Preliminary Geotechnical Evaluation Report

Former Hillcrest Golf Course Site
St. Paul, Minnesota

Prepared for

Saint Paul Port Authority

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

Steven B. Martin, PE
Senior Engineer
License Number: 41271
August 23, 2019

BRAUN INTERTEC
The Science You Build On.

Project B1903316

Braun Intertec Corporation

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August 23, 2019 Project B1903316

Mr. Monte Hilleman
Saint Paul Port Authority
380 St. Peter Street
St. Paul, MN 55102

Re: Preliminary Geotechnical Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

Dear Mr. Hillman:

We are pleased to present this Preliminary Geotechnical Evaluation Report for the redevelopment of the former Hillcrest Golf Course.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Steve Martin at 651.487.7026 (smartin@braunintertec.com) or Bob Janssen at 612.865.8786 (bjanssen@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

Steven B. Martin, PE
Senior Engineer

Robert J. Janssen, PE
President – Principal Engineer

AA/EOE

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A. Introduction

A.1. Project Description

This Preliminary Geotechnical Evaluation Report addresses the proposed redevelopment of the former Hillcrest Golf Course in St. Paul, Minnesota. While the overall site plan is still preliminary in nature, the current plan is to have a mix of industrial, residential and commercial usage for the site. As shown on the attached grading excavation exhibit in Appendix B, it is currently planned for industrial development in the east central portion of the site and commercial development in the northern and northeastern portion of the site. The remainder of the site will be developed with both single and multifamily buildings. Stormwater basins are planned for the northeast, north central, south central and southeastern portions of the site. Table 1 provides project details.

Table 1. Project Details

Aspect	Description
Below grade levels	None for industrial and commercial buildings; One for some or all of the residential buildings. (Assumed)
Above grade levels	One to two levels for industrial and commercial buildings; Up to 5 levels for some of the residential buildings. (Assumed)
Preliminary cuts or fills	It is currently planned that fills will be required in the northern and east central portions of the site. Cuts will be required in the remaining portions of the site. Finished grades not yet established. (Provided)
Assumed pavement types	Light duty for residential areas
	Medium duty for commercial areas
	Heavy duty for industrial areas

A.2. Site Conditions and History

The site was utilized as a golf course from the 1920s until 2017. Currently, the clubhouse, parking lots, swimming pool and maintenance buildings are present at the site. The remaining portions of the site consist of the former golf course.

Current grades at the boring locations range from 994 to 1061. Generally, the existing elevations are highest in the west central portion of the site. From that portion of the site, existing elevations slope gradually downward to the north and south and more steeply downward to the east.

Photograph 1. Aerial Photograph of the Site in 2018

Photograph provided by Google.

A.3. Purpose

The purpose of our preliminary geotechnical evaluation was to characterize subsurface geologic conditions at selected exploration locations, evaluate their impact, and provide preliminary geotechnical recommendations for use in the design and construction of future buildings and related supporting infrastructure at the Site.

A.4. Background Information and Reference Documents

We reviewed the following information:

- Preliminary cut and fill drawing by WSB dated June 15, 2019.
- Communications with the project team regarding site development options and issues.
- Phase I Environmental Site Assessment prepared by Braun Intertec Corporation and dated June 10, 2019.
- Phase II Environmental Site Assessment prepared by Braun Intertec Corporation and August 14, 2019.

In addition to the provided sources, we have used several publicly available sources of information.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

A.5. Scope of Services

We performed our scope of services for the project in accordance with our Proposal for Geotechnical and Environmental Services to Mr. Monte Hilleman of the Saint Paul Port Authority. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.
- Staking and clearing the exploration location of underground utilities. Braun Intertec selected and staked the exploration locations. We acquired the surface elevations and locations with GPS technology using the State of Minnesota's permanent GPS base station network. The Soil Boring Location Sketch included in the Appendix shows the approximate locations of the borings.

- Performing 12 standard penetration test (SPT) borings, denoted as ST-1 to ST-12, to nominal depths of 5 to 21 feet below grade across the site. Boring ST-2 encountered refusal at a depth of 5 feet on apparent foundations/slabs associated with the previous pool. That boring was offset 3 times and encountered refusal at approximately 5 feet each time.

- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.

- Preparing this preliminary report containing a boring location sketch, logs of soil borings, a summary of the soils encountered, results of laboratory tests, and preliminary recommendations for structure and pavement subgrade preparation.

Our authorized scope of services for the project also included Phase I and Phase II Environmental Site Assessments. We submitted those reports separately.

B. Results

B.1. Geologic Overview

The unconsolidated natural sediment in the Site vicinity are Pleistocene age till deposits that consist of sandy loam, clay loam, and silty clay loam. The till deposit, is generally reddish brown in color and is locally compact (Patterson, 1992).

The depth to bedrock in the Site vicinity is 100 to 150 feet below land surface (Mossler and Cleland, 1992). The uppermost bedrock units in the Site vicinity include the Middle Ordovician, Decorah Shale on the western portions of the Site, the Platteville and Glenwood Formations on most of the central and northern portions of the Site, and the St. Peter Sandstone on the southern portions of the Site (Mossler and Bloomgren, 1992). The Decorah Shale is described as a green, calcareous shale with thin limestone interbeds. The Platteville Formation is described as fine-grained dolostone and limestone underlain by thin, green, sandy shale (3-5.5 feet thick) of the Glenwood Formation. The upper portions of the St. Peter Sandstone is described as fine- to medium-grained, quartz sandstone which is generally massive to thick-bedded while the lower portion of the unit contains multicolored beds of mudstone, siltstone and shale, with interbeds of very coarse sandstone.

