

# Geotechnical Evaluation Report

Proposed Street Reconstruction  
Superior Street – Between 7th Ave West and 4th Ave East  
Duluth, Minnesota

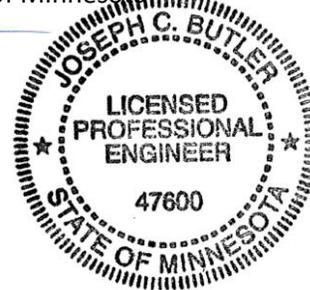
*Prepared for*

**LHB, Inc.**

## 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.

  
Joseph C. Butler, PE  
Senior Engineer  
License Number: 47600  
December 7, 2015



Project B14-08485

Braun Intertec Corporation

December 7, 2015

Project B14-08485

Brad Scott, PE  
LHB, Inc.  
21 West Superior Street, Suite 500  
Duluth, MN 55802

Re: Geotechnical Evaluation  
Proposed Street Reconstruction  
Superior Street – Between 7th Ave W. and 4th Ave E  
Duluth, Minnesota

Dear Mr. Scott:

We are pleased to present this Geotechnical Evaluation Report for the City of Duluth Superior Street Reconstruction project. Please see attached report for a detailed discussion on the field exploration results and our geotechnical recommendations. The report should be read in its entirety.

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 Joe Butler at 218.624.4967 or [jbutler@braunintertec.com](mailto:jbutler@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION



Neil G. Lund, PE  
Senior Engineer



Joseph C. Butler, PE  
Associate Principal/Senior Engineer

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### Appendix

- Boring Location Sketch (12 pages)
- Log of Boring Sheets ST-01 through ST-66
- Existing Pavement Thickness Results
- Fence Diagrams (5 sheets)
- Descriptive Terminology

## **A. Introduction**

### **A.1. Project Description**

The City of Duluth is planning to reconstruct pavements and sidewalks along Superior Street between 7th Ave West and 4th Ave East. Underground utilities will also be reconstructed as part of the project. Water mains and services, storm drains, and power duct banks will be partially or completely replaced. Steam lines will be replaced with hot water supply and return lines.

### **A.2. Purpose**

The purpose of this geotechnical evaluation is to provide subsurface soil and groundwater information and geotechnical recommendations for use in design and construction of the proposed street reconstruction project.

### **A.3. Provided Documents**

Brad Scott, PE, project manager for LHB, Inc., provided us with plan and profile record drawings from the City of Duluth. We also reviewed topographic maps, geologic maps and aerial photos of the project area.

### **A.4. Site Conditions**

The project is currently a bituminous, brick, and concrete paved roadway with curb and gutters. The alignment is about 5200 feet in length and travels parallel to the hillside. The MnDOT traffic mapping application indicates annual average daily traffic (AADTs) between 10,500 and 14,400 along Superior Street (2011 counts). The corridor carries significant bus traffic.

### **A.5. Scope of Services**

Our scope of services for this project was originally submitted in an electronic mail message to LHB on October 31, 2014. We subsequently received authorization to proceed from LHB. Tasks performed in accordance with our authorized scope of services included:

- Coordinating the locating of underground utilities near the boring locations.
- Performing 65 standard penetration test borings to a depth of 15 feet.
- Preparing this report containing a sketch, boring logs, a summary of the geologic materials encountered and results of laboratory tests.

## **A.6. Environmental Sampling**

Our standard penetration test samples were split with onsite personnel from Barr Engineering. We understand the samples were collected as part of the Phase II Environmental Site Assessment for the project.

## **A.7. Boring Locations and Elevations**

The desired boring locations were selected and staked by LHB. The ground surface elevations were provided by LHB, Inc.

# **B. Results**

## **B.1. Exploration Logs**

### **B.1.a. Log of Boring Sheets**

Log of Boring sheets for our penetration test and flight auger borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated, and present the results of penetration resistance and other in-situ tests performed within them, organic vapor screening, laboratory tests performed on penetration test samples retrieved from them, and groundwater measurements. Strata boundaries were inferred from changes in the penetration test samples and the auger cuttings. Because sampling was not performed continuously, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may also occur as gradual rather than abrupt transitions.

### **B.1.b. Geologic Origins**

Geologic origins assigned to the materials shown on the logs and referenced within this report were 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 and other in-situ 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.

## **B.2. Subsurface Profile**

Sixty -five borings were ultimately completed for the project. All of the borings were completed through the pavement surfaces. Below the pavement the borings generally encountered lean clay and silty sand to their termination depths.

The results of the borings are summarized below, however, boring logs and “fence” diagrams provide full detail of the boring results are presented the appendix of this report.

### **B.2.a. Pavement**

Thirty two borings were completed through brick pavers, underlain by bituminous pavement. The bituminous was 1 to 9.5 inches in thickness and was underlain by 4 1/2 to 13 1/2 inches of concrete. Aggregate base was present in 19 of these 32 borings. The aggregate base ranged in thickness from 3 to 13 inches. Boring s ST-1, ST-12, ST-36 and ST- 66 were through 10 inches of concrete. The remaining 29 borings were through bituminous pavement. The bituminous pavement was 1 1/2 to 11 inches in thickness and was underlain by 3 to 12.5 inches of concrete. Below the concrete, 6 borings encountered aggregate base. The aggregate base was 4 to 11 inches in thickness. Boring ST-22 encountered 60 inches of aggregate base. A tabulation of pavement thicknesses is available in the Appendix.

### **B.2.b. Fill**

Below pavements, fill materials generally ranged from 1/2 to 12 1/2 feet in thickness. Four borings encountered no fill below pavement materials. The fill materials were predominantly lean clays or Silty Sands similar to native materials. A tabulation of fill thicknesses is available in the Appendix.

### **B.2.c. Geologic Materials**

Below the pavements and fill, the borings generally encountered lean clay and silty sand to the termination depths of the borings

Penetration resistances in the silty sands and sandy silts ranged from 15 blows per foot (BPF) to 100 blows for 6 inches of drive, indicating they ranged from medium dense to very dense. Penetration resistances in the lean clays ranged from 4 to 32 BPF, indicating they were rather soft to hard.

### **B.2.d. Bedrock**

Auger refusal was encountered in 32 of the 65 borings at depths ranging from 2.1 to 15.3 feet; auger refusal can be caused by cobbles, boulders, hardpan, debris or bedrock. Based on our experience in the area, and our offset borings, it is our opinion the refusal was caused by bedrock. Coring would be required for positive identification. The table below summarizes the auger refusal depths and elevations.

**Table 1. Bedrock Refusal Depth and Elevation**

Boring Number	Refusal Depth [feet]	Refusal Cause
ST-1	9.9	Bedrock
ST-22	12	Bedrock
ST-24	9.8	Bedrock
ST-25	8	Bedrock
ST-26	7.7	Bedrock
ST-27	5	Bedrock
ST-28	4.2	Bedrock
ST-29	5	Bedrock
ST-30	3.5	Bedrock
ST-31	13	Bedrock
ST-37	14.5	Bedrock
ST-38	13.5	Bedrock
ST-42	15.3	Bedrock
ST-45	14.3	Bedrock
ST-46	10	Bedrock
ST-47	9.8	Bedrock
ST-48	8.3	Bedrock
ST-49	2.1	Bedrock
ST-50	5.6	Bedrock
ST-53	7	Bedrock
ST-54	12	Bedrock
ST-55	7.2	Bedrock
ST-56	14	Bedrock
ST-57	11.8	Bedrock
ST-58	8.3	Bedrock
ST-59	12	Bedrock
ST-61	10.5	Bedrock
ST-62	10	Bedrock
ST-63	11.5	Bedrock
ST-64	11.5	Bedrock
ST-65	9	Bedrock
ST-66	12	Bedrock

### **B.2.e. Groundwater**

Groundwater was generally not observed in our borings as they were advanced with the exception of ST-44 and ST-45. We would expect that groundwater would be encountered running on top of the bedrock during periods of wet weather and spring thaw.

Seasonal and annual fluctuations of groundwater, however, should be anticipated.

## **C. Basis for Recommendations**

### **C.1. Proposed Construction**

#### **C.1.a. General**

The City of Duluth is planning to reconstruct pavements along Superior Street, between 7th Ave West and 4th Ave East. The sidewalks and pavements will be reconstructed. Underground utilities will also be reconstructed as part of the project. Water mains and services, storm drains, and power duct banks will be partially or completely replaced. Steam lines will be replaced with hot water supply and return lines.

We have assumed the roadways will be designed and constructed in general accordance with current Minnesota Department of Transportation (Mn/DOT) standards and specifications.

#### **C.1.b. Traffic Loads and Pavements**

New Superior Street pavements will be Portland cement concrete- (PCC) surfaced with the following section per the City of Duluth:

- 8 inches PCC
- 4 inches Class 5 aggregate base
- 24 inches Select Granular subbase
- Geotextile fabric
- Edge drains

As previously mentioned, Superior Street AADTs range from 10,500 and 14,400 by 2011 counts. We used the MnDOT *State Aid ESAL Traffic Forecast Calculator - 04/07/2014* to estimate traffic loading for Superior Street with the following parameters:

- AADT (2016): 14,400 (highest traffic from 2011 counts; zero projection to 2016)
- Traffic projection factor: 1.0 (2013 MSAS Needs Data)
- AADT range: Urban > 1500

The default HCADT proportion (3.57 percent) provides equivalent single axle load (ESAL) values as follows:

- 20-year: 1,812,000
- 35-year: 3,106,000
- 50-year: 4,438,000

### **C.1.c. Precautions Regarding Changed Information**

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

## **C.2. Design Considerations**

### **C.2.a. Utility Installations**

The silty sand and lean clay soils encountered in the borings appear suitable for support of the proposed utilities.

### **C.2.b. Pavement Subgrades**

Silty sands and lean clays were encountered at anticipated subgrade locations. It is our opinion the silty sand soils are marginal pavement subgrade soils. It is our opinion the lean clay soils are poor subgrade soils. The lean clays (CL) and silty sands (SM) are frost-susceptible soils. Mn/DOT design standards require minimum thicknesses of frost-free materials (FFMs) over these subgrade soils.

### **C.2.c. Differential Frost Heave**

As noted above lean clays and silty sands are frost susceptible materials, when these soils are wet and freeze, frost heave will occur. Based upon the observed soil conditions and past experience with similar projects throughout the area, we anticipate that frost heave on the order of 3 to 6 inches is likely. Based on discussions with LHB, we understand the utility trenches will be backfilled with granular materials. Mn/DOT Granular Bedding is being considered for backfill, this material is a relatively non frost susceptible material, and therefore differential frost heave will occur between the silty and clayey soils and the utility trench backfills. Based on our experience in the area, we suspect 3 to 6 inches of frost heave is possible.

We recommend onsite soils be utilized for utility trench backfill wherever possible to minimize the chance of differential frost heave. Where this is not feasible, we recommend a slightly- to moderately-frost susceptible materials be utilized. We recommend silty sands with up to 15 to 30 percent passing the 200

sieve be considered for backfill. In area where rock trenches are expected, we recommend a non-frost susceptible material be utilized to backfill the trench, up to top of rock elevation.

If granular bedding is utilized for utility trench backfill, we recommend the following treatments be considered; a taper from trench sidewalls to subgrade (10:1 minimum) or a sand sub-base be incorporated into the pavement section (2 feet of MnDOT Select Granular Borrow).

#### **C.2.d. Bedrock**

Apparent bedrock was encountered above anticipated utility invert elevations. If rock excavation is required, blasting is generally the preferred method of excavation, however, mechanical breaking methods, such as drilling relief holes and the use of a large breaker may be considered. Alternatively, insulation can be considered for frost protection. If insulation is pursued, we recommend the insulation manufacturer be consulted; they can provide typical sections and specifications for their products.

We should note that if insulation is installed at a depth of less than 2 feet, it can cause frost and ice buildup on the pavement or sidewalk surface, known as differential icing.

#### **C.2.e. Utility Vault and Duct Bank Abandonment**

We understand there are abandoned utility vaults along the alignment. If the vaults or duct banks are wood, we recommend they be completely removed. Where the vaults are concrete, they can either be completely removed or filled with lean concrete. We recommend excavations related to these removals be backfilled in accordance with Section D.1.c below.

#### **C.2.f. Soil Corrections**

We understand excavations to remove contaminated soils will be conducted along the alignment, where soils are removed we recommend they be backfilled in accordance with Section D.1.c below.

## **D. Recommendations**

### **D.1. Utility Installations**

#### **D.1.a. Utility Excavations and Subgrades**

Based on the soils encountered in the borings and the anticipated utility invert elevations, the utility subgrades will consist of native glacial tills. These soils appear suitable for support of the utilities. The

silty sand and lean clay soils are corrosive soils; we recommend the pipes be bedded in imported sand or sand with gravel.

#### **D.1.b. Excavation Dewatering**

If groundwater is encountered in excavations, we recommend the excavation be dewatered. Dewatering can be accomplished with a sump and pump.

#### **D.1.c. Excavation Backfill**

Onsite soils from the trench excavations may be used as backfill material, alternately imported fill can be subject to the discussion in Section C.2.c above. We recommend placing backfill soils lifts, maximum of 1-foot, and compacting to a minimum of 95 percent of standard Proctor maximum dry density, in accordance with ASTM International Test Method D 698. The minimum compaction level should be increased to 100 percent of standard Proctor density within the upper 3 feet of the roadway subgrade.

### **D.2. Subgrade Preparation**

#### **D.2.a. General**

Where the existing pavements are removed, we recommend the pavement subgrades be scarified to a depth of at least 6 inches, mixed, moisture-conditioned, then compacted to a minimum of 95 percent of their maximum dry densities determined in accordance with Mn/DOT Laboratory Procedure 1305 (standard Proctor). Fill placed above the scarified and recompacted material should also be compacted to a minimum of 95 percent. Material placed and/or compacted within 3 feet of the proposed subgrade elevations should be compacted to a minimum of 100 percent.

#### **D.2.b. Treatment of Soft Subgrade Soils**

If an area cannot be compacted, we recommend subcutting 2 to 3 feet, then backfilling with a granular material. The backfill should be compacted to a minimum of 95 percent of its maximum dry density. Material placed within 3 feet of the proposed subgrade elevations should be compacted to a minimum of 95 percent.

#### **D.2.c. Treatment of Frost-Susceptible Soils**

Silty and clayey subgrade soils should be considered potentially frost-susceptible. Mn/DOT design standards (Mn/DOT Technical Memorandum 04-06-MAT-01 dated March 1, 2004) recommend minimum thicknesses of frost-free materials (FFMs) over frost-susceptible subgrade soils. When the anticipated traffic is equal to or less than one million 18-kip equivalent single-axle loads (ESALs), a minimum of 6 inches of FFM (Class 5 or Select Granular Borrow) should be placed between a minimum of 3 inches of Class 5 aggregate base and the frost-susceptible subgrade soils.

### D.2.d. Subsurface Drainage

Clayey and silty soils are relatively impermeable. Water that gets into the aggregate base and/or coarse granular subgrade backfill may collect in the base course and granular backfill and saturate them if drainage is not provided. Subgrade drainage systems should be considered at low points of the vertical alignments.

### D.2.e. Proof-Roll

As a final check prior to placing the pavement section, including sand sub base. We recommend the completed subgrades be proof-rolled with a loaded tandem-axle truck prior to placing the aggregate base course. Unstable areas should be subcut at least 2 feet and replaced with suitable soils.

## D.3. Pavement Design

### D.3.a. Design Resistance (R) Values

R-values of the subgrade soils can be estimated using Table 5-3.2(a) of the current MnDOT *Geotechnical and Pavement Manual*. Estimated R-values for the pertinent soil types are presented in the following table.

**Table 2. Estimated R-Values**

ASTM (AASHTO) Soil Classification	Estimated R-Value
SM (A-4)	20
CL (A-7)	12

We recommend using an R-value of 12 for pavement design on this project.

### D.3.b. Concrete Pavement Sections

As indicated above the new Superior Street pavements will be Portland cement concrete- (PCC) surfaced with the following section per the City of Duluth:

- 8 inches PCC
- 4 inches Class 5 aggregate base
- 24 inches Select Granular subbase
- Geotextile fabric
- Edge drains

The MnDOT *RigidPave* design program and a clay subgrade (R-value of 12), indicates the proposed pavement section is suitable for up to about 8,500,000 ESALs assuming a clay subgrade (R-value of 12).

