GEOTECHNICAL INVESTIGATION REPORT – PHASE II

Proposed IDOT Pump Station #4

SE Quadrant of I-290 and Des Plaines River

Cook County, Illinois

Prepared for:

Mr. Matt Kasper, P.E.
HDR
30 North LaSalle Street, Suite 3220
Chicago, IL 60602

Prepared by:

Geo Services, Inc.
805 Amherst Court
Suite 204
Naperville, Illinois 60565
(630) 305-9186

GSI Job. 12174

November 23, 2016

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering

November 23, 2016
Draft #2: October 10, 2016
Draft #1: August 26, 2016

HDR
30 North LaSalle Street, Suite 3220
Chicago, IL 60602

Attn: Mr. Matt Kasper, P.E.

GSI Project No. 12174

Re: Geotechnical Investigation Report
Phase II - IDOT Pump Station #4
I-290 & Des Plaines River
Cook County, IL.

Dear Mr. Kasper:

The following report presents the geotechnical analysis and recommendations for the construction of the proposed IDOT Pump Station #4 expansion located at the southwest quadrant of I-290 expressway and Des Plaines River. A total of four (4) pump station borings (2016-01 thru 2016-04) and a total of six (6) retaining wall borings (2016-05 thru 2016-10) were completed at the site by Geo Services, Inc. (GSI) as a supplement to the Phase I Geotechnical Investigation borings (2013-01A thru 2013-03A, 2013-04 and 2013-05A) drilled in January, 2013. Copies of the soil boring diagram and profile, along with the boring and core logs, are included in this report.

If there are any questions regarding the information submitted herein, please do not hesitate to contact us.

Very truly yours,

GEO SERVICES, Inc.

Richard Realeza
Staff Engineer
Office Phone: (847) 253-3845x202
richard@geoservicesinc.net

Andrew J. Ptak, P.E.
Office Manager
Office Phone: (847) 253-3845x204
drew@geoservicesinc.net

Stephen A. Bucher, P.E.
Senior Geotechnical Engineer
Office Phone: (847) 253-3845x203
stephenbucher@geoservicesinc.net

enc.

TABLE OF CONTENTS

SECTION 01: INTRODUCTION

The following report presents the results of the geotechnical investigation performed for the proposed IDOT Pump Station #4 expansion located in the southwest quadrant of I-290 and Des Plaines River. As an update from the IDOT Pump Station #4 (Phase I) Geotechnical Investigation Report issued by Geo Services, Inc. (GSI) dated February 25, 2013, this Phase II report is based upon the boring information obtained in January, 2013 (2013-01A thru 2013-03A, 2013-04 and 2013-05A), and additional subsurface information obtained in four (4) pump station borings (2016-01 thru 2016-04) and six (6) retaining wall borings (2016-05 thru 2016-10), which were drilled in July, 2016 at the proposed pump station site.

Boring locations were selected by Geo Services, Inc. and were reviewed and approved by HDR. Boring locations were laid out in the field by GSI personnel at the proposed locations using a GPS handheld device. Where borings were inaccessible to the drill rig at the pre-marked boring/core locations, offsets were made by Geo Services, Inc. field personnel, with the exception of boring 2016-10, which was drilled at the proposed location with the use of hand-auger equipment. As-drilled borings 2016-01 thru 2016-10 were surveyed at the site by American Surveying and Engineering, P.C. field personnel. Elevations of the pre-marked borings were used as benchmarks to determine the boring elevations of the offset borings for borings 2013-01A thru 2013-03A, 2013-04 and 2013-05A.

The project is located in Cook County, Illinois with the following range/township information: T39N R12E, Section 14 SE quadrant. The project location is shown on the site location map included in the Appendix.

This report includes a site location map, boring location diagrams, soil profile and boring/core logs, as well as, descriptions of soil and groundwater conditions, recommendations pertaining to the design and construction of the pump station, retaining walls, earth embankment, and general construction considerations for the site.

SECTION 02: PROJECT DESCRIPTION

The proposed, reconstructed IDOT Pump Station #4 will consist of the new pump station construction to be located approximately 40 feet south of the existing IDOT Pump Station #4. Due to anticipated high volumes of stormwater runoff from the east and west section of the nearby I-290 expressway, creating a larger pump station will improve stormwater management for I-290 in this area. The existing stormwater pipes are planned to be tied-in from the existing wet well to the newly reconstructed pump station.

The footprint of the newly reconstructed wet well chamber (with pump pit, influent and discharge pipes) will be approximately 109 feet long by 70 feet wide. Based on the cross-section drawings provided by HDR, the wet well chamber will be about 74 feet deep, showing the proposed foundations to bear at approximate elevation 545 feet. The proposed concrete mat foundation will be approximately 4 feet thick. Wet well walls are proposed to be approximately 5 feet thick. Soil design values recommended in this report are based on Allowable Stress Design (ASD) factors of safety.

Approximate preliminary service loads for the pump station were provided by HDR, and are as follows:

- Gravity Load for the foundation, building and live loads – 8 ksf
- Gravity (Uplift) Load for foundation only – 3.6 ksf (requires rock anchors)
- Typical Buoyant (Uplift) pressure – 2.5 ksf (based on water levels from the boring logs)
- Design Buoyant (Uplift) pressure – 3.7 ksf (based on water to EL. 623.83 feet)

In addition to the reconstruction of the pump station, a parking lot at the south and east side of the site, as well as retaining walls at the west, east and south side portion of the new pump station building are also proposed.

SECTION 03: SUBSURFACE INVESTIGATION PROCEDURES

Borings 2013-01A thru 2013-03A, 2013-04 and 2013-05A were performed during the month of January, 2013, and borings 2016-01 thru 2016-10 were performed during the month of July, 2016. Majority of the borings were drilled using a truck-mounted drilling rig equipped with a CME automatic hammer, advanced by hollow stem augers to depths of 15 to 30 feet, and then switching to rotary drilling to completion. Representative soil samples were obtained employing split spoon sampling procedures in accordance with AASHTO Method T-206. Also, due to rig inaccessibility and since boring offsets were far from the proposed location, boring 2016-10 was drilled (continuously to 10 feet deep) using hand-auger equipment. Samples obtained in the field were brought to our laboratory for further examination and testing.

Split spoon sampling involves driving a 2.0-inch outside diameter split-barrel sampler into the soil with a 140-pound weight falling freely through a distance of 30 inches. Blow counts are recorded at 6" intervals and the blow counts are shown on the boring logs. The number of blows required to advance the sampler the last 12 inches is termed the Standard Penetration Resistance (N). The N-value is an indication of the relative density of the soil.

Bedrock cores were also obtained from borings 2016-01 thru 2016-04 using an NX-size double tube core barrel with a diamond impregnated bit. Samples obtained in the field were brought to our laboratory for further examination and testing.

SECTION 04: LAB TESTING PROGRAM

The test procedures were performed in accordance with test procedures discussed in the IDOT Geotechnical Manual. All split-spoon samples obtained from the drilling operation were visually classified in the field. Cohesive samples were tested in the field for unconfined compressive strength using an IDOT modified RIMAC test device and/or calibrated penetrometer.

The soil testing program included performing water content, density and either unconfined compression and/or calibrated penetrometer tests on the cohesive samples recovered. Water content tests were performed on the non-cohesive samples recovered. These tests were performed upon representative portions of the samples obtained in the field. The results of the above testing, along with a visual classification of the material based upon both the Illinois textural classification and the AASHTO Soil Classification System, are indicated on the boring logs.

In addition to the general laboratory testing, Organic Content (AASHTO T-194), Atterberg Limits (AASHTO T89/T90), Particle Size Analysis (AASHTO T88), and Triaxial (CU) Consolidation (ASTM D4767) tests were performed on select split spoon and Shelby tubes samples recovered from the borings.

The results of the organic content testing performed on the samples are summarized below in Table 1 – Lab Testing Summary. Additional information of the laboratory testing results can be found in the Appendix E.

Table 1- Laboratory Test Summary

Boring	Sample Depth (feet)	Material Description	Atterberg Limits			Moisture Content (%)	Organic Content (%)
			LL	PL	PI		
2013-02A	28.0-30.0	Sandy Loam with Organics	--	--	--	31.0	4.6
2013-03A	15.0-17.5	Clay Loam with trace of organics	--	--	--	25.0	2.0
2016-01	53.5-55.0	Silty Loam (A-4)	21	20	1	21.0	--
2016-02	26.0-28.0	Silty Clay Loam (A-6)	33	14	19	31.0	--
2016-02	28.5-30.0	Loam (A-6)	24	13	11	26.0	--
2016-03	26.0-28.0	Silty Clay Loam (A-6)	39	16	23	33.0	--
2016-06	23.5-25.0	Silty Clay Loam (A-6)	40	20	20	34.0	--
2016-08	23.5-25.0	Silty Clay	--	--	--	31.0	3.5
2016-10	8.0-10.0	Silty Loam (A-6)	27	13	14	18.8	--

Select samples were also sent to SoilCor laboratory to test for pH (AASTHO T-289-91), Water-Soluble Sulfate Ion Content (AASTHO T 290-95, Method B), and Water-Soluble Chloride Ion Content (AASTHO T 291-94, Method A) to determine levels of alkali and sulfates present that may affects pipe corrosion. Results of the pH, sulfate and chloride are tabulated in Table 2 below, and can be found in Appendix E.

Table 2 – Corrosion Testing Results

Boring	Sample Depth (feet)	Sulfate Content (mg/kg)	Chloride Content (mg/kg)	pH
B-2016-02	68.5 to 70.0	820	ND	6.8
B-2016-04	26.0 to 27.5	80	70	7.9

Unconfined Compressive Strength of Intact Rock Core Specimens (ASTM D7012) tests were also performed on several bedrock core samples recovered from the borings. The rock cores obtained indicated Silurian System, Niagaran Dolomite (Rock Type A), with an average Rock Quality Determination of 61%. The rock core compressive strength test results are summarized in Table 3 – Bedrock Information Summary.

Table 3 – Bedrock Information Summary

Boring	Run	Top of Bedrock Elevation (feet)	Core Thickness, Elevation (feet)	RQD	Compressive Strength (tsf)
2016-01	Run 1	557.1	555.1 to 546.1	71.0%	804
2016-01	Run 2	557.1	546.1 to 535.6	88.0%	477
2016-01	Run 3	557.1	535.6 to 524.6	61.0%	1,322
2016-02	Run 1	556.5	556.0 to 548.0	33.0%	1,313
2016-02	Run 2	556.5	548.0 to 541.0	37.0%	902
2016-03	Run 1	554.8	554.3 to 544.3	75.0%	1,114
2016-03	Run 2	554.8	544.3 to 534.3	76.0%	1,139
2016-03	Run 3	554.8	534.3 to 524.3	96.0%	1,185
2016-04	Run 1	533.8	554.4 to 544.4	49.0%	1,083
2016-04	Run 2	551.9	544.4 to 539.4	24.0%	782

SECTION 05: SUBSURFACE AND GROUNDWATER CONDITIONS

5.1 Soil Site Overview

According to the information shown in the Engineering Properties of Chicago Subsoils text by Ralph Peck and William C. Reed, the maps indicate that the proposed pump station location was crossed by an old rail road. Buried wood ties from the train track may be located within the wood, cinders and/or brick fill encountered in borings 2016-02, 2016-04, 2016-06, 2016-07 and 2016-08. The following soil conditions in Section 5.2 are described based on the soil exploration and soil classifications given from the site.

5.2 Soil Conditions

Boring logs can be found in Appendix D. The stratification lines shown on the boring logs represent the approximate boundary between soil types, and the actual transition may be gradual.

Surface conditions at the boring locations varied from stiff to hard clay to clay loam fill at majority of the boring locations, and 2 to 5 inches asphalt layers with 6 to 8 inches of crushed stone at borings 2013-01A, 2016-01 and 2016-05. Boring 2016-05 also encountered loose to medium dense crushed asphalt underlying the pavement section. The soil profile generally consists of thick layers of stiff to very stiff clay to clay loam fill to elevation ranges 607 to 633 feet. The majority of the borings also noted some organics and urban fill (crushed concrete, cinders, brick, wood, and other miscellaneous debris) within the fill layers at elevations ranging from 613 to 633 feet. Also, due to an unknown wood obstruction encountered at boring 2013-01A, drilling was ceased at approximately 40 feet below ground level.

Beneath the fill layers, the soil profile transitions to interstratified deposits of soft to stiff clay to clay loam, medium dense to dense silt, and medium dense silty loam until top of bedrock was hit at approximate elevation 559 feet. Organic soils were also noted beneath the fill layers at borings 2013-02A, 2016-03, 2016-06 and 2016-08 at approximate elevations 600 to 611 feet. A stratum of very dense clayey sand, gravel, cobbles, boulders, and fractured rock was also encountered at borings 2013-02A and 2016-04 at approximate elevations 554 to 562 feet.

Summary of soil boring termination depths are as follows:

- Borings 2016-01 thru 2016-04 – drilled to top of bedrock elevation ranges at approximately 533 to 557 feet, then advanced with rock coring to elevation ranges at approximately 525 to 544 feet.
- Boring 2013-02A – drilled to cobbles and boulders elevation at approximately 555 feet.

- Borings 2013-01A, 2016-05 thru 2016-08 – elevation ranges at approximately 583 to 592 feet.
- Borings 2013-03A, 2013-04, 2013-05A and 2016-09 – elevation ranges at approximately 609 to 612 feet
- Boring 2016-10 – continuous drilling using hand-auger drilling methods to approximate elevation 621 feet

Moisture contents of the fill (except for the wood layer) and cohesive soils ranged from mid-teens to low twenties. Granular soils had moisture contents that ranged from low to mid-teens. Organic soils had moisture contents in the mid-thirties.

Below the fill and native overburden soils, bedrock was encountered at elevations varying from approximately 533 to 557 feet. The rock cores obtained indicated Silurian System, Niagaran Dolomite. A summary of the bedrock information obtained during our exploration is tabulated in Table 2 of this report.

5.3 Groundwater Conditions

Groundwater was encountered at approximate elevations ranging from 600 to 612 feet at majority of the borings before switching to rotary drilling techniques. Perched water levels may occur within granular layers above the rock or the upper zone of weathered and fractured rock. Based on the coloration change of the soils from brown and gray to gray, we estimate the long term water table at elevation 612 to 614 feet. Normal river water level from the nearby Des Plaines Riven (as shown from the cross-sections provided by HDR) is at approximate elevation 608.5 feet. Fluctuations in the amount of water accumulated and in the hydrostatic water table can be anticipated depending upon variations in precipitation, surface runoff, and from the Des Plaines River.

SECTION 06: GEOTECHNICAL ANALYSIS

6.1 Seismic Conditions

The site has a seismic acceleration coefficient of 0.036g (Site Class C); the project site is considered to be in a low seismic area. Liquefiable layers and scour are not expected to impact the design of the new pump station.

6.2 Settlement Analysis

For the pump station chamber, an estimated maximum enclosure wall height of 74 feet with a bearing stratum of very dense loam to fractured dolomite bedrock at borings 2016-01 thru 2016-04 was used for the settlement analysis. Settlement is calculated to be negligible on bedrock (south side of the pump station chamber footprint) and approximately ½ inch on the very dense loam soils (north side of the pump station

chamber footprint). No settlement concerns are anticipated for the pump station well chamber.

For the paving areas outside the pump station chamber with an estimated embankment fill height of 70 feet, estimated settlement will likely have excess of 6 inches of settlement. Based on GSI's recent experience with well-compacted mixed fill materials of about 25 feet thickness, we would estimate about 6 months to reach 90% settlement time rate if mixed fill material or clay material is used as backfill for the paving areas. Installation and use of settlement platforms are recommended to monitor and determine when adequate settlement has occurred to allow for paving.

6.3 Pipe Corrosion Findings

In addition to geotechnical lab testing, select boring samples were tested to help evaluate corrosion potential of the soil and chemical attack on concrete. A soil sample taken near the invert elevation of the pipe tie-ins and a sample from shallower depth were tested.

Table 2 (Section 03 – Lab Testing Program) lists the corrosion test data obtained except the VOC and PNA results. All of the results including VOC and PNA test results can be found in Appendix E. Total pH values less than 5 and greater than 9 are considered corrosive. Generally, sulfate contents between 150 to 1,500 ppm are considered moderately aggressive to concrete. Chloride contents greater than 350 to 400 ppm are generally considered aggressive to concrete.

We recommend that a corrosion engineer be consulted to determine if cathodic protection for the pipeline is needed and if Type II cement is warranted for the pre-cast concrete pipe design.

SECTION 07: PUMP STATION WET WELL FOUNDATION RECOMMENDATIONS

7.1 Pump Station Foundation Recommendation

The pump station's wet well chamber and pump pit structures are proposed to be founded on approximately 3.5-foot thick reinforced concrete mat foundation. Based on the results of the soil borings, the support of the mat foundations will be based on dense to very dense loam and fractured rock or bedrock materials to approximate bottom of footing foundation at elevation 562 feet at the north end and elevation 555 feet at the south end of the pump station chamber footprint. However, if water seepage occurs through the bedrock and softens the overburden soils, the granular soils above bedrock (mainly on the north side of the pump station chamber footprint) may need to be excavated to bedrock elevation (approximately 555 feet), and then replaced with mass

concrete to bottom level of the mat foundation. Conditions of the bearing material should be evaluated in the field by the Geotechnical Engineer at the time of construction.

The pump station chamber foundation can be designed for a maximum gross allowable bearing capacity of 10 ksf based on very dense loam soils to fractured rock, using a factor of safety of 3.0. Settlement on the very dense loam to fractured rock material is estimated of be on the order of 1/2 inch (settlement in bedrock is anticipated to be negligible).

