STRUCTURE GEOTECHNICAL REPORT
ST. CHARLES ROAD OVER SALT CREEK
VILLAGE OF VILLA PARK
DUPAGE COUNTY, ILLINOIS

PREPARED FOR

V3 COMPANIES OF ILLINOIS LTD.

WOODRIDGE, ILLINOIS

DECEMBER 21, 2015

PREPARED BY

EVEREST ENGINEERING COMPANY

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STRUCTURE GEOTECHNICAL REPORT
ST. CHARLES ROAD OVER SALT CREEK
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DUPAGE COUNTY, ILLINOIS

1. INTRODUCTION

The Village of Villa Park and the Illinois Department of Transportation (IDOT) have proposed the rehabilitation of the St. Charles Road Bridge over Salt Creek. As part of the rehabilitation program, the design engineer, V3 Companies of Illinois Ltd. (V3), is considering one of the following options.

- Removal and replacement of the bridge superstructure utilizing the existing foundations.
- Complete (superstructure and substructure) removal and replacement of the existing bridge.

This report presents geotechnical engineering studies, analyses and recommendations for reconstruction of the proposed bridge. To investigate subsurface conditions, 4 borings B-1 thru B-4 were drilled. The structure location and boring locations are shown on *Sheet 1,* attached in the *Appendix*.

The broad objectives of this investigation were to determine the soil profile, the probable geologic origins of the soils, and the apparent variability of the underlying soils across the site. The objectives also included estimation of the probable behavior of the soils due to imposed loads and to provide soils-related recommendations; and to identify perceived geotechnical conditions that might affect anticipated construction operations. Reference is made to the *General Notices,* attached in the *Appendix,* for additional information that should be considered in the planning and preparation of the contract documents.

The scope of our services for this study did not include any environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report or on the Soil Boring Logs regarding odors, color, or unusual or suspicious items or conditions, if any encountered during the performance of this subsurface investigation, are noted as observations only, strictly for the client's information.

The boring numbers and locations were proposed and staked in the field by V3. The borings were relocated as necessary to accommodate drill rig accessibility. The as-drilled coordinates (northing and easting) and elevations were surveyed by V3.

The investigations were authorized by Mr. George J. Schober of V3 Companies of Illinois Ltd.

2. EXISTING STRUCTURE AND PROPOSED IMPROVEMENTS

The general bridge plan of the existing three span bridge is attached in the *Appendix.* The existing bridge:

- Originally constructed in early 1900 with face to face of abutments of 110'-9" in length and out to out width of 47'-6". It is our understating that original abutments and piers are supported on wooden pile foundations.
- The bridge was widened in 1978 with out to out width of 68'-0". The widened structure is supported on shallow spread footings.

The details of the proposed improvements are not known to Everest at the time of this report. However, it is our understating that the design engineer is considering one of the following options.

- Removal and replacement of the bridge superstructure utilizing the existing foundations.
- Complete (superstructure and substructure) removal and replacement of the existing bridge.

3. GEOLOGY

Proposed bridge structure over Salt Creek is located in the Southeast ¼ of Section 3, Township 39 North and Range 11 East. The surficial deposits in the project area are part of Wisconsinan glaciation system and belong to the Wadsworth and Hager Members of Wedron Formation. The deposits encountered primarily consist of clayey, silty and sandy till relatively low in content of pebbles, cobbles, and boulders.

Adapted from:

Summary of the Geology of Chicago Area by *H. B. Willman (Circular 460,Illinois State Geological Survey)* and *Handbook of Illinois Stratigraphy* by H.B. Willman, et. al., *(Bulletin 95, Illinois State Geological Survey).*

4. EXPLORATION AND TESTING

The drilling and investigation procedures used were in accordance with the guidelines contained in the *IDOT Geotechnical Manual*.

The investigation consisted of:

a) Literature search

b) Drilling the borings to aid in delineation of the variation and distribution of the soils both horizontally and in profile

4.1 Soil Borings

A total of 4 borings, B-1 thru B-4, were drilled by Everest for the proposed bridge in the months of November and December 2015. The depth of overburden varied from 40 feet in boring B-2 to 51.8 feet in boring B-4. The borings were drilled to the bedrock and then cored 10 feet into the bedrock. The boring locations are shown on *Sheet 1,* attached in the *Appendix.*

The borings were performed with a truck mounted rotary drill rig equipped with a hydraulic head. Borings B-1 and B-4 were drilled, behind the existing abutments, through the approach pavement, whereas boring B-3 was drilled, east of the existing east pier, adjacent to the existing bike path at the creek bank. The borings B-1, B-3 and B-4 were drilled using solid stem augers to depths varying from 11 feet to 15 feet and mud rotary drilling technique thereafter. In boring B-2 drilled east of the existing west pier, concrete sidewalk/bridge deck was cored and steel casing was installed through the core hole to the creekbed and mud rotary drilling technique was used.

The soil samples were obtained using standard penetration test (SPT) procedures in general accordance with *AASHTO T 206.* In general, soil samples were obtained at 2.5 foot intervals. To determine the scour reduction factor for various soil types, four continuous soil samples below the creekbed were obtained in borings B-2 and B-3. The subsurface exploration is summarized in *Table 4.1, Exploration Summary.* Subsurface conditions, visual soil descriptions and *IDH* soil classifications of various soil formations are presented on *Soil Boring Logs,* attached in *the Appendix.*

Table 4.1, Exploration Summary

Boring No.	Ground Surface Elevation (Feet)	Overburden / Top of Rock (Feet)	Rock Core Depth (Feet)	Total Depth (Feet)	Groundwater Depth / Elevation (Feet)		
					During Drilling	At Completion	After Completion
B-1	671.0	51 / 620.0	10	61	Dry	Mud Rotary	Grouted Immediately
B-2	671.9	40* / 616.9	10	50*	Stream	Mud Rotary	Grouted Immediately
B-3	661.4	46 / 615.4	10	56	7 / 654.4	Mud Rotary	Grouted Immediately
B-4	670.7	51.8 / 618.9	10	61.8	15 / 655.7	Mud Rotary	Grouted Immediately

* - Depth below creekbed

4.2 Field and Laboratory Testing

The field testing consisted of determination of unconfined compressive strength for the cohesive soil samples using a *Rimac* and/or *pocket penetrometer*. The laboratory testing consisted of determination of natural moisture content for all the soil samples. Nine (9) particle size analysis, 9 Atterberg limits, 2 unconfined compressive strength of soil, 4 unconfined compressive strength of rock, 1 moisture density relations, and 1 Illinois bearing ratio (IBR), tests were also performed for the selected samples. The test results are presented on the *Soil Boring Logs* and *Laboratory Test Data,* both attached in the *Appendix*.

4.3 Groundwater

Solid stem augers were utilized from the ground surface to the depths of 12.5 feet in boring B-1, 11 feet in boring B-3 and 15 feet in boring B-4, from where mud rotary drilling technique was used to the top of the bedrock. Prior to the mud rotary drilling, boring B-1 was found to be dry and groundwater was encountered at a depth of 7 feet (elevation 654.4) in boring B-3 and at a depth of 15 feet (elevation 655.7) in boring B-4. Boring B-2 was drilled using mud rotary drilling technique from the creekbed.

Groundwater levels were not noted during and after the completion of the mud rotary drilling and also after rock coring where water was utilized. Borings were grouted and patched immediately after the completion of drilling/coring. Based on the subsurface investigation, the groundwater elevation of ±655 may be used for the design.

It is expected that the groundwater levels will vary from the observed in the future on a seasonal basis, depending upon the precipitation, runoff, infiltration, land use, and stream levels. Reference is also made to the *Section* on *Water Levels* in the *General Notices* attached in the *Appendix*.

5. GENERALIZED SUBSURFACE CONDITIONS

Borings B-1 and B-4 were drilled through the approach pavement consisting of 3 to 4 inches of asphalt pavement over 12 to 13 inches of concrete pavement. Below the approach pavement, crushed stone fill was encountered to a depth of 3 feet in boring B-1, whereas stiff sandy clay/clay and loose sand fill was encountered to a depth of 10.5 feet in boring B-4. In general, fills were underlain by loose to extremely dense granular soil layers with intermittent layers of medium stiff to hard clayey soils to the bedrock at elevations 620.0 in boring B-1 and 618.9 in boring B-4.

Boring B-2 was drilled through 13 inches thick concrete sidewalk/bridge deck. Upper 4 feet of creekbed soils consisted of 1.5 feet of loose sandy loam underlain by 2.5 feet of very stiff clay. In general, loose to extremely dense granular soil layers with intermittent layers of stiff to very stiff clayey soils were encountered to the bedrock at elevation of 616.9.

In boring B-3, about 1 foot thick topsoil was encountered at the surface, which was generally underlain by soft to very stiff clayey soils to a depth of 20.5 feet and subsequently underlain by loose to extremely dense granular soil layers to the bedrock at elevation of 615.4.

The generalized subsurface conditions are shown on *Sheet 2*, attached in the *Appendix.*

6. ANALYSES AND RECOMMENDATIONS

6.1 Seismic Data

The seismic data for the LRFD design are:

- Seismic Performance Zone(SPZ) = 1
- Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.087g
- Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.153g
- Soil Site Class = D

Based on the seismic data, liquefaction of the granular soils is not anticipated.

6.2 Abandoned Mines

No former mining activity is indicated in the ISGS records near the project location.

6.3 Overall Stability

Based on existing abutment end slopes of 1.5H:1V, no overall stability problems are anticipated for the end slope of 1.5H:1V or flatter.

6.4 Scour Protection

The hydraulic report is not available to Everest at the time of this report. Based on the soils encountered in boring B-2 drilled through the creekbed and using the guidelines provided in the *IDOT Bridge Manual, Section 2.3.6.3.2,* recommended reduction in the theoretical, predicted scour depth is presented in *Table 6.1*.

Table 6.1, Scour Depth Reduction

Depth Below Existing Creekbed in Boring B-2 (Feet)	Elevations (Feet)	Soil Type	Scour Depth Reduction (%)
0 to 1.5	±656.9 to ±655.4	Sand and Gravel	0
1.5 to 4.0	±655.4 to ±652.9	Loam (Qu > 1.5 tsf) with substantial Sand and Gravel	0
4.0 to 6.0	±652.9 to ±650.9	Sandy Loam	0
6.0 to 10.5	±650.9 to ±646.4	Silty Loam	0

Riprap or other revetments at piers and slopewalls at the bridge abutments may be considered for scour protection.

6.5 Foundations

It our understanding that the existing abutments and piers of the original construction are supported on deep foundations (wooden piles) and widened structure is supported on shallow foundations (spread footings). For reconstruction of the new bridge, Everest considered both shallow and deep foundation options.

6.5.1 Shallow Foundation

Everest encountered loose granular and clayey soils with Qu equal to or less than 1.5 tsf below the anticipated footing grades (elevation 651). It is our opinion that shallow foundation may not be an economically viable option due to anticipated removal and replacement of about 5 to 9 feet of weak soils.

6.5.2 Deep Foundation

Deep foundations such as metal shell cast-in-place concrete piles (MSP) or steel H-piles (HP) may be considered to support the new bridge. The pile design tables for various sizes of MSP and HP, using the *IDOT LRFD Geotechnical Pile Design Procedure,* are attached in the *Appendix.* The pile design tables summarize estimated ground surface against pile during driving, estimated bottom of the pile cap elevation, nominal required bearing, factored resistance available below the pile cap and estimated pile length which includes length of pile from the bottom the pile cap and embedment. The estimated ground surface elevation against pile during driving, bottom of pile cap elevation, pile embedment and pile cutoff elevation are presented in *Table 6.2.* The pile lengths should be adjusted for the length of the embedment other than stated in *Table 6.2.*

Table 6.2, Pile Embedment and Elevations

Substructure	Ground Surface Elevation Against Pile During Driving (Feet)	Bottom of Pile Cap Elevation (Feet)	Pile Embedment (Feet)	Pile Cutoff Elevation (Feet)
West Abutment	±664.00	±664.00	1	±665.00
East Abutment	±664.00	±664.00	1	±665.00
West Pier	±651.00	±651.00	1	±652.00
East Pier	±651.00	±651.00	1	±652.00

Piles should be driven in accordance with *Section 512 - Piling,* as presented in the *Standard Specifications for Road and Bridge Construction,* by the *Illinois Department of Transportation.* Based on the subsurface conditions, Everest anticipates some hard driving conditions through dense soil layers and recommends using pile shoes for driving the MSP and HP. Everest recommends driving at least one test pile per substructure. The contractor should drive test piles to 110 percent of the Nominal Required Bearing specified in permanent locations at substructures specified or approved by the Engineer before ordering the remainder of piles.

6.6 Settlement

Everest does not anticipate any significant additional loads behind the abutments and hence, no settlement problems are anticipated.

6.7 Embankment and Backfill

The construction of embankment should be performed in accordance with the *Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction (IDOT SSRBC), Section 205*. In general, after the removal of vegetation, topsoil, and other unsuitable materials, excavated soils along the roadway should be suitable for embankment fill. Prior to the use of any on-site or borrow material in the construction of embankment, the materials should be tested and evaluated to verify that the materials meet the embankment material requirements.

The excavation and backfilling should be in accordance with the requirements of *IDOT SSRBC, Section 502.* The backfill should be placed in approximately continuous horizontal layers not more than ten (10) inches in thickness, loose measurement, and each layer should be compacted in-place in accordance with *Article 205.05* of the *IDOT SSRBC.* Over compaction of materials should be avoided.

6.8 Lateral Loads

In addition to vertical loads, the substructure units will also be subjected to lateral loads including lateral earth pressure due to backfill, live loads, and wind loads.

Lateral Resistance

The lateral loads acting on the bridge structure will be transferred to the deep foundations. Lateral loading of a deep foundation is a soil-structure interaction problem. The deflection of the deep foundation depends on lateral strength of soils and stiffness of the deep foundation. The detailed lateral capacity analysis includes factors such as magnitude, point of application and inclination of load, allowable deflection and structural design of the deep foundation. The nominal resistance of deep foundations to lateral loads should be evaluated based on both soils and foundation element properties. A soil resistance factor of 1.0 should be used to estimate lateral capacity as specified in *AASHTO LRFD Table 10.5.5.2.3-1*.

To determine the lateral capacity of the MSP and HP, analyses may be performed using available computer programs based on the P-Y analysis like *LPILE*. The estimated parameters of various soils for calculating the lateral loads are presented in *Table 6.3.*

Table 6.3, Estimated Soil Parameters

Soil Type	γ Unit weight (lb/ft^3)	γ' Effective Unit Weight (lb/ft^3)	Φ Angle of Internal Friction (deg)	ε_{50} Strain at 50% Stress Level	Soil Modulus k-static (lb/in^3)	Soil Modulus k-cyclic (lb/in^3)	c[(a)] Undrained Shear Strength (tsf)
Fill – Clay, Sandy Clay	125	63	---	0.007	500	200	0.5
Fill – Sand, Crushed Stone	125	63	30	---	20/25 [(b)]	20/25 [(b)]	---
Soft – Clay, Silty Clay, Clay Loam	115	53	---	0.02	30	---	0.1 - 0.25
Medium Stiff – Clay, Silty Clay, Clay Loam	120	58	---	0.01	100	---	0.25 - 0.50
Stiff – Clay, Silty Clay, Clay Loam	125	63	---	0.007	500	200	0.50 -1.00
Very Stiff – Clay, Silty Clay, Clay Loam	130	70	---	0.005	1,000	400	1.00 - 2.00
Hard – Clay, Silty Clay, Clay Loam	135	73	---	0.004	2,000	800	2.00 - 4.00
Loam, Silty Loam	115	53	26	---	20/25 [(b)]	20/25 [(b)]	---
Loose – Sand, Sandy Loam	115	53	30	---	20/25 [(b)]	20/25 [(b)]	---
Medium Dense – Sand, Sandy Loam	125	63	34	---	60/90 [(b)]	60/90 [(b)]	---
Dense to Extremely Dense – Sand, Sandy Loam	130	68	38	---	125/225 [(b)]	125/225 [(b)]	---

(a) - See Soil Boring Logs, $c = q_u/2$ where q_u= unconfined compressive strength
(b) - k for submerged sand/k for sand above water table

Lateral Earth Pressures

The lateral earth pressure exerted on the abutments and wingwalls will depend upon their stiffness, the type and density of the backfill placed behind and the drainage provisions. The backfill materials behind the abutments and wingwalls should be granular with a minimum drained friction angle of 30 degrees. The unit weight of 0.120

kcf, coefficient of active pressure of 0.33 and 2 feet of earth surcharge equivalent to 0.250 ksf should be used to calculate the lateral earth pressure.

