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Subsurface Exploration and Geotechnical Engineering Report

Ryan Field Development
Evanston, Illinois

Submitted to:
Mr. Steven Himes
Northwestern University
2020 Ridge Ave., Suite 200
Evanston, IL 60208

Submitted by:
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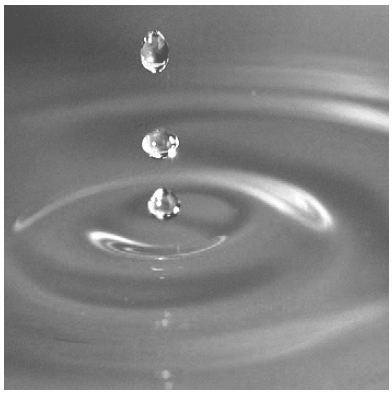
November 14, 2022

Project 2200549

Darren S. Diehm, P.E., D.GE.
Senior Professional



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November 14, 2022
GEI Project No. 2200549

VIA EMAIL: steven.himes@northwestern.edu

Mr. Steven Himes
Northwestern University
2020 Ridge Ave., Suite 200
Evanston, IL 60208

RE: Subsurface Exploration and Geotechnical Engineering Report for the Ryan Field Development at 1501 Central Street in Evanston, IL

Dear Mr. Himes;

GEI Consultants, Inc. (GEI) has completed our geotechnical site exploration for the reconstruction of Ryan Field in Evanston, Illinois.

Shallow foundations would be expected to provide suitable support for light and moderately loaded structures. The clay crust has shear strengths between about 1 and 3 ksf, however, much of the deposit has strengths between 1.75 and 2.5 ksf. To maintain settlement at less than 1 inch, spread footings should be supported at least 5 feet above the top of the soft clay. Spread-type footings bearing between elevation +15 and +5 ECD can be designed for a net allowable bearing pressure of 4,250 psf.

Deep foundations comprised of belled caissons bearing on very stiff to hard silty clay would be expected to be the most economical foundation for larger structures at this site. Caissons bearing between elevation -50 and -55 ECD can be designed for a net allowable bearing capacity of 12 ksf. Caissons extended to elevation -55 to -60 ECD may be designed for 23 ksf.

Occasional silt and sand layers may exist in the lower Park Ridge moraine, but they are not expected to interfere with caisson construction. Bell excavations near the top of hardpan are expected to be stable in most areas of the site. Where wet or seeping silt pockets are encountered, the caisson excavation can be extended deeper into the hardpan to allow belling to be completed in stable materials.

We appreciate the opportunity to provide our services for this project. Please do not hesitate to call with any questions regarding our report.

Sincerely,

GEI CONSULTANTS, INC.

Ati Fathi, P.E.
Senior Professional

Darren S. Diehm, P.E., D.GE.
Senior Professional

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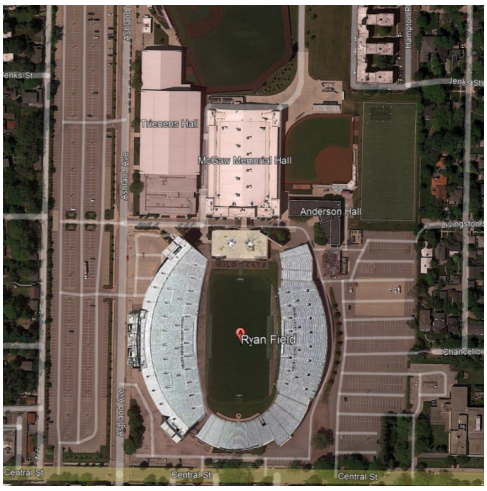
Appendix A

Appendix B

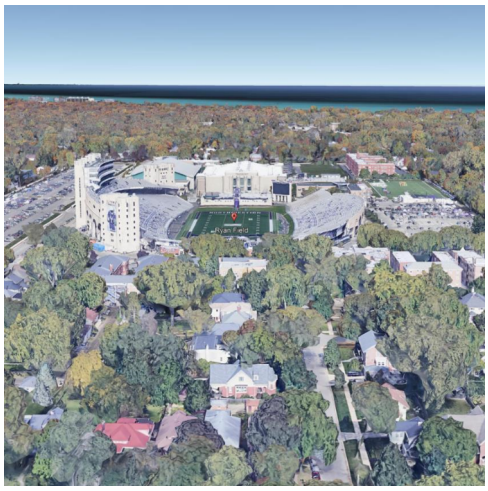
1. Purpose and Scope of Work

1.1 Introduction

We understand that Ryan Field is expected to be reconstructed entirely or mostly within the footprint of the existing stadium. The existing facility was constructed in 1926 and largely renovated in 1997. The new stadium may incorporate parts of the existing west towers.



1a: Project location



1b: Existing site conditions (looking north)

Figure 1: Ryan Field, Evanston, IL (*rep. from Google Earth*)

The new stadium will be rotated counterclockwise by a little less than 40 degrees and it will expand south toward Central Avenue. The field surface is currently planned to be lowered by 20 to 25 feet from existing to grade to approximately elevation +0 Evanston City Datum (ECD). The stadium bowl foundations will extend up to approximately elevation +21 ECD. The maximum height of the stands at Press level will be elevation +93 ECD and the stadium roof is at elevation +128 ECD.

The preliminary stadium foundation loads provided by the structural engineer are as indicated below.

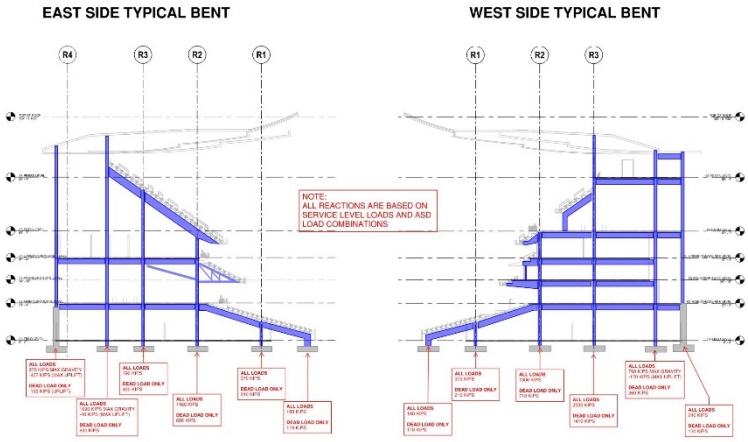


Figure 2: Preliminary foundation loads (*Thornton Tomasetti, Feb 2022*)

2. Exploration Procedures

A total of 24 soil borings and 7 CPT Soundings were completed at the approximate location shown below by Strata Earth Services under subcontract to GEI. The borings were labeled as identified in the request for proposal; Boring B-20 was skipped in the numbering sequence. A full-size boring location diagram is provided in the Appendix.

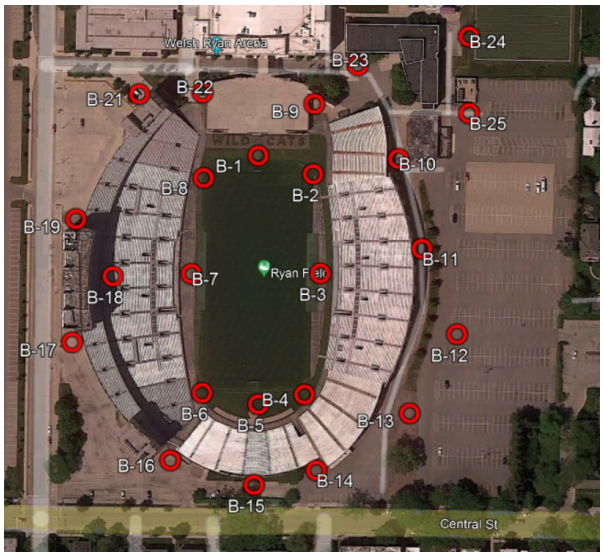


Figure 2: Soil boring locations for Ryan Field in Evanston, IL (*image rep. form Google Earth*)

The boreholes were advanced through the soil using a wash boring technique employing a tricone drilling bit and drilling fluids. Representative soil samples were obtained in the soil borings in general accordance with split-barrel sampling procedures as outlined in ASTM Standard D 1586.

A field log for each boring was prepared by the drill crew. The log included visual classifications of the materials encountered during drilling, as well as the driller's interpretation of the subsurface conditions between samples. The depth at which groundwater was encountered while sampling or drilling was observed and noted on the field log. The groundwater observations are presented on the lower left corner of the soil boring logs included in Appendix A.

The soil samples were sealed in jars and transported to our geotechnical laboratory for further examination and testing. The borehole was grouted to existing grade upon completion of the drilling operations, and the pavement was patched. The final boring logs included with this report represent an interpretation of the field log and include modifications based on laboratory observation and results of tests of the samples.

2.1 Specialized Field Testing Procedures

In addition to the standard exploration and sampling, GEI provided a program of specialized field testing as part of the subsurface investigation.

Cone penetration test soundings were performed at seven locations to further evaluate the shear strength of the soft to very stiff clay. The CPT has a 20mm sampling interval which provides a virtually continuous profile of soil strength. The data obtained during push of the CPT was reduced using friction angle correlations and bearing capacity (or cone) factors consistent with local conditions and published references. Plots of the interpreted soil shear strength, material type and pore water conditions as a function of depth are included in Appendix A. The vane shear testing was utilized to validate the CPT correlations.

A series of pressuremeter tests was performed to provide supplemental for design of foundations and to estimate settlement. The pressuremeter test consists of lowering an inflatable probe into the borehole to the desired test depth. The probe is expanded against the soils forming the walls of the borehole, and the pressure required to expand the probe and the corresponding volume changes are recorded incrementally. In effect, an in-situ stress-strain load test is performed in the soil. The results of the pressuremeter test can be related empirically to both allowable bearing capacity and settlement estimates.

The results of the CPT and pressuremeter tests are included in Appendix A.

2.2 Laboratory Procedures

Representative portions of the soil samples were visually examined by a geotechnical engineer to estimate the distribution of grain sizes, plasticity, organic content, moisture condition, color, presence of lenses and seams, and apparent geological origin. A calibrated hand penetrometer was used to estimate the approximate unconfined compressive strength of the cohesive soil samples. The soils were classified in accordance with our standard practice and assigned group symbols consistent with those recommended by the Unified Soil Classification System. A chart describing the classification system is included in Appendix A.

Results of the field and laboratory tests were plotted on the boring logs which are included in Appendix A. Similar soils were grouped into strata on the log. Please note that the strata contact lines represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in both the horizontal and vertical directions.

All samples recovered from the borings will be retained for a period of 30 days, after which time they will be discarded unless other specific instructions as to their disposition are received.

3. Exploration Results

3.1 Subsurface Conditions

The Evanston subsoils are predominantly composed of large masses of clay deposited by the advances and retreats of the continental ice sheet during the Wisconsin glacial period. The clays consist of a series of ground moraines (or till sheets) lying one atop another. Geologically, six separate till sheets, representing six advances and retreats of the ice front, have been identified: (from bottom up typically) the Valparaiso moraine, Tinley moraine, and the Lake Border moraine which is comprised of the Park Ridge, Deerfield, Blodgett and Highland Park till sheets.

In most area urban fill extends to about 5 feet below surface grade. Isolated areas of deeper fill associated with utilities and previous construction do exist. The fill is underlain by 5 to 8 feet of silty sand and sandy silt which comprises the remnants of the sand blanket. In most areas of Evanston, the sand varies from 10 to 15 feet thick generally thinning from east to west behind Ridge Avenue. Local excavations appear to have replaced the sand with cohesive fill across much of the site.

The fill and sand are underlain by weathered (overconsolidated), stiff to very stiff clay which is often locally described as the "clay crust." This material represents the glacial lake bottom. The crust extends 25 to 30 feet below grade. Interbedded soft clay layers were encountered between 20 and 25 feet; however, they did not appear to be persistent across the site.

The top member (Blodgett and Deerfield) of the glacial drift consists of approximately 20 to 25 feet of compressible clay. The deposit typically has shear strengths less than 600 psf. Between elevation -5 and -10 ECD, the CPT and the borings indicate the soft clay is interbedded with thin (less than about 1 to 2-foot thick) stiff to very stiff clay seams. The shear strength of the seams varies from 1,000 to 3,000 psf.

The soft to medium clay is expected to be underlain by 25 to 30 feet of stiff to very stiff clay and silty clay which represents the Park Ridge moraine. Thin sand and silt seams are common in the deposit. Isolated outwash deposits may exist at the bottom of the Park Ridge moraine. These alluvial fans and streams of sand, silty sand, and sandy silt were deposited in glacial meltwater channels eroded into the underlying hardpan. Typically, the materials are water bearing, but they are not expected to be persistent at this site or to yield flow volumes significant enough to interfere with belled caisson construction.

The top of the Tinley moraine till sheet, which is commonly referred to as "hardpan," is expected between elevation -55 and -60 ECD. The hardpan in this area often exhibits a high silt content and it is generally between 20 and 25 feet thick. Occasional cobbles, gravelly zones, and/or interbedded sand seams may exist in the lower third of the deposit.

The remaining 10 to 15 feet of the soil overburden is expected to be comprised of water bearing granular deposits (sand, silty sand, silty gravel, and sandy silt) interbedded with hardpan clay. Layers of extremely dense sand and gravels are present throughout the Valparaiso moraine, and cobbles, boulders, and broken rock are commonly noted in the lower 5 feet of the deposit.

The Evanston bedrock consists of shallow dolomite formations mainly of Silurian age, and deep sandstone and dolomite formations of Cambrian and Ordovician age. The Devonian shale which once covered the dolomite was almost completely removed by glacial ice sheets and redeposited as part of the Tinley moraine. In the Chicago and Evanston area, the shale survives only as in-fills of fissures within the Silurian dolomite. The Niagaran series immediately underlies the glacial drift, and it varies in thickness from 240 to 425 feet, generally increasing eastwards towards the Lake Michigan basin.

The top of bedrock was not encountered in the completed borings which were extended to maximum depths of 100 feet below grade. Based on information from nearby sites, bedrock would be anticipated between elevation -90 and -95 ECD. The unconfined compressive strength of the dolomite is typically between 12,000 and 21,000 psi. The RQD, recovery, strength, and moisture condition, the Rock Mass Rating (RMR) of cores recovered from the upper 10 feet of bedrock is normally indicative of Good to Excellent quality rock.

The above summary is intended to provide an indication only of the major soil units encountered during the subsurface exploration. Conditions between individual boring locations may vary. The boring logs and CPT soundings are provided in Appendix A.

Table 2: General subsurface profile and geotechnical parameters

							Mohr-Coulomb		Pressuremeter			LPile	
Age	*Unit*	*Log*	*Name*	*Description*		*T/Layer Elevation (ECD)*	*Total Unit Wt, γ*	*Shear Strength, S_u (Adhesion, C_a)*	*Friction Angle, ϕ*	*Creep Pressure, P_f*	*Net Limit Pressure, P_l*	*Pressure Modulus, E_d*	*p-y Subgrade Modulus, k*	*E_{50}*
			Fill	VI	Man placed material consisting predominantly of sand-size particles with varying inclusions of cinders, brick, and concrete fragments.	+20 to +25	120-125 pcf	-	28-32 deg	-	-	-	40-60 pci	-
Pleistocene - Wisconsin			Glacial Lake Bottom	V	Weathered, over-consolidated clay with low to medium PI. Identified by Peck and Reed as "Desiccated Clay Crust."	+15 to +20	125-130 pcf	1-2.5 ksf (0.5-1.3 ksf)	-	3-4	4-7	45-70	450-750 pci	0.006-0.008
	Glacial Drift	*Lake Border moraines*	Blodgett and Deerfield	IVa	Grey to bluish grey clay and silty clay with occasional non-persistent silt and sandy silt seams. Normally to slightly overconsolidated with OCR between 1.1 and 1.6.	+0 to -5	122-127 pcf	0.4-0.6 ksf (0.3-0.5 ksf)	--	-	-	-	330-400 pci	0.01-0.014
				IVb		-10 to -15	125-127 pcf	0.45-0.7 ksf (0.3-0.4 ksf)	--	-	-	-	350-500 pci	0.009-0.011
			Park Ridge	II	Lacustrine and low plasticity clay with natural moisture content between 18-22%. Transitional zone of variable thickness.	-25 to -30	130-135 pcf	1.0-2.5 ksf (0.5-1.3 ksf)	-	10-15	15-22	130-150	550-900 pci	0.005-0.008
		Terminal moraine	Tinley moraine	II	Glacially consolidated low plasticity clay, silty clay and clayey silt. Blow counts in excess of 40 bpf and natural moisture contents below 14%. Locally referred to as "Chicago Hardpan."	-55 to -60	130-135 pcf	4.0-5.0 ksf (2.0-2.5 ksf)	-	17-25	26-39	230-620	1,000-1,200 pci	0.003 – 0.005
			Valparaiso moraine	I	Extremely dense sandy silt, silty gravel and gravelly sand with occasional cobbles and boulders.	-75 to -80	130-135 pcf	-	32-35 deg	25-35	42-55	870-1,150	100-120 pci	-
												Hoek-Brown		
Age	*Unit*	*Log*	*Name*	*Description*		*T/Layer Elevation (CCD)*	*Total Unit Wt, γ*	*Uniaxial Strength*	*Young's Modulus, E_r*	*RQD (RMR)*	*GSI*	*c'*	*ϕ'*	*K_{rm}*
Silurian	Niagran Series		Dolomite		Extremely weathered to disintegrated dolomite	-90 to -92 (Variable)	135-140 pcf	-	-	-	20-25	20-30 ksf	18-23 deg	0.00008
					Fresh to moderately weathered, hard to medium, grey to light tan, blocky, slightly to moderately vuggy dolomite and dolomite limestone. Generally near-horizontal bedding with slightly inclined to near-vertical joints.	-90 to -95 (Estimated)	150-160 pcf	7-30 ksi	1,500-3,000 ksi	71-98 (65-75)	60-70	85-210 ksf	35-38 deg	0.00005

3.2 Groundwater Conditions

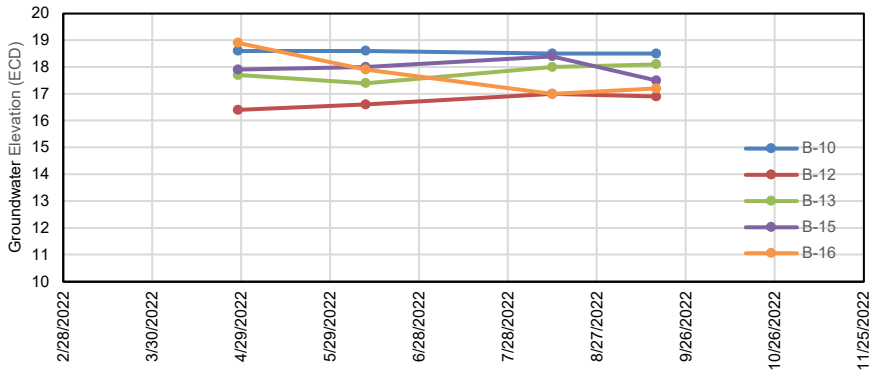
Groundwater in Evanston is contained in three primary aquifer systems. The shallowest aquifer occurs in the fill and upper sand deposits of the glacial drift, and it is directly influenced by the surface level of Lake Michigan. The remaining aquifers are contained within the bedrock.

Groundwater was observed at depths of 4 to 6 feet below grade at locations of predominantly granular fill or where the sand blanket was intact. In areas where the sand was removed and replaced with cohesive fill, or where the glacial lake bottom formed a ridge, groundwater was observed in the borings at 8 to 15 feet below grade. Based on the color change of the recovered cohesive samples, the groundwater table in the clay appears to be located near approximately elevation +18 ECD in most seasons.

Five piezometer wells were installed for long-term monitoring of the groundwater conditions. After installation, the wells were allowed to stand for several days, then they were bailed for development. Readings have been taken as indicated below.

Table 3: Groundwater readings

Boring ID	Surface El (ECD)	Screen Interval	Install (Development)	04/28/2022		06/10/2022		08/12/2022		09/16/2022	
				Water Depth	Elev (ECD)	Water Depth	Elev (ECD)	Water Depth	Elev (ECD)	Water Depth	Elev (ECD)
B-10	+24.8	15-20 ft	03/15/2022 (03/18/2022)	6.2 ft	+18.6	6.2 ft	+18.6	6.3 ft	+18.5	6.3 ft	+18.5
B-12	+24.5	15-20 ft	03/15/2022 (03/18/2022)	8.1 ft	+16.4	7.9 ft	+16.6	7.5 ft	+17	7.6 ft	+16.9
B-13	+24.1	15-20 ft	03/15/2022 (03/18/2022)	6.4 ft	+17.7	6.7 ft	+17.4	6.1 ft	+18	6 ft	+18.1
B-15	+24.7	15-20 ft	03/09/2022 (03/18/2022)	6.8 ft	+17.9	6.7 ft	+18	6.3 ft	+18.4	7.2 ft	+17.5
B-18	+25.6	15-20 ft	03/17/2022 (03/18/2022)	6.7 ft	+18.9	7.7 ft	+17.9	8.6 ft	+17	8.4 ft	+17.2



The groundwater level has remained essentially stable at the wells for the 182-day interval between the development and the last set of readings. At most locations the variation in the water elevation was by less than 6 inches.

Pore pressure dissipation tests were performed at depths of 30 and 35 feet in CPT-10 and CPT-12. Based on the interpreted values for 50% dissipation, t_{50}, the permeability of the upper clay was estimated to be between $1x10^{-7}$ and $2x10^{-7}$ cm/sec using the direct empirical correlation of Parez and Fauriel. Rising head slug tests were performed in the piezometers following the August readings. The permeability within the screen zone of the wells was determined to be 4 to 12 times slower than

the values estimated from the dissipation tests (between about $1x10^{-8}$ and $4x10^{-8}$ cm/sec). At one location the rising head permeability was nearly 25 times slower during the test.

Groundwater flow in the upper aquifer is preferential towards Lake Michigan. The static level of Lake Michigan has recently fallen approximately 2 feet from its historic high to approximately elevation +580 IGLD85 at Calumet Harbor. For the purposes of preliminary design, we would recommend the high long-term shallow groundwater table be assumed at elevation +20 ECD.

Piezometer observations in Chicago and Evanston typically indicate vertical drainage of the upper aquifer to the underlying bedrock. Saturation in most areas extends into the Park Ridge till sheet at which point the low permeability of the glacial drift begins to impede flow. The granular deposits of the Valparaiso moraine commonly exhibit piezometric head levels between 10 and 15 feet above the top elevation of the deposit. The pressure is not artesian, the head is indicative of the level of the upper bedrock aquifer.

4. Foundation Recommendations

4.1 Geotechnical Considerations

Shallow foundations would be expected to provide suitable support for light and moderately loaded structures. The clay crust has shear strengths between about 1 and 3 ksf, however, much of the deposit has strengths between 1.75 and 2.5 ksf. To maintain settlement at less than 1 inch, spread footings should be supported at least 5 feet above the top of the soft clay.

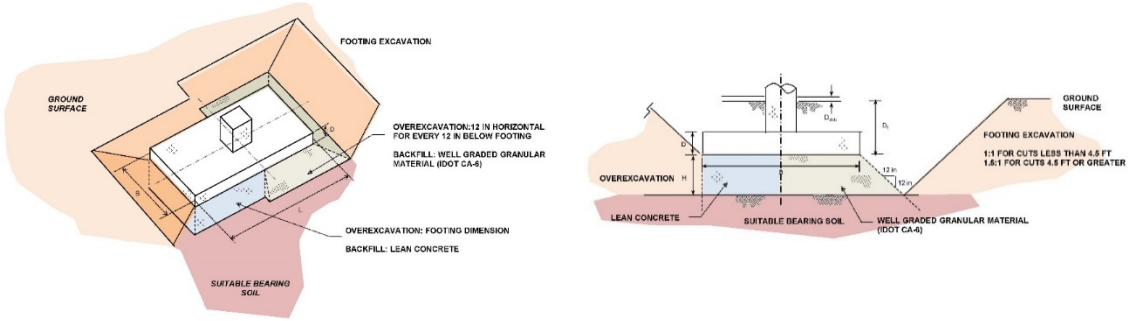
Deep foundations comprised of belled caissons bearing on hardpan silty clay would be expected to be the most economical foundation for larger structures at this site.

Occasional silt and sand layers may exist in the lower Park Ridge moraine, but they are not expected to interfere with caisson construction. Bell excavations near the top of hardpan are expected to be stable in most areas of the site. Where wet or seeping silt pockets are encountered, the caisson excavation can be extended deeper into the hardpan to allow belling to be completed in stable materials.

4.2 Spread Footing Foundations

The natural stiff and very stiff clay and isolated sand soils in the project area generally appear suitable for foundation support. Since variations could occur between the boring locations, the soils exposed in foundation excavations should be observed and tested by a GEI representative to check for the presence of unsuitable bearing soils.

If the unsuitable material is encountered at bearing elevation, they should be overexcavated and replaced with engineered fill. The overexcavation should extend outward 12 inches for every foot below the design bearing level. The foundations could then be extended to bear on the suitable soils at the deeper level, or the excavation could be backfilled back up to design footing elevation with engineered fill or lean concrete. If flowable fill or lean concrete is utilized as backfill, the footing excavation does not need to be extended beyond the edges of the footing.



3a: Footing excavation isometric **3b:** Section for lean concrete and granular backfill

Figure 3: Overexcavation for unsuitable bearing soil

Backfill placed beneath footings should consist of a well-graded granular material, containing less than 12% by weight passing the No. 200 (0.075 mm) sieve (preferably IDOT gradation CA-6). This material should be placed in thin lifts not exceeding 9 inches in loose thickness, and it should be compacted to a minimum of 95% of its maximum dry density as determined by the modified Proctor test (ASTM D 1557). Thinner lifts should be used where material is compacted with light or walk-behind equipment. If flowable fill or lean concrete is utilized as backfill, the footing excavation does not need to be extended beyond the edges of the footing.

Footings bearing on inspected and approved soils may be designed using the maximum net allowable soil bearing pressures provided below.

Table 4: Bearing capacity and **s**ettlement of belled caisson foundations

Geologic Unit		*Description*		*Elevation*	*Footing Type*	*Allowable Bearing Capacity*	*Estimated Settlement*
	Beach Sand	VI	Sand, Silty Sand, Sandy Silt	+22 to +15 ECD (Isolated)	Isolated	5 ksf	¾ - 1 in
					Continuous	4.5 ksf	¾ - 1 in
	Clay Crust	V	Stiff to Very Stiff Clay	+15 to -2 ECD	Isolated	4.25 ksf	¾ - 1 in
					Continuous	3.75 ksf	¾ - 1 in
					Soft Clay layers may be present between El +5 and -5 ECD		

Notes:
1. Subgrade to be inspected for unsuitable soils
2. Overexcavation to extend to suitable soil or nominal 2 feet below footing bearing elevation
3. Allowable load determined for FS = 3

At the maximum bearing pressures, the total settlements of footing foundations designed and constructed as recommended above are estimated to be less than about 1 inch. Differential settlements due to varying foundation loads and support conditions are estimated to be less than about ½-inch.

Footings placed in unheated areas should be embedded a minimum of 4 feet below finished grade to provide for adequate frost protection. Individual column footings should have a minimum width of 30 inches, and continuous wall footings should have a minimum width of 18 inches to prevent disproportionately small footing sizes.

The resistance to sliding of footings, grade beams, and core mats can be evaluated using the earth pressure coefficients and interface friction value tabulated below. Backfill against grade beams and mats should be placed in thin lifts, not exceeding 12 inches in loose thickness, and it should be compacted to 95% of the materials maximum dry density as determined by the modified Proctor test.

Table 5: Earth pressure coefficients and interface friction values

	Interface Friction Factor, tan δ	*Earth Pressure Coefficients*		
		Active, K_a	*Passive, K_p*	*At-Rest, K_0*
Granular Backfill				
(Sides of Grade Beams and Core Mats)	0.45	0.25	3.85	0.40
Footings				
(Mass Concrete on New Fill)	0.55	-	-	-
(Concrete on Cohesive Soil)	0.45	-	-	-

4.3 Caissons

4.3.1 Belled Caisson Bearing Capacity and Settlement

Bearing capacity analyses were performed to verify that the pressures beneath typical belled caissons would be within the limits set forth by Menard (1975) and Briaud (1987). Using the results of the pressuremeter tests, the allowable bearing pressure for typical belled caissons at the site is estimated as:

Table 6: Bearing capacity and **s**ettlement of belled caisson foundations

Geologic Unit		*Description*		*Bearing Elevation*	*Allowable Bearing Capacity*	*Estimated Settlement*
	Park Ridge	III	Stiff to Very Stiff to Hard Clay	-50 to -55 ECD	12 ksf	½ – ¾ in
	Tinley moraine	II	Hard Clay and Silty Clay "Hardpan"	-55 to -60 ECD	23 ksf	¾ – 1 in

Notes:
1. Minimum shaft diameter is 30 inches
2. Caisson bells should be a min. 1-ft thick at design edge and that sides slope at 60 deg (from horiz.)
3. Concrete strength should be at least 3,000 psi & compression stresses should not exceed $0.3f'_c$
4. Settlement estimated for maximum allowable bearing capacity

The maximum net allowable bearing pressure is the pressure which may be transmitted to the foundation soils in excess of the final minimum surrounding overburden pressure. In accordance with the International Building Code, a 33% increase can be applied to the allowable bearing pressure for wind and seismic loading. Side friction is ignored when computing the capacity of belled caissons to resist compression loads.

The estimated settlement was determined for the maximum recommended allowable bearing pressure.

4.3.2 Caisson Uplift Capacity

It is recommended that the ultimate uplift capacity of caissons with full length reinforcement be estimated based on the combined self-weight and side friction on the perimeter of the soil annulus projected above the bell. For the total stress analysis, the average unit weight of the soil should be assumed to be γ_s = 125 pcf, and the unit weight of the concrete can be assumed as γ_c = 150 pcf. The average unit side resistance along soil annulus can be assumed as c_a = 350 psf.

Hydrostatic uplift on the base of the caisson should be subtracted from the ultimate uplift resistance. The hydrostatic head should be assumed at elevation +20 ECD where the finished site elevation is consistent with existing grade. A hydrostatic head of approximately 85 feet would be conservative across the site. Where the site grade is lowered and an underdrain is provided, the hydrostatic head can be estimated from the finished slab-on-grade level.

Table 7: Uplift of belled caisson foundations

Shaft Dia	Bell Dia	Length	Allowable Uplift
2.5 ft	7.5 ft	55	300 kip
3 ft	9 ft		375 kip
3.5 ft	10.5 ft		460 kip
4 ft	12 ft		545 kip
4.5 ft	13.5 ft		640 kip
5 ft	15 ft		740 kip

Notes: 1. Hydrostatic uplift on base determined assuming 60 ft of head
2 Allowable uplift determined using a FS=2

A factor of safety of 2 should be provided against uplift when resistance is determined from self-weight of the foundations and side resistance.

4.3.3 Caisson Lateral Capacity

Lateral analyses of the caisson shafts were performed for free- and fixed-headed boundary conditions using the p-y curve method. A free-headed analysis is generally applied to cases where a pile extends above the ground line, or it can be conservatively applied when the pile is minimally embedded in the cap. A shaft fully embedded in a concrete grade beam, mat for cap may be modeled using fixed-headed boundary conditions. The loading in this case would consist of a lateral shear force and a slope (set equal to zero) at the pile head, and a vertical compression load. In most cases, the actual drilled shaft response will be somewhere between the values predicted for the fixed-headed and free-headed boundary conditions. The input boundary conditions are used by LPile for the solution of the finite difference equations which model the pile as a beam-column. Despite the similarity of the terms, they should not be confused with support conditions as defined by classical mechanics of materials.
Plots of pile-head deflection and moment versus lateral load are included in the attachments. The analyses assume the top of shaft is located at elevation +0 ECD.

Table 8: Summary of parametric lateral load analyses for caisson shafts

Shaft Diameter	*Free Head*		*Fixed Head*		*Equivalent Spring Modulus*	
	Max Shear	*Max Moment*	*Max Shear*	*Max Moment*	*Free Head*	*Fixed Head*
30”	30 kip	1,741 kip-in	61 kip	3,581 kip-in	80 kip/in	160 kip/in
36”	42 kip	2,915 kip-in	83 kip	5,659 kip-in	110 kip/in	220 kip/in
42”	54 kip	4,250 kip-in	104 kip	7,810 kip-in	140 kip/in	275 kip/in
48”	69 kip	6,345 kip-in	135 kip	11,800 kip-in	180 kip/in	360 kip/in
54”	84 kip	8,744 kip-in	164 kip	15,700 kip-in	220 kip/in	435 kip/in
60”	109 kip	13,100 kip-in	208 kip	21,700 kip-in	290 kip/in	555 kip/in

Notes: Tabulated values for allowable deflection of 0.375 inch.

Summary envelope plots for imposed pile-head deflections of 0.25 and 0.375-inch are also provided for each pile diameter.

The LPile analyses were performed for individual piles. Group effects for pile shadowing should be applied to the capacities in base shear analyses. GEI can determine the group reduction factor once the pile layout is finalized.

4.3.4 Caisson Construction Considerations

4.3.4.1 Squeeze Potential

Our experience has indicated that soft clay squeeze into a caisson shaft excavation done in the dry can be correlated with the ratio of total overburden pressure to undisturbed in-situ strength. A general guideline for the likelihood of squeeze as a function of caisson shaft radius and depth is tabulated below.

To use the table, first calculate the ratio of depth to the design shaft radius for the point of interest using consistent units. Second, compare the overburden pressure to the average undrained shear strength at that depth, again using consistent units. If the calculated pressure to strength ratio is greater than the tabulated limiting value, shaft squeeze is likely at that depth.

Table 9: Caisson shaft squeeze potential

Depth to Radius Ratio: $\frac{d}{R_{shaft}}$	*Min. Strength Ratio:* $\frac{\sigma_v}{S_u}$
4	5
8	6
12	6.5
16	7
20	7.5
24	8
28	8*
32	8*

Note: * The strength ratio is limited to a maximum value of 8 in the analyses

Based on the strength profile determined from the CPT soundings, we expect all shaft greater than 2.5 feet in diameter will have probability of squeeze between approximately elevation -15 and -25 ECD if the caissons are installed from existing grade. Squeeze can largely be eliminated if the caissons are installed from inside the excavation below about elevation +15 ECD.

4.3.4.2 Concrete Stresses and Permanent Steel Casing Considerations

In accordance with the International Building Code, the maximum allowable axial stress in the concrete shall not exceed $0.3f'_c$ for caissons without permanent casing. When permanent noncorrugated steel casing is used, the allowable axial stress may not exceed $0.4f'_c$ provided:

1. The design shall not use the casing to resist any portion of the axial load imposed.

2. The casing shall be seamless or provided withs of strength equal to the basic material and be of a configuration that will provide confinement to the cast-in-place concrete.
3. The ratio of steel yield strength (F_y) to the specified compressive strength (f'_c) shall not be less than 6.
4. The wall thickness shall not be less than 3/16 inch for steel pipes or tubes.
5. The casing thickness for rock socketed drilled shafts shall not be less than 3/8 inch.

Thinner wall casing may be used provided it is designed by an Illinois licensed structural engineer, and it is properly reinforced to support the full height earth pressure and hydrostatic loads. The casing must also be checked for bursting under the fluid concrete head pressure. The steel casing cannot be considered in the structural capacity of the caisson.

The casing provision is a material stress limitation on structural capacity. Permanent steel casing is not required where concrete stresses do not exceed $0.3f'_c$.

4.3.5 General Construction Considerations

To prevent surface soils from sloughing into the caisson shaft, and inflows from surface runoff and the shallow water table, it is recommended that an oversized, temporary casing be provided through the fill extending at least 3 feet into the underlying weathered clay. Where squeeze potential exists, the temporary casing should be extended as indicated above. Insofar as possible, the casing should be pushed ahead of the drill excavation. For safety, it is common for the top casing to project 42 inches above the surface working grade.

A corrugated permanent liner should be installed after belling where the design top of caisson is located within the temporary casing. The corrugated liner should extend at least 3 feet below the temporary casing. Once the concrete has set, typically the next day, grout should be placed between the corrugated liner and the temporary casings, and then the temporary casings can be pulled. If the design top of the caisson is below the temporary casing, a permanent corrugated liner will not be required.

Caisson shafts should be a minimum of 30 inches in diameter. Caisson bells should be at least 12 inches thick at the design edge, and that the sides slope at no less than 60 degrees from the horizontal. The caisson bell diameter should not exceed 3 times the shaft diameter.

Due to safety concerns, it is expected that the personnel will not be lowered into excavations to observe the base of the bell caisson excavation directly. For this reason, an explosion-proof camera should be lowered into the bell after final cleanup, to verify it is suitably free of loose material and debris. Alternatively, the caisson bell area can be oversized by 15% or the bell diameter increased by 1 foot, whichever is smaller.

Care should be taken to avoid caisson concrete hitting the sides of the shaft, or the rebar cage, if it is placed by the free-fall method. Caisson shafts and bell excavations should be clean of loose soil and as dry as practical prior to concrete placement. No more than 2 inches of standing water should be present at the bottom of the bell when the concrete is placed. Concrete slump should be in the range of 5 to 7 inches for free-fall placement, and between 7

to 9 inches when tremie methods are used. All concrete within 5 feet of placement grade should be consolidated by vibration.

The caisson design and construction procedures should be reviewed with the contractor selected for this work prior to the start of construction. If you wish, we would be pleased to review the plans and specifications for the foundation work once they are prepared so that we may have the opportunity to comment on soil and groundwater impacts on caisson design and construction procedures.

4.4 Earth Retention System and Excavation

4.4.1 Temporary Earth Retention

Open cut excavations less than 5 feet in height may be performed at slopes of 1H:1V. Excavations extending deeper than 5 feet must be sloped at 1.5H:1V or flatter, or the excavation must be shored.

Temporary earth retention systems may consist of free-draining soldier pile and lagging for depths up to approximately 6 to 8 feet below grade. Where excavations extend below the water table, a diaphragm-type retention system comprised of driven steel sheet pile, slurry wall, or secant pile wall should be used. Slurry walls and secant pile walls may be economic if they can be incorporated as permanent below grade walls for the structure.

Cantilever systems would be expected to support excavation heights up to 8 to 10 feet with suitable performance. Anchored systems with internal cross-lot bracing, rakers, or external tiebacks will be required for excavations greater than approximately 10 feet, and in areas which support heavy or concentrated surcharge loads. Anchored systems may also be used to reduce lateral deflections of the retaining walls in areas that are sensitive to excavation induced ground movements. Tiebacks which extend into the public right-of-way require special approval, and if left in-place will incur easement costs. A secant pile wall can be designed to provide greater stiffness per unit length than most sheet pile systems and they can support greater spans between bracing levels.

For owner-based designs, we would suggest the major soil units be assigned material parameters as provided in Table 2. For contractor-based designs, it is the responsibility of the selected contractor to review the provided geotechnical data and develop their own design profiles and material parameters in accordance with established geo-mechanical methods. GEI can provide a peer review of the contractor developed material parameters and earth retention system design should you desire.

For soils below the water table, the effective unit weight should be determined using a unit weight of water, γ_w = 62.4 pcf. In the case of horizontal backfill with no wall friction ($\delta = \beta =$ 0 deg) the Rankine and Coulomb models give the same result, and the equations become:

Active Earth $\quad K_a = \left(\tan\left(45deg - \frac{\varphi}{2}\right)\right)^2 \quad K_{ac} = 2\sqrt{K_a}$

Passive Earth $K_p = \left(\tan\left(45deg + \frac{\varphi}{2}\right)\right)^2$ $K_{pc} = 2\sqrt{K_p}$

At-rest earth pressure coefficients are given by:

At-Rest Earth $K_0 = 1 - \sin\varphi$

Staged excavation and end-of-construction analyses should be performed using undrained soil strength parameters. For short-term analyses using undrained parameters, the active and passive earth pressure coefficients, K_a and K_p are set to unity in cohesive (ϕ = 0 degree) soils. The cohesive coefficients K_{ac} and K_{pc} then become a value of 2. If the excavation is expected to remain open for an extended period, long-term analyses should be performed using drained parameters.

Flexible-type retaining walls comprised of sheet pile or soldier pile and lagging should be designed to resist loading due to active earth pressures. Unbalanced water pressure arising from internal site dewatering should be considered for sheet pile walls as seepage through interlocks would be expected to be minimal for hot-rolled sections and restricted for cold formed sections. Soldier pile and lagging walls can be assumed to be free draining.

Permanent grouted tiebacks which support the retaining walls should be provided with Double Corrosion Protection (DCP). The minimum unbonded length for ground anchors is 15 feet for strand tendons and 10 feet for bar tendons. These minimum values are intended to prevent significant reductions in load resulting from seating losses during transfer of load to the structure following anchor load testing. Longer unbonded lengths may be required to: (1) locate the bond length a minimum distance behind the critical potential failure surface; (2) locate the anchor bond zone in appropriate ground for anchoring; (3) ensure overall stability of the anchored system; and (4) accommodate long term movements. In general, the unbonded length is extended a minimum distance of H/5 or 5 feet behind the critical potential failure surface to accommodate minor load transfer to the grout column above top of the anchor bond zone.

For pressure grouted anchors, the average ultimate bond stress in the stiff to very stiff clay of the Park Ridge moraine is estimated to be between 30 and 35 psi. Within the hardpan clay below approximately elevation -55 ECD, the ultimate bond stress is estimated to be 50 to 75 psi. A factor of safety of 2 should be applied to the ultimate bond stress to determine the anchor pullout capacity. Pullout tests should be performed in advance of construction to verify the bond strength. The maximum effective bonded length of a grouted anchor is approximately 40 feet.

4.4.2 Permanent Below Grade Walls

Permanent reinforced concrete walls that extend below grade should be designed to support unbalanced earth, water, and lateral pressures due to exterior surcharges. Taking into consideration the variation of the soil profile on the perimeter walls, the lateral pressure due to unbalanced soil and water can be approximated as:

Table 10: Equivalent fluid pressure for design of permanent below grade (non-yielding) walls

Elevation	*Mechanism*	*Equivalent Fluid Pressure*	
		Restrained	*Cantilever*
Above Water Table (El. +20 ECD)	Soil	60 psf/ft	45 psf/ft
Below Water Table (Below El. +20 ECD)	Soil + Water	90 psf/ft	80 psf/ft

Any surcharge loads (due to adjacent roadways, crane pads, or floor slabs) or foundation pressures, within the area that projects upward from the base of the cut on a 45-degree angle should be included as additional lateral pressures on the retention system. A uniform surcharge of 250 psf (or an equivalent 2 feet of soil) should be applied to the ground surface to represent construction equipment or traffic loading. The lateral forces on the wall due to surcharges should be determined using an at-rest earth pressure coefficient, K_0, equal to 0.5.

Any shallow foundations adjacent to below grade walls should be included as localized surcharges. The stress beneath the footings should be assumed to extend outward and downward from the edges of the footings at a 2 vertical to 1 horizontal slope. The lateral pressure on the wall should be determined using an at-rest earth pressure coefficient, K_0 = 0.5, or:

$$p_{ftg} = K_0 q_{ftg} \frac{BL}{(B+z)(L+z)}$$

Where: K_0 = Coefficient of at-rest earth pressure (K_0 = 0.5)
q_{ftg} = Bearing pressure beneath footing
B = Width of footing
L = Length of footing
z = Depth below footing bearing level

Excavations which extend below the water table will require sump pumps with drainage trenches to provide a stable subgrade for construction. No exterior drainage is required for walls properly waterproofed and designed for the above-referenced earth pressures.

4.4.3 Slab-on-Grade

Floor slabs on grade should be isolated from foundations to permit relative displacement without cracking. Slabs should be sufficiently thick, and be provided with adequate reinforcing and jointing, to control minor slab cracking.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

The modulus of subgrade reaction is dependent upon the nature of the soils supporting the slab and the provided thickness as tabulated below. Underdrains and leveling courses can be considered as contributing to the provided thickness.

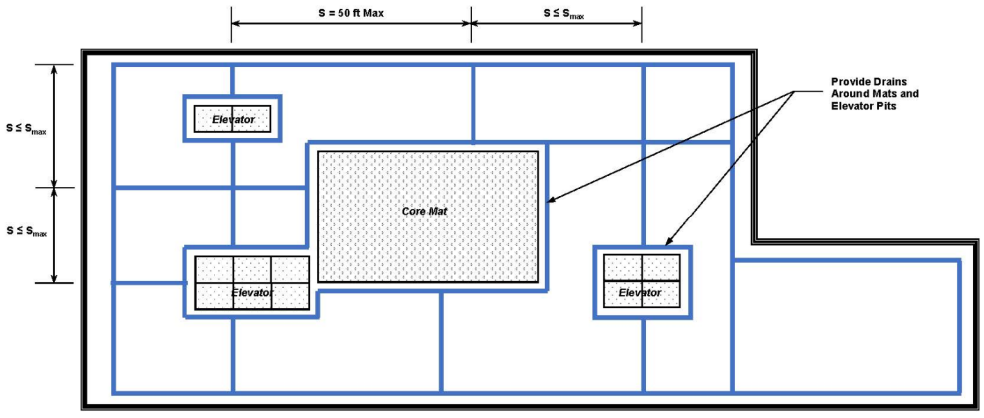
Table 11: Modulus of subgrade reaction for slab-on-grade

Subgrade Material	*Thickness*	*Modulus, k*
Existing Granular Fill	-	50 pci
New Granular Fill	6 in	65 pci
	12 in	100 pci
	24 in	175 pci

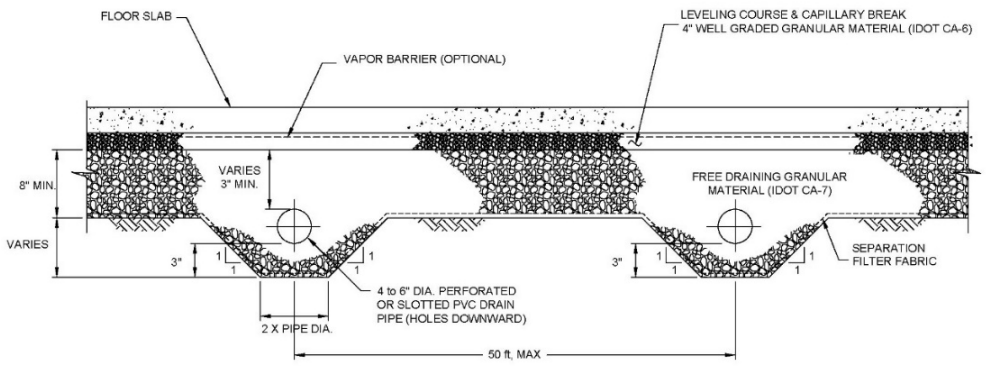
4.4.4 Underslab Drainage

A properly designed subsurface under drainage system should be provided for lower level slabs located below the water table at elevation +20 ECD. The system should include a minimum 8-inch thickness of clean, well-graded granular base similar in gradation to IDOT CA-7 placed over a non-woven geotextile (minimum 7 oz./yd^2) beneath the slabs. The geotextile will help to prevent soil contamination, or "fouling" of the drainage stone. The crushed stone should be compacted to a relative density no less than 90% of its maximum dry density defined by the Modified Proctor test (ASTM D 1557). Due to the risk of long-term degradation, crushed concrete is not recommended for use in underdrain collection systems. New perforated or slotted plastic drain lines should be installed around the interior perimeter of the basement, around the interior perimeter of any provided core mat, and on 50-foot centers beneath the slab interior. All drain pipes should be buried and surrounded in a minimum of 3 inches of crushed stone. The perforated or slotted openings in the drain pipes should be sized to prevent intrusion of the granular subbase materials into the drain. Drain lines do not have to be pitched to drain.

The 50-foot spacing and 8-inch thickness of the collection layer is designed to maintain the water mounding between drain lines below the bottom of the slab-on-grade.



4a: Typical underdrain layout for irregular floor plan



4b: Underdrain section

Figure 4: Underdrain Installation Detail

Groundwater inflow rates into excavations and/or underdrains will vary depending on the tightness of constructed earth retention system and the presence of any silt and sand seams in the relatively impervious silty clay it is keyed into. Considering permeability of the clays on the order of $1x10^{-8}$ cm/sec, the inflow rates can be expected to range as indicated below for an approximately 80,000 to 100,000 square foot area.

Table 12: Estimated groundwater inflow rates for design of underdrain

Condition	*Source*	*Inflow Rate*
Perimeter ERS Keyed into Clay	Base	25 to 50 gal/min
No Perimeter ERS (Fill/Clay)	Base + Sides	90 to 110 gal/min
No Perimeter ERS (Clay)	Base + Sides	30 to 60 gal/min

4.4.5 General Excavation Considerations

The site is surrounded by public right of way and excavations on the site are not expected to adversely impact infrastructure or utilities as ERS systems will be left in place.

In general, mass excavations should not extend below footing bearing level within 2 feet of existing foundations. Beyond this distance, mass excavations should not extend below an imaginary plane extending out and down at a slope of approximately 2H:1V. Even where this criterion is met, excavations which extend below the level of nearby existing footings should be backfilled the same day they are excavated.

We anticipate that excavation side slopes less than 5 feet in height will likely remain stable at slopes of 1.5H:1V for short periods of time. Excavation side slopes remaining open for extended periods may require flatter side slopes. Regardless, all excavations should be performed in accordance with pertinent local, state, federal, and OSHA regulations.

Open cut excavations and earth retention systems located adjacent to existing structures or the public right-of-way should consider the surcharge loading from foundations and infrastructure as described above for permanent below grade walls. For short term loading,

the active earth pressure coefficient for imposed surcharges should be set to unity in cohesive soils.
The global stability of excavations located adjacent to the public right-of-way should be demonstrated by analysis using limit equilibrium methods. A minimum factor of safety of 1.5 should be provided against rotational failure.

4.5 Site Classification

4.5.1 Seismic

Design parameters for Ryan Field were determined in accordance with Standard 9 of ASCE 7: *Minimum Design Loads for Buildings and Other Structures* based on site specific SPT tests, vane shear tests, and the laboratory shear strength measurements of recovered soil samples.

Table 13: Seismic parameters

Description	*Type*	*Value*	
		ASCE 7-16	ASCE 7-10
Site Classification	Stiff Soil	D	D
Risk Category		I-III	I-III
Seismic Design Category	SDC	B	B
MCE_R Ground Motion (0.2 Sec Period)	S_S	0.110	0.125
MCE_R Ground Motion (1 Sec Period)	S_1	0.060	0.059
MCE_G Peak Ground Acceleration	PGA	0.055	0.063

A full list of seismic design parameters for generation of earthquake ground motion response spectrums is provided in the attachments.

4.5.2 Expansive Soil or Fill

The soils encountered above the depth of seasonal change in the groundwater table consisted of predominantly granular urban fill and low plasticity clay. These materials would not experience volume change (shrinkage or swell) in response to inundation or changes in the groundwater table at this site.

4.5.3 Liquefaction

Based on the SPT tests, the level of the groundwater table, and the Seismic Design Category, the site subsoils are not considered liquefiable.

5. Limitations

This report was prepared for the exclusive use of Northwestern University for the Ryan Field Redevelopment in Evanston, Illinois. This report may require modification if there are any changes in the nature, design, or location of the proposed structures. We cannot accept responsibility for designs based on our recommendations unless we are engaged to review the final plans and specifications to evaluate whether any changes in the project affect the validity of our recommendations and whether our recommendations have been properly implemented in the design.

The recommendations in this report are based in part on the data obtained from the subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations from the anticipated conditions are encountered, it may be necessary to revise the recommendations in this report. Therefore, we recommend that GEI be engaged during construction to provide a full-time inspector during foundation installations to: a) verify bell caisson foundations bearing conditions, b) check that the subsurface conditions exposed during construction are in general conformance with our design assumptions, and c) ascertain that, in general, the geotechnical aspects of the work are being performed in compliance with the contract documents.

It was not part of our scope to explore for or research the locations of buried utilities or other buried structures at the site. Before construction of foundations for the proposed structure, a diligent effort should be made to determine the presence and location of any buried structures including utilities. This effort should include a thorough review of available drawings and other records of the site use and facilities. If the presence of such structures is determined to be likely, GEI should be notified so that we may review and revise our recommendations, if appropriate.

Our professional services for this project have been performed in accordance with generally accepted engineering practices; no warranty, expressed or implied, is made.