We based the geologic origins used in this report on the soil types, in-situ and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

B.2. Boring Results

Table 2 provides a summary of the soil boring results, in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheet in the Appendix includes definitions of abbreviations used in Table 2.

Table 2. Subsurface Profile Summary*

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Pavement section	NA	NA	▪ One boring performed in the existing pavement areas. ▪ Bituminous thickness was 3 inches. ▪ No discernible aggregate base was observed below the bituminous.
Topsoil/ Topsoil fill	SC, CL	NA	▪ Predominantly SM. ▪ Dark brown to black. ▪ Thicknesses at boring locations varied from 1 to 4 feet. ▪ Moisture condition generally wet.
Fill	SC, CL	WOH to 5 BPF	▪ Moisture condition generally moist. ▪ Thicknesses at boring locations varied from 0 to 6 feet. ▪ Occasional layers of slightly organic to organic soils throughout, but often organic or mixed with organic soils near boundary with swamp deposited soils.
Swamp deposits	OL	4 to 7 BPF	▪ Organic clay and organic silt. ▪ Generally wet. ▪ Only encountered in Borings ST-3, ST-4 and ST-7 which are located in the eastern portion of the site within the lower elevations.
Alluvial	ML, SC, CL	2 to 14 BPF	▪ General penetration resistance less than 6 BPF. ▪ Moisture condition generally wet. ▪ Typically located in low areas in the eastern portion of the site.

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Glacial deposits	SP, SP-SM, SM	6 to 24 BPF	▪ Intermixed layers of glacial outwash and till. ▪ Variable amounts of gravel; may contain cobbles and boulders. ▪ Moisture condition generally moist, but locally wet at the interface with alluvial soils.
	SC, CL, ML	3 to 33 BPF	

*Abbreviations defined in the attached Descriptive Terminology sheet.

For simplicity in this report, we define existing fill to mean existing, uncontrolled or undocumented fill.

B.3. Groundwater

Table 3 summarizes the depths where we observed groundwater; the attached Log of Boring sheets in the Appendix also include this information and additional details.

Table 3. Groundwater Summary

Location	Surface Elevation	Measured or Estimated Depth to Groundwater (ft)	Corresponding Groundwater Elevation (ft)
ST-3	1024.0	9	1015
ST-4	1037.0	9	1028
ST-7	1022.3	15	1007 1/2
ST-8	1001.0	5	996
ST-9	1033.6	7 1/2	1026
ST-12	993.7	14	980

The soil borings indicate a layered soil profile that is conducive for encountering perched water conditions. Project planning should expect groundwater will fluctuate in relation to seasonal and annual fluctuations in precipitation. Also, for future subsurface investigations on this site, consideration should be given to installing piezometers to better evaluate groundwater elevations.

B.4. Laboratory Test Results

The moisture contents of the fill soils varied from approximately 10 to 19 percent, indicating that the materials varied from near to above of their probable optimum moisture contents. The moisture contents of the alluvial soils varied from approximately 26 to 30 percent, indicating that the alluvial soils were well above of their probable optimum moisture contents. The moisture contents of the organic soils varied from approximately 48 to 69 percent.

Our organic content tests indicated that the samples tested contained 3 to 13 percent organic materials by weight.

C. Preliminary Recommendations

C.1. Design and Construction Discussion

C.1.a. Overall Site Suitability

Based on the currently proposed plan for redevelopment, the subsurface conditions on this site range from favorable to challenging. The soils in the lower elevations in the eastern and northeastern portions of the site initially consist of a combination of existing fill, organic swamp deposits and soft alluvial soils that extend to depths of 4 to 9 feet below existing grades. Those materials are compressible and will experience settlement when exposed to structural loads and/or engineered fill. The existing fill and organic materials should not be left in place below building pads unless it is planned to utilize ground improvement or intermediate foundation options to support the buildings. If the alluvial soils are left in place prior to the placement of engineered fill, it should be anticipated that construction of buildings will need to be delayed after placement of fill soils to allow consolidation of the alluvial soils to occur.

The delay time will be dependent upon the thickness of the alluvial soils left in place as well as the depth of fill required to reach design elevations. The alluvial soils have low load carrying capacities and should be removed within 8 feet of planned finished floor elevations for typical building structures. If heavy industrial loading is planned, that depth will need to be increased. We also recommend removing alluvial silts and clays within the top 3 feet of the subgrade in pavement areas.

The glacial till and outwash soils encountered by the borings are considered to be suitable for support of the proposed building types, pavements and utilities. Other than potential moisture conditioning and surface compaction of the glacial soils, we would not anticipate the need for additional measures to prepare the glacial soils.

C.1.b. Deep Fill Areas

Based on the preliminary cut and fill diagram provided by WSB, there will be between 10 and 30 feet of fill required in the east central and northeastern portions of the site. It is currently planned to utilize on-site soils to balance the site. The on-site soils predominantly consist of silty and clayey sand, with localized deposits of clean sand in the southwest portion of the site. When fill depths reach those magnitudes, there will be long-term consolidation of the fill due to its own weight even when the fill is properly compacted. Due to their fine content, silty and clayey sands will take longer to consolidate than low-fine content sands. We estimate that settlement in the deepest fill areas would be up to several inches if placed on structurally suitable glacial soils. If some or all of the organic and alluvial soils are left in place, the amount of settlement would be significantly greater.

