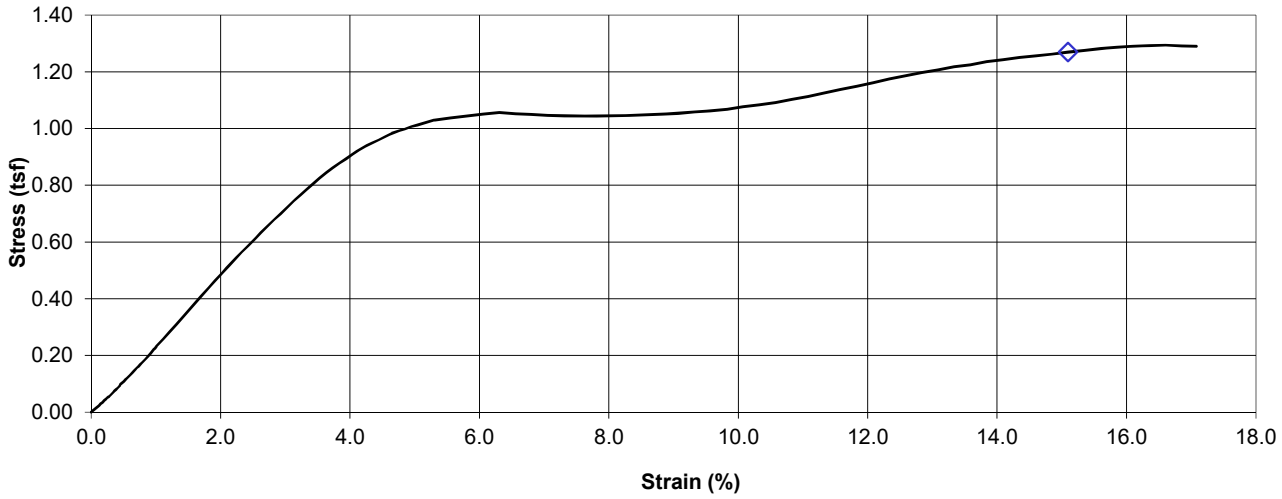
ASTM D 2166

Project Name HCFRRP - Eagle Creek DSB | Project Number 174316204
Source B-2.10a, 10.0'-12.0' | Lab ID 173
Visual Description Lean Clay (CL), brown, moist, firm, horizontal sand layer at 11.4'
Recovered 1.5'
Test Interval 11.0' - 11.5'

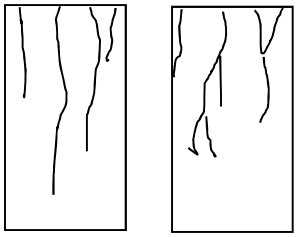
Specimen Type: Undisturbed | LL N/A | PL N/A | PI N/A
Date Extruded 09/24/2019
Date Tested 09/23/2019

Initial Wet Density (pcf)	127.2		
Initial Moisture Content (%)	17.6	Initial MC Taken	After Test, From Whole Specimen
Initial Dry Density (pcf)	108.1		
At Test Moisture Content (%)	N/A	At Test MC Taken	N/A
At Test Dry Density (pcf)	N/A		
Specific Gravity	N/A		
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	1.27
Average Height (in)	6.082	Undrained Shear Strength (tsf)	0.63
Average Diameter (in)	2.816	Strain at Maximum Stress (%)	15.1
Height to Diameter Ratio	2.2	Strain rate to failure (% / min.)	1.00

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) N/A
Torvane Reading (kg/cm^2) N/A

