EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue (218) 727-1239
Duluth, Minnesota 55802 (218) 727-1248 fax

December 16, 2014
EPC # 14G0946

Duluth Airport Authority
Attn: Mr. Mr. Blaine Peterson
4701 Grinden Drive
Duluth, MN 55811

Re: Preliminary Geotechnical Exploration Report
Proposed Cirrus Building Site
Airport Road / Lackland Street and Vanderberg Drive
Duluth, MN

Dear Mr. Peterson,

This letter report is in regard to the five(5) soil borings performed by EPC on November 25 and 26, 2014. All work was performed at the direction of yourself, according to EPC proposal dated November 19, 2014. All borings were staked and numbered in the field by EPC. Boring surface elevations were also determined by EPC, with the base of the fire hydrant near the north end of Vanderberg Drive being assumed elevation 100.0 feet. Borings were performed with EPC's CME 850 track mounted drill rig. Standard penetration tests were performed with an automatic hammer.

Soil Boring Findings:
Generally speaking, soils consisted of 6.0 to 11-feet of silty clayey sand FILL/Could Be Fill soils and ORGANIC soils (Boring 2 only), over native silty clayey sand soils. In Borings 1, 2 and 3 the fill soils were also mainly silty clayey sand. In Borings 4 and 5 the soils encountered from about 4.0 to 11-feet below existing grade (BEG) were more of a sandy silt, that could be fill. These sandy silt soils are generally quite sensitive if disturbed, and often present stability challenges during construction.

Boring 5 reached substantial sampler refusal at a depth of 20.2-feet below existing grade (BEG). The other four borings were voluntarily terminated at 21-feet BEG. Water was observed in all five borings from 6.0 to 18-feet BEG (elevation range 95.0 to 80.0-feet), during the relatively short drilling process. Please refer to the table below and the boring logs in the appendix for details.

Boring Number SB-14-__	Surface Elevation (ft)	Depth/Elevation to Bottom of FILL (ft)	Depth/Elevation to Bottom of ORGANIC (ft)	Depth/Elevation to Bottom of Sandy Silt / Could Be Fill (ft)	Depth/Elevation to Bottom of Native Silty Clayey Sand / Boring (ft)	Required Minimum Excavation Depth/Elevation (ft)
1	96.1	*6.5 / 89.6	None Observed	None Observed	21 / 75.1	6.5 / 89.6
2	98.0	6.5 / 91.5	**10 / 88.0	None Observed	21 / 77.0	10 / 88.0
3	102.4	6.5 / 95.9	None Observed	9.0 / 93.4	21 / 81.4	9.0 / 93.4
4	104.0	4.0 / 100.0	None Observed	*11.5 / 92.5	21 / 83.0	4.0 / 100.0
5	102.7	4.0 / 98.7	None Observed	10.5 / 92.2	20.2 / 82.5	4.0 / 98.7

***Indicates gravel layer observed below fill / could be fill soils.**
****Indicates silt layer observed below bottom of organic layer.**

Laboratory Observation and Testing:
Laboratory testing was limited to moisture content and visual classification of all samples and organic content of three samples. Significantly organic soils were only observed in Boring 2, in the sample from 7.0 to 8.5-feet. Water bearing soils were observed in the gravelly samples of Borings 1 and 4, at about 7.0 and 12-feet, respectively. Water bearing soils were also observed in the sand and silty sand soils of Borings 3 and 5, at about 7 and 15-feet, respectively.

Allowable Bearing Capacity:
Preliminary allowable bearing capacity after performing the soils correction and pending the proposed foundation type/depth and location of construction on this relatively long site, is 3000 psf at/near Borings 1 and 2, and 1500 psf at/near Borings 3, 4 and 5. Additional soils information is necessary to better define this site.

Recommendation:
Perform building specific soil borings and a final geotechnical engineering report, prior to design and construction on this site.