6.9 Drainage

To reduce the buildup of hydrostatic pressure behind the abutments and wingwalls, it is preferred that a free draining granular material be used as backfill. The geocomposite drain may be used for cast-in-place (CIP) concrete walls as described in the *IDOT SSRBC*. In case weepholes are proposed to mitigate the hydrostatic pressure for the CIP concrete walls, the weepholes may be approximately 3 inch in diameter, spaced approximately 8 feet apart horizontally and 6 feet apart vertically. To avoid migration of fines resulting in blockage, the weepholes should be protected on the soil side by using a properly designed granular filter.

7. CONSTRUCTION CONSIDERATIONS

7.1 Seepage

No major excavation is expected for the proposed bridge. Some seepage and associated caving of materials should be expected during construction. For shallow excavations, normal sump and pump dewatering method should be adequate to keep excavations dry during construction. Any soil that has been softened by water should be removed prior to placing any fills and/or concrete. A cofferdam/diversion of the existing creek may be required for excavation and concrete placement to proceed in dry conditions.

7.2 Safety

The Health and Safety Act of the State of Illinois, together with the related Health and Safety Rules, all federal requirements, area specifications for excavation and slopes, and all other ordinances, statutes or building codes relating to construction operations and/or temporary sheeting and bracing of trenches and excavations must be observed.

7.3 Excavation Slopes

In general, the soils on this site should not be excavated with side slopes steeper than 1.5H:1V unless temporary sheeting and bracing are used. For temporary excavation slopes related *Occupational Safety and Health Administration (OSHA)* standards should be observed. Piles of excavated soils and heavy construction equipment should not be permitted closer to the top of any excavation than a distance equal to two (2) times the depth of the excavation, in order to reduce the possibilities of cave-ins.

7.4 Quality Control/Quality Assurance

For quality control/quality assurance purposes in general, and when the field conditions differ from the conditions described in the structure geotechnical report are encountered, the services of a qualified geotechnical engineer/inspector should be utilized for proper testing and evaluation of the soils and other construction materials and activities.

8. GENERAL

Soil conditions can change with the passage of time due to changes in the elevation of the groundwater table, changes in climatic conditions and other factors not evident at the time of this investigation. Also, variations can occur at locations between the borings, due to variations in the fill materials and the time of deposition. For these reasons, any soft areas or soil conditions believed to be different than those described herein, which are revealed during construction should be further investigated before construction proceeds.

The information in *Section 7* has been provided for use by the designers and field inspection personnel. It is not intended to be a complete description of problems which may be encountered by the contractor during construction.

Respectfully submitted,
EVEREST ENGINEERING COMPANY

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APPENDICES

GENERAL NOTICES

GENERAL NOTICES

1. WARRANTY

The Geotechnical Engineer has prepared this report in accordance with generally accepted geotechnical engineering practices and makes no other warranties either expressed or implied. In no event does the Geotechnical Engineer accept any liability beyond the extent of fee collected for this work.

2. SOIL & ROCK DESCRIPTIONS

Unless otherwise noted, the soil and/or rock descriptions indicated on the boring logs are visual identifications and, generally, are not the result of laboratory identification testing. As such, they may not conclusively represent exact subsurface conditions. The soil and/or rock identifications indicated on the boring logs are based upon examination of samples in the field or delivered to the laboratory, and interpretation of field observations during drilling, and may not completely represent conditions in the ground.

Soil and/or rock samples are retained in our laboratory for ninety days and are then destroyed unless special disposition is requested by our client.

3. UNANTICIPATED SOIL & ROCK CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings and/or rock cores performed at the specific locations indicated, and subsequent laboratory testing of these samples. This yields a representative, but not necessarily exhaustive, picture of the subsurface conditions. The possibility of variations from expected conditions increases with spacing between borings and frequently requires that additional information be obtained to attain a properly constructed project. The Geotechnical Engineer should be contacted whenever unanticipated conditions are encountered, as these unanticipated conditions may alter conclusions and recommendations contained in the report.

4. CHANGED CONDITIONS

It is recommended that all construction contracts relating to foundations and earthwork include a *changed conditions* clause to establish procedures to be followed should unanticipated conditions be encountered.

No claim by the contractor for any conditions differing from those anticipated in the plans and specifications and indicated by the original geotechnical studies should be allowed unless the contractor has so notified the owner, verbally and in writing of such change in conditions. It is further recommended that all foundation work and site improvements be inspected by a Registered Professional Engineer with substantial experience in Geotechnical Engineering.

5. CHANGED STRUCTURE OR LOCATIONS

This report has been prepared to aid in the evaluation of this project and to assist the architect and/or engineer in the design of this project. In the event that any changes, however slight, in the design or location of the structure as outlined in this report are planned, or any structures are included or added that are not discussed in this report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or approved in writing by the Geotechnical Engineer.

6. OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water, boulders, hazardous or toxic material, gas, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, odors, obstructions, etc.; however, lack of mention does not preclude their presence.

7. BOULDERS, COBBLES AND GRAVEL

Boulders, cobbles and coarse gravel cannot be accurately observed or measured without special, large diameter borings and special samplers. Therefore, their absence from the boring logs does not preclude their existence.

8. LOCATION OF BURIED OBJECTS

All users of this report are cautioned that no attempt was made by the Geotechnical Engineer to locate any man-made buried objects during the course of this investigation. The Geotechnical Engineer can not be responsible for any buried man-made objects that are encountered during construction that are not discussed in the text of this report. The contractor is reminded to contact all utility companies to verify underground service locations, prior to any excavation work.

9. GROUNDWATER LEVELS

Groundwater level readings have been made in the bore holes at times and under conditions stated on the boring logs. Groundwater levels may not have stabilized at the last reading and show only the conditions observed at the time that the borings were drilled, unless otherwise noted. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, runoff, infiltration, land use, area lake/stream levels, temperature, and other factors not evident at the time measurements were made and reported herein. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

10. USE OF REPORT BY BIDDERS

Bidders who are examining this report prior to submitting a bid are cautioned that this report was prepared as an aid to the designers of the project and it is not intended to reflect subsurface conditions as they may affect actual constructions operations.

11. STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs and soil profiles which accompany this report. However, actual change in the ground may be gradual. Where changes occur between soil samples, the location of the changes are estimated using all available information and may not be shown at the exact actual depth.

12. CONSTRUCTION FOLLOW-UP

It is recommended that during construction of all foundation work and site improvements a qualified Geotechnical Engineer be retained to assure compliance with the recommendations contained in this report and with project specifications and to assist with making necessary field adjustments and to document changed conditions.

Everest Engineering Company would welcome the opportunity to provide continuous on-site geotechnical services during excavation, backfilling, compaction, foundation preparation, and paving operations, etc.

SOIL IDENTIFICATION TERMINOLOGY
AND
LEGEND

SOIL IDENTIFICATION TERMINOLOGY

EVEREST ENGINEERING COMPANY

Soils are identified and classified in this report according to the AASHTO/IDH Classification system with the following modifiers:

RELATIVE DENSITY OF GRANULAR SOILS

DESCRIPTION	BLOWS PER FOOT
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	50 to 80
Extremely Dense	80+

PARTICLE SIZE

COMPONENT	SIZE
Boulders	Over 8"
Cobbles	3" to 8"
Gravel - Coarse	3/4" to 3"
Gravel - Fine	* No. 4 to 3/4"
Sand - Coarse	* No. 10 to *No. 4
Sand - Medium	* No. 40 to *No. 10
Sand - Fine	* No. 200 to *No. 40
Fines - Silt and Clay	Below *No. 200

STRATIFICATION

Parting	0 to 1/16"
Seam	1/16" to 1/2"
Layer	1/2" to 12"
Stratum	Greater than 12"
Varved Clay	Alternating seams or layers of sand, silt and clay
Pocket	Small, erratic deposits, usually less than 12"
Lens	Lenticular deposit
Occasional	One or less per 12"
Frequent	More than one per 12"

CONSISTENCY OF COHESIVE SOILS

DESCRIPTION	Q_u (tsf)
Very Soft	0 to 0.25
Soft	0.25 to 0.50
Medium Stiff	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	4.0 to 8.0
Very Hard	8.0+

RELATIVE PROPORTIONS

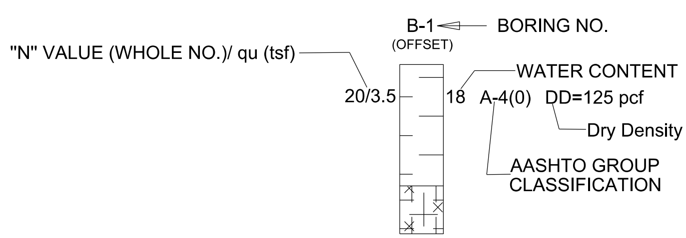
DESCRIPTIVE TERM	PERCENT
Trace	0 to 10
Little	10 to 20
Some	20 to 35
And	35 to 50

ABBREVIATIONS ON LOGS OF SUBSURFACE DATA

AS	Auger Sample
SS	Split spoon sampler, 2" OD, 1 3/8" ID
ST	Thinwall tube sampler, 3" OD, 2 7/8" ID
Q_u	Unconfined compressive strength (pocket penetrometer, Rimac, or load frame)
LL	Liquid Limit
PI	Plasticity Index
OC	Organic Content (%)
B	Bulge
S	Shear
P	Pocket Penetrometer

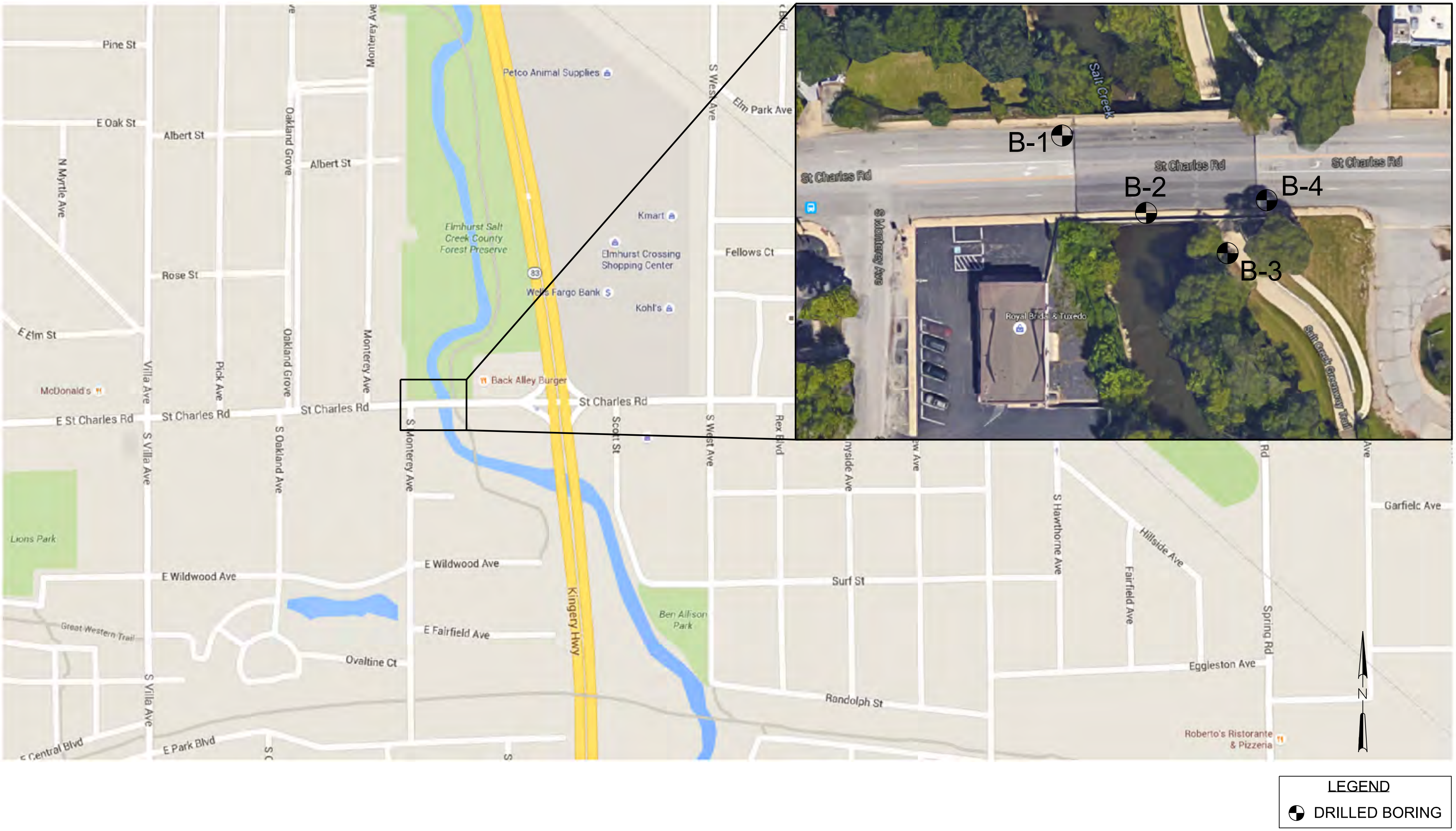
LEGEND

- TOPSOIL
- ASPHALT PAVEMENT
- CONCRETE PAVEMENT
- CRUSHED STONE
- PEAT
- FILL
- CLAY
- SILTY CLAY
- SANDY CLAY
- CLAY LOAM
- SILTY CLAY LOAM
- SANDY CLAY LOAM
- LOAM
- SILTY LOAM
- SILT
- SANDY LOAM
- SAND
- DOLOMITE
- WATER LEVEL DURING DRILLING
- WATER LEVEL AT COMPLETION
- WATER LEVEL HRS. AFTER COMPLETION



Rev. 01/2013

SHEET 1,
PROJECT / BORING LOCATION MAP



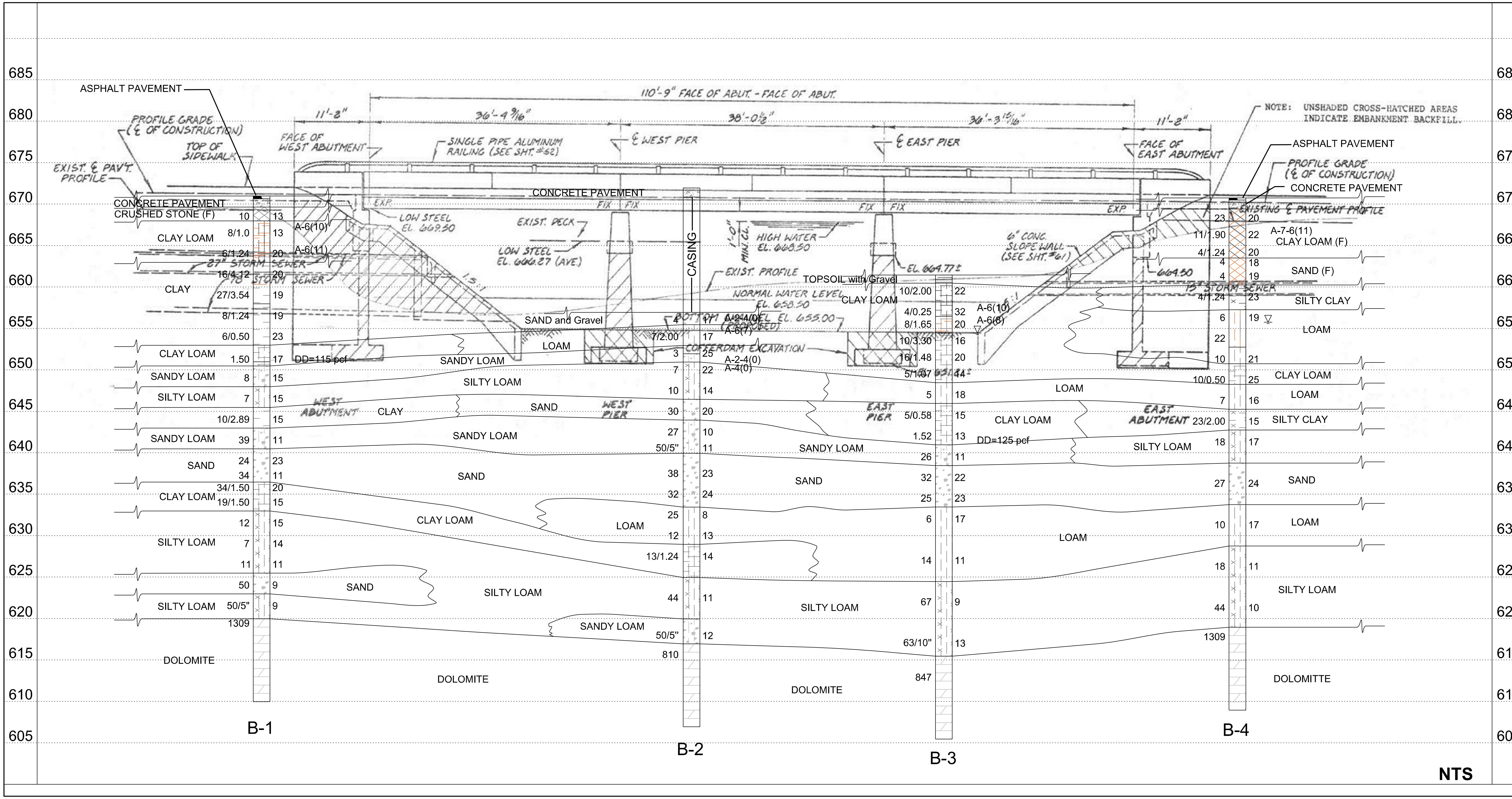
EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