Comments
10.0'-11.0' - Saved in tube

Reviewed By RJ

Stantec

Unconfined Compressive Strength of Cohesive Soil

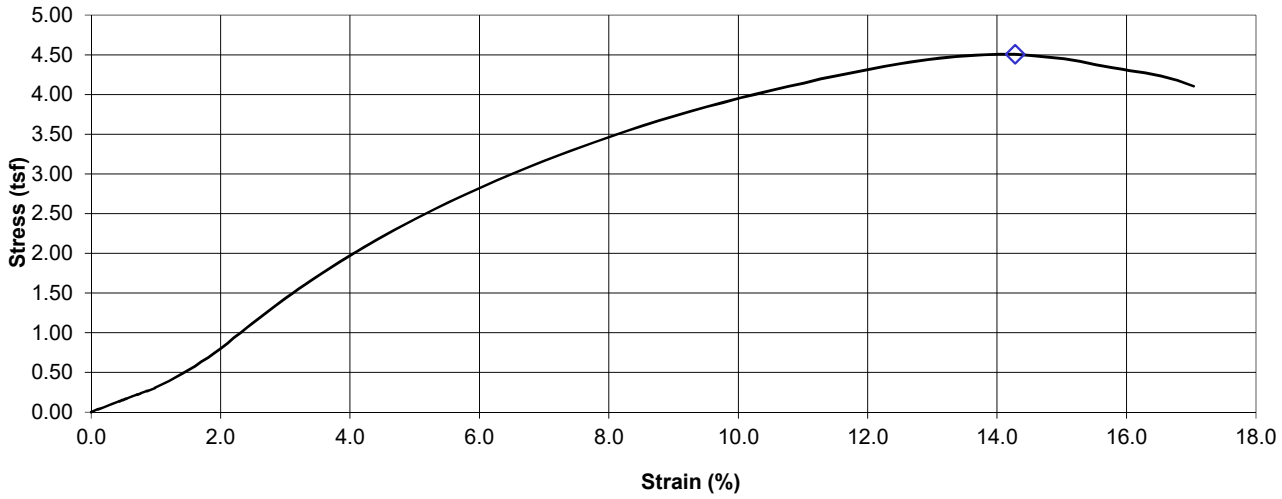
ASTM D 2166

Project Name HCFRRP - Eagle Creek DSB
Project Number 174316204
Source B-2.10a, 12.0'-14.0'
Lab ID 174
Visual Description Lean Clay (CL), brown, moist, firm, gravel
Recovered 1.9'
Test Interval 13.4' - 13.9'

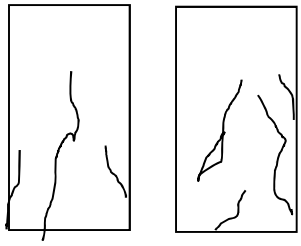
Specimen Type: Undisturbed
LL N/A
PL N/A
PI N/A
Date Extruded 09/24/2019
Date Tested 09/24/2019

Initial Wet Density (pcf)	139.3		
Initial Moisture Content (%)	14.1	Initial MC Taken	After Test, From Whole Specimen
Initial Dry Density (pcf)	122.1		
At Test Moisture Content (%)	N/A	At Test MC Taken	N/A
At Test Dry Density (pcf)	N/A		
Specific Gravity	N/A		
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	4.51
Average Height (in)	5.993	Undrained Shear Strength (tsf)	2.25
Average Diameter (in)	2.863	Strain at Maximum Stress (%)	14.3
Height to Diameter Ratio	2.1	Strain rate to failure (% / min.)	1.00

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) N/A
Torvane Reading (kg/cm^2) N/A

Comments
12.0'-13.4' - Saved in tube

Reviewed By RJ

APPENDIX C
PRESSURE TESTING RESULTS

Appendix C

Project No.	174316204	Ground Surface Elevation:	797.60 ft
Project Name	HCFRRP - Eagle Creek	Groundwater Depth:	4.9 ft
		Groundwater Elev:	792.70 ft
Boring No.	B-1.1	Gauge Height:	0 ft
		Hole Diameter:	2.98 inches