Appendix A

Boring Location Plan

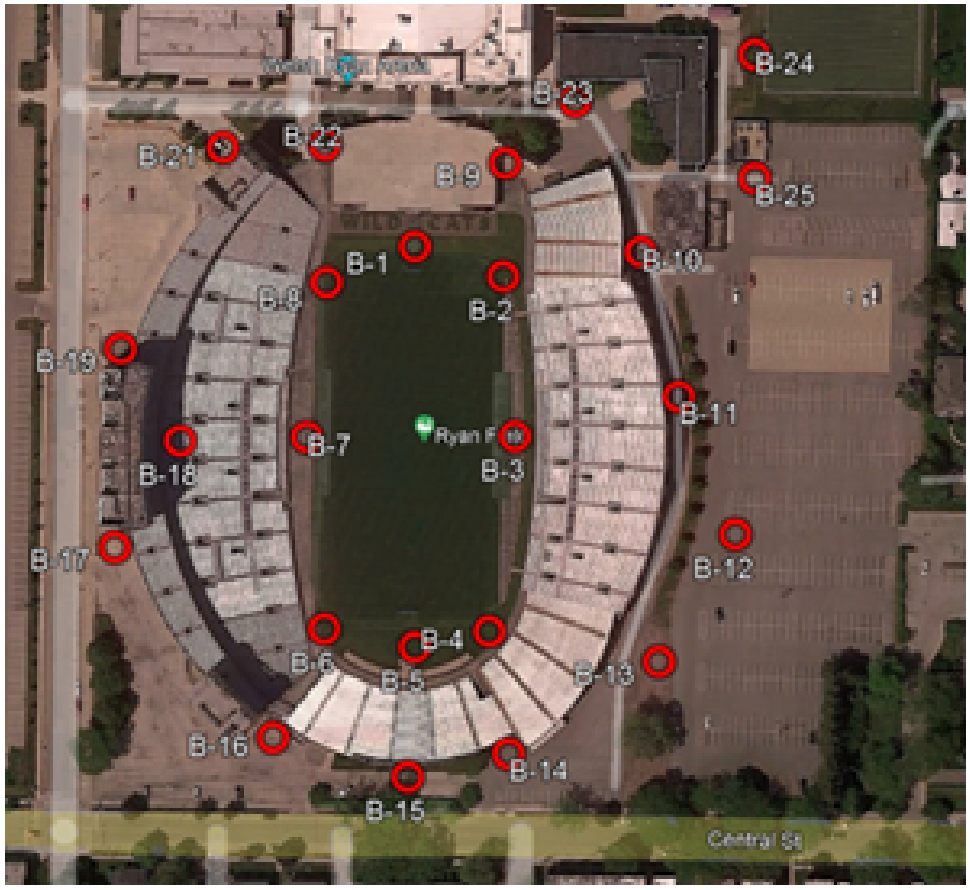
Soil Strength Data Summary

Soil Boring Logs

CPT Soundings

General Notes and Sampling Procedures

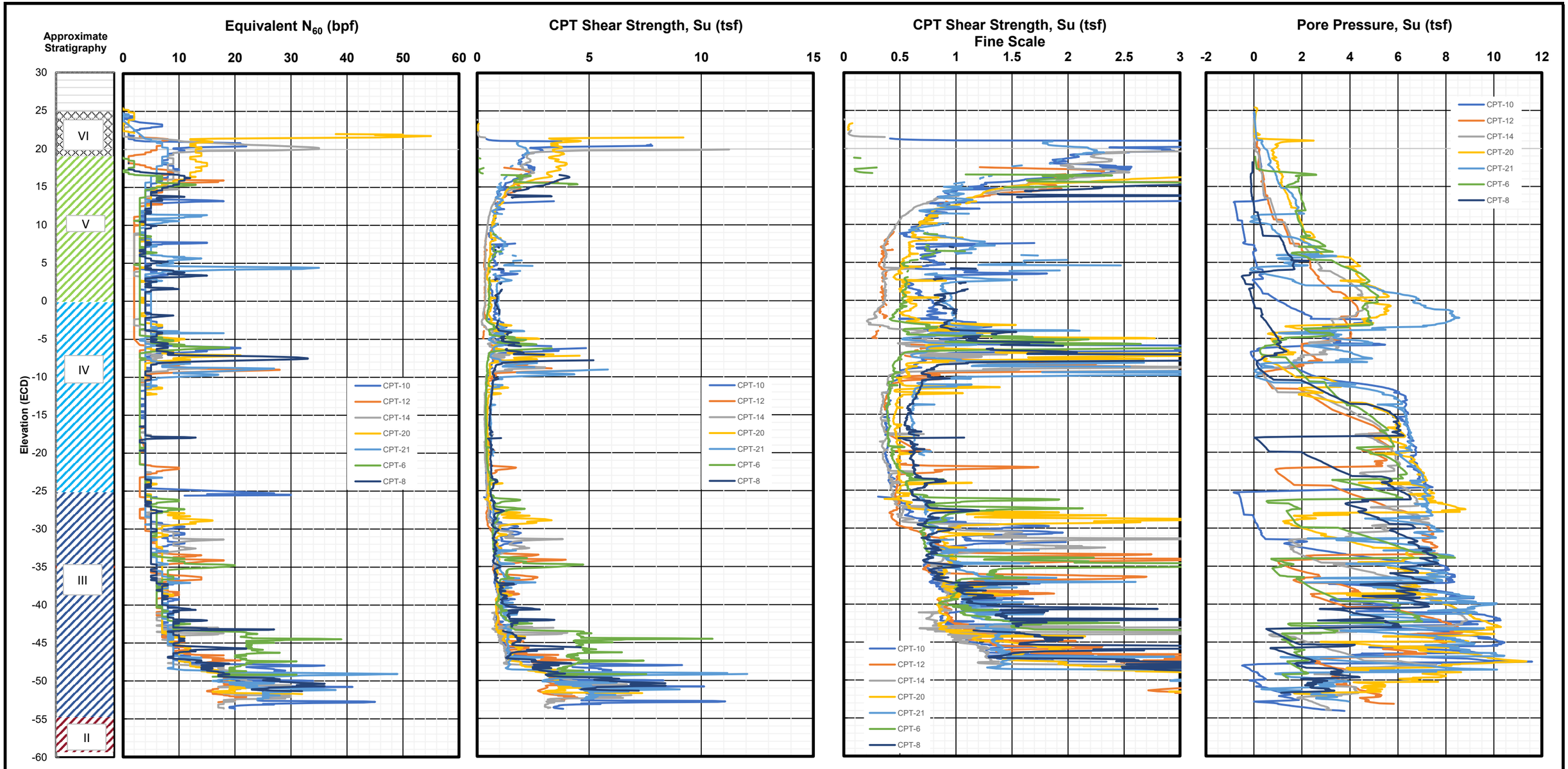
Pressuremeter Test Results



Existing Conditions

Conceptual Design

RYAN FIELD REDEVELOPMENT **EVANSTON, IL**	GEI Consultants	**SOIL BORING LOCATION DIAGRAM**
NORTHWESTERN UNIVERSITY	Project No. 2200549	APRIL 2022



VI. Fill & Sand
V. Glacial Lake Bottom
IV. Boldgett and Deerfield
III. Park Ridge
II. Tinley moraine
I. Valparaiso moraine

Ryan Field Evanston, IL	GEI Consultants	SOIL SHEAR STRENGTH VS. ELEVATION	
Northwestern University Evanston, IL	Project: 2200549	April 22, 2022 AF	Figure 1

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-1**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

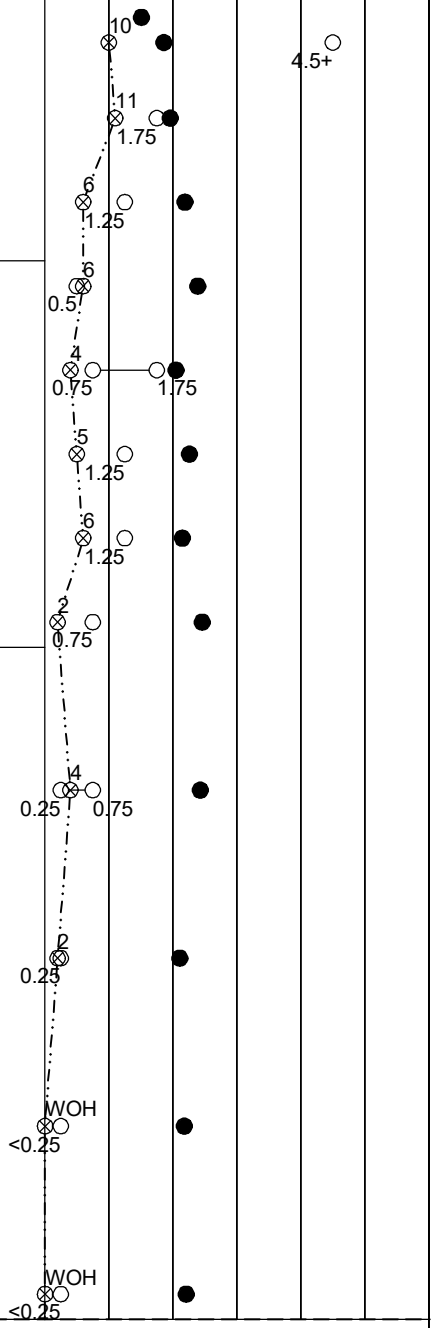
SURFACE ELEVATION (CCD) 20.3

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
20	1	SS			*(0.0)*Fill: Fine to medium sand with silt and fine gravel - brown - loose - medium dense (SP-SM)	
	1A	SS			*(1.5)*Silty clay, trace fine to coarse and sand gravel - brown and gray - hard to stiff (CL)	
5	2	SS				
	3	SS				
10 / 10	4	SS			*(8.5)*Silty clay, trace fine to coarse and sand gravel - gray - stiff to medium (CL)	
	5	SS				
15	6	SS				
	7	SS				
20 / 0	8	SS				
					*(20.0)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)	
25	9	SS				
	10	SS				
30 / -10						
35	11	SS				
	12	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) — WATER CONTENT (%) — LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 14.0' Before Casing Removal	BORING STARTED **3/14/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/15/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-1**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 20.3

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
-20					
	13	SS			
-45					
	14	SS			*(48.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)
-50 / -30					
	15	SS			
-55					
	16	SS			
-60 / -40					
	17	SS			
-65					
	18	SS			*(68.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)
-70 / -50					
	19	SS			
-75					
	20	SS			*(78.5)*Clayey silt, trace to little fine to coarse gravel - gray - very dense - wet (CL-ML)

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

WOH
<0.25
9
15
1.25
17
16
2.5
32
4.0
38
4.5+
41/9"

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 14.0' Before Casing Removal	BORING STARTED **3/14/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/15/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-1**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

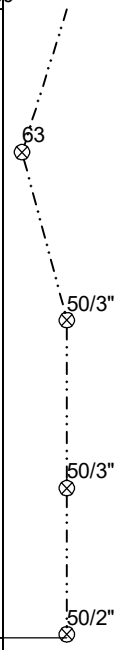
SURFACE ELEVATION (CCD) 20.3

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-60						
85	21	SS				
	22	SS				
90 -70						
	23	SS			*(93.5)*Silty sand, trace to little fine to coarse gravel - gray - extremely dense - wet (SM)	
95						
	24	SS			End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
100 -80						
105						
110 -90						
115						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 14.0' Before Casing Removal	BORING STARTED **3/14/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/15/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-2**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

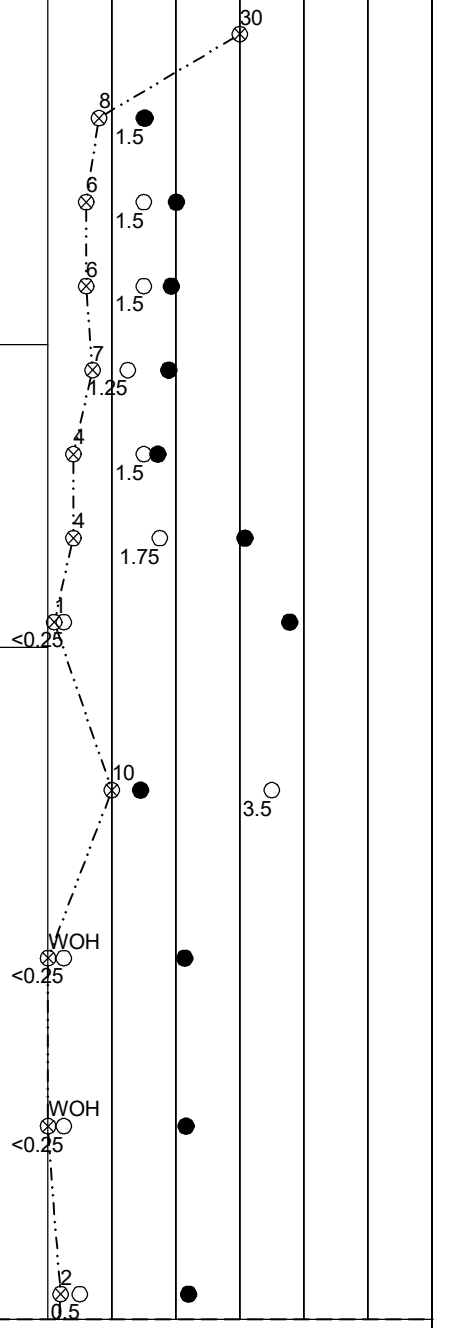
SURFACE ELEVATION (CCD) 18.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
	1	SS			*(0.0)*Fill: Silty well-graded fine to coarse gravel with sand (crushed limestone) - light gray - moist - dense (GM)	
5	2	SS			*(3.5)*Silty clay, trace fine to coarse and sand gravel - brown and gray - stiff (CL)	
	3	SS				
10 / *10*	4	SS				
	5	SS			*(11.0)*Silty clay, trace fine to coarse and sand gravel - gray - stiff to medium (CL)	
15	6	SS				
	7	SS				
0 / 20	8	SS				
	9	SS			*(20.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to soft (CL)	
25 / *-10*	10	SS				
30	11	SS				
35 / *-20*	12	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) × — WATER CONTENT (%) ● — LIQUID LIMIT (%) △ 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 14.0' Before Casing Removal 14.0' After Casing Removal	BORING STARTED **3/15/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/16/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

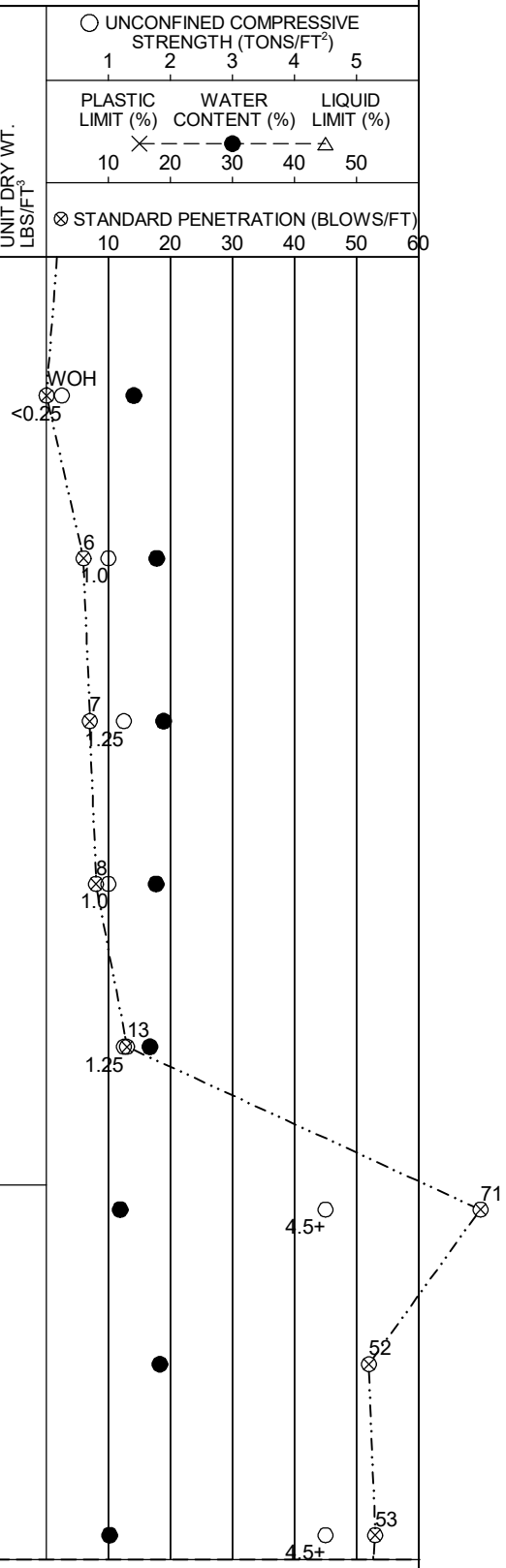
LOG OF BORING NUMBER **B-2**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 18.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-45	13	SS			
-30 / -50	14	SS		*(48.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
-55	15	SS			
-40 / -60	16	SS			
-65	17	SS			
-50 / -70	18	SS		*(68.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
-75	19	SS		Sample 19: Moist silty sand layer noted	
-60	20	SS			



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 14.0' Before Casing Removal 14.0' After Casing Removal	BORING STARTED **3/15/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/16/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-2**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

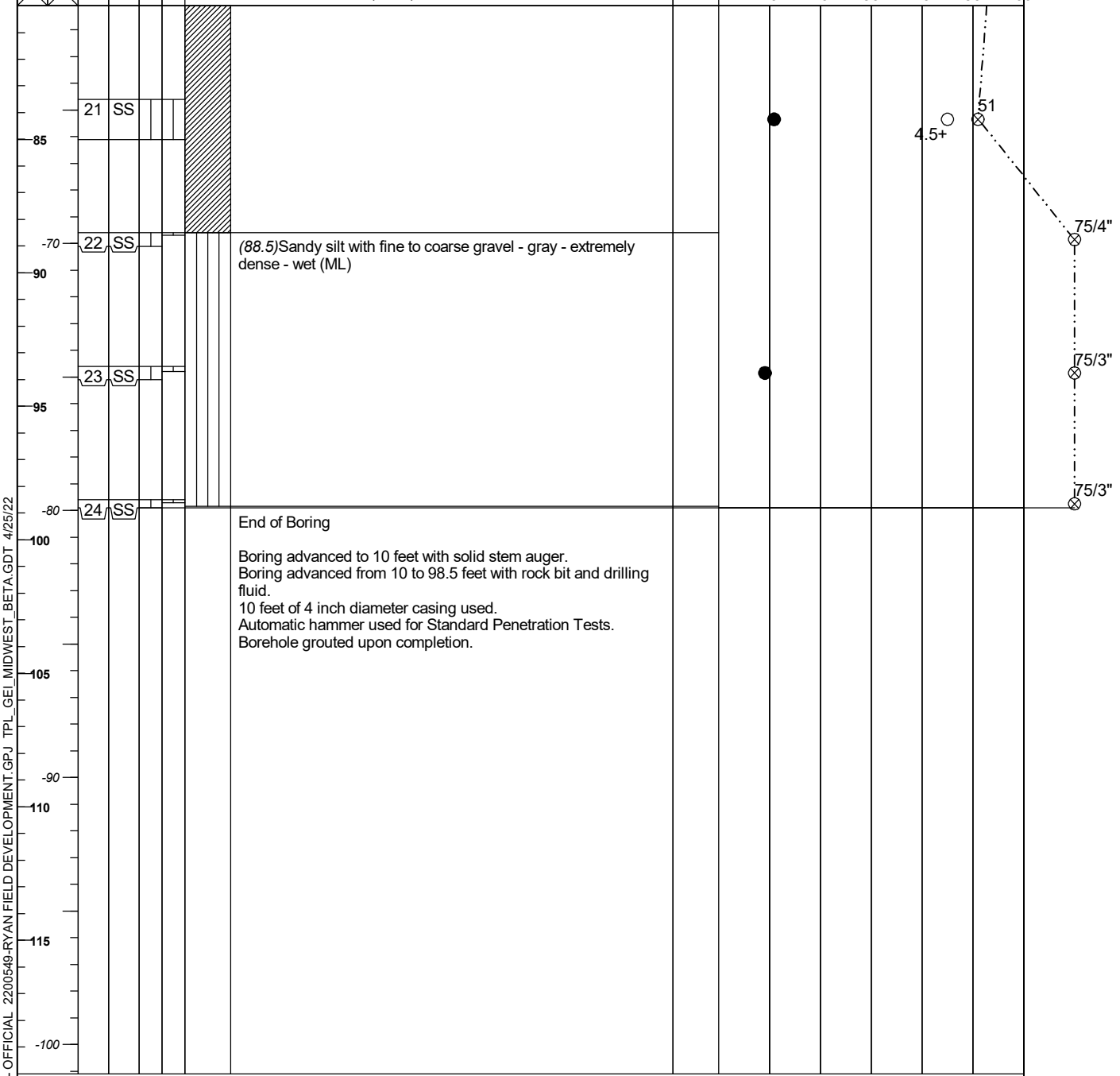
SURFACE ELEVATION (CCD) 18.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
85	21	SS			
-70	22	SS		*(88.5)*Sandy silt with fine to coarse gravel - gray - extremely dense - wet (ML)	
90					
	23	SS			
95					
-80	24	SS			
100				End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105					
-90					
110					
115					
-100					

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 14.0' Before Casing Removal 14.0' After Casing Removal	BORING STARTED **3/15/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/16/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-3**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 18.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					*(0.0)*Fill: 3 inches bituminous concrete; 9 inches sandy gravel
	1	SS			*(1.0)*Silty clay, trace fine to coarse and sand gravel - brown and gray - hard to stiff (CL)
	2	SS			
5	3	SS			*(6.0)*Silty clay, trace fine to coarse and sand gravel - gray - stiff to soft (CL)
10 / *10*	4	SS			
	5	SS			
15	6	SS			
	7	SS			
20 / *0*	8	SS			
25	9	SS			
30 / *-10*	10	SS			
35	11	SS			
-20	12	SS			

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) × WATER CONTENT (%) ● LIQUID LIMIT (%) △ 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

7 6 5 5 5 3 WOH WOH 10 WOH WOH WOH

3.0 4.5+ 1.25 3.25 1.75 0.25 1.5 0.25 1.25 1.0 0.25 0.75 <0.25 <0.25 0.25

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry to 10.0' WS/WD 13.0' Before Casing Removal 13.0' After Casing Removal	BORING STARTED **3/16/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/17/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-3**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

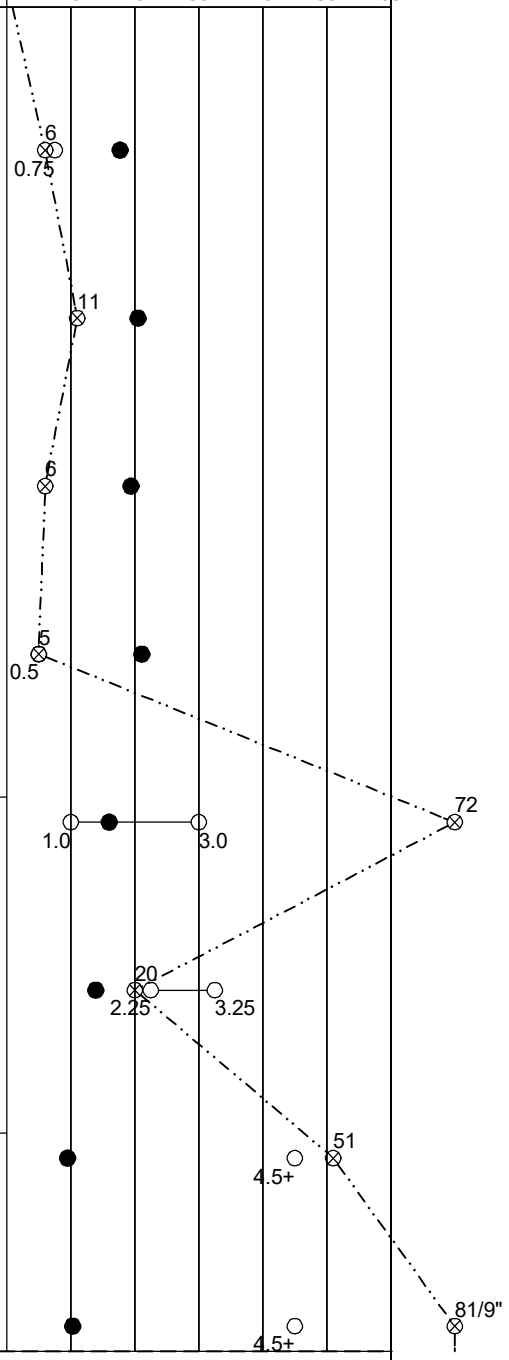
SURFACE ELEVATION (CCD) 18.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
45	13	SS			
-30	14	SS			
50					
55	15	SS			
-40	16	SS			
60					
65	17	SS		*(63.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
-50	18	SS			
70					
75	19	SS		*(73.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
-60	20	SS			

UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry to 10.0' WS/WD
13.0' Before Casing Removal
13.0' After Casing Removal

BORING STARTED **3/16/2022**

BORING COMPLETED **3/17/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **GeoProbe / Bill M (Strata)**

GEI PROJECT NO. **2200549**

PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-3**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 18.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85	21	SS			*(83.5)*Silty fine to coarse sand, trace to little clay and fine to coarse gravel - gray - extremely dense - wet (SM)	
-70 / 90	22	SS				
95	23	SS				
-80 / 100	24	SS			*(98.5)*Clayey silt, trace to little fine to coarse sand and gravel - gray - extremely dense - moist (CL-ML)	

End of Boring

Boring advanced to 10 feet with solid stem auger.
Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid.
10 feet of 4 inch diameter casing used.
Automatic hammer used for Standard Penetration Tests.
Borehole grouted upon completion.

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) — WATER CONTENT (%) — LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

50/4" 50/3" 75/3" 75/6"

105 -90 110 115 -100

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry to 10.0' WS/WD 13.0' Before Casing Removal 13.0' After Casing Removal	BORING STARTED **3/16/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/17/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-4**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 18.9

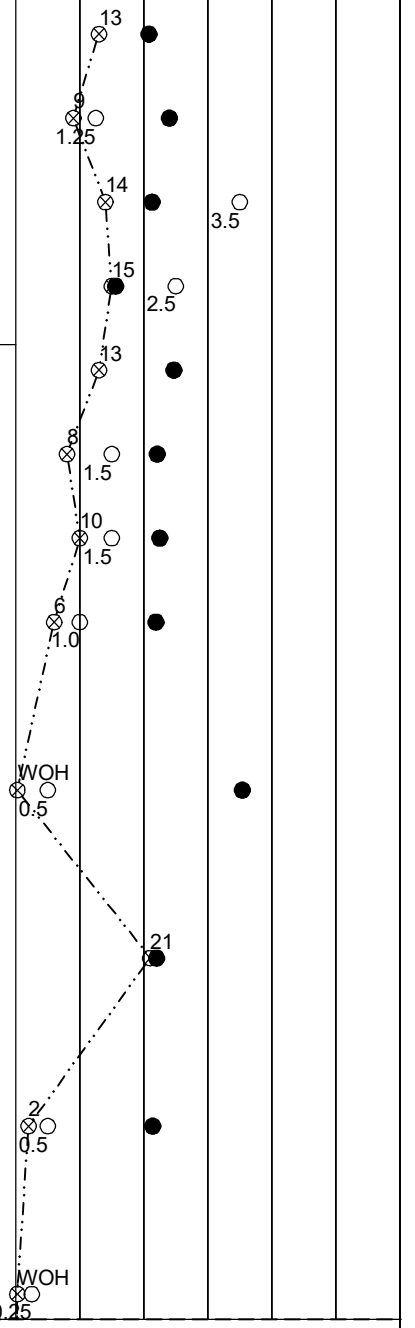
DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					*(0.0)*Fill: 2 inches bituminous concrete
	1	SS			*(0.2)*Fill: Clayey fine to coarse sand - black - medium dense - moist
5	2	SS			*(3.5)*Silty clay, trace fine to coarse and sand gravel - brown and gray - stiff to very stiff (CL)
	3	SS			
10 / 10	4	SS			
	5	SS			*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to soft (CL)
15	6	SS			
	7	SS			
0 / 20	8	SS			
25	9	SS			
-10 / 30	10	SS			
35	11	SS			
-20	12	SS			

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry to 6.0' WS/WD 9.0' Before Casing Removal 9.0' After Casing Removal	BORING STARTED **3/14/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/15/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

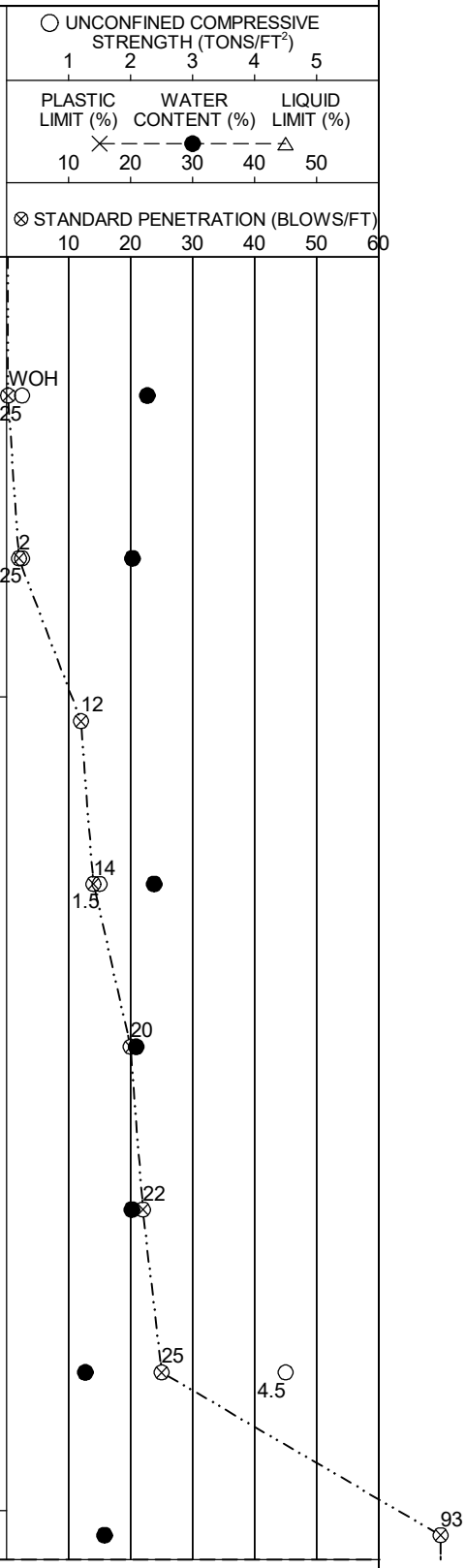
LOG OF BORING NUMBER **B-4**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 18.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-45	13	SS			
-30	14	SS			
-50	15	SS		*(53.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to hard (CL)	
-40	16	SS			
-60	17	SS			
-50	18	SS			
-70	19	SS			
-60	20	SS		*(78.5)*Silty clay, trace to little fine to coarse sand and gravel - gray - hard (CL)	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry to 6.0' WS/WD 9.0' Before Casing Removal 9.0' After Casing Removal	BORING STARTED **3/14/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/15/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-4**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

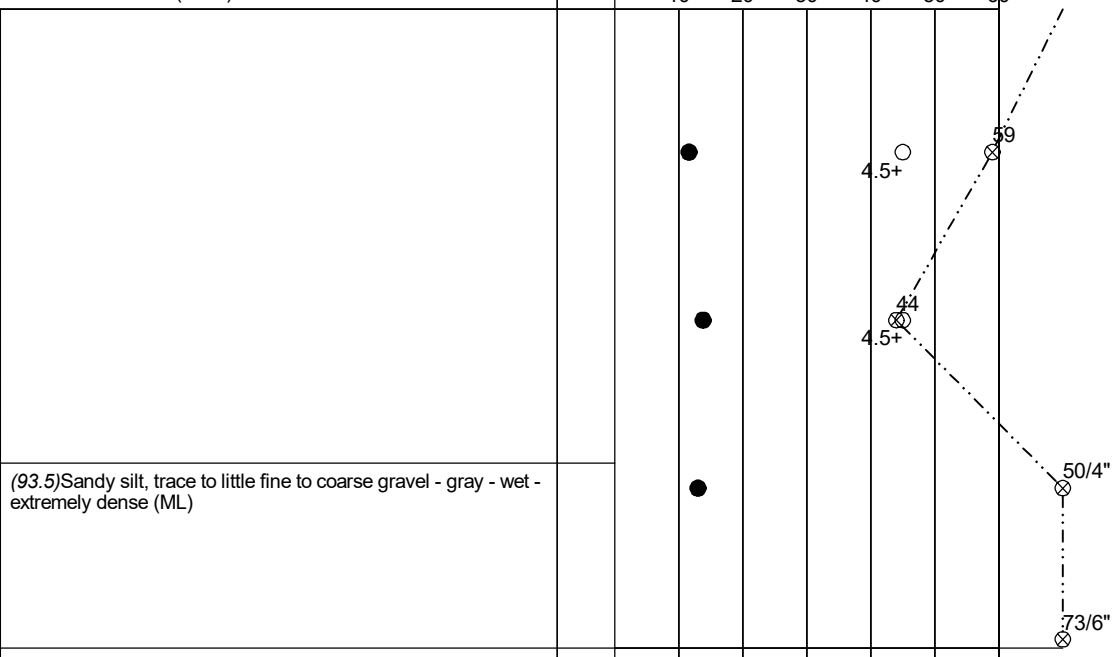
SURFACE ELEVATION (CCD) 18.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85	21	SS				
-70 / 90	22	SS				
95	23	SS			*(93.5)*Sandy silt, trace to little fine to coarse gravel - gray - wet - extremely dense (ML)	
-80 / 100	24	SS			End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105						
-90 / 110						
115						
-100						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry to 6.0' WS/WD
9.0' Before Casing Removal
9.0' After Casing Removal

BORING STARTED **3/14/2022**

BORING COMPLETED **3/15/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **GeoProbe / Bill M (Strata)**

GEI PROJECT NO. **2200549**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-5**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL
				*(0.0)*Fill: 2 inches bituminous concrete
	1	SS		*(0.2)*Fill: Silty fine to medium sand, trace to little clay - black - medium dense - moist
5 / 20	2	SS		*(3.5)*Silty clay, trace fine to coarse and sand gravel - brown and gray - stiff to very stiff (CL)
	3	SS		
10	4	SS		
	5	SS		*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to soft (CL)
15 / 10	6	SS		
	7	SS		
20	8	SS		
	9	SS		
25 / 0				
	10	SS		
30				
	11	SS		
35 / 10				
	12	SS		

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

16 4 1.25 15 3.0 13 9 1.5 WOH 0.25 WOH 0.25 WOH 0.25 WOH <0.25 8 3.0 WOH 0.25 WOH 0.25

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 21.0' Before Casing Removal 21.0' After Casing Removal	BORING STARTED **3/15/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/16/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-5**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³	○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²) 1 2 3 4 5 / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50 / ⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60
45 / 20	13	SS				WOH <0.25
50	14	SS				WOH 0.25
55 / 30	15	SS		*(53.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to hard (CL)		21
60	16	SS				16 0.25
65 / 40	17	SS				15
70	18	SS				11
75 / 50	19	SS		*(72.5)*Silty clay, trace to little fine to coarse sand and gravel - gray - hard (CL)		41 4.5+
	20	SS				26 3.0

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 21.0' Before Casing Removal
21.0' After Casing Removal

BORING STARTED **3/15/2022**

BORING COMPLETED **3/16/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING

EASTING

RIG/FOREMAN **CME-75 / Mark B (Strata)**

GEI PROJECT NO. **2200549**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

LOG OF BORING NUMBER **B-5**

PROJECT NAME: **Ryan Field Development**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

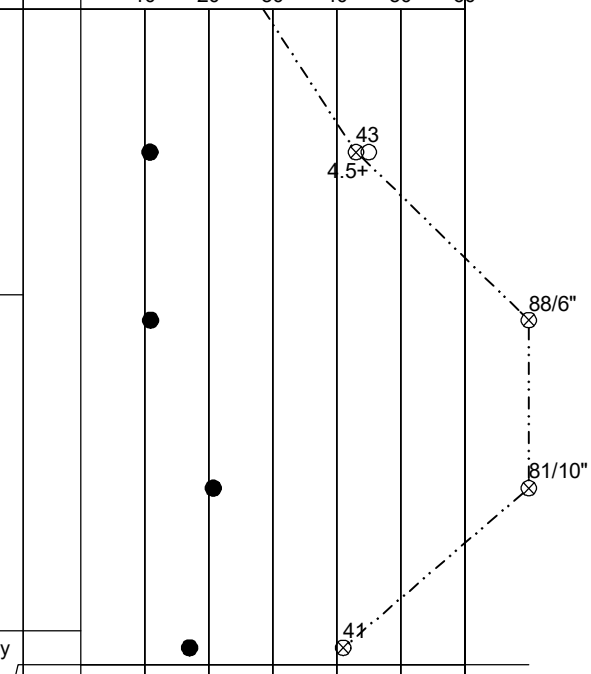
SURFACE ELEVATION (CCD) 24.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85 / 60	21	SS			
90	22	SS		*(88.5)*Clayey silt, trace to little fine to coarse sand and gravel - gray - extremely dense - moist (CL-ML)	
95 / 70	23	SS			
	24	SS		*(98.5)*Clayey sandy silt, trace to little fine to coarse gravel - gray - extremely dense - wet (ML)	
100				End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105 / 80					
110					
115 / 90					

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 21.0' Before Casing Removal 21.0' After Casing Removal	BORING STARTED **3/15/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/16/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-6**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 19.0

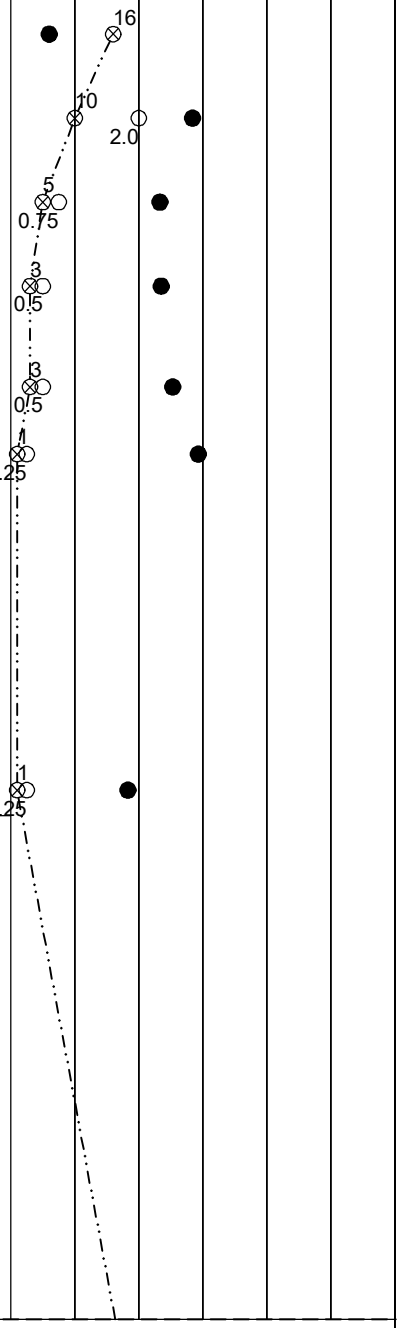
DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					*(0.0)*Fill: 3 inches bituminous concrete
	1	SS			*(0.3)*Fill: Sandy gravel with silt (crushed concrete and asphalt) - gray and black - medium dense - moist
	2	SS			*(2.5)*Silty clay, trace fine to coarse and sand gravel - brown and gray - very stiff (CL)
5	3	SS			*(6.0)*Silty clay, trace fine to coarse sand and gravel - gray - medium to soft (CL)
10 / 10	4	SS			**Pressuremeter Test performed at 9.0 to 11.5 ft** **P_f = 3.9 tsf -- E_d = 66.0 tsf**
	5	SS			
15 / 0	6	SS			**Pressuremeter Test performed at 14.0 to 16.5 ft** **P_f = 3.6 tsf -- E_d = 138.0 tsf**
20 / -10	7	SS			**Pressuremeter Test performed at 24.0 to 26.5 ft** **P_f = 2.9 tsf -- E_d = 55.0 tsf**
25 / -20					*(25.0)*No sampling
30					
35					

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' WD	BORING STARTED **3/8/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/9/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-6**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

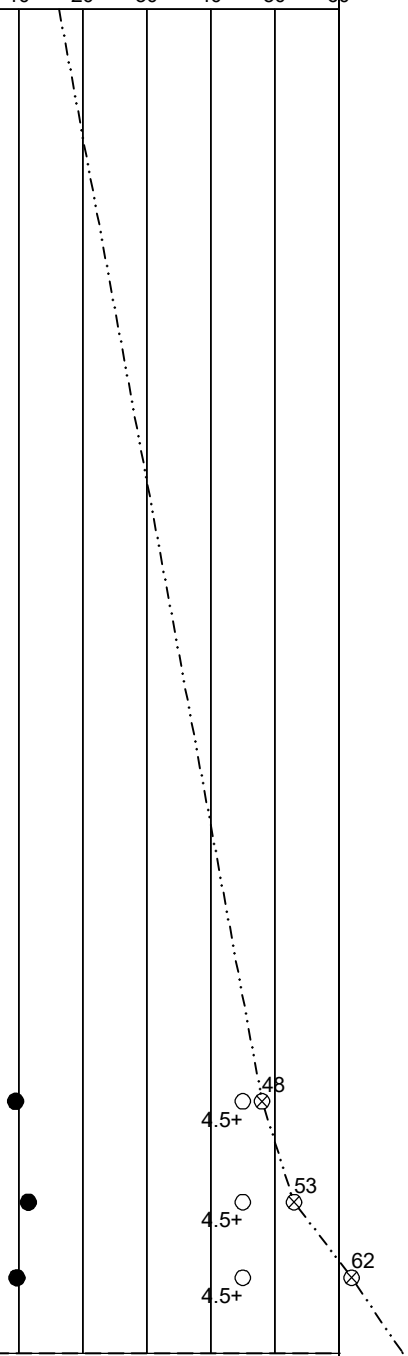
SURFACE ELEVATION (CCD) 19.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
45 / -30						
50 / -40						
55 / -50						
60 / -60						
65 / -70						
70 / -75	8	SS			*(69.0)*Silty clay, trace to little fine to coarse sand and gravel - gray - hard (CL)	
75 / -80	9	SS			**Pressuremeter Test performed at 72.5 to 75.0 ft P_f = 12.0 tsf -- E_d = 268.0 tsf**	
	10	SS			**Pressuremeter Test performed at 77.5 to 80.0 ft P_f = 17.0 tsf -- E_d = 258.0 tsf**	

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' WD	BORING STARTED **3/8/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/9/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

LOG OF BORING NUMBER **B-6**

PROJECT NAME: **Ryan Field Development**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 19.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE / RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³	UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²) / PLASTIC LIMIT (%) / WATER CONTENT (%) / LIQUID LIMIT (%) / STANDARD PENETRATION (BLOWS/FT)
	11	SS				4.5+ ○
	12	SS		*(82.0)*Clayey silt, trace to little fine to coarse sand and gravel - gray - extremely dense - moist (CL-ML)		4.5+ ○
85	13	SS		**Pressuremeter Test performed at 82.5 to 85.0 ft P_f = >24.1 tsf -- E_d = 628.0 tsf**		4.5+ ○
-70						
90	14	SS				4.5+ ○
95	15	SS		*(95.0)*Sandy silt with fine to coarse gravel, trace clay - gray - extremely dense - wet (ML)		
-80						
100	16	SS		End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.		
105						
-90						
110						
115						
-100						

⊗ STANDARD PENETRATION (BLOWS/FT): 10 20 30 40 50 60

74 ⊗
50/3" ⊗
78/6" ⊗
78 ⊗
75/3" ⊗
71/6" ⊗

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' WD	BORING STARTED **3/8/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/9/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

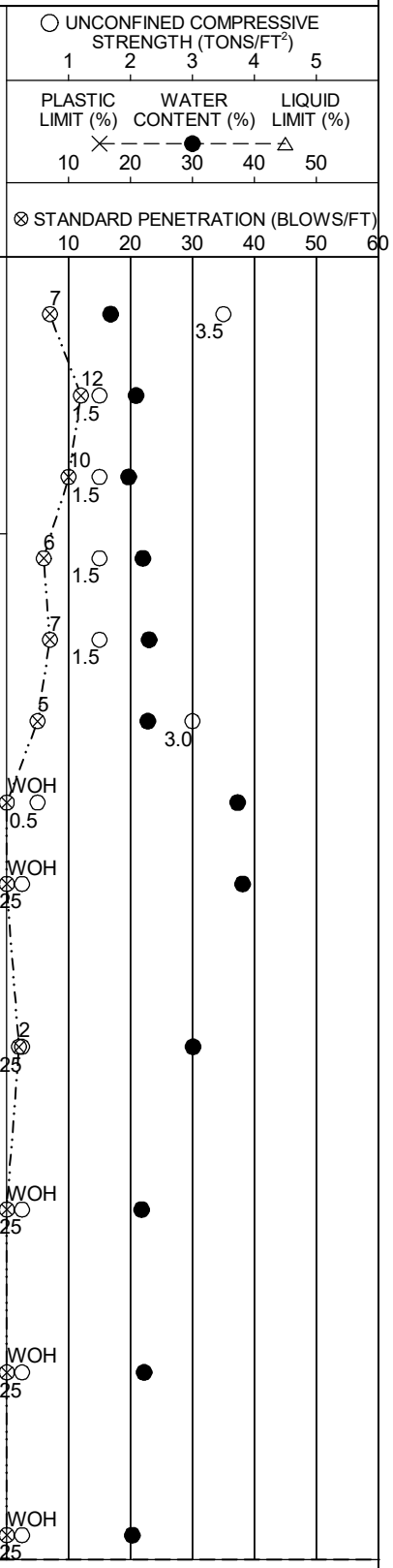
LOG OF BORING NUMBER **B-7**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 19.1

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 2 inches bituminous concrete; 10 inches asphalt grindings	
	1	SS			*(1.0)*Silty clay, trace fine to coarse and sand gravel - brown and gray - very stiff to stiff (CL)	
	2	SS				
5	3	SS				
10	4	SS			*(8.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to soft (CL)	
10	5	SS				
	6	SS				
15	7	SS				
0	8	SS				
20						
	9	SS				
25						
-10	10	SS				
30						
	11	SS				
35						
-20	12	SS				



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 18.0' Before Casing Removal 18.0' After Casing Removal	BORING STARTED **3/16/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/17/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

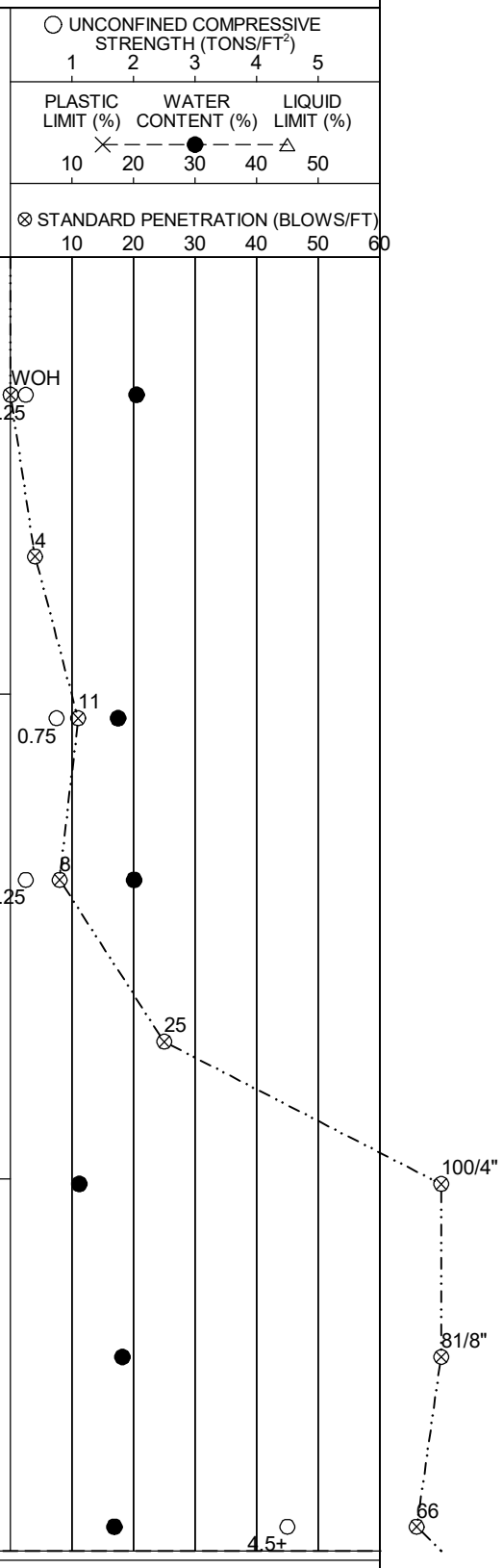
LOG OF BORING NUMBER **B-7**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 19.1

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
-45	13	SS			
-30 / -50	14	SS			
-55	15	SS		*(53.5)*Silty clay, trace fine to coarse sand and gravel - gray - medium to soft (CL)	
-40 / -60	16	SS			
-65	17	SS			
-50 / -70	18	SS		*(68.5)*Silty clay, trace to little fine to coarse sand and gravel - gray - hard (CL)	
-75	19	SS			
-60	20	SS			



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 18.0' Before Casing Removal 18.0' After Casing Removal	BORING STARTED **3/16/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/17/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-7**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

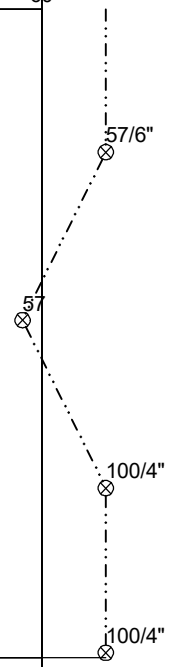
SURFACE ELEVATION (CCD) 19.1

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85	21	SS			
-70 / 90	22	SS			
95	23	SS		*(93.8)*Sandy silt with fine to coarse gravel, trace clay - gray - extremely dense - wet (ML)	
-80 / 100	24	SS		End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
-90 / 110					
115					
-100					

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) — WATER CONTENT (%) — LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 18.0' Before Casing Removal 18.0' After Casing Removal	BORING STARTED **3/16/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/17/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

LOG OF BORING NUMBER **B-8**

PROJECT NAME: **Ryan Field Development**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 19.0

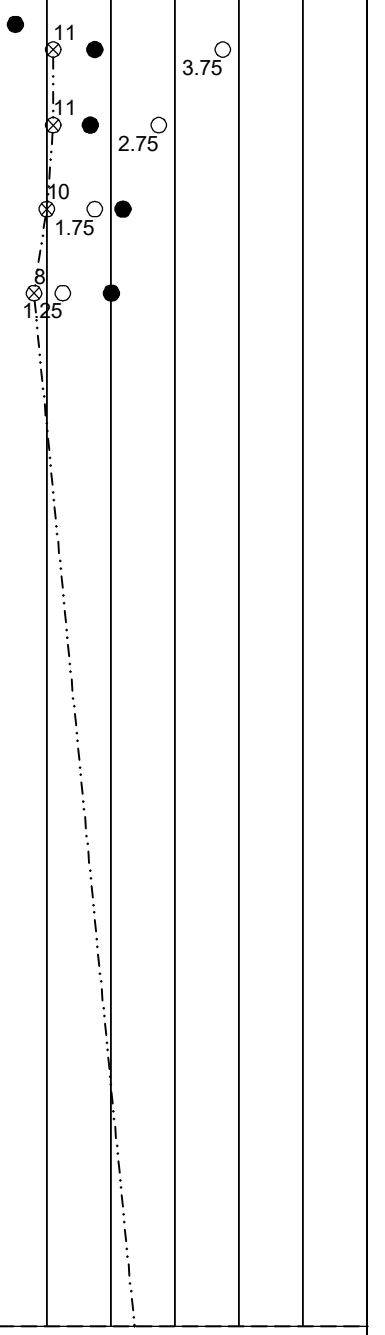
DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					*(0.0)*Fill: 2 inches bituminous concrete
	1	SS			*(0.2)*Fill: Sandy gravel (crushed asphalt and concrete) - gray and black - medium dense - moist
	1A	SS			
					*(1.5)*Silty clay, trace fine to coarse and sand gravel - brown and gray - very stiff to stiff (CL)
	2	SS			
5					
	3	SS			
10	4	SS			
10					*(10.0)*No sampling
15					
0					
20					
25					
-10					
30					
35					
-20					

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.5' WD	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/8/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-8**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

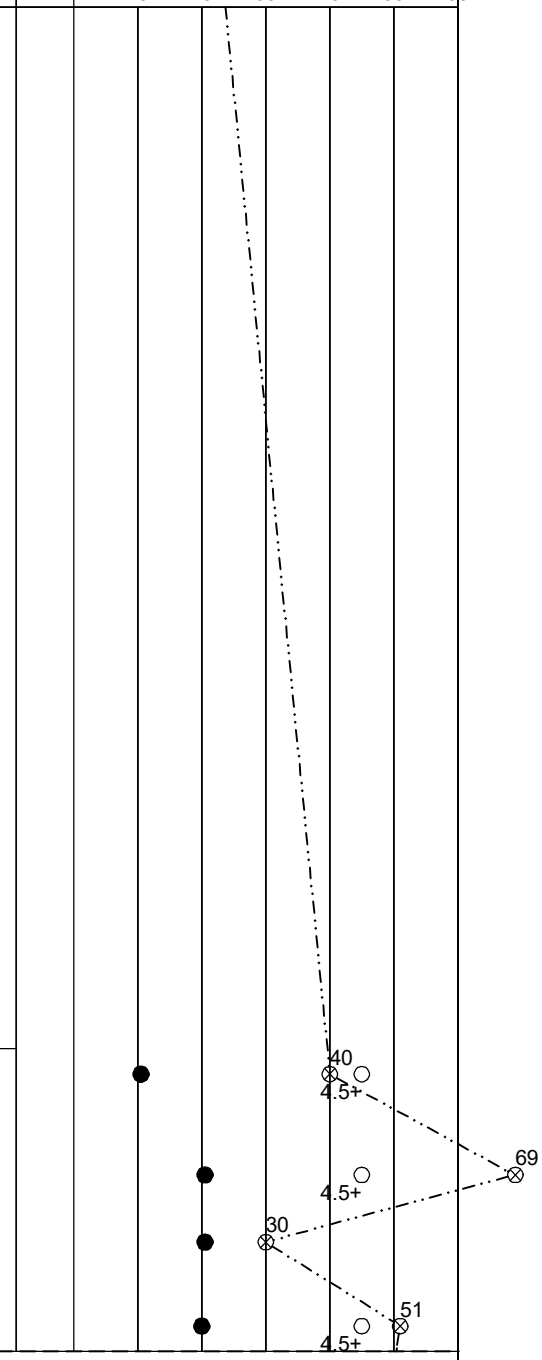
SURFACE ELEVATION (CCD) 19.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
45 / -30						
50 / -40						
55 / -50						
60 / -60						
65 / -70						
70 / -75	5	SS			*(71.0)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
					Pressuremeter Test performed at 71.5 to 74.0 ft **P_f = 16.5 tsf -- E_d = 307.0 tsf**	
75	6	SS				
	7	SS			**Pressuremeter Test performed at 76.0 to 78.5 ft** **P_f = 22.0 tsf -- E_d = 873.0 tsf**	
-60	8	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.5' WD	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/8/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