PROJECT / BORING LOCATION MAP

ST. CHARLES ROAD BRIDGE OVER SALT CREEK
VILLA PARK, IL

CLIENT	V3 COMPANIES OF ILLINOIS LTD.
DATE	12/16/2015
JOB NO.	1264
SHEET NO.	1

SHEETS 2,
GENERALIZED SUBSURFACE PROFILE



GENERALIZED SUBSURFCE PROFILE

ST. CHARLES ROAD BRIDGE OVER SALT CREEK
VILLA PARK, IL

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

CLIENT	V3 COMPANIES OF ILLINOIS LTD.
DATE	12/21/2015
JOB NO.	1264
SHEET NO.	2

SOIL BORING LOGS

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

SOIL BORING LOG

Date 11/29/15

PROJECT BRM-4003 (508) **DESCRIPTION** St. Charles Road Bridge over Salt Creek **LOGGED BY** K. Krug

ROUTE FAU 1397 (St. Charles Road) **SECTION** 15-00094-00-BR **LOCATION** SE 1/4 **SEC.** 3 **TWP.** 39N **RNG.** 11E **PM.** 3rd

COUNTY DuPage **DRILLING METHOD** Solid Stem Auger / Mud Rotary below 12.5 feet **HAMMER TYPE** Automatic

STRUCT. NO. 0226950
Station
BORING NO. **B-1**
Station
Offset
Northing 1,902,818.84
Easting 1,084,759.95
Ground Surface Elev. 671.0 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Mud Rotary ft
After Hrs. ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
ASPHALT PAVEMENT	670.6				
CONCRETE PAVEMENT	669.6				
CRUSHED STONE FILL	668.0		5, 5, 5		13
Stiff, Brown and Black CLAY LOAM trace - gravel BAG (3'-8') MDD=114 pcf, OMC=15.5% Grain Size LL=38, PI=18, A-6(10)		-5	4, 4, 4	1.0_P	13
Grain Size LL=38, PI=17, A-6(11)	663.0		3, 3, 3	1.24_B	20
Soft to Hard, Brown and Gray CLAY trace - gravel		-10	5, 6, 10	4.12_B	20
			10, 12, 15	3.54_B	19
Gray below 13 feet	658.0	-15	4, 3, 5	1.24_B	19
	653.0		3, 3, 3	0.50_P	23
Stiff, Gray CLAY LOAM Dry Density=115 pcf	651.0	-20		1.50^{ST}_B	17

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	650.5				
Loose, Gray SANDY LOAM trace - gravel	648.0		2, 3, 5		15
Loose, Gray SILTY LOAM trace - gravel	645.5	-25	1, 2, 5		15
Very Stiff, Gray CLAY trace - gravel	643.0		3, 5, 5	2.89_B	15
Dense, Gray SANDY LOAM some - gravel	640.5	-30	4, 14, 25		11
Medium Dense to Dense, Gray SAND trace - gravel			10, 10, 14		23
	636.5		13, 17		11
Stiff, Gray CLAY LOAM trace - gravel		-35	17	1.50_P	20
	633.0		6, 9, 10	1.50_P	15
Loose to Medium Dense, Gray SILTY LOAM some - gravel		-40	5, 8, 4		15

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

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

SOIL BORING LOG

Date 11/29/15

PROJECT BRM-4003 (508) **DESCRIPTION** St. Charles Road Bridge over Salt Creek **LOGGED BY** K. Krug

ROUTE FAU 1397 (St. Charles Road) **SECTION** 15-00094-00-BR **LOCATION** SE 1/4 **SEC.** 3 **TWP.** 39N **RNG.** 11E **PM.** 3rd

COUNTY DuPage **DRILLING METHOD** Solid Stem Auger / Mud Rotary below 12.5 feet **HAMMER TYPE** Automatic

STRUCT. NO. 0226950
Station
BORING NO. B-1
Station
Offset
Northing 1,902,818.84
Easting 1,084,759.95
Ground Surface Elev. 671.0 ft

Surface Water Elev. ft
Stream Bed Elev. ft
Groundwater Elev.:
First Encounter Dry ft
Upon Completion Mud Rotary ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Loose to Medium Dense, Gray SILTY LOAM some - gravel *(continued)*			6		
			3		14
			4		
			4		
			5		11
		-45	6		
	625.5				
Very Dense, Gray SAND some - gravel			18		
			30		9
			20		
	623.0				
Extremely Dense, Gray SILTY LOAM some - gravel			15		
			50/5"		9
		-50			
	620.0				
DOLOMITE: Light to dark gray, slightly to moderately weathered, massive, fine grained, moderately to highly fractured, thin to thick bedded; trace - vugs, stylolites, chert; Recovery = 99%; RQD = 62.5% (Fair)				1309	
		-55			
		-60			
	610.0				
END OF BORING		-65			
MDD - Meximum Dry Density; OMC - Optimum Moisture Content		-70			
		-75			
		-80			

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

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

SOIL BORING LOG

Date 12/3/15

PROJECT BRM-4003 (508) **DESCRIPTION** St. Charles Road Bridge over Salt Creek **LOGGED BY** K. Krug

ROUTE FAU 1397 (St. Charles Road) **SECTION** 15-00094-00-BR **LOCATION** SE 1/4 **SEC.** 3 **TWP.** 39N **RNG.** 11E **PM.** 3rd

COUNTY DuPage **DRILLING METHOD** Mud Rotary below Creek Bed **HAMMER TYPE** Automatic

STRUCT. NO. 0226950
Station ______
BORING NO. **B-2**
Station ______
Offset ______
Northing 1,902,768.96
Easting 1,084,803.60
Ground Surface Elev. 671.9 ft

Surface Water Elev. ______ ft
Stream Bed Elev. ______ ft

Groundwater Elev.:
First Encounter Mud Rotary ft
Upon Completion Mud Rotary ft
After ______ **Hrs.** ______ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CONCRETE PAVEMENT				
670.8				
Casing: Bridge deck/sidewalk to creekbed				
	-5			
	-10			
656.9	-15	2		
Loose, Gray SAND and Gravel		2		17
Grain Size		2		
LL=28, PI=7, A-2-4(0) 655.4				
Very Stiff, Gray LOAM		3		
trace - shells		2		
little - gravel		3	2.00$_P$	17
Grain Size		4		
LL=38, PI=17, A-6(7) 652.9		4		
Very Loose to Loose, Gray		1		
SANDY LOAM 651.9	-20	1		25

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
trace to little - organics		2		
Grain Size 650.9		2		
LL=31, PI=7, A-2-4(0)		2		
Loose to Medium Dense, Gray		3		22
SILTY LOAM		4		
trace - gravel				
Grain Size				
LL=22, PI=3, A-4(0)				
		2		
		4		14
	-25	6		
646.4				
Dense, Gray Medium SAND				
		11		
		15		20
		15		
643.9				
Medium Dense to Extremely Dense, Gray SANDY LOAM		20		
some - gravel		15		10
	-30	12		
		25		
639.9		50/5"		11
Dense, Gray Medium SAND				
		14		
		18		23
	-35	20		
		18		
		22		24
		10		
633.4		24		
Medium Dense, Gray LOAM				
trace - gravel		11		8
	-40	14		

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

EVERSET ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

SOIL BORING LOG

Date 12/3/15

PROJECT BRM-4003 (508) **DESCRIPTION** St. Charles Road Bridge over Salt Creek **LOGGED BY** K. Krug

ROUTE FAU 1397 (St. Charles Road) **SECTION** 15-00094-00-BR **LOCATION** SE 1/4 **SEC.** 3 **TWP.** 39N **RNG.** 11E **PM.** 3rd

COUNTY DuPage **DRILLING METHOD** Mud Rotary below Creek Bed **HAMMER TYPE** Automatic

STRUCT. NO. 0226950
Station
BORING NO. **B-2**
Station
Offset
Northing 1,902,768.96
Easting 1,084,803.60
Ground Surface Elev. 671.9 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter Mud Rotary ft
Upon Completion Mud Rotary ft
After Hrs. ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium Dense, Gray LOAM trace - gravel *(continued)*			4 5 7		13
	628.9				
Stiff, Gray CLAY LOAM trace - gravel			5 6 7	1.24_B	14
		-45			
	624.9				
Dense, Gray SILTY LOAM some - gravel			33 24 20		11
		-50			
	619.9				
Extremely Dense, Gray SANDY LOAM some - gravel			50/5"		12
	616.9	-55			
DOLOMITE: Light to dark gray, massive, fine grained, thin to thick bedded, moderately to intensely fractured, hard, slightly weathered trace - vugs, stylolites, chert Recovery = 100.0% RQD = 83.0% (Good)				810	
	611.9	-60			
	606.9	-65			
END OF BORING					
		-70			
		-75			
		-80			

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

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

SOIL BORING LOG

Date 11/24/15

PROJECT BRM-4003 (508) **DESCRIPTION** St. Charles Road Bridge over Salt Creek **LOGGED BY** K. Krug

ROUTE FAU 1397 (St. Charles Road) **SECTION** 15-00094-00-BR **LOCATION** SE 1/4 **SEC.** 3 **TWP.** 39N **RNG.** 11E **PM.** 3rd

COUNTY DuPage **DRILLING METHOD** Solid Stem Auger / Mud Rotary below 12.5 feet **HAMMER TYPE** Automatic

STRUCT. NO. 0226950
Station
BORING NO. **B-3**
Station
Offset
Northing 1,902,759.65
Easting 1,084,859.85
Ground Surface Elev. 661.4 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 654.4 (7.0) ft ▽
Upon Completion Mud Rotary ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
TOPSOIL with Gravel	660.4				
Very Soft to Very Stiff, Black CLAY LOAM trace - organics, roots, gravel			3 5 5	2.00P	22
Grain Size LL=41, PI=20, A-6(10)	656.4	-5	1 2 2	0.25P	32
Brown and Gray from 5 to 7 feet Grain Size LL=32, PI=13, A-6(8)	654.4 ▽		1 3 5 7	1.65B	20
Gray below 7 feet			3 5 5 10	3.30B	16
		-10	5 8 8 9	1.48B	20
			0 1 4	1.07B	14
Loose, Gray LOAM trace - gravel	648.4	-15	2 2 3		18
Medium Stiff to Stiff, Gray CLAY LOAM trace - gravel	645.9		2 2 3	0.58B	15
Dry Density=125 pcf		-20		1.52B ST	13

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	640.9				
Medium Dense, Gray SANDY LOAM some - Gravel			13 14 12		11
Medium Dense to Dense, Gray SAND	638.4	-25	10 15 17		22
			15 15 10		23
Loose to Medium Dense, Gray LOAM trace - gravel	633.4	-30	2 3 3		17
		-35	6 6 8		11
Very Dense to Extremely Dense, Gray SILTY LOAM some - gravel	624.4	-40	34 28 39		9

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

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

SOIL BORING LOG

Date 11/24/15

PROJECT BRM-4003 (508) **DESCRIPTION** St. Charles Road Bridge over Salt Creek **LOGGED BY** K. Krug

ROUTE FAU 1397 (St. Charles Road) **SECTION** 15-00094-00-BR **LOCATION** SE 1/4 **SEC.** 3 **TWP.** 39N **RNG.** 11E **PM.** 3rd

COUNTY DuPage **DRILLING METHOD** Solid Stem Auger / Mud Rotary below 12.5 feet **HAMMER TYPE** Automatic

STRUCT. NO. 0226950
Station
BORING NO. B-3
Station
Offset
Northing 1,902,759.65
Easting 1,084,859.85
Ground Surface Elev. 661.4 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 654.4 (7.0) ft ▽
Upon Completion Mud Rotary ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Dense to Extremely Dense, Gray SILTY LOAM some - gravel *(continued)*			15		
			13		13
		-45	50/4"		
	615.4				
DOLOMITE: Light to dark gray, massive, fine grained, thin to medium bedded, moderately to intensely fractured, hard, slightly to moderately weathered trace - vugs, stylolites, chert Recovery = 97.5% RQD = 79.0% (Good)				847	
		-50			
		-55			
	605.4				
END OF BORING					
		-60			

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

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

SOIL BORING LOG

Date 12/1/15

PROJECT BRM-4003 (508) **DESCRIPTION** St. Charles Road Bridge over Salt Creek **LOGGED BY** K. Krug

ROUTE FAU 1397 (St. Charles Road) **SECTION** 15-00094-00-BR **LOCATION** SE 1/4 **SEC.** 3 **TWP.** 39N **RNG.** 11E **PM.** 3rd

COUNTY DuPage **DRILLING METHOD** Solid Stem Auger / Mud Rotary below 15 feet **HAMMER TYPE** Automatic

STRUCT. NO. 0226950
Station
BORING NO. B-4
Station
Offset
Northing 1,902,780.79
Easting 1,084,895.61
Ground Surface Elev. 670.7 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 655.7 (15.0) ft ▽
Upon Completion Mud Rotary ft
After Hrs. ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
ASPHALT PAVEMENT	670.5				
CONCRETE PAVEMENT	669.4				
Stiff, Brown and Black CLAY LOAM trace - gravel			12 13 10		20
Grain Size LL=45, PI=23, A-7-6(11)		-5	6 4 7	1.90_B	22
FILL	663.5		2 2 2	1.24_B	20
Loose, Brown SAND some - gravel, miscellaneous fill					18
		-10	2 2 2		19
FILL	660.2				
Stiff, Black SILTY CLAY trace - organics	657.2		2 2 2	1.24_B	23
Loose to Medium Dense, Brown and Gray LOAM trace - gravel		▽-15	4 3 3		19
			9 11 11		
Gray below 18 feet	652.7				
	650.7	-20	3 4 6		21

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium Stiff, Gray CLAY LOAM trace - gravel	648.2		2 3 7	0.50_P	25
Loose, Gray LOAM trace - gravel	645.2	-25	2 3 4		16
Very Stiff, Gray SILTY CLAY trace - gravel	642.7		8 9 14	2.00_P	15
Medium Dense, Gray SILTY LOAM trace - gravel	638.7	-30	8 9 9		17
Medium Dense, Gray Medium SAND	633.7	-35	11 13 14		24
Medium Dense, Gray LOAM trace - gravel		-40	3 3 7		17

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

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

SOIL BORING LOG

Date 12/1/15

PROJECT BRM-4003 (508) **DESCRIPTION** St. Charles Road Bridge over Salt Creek **LOGGED BY** K. Krug

ROUTE FAU 1397 (St. Charles Road) **SECTION** 15-00094-00-BR **LOCATION** SE 1/4 **SEC.** 3 **TWP.** 39N **RNG.** 11E **PM.** 3rd

COUNTY DuPage **DRILLING METHOD** Solid Stem Auger / Mud Rotary below 15 feet **HAMMER TYPE** Automatic

STRUCT. NO. 0226950
Station
BORING NO. B-4
Station
Offset
Northing 1,902,780.79
Easting 1,084,895.61
Ground Surface Elev. 670.7 ft