Based on the projected traffic, design ESALS, standard pavement characteristics, and R-value assumption, the minimum pavement thickness determined using MnDOT RigidPave is less than the proposed design: therefore the proposed design meets or exceed the minimum State Aid design requirements for a State Aid street.

The design is for a 35-year structural life, which is the amount of time before total reconstruction is anticipated. There will still be a need for minor and major rehabilitation during this period such as joint repair or panel replacement. Note that the MnDOT method of thickness design does not recognize a 50-year structural life. This is due to the unpredictability of environmental effects (frost heave, material deterioration from weather exposure, etc.) vs. true structural failure over the analysis period. This uncertainty should be accounted for if the pavement design is intended for a period greater than 35 years.

#### **D.3.c. Materials and Compaction**

We recommend specifying crushed aggregate base meeting the requirements of Minnesota Department of Transportation (MnDOT) Specification 3138 for Class 5 or Class 6. We recommend the sand subbase material meet the requirements of MnDOT Specification 3149.2B2, Select Granular Borrow. We recommend specification 3149.2B2 be modified so that the percent passing the 200 sieve is less than 7 percent.

We recommend compacting the aggregate base and sand subbase to meet the Penetration Index Method standards of MnDOT Specifications 2105.3F3 and 2211.3.D.2.c, respectively.

### **D.4. Construction Quality Control**

#### **D.4.a. Excavation Observations**

We recommend having a geotechnical engineer observe excavations related to subgrade preparation and utility installations. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations and at the roadway subgrade.

#### **D.4.b. Materials Testing**

We recommend density tests be taken in excavation backfill placed below pavements.

We recommend performing Gyrotory gravity tests and other necessary tests in accordance with Specification 2360 to evaluate strength and air voids, and density tests to evaluate compaction.

#### **D.4.c. Cold Weather Precautions**

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

Concrete delivered to the site should meet the temperature requirements of ASTM C 94. Concrete should not be placed on frozen subgrades. Concrete should be protected from freezing until the necessary strength is attained.

### **E. Procedures**

#### **E.1. Penetration Test Borings**

The penetration test borings were drilled with a floatation tire, mounted core and auger drill equipped with hollow-stem auger. The borings were performed in general accordance with ASTM D 1586. Samples were occasionally collected off the auger flights from 1 to 4 feet (due to frozen conditions adversely impacting the effectiveness of sample collection through a split-spoon sampler). Penetration test samples were taken at 2 1/2- or 5-foot intervals at greater depths. Actual sample intervals and corresponding depths are shown on the boring logs.

#### **E.2. Material Classification and Testing**

##### **E.2.a. Visual and Manual Classification**

The geologic materials encountered were visually and manually classified in accordance with ASTM Standard Practice D 2488. A chart explaining the classification system is attached. Samples were placed in jars or bags and returned to our facility for review and storage.

#### **E.3. Groundwater Measurements**

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

## **F. Qualifications**

### **F.1. Variations in Subsurface Conditions**

#### **F.1.a. Material Strata**

Our evaluation, analyses and recommendations were developed 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, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions, and can be expected 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 additional exploration work is completed, or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

#### **F.1.b. Groundwater Levels**

Groundwater measurements were made under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. It should be noted that the observation periods were relatively short, and groundwater can be expected to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

### **F.2. Continuity of Professional Responsibility**

#### **F.2.a. Plan Review**

This report is based on a limited amount of information, and a number of assumptions were necessary to help us develop our recommendations. It is recommended that our firm review the geotechnical aspects of the designs and specifications, and evaluate whether the design is as expected, if any design changes have affected the validity of our recommendations, and if our recommendations have been correctly interpreted and implemented in the designs and specifications.

#### **F.2.b. Construction Observations and Testing**

It is recommended that we be retained to perform observations and tests during construction. This will allow correlation of the subsurface conditions encountered during construction with those encountered by the borings, and provide continuity of professional responsibility.

### **F.3. Use of Report**

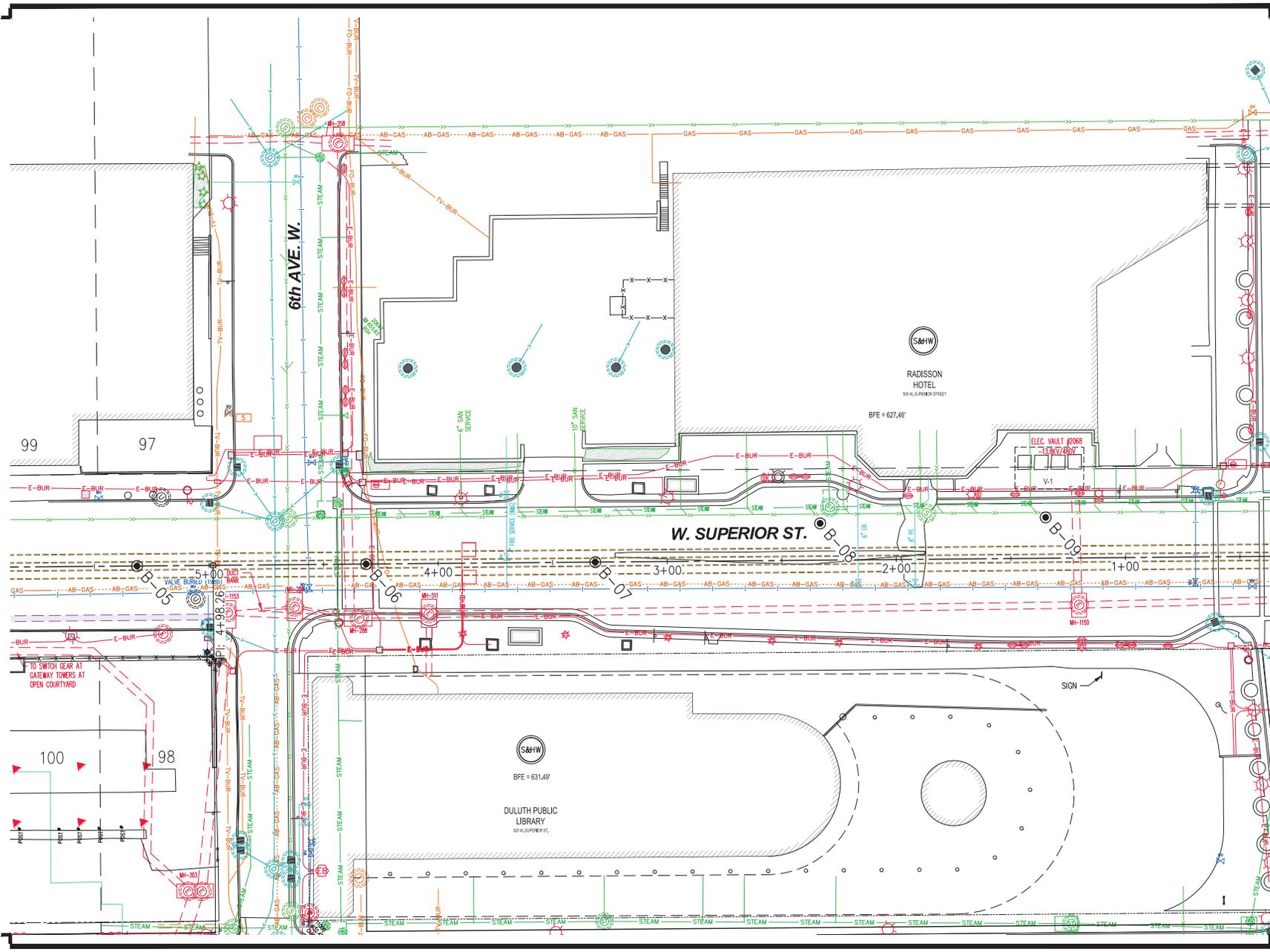
This report is for the exclusive use of the parties to which it has been addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

### **F.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**





290 3rd Ave. N. Ste 450 | Minneapolis, MN 55401 | 612.338.2029



Client:  
**CITY OF  
DULUTH**

**DULUTH, MINNESOTA**

THIS SQUARE APPEARS 12" x 12" ON  
FULL SIZE SHEETS.

NO.	DATE	ISSUED FOR
NO.	DATE	REVISION

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 Land Surveyor under the laws of the State of Minnesota.

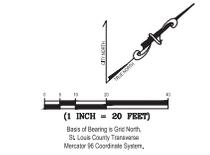
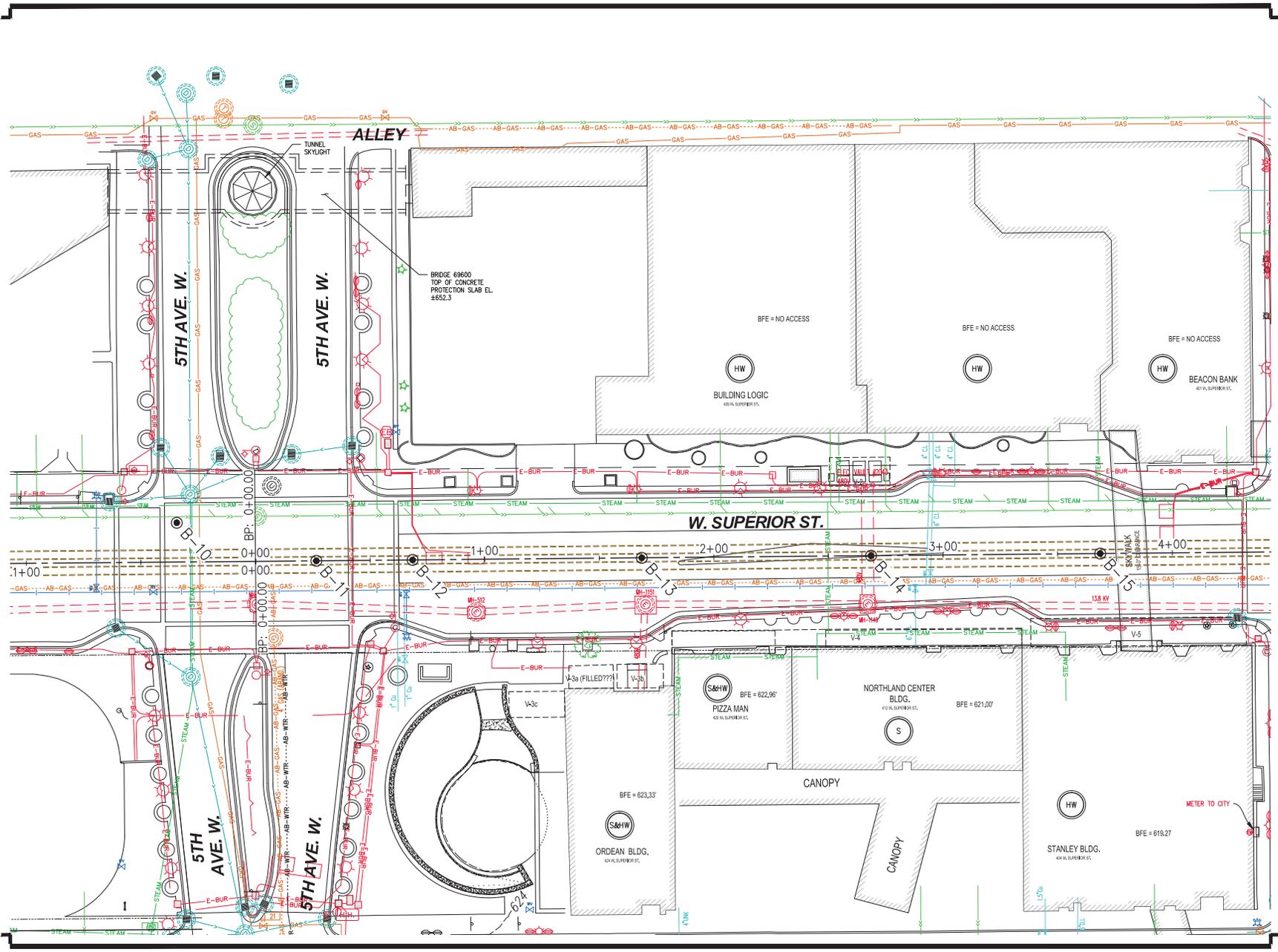
SIGNATURE: *[Signature]*  
 TYPED OR PRINTED NAME: **PAMEL A. VOGEL**  
 DATE: 10/3/2013 LIC. NO.: 44075

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PROJECT NAME:  
**SUPERIOR STREET  
TOPOGRAPHIC AND  
UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC  
SURVEY**

FILE: ...130417600 Drawings\CI130417 S&U Borings.dwg  
 DRAWN BY: PAV  
 CHECKED BY: PAV  
 PROJ. NO.: 130417  
 DRAWING NO.:



CLIENT:  
**CITY OF DULUTH**

**DULUTH, MINNESOTA**

THIS SQUARE APPEARS 1/2" x 1/2" ON FULL SIZE SHEETS.

NO.	DATE	ISSUED FOR

NO.	DATE	REVISION

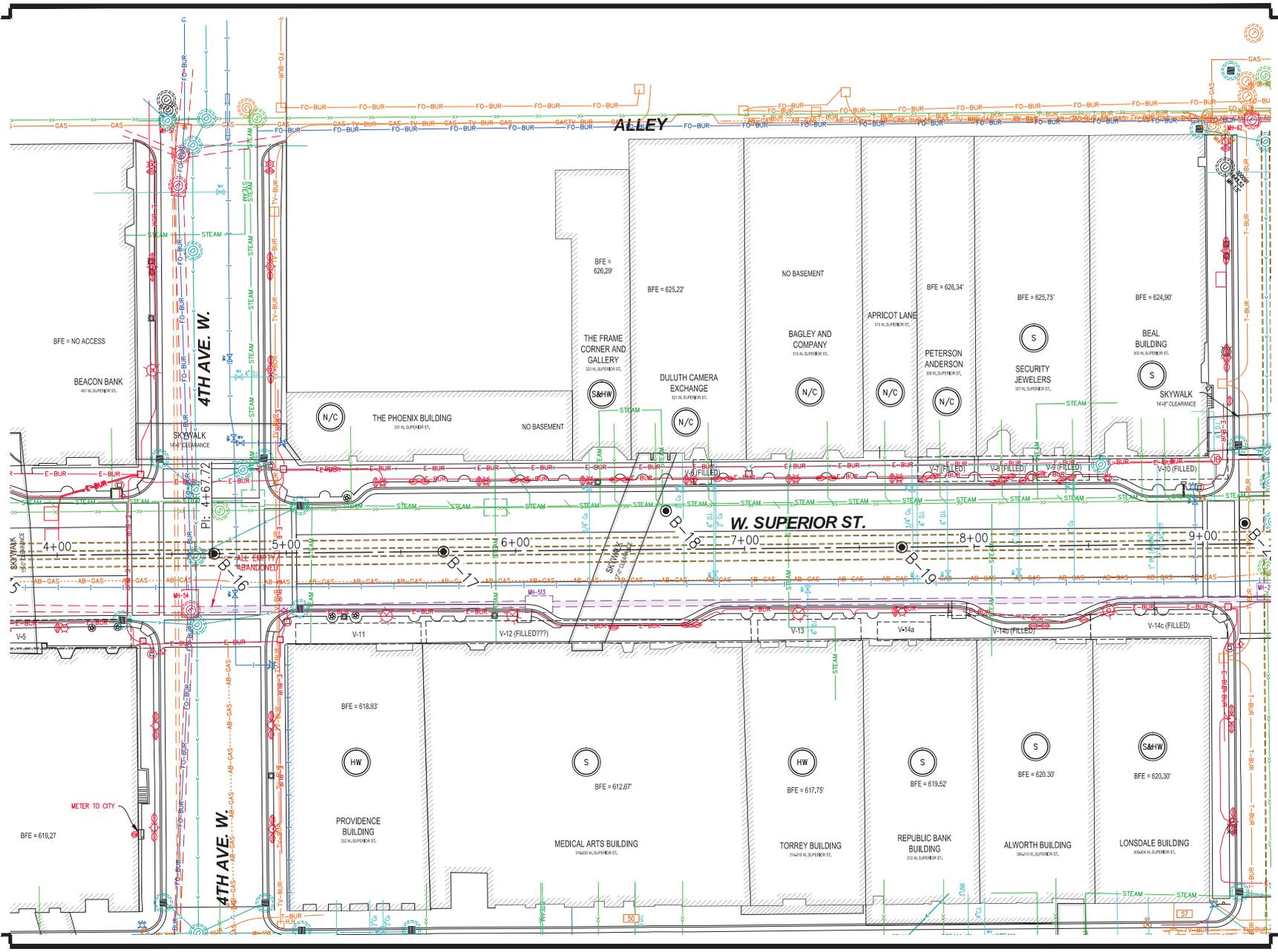
I HEREBY CERTIFY that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Land Surveyor under the laws of the State of Minnesota.