This report completes EPC's work on this project to date. We must caution you that this report, prepared for preliminary design information only, is not a complete geotechnical engineering report. EPC cannot be responsible for possible misinterpretation of the contents of the boring logs, or the strengths of the soils described in them. Soil samples from this project will be saved for two months from the date of this report unless EPC is directed in writing to do otherwise.

We would like to thank you for allowing EPC to be of service to you on this project. If you have any questions or comments, please call us at (218) 727-1239 (w) or (218) 341-4536 (c).

Sincerely,
EPC Engineering & Testing,

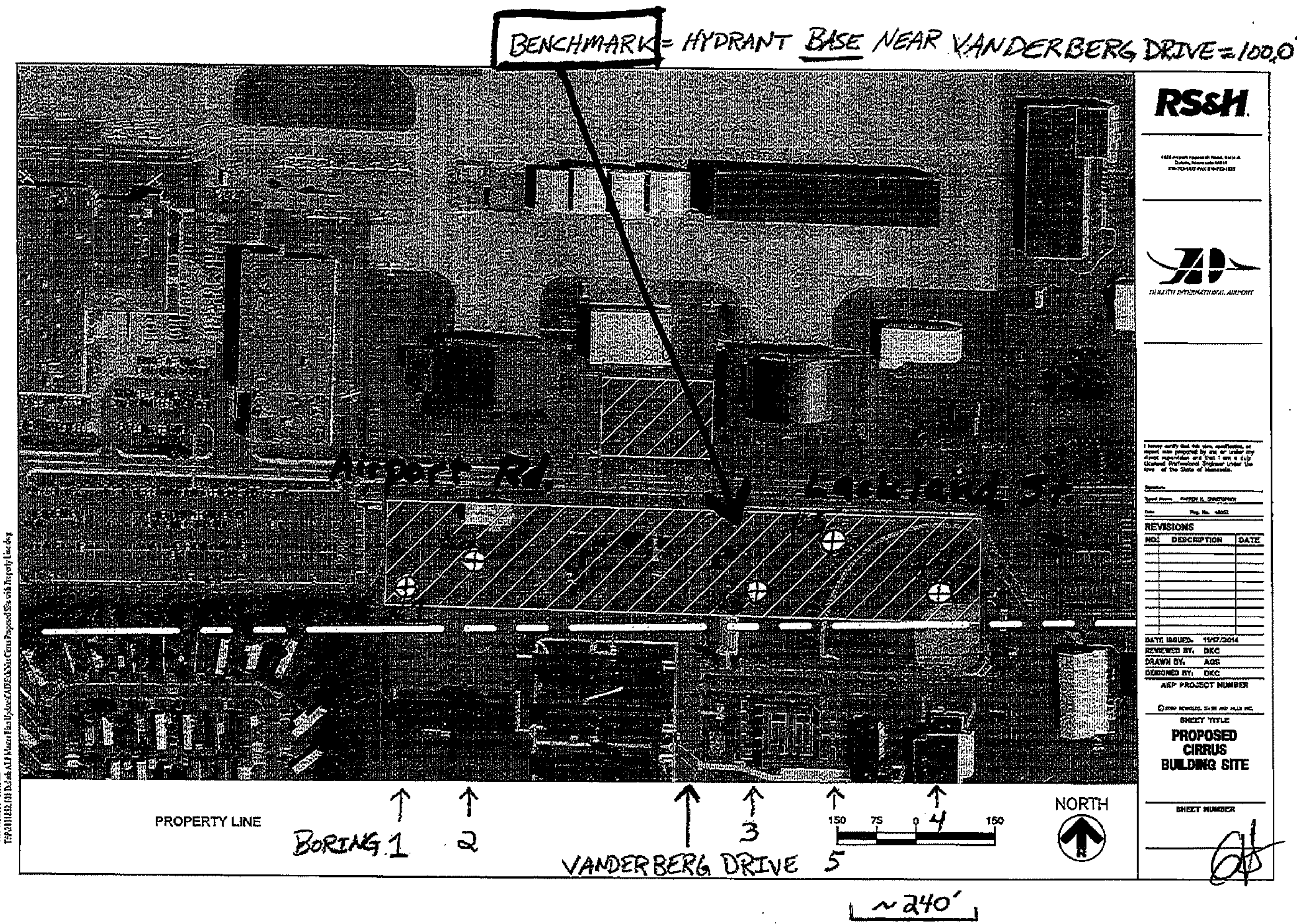
Gary E. Hage, P.E.
Principal Engineer

Reviewed by:

Brian E. McVean, P.E.
Principal Engineer

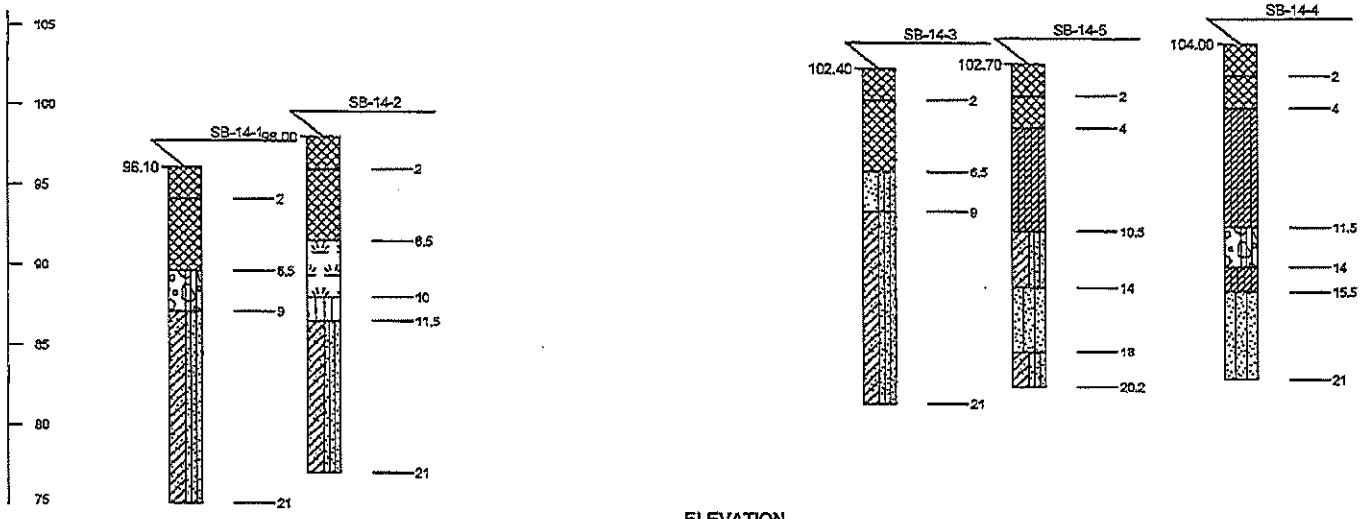
CC: Reynolds Smith & Hills - Mr. Darren Christopher
DSGW – Mr. John Guissler

Enclosures: Location Map, Boring Plan/Elevation Drawing and Boring Logs


BENCHMARK = HYDRANT BASE NEAR VANDERBERG DRIVE = 100.0'
Airport Rd.
Lackland St.
PROPERTY LINE
BORING 1
2
3
4
5
VANDERBERG DRIVE
150 75 0 150
NORTH
~240'
RS&H
DULUTH INTERNATIONAL AIRPORT
REVISIONS
NO. DESCRIPTION DATE
DATE ISSUED: 11/07/2014
REVIEWED BY: DKC
DRAWN BY: AGS
DESIGNED BY: DKC
AEP PROJECT NUMBER
SHEET TITLE
PROPOSED CIRRUS BUILDING SITE
SHEET NUMBER