	Depth (ft)	Elevation (Plant Datum)	Test Length (ft)	Water Pressure Gage (psi)	Test (psi)	Losses due flow	Time Step (min)	Flowmeter (gal)	Flow Rate (gpm)	Take (cuft/ft)	Average Take (cuft/ft)	Net Pressure	Lugeon Value
								6520.6					
	17.5	780.10	7.3	5	7.1	0.20	1	6521.8	1.2	0.0220			
	24.8	772.80					2	6522.7	0.9	0.0165			
							3	6523.9	1.2	0.0220			
							4	6524.7	0.8	0.0147			
							5	6525.5	0.8	0.0147	1.79E-02	6.90	35
								6550.4					
	17.5	780.10	7.3	10	12.1	5.48	1	6556.1	5.7	0.1044			
	24.8	772.80					2	6561.0	4.9	0.0897			
							3	6566.6	5.6	0.1026			
							4	6571.5	4.9	0.0897			
							5	6576.9	5.4	0.0989	9.71E-02	6.62	198
								6579.2					
	17.5	780.10	7.3	15	17.1	7.88	1	6586.0	6.8	0.1245			
	24.8	772.80					2	6592.0	6.0	0.1099			
							3	6598.3	6.3	0.1154			
							4	6605.2	6.9	0.1264			
							5	6611.0	5.8	0.1062	1.16E-01	9.22	170
								6614.0					
	17.5	780.10	7.3	10	12.1	3.84	1	6618.8	4.8	0.0879			
	24.8	772.80					2	6624.3	5.5	0.1007			
							3	6629.0	4.7	0.0861			
							4	6634.4	5.4	0.0989			
							5	6639.0	4.6	0.0842	9.16E-02	8.26	149
								6640.2					
	17.5	780.10	7.3	5	7.1	3.05	1	6644.5	4.3	0.0787			
	24.8	772.80					2	6647.8	3.3	0.0604			
							3	6651.5	3.7	0.0678			
							4	6655.6	4.1	0.0751			
							5	6658.9	3.3	0.0604	6.85E-02	4.05	228

Note: Representative Lugeon value based on "Wash-out" Behavior in Table 3. Summary of current Lugeon interpretation practice, "Lugeon Test Interpretation, Revisited," Camilo Quinones-Rozo, P.E.

Average of Valid Stages: **156**

Representative Lugeon Value: **186**

Appendix C

174316204	HCFRRP - Eagle Creek	Ground Elevation:	794.40 ft
	Geotechnical Investigation	Groundwater Depth:	4.3 ft
	Water Pressure Testing	Groundwater Elev:	790.10 ft
	B-2.14a	Gage Height:	0 ft
		Hole Diameter:	2.98 inches

Stantec

Depth (ft)	Elevation (Plant Datum)	Test Length (ft)	Gage (psi)	Test (psi)	Losses due flow	Time Step (min)	Flowmeter (gal)	Flow Rate (gpm)	Take (cuft/ft)	Average Take (cuft/ft)	Net Pressure	Lugeon Value
							6373.5					
22	772.40	9.4	5	6.9	1.87	1	6376.9	3.4	0.0484			
31.4	763.00					2	6380.6	3.7	0.0526			
						3	6383.4	2.8	0.0398			
						4	6386.5	3.1	0.0441			
						5	6390.2	3.7	0.0526	4.75E-02	5.03	127
							6396.0					
22	772.40	9.4	10	11.9	4.53	1	6401.2	5.2	0.0740			
31.4	763.00					2	6406.6	5.4	0.0768			
						3	6412.0	5.4	0.0768			
						4	6417.2	5.2	0.0740			
						5	6422.5	5.3	0.0754	7.54E-02	7.37	138
							6425.0					
22	772.40	9.4	15	16.9	8.37	1	6432.0	7	0.0996			
31.4	763.00					2	6439.3	7.3	0.1038			
						3	6445.6	6.3	0.0896			
						4	6452.5	6.9	0.0981			
						5	6459.8	7.3	0.1038	9.90E-02	8.53	156
							6462.5					
22	772.40	9.4	10	11.9	5.28	1	6468.1	5.6	0.0796			
31.4	763.00					2	6473.2	5.1	0.0725			
						3	6478.9	5.7	0.0811			
						4	6483.7	4.8	0.0683			
						5	6489.5	5.8	0.0825	7.68E-02	6.62	156
							6491.5					
22	772.40	9.4	5	6.9	1.87	1	6494.9	3.4	0.0484			
31.4	763.00					2	6498.9	4	0.0569			
						3	6502.0	3.1	0.0441			
						4	6505.3	3.3	0.0469			
						5	6509.1	3.8	0.0540	5.01E-02	5.03	134

Note: Representative Lugeon value based on "Dilation" Behavior in Table 3. Summary of current Lugeon interpretation practice, "Lugeon Test Interpretation, Revisited," Camilo Quinones-Rozo, P.E.