To mitigate or eliminate the risk of detrimental consolidation, there are several options that could be utilized. If building pad locations are known at the time of mass grading, one option could be chosen for building pads and another option for pavement and landscape areas. We have listed those options from the least settlement to the most settlement.

- Prior to filling, remove surface vegetation, root zones, organic soils and soft/loose alluvial soils. For fill depths more than 12 feet below finished elevations, utilize sand with less than 12 percent passing the #200 sieve. Based on the borings, there appears to be limited amounts of sand meeting this requirement available on-site. Fill placed in the upper 12 feet could consist of on-site soils with an organic content less than 3 percent. With this approach, building construction could likely start immediately after fill placement is completed.

- Utilize the same approach as the previous bullet, but utilize on-site silty and clayey soils for the entire fill depth. With this approach, a construction delay would be required prior to construction of buildings, and possibly pavements or utilities. The duration of the delay would depend upon the fill depth and the tolerance for settlement. Within the deepest fill areas, the delay could as much as 1 to 3 years. If a delay is chosen, settlement plates should be installed and monitored to determine when construction can proceed in those areas.

- Utilize the same approach as the first bullet, but leave the soft/loose alluvial soils in place. Similar to the previous option, a construction delay would be required. In this case, the duration of the delay would be impacted by the thickness of the alluvial soils left in place as well as the type of fill used to reach design elevations. Settlement plates would be recommended in this scenario as well.

C.1.c. Reuse of On-Site Soils

From a geotechnical perspective, surface vegetation, root zones and topsoil are considered unsuitable for use as fill within building and pavement areas. We typically recommend that those materials are either placed in landscaped areas or hauled off-site. Due to the past use of this site as a golf course as indicated in the environmental reports, the upper 6 to 12 inches of the tee boxes, fairways and greens have mercury impacts from a fungicide that was formerly used on the course. Based on discussions with Braun Intertec Environmental staff working on the Phase II ESA, the materials have concentration levels that may allow them to remain on-site provided a suitable location can be found for them. Preferred locations would be in landscaped areas or below the stormwater basins where long-term settlement is less of a concern. Consideration could also be given to placing the lower portion of the topsoil (exclusive of the vegetation and heavy root zone) at some depth below the utilities in pavement areas, but that would also cause a risk of long-term settlement in those areas. We also understand that if those materials are left or placed on-site, they will require a buffer of clean soil above them. As the Response Action Plan (RAP) or Construction Contingency Plan (CCP) are being prepared, we recommend coordinating with the geotechnical and civil engineers to determine the most cost effective way to manage impacted on-site soils.

The existing fill encountered by the borings consisted of a mix of lean clay and clayey sand that often contained organic materials intermixed with the fill. If the existing fill is to be reused within future building and pavement areas, it should be anticipated that some segregating of organic materials and moisture conditioning will be required.

The alluvial soils encountered by the borings was typically well above their probable optimum moisture contents and contained some organic materials. Similar to the existing fill, it should be anticipated that some segregating of organic materials and extensive drying of the alluvial soils will be required. Also, alluvial silts and clays should not be reused as structural fill within 8 feet of floor slabs for buildings and within the top 3 feet of pavement areas.

The glacial soils encountered by the borings can be reused as engineered fill in building and pavement areas. The glacial soils generally appeared to be moist (i.e. near to below their probable optimum moisture content) at the time of drilling. The exception would be the initial layer directly below alluvial soils. In those areas, some drying of the glacial soils may be required.

C.1.d. Probable Foundation Options

Based on the subsurface conditions, it is our opinion that types of structures anticipated at this site can be supported on conventional spread footings provided the surface vegetation, root zones, existing fill, organic soils and soft alluvial soils are removed and replaced with engineered backfill.

C.1.e. Groundwater

Groundwater was observed in the borings are widely varying elevations across the site. With the layered soil profile, it is our opinion that most of the water observed in the borings is perched rather than the actual groundwater table. It should be anticipated that perched water will be encountered during mass grading and within the cut portions of the site. The predominant soils at this site are silty and clayey such that sumps and pumps can likely be used to dewater excavations at this site.

C.1.f. Construction Disturbance

The majority of the soils at this site contain moderate to high amounts of silt and clay which make them highly susceptible to disturbance and loss of strength from construction traffic. If earthwork operations take place during wetter times of the year, it should be anticipated that multiple stabilization efforts will be required. Typical stabilization options include disking and drying the soils, removal of overly wet soils and replaced with drier soils or aggregate or chemical stabilization. The use of aggregate or recycled materials for haul roads and lay down areas will also protect the subgrade soils from disturbance.

C.1.g. Pavement

Based on the proposed site usage, we anticipate that there will be areas of light-duty pavements, medium duty pavements and heavy-duty pavements. The predominant on-site silty and clayey soils are judged to be moderately to highly frost susceptible and will require relatively thick aggregate base sections to provide the necessary support during the spring thaw period. We understand that the current cut fill plan is based on achieving a balanced site (no significant import or export of soils). If this site required a significant import of soils, than it may be cost effective to import sand for use as a subbase directly below the aggregate section. A sand subbase would provide better long-term performance due to its improved drainage and frost protection characteristics. Note that if any of the streets will be City of St. Paul streets, they may be required to utilize a sand subbase. Regardless if sand subbases are utilized within pavement areas, we recommend drain tile be placed in low areas of the pavements, directly beneath the sand subbase or aggregate base.

