FOUNDATION ANALYSIS AND DESIGN REPORT

TO: Mark Bishop, PE, Kimley-Horn and Associates, Inc.

FROM: Jeffery K. Voyen, PE, American Engineering Testing, Inc.

DATE: June 25, 2014

SUBJECT: Cedar Lake Trail Pedestrian Bridge (East of Beltline Station)
Southwest Light Rail Transit Project
St. Louis Park, Minnesota
AET No. 01-05697.11

1.0 PROJECT INFORMATION

This report provides preliminary foundation recommendations for the pedestrian bridge which is intended to carry the Cedar Lake Trail over the LRT and freight rail tracks to the east of the Beltline Station in St. Louis Park. The location of the bridge has not been firmly established, although the current layout addressed in this report is presented on attached Figure 1. For the purpose of this report, bottom of foundation elevation is assumed to be about 5 feet below the current grade at the site.

The plan and profile sheets from the preliminary bridge plans are attached to this report.

The intent of this report is not to serve as a final design report, but a preliminary report to assist advanced design and preliminary pricing. Additional testing and analysis is intended to be performed for final design.

2.0 SUBSURFACE EXPLORATION SUMMARY

2.1 Scope

Numerous borings have been conducted in the area. This report includes those borings which were specifically completed for the current bridge layout, but also includes borings away from the bridge which may assist evaluation of potential relocation. This report includes the following borings:

- Current bridge location: 1232 SB, 1235 SB, 1236 SB, 1238 SB
- Current approach/retaining walls: 1227 SW, 1065 SS, 1167 ST, 1062 ST, 1061 ST
- Potential relocation areas: 1263 SB, 1166 ST, 1064 ST

The locations of the above listed borings appear on attached Figure 1.

2.2 Laboratory Scope

During laboratory classification logging, water content tests were conducted on cohesive soil samples. In addition, a sieve analysis test (-#200) was performed on a sample from Boring 1064 ST. The test results appear on the individual boring logs, opposite the samples upon which they were performed.

2.3 Methods

2.3.1 Standard Penetration Test Borings

Logs of the above noted borings are attached. The SPT borings were drilled with 3.25 inch diameter hollow stem augers and mud rotary drilling methods. Standard penetration test samples were taken with split-barrel samplers per ASTM: D1586, with the exception that the hammers were calibrated to near N_{60} values, consistent with MnDOT requirements. Additional details of the methods used appear on the attached sheet entitled *Exploration/Classification Methods*.

The soils were classified per the Unified Soil Classification System. The Soil Group category per the AASHTO Soil Classification System is also noted. The attached boring logs contain information concerning soil layering, soil classification, geologic description, and moisture condition. Relative density or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

2.4 Geology/Soils Review

The generalized geologic profile consists of mixed fill over water-deposited (alluvial) soils, with glacial till deposits at depth. Limestone bedrock (Platteville Formation) is about 63½ feet to 67½ feet deep. The fill is sometimes underlain by organic swamp deposits (peats and organic clays).

The fill thickness ranges from about 2 feet to 16½ feet. The fill is generally granular (sands to silty sands), with occasional clayey or organic inclusions. Many of the borings also encountered ashes/cinders and debris, such as wood, brick, glass, metal, and bituminous.

The alluvium is mostly sand and sand with silt, sometimes having significant gravel content. Lean clay is occasionally present at the top of the alluvial deposit. The glacial till is mostly clayey sand.

2.5 Ground Water

Water levels appeared in the boreholes at depths ranging from about 7½ feet to 16½ feet. As many levels were measured in granular soils, they should reasonably represent the hydrostatic ground-water level for that time and location. Some of the higher levels may be held-up on slower draining soils. Water levels are generally anticipated to be in the vicinity of 873½ feet on the west end to 870 feet on the east end. Ground-water levels should be expected to fluctuate both seasonally and annually.

3.0 FOUNDATION REVIEW

3.1 Foundation Type

In much of the bridge and retained wall approach area, either alluvial sands are present at foundation grade or are at a reasonable depth below foundation grade such that a local excavate/refill correction operation could be performed to allow spread foundation support. However, there are areas where the compressible swamp deposits are present to substantial depths where soil correction is not practical or cost effective. In these areas, a deep foundation system is likely more feasible. A ground improvement approach, such as rammed aggregate piers, could also be considered.

3.2 Spread Foundation for Bridge and Retained Wall Approaches

The alluvial sands are judged competent to support spread foundations. However, we recommend the existing fill and any underlying organic soils and very soft to soft clays not be relied upon for foundation support. Excavation to assumed foundation grade is expected to expose either the mixed fill, or the alluvial sandy soils in some cases. Where fill is encountered, we recommend excavation of the fill, plus any underlying organic and very soft to soft soils which are found beneath the fill. The excavation should mainly expose alluvial sandy soils (the clayey soils are more likely to be found in areas where spread foundations are not feasible). Excavation depth needed at each boring included in the report is shown on Table 3.2.

Table 3.2 –Required Excavation Depth

Boring No.	Boring Surface Elevation, ft	Excavation Depth, ft	Excavation Elevation, ft	Ground Water Anticipated
1061 ST	886.4	2	884½	no
1062 ST	887.8	4	883½	no
1063 ST	887.6	6½	881	no
1064 ST	884.9	24	861	yes
1065 SS	886.9	2	885	no
1166 ST	884.3	12	873	possible
1167 ST	886.4	9	877½	no
1227 SW	886.9	29	858	yes
1232 SB	885.6	9	876½	no
1235 SB	886.5	14	872½	no
1236 SB	886.1	16½	869½	yes
1238 SB	888.4	4	884½	no
1262 ST	884.7	12	872½	yes
1263 SB	884.9	26½	858½	yes

Where excavation depths extend below the water level, it will likely be more feasible to consider alternate foundation support. Space constraints may also impact spread foundation support feasibility, considering excavation oversizing requirements.

Excavations and subsequent engineered fill placement should maintain minimum lateral oversizing of the excavation bottom. This lateral excavation oversizing should be a minimum of 1:1(H:V). The exception would be if organic soils are encountered during the excavation. If excavation sides expose organic soils, the lateral excavation bottom oversize requirement should be increased to at least 1.5:1 (H:V).

Engineered fill placed below foundations should meet the requirements of MnDOT Specification 3149.2B1 for Granular Borrow. On-site soils could be used, provided they are evaluated at the time of construction to uniformly meet material specifications and to be free of organic soils and debris.

The fill should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 98% of the *standard maximum dry unit weight* per ASTM:D698 (Standard Proctor test). The fill lift thicknesses should be no greater than 12 inches for granular soils and no greater than 8 inches for more clayey/silty soils. The lifts should be thinner than the above if needed to achieve the minimum specified compaction level with the type of compaction equipment being used.

3.3 Spread Foundation Design

Considering the preliminary nature of the bridge and approach design, specific foundation load information is not yet available. Advanced design should consider strength resistance and settlement control under axial loads; and for imbalanced/retained loads, resistance to sliding and global stability. For preliminary purposes, the foundations can be sized for an allowable bearing pressure of 4,000 psf (per Allowable Stress Design methods).

3.4 Pile Foundation Support

Where correction needs or space limitations deem spread foundation support unfeasible, it would be possible to support foundations on driven piling. As bedrock is on the order of 63½ feet to 67½ feet deep, the use of H-pile driven to refusal on the bedrock may be the feasible foundation approach. The following Factored Bearing Resistance values can be assumed for the listed sizes:

- HP10x42: φR_n = 110 tons
- HP12x53: φR_n = 140 tons
- HP14x73: φR_n = 190 tons

It may be possible to consider CIP steel pipe pile driven to more shallow depths, particularly if pile resistance needs are somewhat less.

3.5 Approach Considerations

Fill will be placed between the retained walls leading up to the structured bridge. The fill will impose loads upon underlying soils. If areas of organic soils are not corrected per that recommended for foundation support, excessive trail settlement may result. In the current bridge location, this is mainly an issue with the west end of the west approach, defined by Boring 1227 SW. If an approach and structured wall is to remain at this location, driven piles will likely be used for wall support. Approach fill could also be supported on pile in conjunction with the wall support. Other alternates include the use of lightweight fill to avoid added loads or specialty contractor ground improvement techniques.

4.4 Retaining Wall Backfilling

Imbalanced retaining walls and abutment/wing walls should be designed to properly resist the lateral pressures exerted. The backfill material should consist of Select Granular Borrow (MnDOT 3149.2B2), which is modified to containing less than 10% by weight passing the #200 sieve. The "Select Granular Borrow 10% Modified" geometry should be maintained per the requirements shown on attached MnDOT *Diagram F-1*. However, all excavation backsloping must also meet OSHA requirements and the need for frost zone tapering below the approach pavement. For trail approach performance, frost tapering of the Select Granular Borrow below the trail of 1V:10H is recommended within the frost zone (assume a frost zone of 4.5 feet). The backfill should be compacted per the Specified Density Method (MnDOT 2105.3F1). The wall design can be based on lateral pressures presented in MnDOT design charts.