Average of Valid Stages: **142**

Representative Lugeon Value: **142**

Appendix C

174316204	HCFRRP - Eagle Creek	Ground Elevation:	776.40	ft	
	Geotechnical Investigation	Groundwater Depth:	6.8	ft	
	Water Pressure Testing	Groundwater Elev:	769.60	ft	
	B-2.13a	Gage Height:	0	ft	
		Hole Diameter:	2.98	inches	

Stantec

	Depth (ft)	Elevation (Plant Datum)	Test Length (ft)	Water Pressure Gage (psi)	Test (psi)	Losses due flow	Time Step (min)	Flowmeter (gal)	Flow Rate (gpm)	Take (cuft/ft)	Average Take (cuft/ft)	Net Pressure	Lugeon Value
								6269.0					
	21.9	754.50	7.8	5	7.9	0.33	1	6270.5	1.5	0.0257			
	29.7	746.70					2	6273.4	2.9	0.0497			
							3	6275.4	2.0	0.0343			
							4	6277.7	2.3	0.0394			
							5	6280.1	2.4	0.0411	3.81E-02	7.57	68
								6283.0					
	21.9	754.50	7.8	10	12.9	1.15	1	6285.7	2.7	0.0463			
	29.7	746.70					2	6288.9	3.2	0.0548			
							3	6292.4	3.5	0.0600			
							4	6295.2	2.8	0.0480			
							5	6297.8	2.6	0.0446	5.07E-02	11.75	58
								6302.0					
	21.9	754.50	7.8	15	17.9	1.87	1	6305.4	3.4	0.0583			
	29.7	746.70					2	6308.9	3.5	0.0600			
							3	6312.8	3.9	0.0668			
							4	6315.8	3.0	0.0514			
							5	6319.2	3.4	0.0583	5.90E-02	16.03	50
								6323.0					
	21.9	754.50	7.8	10	12.9	0.82	1	6325.3	2.3	0.0394			
	29.7	746.70					2	6327.8	2.5	0.0428			
							3	6330.5	2.7	0.0463			
							4	6333.5	3	0.0514			
							5	6335.6	2.1	0.0360	4.32E-02	12.08	48
								6337.0					
	21.9	754.50	7.8	5	7.9	0.48	1	6338.8	1.8	0.0309			
	29.7	746.70					2	6340.6	1.8	0.0309			
							3	6342.7	2.1	0.0360			
							4	6344.4	1.7	0.0291			
							5	6345.7	1.3	0.0223	2.98E-02	7.42	54

Note: Representative Lugeon value based on "Turbulent" Behavior in Table 3. Summary of current Lugeon interpretation practice, "Lugeon Test Interpretation, Revisited," Camilo Quinones-Rozo, P.E.

Average of Valid Stages: **56**

Representative Lugeon Value: **58**

Appendix C

174316204	HCFRRP - Eagle Creek	Ground Elevation:	792.00 ft
	Geotechnical Investigation	Groundwater Depth:	1.2 ft
	Water Pressure Testing	Groundwater Elev:	790.80 ft
	B-1.3	Gage Height:	0 ft
		Hole Diameter:	2.98 inches