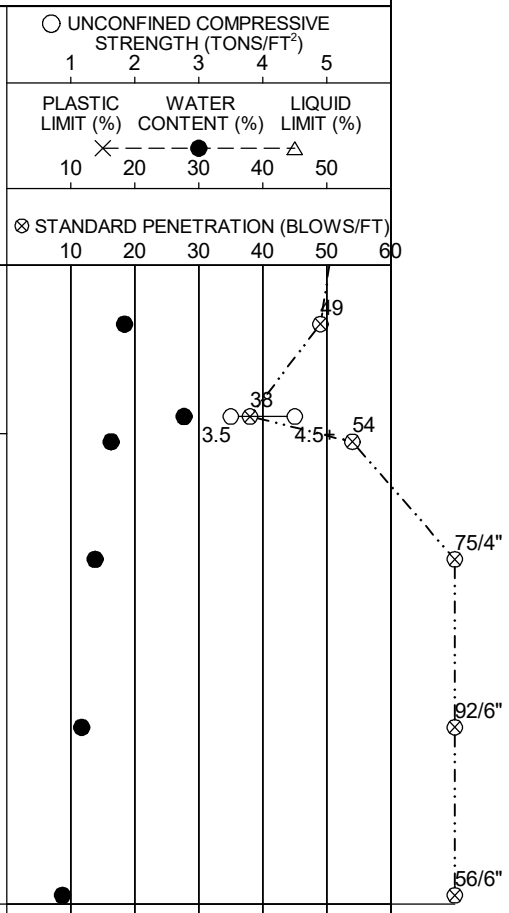
MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants	CLIENT: **Northwestern University**	LOG OF BORING NUMBER **B-8**
	PROJECT NAME: **Ryan Field Development**	ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 19.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
	9	SS			**Pressuremeter Test performed at 81.5 to 84.0 ft P_f = 10.0 tsf -- E_d = 133.0 tsf**	
	10	SS				
85	10A	SS			*(85.0)*Silty fine to coarse sand, trace to little fine to coarse gravel, trace clay - gray - extremely dense - moist to wet (SM)	
-70	11	SS				
90						
	12	SS				
95						
-80	13	SS				
100					End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105						
-90						
110						
115						
-100						



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.5' WD	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/8/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

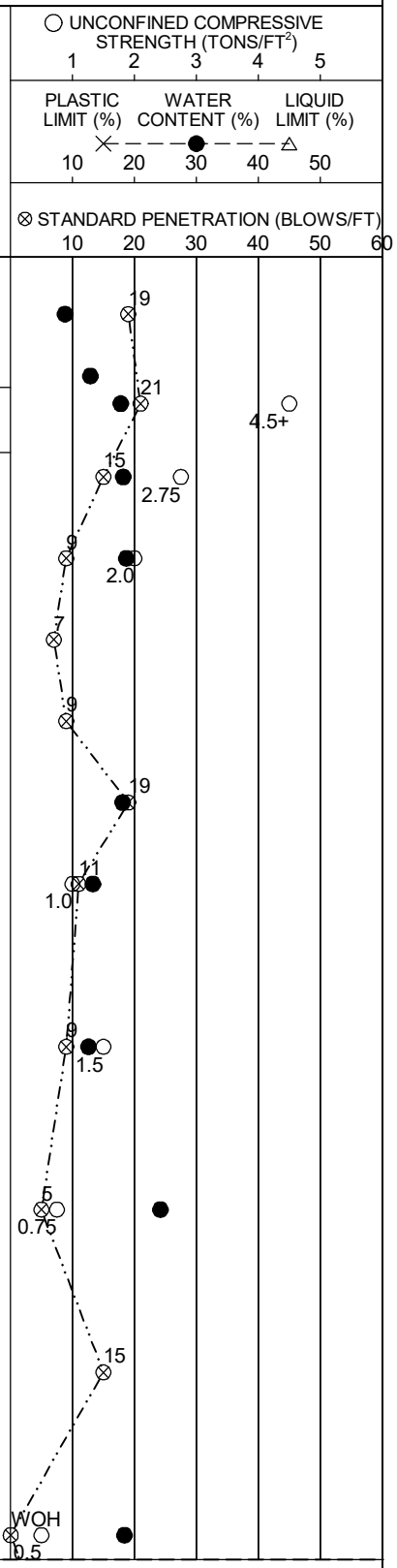
LOG OF BORING NUMBER **B-9**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 3 inches bituminous concrete; 9 inches base course	
	1	SS			*(1.0)*Silty sand with fine gravel - brown - medium dense - moist to wet (SM)	
	2	SS				
5 / 20	2A	SS			*(4.0)*Silty clay, trace fine to coarse and sand gravel - brown and gray - hard to very stiff (CL)	
	3	SS			*(6.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to soft (CL)	
	4	SS				
10	5	SS				
	6	SS				
15 / 10	7	SS				
	8	SS				
20						
	9	SS				
25 / 0						
	10	SS				
30						
	11	SS				
35 / 10						
	12	SS				



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 3.5' WS	BORING STARTED **3/3/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/4/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-9**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

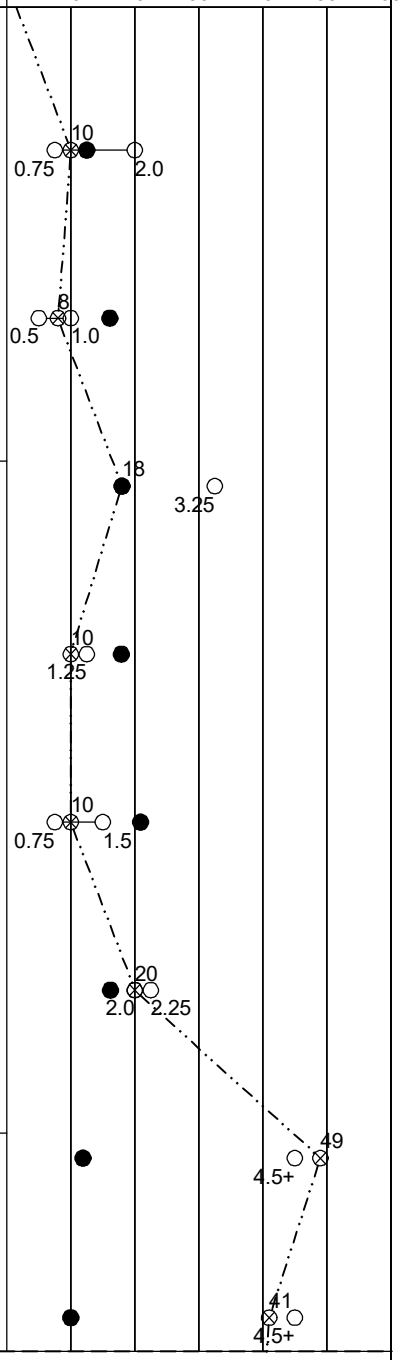
SURFACE ELEVATION (CCD) 25.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
45 / 20	13	SS				
50	14	SS				
55 / 30	15	SS			*(53.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
60	16	SS				
65 / 40	17	SS				
70	18	SS				
75 / 50	19	SS			*(73.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
	20	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²) 1 2 3 4 5

PLASTIC LIMIT (%) × — WATER CONTENT (%) ● — LIQUID LIMIT (%) △ 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 3.5' WS	BORING STARTED **3/3/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/4/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-9**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85 / 60	21	SS				
90	22	SS			*(88.5)*Silt with sand and gravel - gray - extremely dense - wet (ML)	
95 / 70	23	SS				
100	24	SS			End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105 / 80						
110						
115 / 90						

UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2): 1 2 3 4 5

PLASTIC LIMIT (%) / WATER CONTENT (%) / LIQUID LIMIT (%): 10 20 30 40 50

STANDARD PENETRATION (BLOWS/FT): 10 20 30 40 50 60

39

4.5+

36

72/5"

75/3"

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 3.5' WS	BORING STARTED **3/3/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/4/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

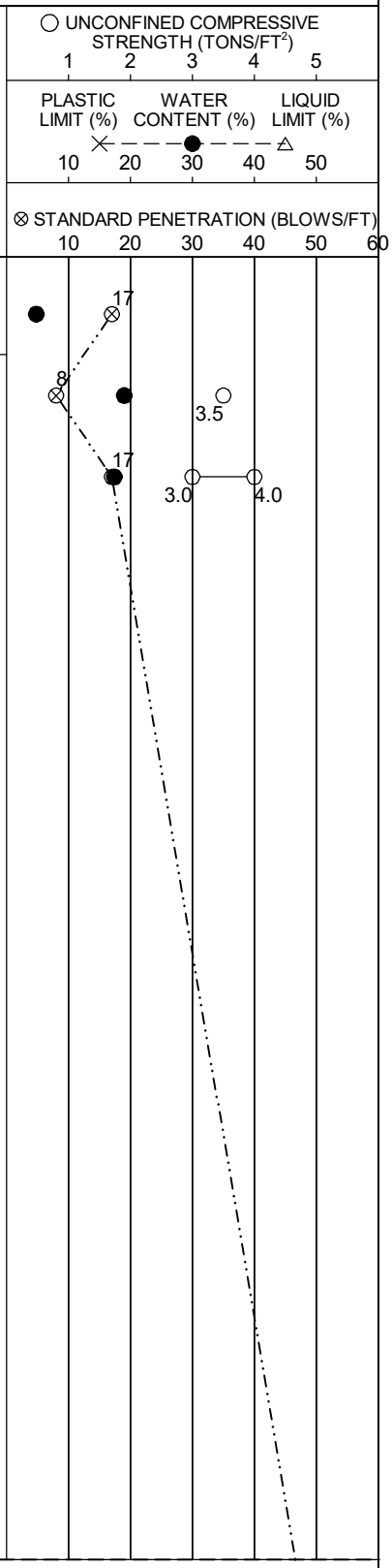
LOG OF BORING NUMBER **B-10**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.8

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 3 inches bituminous concrete; 9 inches base course	
	1	SS			*(1.0)*Fill: Silty sandy fine to coarse gravel (crushed limestone) - light gray - medium dense - moist	
5 / 20	2	SS			*(3.0)*Silty clay, trace fine to coarse and sand gravel - brown and gray - hard to very stiff (CL)	
	3	SS				
10 / 15					*(7.5)*No sampling	
20						
25 / 0						
30						
35 / 10						



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 7.5' WS	BORING STARTED **3/1/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/2/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

LOG OF BORING NUMBER **B-10**

PROJECT NAME: **Ryan Field Development**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

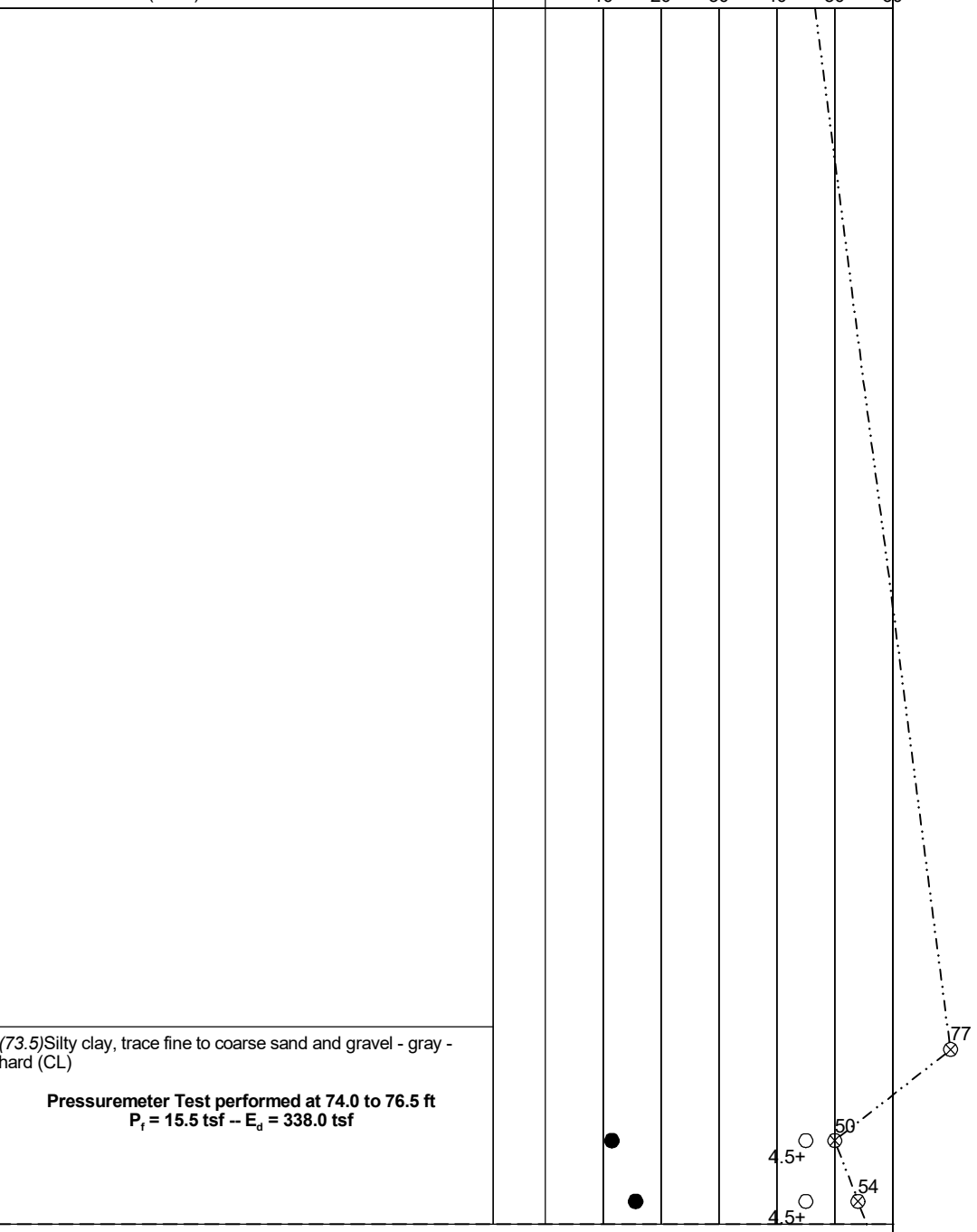
SURFACE ELEVATION (CCD) 24.8

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
45 / 20						
50						
55 / 30						
60						
65 / 40						
70						
75 / 50	4	SS			*(73.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
					Pressuremeter Test performed at 74.0 to 76.5 ft **P_f = 15.5 tsf -- E_d = 338.0 tsf**	
	5	SS				
	6	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 7.5' WS	BORING STARTED **3/1/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/2/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-10**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.8

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					Pressuremeter Test performed at 79.0 to 81.5 ft **P_f = >25.1 tsf -- E_d = 474.0 tsf**
	7	SS			
	8	SS			
85 / 60					**Pressuremeter Test performed at 84.0 to 86.5 ft** **P_f = 17.5 tsf -- E_d = 237.0 tsf**
	9	SS			
	10	SS			
90					
	11	SS			
95 / 70					
	12	SS			*(98.5)*Silt, trace to little sand and gravel, trace clay - gray - very dense - wet (ML)
100					End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.
105 / 80					
110					
115 / 90					

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) — WATER CONTENT (%) — LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 7.5' WS	BORING STARTED **3/1/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/2/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-11**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.9

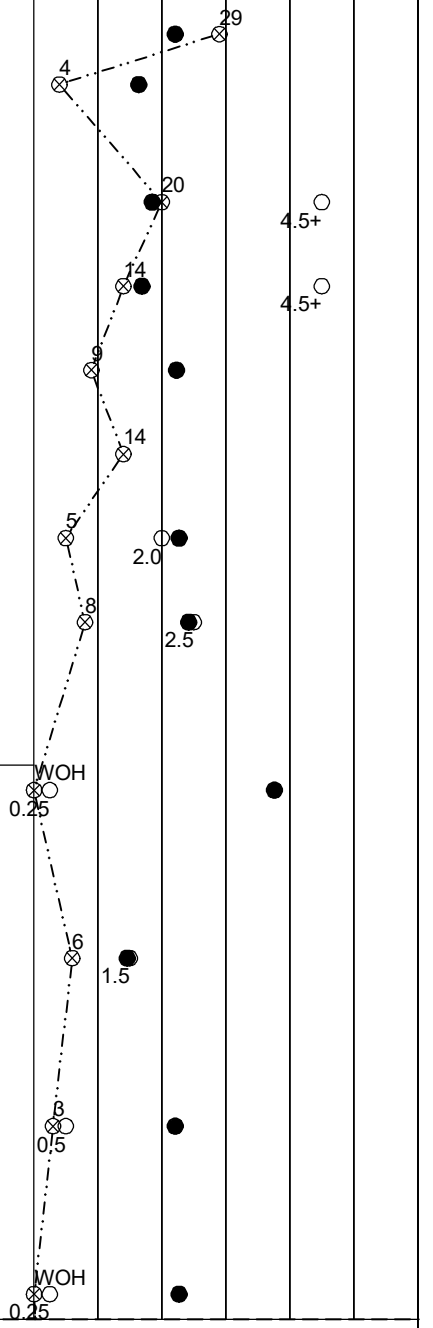
DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					*(0.0)*Fill: 4 inches bituminous concrete
	1	SS			*(0.3)*Fill: Silty fine to coarse sand with gravel - brown and black - medium dense to loose - moist (SM)
	2	SS			
5 / 20	3	SS			*(4.8)*Silty clay, trace fine to coarse and sand gravel - brown and gray - hard (CL)
	4	SS			
10	5	SS			*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)
	6	SS			
15 / 10	7	SS			
	8	SS			
20	9	SS			*(23.5)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)
25 / 0	10	SS			
30	11	SS			
35 / 10	12	SS			

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 10.0' WS 14.0' Before Casing Removal 16.0' After Casing Removal	BORING STARTED **3/3/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/4/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

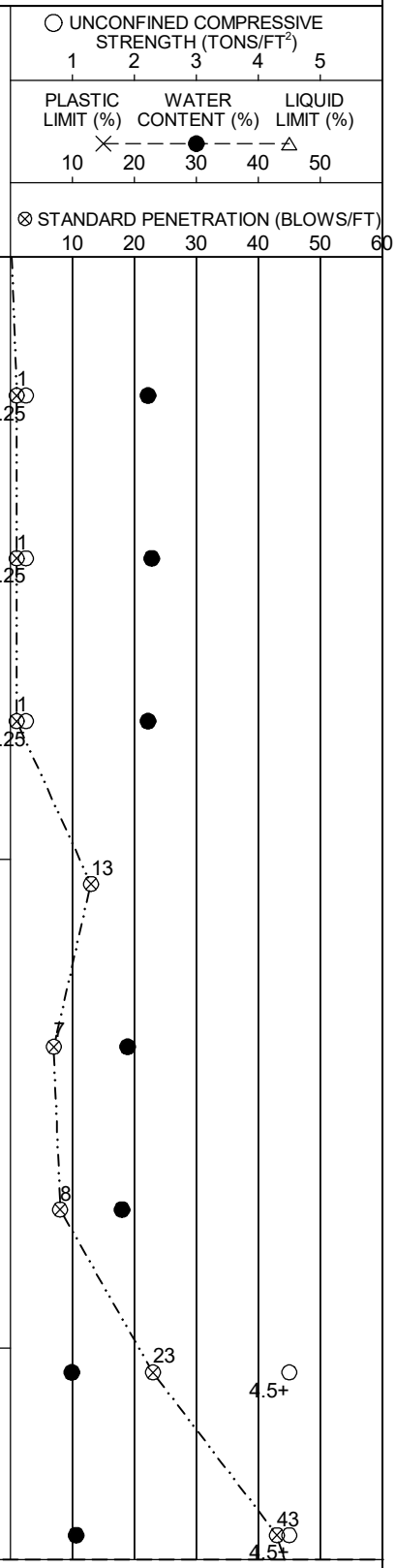
LOG OF BORING NUMBER **B-11**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
45 / 20	13	SS				0.25
50	14	SS				0.25
55 / 30	15	SS				0.25
60	16	SS			*(58.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
65 / 40	17	SS				
70	18	SS				
75 / 50	19	SS			*(73.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
	20	SS				



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 10.0' WS 14.0' Before Casing Removal 16.0' After Casing Removal	BORING STARTED **3/3/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/4/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-11**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

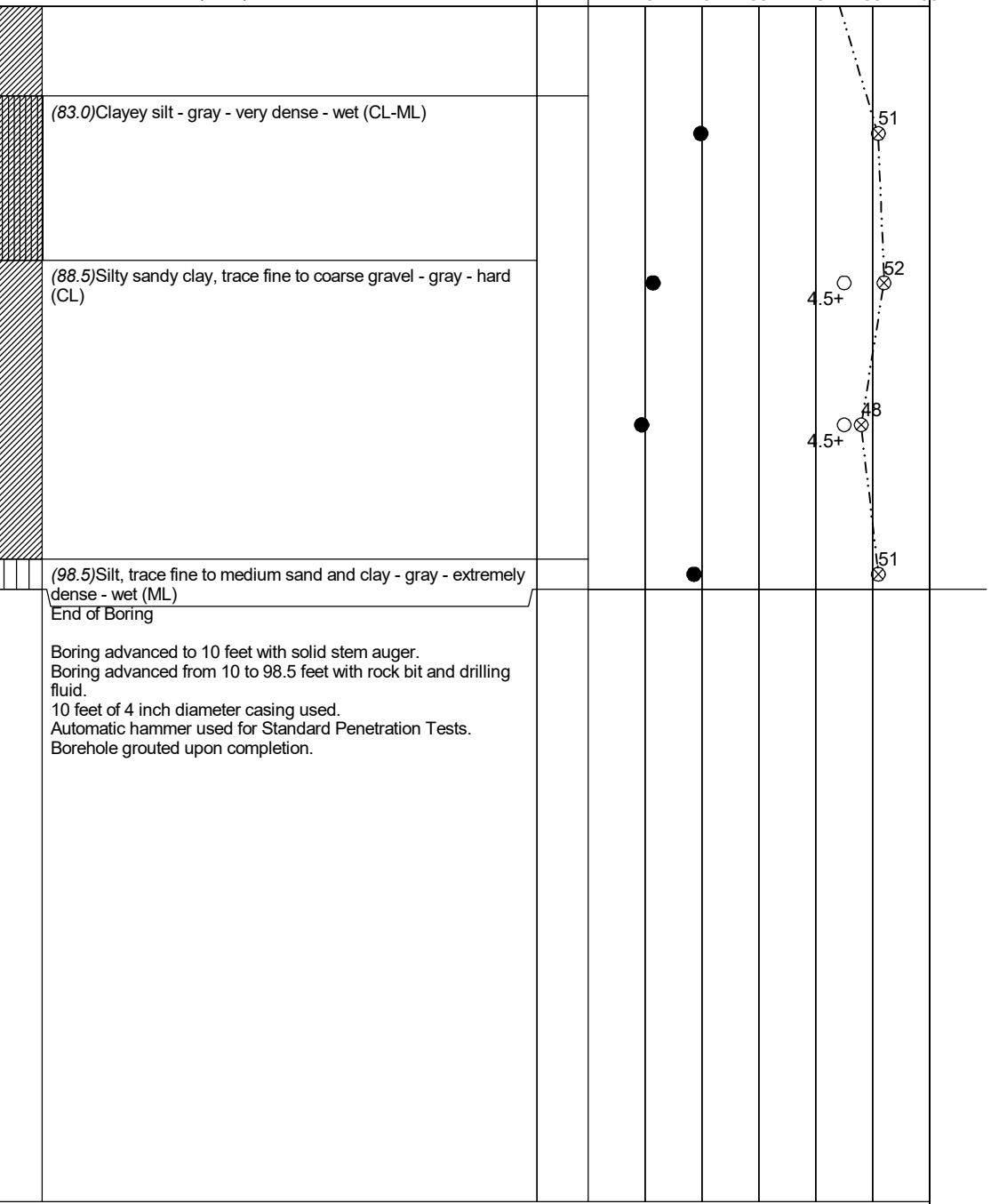
SURFACE ELEVATION (CCD) 24.9

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85 60	21	SS			*(83.0)*Clayey silt - gray - very dense - wet (CL-ML)	
90	22	SS			*(88.5)*Silty sandy clay, trace fine to coarse gravel - gray - hard (CL)	
95 70	23	SS				
100	24	SS			*(98.5)*Silt, trace fine to medium sand and clay - gray - extremely dense - wet (ML)	
105 80					End of Boring	
110					Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
115 90						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 10.0' WS
14.0' Before Casing Removal
16.0' After Casing Removal

BORING STARTED **3/3/2022**
BORING COMPLETED **3/4/2022**
GEI OFFICE **Chicago**
ENTERED BY **LJE**
APPROVED BY **RCR**
NORTHING
EASTING
RIG/FOREMAN **B-57 / Dan (Strata)**
GEI PROJECT NO. **2200549**
PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-12**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

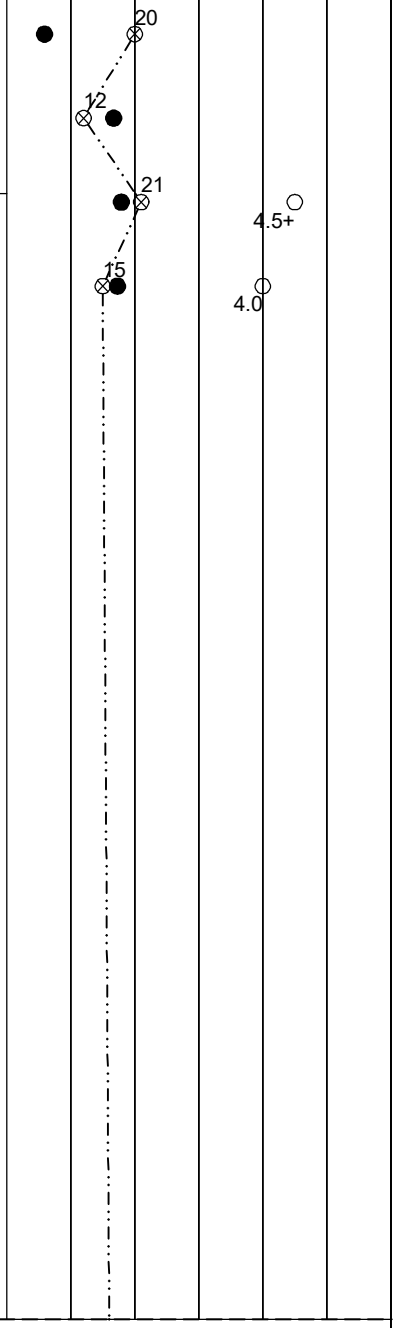
SURFACE ELEVATION (CCD) 24.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 4 inches bituminous concrete	
	1	SS			*(0.3)*Fill: Sandy gravel with silt (crushed asphalt and concrete) - black - medium dense - moist	
5 / 20	2	SS			*(3.5)*Fine to medium sand with silt - brown - medium dense - moist (SP-SM)	
	3	SS			*(6.5)*Silty clay, trace fine to coarse sand and gravel - brown - hard (CL)	
	4	SS				
10					*(10.0)*No sampling	
15 / 10						
20						
25 / 0						
30						
35 / -10						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL:	BORING STARTED 3/2/2022	GEI OFFICE Chicago	
	BORING COMPLETED 3/3/2022	ENTERED BY LJE	APPROVED BY RCR
NORTHING EASTING	RIG/FOREMAN B-57 / Dan (Strata)	GEI PROJECT NO. 2200549	PAGE NO. 1 OF 3

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-12**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

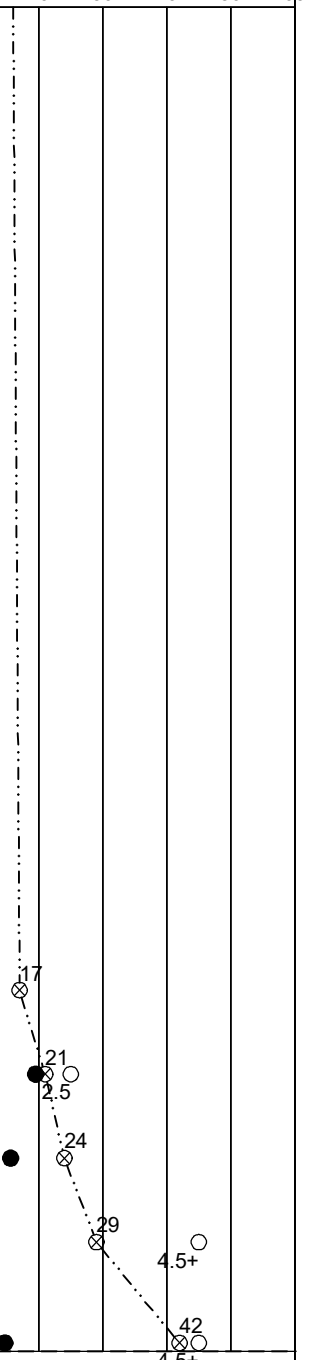
SURFACE ELEVATION (CCD) 24.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-20 / 45						
50						
-30 / 55						
60						
-40 / 65						
70	5	SS			*(68.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
	6	SS				
-50 / 75	7	SS				
	8	SS			*(76.0)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
	9	SS			**Pressuremeter Test performed at 76.5 to 79.0 ft P_f = 10.0 tsf -- E_d = 139.0 tsf**	

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL:	BORING STARTED 3/2/2022	GEI OFFICE Chicago	
	BORING COMPLETED 3/3/2022	ENTERED BY LJE	APPROVED BY RCR
NORTHING EASTING	RIG/FOREMAN B-57 / Dan (Strata)	GEI PROJECT NO. 2200549	PAGE NO. 2 OF 3

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-12**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

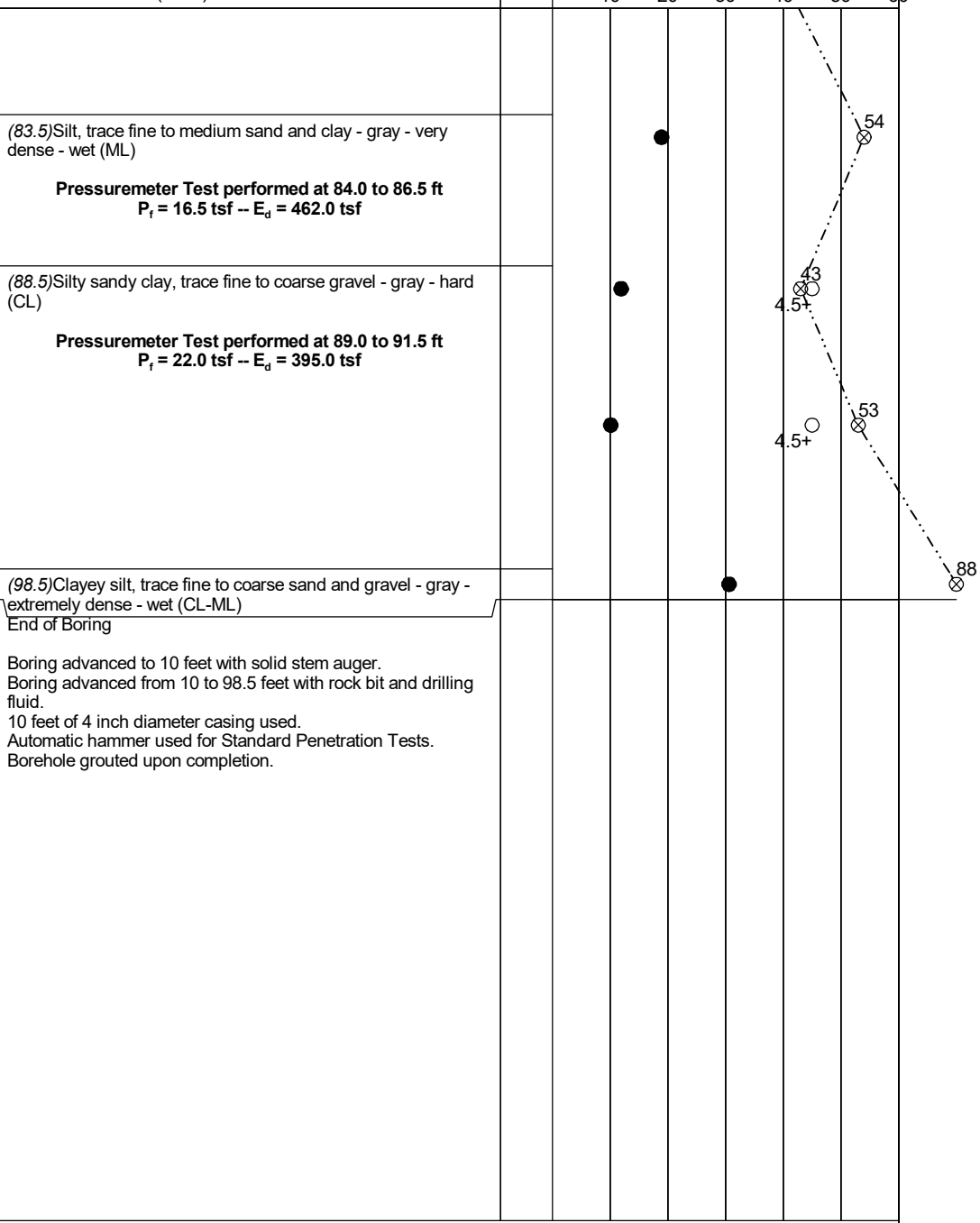
SURFACE ELEVATION (CCD) 24.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE / RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-60 / 85	10	SS		*(83.5)*Silt, trace fine to medium sand and clay - gray - very dense - wet (ML) **Pressuremeter Test performed at 84.0 to 86.5 ft** **P_f = 16.5 tsf -- E_d = 462.0 tsf**	
-70 / 90	11	SS		*(88.5)*Silty sandy clay, trace fine to coarse gravel - gray - hard (CL) **Pressuremeter Test performed at 89.0 to 91.5 ft** **P_f = 22.0 tsf -- E_d = 395.0 tsf**	
-70 / 95	12	SS			
-80 / 100	13	SS		*(98.5)*Clayey silt, trace fine to coarse sand and gravel - gray - extremely dense - wet (CL-ML) End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
-90 / 105					
110					
-90 / 115					

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) — WATER CONTENT (%) — LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL:	BORING STARTED 3/2/2022	GEI OFFICE Chicago	
	BORING COMPLETED 3/3/2022	ENTERED BY LJE	APPROVED BY RCR
NORTHING EASTING	RIG/FOREMAN B-57 / Dan (Strata)	GEI PROJECT NO. 2200549	PAGE NO. 3 OF 3

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-13**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

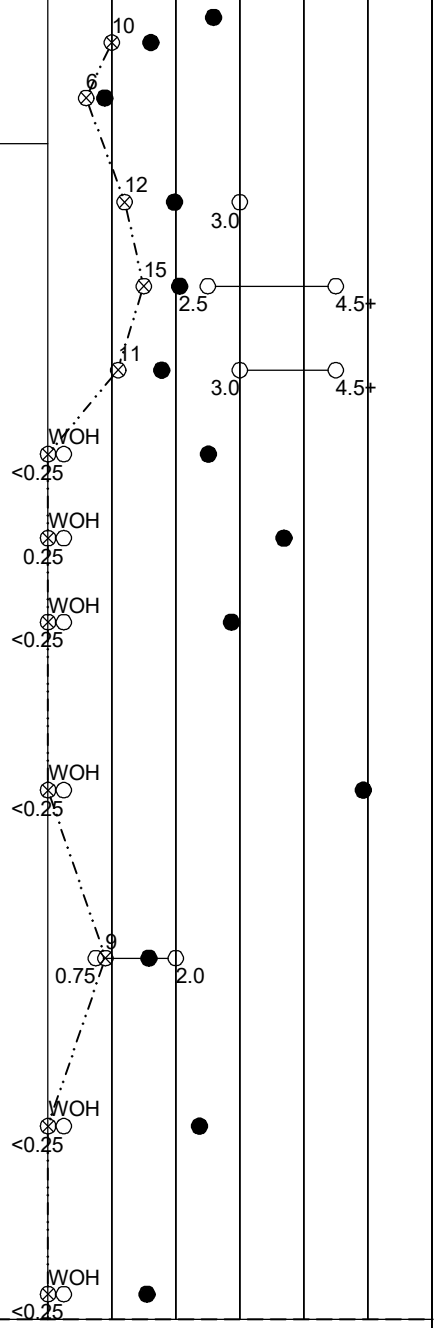
SURFACE ELEVATION (CCD) 24.1

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
					*(0.0)*Fill: 5 inches bituminous concrete	
	1	SS			*(0.4)*Fill: Silty sand, trace clay - black - medium dense - moist (SM)	
	1A	SS				
20 / 5	2	SS			*(1.5)*Fine to medium sand with silt - brown - medium dense to loose - moist (SP-SM)	
	3	SS			*(5.0)*Silty clay, trace fine to coarse sand and gravel - brown - very stiff to hard (CL)	
	4	SS				
10	5	SS				
10 / 15	6	SS			*(13.5)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)	
	7	SS				
20	8	SS				
0 / 25	9	SS				
30	10	SS				
-10 / 35	11	SS				
	12	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 10.0' WS/WD	BORING STARTED **3/4/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/7/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-13**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.1

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3	○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)	PLASTIC LIMIT (%)	WATER CONTENT (%)	LIQUID LIMIT (%)	⊗ STANDARD PENETRATION (BLOWS/FT)
-20 / 45	13	SS					WOH 0.25				
-30 / 50	14	SS					WOH <0.25				
-40 / 55	15	SS					WOH <0.25				
-50 / 60	16	SS			*(58.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff (CL)		1.0				11
-60 / 65	17	SS									19
-70 / 70	18	SS			*(69.0)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)						27
-80 / 75	19	SS					4.5+				35
-90 / 80	20	SS					3.5				28

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 10.0' WS/WD	BORING STARTED **3/4/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/7/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-13**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

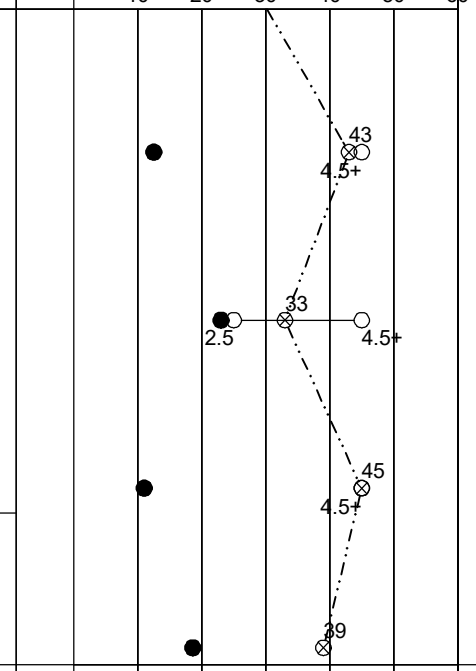
SURFACE ELEVATION (CCD) 24.1

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
-60 / 85	21	SS			
-70 / 95	22	SS			
	23	SS			
	24	SS		*(95.0)*Silty sand, trace lcay - gray - very dense - wet (SM)	
-80 / 105				End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
-90 / 115					
100 / 110					

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 10.0' WS/WD	BORING STARTED **3/4/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/7/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

LOG OF BORING NUMBER **B-14**

PROJECT NAME: **Ryan Field Development**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

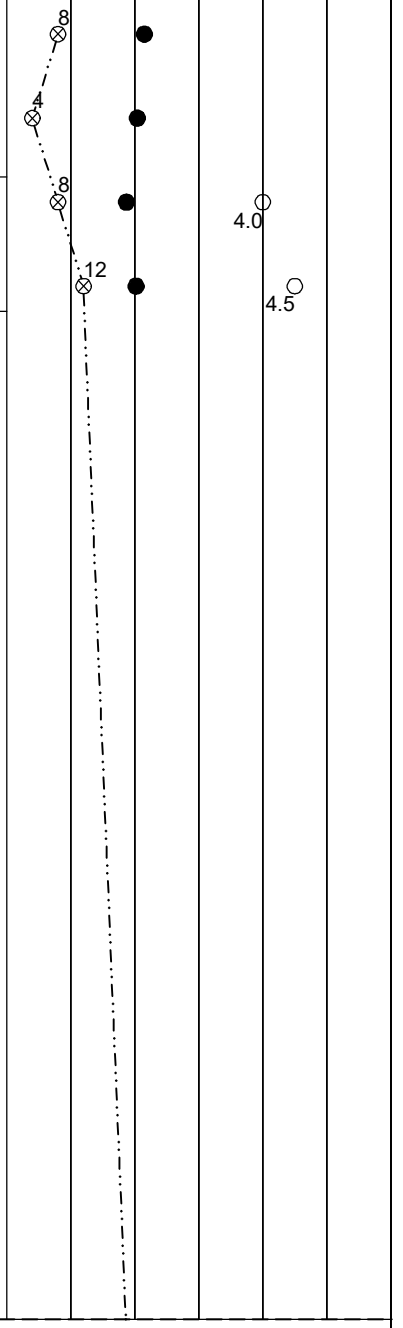
SURFACE ELEVATION (CCD) 24.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 3 inches bituminous concrete; 4 inches gravel base course	
	1	SS			*(0.6)*Fill: Silty sand, trace clay - brown and black - loose - moist (SM)	
20 / 5	2	SS			*(3.5)*Fine to medium sand with silt - brown - loose - moist (SP-SM)	
	3	SS			*(6.0)*Silty clay, trace fine to coarse sand and gravel - brown - very stiff to hard (CL)	
10	4	SS			*(10.0)*No sampling	
10 / 15						
20 / 0						
25						
30 / -10						
35						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' WS	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/8/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-14**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-20 / 45						
-30 / 55						
-40 / 65						
-50 / 75	5	SS			*(73.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
	6	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

26

4.5+

31

4.5+

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' WS	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/8/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-14**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

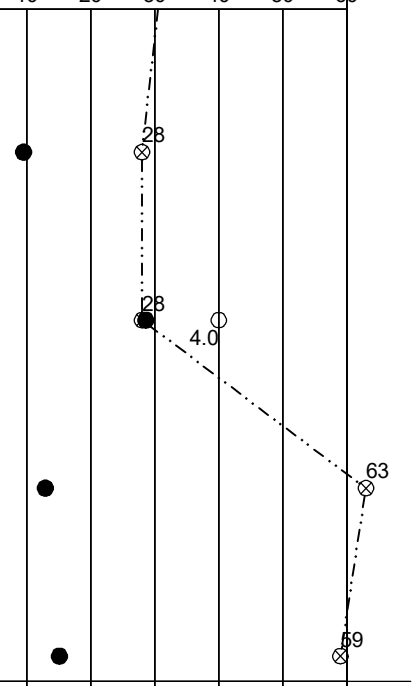
SURFACE ELEVATION (CCD) 24.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-60 / 85	7	SS			
	8	SS			
-70 / 95	9	SS		*(93.5)*Silty sandy clay, trace fine to coarse gravel - gray - hard (CL)	
-80 / 105	10	SS		*(98.5)*Fine to coarse sand with silt, trace clay and fine gravel - gray - very dense - wet (SP-SM)	
-90 / 115				End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' WS	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/8/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-15**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.7

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					*(0.0)*Fill: 3 inches bituminous concrete; 4 inches gravel base course
	1	SS			*(0.3)*Fill: Silty fine to coarse sand, trace clay and fine to coarse gravel - dark brown and black - medium dense to loose - moist
5 / 20	2	SS			
	3	SS			
	4	SS			
10					
	5	SS			*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)
15 / 10	6	SS			
	7	SS			
	8	SS			
20					
25 / 0	9	SS			
	10	SS			
30					
35 / 10	11	SS			
	12	SS			

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) × — WATER CONTENT (%) ● — LIQUID LIMIT (%) △ 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

11	0.25	
5		
2		
WOH		
1	0.25	
4	0.25	
WOH	0.25	
WOH	0.25	
WOH	0.25	
8		
1	0.25	
WOH	0.25	

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS
14.0' Before Casing Removal
14.0' After Casing Removal

BORING STARTED **3/8/2022**

BORING COMPLETED **3/9/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **B-57 / Dan (Strata)**

GEI PROJECT NO. **2200549**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-15**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.7

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
20 / 45	13	SS			
50	14	SS			
30 / 55	15	SS		*(53.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
60	16	SS			
40 / 65	17	SS			
70	18	SS			
50 / 75	19	SS		*(73.0)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
	20	SS			

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²) 1 2 3 4 5

PLASTIC LIMIT (%) × — WATER CONTENT (%) ● — LIQUID LIMIT (%) △ 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

WOH 0.25 | 1 0.25 | 5 0.25 | 11 1.75 | 6 1.25 | 11 | 26 4.5+ | 32 4.5+

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS
14.0' Before Casing Removal
14.0' After Casing Removal

BORING STARTED **3/8/2022**

BORING COMPLETED **3/9/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **B-57 / Dan (Strata)**

GEI PROJECT NO. **2200549**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-15**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

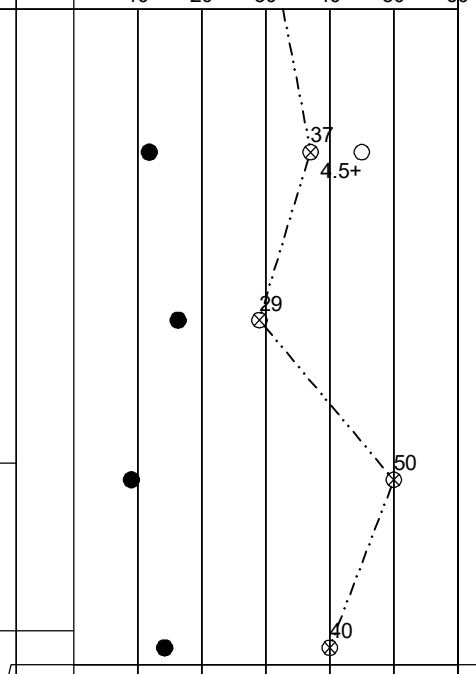
SURFACE ELEVATION (CCD) 24.7

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85 (60)	21	SS				
90	22	SS				
95 (70)	23	SS			*(93.5)*Silty sandy clay, trace fine to coarse gravel - gray - hard (CL)	
100	24	SS			*(98.5)*Fine to coarse sand with silt, trace clay and fine gravel - gray - extremely dense - wet (SP-SM)	
					End of Boring	
105 (80)					Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
110						
115 (90)						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS
14.0' Before Casing Removal
14.0' After Casing Removal

BORING STARTED **3/8/2022**

BORING COMPLETED **3/9/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **B-57 / Dan (Strata)**

GEI PROJECT NO. **2200549**

PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-16**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.6

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					*(0.0)*Fill: 2 inches bituminous concrete; 10 inches gravel base course
	1	SS			*(1.0)*Fine to medium sand with silt - brown - loose - moist (SP-SM)
5 / 20	2	SS			*(3.5)*Silty clay, trace fine to coarse sand and gravel - brown - hard (CL)
	3	SS			
	4	SS			*(8.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)
10	5	SS			*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)
15 / 10	6	SS			
	7	SS			
20	8	SS			
25 / 0	9	SS			
	10	SS			
30					
35 / -10	11	SS			
	12	SS			

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

7, 10, 13, 16, 4, 1, WOH, 1, WOH, 7, WOH, WOH

0.5, 0.25, 0.25, 0.25, 0.25, 0.25

4.5+, 4.5+

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 7.5' WS
12.0' Before Casing Removal
12.0' After Casing Removal

BORING STARTED **3/9/2022**

BORING COMPLETED **3/10/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **B-57 / Dan (Strata)**

GEI PROJECT NO. **2200549**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-16**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 24.6

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-20 / 45	13	SS				WOH 0.25
	14	SS				WOH 0.25
-30 / 55	15	SS				1 0.25
	16	SS			*(58.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	10 1.75
-40 / 65	17	SS			*(63.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	29 4.5+
	18	SS				45 4.5+
-50 / 75	19	SS				50 4.5+
	20	SS				100/6"

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 7.5' WS 12.0' Before Casing Removal 12.0' After Casing Removal	BORING STARTED **3/9/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/10/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-16**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

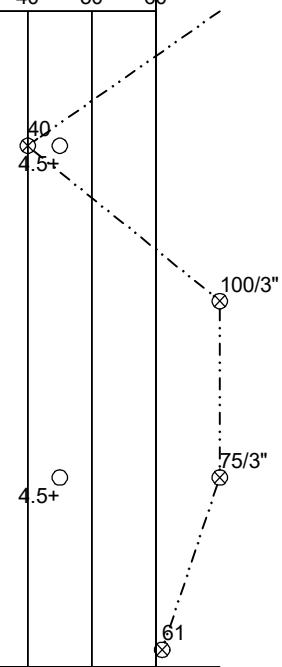
SURFACE ELEVATION (CCD) 24.6

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
-60 / 85	21	SS				
	22	SS			*(88.5)*Clayey silt, trace to little fine to coarse sand and gravel - gray - extremely dense - moist to wet (CL-ML)	
90						
	23	SS				
-70 / 95						
	24	SS			*(97.5)*Silt, trace clay and sand - gray - extremely dense - wet (ML)	
100					End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
-80 / 105						
110						
-90 / 115						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: Dry at 7.5' WS
12.0' Before Casing Removal
12.0' After Casing Removal

BORING STARTED **3/9/2022**
BORING COMPLETED **3/10/2022**
GEI OFFICE **Chicago**
ENTERED BY **LJE**
APPROVED BY **RCR**
NORTHING
EASTING
RIG/FOREMAN **B-57 / Dan (Strata)**
GEI PROJECT NO. **2200549**
PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

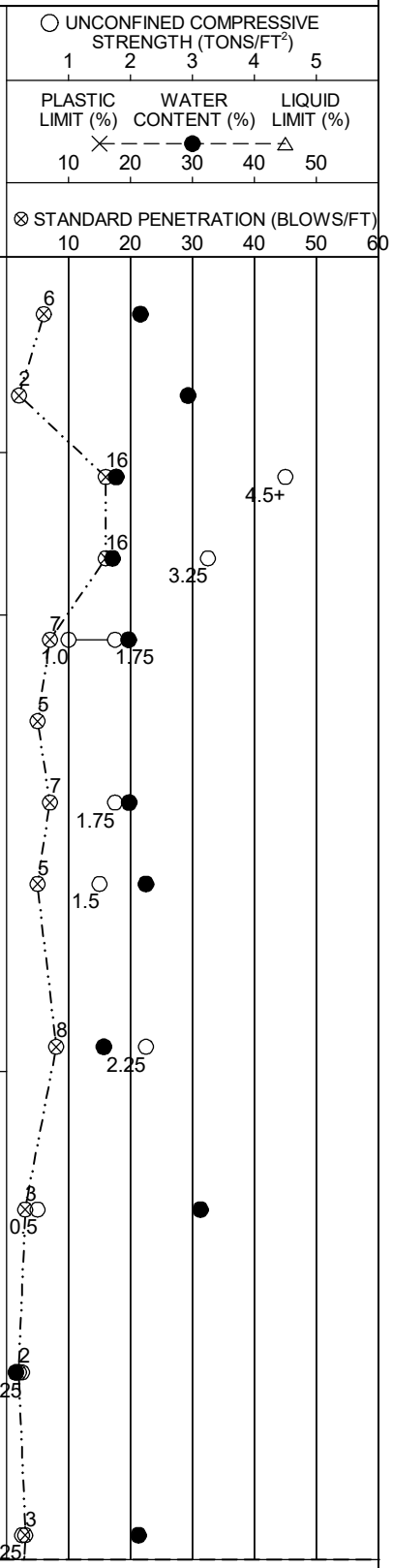
LOG OF BORING NUMBER **B-17**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.4

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 2 inches bituminous concrete; 4 inches gravel base course	
	1	SS			*(0.5)*Fill: Silty sand with gravel - black - loose - moist (SM)	
5 / 20	2	SS			*(3.5)*Clay, trace silt and fine sand - brown and gray - stiff (CH)	
	3	SS			*(6.0)*Silty clay, trace fine to coarse sand and gravel - brown - very stiff to hard (CL)	
10	4	SS				
	5	SS			*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
	6	SS				
15 / 10	7	SS				
	8	SS				
20						
	9	SS				
25 / 0					*(25.0)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)	
	10	SS				
30						
	11	SS				
35 / -10						
	12	SS				