SIGNATURE: *Paul A. Vogel*  
 TYPED OR PRINTED NAME: **PAUL A. VOGEL**  
 DATE: **10/3/2013** LIC. NO.: **44075**

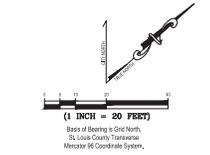
COPYRIGHT 2013 BY LHD, INC. ALL RIGHTS RESERVED.  
 PROJECT NAME:  
**SUPERIOR STREET TOPOGRAPHIC AND UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC SURVEY**

FILE: ...130417600 Drawings\130417 S&H Borings.dwg  
 DRAWN BY: PDS/SH  
 CHECKED BY: PAW  
 PROJ. NO.: 130417  
 DRAWING NO.:



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**DULUTH, MINNESOTA**

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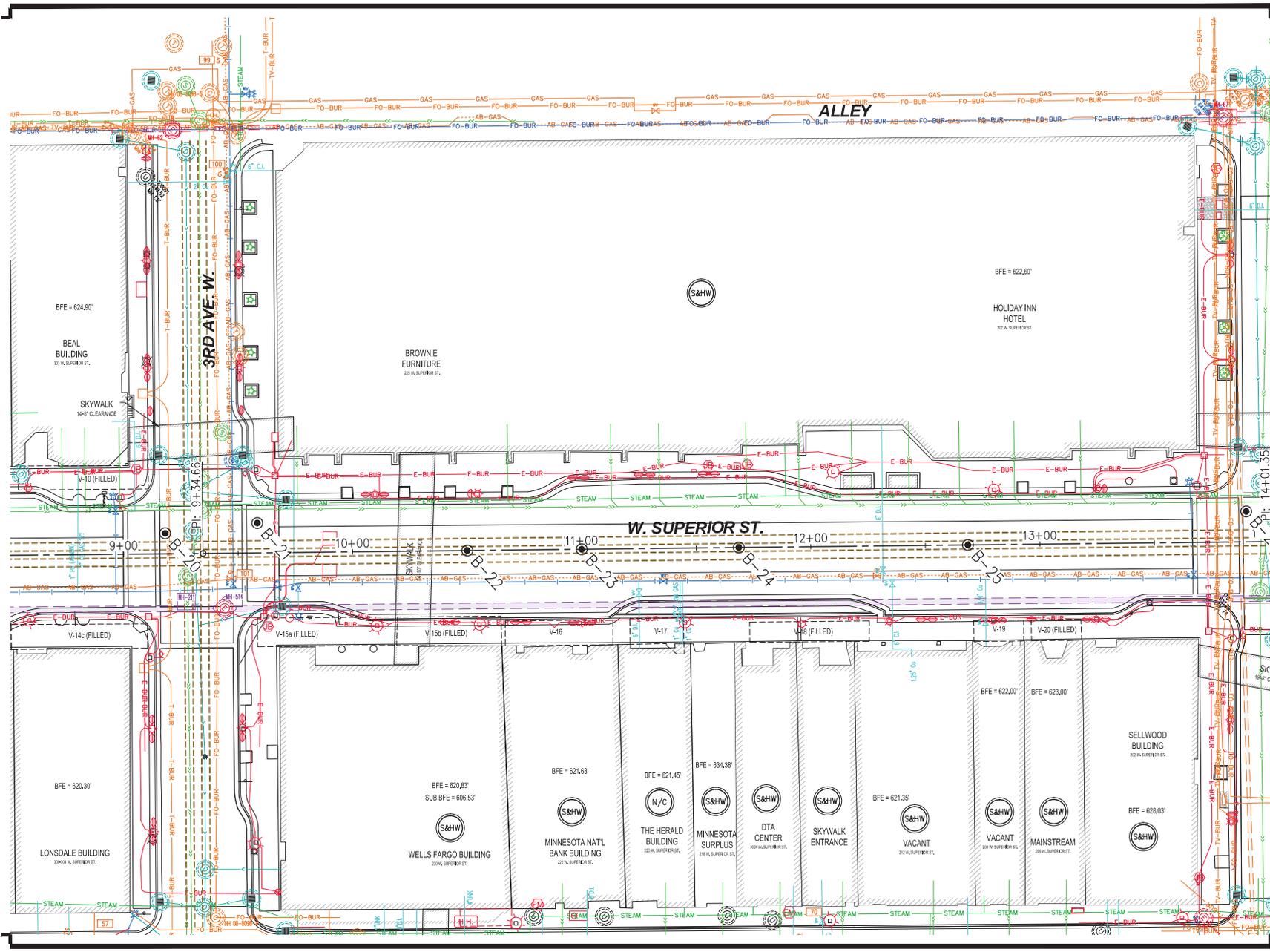
SIGNATURE: *[Signature]*  
 TYPED OR PRINTED NAME: **PAMELA A. VOGEL**  
 DATE: **10/3/2013** LIC. NO.: **44075**

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PROJECT NAME:  
**SUPERIOR STREET TOPOGRAPHIC AND UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC SURVEY**

FILE: ...10417600 Drawings\10417 5-81 Borings.dwg  
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(1 INCH = 20 FEET)  
 Basis of Bearing is Grid North,  
 @ Local County Traverse  
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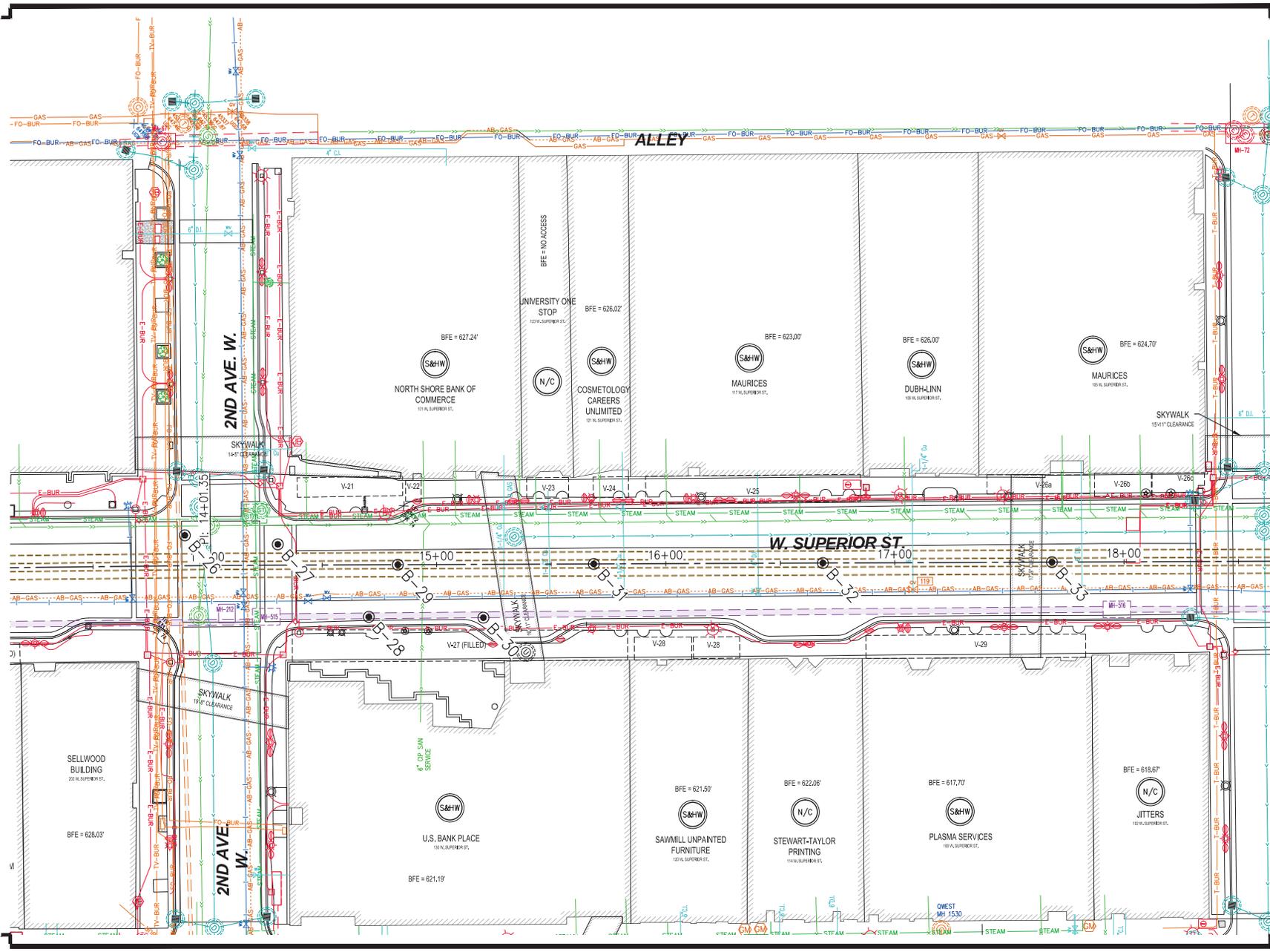
SIGNATURE: *[Signature]*  
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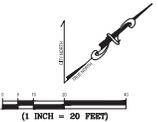
PROJECT NAME:  
**SUPERIOR STREET TOPOGRAPHIC AND UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC SURVEY**

FILE: ...130417600 Drawings\130417 S&W Borrings.dwg  
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 CHECKED BY: PAW  
 PROJ. NO.: 130417  
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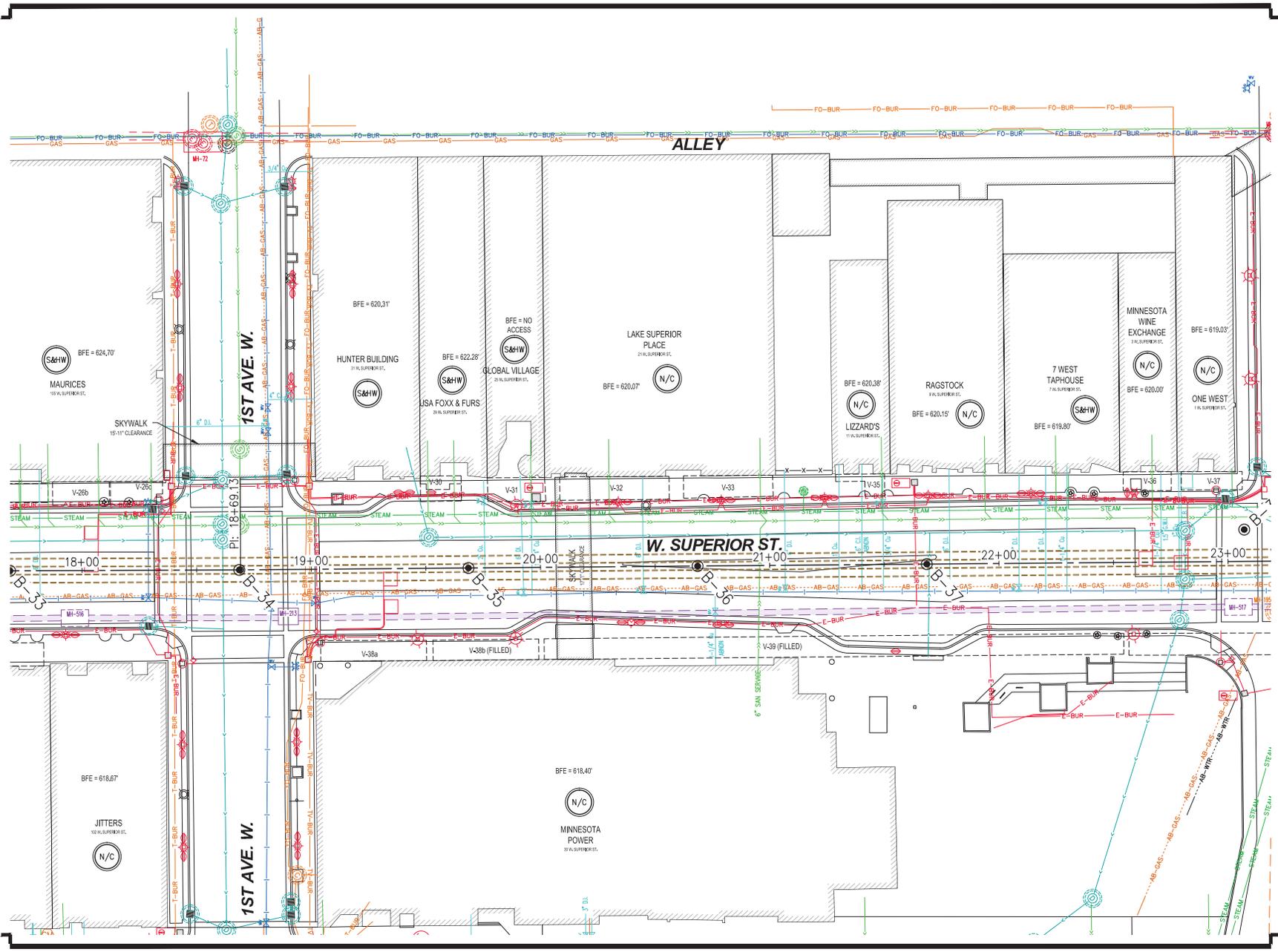
SIGNATURE: *[Signature]*  
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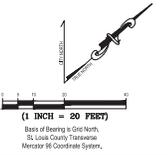
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**SUPERIOR STREET TOPOGRAPHIC AND UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC SURVEY**

FILE: ...130417600 Drawings\CI130417 S&U Borings.dwg  
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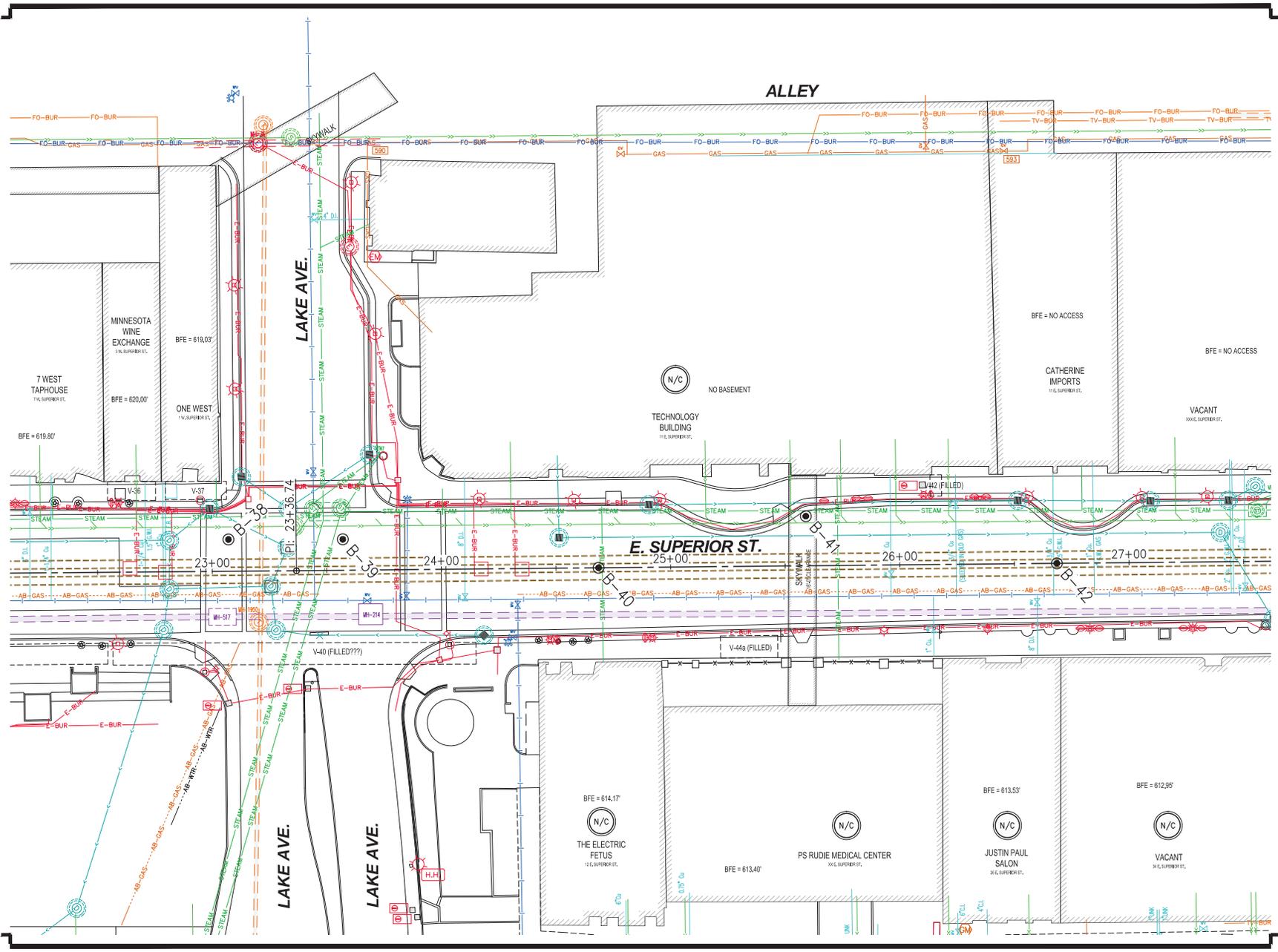
SIGNATURE: *[Signature]*  
 TYPED OR PRINTED NAME: **PAUL A. VOGEL**  
 DATE: 10/3/2013 LIC. NO.: 44075