Stantec

	Depth (ft)	Elevation (Plant Datum)	Test Length (ft)	Gage (psi)	Test (psi)	Losses due flow	Time Step (min)	Flowmeter (gal)	Flow Rate (gpm)	Take (cuft/ft)	Average Take (cuft/ft)	Net Pressure	Lugeon Value
Water Pressure													
								6349.5					
	22.5	769.50	7.7	5	5.5	0.09	1	6350.3	0.8	0.0139			
	30.2	761.80					2	6350.9	0.6	0.0104			
							3	6351.5	0.6	0.0104			
							4	6352.1	0.6	0.0104			
							5	6352.4	0.3	0.0052	1.01E-02	5.41	25
								6352.7					
	22.5	769.50	7.7	10	10.5	0.07	1	6353.4	0.7	0.0122			
	30.2	761.80					2	6354.0	0.6	0.0104			
							3	6354.7	0.7	0.0122			
							4	6355.3	0.6	0.0104			
							5	6356.0	0.7	0.0122	1.15E-02	10.43	15
								6356.7					
	22.5	769.50	7.7	15	15.5	0.28	1	6358.1	1.4	0.0243			
	30.2	761.80					2	6359.0	0.9	0.0156			
							3	6360.0	1.0	0.0174			
							4	6360.8	0.8	0.0139			
							5	6361.7	0.9	0.0156	1.74E-02	15.22	15
								6362.5					
	22.5	769.50	7.7	10	10.5	0.03	1	6362.9	0.4	0.0069			
	30.2	761.80					2	6363.5	0.6	0.0104			
							3	6364.0	0.5	0.0087			
							4	6364.5	0.5	0.0087			
							5	6365.0	0.5	0.0087	8.68E-03	10.47	11
								6365.2					
	22.5	769.50	7.7	5	5.5	0.03	1	6365.6	0.4	0.0069			
	30.2	761.80					2	6365.9	0.3	0.0052			
							3	6366.2	0.3	0.0052			
							4	6366.5	0.3	0.0052			
							5	6366.9	0.4	0.0069	5.90E-03	5.47	15

Note: Representative Lugeon value based on "Void Filling" Behavior in Table 3. Summary of current Lugeon interpretation practice, "Lugeon Test Interpretation, Revisited," Camilo Quinones-Rozo, P.E.

Average of Valid Stages: **16**

Representative Lugeon Value: **16**

Appendix C

174316204	HCFRRP - Eagle Creek	Ground Elevation:	796.30	ft	
	Geotechnical Investigation	Groundwater Depth:	0	ft	
	Water Pressure Testing	Groundwater Elev:	796.30	ft	
	B-2.10	Gage Height:	0	ft	
		Hole Diameter:	2.98	inches	

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	Depth (ft)	Elevation (Plant Datum)	Test Length (ft)	Gage (psi)	Water Pressure Test (psi)	Losses due flow	Time Step (min)	Flowmeter (gal)	Flow Rate (gpm)	Take (cuft/ft)	Average Take (cuft/ft)	Net Pressure	Lugeon Value
								6367.1					
	21.5	774.80	7.3	5	5.0	0.03	1	6367.2	0.1	0.0018			
	28.8	767.50					2	6367.2	0.0	0.0000			
							3	6367.3	0.1	0.0018			
							4	6367.6	0.3	0.0055			
							5	6367.7	0.1	0.0018	2.20E-03	4.97	6
								6368.0					
	21.5	774.80	7.3	10	10.0	0.00	1	6368.0	0	0.0000			
	28.8	767.50					2	6368.0	0.0	0.0000			
							3	6368.0	0.0	0.0000			
							4	6368.0	0.0	0.0000			
							5	6368.0	0.0	0.0000	0.00E+00	10.00	0
								6368.6					
	21.5	774.80	7.3	15	15.0	0.03	1	6368.7	0.1	0.0018			
	28.8	767.50					2	6368.8	0.1	0.0018			
							3	6368.9	0.1	0.0018			
							4	6369.0	0.1	0.0018			
							5	6369.0	0.0	0.0000	1.47E-03	14.97	1
								6369.0					
	21.5	774.80	7.3	10	10.0	0.00	1	6369.0	0	0.0000			
	28.8	767.50					2	6369.0	0	0.0000			
							3	6369.0	0	0.0000			
							4	6369.0	0	0.0000			
							5	6369.0	0	0.0000	0.00E+00	10.00	0
								6368.8					
	21.5	774.80	7.3	5	5.0	0.00	1	6368.8	0	0.0000			
	28.8	767.50					2	6368.8	0	0.0000			
							3	6368.8	0	0.0000			
							4	6368.8	0	0.0000			
							5	6368.8	0	0.0000	0.00E+00	5.00	0

Note: Representative Lugeon value based on "Laminar" Behavior in Table 3. Summary of current Lugeon interpretation practice, "Lugeon Test Interpretation, Revisited," Camilo Quinones-Rozo, P.E.