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS
15.0' Before Casing Removal
15.0' After Casing Removal

BORING STARTED **3/10/2022**

BORING COMPLETED **3/11/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **B-57 / Dan (Strata)**

GEI PROJECT NO. **2200549**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

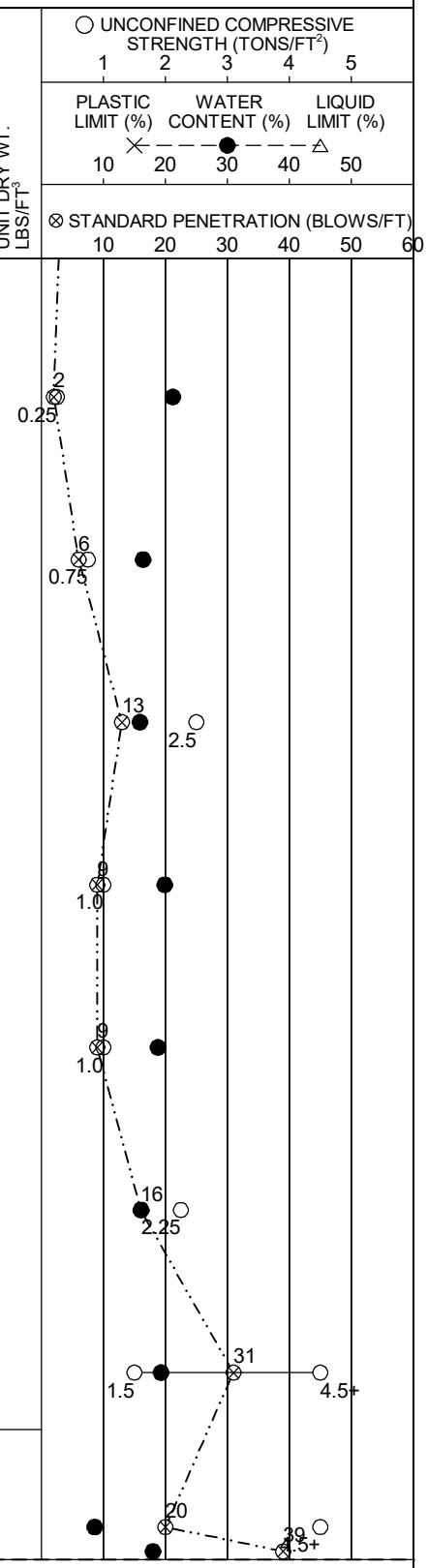
LOG OF BORING NUMBER **B-17**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.4

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
45 -20	13	SS				
50	14	SS				
55 -30	15	SS			*(53.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
60	16	SS				
65 -40	17	SS				
70	18	SS				
75 -50	19	SS			*(76.0)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
	20	SS				



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS 15.0' Before Casing Removal 15.0' After Casing Removal	BORING STARTED **3/10/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/11/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

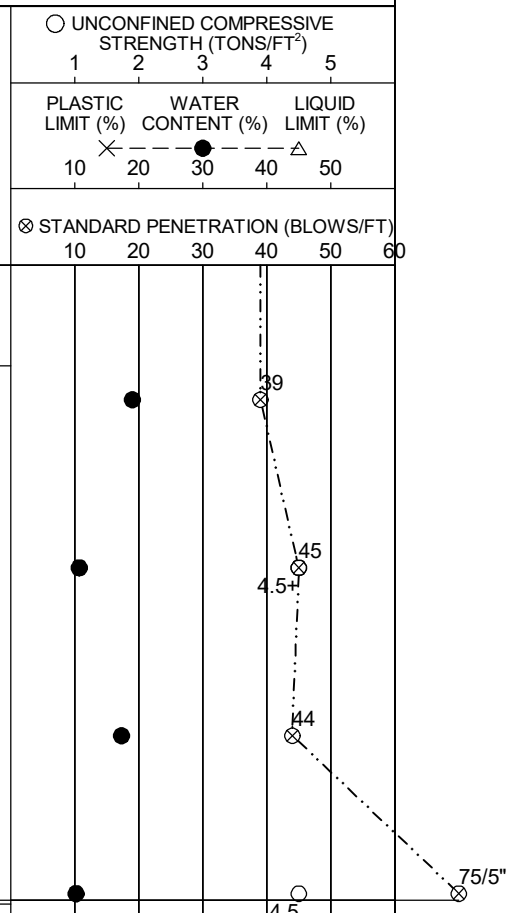
LOG OF BORING NUMBER **B-17**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.4

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
	20A	SS		*(79.5)*Clayey silt - gray - very dense - moist to wet (CL-ML)	
	21	SS		*(83.0)*Silty fine sand - gray - very dense - moist to wet (SM)	
85 -60	22	SS		*(88.0)*Silty clay, trace to little fine to coarse sand and gravel - gray - hard (CL)	
90	23	SS		*(93.5)*Sandy silt with fine to coarse gravel, trace clay - gray - very to extremely dense - wet (ML)	
95 -70	24	SS			
100				End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105 -80					
110					
115 -90					



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS 15.0' Before Casing Removal 15.0' After Casing Removal	BORING STARTED **3/10/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/11/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-18**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.6

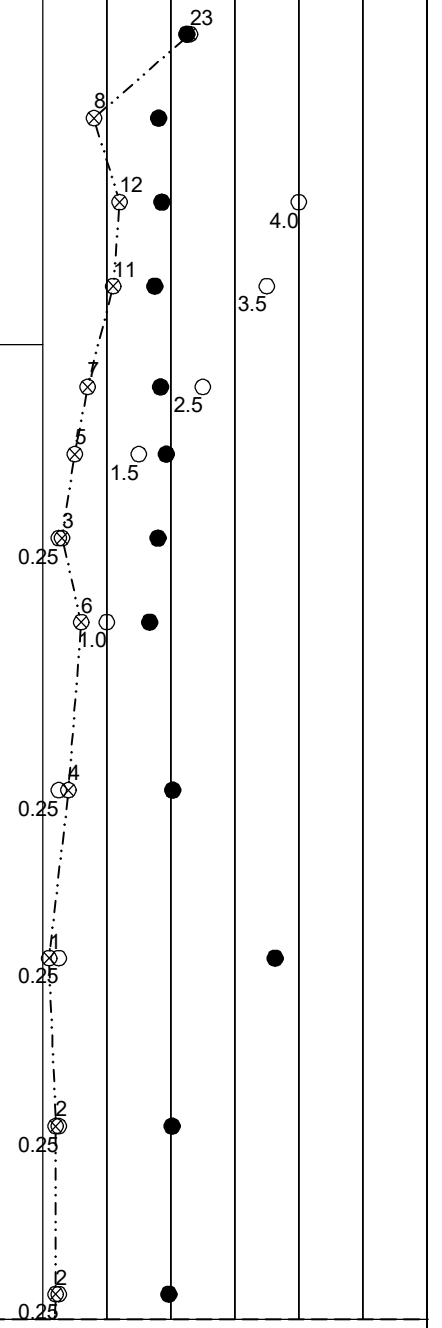
DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL
				*(0.0)*Fill: 3 inches bituminous concrete
	1	SS		*(0.3)*Fill: Gravelly fine to coarse sand mixed with topsoil - gray and black - medium dense - moist
	2	SS		*(3.0)*Fine to medium sand with silt - brown - medium dense - moist (SP-SM)
5 / 20	3	SS		*(6.0)*Silty clay, trace fine to coarse sand and gravel - brown - very stiff to hard (CL)
	4	SS		
10				**Pressuremeter Test performed at 9.0 to 11.5 ft P_f = 3.9 tsf -- E_d = 61.0 tsf**
	5	SS		*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)
	6	SS		
15 / 10	7	SS		*(16.0)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)
	8	SS		
20				
	9	SS		
25 / 0				
	10	SS		
30				
	11	SS		
35 / -10				
	12	SS		

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) × — WATER CONTENT (%) ● — LIQUID LIMIT (%) △ 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 13.0' Before Casing Removal

BORING STARTED **3/17/2022**

BORING COMPLETED **3/18/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **B-57 / Dan (Strata)**

GEI PROJECT NO. **2200549**

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

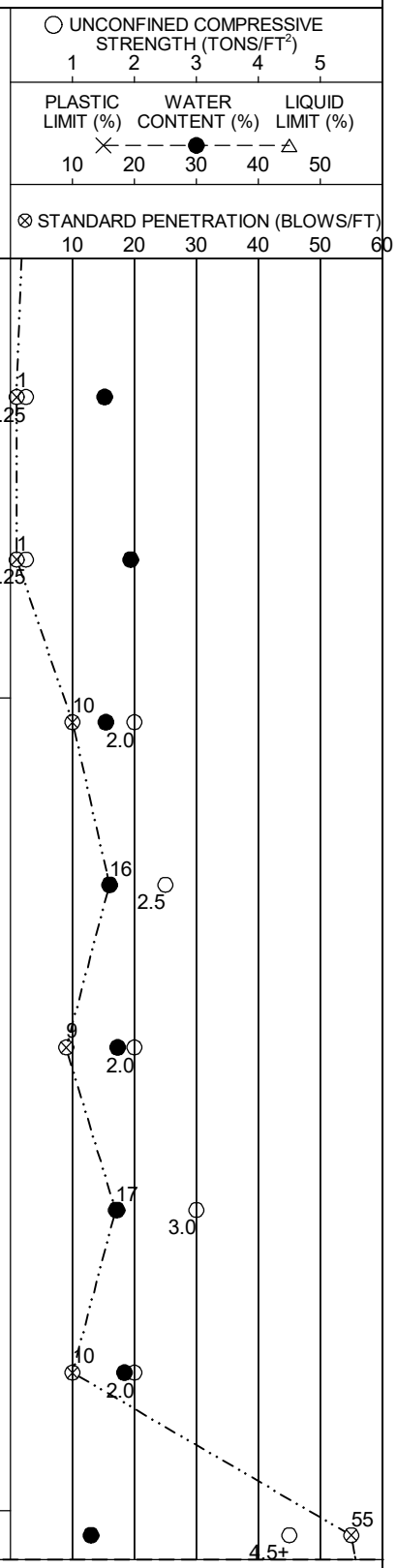
LOG OF BORING NUMBER **B-18**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.6

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
45 / -20	13	SS				
50	14	SS				
55 / -30	15	SS			*(53.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
60	16	SS				
65 / -40	17	SS				
70	18	SS				
75 / -50	19	SS				
	20	SS			*(78.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 13.0' Before Casing Removal	BORING STARTED **3/17/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/18/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

LOG OF BORING NUMBER **B-18**

PROJECT NAME: **Ryan Field Development**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

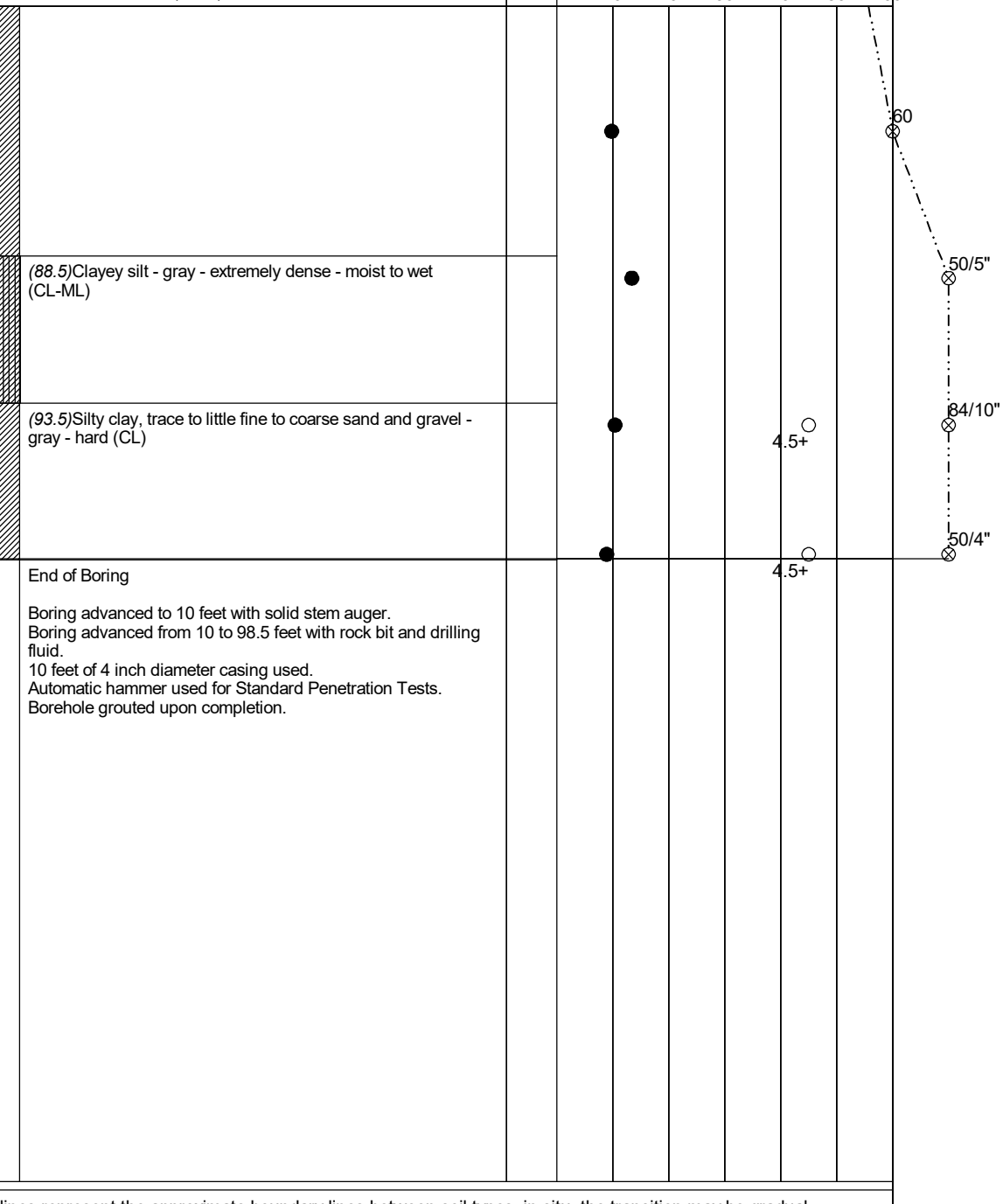
SURFACE ELEVATION (CCD) 25.6

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85 / -60	21	SS				
90	22	SS			*(88.5)*Clayey silt - gray - extremely dense - moist to wet (CL-ML)	
95 / -70	23	SS			*(93.5)*Silty clay, trace to little fine to coarse sand and gravel - gray - hard (CL)	
	24	SS			End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
100						
105 / -80						
110						
115 / -90						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 13.0' Before Casing Removal	BORING STARTED **3/17/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/18/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-19**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.6

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
0 / 25.6					*(0.0)*Fill: 3 inches bituminous concrete	
	1	SS			*(0.3)*Fill: Silty fine to coarse sand, some fine to coarse gravel - black - loose - moist	
	1A	SS				
					*(1.5)*Fill: Clayey sand, trace gravel - dark brown - loose - moist	
	2	SS			*(3.5)*Fill: Fine to coarse sand with silt and fine to coarse gravel - brown - dense - moist (SP-SM)	
5 / 20	3	SS			*(6.0)*Silty clay, trace fine to coarse sand and gravel - brown - very stiff to hard (CL)	
	4	SS			*(8.5)*Silty clay, trace fine to coarse sand and gravel - gray - very stiff (CL)	
10	5	SS			*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)	
	6	SS				
15 / 10	7	SS				
	8	SS				
20						
25 / 0	9	SS				
	10	SS				
30						
35 / -10	11	SS				
	12	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60

7 0.75 1.5
47
22 3.25 4.5+
13 2.0
3 0.5
WOH 0.25
17 1.0
5 0.5
WOH <0.25
6 0.5
14 0.75 4.5+
WOH <0.25

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.5' WD
16.0' Before Casing Removal
16.0' After Casing Removal

BORING STARTED **3/1/2022**
BORING COMPLETED **3/1/2022**
GEI OFFICE **Chicago**
ENTERED BY **LJE**
APPROVED BY **RCR**
NORTHING
EASTING
RIG/FOREMAN **CME-75 / Mark B (Strata)**
GEI PROJECT NO. **2200549**
PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-19**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.6

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³	○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²) 1 2 3 4 5 / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50 / ⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60
45 -20	13	SS				WOH <0.25
50	14	SS				WOH 0.25
55 -30	15	SS				WOH 0.25
60	16	SS				WOH 0.5
65 -40	17	SS		*(63.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)		12 1.5
70	18	SS				13 1.75
75 -50	19	SS		*(71.0)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)		35 4.5+
	20	SS				36 4.5+

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.5' WD 16.0' Before Casing Removal 16.0' After Casing Removal	BORING STARTED **3/1/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/1/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

LOG OF BORING NUMBER **B-19**

PROJECT NAME: **Ryan Field Development**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

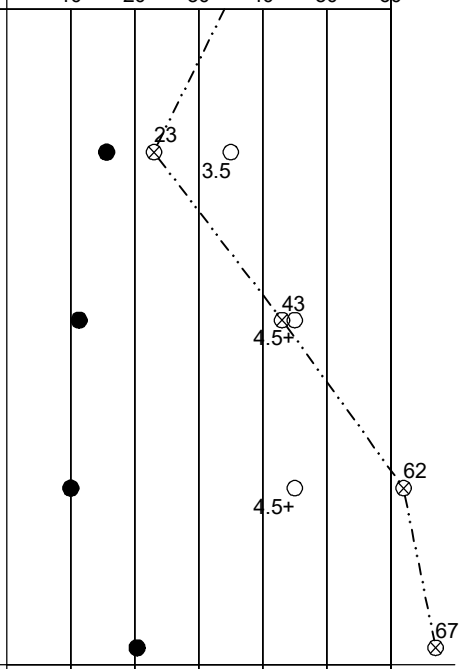
SURFACE ELEVATION (CCD) 25.6

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85 / -60	21	SS			
90	22	SS			
95 / -70	23	SS			
	24	SS		*(98.5)*Silty, trace clay and fine sand - gray - extremely dense - wet (ML)	
				End of Boring	
100				Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105 / -80					
110					
115 / -90					

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.5' WD 16.0' Before Casing Removal 16.0' After Casing Removal	BORING STARTED **3/1/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/1/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-20**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

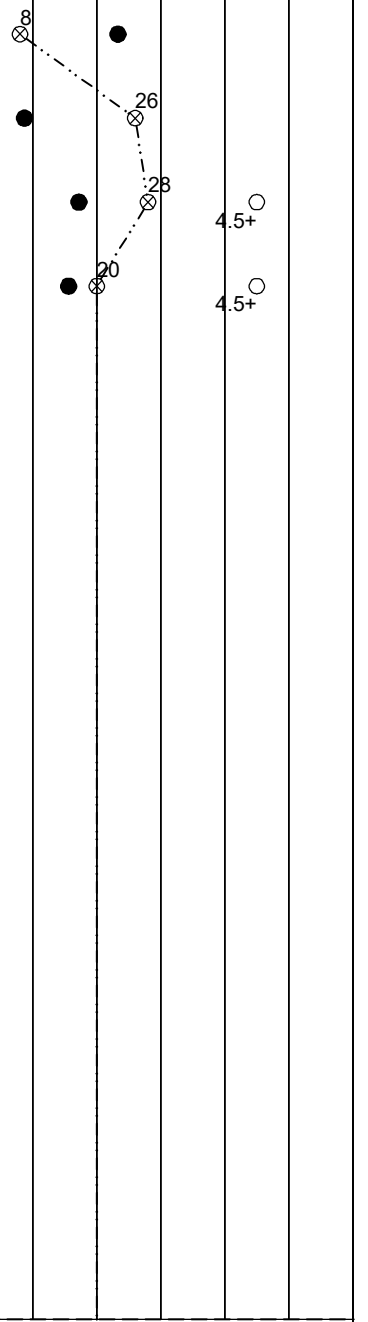
SURFACE ELEVATION (CCD) 25.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 3 inches bituminous concrete; 9 inches gravel base course	
	1	SS			*(1.0)*Fill: Silty fine to coarse sand, trace fine to coarse gravel - black - loose - moist	
5 / 20	2	SS			*(3.5)*Fill: Sandy fine to coarse gravel, trace silt - brown - medium dense - moist	
	3	SS			*(6.0)*Silty clay, trace fine to coarse sand and gravel - brown - hard (CL)	
10 / 15	4	SS			*(8.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
					*(10.0)*No sampling	
15 / 10						
20 / 5						
25 / 0						
30 / -5						
35 / -10						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS 14.0' Before Casing Removal	BORING STARTED **3/4/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/4/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-20**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
45 / -20						
50						
55 / -30						
60						
65 / -40						
70						
75 / -50	5	SS			*(73.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
	6	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

20

24

3.5

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS 14.0' Before Casing Removal	BORING STARTED **3/4/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/4/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

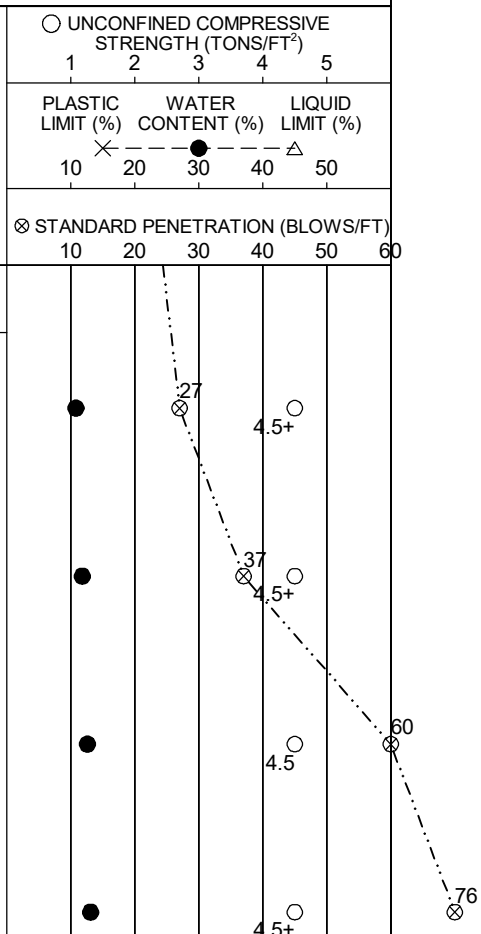
LOG OF BORING NUMBER **B-20**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(82.0)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)	
85 / -60	7	SS				
90	8	SS				
95 / -70	9	SS				
100	10	SS				
					End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105 / -80						
110						
115 / -90						



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS 14.0' Before Casing Removal	BORING STARTED **3/4/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/4/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-20A**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3	○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5 / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50 / ⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60
				*(0.0)*Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 23.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Borehole grouted upon completion.		
5 / *20*						
	1	PMT		**Pressuremeter Test performed at 9.0 to 11.5 ft** **P_f = 3.5 tsf -- E_d = 44.0 tsf**		
10						
	2	PMT		**Pressuremeter Test performed at 14.5 to 17.0 ft** **P_f = 3.2 tsf -- E_d = 90.0 tsf**		
15 / *10*						
20						
	3	PMT		**Pressuremeter Test performed at 24.0 to 26.5 ft** **P_f = 2.8 tsf -- E_d = 49.0 tsf**		
25 / *0*						
30						
35 / *-10*						

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL:	BORING STARTED **3/17/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/17/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **1**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-21**
Offset 24' Northeast

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

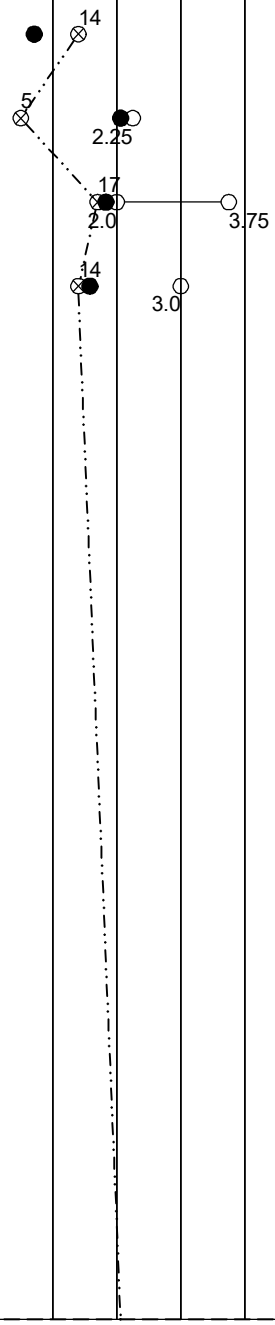
SURFACE ELEVATION (CCD) 25.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 6 inches bituminous concrete; 6 inches gravel base course	
	1	SS			*(1.0)*Fill: Sandy silty gravel - gray and black - medium dense - moist	
5 / 20	2	SS			*(3.5)*Silty clay, trace fine to coarse sand and gravel - brown - very stiff to hard (CL)	
	3	SS				
10	4	SS			*(8.5)*Silty clay, trace fine to coarse sand and gravel - gray - very stiff (CL)	
					*(10.0)*No sampling	
15 / 10						
20						
25 / 0						
30						
35 / 10						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 15.0' Before Casing Removal
8.0' After Casing Removal

BORING STARTED **3/2/2022**
BORING COMPLETED **3/3/2022**
GEI OFFICE **Chicago**
ENTERED BY **LJE**
APPROVED BY **RCR**
NORTHING
EASTING
RIG/FOREMAN **CME-75 / Mark B (Strata)**
GEI PROJECT NO. **2200549**
PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-21**
Offset 24' Northeast

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
45 / 20						
50						
55 / 30						
60						
65 / 40						
70						
75 / 50	5	SS			*(73.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
	6	SS			*(76.0)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL) **Pressuremeter Test performed at 76.5 to 79.0 ft** **P_f = 14.0 tsf -- E_d = 150.0 tsf**	
	7	SS				

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60

28
59
4.5+
53

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 15.0' Before Casing Removal
8.0' After Casing Removal

BORING STARTED **3/2/2022**
BORING COMPLETED **3/3/2022**
GEI OFFICE **Chicago**
ENTERED BY **LJE**
APPROVED BY **RCR**
NORTHING
EASTING
RIG/FOREMAN **CME-75 / Mark B (Strata)**
GEI PROJECT NO. **2200549**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-21**
Offset 24' Northeast

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

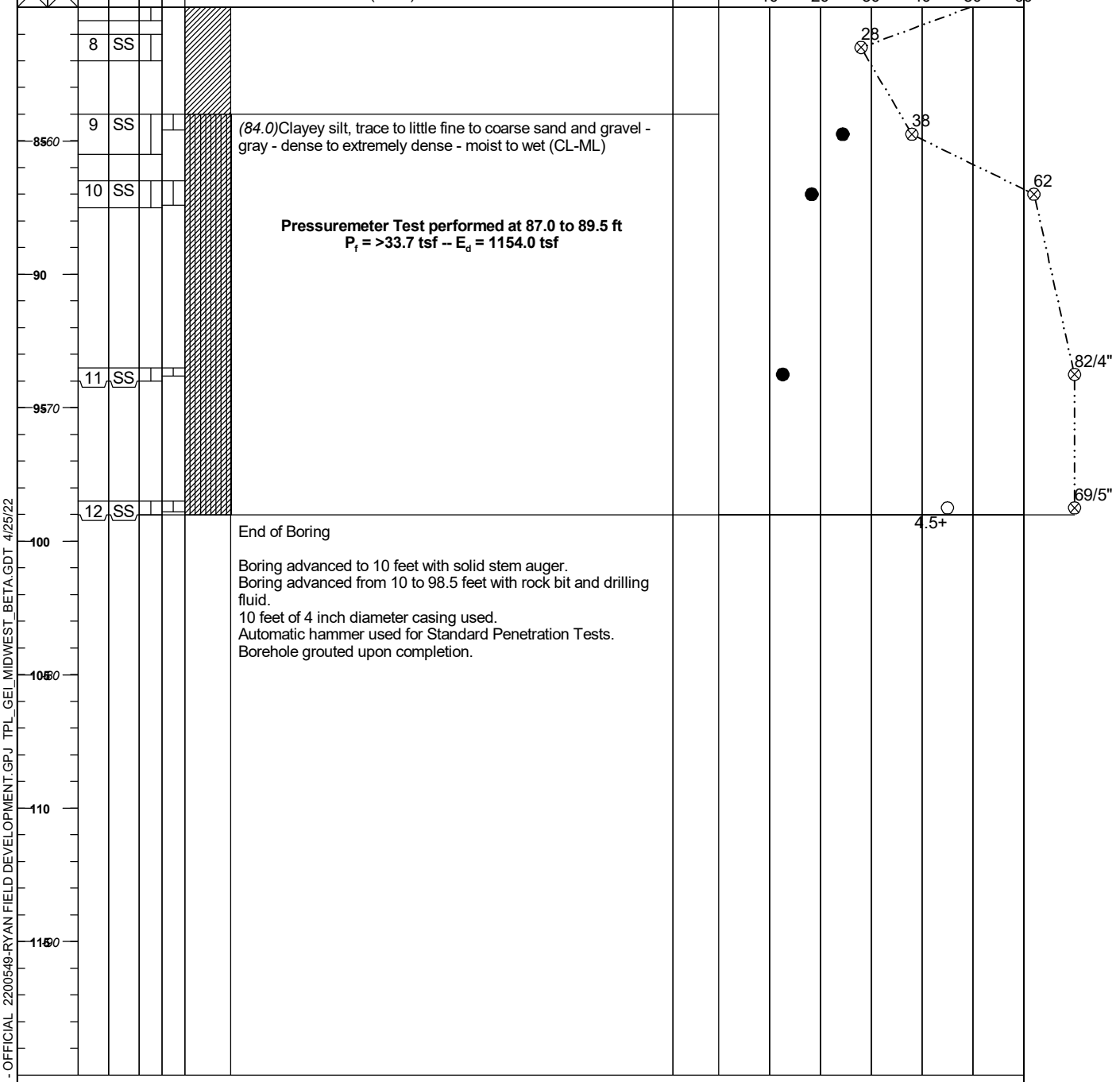
SURFACE ELEVATION (CCD) 25.0

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE / RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
	8	SS			
85.60	9	SS		*(84.0)*Clayey silt, trace to little fine to coarse sand and gravel - gray - dense to extremely dense - moist to wet (CL-ML)	
	10	SS		**Pressuremeter Test performed at 87.0 to 89.5 ft** **P_f = >33.7 tsf -- E_d = 1154.0 tsf**	
90					
95.70	11	SS			
	12	SS			
100				End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105.80					
110					
115.90					

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 15.0' Before Casing Removal 8.0' After Casing Removal	BORING STARTED **3/2/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/3/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-75 / Mark B (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

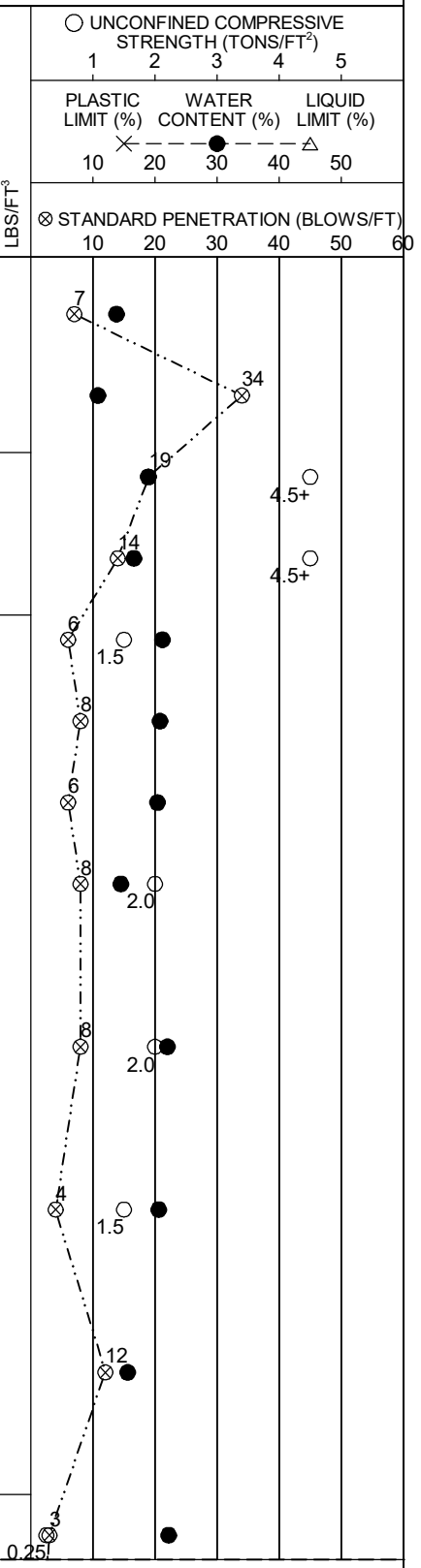
LOG OF BORING NUMBER **B-22**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 26.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
					*(0.0)*Fill: 3-1/2 inches bituminous concrete	
	1	SS			*(0.3)*Fill: Silty sand, trace clay - black - loose - moist	
	2	SS			*(3.5)*Gravelly sand with silt - brown - dense - moist (SP-SM)	
5 / 20	3	SS			*(6.0)*Silty clay, trace fine to coarse sand and gravel - brown - very stiff to hard (CL)	
	4	SS				
10	5	SS			*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - medium to very stiff (CL)	
	6	SS				
15 / 10	7	SS				
	8	SS				
20						
	9	SS				
25 / 0						
	10	SS				
30						
	11	SS			Sample 11: Moist to wet clayey silt	
35 / -10						
	12	SS			*(38.0)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/13/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

LOG OF BORING NUMBER **B-22**

PROJECT NAME: **Ryan Field Development**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 26.5

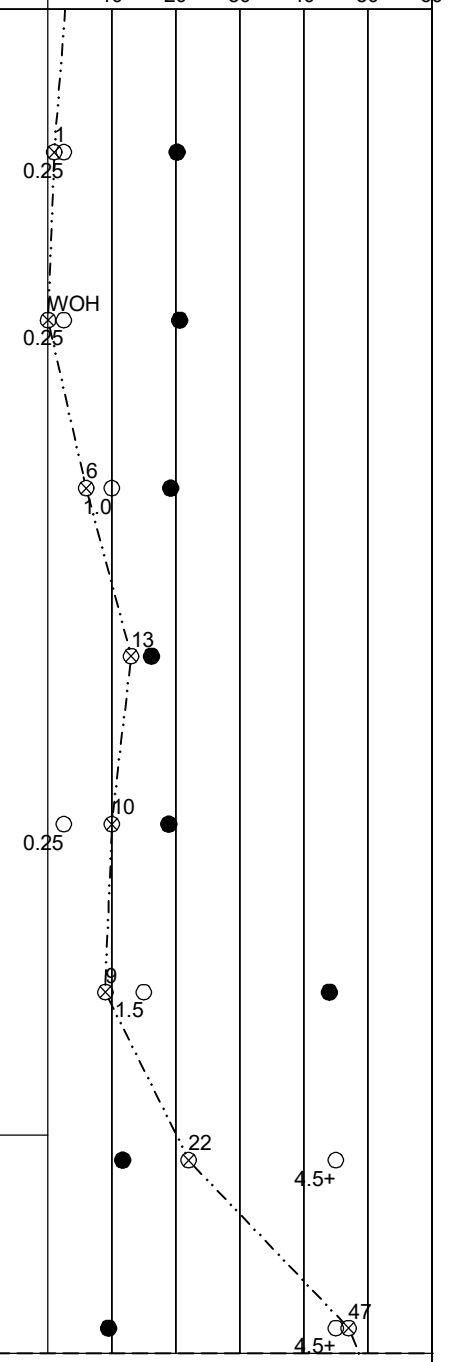
DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL
45 / -20	13	SS		
50 / -25	14	SS		
55 / -30	15	SS		
60 / -35	16	SS		*(58.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)
65 / -40	17	SS		
70 / -45	18	SS		
75 / -50	19	SS		*(73.5)*Silty clay, trace fine to coarse sand and gravel - gray - hard (CL)
	20	SS		

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/13/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-22**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 26.5

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
85 / -60	21	SS				
90	22	SS				
95 / -70	23	SS			*(93.5)*Silty fine to medium sand - gray - very dense - wet (SM)	
100 / -80	24	SS			*(98.5)*Limestone gravel fragments End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
105 / -80						
110						
115 / -90						

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2)
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT)
10 20 30 40 50 60

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS	BORING STARTED **3/7/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/13/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-23**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

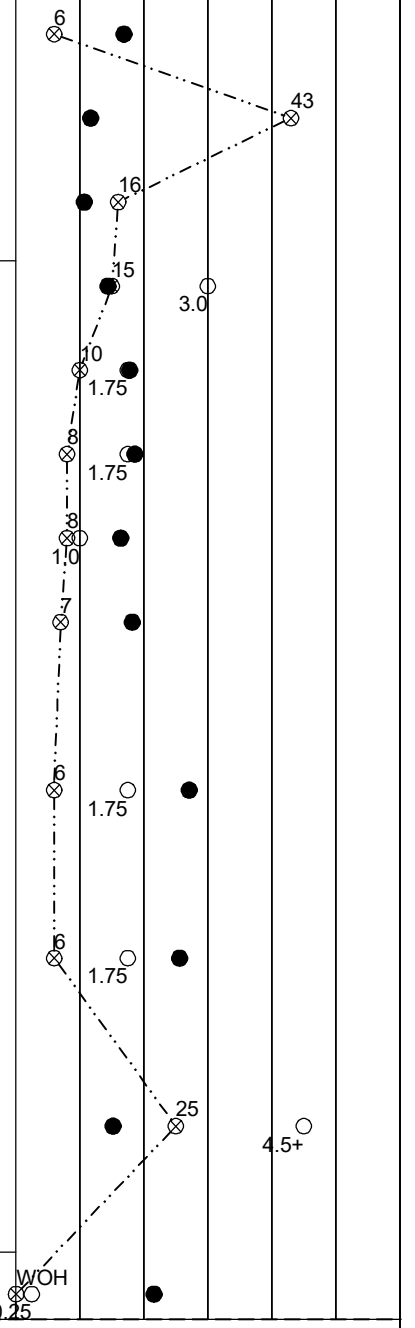
SURFACE ELEVATION (CCD) 25.2

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
					*(0.0)*Fill: 4 inches bituminous concrete	
	1	SS			*(0.3)*Fill: Silty sand, trace clay - brown and black - loose - moist	
5 / 20	2	SS			*(3.5)*Gravelly sand with silt - brown and gray - dense to medium dense - moist to wet (SP-SM)	
	3	SS				
	4	SS			*(8.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)	
10	5	SS				
	6	SS				
15 / 10	7	SS				
	8	SS				
20						
	9	SS				
25 / 0						
	10	SS				
30						
	11	SS				
35 / 10						
	12	SS			*(38.0)*Silty clay, trace fine to coarse sand and gravel - gray - soft to medium (CL)	

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 3.5' WS	BORING STARTED **3/1/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/2/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-23**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.2

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
45 20	13	SS			
50	14	SS			
55 30	15	SS			
60	16	SS			*(58.5)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)
65 40	17	SS			
70	18	SS			
75 50	19	SS			
	20	SS			78.0 - 78.5: Gravel zone noted *(78.5)*Silty clay, trace fine to coarse sand and gravel - gray -

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

WOH 0.25
WOH 0.25
4 0.25
15 2.5
12 2.25
12 2.25
22 3.5
41

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 3.5' WS

BORING STARTED **3/1/2022**

BORING COMPLETED **3/2/2022**

GEI OFFICE **Chicago**

ENTERED BY **LJE**

APPROVED BY **RCR**

NORTHING EASTING

RIG/FOREMAN **B-57 / Dan (Strata)**

GEI PROJECT NO. **2200549**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

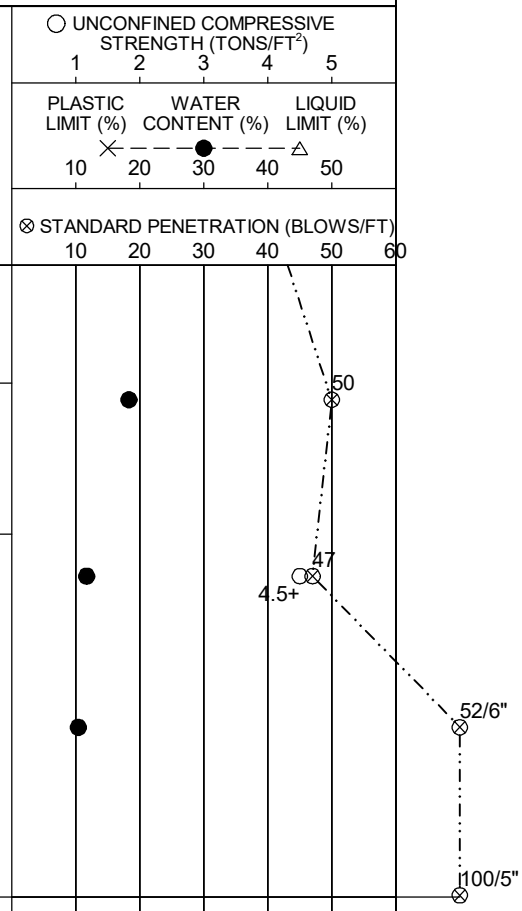
LOG OF BORING NUMBER **B-23**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD) 25.2

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
				hard (CL)	
85 / 60	21	SS		*(83.5)*Silt, trace clay and fine sand - gray - extremely dense - wet (ML)	
90	22	SS		*(88.0)*Silty sandy clay, trace to little gravel - gray - hard (CL)	
95 / 70	23	SS			
	24	SS		End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 98.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
100					
105 / 80					
110					
115 / 90					



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 3.5' WS	BORING STARTED **3/1/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/2/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **B-57 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

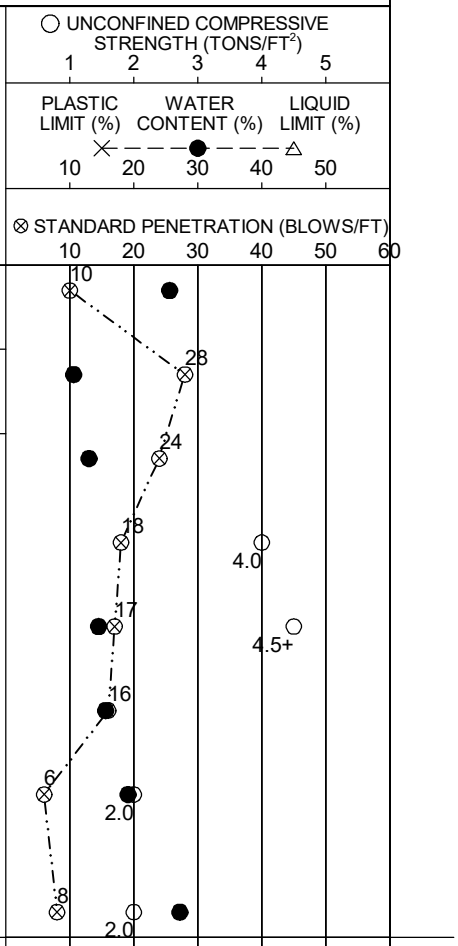
LOG OF BORING NUMBER **B-24**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD)

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT^3
	1	SS			*(0.0)*Fill: Sandy topsoil - black - moist	
	2	SS			*(2.5)*Fill: Sandy gravel with silt - brown - medium dense - moist	
5	3	SS			*(5.0)*Silty clay, trace fine to coarse sand and gravel - brown - hard to very stiff (CL)	
	4	SS				
10	5	SS				
	6	SS				
15	7	SS				
	8	SS				
20					End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 18.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.	
25						
30						
35						



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' WS	BORING STARTED **3/8/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/8/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **CME-45 / Dan (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **1**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

GEI Consultants

CLIENT: **Northwestern University**

PROJECT NAME: **Ryan Field Development**

LOG OF BORING NUMBER **B-25**

ENGINEER

LOCATION: 1501 Central Ave., Evanston, IL

SURFACE ELEVATION (CCD)

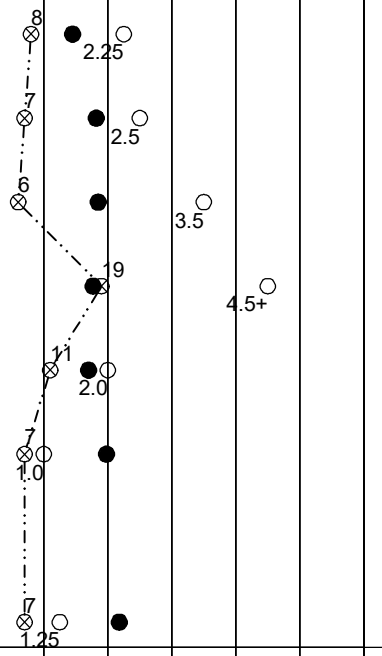
DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
0	1	SS			*(0.0)*Fill: Clayey sand - dark brown and black - loose - moist
	2	SS			
5	3	SS			*(6.0)*Silty clay, trace fine to coarse sand and gravel - brown - hard to very stiff (CL)
	4	SS			
10	5	SS			*(11.0)*Silty clay, trace fine to coarse sand and gravel - gray - stiff to very stiff (CL)
	6	SS			
15	7	SS			
20					End of Boring Boring advanced to 10 feet with solid stem auger. Boring advanced from 10 to 18.5 feet with rock bit and drilling fluid. 10 feet of 4 inch diameter casing used. Automatic hammer used for Standard Penetration Tests. Borehole grouted upon completion.
25					
30					
35					

UNIT DRY WT. LBS/FT^3

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

PLASTIC LIMIT (%) × — WATER CONTENT (%) ● — LIQUID LIMIT (%) △ 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FT) 10 20 30 40 50 60

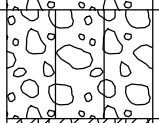
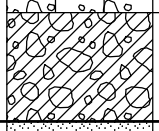
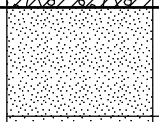
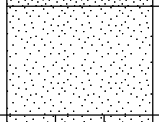
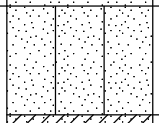
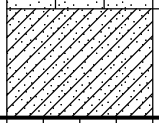
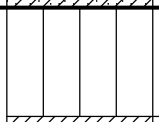
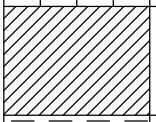
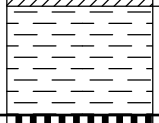
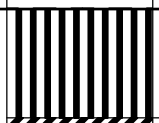
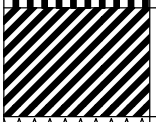
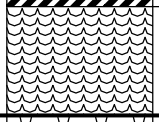
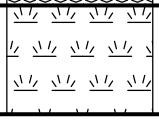


The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 6.0' WS 23.5' AB	BORING STARTED **3/14/2022**	GEI OFFICE **Chicago**	
	BORING COMPLETED **3/14/2022**	ENTERED BY **LJE**	APPROVED BY **RCR**
NORTHING EASTING	RIG/FOREMAN **GeoProbe / Bill M (Strata)**	GEI PROJECT NO. **2200549**	PAGE NO. **1** OF **1**

MIDWEST BORING LOG - OFFICIAL 2200549-RYAN FIELD DEVELOPMENT.GPJ TPL_GEI_MIDWEST_BETA.GDT 4/25/22

SOIL CLASSIFICATION CHART

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

COARSE-GRAINED SOILS

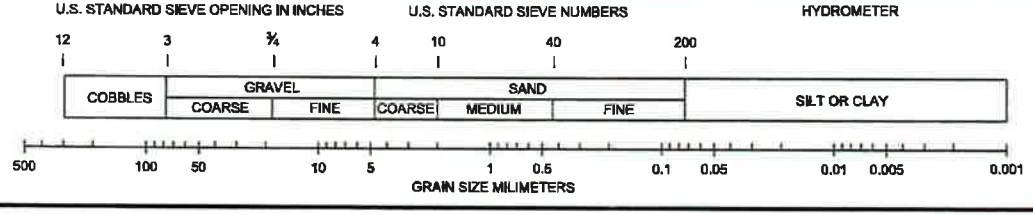
VISUAL-MANUAL DESCRIPTIONS

GEI Consultants

TYPICAL SOIL COLORS

- YELLOW
- OLIVE
- LIGHT BROWN
- BROWN
- REDDISH BROWN
- RED
- GRAY
- BLACK

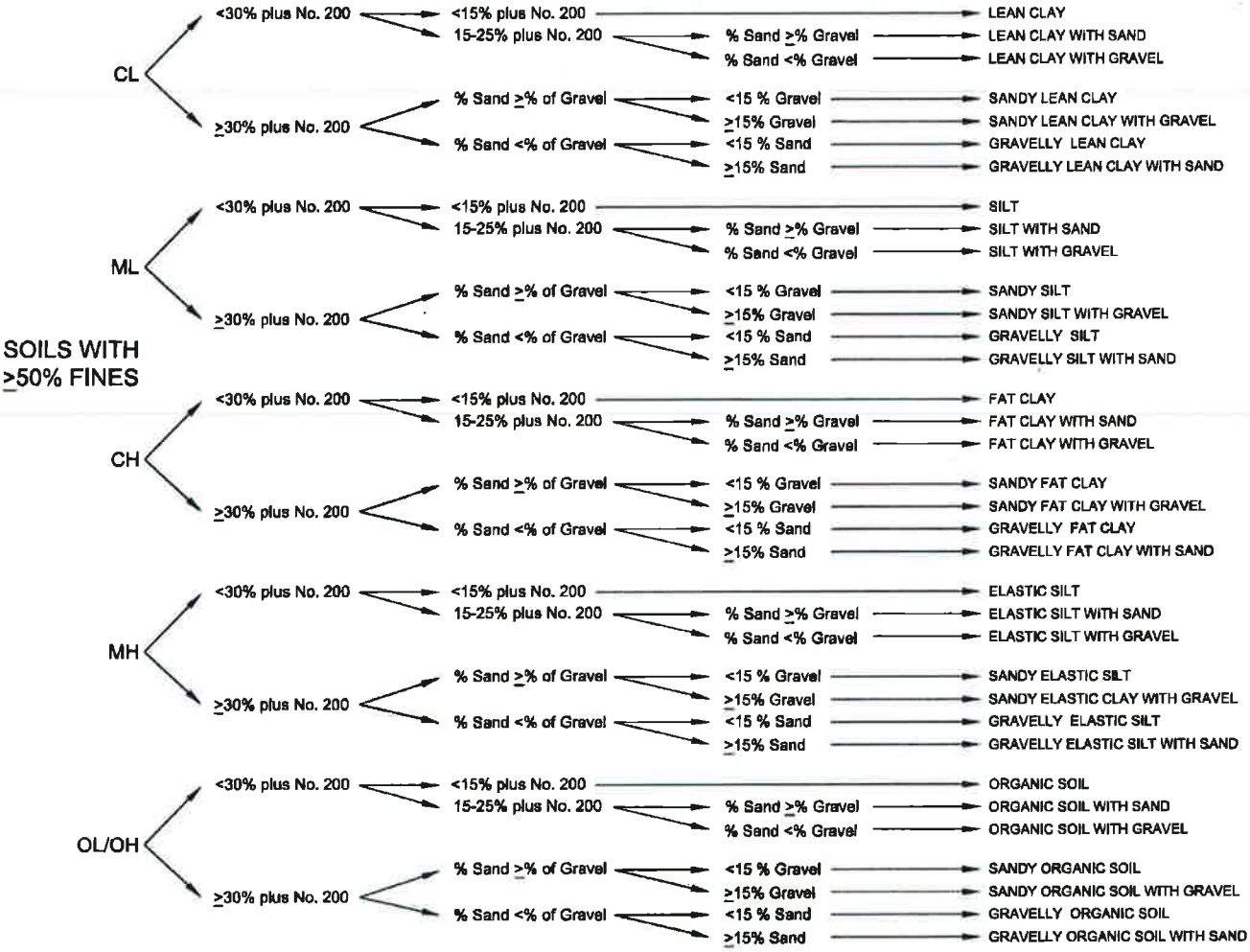
				GROUP SYMBOL	GROUP NAME
GRAVEL % Gravel > % Sand	≤5% Fines	WIDELY GRADED		GW	<15% Sand → WIDELY GRADED GRAVEL ≥15% Sand → WIDELY GRADED GRAVEL WITH SAND
		NARROWLY GRADED		GP	<15% Sand → NARROWLY GRADED GRAVEL ≥15% Sand → NARROWLY GRADED GRAVEL WITH SAND
	~10% Fines	WIDELY GRADED	Fines = ML or MH	GW-GM	<15% Sand → WIDELY GRADED GRAVEL WITH SILT ≥15% Sand → WIDELY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GW-GC	<15% Sand → WIDELY GRADED GRAVEL WITH CLAY ≥15% Sand → WIDELY GRADED GRAVEL WITH CLAY AND SAND
		NARROWLY GRADED	Fines = ML or MH	GP-GM	<15% Sand → NARROWLY GRADED GRAVEL WITH SILT ≥15% Sand → NARROWLY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GP-GC	<15% Sand → NARROWLY GRADED GRAVEL WITH CLAY ≥15% Sand → NARROWLY GRADED GRAVEL WITH CLAY AND SAND
	≥15% Fines		Fines = ML or MH	GM	<15% Sand → SILTY GRAVEL ≥15% Sand → SILTY GRAVEL WITH SAND
			Fines = CL or CH	GC	<15% Sand → CLAYEY GRAVEL ≥15% Sand → CLAYEY GRAVEL WITH SAND
SOILS WITH <50% FINES					
SAND % Sand ≥ % Gravel	≤5% Fines	WIDELY GRADED		SW	<15% Gravel → WIDELY GRADED SAND ≥15% Gravel → WIDELY GRADED SAND WITH GRAVEL
		NARROWLY GRADED		SP	<15% Gravel → NARROWLY GRADED SAND ≥15% Gravel → NARROWLY GRADED SAND WITH GRAVEL
	~10% Fines	WIDELY GRADED	Fines = ML or MH	SW-SM	<15% Gravel → WIDELY GRADED SAND WITH SILT ≥15% Gravel → WIDELY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SW-SC	<15% Gravel → WIDELY GRADED SAND WITH CLAY ≥15% Gravel → WIDELY GRADED SAND WITH CLAY AND GRAVEL
		NARROWLY GRADED	Fines = ML or MH	SP-SM	<15% Gravel → NARROWLY GRADED SAND WITH SILT ≥15% Gravel → NARROWLY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SP-SC	<15% Gravel → NARROWLY GRADED SAND WITH CLAY ≥15% Gravel → NARROWLY GRADED SAND WITH CLAY AND GRAVEL
	≥15% Fines		Fines = ML or MH	SM	<15% Gravel → SILTY SAND ≥15% Gravel → SILTY SAND WITH GRAVEL
			Fines = CL or CH	SC	<15% Gravel → CLAYEY SAND ≥15% Gravel → CLAYEY SAND WITH GRAVEL



1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
6. "Fill," local name or geologic name, if known

GEI Consultants

FINE-GRAINED SOILS
VISUAL-MANUAL DESCRIPTIONS



ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
5. "Fill," local name or geologic name, if known

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include percentages of sand, gravel or fines.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

GENERAL NOTES

Drilling and Sampling Symbols:

SS: Split-Spoon, 1 3/8-inch ID, 2-inch OD Unless otherwise noted
ST: Shelby Tube
PA: Power Auger
DB: Diamond Bit
AS: Auger Sample
JS: Jar Sample
VS: Vane Shear
WOH: Weight of Hammer
OS: Osterburg Sampler
HSA: Hollow Stem Auger
WS: Wash Sample
FT: Fish Tail
RB: Rock Bit
BS: Bulk Sample
PMT: Pressuremeter Test
GS: Giddings Sampler

Standard Penetration Test (STP) Value: Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch OD split-spoon sampler, except where otherwise noted.

