# FEASIBILITY REPORT

# STANHOPE TERRACE STREET RECONSTRUCTIONS

## CITY IMPROVEMENT PROJECT NO. 18-00

**October 20, 2017**

**Prepared By:**

**City of Ramsey**
**Engineering Department**
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October 20, 2017

Honorable Mayor and City Council
City of Ramsey
7550 Sunwood Drive NW
Ramsey, MN 55303

Re: Feasibility Report - City of Ramsey Improvement Project #18-00
Stanhope Terrace Reconstruction

Dear Mayor and City Council Members:

Transmitted herewith is a Feasibility Report for the proposed Stanhope Terrace Reconstruction project including; Ute Street from Alpine Drive to its termini cul-de-sac, 154th Avenue between Ute Street and Roanoke Street, and 153rd Court from Roanoke Street to its termini cul-de-sac. The report examines the feasibility of reconstructing the bituminous street section and completing other appurtenant improvements.

This Feasibility Report examines the scope of the proposed improvements, explores estimated costs and available funding sources, defines a preliminary project schedule, and determines the necessity, feasibility and general cost-effectiveness of the proposed improvements, including any alternate designs, as well as whether the improvements would best be completed separately or in conjunction with another project.

I would be happy to discuss this report with you at your convenience. Please feel free to contact me at 763-433-9825 or bwestby@cityoframsey.com with any questions.

Sincerely,
***City of Ramsey***

Bruce Westby, PE
City Engineer

Enclosure

C: Kurt Ulrich, City Administrator
Leonard Linton, Civil Engineer IV

## 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.

Bruce Westby, PE

Date: October 20, 2017 License No. 40116

I hereby certify that this plan, specification or report was reviewed for Quality Control and Quality Assurance purposes and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Leonard Linton, PE

Date: October 20, 2017 License No. 21112

**TITLE SHEET**
**LETTER OF TRANSMITTAL**
**CERTIFICATION SHEET**
**TABLE OF CONTENTS**

**Appendix A**

Figure 1 – Project Scope
Figure 2 – Typical Section
Project Site Pictures

**Appendix B**

Opinion of Probable Costs
Preliminary Assessment Map
Preliminary Assessment Roll

**Appendix C**

Ground Penetrating Radar Summary
Geotechnical Exploration and Engineering Review (Braun 49 pages)

## 1. EXECUTIVE SUMMARY

City Improvement Project No. 18-00 proposes to reconstruct streets within the Stanhope Terrace neighborhood including Ute Street, 154th Avenue, and 153rd Court. The streets total approximately 2,800 linear feet (0.52 miles) in length. A map showing the location and scope of the proposed improvements is included as ***Figure 1*** in ***Appendix A.***

The streets were constructed in 1991. Based on results from the geotechnical report and ground penetrating radar (GPR) analysis performed by Braun Intertec, field observation and record plan documents, the bituminous pavement section ranges from 1.6 to 6.1 inches thick with an average of 2.9 inches. The aggregate base ranges from 2.1 to 10.6 inches thick with an average of 4.9 inches. The road section was built on sandy subgrade material generally considered suitable for pavement support. The streets were constructed with bituminous curb to a width of 29 feet from face-of-curb to face-of-curb. The streets are generally centered within a 66 foot wide right-of-way. The storm sewer system consists of catch basins along 154th Lane which drain runoff from the street to a low-lying area with storm sewer and utility easements located on the northern 75 feet of 4851 154th Lane. Storm runoff not collected by the catch basins is carried to Roanoke Street and collected within its storm sewer system.

City staff evaluates and rates the condition of pavement sections on all City streets on an annual basis using the Pavement Surface Evaluation and Rating (PASER) system. In the summer of 2017, the pavement section of the above-referenced street segments were rated with a PASER rating of 3 which indicates these streets require complete reconstruction, and for City staff to patch the streets at least once per year, particularly before winter so the street can be plowed without damaging the pavement in the process. Pictures of the street are located in ***Appendix A.***

Proposed improvements include removing existing bituminous curb and replacing with B618 concrete curb and gutter, and reconstructing the existing bituminous pavement section using the Full Depth Reclamation (FDR) process. This process involves reclaiming the entire existing bituminous pavement section, along with the existing aggregate base material. A portion of this reclaimed (ground and mixed) material would then be spread and compacted on top of the reshaped and compacted subgrade. Then, 3.5 inches of bituminous pavement would be placed, generally meeting the City of Ramsey's standard pavement design.

The existing storm sewer system is in good condition and generally meets City design standards and therefore requires only minimal improvements, including resetting the castings after concrete curb and gutter placement, which will include replacing adjustment rings and re-grouting the inside of the catch basins to a smooth finish.

The engineer's opinion of probable costs for completing the proposed improvements outlined in this report is $430,934.81. Estimated costs include 5-percent contingency costs plus 23-percent indirect costs for administrative, engineering, finance and legal costs. A summary of the engineer's opinion of probable costs is included in ***Appendix B***.

A total of 16 assessable parcels have been identified. Staff recommends applying 25-percent of the eligible project costs equally across the 16 assessable properties using the "per lot" assessment method. This results in a proposed preliminary assessment rate of $6,733.36 per assessable parcel.

Staff recommends ordering a special benefit consultation report for this project to verify the proposed assessment amount will not exceed the benefit to the properties. If the report concludes the benefit to the properties is less than the proposed preliminary assessment rate, Staff will then propose to lower the assessment rate accordingly during the Assessment Hearing, which is scheduled for October 9, 2018. If the report verifies the assessment rate as proposed is justified, Staff will propose to adopt the final assessment roll using the rate as preliminarily proposed.

Five (5) soil borings were completed by Braun Intertec to assist with the preparation of this report. Pavement design recommendations were offered by Braun Intertec, and Staff considered and incorporated Braun's recommendations to varying degrees while preparing this report. Ground Penetrating Radar (GPR) was conducted on all street segments within the project. The GPR identifies existing bituminous pavement and aggregate base thicknesses, and is used to help staff determine the appropriate treatment. Copies of Braun Intertec's GPR results and Geotechnical Exploration are attached in ***Appendix C***.

This improvement project, which is listed in the City's current 10-year Capital Improvement Plan, is proposed to be funded using a combination of special assessments to benefiting properties, street reconstruction bond proceeds, and storm sewer funds.

Staff has not yet discussed the proposed improvements with local property owners. However, Staff has scheduled a neighborhood information meeting for November 1, 2017 for the purpose of explaining the proposed improvements and assessments in more detail, and to gather their input on the project, including any information which should be explored in more detail during development of plans and specifications. Staff will incorporate comments and present this information to Council during the Public Hearing.

This project would best be constructed in conjunction with the River's Bend and The North Forty Street Reconstruction projects, is necessary, feasible, and cost-effective from an engineering standpoint, and can be constructed as proposed herein.

## 2. INTRODUCTION

### 2.1 Authorization

The preparation of this report was authorized by the Ramsey City Council on July 11, 2017. This project has been designated as City Improvement Project No. 18-00.

### 2.2 Program Overview

In support of the City's long-term Street Maintenance Program, the entire existing bituminous pavement section will be reconstructed using a full-depth reclamation (FDR) process. The existing bituminous curb will be replaced with B618 concrete curb and gutter, plus other appurtenant work will be completed as outlined in this report.

The City's pavement evaluation process involves a visual evaluation of each street's pavement surface based on the type, extent and severity of each pavement distress observed. Numerous types of pavement distresses may exist within a pavement section including, but not limited to, alligator cracking, block cracking, longitudinal cracking, transverse cracking, rutting, raveling, shoving, potholes and patches. This field data is then used to rate the pavement condition.

The City uses the Pavement Surface Evaluation and Rating (PASER) system to rate pavement condition. A PASER rating is a numerical index between 1 and 10 indicating the condition of a pavement based on the various pavement distresses recorded during visual observations. A PASER rating of 10 represents brand new pavement, while a PASER rating of 1 represents a pavement section that has fallen into complete disrepair requiring full reconstruction.

In the summer of 2017, City staff evaluated and rated the condition of the pavement along the Stanhope Terrace street segments. A PASER rating of 3 was determined for Ute Street, 154$^{th}$ Lane and 153$^{rd}$ Court.

### 2.3 Scope

City of Ramsey Improvement Project 18-00 proposes to reconstruct the existing bituminous pavement, remove existing bituminous curb and replace with B618 concrete curb and gutter, and to complete other appurtenant work on Ute Street from Alpine Drive to its termini cul-de-sac, 154$^{th}$ Lane between Ute Street and Roanoke Street, and 153$^{rd}$ Court from Roanoke Street to its termini cul-de-sac which totals approximately 2,800 linear feet (0.52 miles) in length.