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under Minnesota Statute Section 326.02 to 326.15

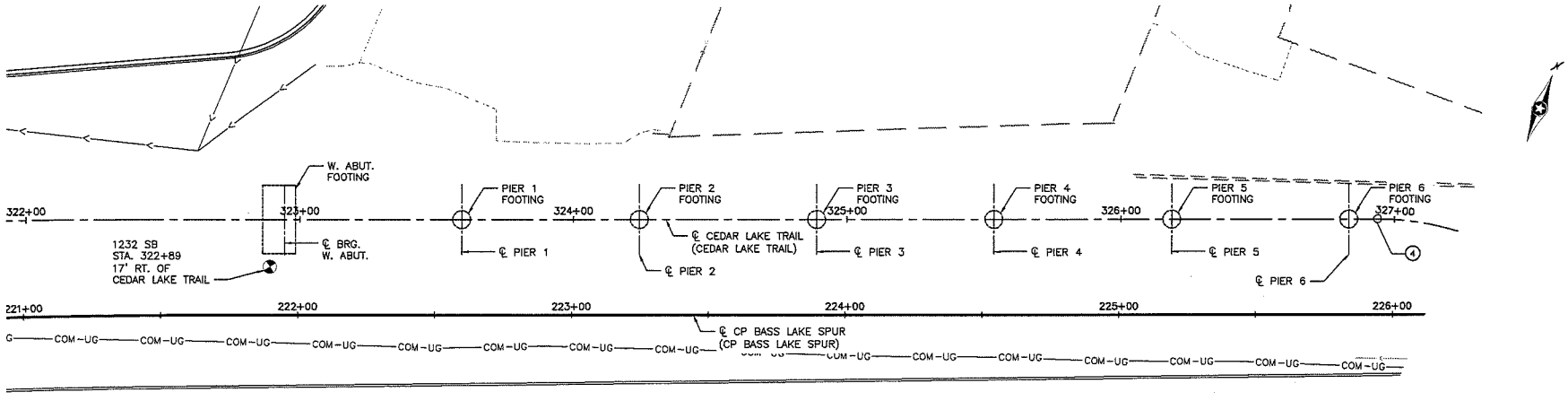
Name: Jeffery K. Voyen
Jeffery K. Voyen

Date: 6/25/14 **License #: 15928**

Report Reviewed By: Joseph G. Bentler
Joseph G. Bentler, PE

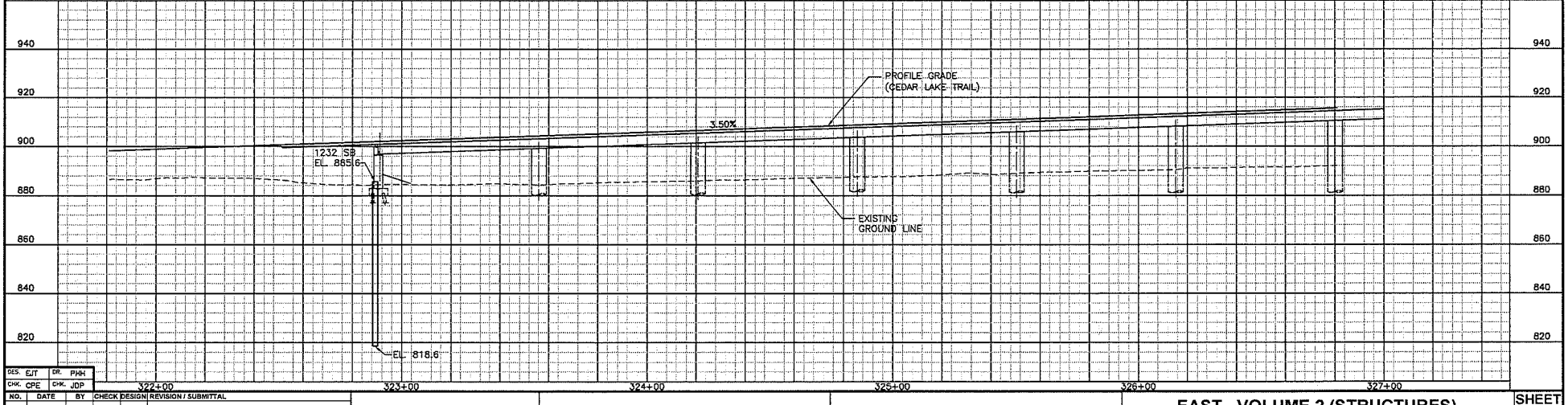
Attachments:

- Preliminary Bridge Plan-Profile Sheets
- Figure 1 – Boring Locations
- Subsurface Boring Logs
- Exploration/Classification Methods
- Boring Log Notes
- Unified Soil Classification System
- AASHTO Soil Classification System
- MnDOT Diagram F-1



NOTES:

1. THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS UTILITY QUALITY LEVEL WAS DETERMINED ACCORDING TO GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA".
2. FOR COORDINATES OF P.C. AND P.T., SEE GENERAL PLAN , SHEET 112.



DES. EJT	DR. PMH
CHK. CPE	CHK. JDP

NO.	DATE	BY	CHECK	DESIGN	REVISION / SUBMITTAL

Kimley»Horn

PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

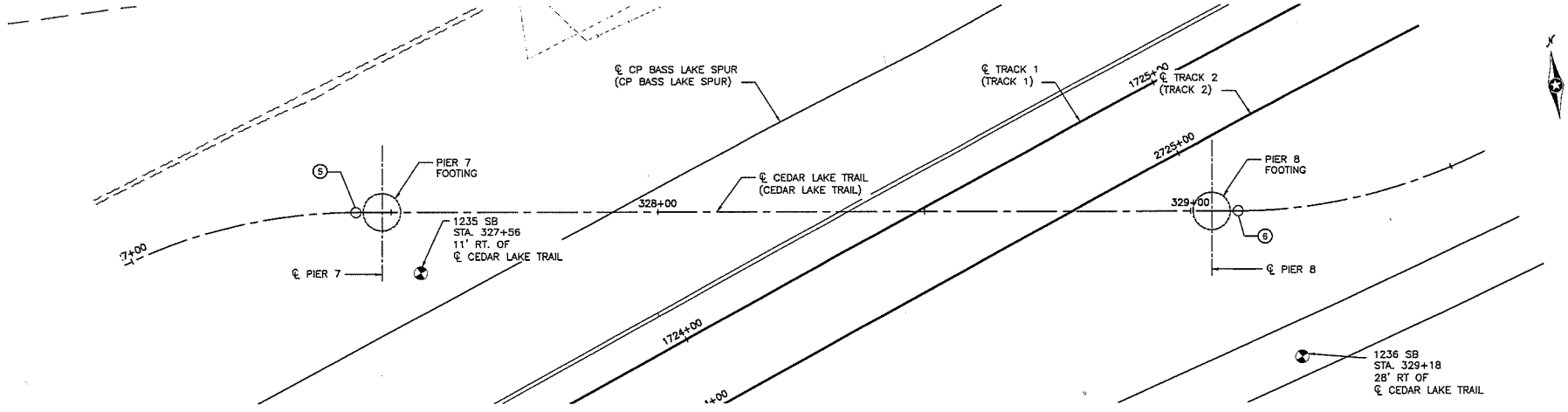
EAST - VOLUME 2 (STRUCTURES)
CEDAR LAKE TRAIL
BRIDGE XXXXX (TRL)
BORINGS (1 OF 4)

DISCIPLINE: STRUCTURES

SHEET NAME: E2-STU-BRG-CLTR-TRL-BOR-001

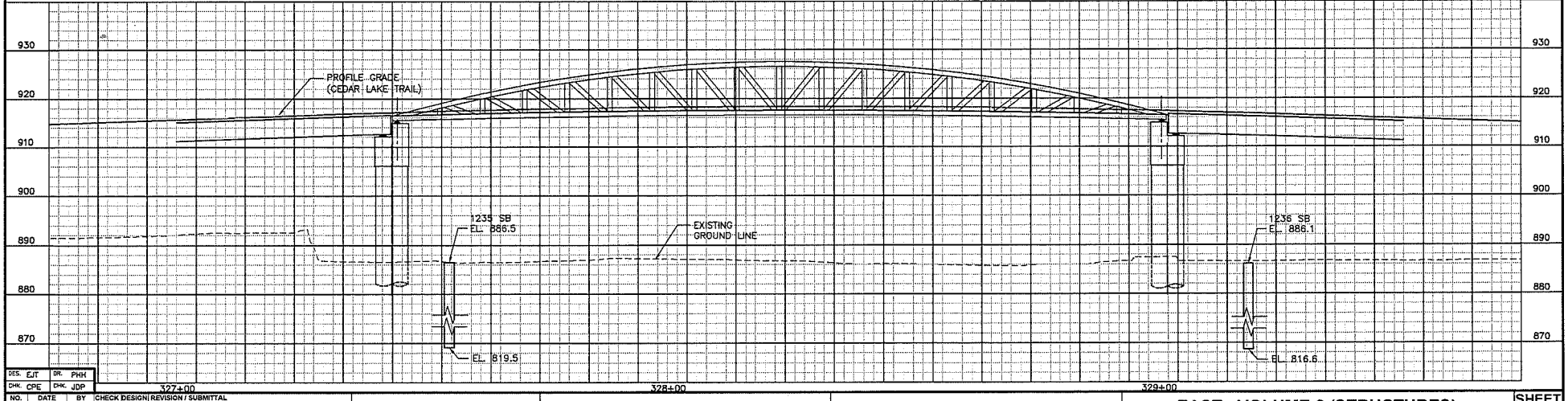
SHEET 119 OF 277

Jun. 20 2014 11:40 am V:\3300_pec-e\CAD\segment e2\plan sheets\structures\E2-STU-BRG-CLTR-TRL-SUR-002.dwg By: Katie.Ellis



NOTES:

1. THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS UTILITY QUALITY LEVEL WAS DETERMINED ACCORDING TO GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA".
2. FOR COORDINATES OF P.C. AND P.T., SEE GENERAL PLAN, SHEET 112.