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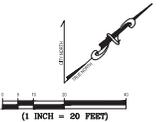
PROJECT NAME:  
**SUPERIOR STREET TOPOGRAPHIC AND UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC SURVEY**

FILE: ...130417600 Drawings\CI130417 S&H Borings.dwg  
 DRAWN BY: PAV  
 CHECKED BY: PAV  
 PROJ. NO.: 130417  
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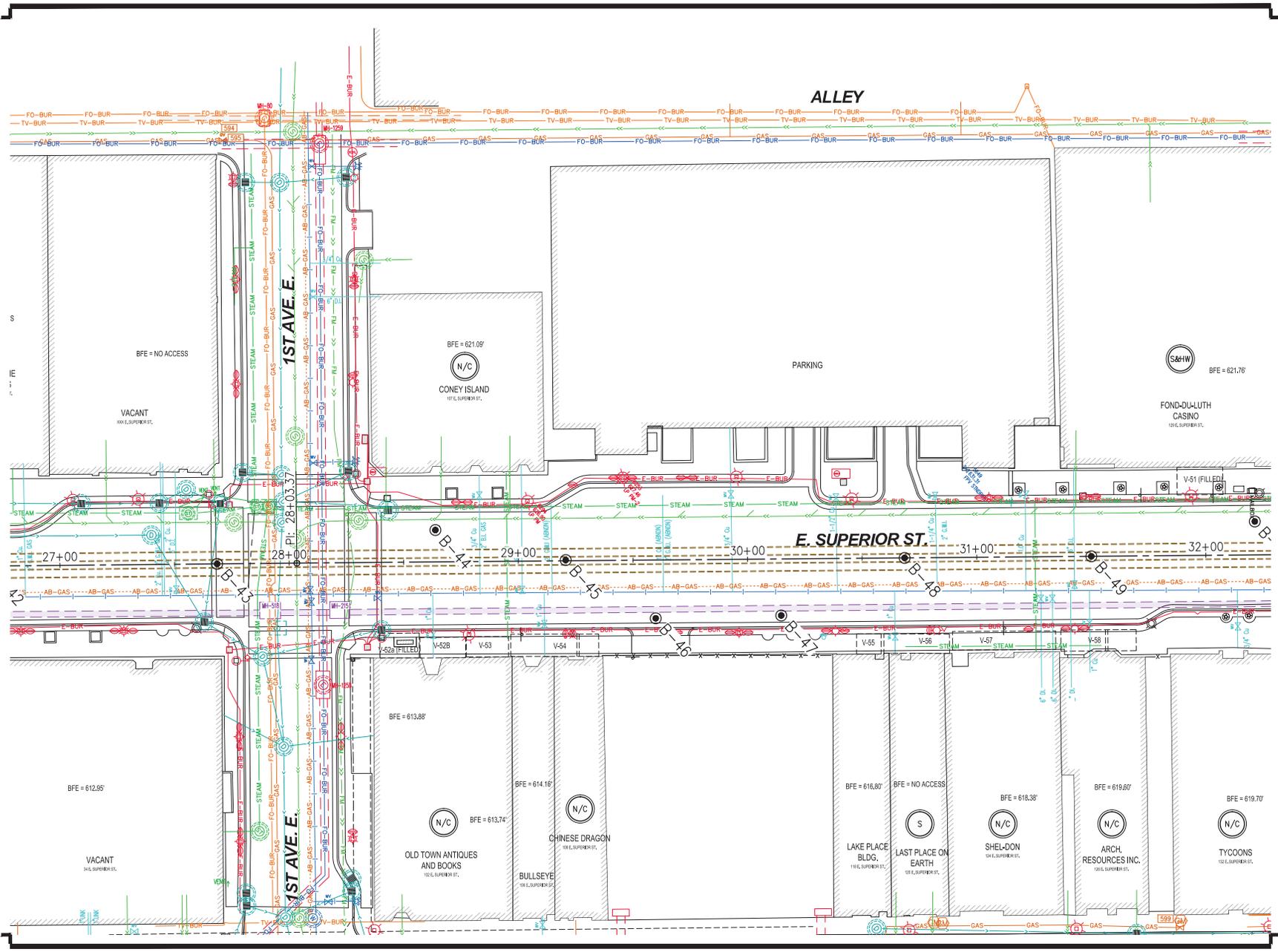
SIGNATURE: *[Signature]*  
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DRAWING TITLE:  
**TOPOGRAPHIC SURVEY**

FILE: ...130417600 Drawings\130417 S&U Borings.dwg  
 DRAWN BY: **PROBHM**  
 CHECKED BY: **PAV**  
 PLOT NO.: **130417**  
 DRAWING NO.:



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 Meridian 86 Coordinate System.

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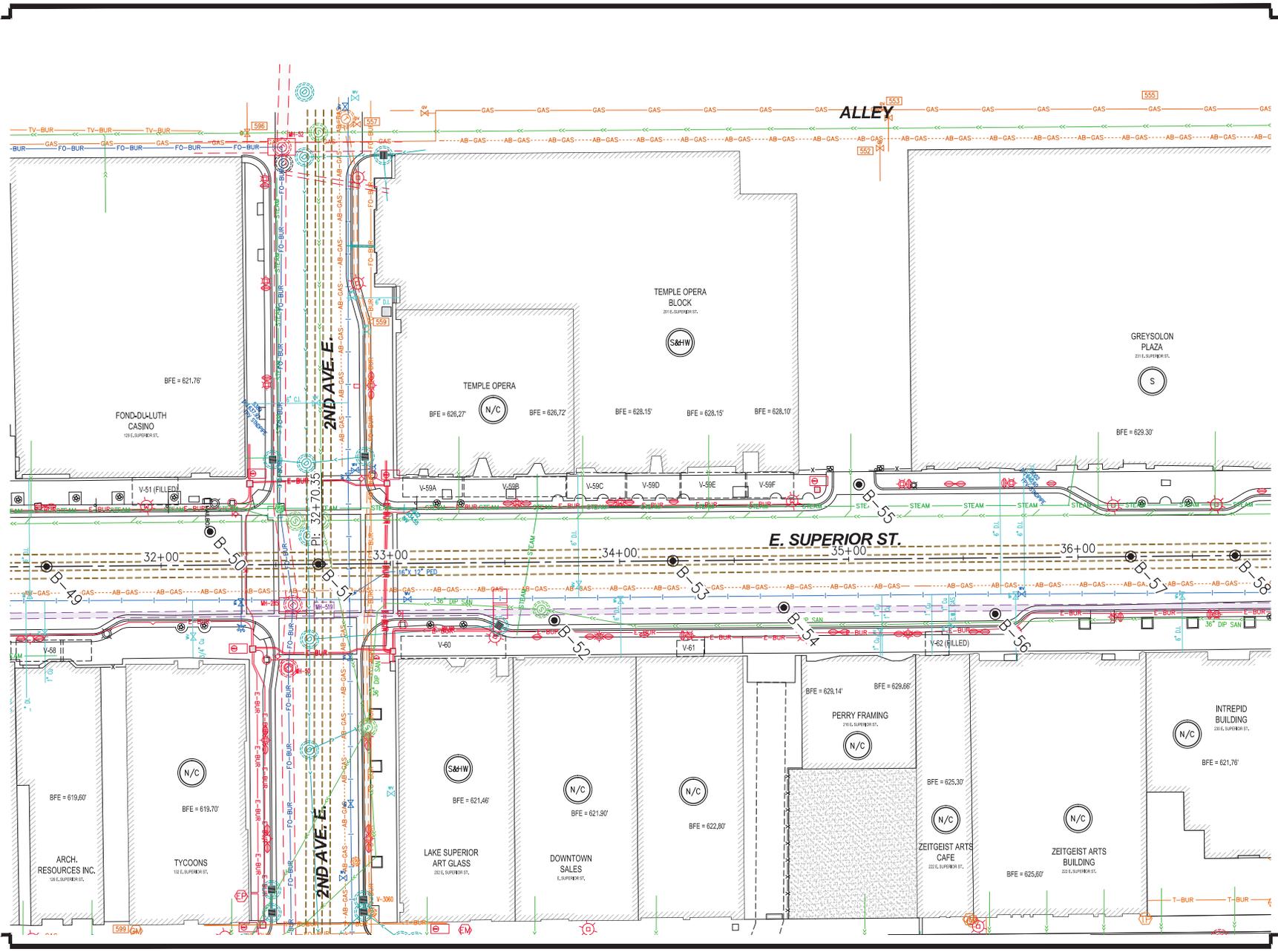
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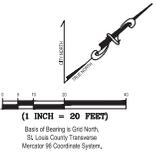
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**SUPERIOR STREET TOPOGRAPHIC AND UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC SURVEY**

FILE: ...130417600 Drawings\CI130417 S&U Borings.dwg  
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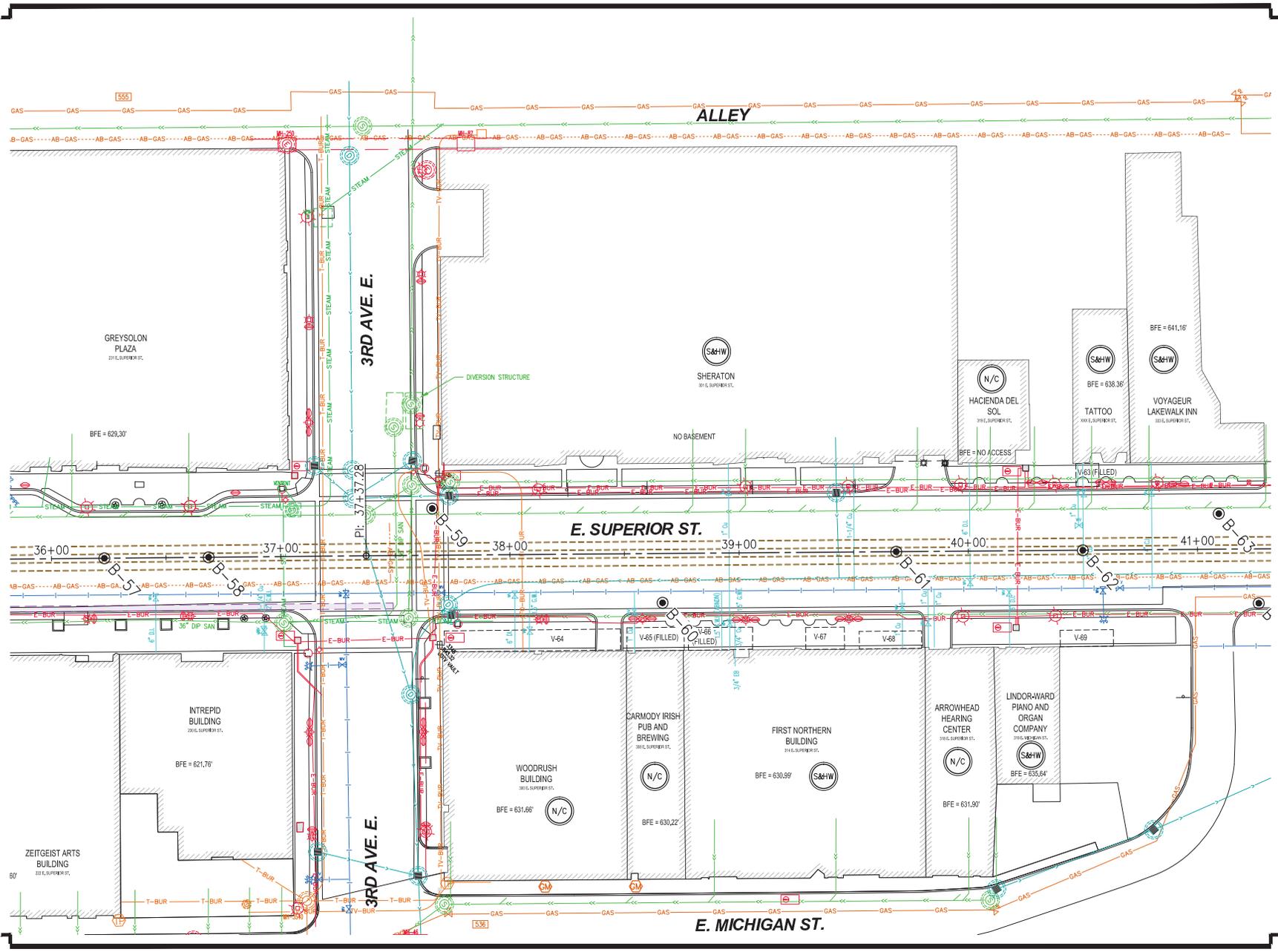
SIGNATURE: *[Signature]*  
 TYPED OR PRINTED NAME: **PAMELA A. VOGEL**  
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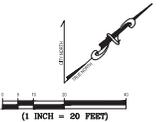
PROJECT NAME:  
**SUPERIOR STREET  
 TOPOGRAPHIC AND  
 UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC  
 SURVEY**

FILE: ...130417600 Drawings\CI130417 S&B Borings.dwg  
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NO.	DATE	REVISION

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SIGNATURE: *Paul A. Vogel*  
 TYPED OR PRINTED NAME: **PAUL A. VOGEL**  
 DATE: **10/3/2013** LIC. NO.: **44075**

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**SUPERIOR STREET TOPOGRAPHIC AND UTILITY SURVEY**

DRAWING TITLE:  
**TOPOGRAPHIC SURVEY**

FILE: ...130417600 Drawings\130417 S&W Borings.dwg  
 DRAWN BY: PMS/SH  
 CHECKED BY: PAW  
 PROJ. NO.: 130417  
 DRAWING NO.:



(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:52

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-01</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 11/2/14	SCALE: 1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.9	CONC	10 1/2 inches of concrete.			The ground surface elevations at the boring location are to be provided by LHB.
1.5	FILL	FILL: SILTY SAND with Gravel, brown, moist.			
	SM	SILTY SAND, fine- to medium-grained, reddish brown, moist, medium dense.  (Glacial Till)		13	
4.0	CL	LEAN CLAY with sand and Gravel, reddish brown, moist, stiff. (Glacial Till)		13	
6.5	SM	SILTY SAND with Gravel, reddish brown, moist, dense to very dense.  (Glacial Till)		*	
9.9		END OF BORING - Refusal to auger.  Water not observed while drilling.  Boring immediately backfilled.	50/4"		*Set

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:52

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-02</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 11/2/14	SCALE: 1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.8	CONC	9 1/2 inches of concrete.			
1.3	BIT	6 1/2 inches of bituminous surfacing.			
2.2	CONC	10 inches of concrete.			
4.0	FILL	FILL: SILTY SAND with Gravel, fine- to coarse-grained, gray, moist.	10		
4.0	FILL	FILL: LEAN CLAY with Gravel, black, moist.	6		
8.0	CL	LEAN CLAY with Gravel, reddish brown, rather stiff to very stiff. (Glacial Till)	14		
14.0	SM	SILTY SAND with Gravel, fine- to medium-grained, brown, very dense. (Glacial Till)	77		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

LOG OF BORING (See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:52

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota		BORING: <b>ST-03</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/2/14		SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF WL	Tests or Notes
0.0				
0.6	BIT	7 inches of bituminous surfacing.		
1.2	CONC	7 inches of concrete.		
1.5	FILL	FILL: SILTY SAND with Gravel, gray, moist.		
	FILL	FILL: LEAN CLAY with organics and Gravel, black, moist.	6	
			6	
			5	
			15	▽ An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling. Groundwater levels fluctuate.
11.5	CL	LEAN CLAY with a trace of Gravel, reddish brown, moist, medium to very stiff.	7	
			21	
16.0		END OF BORING.		
		Water observed at 10 1/2 feet while drilling.		
		Boring immediately backfilled.		