Surface Water Elev. ft
Stream Bed Elev. ft
Groundwater Elev.:
First Encounter 655.7 (15.0) ft ▽
Upon Completion Mud Rotary ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium Dense, Gray LOAM trace - gravel *(continued)*	628.7				
Medium Dense to Dense, Gray SILTY LOAM trace - gravel			6		
			13		11
		-45	5		
			25		
			21		10
		-50	23		
	618.9				
DOLOMITE: Light to dark gray, fine grained, massive, thin to thick bedded, moderately to highly fractured, hard, slightly to moderately weathered trace - vugs, stylolites, chert Recovery = 98.0% RQD = 62.0% (Fair)				1309	
		-55			
		-60			
	608.9				
END OF BORING		-65			
		-70			
		-75			
		-80			

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

LABORATORY TEST DATA

PARTICLE SIZE ANALYSIS
&
ATTERBERG LIMITS

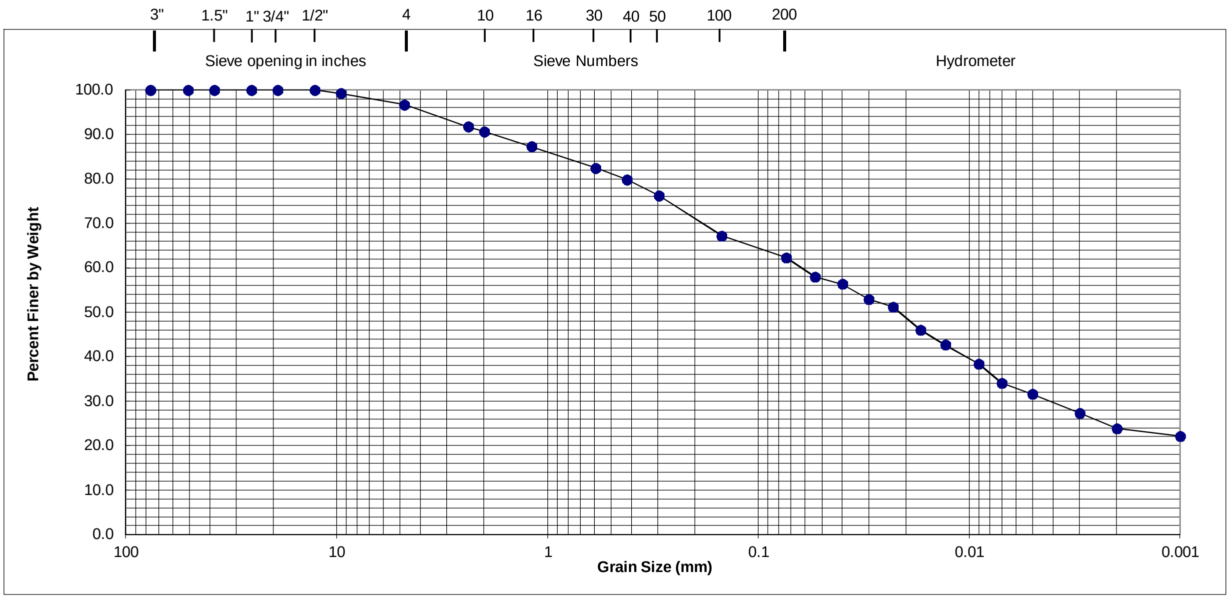
Project:	ST. CHARLES ROAD OVER SALT CREEK
Client:	V3 COMPANIES OF ILLINOIS LTD.
Location:	DEPAGE COUNTY, ILLINOIS
Job No:	1264
Date:	12/17/2015

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Boring No: B-1 **Sample No:** Bag-1 **Depth (ft):** 3-8

Soil Description: BROWN AND BLACK CLAY LOAM / A-6(10)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



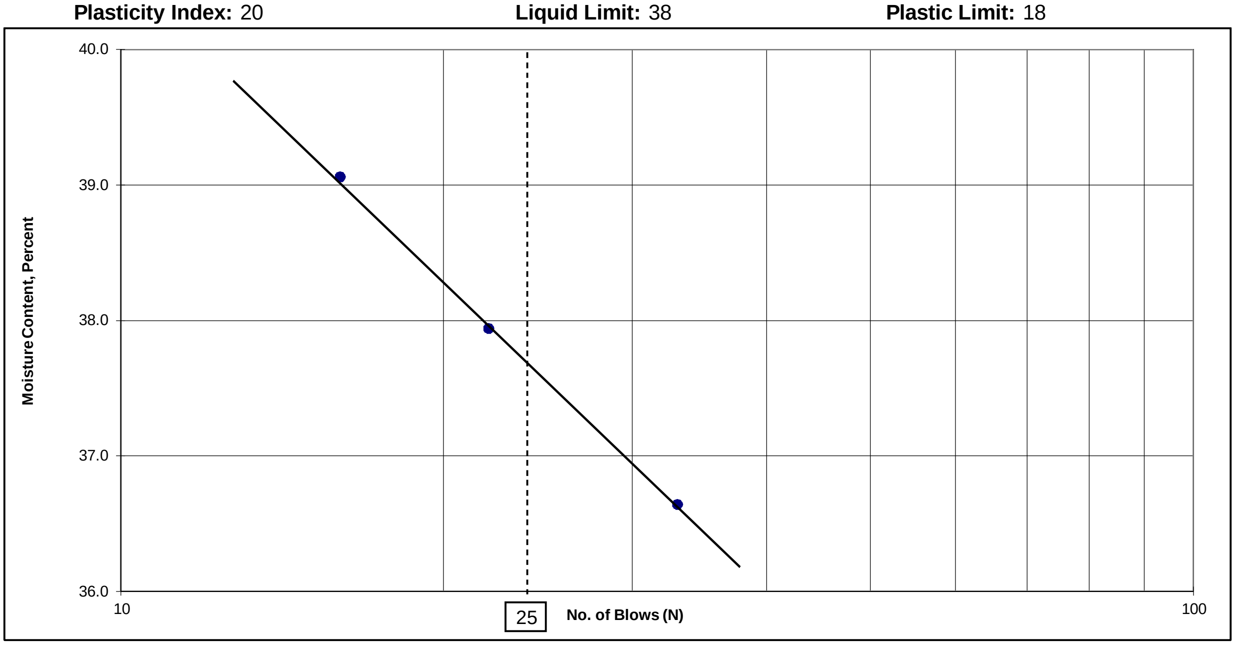
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 9.3% **Sand:** 28.4% **Silt:** 38.4% **Clay:** 23.9%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 20.2

Plasticity Index: 20 **Liquid Limit:** 38 **Plastic Limit:** 18



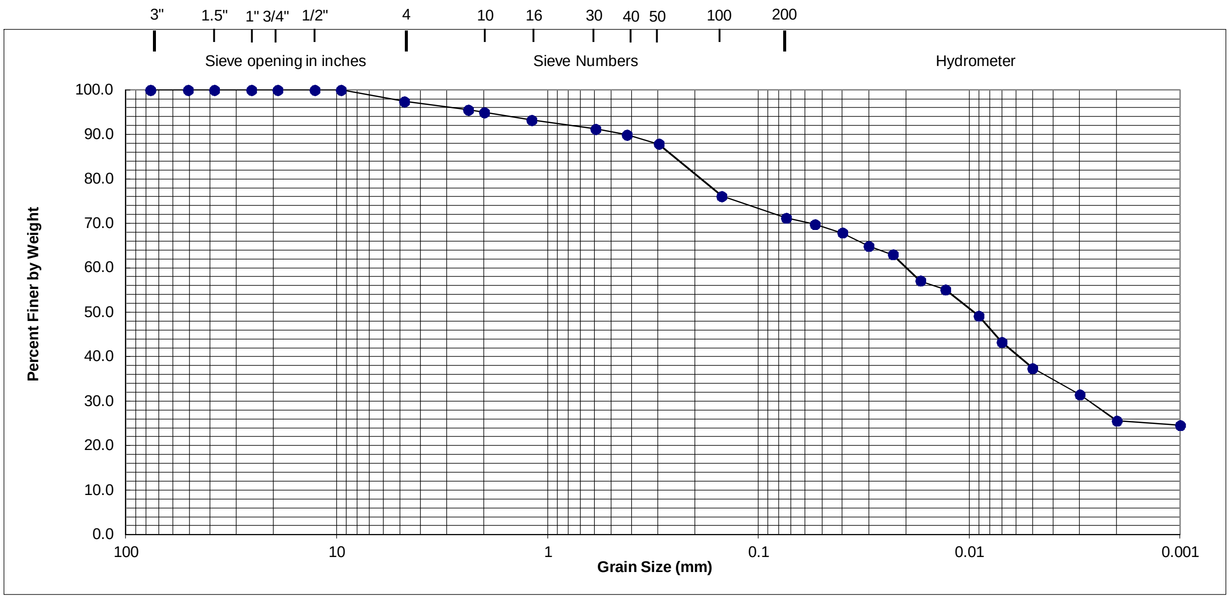
EVERST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Project:	ST. CHARLES ROAD OVER SALT CREEK		
Client:	V3 COMPANIES OF ILLINOIS LTD.		
Location:	DEPAGE COUNTY, ILLINOIS		
Job No:	1264	**Date:**	12/17/2015

Boring No: B-1 **Sample No:** SS-3 **Depth (ft):** 6-7.5

Soil Description: BROWN AND BLACK CLAY LOAM / A-6(11)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



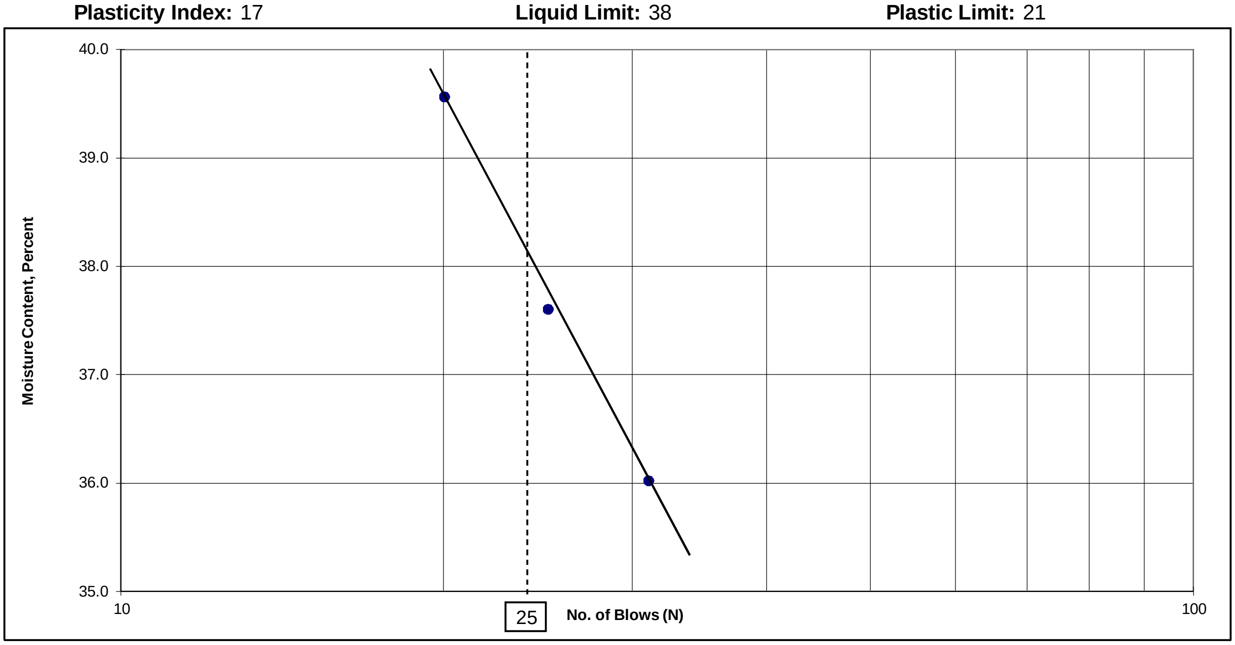
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 5.1% **Sand:** 23.7% **Silt:** 45.7% **Clay:** 25.6%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 10.1

Plasticity Index: 17 **Liquid Limit:** 38 **Plastic Limit:** 21



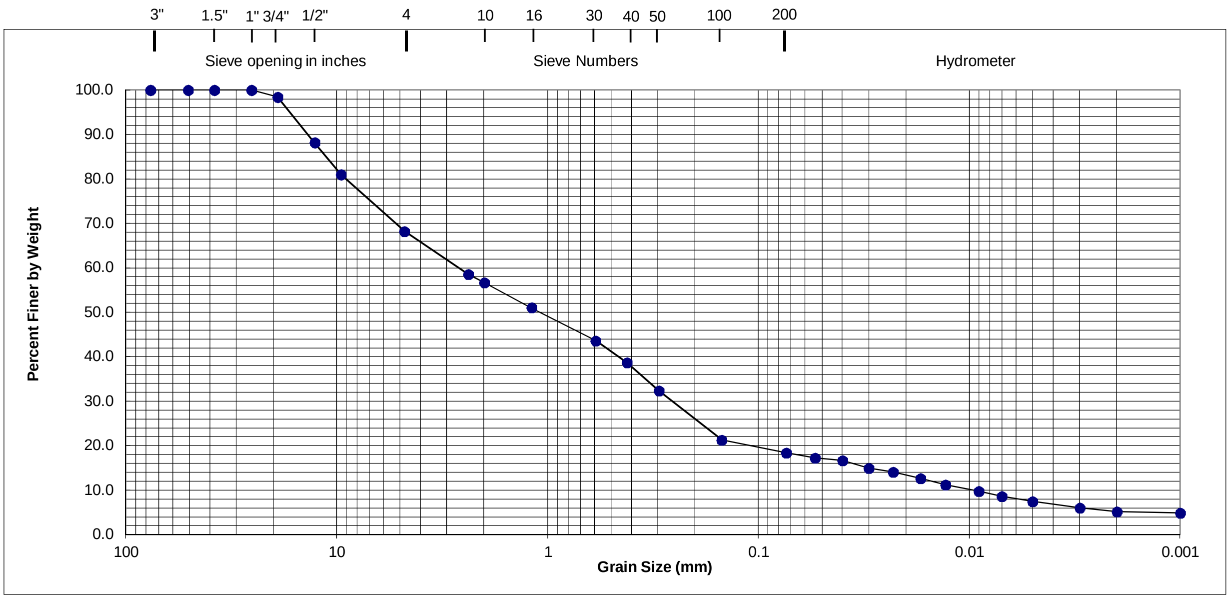
Project:	ST. CHARLES ROAD OVER SALT CREEK
Client:	V3 COMPANIES OF ILLINOIS LTD.
Location:	DEPAGE COUNTY, ILLINOIS
Job No:	1264
Date:	12/17/2015

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Boring No: B-2 **Sample No:** SS-1 **Depth (ft):** 15-16.5

Soil Description: GRAY SAND / A-2-4(0)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



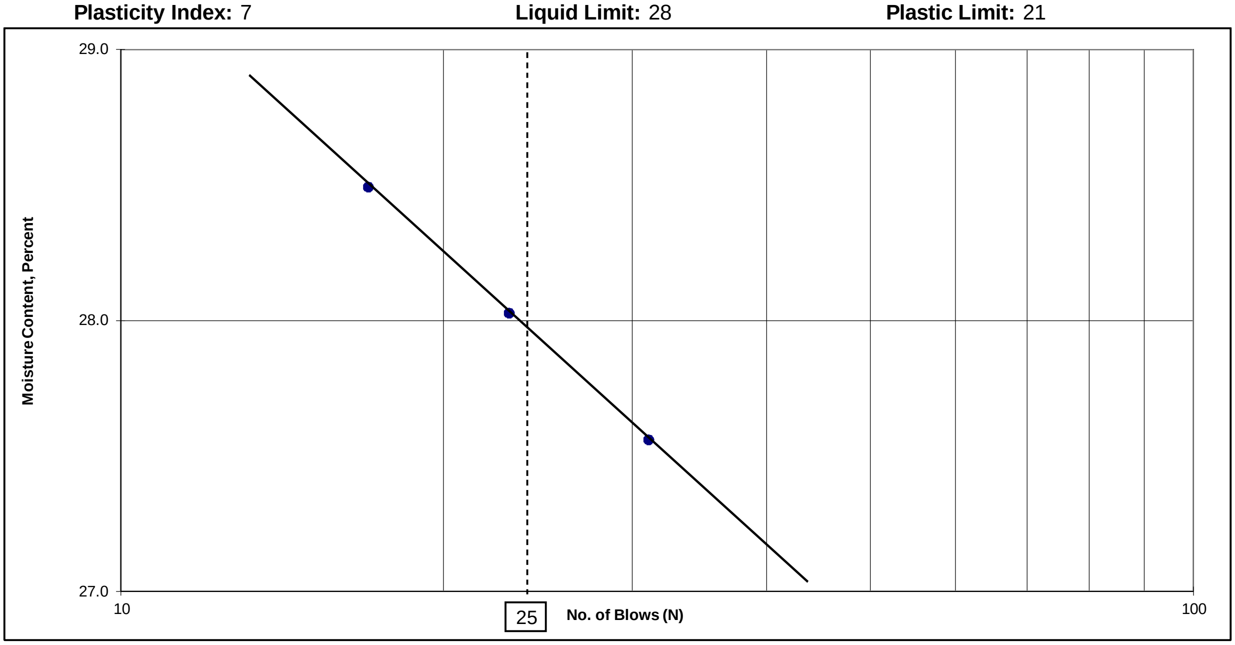
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 43.3% **Sand:** 38.3% **Silt:** 13.2% **Clay:** 5.2%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 61.3