The existing bituminous pavement section is proposed to be reconstructed using the FDR process. This involves reclaiming the entire bituminous pavement section from back of curb to back of curb, along with a portion of the existing aggregate base, hauling and disposing of excess reclaim material off site, spreading and compacting the reclaimed material on top of the reshaped and compacted subgrade, then placing 3.5 inches of new bituminous pavement on top. The resulting pavement design will generally meet current City design standards.

A map showing the location and scope of the proposed improvements is included as ***Figure 1*** in ***Appendix A.***

# 3. EXISTING CONDITIONS

## 3.1 Existing Pavement and Soil Conditions

All streets proposed to be improved were constructed in 1991 with bituminous pavement, class 5 aggregate base, bituminous curb, and concrete storm sewer. The streets were constructed to a width of 29-feet from face-of-curb to face-of-curb. The streets are generally centered within a 66-foot wide right-of-way.

The only pavement maintenance treatments applied to the street segments included cracksealing and sealcoating Ute Street and 154th Lane in 1996, and 153rd Court in 1998. Spot patching has been performed on an as-needed basis, and has been a yearly treatment recently. In 2017, Staff observed a PASER of 3 on all the street segments.

In July of 2017, City staff recorded a traffic volume of 114 average annual daily traffic (AADT) on Ute Street north of Alpine Drive, and 43 AADT on Ute Street west of Roanoke Street. Traffic counts were not taken on 153rd Court, however it can be reasonably expected 153rd Court would have similar traffic volumes. The speed limit is 30 mph for these street segments.

Braun Intertec was employed to complete a Geotechnical Exploration and Engineering Review for this project, which included five (5) soil borings spaced at approximately 600 feet along Ute Street/154th Lane and 1 boring in each cul-de-sac. The locations of the borings are shown in the Soil Boring Location Map in the Appendix of Braun's report, attached in ***Appendix C***.

The soil borings provide information on existing bituminous pavement and aggregate base course thicknesses, subsurface soil conditions, existing ground water elevations, and potential issues, which may be encountered during construction. All borings terminated at a nominal depth of 11 feet below the existing ground surface. There was no groundwater observed during the soil borings. Based on the work proposed and the lack of groundwater at a depth of 11 feet below the existing ground surface, groundwater is not anticipated to be a significant issue for work completed with this proposed project.

The soil borings generally indicate the existing bituminous pavement thickness ranges between 3 to 4 inches, and aggregate base thickness ranges between 4 to 6 inches. The subgrade generally consists of poorly graded sand with silt at depths ranging from 2.0 to 6.0 feet below the top of pavement. Native alluvial soils consisting of poorly grades sand (SP) generally extend to the bottom of the borings (11 feet).

Braun Intertec was employed to complete a ground penetrating radar (GPR) analysis for the project area, which included driving the GPR equipped vehicle throughout all street segments within the project area. A summary table and charts of the GPR Analysis are attached in ***Appendix C***. The GPR data determined an average bituminous pavement thickness of 2.9 inches, and an average aggregate base thickness of 4.9 inches. The average street pavement and base section thickness was 7.7 inches, with a minimum section of 5.1 inches located on Ute Street, 91 feet south of the intersection with 154th Lane.

## 3.2 Watermain

Watermain does not exist on site.

## 3.3 Sanitary Sewer

Sanitary sewer does not exist on site.

## 3.4 Storm Sewer/Drainage

The storm sewer system consists of catch basins along 154th Lane which drain runoff from the street to a low-lying area with storm sewer and utility easements located on the northern 75 feet of 4851 154th Lane. Storm runoff not collected by the catch basins is carried to Roanoke Street and collected within its storm sewer system.

## 3.5 Streets

### *3.5.1 Existing Typical Sections*

The width of Ute Street, 154th Lane, and 153rd Court is 29 feet from face-of-curb to face-of-curb. The cul-de-sacs on Ute Street and 153rd Court have a 50 foot radius to the back of curb. The streets are centered within a 66-foot wide City-owned right-of-way, with a 65-foot wide right-of-way around the cul-de-sac on 153rd Court. The cul-de-sac on Ute Street was not platted with a widened City-owned right-of-way, therefore the City will have to obtain a right of entry from the property owners to complete the proposed work.

### *3.5.2 Maintenance History*

Stanhope Terrace was originally constructed in 1991. Ute Street and 154th Lane received crack seal and seal coat in 1996, 153rd Court received crack seal and seal coat in 1998. The street segments have regularly received spot patching on an as-needed basis.

## 3.6 Land Use

The parcels within the construction area are zoned residential.

# 4. PROPOSED IMPROVEMENTS

## 4.1 Street and Stormwater Improvements

### *4.1.1 Street Improvements*

Stanhope Terrace is proposed to be reconstructed with bituminous pavement and concrete curb and gutter, which will better facilitate drainage over time. Numerous streets exist throughout the City with bituminous curbing and almost all of them are deteriorating more rapidly than streets with concrete curb and gutter due to their inability to rapidly convey drainage off of the pavement surface, particularly along edges of streets.

The proposed surface improvements are shown on ***Figure 1 in Appendix A.***

*Street Design:*
Ute Street, 154th Lane, and 153rd Court are currently urban residential streets with bituminous curb and pavement, 30-feet wide from back-of-curb to back-of-curb. The cul-de-sacs on Ute Street and 153rd Court are 100-feet in diameter from back-of-curb to back-of-curb. Existing and proposed traffic counts are consistent with typical residential streets.

All street segments are proposed to be reconstructed at their current width. A typical section for the proposed pavement reconstruction improvements is shown in ***Figure 2*** in ***Appendix A.***

City staff is proposing a pavement section design of 1.5 inches bituminous wear course, 2 inches bituminous base course, and 4 inches of aggregate base composed of full depth reclamation material. This pavement section would be constructed over the existing subgrade after it is reshaped and compacted.

### *4.1.2 Storm Sewer Improvements*

The existing storm sewer system is in good condition. Catch basin castings will require new rings and will be regrouted. No stormwater treatment improvements are required for this project since the street is proposed to be reconstructed at its current width.

### *4.1.3 Geotechnical Considerations*

Braun Intertec, Inc. (Braun) completed a Geotechnical Exploration and Engineering Review including five (5) soil borings spaced at approximate 600-foot intervals along Ute Street and 154th Lane, and one (1) soil boring in each cul-de-sac. The locations of the borings are shown in the Boring Location Map in the Appendix of Braun's report, attached in ***Appendix C***. Braun recommends completing a 6 - 8 inch deep reclamation of the existing bituminous pavement and placing 6-inches of aggregate base class 5 or reclaim material, and 3.5-inches of new bituminous pavement. City staff is in close agreement and proposes completing a full-depth reclamation of the existing pavement by placing 4-inches of aggregate base class 5 or reclaim material, and 3.5-inches of new bituminous pavement.

The proposed improvements should have a service life of approximately 60-years, assuming maintenance such as overlays, crack sealing and seal coating is routinely performed.

### *4.1.4 Other Considerations*

*Driveways:*
Existing driveway aprons may need to be reconstructed to varying degrees. The limits of construction will vary with each driveway apron based on the elevation of the street abutting the driveway and the driveway pavement type. During design, staff will evaluate the construction limits for each driveway and will incorporate this into the plans, but as with all street reconstruction projects, the exact limits of construction will be determined in the field during construction. Right-of-entry forms will be obtained from private property owners where work is required outside City right-of-ways and easements.

*Irrigation Systems:*
Developed properties along the project corridor may have private irrigation systems. Staff will notify property owners of pending construction as far in advance as practical to allow them time to move their irrigation systems out of harm's way before work begins.

*Parking Restrictions:*
Parking is currently provided along both sides of the streets and is not currently restricted except for overnight parking per City code. During this project, parking will be restricted during allowable working hours.

*Pavement Corings:*
Existing pavement thicknesses have been found to be inconsistent throughout the City. It is now standard practice to have City staff on-site during pavement installation to insure the proper quantities are being placed. As further conformation, staff is proposing to have pavement corings taken at the conclusion of all reconstruction projects. This is already a requirement on all State Aid projects, and will leave more data on the pavement section for future street maintenance projects.

## 4.2 Stormwater Treatment

No stormwater retention and/or treatment improvements will be required as a result of this project.

## 4.3 Water Main Improvements

No watermain improvements are proposed with this project.

## 4.4 Sanitary Sewer Improvements

No sanitary sewer improvements are proposed with this project.

## 4.5 Construction Methods

The existing bituminous pavement section will be reconstructed using the FDR process outlined within this report.