DES. EJT	DR. PHK
CHK. CPE	CHK. JDP

NO.	DATE	BY	CHECK	DESIGN	REVISION / SUBMITTAL

Kimley»Horn

PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

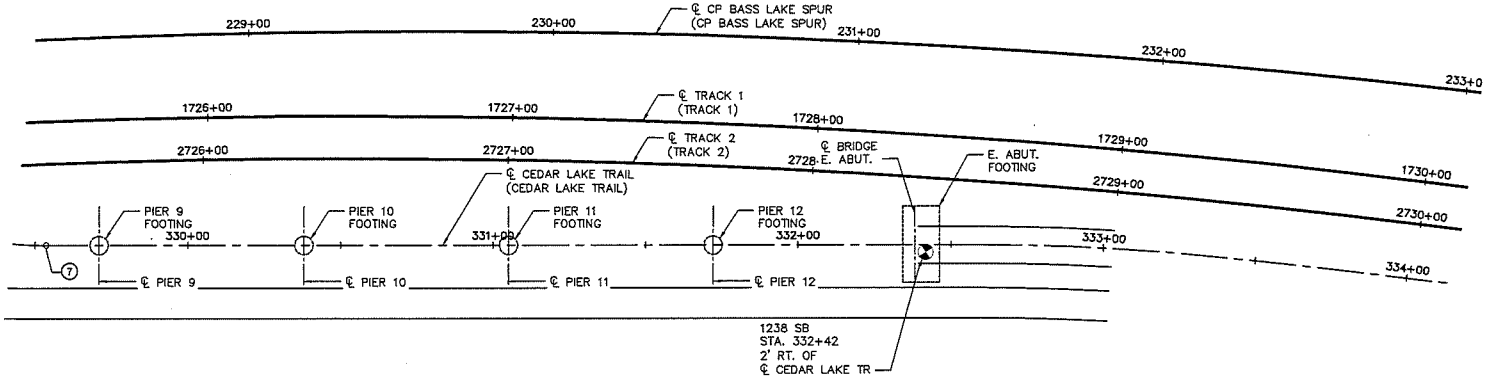
EAST - VOLUME 2 (STRUCTURES)
CEDAR LAKE TRAIL
BRIDGE XXXXX (TRL)
BORINGS (2 OF 4)

DISCIPLINE: STRUCTURES

SHEET NAME: E2-STU-BRG-CLTR-TRL-BOR-002

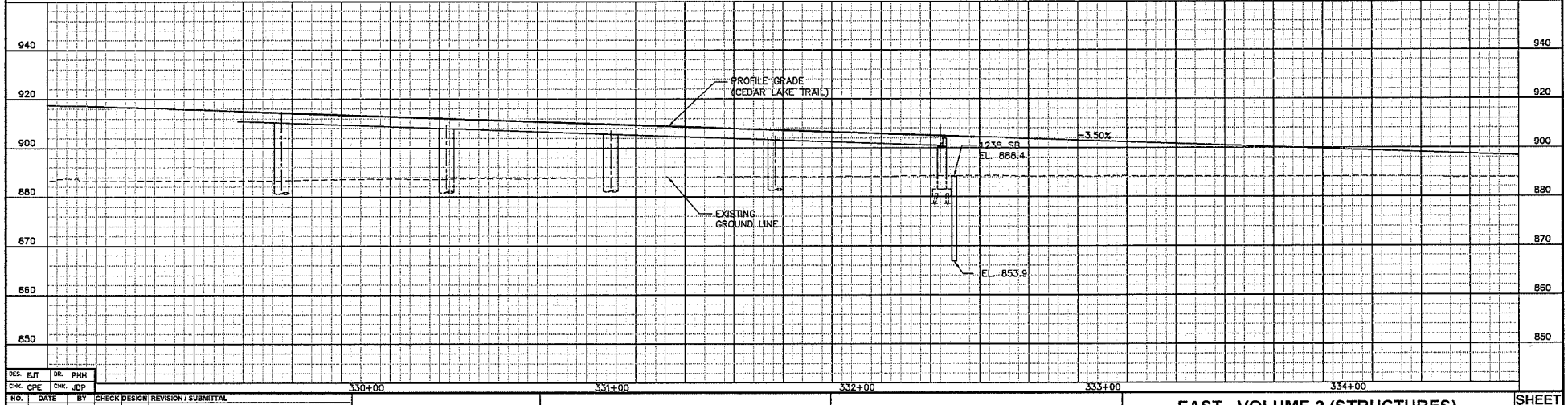
SHEET 120 OF 277

Jun, 20 2014 11:41 am V:\3300_pec--e\CAD\segment e2\plan sheets\structures\E2-STU-BRG-CLTR-TRL-SUR-003.dwg By: Katie.Ellis



NOTES:

1. THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS UTILITY QUALITY LEVEL WAS DETERMINED ACCORDING TO GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA".
2. FOR COORDINATES OF P.C. AND P.T., SEE GENERAL PLAN, SHEET 112.



DES. EJT	DR. PHH
CHK. CPE	CHK. JDP

NO.	DATE	BY	CHECK	DESIGN	REVISION / SUBMITTAL

Kimley»Horn

PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

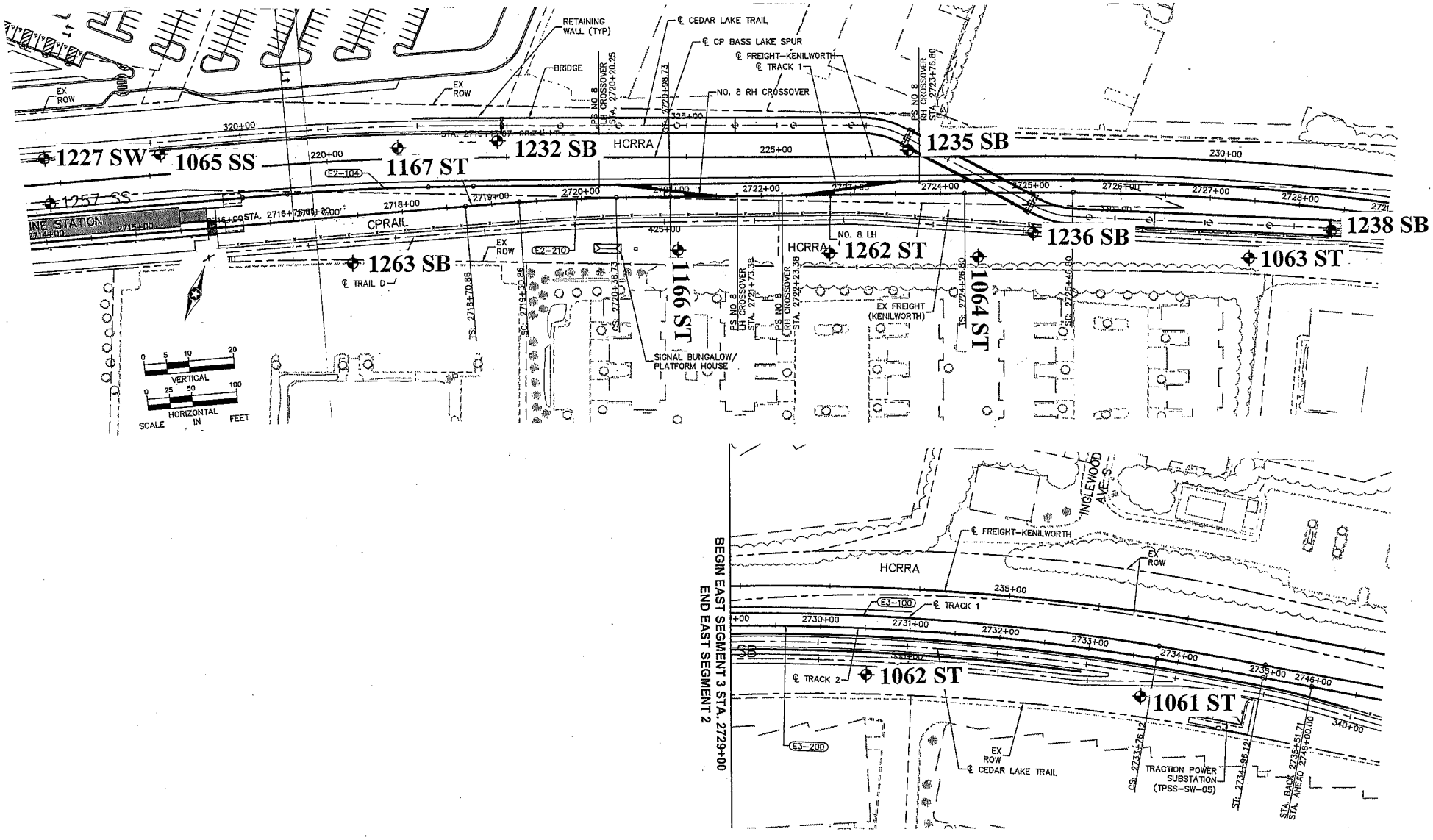
EAST - VOLUME 2 (STRUCTURES)
CEDAR LAKE TRAIL
BRIDGE XXXXX (TRL)
BORINGS (3 OF 4)

DISCIPLINE: STRUCTURES

SHEET NAME: E2-STU-BRG-CLTR-TRL-BOR-003

SHEET 121 OF 277

Jun, 20 2014 11:43 am W:\3300_pec-e\CAD\segment e2\plan sheets\structures\E2-STU-BRG-CLTR-TRL-SUR-004.dwg By: Kolie.Ellis



AMERICAN ENGINEERING TESTING, INC.	**PROJECT** Cedar Lake Trail Pedestrian Bridge, East of SWLRT Beltline Station			**AET NO.** 01-05697.11
	SUBJECT Boring Locations			**DATE** June 24, 2014
	SCALE 1" = 160'±	**PREPARED BY** KHA	**CHECKED BY** JV	**FIGURE 1**

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	Southwest LRT, PEC East	1061 ST	886.4 (Surveyed)

Location , , ft. LT

Co. Coordinate: X=513217 Y=156234 (ft.)