Average of Valid Stages: 1

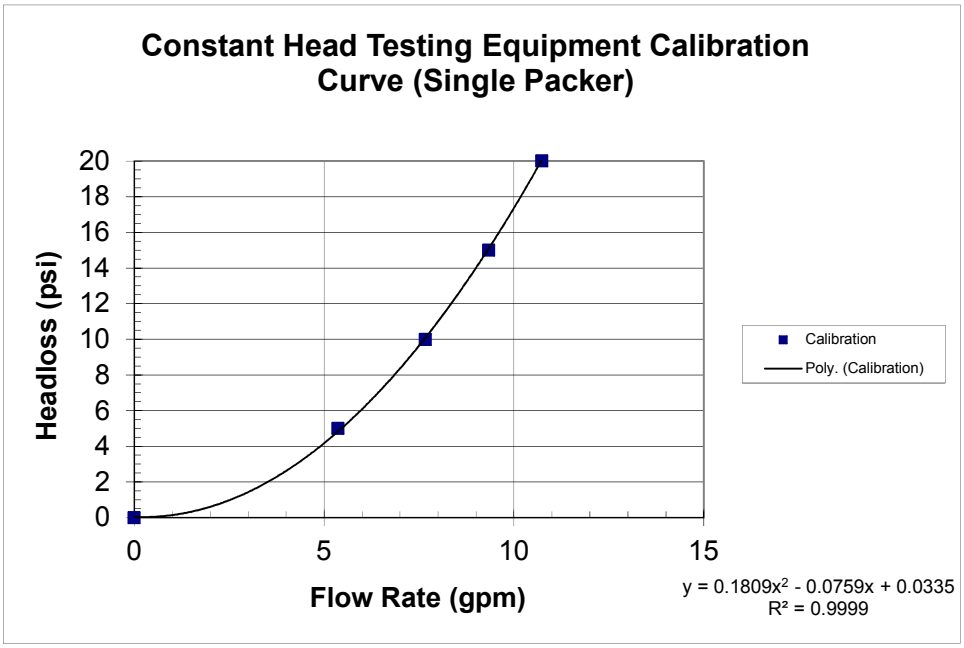
Representative Lugeon Value: 1

HCFRRP - Eagle Creek
Geotechnical Exploration
Water Pressure Testing Calibration

Surface Elevation:	794.90 ft
Groundwater Depth:	6.5 ft
Groundwater Elev:	743.80 ft
Gage Height:	0 ft
Hole Diameter:	0 inches

Geologic Unit	Depth (ft)	Elevation (Plant Datum)	Test Length (ft)	Water Pressure Gage (psi)	Water Pressure Test (psi)	Time Step (min)	Flowmeter (gal)	Flow Rate (gpm)	Average
							6095.0		
	0	794.90	0	5	7.8	1	6102.3	7.3	
	0	794.90				2	6105.8	3.5	
						3	6111.1	5.3	
									5.4
							6115.0		
	0	794.90	0	10	12.8	1	6122.5	7.5	
	0	794.90				2	6130.5	8.0	
						3	6138.0	7.5	
									7.7
							6145.0		
	0	794.90	0	15	17.8	1	6154.4	9.4	
	0	794.90				2	6163.6	9.2	
						3	6173.0	9.4	
									9.3
							6181.0		
	0	794.90	0	20	22.8	1	6191.5	10.5	
	0	794.90				2	6202.3	10.8	
						3	6213.2	10.9	
									10.7
							6220.0		
	0	794.90	0	25	27.8	1	6231.5	11.5	
	0	794.90				2	6243.5	12.0	
						3	6255.8	12.3	
									11.9