It should be noted that for footing excavations at the pump pit area where the fractured rock are present at approximate elevation 560 feet, a potential for “blow-in” may occur at the base of the excavation following the release in confining overburden pressure from construction activity. For this reason, we recommend that once the wet well chamber footprint is excavated to elevation approximately 592 feet that dewatering wells be installed to dewater the underlying sand, silt and loam stratum before excavation for the pump pit**.** Grain size testing of the granular strata below the groundwater table has been performed to assist a dewatering well subcontractor. Results are included in the Appendix E.

All soils which become softened or loosened at the base of foundation excavation areas or subgrade areas should be carefully recompacted or removed prior to placement of foundation concrete. No foundation concrete should be placed in areas of ponded water or frozen soil.

7.2 Pump Station Wet Well Chamber Construction

Based on the pump station cross-sections as provided by HDR, the construction of the well chamber will require a temporary soil retention system.

Open cut excavation will not be an option for the wet well construction due to the depth of excavation, limited site area and proximity of the nearby Des Plaines River.

Since the proposed retained height of the wall is about 74 feet, it is beyond the limits of the IDOT Temporary Sheet Piling Design Charts 3.13.1, and due to the difficulty of driving sheeting into very dense granular soils below approximate elevation 570 feet, cantilevered sheet piling option will not work for the temporary soil retention and is not recommended.

Two options are considered viable for the temporary soil retention system of the wet well chamber excavation:

- Secant Pile Wall (with internal bracing or tie-backs)
- Slurry Wall (with internal bracing or tie-backs)

A top-down construction procedure will be applied for the construction of the Secant Pile Wall or Slurry Wall systems. This procedure has the ability of the system to minimize inward wall and outside soil movements, and reduce the potential for lowering the groundwater table outside the excavation. Each of the alternatives is discussed in the following subsections:

7.2.1 Secant Pile Wall (with internal bracing or tie-backs)

A top-down construction procedure using a Secant Pile Wall with internal bracing or tie-backs is considered a viable option for temporary soil retention system for the wet well chamber construction. A guide wall is constructed to set out the position of the secant pile wall. Secant pile walls are constructed by excavating overlapping drilled shafts along the perimeter of the wet well, inserting reinforced steel cage or steel beams and filling the holes with concrete, creating a continuous wall of drilled piers in the process. Drilled piers will be installed on an alternating pattern to create an overlap/interlock between the drilled shafts. The drilled piers should be keyed into bedrock at a minimum elevation of 540 feet.

It should be noted that hard drilling can be expected to occur starting at approximate elevation 570 feet due to high blow-count granular soils. Also, due to the saturated sands, silt and fractured rock noted above bedrock and possible caving of this material during construction, drilled piers of the Secant Pile Wall will require slurry and temporary casing to bedrock elevation at approximate elevation 560 feet.

Multiple levels of internal bracing (i.e. waler and rakers) or tie-back anchors will be needed to provide adequate lateral stability for the required temporary soil retention wall heights. For the tie-back anchor and bracing design, soil properties presented in ***Table 4 – Soil Parameters for Lateral Resistance*** and ***Table 5 – Bedrock Parameters for Lateral Resistance*** of this report can be used.

After the internal bracing or tie-back anchors are installed and tested at one level, excavation can proceed to the next bracing level. Seepage may occur between the drilled piers, and could then be controlled by grouting behind the wall. Additional guidelines are described in subsection ***7.2.3 Bottom Floor Slab Construction*** for the Secant Pile Wall construction.

7.2.2 Concrete Slurry Wall (with internal bracing or tie-backs)

A top-down construction procedure using a Slurry Wall with internal bracing or tie-backs also is considered a viable option for temporary soil retention system for the wet well chamber construction. Slurry wall construction begins by excavating a deep trench (trench width is typically about 3 to 4 feet) along the wet well perimeter, filling the trench with slurry (bentonite or polymers and water) to keep the trench from collapsing, placing the reinforced steel cage within the trench, and tremie placement of final concrete from the bottom up, displacing the slurry. The level of the slurry must be maintained at least 2 feet above the groundwater level and not be permitted to drop more than 3 feet below

the surface of the slurry trench working platform.

Internal bracing or tie-back anchors will be needed depending on the height of retained wall section to provide adequate lateral stability for the temporary soil retention wall. For additional tie-back anchor and bracing design, soil properties presented in ***Table 3 – Soil Parameters for Lateral Resistance*** and ***Table 4 – Bedrock Parameters for Lateral Resistance*** of this report can be used.

The slurry wall will be extended into bedrock at a minimum elevation of 540 feet. It should be noted that excavation may experience hard, competent granular soils starting at approximate elevation 570 feet.

Consideration could also be given to using the slurry wall as permanent wall. Additional guidelines are described in subsection ***7.2.3 Bottom Floor Slab Construction*** for the Slurry Wall construction.

7.2.3 Bottom Floor Slab Construction

Prior to the installation of the mat foundation, a “mud mat” may need to be placed to safely allow access of personnel. The “mud mat” can consist of a lean concrete mix to resist the hydrostatic uplift and to provide a dry working surface condition for construction of the floor slab. Once the bottom floor slab is reached and leveled, the bottom floor slab is cast either directly on the rock surface or on a mud mat over the rock. Any water-producing fissures or cracks in the bedrock surface exposed after excavation should be grouted to avoid any excess water seepage. Sump pits and pumps and/or dewatering methods will be needed to control groundwater seepage inside the wet well and relieve any buildup of hydrostatic pressure on the mud mat.

Provided the Secant or Slurry Wall extend into bedrock, expected groundwater seepage and uplift forces should be reduced. Per the IDOT District I – General Guidelines for Pump Station Design Manual (January, 2016), if a perimeter exterior drainage system is installed at the base slab elevation, the base slab can be designed for 50% of the difference between the full uplift head and that the elevation of the exterior perimeter drain.

7.2.4 Pipe Tie-in Construction

The proposed new pump station will also have pipe tie-ins to connect to the existing pump station. For construction and installation of the piping tie-ins, viable options for reducing potential groundwater inflows include:

- Jet grouting the soils within the zone surrounding the pipe penetrations
- Installation of two lines of secant piles parallel to the pipes and tied into the circular secant pile wall and into (or nearly so) the existing pump station wall. Groundwater should then be pumped out prior to opening holes in the secant pile wall.

7.3 Lateral Earth Support (For Earth Retention)

The earth retention system (secant pile wall) should be designed to resist the appropriate lateral earth pressures. Allowances should be made for any surcharge loads adjacent to the earth retention system. The retention system should be designed for hydrostatic pressure. The base of the wall chamber is anticipated to be founded in fractured rock. According to the NAVFAC Design Manual 7.2, a value of 0.55 may be used for the coefficient of friction (ultimate) between the concrete foundation and bedrock. On the following Table 4 is a tabulation of lateral soil parameters to be used for design of the earth retention system.

Table 4 – Soil Parameters for Lateral Resistance of Earth Retention System

Material (elevation)	Unit Weight (pcf)	Drained Friction Angle (°)	Allowable Bond Strength (ksf) [1]	Undrained Cohesion (psf)	Lateral Modulus of Subgrade Reaction (pci)	Strain
Stiff to Very Stiff Clay to Clay Loam and Miscellaneous Fill (633 to 608)	125	28	0.4	1,000	500	0.007
Soft to Medium Stiff Silty Clay with Organics (608 to 604)	92	21	0.3	300	10	0.020
Stiff to Hard Clay to Clay Loam (604 to 570)	125	28	0.7	2,000	900	0.005
Medium Dense to Dense Silt/ Sandy Loam (570 to 560)	125	30	1.0	n/a	120	0.004
Dense to Very Dense Sand with Fractured Rock (560 to 555)	135	34	1.3	n/a	150	0.004

Note: 1. Allowable bond strength is determined from the Ultimate Bond Stress divided by Factor of Safety of 3.0. Allowable bond strength assumes gravity grouted, straight shaft anchors. Average Ultimate Bond Stress values are referenced from FHWA Geotechnical Engineering Circular No. 4, Table 7 (page 73).

Table 5 – Bedrock Parameters for Lateral Resistance of Earth Retention System

Material (Approximate Top of Bedrock Elevation, feet)	Unit Weight (pcf)	Young's Modulus (psi)	Uniaxial Compressive Strength (psi)	Allowable Bond Stress (ksf) [1]	RQD (%)	Strain (k_m)
Bedrock (560 feet)	150	2×10^6	See Lab Data on Rock Core Logs	9.5 [2]	24% to 96%	0.0001

Note: 1. Allowable bond strength is determined from the Ultimate Bond Stress divided by Factor of Safety of 3.0. Allowable bond strength assumes gravity grouted, straight shaft anchors. Average Ultimate Bond Stress values are referenced from FHWA Geotechnical Engineering Circular No. 4, Table 7 (page 73).
2. Note that allowable bond strength should also be designed for no greater than 25% of the grout strength per FHWA-IF-99-015 (Geotechnical Engineering Circular No. 4), Chapter 5 – Design of Anchored Systems.

7.4 General Wall Design for the Pump Station Wet Well Chamber

Table 6 below provides the recommended earth pressures to be used for design of pump station wet well chamber wall. Earth pressures are influenced by the structural design of the walls, wall restraint conditions, construction methods, as well as backfill materials and compaction.

Table 6 –Lateral Earth Pressure Coefficients for the Pump Station Wet Well Chamber

Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
At-Rest (Ko), Above Water Table	Granular - 0.46	57.5	(0.46)S	(57.5)H
	Cohesive or Mixed Backfill - 0.52	65	(0.52)S	(65)H
At-Rest (Ko), Below Water Table [1]	Granular - 0.46	29	(0.46)S	(29)H
	Cohesive or Mixed Backfill - 0.52	32.5	(0.52)S	(32.5)H

Note: 1. Below water table, the full hydrostatic head (62.4 psf/ft) also needs to be included. Water table should be assumed to be no lower than top of secant pile wall top elevation.

Applicable conditions to the above include:

- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 125 pcf
- Horizontal backfill, compacted between 95 and 98 percent of modified Proctor maximum dry density
- Loading from heavy compaction equipment not included
- With hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters

Allowances should be made for any surcharge loads adjacent to the pump station chamber structure.

7.5 General Construction Considerations for the Pump Station Wet Well Chamber

Where backfill will provide support for other structures adjacent to the pump station wet well chamber wall, it should consist of uniform granular material and be placed in layers of not more than 8-inches in loose thickness. If granular materials (SP, SW, GP and GW) are not specified, settlement in paved areas for approximately 70 feet of embankment fill will likely be in excess of 6 inches and require about 6 months to reach 90% consolidation. We recommend monitoring settlement of the backfill upon embankment fill completion with settlement plates and delaying paving until rate of settlement has subsided to an acceptable rate.

For backfill material requirements placed between the secant wall and permanent walls, backfill should be in compliance with Section 502, Article 202.03, Article 204.02, Article 205.05, and Article 205.06 of the IDOT Standard Specifications for Road and Bridge construction. Backfill behind the wall may consist of compacted, granular material or clay fill. In addition, we recommend limiting top size to no greater than 6 inches in diameter to allow for ease of installation of deep foundations for support of the outside slabs.

We recommend that the backfill be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557(Modified Proctor) method of test due to the amount of fill going in (approximate depth of 70 feet) to limit settlement of the backfill and speed rate of the settlement. Proper moisture control is essential to achieve the desired densities. Compaction requirements should also be applicable to inside the secant pile wall.

Sump pits and pumps and/or dewatering methods may be needed to control groundwater in the deepest excavations based on the groundwater level encountered within the boring strata. Whenever groundwater is encountered, steps should be taken to allow the construction to be completed in relatively dry conditions.

The excavation walls will have to be shored or the sides of the excavations will have to be properly sloped in accordance with OSHA regulations. Movement of adjacent soils near the edge of and into excavation areas (especially the soils near the Des Plaines River) should be prevented. All excavations should be performed in accordance with the latest Occupational Safety and Health Administration (OSHA) requirements. Allowances should be made for any surcharge loads adjacent to the excavation areas.

SECTION 08: FOUNDATION RECOMMENDATIONS FOR THE PUMP STATION BUILDING SUPPORT

8.1 Recommended Foundation Types

Portions of the pump station will be constructed over 70 feet of backfill materials outside the wet well and will require support using deep foundations. Feasible foundation types include end-bearing, non-displacement driven steel H-piles and Drilled Piers extended to top of bedrock. Shallow foundations are not recommended for the portions of the pump station building support due to the variable nature of the underlying fill (if reusing the existing clay material), and the risk of significant total and differential settlements. However, both deep foundation options will experience downdrag due to the anticipated settlement of the backfill, and downdrag loads should be accounted for in the deep foundation design.

Both H-piles and drilled piers are readily available locally. Although we expect that driven H-Piles will be easier to install and will likely be more economical, both foundation types are considered feasible and are discussed in this report. We recommend that the cost and schedule for each foundation option be compared for comparison before choosing a deep foundation system for the design.

A gross downdrag pressure 1 ksf (allowable design parameter; for concrete or steel) is estimated based on 70 feet of new mixed fill materials above the bedrock. If necessary, the piles should be encased with bituminous coating to relieve downdrag stresses caused by the new embankment fill or deep foundations installation be delayed until settlement readings on the fill have slowed to a negligible rate.

8.2 End Bearing H-Pile Recommendations

Based on the results of the borings and proposed foundation loadings, non-displacement H-piles (end-bearing) to top of bedrock may be considered for foundation support. Maximum pile capacity and bearing level data for several steel H-piles is tabulated in Table 7.

Table 7 – Pile Capacity Table
(Estimated pile cut-off near 618 feet, Max Pile Length near 555 feet)

Pile Size	Maximum Nominal Required Bearing of Pile (kips)	Maximum Allowable Resistance Available (kips) [1]
HP 10x42	335	122
HP 12x53	419	152
HP 14x73	578	210

Note: 1. A factor of safety of 2.75 is used for the Maximum Allowable Resistance Available for the H-piles. Downdrag is not included in the Maximum Resistance Available.

We recommend that a minimum of one test pile be performed prior to ordering pile lengths for the project from the Contractor to avoid the potential for splicing on additional pile length if piles drive deeper than static pile calculations predict.

For the new driven piles, it is estimated settlement of ¼ inch or less excluding the elastic shortening of the pile due to loading.

8.3 Drilled Pier Recommendations

A deep foundation system of drilled piers may also be considered for support of the portions of the pump station building over deep fill thicknesses. The end-bearing, drilled piers are expected to extend to top of bedrock (approximate elevation 555 feet). A maximum gross allowable bearing capacity of 36 ksf (per Carter and Kulhawy equation from AASTHO Bridge Manual 10.6.3.2.2), and using a factor of safety of 2.5 could be used in the design.

A minimum caisson shaft diameter of 2.5 feet is recommended. The concrete slump should be in the range of 5 to 7 inches. The recommended minimum 28-day compression strength of the concrete should be 4,000 psi. Caisson concrete may be placed by the free fall method into the clean and dry shaft excavations as long as concrete does not hit the sides of the shaft or the rebar cage during placement. The caissons should be excavated and backfilled with concrete in one work-day shifts.

Due to the expected mixed fill soils to be used as backfill, temporary casing will be needed to maintain open, dry shaft excavation through the backfill.

SECTION 09: PERIMETER RETAINING WALL RECOMMENDATIONS

9.1 Perimeter Retaining Wall Options

Perimeter Retaining Walls are also proposed as part of the IDOT Pump Station #4 expansion improvements. For the proposed perimeter retaining walls (located at the west, east, and south portion of the proposed pump station), cross-sections show that the west, south and southwest portion of the site will be cut walls, and the east portion of the site will be a fill wall. Considering the proposed perimeter retaining walls with exposed retaining wall heights ranging from 5 to 15 feet and based on the review of the boring logs, feasible wall types include:

- Driven Soldier Pile and Lagging or Sheet Pile Walls
- Retaining Walls on Shallow Spread Foundations using:
    - Cast-in-place Cantilever Concrete Wall
    - Mechanically Stabilized Earth (MSE) Wall

Soldier pile and lagging would likely be the most economical wall types for cut walls of those listed. For fill walls, MSE type walls will likely be more cost-effective. However, economic, construction and scheduling factors should be evaluated for the decision of perimeter retaining wall design. Each of the perimeter retaining wall options is discussed in the following subsections:

9.1.1 Driven Soldier Pile and Lagging/Sheet Pile Wall

If driven soldier pile and lagging wall or driven sheet pile wall is selected by the designer for the proposed perimeter retaining walls, soil properties in ***Table 4 – Soil Parameters for Lateral Resistance*** may be used for design of the wall. Support of the wall will be from stiff to hard clay to clay loam soils.

9.1.2 Perimeter Retaining Walls on Shallow Spread Foundations

If shallow spread foundation, either cast-in-place cantilever concrete wall or MSE wall, is selected by the designer for the proposed perimeter retaining walls, estimated bottom of spread footing foundations (approximate elevation 604 feet) may be situated at soft to stiff clay to loose to medium dense sand or loam soils based on the cross-section drawings provided. Due to low strength and high moisture soils encountered at the majority of the wall areas, remedial treatments will be required in order to reach adequate bearing and to ensure that suitable bearing soils are achieved.

Table 8 contains our recommendations for remedial treatments necessary to remove the unsuitable soils beneath the perimeter retaining wall foundations.