Latitude (North)=44.9453290 Longitude (West)=-93.3322907

Drill Machine 1C

Hammer CME Automatic Calibrated

SHEET 1 of 1

Drilling Completed 6/3/13

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60	MC (%)	COH (psf)	γ (pcf)	Soil / Rock	Other Tests Or Remarks / Formation or Member
	0.3 / 886.2		Gravel with sand, brown (A-1-b) fill							
	2.0 / 884.4		Gravel with sand, a little silty sand with organic fines, pieces of wood, trace roots, brownish gray, a little black (A-1-b) fill		13					Hammer Calibration: 66% efficiency with 105 lb. hammer, 9/18/13
	4.0 / 882.4		SAND, fine to medium grained, light brown, moist, medium dense (SP) (A-3) alluvium or fill		22					
5	6.5 / 879.9		GRAVELLY SAND, medium grained, light brown, moist, medium dense (SP) (A-1-b) alluvium or fill		20					
	9.0 / 877.4		SAND, a little gravel, trace roots, medium grained, light brown, moist, medium dense (SP) (A-1-b) alluvium or fill		16					
10	11.5 / 874.9		SAND, medium grained, light brown, moist, medium dense (SP) (A-1-b) alluvium		16					
	14.0 / 872.4		SAND WITH GRAVEL, medium to fine grained, light brown, moist, medium dense (SP) (A-1-b) alluvium		20					
15	16.5 / 869.9		GRAVELLY SAND, medium to coarse grained, brown, waterbearing, medium dense (SP) (A-1-b) alluvium		16					Water level measured at 16.4' deep with HSA to 19.5' deep
	19.0 / 867.4		SAND WITH GRAVEL, fine to medium grained, brown, waterbearing, medium dense (SP) (A-1-b) alluvium		16					
20	21.5 / 864.9		SAND, a little gravel, medium to fine grained, brown, waterbearing, medium dense (SP) (A-1-b) alluvium		15					
			END OF BORING							

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1062 ST**	**887.8** (Surveyed)

Location , , **ft. LT**

Co. Coordinate: X=512914 Y=156191 (ft.)

Latitude (North)=44.9452116 Longitude (West)=-93.3334609

Drill Machine **1C**

Hammer **CME Automatic Calibrated**

SHEET 1 of 1

Drilling Completed **6/3/13**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} (%)	MC (%)	COH (psf)	γ (pcf)	Soil / Rock	Other Tests Or Remarks / Formation or Member
	0.3 / 887.5		Gravel with sand (A-1-b) fill							
	2.0 / 885.8		Silty sand with gravel, a little clayey sand with organic fines, brown, a little dark brown (A-2-4) fill		13					Hammer Calibration: 66% efficiency with 105 lb. hammer, 9/18/13
	4.0 / 883.8		Sand, a little ashes/cinders and gravel, light brown (A-1-b) fill		17					
5	6.5 / 881.3		SAND WITH SILT, a little gravel, fine to medium grained, light grayish brown, moist, medium dense (SP-SM) (A-3) alluvium		17					
10	11.5 / 876.3		SAND WITH GRAVEL, medium grained, light brown, moist, medium dense (SP) (A-1-b) alluvium		23					
	14.0 / 873.8		SAND, a little gravel, medium to fine grained, light brown, moist, medium dense (SP) (A-1-b) alluvium		22					
15	16.5 / 871.3		SAND WITH SILT AND GRAVEL, medium to fine grained, brown, moist, dense (SP-SM) (A-1-b) alluvium		23					
▼					40					Water level measured at 16.6' deep with HSA to 17' deep
20	21.0 / 866.8		SAND WITH GRAVEL, medium grained, brown, waterbearing, medium dense (SP) (A-1-b) alluvium		16					
			END OF BORING		19					

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

METROPOLITAN COUNCIL

MINNESOTA DEPARTMENT OF TRANSPORTATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1063 ST**	**887.6** *(Surveyed)*

Location **, , ft. LT**

Co. Coordinate: X=512626 Y=156111 (ft.)

Latitude (North)=44.9449927 *Longitude (West)=-93.3345733*

Drill Machine **1C**

Hammer **CME Automatic Calibrated**

SHEET 1 of 1

Drilling Completed **6/3/13**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	0.3 887.4		Gravelly sand, a little clayey sand with organic fines, trace roots, brown, a little black (A-1-b) fill		19					Hammer Calibration: 66% efficiency with 105 lb. hammer, 9/18/13
			Sand with silt and gravel, a little clayey sand, light brown, a little brown (A-1-b) fill		25					
	4.0 883.6		Sand with gravel, a little sand with silt, light brown, a little brown (A-3) fill		23					
5	6.5 881.1		SAND WITH GRAVEL, medium to fine grained, light grayish brown, moist, medium dense (SP) (A-1-b) alluvium or fill		19					
	9.0 878.6		GRAVELLY SAND WITH SILT, medium to fine grained, brown, moist, medium dense (SP-SM) (A-1-b) alluvium or fill		21					
10	11.5 876.1		SAND WITH GRAVEL, medium to fine grained, light grayish brown, a little brown, moist, medium dense (SP) (A-1-b) alluvium		14					
	14.0 873.6		SAND WITH SILT, a little gravel, fine to medium grained, brown, moist to waterbearing, medium dense, a lens of fine grained silty sand (SP-SM) (A-3) alluvium		30					Water level measured at 15.2' deep with HSA to 19.5' deep
▼15	16.5 871.1		SAND, a little gravel, medium grained, brown, waterbearing, medium dense (SP) (A-1-b) alluvium		14					
20	21.0 866.6		END OF BORING		12					

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1064 ST**	**884.9** *(Surveyed)*

Location **, , ft. LT**
Co. Coordinate: X=512344 Y=156005 (ft.)
Latitude (North)=44.9447024 Longitude (West)=-93.3356626

Drill Machine **1C**
Hammer **CME Automatic Calibrated**

SHEET 1 of 2
Drilling Completed **6/11/13**

DEPTH / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
0.3 / 884.6		Mixture of gravelly sand with silt and clayey sand, trace roots, dark brown (A-2-4) fill		17					Hammer Calibration: 66% efficiency with 105 lb. hammer, 9/18/13
2.0 / 882.9		Sand with silt and gravel, brown (A-3) fill		4					-#200 = 21%
5		Silty sand, pieces of glass, ashes/cinders, trace roots, dark brown (A-1-b) fill		4					
7.0 / 877.9		Sand with silt and gravel, pieces of brick, dark brown and grayish brown (A-3) fill		4					
▼10				21					Water level measured at 10.0' deep with HSA to 12' deep
12.0 / 872.9		Sand, a little sand with silt, grayish brown, a little dark gray (A-1-b) fill		11					
14.5 / 870.4		ORGANIC CLAY, black, soft (OL/OH) (A-8) swamp deposit		4	43				
15 / 17.5 / 867.4		LEAN CLAY, gray, firm, a lamination of fine grained sand (CL) (A-6) alluvium		6	33				
19.5 / 865.4		SAND WITH SILT, medium to fine grained, dark brown, a little gray, waterbearing, very loose, a lens of lean clay (SP-SM) (A-1-b) alluvium		1½					
20 / 22.0 / 862.9		LEAN CLAY, brownish gray, very soft to firm, a lens of medium to fine grained sand with silt at 25' (CL) (A-6) alluvium		WH	28				
25			PD	6	30				
			PD	7	25				
29.5 / 855.4		SAND WITH SILT, a little gravel, medium to fine grained, dark gray, waterbearing, loose (SP-SM) (A-1-b) alluvium	PD	8					
30 / 32.0 / 852.9		SAND WITH SILT, a little gravel, fine to medium grained, gray, medium dense (SP-SM) (A-1-b) alluvium	PD	12					
34.5 / 850.4		SAND WITH GRAVEL, medium grained, gray, waterbearing, loose to medium dense, a lens of fine to medium grained sand at 40' (SP) (A-1-b) alluvium	PD	9					
35			PD	10					
40			PD	9					

Index Sheet Code

(Continued Next Page)

Soil Class: Rock Class: Edit: Date: 8/25/14
X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1064 ST**	**884.9** *(Surveyed)*

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
45	46.5 838.4		SAND WITH GRAVEL, medium grained, gray, waterbearing, loose to medium dense, a lens of fine to medium grained sand at 40' (SP) (A-1-b) alluvium *(continued)* **END OF BORING**	PD	12 12					

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	Southwest LRT, PEC East	1065 SS	886.9 (Surveyed)

Location , , ft. LT
Co. Coordinate: X=511450 Y=155787 (ft.)
Latitude (North)=44.9441059 Longitude (West)=-93.3391156

Drill Machine 1C
Hammer CME Automatic Calibrated

SHEET 1 of 1
Drilling Completed 5/9/13

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	2.0 884.9		Silty sand, a little gravel, black (A-2-4) fill		15					Hammer Calibration: 66% efficiency with 105 lb. hammer, 9/18/13
	4.5		SAND WITH GRAVEL, fine to medium grained, light brown, moist, dense (SP) (A-1-b) alluvium or fill		31					
5	882.4		SAND WITH SILT AND GRAVEL, fine to medium grained, brown, moist, medium dense (SP-SM) (A-1-b) alluvium		11					
	7.0 879.9				14					
10			SAND WITH GRAVEL, medium to fine grained, light brown, moist to about 13½' then waterbearing, medium dense (SP) (A-1-b) alluvium		20					
▼					15					Water level measured at 13.6' deep with HSA to 14.5' deep
15	17.0 869.9			PD	18					
	19.5		SAND WITH SILT, fine grained, brown, waterbearing, medium dense (SP-SM) (A-3) alluvium	PD	14					
20	867.4		SAND, a little gravel, medium grained, brown, waterbearing, medium dense (SP) (A-1-b) alluvium	PD	12					
	22.0 864.9		SAND WITH GRAVEL, medium to fine grained, brown, waterbearing, medium dense (SP) (A-1-b) alluvium	PD	12					
	24.5			PD						
25	862.4		SAND, a little gravel, medium grained, brown to brownish gray, waterbearing, loose to medium dense (SP) (A-1-b) alluvium	PD	10					
				PD	16					
30										
	31.5 855.4		END OF BORING		21					

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14
X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

METROPOLITAN COUNCIL

MINNESOTA DEPARTMENT OF TRANSPORTATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1166 ST**	**884.3** *(Surveyed)*

Location **, , ft. LT**

Co. Coordinate: X=512029 Y=155893 (ft.)