## 4.6 Private Utilities

Staff has not yet met with the telephone, gas, power and cable utilities regarding this project. During preparation of plans and specifications, staff will meet with the private utility companies to discuss the proposed improvements as noted in the project schedule within this report. The alignment and footprint of the streets will be considered to minimize impacts to private utilities. No impacts to power poles or street lights are anticipated with this project.

Should any utility company indicate they wish to upgrade, replace and/or otherwise modify their services during this project, any such upgrades, replacements and/or modifications will be at the sole discretion and cost of the utility company.

## 4.7 Permits

Permits that are anticipated to be required as part of the proposed improvements include:

- MPCA General Stormwater Permit (NPDES)..... Grading and Storm Water

A stormwater permit from the Lower Rum River Watershed Management Organization will not be required with this project.

## 4.8 Right-of-Ways/Easements

During preparation of this report, City staff found the Ute Street cul-de-sac was constructed without the necessary permanent easement. It is likely this cul-de-sac was built as a temporary cul-de-sac before development to the north took place, with the intention of extending Ute Street at a later date. Unfortunately the Highlands at River Park 3rd Addition did not extend Ute Street, and additional right-of-way was never secured. Three properties access Ute Street including one from the cul-de-sac. City staff will contact the two property owners to discuss options for securing easements. The costs for easement acquisitions are not included in the probable project costs.

City staff will obtain required right of entries on a case by case basis.

## 5. FINANCING

### 5.1 Opinion of Cost

A detailed opinion of probable costs for the proposed improvements can be found in ***Appendix B*** of this report. The opinion of probable costs incorporates anticipated 2018 construction costs for the proposed improvements with 5-percent contingency costs, plus 23-percent indirect costs for administrative, engineering, financing and legal costs.

City staff prepared the Feasibility Report in-house as part of staff's normal duties.

Braun Intertec prepared the Geotechnical Exploration and Engineering Review, included in ***Appendix C***, at a cost of $3,228.67.

### 5.2 Funding

#### *5.2.1 Assessments*

A portion of the project costs is proposed to be recovered through special assessments levied against the 16 identified benefiting properties; 7 along Ute Street, 5 along 154th Lane, and 4 along 153rd Court. Assessments are proposed to be collected for eligible improvements benefiting residential properties with direct access to the improved segments of Stanhope Terrace as described below. A preliminary assessment summary is included below in ***Table 1***.

Residential Assessments:
Special assessments are proposed to be levied against residential properties having direct access to improved streets. To be consistent with previous applications of the Special Assessments Policy, each residential property is proposed to be assessed using the "per lot" method.

Each residential property is preliminarily proposed to be assessed at the rate of $6,733.36 per lot. Since State Statute and the City Charter do not allow for assessments to exceed the benefit to the property, staff requests Council authorization to order a benefit appraisal consultation for this project in accordance with the City's Special Assessment Policy.

The Preliminary Assessment Map and Roll are included in ***Appendix B.***

**TABLE 1**
**Proposed Preliminary Assessments – Ute Street, 154th Lane, and 153rd Court**

| STREET SEGMENT | ASSESSMENT PER LOT | NO. OF LOTS | TOTAL ASSESSMENTS |
|---|---|---|---|
| Ute Street Residential Assessment | $6,733.36 | 7 | $47,133.50 |
| 154th Lane Residential Assessment | $6,733.36 | 5 | $33,666.80 |
| 153rd Court Residential Assessment | $6,733.36 | 4 | $26,933.40 |
| **TOTAL PROJECT ASSESSMENTS** | | | **$107,733.70** |

### *5.2.2 City Contribution*

The City contribution to the project would include all funding in excess of the amount collected through special assessments to benefiting properties. No funds have been budgeted for this project. The City's share of eligible project costs related to surface (street) improvements is proposed to come from the previously encumbered 5-year Street Reconstruction and Overlay Program bonds. Stormwater Utility Funds are proposed to pay for all storm sewer improvements.

***Table 2*** illustrates the proposed project funding based on the design proposed within this report. This funding program assumes construction will occur in 2018.

**TABLE 2**
**Proposed Project Funding**

| | ASSESSMENTS | CITY FUNDS | TOTAL |
|---|---|---|---|
| **Surface** | **$106,119.33** | **$318,357.98** | **$424,477.31** |
| **Storm Sewer** | **$1,614.37** | **$4,843.13** | **$6,457.50** |
| **TOTALS** | **$107,733.70** | **$323,201.11** | **$430,934.81** |

| | | |
|---|---|---|
| **Total Project Cost** | | **$430,934.81** |
| Less Special Assessments | - | $107,733.70 |
| **Subtotal** | **=** | **$323,201.11** |
| Less City Bonding Funds | - | $318,357.98 |
| **Subtotal** | **=** | **$4,843.13** |
| Less Stormwater Utility Funds | - | $4,843.13 |
| **TOTAL Remaining Cost** | **=** | **$0** |

## 6. PROJECT SCHEDULE

The proposed project schedule is as follows:

Council Orders Feasibility Report ..... July 11, 2017

Council Accepts Feasibility Report/Orders Public Hearing ..... October 24, 2017

Staff Conducts Neighborhood Information Meeting ..... November 1, 2017

Council Conducts Public Hearing Authorizes Plans and Specifications ..... November 14, 2017

Staff Conducts Private Utility Coordination Meeting ..... December, 2017

Council Approves Plans and Specifications / Authorizes Ad for Bids ..... January 9, 2018

Staff Receives Bids ..... February 6, 2018

Council Awards Contract ..... February 13, 2018

Contractor Begins Construction ..... May / June, 2018

Contractor Completes Construction ..... September, 2018

Council Conducts Assessment Hearing ..... October 9, 2018

## 7. CONCLUSIONS AND RECOMMENDATIONS

City of Ramsey Improvement Project No. 18-00 proposes to reconstruct the bituminous pavement section, to remove the existing bituminous curb and replace it with B618 concrete curb and gutter, and to complete miscellaneous appurtenant work on the following street segments within the Stanhope Terrace residential subdivision:

1. Ute Street (approx. 1,320 linear feet) – Alpine Drive to north cul-de-sac.
2. 154th Lane (approx. 950 linear feet) – Ute Street to Roanoke Street.
3. 153rd Court (approx. 300 linear feet) – Roanoke Street to west cul-de-sac.

It is the recommendation of City staff that City Project No. 18-00 is feasible, necessary, and cost-effective from an engineering standpoint, and this project would best be constructed in conjunction with the River's Bend and The North Forty Street Reconstruction projects as proposed herein.

The following Staff recommendations related to the proposed project are presented for Council consideration and concurrence:

1. Remove existing bituminous curb and replace with B618 concrete curb and gutter.

2. Reconstruct existing bituminous pavement using full-depth reclamation process, meeting the City's standard residential pavement section of 4-inches aggregate base class 5 or (reclaim), 2-inches new bituminous base course, and 1½-inches new bituminous wear course.

3. Staff recommends excluding private irrigation system work from this project. Instead, staff will notify property owners of pending construction as far in advance as possible, and instruct them to relocate their irrigation system(s) away from the construction area during construction, then allow replacement in or near the original location after construction is complete.

4. Staff recommends holding a neighborhood information meeting on November 1, 2017 to inform property owners of the proposed improvements and to gather their input prior to competing plans and specifications and requesting Council approval to advertise for bids as outlined in the project schedule.

5. Order an assessment appraisal consultation to ensure special assessments do not exceed the benefit received as a result of the improvements.

6. Meet with Ute Street property owners to discuss acquisition of easements for cul-de-sac.

The City Council is asked to act on the following items related to the proposed project:

1. Accept the preliminary residential special assessment rate of $6,733.36 per lot.
2. Authorize an assessment appraisal consultation to ensure all special assessments are commensurate with benefit received from the proposed improvements.
3. Adopt Resolution #17-10-271 approving this Feasibility Report and ordering the Public Hearing for November 14, 2017.