LOG OF BORING (See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:52

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-04</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer	DATE: 11/2/14	SCALE: 1" = 4'	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.6	BIT	7 1/2 inches of bituminous surfacing.			
1.2	CONC	7 inches of concrete.			
2.0	FILL	FILL: SILTY SAND with Gravel, gray, moist.			
	FILL	FILL: LEAN CLAY with sand, Gravel, and organics, reddish black, moist.	7		*No recovery.
			9		
			4*		
			2		
11.5	SM	SILTY SAND, brown, moist, medium dense. (Glacial Till)	29		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	31		

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:52

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-05</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 11/2/14	SCALE: 1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.5	BIT	6 1/2 inches of bituminous surfacing.			
1.0	CONC	6 inches of concrete.			
	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, black, moist.	6		
4.0	FILL	FILL: LEAN CLAY with Gravel, brownish black, moist.	9		
6.5	CL	LEAN CLAY with Gravel, reddish brown, moist, soft to medium. (Glacial Till)	16		
			11		
			8		
14.0	SM	SILTY SAND with Gravel, fine- to medium-grained, black, moist, medium dense. (Glacial Till)	20		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

LOG OF BORING (See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:52

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-06</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer	DATE: 11/2/14	SCALE: 1" = 4'	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.8	BIT	7 1/2 inches of bituminous surfacing.			
1.4	CONC	7 inches of concrete.			
2.0	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, gray, moist.			
	FILL	FILL: LEAN CLAY with Gravel, reddish brown, moist.	13*		*No recovery.
			11		
6.5	CL	LEAN CLAY with traces of Gravel, reddish brown, moist, stiff to rather stiff.  (Glacial Till)	16		
			14		
			12		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	9		

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			<b>BORING: ST-07</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 11/2/14	SCALE: 1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
1.0	BIT	9 1/2 inches of bituminous surfacing.			
1.7	CONC	8 1/2 inches of concrete.			
3.0	FILL	FILL: SILTY SAND with Gravel, brownish black, moist.	10		
	FILL	FILL: LEAN CLAY with Gravel, brownish black, moist.	12		
			6		
9.0	CL	LEAN CLAY with a trace of Gravel, reddish brown, moist, rather stiff to hard.	10		
			10		
16.0		END OF BORING.	44		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:52

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-08</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/2/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.8	BIT	7 inches of bituminous surfacing.			
1.4	CONC	8 inches of concrete.			
2.0	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, gray, moist.	10		
	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, yellowish brown, moist.	5		
			2*		*No recovery.
9.0	CL	LEAN CLAY with a trace of Gravel, reddish brown, moist rather soft to medium.  (Glacial Till)	4		
			7		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	6		

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-09</b>		
DRILLER: M. Heinzen			METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/4/14			SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.8	BIT	7 inches of bituminous surfacing.			
1.3	CONC	6 inches of concrete.			
2.0	FILL	FILL: SILTY SAND, grayish brown, moist.			
	FILL	FILL: LEAN CLAY with Gravel and organics, reddish brown, moist.	27		
			13		
			17		
			9		
11.5	CH	FAT CLAY with sand, dark red, moist, rather stiff to medium. (Glacial Till)	9		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	6		

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-10</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/4/14</b>	
SCALE: <b>1" = 4'</b>		LOCATION: See attached sketch.			
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.7	BIT	6 inches of bituminous surfacing.			
1.2	CONC	6 inches of concrete.			
2.0	FILL	FILL: SILTY SAND with Gravel, gray, moist.			
	FILL	FILL: LEAN CLAY with Gravel, reddish black, moist.	8*		*No recovery.
			5*		*No recovery.
6.5	CL	LEAN CLAY with sand, reddish brown, moist, rather stiff to very stiff.  (Glacial Till)	11		
			18		
			27		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-11</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/4/14</b>	
SCALE: <b>1" = 4'</b>		LOCATION: See attached sketch.			
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.8	BIT	7 inches of bituminous surfacing.			
1.4	CONC	7 1/2 inches of concrete.			
	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, brownish black, moist.	14		
4.0	SM	SILTY SAND with a trace of Gravel, fine- to medium-grained, brownish black, moist, loose. (Glacial Till)	10		
			10		
9.0	CL	LEAN CLAY, reddish brown, moist, medium to rather stiff. (Glacial Till)	8		
			9		
15.0					
16.0	SM	SILTY SAND with Gravel, black, moist, dense. (Glacial Till)	47		
		END OF BORING.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>	<b>BORING: ST-12</b> LOCATION: See attached sketch.
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DRILLER: M. Heinzen	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/4/14	SCALE: 1" = 4'
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(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:53

Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.7	BIT	8 inches of bituminous surfacing.			
1.5	CONC	10 inches of concrete.			
2.5	AGG	13 inches of aggregate base.			
4.0	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.	15		
	CL	LEAN CLAY with Gravel, reddish brown, moist, rather stiff. (Glacial Till)			
			9		
			9		
			23		
12.6		END OF BORING - Refusal to auger.	50/4"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-13</b>		
DRILLER: M. Heinzen			METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/4/14			SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.6	BIT	7 1/2 inches of bituminous surfacing.			
1.2	CONC	7 inches of concrete.			
1.9	AGG	8 inches of aggregate base.			
	FILL	FILL: LEAN CLAY with Gravel, brownish black, moist.			
4.0			9		
	SM	SILTY SAND with Gravel, brownish black, moist, medium dense. (Glacial Till)			
6.5			14		
	CL	LEAN CLAY with sand, reddish brown, moist, stiff.			
			14		
			14		
			14		
			11		
16.0			10		
		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-14</b>		
DRILLER: M. Heinzen			METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/4/14			SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.4	BIT	5 inches of bituminous surfacing.			
1.1	CONC	8 inches of concrete.			
2.0	AGG	10 inches of aggregate base.			
	SM	SILTY SAND with a trace of Gravel, reddish brown, moist, loose. (Glacial Till)	10		
4.0	CL	LEAN CLAY, reddish brown, moist, rather stiff to rather soft. (Glacial Till)	12		
			11		
			11		
			6		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	5		

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-15</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 11/2/14	SCALE: 1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.7	BIT	8 inches of bituminous surfacing.			
1.3	CONC	8 inches of concrete.			
	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, black, moist.			
4.0			15*		*No recovery.
	CL	LEAN CLAY with Gravel, reddish brown, moist, rather soft to medium.  (Glacial Till)			
			12		
			11		
			9		
			7		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	6		

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 (See Descriptive Terminology sheet for explanation of abbreviations)

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-16</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer	DATE: <b>11/2/14</b>	SCALE: <b>1" = 4'</b>	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.7	CONC	9 inches of concrete.			
	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, brown, moist.			
4.0	FILL	FILL: LEAN CLAY with sand, reddish brown, moist.	21		
			7		
8.5	SM	SILTY SAND with Gravel, fine- to medium-grained, brown, moist, dense. (Glacial Till)	5		
			4		
			20		
			13		
21.0			41		
		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-17</b>		
DRILLER: M. Heinzen			METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/2/14			SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.3	BIT	3 1/2 inches of bituminous surfacing.			
0.8	CONC	6 1/2 inches of concrete.			
1.5	FILL	FILL: SILTY SAND with Gravel, fine- to coarse-grained, black, moist.			
	FILL	FILL: LEAN CLAY with Gravel, reddish black, moist.	9		
			6		
			9		
9.0	CL	LEAN CLAY with a trace of Gravel, reddish brown, moist, medium to rather soft. (Glacial Till)	9		
			7		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	7		

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-18</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer	DATE: <b>11/4/14</b>	SCALE: <b>1" = 4'</b>	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.8	BIT	7 1/2 inches of bituminous surfacing.			
1.2	CONC	4 1/2 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT with Gravel, fine- to medium-grained, gray, moist.	16		
	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, black, moist.			
			9		
6.5	CL	LEAN CLAY with cobbles, reddish brown, moist. (Glacial Till)			
			5		
			41		
			8		
			9		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

LOG OF BORING (See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-19</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 11/4/14	SCALE: 1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.3	BIT	3 1/2 inches of bituminous surfacing.			
0.7	CONC	5 inches of concrete.			
	FILL	FILL: LEAN CLAY with Gravel, reddish black, moist.			
			8		
			3*		*No recovery.
			4*		*No recovery.
			4*		*No recovery.
11.5	CL	LEAN CLAY with sand, reddish brown, moist, rather soft to stiff. (Glacial Till)			
			9		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			
			16		

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-20</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/4/14</b>	
SCALE: <b>1" = 4'</b>		LOCATION: See attached sketch.			
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.1	BIT	1 1/2 inches of bituminous surfacing.			
1.2	CONC	12 1/2 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT with Gravel, gray, moist.			
	FILL	FILL: SILTY SAND with Gravel, brown, moist.	9		
			12		
6.5	SM	SILTY SAND with a trace of Gravel, brown, moist, medium dense. (Glacial Till)	13		
			16		
11.5	CL	LEAN CLAY with sand, reddish brown, moist, very stiff to hard.	38		
			51		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota		BORING: <b>ST-21</b>			
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer			
DATE: 11/4/14		SCALE: 1" = 4'			
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.3	BIT	3 1/2 inches of bituminous surfacing.			
1.0	CONC	9 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT and Gravel, gray, moist.			
	FILL	FILL: SILTY SAND with Gravel and organics, brown, moist.	7		
4.0	CL	LEAN CLAY with sand and Gravel, reddish brown, moist, medium to rather stiff.  (Glacial Till)	8		
			11		
			11		
11.5	SM	SILTY SAND with sand and Gravel, brown, moist, dense.  (Glacial Till)	43		
			48		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-22</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/13/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.3	BIT	9 inches of bituminous surfacing.			
1.2	CONC	3 inches of concrete.			
	AGG	5 inches of aggregate base.			
			9*		*No recovery.
			11		
6.5	CL	LEAN CLAY with traces of Gravel, brown, moist, stiff to very stiff.  (Glacial Till)	13		
			24		
12.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	50/2"		

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-23</b>		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/13/14</b>	
SCALE: <b>1" = 4'</b>		LOCATION: See attached sketch.			
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.4	BIT	5 inches of bituminous surfacing.			
1.1	CONC	9 inches of concrete.			
	FILL	FILL: LEAN CLAY with Gravel and organics, brown, moist.			
			10		
			10		
6.5	SM	SILTY SAND, dark brown, moist, medium dense. (Glacial Till)			
			13		
9.0	CL	LEAN CLAY with a trace of Gravel, reddish brown, moist, stiff. (Glacial Till)			
			13		
11.5	SM	SILTY SAND, dark brown, moist, very dense. (Glacial Till)			
			12		
16.0		END OF BORING.			
		Water not observed while drilling.			
		Boring immediately backfilled.			
			*		*60 for 6 inches, then 50 for 3 inches.

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-24</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/13/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.3	BIT	4 inches of bituminous surfacing.			
1.0	CONC	7 inches of concrete.			
1.2	AGG	8 inches of aggregate base.			
	CL	LEAN CLAY, reddish brown, moist, stiff to medium. (Glacial Till)			
			14		
			8*		*No recovery.
			10		
9.8		END OF BORING - Refusal to auger.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>				BORING: <b>ST-25</b>	
				LOCATION: See attached sketch.	
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/13/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes
0.0					
0.3	BIT	4 inches of bituminous surfacing.			
0.6	CONC	8 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT and Gravel, black, moist.			
	CL	LEAN CLAY with Gravel, black, moist, rather soft to soft. (Glacial Till)		13	
				11	
8.0		END OF BORING - Refusal to auger.		50/4"	
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			<b>BORING: ST-26</b> LOCATION: See attached sketch.				
DRILLER:	M. Heinzen	METHOD:	3 1/4" HSA, Autohammer	DATE:	11/5/14	SCALE:	1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes		
0.0							
0.2	CONC	2 inches of brick.					
0.3	BIT	1 inch of bituminous surfacing.					
1.1	CONC	10 inches of concrete.					
2.3	AGG	15 inches of aggregate base.					
	FILL	FILL: LEAN CLAY with sand and Gravel, brown, moist.		12			
4.0	SM	SILTY SAND with lenses of LEAN CLAY, brown, moist, loose. (Glacial Till)		6			
7.7		END OF BORING - Refusal to auger.		50/3"			
		Water not observed while drilling.					
		Boring immediately backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			<b>BORING: ST-27</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/5/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.6	BIT	5 1/2 inches of bituminous surfacing.			
1.5	CONC	10 inches of concrete.			
1.7	AGG	3 inches of aggregate base.			
2.0	FILL	FILL: SILTY SAND with Gravel, grayish brown, moist.			
	CL	LEAN CLAY with sand, reddish brown, moist, stiff.	14		
5.0		END OF BORING - Refusal to auger.	50/4"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

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(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>				<b>BORING: ST-28</b> LOCATION: See attached sketch.	
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/5/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.6	BIT	5 1/2 inches of bituminous surfacing.			
1.3	CONC	8 inches of concrete.			
2.0	AGG	8 inches of aggregate base.			
4.2	FILL	FILL: LEAN CLAY with Gravel, brown to black, moist.	9		
		END OF BORING - Refusal to auger.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-29</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/5/14	SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM11110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.5	BIT	6 inches of bituminous surfacing.			
1.4	CONC	11 inches of concrete.			
	FILL	FILL: POORLY GRADED SAND with SILT and Gravel, dark brown, moist.			
5.0		END OF BORING - Refusal to auger.	14		
		Water not observed while drilling.			
		Boring immediately backfilled.	50/5"		*No recovery.