Table 8 – Remedial Treatment Recommendations for the Perimeter Retaining Walls

Boring(s)	Subgrade Description (wc %)	Unconfined Compressive Strength (tsf)	Reason for Remedial Treatment	Remedial Treatment [1, 2]
2016-02 and 2016-10	Stiff Silty Clay to Clay Loam (26% to 31%)	1.3 to 1.5	High Moisture Content	Undercut from the estimated bottom of footing elevation 604 to approx. elevation 601 & replace with approved structural fill
2016-03 and 2016-09	Soft to Medium Stiff Silty Clay (33% to 45%)	0.3 to 0.8	Low Strength Soils, High Moisture Content	Undercut from estimated bottom of footing elevation 604 to approx. elevation 600 & replace with approved structural fill
2016-05	Soft to Medium Stiff Silty Clay (25%)	0.3	Low Strength Soils	Undercut from estimated bottom of footing elevation 604 to approx. elevation 601 & replace with approved structural fill
2016-06	Very Loose Silty Sand (29%)	n/a	Loose Soils, High Moisture Content	Undercut from estimated bottom of footing elevation 604 to approx. elevation 602 & replace with approved structural fill or disk, dry, recompact loose soils
2016-08	Soft to Medium Stiff Silty Clay to Loose Silty Sand & Gravel (15% to 24%)	0.4 (Clays)	Low Strength Soils	Undercut from estimated bottom of footing elevation 604 to approx. elevation 602, recompact loose sands & replace with approved structural fill.

Notes: 1. Estimated bottom of retaining wall footing at approximately 604 feet.
2. Verify undercuts in field

We recommend that shallow spread footings founded on top of compacted structural fill or native soils can be designed with a net allowable bearing pressure of 3,000 psf (pounds per square foot) based on a factor of safety (FOS) of 3.0 for the cast-in-place cantilever concrete wall, and a net allowable bearing pressure of 4,500 psf based on a FOS of 2.0 for the MSE wall. The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation soils in excess of the final minimum surrounding overburden pressure.

If soils with less than adequate bearing strength are noted at the foundation level during footing construction, the weaker soils encountered at the base of the footings should be undercut to reach suitable bearing soils, and the undercut area filled with lean concrete or a suitable compacted crushed stone structural fill material. Suitable crushed stone fill materials include materials meeting the gradation requirements of IDOT CA-1, CA-7 and CA-6.

Undercutting (if any) should be performed in such a manner as to minimize disturbance to the undercut subgrade, and heavy equipment traffic directly on the subgrade should be minimized. The actual extent of undercut should be determined in the field and at the time of construction by the geotechnical engineer.

Structural fill utilized to support footings should be extended at least 6 inches beyond the proposed footing limits and then one foot horizontally for each one foot of fill placed below the base of the footing. This new fill should consist of inorganic material free of debris and should be placed in maximum 9-inch loose lifts and compacted to a minimum of 95% of the maximum dry density obtained in accordance with ASTM Standard D-1557, modified Proctor method. If CA-1 or CA-7 crushed stone materials are used, they can be compacted by tamping with a backhoe bucket. The moisture content of the fill should be controlled within ±2% of the optimum moisture content.

To provide adequate frost protection, we recommend that wall footing foundations be situated at a minimum depth of 4 feet (minimum of 3.5 feet for MSE wall) below final grade.

9.2 General Wall Design for the Perimeter Retaining Walls

Table 9 below provides the recommended earth pressures to be used for design of pump station wet well chamber wall. Earth pressures are influenced by the structural design of the walls, wall restraint conditions, construction methods, as well as backfill materials and compaction.

Table 9 –Lateral Earth Pressure Coefficients for the Perimeter Retaining Walls

Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	Granular - 0.33	40	(0.33)S	(40)H
Active (Ka)	Cohesive or Mixed Backfill – 0.42	50	(0.42)S	(50)H
Passive (Kp)	Granular – 3.0	360	--	--
Passive (Kp)	Cohesive or Mixed Backfill – 2.4	290	--	--
At-Rest (Ko)	Granular - 0.46	57.5	(0.46)S	(57.5)H
At-Rest (Ko	Cohesive or Mixed Backfill - 0.52	65	(0.52)S	(65)H

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 125 pcf
- Horizontal backfill, compacted between 95 and 98 percent of standard Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No dynamic loading
- No safety factor included in soil parameters

If no perimeter drainage is proposed, the perimeter walls should be designed for full hydrostatic water pressure (62.4 psf per foot) to top of the wall as well.

Allowances should be made for any surcharge loads adjacent to the retaining structure. Drainage shall be provided behind the wall. The bases of the retaining walls are to be founded in natural clay and undercut areas. According to the NAVFAC Design Manual 7.2, a value of 0.34 may be used for the coefficient of friction (ultimate) between the concrete base and drained cohesive soils (this assumes a concrete base on the stiff cohesive soils). Assuming granular fill, a friction angle of 28 degrees may be used for the concrete on granular fill, leading to a coefficient friction value (ultimate) of 0.53.

9.3 General Construction Considerations for the Retaining Walls

Where backfill will provide support for driveways, sidewalks, steps, or other structures adjacent to the retaining wall, it should consist of uniform granular material and be placed in layers of not more than 8-inches in loose thickness. If granular materials (SP, SW, GP and GW) are not specified, settlement in paved areas for approximately 70 feet of embankment fill will likely be in excess of 6 inches and require about 6 months to reach 90% consolidation. We recommend monitoring settlement of the backfill upon embankment fill completion with settlement plates and delaying paving until rate of settlement has subsided.

For backfill material requirements placed between the secant wall and permanent wall, backfill should be in compliance with Section 502, Article 202.03, Article 204.02, Article 205.05, and Article 205.06 of the IDOT Standard Specifications for Road and Bridge construction. Backfill behind the wall may consist of compacted, granular material or clay fill.

Structural backfill should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor) method of test. Proper moisture control is essential to achieve the desired densities.

Sump pits and pumps and/or dewatering methods may be needed to control groundwater in the deepest excavations based on the groundwater level encountered within the boring strata. Whenever groundwater is encountered, steps should be taken to allow the construction to be completed in relatively dry conditions.

When designing site drainage patterns at the retaining wall, site runoff should be diverted away from the structures. Such measures reduce the potential for softening and possible erosion of the retaining wall foundation soils. It is especially important that water not be allowed to collect next to the structures.

The excavation walls will have to be shored or the sides of the excavations will have to be properly sloped in accordance with OSHA regulations. Movement of adjacent soils near the edge of and into excavation areas (especially the soils near the Des Plaines River) should be prevented. All excavations should be performed in accordance with the latest Occupational Safety and Health Administration (OSHA) requirements. Allowances should be made for any surcharge loads adjacent to the excavation areas.

SECTION 10: PARKING LOT/PAVEMENT RECOMMENDATIONS

It is intended that a newly paved parking lot will be constructed at the southwest section of the proposed IDOT Pump Station #4. Based on the boring information and approximate subgrade level (elevation estimated at 623 feet), pavements will be situated on existing and new fill soils. A summary of the existing fill soils (below elevation 623 feet), are listed in Table 10 on the next page.

Table 10 - Existing Fill Summary

Boring	Approx. Depth of Existing Fill from Existing Ground Level (feet)	Material Description	Average Moisture Content [1]	Average Dry Density (pcf) [2]
2013-01A	25.0	Loose to Medium Dense Silty Clay Loam Fill with Gravel and Stone	12.0%	117.0
2013-02A	23.0	Medium Stiff to Very Stiff Clay Loam Fill	23.4%	106.3
2013-03A	20.0	Stiff to Very Stiff Clay Loam Fill	23.8%	103.7
2013-04	20.0	Medium Stiff to Very Stiff Clay Loam Fill	24.2%	101.2
2013-05A	20.0	Medium Stiff to Very Stiff Clay Loam Fill	21.4%	105.3
2016-01	16.0	Silty Clay to Clay Loam Fill to Clay Loam Fill with Organics	16.3%	107.2
2016-02	24.0	Clay Loam Fill to Clay Loam with Cinders, Brick and Wood Fill	20.8%	99.1
2016-03	24.0	Clay Loam with Cinders and Brick Fill to Crushed Concrete and Stone Fill	26.6%	94.9
2016-04	25.5	Clay Loam with Cinders, Brick and Wood Fill	26.8% (Clay Loam Fill), 213% (Wood)	76.9
2016-05	13.0	Crushed Asphalt and Stone Fill to Clay Loam with Wood & Stone Fill	10.5%	90.0
2016-06	23.0	Wood Fill to Silty Sand, Cinders and Stone Fill	21.0% (Clay Loam Fill), 235% (Wood)	103.0
2016-07	23.0	Clay Loam Fill to Wood, Cinders, Ash and Brick Fill	29% (Wood), 24.3% (Clay Loam, Cinders and Ash Fill),	93.0
2016-08	20.5	Clay Loam Fill with some Wood	22.5%	100.0
2016-09	20.0	Clay Loam Fill to Cinders, Sand, Gravel and Stone Fill	20.2%	102.6
2016-10	10.0	Clay Loam Fill	15.0%	104.0

Notes: 1. Average Moisture Content is based within 10 feet below EL. 623 feet of the existing fill or native soils.
2. Average Dry Density is based based within 10 feet below EL. 623 feet of the existing fill or native soils.

Considering the condition of the existing clay fill below parking lot subgrade elevation (approximate elevation 623 feet) based on the blow-counts, moisture contents, dry densities and soil strengths, the fill soils appear suitable for supporting a parking lot pavement. Note that the existing fill was placed by unknown and likely uncontrolled method; thus, there is some risk of future settlement of the parking lot. However, the boring data did not indicate any voids and the poor areas containing topsoil and/or wood at deeper depths appear localized.

If any unsuitable or soft areas are encountered at the time of construction, it is recommended that these soils be undercut and replaced with an approved embankment fill per IDOT Standard Specifications for Road and Bridge Construction guidelines. The actual extent of stripping and undercutting of unstable soils should be determined in the field at the time of construction by the geotechnical engineer. In addition, standard proctor tests can be performed help estimate the degree of compaction of the existing fill soils.

For the new paved areas, we recommend the stripping of all topsoil (if any) from the surface prior to use. After this stripping operation and before placing any fill, we recommend that the exposed sub base or subgrade be proofrolled. Proofrolling aids in providing a firm subgrade for new pavement and for delineating soft or disturbed areas that may exist at or slightly below the sub base/subgrade level. Proofrolling may be accomplished with a fully loaded, tandem-axle dump truck or other equipment providing an equivalent subgrade loading. A minimum gross weight of 25 tons is recommended for the proofrolling equipment.

New embankment fill should consist of approved low-plasticity cohesive or granular materials that are free of organic matter and debris. The fill should have a maximum of 3 inches nominal particle size. Low plasticity cohesive soil should have a liquid limit of less than 45% and a plasticity index less than 20%, and the moisture content of the fill should not vary by more than ±3% of the optimum moisture content. Suitable granular fill materials include crushed materials meeting the IDOT gradation CA-6. Fill material used in pavement subgrade should also be non-frost susceptible. New fill should be placed in maximum 9-inch loose lifts compacted to a minimum of 95% of the maximum dry density obtained in accordance with ASTM Standard D-698, modified Proctor method.

The fill materials should be placed during weather conditions and at moisture contents that permit the recommended degree of compaction to be obtained. Adjustment in the soil's moisture content may be required to obtain the recommended degree of compaction. The use of clay soils as a fill material during the winter, early spring or late fall will likely be limited because of poor weather conditions. The clay and silty clay soils present at the site are considered suitable for use as fill materials.

In new pavement sections where granular base materials are used over cohesive (clay) subgrade materials, it is possible that water can collect and become trapped causing a

saturated subgrade condition which may soften the subgrade and increase the effects of frost action in these soils resulting in premature deterioration of the pavement section.

The clay fill soils found at the site are sensitive to remolding in the presence of water. Control of surface water from precipitation is required. Active measures, including proper grading and the use of inlets and storm drains, must be taken to properly drain the excavated areas. Construction traffic directly on the subgrade soils should be minimized.

Care should be taken in the design and construction of paved areas to provide rapid drainage of surface water and to develop surface drainage patterns which will divert water away from the pavement edges. When water is allowed to pond on or adjacent to the pavement, the subgrade may become saturated and accelerate pavement deterioration.

During excavation for the proposed improvements, movement of adjacent soils into the excavation should be prevented. All excavations should be performed in accordance with the latest Occupational Safety and Health Administration (OSHA) requirements.

SECTION 11: GENERAL QUALIFICATIONS

The analysis and recommendations presented in this report are based upon the data obtained from the soil borings performed at the indicated locations and from any other information discussed in this report. This report does not reflect any variations that may occur between borings or across the site. In addition, the soil samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. The nature and extent of such variations may not become evident until construction. If variations appear evident, it will be necessary to reevaluate the recommendations of the report. In addition, it is recommended that Geo Services Inc. be retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No other warranties, either expressed or implied, are intended or made. In the event that any changes in the nature, design or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing by the geotechnical engineer. Also note that Geo Services Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of the report's subsurface data or engineering analyses without the express written authorization of Geo Services Inc.

APPENDIX A

GENERAL NOTES

GENERAL NOTES

CLASSIFICATION

American Association of State Highway & Transportation Officials (AASHTO) System used for soil classification.

Cohesionless Soils

Relative Density	No. of Blows per foot N
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	Over 50

TERMINOLOGY

Streaks are considered to be paper thick. **Lenses** are considered to be less than 2 inches thick. **Layers** are considered to be less than 6 inches thick. **Stratum** are considered to be greater than 6 inches thick.

Cohesive Soils

Consistency	Unconfined Compressive Strength - qu (tsf)
Very Soft	Less than 0.25
Soft	0.25 - 0.5
Medium Stiff	0.5 - 1.0
Stiff	1.0 - 2.0
Very Stiff	2.0 - 4.0
Hard	Over 4.0

DRILLING AND SAMPLING SYMBOLS

SS:	Split Spoon 1-3/8" I.D., 2" O.D.	HS:	Housel Sampler
ST:	Shelby Tube 2" O.D., except where noted	WS:	Wash Sample
AS:	Auger Sample	FT:	Fish Tail
DB:	Diamond Bit - NX: BX: AX	RB:	Rock Bit
CB:	Carboloy Bit - NX: BX: AX	WO:	Wash Out
OS:	Osterberg Sampler		

Standard "N" Penetration: Blows per foot of a 140 lb. hammer falling 30" on a 2" O.D. Split Spoon

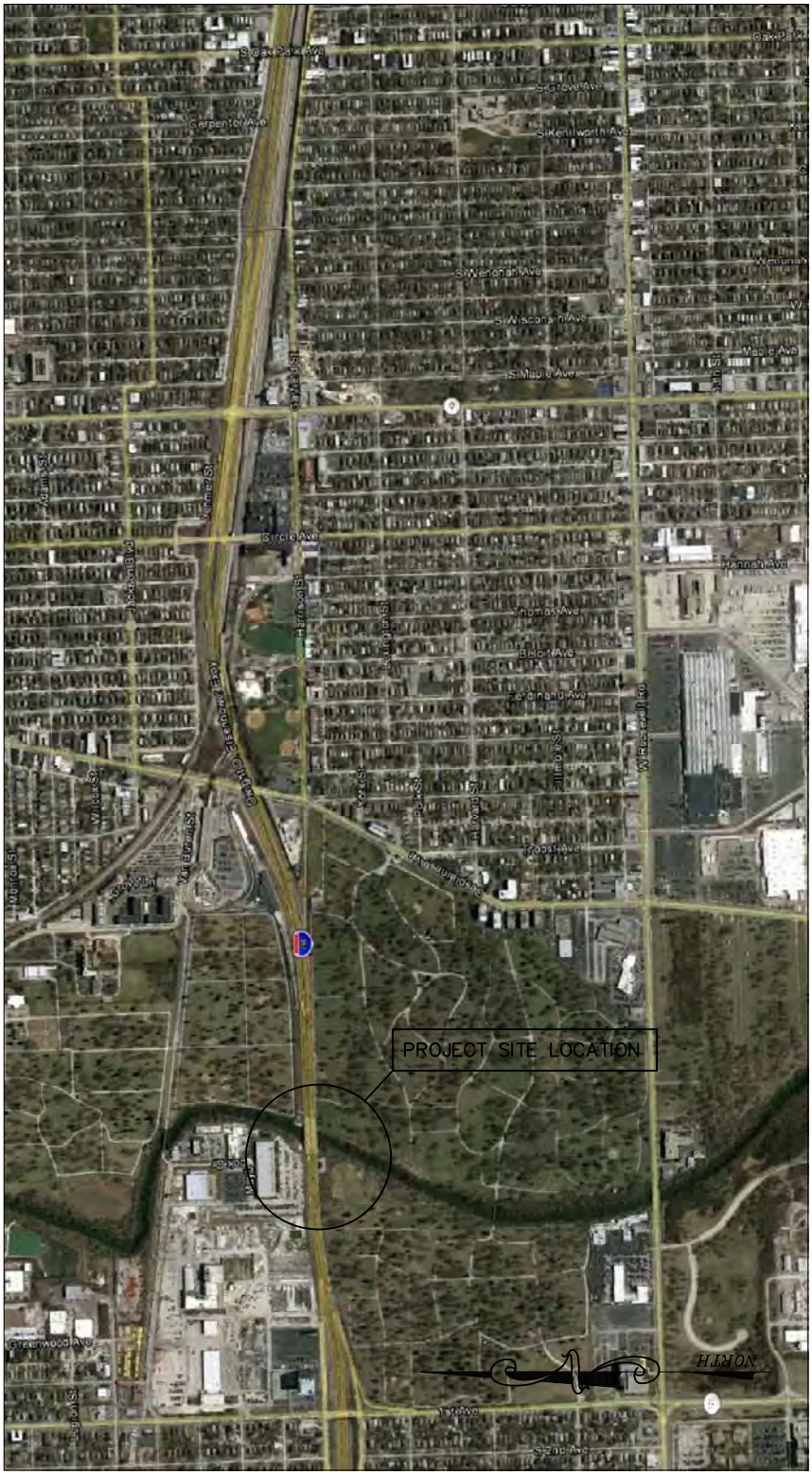
WATER LEVEL MEASUREMENT SYMBOLS

WL:	Water	WD:	While Drilling
WCI:	Wet Cave In	BCR:	Before Casing Removal
DCI:	Dry Cave In	ACR:	After Casing Removal
WS:	While sampling	AB:	After Boring

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In impervious soils, the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence on ground water elevations must be sought.