# APPENDIX A

**Figure 1 – Project Scope**
**Figure 2 – Typical Section**
**Project Site Pictures**

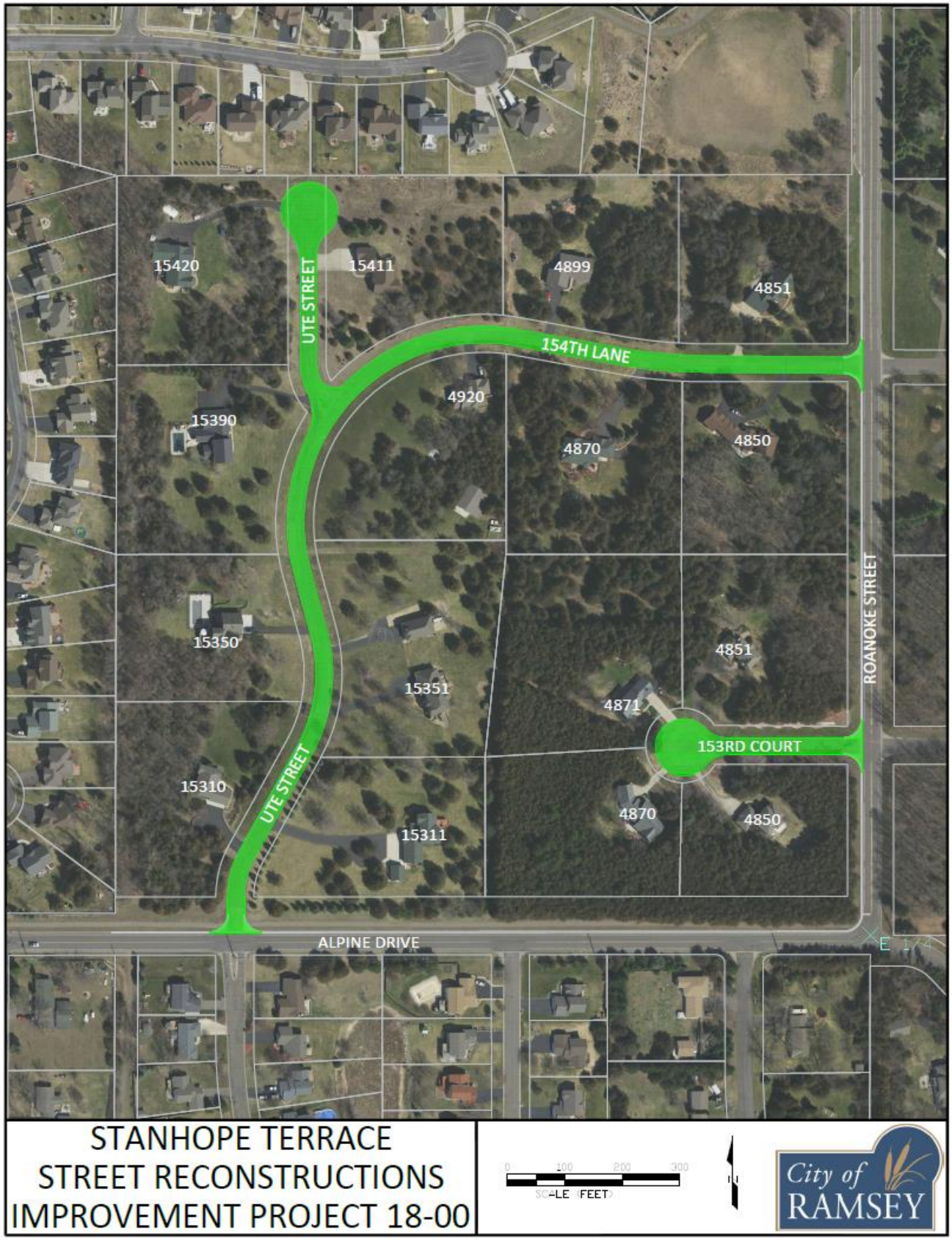



**FIGURE 1**
**PROJECT SCOPE**

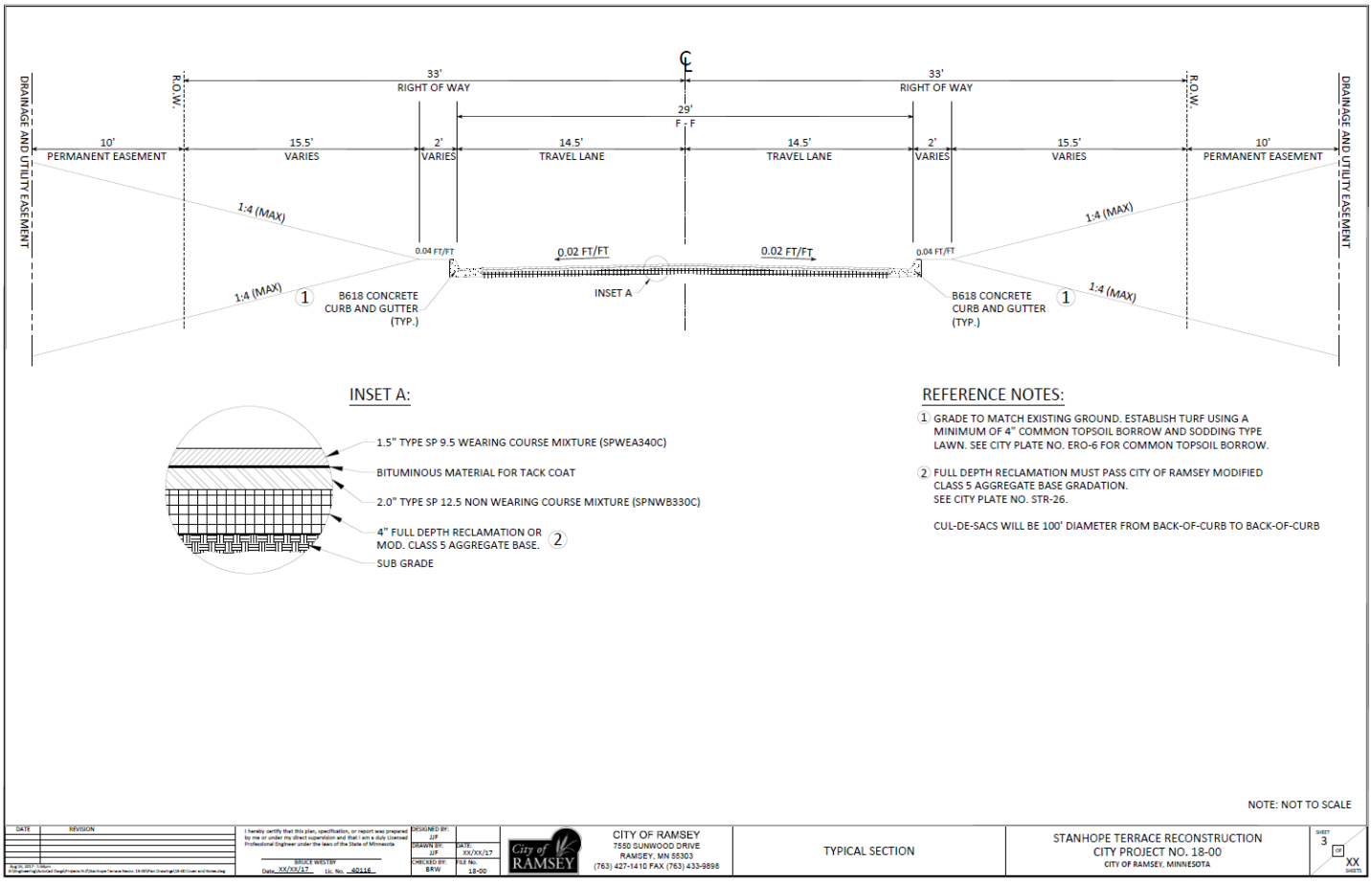



**FIGURE 2**
**TYPICAL SECTION – PROPOSED IMPROVEMENTS**

# PROJECT SITE PICTURES

1**: Ute Street from Alpine Drive**

2**: Ute Street Cul-de-Sac from the North**

3**: 154th Lane from Roanoke Street**


**4: 153rd Court from Roanoke Street**

# APPENDIX B

## Opinion of Probable Costs
## Preliminary Assessment Map
## Preliminary Assessment Roll

| 18-00 STANHOPE TERRACE RECONSTRUCTION | | | | | |
|---|---|---|---|---|---|
| **Preliminary Engineer's Estimate 10/19/2017** | | | | | |
| ***STREET CONSTRUCTION*** | | | | | |
| **Item No.** | **Description** | **Unit** | **Estimated Quantity** | **Unit Cost** | **Cost Extension** |
| 1 | Mobilization | LS | 1 | $12,000.00 | $12,000.00 |
| 2 | Remove Concrete Curb and Gutter | LF | 64 | $5.50 | $352.00 |
| 3 | Remove Concrete Driveway Pavement | SF | 600 | $3.00 | $1,800.00 |
| 4 | Remove Bituminous Driveway Pavement | SY | 160 | $8.00 | $1,280.00 |
| 5 | Remove Concrete Valley Gutter | EA | 3 | $500.00 | $1,500.00 |
| 6 | Sawing Concrete Pavement – Full Depth | LF | 190 | $6.00 | $1,140.00 |
| 7 | Sawing Bituminous Pavement – Full Depth | LF | 375 | $3.00 | $1,125.00 |
| 8 | Salvage Mail Box Support | EA | 16 | $50.00 | $800.00 |
| 9 | Temporary Mail Box Cluster | EA | 2 | $400.00 | $800.00 |
| 10 | Common Excavation (EV) | CY | 370 | $12.00 | $4,440.00 |
| 11 | Subgrade Preparation | RDST | 27 | $200.00 | $5,400.00 |
| 12 | Water | MGAL | 50 | $30.00 | $1,500.00 |
| 13 | Aggregate Base Class 5 Modified (CV) | CY | 1,433 | $20.00 | $28,660.00 |
| 14 | Bituminous Pavement Reclamation – Full Depth | SY | 10,089 | $2.00 | $20,178.00 |
| 15 | Haul Bit Pavement Reclamation (LV) | CY | 1,350 | $11.00 | $14,850.00 |
| 16 | Bituminous Material for Tack Coat | GAL | 617 | $3.00 | $1,851.00 |
| 17 | Type SP 9.5 Wearing Course Mixture (SPWEA340C) (1.5") | TON | 730 | $68.00 | $49,640.00 |
| 18 | Type SP 12.5 Non Wearing Course Mixture (SPNWB330C) (2.0") | TON | 970 | $60.00 | $58,200.00 |
| 19 | Type SP 9.5 Wearing Course Mixture (SPWEA340C) Driveways (2.0") | TON | 20 | $68.00 | $1,360.00 |
| 20 | Concrete Curb & Gutter Design B618 (HE) | LF | 5,518 | $13.00 | $71,734.00 |
| 21 | 6" Concrete Driveway Pavement (HE) | SY | 64 | $55.00 | $3,520.00 |
| 22 | 7" Concrete Valley Gutter (HE) | SY | 96 | $80.00 | $7,680.00 |
| 23 | Install Mail Box Support | EA | 16 | $50.00 | $800.00 |
| 24 | Traffic Control | LS | 1 | $3,000.00 | $3,000.00 |
| 25 | Storm Drain Inlet Protection | EA | 12 | $200.00 | $2,400.00 |
| 26 | Common Topsoil Borrow (LV) | CY | 450 | $30.00 | $13,500.00 |
| 27 | Sodding Type Lawn | SY | 3,332 | $5.00 | $16,660.00 |
| | | | | | |
| | | | | *Total Street Construction Cost* | *$328,670.00* |