Plasticity Index: 7 **Liquid Limit:** 28 **Plastic Limit:** 21



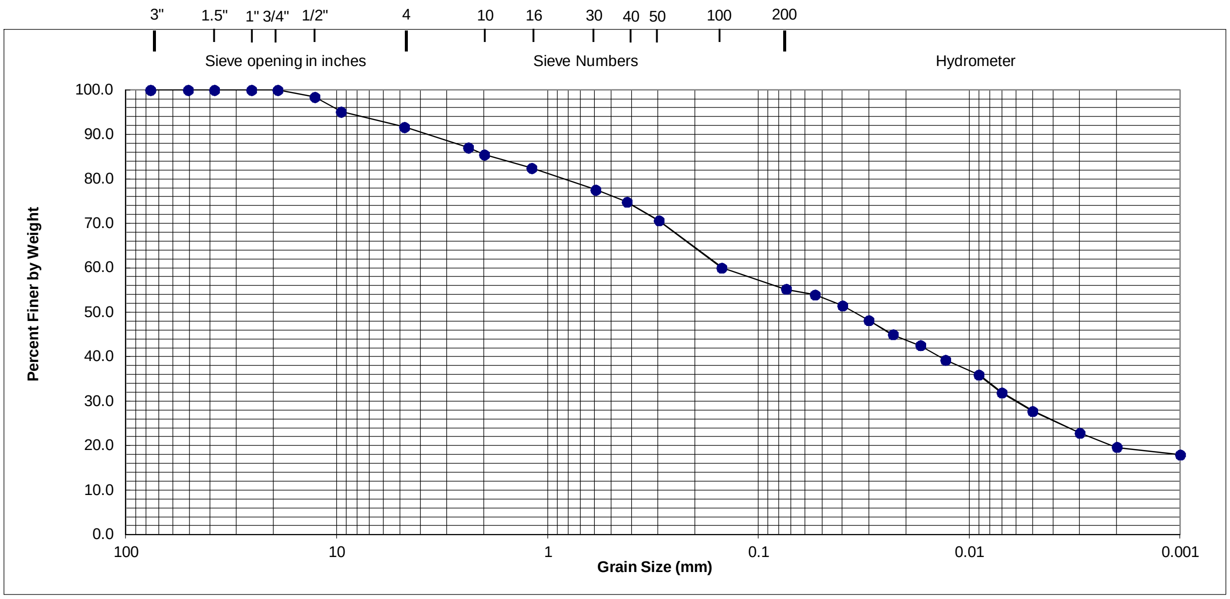
EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Project: ST. CHARLES ROAD OVER SALT CREEK
Client: V3 COMPANIES OF ILLINOIS LTD.
Location: DEPAGE COUNTY, ILLINOIS
Job No: 1264 **Date:** 12/17/2015

Boring No: B-2 **Sample No:** SS-2 **Depth (ft):** 16.5-18

Soil Description: GRAY LOAM / A-6(7)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



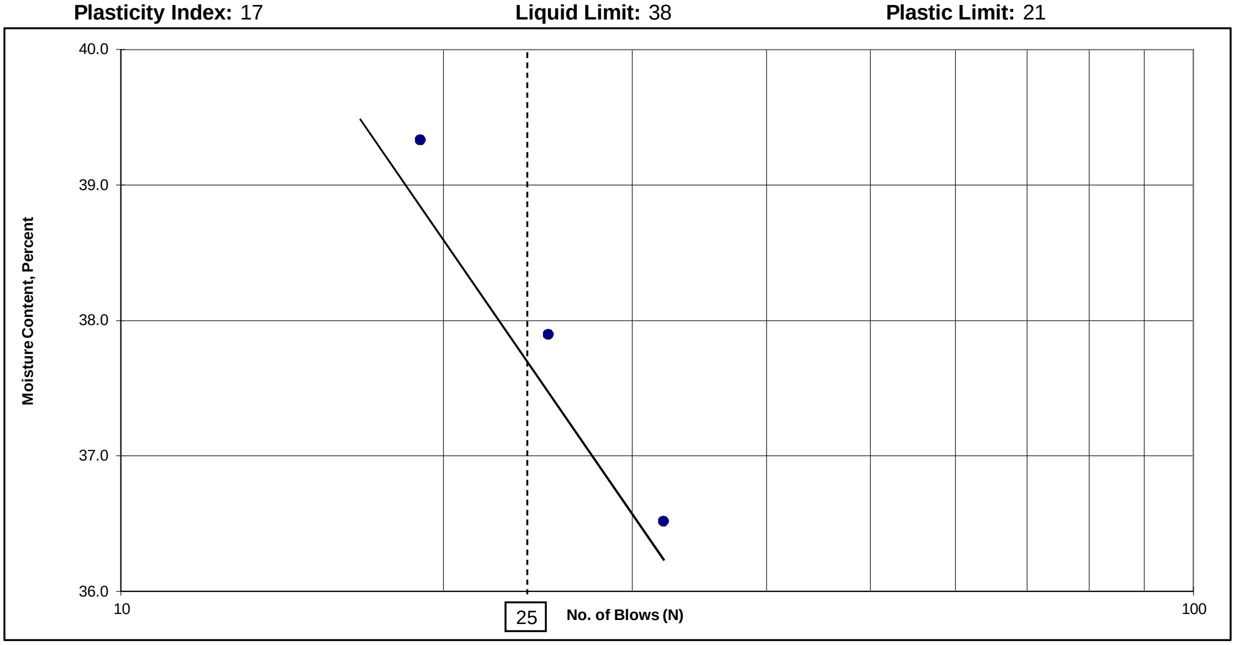
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 14.6% **Sand:** 30.3% **Silt:** 35.5% **Clay:** 19.6%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 25.2

Plasticity Index: 17 **Liquid Limit:** 38 **Plastic Limit:** 21



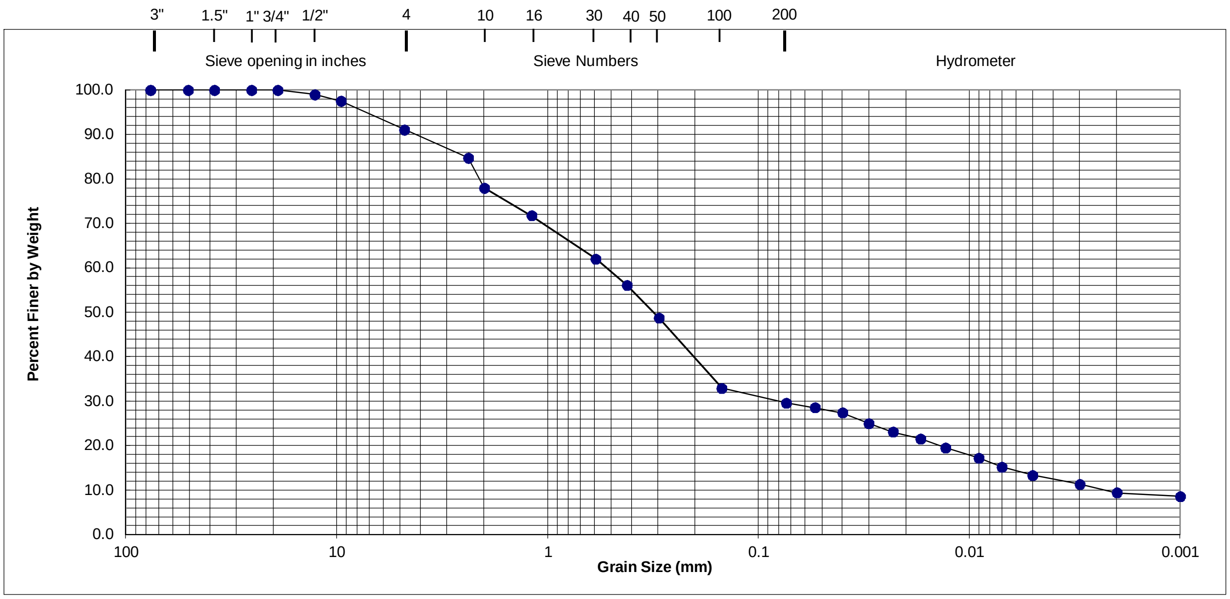
EVERST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Project: ST. CHARLES ROAD OVER SALT CREEK
Client: V3 COMPANIES OF ILLINOIS LTD.
Location: DEPAGE COUNTY, ILLINOIS
Job No: 1264 **Date:** 12/17/2015

Boring No: B-2 **Sample No:** SS-3 **Depth (ft):** 19-21

Soil Description: GRAY SANDY LOAM / A-2-4(0)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



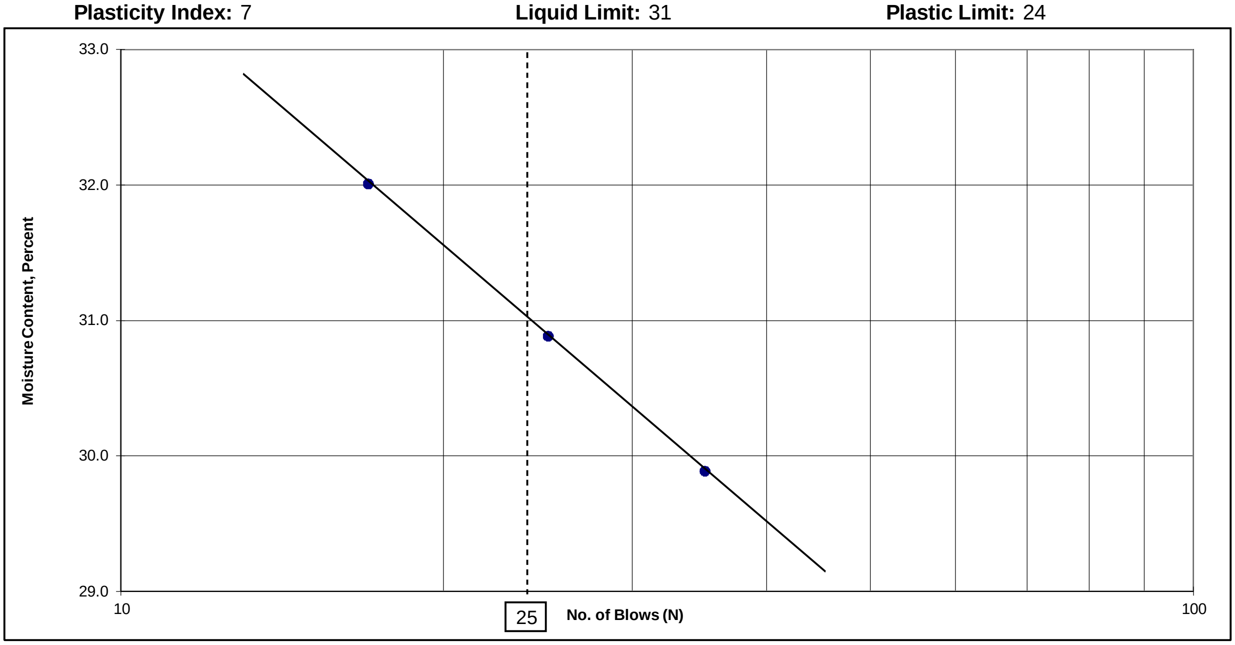
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 22.0% **Sand:** 48.4% **Silt:** 20.2% **Clay:** 9.4%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 43.9

Plasticity Index: 7 **Liquid Limit:** 31 **Plastic Limit:** 24



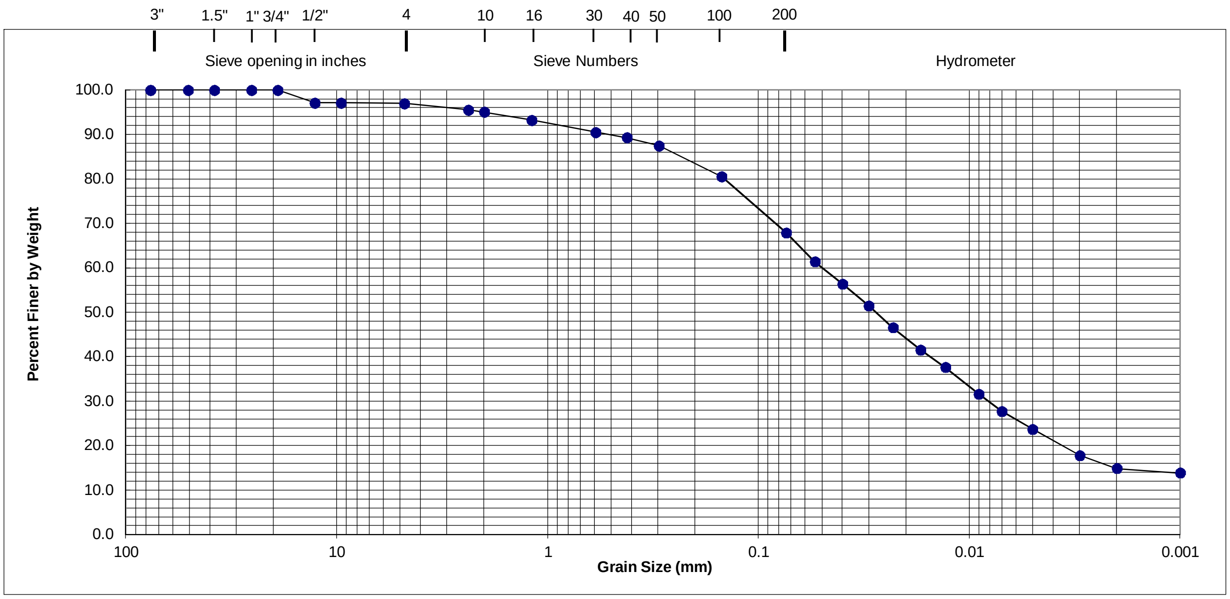
Project:	ST. CHARLES ROAD OVER SALT CREEK
Client:	V3 COMPANIES OF ILLINOIS LTD.
Location:	DEPAGE COUNTY, ILLINOIS
Job No:	1264
Date:	12/17/2015

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Boring No: B-2 **Sample No:** SS-11 **Depth (ft):** 21-22.5

Soil Description: GRAY SILTY LOAM / A-4(0)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



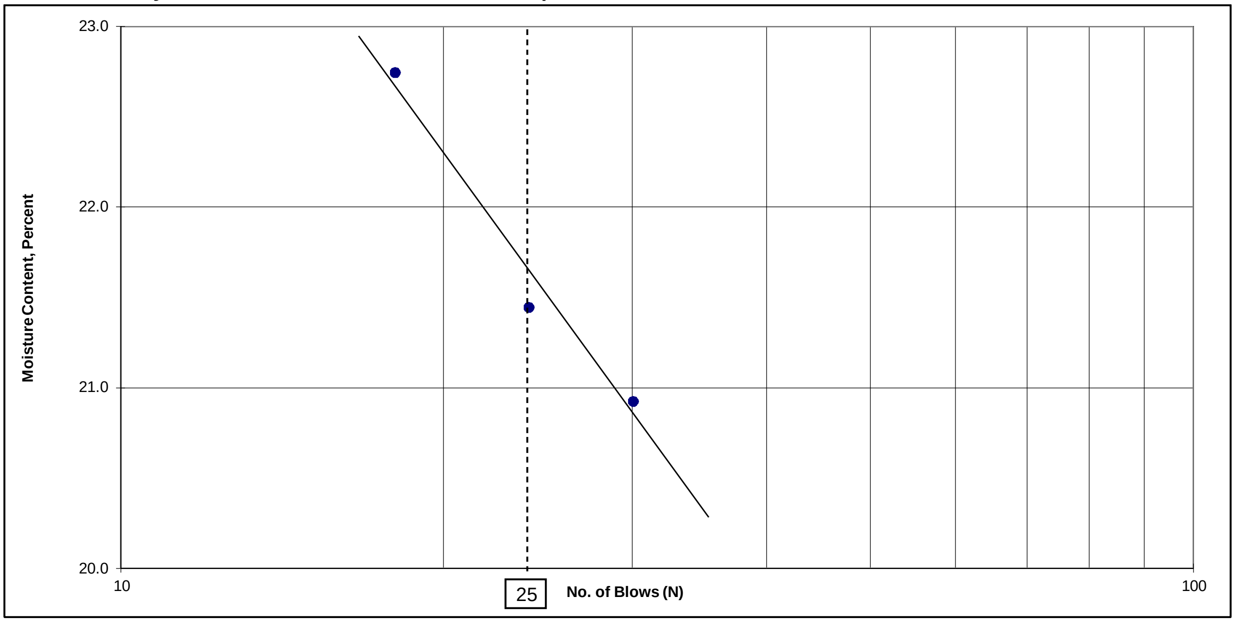
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 4.9% **Sand:** 27.1% **Silt:** 53.1% **Clay:** 14.8%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 10.7