Water Level Measurement Symbols:

WL: Water Level
WS: While Sampling
WD: While Drilling
AB: After Boring
WCI: Wet Cave-in
DCI: Dry Cave-in
BCI: Before Casing Installation
BCR: Before Casing Removal
ACR: After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the time indicated. In permeable soils, the indicated elevations can be considered a reliable groundwater level. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations. In these cases, groundwater monitoring wells may need to be constructed and monitored for an extended period of time to determine the actual groundwater level.

Gradation Description and Terminology:

Coarse-grained or granular soils are defined as having more than 50% of their dry weight retained on the No. 200 sieve. Coarse grained soils include boulders, cobbles, gravel, and/or sand. Fine-grained soils are defined as having less than 50% of their dry weight retained on the No. 200 sieve. Fine grained soils include clay or clayey silt (cohesive), and silt (non-cohesive). In addition to gradation, granular soils are further defined based on their relative in-place density. Fine-grained soils are further defined based of their strength or consistency and plasticity. Additional information is provided below.

Major Component of Sample	Size Range	Other Components Present in Sample	Dry Weight, %
Boulders	Over 8 inches (200 mm)	Trace	1 to 5
Cobbles	8 inches to 3 inches (200 mm to 75 mm)	Trace to Some	5 to 12
Gravel	3 inches to No. 4 sieve	Some	12 to 34
Sand	Nos. 4 to 200 sieves (4.76 mm to 0.074 mm)	And	34 to 50
Silt	Passing No. 200 sieve (0.074 mm to 0.005 mm)		
Clay	Smaller than 0.005 mm		

Consistency of Cohesive Soils		Relative Density of Granular Soils	
Unconfined Compressive Strength, Qu, tsf	Consistency	N, blows per foot	Relative Density
<0.25	Very Soft	0 to 3	Very Loose
0.25 to 0.49	Soft	4 to 9	Loose
0.50 to 0.99	Medium (firm)	10 to 29	Medium Dense
1.0 to 1.99	Stiff	30 to 49	Dense
2.00 to 3.99	Very Stiff	50 – 80	Very Dense
4.00 to 8.00	Hard	>80	Extremely Dense
>8.00	Very Hard		

FIELD AND LABORATORY PROCEDURES

Field Sampling Procedures

Auger Sampling (AS)

In this procedure, soil samples are collected from cuttings off the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

Split-Barrel Sampling (SS) – (ASTM Standard D-1586-99)

In the split-barrel sampling procedures, a 2-inch O.D. split-barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. The value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is only qualitative, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, frilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is place in a sample jar and returned to the laboratory for further analysis and testing.

Shelby Tube Sampling Procedure (ST) - (ASTM D-1587-94)

In the Shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undisturbed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are identified, sealed, and carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

Giddings Sampler (GS)

This type of sampling device consists of 5-foot sections of thin-wall tubing, which are capable of retrieving continuous columns of soil in 5-foot maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-foot interval.

FIELD AND LABORATORY PROCEDURES

Subsurface Exploration Field Procedures

Hand-Auger Drilling (HA)

In this procedure, a sampling device is driven into the soil by repeated blows of a sledge hammer or a drop hammer. When the sampler is driven to the desired depth, the soil sample is retrieved. The hole is then advanced by manually turning the hand auger until the next sampling depth increment is reached. The hand auger drilling between sampling intervals also helps to clean and enlarge the borehole in preparation for obtaining the next sample.

Power Auger Drilling (PA)

In this type of drilling procedures, continuous flight augers are used to advance the boreholes. They are turned and hydraulically advanced by a truck, trainer, or track-mounted unit as site accessibility dictates. In auger drilling, casing and drilling mud are not required to maintain open boreholes.

Hollow-Stem Auger Drilling (HS)

In this drilling procedure, continuous flight augers (with open stems) are used to advance the boreholes. The open stem allows the sampling tool to be used without removing the augers from the borehole. Hollow-stem augers thus provide support to the sides of the borehole during the sampling operations.

Rotary Drilling (RD)

In employing rotary drilling methods, various cutting bits are used to advance the boreholes. In this process, surface casing and/or drilling fluids are used to maintain open boreholes.

Diamond Core Drilling (DB)

Diamond core drilling is used to sample cemented formations. In this procedure, a double tube (or triple tube) core barrel with a diamond bit cuts an annular space around a cylindrical prism of the material sampled. The sample is retrieved by a catcher just above the bit. Samples recovered by this procedure are placed in study containers in sequential order.

FIELD AND LABORATORY PROCEDURES

Laboratory Procedures

Water Content (Wc)

The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

Hand Penetrometer (Qp)

In the hand penetrometer gtest, the unconfined compressive strength of a soil is determined to a maximum value of 4.5 tons per square foot (tsf) or 7.0 tsf, depending on the testing device utilized, by measuring the resistance of the soil sample to penetration by a small spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests and thereby provides a useful and a relative simple testing procedure in which soil strength can be quickly and easily estimated.

Unconfined Compression Tests (Qu)

In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever comes first.

Dry Density (γd)

The dry density is a measure of the amount of solids in a unit volume of soil. Use of this value is often made when measuring the degree of compaction of a soil.

Classification of Samples

In conjunction with the sample testing program, all soil samples are examined in our laboratory and visually classified on the basis of their texture and plasticity in general accordance with the Unified Soil Classification System. The soil descriptions on the boring logs are derived from this system, as well as the component gradation terminology, consistency of cohesive soils, and relative density of granular soils, as described on a separate sheet entitled General Notes. The estimated groups symbols, included in parentheses following the soil descriptions on the boring logs, are in general conformance with the Unified Soil Classification System (USCS).

FIELD AND LABORATORY PROCEDURES

Standard Boring Log Procedures

In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets, and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations, and procedures.

Samples obtained in the field are frequently subjected to additional testing an re-classification in the laboratory by experienced Geotechnical Engineers; and therefore, differences between the field logs and the final logs may exist. The engineer preparing the report reviews the field logs, laboratory test data, and classifications and then, using judgement and experience in interpreting this data, may make further changes. It is common practice in the geotechnical engineering profession not to include field logs and laboratory data sheets in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for 60 days and then discarded, unless special disposition is requested by our client. Samples retained over a long period of time, even though in sealed jars, are subject to moisture loss, which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples need to recognize this factor.

GEI Consultants

Northwestern Ryan Field
Ryan Field (Evanston,IL)
Project Number :2200549

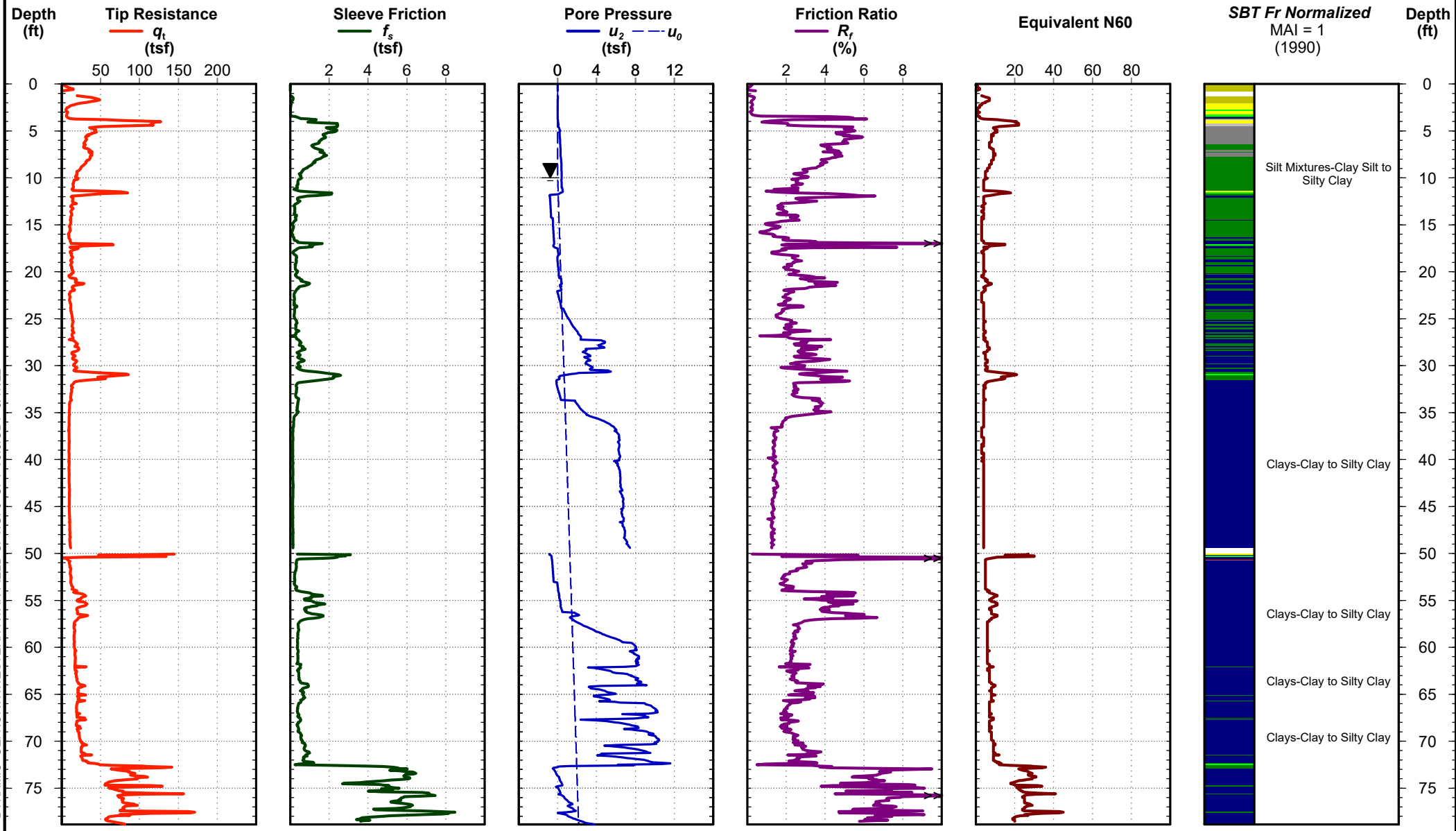
Cone Penetration Test

CPT-10

Date: Mar. 10, 2022
Estimated Water Depth: 10 ft
Rig/Operator: SBB

Latitude:
Longitude:
Elevation:

Total Depth: 78.9 ft
Termination Criteria:
Cone Size:



CPT REPORT - DYNAMIC GEI NORTHWESTERN RYAN FIELD CPT.GPJ CPT V3.0.GDT 3/17/22

CPT-10

Electronic File Name: CPT-10.cpt

GEI Consultants

Northwestern Ryan Field
Ryan Field (Evanston,IL)
Project Number :2200549

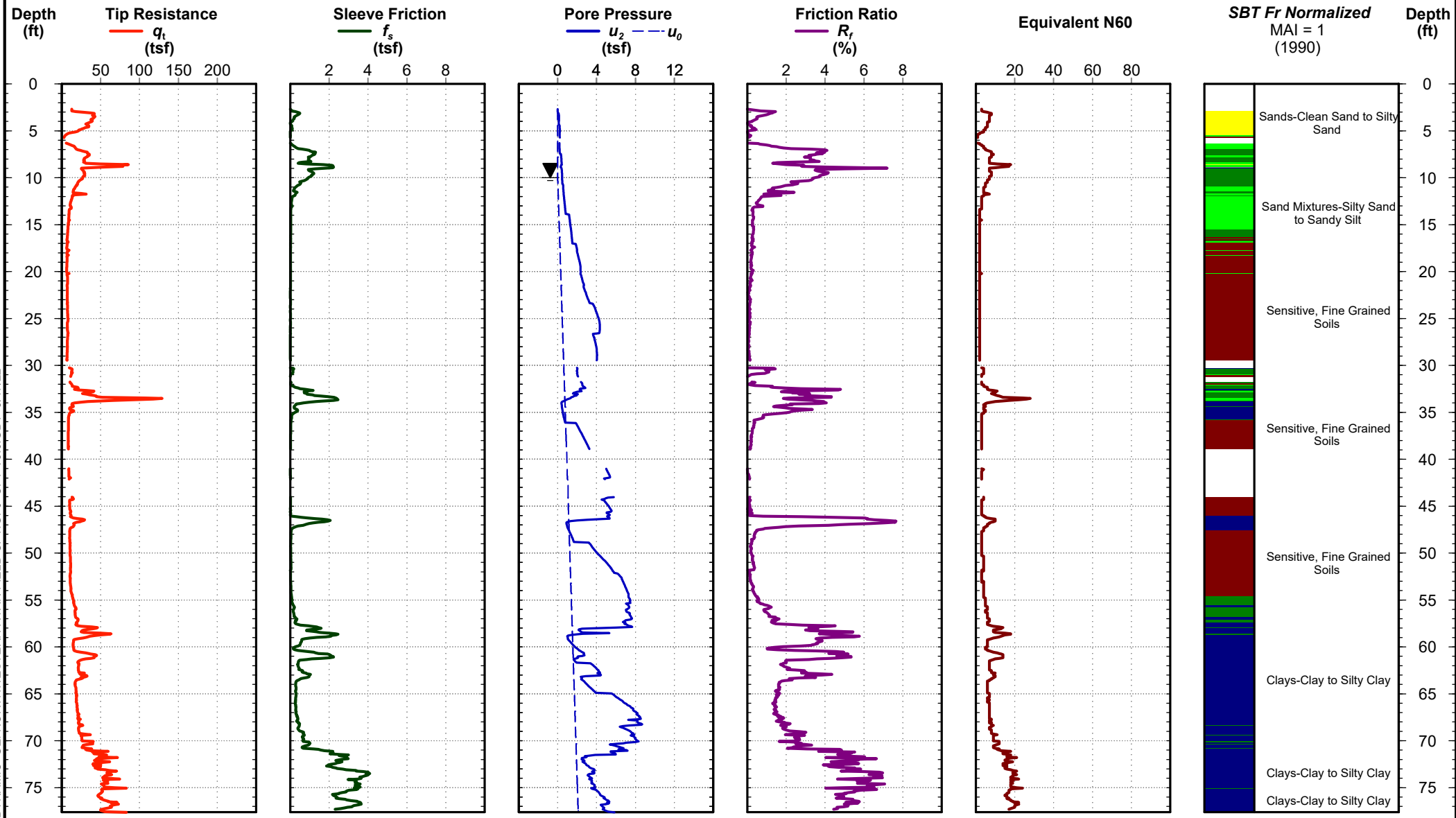
Cone Penetration Test

CPT-12

Date: Mar. 10, 2022
Estimated Water Depth: 10 ft
Rig/Operator: SBB

Latitude:
Longitude:
Elevation:

Total Depth: 77.6 ft
Termination Criteria:
Cone Size:



CPT REPORT - DYNAMIC GEI NORTHWESTERN RYAN FIELD CPT.GPJ CPT V3.0.GDT 3/17/22

CPT-12

Electronic File Name: CPT-12.cpt

GEI Consultants

Northwestern Ryan Field
Ryan Field (Evanston,IL)
Project Number :2200549

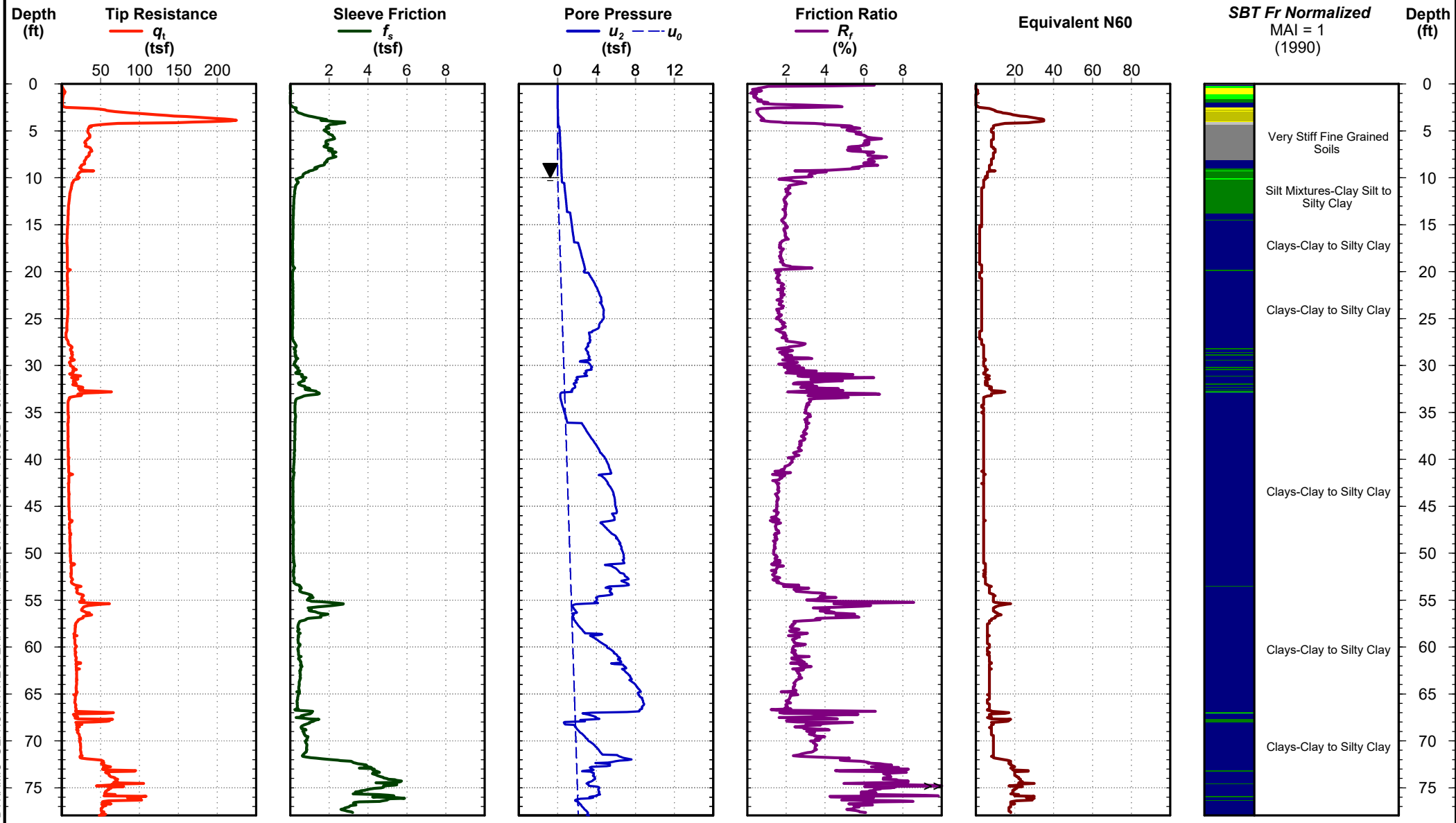
Cone Penetration Test

CPT-14

Date: Mar. 10, 2022
Estimated Water Depth: 10 ft
Rig/Operator: SBB

Latitude:
Longitude:
Elevation:

Total Depth: 78.0 ft
Termination Criteria:
Cone Size:



CPT REPORT - DYNAMIC GEI NORTHWESTERN RYAN FIELD CPT.GPJ CPT V3.0.GDT 3/17/22

Electronic File Name: CPT-14.cpt

CPT-14

GEI Consultants

Northwestern Ryan Field
Ryan Field (Evanston,IL)
Project Number :2200549

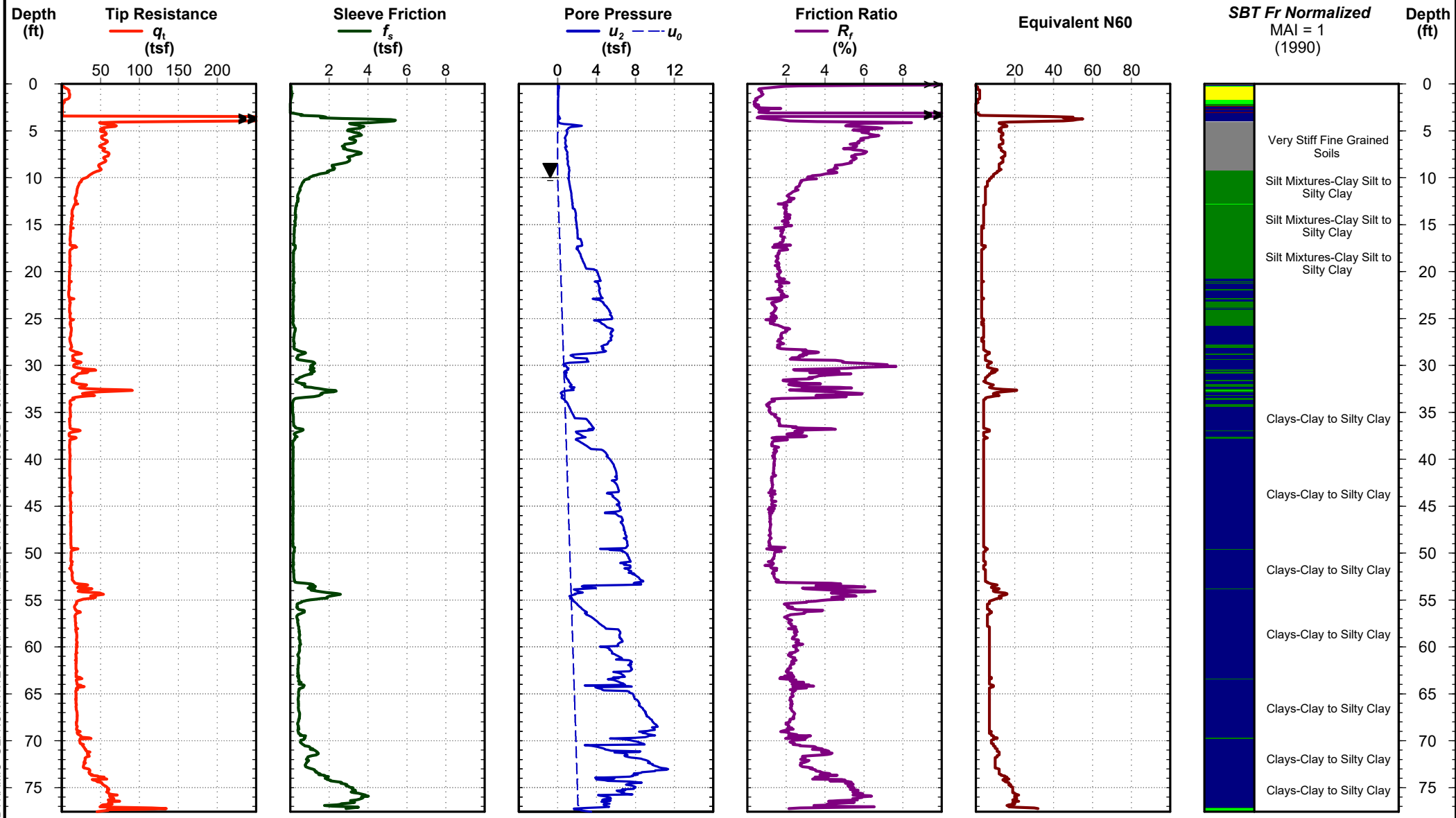
Cone Penetration Test

CPT-20

Date: Mar. 10, 2022
Estimated Water Depth: 10 ft
Rig/Operator: SBB

Latitude:
Longitude:
Elevation:

Total Depth: 77.6 ft
Termination Criteria:
Cone Size:



CPT REPORT - DYNAMIC GEI NORTHWESTERN RYAN FIELD CPT.GPJ CPT V3.0.GDT 3/17/22

CPT-20

Electronic File Name: CPT-20.cpt

GEI Consultants

Northwestern Ryan Field
Ryan Field (Evanston,IL)
Project Number :2200549

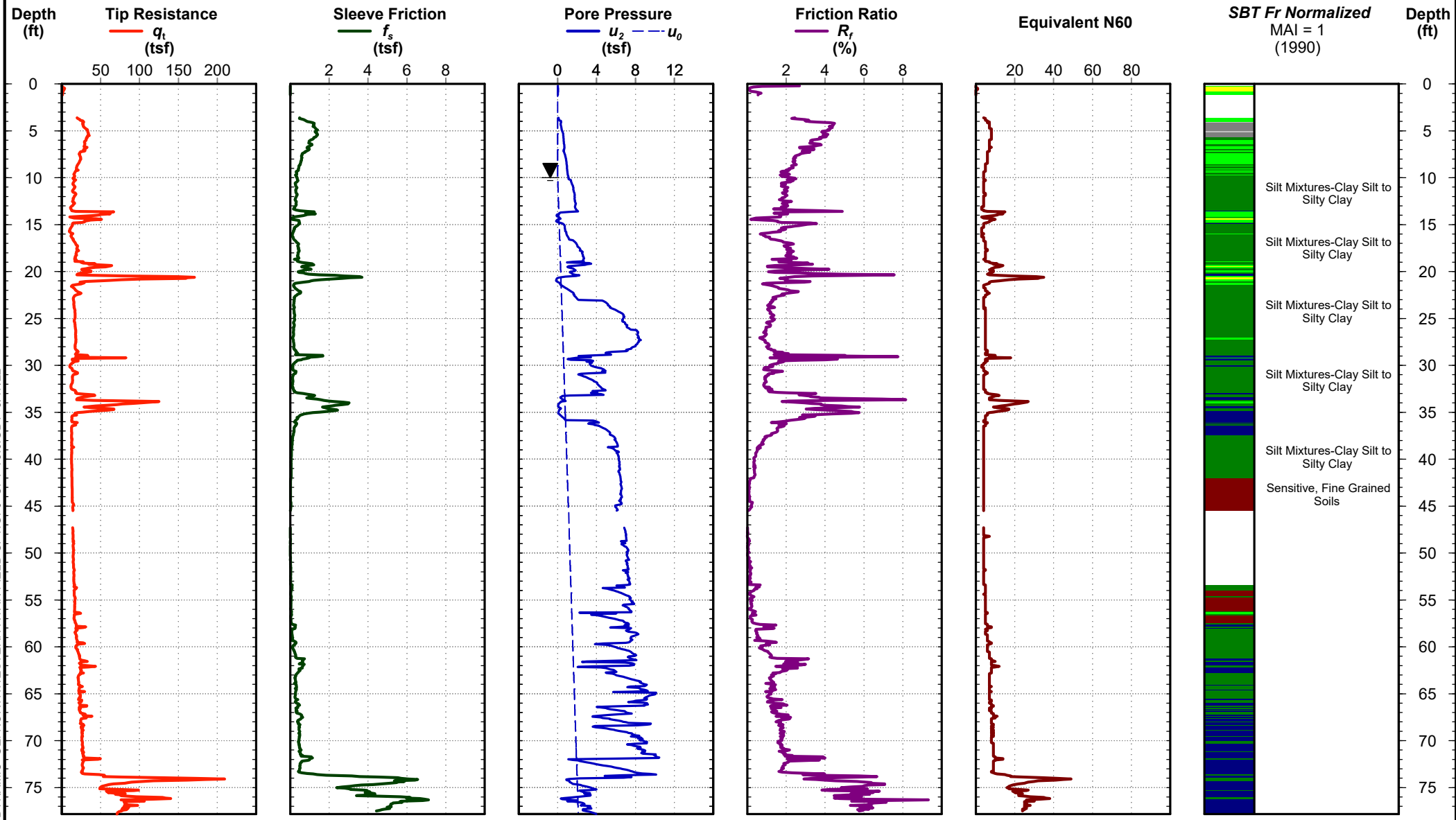
Cone Penetration Test

CPT-21

Date: Mar. 10, 2022
Estimated Water Depth: 10 ft
Rig/Operator: SBB

Latitude:
Longitude:
Elevation:

Total Depth: 77.8 ft
Termination Criteria:
Cone Size:



CPT REPORT - DYNAMIC GEI NORTHWESTERN RYAN FIELD CPT.GPJ CPT V3.0.GDT 3/17/22

CPT-21

Electronic File Name: CPT-21.cpt

GEI Consultants

Northwestern Ryan Field
Ryan Field (Evanston,IL)
Project Number :2200549

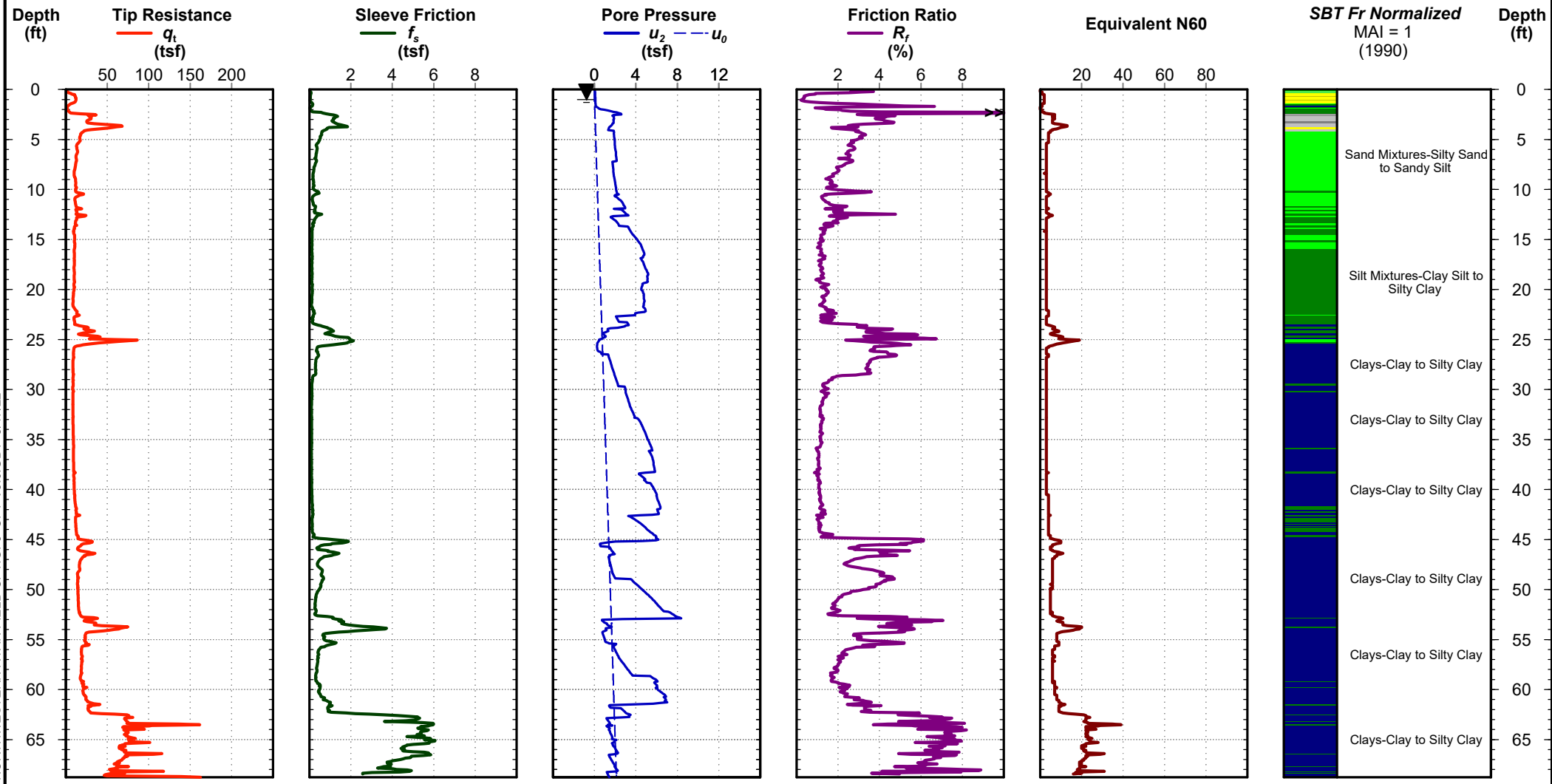
Cone Penetration Test

CPT-6

Date: Mar. 10, 2022
Estimated Water Depth: 1 ft
Rig/Operator: SBB

Latitude:
Longitude:
Elevation:

Total Depth: 68.8 ft
Termination Criteria:
Cone Size:



CPT REPORT - DYNAMIC GEI NORTHWESTERN RYAN FIELD CPT.GPJ CPT V3.0.GDT 3/17/22

Electronic File Name: CPT-6.cpt

CPT-6

GEI Consultants

Northwestern Ryan Field
Ryan Field (Evanston,IL)
Project Number :2200549

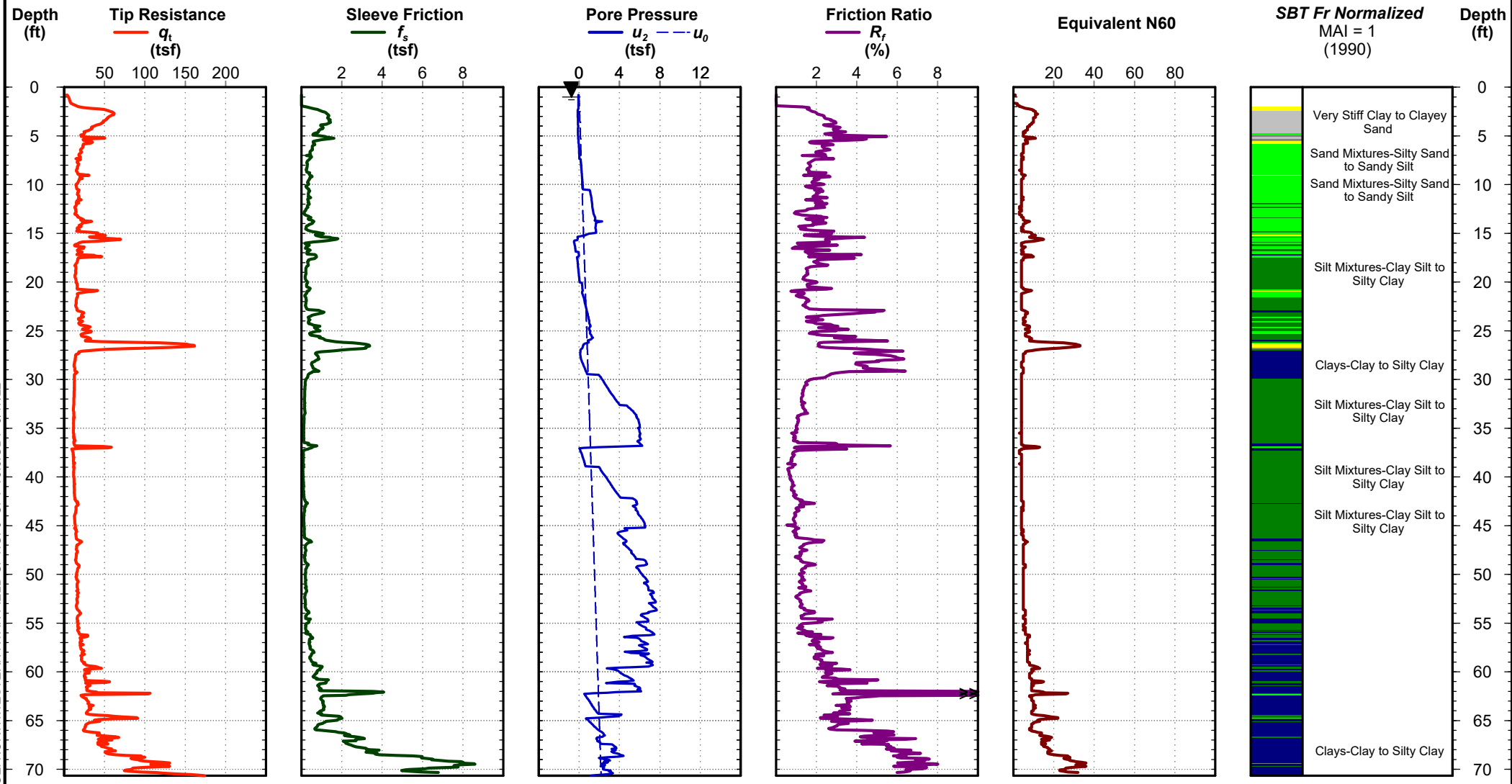
Cone Penetration Test

CPT-8

Date: Mar. 10, 2022
Estimated Water Depth: 1 ft
Rig/Operator: SBB

Latitude:
Longitude:
Elevation:

Total Depth: 70.7 ft
Termination Criteria:
Cone Size:

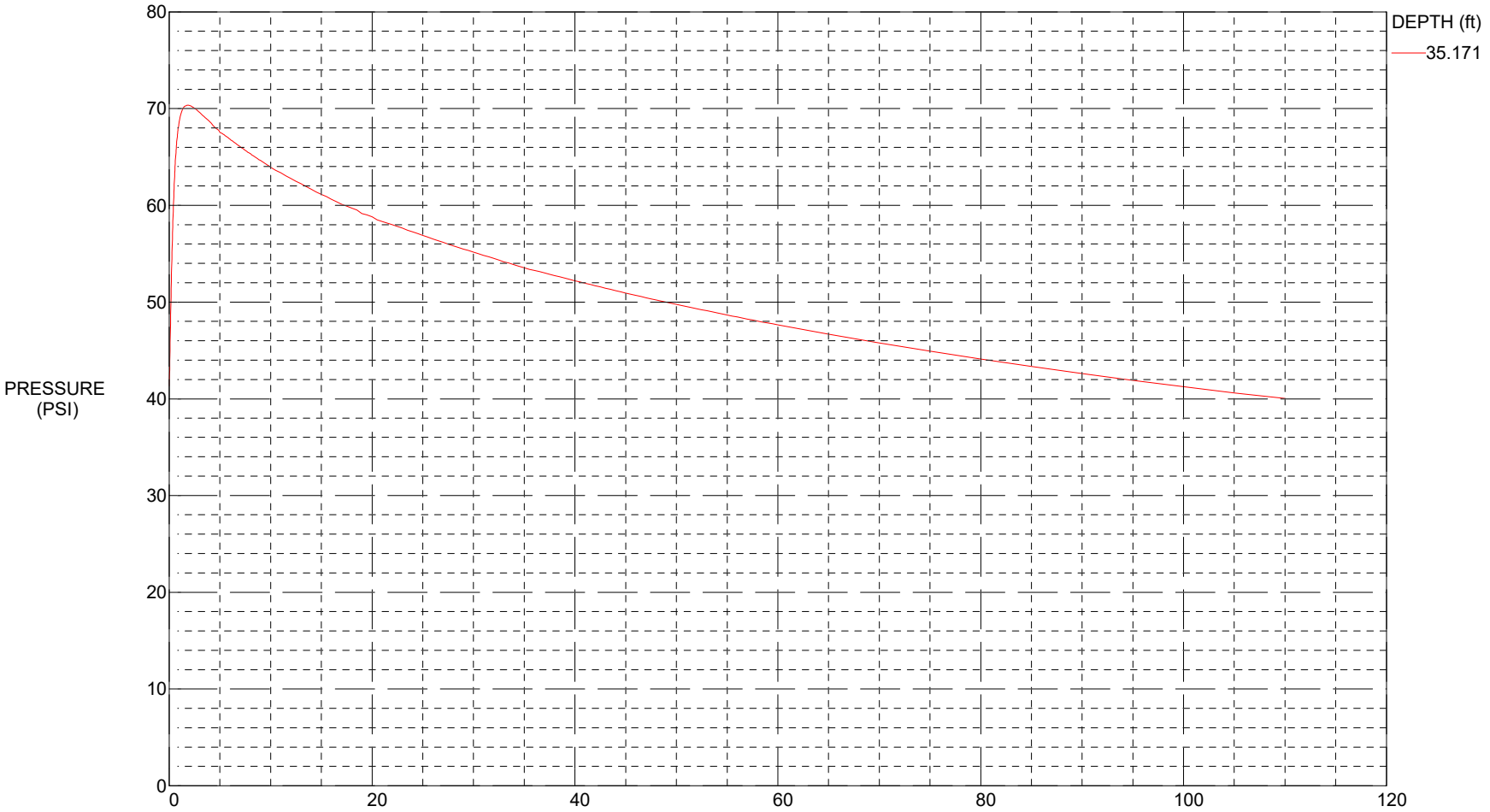


CPT REPORT - DYNAMIC GEI NORTHWESTERN RYAN FIELD CPT.GPJ CPT V3.0.GDT 3/17/22

Electronic File Name: CPT-8.cpt

CPT-8

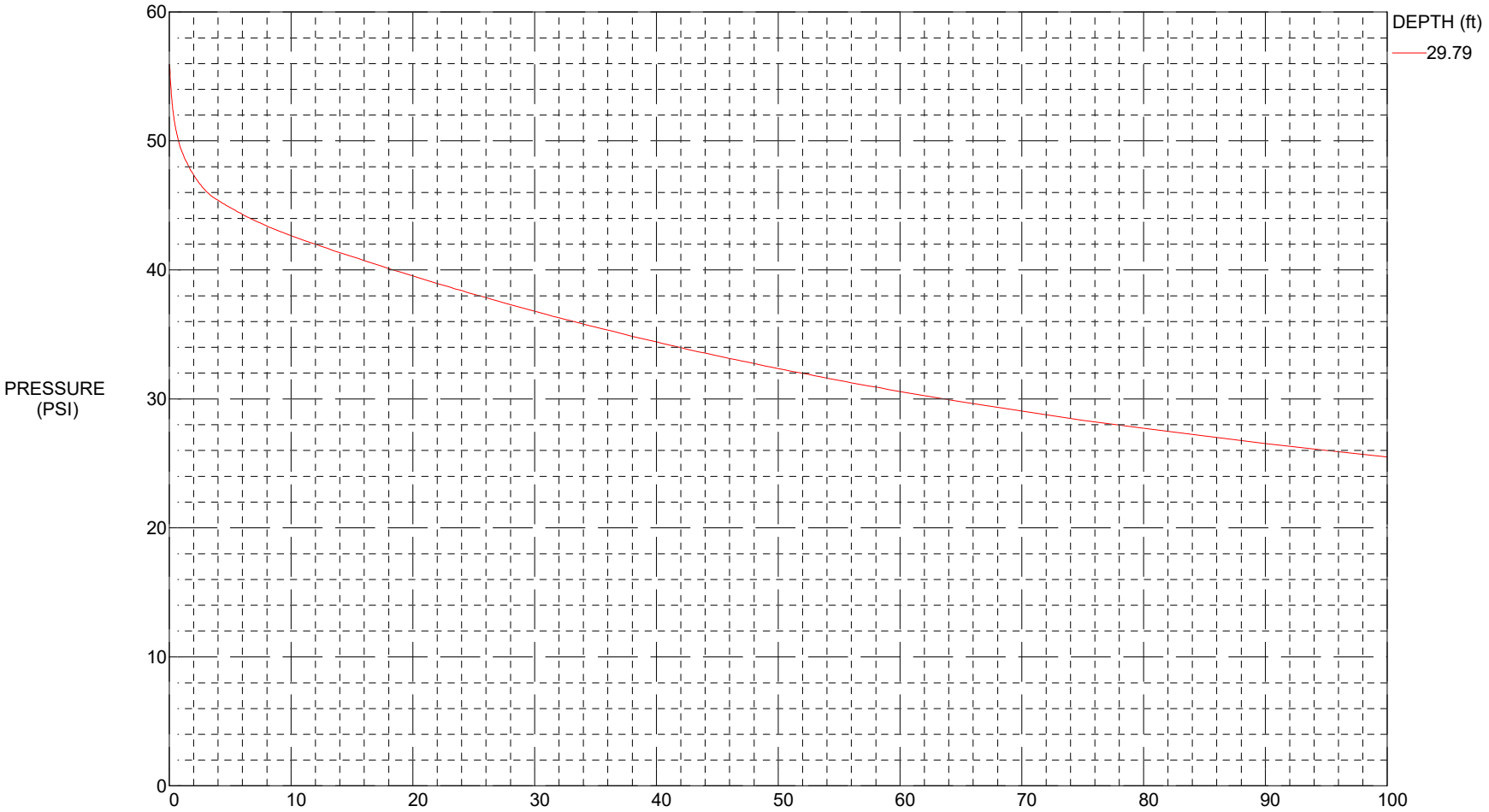
DISSIPATION
CUSTOMER: Customer
OPERATOR: SBB
CONE ID: DDG1168
LOCATION: Ryan Field
HOLE NUMBER: CPT-10
PREPARED BY: GEI Consultants



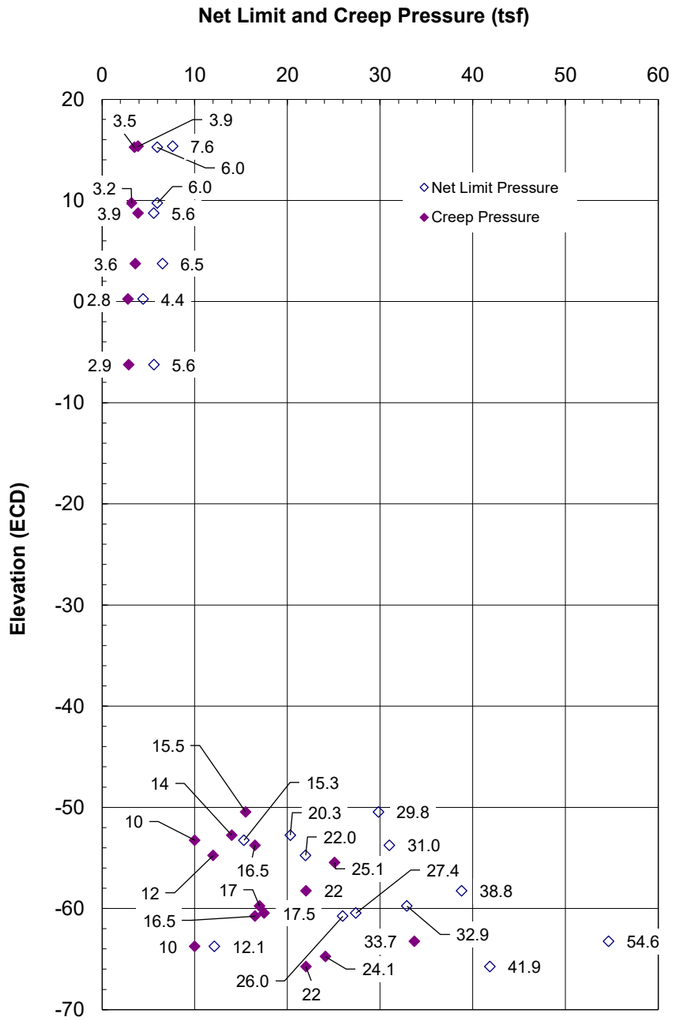
MAXIMUM PRESSURE = 70.351 (PSI)
HYDROSTATIC PRESSURE = 10.909 (PSI), WATER TABLE: 10.00 ft

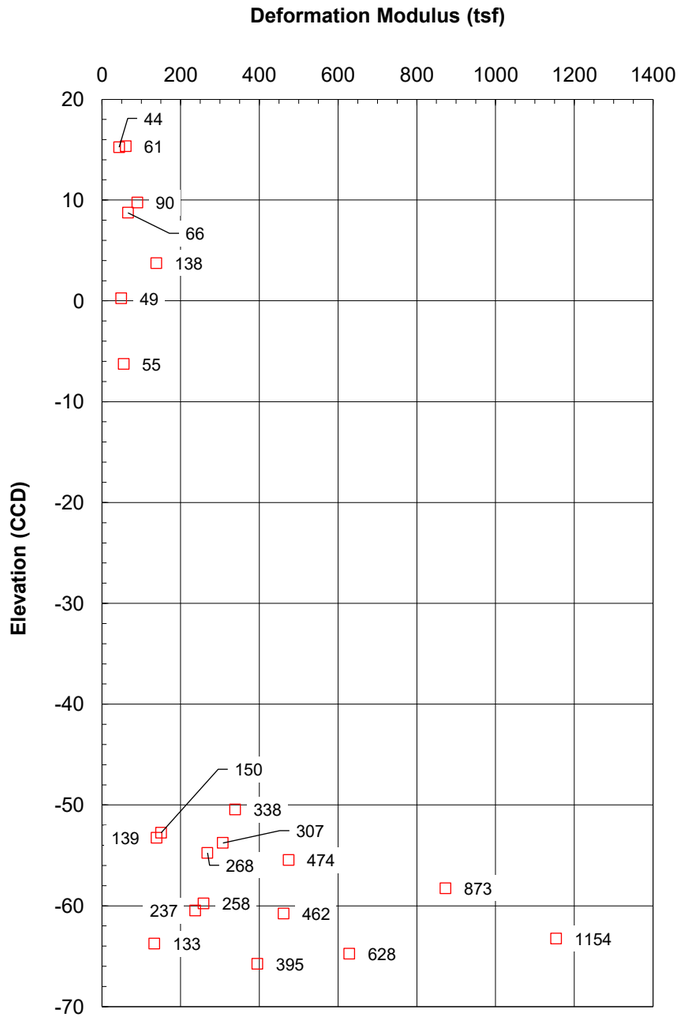
GEI Consultants

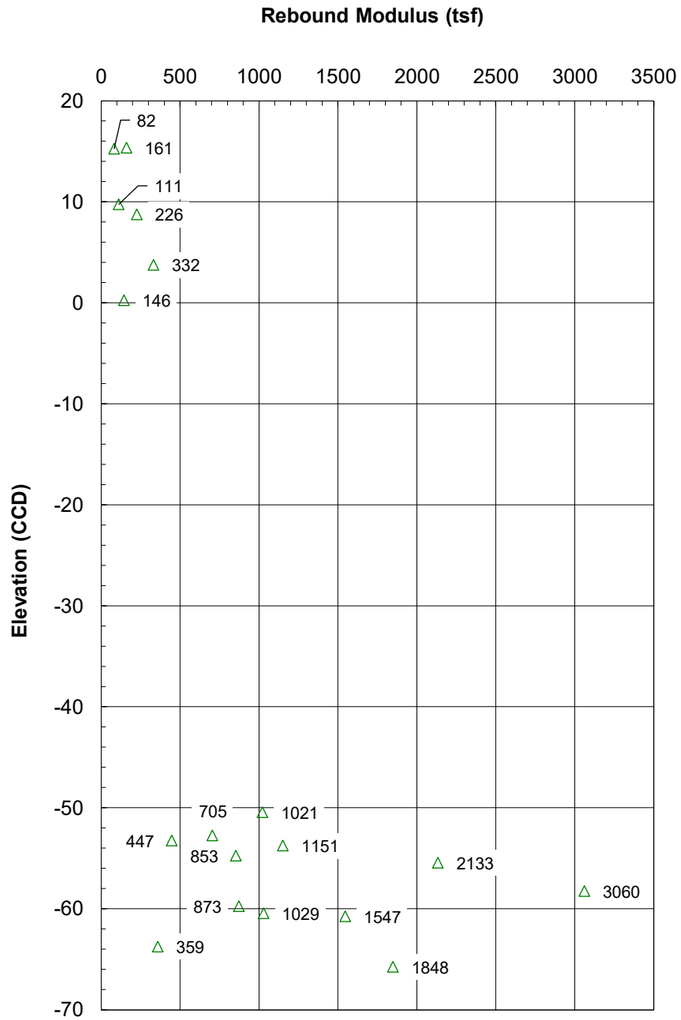
DISSIPATION
CUSTOMER: Customer
OPERATOR: SBB
CONE ID: DSG1096
LOCATION: Ryan Field
HOLE NUMBER: CPT-12
PREPARED BY: GEI Consultants



MAXIMUM PRESSURE = 55.92 (PSI)
HYDROSTATIC PRESSURE = 8.577 (PSI), WATER TABLE: 10.00 ft







GRAPHICAL PRESSUREMETER RESULTS

(PMT data from 2022 GEI Borings B-6, B-8, B-10, B-12, B-18, B-20A and B-21)

DRAWN BY AF	DATE 4/25/22		
CHECKED BY DSD	DATE 4/25/22		
CALC. NO.	REV. NO.		