Based on the predominant soil types and planned traffic volumes, it is our opinion that typical pavement sections will be in the range of 4 to 5 inches of bituminous over 8 to 10 inches of aggregate base for light and medium duty traffic loads. Heavy-duty pavements will likely be in the range of 6 to 8 inches of bituminous over 12 to 15 inches of aggregate base for heavy-duty industrial traffic. As the site plans are finalized and actual traffic loading is known, the pavement sections should be revised.

C.1.h. Utilities

The majority of the on-site soils should be suitable for support of utilities. There may be areas within the swamp deposits or alluvial soils where localized subcuts will be required to provide a stable subgrade for utility support. The majority of the on-site soils are considered moderately corrosive to metallic conduit, but will not be corrosive to concrete.

C.1.i. Stormwater Management

The majority of the soils on this site fall into Hydrologic Soil Groups C (ML) or D (SC). It has been our experience that the Superior Lobe Silty Sand glacial till does NOT perform like a Group B soil and performs like a Group C soil.

Borings ST-11 and ST-12 encountered the lower rate (0.8 in/hr) Group A soils in the southern portion of the site. It is common for those layers to be discontinuous and variable in thickness and horizontal extent within the glacial till layers. Both samples of the SP-SM in Boring ST-12 had visible free water. If infiltration is planned within those soils, a more detailed subsurface investigation program should be performed in those areas.

C.1.j. Additional Borings

As the site plan evolves and building locations are determined, we recommend that additional soil borings and evaluation be performed.

D. Procedures

D.1. Penetration Test Borings

We drilled the penetration test borings with an all-terrain-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 1/2- or 5 foot intervals in general accordance to ASTM D1586. The boring logs show the actual sample intervals and corresponding depths.

We sealed penetration test boreholes meeting the Minnesota Department of Health (MDH) Environmental Borehole criteria with an MDH-approved grout. We will forward/forwarded a sealing record (or sealing records) for those boreholes to the Minnesota Department of Health Well Management Section.

D.2. Exploration Logs

D.2.a. Log of Boring Sheets

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials, and present the results of penetration resistance and other in-situ tests performed. The logs also present the results of organic vapor screening, laboratory tests performed on penetration test samples, and groundwater measurements.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

D.2.b. Organic Vapor Measurements

We screened the material samples retrieved during drilling for the presence of organic vapors with a photoionization detector (PID) using both: (1) direct readings from each sample, and (2) the headspace method of analysis recommended in “Soil Sample Collection and Analysis Procedures,” Minnesota Pollution Control Agency (MPCA) Petroleum Remediation Guidance Document 4-04 (September 2008). The PID is equipped with a 10.6 eV lamp and calibrated to an isobutylene standard, prior to the start of fieldwork.

D.2.c. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

D.3. Material Classification and Testing

D.3.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

D.3.b. Laboratory Testing

The exploration logs in the Appendix note the results of the laboratory tests performed on geologic material samples. We performed the tests in general accordance with ASTM procedures.

D.4. Groundwater Measurements

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes or allowed them to remain open for an extended period of observation, as noted on the boring logs.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

E.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

E.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

E.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix A

Soil Boring Location Sketch
Log of Boring Sheets ST-1 to ST-12
Descriptive Terminology of Soil

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DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

N

150' 0 300'

SCALE: 1"= 300'

F:\2019\B1903316.dwg,Geo,5/21/2019 10:45:40 AM

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Drawing Information

Project No:	B1903316
Drawing No:	B1903316
Drawn By:	JAG
Date Drawn:	4/5/19
Checked By:	MK
Last Modified:	5/21/19

Project Information

Geotechnical Evaluation

Former Hillcrest Golf Course

St. Paul, Minnesota

Soil Boring Location Sketch

Figure 2

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-1**

LOCATION: See attached sketch

NORTHING: 173294 EASTING: 596928

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/12/19 | END DATE: 04/12/19

SURFACE ELEVATION: 1030.6 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1029.7		CLAYEY SAND (SC), trace roots, dark brown, moist (TOPSOIL FILL)			0.0		
0.9		FILL: CLAYEY SAND (SC), trace roots, dark brown, moist		1-2-2 (4) 17"		16	
					0.0		
			5	2-2-3 (5) 16"		14	
1024.6					0.0		
6.0		CLAYEY SAND (SC), trace Cobbles, reddish brown, moist (GLACIAL TILL)		3-2-3 (5) 15"	0.0		
			10	4-10-10 (20) 18"	0.0		
				12-13-15 (28) 18"			
		No odors			0.0		
		Cobbles at 15 feet	15	20-18-14 (32) 16"	0.0		
			20	9-9-9 (18) 18"			
1009.6							
21.0		END OF BORING					
		Boring immediately grouted					
			25				
			30				

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-2**

LOCATION: See attached sketch

NORTHING: 172891 EASTING: 596924

DRILLER: A. Holmbo LOGGED BY: S. Martin START DATE: 04/12/19 END DATE: 04/12/19

SURFACE ELEVATION: 1037.5 ft RIG: GP-2 METHOD: 3 1/4" HSA SURFACING: Grass WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
		FILL: CLAYEY SAND (SC), trace Gravel, trace organic, gray to dark brown, moist *Mixed with Poorly Graded Sand* *No odor, possible fertilizer*		50/3" (REF) 6"	0.0		Soil sample ST-2 (0-2') collected for VOC and RCRA
1032.5 5.0		END OF BORING Boring immediately backfilled		50/2" (REF) 3"			Auger met refusal at 5 feet. Boring offset 2 times with refusal at 5 feet.