APPENDIX B

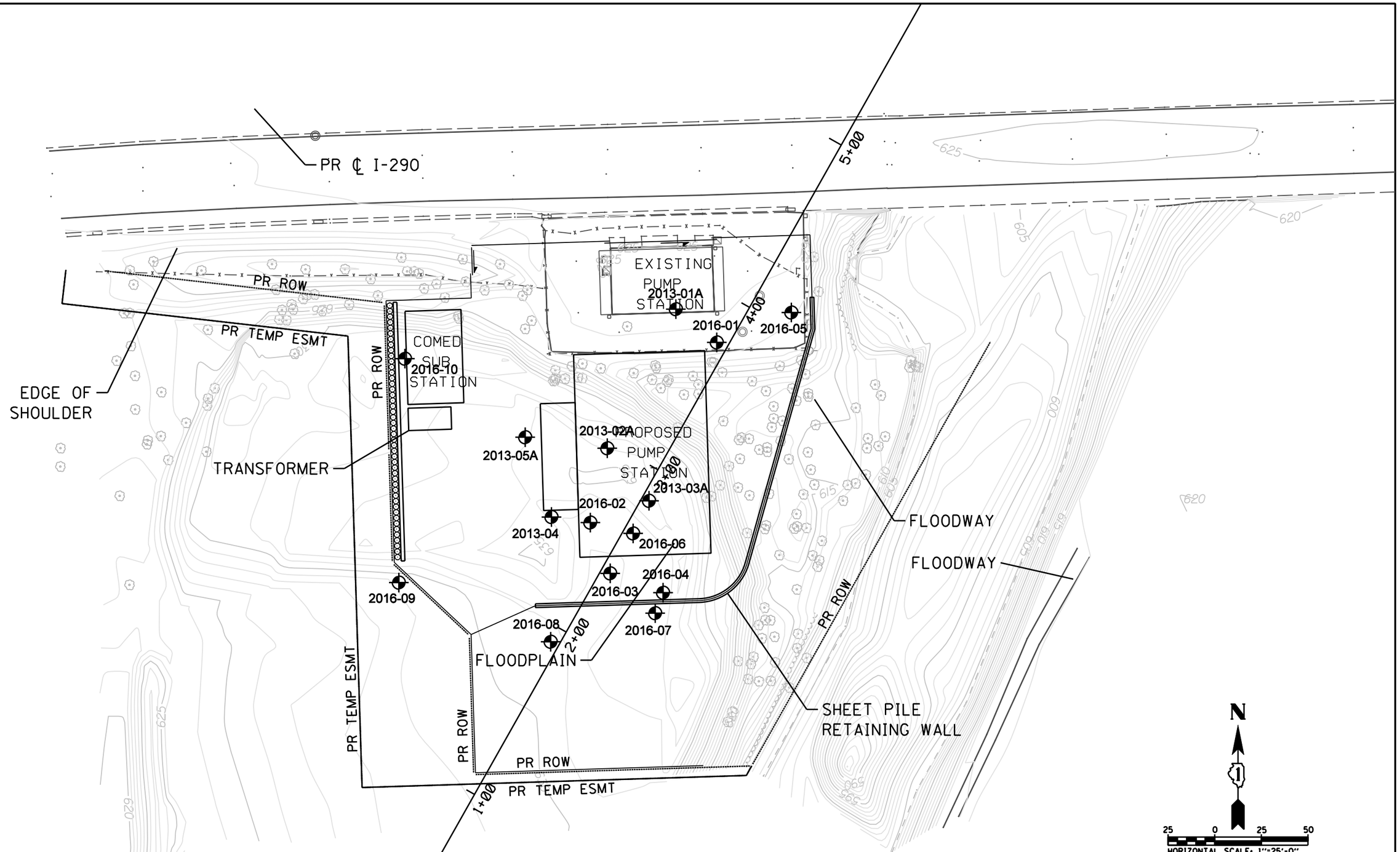
SITE LOCATION PLAN



SITE MAP			
Geotechnical Investigation Report IDOT Pump Station # 4 I–290 & Des Plaines River Cook County, IL	Geo Services, Inc. Geotechnical, Environmental & Civil Engineering 805 Amherst Court, Suite 204 Naperville, Illinois 60565 (630) 355–2838	DRAWN BY	RR
		APPROVED BY	AJP
		DATE	February 27, 2013
		GSI JOB No.	12174
		SCALE	Not To Scale

APPENDIX C

SOIL BORING PLAN AND PROFILES



MODEL NAME = #MODELNAME#
USER NAME = #USER#

PLOT DATE = #DATE#
FILE NAME = #FILE#

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Ambriar Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

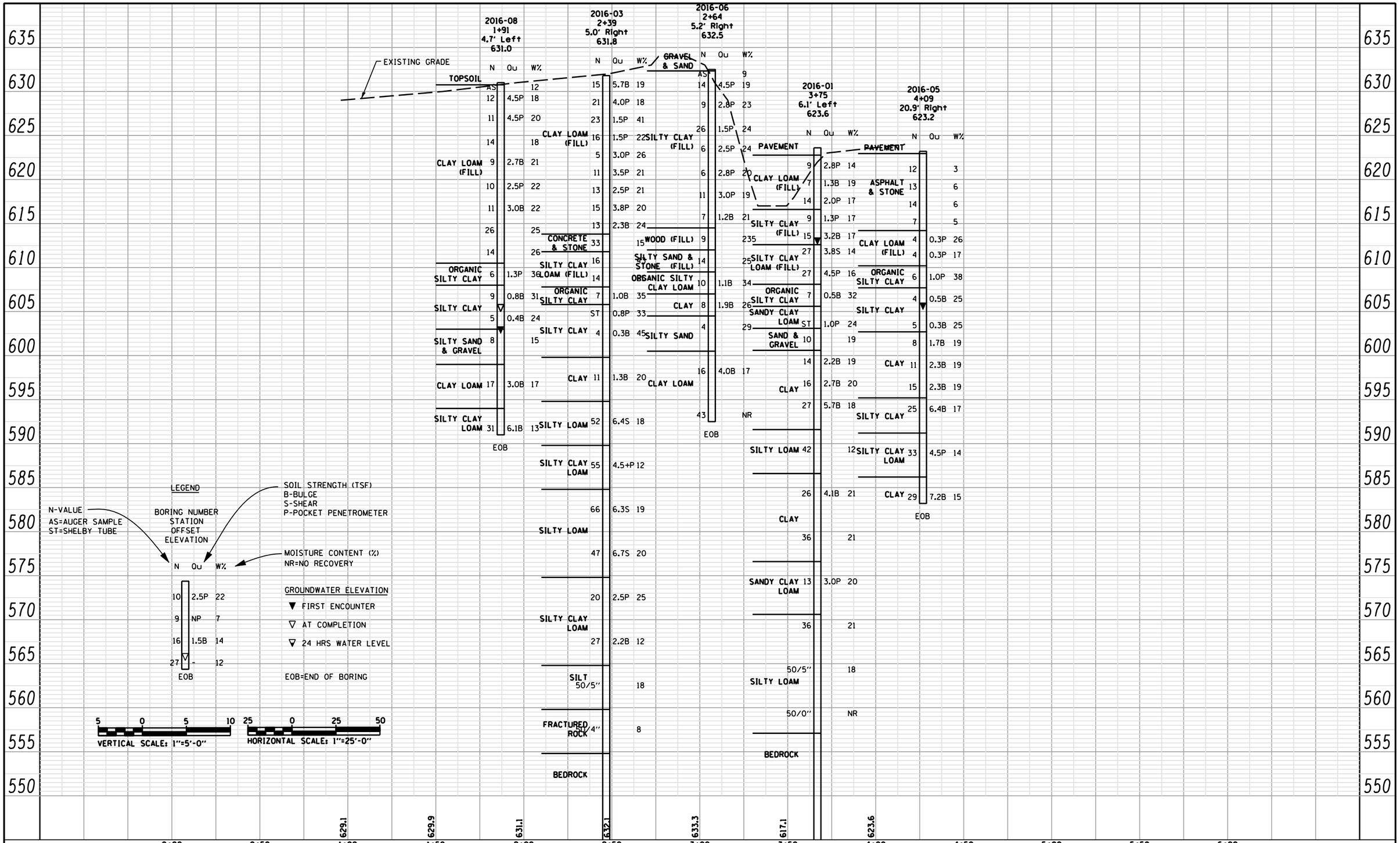
USER NAME =	DESIGNED - RWC	REVISED -
	DRAWN - RWC	REVISED -
PLOT SCALE =	CHECKED - AJP	REVISED -
PLOT DATE =	DATE - 8/18/2016	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT PUMP STATION No. 4
I-290 & THE DES PLAINES RIVER
SOIL BORING PLAN

SCALE: 1"=25' | SHEET NO. 1 OF 1 SHEETS | STA. - TO STA. -

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
-	-	COOK	2	1
		CONTRACT NO. -		
	ILLINOIS FED. AID PROJECT			



MODEL NAME = #MODELNAME#
USER NAME = #USER#

PLOT DATE = #DATE#
FILE NAME = #FILE#

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Ambriar Circle, Suite 204
Naperville, Illinois 60565
(630) 355-2838

USER NAME =		DESIGNED -	RWC	REVISED -	
		DRAWN -	RWC	REVISED -	
PLOT SCALE =		CHECKED -	AJP	REVISED -	
PLOT DATE =		DATE -	8/18/2016	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT PUMP STATION No. 4
I-290 & THE DES PLAINES RIVER
SOIL BORING PROFILE

SCALE: 1"=25'H, 1"=5'V | SHEET NO. 1 OF 1 SHEETS | STA. 0+00 TO STA. 6+00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
-	-	COOK	2	1
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

APPENDIX D

SOIL BORING AND ROCK CORE LOGS

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 1/25/13

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** RJ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2013-01A
Station
Offset
Ground Surface Elev. 623.90 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				5.0" ASPHALT, 6.0" CRUSHED STONE
				622.98
	18			SILTY CLAY LOAM-brown & gray-loose to medium dense (Fill)
	6 5	2.3 P	15	
	3			
	4 7	2.5 B	12	
-5				
	3			
	4 10	1.4 B	17	
	4			
	4 5	3.0 P	17	
-10				
				613.40
	9			CLAY LOAM with Gravel & Stone-dense (Fill)
	18 17		19	
				610.90
	4			SILTY LOAM-gray-loose (Fill)
	3 5	1.9 B	23	
-15				
				608.40
	7			SILTY CLAY LOAM-gray-medium dense (Possible Fill)
	9 5	1.3 P	22	
	4			
	5 14	3.5 P	21	
				603.90
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	5			Clayey GRAVEL with Sand-gray-loose to medium dense (Possible Fill)
	6 8		7	
	13			
	6 4		10	
-25				
				598.40
	3			SILTY CLAY LOAM-gray-loose to medium dense (Possible Fill)
	4 5		1	
	3			
	5 9	2.0 P	16	
-30				
				591.90
	10			Clayey GRAVEL with Sand-gray-dense (Possible Fill)
	11 19		16	
-35				
				585.90
	15			WOOD (Fill) Obstruction
	12 39		93	
				583.90
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 1/25/13

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** RJ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2013-01A
Station
Offset
Ground Surface Elev. 623.90 **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
End Of Boring @ -40.0'. Boring backfilled with cuttings.			
-45			
-50			
-55			
-60			

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion Dry **ft**
After ____ **Hrs.** ____ **ft**

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 1/24/13

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** JZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2013-02A
Station
Offset
Ground Surface Elev. 632.00 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion Dry **ft**
After ____ **Hrs.** ____ **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
			17
	6		
	5	1.0	19
	7	P	
	4		
	5	1.8	19
-5	5	P	
	5		
	4	2.0	22
	5	P	
	3		
	4	1.3	21
-10	5	B	
	3		
	4	1.8	21
	6	B	
	3		
	6	1.2	24
-15	7	B	
	3		
	5	1.4	26
	6	B	
	4		
	5	0.6	25
-20	7	B	
	3		
	5	3.1	16
	6	S	
	3		
	3	1.1	32
-25	6	B	
	3		
	3	0.5	30
	4	B	
	2		
	2		31
-30	6		
	6		
	11	1.9	20
-35	13	B	
	9		
	12	8.1	17
-40	17	S	

CLAY LOAM-brown & gray spotted black-medium stiff to very stiff (Fill)

CLAY LOAM-brown & gray spotted black-medium stiff to very stiff (Fill) *(continued)*

609.00 CLAY LOAM-brown & gray-medium stiff to stiff

604.00 SANDY LOAM with Organics-dark gray-loose

600.00 CLAY-gray-stiff

595.00 SILT-gray-medium dense to dense

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 1/24/13

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** JZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2013-02A
Station
Offset
Ground Surface Elev. 632.00 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT-gray-medium dense to dense *(continued)*			
	10		
-45	14 19	4.5 S	12
585.00			
SILTY CLAY LOAM-gray-stiff			
	10		
-50	11 15	1.4 B	21
580.00			
SILTY LOAM-gray-medium dense			
	7		
-55	11 14	2.6 S	20
	10		
-60	9 7		25
SILTY LOAM-gray-medium dense *(continued)*			
	9		
-65	8 7		29
565.00			
SILT-gray-dense			
	17		
562.50	16		22
-70 SILTY CLAY LOAM with Fractured Rock-gray-very dense	50		
561.50			
Drillers Observation: Cobbles & boulders.			
	50/4"		
-75			8
555.50			
End Of Boring @ -76.5'. Boring backfilled with cuttings.			
-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 1/25/13

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** JZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2013-03A
Station
Offset
Ground Surface Elev. 632.60 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After ____ **Hrs.** ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY LOAM-dark brown & gray spotted black-stiff to very stiff (Fill)			19
	6		
	9	2.5	18
	10	P	
	7		
	6	1.8	25
-5	5	B	
	4		
	5	1.8	23
	6	P	
	3		
	3	1.2	23
-10	4	B	
	3		
	4	1.5	24
	5	P	
	3		
	5	3.0	23
-15	5	P	
trace organics & wood from -16.0' to -17.5'	5		
	7	2.0	25
	9	P	
	5		
	6	2.0	24
612.60 -20	7	P	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
End Of Boring @ -20.0'. Boring backfilled with cuttings.			
-25			
-30			
-35			
-40			

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Page 1 **of** 1

Date 1/24/13

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** JZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2013-04
Station
Offset
Ground Surface Elev. 632.20 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion Dry **ft**
After ____ **Hrs.** ____ **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
			17
	5		
	6	3.8	18
	6	S	
	4		
	5	2.2	22
-5	5	S	
	3		
	4	2.0	23
	5	P	
	4		
	6	4.1	21
-10	9	B	
	4		
	5	1.3	24
	6	B	
	4		
	5	2.4	20
-15	6	B	
	10		
	11	3.0	32
	13	P	
	5		
	6	0.7	24
612.20 -20	7	B	

CLAY LOAM-dark brown & gray spotted black-medium stiff to hard (Fill)

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-25			
-30			
-35			
-40			

End Of Boring @ -20.0'. Boring backfilled with cuttings.

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Page 1 **of** 1

Date 1/24/13

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** JZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2013-05A
Station
Offset
Ground Surface Elev. 631.20 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion Dry **ft**
After ____ **Hrs.** **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
			21
	6		
	5	1.5	22
	7	P	
	3		
	6	2.3	20
-5	9	P	
	4		
	4	1.4	24
	5	B	
	7		
	8	2.4	17
-10	10	B	
	8		
	10	1.4	22
	12	B	
	4		
	5	1.5	20
-15	7	B	
	50/4"		
		0.8	23
		P	
	5		
	5	0.8	25
611.20 -20	6	B	

CLAY LOAM-dark brown & gray spotted black-medium stiff to very stiff (Fill)

End Of Boring @ -20.0'. Boring backfilled with cuttings.

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-25			
-30			
-35			
-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/25/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** RT

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-01
Station
Offset
Ground Surface Elev. 623.60 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter 612.6 ft ▼
Upon Completion n/a ft
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
2.0" ASPHALT, 8.0" CRUSHED STONE 622.93			
CLAY LOAM-brown & gray-stiff to very stiff (Fill)	2		
	4 4 5	2.8 P	14
	3		
	4 3 4	1.3 B	19
-5	3		
	5 6 8	2.0 P	17
616.60			
SILTY CLAY-brown & gray-stiff to very stiff (Fill)	3		
	3 4 5	1.3 P	17
	3		
-10	4 5 16	3.2 B	17
612.60 ▼			
SILTY CLAY LOAM-gray-very stiff to hard (Apparent Fill)	7		
	12 15	3.8 S	14
	16		
	17 10	4.5 P	16
-15			
608.10			
SILTY CLAY with Organics-dark gray-medium stiff	2		
	3 4	0.5 B	32
605.60			
SANDY CLAY LOAM-gray-stiff			
-20	ST		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SANDY CLAY LOAM-gray-stiff *(continued)* 603.10		1.0 P	24
SAND with Gravel-gray-very dense	2		
	4 6		19
600.60			
CLAY-gray-very stiff to hard	3		
	5 9	2.2 B	19
-25			
	5		
	6 10	2.7 B	20
	5		
	11 16	5.7 B	18
-30			
591.60			
SILTY LOAM to LOAM-gray-dense	21		
	21 21		12
-35			
586.60			
CLAY-gray-hard	14		
	12 14	4.1 B	21
-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/25/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** RT

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-01
Station
Offset
Ground Surface Elev. 623.60 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter 612.6 ft ▼
Upon Completion n/a ft
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY-gray-hard *(continued)*			
	15		
	16		21
-45	20		
576.60			
SANDY CLAY LOAM-gray-medium dense			
	6		
	6	3.0	20
-50	7	P	
570.60			
SILTY LOAM-gray-very dense (A-4)			
	6		
	6		21
-55	30		
	30		
	50/5"		18
-60			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY LOAM-gray-very dense (A-4) *(continued)*			
	50/0"		
			NR
-65			
557.10			
Drillers Observation: Apparent Bedrock			
555.10			
Borehole continued with rock coring.			
-70			
-75			
-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/25/2016

LOGGED BY RT

GSI JOB No. 12174

ROUTE –

DESCRIPTION IDOT Pump Station No. 4

SECTION –

LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook

CORING METHOD Rotary Wash

STRUCT. NO. –

CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station –

Core Diameter 2.0 in

BORING NO. **2016-01**

Top of Rock Elev. 557.1

Northing 1122343.3

Begin Core Elev. 555.1

Easting 1896250.3

Ground Surface Elev. 623.6

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	1	96.0	71.0	n/a	804 @ –69.4'
–73.5					
–77.5					

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 1 (–68.5' to –77.5')
Light gray mottled gray & porous with horizontal to wavy bedding. Thin clay parting @ –77.1'.

Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/25/2016

LOGGED BY RT

GSI JOB No. 12174

ROUTE –

DESCRIPTION IDOT Pump Station No. 4

SECTION –

LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook

CORING METHOD Rotary Wash

STRUCT. NO. –

CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station –

Core Diameter 2.0 in

BORING NO. **2016-01**

Top of Rock Elev. 557.1

Northing 1122343.3

Begin Core Elev. 555.1

Easting 1896250.3

Ground Surface Elev. 623.6

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	2	98.0	88.0	n/a	477 @ –79.2'

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 2 (–77.5' to –88.0')
Light gray mottled gray & porous with horizontal to wavy bedding.

–82.5

–88.0

Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/25/2016

LOGGED BY RT

GSI JOB No. 12174

ROUTE –

DESCRIPTION IDOT Pump Station No. 4

SECTION –

LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook

CORING METHOD Rotary Wash

STRUCT. NO. –

CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station –

Core Diameter 2.0 in

BORING NO. **2016-01**

Top of Rock Elev. *557.1*

Northing 1122343.3

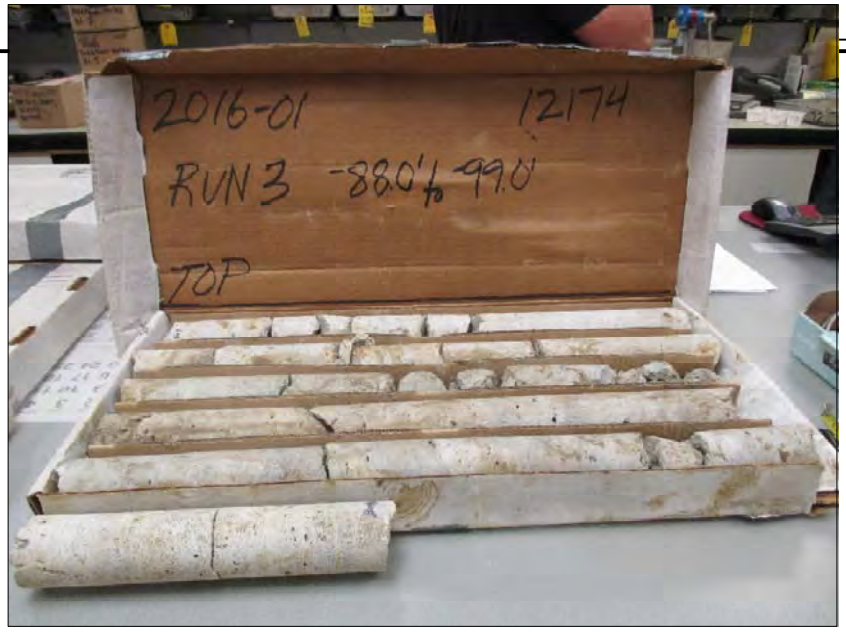
Begin Core Elev. *555.1*

Easting 1896250.3

Ground Surface Elev. *623.6*

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	3	99.0	61.0	n/a	1322 @ –89.3'
–93.0					
–99.0					

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 3 (–88.0' to –99.0')
Light gray mottled gray & porous with horizontal to wavy bedding. Weathered with numerous horizontal fractures throughout. Soft & argillaceous from –92.9' to –94.0'.



Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/21/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** TZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-02
Station
Offset
Ground Surface Elev. 632.50 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry to 24.0' **ft**
Upon Completion n/a **ft**
After ____ **Hrs.** **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DESCRIPTION
	10			CLAY LOAM-brown & gray spotted black-stiff to hard (Fill)
	7 7 8	3.5 P	15	
	7			
	9 9 10	4.4 S	18	
	3			
-5	4 4 5	4.5 P	17	
	2			
	2 3 5	2.3 B	20	
	2			
	2 3 3	3.0 P	19	
-10	3			
	3 6 8 9	4.0 P	18	
	6 7 8 9	3.7 B	19	
				some wood from -14.0' to -16.0'
-15	4 5 6 6	2.5 P	20	
	3 4 4 5	1.1 B	21	some topsoil from -18.0' to -20.0'
	2 3 4	1.1 S	26	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DESCRIPTION
	6			CLAY LOAM-brown & gray spotted black-stiff to hard (Fill) *(continued)* some wood from -20.0' to -22.0'
	3 4 5	2.0 P	44	
610.50				CINDERS with Brick & Wood-black-medium dense (Fill)
	7			
	4 6 10		24	
608.50				SILTY CLAY-dark brown & gray-stiff
	11			
-25	3 4 4 5	1.5 P	24	
	ST	1.5 P	31	
604.00				CLAY to CLAY LOAM-gray-stiff (A-6)
	1			
	2 3	1.3 P	26	
-30				
	2			
	3 4	1.3 B	20	
-35				
595.50				SILTY CLAY LOAM-gray-medium dense to dense
	5			
	12 17	6.0 S	17	
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/21/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** TZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-02
Station
Offset
Ground Surface Elev. 632.50 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry to 24.0' **ft**
Upon Completion n/a **ft**
After ____ **Hrs.** **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY LOAM-gray-medium dense to dense *(continued)*			
	13		
-45	21 33	1.1 B	13
585.50			
CLAY-gray-hard			
	5		
-50	11 15	6.7 B	20
580.50			
SILTY CLAY LOAM-gray-dense			
	9		
-55	26 33	5.6 B	21
575.50			
SILTY CLAY-gray-stiff			
	5		
-60	6 6	1.2 B	27
SILTY CLAY-gray-stiff *(continued)*			
570.50			
SILTY LOAM-gray-medium dense			
	4		
-65	5 6		26
	6		
-70	6 7		26
560.50			
Drillers Observation: Apparent Bedrock 560.00			
	43		
-75	34 50/2"		11
Borehole continued with rock coring.			
-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/21/2016

LOGGED BY TZ

GSI JOB No. 12174

ROUTE – DESCRIPTION IDOT Pump Station No. 4

SECTION – LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook CORING METHOD Rotary Wash

STRUCT. NO. – CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station – Core Diameter 2.0 in

BORING NO. **2016-02** Top of Rock Elev. 556.5

Northing 1122275.5 Begin Core Elev. 556.0

Easting 1896153.6

Ground Surface Elev. 632.5

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	1	91.0	33.0	n/a	1313 @ –76.6'

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 1 (–76.5' to –84.5')
Light gray to gray & slightly porous with horizontal bedding. Highly fractured below –78.1'.

–81.5

–84.5

Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/21/2016

LOGGED BY TZ

GSI JOB No. 12174

ROUTE – DESCRIPTION IDOT Pump Station No. 4

SECTION – LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook CORING METHOD Rotary Wash

STRUCT. NO. – CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station – Core Diameter 2.0 in

BORING NO. **2016-02** Top of Rock Elev. 556.5

Northing 1122275.5 Begin Core Elev. 556.0

Easting 1896153.6

Ground Surface Elev. 632.5

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	2	97.0	37.0	n/a	902 @ –85.6'
–89.5					
–91.5					

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 2 (–84.5' to –91.5')
Light gray mottled gray & porous with horizontal to wavy bedding. Highly fractured & weathered throughout.

Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/25/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** TZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-03
Station
Offset
Ground Surface Elev. 631.80 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry to 27.0' **ft**
Upon Completion n/a **ft**
After ____ **Hrs.** **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	5			CLAY LOAM-brown & gray-stiff to hard (Fill)
	6 7 8	5.7 B	19	
	3			
	6 10 11	4.0 P	18	
	3			some wood from -4.0' to -8.0'
-5	7 10 13	1.5 P	41	
	7			
	5 8 8	1.5 P	22	becoming spotted black @ -8.0'
	2			
	2 2 3	3.0 P	26	
-10	2			
	4 5 6	3.5 P	21	
	4 6 6 7	2.5 P	21	
-15	3 4 7 8	3.8 P	20	
	3 4 6 7	2.3 B	24	
613.80				CRUSHED CONCRETE & STONE-dense (Fill)
	9 10		15	
611.80 -20	22			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	11			SILTY CLAY LOAM with Cinders & Brick-dark brown, gray & black-medium dense (Fill)
	4 6 7 9		43	
	3 4 9		25	
607.80				ORGANIC SILTY CLAY-black-loose
	5			
-25	3 3 3	1.0 B	35	
605.80				SILTY CLAY-dark brown & gray-soft to medium stiff
	4 ST	0.8 P	33	
	1			
	2 2	0.3 B	45	
-30				
599.80				CLAY-gray-stiff
	3			
	5 8	1.3 B	20	
-35				
594.80				SILTY LOAM-gray-dense
	9			
	22 30	6.4 S	18	
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/25/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** TZ

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-03
Station
Offset
Ground Surface Elev. 631.80 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry to 27.0' **ft**
Upon Completion n/a **ft**
After ____ **Hrs.** ____ **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY LOAM-gray-dense *(continued)*			
589.80			
SILTY CLAY LOAM-gray-dense			
	21		
	26	4.5+P	12
-45	29	P	
584.80			
SILTY LOAM-gray-dense			
	14		
	26	6.3	19
-50	40	S	
	13		
	21	6.7	20
-55	26	S	
574.80			
SILTY CLAY LOAM-gray-medium dense			
	9		
	10	2.5	25
-60	10	P	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY LOAM-gray-medium dense *(continued)*			
	10		
	11	2.2	12
-65	16	B	
564.80			
SILT-gray-very dense			
	31		
	50/5"		18
-70			
559.80			
FRACTURED ROCK-gray-very dense			
	29		
	50/4"		8
-75			
554.80			
Drillers Observation: Apparent Bedrock	554.30		
Borehole continued with rock coring.			
-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/25/2016

LOGGED BY TZ

GSI JOB No. 12174

ROUTE –

DESCRIPTION IDOT Pump Station No. 4

SECTION –

LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook

CORING METHOD Rotary Wash

STRUCT. NO. –

CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station –

Core Diameter 2.0 in

BORING NO. **2016-03**

Top of Rock Elev. *554.8*

Northing 1122286.1

Begin Core Elev. *554.3*

Easting 1896126.4

Ground Surface Elev. *631.8*

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	1	100.0	75.0	n/a	1114 @ –79.3'
–82.5					
–87.5					

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 1 (–77.5' to –87.5')
Light gray to gray & porous with horizontal to wavy bedding. Some horizontal fractures throughout.

Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/25/2016

LOGGED BY TZ

GSI JOB No. 12174

ROUTE – DESCRIPTION IDOT Pump Station No. 4

SECTION – LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook CORING METHOD Rotary Wash

STRUCT. NO. – CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station –

BORING NO. **2016-03**

Northing 1122286.1

Easting 1896126.4

Ground Surface Elev. *631.8*

Core Diameter 2.0 in

Top of Rock Elev. *554.8*

Begin Core Elev. *554.3*

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	2	100.0	76.0	n/a	1139 @ –88.5'
–92.5					
–97.5					

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 2 (–87.5' to –97.5')
Light gray to gray & porous with horizontal to wavy bedding.

Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/25/2016

LOGGED BY TZ

GSI JOB No. 12174

ROUTE –

DESCRIPTION IDOT Pump Station No. 4

SECTION –

LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook

CORING METHOD Rotary Wash

STRUCT. NO. –

CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station –

Core Diameter 2.0 in

BORING NO. **2016-03**

Top of Rock Elev. *554.8*

Northing 1122286.1

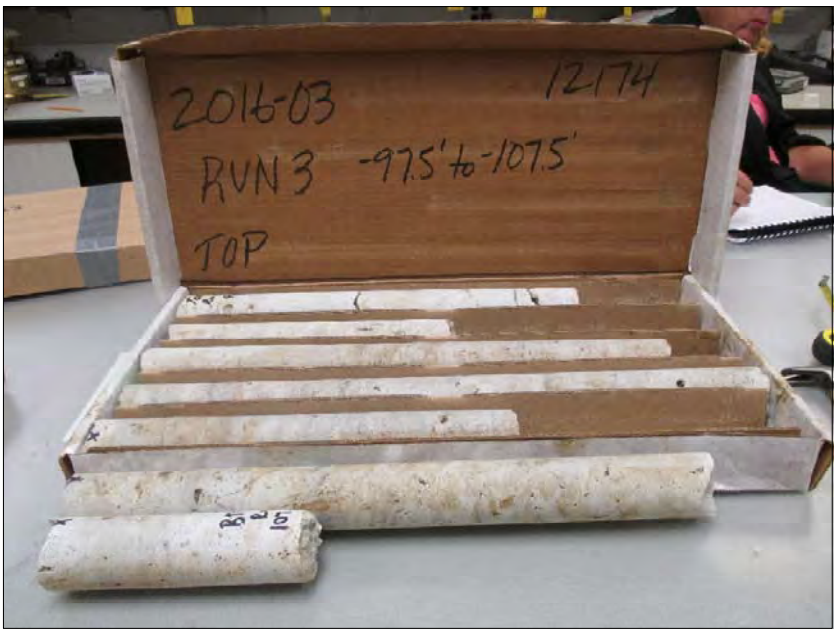
Begin Core Elev. *554.3*

Easting 1896126.4

Ground Surface Elev. *631.8*

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	3	99.0	96.0	n/a	1185 @ –98.4'
–102.5					
–107.5					

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 3 (–97.5' to –107.5')
Light gray mottled gray & porous with horizontal to wavy bedding.



Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/27/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** NW

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-04
Station
Offset
Ground Surface Elev. 632.40 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry to 15.0' **ft**
Upon Completion n/a **ft**
After ____ **Hrs.** **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	4			3.0" TOPSOIL 632.15
	6 6 7	4.5 P	22	SANDY CLAY LOAM-dark brown spotted black-medium dense (Fill)
	4			
	6 5 5	2.5 P	13	
	2			
-5	3 3 4	1.1 B	22	626.40
	2			CLAY LOAM-dark brown spotted black-medium stiff to stiff (Fill)
	2 3 4	0.6 B	24	
	2			
	2 2 4 4	0.9 B	25	
-10	3			
	3 3 4	0.5 B	28	
	2			
	2 2 3 3	1.0 P	26	
-15				
	2			
	2 2	1.0 P	28	
				614.40
	50/5"			WOOD (Fill)
-20			213	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				WOOD (Fill) *(continued)* 611.90
	5			CLAY LOAM with Brick & Cinders-dark brown, gray & black-loose (Fill)
	2 3	1.5 P	31	
	4			
-25	2 3		NR	
				606.90
	2			SILTY CLAY-brown & gray-very soft
	2 2	0.2 B	29	
				604.40
	ST			SILTY SAND-dark gray
-30			30	
				600.40
	5			CLAY to CLAY LOAM-gray-very stiff to hard
-35	8 11	2.9 B	21	
	9			
-40	13 16	4.9 B	16	

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/27/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** NW

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-04
Station
Offset
Ground Surface Elev. 632.40 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry to 15.0' **ft**
Upon Completion n/a **ft**
After ____ **Hrs.** ____ **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY to CLAY LOAM-gray-very stiff to hard *(continued)*			
590.40			
SILTY CLAY LOAM-gray-very dense			
	17		
	22	3.9	15
-45	34	B	
585.40			
SILTY LOAM-gray-dense to very dense			
	20		
	29		18
-50	37		
	14		
	19		21
-55	23		
575.40			
SILTY CLAY LOAM-gray-very dense			
	24		
	39	7.0	11
-60	50/4"	B	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY LOAM-gray-very dense *(continued)*			
	50/5"		
		5.1	11
-65		B	
565.40			
SILT-gray-very dense			
	33		
	50/5"		20
-70			
560.40			
CLAYEY SAND, GRAVEL & FRACTURED ROCK-gray-very dense			
	50/5"		
			8
-75			
554.40			
Borehole continued with rock coring.			
-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/27/2016

LOGGED BY NW

GSI JOB No. 12174

ROUTE –

DESCRIPTION IDOT Pump Station No. 4

SECTION –

LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook

CORING METHOD Rotary Wash

STRUCT. NO. –

CORING BARREL TYPE & SIZE NX Double Swivel–10 ft

Station –

Core Diameter 2.0 in

BORING NO. **2016-04**

Top of Rock Elev. 554.4

Northing 1122314.5

Begin Core Elev. 554.4

Easting 1896116.0

Ground Surface Elev. 632.4

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	1	93.0	49.0	n/a	1083 @ –81.3'
–93.0					
–88.0					

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 1 (–78.0' to –88.0')
Light gray & porous with horizontal bedding. Weathered & highly fractured throughout.

Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

ROCK CORE LOG

DATE 7/27/2016

LOGGED BY NW

GSI JOB No. 12174

ROUTE –

DESCRIPTION IDOT Pump Station No. 4

SECTION –

LOCATION SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM

COUNTY Cook

CORING METHOD Rotary Wash

STRUCT. NO. –

CORING BARREL TYPE & SIZE NX Double Swivel–5 ft

Station –

Core Diameter 2.0 in

BORING NO. **2016-04**

Top of Rock Elev. 554.4

Northing 1122314.5

Begin Core Elev. 554.4

Easting 1896116.0

Ground Surface Elev. 632.4

DEPTH (ft)	CORE RUN (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
	2	94.0	24.0	n/a	782 @ –88.7'

SILURIAN SYSTEM, NIAGARAN SERIES DOLOMITE
RUN 2 (–88.0' to –93.0')
Light gray & porous with horizontal bedding. Vertical fractures from –89.6' to –91.4' & from –91.9' to –93.0'.

–93.0

Color pictures of the cores Yes Cores will be stored for examination for –

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D–2938)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Page 1 **of** 1

Date 7/26/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** TC

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** HSA/Mud Rotary **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-05
Station
Offset
Ground Surface Elev. 623.20 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter 605.2 ft ▼
Upon Completion n/a ft
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				3.0" ASPHALT 622.95
				CRUSHED ASPHALT & STONE-loose to medium dense (Fill)
	5			
	5		3	
	6			
	6			
	5			
	5		6	
	6			
-5	7			
	5			
	6		6	
	7			
	7			
	6			
	4		5	
	3			
	4			614.20
	4			CLAY LOAM with Wood & Stone-dark gray to black-soft (Fill)
-10	3	0.3 P	26	
	2			
	2			
	3			
	2	0.3 P	17	
	2			
				610.20
				ORGANIC SILTY CLAY-black-loose
	3			
	3	1.0 P	38	
-15	3			
				607.70
				SILTY CLAY-dark gray-soft to medium stiff
	2			
	2	0.5 B	25	
	2			
				▼
				becoming brown & gray @ -18.5'
-20	2			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				602.70
	2	0.3	25	CLAY-gray-stiff to very stiff
	3	B		
	3			
	4	1.7	19	
	4	B		
	4			
	5	2.3	19	
-25	6	B		
	6			
	7	2.3	19	
	8	B		
				595.20
				SILTY CLAY-gray-hard
	10			
	12	6.4	17	
-30	13	B		
				591.20
				SILTY CLAY LOAM-gray-dense
	10			
	15	4.5	14	
-35	18	P		
				586.20
				CLAY-gray-hard
	12			
	14	7.2	15	End Of Boring @ -40.0'. Boring backfilled with cuttings.
-40	15	B		583.20

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/28/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** NW

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-06
Station
Offset
Ground Surface Elev. 632.50 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
632.33				2.0" SILTY SAND & GRAVEL-brown (Fill)
			9	
	5			CLAY LOAM-dark brown spotted black-stiff to hard (Fill)
	7	4.5	19	
	7	P		
	4			
	4	2.8	23	
-5	5	P		
	2			
	9	1.5	24	
	17	P		
	2			
	3	2.5	24	
-10	3	P		
	2			
	2	2.8	20	
	4	P		
	3			
	5	3.0	19	
-15	6	P		
	3			
	3	1.2	21	
	4	B		
614.50				WOOD (Fill)
	2			
	3		235	
-20	6			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
612.00				WOOD (Fill) *(continued)*
	3			SILTY SAND, CINDERS & STONE-dark gray & black-medium dense (Fill)
	7		25	
609.50	7			
	3			SILTY CLAY LOAM with Organics-dark gray-stiff (A-6)
-25	5	1.1	34	
	5	B		
607.00				CLAY-gray-stiff
	2			
	4	1.9	26	
	4	B		
604.50				SILTY SAND-dark gray-very loose
	2			
	2		29	
-30	2			
600.50				CLAY LOAM-gray-hard
	5			
	7	4.0	17	
-35	9	B		
	8			
	17		NR	End Of Boring @ -40.0'. Boring backfilled with cuttings.
592.50 -40	26			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/1/40

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** NW

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-07
Station
Offset
Ground Surface Elev. 632.60 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter 600.6 ft ▼
Upon Completion 605.6 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
632.43				2.0" SILTY SAND & GRAVEL-brown (Fill)
			7	
	6			CLAY LOAM-dark brown spotted black-stiff to hard (Fill)
	4	4.5	20	
	7	P		
	3			
	3	2.5	21	
-5	4	P		
	2			
	3	1.3	32	
	10	P		
624.60				WOOD (Fill)
	3			
	2		NR	
-10	3			
	6			
	7		29	
	4			
619.60				CLAY LOAM-dark brown spotted black-very stiff (Fill)
	2			
	3	3.0	22	
-15	5	P		
	4			
	5	2.0	23	
	6	P		
614.60				SILTY CLAY LOAM with Cinders & Brick-black-loose (Fill)
	2			
	3	2.0	23	
-20	5	P		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
612.10				CINDERS & ASH-brown & gray-loose (Fill)
	2			
	2		55	
	3			
609.60				SILTY CLAY-dark brown & gray-medium stiff to very stiff
	3			
	3	2.0	28	
-25	4	P		
	2			
▽	2	0.8	30	
	2	B		
604.60				SAND-brown & gray-medium dense
	2			
	3		27	
-30	5			
600.60 ▼				CLAY LOAM-gray-very stiff
	3			
	5	3.3	20	
-35	6	B		
595.60				SILTY CLAY LOAM-gray-dense
	7			
	16	3.4	19	End Of Boring @ -40.0'. Boring backfilled with cuttings.
592.60 -40	24	B		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Page 1 **of** 1

Date 7/29/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** NW

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-08
Station
Offset
Ground Surface Elev. 631.00 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter 602.5 ft ▼
Upon Completion 605.0 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				3.0" CLAYEY TOPSOIL 630.75
			12	CLAY LOAM-dark brown spotted black-very stiff to hard (Fill)
	4			
	6	4.5	18	
	6	P		
	3			
	5	4.5	20	
-5	6	P		
	3			
	7		18	
	7			
	3			
	4	2.7	21	
-10	5	B		
	3			
	5	2.5	22	
	5	P		
	3			
	5	3.0	22	
-15	6	B		
	3			
	8		25	
	18			
	5			some wood from -18.5' to -20.0'
	7		26	
-20	7			
				610.50
				SILTY CLAY with Organics-black-loose
	2			
	3	1.3	36	
	3	P		
				608.00
	3			SILTY CLAY-dark brown & gray-soft to medium stiff
	4	0.8	31	
-25	5	B		
	2			▽
	2	0.4	24	
	3	B		
				603.00
	3			SILTY SAND & GRAVEL-gray-loose ▼
	3		15	
-30	5			
				599.00
	5			CLAY LOAM-gray-very stiff
	7	3.0	17	
-35	10	B		
				594.00
	10			SILTY CLAY LOAM-gray-hard
	14	6.1	13	
-40	17	B		End Of Boring @ -40.0'. Boring backfilled with cuttings. 591.00

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Date 7/29/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** NW

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-09
Station
Offset
Ground Surface Elev. 629.10 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter 609.6 ft ▼
Upon Completion 610.1 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				2.0" TOPSOIL with Wood & Stone-dark brown & black (Fill) 628.93
			11	
	5			CLAY LOAM-dark brown spotted black-stiff to hard (Fill)
	4 5	1.7 B	22	
	2			
	3 5	2.8 P	26	
-5				
	4			
	4 7	4.8 B	20	
	4			
	7 11	6.6 B	18	
-10				
	2			
	4 5	2.8 P	22	
	2			
	2 2	1.4 B	23	
-15				
				613.60
	2			CINDERS, SAND & STONE-black-loose (Fill)
	3 3		18	
				611.10
	4			SILTY SAND, GRAVEL & STONE-dark brown & gray-medium dense (Fill) ▽ ▼
	7 9		25	
-20				609.10

End Of Boring @ -20.0'. Boring backfilled with cuttings.

-25 -30 -35 -40

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

GSI Job No. 12174

SOIL BORING LOG

Page 1 **of** 1

Date 7/28/16

ROUTE - **DESCRIPTION** IDOT Pump Station No. 4, I-290 & Des Plaines River, Cook County, Il. **LOGGED BY** NW

SECTION - **LOCATION** SE 1/4, **SEC.** 14, **TWP.** T39N, **RNG.** R12E, 3rd **PM**

COUNTY Cook **DRILLING METHOD** Hand Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. -
Station -

BORING NO. 2016-10
Station
Offset
Ground Surface Elev. 631.60 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion Dry **ft**
After ____ **Hrs.** ____ **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
CLAY LOAM-dark brown spotted black-medium stiff to very stiff (Fill)	HA			
		2.1 P	20	
	HA			
		0.9 P	20	
	HA			
-5		2.1 P	20	
	HA			
		1.5 P	21	
	HA			
		3.5 P	15	
621.60 -10				
End Of Boring @ -10.0'. Boring backfilled with cuttings.				
-15				
-20				

Z:\PROJECTS\2012\12174 HDR, IDOT PUMP STATION #4\12174 BORING LOGS\12174_LOG.GPJ 8/26/16

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

APPENDIX E

LAB TESTING RESULTS

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm

1235 E. Davis Street
Arlington Heights, Illinois 60005
Phone: (847) 253-3845 Fax: (847) 253-0482

UNCONFINED COMPRESSIVE STRENGTH of INTACT ROCK CORE SPECIMENS - ASTM D 7012

Project Name: IDOT Pump Station No. 4
Location: SE 1/4 SEC. 14, TWP. T39N, RNG. R12E, 3rd PM
County: Cook
Sample Type: Drilled Bedrock Core Sample

Date: 8/20/16
Job No.: 12174
Tested By: RWC

Sample No.	Depth (ft)	Length (in)	Diameter (in)	Weight (g)	Load (lbs)	Area (in^2)	Unit Weight ($lbs\ ft^3$)	Compressive Strength (tsf)	(psi)
2016-01 Run 1	-69.4	4.077	2.049	568.7	36820	3.30	161.1	804	11166
2016-01 Run 2	-79.2	4.067	2.054	554.2	21940	3.31	156.6	477	6621
2016-01 Run 3	-89.3	4.066	2.056	576.7	60950	3.32	162.7	1322	18358
2016-02A Run 1	-76.6	4.075	2.054	588.2	60410	3.31	165.9	1313	18231
2016-02A Run 2	-85.6	4.077	2.061	584.6	41790	3.34	163.7	902	12526
2016-03 Run 1	-79.3	4.075	2.037	574.4	50420	3.26	164.7	1114	15471
2016-03 Run 2	-89.5	4.075	2.060	577.8	52730	3.33	162.0	1139	15821
2016-03 Run 3	-98.4	4.086	2.054	578.0	54520	3.31	162.6	1185	16454
2016-04A Run 1	-81.3	4.077	2.055	596.5	49910	3.32	168.0	1083	15048
2016-04A Run 2	-88.7	4.073	2.054	577.4	36000	3.31	162.9	782	10865

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm

1235 East Davis Street, Suite 101
Arlington Heights, IL 60005
(847) 253-3845

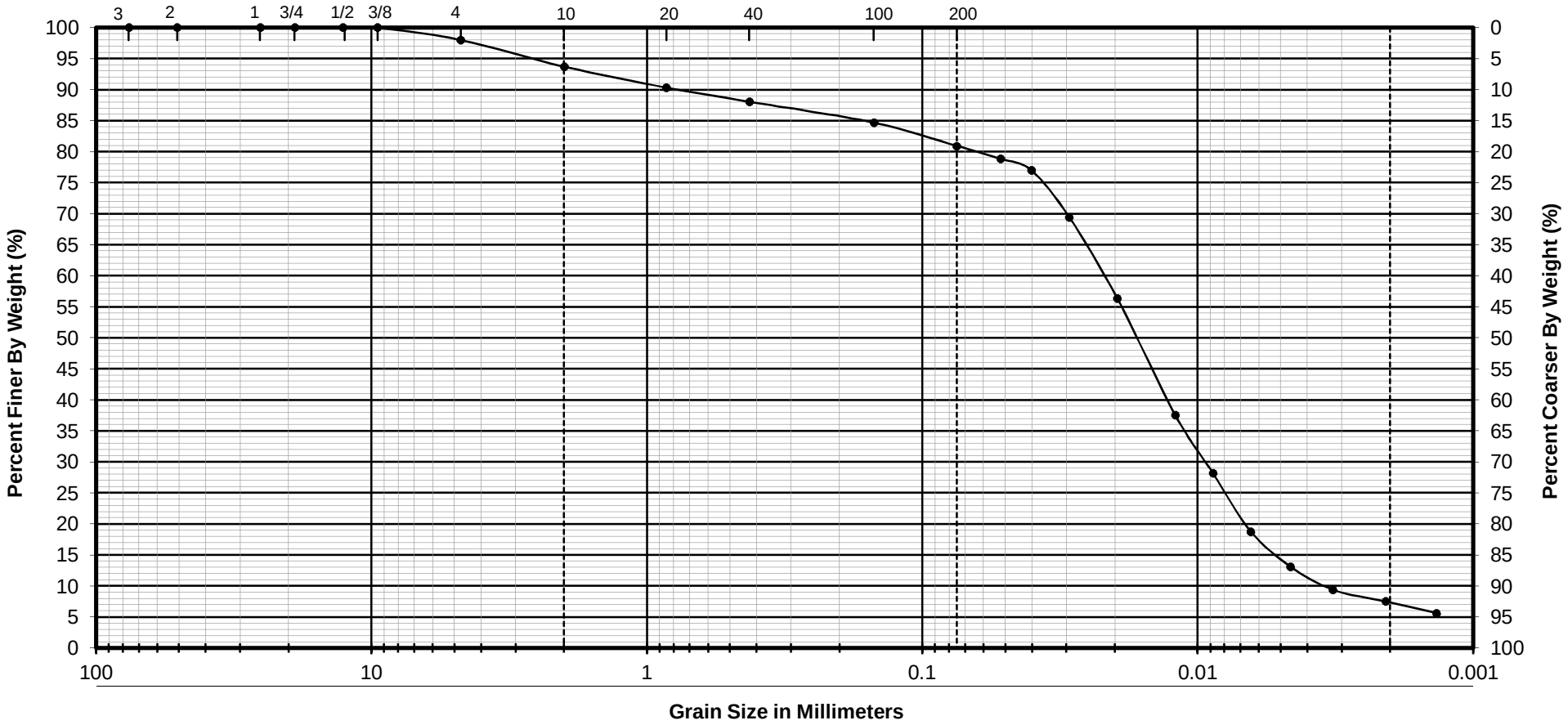
Liquid Limit, Plastic Limit, and Plasticity Index of Soils
AASHTO T89/T90

Project Name IDOT Pump Station No. 4, I-290 & Des Plaines River Job No 12174

Location Cook County, Illinois Date 8/17/16

SAMPLE NO.	2016-01, S-19	2016-02A, S-15	2016-02A, ST-14	2016-03, ST-14	2016-06A, S-11	2016-10A, S-5
DEPTH	53.5'-55.0'	28.5'-30.0'	26.0'-28.0'	26.0'-28.0'	23.5'-25.0	8.0'-10.0'
LIQUID LIMIT (LL)	21	24	33	39	40	27
PLASTIC LIMIT (PL)	20	13	14	16	20	13
PLASTICITY INDEX (PI)	1	11	19	23	20	14

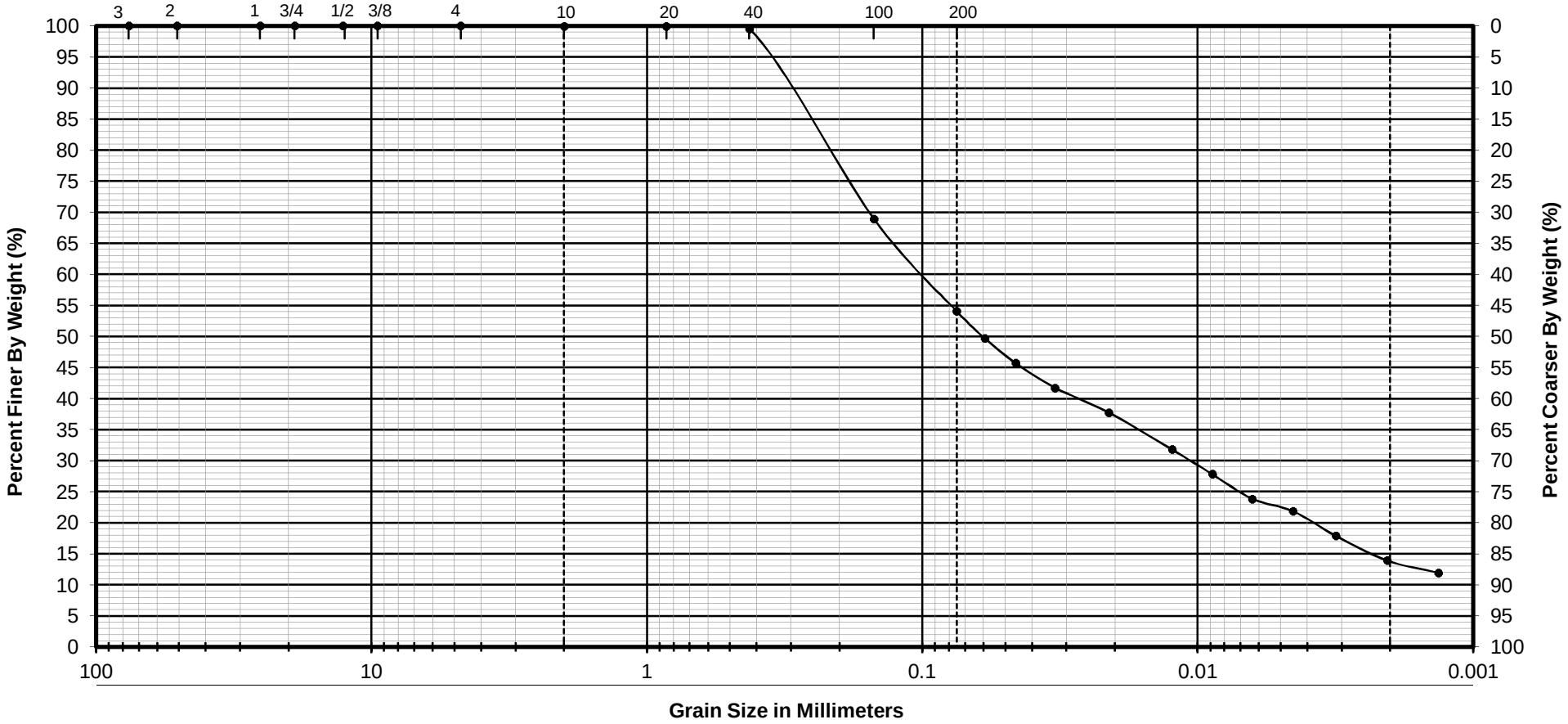
Test by MT



GRAVEL	SAND		SILT	CLAY
	COARSE	FINE		

Boring No.	2016-01	CLASSIFICATION		PARTICLE SIZE ANALYSIS-AASHTO T88
Sample No.	19			
Depth	53.5'-55.0'	SILTY LOAM		IDOT Pump Station No. 4
Liquid Limit	21	A-4		I-290 & Des Plaines River
Plastic Limit	20	gray		Cook County, Illinois
Plasticity Index	1	Group Index	0	
Test By	VH/MT	% Gravel	6.3	
Date	8/17/16	% Sand	12.8	
Reviewed By	RR	% Silt	73.4	1235 E. Davis St., Arlington Heights, IL 60005
Job No	12174	% Clay	7.5	Phone 847-253-3845 • Fax 847-253-0482