| | | | | *5% Contingency Cost* | *$16,433.50* |
| | | | | *23% Indirect Cost* | *$79,373.81* |
| | | | | *Total Street Project Cost* | *$424,477.31* |
| | | | | | |
| ***STORM SEWER CONSTRUCTION*** | | | | | |
| **Item No.** | **Description** | **Unit** | **Estimated Quantity** | **Unit Cost** | **Cost Extension** |
| 1 | Reset Catch Basin Casting | EA | 5 | $1,000.00 | $5,000.00 |
| | | | | | |
| | | | | *Total Storm Sewer Construction Cost* | *$5,000.00* |
| | | | | *5% Contingency Cost* | *$250.00* |
| | | | | *23% Indirect Cost* | *$1,207.50* |
| | | | | *Total Storm Sewer Project Cost* | *$6,457.50* |
| | | | | | |
| | | | | **TOTAL ESTIMATED PROJECT COST** | **$430,934.81** |

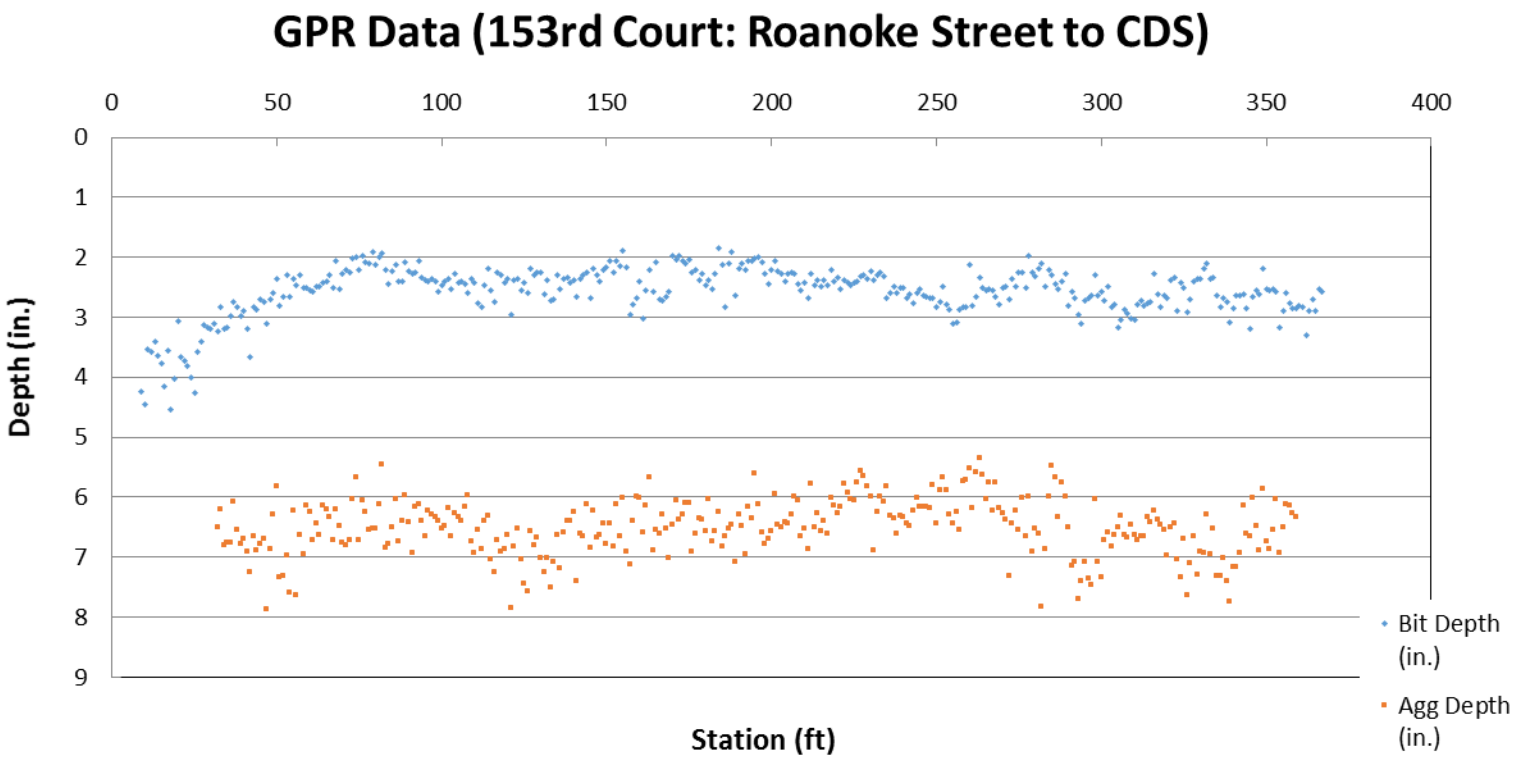

15420
UTE STREET
15411
4899
4851
154TH LANE
4920
15390
4870
4850
ROANOKE STREET
15350
4851
15351
4871
153RD COURT
15310
UTE STREET
4870
4850
15311
ALPINE DRIVE
STANHOPE TERRACE
ASSESSABLE PROPERTIES
City of
RAMSEY

| PROPOSED ASSESSMENT ROLL – 18-00 STANHOPE TERRACE | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PID** | **NAME / OWNER** | **ADDRESS 1** | **CITY** | **STATE** | **ZIP** | **ASSESSABLE UNITS** | **PROPOSED ASSESSMENT** |
| 243225140002 | JOSEPHS CORY | 15311 UTE ST NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140003 | VARELA AIDA | 15351 UTE ST NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140004 | LEMM RONALD H & CHERYL A | 4920 154TH LN NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140005 | FRITCH CHRISTOPHER A & PEGGY A | 4870 154TH LN NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140006 | STAHMANN JEFFREY | 4850 154TH AVE NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140007 | OATES RAY H & CAROL S | 4851 153RD CT NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140008 | JACOBSON BRADLEY J & PAMELA E | 4871 153RD CT NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140009 | RODMAN WILLIAM W & PAMELA M | 4870 153RD CT NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140010 | HIATT MICHAEL G & PATTI J | 4850 153RD CT NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140011 | SKIBA TRUSTEE JAYNE & SKIBA TRUSTEE THOMAS | 15310 UTE ST NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140012 | LEPAGE GREGORY A & MARY B | 15350 UTE ST NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140013 | NESS ERIC M & JULIE A | 15390 UTE ST NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140014 | NELSON DANIEL C & SARAH A | 15420 UTE ST NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140015 | QUAM DAVID | 15411 UTE ST NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140016 | GARBERG BRENT | 4899 154TH LN NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| 243225140017 | BOXY SCOTT A & LISA L | 4851 154TH LN NW | RAMSEY | MN | 55303-0000 | 1 | $6,733.36 |
| **TOTALS** | | | | | | **16** | **$107,733.70** |