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-3**

LOCATION: See attached sketch

NORTHING: 173268 EASTING: 597749

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/13/19 | END DATE: 04/13/19

SURFACE ELEVATION: 1024.0 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1022.0		FILL: CLAYEY SAND (SC), with roots, intermixed with Sand, black to brown, moist			0.1	10	Soil sample ST-3 (0-2') @ 08:30 collected for VOC, DRO, GRO, RCRA, and PAH
2.0 / 1020.0		FILL: SANDY LEAN CLAY (CL), trace roots, dark brown to black, moist		2-2-3 (5) 18"	0.0		
4.0 / 1017.0		ORGANIC CLAY (OL), black to gray, moist (SWAMP DEPOSIT)	5	2-3-4 (7) 16"	0.1	48	OC=9.5%
					0.0	26	Soil sample ST-3 (5-7') collected for RCRA
7.0 / 1015.0		LEAN CLAY (CL), black to gray, wet, medium (ALLUVIUM)		0-1-3 (4) 17"	0.0		Water sample ST-3W @ 09:00 collected for analytical testing
9.0 / 1013.0	▼	CLAYEY SAND (SC), brown to gray, moist, stiff (ALLUVIUM)	10	2-3-3 (6) 15"	0.0		
11.0 / 1010.0		SILTY SAND (SM), fine to medium sand, trace Gravel, reddish brown, wet, loose (GLACIAL TILL)		0-4-5 (9) 15"	0.0		Temporary well installed with screen set from 9.3 to 14.3 feet
14.0 / 1007.0		SANDY SILT (ML), gray, wet, loose (GLACIOFLUVIUM)	15	2-3-3 (6) 18"	0.0		
17.0 / 1003.0		CLAYEY SAND (SC), trace Gravel, reddish brown, moist, stiff to very stiff (GLACIAL TILL)	20	1-2-9 (11) 16" / 12-12-12 (24) 50"	0.0		
21.0		END OF BORING Boring immediately grouted	25 / 30				Water observed at 9.4 feet with 21.0 feet of tooling in the ground at end of drilling.

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-4**

LOCATION: See attached sketch

NORTHING: 172391 EASTING: 597673

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/13/19 | END DATE: 04/13/19

SURFACE ELEVATION: 1037.0 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1033.0		ORGANIC SILT (OL), with roots, wood fragments, black, wet (SWAMP DEPOSIT)		2-2-2 (4) 22"	0.1 0.1	69	OC=12.9%
4.0 1028.0		SANDY SILT (ML), contains layers of Lean Clay, gray, wet, very loose (ALLUVIUM)	5	0-1-1 (2) 12" 0-0-3 (3) 18"	0.4 0.1 0.1	30	Soil sample ST-4 (4-6') collected for RCRA
9.0 1016.0	▽	CLAYEY SAND (SC), trace Gravel, brown, moist, stiff (GLACIAL TILL)	10 15 20	7-7-7 (14) 16" 6-7-8 (15) 14" 4-6-7 (13) 16" 4-5-6 (11) 18"	0.0 0.0 0.0		
21.0		END OF BORING Boring immediately grouted	25 30				Water observed at 9.0 feet with 21.0 feet of tooling in the ground while drilling.

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See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-5**

LOCATION: See attached sketch

NORTHING: 172462 EASTING: 596968

DRILLER: A. Holmbo LOGGED BY: S. Martin START DATE: 04/12/19 END DATE: 04/12/19

SURFACE ELEVATION: 1056.4 ft RIG: GP-2 METHOD: 3 1/4" HSA SURFACING: Grass WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1054.4		CLAYEY SAND (SC), with roots, moist (TOPSOIL)			0.0	12	Soil sample ST-5 (1-3') @ 13:40 collected for analytical testing
2.0		CLAYEY SAND (SC), trace Gravel, reddish brown, moist, stiff to very stiff (GLACIAL TILL)		2-3-4 (7) 20"	0.0		
			5	5-8-6 (14) 18"	0.0		
				4-6-9 (15) 16"	0.0		
			10	10-9-4 (13) 17"	0.0		
				9-7-10 (17) 17"	0.0		
			15	12-10-10 (20) 20"	0.0		
				20-17-16 (33) 18"	0.0		
1035.4			20	13-14 (14) 13"	0.0		
21.0		END OF BORING Boring immediately grouted					
			25				
			30				

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-6**

LOCATION: See attached sketch

NORTHING: 171711 EASTING: 596769

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/12/19 | END DATE: 04/12/19

SURFACE ELEVATION: 1061.0 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1060.1		CLAYEY SAND (SC), with roots, dark brown, moist (TOPSOIL)			0.0		
0.9		CLAYEY SAND (SC), trace Gravel, reddish brown, moist, medium dense (GLACIAL TILL)		6-7-11 (18) 18"	0.0	11	Soil sample ST-6 (2-4') @ 15:00 collected for VOC, DRO, GRO, RCRA, and PAH
1057.0							
4.0		SILTY SAND (SM), fine to medium sand, reddish brown, moist, medium dense (GLACIAL TILL)	5	8-8-9 (17) 18"	0.0		
				13-12-12 (24) 15"	0.0		
			10	10-11-13 (24) 16"	0.0		
				14-12-13 (25) 18"	0.0		
			15	15-15-10 (25) 16"	0.0		
			20	15-14-16 (30) 17"			
1040.0							
21.0		END OF BORING Boring immediately grouted					
			25				
			30				