Latitude (North)= *Longitude (West)=*

Drill Machine **41C**

Hammer **CME Automatic Calibrated**

SHEET 1 of 1

Drilling Completed **6/4/14**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	2.0 882.3		Silty sand, a little gravel and ashes/cinders, trace roots, black (A-2-4) fill		6					Hammer Calibration: 68% efficiency with 101 lb. hammer, 9/27/13
	4.0 880.3		Sand with silt, a little gravel and clayey sand, brown, a little black (A-2-4) fill		4					
5			Silty sand, a little gravel, pieces of brick, wood and metal, gray, black and brown (A-2-4) fill		10					
	9.0 875.3				4					
10	12.0 872.3		SAPRIC PEAT, pieces of wood, black, a little gray, laminations of sand (PT) (A-8) swamp deposit		3	84				
▼	14.0 870.3		SAND WITH SILT, a little gravel, fine to medium to fine grained, gray, waterbearing, loose (SP-SM) (A-3) alluvium		6					Water level measured at 12.7' deep with HSA to 14.5' deep
15	16.5 867.8		SAND, a little gravel, medium to fine grained, gray, waterbearing, loose (SP) (A-1-b) alluvium		6					
20	21.0 863.3		SAND WITH GRAVEL, medium grained, gray, waterbearing, loose to medium dense, a lens of sand with silt at 18' (SP) (A-1-b) alluvium		6 13					
			END OF BORING							

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

METROPOLITAN COUNCIL

MINNESOTA DEPARTMENT OF TRANSPORTATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1167 ST**	**886.4** *(Surveyed)*

Location **, , ft. LT**

Co. Coordinate: X=511697 Y=155888 (ft.)

Latitude (North)=44.9258896 *Longitude (West)=-93.3918073*

Drill Machine **69C**

Hammer **CME Automatic Calibrated**

SHEET 1 of 1

Drilling Completed **4/29/14**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} (%) REC	MC (%) RQD	COH (psf) ACL (ft)	γ (pcf) Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	2.0 884.4		Silty sand, a little gravel and clayey sand, dark brown and brown (A-2-4) fill		6					Hammer Calibration: 65% efficiency with 105 lb. hammer, 10/4/13
	4.0 882.4		Sand with gravel, a little silty sand, brown, a little dark brown (A-1-b) fill		8					
5	6.5 879.9		Sand with gravel, a little clayey sand and silty sand (A-1-b) fill		7					
	9.0 877.4		Sand, a little gravel, light brown (A-1-b) fill		33					
10	11.5 874.9		SILTY SAND, a little gravel, fine to medium grained, dark brown, moist, dense (SP-SM) (A-2-4) alluvium		38					
▼	14.0 872.4		SAND WITH SILT, a little gravel, medium to fine grained, brown, moist, medium dense (SP-SM) (A-1-b) alluvium		23					Water level measured at 12.5' deep with HSA to 14.5' deep
15	16.5 869.9		SAND, a little gravel, medium to fine grained, brown, waterbearing, loose, a lens of sand with silt (SP-SM) (A-1-b) alluvium		8					
	19.0 867.4		SAND, a little gravel, medium to fine grained, brown, a little grayish brown, waterbearing, medium dense, a lens of sand with silt (SP) (A-1-b) alluvium		11					
20			SAND WITH GRAVEL, medium grained, light brown, a little brown, waterbearing, loose to medium dense (SP) (A-1-b) alluvium	PD	8					
				PD	12					
25	26.5 859.9			PD	11					
			SAND, a little gravel, medium grained, light grayish brown, waterbearing, medium dense to loose (SP) (A-1-b) alluvium	PD	14					
30	31.0 855.4		**END OF BORING**		9					

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	Southwest LRT, PEC East	1227 SW	886.9 (Surveyed)

Location , , ft. LT
Co. Coordinate: X=511331 Y=155737 (ft.)
Latitude (North)=44.9448313 Longitude (West)=-93.3354810

Drill Machine 69C
Hammer CME Automatic Calibrated

SHEET 1 of 1
Drilling Completed 4/29/14

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	2.0 / 884.9		Silty sand with gravel, pieces of bituminous and brick, black and dark brown (A-1-b) fill		8					Hammer Calibration: 65% efficiency with 105 lb. hammer, 10/4/13
5	6.5 / 880.4		Mixture of sand with silt and silty sand with gravel, a little sandy lean clay, light brown, brown and dark brown (A-1-b) fill		18 / 15					
▼	9.0 / 877.9		Sand with silt, a little gravel, brown (A-1-b) fill		15					Water level measured at 7.4' deep with HSA to 12' deep
10	14.0 / 872.9		Sand with gravel, a little clayey sand, light brown, brownish gray and brown (A-1-b) fill		20 / 13					
15	16.5 / 870.4		Clayey sand with gravel, a little organic clay, brownish gray, a little black (A-2-6) fill	PD	5	12				
	19.0 / 867.9		HEMIC PEAT, brown (PT) (A-8) swamp deposit	PD	9	357				
20	21.5 / 865.4		ORGANIC CLAY WITH GRAVEL, black, firm (OH) (A-8) swamp deposit	PD	5	142				
25	29.0 / 857.9		ORGANIC CLAY, trace shells and roots, brownish gray, soft (OH) (A-8) swamp deposit	PD / PD / PD	2 / 2 / 2	114 / 207 / 109				
30	31.5 / 855.4		SAND WITH SILT, a little gravel, medium to fine grained, dark brownish gray, waterbearing, loose, a lens of clayey sand (SP-SM) (A-1-b) alluvium	PD	8					
	34.0 / 852.9		SAND, a little gravel, medium to coarse grained, gray, a little black, waterbearing, loose (SP) (A-1-b) alluvium	PD	8					
35	38.0 / 848.9		SAND, a little gravel, medium grained, gray, a little black, waterbearing, loose (SP) (A-1-b) alluvium	PD / PD	7 / 9					
40	41.0 / 845.9		SAND, a little gravel, fine to medium grained, gray, waterbearing, loose (SP) (A-3) alluvium END OF BORING	PD	6					

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14
X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	Southwest LRT, PEC East	1232 SB	885.6 (Surveyed)

Location , , ft. LT

Co. Coordinate: X=511798 Y=155935 (ft.)

Latitude (North)=44.9451626 Longitude (West)=-93.3342835

Drill Machine 69C

Hammer CME Automatic Calibrated

SHEET 1 of 2

Drilling Completed 5/1/14

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	0.0		Sandy silt, a little silty sand and gravel, trace roots, dark brown (A-4) fill		10					Hammer Calibration: 65% efficiency with 105 lb. hammer, 10/4/13
	2.5 883.1		Sand with gravel, light brown (A-1-b) fill		13					
	4.0 881.6		Lean clay, a little sand, light grayish brown (A-4) fill		5	18				
5	6.5 879.1		Sand with silt and gravel, trace roots, grayish brown, a little black (A-2-4) fill		17					
	9.0 876.6		SAND WITH SILT, a little gravel, trace roots, medium to fine grained, light brownish gray, a little grayish brown, moist, medium dense to loose, lenses of silty sand and clayey sand (SP-SM) (A-1-b) alluvium		17					
10					6					
	14.0 871.6		SAND, a little gravel, medium to fine grained, light grayish brown, waterbearing, loose (SP) (A-1-b) alluvium		7					Water level measured at 16.2' deep with HSA to 19.5' deep
15 ▼					7					
	19.0 866.6		SAND, a little gravel, medium grained, light brownish gray, waterbearing, medium dense (SP) (A-1-b) alluvium		23					
20	21.5 864.1		GRAVEL WITH SAND, brown, waterbearing, medium dense (GP) (A-1-a) alluvium		28					
	24.0 861.6		SAND WITH GRAVEL, fine to medium grained, brown, waterbearing, dense (SP) alluvium		31					
25	27.0 858.6		GRAVEL WITH SAND, brown, waterbearing, loose to medium dense (GP) alluvium		10					
					11					
				PD						
30					11					
				PD						
	34.0 851.6		GRAVEL WITH CLAY AND SAND, brown, waterbearing, medium dense (GP-GC) (A-1-b) alluvium		27					
35	36.5 849.1		CLAYEY SAND WITH GRAVEL, lenses of silty sand, brown, hard to stiff (SC) (A-2-6) till	PD						
					36	12				
				PD						
40					32	12				
				PD						

Index Sheet Code

(Continued Next Page)

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

SHEET 2 of 2

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1232 SB**	**885.6** *(Surveyed)*

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
45			CLAYEY SAND WITH GRAVEL, lenses of silty sand, brown, hard to stiff (SC) (A-2-6) till *(continued)*	PD	15	13				
	48.0 837.6			PD	17	11				
50				PD						
55			CLAYEY SAND, a little gravel, brown, stiff to hard (SC) (A-2-6) till		12	13				
				PD						
60					100/.9	11				
	63.6 822.0		Top of Bedrock	PD						PLATTEVILLE FORMATION
65			LIMESTONE, weathered, gray to light gray	WS	100/.1					
	67.0 818.6		**END OF BORING**							

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1235 SB**	**886.5** *(Surveyed)*

Location **, , ft. LT**

Co. Coordinate: X=512229 Y=156089 (ft.)