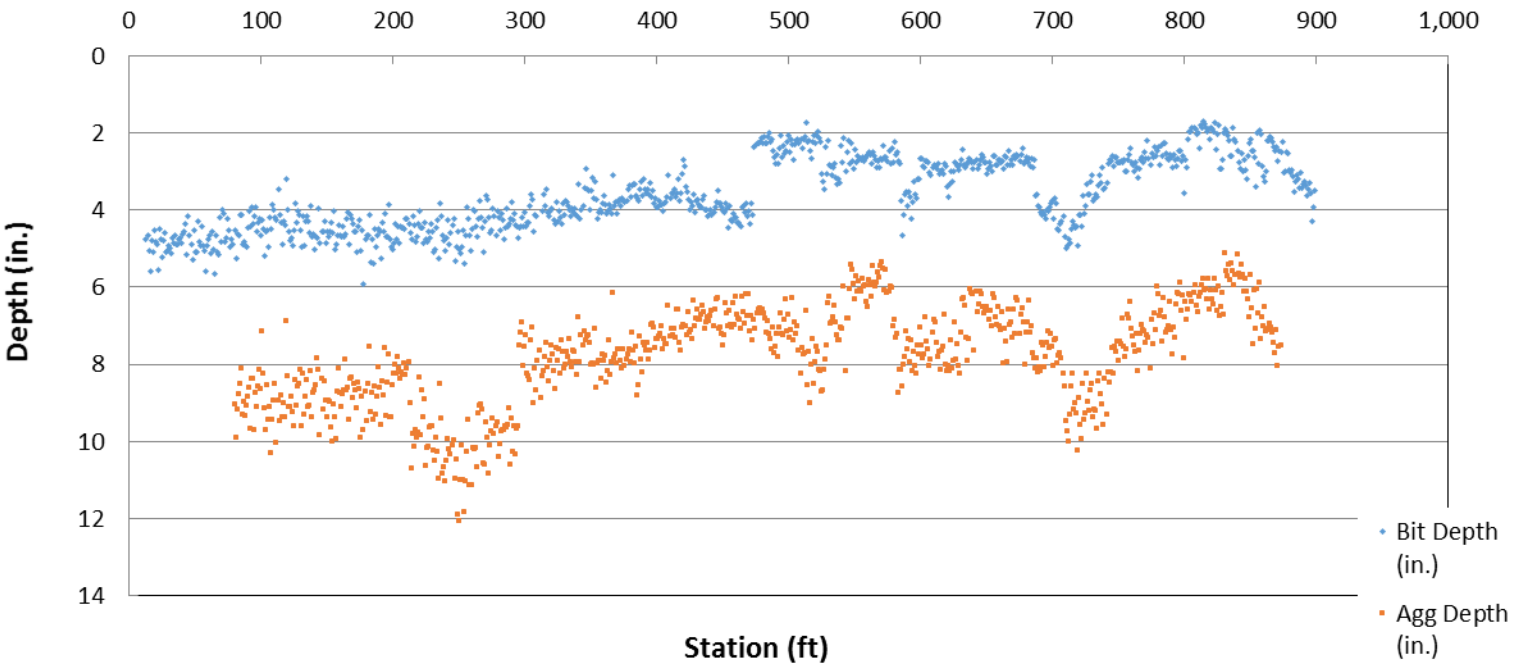
# APPENDIX C

## Ground Penetrating Radar (GPR) Results
## Geotechnical Exploration and Engineering Review

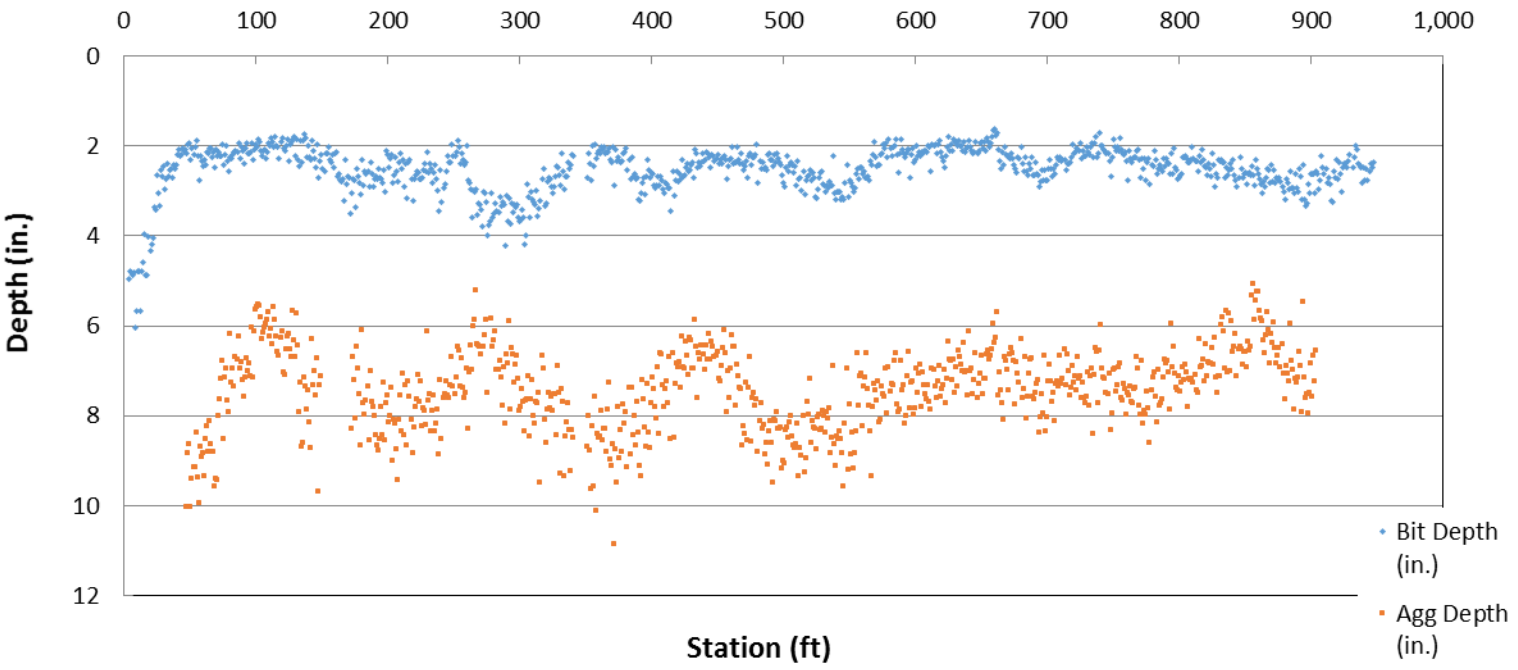
| Stanhope Terrace GPR Summary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Project Segment** | | **Pavement** | | | **Aggregate** | | | **Section** | | |
| **Street** | **Segment Description** | **Min** | **Max** | **Avg** | **Min** | **Max** | **Avg** | **Avg** | **Min** | **Location** |
| 153rd Court | Roanoke St / CDS | 1.9 | 4.5 | 2.6 | 2.9 | 5.7 | 4.0 | 6.5 | 5.4 | 263' West of Roanoke Street. |
| 154th Lane | Ute St / Roanoke St | 1.7 | 5.9 | 3.6 | 2.1 | 8.9 | 4.3 | 7.8 | 5.1 | 68' West of Roanoke Street. |
| Ute Street | Alpine Dr / 154th Ln | 1.6 | 6.1 | 2.5 | 2.2 | 8.0 | 5.0 | 7.4 | 5.1 | 91' South of 154th Lane. |
| Ute Street CDS | 154th Ln / CDS | 1.7 | 3.8 | 2.5 | 4.8 | 10.6 | 7.0 | 9.4 | 7.3 | 135' North of 154th Lane. |
| *Project Summary* | | *1.6* | *6.1* | *2.9* | *2.1* | *10.6* | *4.9* | *7.7* | *5.1* | *91' South of 154th Lane.* |