Plasticity Index: 3 **Liquid Limit:** 22 **Plastic Limit:** 19



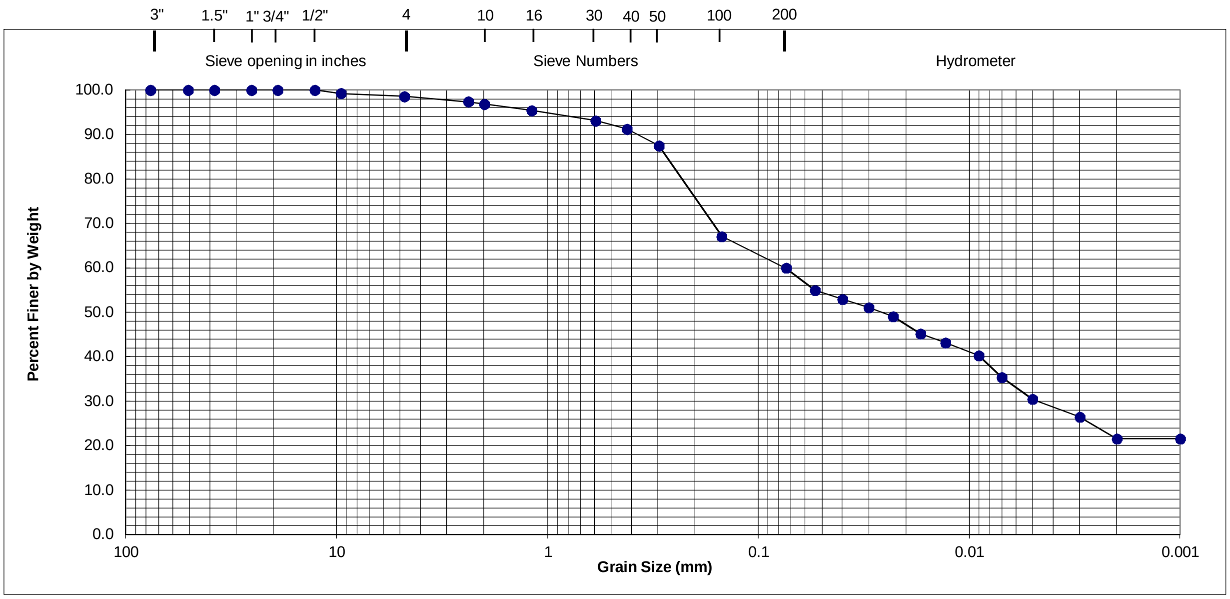
EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Project: ST. CHARLES ROAD OVER SALT CREEK
Client: V3 COMPANIES
Location: DEPAGE COUNTY, ILLINOIS
Job No: 1264 **Date:** 12/17/2015

Boring No: B-3 **Sample No:** SS-2 **Depth (ft):** 3.5-5

Soil Description: BLACK CLAY LOAM / A-6(10)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



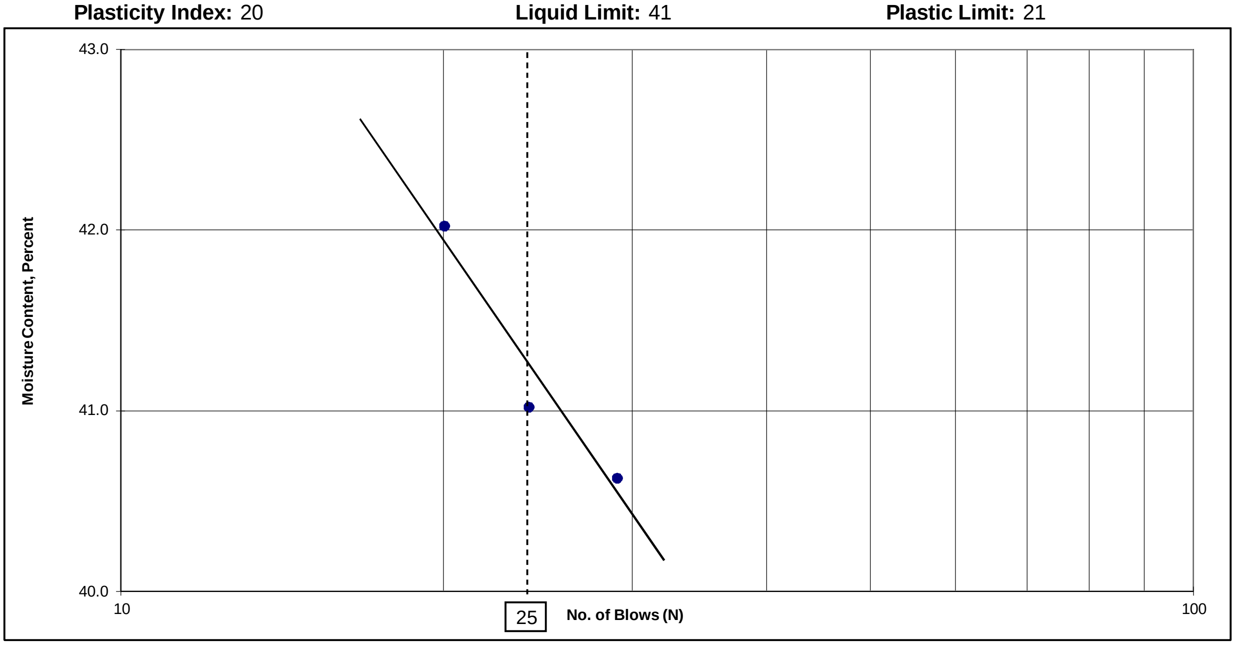
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 3.2% **Sand:** 36.9% **Silt:** 38.3% **Clay:** 21.6%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 8.8

Plasticity Index: 20 **Liquid Limit:** 41 **Plastic Limit:** 21



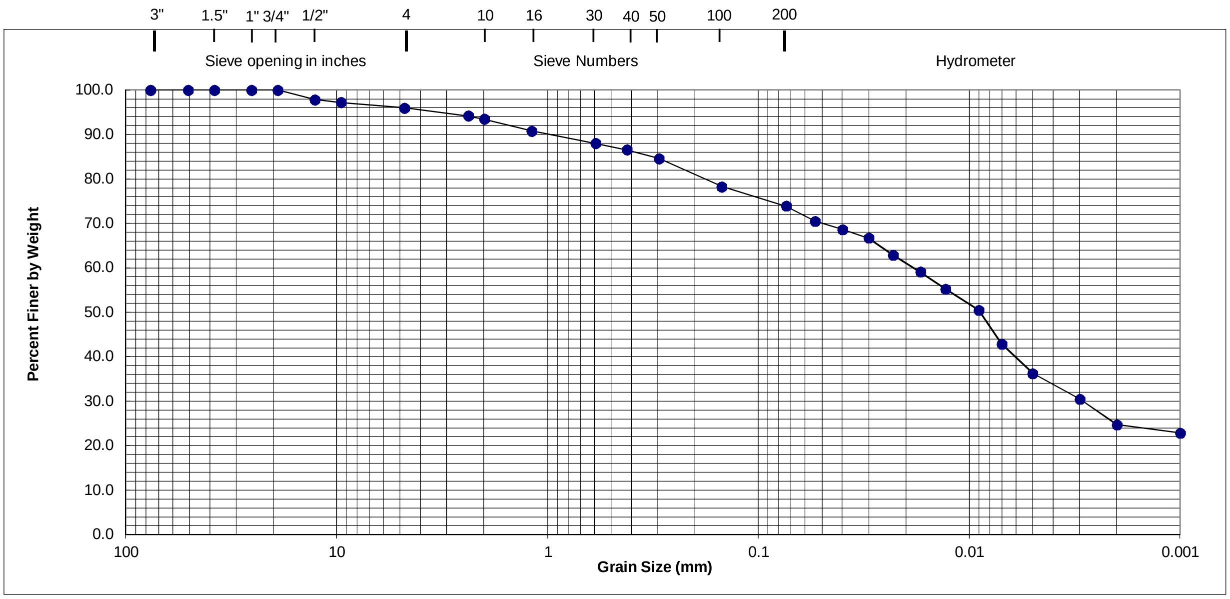
EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Project: ST. CHARLES ROAD OVER SALT CREEK
Client: V3 COMPANIES OF ILLINOIS LTD.
Location: DEPAGE COUNTY, ILLINOIS
Job No: 1264 **Date:** 12/17/2015

Boring No: B-3 **Sample No:** SS-3 **Depth (ft):** 5-7

Soil Description: BROWN AND GRAY CLAY LOAM / A-6(8)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



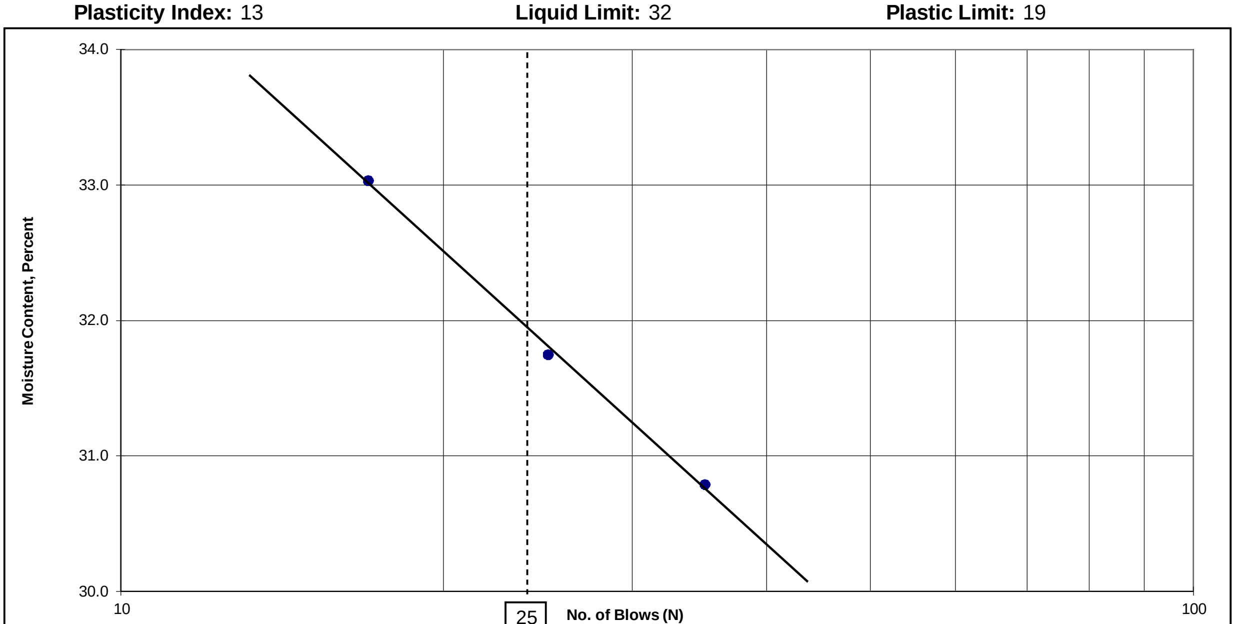
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 6.5% **Sand:** 19.6% **Silt:** 49.1% **Clay:** 24.8%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 13.4

Plasticity Index: 13 **Liquid Limit:** 32 **Plastic Limit:** 19



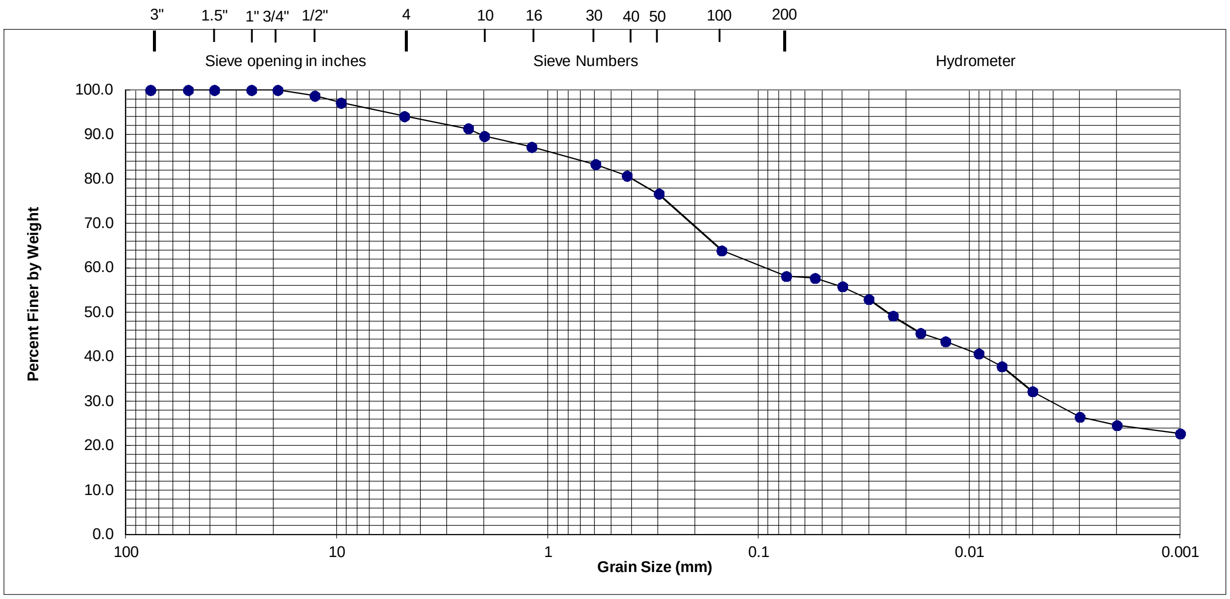
EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

Project: ST. CHARLES ROAD OVER SALT CREEK
Client: V3 COMPANIES OF ILLINOIS LTD.
Location: DEPAGE COUNTY, ILLINOIS
Job No: 1264 **Date:** 12/17/2015

Boring No: B-4 **Sample No:** SS-2 **Depth (ft):** 3.5-5

Soil Description: BLACK AND BROWN CLAY LOAM / A-7-6(11)
(IDH/AASHTO Classification)

PARTICLE SIZE ANALYSIS OF SOIL (AASHTO T 88)