PROJECT

SUMMARY OF PRESSUREMETER TEST RESULTS

Ryan Field
1501 Central Street
Evanston, Illinois

GEI Consultants

CALCULATION SHEET

STS PROJECT NO. 2002549

STS PROJECT FILE

SCALE

SHEET NO.

GEI Consultants
Consulting Engineers & Scientists

Project Name: Ryan Field Development
GEI Project Number: 2200549
Operator: R.Rusk
Date: March 26, 2022

PRESSUREMETER TEST RESULTS

Boring ID	Top of Boring Elevation (ft)	Test Depth (ft)	Test Midpoint Depth (ft)	Test Midpoint Elevation (ft)	P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
B-6	19.0	9.0 to 11.5	10.3	8.75	1.8	3.9	7.4	5.6	66	226	0.29	11.8	1.9
		14.0 to 16.5	15.3	3.75	1.8	3.6	8.3	6.5	138	332	0.41	21.1	2.3
		24.0 to 26.5	25.3	-6.25	1.5	2.9	7.1	5.6	55	-	-	9.8	2.5
		72.5 to 75.0	73.8	-54.75	5.0	12.0	27.0	22.0	268	853	0.31	12.2	2.2
		77.5 to 80.0	78.8	-59.75	5.0	17.0	37.9	32.9	258	873	0.30	7.9	2.2
		82.5 to 85.0	83.8	-64.75	7.0	>24.1	-	-	628	-	-	-	-
B-8	19.0	71.5 to 74.0	72.8	-53.75	5.0	16.5	36.0	31.0	307	1151	0.27	9.9	2.2
		76.0 to 78.5	77.3	-58.25	6.0	22.0	44.8	38.8	873	3060	0.29	22.5	2.0
		81.5 to 84.0	82.8	-63.75	5.5	10.0	17.6	12.1	133	359	0.37	11.0	1.8
B-10	24.8	74.0 to 76.5	75.3	-50.45	4.5	15.5	34.3	29.8	338	1021	0.33	11.3	2.2
		79.0 to 81.5	80.3	-55.45	6.5	>25.1	-	-	474	2133	0.22	-	-
		84.0 to 86.5	85.3	-60.45	6.5	17.5	33.9	27.4	237	1029	0.23	8.6	1.9
B-12	24.5	76.5 to 79.0	77.8	-53.25	5.0	10.0	20.3	15.3	139	447	0.31	9.1	2.0
		84.0 to 86.5	85.3	-60.75	6.0	16.5	32.0	26.0	462	1547	0.30	17.8	1.9
		89.0 to 91.5	90.3	-65.75	6.5	22.0	48.4	41.9	395	1848	0.21	9.4	2.2
B-18	25.6	9.0 to 11.5	10.3	15.35	1.4	3.9	9.0	7.6	61	161	0.38	8.0	2.3
B-20A	25.5	9.0 to 11.5	10.3	15.25	1.4	3.5	7.4	6.0	44	82	0.53	7.4	2.1
		14.5 to 17.0	15.8	9.75	1.5	3.2	7.5	6.0	90	111	0.81	15.1	2.3
		24.0 to 26.5	25.3	0.25	1.4	2.8	5.8	4.4	49	146	0.34	11.1	2.1
B-21	25.0	76.5 to 79.0	77.8	-52.75	5.5	14.0	25.8	20.3	150	705	0.21	7.4	1.8
		81.5 to 84.0	82.8	-57.75	Test zone disturbed by gravel. No test interpretation.								
		87.0 to 89.5	88.3	-63.25	6.5	>33.7	-	54.6	1154	-	-	-	-

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Tuesday, March 8, 2022
Boring No.: B-6
Test Depth (ft): 9.0 to 11.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.0	64	70	6	0.4	0.02	0.4	4.0	10.0	0.93
2	0.5	107	127	20	0.4	0.15	0.8	46.9	66.9	6.07
3	1.0	164	183	19	0.4	0.28	1.2	103.9	122.9	10.89
4	1.5	216	234	18	0.4	0.39	1.6	155.9	173.9	15.11
5	2.0	262	277	15	0.4	0.48	2.0	201.9	216.9	18.55
6	2.5	293	296	3	0.4	0.52	2.5	232.8	235.8	20.03
7	3.0	307	309	2	0.4	0.55	3.0	246.8	248.8	21.04
8	3.5	322	327	5	0.4	0.59	3.5	261.8	266.8	22.42
9	4.0	344	350	6	0.4	0.64	4.0	283.7	289.7	24.16
10	2.5	346	346	0	0.4	0.63	2.4	285.8	285.8	23.87
11	3.5	356	356	0	0.4	0.65	3.4	295.8	295.8	24.61
12	4.5	378	389	11	0.4	0.73	4.4	317.7	328.7	27.06
13	5.0	409	421	12	0.4	0.79	4.8	348.7	360.7	29.39
14	5.5	447	459	12	0.4	0.87	5.3	386.6	398.6	32.10
15	6.0	484	497	13	0.4	0.95	5.7	423.6	436.6	34.76
16	6.5	525	540	15	0.4	1.04	6.2	464.6	479.6	37.71
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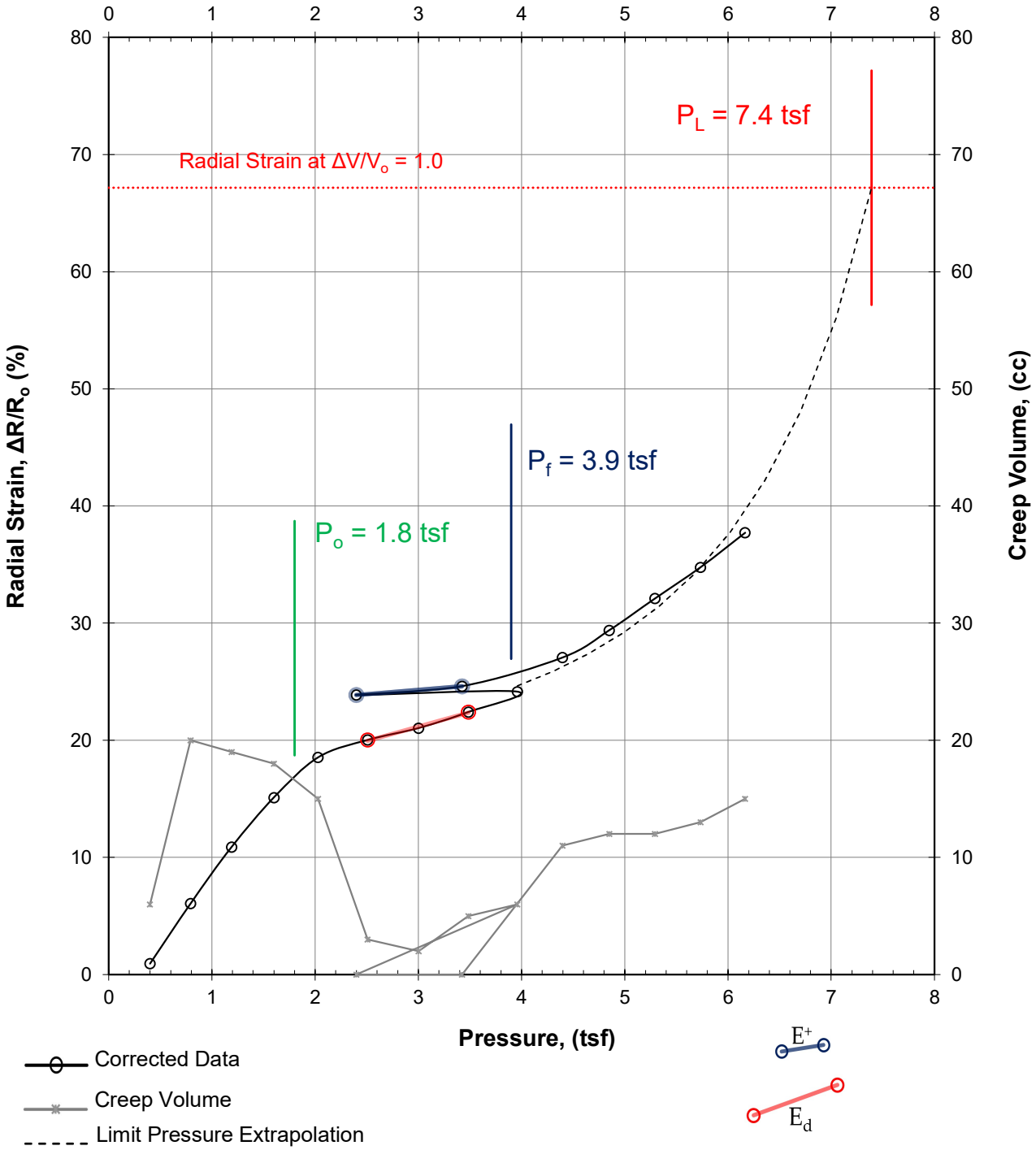
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-6
Test Depth (ft): 9.0 to 11.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
1.8	3.9	7.4	5.6	66	226	0.29	11.8	1.9

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Tuesday, March 8, 2022
Boring No.: B-6
Test Depth (ft): 14.0 to 16.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.0	60	60	0	0.6	0.00	0.6	0.0	0.0	0.00
2	0.5	90	112	22	0.6	0.12	1.0	29.9	51.9	4.74
3	1.0	155	180	25	0.6	0.27	1.4	94.9	119.9	10.64
4	1.5	216	222	6	0.6	0.36	1.8	155.9	161.9	14.13
5	2.0	230	231	1	0.6	0.38	2.3	169.8	170.8	14.86
6	2.5	237	237	0	0.6	0.40	2.8	176.8	176.8	15.35
7	3.0	244	245	1	0.6	0.41	3.3	183.8	184.8	15.99
8	3.5	257	261	4	0.6	0.45	3.8	196.7	200.7	17.27
9	4.0	271	275	4	0.6	0.48	4.3	210.7	214.7	18.38
10	4.5	288	294	6	0.6	0.52	4.8	227.7	233.7	19.87
11	2.8	289	289	0	0.6	0.51	2.9	228.8	228.8	19.48
12	4.0	297	297	0	0.6	0.53	4.2	236.7	236.7	20.10
13	5.5	329	347	18	0.6	0.63	5.7	268.6	286.6	23.92
14	6.5	389	416	27	0.6	0.78	6.6	328.6	355.6	29.02
15	7.3	465	497	32	0.6	0.95	7.2	404.5	436.5	34.76
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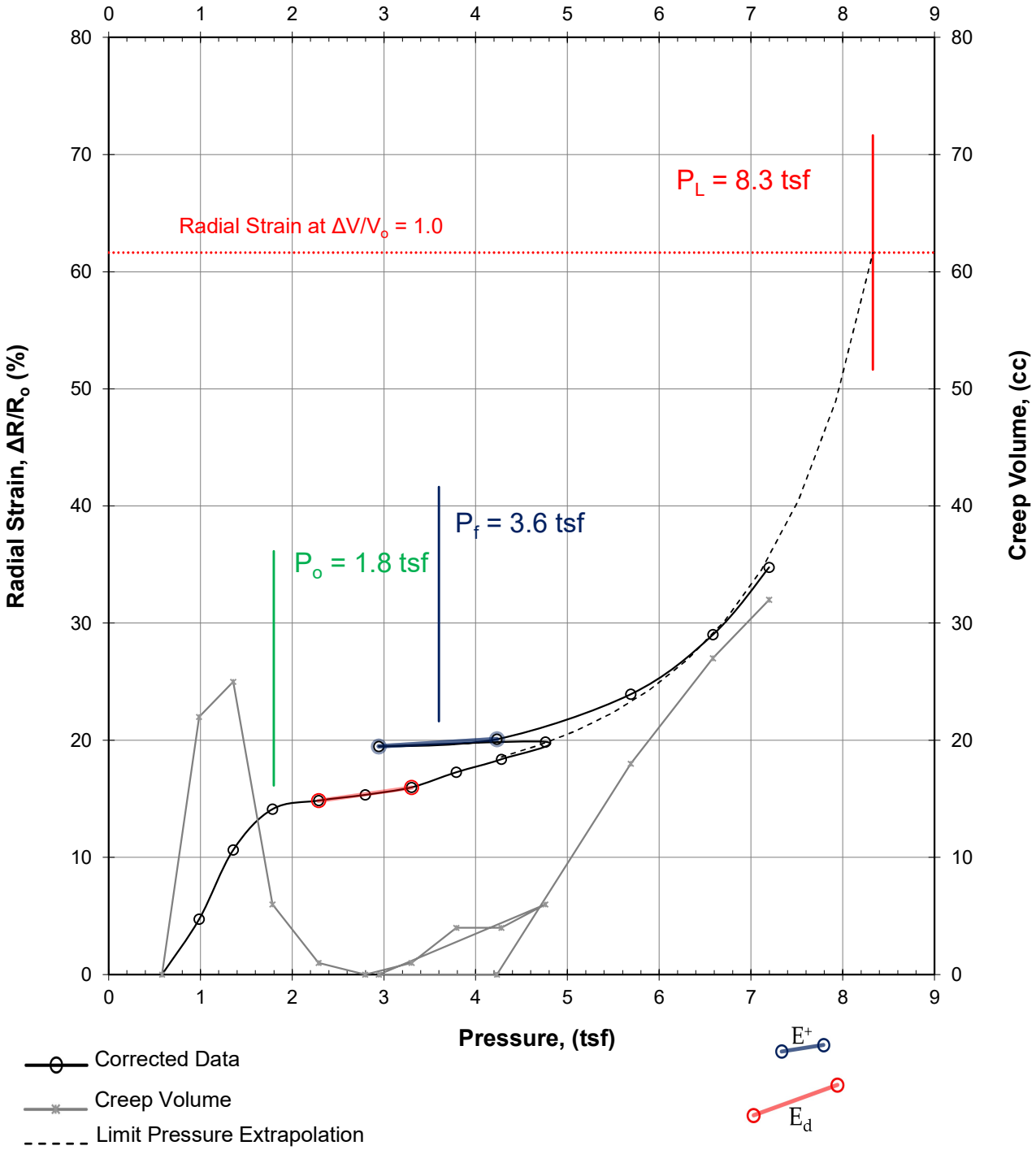
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-6
Test Depth (ft): 14.0 to 16.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
1.8	3.6	8.3	6.5	138	332	0.41	21.1	2.3

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Tuesday, March 8, 2022
Boring No.: B-6
Test Depth (ft): 24.0 to 26.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.0	74	74	0	0.9	0.03	0.9	13.9	13.9	1.29
2	0.5	112	125	13	0.9	0.15	1.3	51.9	64.9	5.89
3	1.0	145	152	7	0.9	0.21	1.7	84.9	91.9	8.25
4	1.5	167	167	0	0.9	0.24	2.2	106.8	106.8	9.53
5	2.3	191	197	6	0.9	0.31	2.9	130.8	136.8	12.06
6	3.0	220	228	8	0.9	0.38	3.7	159.8	167.8	14.61
7	3.8	259	274	15	0.9	0.48	4.3	198.7	213.7	18.30
8	4.5	308	325	17	0.9	0.59	5.0	247.7	264.7	22.26
9	5.3	365	390	25	0.9	0.73	5.7	304.6	329.6	27.13
10	6.0	437	467	30	0.9	0.89	6.3	376.6	406.6	32.66
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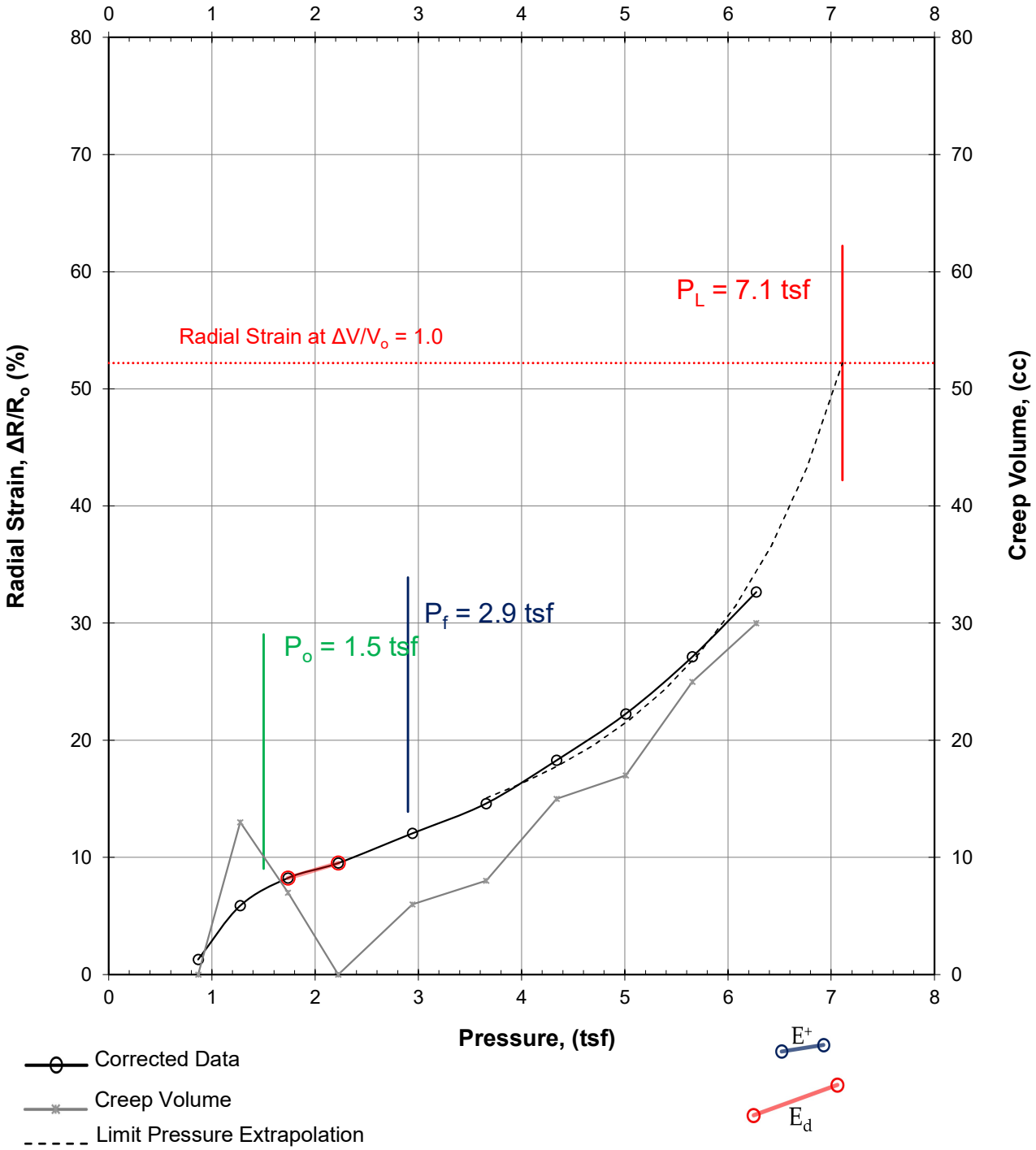
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-6
Test Depth (ft): 24.0 to 26.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
1.5	2.9	7.1	5.6	55	-	-	9.8	2.5

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 9, 2022
Boring No.: B-6
Test Depth (ft): 72.5 to 75.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	112	134	22	2.4	0.17	3.3	51.8	73.8	6.67
2	3.0	159	161	2	2.4	0.23	5.3	98.6	100.6	9.00
3	6.0	181	181	0	2.4	0.27	8.4	120.4	120.4	10.68
4	10.0	216	222	6	2.4	0.36	12.5	155.1	161.1	14.07
5	14.0	267	276	9	2.4	0.48	16.6	205.9	214.9	18.39
6	9.0	271	271	0	2.4	0.47	11.4	210.2	210.2	18.02
7	13.0	281	281	0	2.4	0.49	15.5	219.9	219.9	18.79
8	17.0	327	337	10	2.4	0.61	19.6	265.7	275.7	23.10
9	18.0	356	363	7	2.4	0.67	20.6	294.6	301.6	25.05
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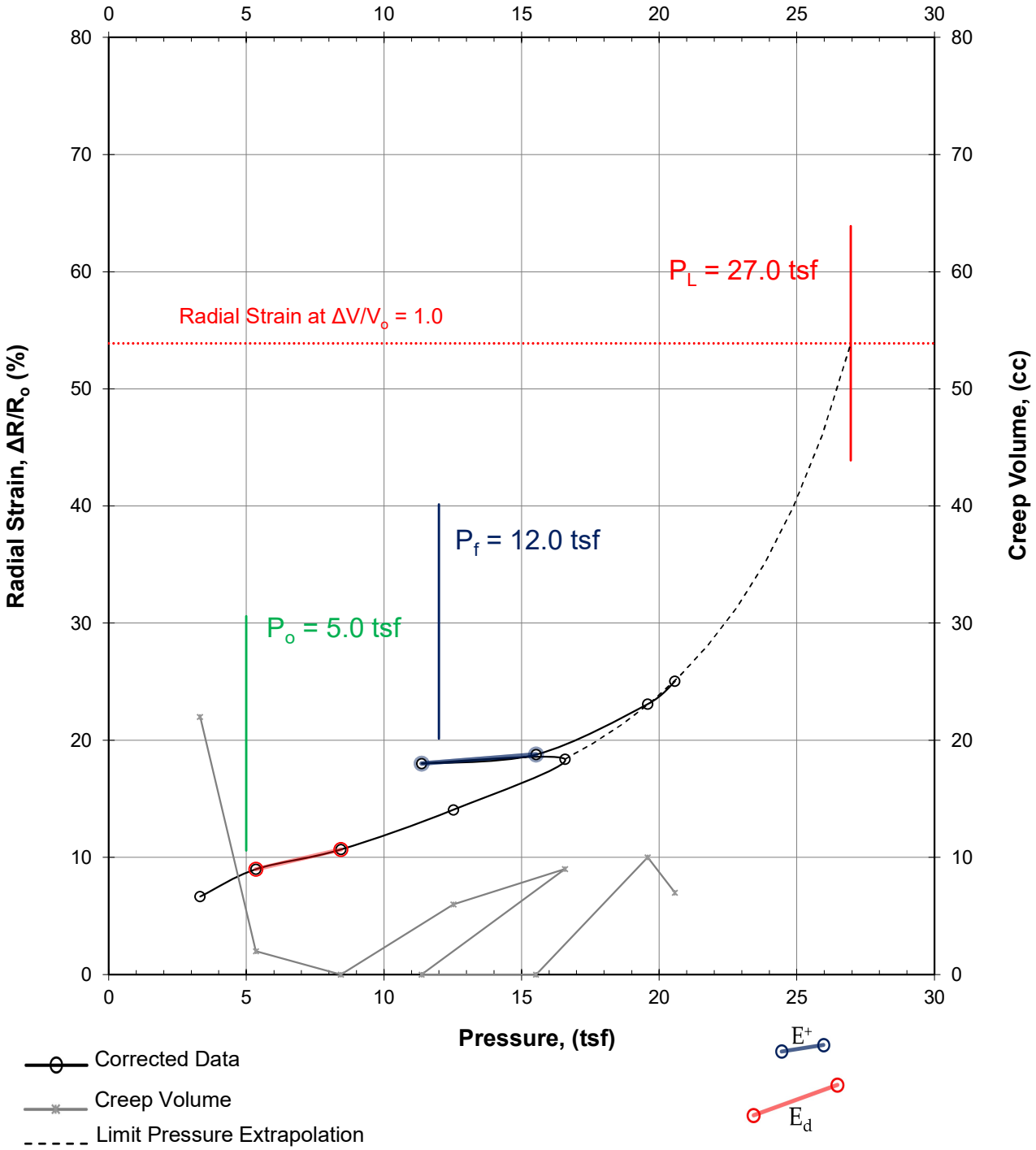
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-6
Test Depth (ft): 72.5 to 75.0



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
5.0	12.0	27.0	22.0	268	853	0.31	12.2	2.2

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 9, 2022
Boring No.: B-6
Test Depth (ft): 77.5 to 80.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	98	111	13	2.6	0.12	3.5	37.8	50.8	4.64
2	3.0	164	165	1	2.6	0.24	5.5	103.6	104.6	9.34
3	6.0	184	184	0	2.6	0.28	8.6	123.4	123.4	10.94
4	10.0	211	211	0	2.6	0.34	12.7	150.1	150.1	13.16
5	14.0	244	245	1	2.6	0.41	16.8	182.9	183.9	15.92
6	18.0	278	281	3	2.6	0.49	20.9	216.6	219.6	18.76
7	22.0	323	328	5	2.6	0.59	25.0	261.3	266.3	22.38
8	15.3	321	321	0	2.6	0.58	17.9	259.8	259.8	21.88
9	21.0	336	336	0	2.6	0.61	23.9	274.4	274.4	23.00
10	25.0	373	381	8	2.6	0.71	28.0	311.1	319.1	26.35
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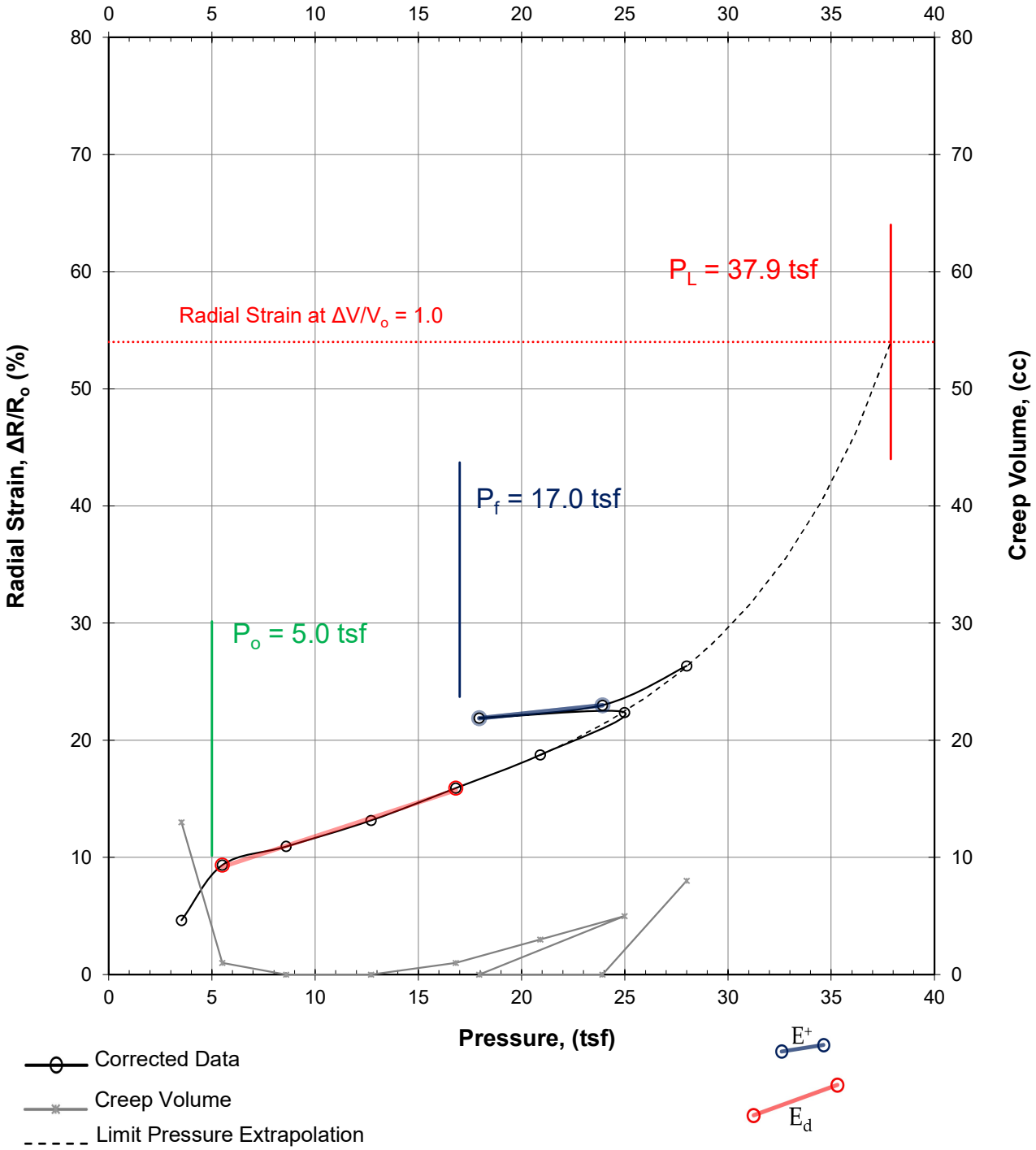
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-6
Test Depth (ft): 77.5 to 80.0



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
5.0	17.0	37.9	32.9	258	873	0.30	7.9	2.2

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 9, 2022
Boring No.: B-6
Test Depth (ft): 82.5 to 85.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	81	84	3	2.8	0.05	3.8	20.7	23.7	2.20
2	3.0	154	170	16	2.8	0.25	5.6	93.6	109.6	9.77
3	6.0	222	260	38	2.8	0.45	8.6	161.4	199.4	17.16
4	9.0	269	269	0	2.8	0.47	11.7	208.2	208.2	17.86
5	13.0	282	282	0	2.8	0.49	15.8	220.9	220.9	18.87
6	17.0	296	296	0	2.8	0.52	20.0	234.6	234.6	19.94
7	21.0	311	311	0	2.8	0.56	24.1	249.4	249.4	21.08
8	Gravel in test zone. Test ended to reduce risk of membrane rupture.									
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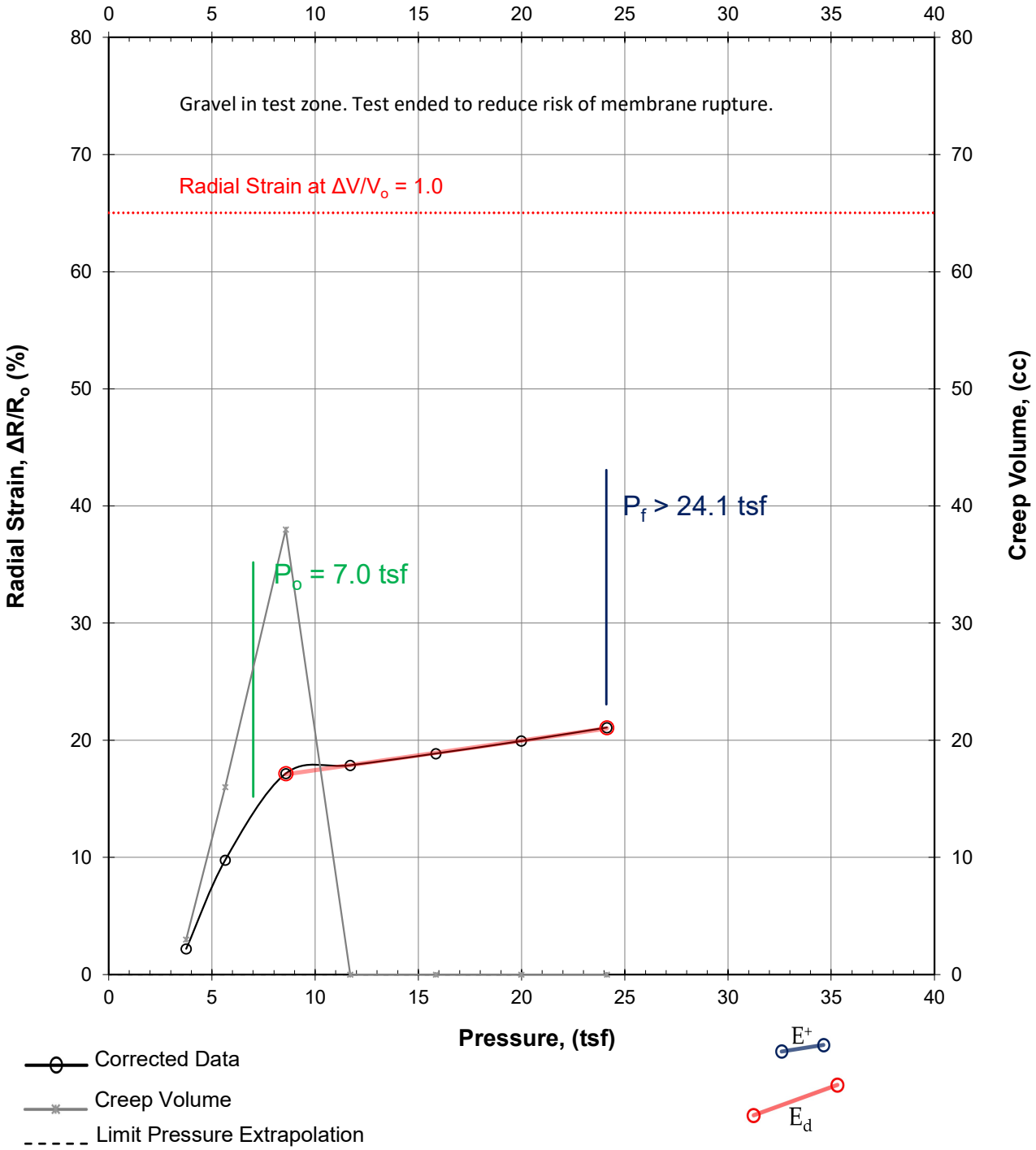
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-6
Test Depth (ft): 82.5 to 85.0



Test Results

P$_o$ (tsf)	P$_f$ (tsf)	P$_L$ (tsf)	P$^*_L$ (tsf)	E$_d$ (tsf)	E$^+$ (tsf)	E$_d$/E$^+$	E$_d$/P$^*_L$	P$_L$/P$_f$
7.0	>24.1	-	-	628	-	-	-	-

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Tuesday, March 8, 2022
Boring No.: B-8
Test Depth (ft): 71.5 to 74.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	104	119	15	2.4	0.13	3.3	43.8	58.8	5.35
2	3.0	140	141	1	2.4	0.18	5.4	79.6	80.6	7.27
3	6.0	156	156	0	2.4	0.22	8.5	95.4	95.4	8.55
4	10.0	181	181	0	2.4	0.27	12.6	120.1	120.1	10.66
5	14.0	216	217	1	2.4	0.35	16.7	154.9	155.9	13.64
6	18.0	257	262	5	2.4	0.45	20.8	195.6	200.6	17.26
7	11.0	254	254	0	2.4	0.43	13.5	193.1	193.1	16.66
8	17.0	265	265	0	2.4	0.46	19.7	203.7	203.7	17.50
9	22.0	310	318	8	2.4	0.57	24.8	248.3	256.3	21.62
10	24.0	343	352	9	2.4	0.65	26.8	281.2	290.2	24.19
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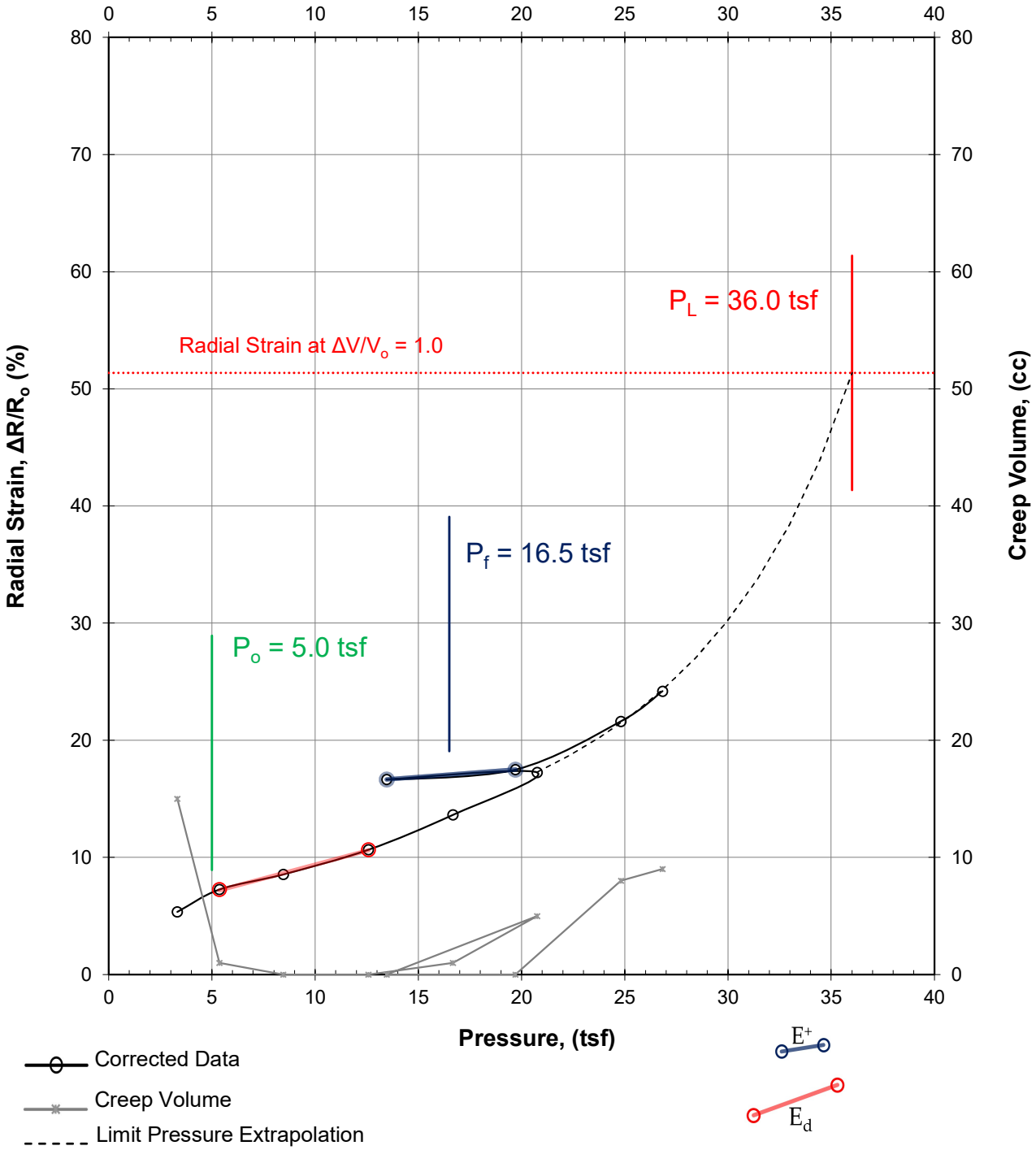
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-8
Test Depth (ft): 71.5 to 74.0



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
5.0	16.5	36.0	31.0	307	1151	0.27	9.9	2.2

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Tuesday, March 8, 2022
Boring No.: B-8
Test Depth (ft): 76.0 to 78.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	94	128	34	2.6	0.15	3.4	33.8	67.8	6.14
2	3.0	200	217	17	2.6	0.35	5.3	139.6	156.6	13.70
3	6.0	234	234	0	2.6	0.39	8.4	173.4	173.4	15.07
4	10.0	242	242	0	2.6	0.41	12.6	181.1	181.1	15.70
5	15.0	255	255	0	2.6	0.43	17.8	193.8	193.8	16.71
6	20.0	273	275	2	2.6	0.48	23.0	211.4	213.4	18.28
7	25.0	303	308	5	2.6	0.55	28.1	241.1	246.1	20.83
8	15.0	303	303	0	2.6	0.54	17.7	241.8	241.8	20.50
9	24.0	310	310	0	2.6	0.55	27.1	248.2	248.2	20.99
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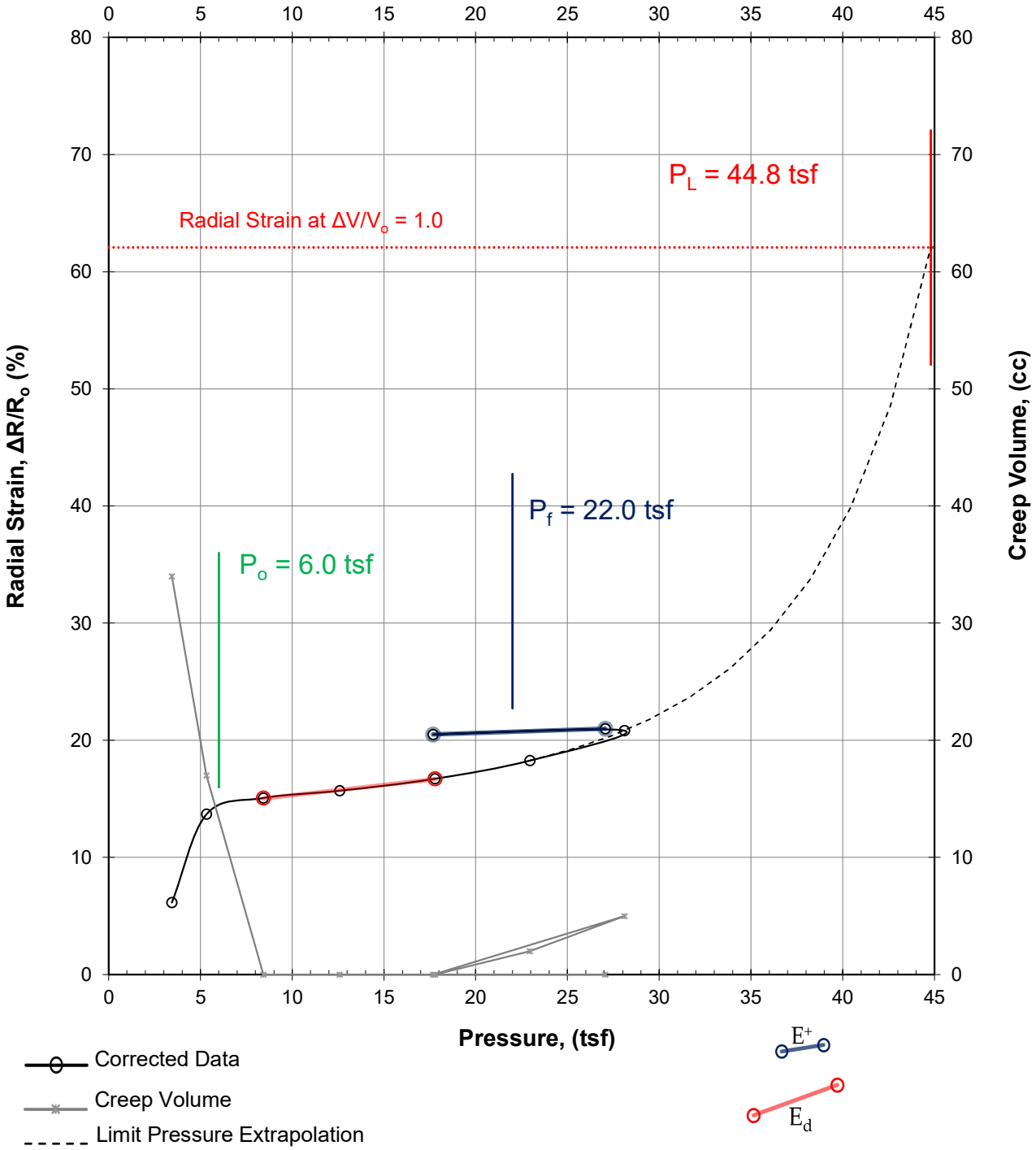
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-8
Test Depth (ft): 76.0 to 78.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
6.0	22.0	44.8	38.8	873	3060	0.29	22.5	2.0

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Tuesday, March 8, 2022
Boring No.: B-8
Test Depth (ft): 81.5 to 84.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 60
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	94	118	24	2.7	0.13	3.6	33.8	57.8	5.26
2	3.0	168	175	7	2.7	0.26	5.6	107.6	114.6	10.19
3	6.0	209	216	7	2.7	0.35	8.6	148.4	155.4	13.60
4	10.0	280	299	19	2.7	0.53	12.6	219.1	238.1	20.21
5	6.0	293	293	0	2.7	0.52	8.5	232.4	232.4	19.77
6	9.0	311	311	0	2.7	0.56	11.6	250.2	250.2	21.15
7	12.0	366	385	19	2.7	0.72	14.5	305.0	324.0	26.71
8	13.0	424	445	21	2.7	0.84	15.5	362.9	383.9	31.06
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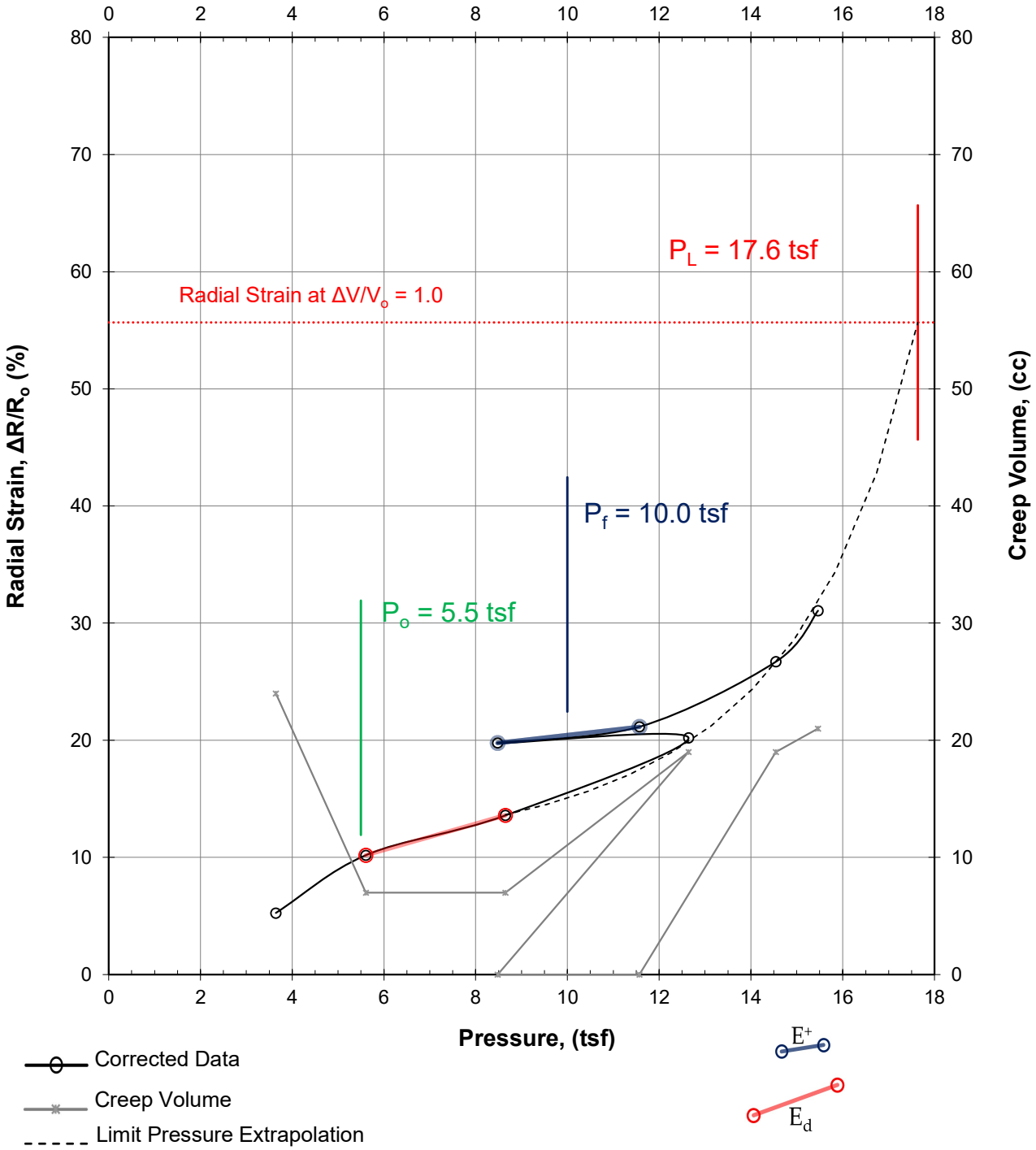
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-8
Test Depth (ft): 81.5 to 84.0



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
5.5	10.0	17.6	12.1	133	359	0.37	11.0	1.8

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 2, 2022
Boring No.: B-10
Test Depth (ft): 74.0 to 76.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 37
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.5	47	50	3	2.5	0.03	3.0	9.8	12.8	1.19
2	2.0	76	77	1	2.5	0.09	4.5	38.7	39.7	3.64
3	5.0	87	87	0	2.5	0.11	7.6	49.5	49.5	4.52
4	8.0	102	102	0	2.5	0.15	10.7	64.3	64.3	5.84
5	11.0	121	121	0	2.5	0.19	13.8	83.1	83.1	7.48
6	14.0	147	149	2	2.5	0.25	16.9	108.9	110.9	9.87
7	17.0	174	177	3	2.5	0.31	19.9	135.6	138.6	12.21
8	20.0	208	215	7	2.5	0.40	23.0	169.4	176.4	15.32
9	13.5	210	210	0	2.5	0.39	16.2	171.9	171.9	14.95
10	19.0	221	221	0	2.5	0.41	21.9	182.5	182.5	15.81
11	23.0	255	266	11	2.5	0.51	26.0	216.2	227.2	19.36
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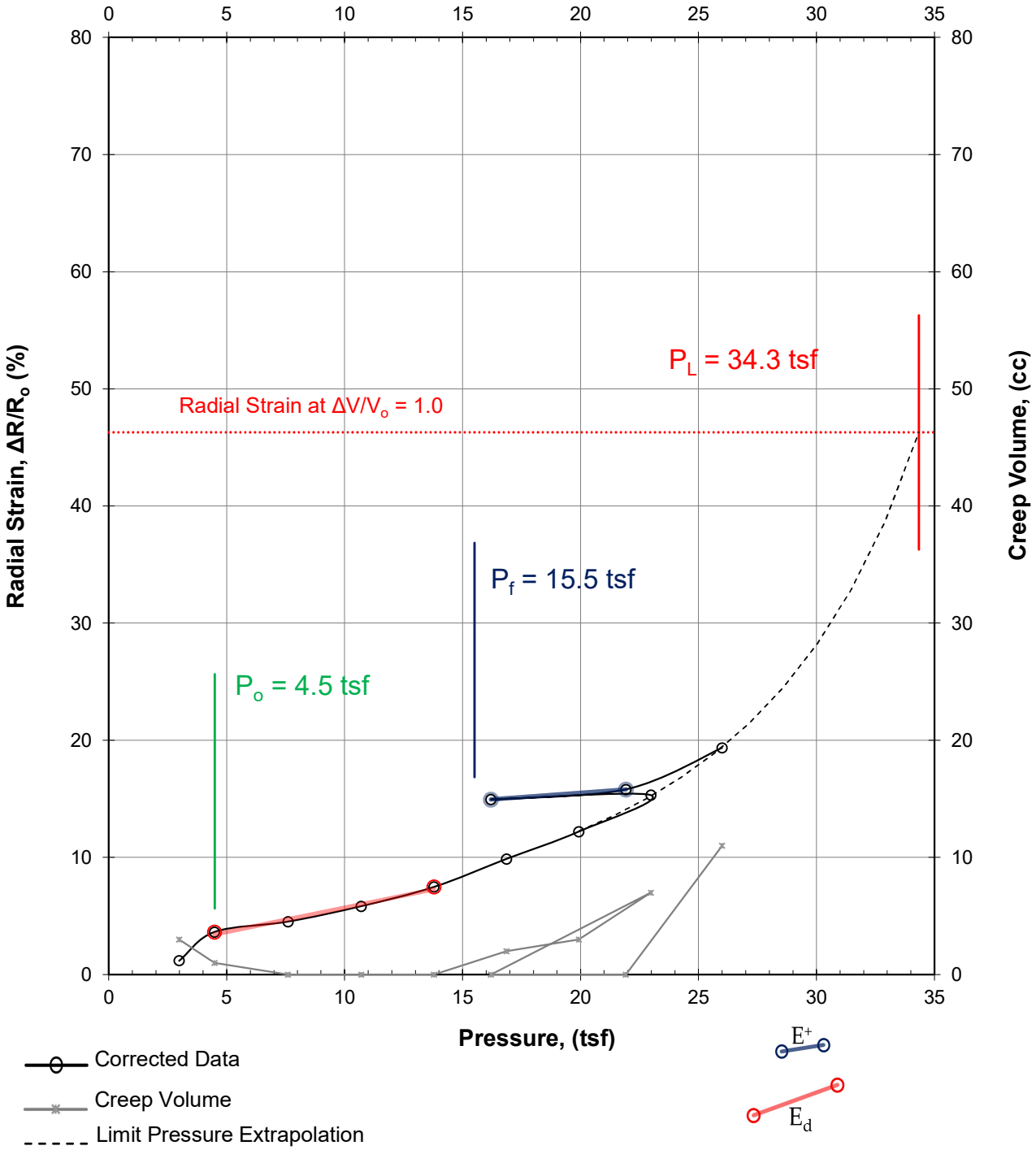
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-10
Test Depth (ft): 74.0 to 76.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
4.5	15.5	34.3	29.8	338	1021	0.33	11.3	2.2