Plot Numbers	
y	x
0	0
5	5.4
10	7.7
15	9.3
20	10.7
25	11.9

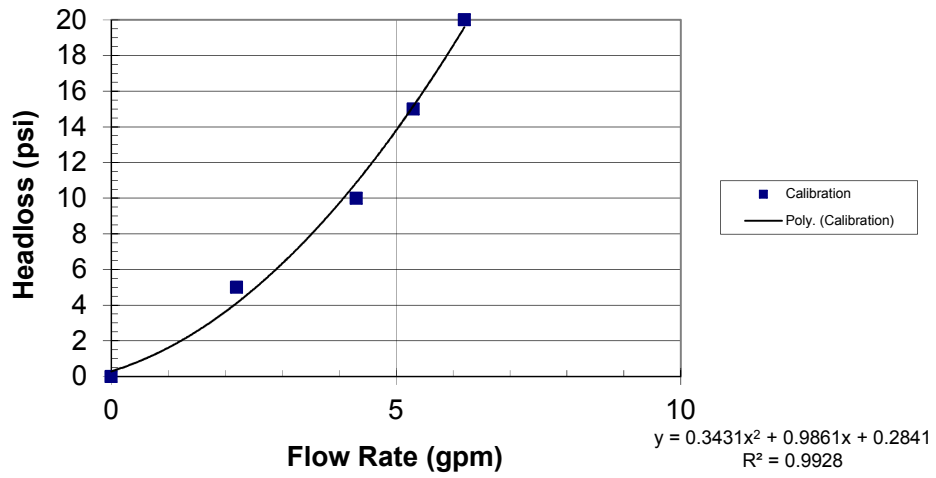


Surface Elevation:	656.00 ft
Groundwater Depth:	0 ft
Groundwater Elev:	656.00 ft
Gage Height:	0 ft
Hole Diameter:	3.125 inches

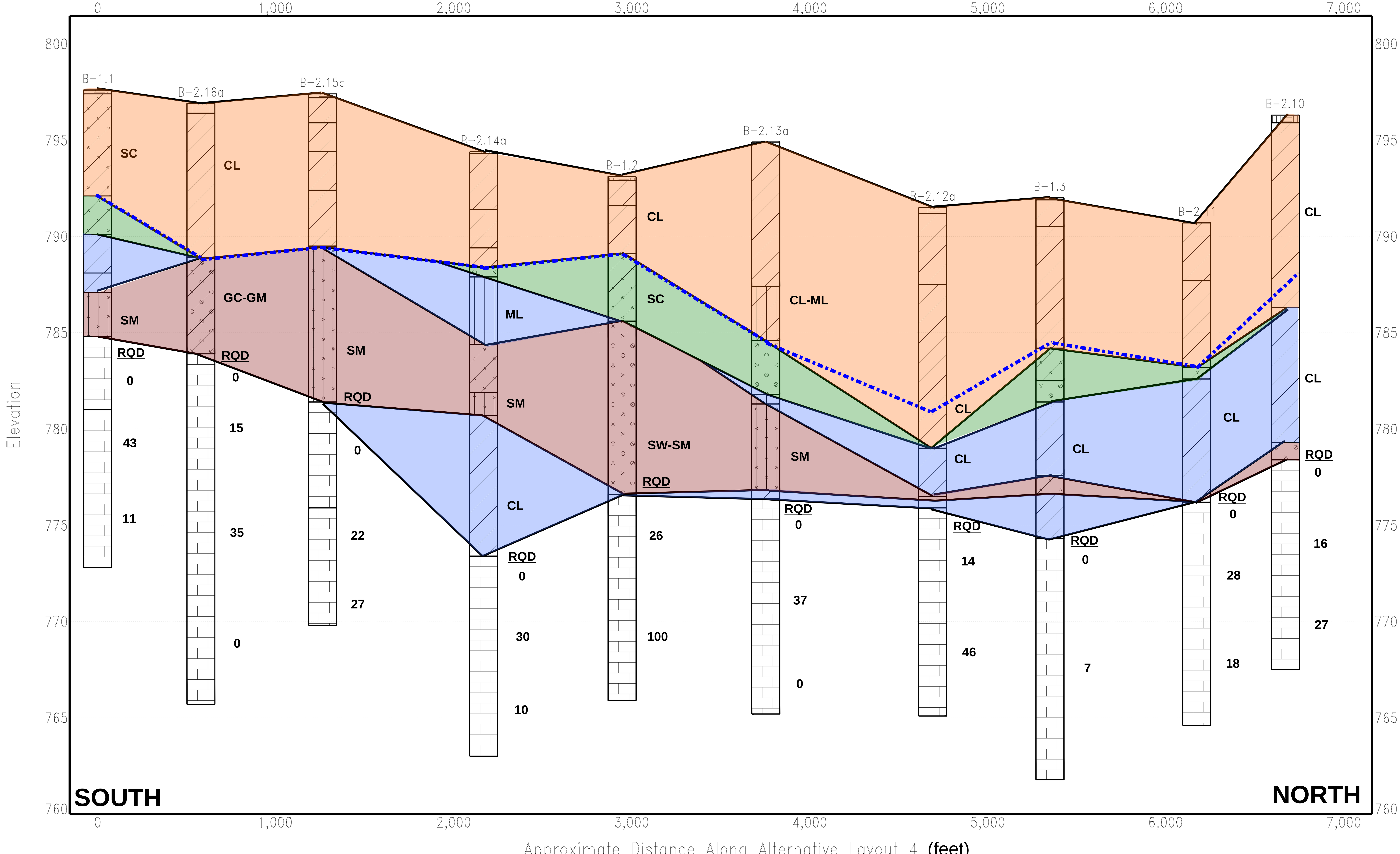
Geologic Unit	Depth (ft)	Elevation (Plant Datum)	Test Length (ft)	Water Pressure Gage (psi)	Test (psi)	Time Step (min)	Flowmeter (gal)	Flow Rate (gpm)	Average
							2533.0		
	0	656.00	0	5	5.0	1	2535.2	2.2	
	0	656.00				2	2537.4	2.2	
						3	2539.5	2.1	
									2.2
							2539.5		
	0	656.00	0	10	10.0	1	2543.5	4	
	0	656.00				2	2548.0	4.5	
						3	2552.5	4.5	
									4.3
							2552.5		
	0	656.00	0	15	15.0	1	2557.7	5.2	
	0	656.00				2	2562.9	5.2	
						3	2568.5	5.6	
									5.3
							2568.5		
	0	656.00	0	20	20.0	1	2575.0	6.5	
	0	656.00				2	2580.9	5.9	
						3	2587.2	6.3	
									6.2