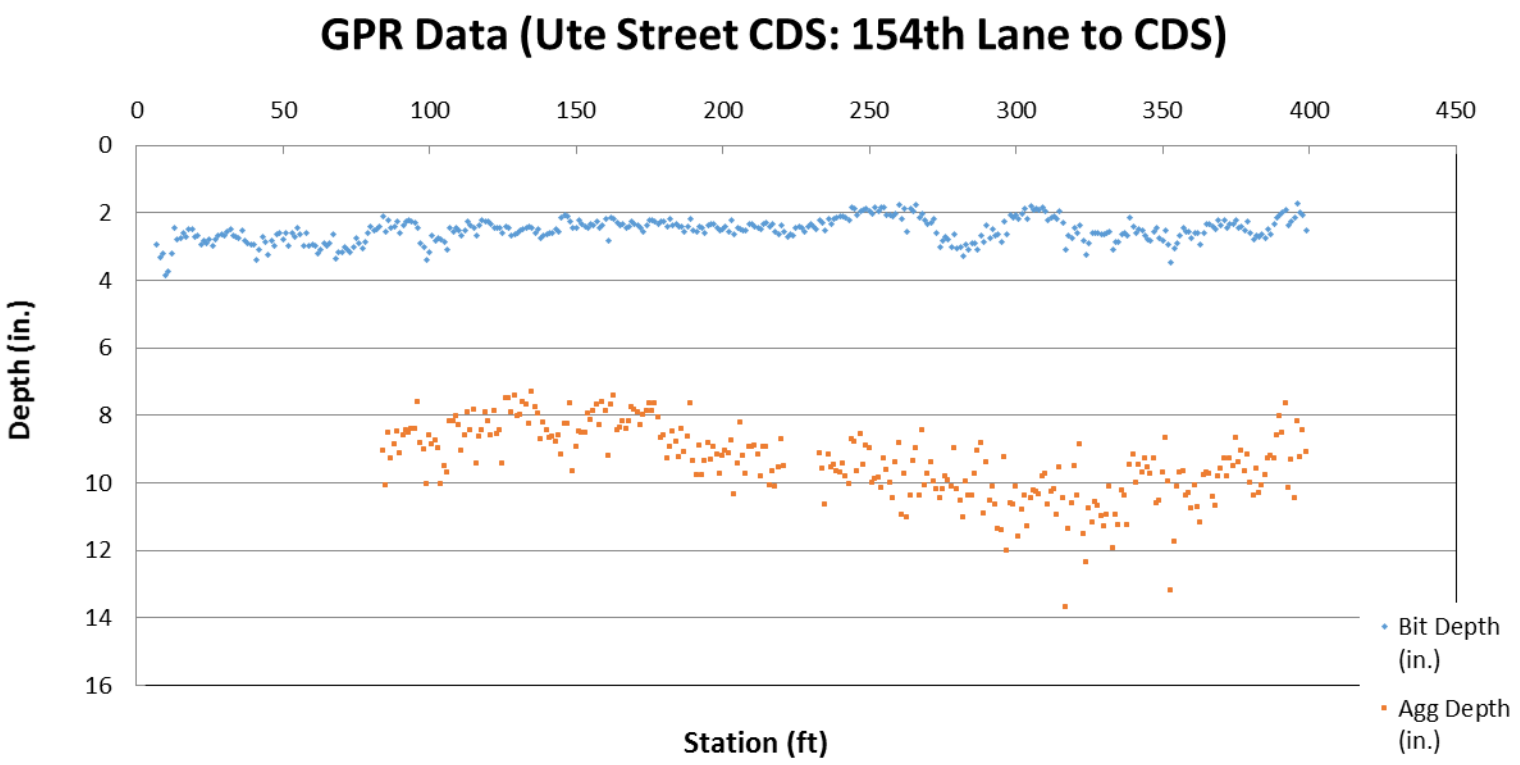


## GPR Data (154th Lane: Ute Street to Roanoke Street)




## GPR Data (Ute Street: Alpine Drive to 154th Lane)




GPR Data (Ute Street CDS: 154th Lane to CDS)
0
50
100
150
200
250
300
350
400
450
0
2
4
6
8
10
12
14
16
Depth (in.)
Station (ft)
Bit Depth (in.)
Agg Depth (in.)

# Geotechnical Evaluation Report

2018-2019 Reconstruction Projects
North Forty, Stanhope Terrace, Ford Brook Estates Subdivisions
Ramsey, Minnesota

*Prepared for*

# City of Ramsey



**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.

Neil G. Lund, PE
Senior Engineer
License Number: 46212
August 11, 2017

Project B1705491

Braun Intertec Corporation

**Braun Intertec Corporation**
11001 Hampshire Avenue S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

August 11, 2017 Project B1705491

Bruce Westby, PE
City of Ramsey
7550 Sunwood Dr NW
Ramsey, MN 55303

Re: Geotechnical Evaluation
2018-2019 Reconstruction Projects
North Forty, Stanhope Terrace, Ford Brook Estates Subdivisions
Ramsey, Minnesota

Dear Mr. Westby:

We are pleased to present this Geotechnical Evaluation Report for the 2018-2019 Reconstruction Projects in Ramsey, Minnesota. Our results and recommendations in light of the geotechnical issues influencing design and construction are presented in the attached report, which we request you read in its entirety.

## Remarks

Thank you for making Braun Intertec Corporation 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 call Neil Lund at 952.995.2284.

Sincerely,

BRAUN INTERTEC CORPORATION

Neil G. Lund, PE
Senior Engineer

Matthew S. Oman, PE
Principal Engineer

# Table of Contents

# Table of Contents (continued)

**Description** **Page**



**Appendix**

# A. Introduction

## A.1. Project Description

This Geotechnical Evaluation Report addresses the proposed 2018-2019 Reconstruction Projects in Ramsey, Minnesota. The projects will be in three subdivisions as summarized in Table 1.

**Table 1. Project Area Details**

| Subdivision | Approximate Street Length (feet) | Borings |
|---|---|---|
| The North Forty (Area A) | 2,939 | ST-A1 to ST-A5 |
| Stanhope Terrace (Area B) | 2,763 | ST-B1 to ST-B5 |
| Ford Brook Estates (Area C) | 7,369 | ST-C1 to ST-C15 |

The proposed projects will include pavement reconstruction and storm sewer improvements.

## A.2. Purpose

The purpose of this geotechnical evaluation was to characterize subsurface geologic conditions at selected exploration locations and provide geotechnical recommendations for the design and construction of the Ramsey 2018-2019 Reconstruction Projects.

## A.3. Background Information and Reference Documents

To facilitate our evaluation, we were provided with or reviewed the following information or documents:

- A base map of the project area provided by City of Ramsey
- *Geologic Atlas of Anoka County* available from the Minnesota Geological Survey.

## A.4. Project Area Conditions

Based on our referenced documents and past experience, the native soils underlying the project area include sandy alluvium.

The 2018-2019 Reconstruction Project areas are zoned as residential.

The current streets are surfaced with bituminous pavement with rural cross-sections. The topography of each project area is slightly rolling.

## A.5. Scope of Services

Our scope of services for this project was originally submitted as a quote to Mr. Bruce Westby of the City of Ramsey, for which we received authorization to proceed on June 8, 2017. Tasks performed in accordance with our authorized scope of services included:

- Staking and clearing exploration locations of underground utilities.
- Performing 25 penetration test borings and extending them to a nominal 10 feet below the current pavement surface.
- Performing laboratory moisture content tests and mechanical analyses (#200 sieve only) on selected penetration test samples.
- Preparing this report containing a CAD sketch, exploration logs, a summary of the geologic materials encountered, results of laboratory tests, and recommendations for subgrade preparation, pavement thickness design and utility placement.

Exploration locations and surface elevations at the exploration locations were determined using GPS technology that utilizes the Minnesota Department of Transportation's (MnDOT's) permanent GPS Virtual Reference Network (VRN).

Our scope of services was performed under the terms of our July 18, 2016 General Conditions.

# B. Results

## B.1. Exploration Logs

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

Log of Boring sheets for our penetration test borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated, and present the results of penetration resistance tests, 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 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. Geologic Profile

### B.2.a. Pavement Materials

The borings first encountered an average bituminous pavement thickness of 4.3 inches as shown in Table 2. The aggregate base averaged 7.5 inches.