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 2, 2022
Boring No.: B-10
Test Depth (ft): 79.0 to 81.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 37
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	97	120	23	2.6	0.19	3.5	59.8	82.8	7.46
2	3.0	170	181	11	2.6	0.32	5.5	132.6	143.6	12.63
3	6.0	210	210	0	2.6	0.39	8.5	172.4	172.4	14.99
4	10.0	226	227	1	2.6	0.42	12.7	188.1	189.1	16.34
5	14.0	245	245	0	2.6	0.46	16.8	206.9	206.9	17.76
6	18.0	262	262	0	2.6	0.50	20.9	223.6	223.6	19.08
7	22.0	280	280	0	2.6	0.54	25.1	241.3	241.3	20.46
8	13.5	274	274	0	2.6	0.53	16.2	235.9	235.9	20.04
9	20.0	281	281	0	2.6	0.54	23.0	242.4	242.4	20.55
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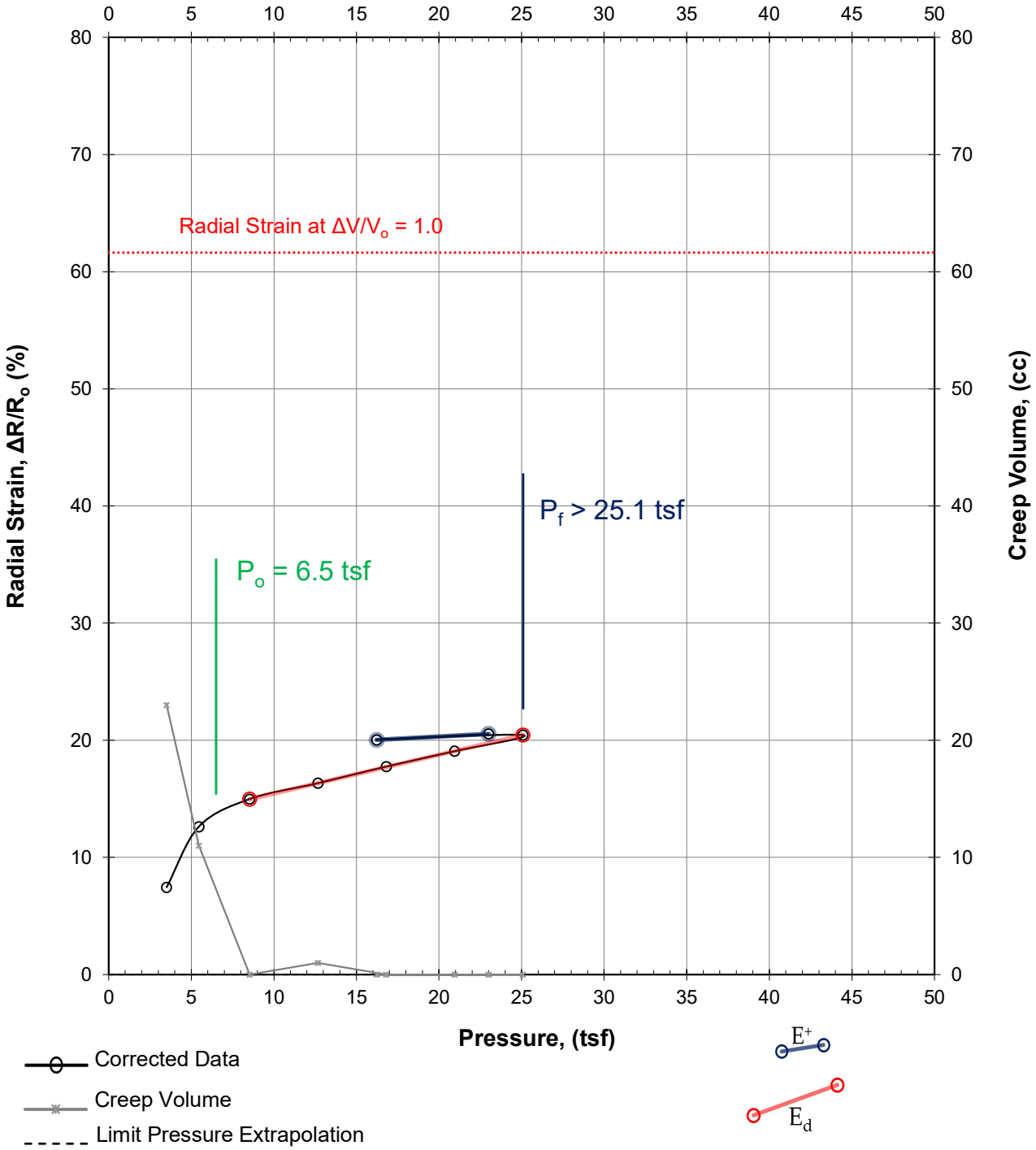
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-10
Test Depth (ft): 79.0 to 81.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
6.5	>25.1	-	-	474	2133	0.22	-	-

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 2, 2022
Boring No.: B-10
Test Depth (ft): 84.0 to 86.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 37
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.5	40	45	5	2.8	0.02	3.3	2.8	7.8	0.72
2	2.0	69	70	1	2.8	0.07	4.8	31.7	32.7	3.01
3	3.0	79	80	1	2.8	0.10	5.8	41.6	42.6	3.91
4	5.0	106	108	2	2.8	0.16	7.9	68.5	70.5	6.38
5	10.0	145	145	0	2.8	0.24	13.0	107.1	107.1	9.55
6	14.0	174	175	1	2.8	0.31	17.1	135.8	136.8	12.06
7	18.0	207	210	3	2.8	0.39	21.2	168.6	171.6	14.92
8	22.0	266	277	11	2.8	0.53	25.3	227.3	238.3	20.22
9	24.0	310	321	11	2.8	0.63	27.2	271.1	282.1	23.59
10	15.5	312	312	0	2.8	0.61	18.4	273.7	273.7	22.95
11	21.3	325	325	0	2.8	0.64	24.4	286.3	286.3	23.90
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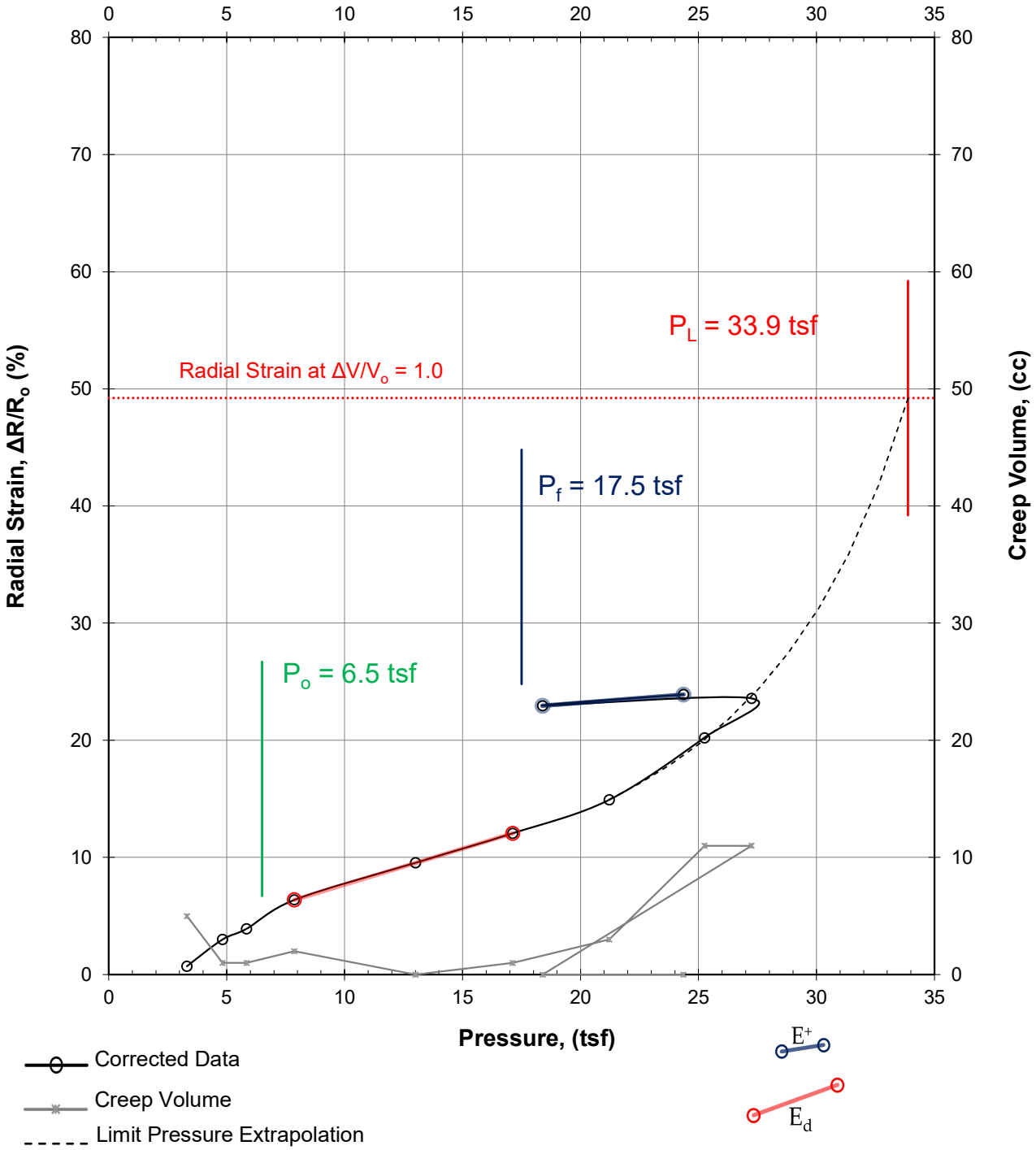
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-10
Test Depth (ft): 84.0 to 86.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
6.5	17.5	33.9	27.4	237	1029	0.23	8.6	1.9

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 2, 2022
Boring No.: B-12
Test Depth (ft): 76.5 to 79.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 37
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	86	87	1	2.6	0.11	3.5	48.8	49.8	4.55
2	3.0	107	130	23	2.6	0.21	5.5	69.6	92.6	8.31
3	6.0	163	168	5	2.6	0.29	8.5	125.4	130.4	11.52
4	9.0	216	229	13	2.6	0.43	11.5	178.2	191.2	16.51
5	12.0	281	301	20	2.6	0.58	14.5	243.0	263.0	22.13
6	7.8	297	297	0	2.6	0.58	10.1	259.3	259.3	21.85
7	10.8	312	312	0	2.6	0.61	13.2	274.1	274.1	22.98
8	14.0	357	378	21	2.6	0.75	16.4	318.9	339.9	27.88
9	15.0	410	429	19	2.6	0.86	17.4	371.8	390.8	31.55
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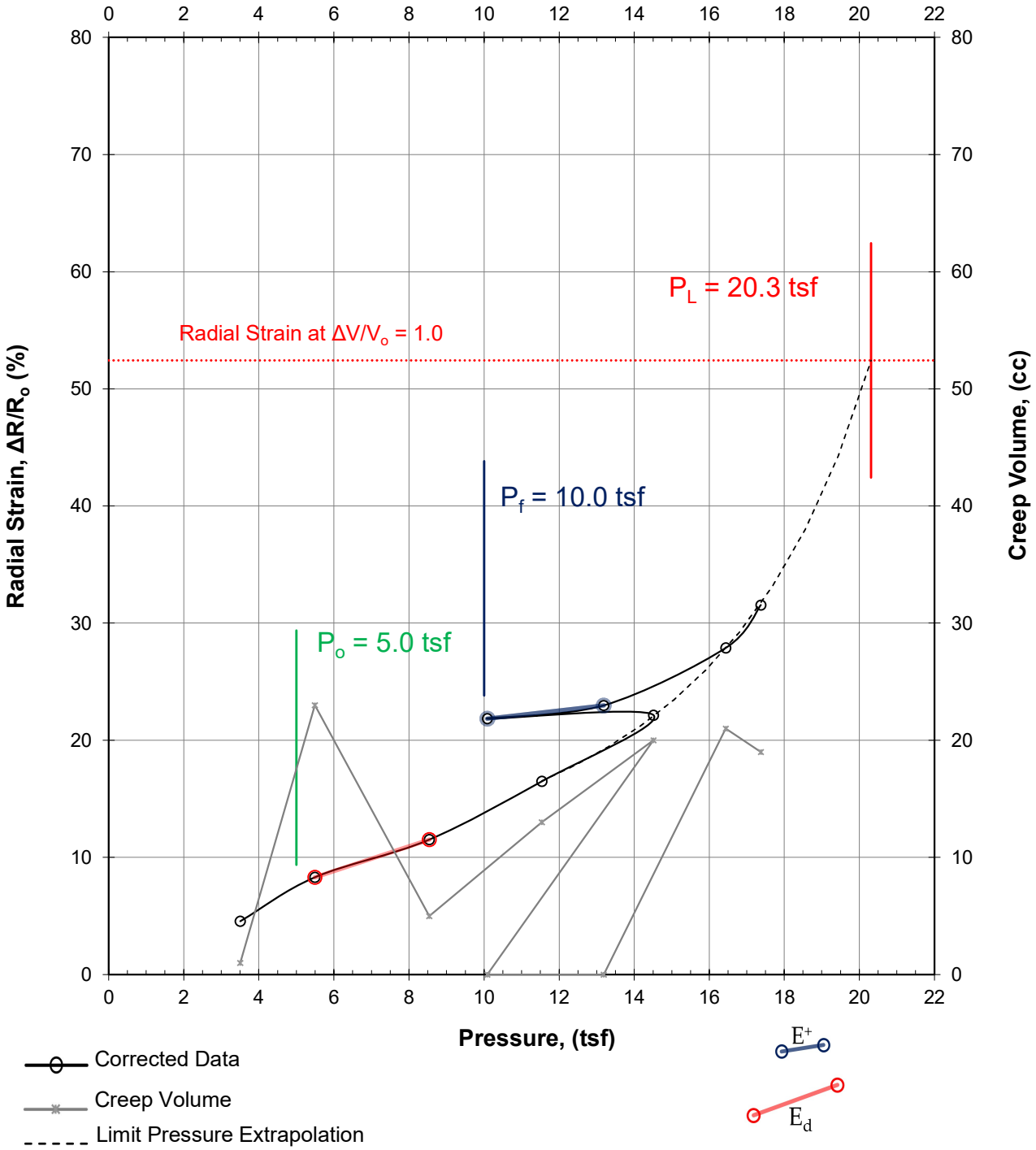
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-12
Test Depth (ft): 76.5 to 79.0



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
5.0	10.0	20.3	15.3	139	447	0.31	9.1	2.0

GEI Consultants
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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 2, 2022
Boring No.: B-12
Test Depth (ft): 84.0 to 86.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 37
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	120	141	21	2.8	0.23	3.6	82.8	103.8	9.27
2	3.0	201	212	11	2.8	0.39	5.6	163.6	174.6	15.17
3	6.0	236	237	1	2.8	0.45	8.6	198.4	199.4	17.16
4	10.0	255	255	0	2.8	0.48	12.8	217.1	217.1	18.57
5	14.0	281	283	2	2.8	0.55	16.9	242.9	244.9	20.73
6	18.0	322	330	8	2.8	0.65	21.0	283.6	291.6	24.30
7	12.5	329	329	0	2.8	0.65	15.2	291.0	291.0	24.25
8	17.0	336	336	0	2.8	0.66	19.9	297.6	297.6	24.75
9	21.0	375	389	14	2.8	0.77	24.0	336.4	350.4	28.64
10	23.0	424	441	17	2.8	0.88	25.9	385.2	402.2	32.36
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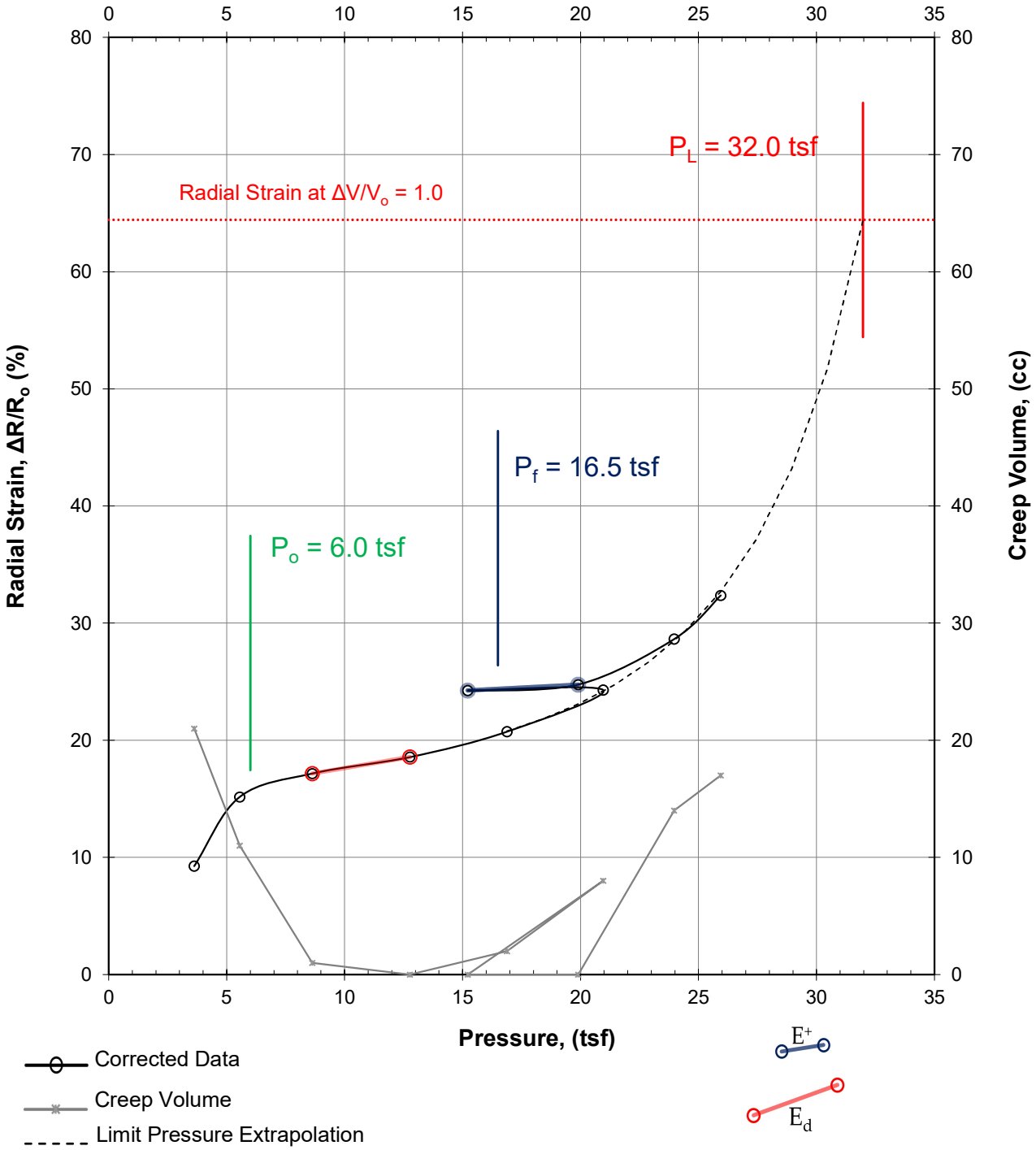
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-12
Test Depth (ft): 84.0 to 86.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
6.0	16.5	32.0	26.0	462	1547	0.30	17.8	1.9

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Wednesday, March 2, 2022
Boring No.: B-12
Test Depth (ft): 89.0 to 91.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 37
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	50	65	15	3.0	0.06	3.9	12.7	27.7	2.56
2	3.0	134	160	26	3.0	0.28	5.8	96.6	122.6	10.87
3	6.0	190	190	0	3.0	0.34	8.9	152.4	152.4	13.35
4	10.0	207	207	0	3.0	0.38	13.0	169.1	169.1	14.72
5	14.0	226	226	0	3.0	0.42	17.2	187.8	187.8	16.24
6	18.0	250	251	1	3.0	0.48	21.3	211.6	212.6	18.21
7	22.0	277	280	3	3.0	0.54	25.4	238.3	241.3	20.46
8	25.0	300	304	4	3.0	0.59	28.5	261.1	265.1	22.29
9	19.3	296	296	0	3.0	0.57	22.5	257.5	257.5	21.71
10	24.0	302	302	0	3.0	0.59	27.4	263.1	263.1	22.14
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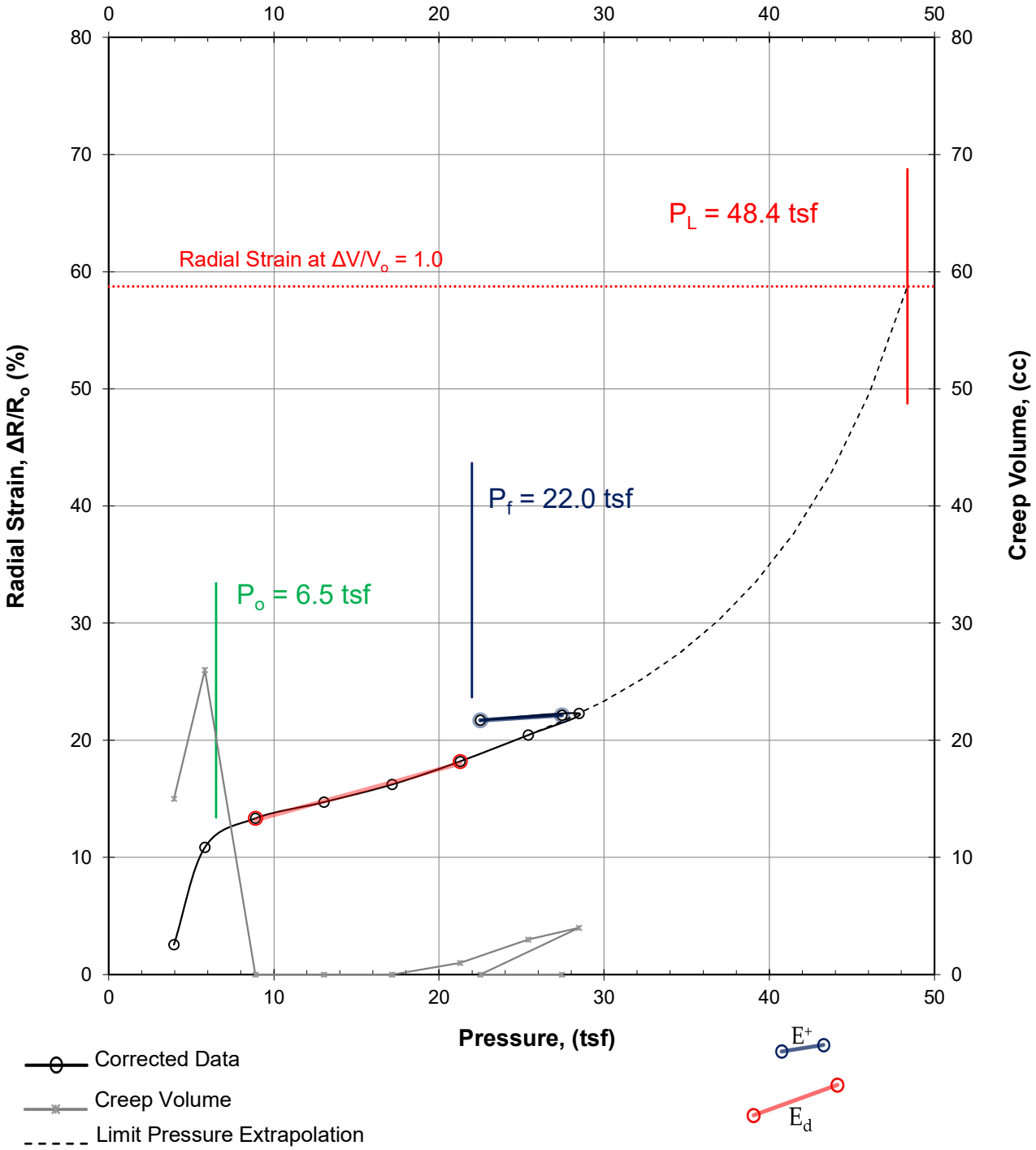
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-12
Test Depth (ft): 89.0 to 91.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
6.5	22.0	48.4	41.9	395	1848	0.21	9.4	2.2

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Thursday, March 17, 2022
Boring No.: B-18
Test Depth (ft): 9.0 to 11.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 27
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.0	52	52	0	0.4	0.06	0.4	25.0	25.0	2.31
2	0.8	106	127	21	0.4	0.22	1.0	78.9	99.9	8.94
3	1.5	165	173	8	0.4	0.33	1.7	137.9	145.9	12.81
4	2.5	195	198	3	0.4	0.38	2.7	167.8	170.8	14.86
5	3.5	227	234	7	0.4	0.46	3.6	199.8	206.8	17.75
6	4.5	259	270	11	0.4	0.54	4.6	231.7	242.7	20.57
7	5.5	299	312	13	0.4	0.63	5.5	271.6	284.6	23.77
8	4.0	318	318	0	0.4	0.64	4.0	290.7	290.7	24.23
9	5.0	332	332	0	0.4	0.67	5.0	304.7	304.7	25.28
10	6.0	358	368	10	0.4	0.75	5.9	330.6	340.6	27.93
11	7.0	397	412	15	0.4	0.84	6.9	369.5	384.5	31.10
12	7.5	440	456	16	0.4	0.94	7.3	412.5	428.5	34.20
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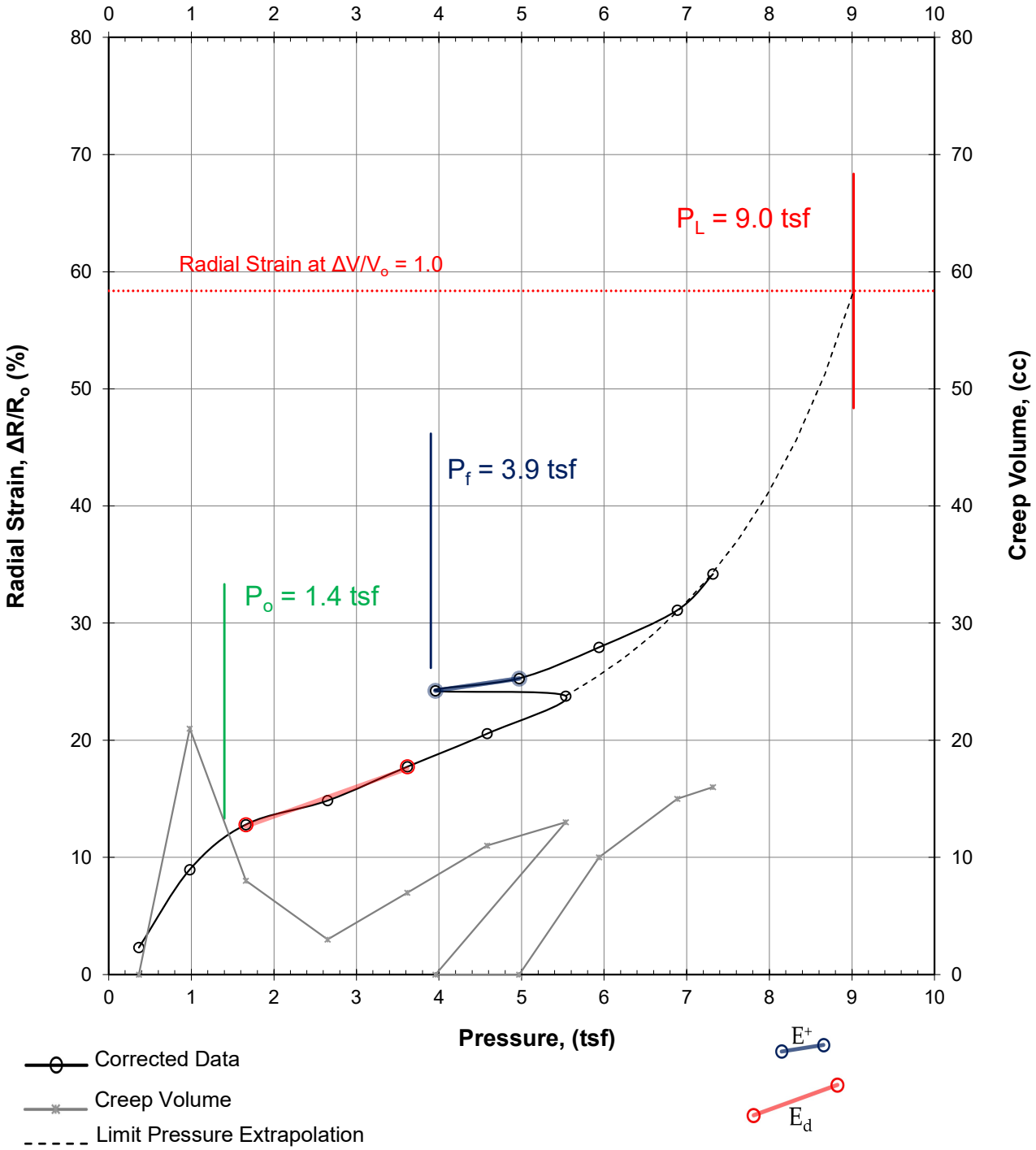
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-18
Test Depth (ft): 9.0 to 11.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
1.4	3.9	9.0	7.6	61	161	0.38	8.0	2.3

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Thursday, March 17, 2022
Boring No.: B-20A
Test Depth (ft): 9.0 to 11.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 27
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.3	42	42	0	0.4	0.03	0.6	15.0	15.0	1.39
2	0.8	53	56	3	0.4	0.07	1.1	25.9	28.9	2.67
3	1.5	80	90	10	0.4	0.14	1.8	52.9	62.9	5.71
4	2.3	117	120	3	0.4	0.21	2.6	89.8	92.8	8.33
5	3.0	142	145	3	0.4	0.26	3.3	114.8	117.8	10.46
6	3.8	176	183	7	0.4	0.35	4.0	148.7	155.7	13.63
7	4.5	210	230	20	0.4	0.45	4.7	182.7	202.7	17.42
8	3.3	230	230	0	0.4	0.45	3.4	202.8	202.8	17.43
9	4.0	248	248	0	0.4	0.49	4.1	220.7	220.7	18.85
10	5.5	300	320	20	0.4	0.65	5.5	272.6	292.6	24.38
11	6.4	366	388	22	0.4	0.79	6.3	338.6	360.6	29.38
12	6.8	430	449	19	0.4	0.92	6.5	402.6	421.6	33.71
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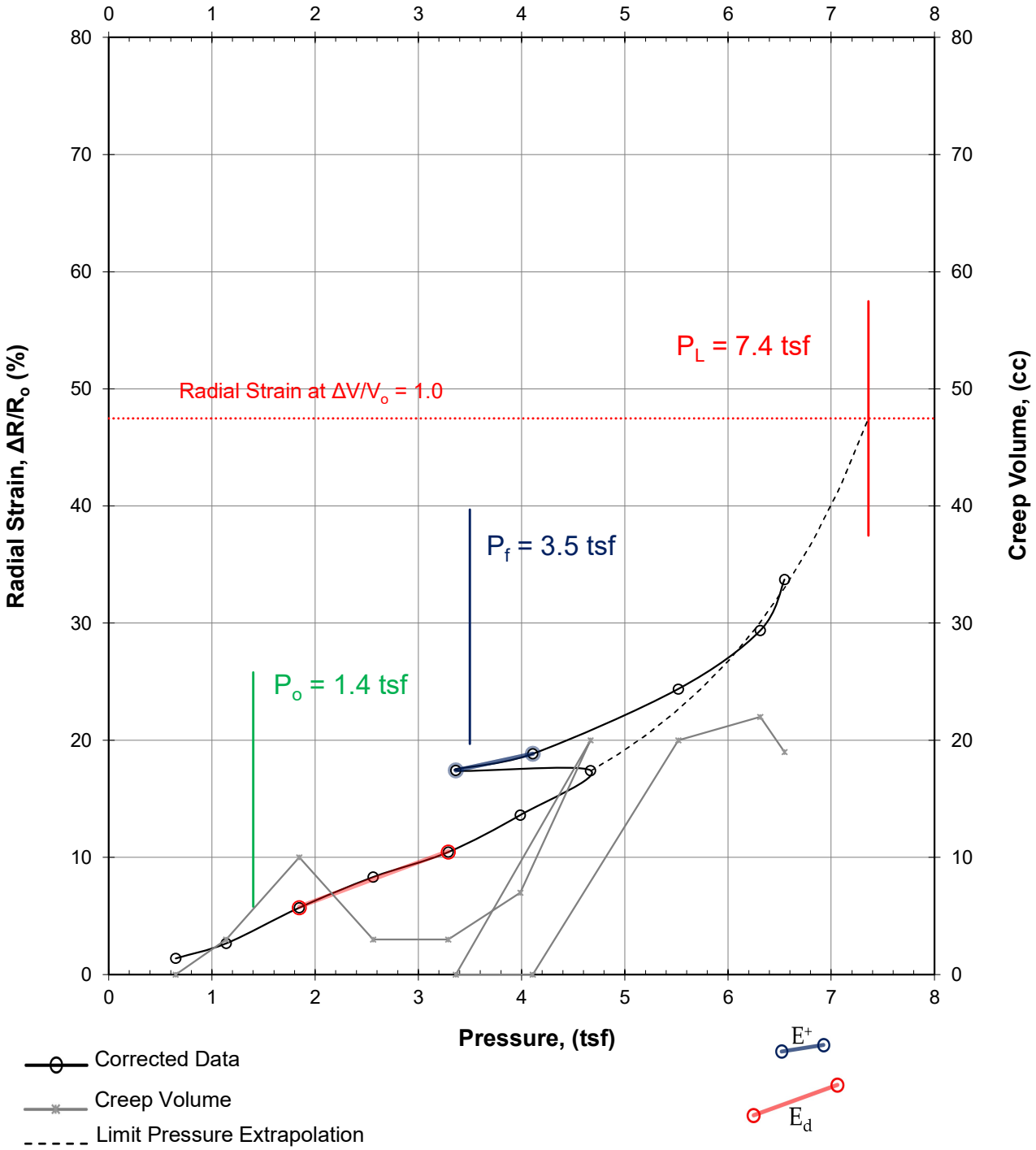
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-20A
Test Depth (ft): 9.0 to 11.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
1.4	3.5	7.4	6.0	44	82	0.53	7.4	2.1

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Thursday, March 17, 2022
Boring No.: B-20A
Test Depth (ft): 14.5 to 17.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 27
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.5	45	45	0	0.6	0.04	1.1	17.9	17.9	1.66
2	1.0	120	150	30	0.6	0.28	1.4	92.9	122.9	10.89
3	1.3	193	212	19	0.6	0.41	1.5	165.9	184.9	16.00
4	1.5	231	237	6	0.6	0.47	1.7	203.9	209.9	18.00
5	1.8	253	257	4	0.6	0.51	1.9	225.9	229.9	19.57
6	2.0	271	277	6	0.6	0.55	2.1	243.9	249.9	21.12
7	2.3	292	299	7	0.6	0.60	2.3	264.8	271.8	22.81
8	3.0	312	317	5	0.6	0.64	3.1	284.8	289.8	24.16
9	1.5	310	310	0	0.6	0.63	1.5	282.9	282.9	23.64
10	2.5	330	330	0	0.6	0.67	2.5	302.8	302.8	25.14
11	3.8	351	364	13	0.6	0.74	3.8	323.7	336.7	27.65
12	4.5	389	400	11	0.6	0.82	4.5	361.7	372.7	30.25
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GEI Consultants
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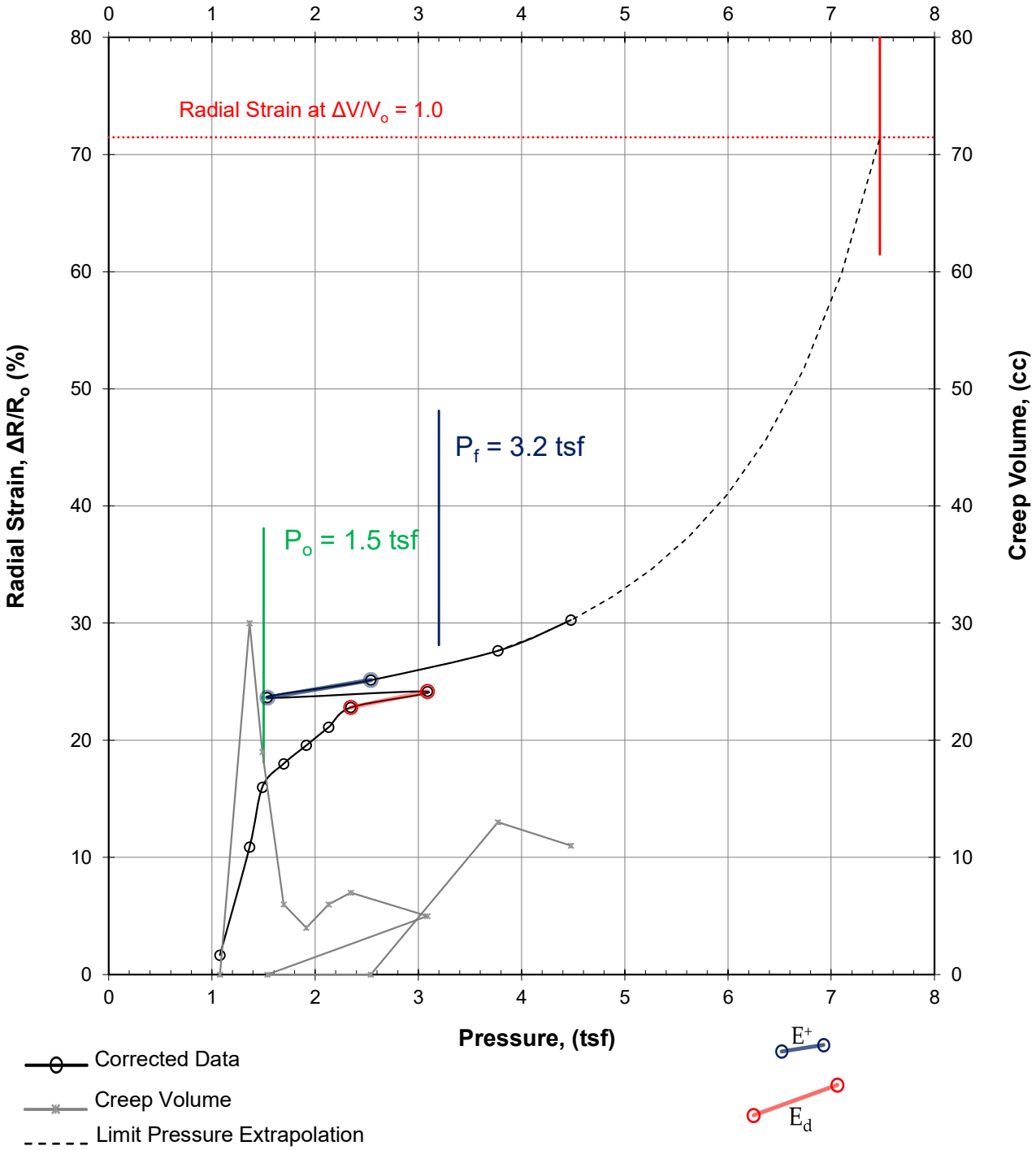
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-20A
Test Depth (ft): 14.5 to 17.0



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
1.5	3.2	7.5	6.0	90	111	0.81	15.1	2.3

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Consulting Engineers & Scientists

Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Thursday, March 17, 2022
Boring No.: B-20A
Test Depth (ft): 24.0 to 26.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 27
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	0.3	86	100	14	0.9	0.16	1.0	58.9	72.9	6.60
2	0.5	114	117	3	0.9	0.20	1.2	86.9	89.9	8.08
3	0.8	126	129	3	0.9	0.23	1.5	98.9	101.9	9.11
4	1.0	138	142	4	0.9	0.26	1.7	110.9	114.9	10.22
5	1.3	155	162	7	0.9	0.30	1.9	127.9	134.9	11.90
6	1.5	172	177	5	0.9	0.34	2.1	144.9	149.9	13.14
7	1.8	186	186	0	0.9	0.36	2.4	158.8	158.8	13.88
8	2.3	206	211	5	0.9	0.41	2.8	178.8	183.8	15.91
9	2.8	237	247	10	0.9	0.49	3.3	209.8	219.8	18.78
10	1.8	241	241	0	0.9	0.48	2.3	213.8	213.8	18.31
11	2.3	248	248	0	0.9	0.49	2.8	220.8	220.8	18.86
12	3.3	278	293	15	0.9	0.59	3.7	250.7	265.7	22.34
13	3.8	316	330	14	0.9	0.67	4.1	288.7	302.7	25.13
14	4.3	363	386	23	0.9	0.79	4.5	335.7	358.7	29.25
15	5.0	444	479	35	0.9	0.99	5.1	416.7	451.7	35.80
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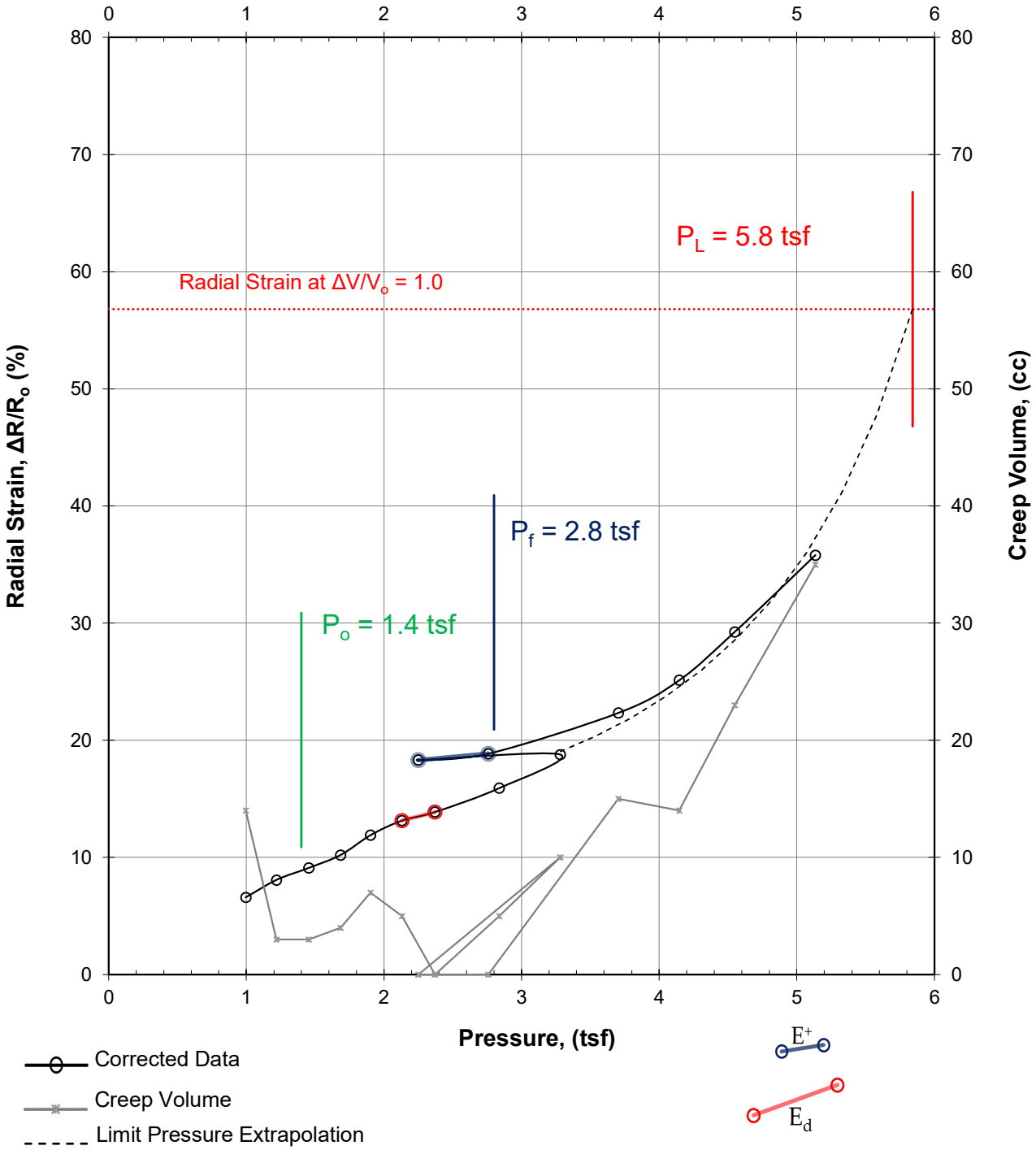
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-20A
Test Depth (ft): 24.0 to 26.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
1.4	2.8	5.8	4.4	49	146	0.34	11.1	2.1

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Thursday, March 3, 2022
Boring No.: B-21
Test Depth (ft): 76.5 to 79.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 27
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	80	95	15	2.6	0.15	3.5	52.8	67.8	6.14
2	3.0	172	197	25	2.6	0.38	5.3	144.6	169.6	14.76
3	6.0	242	248	6	2.6	0.49	8.3	214.4	220.4	18.83
4	9.0	285	290	5	2.6	0.58	11.4	257.2	262.2	22.07
5	12.0	330	338	8	2.6	0.69	14.4	302.0	310.0	25.68
6	15.0	382	398	16	2.6	0.81	17.4	353.8	369.8	30.05
7	9.0	386	386	0	2.6	0.79	11.2	358.2	358.2	29.21
8	14.0	404	404	0	2.6	0.83	16.4	375.9	375.9	30.48
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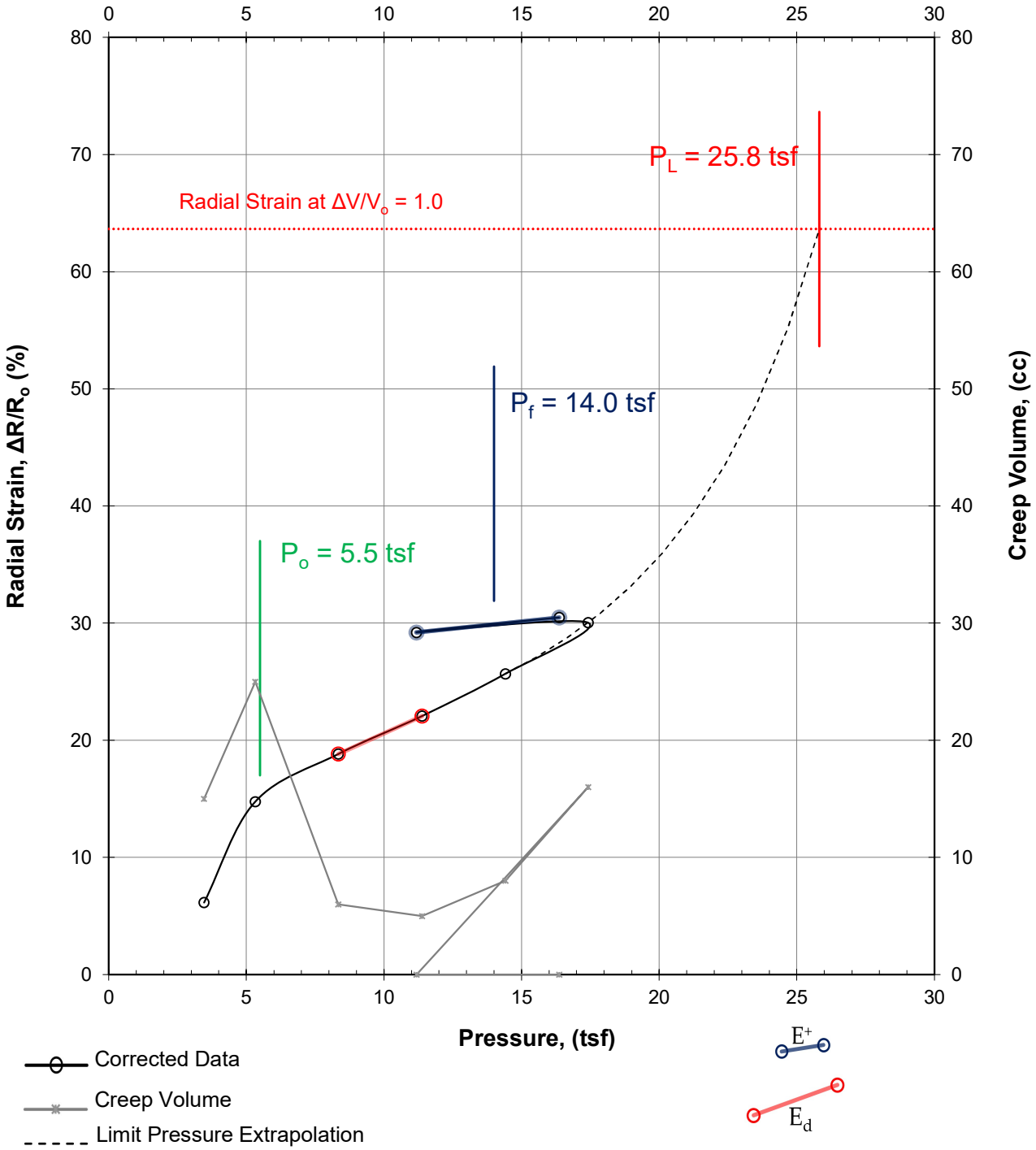
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-21
Test Depth (ft): 76.5 to 79.0



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
5.5	14.0	25.8	20.3	150	705	0.21	7.4	1.8

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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Thursday, March 3, 2022
Boring No.: B-21
Test Depth (ft): 81.5 to 84.0
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 27
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	96	102	6	2.7	0.17	3.6	68.8	74.8	6.76
2	3.0	132	137	5	2.7	0.25	5.6	104.6	109.6	9.77
3	5.0	175	182	7	2.7	0.35	7.6	147.5	154.5	13.52
4	7.0	220	227	7	2.7	0.45	9.6	192.3	199.3	17.16
5	9.0	272	286	14	2.7	0.57	11.6	244.2	258.2	21.76
6	11.0	334	356	22	2.7	0.73	13.5	306.1	328.1	27.01
7	9.0	348	348	0	2.7	0.71	11.4	320.2	320.2	26.43
8	10.0	374	374	0	2.7	0.76	12.4	346.2	346.2	28.34
9	Test zone disturbed by gravel. No test interpretation.									
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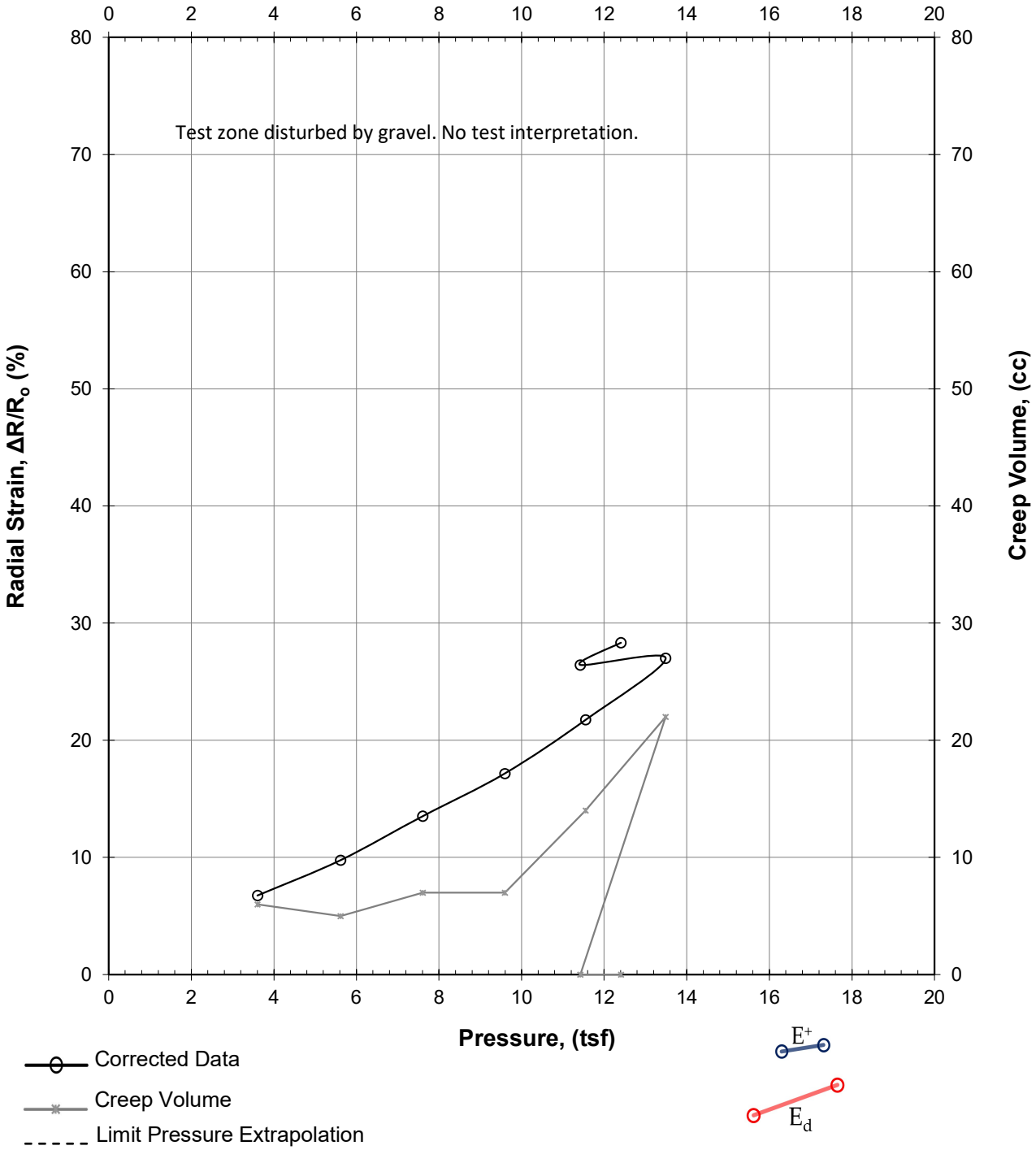
GEI Consultants
Consulting Engineers & Scientists

Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-21
Test Depth (ft): 81.5 to 84.0



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
-	-	-	-	-	-	-	-	-

GEI Consultants
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Project Name: Ryan Field Development
GEI Job #: 2200549
Test Date: Thursday, March 3, 2022
Boring No.: B-21
Test Depth (ft): 87.0 to 89.5
Test Zone Preparation: 2-5/8 In. Rock Bit

Probe Size: BX (58 mm)
Probe Deflated Vol. (cc): 535
Volumetric Zero Offset (cc): 27
Assumed Poisson's Ratio, ν: 0.33
Instrument Height (ft): 3
Operator: R.Rusk

No.	Field Pressure Readings (bars)	Field 30 Sec. Volume (cc)	Field 60 Sec. Volume (cc)	Creep Volume (cc)	Hydrostatic Pressure (tsf)	Membrane Resistance (tsf)	Corrected Pressure (tsf)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume, v_{60} (cc)	60 Sec. Radial Strain, $\Delta R/R_o$ (%)
1	1.0	82	109	27	2.9	0.18	3.8	54.7	81.7	7.37
2	3.0	173	187	14	2.9	0.36	5.7	145.6	159.6	13.94
3	6.0	206	206	0	2.9	0.40	8.8	178.4	178.4	15.48
4	10.0	215	215	0	2.9	0.42	12.9	187.1	187.1	16.18
5	15.0	223	223	0	2.9	0.44	18.1	194.8	194.8	16.79
6	20.0	232	232	0	2.9	0.46	23.3	203.4	203.4	17.48
7	25.0	241	241	0	2.9	0.48	28.5	212.1	212.1	18.17
8	30.0	251	251	0	2.9	0.50	33.7	221.7	221.7	18.93
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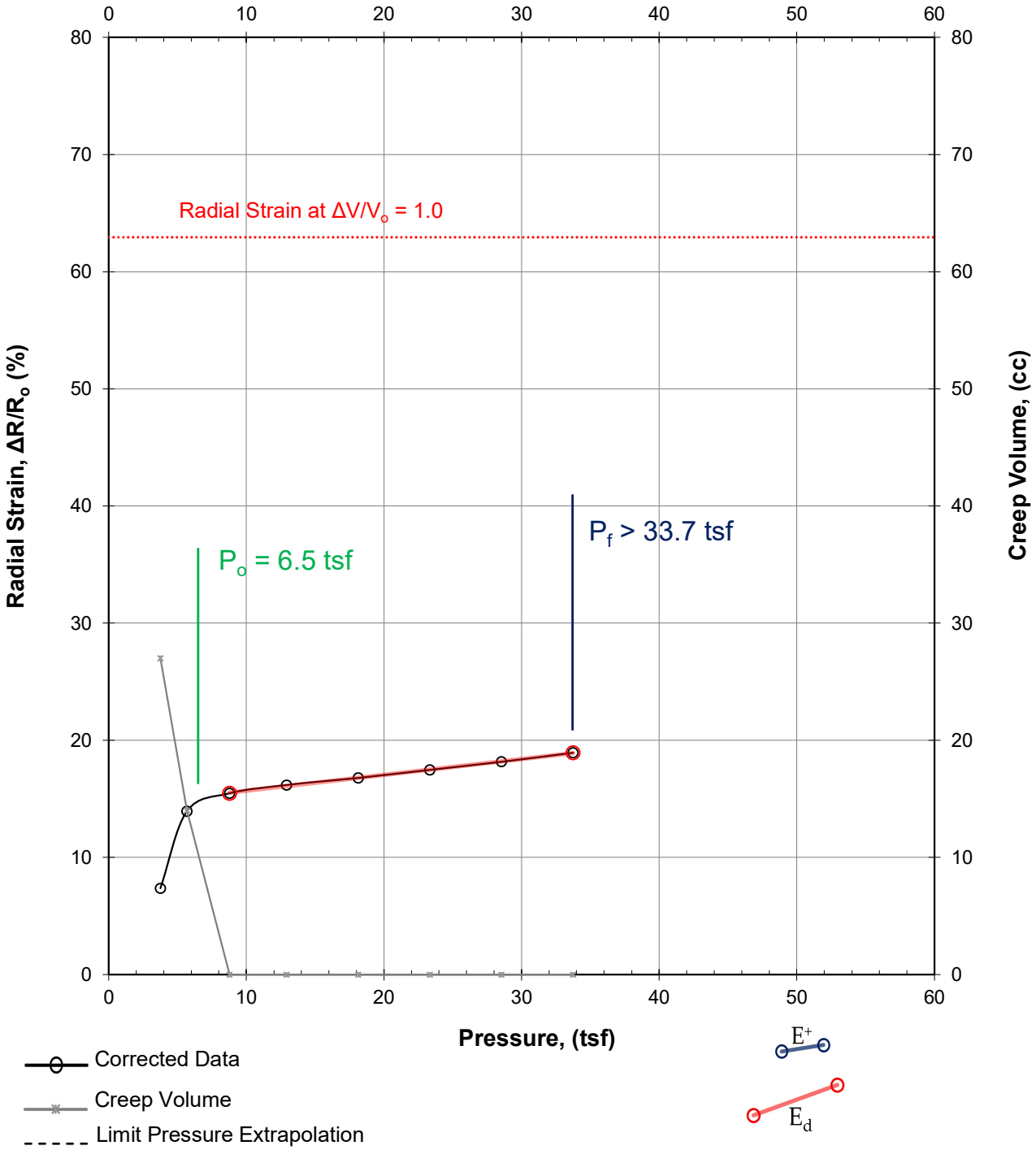
Project Name: Ryan Field Development
GEI Job #: 2200549

Boring No.: B-21
Test Depth (ft): 87.0 to 89.5



Test Results

P_o (tsf)	P_f (tsf)	P_L (tsf)	P^*_L (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P^*_L	P_L/P_f
6.5	>33.7	-	54.6	1154	-	-	-	-

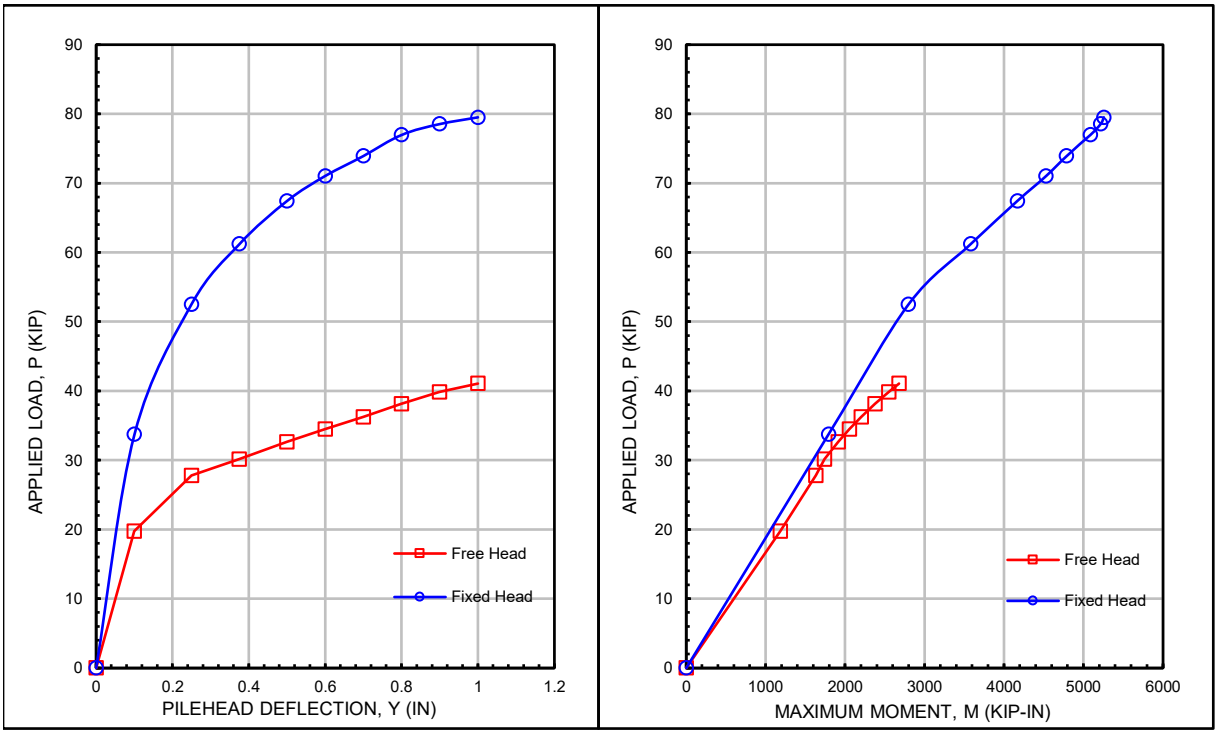
Appendix B

Lateral Capacity Analyses

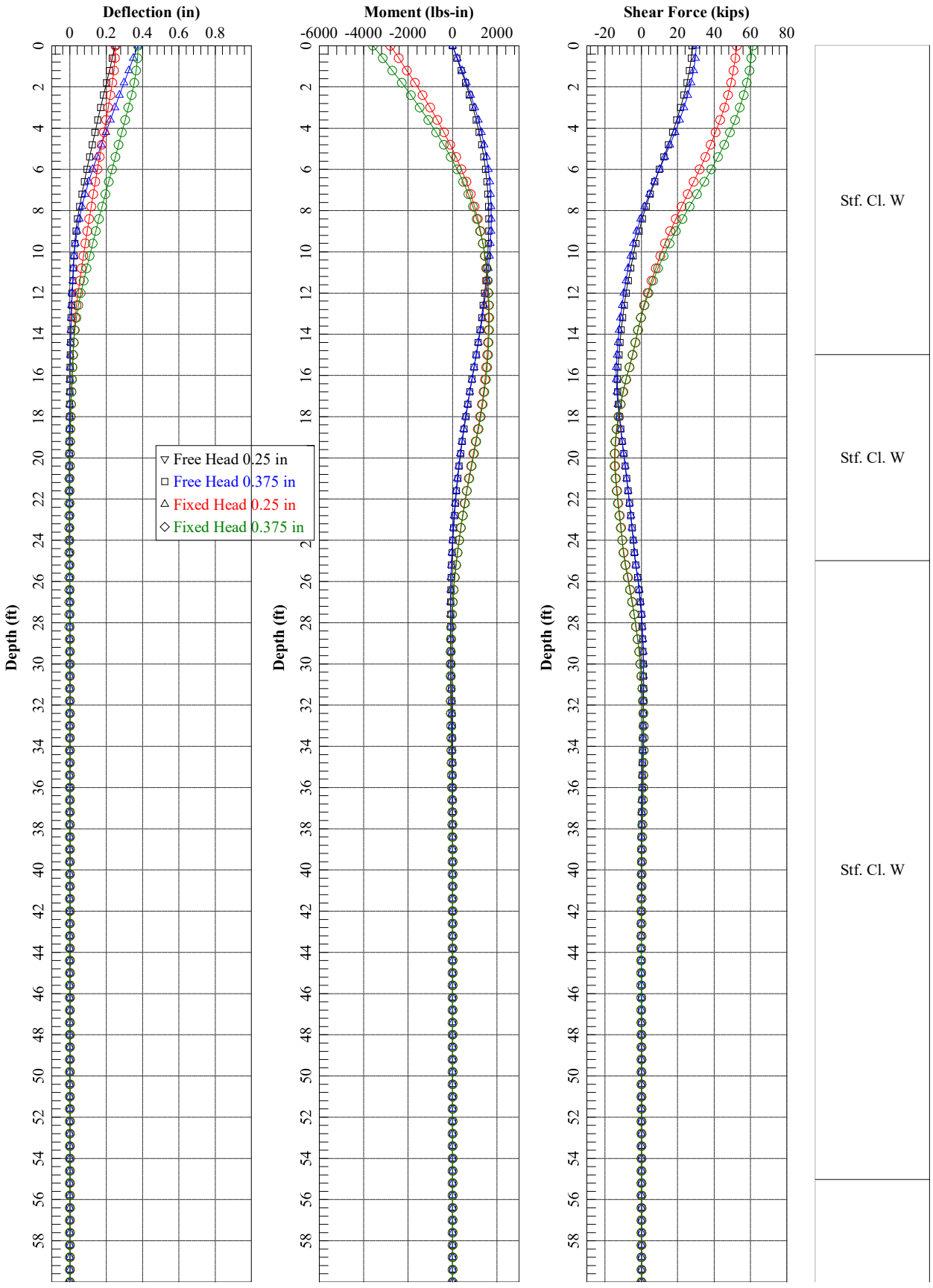
Seismic Design Category

ORIGINATED BY: AF 5/18/2022
CHECKED BY: DSD 5/18/2022

LATERAL LOAD ANALYSIS - LPILE
(30-in Diameter)



	FREE HEAD		FIXED HEAD					
DEFLECTION	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM
0	0	0	0	0				
0.1	20	1186	34	1793				
0.25	28	1634	53	2798				
0.375	30	1741	61	3581				
0.5	33	1913	67	4168				
0.6	34	2056	71	4530				
0.7	36	2205	74	4789				
0.8	38	2380	77	5087				
0.9	40	2552	79	5217				
1	41	2680	80	5257				


Deflection (in)
0
0.2
0.4
0.6
0.8
Moment (lbs-in)
-6000
-4000
-2000
0
2000
Shear Force (kips)
-20
0
20
40
60
80
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
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Free Head 0.25 in
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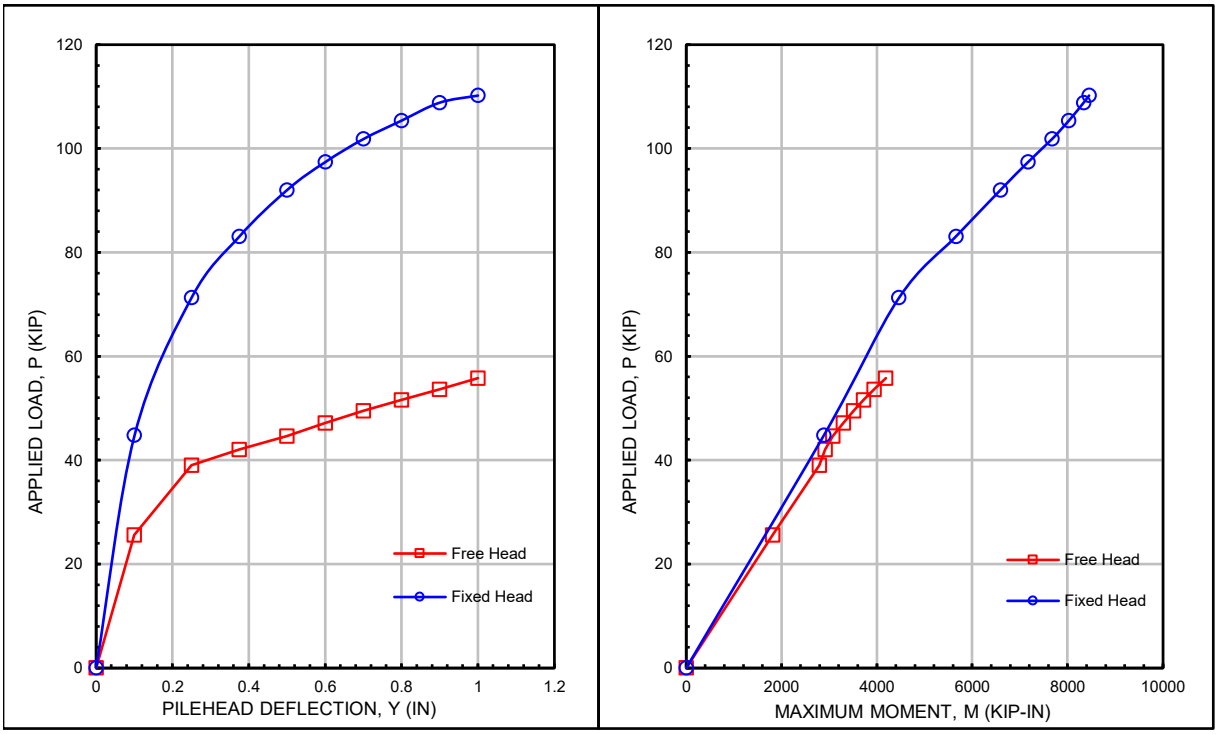
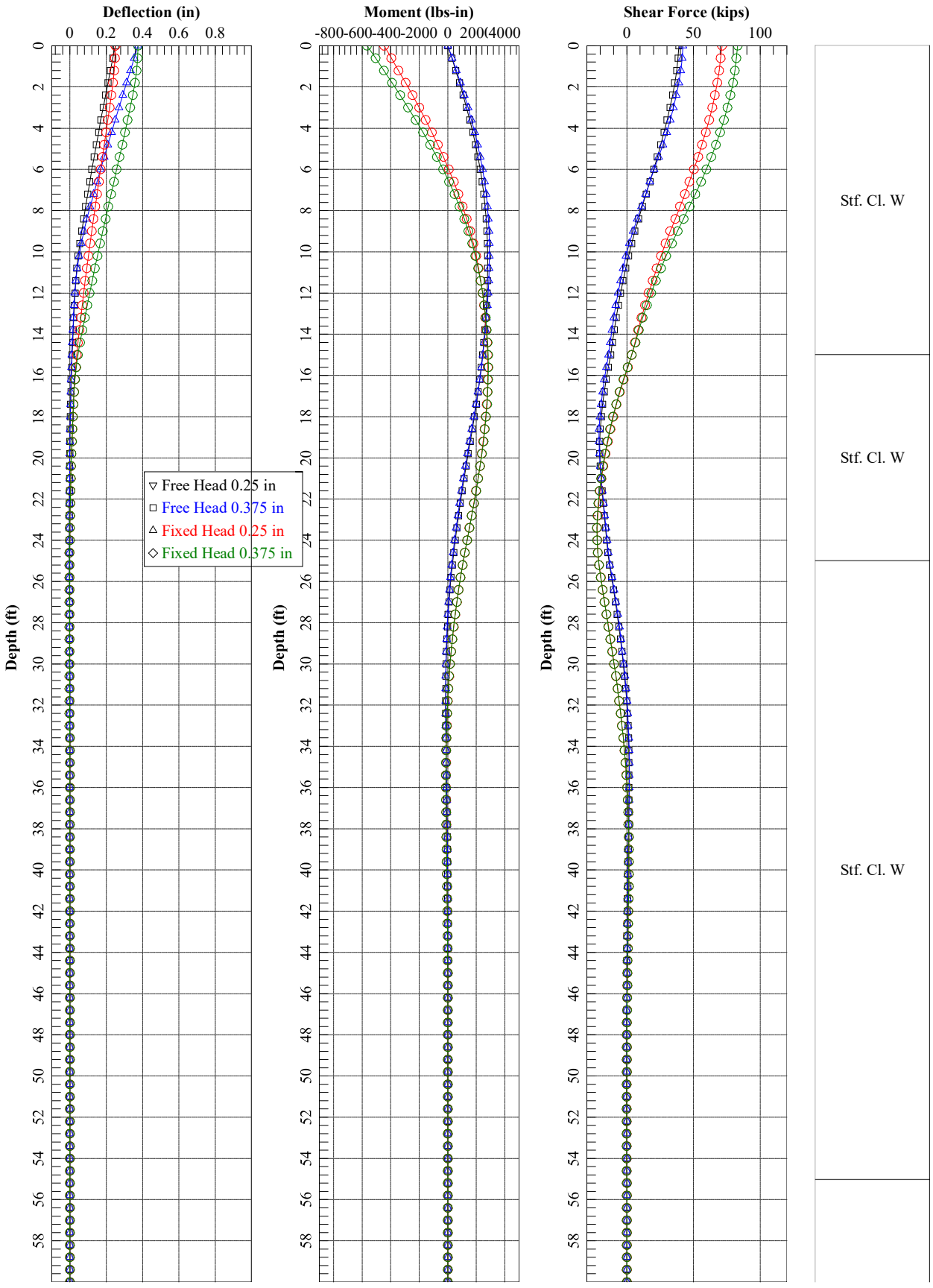
ORIGINATED BY: AF 5/18/2022
CHECKED BY: DSD 5/18/2022

LATERAL LOAD ANALYSIS - LPILE
(36-in Diameter)

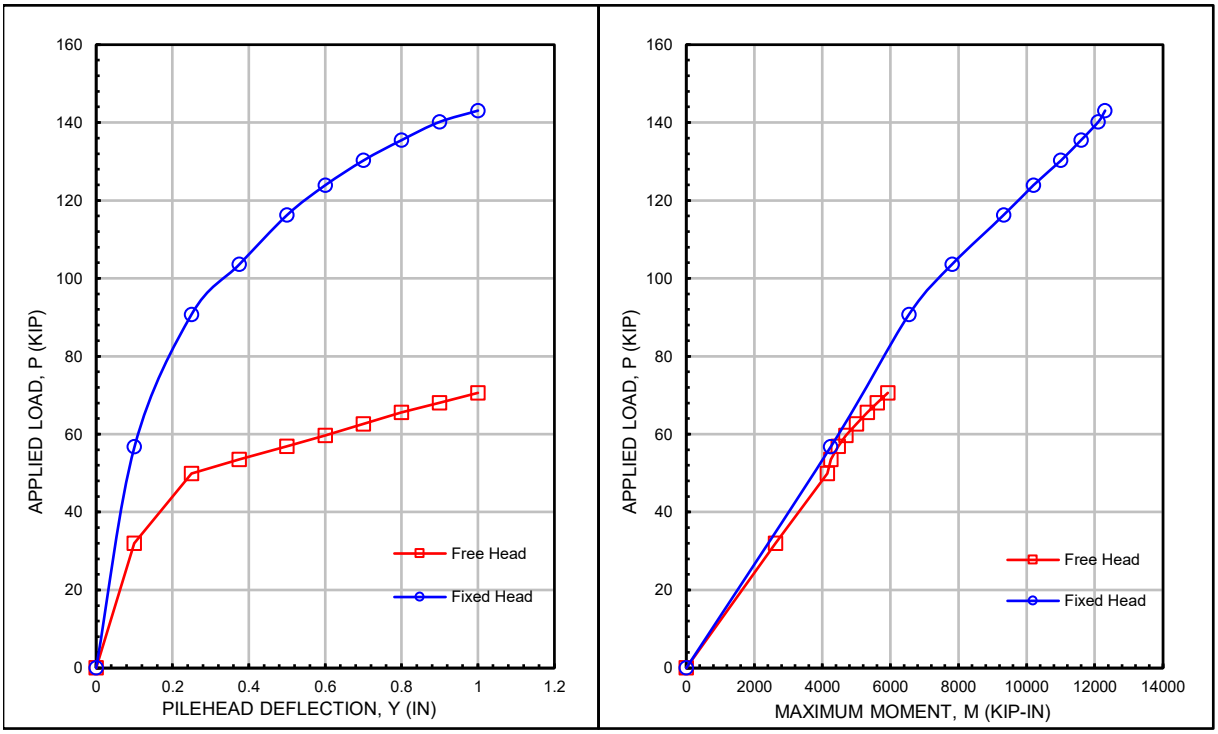


	FREE HEAD		FIXED HEAD					
DEFLECTION	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM
0	0	0	0	0				
0.1	26	1815	45	2885				
0.25	39	2797	71	4461				
0.375	42	2915	83	5659				
0.5	45	3074	92	6593				
0.6	47	3298	97	7171				
0.7	49	3515	102	7675				
0.8	52	3724	105	8025				
0.9	54	3942	109	8338				
1	56	4187	110	8452				

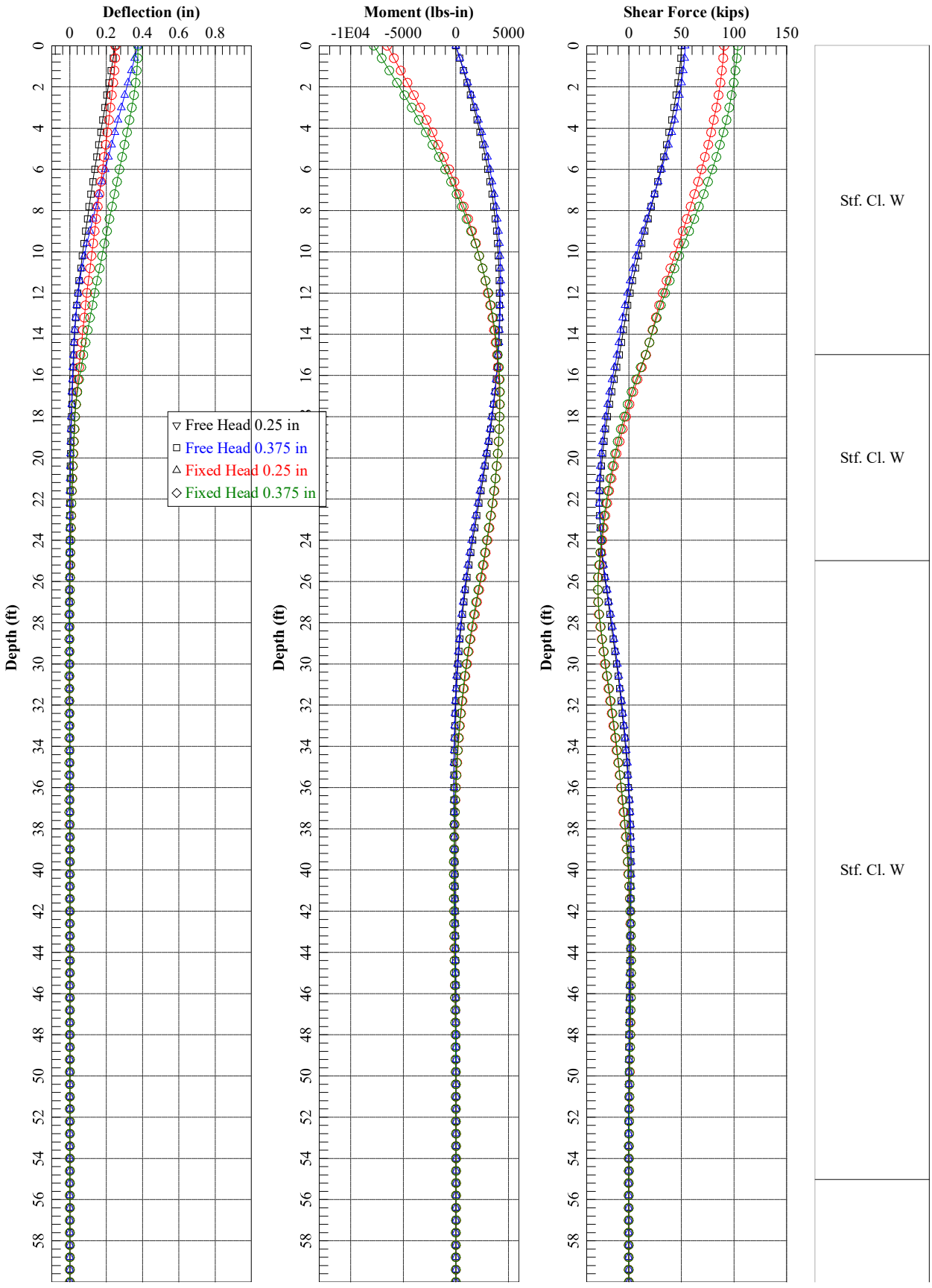

Deflection (in)
0 0.2 0.4 0.6 0.8
Moment (lbs-in)
-800-600-400-2000 0 200(4000
Shear Force (kips)
0 50 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58
▽ Free Head 0.25 in
□ Free Head 0.375 in
△ Fixed Head 0.25 in
◇ Fixed Head 0.375 in
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W

ORIGINATED BY: AF 5/18/2022
CHECKED BY: DSD 5/18/2022

LATERAL LOAD ANALYSIS - LPILE
(42-in Diameter)

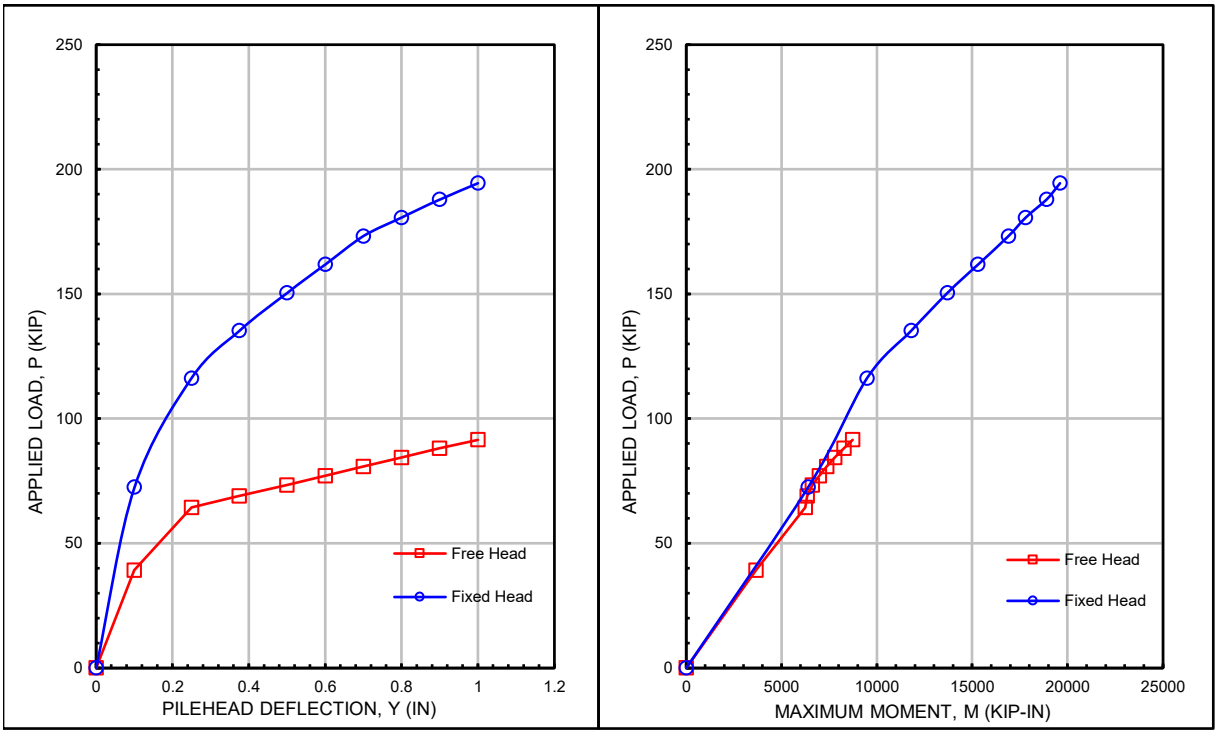


	FREE HEAD		FIXED HEAD					
DEFLECTION	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM
0	0	0	0	0				
0.1	32	2624	57	4245				
0.25	50	4145	91	6544				
0.375	54	4250	104	7810				
0.5	57	4467	116	9322				
0.6	60	4695	124	10200				
0.7	63	5000	130	11000				
0.8	66	5322	136	11600				
0.9	68	5610	140	12100				
1	71	5922	143	12300				

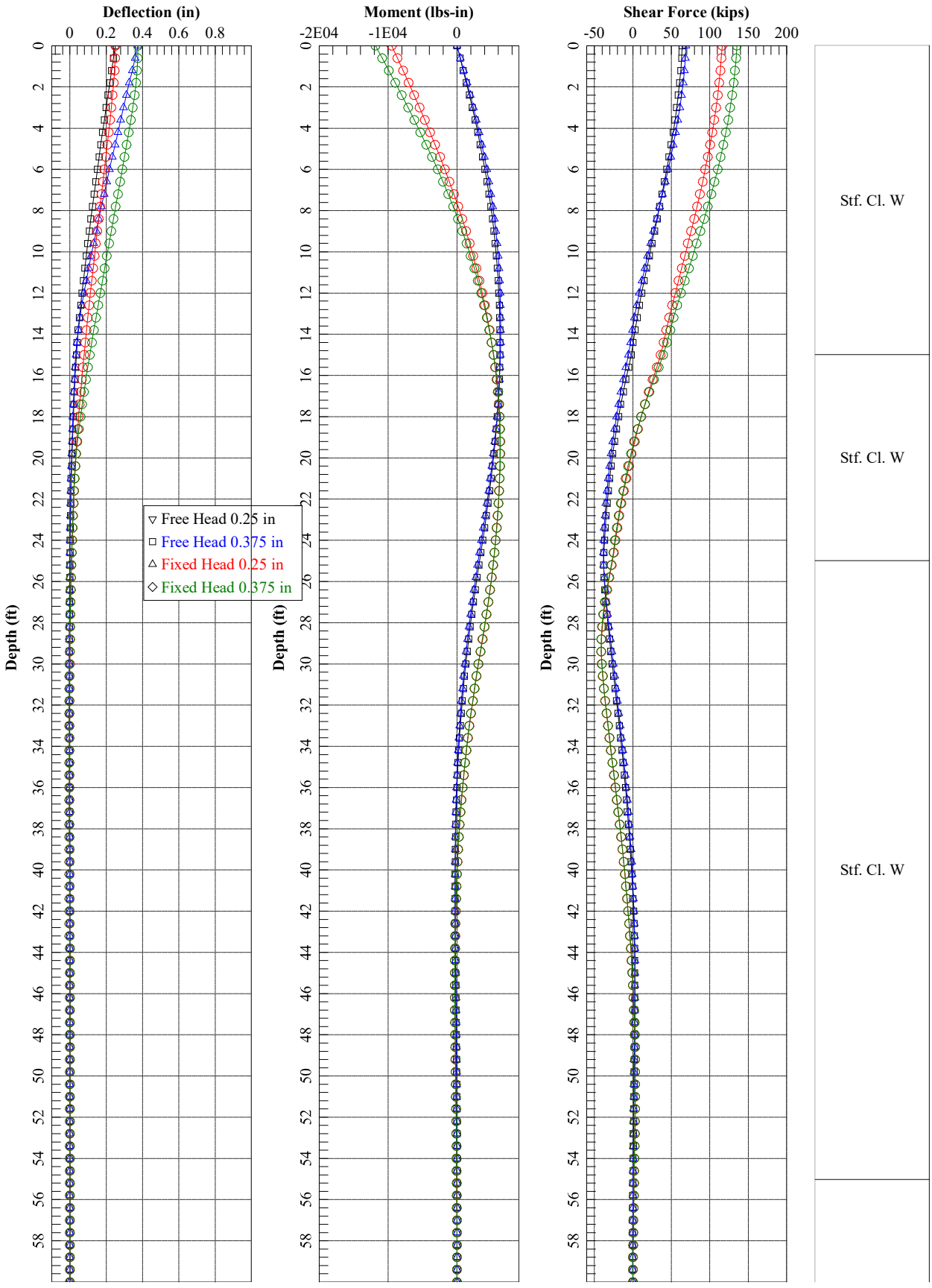

Deflection (in)
0
0.2
0.4
0.6
0.8
Moment (lbs-in)
-1E04
-5000
0
5000
Shear Force (kips)
0
50
100
150
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
Free Head 0.25 in
Free Head 0.375 in
Fixed Head 0.25 in
Fixed Head 0.375 in
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W

ORIGINATED BY: AF 5/18/2022
CHECKED BY: DSD 5/18/2022

LATERAL LOAD ANALYSIS - LPILE
(48-in Diameter)

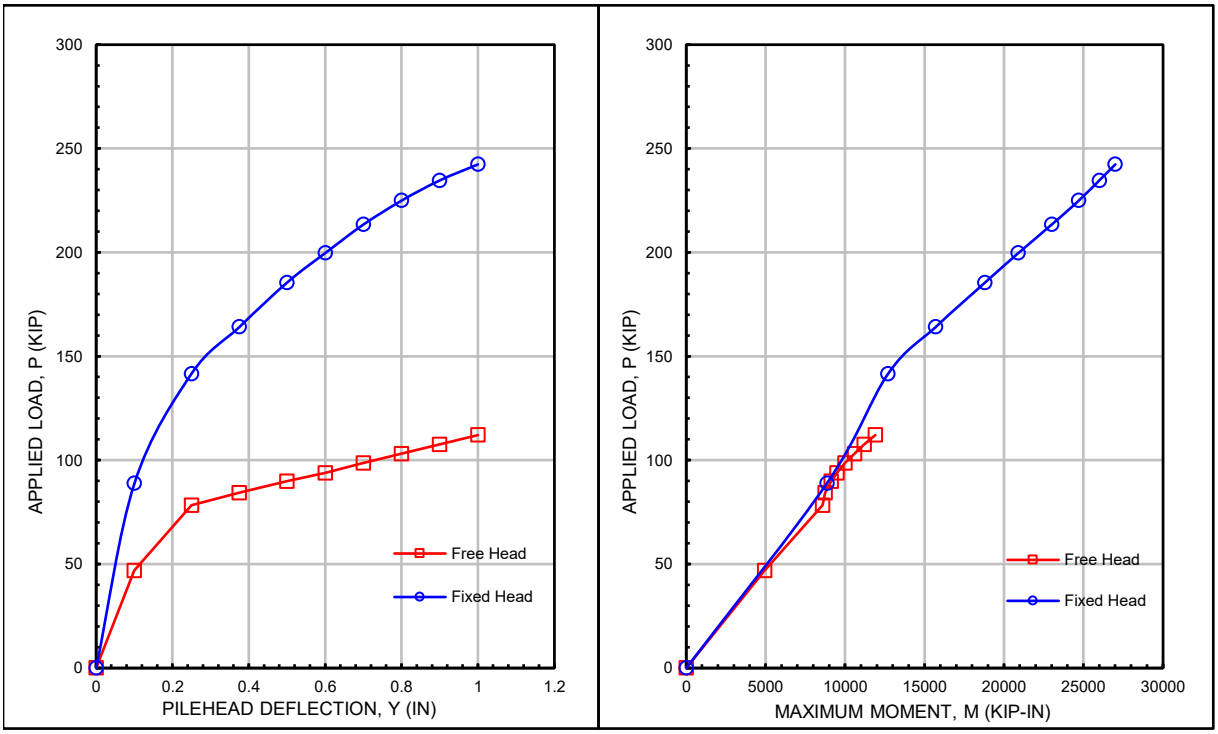


	FREE HEAD		FIXED HEAD					
DEFLECTION	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM
0	0	0	0	0				
0.1	39	3663	73	6398				
0.25	64	6242	116	9486				
0.375	69	6345	135	11800				
0.5	73	6617	150	13700				
0.6	77	6979	162	15300				
0.7	81	7368	173	16900				
0.8	84	7792	181	17800				
0.9	88	8270	188	18900				
1	92	8730	194	19600				

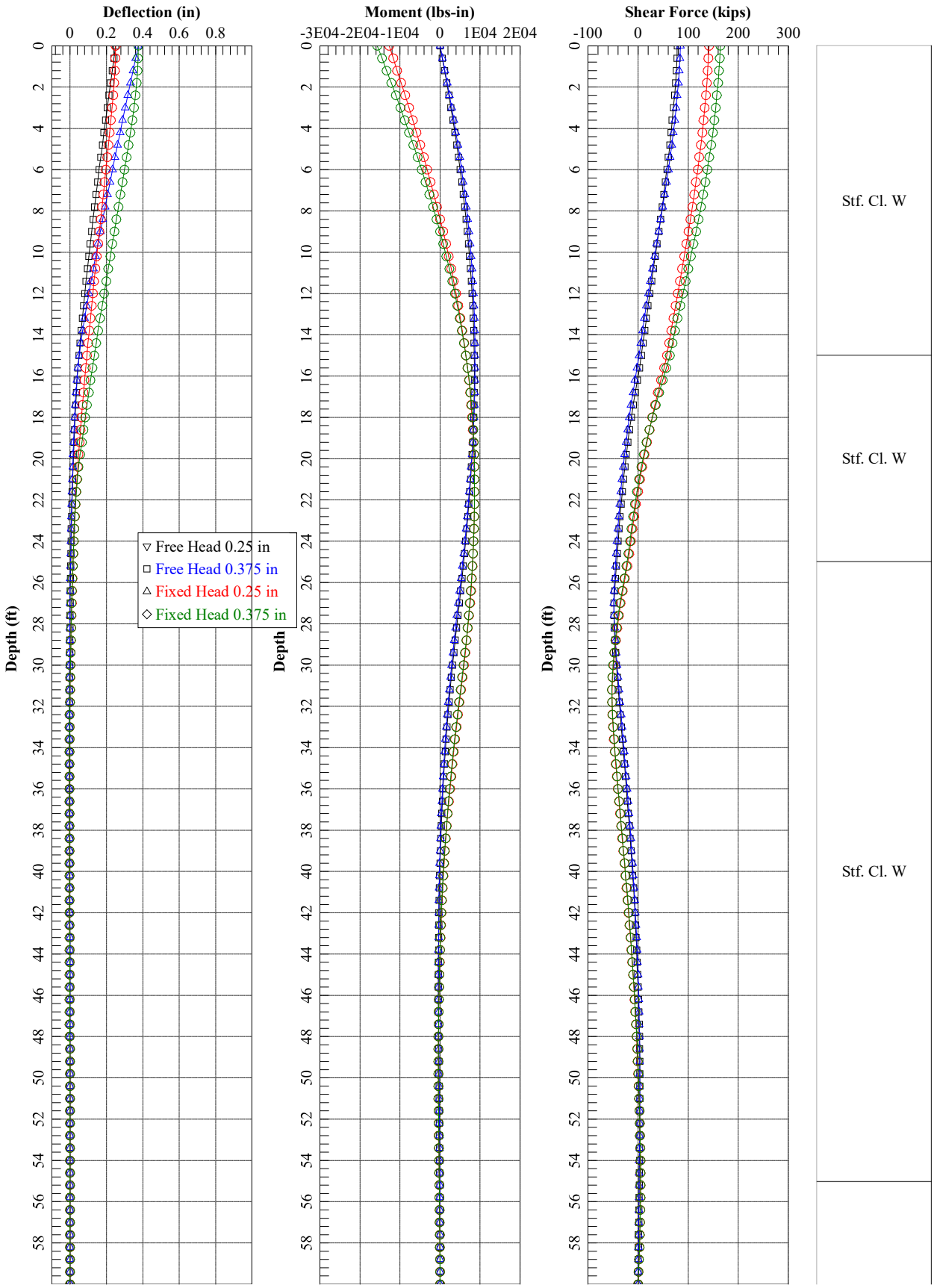

Deflection (in)
0
0.2
0.4
0.6
0.8
Moment (lbs-in)
-2E04
-1E04
0
Shear Force (kips)
-50
0
50
100
150
200
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
Free Head 0.25 in
Free Head 0.375 in
Fixed Head 0.25 in
Fixed Head 0.375 in
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W

ORIGINATED BY: AF 5/18/2022
CHECKED BY: DSD 5/18/2022

LATERAL LOAD ANALYSIS - LPILE
(54-in Diameter)

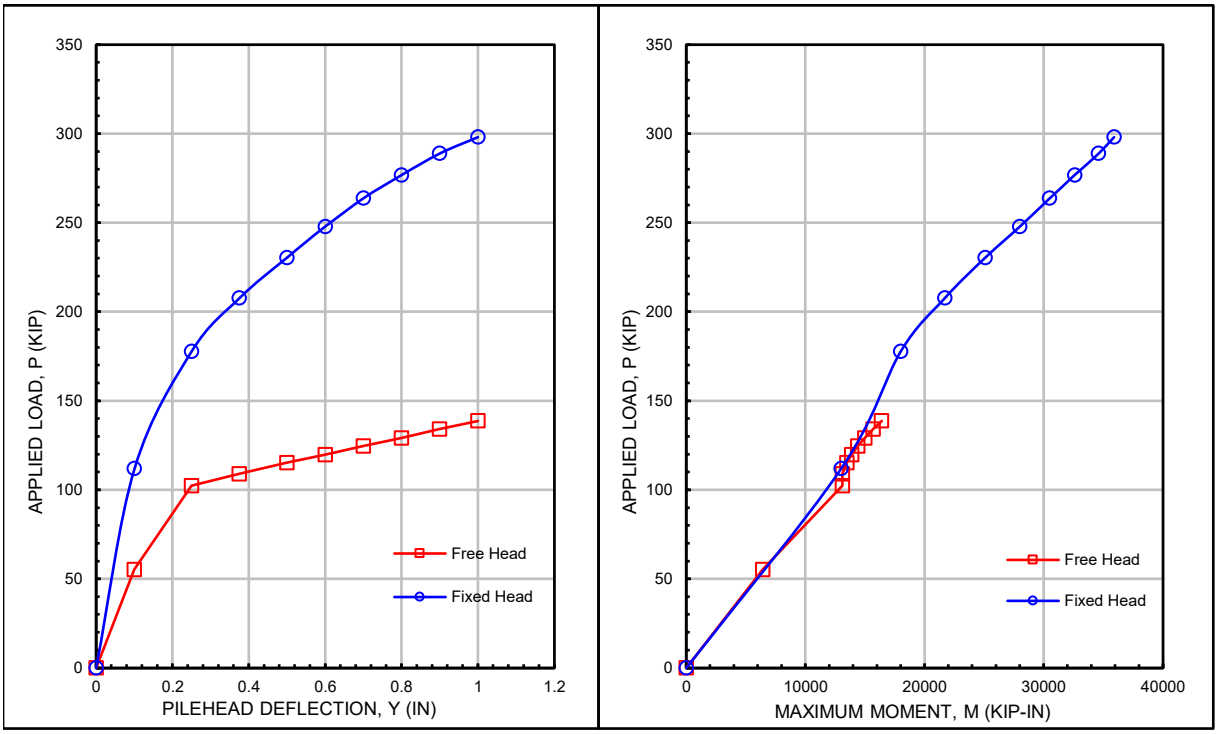


	FREE HEAD		FIXED HEAD					
DEFLECTION	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM
0	0	0	0	0				
0.1	47	4931	89	8859				
0.25	78	8594	142	12700				
0.375	84	8744	164	15700				
0.5	90	9124	186	18800				
0.6	94	9482	200	20900				
0.7	99	10000	213	23000				
0.8	103	10600	225	24700				
0.9	108	11200	235	26000				
1	112	11900	242	27000				

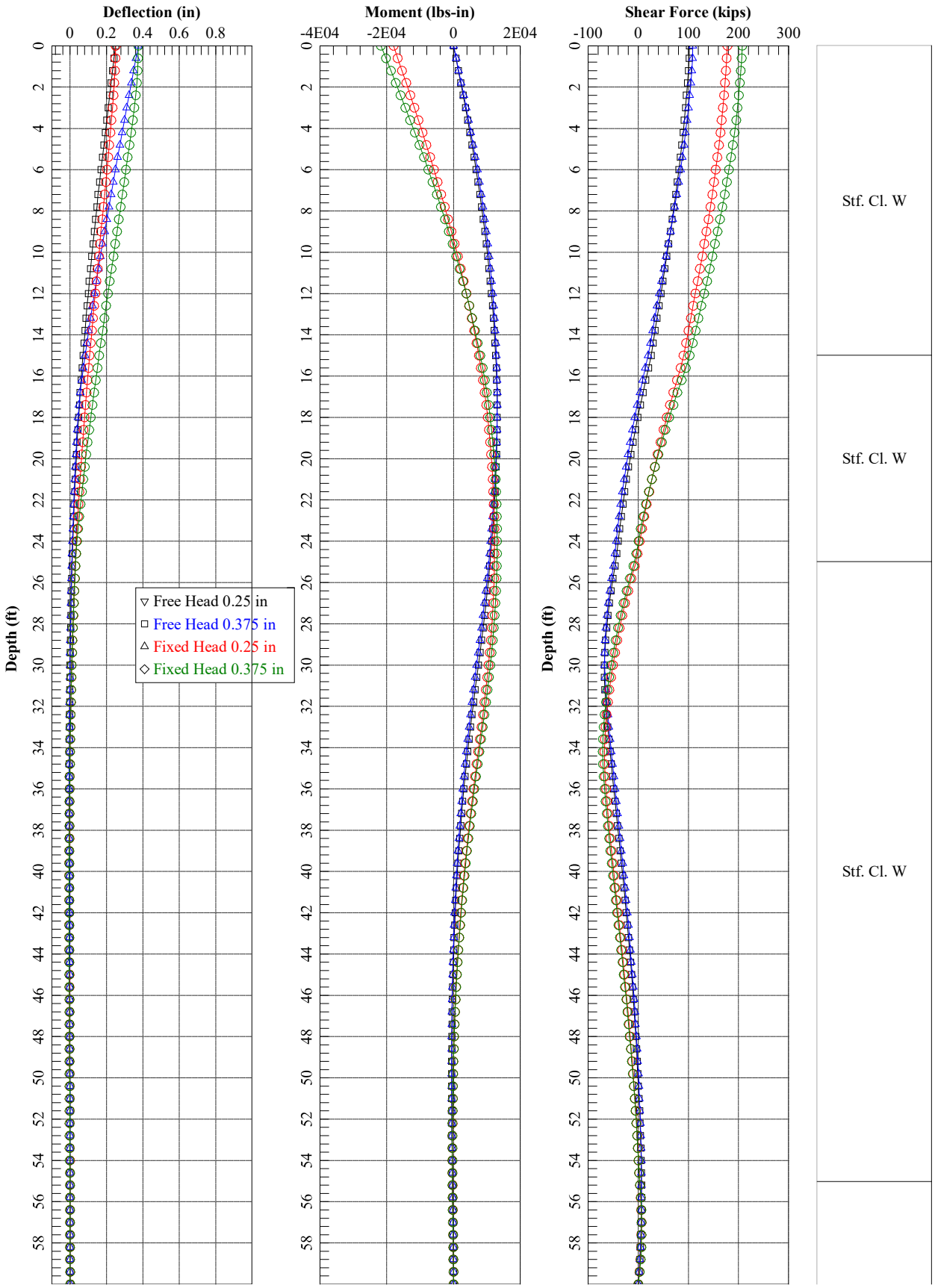

Deflection (in)
0 0.2 0.4 0.6 0.8
Moment (lbs-in)
-3E04 -2E04 -1E04 0 1E04 2E04
Shear Force (kips)
-100 0 100 200 300
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58
Free Head 0.25 in
Free Head 0.375 in
Fixed Head 0.25 in
Fixed Head 0.375 in
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W

ORIGINATED BY: AF 5/18/2022
CHECKED BY: DSD 5/18/2022

LATERAL LOAD ANALYSIS - LPILE
(60-in Diameter)



	FREE HEAD		FIXED HEAD					
DEFLECTION	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM	SHEAR	MAX MOM
0	0	0	0	0				
0.1	55	6429	112	13000				
0.25	102	13100	178	18000				
0.375	109	13100	208	21700				
0.5	115	13500	231	25100				
0.6	120	13900	248	28000				
0.7	125	14400	264	30500				
0.8	129	15000	277	32600				
0.9	134	15700	289	34600				
1	139	16400	298	35900				


Deflection (in)
0
0.2
0.4
0.6
0.8
Moment (lbs-in)
-4E04
-2E04
0
2E04
Shear Force (kips)
-100
0
100
200
300
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
Free Head 0.25 in
Free Head 0.375 in
Fixed Head 0.25 in
Fixed Head 0.375 in
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W

1501 Central St, Evanston, IL 60208, USA

Latitude, Longitude: 42.0654464, -87.69249459999999

Date	3/6/2022, 3:20:04 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	0.11	MCE_R ground motion. (for 0.2 second period)
S_1	0.06	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.176	Site-modified spectral acceleration value
S_{M1}	0.144	Site-modified spectral acceleration value
S_{DS}	0.117	Numeric seismic design value at 0.2 second SA
S_{D1}	0.096	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.055	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.088	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	0.11	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.116	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.06	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.068	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.952	Mapped value of the risk coefficient at short periods
C_{R1}	0.886	Mapped value of the risk coefficient at a period of 1 s

1501 Central St, Evanston, IL 60201, USA

Latitude, Longitude: 42.0651698, -87.69282249999999

Date	11/15/2022, 11:35:28 AM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	0.125	MCE_R ground motion. (for 0.2 second period)
S_1	0.059	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.2	Site-modified spectral acceleration value
S_{M1}	0.141	Site-modified spectral acceleration value
S_{DS}	0.133	Numeric seismic design value at 0.2 second SA
S_{D1}	0.094	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.062	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.1	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	0.125	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.137	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.059	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.067	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.062	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.913	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.873	Mapped value of the risk coefficient at a period of 1 s
C_V		Vertical coefficient

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