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-7**

LOCATION: See attached sketch

NORTHING: 171433 EASTING: 597530

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/13/19 | END DATE: 04/13/19

SURFACE ELEVATION: 1022.3 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1021.4		CLAYEY SAND (SC), with roots, black, moist (TOPSOIL)					
0.9		ORGANIC SILT (OL), with roots, dark brown, wet, very loose (SWAMP DEPOSIT)		1-1-1 (2) 16"		27	OC=3.0%
1018.3							
4.0		CLAYEY SAND (SC), trace Gravel, brown to reddish brown, moist, medium to very stiff (GLACIAL TILL)	5	3-2-3 (5) 15"			
				0-5-8 (13) 17"			
			10	6-10-10 (20) 18"			
1008.3				3-8-8 (16) 16"			
14.0	▽	SILTY SAND (SM), fine to medium sand, trace Gravel, reddish brown, wet, loose (GLACIAL TILL)	15	1-2-3 (5) 16"			
			20	3-3-5 (8) 14"			
1001.3							
21.0		END OF BORING Boring immediately grouted					Water observed at 15.0 feet with 21.0 feet of tooling in the ground while drilling.
			25				
			30				

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See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-8**

LOCATION: See attached sketch

NORTHING: 170893 EASTING: 597738

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/13/19 | END DATE: 04/13/19

SURFACE ELEVATION: 1001.0 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Bituminous | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
~~1000.7~~ 0.3		BITUMINOUS, 3 inches of bituminous FILL: LEAN CLAY (CL), trace Gravel, brown, wet		0-0-0 WOH/18" 4"	0.1	19	
997.0 4.0	▼	LEAN CLAY (CL), with roots, gray to brown, wet, soft (ALLUVIUM)	5	0-0-2 (2) 16"	0.1	26	Water sample ST-8W @ 10:45 collected for analytical testing
994.0 7.0	▽	CLAYEY SAND (SC), trace Gravel, brown, moist to wet, soft to very stiff (GLACIAL TILL)		0-0-3 (3) 18"	0.1		Soil sample ST-8 (5-7') @ 10:45 collected for VOC, DRO, GRO, RCRA, and PAH
			10	3-5-8 (13) 16"	0.0		Temporary well installed with a screen set from 5.4 to 10.4 feet
				5-7-7 (14) 15"	0.0		
			15	5-9-10 (19) 5"	0.0		
			20	2-5-7 (12) 13"			
980.0 21.0		END OF BORING Boring immediately grouted					Water observed at 8.5 feet with 21.0 feet of tooling in the ground while drilling. Water observed at 5.4 feet with 21.0 feet of tooling in the ground at end of drilling.
			25				
			30				

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See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-9**

LOCATION: See attached sketch

NORTHING: 170879 EASTING: 596783

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/13/19 | END DATE: 04/13/19

SURFACE ELEVATION: 1033.6 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1032.1		CLAYEY SAND (SC), with roots, dark brown, moist (TOPSOIL)			0.0		
1.5		LEAN CLAY (CL), brown, moist, soft (ALLUVIUM)		1-2-2 (4) 10"	0.0	28	
1029.6							
4.0		CLAYEY SAND (SC), trace Gravel, reddish brown, moist, very stiff (GLACIAL TILL)	5	5-8-10 (18) 18"	0.0		
1026.6							
7.0	▽	POORLY GRADED SAND with SILT (SP-SM), fine to medium sand, reddish brown, wet, medium dense (GLACIAL OUTWASH)		7-8-9 (17) 16"	0.0		
1024.6							
9.0		SILTY SAND (SM), fine to medium sand, trace Gravel, reddish brown, moist, medium dense (GLACIAL TILL)	10	5-12-15 (27) 15"	0.0		
				10-12-14 (26) 18"	0.0		
			15	9-10-10 (20) 17"			
					0.0		
			20	8-7-8 (15) 18"			
1012.6							
21.0		END OF BORING Boring immediately grouted					Water observed at 7.5 feet with 21.0 feet of tooling in the ground while drilling.
			25				
			30				

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See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-10**

LOCATION: See attached sketch

NORTHING: 170319 EASTING: 597182

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/13/19 | END DATE: 04/13/19

SURFACE ELEVATION: 1017.1 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1015.1		CLAYEY SAND (SC), with roots, dark brown, moist (TOPSOIL)			0.0	13	Soil sample ST-10 (1-3') collected for VOC, DRO, GRO, RCRA, and PAH
2.0 / 1013.1		CLAYEY SAND (SC), trace Gravel, reddish brown, moist to moist, stiff (GLACIAL TILL)		3-7-4 (11) 16"	0.0		
4.0		SILTY SAND (SM), fine to medium sand, trace Gravel, reddish brown, moist, medium (GLACIAL TILL)	5	6-8-8 (16) 14"			
				6-10-10 (20) 18"			
			10	7-8-9 (17) 16"			
				7-9-9 (18) 16"			
1000.1			15	7-6-7 (13) 14"			
17.0		CLAYEY SAND (SC), trace Gravel, reddish brown, moist to wet, stiff (GLACIAL TILL)					
996.1			20	6-7-9 (16) 18"			
21.0		END OF BORING Boring immediately grouted	25				
			30				