Latitude (North)=44.9306372 *Longitude (West)=-93.3782408*

Drill Machine **69C**

Hammer **CME Automatic Calibrated**

SHEET 1 of 2

Drilling Completed **5/1/14**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} (%) REC	MC (%) RQD	COH (psf) ACL (ft)	γ (pcf) Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	2.0 / 884.5		Sand with silt, ash/cinders, trace roots, black (A-1-b) fill		5					Hammer Calibration: 65% efficiency with 105 lb. hammer, 10/4/13
	4.0 / 882.5		Sand with silt and gravel, trace roots, brown (A-1-b) fill		15					
5	6.5 / 880.0		Clayey sand, a little gravel, sand with silt and lean clay, trace roots, dark brownish gray and brown (A-6) fill		7	18				
			Sand and sand with silt, with gravel, light brown and brown (A-1-b) fill		8					
10	11.5 / 875.0				11					
	14.0 / 872.5		Clayey sand, trace roots, a little sandy lean clay and sand with silt, dark brown and black (A-6) fill		9	21				
15	16.5 / 870.0		SAND WITH SILT, trace roots, fine to medium grained, brownish gray, moist, medium dense, laminations of clayey sand (SP-SM) (A-3) alluvium		12					
▼			SAND WITH GRAVEL, medium grained, brownish gray, waterbearing, loose (SP) (A-1-b) alluvium		9					Water level measured at 16.5' deep with HSA to 17' deep
	19.0 / 867.5		SAND, fine grained, light brown, waterbearing, medium dense (SP) (A-3) alluvium		12					
20	21.5 / 865.0		GRAVEL WITH SAND, brown, waterbearing, medium dense (GP) (A-1-b) alluvium	PD	18					
	24.0 / 862.5		SAND, a little gravel, fine to medium grained, brown, waterbearing, medium dense (SP) (A-3) alluvium	PD	15					
25				PD	16					
	29.0 / 857.5		GRAVEL WITH SAND, brownish gray, waterbearing, loose to medium dense (GP) (A-1-b) alluvium	PD	17					
30	31.5 / 855.0		SAND WITH GRAVEL, medium grained, grayish brown, waterbearing, loose to medium dense (SP) (A-1-b) alluvium	PD	10					
				PD	15					
35	36.5 / 850.0		SAND, a little gravel, medium to fine grained, grayish brown, waterbearing, medium dense (SP) (A-1-b) alluvium	PD	13					
				PD	14					
40				PD						

Index Sheet Code

(Continued Next Page)

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1235 SB**	**886.5** *(Surveyed)*

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60}	MC (%)	COH (psf)	γ (pcf)	Soil / Rock	Other Tests Or Remarks / Formation or Member
	42.5 844.0			PD						
45			CLAYEY SAND, a little gravel, grayish brown, a little brown, very stiff, a lens of waterbearing sand (SC/SM) (A-2-4) till		18	11				
	47.5 839.0			PD						
50			CLAYEY SAND, a little gravel, brownish gray, firm (SC/SM) (A-2-4) till		6	13				
	52.5 834.0			PD						
55			CLAYEY SAND, with gravel, grayish brown, firm (SC) (A-6) till		7	14				
	57.5 829.0			PD						
60			CLAYEY SAND, with gravel, grayish brown, firm (SC/SM) (A-2-6) till		6	17				
				PD						
65	65.0 821.5		SILTY SAND, a little gravel, brownish gray, very dense, a lens of sand (SM) (A-2-4) till		*	9				PLATTEVILLE FORMATION
	65.4 821.1		Top of Bedrock	WS						
	67.0 819.5		LIMESTONE, weathered, gray **END OF BORING**							

*11/.5 + 22/.5 + 46/.5 + 100.1

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1236 SB**	**886.1** *(Surveyed)*

Location **, , ft. LT**
Co. Coordinate: X=512391 Y=156052 (ft.)
Latitude (North)=44.9307387 Longitude (West)=-93.3779705

Drill Machine **69C**
Hammer **CME Automatic Calibrated**

SHEET 1 of 2
Drilling Completed **5/2/14**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
0	0.0		Mixture of sand with silt and silty sand, with gravel, a little ash/cinders, pieces of brick and coal, brown and dark brown, a little black (A-1-b and A-2-4) fill		9					Hammer Calibration: 65% efficiency with 105 lb. hammer, 10/4/13
					7					
5					3					
					4					
	9.0 / 877.1									
10			Sand, light brown, a little brown (A-1-b) fill		13					
	11.5 / 874.6									
	13.0 / 873.1		FIBRIC PEAT, brown to dark brown, a lens of hemic peat (PT) (A-8) swamp deposits		4	311 / 60				
	14.5 / 871.6		ORGANIC CLAY, dark brown, a little gray to black, soft, laminations of sand to around 14' (OH) (A-8) swamp deposits		2	35 / 27				Organic content = 2.8%
15			LEAN CLAY, slightly organic, dark brown, soft (CL/OL) (A-6) alluvium							
▼	16.5 / 869.6									Water level measured at 16.5' deep with HSA to 19.5' deep
			LEAN CLAY, trace roots, gray, firm to stiff (CL) (A-6) alluvium		6	30				
20	20.5 / 865.6				11	26				
			SAND WITH SILT, a little gravel, medium grained, brownish gray, waterbearing, medium dense (SP-SM) (A-1-b) alluvium		12					
	24.0 / 862.1									
25			SAND WITH GRAVEL, medium grained, light brownish gray, waterbearing, loose (SP) (A-1-b) alluvium		7					
	26.5 / 859.6			PD						
					11					
				PD						
30			SAND WITH SILT AND GRAVEL, medium to fine grained, black, waterbearing, medium dense to loose (SP-SM) (A-1-b) alluvium		8					
				PD						
					10					
				PD						
35					10					No recovery
	36.5 / 849.6			PD						
					9					
			SAND, a little gravel, medium grained, brownish gray, waterbearing, loose (SP) (A-1-b) alluvium	PD						
40					10					
				PD						

Index Sheet Code

(Continued Next Page)

Soil Class: Rock Class: Edit: Date: 8/25/14
X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1236 SB**	**886.1** (Surveyed)

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
45			SAND, a little gravel, medium grained, brownish gray, waterbearing, loose (SP) (A-1-b) alluvium *(continued)*	PD	9					
				PD						
50					8					
				PD						
	54.0 832.1									
55			CLAYEY SAND, a little gravel, brown, very stiff (SC) (A-6) till		25	10				
				PD						
	58.0 828.1									
60			CLAYEY SAND, a little gravel, brown, firm (SC) (A-2-6) till		7	14				
				PD						
65					6					No recovery
	67.5		Top of Bedrock							
	818.6		LIMESTONE, weathered, gray	PD						PLATTEVILLE FORMATION
	69.6 816.5		**END OF BORING**		100/.1					

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1238 SB**	**888.4** (Surveyed)

Location , , **ft. LT**

Co. Coordinate: X=512701 Y=156173 (ft.)

Latitude (North)=44.9451626 Longitude (West)=-93.3342835

Drill Machine **69C**

Hammer **CME Automatic Calibrated**

SHEET 1 of 1

Drilling Completed **5/5/14**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	0.0 888.4		Mixture of sand with silt and silty sand, with gravel, a little sand and clayey sand, pieces of glass, trace roots, dark brown, light brown and brown (A-1-b) fill		11					Hammer Calibration: 65% efficiency with 105 lb. hammer, 10/4/13
	4.0 884.4				26					
5	6.5 881.9		SAND, a little gravel, fine grained, light brown, moist, medium dense (SP) (A-3) alluvium		25					
			SAND WITH GRAVEL, medium grained, light brown, moist, medium dense (SP) (A-1-b) alluvium		19					
10	11.5 876.9				17					
			SAND WITH SILT AND GRAVEL, medium grained, brown, a little light brown and light tan, moist, medium dense, a lens of silt at 15', laminations of silty sand (SP-SM) (A-1-b) alluvium		18					
15					17					
▼	16.5 871.9		SAND, a little gravel, medium grained, brown, a little light light tan, waterbearing, loose, laminations of silt (SP) alluvium		8					Water level measured at 16.3' deep with HSA to 17.0' deep (rose from 16.7' deep 10 minutes earlier)
	17.5 870.9		SAND, fine grained, light brown, waterbearing, loose (SP) (A-3) alluvium	PD						
20	19.0 869.4		GRAVELLY SAND WITH SILT, medium to fine grained, brown, waterbearing, medium dense (SP-SM) (A-1-b) alluvium		17					
	21.5 866.9		GRAVELLY SAND, medium grained, brownish gray, a little light tan, waterbearing, medium dense, laminations of silt around 22.5' (SP) (A-1-b) alluvium	PD						
25				PD	23					
	26.5 861.9		SAND WITH GRAVEL, medium to fine grained, brownish gray, waterbearing, medium dense (SP) (A-1-b) alluvium	PD	12					
	29.0 859.4			PD	20					
30			SILTY SAND, a little gravel, grayish brown, waterbearing, medium dense (SM) (A-2-4) till	PD	15					
				PD	28					
	34.5 853.9		LIMESTONE GRAVEL, light gray (likely boulder)	PD	100/.1					
	34.6 853.8		**END OF BORING**							

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1262 ST**	**884.7** (Surveyed)

Location , , **ft. LT**

Co. Coordinate: X=512188 Y=155950 (ft.)

Latitude (North)= Longitude (West)=

Drill Machine **41C**

Hammer **CME Automatic Calibrated**

SHEET 1 of 1

Drilling Completed **6/4/14**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
			Sand with silt and gravel, brown (A-1-b) fill		3					Hammer Calibration: 68% efficiency with 101 lb. hammer, 9/27/13
					6					
	4.0 / 880.7									
5			Silty sand, a little gravel, sand, ashes/cinders and brick, brown and black (A-2-4) fill		6					
					3					
10					15					
▼	12.0 / 872.7									Water level measured at 11.7' deep with HSA to 12' deep
			SAND, a little gravel, medium grained, brown to grayish brown, waterbearing, medium dense to loose (SP) (A-1-b) alluvium		20					
15					7					
	17.0 / 867.7		SAND WITH SILT AND GRAVEL, fine to medium grained, grayish brown, waterbearing, dense (SP-SM) (A-1-b) alluvium		6					
20	20.5 / 864.2		SANDY LEAN CLAY, a little gravel, possible cobbles, dark grayish brown, very stiff (CL) (A-6) till		23	15				
					16	16				
	24.5 / 860.2		SAND WITH SILT, a little gravel, grayish brown, waterbearing, medium dense, lenses of clayey sand (SP-SM) (A-2-4) alluvium		17					
	27.0 / 857.7		SILTY SAND, a little gravel, grayish brown, wet, medium dense, lenses of clayey sand (SM) (A-2-4) alluvium	PD	27					
	29.0 / 855.7		GRAVELLY SAND, medium grained, grayish brown, waterbearing, medium dense, lenses of silty sand (SP) (A-1-b) alluvium	PD						
30	31.0 / 853.7		END OF BORING		15					

Index Sheet Code

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	Southwest LRT, PEC East	1263 SB	884.9 (Surveyed)

Location , , ft. LT

Co. Coordinate: X=511696 Y=155750 (ft.)