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>	<b>BORING: ST-30</b> LOCATION: See attached sketch.
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DRILLER: M. Heinzen	METHOD: 3 1/4" HSA, Autohammer	DATE: <b>11/5/14</b>	SCALE: <b>1" = 4'</b>
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(See Descriptive Terminology sheet for explanation of abbreviations)

Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.5	BIT	5 1/2 inches of bituminous surfacing.			
1.3	CONC	8 inches of concrete.			
1.7	AGG	5 inches of aggregate base.			
3.5	FILL	FILL: LEAN CLAY with sand and Gravel, brown, moist.	13		
		END OF BORING - Refusal to auger.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>	<b>BORING: ST-31</b> LOCATION: See attached sketch.
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DRILLER: M. Heinzen	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/5/14	SCALE: 1" = 4'
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(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.4	BIT	5 inches of bituminous surfacing.			
1.8	CONC	17 inches of concrete.			
	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, dark brown, moist.	13		
6.5	FILL	FILL: LEAN CLAY with Gravel and wood, dark red, moist.	10		
9.0	FILL	FILL: SILTY SAND with Gravel, red to black, moist.	13		
	FILL	FILL: SILTY SAND with Gravel, red to black, moist.	19		
13.0		END OF BORING - Refusal to auger.	50/5"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-32</b>		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/12/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0	BIT	11 inches of bituminous surfacing.			
0.9	CONC	6 inches of concrete.			
1.4	FILL	FILL: POORLY GRADED SAND with SILT, brown, moist.			
2.0	FILL	FILL: LEAN CLAY, brown, moist.			
			10*		*No recovery.
			12*		*No recovery.
6.5	CL	LEAN CLAY, brown, moist, stiff to rather stiff.			
			14		
			11		
11.5	SM	SILTY SAND with sand, dark red, very dense. (Glacial Till)			
			60		
16.0		END OF BORING.			
		Water not observed while drilling.			
		Boring immediately backfilled.			
			30		

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

(See Descriptive Terminology sheet for explanation of abbreviations)

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-33</b>		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/12/14</b>	
				SCALE: <b>1" = 4'</b>	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.5	BIT	5 inches of bituminous surfacing.			
1.1	CONC	8 inches of concrete.			
1.5	AGG	4 inches of aggregate base.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.			
	CL	LEAN CLAY with sand, reddish brown, moist.	13		
			11		
			12		
			6		
12.5	SM	SILTY SAND, fine- to medium-grained, brown, moist, medium dense to very dense. (Glacial Till)	23		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	51		

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-34</b>		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer	DATE: <b>11/12/14</b>	SCALE: <b>1" = 4'</b>	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	2 inches of bituminous surfacing.			
1.3	CONC	12 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.	10		
	FILL	FILL: LEAN CLAY with sand, Gravel, rubble, and organics, gray, moist.	8		
			6		
9.0	SM	SILTY SAND with sand and Gravel, fine- to medium-grained, reddish brown, moist, medium dense to dense. (Glacial Till)	28		
			37		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	28		

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>		<b>BORING: ST-35</b> LOCATION: See attached sketch.			
DRILLER:	J. Boehmke	METHOD:	3 1/4" HSA, Autohammer		
DATE:	11/12/14	SCALE:	1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.6	BIT	7 1/2 inches of bituminous surfacing.			
1.6	CONC	12 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.			
	FILL	FILL: LEAN CLAY with sand, Gravel, organics, and wood, black, moist.	9		
			9		
			5		
			6		
			7		
14.0	CL	LEAN CLAY with Gravel, red, moist, rather soft. (Glacial Till)			
16.0		END OF BORING.	9		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			<b>BORING: ST-36</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: 11/12/14	SCALE: 1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.8	CONC	10 inches of concrete.			
1.6	AGG	9 inches of aggregate base.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT, brown, moist.			
	CL	LEAN CLAY with Gravel, red, moist, very soft to soft. (Glacial Till)			
			17		
			17		
			20		
			13		
			14		
16.0			19		
		END OF BORING.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-37</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/12/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.3	BIT	4 inches of bituminous surfacing.			
1.2	CONC	10 inches of concrete.			
2.1	AGG	11 inches of aggregate base.			
4.0	FILL	FILL: POORLY GRADED SAND with SILT and Gravel, fine- to medium-grained, black, moist.	13		
6.5	FILL	FILL: SILTY SAND with Gravel and organics, fine- to medium-grained, black, moist.	5		
9.0	SM	SILTY SAND with sand, fine- to medium-grained, gray, moist, medium dense. (Glacial Till)	18		
14.5	CL	LEAN CLAY, red, moist, stiff to very stiff.	14		
		END OF BORING.	50/4"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-38</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer	DATE: <b>11/5/14</b>	SCALE: <b>1" = 4'</b>	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	2 inches of bituminous surfacing.			
1.2	CONC	10 inches of concrete.			
1.8	AGG	8 inches of aggregate base.			
	FILL	FILL: SILTY SAND with sand, Gravel, and LEAN CLAY, black, moist.	12		
6.5	CL	LEAN CLAY with sand and a trace of Gravel, brown, moist, rather soft.  (Glacial Till)	2 10 20		
13.5		END OF BORING - Refusal to auger.  Water not observed while drilling.  Boring immediately backfilled.	50/3"		

LOG OF BORING (See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-39</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer	DATE: <b>11/5/14</b>	SCALE: <b>1" = 4'</b>	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	2 inches of bituminous surfacing.			
1.1	CONC	9 inches of concrete.			
1.6	AGG	6 inches of aggregate base.			
	FILL	FILL: LEAN CLAY with sand and Gravel, black, moist.	13		
			16		
6.5	CL	LEAN CLAY with a trace of Gravel, reddish brown, moist, rather soft to soft.  (Glacial Till)	9		
			13		
			47		
13.5	SM	SILTY SAND with Gravel, brown, moist, dense. (Glacial Till)			
15.0			50/5"		

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-40</b>		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/5/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.7	BIT	6 inches of bituminous surfacing.			
1.3	CONC	8 inches of concrete.			
2.0	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, dark brown, moist.	12		
	FILL	FILL: LEAN CLAY with sand and Gravel, dark brown, moist.	12		
6.5	CL	LEAN CLAY with sand, reddish brown, moist, rather stiff to hard.	13		
			11		
			50/3"		
16.0		END OF BORING.	33		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-41</b>		
DRILLER:			METHOD: 3 1/4" HSA, Autohammer		
DATE: <b>11/5/14</b>			SCALE: <b>1" = 4'</b>		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.4	BIT	2 1/2 inches of bituminous surfacing.			
1.2	CONC	10 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.			
	FILL	FILL: LEAN CLAY with sand and Gravel, reddish brown, moist.			
4.0	CL	LEAN CLAY with sand, reddish brown, moist, stiff to rather stiff. (Glacial Till)			
				19	
				13	
				9	
9.0	SM	SILTY SAND with Gravel, fine- to medium-grained, brown, moist, very dense. (Glacial Till)			
				66	
				50/6"	
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			
				*	37 for 6 inches, then 50 for 4 inches.

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			<b>BORING: ST-42</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/6/14	SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.9	BIT	9 inches of bituminous surfacing.			
1.8	CONC	10 inches of concrete.			
2.4	AGG	8 inches of aggregate base.			
	FILL	FILL: LEAN CLAY with sand and Gravel, brown to black, moist.	9		
			12		
6.5	FILL	FILL: SILTY SAND with organics, fine- to medium-grained, black, moist.			
			17		
9.0	CL	LEAN CLAY with sand and Gravel, brown, wet, rather soft to very soft.  (Glacial Till)	9		
			19		
15.3		END OF BORING - Refusal to auger.  Water not observed while drilling.  Boring immediately backfilled.	50/3"		

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:54

LOG OF BORING (See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-43</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/6/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	1 inch of bituminous surfacing.			
1.3	CONC	12 inches of concrete.			
	FILL	FILL: POORLY GRADED SAND with SILT with Gravel, fine- to medium-grained, brown, moist.	13		
4.0	FILL	FILL: LEAN CLAY with sand, Gravel, and organics, brown, moist.	5		
			5		
			9		
11.5	SM	SILTY SAND with Gravel, gray, moist, medium dense to very dense.  (Glacial Till)	29		
16.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	59		

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			<b>BORING: ST-44</b> LOCATION: See attached sketch.				
DRILLER:	M. Heinzen	METHOD:	3 1/4" HSA, Autohammer	DATE:	11/6/14	SCALE:	1" = 4'
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes		
0.0							
0.2	CONC	2 inches of brick.					
0.7	BIT	6 1/2 inches of bituminous surfacing.					
1.4	CONC	8 inches of concrete.					
1.9	AGG	6 inches of aggregate base.					
	FILL	FILL: SILTY SAND with sand and Gravel, fine- to medium-grained, brown to black, moist.	26				
			39				
6.5	SM	SILTY SAND with sand and Gravel, fine- to medium-grained, brown, moist, very dense. (Glacial Till)	79				
			68				
			63				
15.0		END OF BORING.	50/5"				
		Water observed at 13.6 feet while drilling.					
		Water observed at 13 1/2 feet with 14 1/2 feet of hollow-stem auger in the ground.					
		Boring immediately backfilled.					
					An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling. Groundwater levels fluctuate.		

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			<b>BORING: ST-45</b> LOCATION: See attached sketch.		
DRILLER: M. Heinzen	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/5/14	SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.6	BIT	5 inches of bituminous surfacing.			
1.4	CONC	10 inches of concrete.			
2.1	AGG	8 inches of aggregate base.			
4.0	CL	LEAN CLAY with Gravel, reddish brown, moist, rather soft.	12		
	SM	SILTY SAND with sand and Gravel, reddish brown, wet, dense to very dense. (Glacial Till)	44 72 *		*44 for 6 inches, then 50 for 5 inches.
14.3		END OF BORING - Refusal to auger.  Water observed at 13.4 feet while drilling.  Boring immediately backfilled.	50/3"	▽	

(See Descriptive Terminology sheet for explanation of abbreviations)

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(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-46</b>		
DRILLER: M. Heinzen			METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/5/14			SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.6	BIT	5 inches of bituminous surfacing.			
1.7	CONC	13 1/2 inches of concrete.			
2.5	AGG	10 inches of aggregate base.			
4.0	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.	7		
6.5	CL	LEAN CLAY with Gravel, reddish brown, moist, medium. (Glacial Till)	12		
6.5	SM	SILTY SAND with Gravel, fine- to medium-grained, brown, moist, very dense. (Glacial Till)	68		
10.0		END OF BORING - Refusal to auger.	50/4"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:55

Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-47</b>		
DRILLER: M. Heinzen			METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/6/14			SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.7	BIT	6 inches of bituminous surfacing.			
1.3	CONC	8 inches of concrete.			
1.8	AGG	6 inches of aggregate base.			
4.0	FILL	FILL: POORLY GRADED SAND with SILT and Gravel, fine- to medium-grained, brown, moist.	11		
	FILL	FILL: LEAN CLAY with sand, brown, moist.	11		
6.5	SM	SILTY SAND with cobbles, fine- to medium-grained, brown, moist, very dense.  (Glacial Till)	52		
9.8		END OF BORING - Refusal to auger.	50/1"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:55

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>				<b>BORING: ST-48</b> LOCATION: See attached sketch.	
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/12/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			*No recovery.
0.5	BIT	3 1/2 inches of bituminous surfacing.			
1.3	CONC	10 1/2 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT, brown, moist.	10*		
	FILL	FILL: LEAN CLAY with Gravel and sand, grayish brown, moist.	45		
8.3		END OF BORING.	50/4"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:55

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>				BORING: <b>ST-49</b> LOCATION: See attached sketch.	
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/12/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.6	BIT	5 inches of bituminous surfacing.			
1.1	CONC	6 inches of concrete.			
2.1	AGG	12 inches of aggregate base.			
		END OF BORING - Refusal to auger.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>	<b>BORING: ST-50</b> LOCATION: See attached sketch.
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DRILLER:	METHOD: 3 1/4" HSA, Autohammer	DATE:	SCALE: 1" = 4'
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(See Descriptive Terminology sheet for explanation of abbreviations)

Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.7	BIT	6 1/2 inches of bituminous surfacing.			
1.5	CONC	10 inches of concrete.			
	FILL	FILL: LEAN CLAY with Gravel, brown, moist.	14		
5.6		END OF BORING - Refusal to auger.	50/3"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:55

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			<b>BORING: ST-51</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/9/14	SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.4	BIT	3 inches of bituminous surfacing.			
1.7	CONC	15 inches of concrete.			
2.2	AGG	6 inches of aggregate base.			
	FILL	FILL: POORLY GRADED SAND with SILT and cobbles, fine- to medium-grained, brown, moist.	32		
			8		
			2		
8.5		END OF BORING - Borehole abandoned.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:55

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>				<b>BORING: ST-53</b> LOCATION: See attached sketch.	
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/12/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM11110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.9	BIT	8 1/2 inches of bituminous surfacing.			
1.9	AGG	12 inches of aggregate base.			
4.0	FILL	FILL: LEAN CLAY with a trace of Gravel, dark brown, moist.	9		
7.0	SM	SILTY SAND with a trace of Gravel, fine- to medium-grained, brown, moist, medium dense. (Glacial Till)	15		
		END OF BORING.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-54</b>		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer	DATE: <b>11/9/14</b>	SCALE: <b>1" = 4'</b>	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	2 inches of bituminous surfacing.			
1.1	CONC	9 inches of concrete.			
1.7	AGG	7 inches of aggregate base.			
	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.	14		
			10		
6.5	FILL	FILL: LEAN CLAY with sand and Gravel, brown, moist.			
			32		
9.0	SM	SILTY SAND with a trace of Gravel, gray, moist, very dense. (Glacial Till)			
			131		
12.0		END OF BORING - Refusal to auger.			
		Water not observed while drilling.			
		Boring immediately backfilled.			
			50/1"		

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>	<b>BORING: ST-55</b> LOCATION: See attached sketch.
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DRILLER: J. Boehmke	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/9/14	SCALE: 1" = 4'
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(See Descriptive Terminology sheet for explanation of abbreviations)

Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	2 inches of bituminous surfacing.			
1.2	CONC	10 inches of concrete.			
1.8	AGG	8 inches of aggregate base.			
	FILL	FILL: SILTY SAND with clay, sand, and Gravel, fine- to medium-grained, brown, moist.	6		
			88*		*No recovery.
7.2		END OF BORING - Refusal to auger.	50/1.5"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

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(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-56</b>		
DRILLER: J. Boehmke			LOCATION: See attached sketch.		
METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/9/14</b>	SCALE: <b>1" = 4'</b>		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.7	BIT	6 inches of bituminous surfacing.			
1.6	CONC	11 inches of concrete.			
2.3	AGG	8 inches of aggregate base.			
4.0	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.	20		
	FILL	FILL: SILTY SAND with Gravel, fine- to medium-grained, brown, moist.	10		
			10		
9.0	SM	SILTY SAND with Gravel, fine- to medium-grained, brown, moist, very dense.  (Glacial Till)	*		*60 for 6 inches, then 50 for 4 inches.
14.0		END OF BORING - Refusal to auger.	100/6"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-57</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/9/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.6	BIT	5 inches of bituminous surfacing.			
1.7	CONC	13 inches of concrete.			
2.0	FILL	FILL: POORLY GRADED SAND with SILT and Gravel, fine- to medium-grained, brown, moist.			
	FILL	FILL: LEAN CLAY with sand and Gravel, reddish brown, moist.	13		
			16		
6.5	SM	SILTY SAND with Gravel, fine- to medium-grained, brown, moist, hard.  (Glacial Till)	96		
			*		*42 for 6 inches, then 50 for 4 inches.
11.8		END OF BORING - Refusal to auger.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-58</b>		
DRILLER: J. Boehmke			METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/11/14			SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.8	BIT	7 1/2 inches of bituminous surfacing.			
1.4	CONC	7 inches of concrete.			
2.5	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.			
	CL	LEAN CLAY with sand, reddish brown, moist, rather soft. (Glacial Till)	10*		*No recovery.
6.5			11		
	SM	SILTY SAND with Gravel, fine- to medium-grained, dark brown, moist, very dense.			
8.3			125		
		END OF BORING - Refusal to auger.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

LOG OF BORING (See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-59</b>		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/9/14</b>	
SCALE: 1" = 4'		LOCATION: See attached sketch.			
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.5	BIT	6 inches of bituminous surfacing.			
1.3	CONC	10 inches of concrete.			
2.4	AGG	13 inches of aggregate base.			
	FILL	FILL: LEAN CLAY with sand and Gravel, brown, moist.	17		
			11		
6.5	SM	SILTY SAND with a trace of Gravel, fine- to medium-grained, brown, moist, very dense. (Glacial Till)	66		
			70		
12.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	100/2"		

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-60</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/11/14	SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.8	BIT	7 inches of bituminous surfacing.			
1.6	CONC	10 inches of concrete.			
	FILL	FILL: POORLY GRADED SAND with SILT and Gravel, fine- to medium-grained, brown, moist.	14		
4.0	CL	LEAN CLAY with sand, reddish brown, moist, medium. (Glacial Till)	8		
			8		
9.0	SM	SILTY SAND with Gravel, fine- to medium-grained, dark brown, moist, very dense. (Glacial Till)	83		
			*		50, then 50/1"
15.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	50/5"		

(See Descriptive Terminology sheet for explanation of abbreviations)

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(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-61</b>		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer	DATE: <b>11/11/14</b>	SCALE: <b>1" = 4'</b>	
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.4	BIT	2 1/2 inches of bituminous surfacing.			
1.2	CONC	10 inches of concrete.			
1.8	AGG	6 inches of aggregate base.			
4.0	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.	7		
	CL	LEAN CLAY with a trace of Gravel, reddish brown, moist, rather soft.  (Glacial Till)	10		
6.5	SM	SILTY SAND with a trace of Gravel, fine- to medium-grained, brown, moist, medium dense.  (Glacial Till)	22		
10.5		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.	*		30, then 50/4"