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-11**

LOCATION: See attached sketch

NORTHING: 169708 EASTING: 596658

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/13/19 | END DATE: 04/13/19

SURFACE ELEVATION: 1019.2 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
1018.2		CLAYEY SAND (SC), with roots, dark brown, moist (TOPSOIL)					
1.0		CLAYEY SAND (SC), trace roots, dark brown, moist, medium (GLACIAL TILL)					
1017.2							
2.0		SILTY SAND (SM), fine to medium sand, trace Gravel, reddish brown, moist, loose to medium dense (GLACIAL TILL)		1-2-4 (6) 18"			
			5	2-3-3 (6) 15"			Soil sample ST-11 (4-6') @ 13:15 collected for RCRA and dry weight
				8-6-7 (13) 17"			
			10	8-7-8 (15) 3"			
1007.2							
12.0		POORLY GRADED SAND (SP), fine to medium sand, trace Gravel, light brown, moist, loose to medium dense (GLACIAL OUTWASH)		4-3-4 (7) 12"			
			15	5-7-10 (17) 15"			
			20	10-8-8 (16) 17"			
998.2							
21.0		END OF BORING Boring immediately grouted					
			25				
			30				

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1903316
Geotechnical & Environmental Evaluation
Former Hillcrest Golf Course
St. Paul, Minnesota

BORING: **ST-12**

LOCATION: See attached sketch

NORTHING: 169601 EASTING: 597752

DRILLER: A. Holmbo | LOGGED BY: S. Martin | START DATE: 04/13/19 | END DATE: 04/13/19

SURFACE ELEVATION: 993.7 ft | RIG: GP-2 | METHOD: 3 1/4" HSA | SURFACING: Grass | WEATHER: Snow

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	PID ppm	MC %	Tests or Remarks
991.7		FILL: LEAN CLAY (CL), with roots, dark brown, moist					
2.0		LEAN CLAY (CL), brown, wet, soft to stiff (ALLUVIUM)		2-2-12 (14) 18"			Soil sample ST-12 (2-4') collected for RCRA and dry weight
987.7			5	2-1-3 (4) 14"			
6.0		SILTY SAND (SM), fine to medium sand, trace Gravel, reddish brown, wet, medium dense (GLACIAL TILL)		7-7-8 (15) 15"			Soil sample ST-12 (6-8') @ 12:10 collected for RCRA and dry weight
			10	6-10-8 (18) 18"			
979.7	▼			12-10-11 (21) 15"			
14.0	▽	POORLY GRADED SAND with SILT (SP-SM), fine to medium sand, trace Gravel, reddish brown, wet, medium dense (GLACIAL OUTWASH)	15	6-8-10 (18) 17"			Water sample ST-12W @ 12:30 collected for analytical testing
							Temporary well installed with a screen set from 13.8 to 18.8 feet
			20	9-8-4 (12) 16"			
972.7							
21.0		END OF BORING Boring immediately grouted					Water observed at 15.0 feet with 21.0 feet of tooling in the ground while drilling. Water observed at 13.9 feet with 21.0 feet of tooling in the ground at end of drilling.
			25				
			30				

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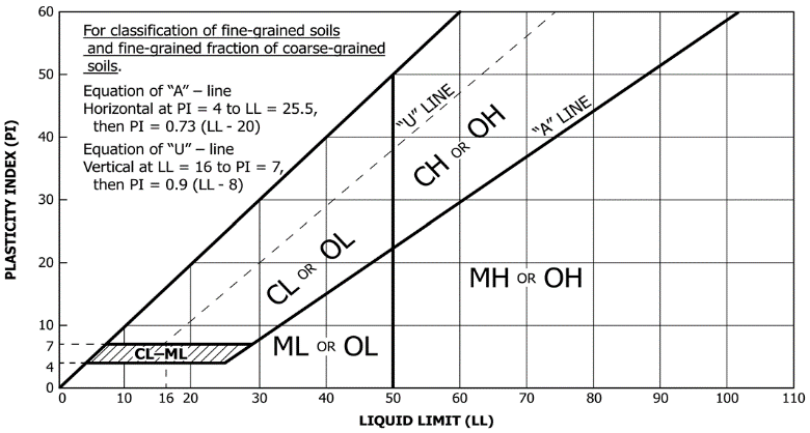
Descriptive Terminology of Soil

Based on Standards ASTM D2487/2488
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines[C])	$C_u \geq 4$ and $1 \leq C_c \leq 3$[D]	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E F G]
			Fines Classify as CL or CH	GC	Clayey gravel[E F G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3$[D]	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[J]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F G I]
			Fines classify as CL or CH	SC	Clayey sand[F G I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	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 Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (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. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. 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
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% 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.



Particle Size Identification

Boulders..... over 12"
Cobbles..... 3" to 12"
Gravel
  Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)
  Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
  Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)
  Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)
  Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt..... No. 200 (0.075 mm) to .005 mm
Clay..... < .005 mm

Relative Proportions[L, M]

trace..... 0 to 5%
little..... 6 to 14%
with..... ≥ 15%

Inclusion Thicknesses

lens..... 0 to 1/8"
seam..... 1/8" to 1"
layer..... over 1"

Apparent Relative Density of Cohesionless Soils

Very loose ..... 0 to 4 BPF
Loose ..... 5 to 10 BPF
Medium dense..... 11 to 30 BPF
Dense..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft	0 to 1 BPF	< 0.25 tsf
Soft	2 to 4 BPF	0.25 to 0.5 tsf
Medium	5 to 8 BPF	0.5 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

Recovery: Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (▽), at the end of drilling (▼), or at some time after drilling (▼).