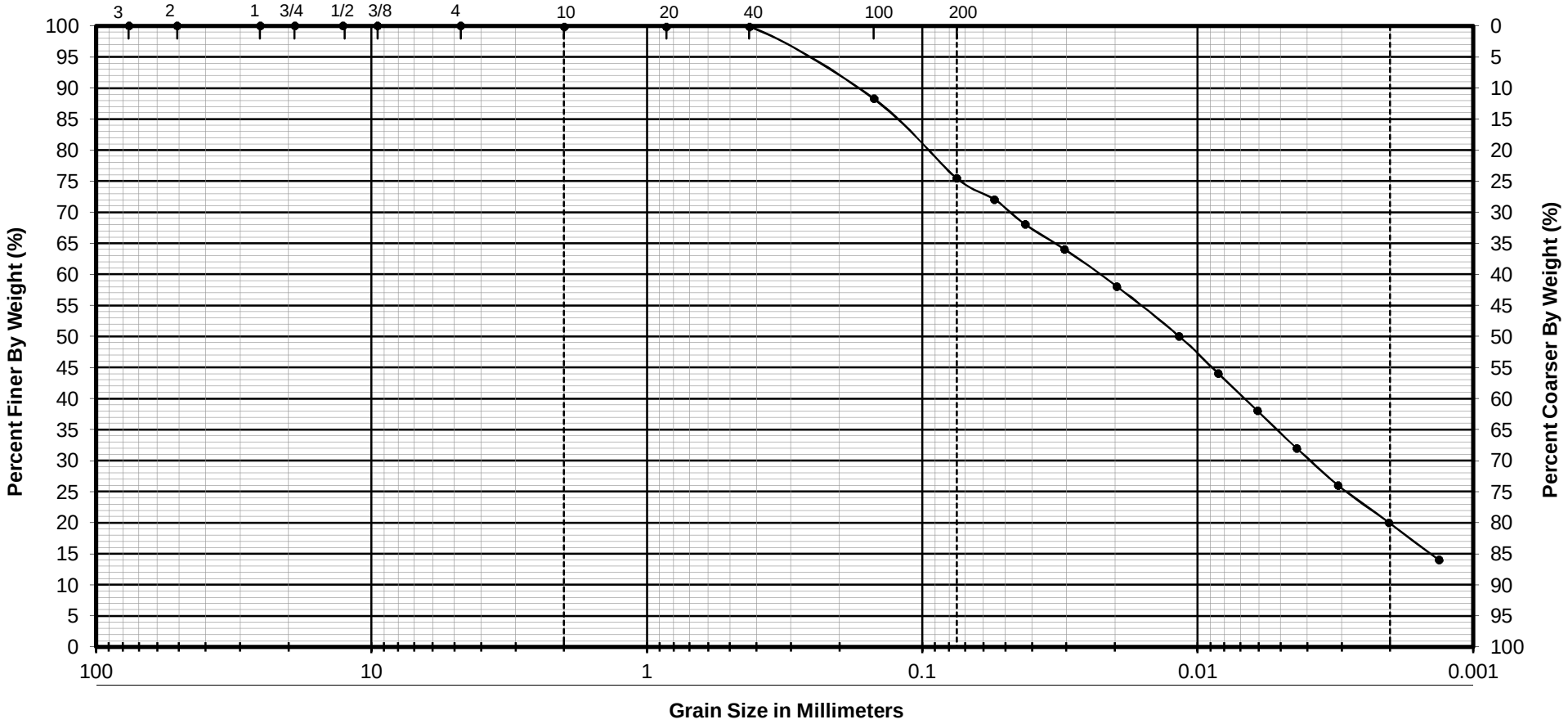
Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm



GRAVEL	SAND		SILT	CLAY
	COARSE	FINE		

Boring No.	2016-02	CLASSIFICATION		PARTICLE SIZE ANALYSIS-AASHTO T88
Sample No.	15			
Depth	28.5'-30.0'	LOAM		IDOT Pump Station No. 4
Liquid Limit	24	A-6		I-290 & Des Plaines River
Plastic Limit	13	gray		Cook County, Illinois
Plasticity Index	11	Group Index	3	
Test By	VH/MT	% Gravel	0.0	
Date	8/17/16	% Sand	45.9	
Reviewed By	RR	% Silt	40.1	
Job No	12174	% Clay	13.9	

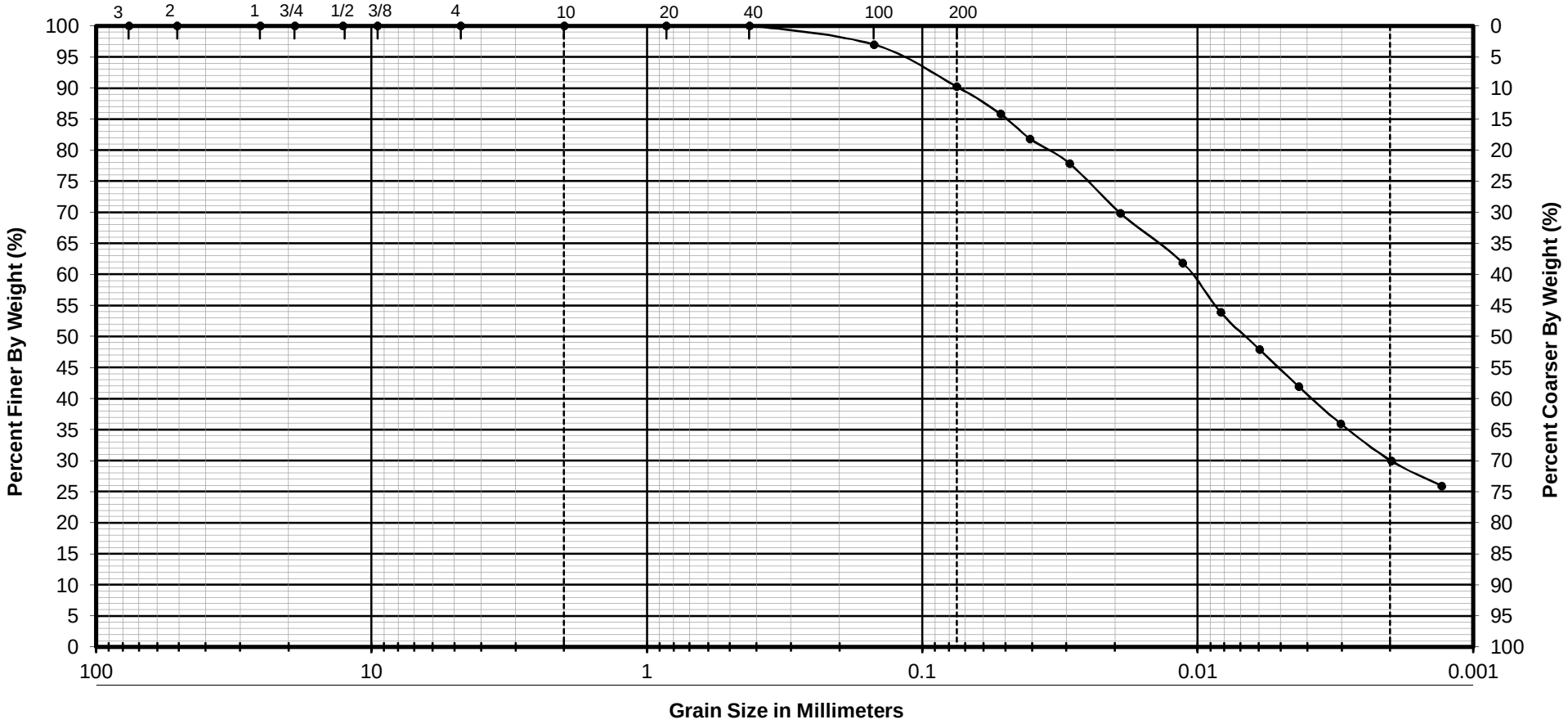
Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm
1235 E. Davis St., Arlington Heights, IL 60005
Phone 847-253-3845 • Fax 847-253-0482



GRAVEL	SAND		SILT	CLAY
	COARSE	FINE		

Boring No.	2016-02	CLASSIFICATION		PARTICLE SIZE ANALYSIS-AASHTO T88
Sample No.	14			
Depth	26.0'-28.0'	SILTY CLAY LOAM		IDOT Pump Station No. 4
Liquid Limit	33	A-6		I-290 & Des Plaines River
Plastic Limit	14	gray		Cook County, Illinois
Plasticity Index	19	Group Index	12	
Test By	VH/MT	% Gravel	0.1	
Date	8/17/16	% Sand	24.4	
Reviewed By	RR	% Silt	55.5	
Job No	12174	% Clay	20.0	

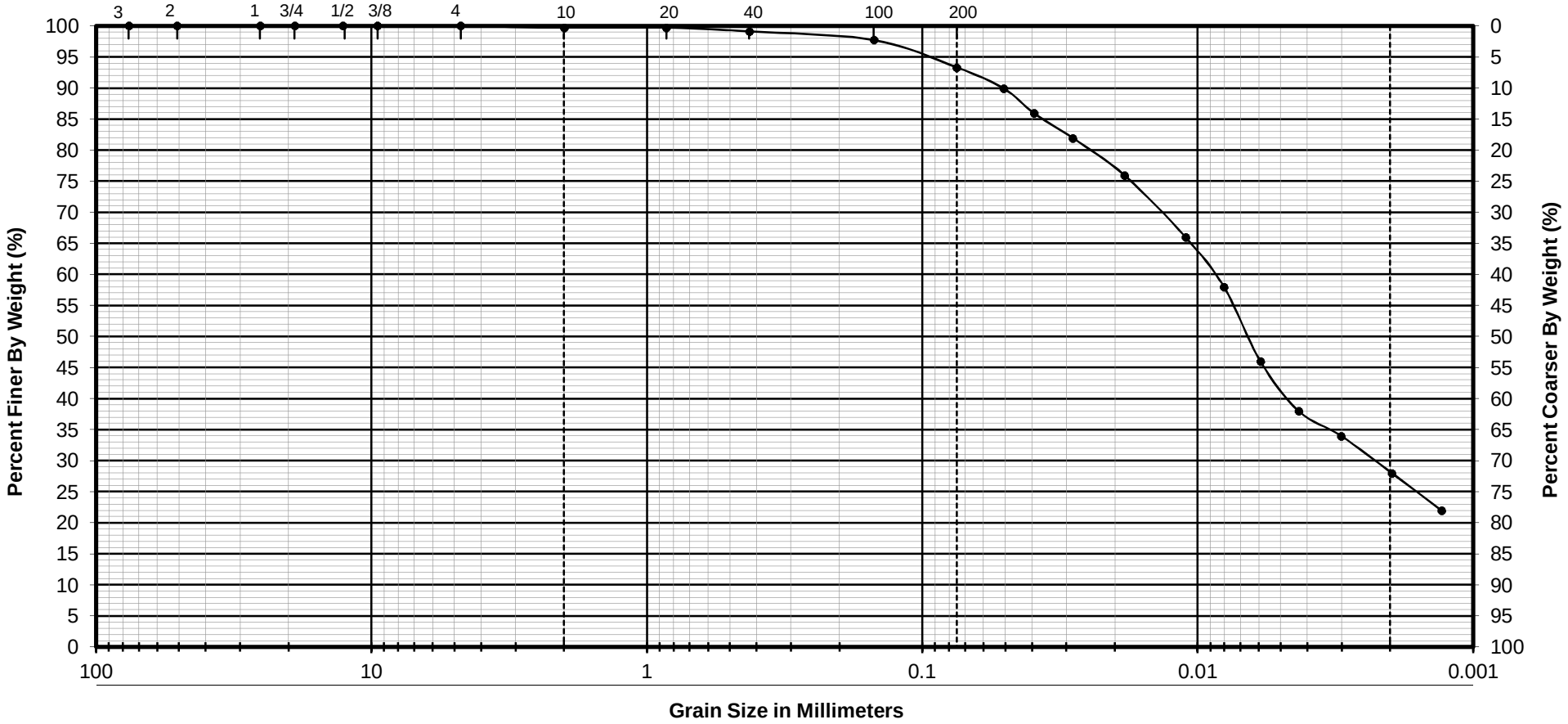
Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm
1235 E. Davis St., Arlington Heights, IL 60005
Phone 847-253-3845 • Fax 847-253-0482



GRAVEL	SAND		SILT	CLAY
	COARSE	FINE		

Boring No.	2016-03	CLASSIFICATION		PARTICLE SIZE ANALYSIS-AASHTO T88
Sample No.	14			
Depth	26.0'-28.0'	SILTY CLAY LOAM		IDOT Pump Station No. 4
Liquid Limit	39	A-6		I-290 & Des Plaines River
Plastic Limit	16	gray		Cook County, Illinois
Plasticity Index	23	Group Index	20	
Test By	VH/MT	% Gravel	0.0	
Date	8/17/16	% Sand	9.8	
Reviewed By	RR	% Silt	60.3	
Job No	12174	% Clay	29.9	

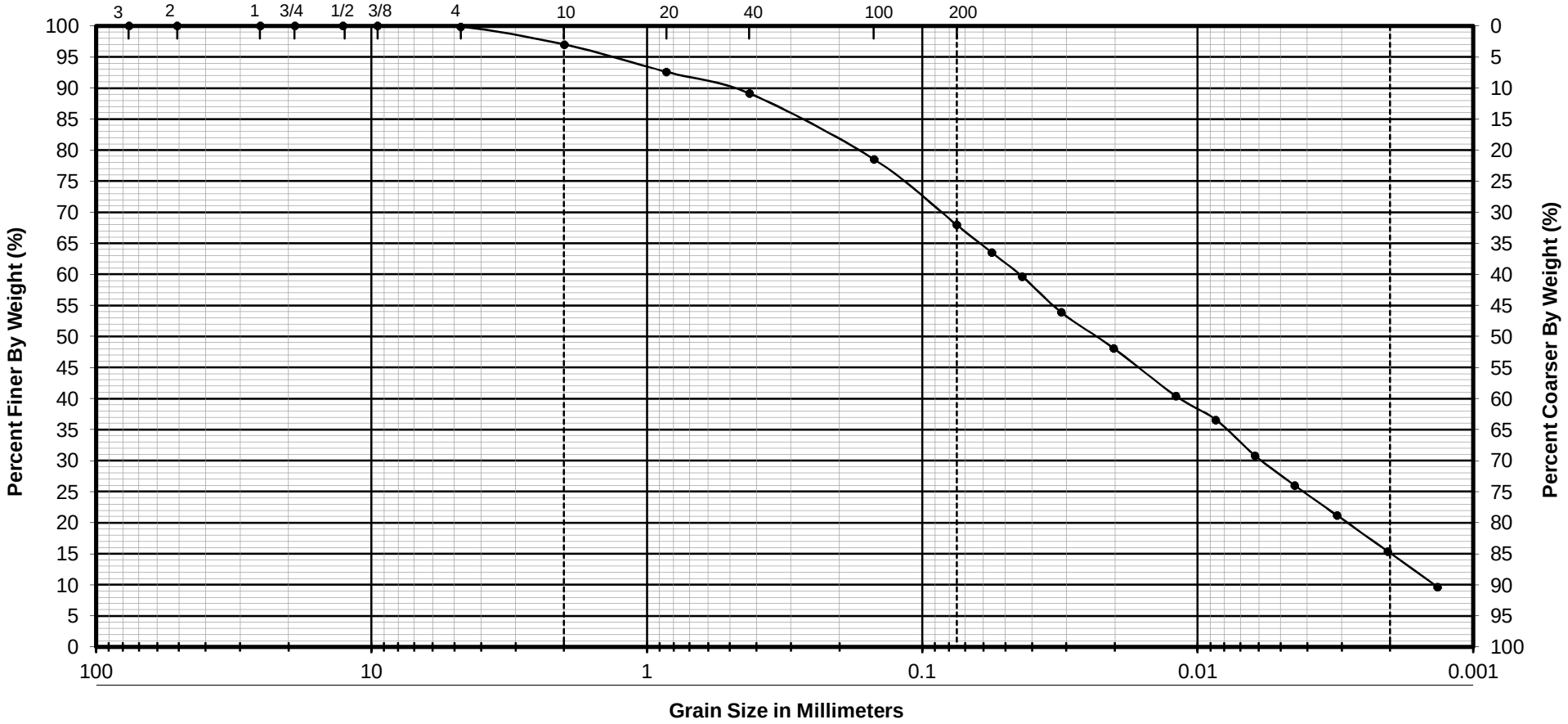
Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm
1235 E. Davis St., Arlington Heights, IL 60005
Phone 847-253-3845 • Fax 847-253-0482