REGION	STATE	PROJECT	SHEET NO.	TOTAL SHEETS

PLAN



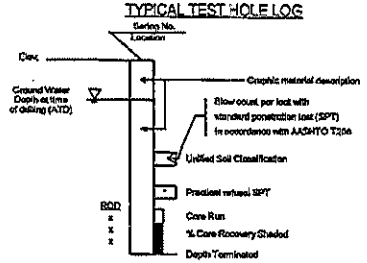
ELEVATION

LEGEND

- Fill (made ground)
- Poorly-graded Gravel with Silt
- Clayey Sand
- Peat
- Silt
- Poorly-graded Sand with Silt
- USCS Low Plasticity Silty Clay
- silty Sand

TYPICAL TEST HOLE SYMBOL
Plan View
Location of any test hole

TYPICAL TEST HOLE LOG



For additional information, refer to Geotechnical Report Proposed Development.

EPC ENGINEERING & TESTING
539 Garfield Avenue
Duluth, MN 55802

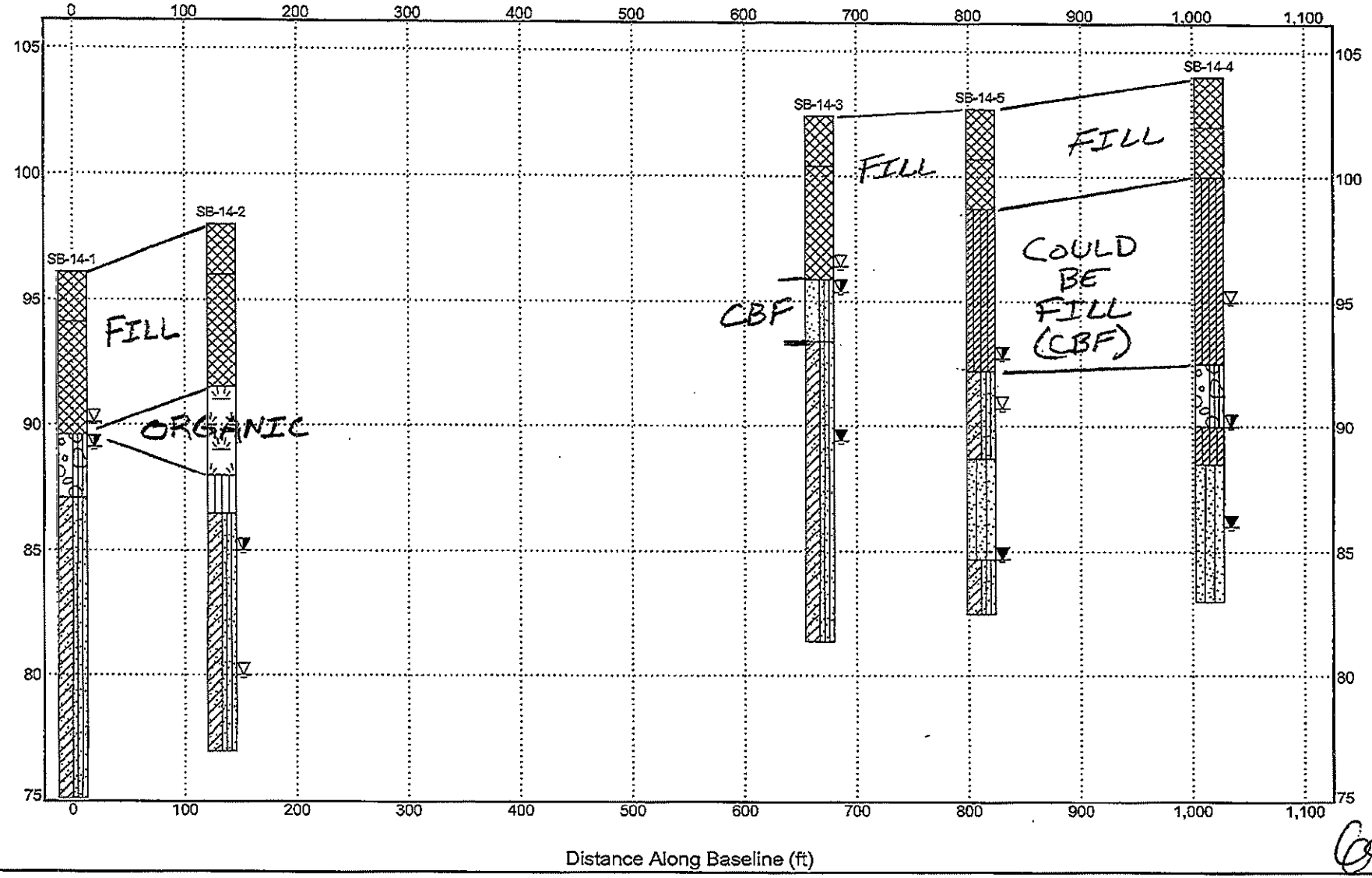
SUBSURFACE PROFILE
Proposed Development
Duluth International Airport