Latitude (North)= Longitude (West)=

Drill Machine 68C

Hammer CME Automatic Calibrated

SHEET 1 of 2

Drilling Completed 6/4/14

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
			Mixture of sand with silt and silty sand with gravel, light brown and black (A-1-b, A-2-4) fill		10					Hammer Calibration: 68% efficiency with 110 lb. hammer, 6/9/14
					11					
	4.0 / 880.9									
5			Silty sand with organic fines, a little gravel ash/cinders, trace roots, black (A-2-4) fill		4					
					2					
	9.0 / 875.9									
10			Mixture of silty sand with organic fines and clayey sand, a little gravel and ashes/cinders, pieces of wood and glass, trace roots, black (A-2-4) fill		3					
▼					3					Water level measured at 12.1' deep with HSA to 27' deep
15					3					
	16.5 / 868.4									
					3	165				
20			SAPRIC PEAT, dark brownish gray to dark brown (PT) (A-8) swamp deposit		3					1" recovery
					3	146				
	24.5 / 860.4					106				
25	26.5 / 858.4		ORGANIC CLAY, pieces of wood (roots), trace roots, gray, lenses and laminations of boglime (OH) (A-6) swamp deposit			72				
			SAND, a little gravel, medium grained, gray, waterbearing, loose, lenses of sand with silt (SP) (A-1-b) alluvium		7					
	29.0 / 855.9									
30			SAND, a little gravel, medium to fine grained, gray, waterbearing, loose, lenses of sand with silt (SP) (A-1-b) alluvium		9					
	31.5 / 853.4			PD						
			GRAVEL WITH SAND, gray, waterbearing, loose (GP) (A-1-b) alluvium	PD	10					
35	35.5 / 849.4				9					
			SAND, a little gravel, medium grained, waterbearing, loose (SP) (A-1-b) alluvium	PD						
				PD	6					
40					5					
	41.5			PD						

Index Sheet Code

(Continued Next Page)

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

AMERICAN ENGINEERING TESTING, INC.

This boring was taken by American Engineering Testing

UNIQUE NUMBER

U.S. Customary Units

SHEET 2 of 2

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
	CLT Ped Bridge	**Southwest LRT, PEC East**	**1263 SB**	**884.9** (Surveyed)

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 (%) REC (%)	MC (%) RQD (%)	COH (psf) ACL (ft)	γ (pcf) Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	843.4									
45				PD	2	16				
					7	12				
				PD						
					10	14				
				PD						
50			CLAYEY SAND, a little gravel, apparent cobble at 55', brown, soft to stiff (SC/SM) (A-2-4) till *(continued)*		28	13				
				PD						
55					117					No recovery
	58.0 826.9			PD						
60			CLAYEY SAND, a little gravel, brown, hard (SC) (A-6) till		50/.3	10				
				PD						
	64.7 820.2		**END OF BORING**		100/.1					No recovery

Soil Class: Rock Class: Edit: Date: 8/25/14

X:\01-GEO\GINTW\1 GINT PROJECTS\01-05697 MNDOT TEMPLATE.GPJ

SAMPLING METHODS

Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2" O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30". The sampler is driven a total of 18" into the soil. After an initial set of 6", the number of hammer blows to drive the sampler the final 12" is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

Most of today's drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30". The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviations of the N-values using this method are significantly better than the standard ASTM Method.

Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

CLASSIFICATION METHODS

Soil classifications shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil classifications shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

Visual-manual judgment of the AASHTO Soil Group is also noted as a part of the soil description. A chart presenting details of the AASHTO Soil Classification System is also attached.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

WATER LEVEL MEASUREMENTS

The ground-water level measurements/comments are shown on the boring logs in the remarks section. The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
AR:	Sample of material obtained from cuttings blown out the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in inches
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
DP:	Direct push drilling; a 2.125 inch OD outer casing with an inner 1½ inch ID plastic tube is driven continuously into the ground.
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PD:	Plug Drilling (same as RDF)
PQ:	PQ wireline core barrel
RDA:	Rotary drilling with compressed air and roller or drag bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
SS:	Standard split-spoon sampler (steel; 1.5" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
▽:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
COH:	Cohesion, psf (0.5 x q_u)
CONS:	One-dimensional consolidation test
γ:	Wet density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
MC:	Moisture Content, %
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q_p:	Pocket Penetrometer strength, tsf (approximate)
q_c:	Static cone bearing pressure, tsf
q_u:	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES

(Calibrated Hammer Weight)

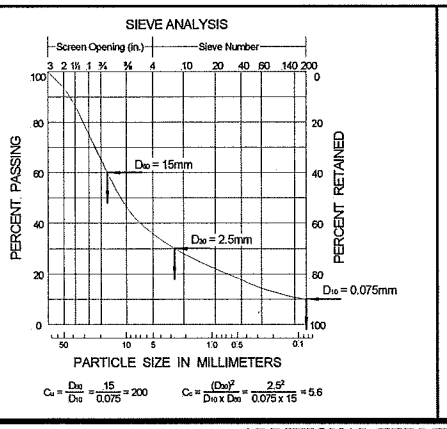
The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide N_{60} values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

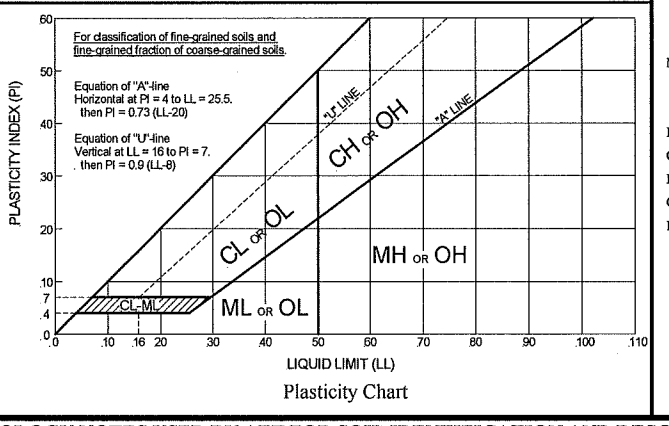
The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried < 0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried < 0.75	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]





Plasticity Chart

Notes

[A]Based on the material passing the 3-in (75-mm) sieve.

[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C]Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E]$Cu = D_{60} / D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.

[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H]If fines are organic, add "with organic fines" to group name.

[I]If soil contains ≥15% gravel, add "with gravel" to group name.

[J]If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.

[K]If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.

[L]If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.

[M]If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N]PI≥4 and plots on or above "A" line.

[O]PI<4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.

[R]Fiber Content description shown below.

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition (MC Column)

D (Dry): Absence of moisture, dusty, dry to touch.

M (Moist): Damp, although free water not visible. Soil may still have a high water content (over "optimum").

W (Wet/ Waterbearing): Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.

F (Frozen): Soil frozen

Layering Notes

Laminations: Layers less than ½" thick of differing material or color.

Lenses: Pockets or layers greater than ½" thick of differing material or color.

Peat Description

Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the Liquid Limit properties. *Slightly organic* used for borderline cases.

Root Inclusions

With roots: Judged to have sufficient quantity of roots to influence the soil properties.

Trace roots: Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.

AASHTO SOIL CLASSIFICATION SYSTEM

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

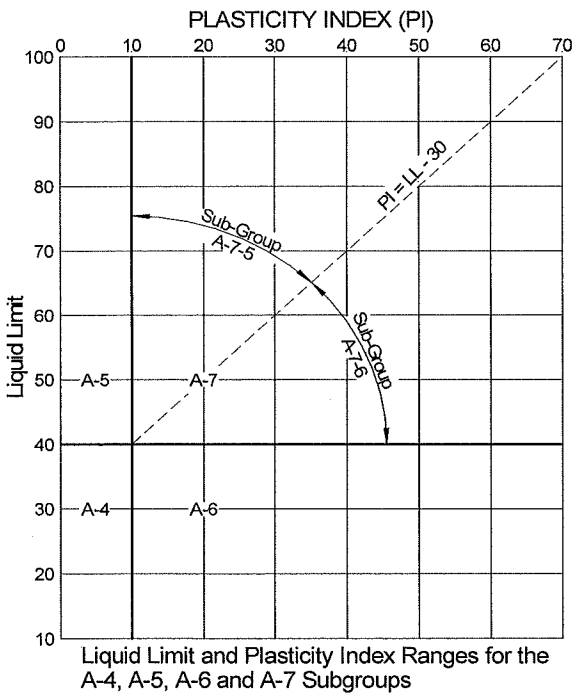
Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35% or less passing No. 200 sieve)							Silt-Clay Materials (More than 35% passing No. 200 sieve)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis, Percent passing:											
No. 10 (2.00 mm)	50 max.	....	....	....	....	....	....	....	....	....	....
No. 40 (0.425 mm)	30 max.	50 max.	51 min.	....	....	....	....	....	....	....	....
No. 200 (0.075 mm)	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of Fraction Passing No. 40 (0.425 mm)											
Liquid limit	....		....	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index	6 max.		N.P.	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.
Usual Types of Significant Constituent Materials	Stone Fragments, Gravel and Sand		Fine Sand	Silty or Clayey Gravel and Sand				Silty Soils		Clayey Soils	
General Ratings as Subgrade	Excellent to Good							Fair to Poor			