GRAVEL	SAND		SILT	CLAY
	COARSE	FINE		

Boring No.	2016-06	CLASSIFICATION		PARTICLE SIZE ANALYSIS-AASHTO T88
Sample No.	12			
Depth	23.5'-25.0'	SILTY CLAY LOAM		IDOT Pump Station No. 4
Liquid Limit	40	A-6		I-290 & Des Plaines River
Plastic Limit	20	gray		Cook County, Illinois
Plasticity Index	20	Group Index	19	
Test By	VH/MT	% Gravel	0.3	
Date	8/17/16	% Sand	6.4	
Reviewed By	RR	% Silt	65.3	
Job No	12174	% Clay	28.0	

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm
1235 E. Davis St., Arlington Heights, IL 60005
Phone 847-253-3845 • Fax 847-253-0482



GRAVEL	SAND		SILT	CLAY
	COARSE	FINE		

Boring No.	2016-10	CLASSIFICATION		PARTICLE SIZE ANALYSIS-AASHTO T88
Sample No.	5			
Depth	8.0'-10.0'	SILTY LOAM		IDOT Pump Station No. 4
Liquid Limit	27	A-6		I-290 & Des Plaines River
Plastic Limit	13	brown		Cook County, Illinois
Plasticity Index	14	Group Index	7	
Test By	VH/MT	% Gravel	3.0	
Date	8/17/16	% Sand	29.1	
Reviewed By	RR	% Silt	52.6	
Job No	12174	% Clay	15.4	

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm
1235 E. Davis St., Arlington Heights, IL 60005
Phone 847-253-3845 • Fax 847-253-0482

CONSOLIDATED–UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE SOIL ASTM D 4767

Project IDOT Pump Station No. 4, I–290/Des Plaines River JOB No.: 12174 PREPARED BY: JE

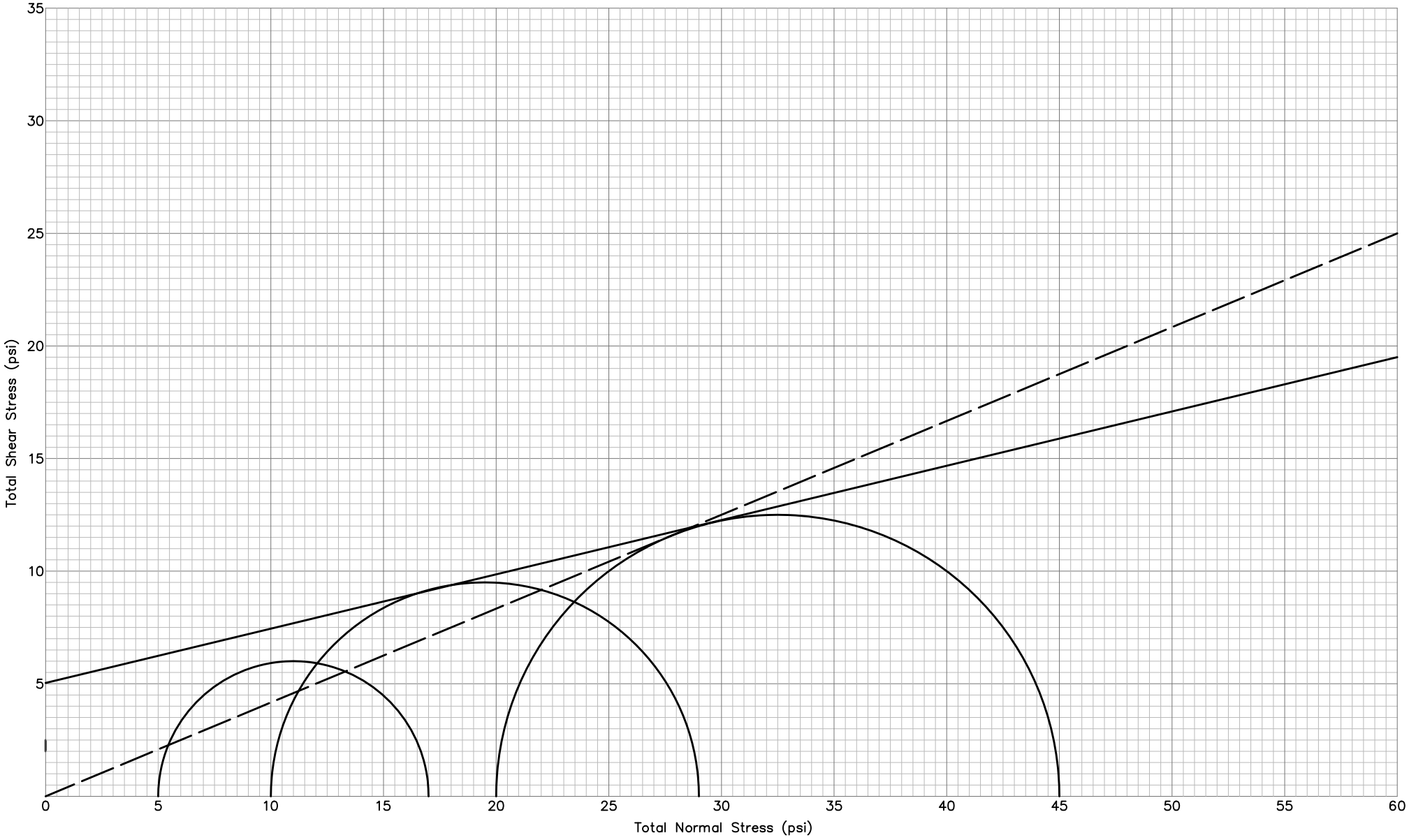
Sample No. 2016–03 S–14 Depth: 26.0'–28.0' DATE: 8/22/16 REVIEWED BY: RR

Coc= 720 psf

Friction Angle = 21 degrees

Friction Angle oc= 15 degrees

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355–2838



Geo Services, Inc.
Consulting Engineers

1235 E. DAVIS STREET
ARLINGTON HEIGHTS, ILLINOIS
(847) 253-3845

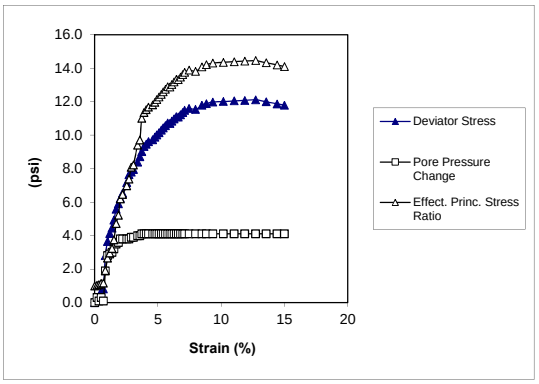
CONSOLIDATED-UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE SOIL, ASTM D 4767

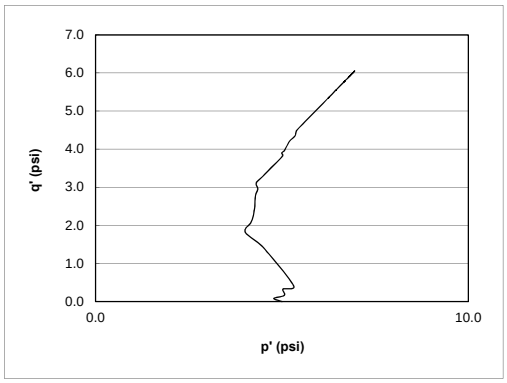
Project Name IDOT Pump Station No. 4, I-290 & Des Plaines River **Location** Cook County, Illinois **Project No.** 12174

Boring No 2016-03 **Sample No** 14 **Depth** 26.0'-28.0' **Date** 8/17/16

Description of Sample CLAY-gray **Sg (est.)** 2.684

						Before Consol.	After Consol.
					Height (in.)	5.95	5.90
MC% (Before)	29.1	**Maximum Dev. Stress (psi)**	12.1	psi	**Diameter (in.)**	2.76	-
MC% (After)	27.6	**Strain at Max. Dev. Stress**	12.72	%	**Area (sq.in.)**	5.98	-
		Pore Press. Change at Max. Dev. Stress	4.1	psi			
Test No.	1				**Wet Wt. (g)**	1113.3	
Confining Pressure	5.0 psi	**Cell Pressure**	100	psi	**Dry Density (lbs/ft^3)**	92.3	





Test Data

Axial Load (lb)	Strain (0.001 in)	Axial Strain	Axial Strain %	Pore Pressure (psi)	Corrected Area (sq. in.)	Deviator Stress (psi)	Pore Pressure Change	Major Effective Principal Stress (psi)	Minor Effective Principal Stress (psi)	Effective Principal Stress Ratio	q (psi)	p' (psi)	q/p'
0	0.000	0	0	95.0	5.98	0.0	0.0	5.0	5.0	1.00	0.0	5.0	0.00
1	0.010	0.002	0.17	95.3	5.99	0.2	0.3	4.9	4.7	1.04	0.1	4.8	0.02
2	0.020	0.003	0.34	95.1	6.00	0.3	0.1	5.2	4.9	1.07	0.2	5.1	0.03
4	0.030	0.005	0.51	95.3	6.01	0.7	0.3	5.4	4.7	1.14	0.3	5.0	0.07
5	0.040	0.007	0.68	95.1	6.02	0.8	0.1	5.7	4.9	1.17	0.4	5.3	0.08
17	0.050	0.008	0.85	96.9	6.03	2.8	1.9	5.9	3.1	1.91	1.4	4.5	0.31
22	0.060	0.010	1.02	97.8	6.04	3.6	2.8	5.8	2.2	2.65	1.8	4.0	0.45
25	0.070	0.012	1.19	97.9	6.05	4.1	2.9	6.2	2.1	2.97	2.1	4.2	0.50
27	0.080	0.014	1.36	98.0	6.07	4.5	3.0	6.5	2.0	3.23	2.2	4.2	0.53
30	0.090	0.015	1.53	98.2	6.08	4.9	3.2	6.7	1.8	3.74	2.5	4.3	0.58
34	0.100	0.017	1.70	98.5	6.09	5.6	3.5	7.1	1.5	4.72	2.8	4.3	0.65
36	0.110	0.019	1.87	98.6	6.10	5.9	3.6	7.3	1.4	5.22	3.0	4.4	0.68
38	0.120	0.020	2.04	98.8	6.11	6.2	3.8	7.4	1.2	6.19	3.1	4.3	0.72
40	0.130	0.022	2.20	98.8	6.12	6.5	3.8	7.7	1.2	6.45	3.3	4.5	0.73
44	0.150	0.025	2.54	98.8	6.14	7.2	3.8	8.4	1.2	6.97	3.6	4.8	0.75
47	0.160	0.027	2.71	98.8	6.15	7.6	3.8	8.8	1.2	7.37	3.8	5.0	0.76
48	0.170	0.029	2.88	98.9	6.16	7.8	3.9	8.9	1.1	8.08	3.9	5.0	0.78
49	0.180	0.031	3.05	98.9	6.17	7.9	3.9	9.0	1.1	8.22	4.0	5.1	0.78
52	0.200	0.034	3.39	99.0	6.19	8.4	4.0	9.4	1.0	9.40	4.2	5.2	0.81
54	0.210	0.036	3.56	99.0	6.20	8.7	4.0	9.7	1.0	9.70	4.4	5.4	0.81
56	0.220	0.037	3.73	99.1	6.21	9.0	4.1	9.9	0.9	11.01	4.5	5.4	0.83
58	0.230	0.039	3.90	99.1	6.23	9.3	4.1	10.2	0.9	11.35	4.7	5.6	0.84
59	0.240	0.041	4.07	99.1	6.24	9.5	4.1	10.4	0.9	11.51	4.7	5.6	0.84
60	0.250	0.042	4.24	99.1	6.25	9.6	4.1	10.5	0.9	11.67	4.8	5.7	0.84
61	0.270	0.046	4.58	99.1	6.27	9.7	4.1	10.6	0.9	11.81	4.9	5.8	0.84
62	0.280	0.047	4.75	99.1	6.28	9.9	4.1	10.8	0.9	11.97	4.9	5.8	0.85
63	0.290	0.049	4.92	99.1	6.29	10.0	4.1	10.9	0.9	12.12	5.0	5.9	0.85
64	0.300	0.051	5.09	99.1	6.30	10.2	4.1	11.1	0.9	12.28	5.1	6.0	0.85
65	0.310	0.053	5.26	99.1	6.31	10.3	4.1	11.2	0.9	12.44	5.1	6.0	0.85
66	0.320	0.054	5.43	99.1	6.33	10.4	4.1	11.3	0.9	12.59	5.2	6.1	0.85
67	0.330	0.056	5.60	99.1	6.34	10.6	4.1	11.5	0.9	12.75	5.3	6.2	0.85
68	0.340	0.058	5.77	99.1	6.35	10.7	4.1	11.6	0.9	12.90	5.4	6.3	0.86
68	0.350	0.059	5.94	99.1	6.36	10.7	4.1	11.6	0.9	12.88	5.3	6.2	0.86
69	0.360	0.061	6.11	99.1	6.37	10.8	4.1	11.7	0.9	13.03	5.4	6.3	0.86
70	0.370	0.063	6.28	99.1	6.38	11.0	4.1	11.9	0.9	13.18	5.5	6.4	0.86
71	0.380	0.064	6.45	99.1	6.40	11.1	4.1	12.0	0.9	13.34	5.6	6.5	0.86
71	0.390	0.066	6.61	99.1	6.41	11.1	4.1	12.0	0.9	13.31	5.5	6.4	0.86
72	0.400	0.068	6.78	99.1	6.42	11.2	4.1	12.1	0.9	13.46	5.6	6.5	0.86
73	0.410	0.070	6.95	99.1	6.43	11.4	4.1	12.3	0.9	13.61	5.7	6.6	0.86
74	0.420	0.071	7.12	99.1	6.44	11.5	4.1	12.4	0.9	13.76	5.7	6.6	0.86
75	0.440	0.075	7.46	99.1	6.47	11.6	4.1	12.5	0.9	13.89	5.8	6.7	0.87
75	0.470	0.080	7.97	99.1	6.50	11.5	4.1	12.4	0.9	13.82	5.8	6.7	0.87
77	0.500	0.085	8.48	99.1	6.54	11.8	4.1	12.7	0.9	14.09	5.9	6.8	0.87
78	0.520	0.088	8.82	99.1	6.56	11.9	4.1	12.8	0.9	14.21	5.9	6.8	0.87
79	0.550	0.093	9.33	99.1	6.60	12.0	4.1	12.9	0.9	14.30	6.0	6.9	0.87
80	0.600	0.102	10.18	99.1	6.66	12.0	4.1	12.9	0.9	14.35	6.0	6.9	0.87
81	0.650	0.110	11.02	99.1	6.72	12.0	4.1	12.9	0.9	14.38	6.0	6.9	0.87
82	0.700	0.119	11.87	99.1	6.79	12.1	4.1	13.0	0.9	14.42	6.0	6.9	0.87
83	0.750	0.127	12.72	99.1	6.85	12.1	4.1	13.0	0.9	14.45	6.1	7.0	0.87
83	0.800	0.136	13.57	99.1	6.92	12.0	4.1	12.9	0.9	14.32	6.0	6.9	0.87
83	0.850	0.144	14.42	99.1	6.99	11.9	4.1	12.8	0.9	14.19	5.9	6.8	0.87
83	0.885	0.150	15.00	99.1	7.04	11.8	4.1	12.7	0.9	14.10	5.9	6.8	0.87

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm

1235 E. DAVIS STREET
ARLINGTON HEIGHTS, IL 60005
(847) 253-3845 FAXES (847) 253-0482

Organic Matter in Soils by Wet Combustion
AASHTO T 194

Project Name IDOT Pump Station No. 4
I-290 & Des Plaines River
Location Cook County, Illinois

Date 2/7/13
Job No 12174

Sample Location	2013-2A	2013-3A						
Sample No	13	8						
Depth	28.0'-30.0'	15.0'-17.5'						
Total Organic Matter %	4.1	2.0						

Performed by: JE

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm

1235 E. DAVIS STREET
ARLINGTON HEIGHTS, IL 60005
(847) 253-3845 FAXES (847) 253-0482

Organic Matter in Soils by Wet Combustion
AASHTO T 194

Project Name IDOT Pump Station No. 4
I-290 & Des Plaines River
Location Cook County, Illinois

Date 8/23/16
Job No 12174

Sample Location	**2016-08A**							
Sample No	12							
Depth	23.5'-25.0'							
Total Organic Matter %	3.5							

Performed by: JE

SoilCor
CORROSION & THERMAL SCIENCES
41765 Hawthorn Street Murrieta, CA 92562
ph (951) 894-2682 • fx (951) 894-2683

Work Order No.: 16J1306
Client: Geo Services, Inc.
Project No.: 12174
Project Name: IDOT Pump Station #4 (Phase II)
Report Date: October 6, 2016

Laboratory Test(s) Results Summary

The subject soil samples were tested for pH per AASHTO T 289-91 (2004), Water-Soluble Sulfate Ion Content per AASHTO T 290-95 (2012) Method B and Water-Soluble Chloride Ion Content per AASHTO T 291-94 (2008) Method A. The test results follow:

Sample Identification	pH	Sulfate Content (mg/kg)	Chloride Content (mg/kg)
B-2016-02A, S-23 @ 68.5-70.0'	6.8	820	ND
B-2016-04A, S-12 @ 26.0-27.5'	7.9	80	70

*ND=No Detection

We appreciate the opportunity to serve you. Please do not hesitate to contact us with any questions or clarifications regarding these results or procedures.

Ahmet K. Kaya, Laboratory Manager