DRAWING NO.

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

SUBSURFACE DIAGRAM

CLIENT Duluth Airport Authority
PROJECT NUMBER 14G0946
PROJECT NAME Proposed Development
PROJECT LOCATION Duluth International Airport



STRATIGRAPHY & GW - A SIZE 14G0946 DAA DEVELOPMENT.GPJ GINT US LAB.GDT 11/27/14

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER SB-14-1

CLIENT Duluth Airport Authority
PROJECT NAME Proposed Development
PROJECT NUMBER 14G0946
PROJECT LOCATION Duluth International Airport
DATE STARTED 11/25/14 COMPLETED 11/25/14
GROUND ELEVATION 96.1 ft HOLE SIZE 7-Inch
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
▽ AT TIME OF DRILLING 6.0 ft / Elev 90.1 ft
LOGGED BY NEW CHECKED BY GH
AT END OF DRILLING None
NOTES Southwest corner of west-most one-quarter of parcel.
▼ 0hrs AFTER DRILLING 7.0 ft / Elev 89.1 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
95	0		SILTY CLAYEY SAND (SC-SM) (FILL) Brown, wet, with to trace organics, little gravel, loose relative density.	SPT 1	33	1-4-3-3 (7)			19.6
			SANDY SILTY CLAY (CL-ML) to SILTY CLAYEY SAND (SC-SM) (FILL) Light brown to brown, wet, trace gravel, soft consistency / loose relative density.	SPT 2	21	2-2-2-2 (4)			26.1
	5		1-inch layer of gray silt in sample from 4 to 6-feet.	SPT 3	25	2-2-3-3 (5)			18.1
90			SANDY SILTY GRAVEL (GP-GM) Brown, water bearing, fine grained, medium dense relative density.	SPT 4	39	2-9-13 (22)			13.9
	10		SILTY CLAYEY SAND (SC-SM) Dark brown, moist to wet, little gravel, very dense to dense to medium dense to dense relative density. Cave-in level = 10-feet.	SPT 5	100	17-47-50/4"			8.6 >>
85			Boulder at 12-feet.	SPT 6	67	13-18-17 (35)			10.2
	15			SPT 7	106	8-12-13 (25)			10.2
80									
	20			SPT 8	67	9-17-21 (38)			9.3
			Bottom of hole at 21.0 feet.						