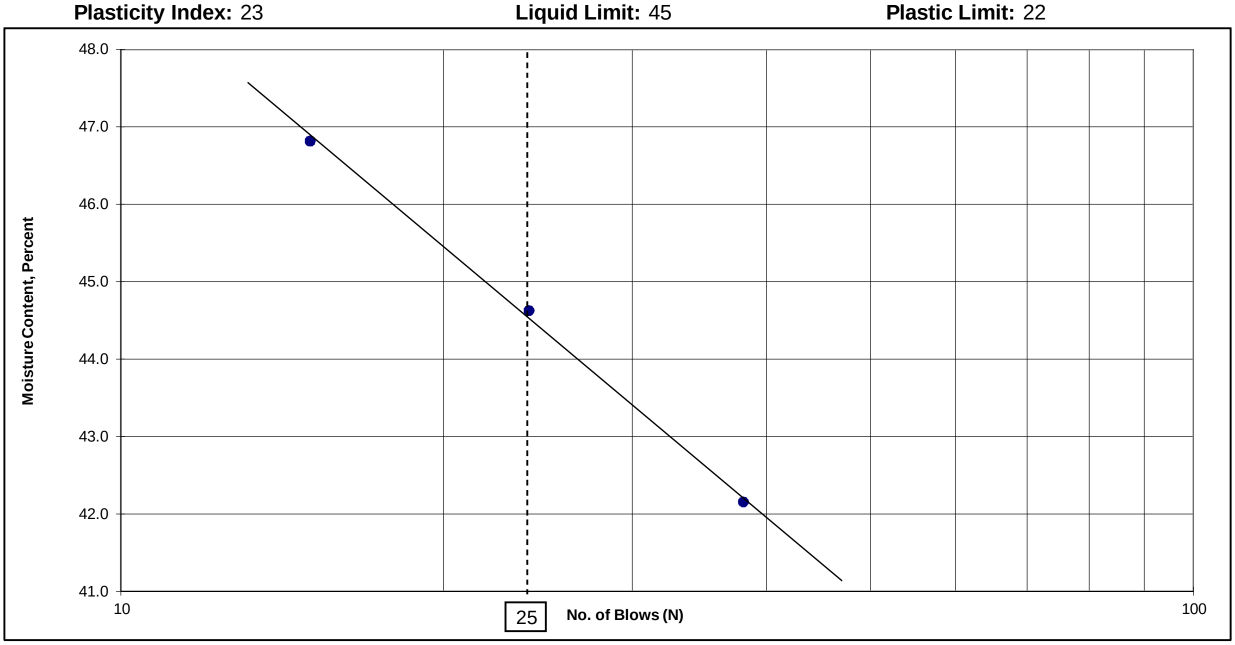
UNIFIED	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	
AASHTO	GRAVEL		COARSE SAND	FINE SAND	SILT	CLAY
IDH	GRAVEL		SAND		SILT	CLAY

Gravel: 10.3% **Sand:** 31.6% **Silt:** 33.5% **Clay:** 24.6%

ATTERBERG LIMITS (AASHTO T 89 and T 90)

Preparation Method: AIR DRY **Estimated Retained on No. 40 Sieve (%):** 19.3

Plasticity Index: 23 **Liquid Limit:** 45 **Plastic Limit:** 22



UNCONFINED COMPRESSIVE STRENGTH
(SOIL)

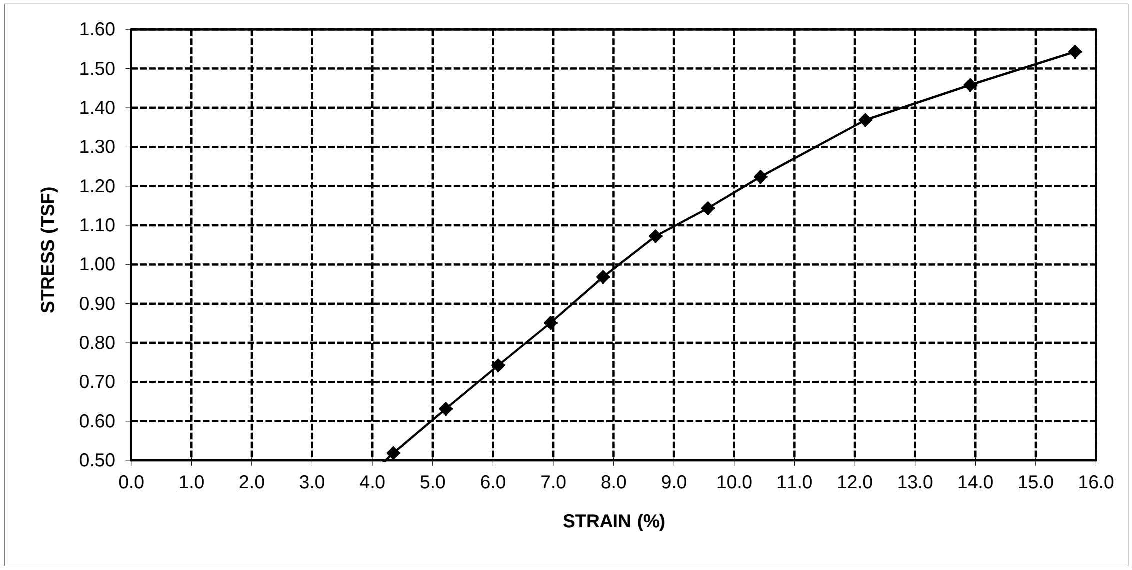
EVERST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL (AASHTO T 208)

Project: St. Charles Road over Salt Creek
Location: DuPage County, Illinois
Client : V3 Companies of Illinois Ltd.
Boring No. : B-1
Soil Description : Gray Clay Loam
Moisture Content (%) : 17
Dry Density (pcf): 115
Unconfined Compressive Strength (tsf) : 1.50
Strain at Failure: 15.0%

Date: 12/1/2015
Job No.: 1264
Sample No. : ST-8
Sample Depth : 18.5'-20.5'
Test Depth : 19'-19.5'
Initial Diameter (in.): 2.85
Initial Height (in.): 5.75
Height -to-Diameter Ratio: 2.02
Strain Rate (in/min): 0.1

TIME (MINUTES)	LOAD (LB)	CORRECTED AREA (SQ. FT.)	STRAIN (%)	STRESS (TSF)
0.0	0	0.0443	0.0	0.00
1.0	17	0.0451	1.7	0.19
1.5	26	0.0455	2.6	0.29
2.0	36	0.0459	3.5	0.39
2.5	48	0.0463	4.3	0.52
3.0	59	0.0467	5.2	0.63
3.5	70	0.0471	6.1	0.74
4.0	81	0.0476	7.0	0.85
4.5	93	0.0480	7.8	0.97
5.0	104	0.0485	8.7	1.07
5.5	112	0.0490	9.6	1.14
6.0	121	0.0494	10.4	1.22
7.0	138	0.0504	12.2	1.37
8.0	150	0.0514	13.9	1.46
9.0	162	0.0525	15.7	1.54



SKETCH AT FAILURE

TYPE OF FAILURE
Diagonal: ☐
Bulge: ☑
Vertical: ☐

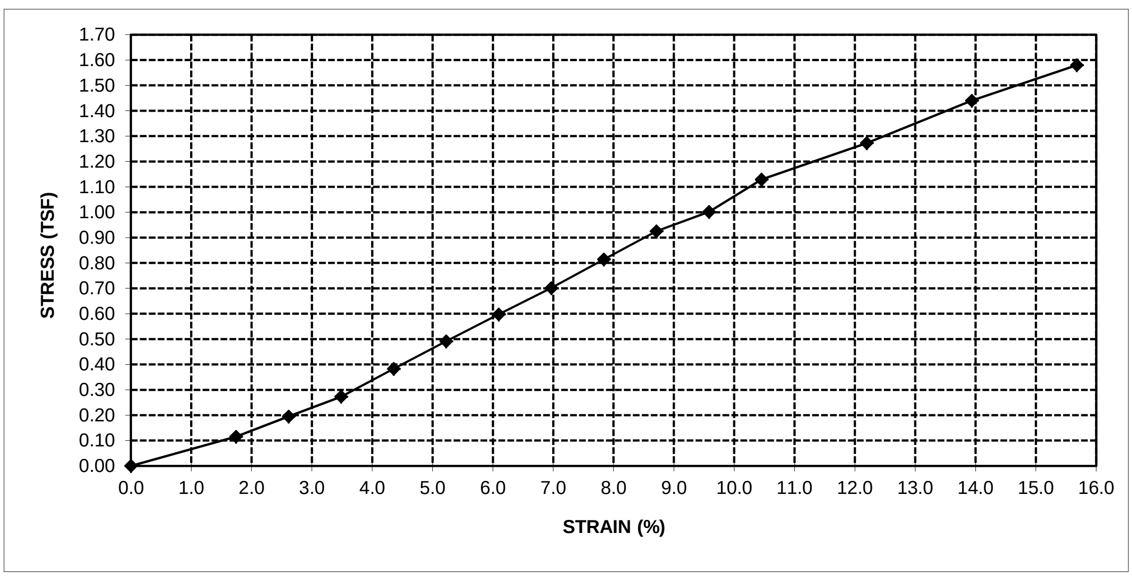
EVERESTENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL (AASHTO T 208)

Project: St. Charles Road over Salt Creek
Location: DuPage County, Illinois
Client : V3 Companies of Illinois Ltd.
Boring No. : B-3
Soil Description : Gray Clay Loam
Moisture Content (%) : 13
Dry Density (pcf): 125
Unconfined Compressive Strength (tsf) : 1.52
Strain at Failure: 15.0%

Date: 12/1/2015
Job No.: 1264
Sample No. : ST-9
Sample Depth : 18.5'-20.5'
Test Depth : 19.5'-20'
Initial Diameter (in.): 2.79
Initial Height (in.): 5.74
Height -to-Diameter Ratio: 2.06
Strain Rate (in/min): 0.1

TIME (MINUTES)	LOAD (LB)	CORRECTED AREA (SQ. FT.)	STRAIN (%)	STRESS (TSF)
0.0	0	0.0424	0.0	0.00
1.0	10	0.0432	1.7	0.12
1.5	17	0.0436	2.6	0.20
2.0	24	0.0440	3.5	0.27
2.5	34	0.0444	4.4	0.38
3.0	44	0.0448	5.2	0.49
3.5	54	0.0452	6.1	0.60
4.0	64	0.0456	7.0	0.70
4.5	75	0.0460	7.8	0.81
5.0	86	0.0465	8.7	0.93
5.5	94	0.0469	9.6	1.00
6.0	107	0.0474	10.5	1.13
7.0	123	0.0483	12.2	1.27
8.0	142	0.0493	13.9	1.44
9.0	159	0.0503	15.7	1.58



SKETCH AT FAILURE

TYPE OF FAILURE
Diagonal: ☐
Bulge: ☑
Vertical: ☐

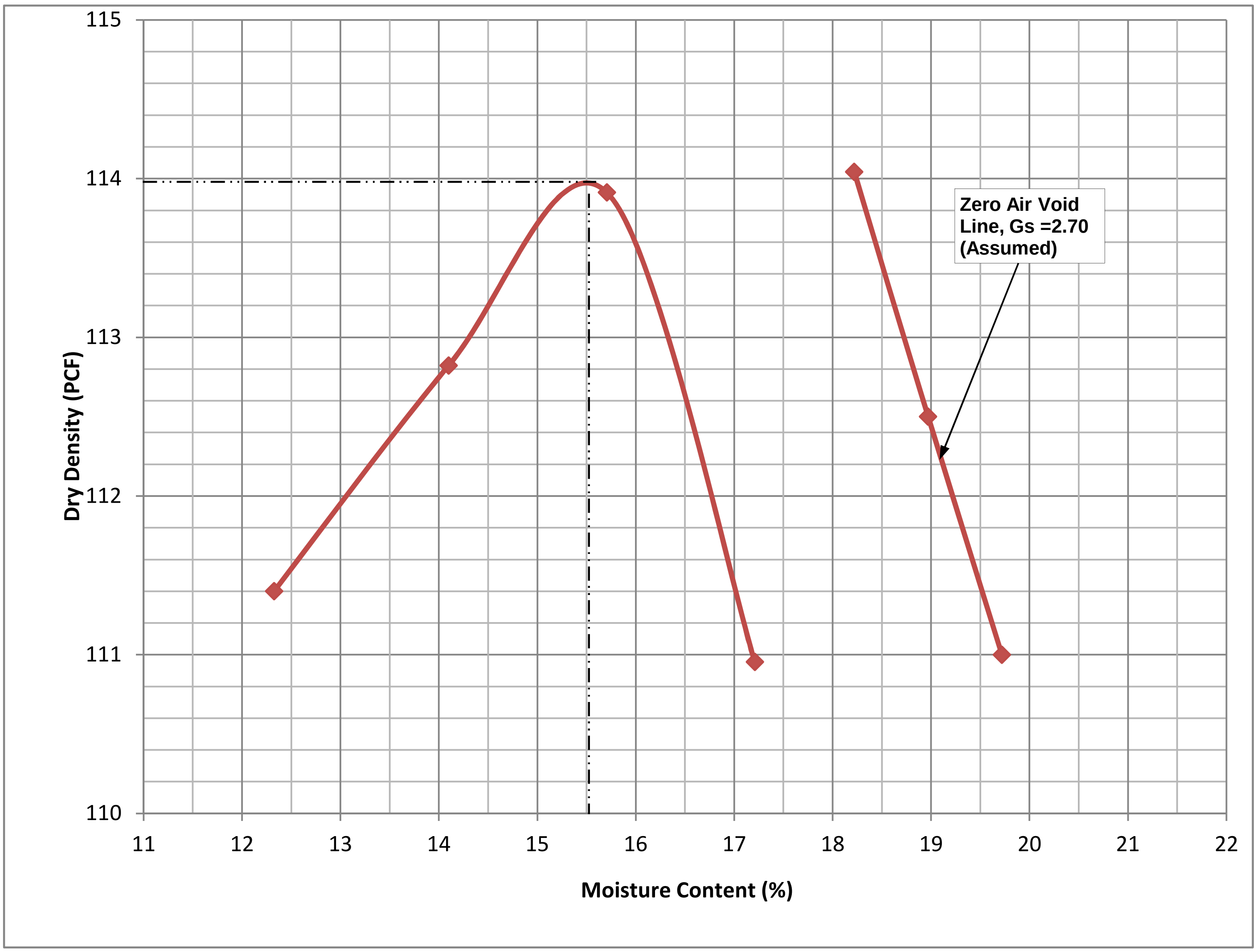
MOISTURE-DENSITY RELATIONS

EVEREST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

MOISTURE-DENSITY RELATIONS OF SOILS
Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in) Drop
AASHTO T 99 (Method C)

Project: St. Charles Road Bridge over Salt Creek
Location.: DuPage County, Illinois
Client: V3 Companies of Illinois Ltd.
Soil Identification: Brown and Black Clay Loam
Remarks: No material retained on No. 4 sieve
Preparation Method: Air Dry
Rammer Type: Mechanical
Maximum Dry Density (pcf): 114

Date: 12/02/2015
Report No.: NA
Job No.: 1264
Boring No.: B-1
Depth: 3'-8'
Sample No.: Bag-1
EEC Sample No.: NA
Optimum Moisture Content (%) : 15.5



 Rev. 03/00

ILLINOIS BEARING RATIO (IBR)

EVERST ENGINEERING COMPANY
915 WEST LIBERTY DRIVE, WHEATON, IL 60187

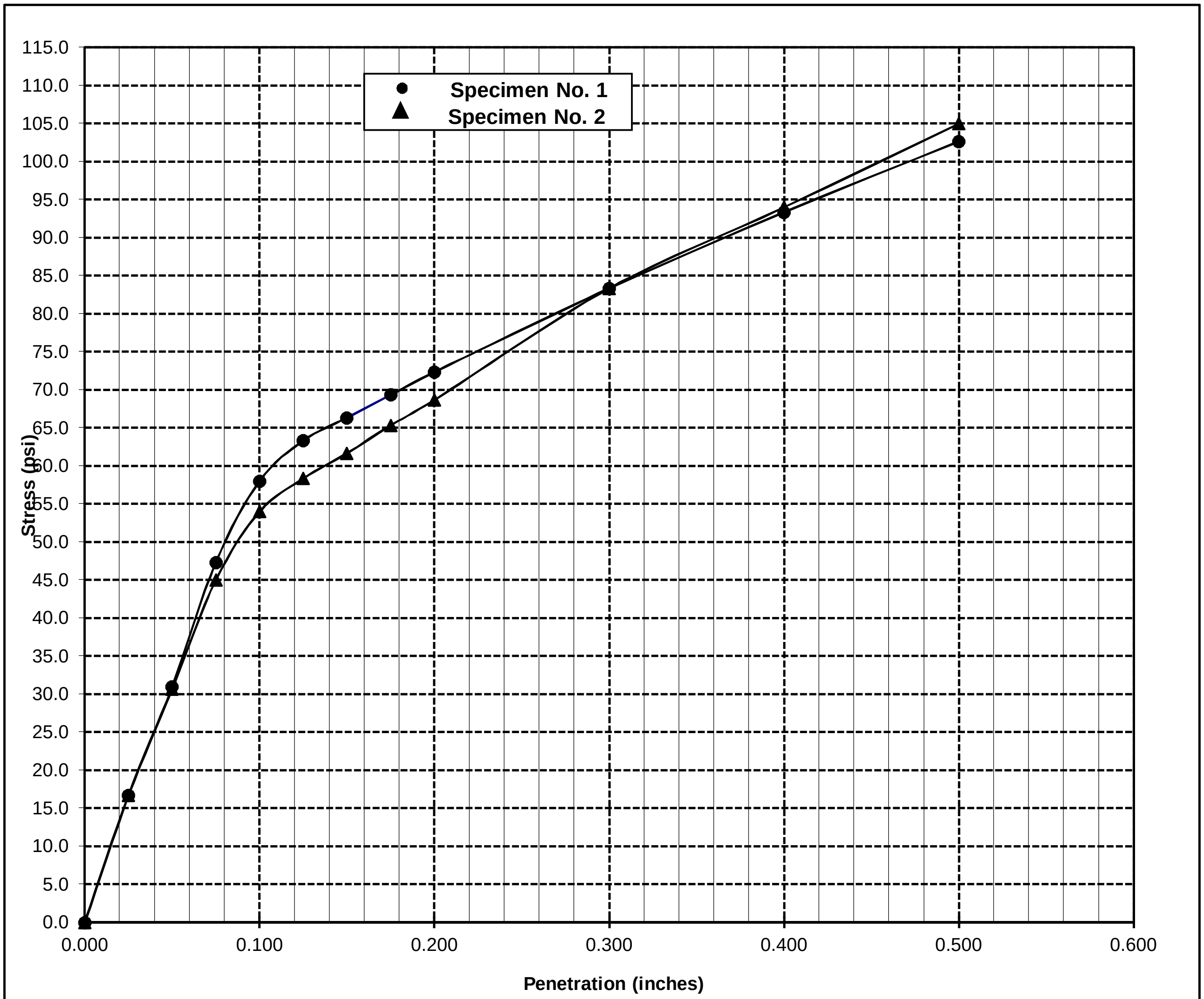
ILLINOIS BEARING RATIO (IBR)