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B14-08485 Geotechnical Evaluation Superior Street Reconstruction Superior Street (Downtown) Duluth, Minnesota			BORING: <b>ST-62</b>		
DRILLER: J. Boehmke			METHOD: 3 1/4" HSA, Autohammer		
DATE: 11/11/14			SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	2 inches of bituminous surfacing.			
1.3	CONC	10 1/2 inches of concrete.			
2.1	AGG	11 inches of aggregate base.			
	CL	LEAN CLAY with sand, reddish brown, moist, stiff. (Glacial Till)	10		
			16		
6.5	SM	SILTY SAND with a trace of Gravel, fine- to medium-grained, brown, moist, dense. (Glacial Till)	32		
10.0		END OF BORING.	50/2"		
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2014\08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/6/15 11:55

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-63</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/11/14	SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	2 inches of bituminous surfacing.			
1.0	CONC	7 inches of concrete.			
1.5	AGG	7 inches of aggregate base.			
	FILL	FILL: POORLY GRADED SAND with SILT, brown, moist.	29*		*No recovery.
4.0	SM	SILTY SAND with Gravel, reddish brown, moist, very dense. (Glacial Till)	55		
			74		
			*		55, then 50/2"
11.5		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-64</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke	METHOD: 3 1/4" HSA, Autohammer	DATE: 11/11/14	SCALE: 1" = 4'		
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.7	BIT	2 inches of bituminous surfacing.			
1.0	CONC	8 1/2 inches of concrete.			
1.5	AGG	6 inches of aggregate base.			
	FILL	FILL: POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist.	16		
4.0	FILL	FILL: LEAN CLAY with sand, brown, moist.	4		
6.5	SM	SILTY SAND with Gravel, fine- to medium-grained, reddish brown, moist, very dense. (Glacial Till)	50/3"		
11.5		END OF BORING - Refusal to auger.  Water not observed while drilling.  Boring immediately backfilled.	*		60, then 50/4"

(See Descriptive Terminology sheet for explanation of abbreviations)

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(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-65</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/11/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.2	CONC	2 inches of brick.			
0.3	BIT	2 inches of bituminous surfacing.			
1.1	AGG	12 inches of aggregate base.			
2.1	CONC	9 inches of concrete.			
	SM	SILTY SAND with Gravel, fine- to medium-grained, reddish brown, moist, medium dense to dense. (Glacial Till)			
			28		
			38		
			50/4"		
9.0		END OF BORING.			
		Water not observed while drilling.			
		Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

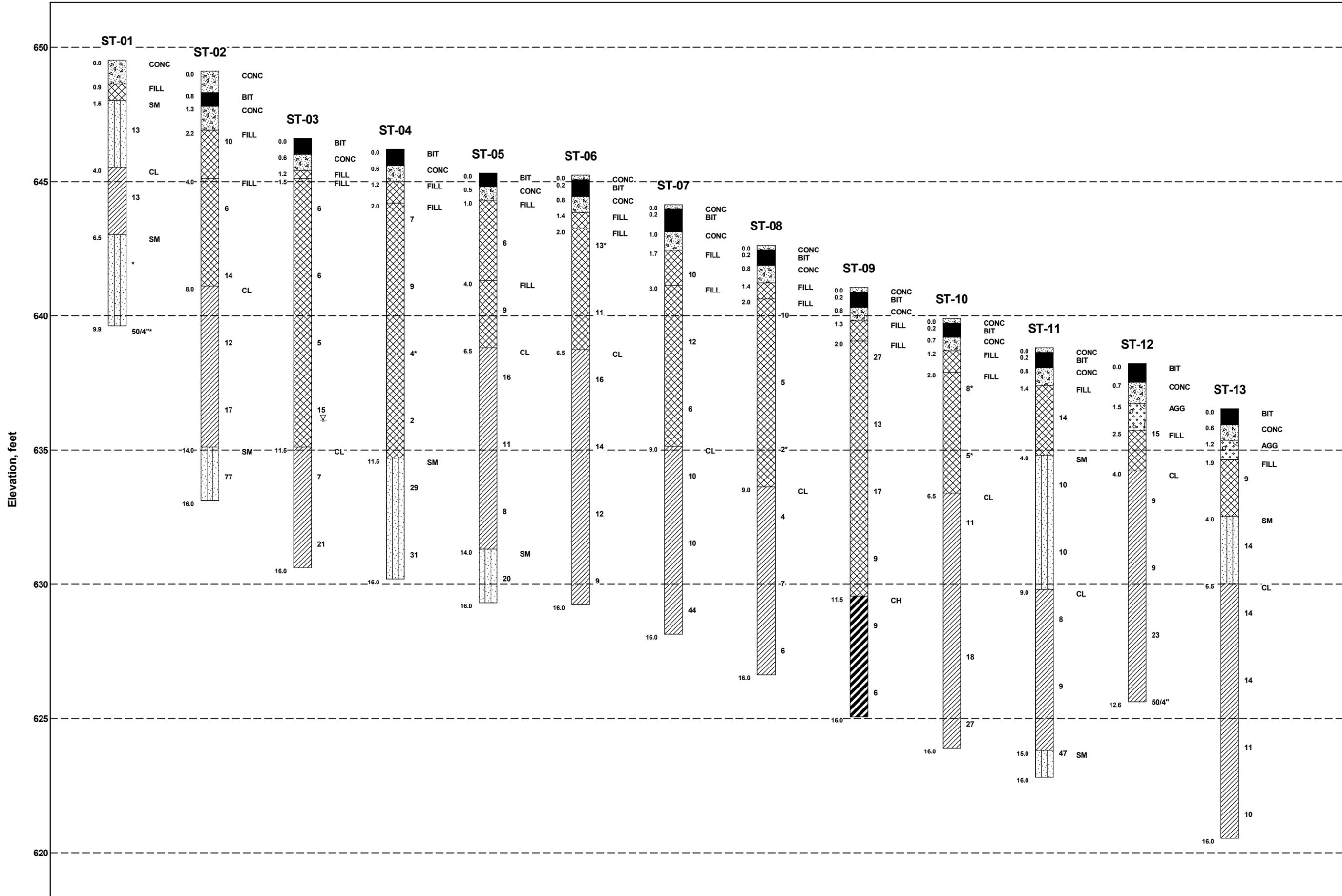
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<b>Braun Project B14-08485</b> <b>Geotechnical Evaluation</b> <b>Superior Street Reconstruction</b> <b>Superior Street (Downtown)</b> <b>Duluth, Minnesota</b>			BORING: <b>ST-66</b> LOCATION: See attached sketch.		
DRILLER: J. Boehmke		METHOD: 3 1/4" HSA, Autohammer		DATE: <b>11/11/14</b>	SCALE: <b>1" = 4'</b>
Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
0.0					
0.8	CONC	10 inches of concrete.			
1.4	AGG	7 inches of aggregate base.			
	FILL	FILL: POORLY GRADED SAND with SILT and Gravel, fine- to medium-grained, brown, moist.			
4.0			23		
	SM	SILTY SAND with a trace of Gravel, fine- to medium-grained, brown, moist, very dense to dense. (Glacial Till)			
			50/3"		
			92		
			45		
12.0		END OF BORING.  Water not observed while drilling.  Boring immediately backfilled.			

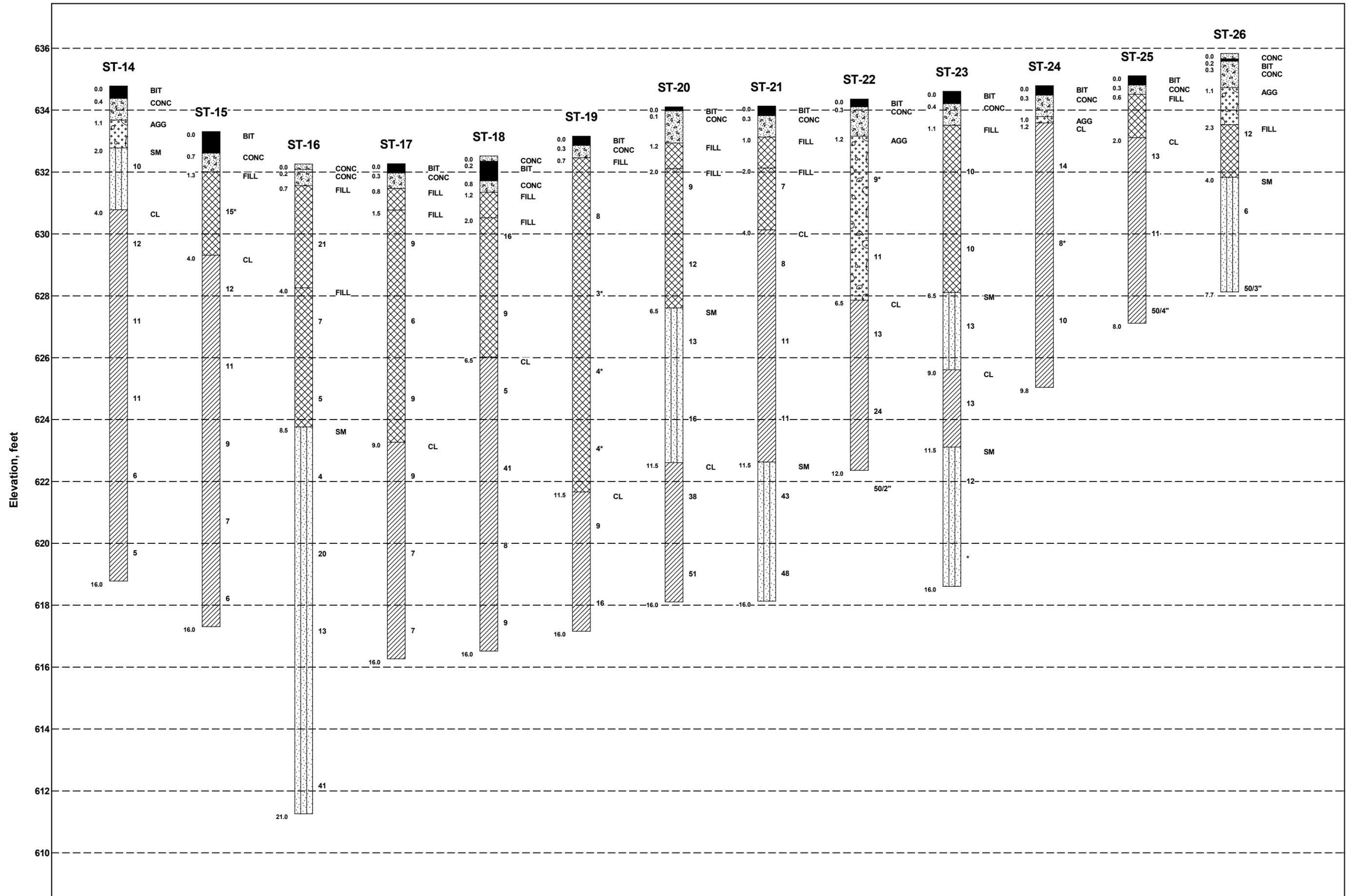
## Existing Pavement Results

Boring Number	Brick Pavement Thickness [inches]	Bituminous Pavement Thickness [inches]	Concrete Pavement Thickness [inches]	Aggregate Base Thickness [inches]	Total Thickness [inches]
ST-1			10.5		10.5
ST-2		6.5	9.5		16
ST-3		7	7		14
ST-4		7.5	7		14.5
ST-5		6.5	6		12.5
ST-6	2	7.5	7		16.5
ST-7	2	9.5	8.5		20
ST-8	2	7	8		17
ST-9	2	7	6	13	28
ST-10	2	6	6	8	22
ST-11	2	7	7.5	10	26.5
ST-12		8	10		18
ST-13		7.5	7		14.5
ST-14		5	8		13
ST-15		8	8		16
ST-16	2		9		11
ST-17		3.5	6.5		10
ST-18	2	7.5	4.5		14
ST-19		3.5	5		8.5
ST-20		1.5	12.5		14
ST-21		3.5	9		12.5
ST-22		9	3	60	72
ST-23		5	9		14
ST-24		4	7	8	19
ST-25		4	8		12
ST-26	2	1	10		13
ST-27	2	5.5	10	15	32.5
ST-28	2	5.5	8	8	23.5
ST-29		6	11		17
ST-30	2	5.5	8	5	20.5
ST-31		5	17		22
ST-32		11	6		17
ST-33		5	8	4	17
ST-34	2	2	12		16
ST-35		7.5	12		19.5
ST-36			10	9	19

Boring Number	Brick Pavement Thickness [inches]	Bituminous Pavement Thickness [inches]	Concrete Pavement Thickness [inches]	Aggregate Base Thickness [inches]	Total Thickness [inches]
ST-37		4	10	11	25
ST-38	2	2	10	8	22
ST-39	2	2	9	6	19
ST-40	2	6	8		16
ST-41	2	2.5	10		14.5
ST-42	2	9	10	8	29
ST-43	2	1	12		15
ST-44	2	6.5	8	6	22.5
ST-45	2	5	10	8	25
ST-46	2	5	13.5	10	30.5
ST-47	2	6	8	3	19
ST-48	2	3.5	10.5		16
ST-49	2	5	6	12	25
ST-50	2	6.5	10		18.5
ST-51	2	3	15	6	26
ST-53	2	8.5		12	22.5
ST-54	2	2	9	7	20
ST-55	2	2	10	8	22
ST-56	2	6	11	8	27
ST-57	2	5	13		20
ST-58	2	7.5	7		16.5
ST-59	2	6	10	13	31
ST-60	2	7	10		19
ST-61	2	2.5	10	6	20.5
ST-62	2	2	10.5	11	25.5
ST-63	2	2	7	7	18
ST-64	2	2	8.5	6	18.5
ST-65	2	2	12	9	25
ST-66			10	7	17

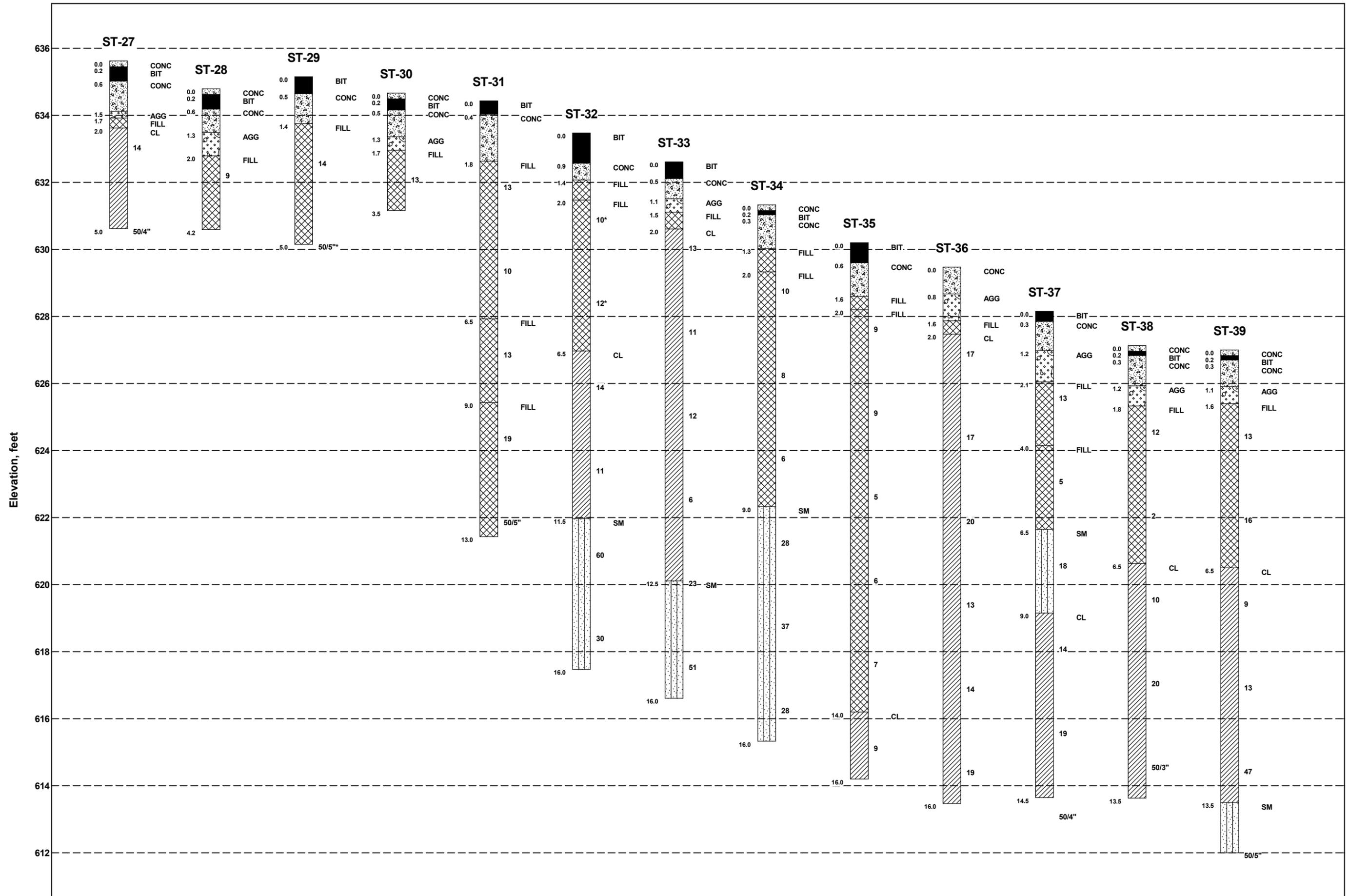


FENCE DIAGRAM  
GEOTECHNICAL EVALUATION  
SUPERIOR STREET RECONSTRUCTION  
SUPERIOR STREET (DOWNTOWN)  
DULUTH, MINNESOTA