Laboratory Tests

DD	Dry density, pcf	**OC**	Organic content, %	**LL**	Liquid limit
WD	Wet density, pcf	**q_p**	Pocket penetrometer strength, tsf	**PL**	Plastic limit
P200	% Passing #200 sieve	**MC**	Moisture content, %	**PI**	Plasticity index
		q_U	Unconfined compression test, tsf		

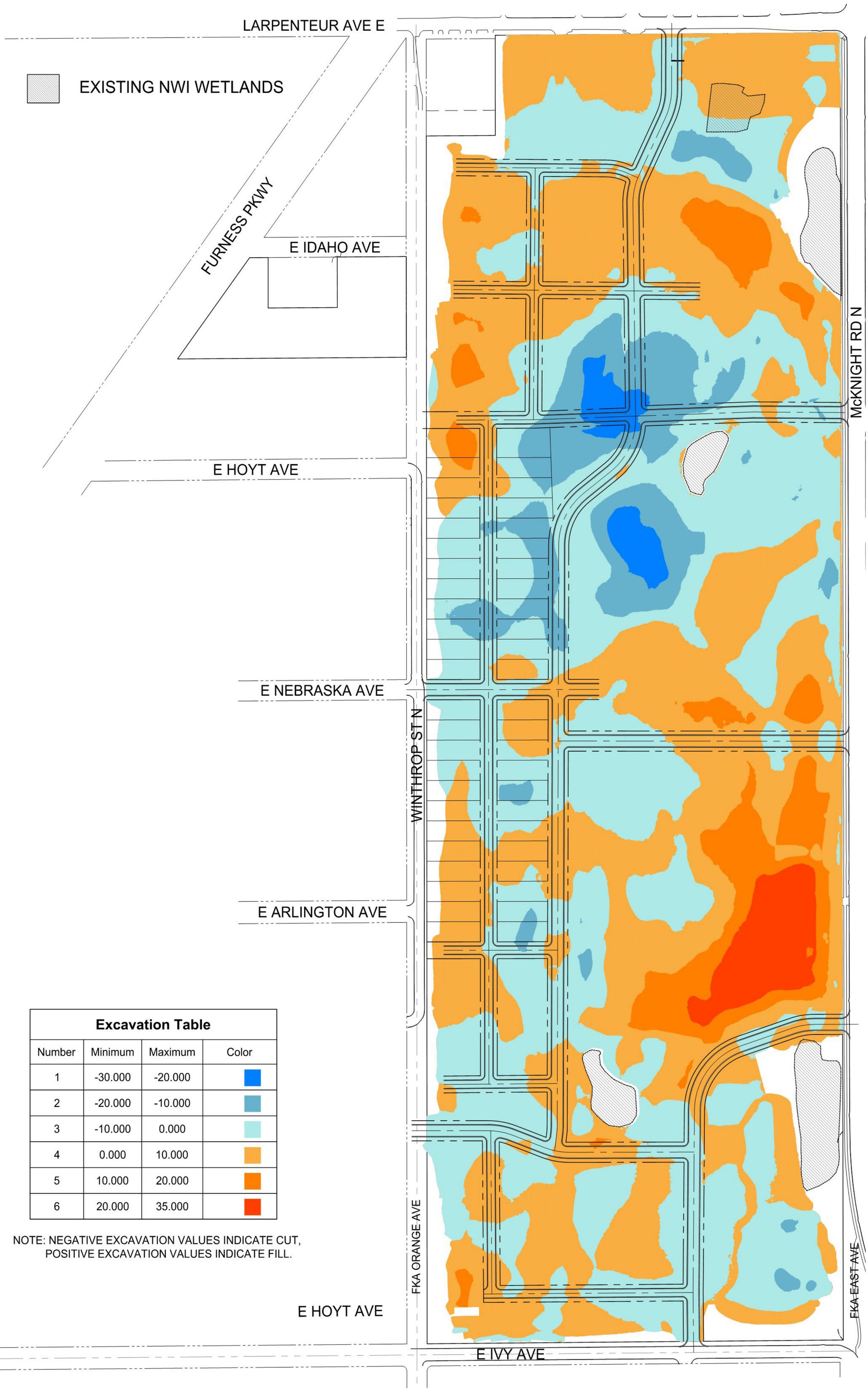
3/2019

Appendix B

Grading Excavation Exhibit

BRAUN INTERTEC

K:\013987-000\Cad\Plan\013987-000 C-EXCAV-PLAN.dwg 7/30/2019 4:30:33 PM



Excavation Table			
Number	Minimum	Maximum	Color
1	-30.000	-20.000	
2	-20.000	-10.000	
3	-10.000	0.000	
4	0.000	10.000	
5	10.000	20.000	
6	20.000	35.000	

NOTE: NEGATIVE EXCAVATION VALUES INDICATE CUT,
POSITIVE EXCAVATION VALUES INDICATE FILL.

SCALE: 1" = 150'
PLAN BY: CMM
DESIGN BY: PJM
DATE: 06-15-2019

GRADING EXCAVATION EXHIBIT

ST PAUL, MN

SHEET 3 OF 3