Project: St. Charles Road Bridge over Salt Creek
Location.: DuPage County, Illinois
Client: V3 Companies of Illinois Ltd.
Job No.: 1264
Soil Identification: Brown and Black Clay Loam

Date: 12/2/2015
Boring No.: B-1
Depth: 3'-8'
Sample No.: Bag-1

		Spec. No. 1	Spec. No. 2
Maximum Dry Density	**(PCF)**	114.0	114.0
Optimum Moisture Content	**(%)**	15.5	15.5
Moisture before soaking	**(%)**	15.9	15.9
Moisture after soaking	**(%)**	17.4	17.5
Expansion	**(%)**	0.7	0.7

Test No.	IBR for 0.10 inch penetratior	IBR for 0.20 inch penetratior
1	5.8	4.8
2	5.4	4.6



PILE DESIGN TABLES

Pile Design Table for West Abutment utilizing Boring #B-1

GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = ±664.00 **BOTTOM OF PILE CAP ELEV. = 664.00**

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	40	22	2
	58	32	5
	60	33	7
	64	35	10
	77	42	12
	106	58	15
	107	59	17
	110	61	20
	248	136	25
	171	94	29
	176	97	30
	220	121	32
	208	115	35
	228	125	37
	254	140	40
Metal Shell 12"Φ w/.25" walls			
	40	22	2
	58	32	5
	60	33	7
	64	35	10
	77	42	12
	106	58	15
	107	59	17
	110	61	20
	171	94	29
	176	97	30
	208	115	35
	228	125	37
	353	194	40
Metal Shell 14"Φ w/.25" walls			
	53	29	2
	72	40	7
	75	41	10
	93	51	12
	129	71	15
	130	71	17
	134	73	20
	203	111	29
	208	114	30
	248	137	35
	274	150	37
	413	227	40
Metal Shell 14"Φ w/.312" walls			
	53	29	2
	72	40	7
	75	41	10
	93	51	12
	129	71	15
	130	71	17
	134	73	20
	203	111	29
	208	114	30
	248	137	35
	274	150	37
	513	282	40

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	8	4	2
	26	14	5
	35	19	7
	36	20	10
	45	25	12
	49	27	17
	62	34	20
	72	40	29
	75	41	30
	79	43	35
	83	46	37
	117	65	40
	126	70	42
	151	83	45
	286	157	47
Steel HP 10 X 42			
	9	5	2
	32	18	5
	45	25	10
	57	32	12
	61	34	17
	81	44	20
	91	50	29
	94	52	30
	98	54	35
	104	57	37
	146	80	40
	160	88	42
	186	103	45
	335	184	47
Steel HP 10 X 57			
	11	6	2
	34	18	5
	46	25	10
	59	32	12
	62	34	17
	83	46	20
	93	51	29
	96	53	30
	100	55	35
	107	59	37
	150	83	40
	163	90	42
	195	107	45
	454	250	48

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 53			
	11	6	2
	38	21	5
	55	30	10
	73	40	12
	76	42	17
	98	54	20
	113	62	29
	117	64	30
	120	66	35
	129	71	37
	175	96	40
	191	105	42
	224	123	45
	418	230	47
Steel HP 12 X 63			
	12	7	2
	40	22	5
	55	30	10
	73	40	12
	76	42	17
	100	55	20
	114	63	29
	118	65	30
	121	67	35
	130	71	37
	179	99	40
	195	107	42
	232	127	45
	497	273	47
Steel HP 12 X 74			
	14	8	2
	41	23	5
	56	31	10
	75	41	12
	77	43	17
	101	56	20
	116	64	29
	120	66	30
	123	68	35
	132	73	37
	183	101	40
	198	109	42
	238	131	45
	589	324	48
Steel HP 12 X 84			
	15	8	2
	42	23	5
	57	31	10
	76	42	12
	79	43	17
	102	56	20
	117	65	29
	121	67	30
	125	69	35
	134	74	37
	186	102	40
	201	111	42
	244	134	45
	664	365	48

Pile Design Table for West Abutment utilizing Boring #B-1

GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = ±664.00 **BOTTOM OF PILE CAP ELEV. = 664.00**

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73			
	14	8	2
	47	26	5
	67	37	10
	90	50	12
	92	51	17
	118	65	20
	138	76	29
	143	79	30
	145	80	35
	157	86	37
	212	117	40
	231	127	42
	274	151	45
	578	318	47
Steel HP 14 X 89			
	16	9	2
	49	27	5
	67	37	10
	92	50	12
	93	51	17
	120	66	20
	140	77	29
	145	80	30
	147	81	35
	159	87	37
	218	120	40
	236	130	42
	284	156	45
	705	388	48

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 102			
	18	10	2
	50	28	5
	68	38	10
	93	51	12
	95	52	17
	122	67	20
	142	78	29
	146	81	30
	149	82	35
	161	88	37
	222	122	40
	240	132	42
	292	160	45
	810	445	48
Steel HP 14 X 117			
	20	11	2
	52	29	5
	69	38	10
	94	52	12
	96	53	17
	124	68	20
	144	79	29
	148	82	30
	151	83	35
	163	90	37
	227	125	40
	244	134	42
	301	166	45
	929	511	49

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)

Pile Design Table for East Abutment utilizing Boring #B-4

GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = ±664.00 **BOTTOM OF PILE CAP ELEV. = 664.00**

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	10	5	2
	16	9	5
	40	22	8
	45	25	15
	67	37	20
	131	72	22
	158	87	31
	200	110	36
	254	140	41
Metal Shell 12"Φ w/.25" walls			
	10	5	2
	16	9	5
	40	22	8
	45	25	15
	67	37	20
	131	72	22
	158	87	31
	200	110	36
	319	175	41
	353	194	46
Metal Shell 14"Φ w/.25" walls			
	11	6	2
	21	11	5
	51	28	8
	53	29	15
	81	45	20
	165	91	22
	192	105	31
	247	136	36
	404	222	41
	413	227	46
Metal Shell 14"Φ w/.312" walls			
	11	6	2
	21	11	5
	51	28	8
	53	29	15
	81	45	20
	165	91	22
	192	105	31
	247	136	36
	404	222	41
	513	282	46

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	2	1	2
	4	2	5
	13	7	8
	16	9	15
	20	11	17
	24	13	20
	36	20	22
	41	23	31
	50	28	36
	62	34	41
	89	49	46
	286	157	49
Steel HP 10 X 42			
	2	1	2
	5	2	5
	16	9	8
	20	11	10
	20	11	15
	27	15	17
	30	17	20
	45	25	22
	53	29	31
	66	36	36
	77	42	41
	109	60	46
	335	184	48
Steel HP 10 X 57			
	3	1	2
	5	3	5
	17	9	8
	20	11	15
	27	15	17
	31	17	20
	46	25	22
	54	30	31
	67	37	36
	80	44	41
	117	64	46
	454	250	49
Steel HP 12 X 53			
	3	2	2
	5	3	5
	19	11	8
	24	13	10
	25	14	15
	32	18	17
	36	20	20
	53	29	22
	64	35	26
	67	37	31
	79	43	36
	92	51	41
	131	72	46
	418	230	48

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 63			
	3	2	2
	6	3	5
	20	11	8
	25	14	10
	25	14	15
	33	18	17
	37	20	20
	55	30	22
	66	36	26
	67	37	31
	81	44	36
	95	52	41
	138	76	46
	497	273	49
Steel HP 12 X 74			
	3	2	2
	6	3	5
	20	11	8
	26	14	15
	34	18	17
	38	21	20
	56	31	22
	68	37	26
	69	38	31
	82	45	36
	97	54	41
	144	79	46
	589	324	50
Steel HP 12 X 84			
	3	2	2
	7	4	5
	21	11	8
	26	14	15
	34	19	17
	39	21	20
	57	31	22
	69	38	26
	70	38	31
	83	46	36
	99	55	41
	150	82	46
	664	365	50

Pile Design Table for East Abutment utilizing Boring #B-4

GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = ±664.00 **BOTTOM OF PILE CAP ELEV. = 664.00**

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73			
	3	2	2
	7	4	5
	24	13	8
	29	16	10
	31	17	15
	39	22	17
	44	24	20
	65	36	22
	78	43	26
	83	46	31
	96	53	36
	113	62	41
	163	90	46
	578	318	49
Steel HP 14 X 89			
	4	2	2
	8	4	5
	24	13	8
	31	17	10
	32	17	15
	40	22	17
	45	25	20
	67	37	22
	81	44	26
	84	46	31
	97	54	36
	116	64	41
	172	95	46
	705	388	50

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 102			
	4	2	2
	8	4	5
	25	13	8
	32	18	15
	41	22	17
	46	25	20
	68	37	22
	83	45	26
	85	47	31
	99	54	36
	119	65	41
	179	99	46
	810	445	50
Steel HP 14 X 117			
	4	2	2
	9	5	5
	25	14	8
	32	18	15
	41	23	17
	47	26	20
	69	38	22
	85	47	26
	87	48	31
	100	55	36
	122	67	41
	188	103	46
	929	511	50

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)

Pile Design Table for West Pier utilizing Boring #B-2

GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = ±651.00

BOTTOM OF PILE CAP ELEV. = 651.00

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	25	14	3
	114	63	6
	132	72	8
	177	97	21
	254	140	27
Metal Shell 12"Φ w/.25" walls			
	25	14	3
	114	63	6
	132	72	8
	177	97	23
	346	190	27
	353	194	32
Metal Shell 14"Φ w/.25" walls			
	30	16	3
	133	73	6
	173	95	8
	208	114	23
	413	227	27
Metal Shell 14"Φ w/.312" walls			
	30	16	3
	133	73	6
	173	95	8
	208	114	23
	435	239	27
	513	282	32
Steel HP 8 X 36			
	2	1	3
	8	4	6
	11	6	8
	19	10	11
	24	13	12
	34	19	16
	36	20	23
	60	33	27
	75	42	32
	98	54	35
	286	157	37
Steel HP 10 X 42			
	2	1	3
	8	4	6
	14	8	8
	23	13	11
	30	16	12
	42	23	16
	46	25	23
	74	41	27
	94	52	32
	121	66	35
	335	184	37

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57			
	2	1	3
	10	6	6
	16	9	8
	26	14	11
	33	18	12
	45	25	16
	47	26	23
	77	42	27
	97	53	32
	129	71	35
	454	250	38
Steel HP 12 X 53			
	2	1	3
	9	5	6
	17	9	8
	28	15	11
	36	20	12
	51	28	16
	58	32	19
	59	32	23
	89	49	27
	112	62	32
	145	80	35
	418	230	37
Steel HP 12 X 63			
	2	1	3
	10	6	6
	18	10	8
	30	16	11
	38	21	12
	53	29	16
	59	33	23
	92	50	27
	116	64	32
	152	84	35
	497	273	38
Steel HP 12 X 74			
	3	1	3
	11	6	6
	19	11	8
	32	18	11
	40	22	12
	55	30	16
	60	33	23
	94	52	27
	118	65	32
	158	87	35
	589	324	38
Steel HP 12 X 84			
	3	2	3
	12	7	6
	20	11	8
	34	19	11
	42	23	12
	57	31	16
	61	34	23
	96	53	27
	121	66	32
	164	90	35
	664	365	39

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73			
	3	1	3
	11	6	6
	21	12	8
	35	19	11
	45	25	12
	63	35	16
	71	39	19
	73	40	21
	73	40	23
	109	60	27
	137	75	32
	179	99	35
	578	318	38
Steel HP 14 X 89			
	3	2	3
	12	7	6
	23	13	8
	38	21	11
	48	27	12
	66	36	16
	73	40	19
	74	41	23
	112	62	27
	141	78	32
	189	104	35
	705	388	38
Steel HP 14 X 102			
	3	2	3
	13	7	6
	25	13	8
	41	22	11
	51	28	12
	68	38	16
	75	41	19
	75	41	21
	75	41	23
	115	63	27
	144	79	32
	196	108	35
	810	445	39
Steel HP 14 X 117			
	4	2	3
	15	8	6
	26	14	8
	44	24	11
	54	30	12
	71	39	16
	76	42	23
	118	65	27
	148	81	32
	205	113	35
	929	511	39

Pile Design Table for East Pier utilizing Boring #B-3

GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = ±651.00 **BOTTOM OF PILE CAP ELEV. = 651.00**

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	18	10	6
	31	17	9
	104	57	19
	143	79	24
	254	140	28
Metal Shell 12"Φ w/.25" walls			
	18	10	6
	31	17	9
	104	57	19
	143	79	24
	353	194	28
Metal Shell 14"Φ w/.25" walls			
	22	12	6
	39	21	9
	125	69	19
	177	98	24
	413	227	28
Metal Shell 14"Φ w/.312" walls			
	22	12	6
	39	21	9
	125	69	19
	177	98	24
	461	254	28
	513	282	33
Steel HP 8 X 36			
	8	5	4
	9	5	6
	14	8	9
	26	14	11
	29	16	19
	38	21	24
	50	27	28
	77	42	33
	103	57	37
	286	157	39
Steel HP 10 X 42			
	10	6	4
	11	6	6
	18	10	9
	32	17	11
	37	20	19
	49	27	24
	61	34	28
	96	53	33
	127	70	37
	335	184	39

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57			
	10	6	4
	11	6	6
	18	10	9
	33	18	11
	37	21	19
	50	27	24
	66	36	28
	99	54	33
	135	74	37
	454	250	40
Steel HP 12 X 53			
	12	7	4
	13	7	6
	21	12	9
	38	21	11
	46	25	19
	58	32	24
	74	41	28
	115	63	33
	153	84	37
	418	230	39
Steel HP 12 X 63			
	12	7	4
	14	8	6
	22	12	9
	40	22	11
	46	25	19
	60	33	24
	77	43	28
	118	65	33
	160	88	37
	497	273	40
Steel HP 12 X 74			
	12	7	4
	14	8	6
	22	12	9
	41	23	11
	47	26	19
	60	33	24
	81	44	28
	121	66	33
	166	91	37
	589	324	40
Steel HP 12 X 84			
	13	7	4
	14	8	6
	23	13	9
	42	23	11
	47	26	19
	61	34	24
	83	46	28
	123	68	33
	172	95	37
	664	365	41

	Nominal Required Bearing (Kips)	Bearing Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73			
	14	8	4
	16	9	6
	26	14	9
	47	26	11
	56	31	19
	71	39	24
	91	50	28
	140	77	33
	189	104	37
	578	318	40
Steel HP 14 X 89			
	15	8	4
	17	9	6
	27	15	9
	49	27	11
	57	31	19
	72	40	24
	96	53	28
	144	79	33
	198	109	37
	705	388	40
Steel HP 14 X 102			
	15	8	4
	17	9	6
	27	15	9
	50	28	11
	57	32	19
	73	40	24
	100	55	28
	147	81	33
	205	113	37
	810	445	41
Steel HP 14 X 117			
	15	8	4
	17	9	6
	28	16	9
	52	29	11
	58	32	19
	74	41	24
	104	57	28
	151	83	33
	214	118	37
	929	511	41