Plot Numbers	
y	x
0	0
5	2.2
10	4.3
15	5.3
20	6.2

Figure 4.5: Constant Head Testing Equipment Calibration Curve



APPENDIX D
SOIL PROFILE DIAGRAM



Upper Fine-Grained Soil

Upper Coarse-Grained Soil

Lower Fine-Grained Soil

Lower Coarse-Grained Soil

Bedrock (Dolomite)

Observed Water Level at Time of Drilling

Note: The subsurface profile shown here is based on available information, laboratory testing and approximate soil properties. The drawing depicts approximate subsurface conditions based on specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

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Revision | By | Appd. | YY.MM.DD

Issued | By | Appd. | YY.MM.DD

Client/Project
HCFRRP

DRY STORAGE BASIN DESIGN
HANCOCK COUNTY, OHIO
Project Location

Title
BORING LOGS

Permit-Seal

Project Number: 174316204

File Name: soil profile.dwg

Dwn. Chkd. Dsgn. YY.MM.DD

Drawing No. #

Revision 0

Sheet # of #

APPENDIX E
ROCK CORE PHOTOS

Eagle Creek DSB Phase 1 Design
Rock Core Photos

B-1.1 – Box 1 of 1. Depth: 14.3 to 24.8 feet

B-1.2 – Box 1 of 1. Depth: 16.9 to 27.2 feet

Eagle Creek DSB Phase 1 Design
Rock Core Photos

B-1.3 – Box 1 of 1. Depth: 20.0 to 30.2 feet

B-2.10 – Box 1 of 1. Depth: 18.5 to 28.8 feet

Eagle Creek DSB Phase 1 Design
Rock Core Photos

B-2.11 – Box 1 of 1. Depth: 15.1 to 26.1 feet

B-2.12a – Box 1 of 1. Depth: 16.4 to 26.4 feet

Eagle Creek DSB Phase 1 Design
Rock Core Photos

B-2.13a – Box 1 of 1. Depth: 18.9 to 29.7 feet

B-2.14a – Box 1 of 1. Depth: 21.0 to 31.4 feet

Eagle Creek DSB Phase 1 Design
Rock Core Photos

B-2.15a – Box 1 of 1. Depth: 17.7 to 27.7

B-2.16a – Box 1 of 1. Depth: 15.1 to 31.2 feet