FENCE DIAGRAM  
 GEOTECHNICAL EVALUATION  
 SUPERIOR STREET RECONSTRUCTION  
 SUPERIOR STREET (DOWNTOWN)  
 DULUTH, MINNESOTA

Project No:  
 B14-08485  
 Scale:  
 Vert=3 ft  
 Hor NTS  
 Date: 11-20-15  
 Figure:

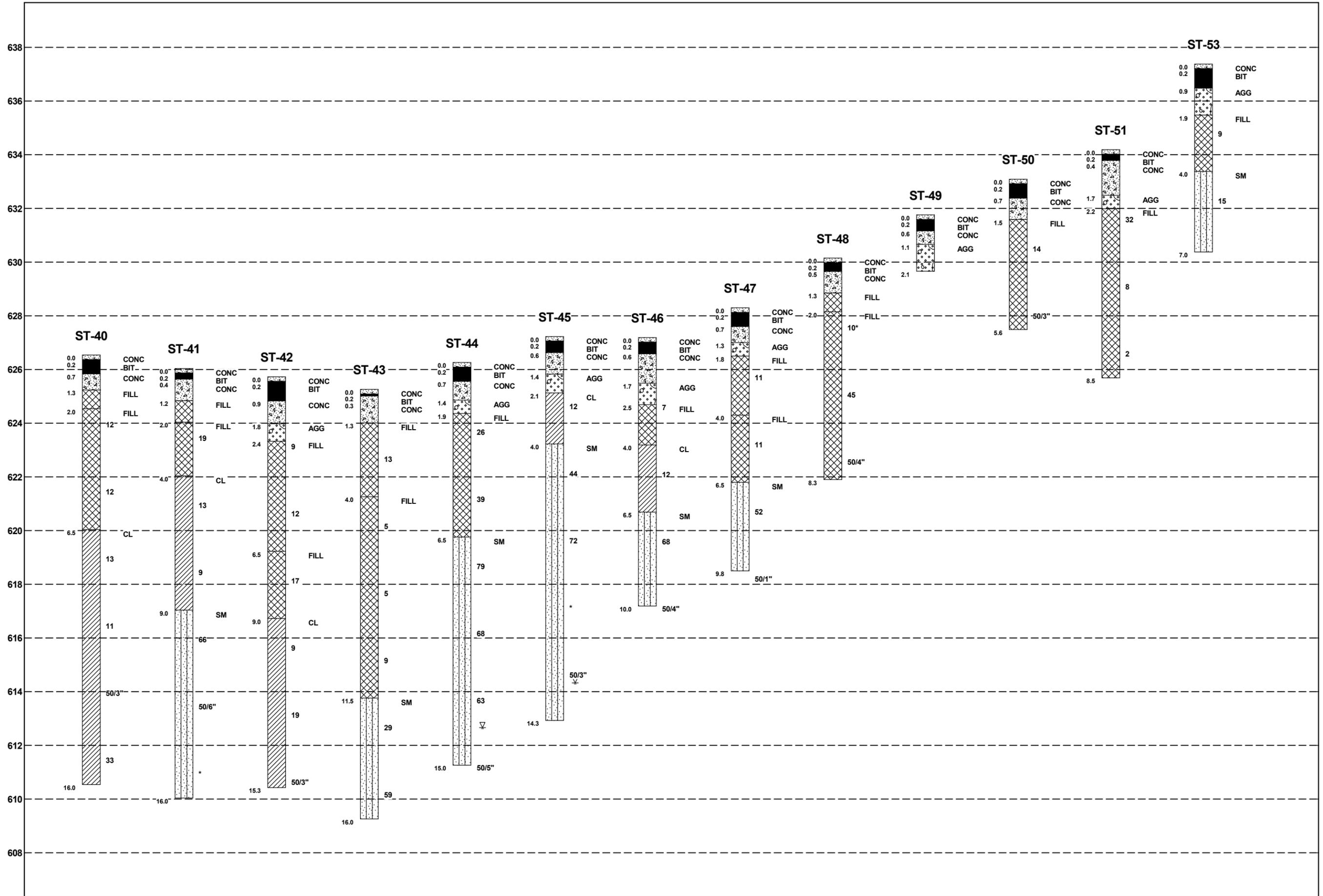


11X17 ELEVATION-TITLE BLOCK 08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/20/15 16:00

FENCE DIAGRAM  
GEOTECHNICAL EVALUATION  
SUPERIOR STREET RECONSTRUCTION  
SUPERIOR STREET (DOWNTOWN)  
DULUTH, MINNESOTA

Project No:  
B14-08485  
Scale:  
Vert=3 ft  
Hor NTS  
Date: 11-20-15  
Figure:

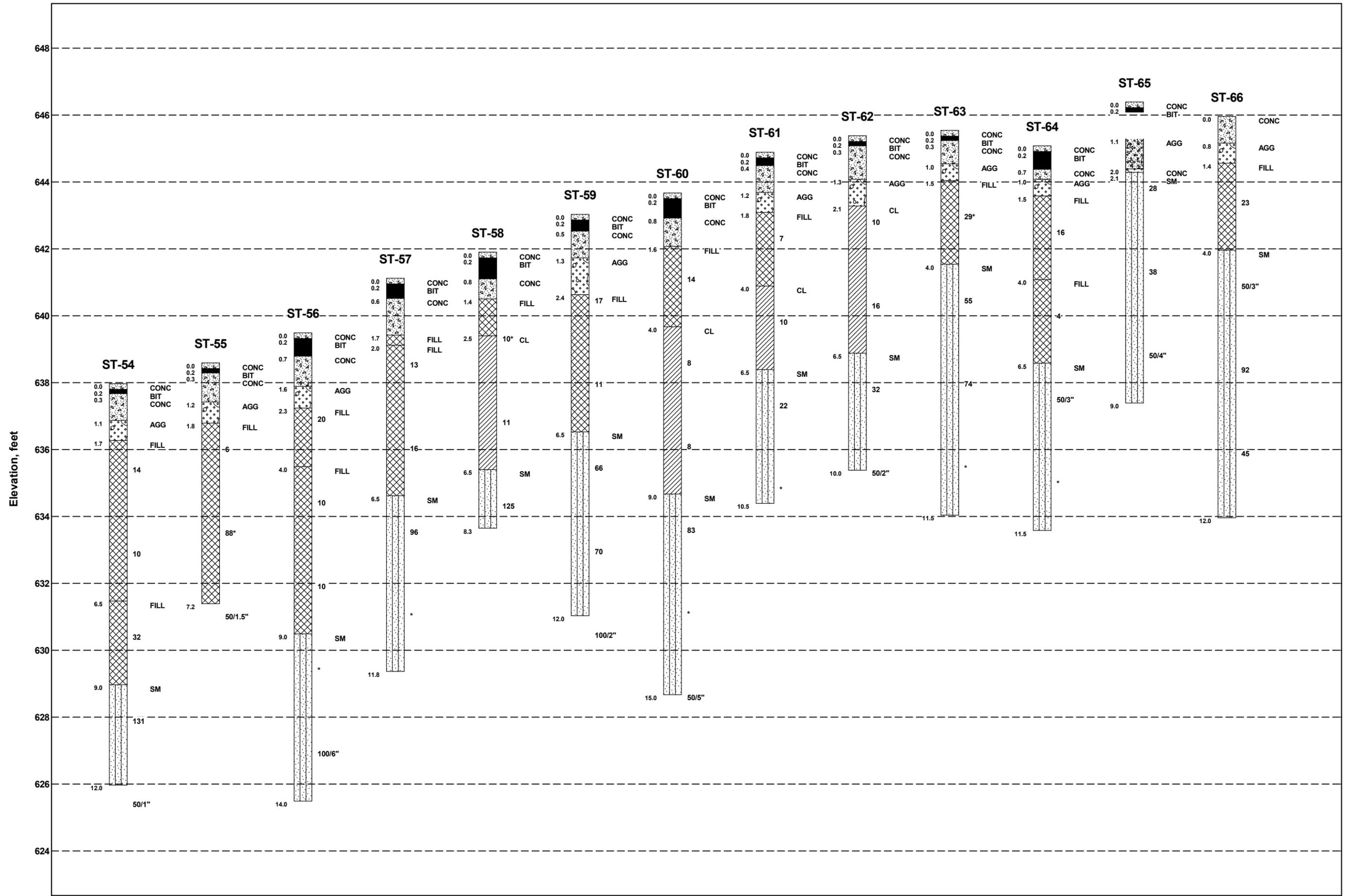
Elevation, feet



11X17 ELEVATION-TITLE BLOCK 08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/20/15 16:01

FENCE DIAGRAM  
GEOTECHNICAL EVALUATION  
SUPERIOR STREET RECONSTRUCTION  
SUPERIOR STREET (DOWNTOWN)  
DULUTH, MINNESOTA

Project No:  
B14-08485  
Scale:  
Vert=3 ft  
Hor NTS  
Date: 11-20-15  
Figure:



11X17 ELEVATION-TITLE BLOCK 08485.GPJ BRAUN\_V8\_CURRENT.GDT 11/20/15 16:01

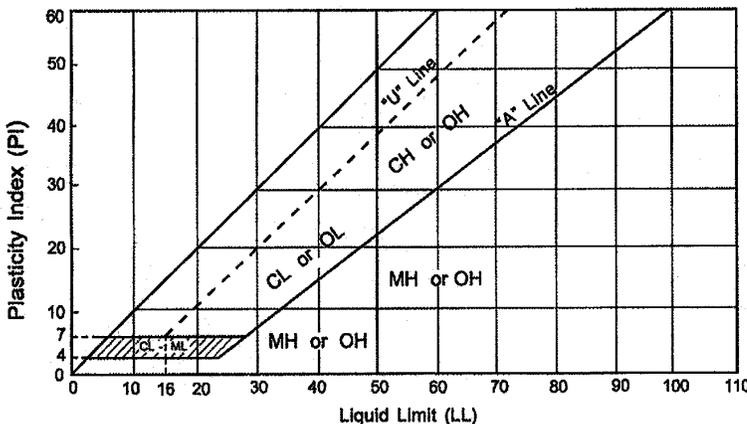
FENCE DIAGRAM  
GEOTECHNICAL EVALUATION  
SUPERIOR STREET RECONSTRUCTION  
SUPERIOR STREET (DOWNTOWN)  
DULUTH, MINNESOTA

Project No:  
B14-08485  
Scale:  
Vert=3 ft  
Hor NTS  
Date: 11-20-15  
Figure:



Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>a</sup>				Soils Classification	
				Group Symbol	Group Name <sup>b</sup>
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 <sup>e</sup>	$C_u \geq 4$ and $1 \leq C_c \leq 3$ <sup>c</sup>	GW	Well-graded gravel <sup>d</sup>
		Gravels with Fines More than 12% fines <sup>e</sup>	Fines classify as ML or MH	GM	Silty gravel <sup>d f g</sup>
			Fines classify as CL or CH	GC	Clayey gravel <sup>d f g</sup>
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines <sup>i</sup>	$C_u \geq 6$ and $1 \leq C_c \leq 3$ <sup>c</sup>	SW	Well-graded sand <sup>h</sup>
		Sands with Fines More than 12% <sup>i</sup>	Fines classify as ML or MH	SM	Silty sand <sup>f g h</sup>
			Fines classify as CL or CH	SC	Clayey sand <sup>f g h</sup>
Fine-grained Soils 50% or more passed the No. 200 sieve	Silt and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line <sup>j</sup>	CL	Lean clay <sup>k l m</sup>
		Organic	PI < 4 or plots below "A" line <sup>j</sup>	ML	Silt <sup>k l m</sup>
	Silt and clays Liquid limit 50 or more	Inorganic	Liquid limit - oven dried < 0.75	OL	Organic clay <sup>k l m n</sup>
			Liquid limit - not dried < 0.75	OL	Organic silt <sup>k l m o</sup>
		Organic	PI plots on or above "A" line	CH	Fat clay <sup>k l m</sup>
			PI plots below "A" line	MH	Elastic silt <sup>k l m</sup>
		Organic	Liquid limit - oven dried < 0.75	OH	Organic clay <sup>k l m p</sup>
			Liquid limit - not dried < 0.75	OH	Organic silt <sup>k l m q</sup>
Highly Organic Soils	Primarily organic matter, dark in color and organic odor			PT	Peat

- Based on the material passing the 3-inch (75mm) sieve.
- If field sample contains cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
- $C_u = D_{60}/D_{10}$ ,  $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
- If soil contains  $\geq 15\%$  sand, add "with sand" to group name.
- 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
- If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
- If fines are organic, add "with organic fines" to group name.
- If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.
- Sand 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
- If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
- If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
- If soil contains  $\geq 30\%$  plus No. 200, predominantly sand, add "sandy" to group name.
- If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.
- $PI \geq 4$  and plots on or above "A" line.
- $PI < 4$  or plots below "A" line.
- PI plots on or above "A" lines.
- PI plots below "A" line.



**Laboratory Tests**

<b>DD</b> Dry density, pcf	<b>OC</b> Organic content, %
<b>WD</b> Wet density, pcf	<b>S</b> Percent of saturation, %
<b>MC</b> Natural moisture content, %	<b>SG</b> Specific gravity
<b>LL</b> Liquid limit, %	<b>C</b> Cohesion, psf
<b>PL</b> Plastic limits, %	<b>Ø</b> Angle of internal friction
<b>PI</b> Plasticity index, %	<b>qu</b> Unconfined compressive strength, psf
<b>P200</b> % passing 200 sieve	<b>qp</b> Pocket penetrometer strength, tsf

**Particle Size Identification**

Boulders.....	over 12"
Cobbles .....	3" to 12"
Gravel	
Coarse .....	3/4" to 3"
Fine.....	No. 4 to 3/4"
Sand	
Coarse .....	No. 4 to No. 10
Medium.....	No. 10 to No. 40
Fine.....	No. 40 to No. 200
Silt .....	<No. 200, PI < 4 or below "A" line
Clay .....	<No. 200, PI $\geq 4$ and on or about "A" line

**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**

Very soft.....	0 to 1 BPF
Soft .....	2 to 3 BPF
Rather soft .....	4 to 5 BPF
Medium.....	6 to 8 BPF
Rather stiff .....	9 to 12 BPF
Stiff .....	13 to 16 BPF
Very stiff.....	17 to 30 BPF
Hard.....	over 30 BPF

**Drilling Notes**

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers, unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. All samples were taken with the standard 2" OD split-tube samples, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous flight, solid-stern augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface, and are therefore, somewhat approximate.

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn.

**BPF:** Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments, and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

**WH:** WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

**WR:** WR indicates the sampler penetrated soil under weight of rods alone; hammer weight, and driving not required.

**TW:** TW indicates thin-walled (undisturbed) tube sample.

**Note:** All tests were run in general accordance with applicable ASTM standards.