GEOTECH BH PLOTS 14G0946 DAA DEVELOPMENT.GPJ GINT US LAB.GDT 12/16/14

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER SB-14-2

CLIENT Duluth Airport Authority
PROJECT NAME Proposed Development
PROJECT NUMBER 14G0946
PROJECT LOCATION Duluth International Airport
DATE STARTED 11/25/14 COMPLETED 11/25/14
GROUND ELEVATION 98 ft HOLE SIZE 7-Inch
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
AT TIME OF DRILLING 18.0 ft / Elev 80.0 ft
LOGGED BY NEW CHECKED BY GH
AT END OF DRILLING None
NOTES Central portion of west-most one-quarter of parcel.
0hrs AFTER DRILLING 13.0 ft / Elev 85.0 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
	0		SILTY CLAYEY SAND (SC-SM) (FILL) Brown, wet, trace gravel, organics and concrete, loose relative density.	SPT 1	46	1-2-3-4 (5)			13.9
95			SILTY CLAYEY SAND (SC-SM) to SILTY SAND (SM) (FILL) Brown, wet, trace gravel, medium dense relative density.	SPT 2	50	5-10-8-9 (18)			10.9
	5			SPT 3	33	2-6-8-5 (14)			11.2
90			PEAT (PT) to ORGANIC SILT (OL) (SWAMP / ORGANIC) Dark greenish brown to dark brown, moist, soft consistency.	SPT 4	72	1-2-2 (4)			76.4
	10		SILT (ML) Dark brown, wet, trace organics, trace sand, very stiff consistency. Organic content of sample from 9.5 to 11-feet = 1.6%.	SPT 5	61	0-8-13 (21)			22.9
85			SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) Dark brown, wet to water bearing to wet, medium dense relative density / very stiff to stiff to very stiff consistency.	SPT 6	44	4-6-8 (14)			15.6
	15		Cave-in level = 15-feet.	SPT 7	28	4-6-4 (10)			11.4
80									
	20			SPT 8	56	8-8-12 (20)			11.9
			Bottom of hole at 21.0 feet.						

GEOTECH BH PLOTS 14G0946 DAA DEVELOPMENT.GPJ GINT US LAB.GDT 12/16/14

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER SB-14-3

CLIENT Duluth Airport Authority
PROJECT NAME Proposed Development
PROJECT NUMBER 14G0946
PROJECT LOCATION Duluth International Airport
DATE STARTED 11/25/14 COMPLETED 11/25/14
GROUND ELEVATION 102.4 ft HOLE SIZE 7-inch
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
AT TIME OF DRILLING 6.0 ft / Elev 96.4 ft
LOGGED BY NEW CHECKED BY GH
AT END OF DRILLING 13.0 ft / Elev 89.4 ft
NOTES South-central portion of east-central one-quarter of parcel.
0hrs AFTER DRILLING 7.0 ft / Elev 95.4 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
	0		SILTY CLAYEY SAND (SC-SM) (FILL) Brown, trace black, moist, medium dense relative density.	SPT 1	67	3-8-10-16 (18)			11.5
100			SILTY SAND (SM) to SAND with Silt (SP-SM) (FILL) Brown, moist to wet, trace gravel, medium dense to loose relative density. Boulder at 3-feet.	SPT 2	29	11-16-12-8 (28)			5.2
	5			SPT 3	25	1-3-3-3 (6)			8.1
95			SAND with Silt (SP-SM) Black, water bearing, fine to medium grained, with gravel, very loose relative density. Organic content of sample from 7.0 to 8.5-feet = 0.5%. Cave-in level = 7-feet.	SPT 4	33	0-1-1 (2)			19.5
	10		SILTY CLAYEY SAND (SC-SM) Brown to dark brown, wet to water bearing to wet, trace to little gravel, medium dense to dense to medium dense relative density.	SPT 5	72	6-10-18 (28)			14.1
90				SPT 6	56	1-10-8 (18)			13.7
	15			SPT 7	72	11-14-20 (34)			10.0
85									
	20			SPT 8	83	10-12-17 (29)			11.5
			Bottom of hole at 21.0 feet.						