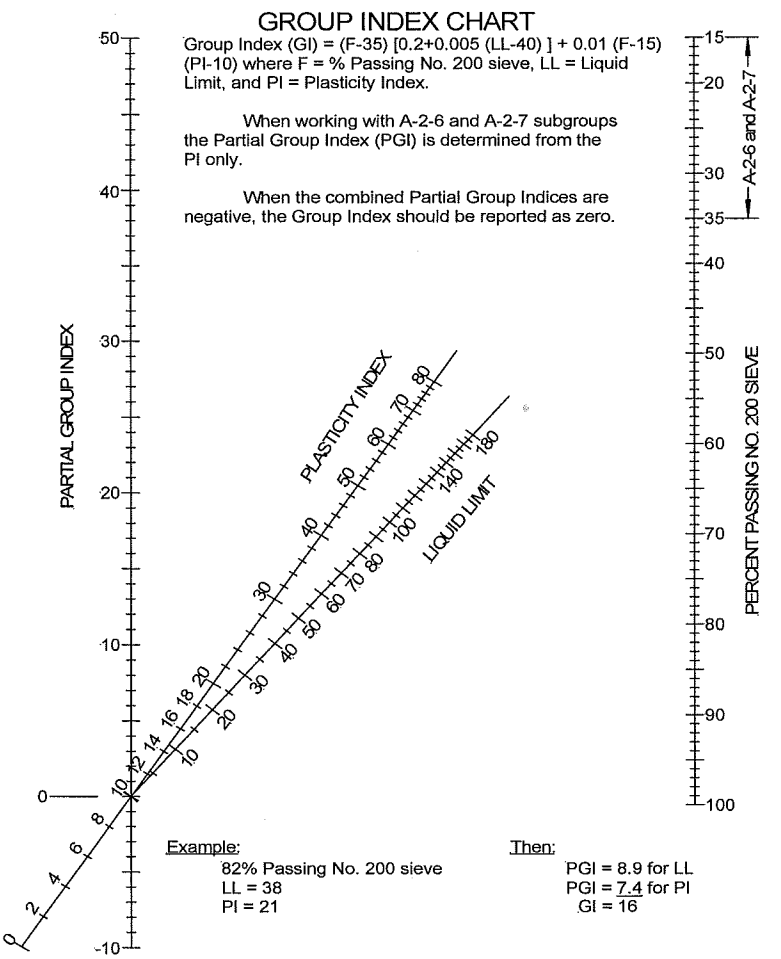
The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.

Group A-8 soils are organic clays or peat with organic content >5%.



Liquid Limit and Plasticity Index Ranges for the A-4, A-5, A-6 and A-7 Subgroups



Example:
82% Passing No. 200 sieve
LL = 38
PI = 21

Then:
PGI = 8.9 for LL
PGI = 7.4 for PI
GI = 16

Definitions of Gravel, Sand and Silt-Clay

The terms "gravel", "coarse sand", "fine sand" and "silt-clay", as determinable from the minimum test data required in this classification arrangement and as used in subsequent word descriptions are defined as follows:

GRAVEL - Material passing sieve with 3-in. square openings and retained on the No. 10 sieve.

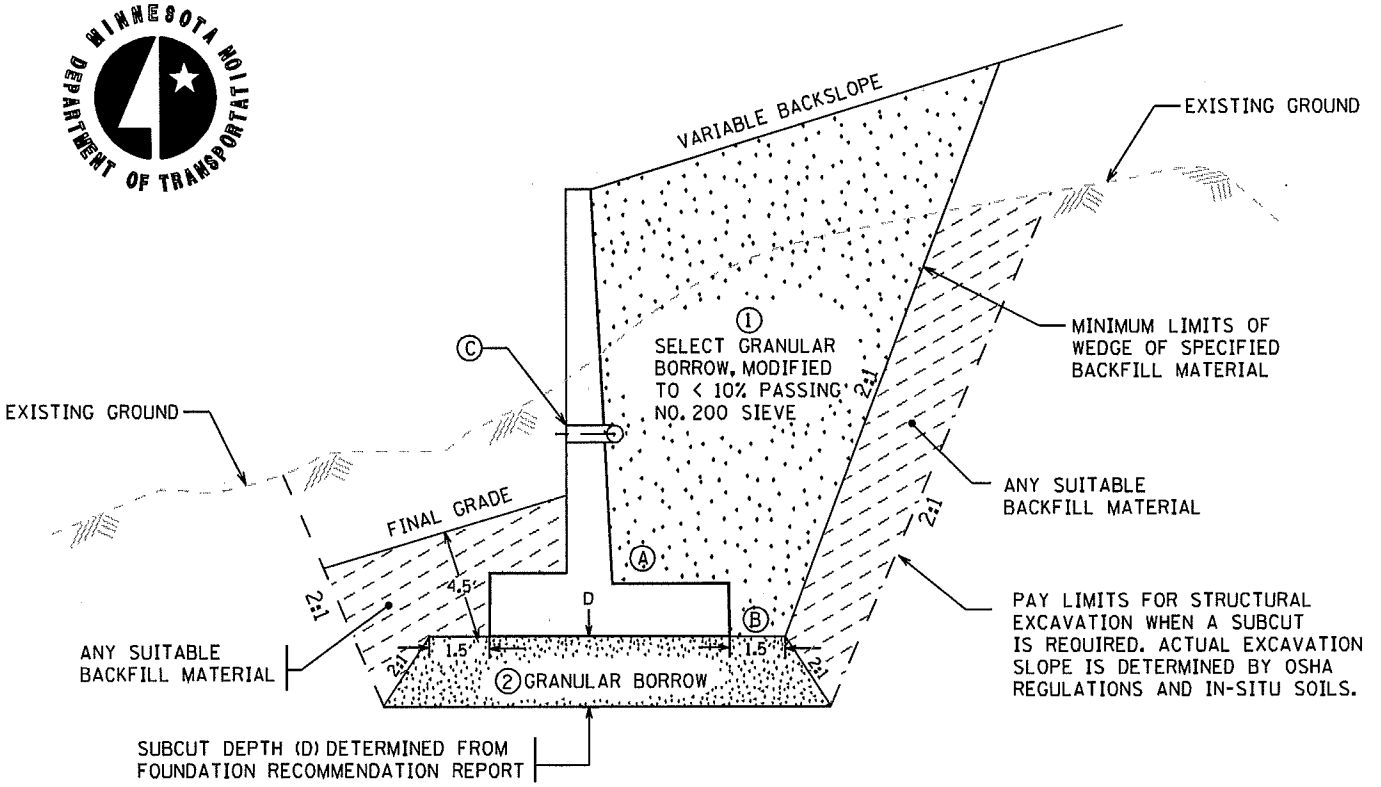
COARSE SAND - Material passing the No. 10 sieve and retained on the No. 40 sieve.

FINE SAND - Material passing the No. 40 sieve and retained on the No. 200 sieve.

COMBINED SILT AND CLAY - Material passing the No. 200 sieve

BOULDERS (retained on 3-in. sieve) should be excluded from the portion of the sample to which the classificaiton is applied, but the percentage of such material, if any, in the sample should be recorded.

The term "silty" is applied to fine material having plasticity index of 10 or less and the term "clayey" is applied to fine material having plasticity index of 11 or greater.



NOT TO SCALE

All slope dimensions shown as V:H

THE RECOMMENDATIONS MAY BE MODIFIED AS PER THE ATTACHED FOUNDATIONS INVESTIGATION AND RECOMMENDATION REPORT

EXCAVATION AND BACKFILL NOTES:

① Mn/DOT SPEC. 3149.2B2 MODIFIED TO 10% PASSING THE NO. 200 SIEVE COMPACT BACKFILL TO SPECIFIED DENSITY METHOD Mn/DOT SPEC. 2105.3F1

② IF SUBCUT IS REQUIRED, BACKFILL WITH GRANLAR BORROW, Mn/DOT SPEC. 3149.2B1. COMPACT BACKFILL TO 100% OF STANDARD PROCTOR (T-99). REFER TO FOUNDATION RECOMMENDATION LETTER FOR SUBCUT DEPTHS.

DRAINAGE SYSTEM NOTES:

PROVIDE WALL DRAINAGE SYSTEM A, B OR C

Ⓐ Ⓑ PLACE A 6 IN. I.D. NON-STEEL PERFORATED PIPE(Mn/DOT SPEC. 3245) WRAPPED WITH A TYPE I GEOTEXTILE FABRIC (Mn/DOT SPEC. 3733) RUNNING THE ENTIRE LENGTH OF THE WALL AND LAID A MINIMUM OF 2 IN. ABOVE THE TOP OF FOOTING (OPTION A) OR BOTTOM ELEVATION OF THE FOOTING (OPTION B). STRUCTURAL BACKFILL MATERIALS SHALL COMPLETELY SURROUND THE PIPE. AT ALL TIMES, THE SLOPE OF THE PIPE SHALL BE CHECKED TO ENSURE POSITIVE DRAINAGE. FREQUENT TIES (SPACED APPROXIMATELY 200 FT. APART) SHALL BE MADE FROM THE PIPE TO THE INPLACE OR PROPOSED DRAINAGE SYSTEM.

Ⓒ PROVIDE WEEP HOLES AS SPECFIED IN THE BRIDGE STANDARD PLANS MANUAL, STANDARD SHEET 5-297.621 TO 5-297.623.

STATE OF MINNESOTA DEPARTMENT OF TRANSPORTATION
STRUCTURAL BACKFILL, FOOTING SUBCUT & DRAINAGE SYSTEM TREATMENT
(STANDARD CANTILEVER RETAINING WALL DESIGN)

DIAGRAM NO. F–1

November 2005

PREPARED BY THE FOUNDATIONS UNIT
GEOTECHNICAL ENGINEERING SECTION – OFFICE OF MATERIALS