GEOTECH BH PLOTS 14G0946 DAA DEVELOPMENT.GPJ GINT US LAB.GDT 12/16/14

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER SB-14-4

CLIENT Duluth Airport Authority
PROJECT NAME Proposed Development
PROJECT NUMBER 14G0946
PROJECT LOCATION Duluth International Airport
DATE STARTED 11/26/14 COMPLETED 11/26/14
GROUND ELEVATION 104 ft HOLE SIZE 7-Inch
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
AT TIME OF DRILLING 9.0 ft / Elev 95.0 ft
LOGGED BY NEW CHECKED BY GH
AT END OF DRILLING 18.0 ft / Elev 86.0 ft
NOTES Southeast portion of east-most one-quarter of parcel.
0hrs AFTER DRILLING 14.0 ft / Elev 90.0 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
	0		SILTY CLAYEY SAND (SC-SM) (FILL) Dark brown, wet, with to trace organics.	SPT 1	25	8-7-6-5 (13)			49.4
			SANDY SILTY CLAY (CL-ML) (Topsoil-like) (FILL) Black and dark brown, moist, with organics.	SPT 2	33	2-3-5-3 (8)			26.8
100	5		SANDY SILTY CLAY (CL-ML) to SANDY SILT (ML) (Could Be Fill) Brown, wet, trace gravel, medium to stiff to medium consistency. Organic content of sample from 4.0 to 6.0-feet = 1.0%.	SPT 3	50	1-2-3-4 (5)	1.0		17.2
				SPT 4	78	4-4-5 (9)	2.2		7.9
95	10			SPT 5	72	1-3-4 (7)	2.1		19.3
			SANDY SILTY GRAVEL (GP-GM) Brown, water bearing, fine to medium grained, trace cobbles and boulders, very dense relative density.	SPT 6	89	12-35-35 (70)			14.7
90	15		SANDY SILTY CLAY (CL-ML) Dark brown, wet, little gravel, very stiff consistency. Cave-in level = 15-feet.	SPT 7	100	7-8			12.3
			SILTY SAND (SM) Dark brown, wet to water bearing, dense to medium dense relative density.	SPT 8	67	25			
85	20			SPT 9	67	5-15-13 (28)			18.8
			Bottom of hole at 21.0 feet.						

GEOTECH BH PLOTS 14G0946 DAA DEVELOPMENT.GPJ GINT US LAB.GDT 12/16/14

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER SB-14-5

CLIENT Duluth Airport Authority
PROJECT NAME Proposed Development
PROJECT NUMBER 14G0946
PROJECT LOCATION Duluth International Airport
DATE STARTED 11/26/14 COMPLETED 11/26/14
GROUND ELEVATION 102.7 ft HOLE SIZE 7-Inch
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
▽ AT TIME OF DRILLING 12.0 ft / Elev 90.7 ft
LOGGED BY NEW CHECKED BY GH
▼ AT END OF DRILLING 18.0 ft / Elev 84.7 ft
NOTES Northeast corner of east-central one-quarter of parcel.
▼ 0hrs AFTER DRILLING 10.0 ft / Elev 92.7 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
	0		SILTY CLAYEY SAND (SC-SM) (FILL) Brown, moist, little gravel.	SPT 1	63	1-8-11-10 (19)			6.8
100			SILTY CLAYEY SAND (SC-SM) (FILL) Black and brown, wet.	SPT 2	67	5-7-11-6 (18)			16.7
	5		SANDY SILTY CLAY (CL-ML) to SANDY SILT (ML) (Could Be Fill) Brown, wet, stiff consistency.	SPT 3	25	4-4-5-5 (9)			19.0
95				SPT 4	39	3-5-8 (13)			11.8
	10			SPT 5	67	8-8			10.5
			SILTY CLAYEY SAND (SC-SM) Dark brown, wet to moist, little gravel, dense relative density.	SPT 6	33	16			
90				SPT 7	78	6-13-28 (41)			9.0
	15		SILTY SAND (SM) Dark brown to brown, water bearing, little gravel, trace cobbles and boulders, very dense relative density. Cave-in level = 15-feet.	SPT 8	72	23-34-21 (55)			15.9
85			SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) Dark grayish brown, wet, little gravel, trace cobbles and boulders, very dense relative density.						
	20			SPT 9	88	50-50/2"			10.4 >>
			Substantial sampler refusal at 20.2-feet. Bottom of hole at 20.2 feet.						

GEOTECH BH PLOTS 14G0946 DAA DEVELOPMENT.GPJ GINT US LAB.GDT 12/16/14