**Table 2. Pavement Thickness Summary**

| Boring | Subdivision | Street | Pavement Thickness (in.) | | Notes |
|---|---|---|---|---|---|
| | | | Bituminous | Aggregate Base | |
| ST-A1 | The North Forty | 163rd Ln | 3 | 5 | |
| ST-A2 | | 163rd Ln | 3 | 5 | |
| ST-A3 | | Alpaca St | 3 | --- | Aggregate base not noted |
| ST-A4 | | Chameleon St | 3 | 8 | |
| ST-A5 | | Chameleon St | 3 | 4 | |
| **AREA A AVERAGE** | | | **3.0** | **5.5** | |
| ST-B1 | Stanhope Terrace | Ute St | 3 | 5 | |
| ST-B2 | | Ute St | 4 | 6 | |
| ST-B3 | | 154th Ln | 4 | 5 | |
| ST-B4 | | Ute St | 3 | 4 | |
| ST-B5 | | 153rd Ct | 3 | 4 | |
| **AREA B AVERAGE** | | | **3.4** | **4.8** | |
| ST-C1 | Ford Brook Estates | Junkite St | 4 | 5 | |
| ST-C2 | | 180th Ave | 5 | 5 | |
| ST-C3 | | 180th Ave | 3 | 5 | |
| ST-C4 | | 180th Ave | 3 | 4 | |
| ST-C5 | | 180th Ave | 4 | 4 | |
| ST-C6 | | 180th Ave | 6 | 4 | 3 inches of bituminous and 4 inches of aggregate base underlay the surface section |
| ST-C7 | | Iodine St | 3 | 5 | |
| ST-C8 | | Germanium St | 3 | 4 | |
| ST-C9 | | Flourine St | 3 | 5 | |
| ST-C10 | | Erkium St | 5 | --- | Aggregate base not noted |
| ST-C11 | | Erkium St | 3 | 6 | |
| ST-C12 | | 180th Ln | 3 | 6 | |
| ST-C13 | | Iodine St | 4 | 5 | |
| ST-C14 | | 180th Ln | 5 | 5 | |
| ST-C15 | | Krypton St | 4 | 5 | |
| **AREA C AVERAGE** | | | **3.9** | **4.9** | |

### B.2.b. Geologic Materials

Table 3 provides a summary of the soil boring results, in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheet in the Appendix includes definitions of abbreviations used in Table 3.

**Table 3. Subsurface Profile Summary***

| Strata | Soil Type - ASTM Classification | Range of Penetration Resistances | Commentary and Details |
|---|---|---|---|
| Pavement section | N/A | N/A | ▪ See Table 1. |
| Fill | SP-SM, SP, SC, CL | 3 to 24 blows per foot (BPF) | ▪ Overwhelmingly SP-SM or SP.<br>▪ General penetration resistance of about 10 BPF.<br>▪ Moisture condition moist to wet.<br>▪ Thicknesses at boring locations varied from 1 to 11 feet (boring ST-A% terminated in likely fill material).<br>▪ Limited clayey layers (ST-C5, ST-C14). |
| Alluvium | SP, SP-SM, CL, SC | 3 to 28 BPF | ▪ General penetration resistances of less than 10 BPF in sands (loose), or 3 to 7 BPF in clays (soft to medium).<br>▪ Sands typically brown to light brown, fine-grained and moist.<br>▪ Clays generally present near observed water; usually gray in color, with limited sandy soil content. Present in ST-C3, ST-C5, ST-C14, ST-C15.<br>▪ Moisture condition variable above the apparent water table, though generally moist.<br>▪ Water table penetrated in a limited number of borings (see Table 3). |
| Swamp deposits | SM, CH | 1 to 7 BPF | ▪ Present in two locations: ST-C6 and ST-C11.<br>▪ SM layer was black, 4 to 5 feet thick and included organic fines and trace wood pieces (ST-C06).<br>▪ Underlain by gray, fat clay to boring termination depth in ST-C11. |

*Abbreviations defined in the attached Descriptive Terminology sheet.

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

### B.2.c. Groundwater

Groundwater was observed during our drilling operations as shown in Table 4.

**Table 4. Groundwater Observation Summary**

| Boring | Surface Elevation (ft)* | Observed Groundwater Depth (ft) | Corresponding Groundwater Elevation (ft) |
|---|---|---|---|
| ST-C3 | 882 | 7 | 875 |
| ST-C4 | 883 | 9 | 874 |
| ST-C10 | 889 | 8 1/2 | 880 1/2 |

*Rounded to nearest 1/2 foot.

The groundwater elevation was approximately between 874 and 880 1/2 feet. Seasonal and annual fluctuations of groundwater should be anticipated.

## B.3. Laboratory Test Results

Laboratory test results, including moisture content, organic content and mechanical analysis (#200 sieve only) tests, are summarized in Table 5. The moisture contents of the sandy fill and native soils were around 3 to 15 percent, indicating the materials ranged from below to above their optimum moisture contents for compaction. The higher moisture contents of noted clayey soils, ranging from 15 to 37 percent, are likely near or above their optimum moisture contents for compaction.

**Table 5. Laboratory Testing Results**

| Borehole | Soil Classification | Depth | %<#200 Sieve | Water Content (%) | Organic Content (%) |
|---|---|---|---|---|---|
| ST-A2 | SP-SM | 2 1/2 | 9 | 8 | --- |
| ST-A4 | SP | 2 1/2 | --- | 3 | --- |
| ST-B4 | SP-SM | 2 1/2 | 6 | 4 | --- |
| ST-C1 | SP-SM | 5 | 6 | 4 | --- |
| ST-C3 | SP-SM | 5 | --- | 18 | --- |
| ST-C7 | SP | 7 1/2 | --- | 8 | --- |
| ST-C10 | SP-SM | 5 | 12 | 10 | --- |
| ST-C11 | SM | 5 | --- | 15 | 2 |
| ST-C13 | SP-SM | 2 1/2 | --- | 9 | --- |
| ST-C14 | CL | 2 1/2 | --- | 15 | 2 |
| ST-C14 | CL | 5 | 98 | 37 | -- |

# C. Basis for Recommendations

## C.1. Design Details

### C.1.a. Traffic Loads

Traffic counts for the streets were not available. Based on the residential zoning in the project areas, we anticipate they will experience approximately 50,000 equivalent single axle loads (ESALs) over a 20-year service life.

### C.1.b. Anticipated Grade Changes

Based on the nature of construction, we anticipate grade changes will be minimal.

### C.1.c. Utility Depths

Design utility depths were not available. We also assume storm sewer improvements will be less than 10 feet below grade.

### C.1.d. 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 and Construction Considerations

### C.2.a. Reuse of Pavement Materials

Our borings encountered a bituminous layer averaging 3 to 4 inches thick, depending on the project area. The aggregate base was 5 to 5 1/2 inches thick, on average, and was underlain with sandy fill material in nearly all of our soil borings.

In our opinion, full-depth reclamation (FDR) can be utilized in order to obtain materials for aggregate base on the projects, assuming the material can be stockpiled or processed on site, or hauled to an off-site location to be sorted and reused. A proper reclamation depth will likely vary be between 6 and 8 inches. It may be possible to increase this thickness locally depending on the conditions encountered and nature of the subbase materials.

We recommend thorough quality control practices, including frequent sieve analyses of the reclaimed material, if the product will be reused directly on site as aggregate base or as a stabilizing material with minimal processing.

### C.2.b. Pavement Subgrades

The pavement subgrades will consist almost exclusively of sandy materials, though areas of clayey sand or lean and fat clay were also present.

We anticipate the subgrade soils present beneath the streets will generally be suitable for pavement support in their current condition or with minor rework such as surface compaction. The exception is the swamp-deposited soils, which should be removed from excavations for pavements and in utility trenches. The shallow clayey sand or lean clay fill, present in ST-C5, ST-C14 and ST-C15, may be wet or become wet upon exposure. These soils in particular may require additional work, such as drying or moisture conditioning, before they can be properly compacted.

### C.2.c. Utility Support and Impact of Groundwater

The reuse of the utility trench backfill soils will have potential impacts on the pavement subgrades. If the backfill is not properly compacted, there is the potential for subgrade instability and settlement (and premature deterioration) of the driving surface. We anticipate the trench soils will consist mostly of granular soils (poorly graded sand and poorly graded sand with silt). In some cases, poor or unsuitable soils will be encountered that should be removed or will need additional effort to properly compact.

Depending on the conditions at the time of excavation, drying of the clayey and silty soils may be necessary to achieve the levels of compaction recommended for utility support. Clayey and particularly silt-rich trench soils that are exposed to moisture will be more susceptible to strength loss and may also become unstable, which will require moisture conditioning or removal and replacement with suitable soils. Fat clay and organic soils (ST-C6, ST-C11) should not be used as utility support or backfill material.

Groundwater was present in a limited number of borings (see Table 3), which may affect the placement of storm sewer. A coarse stabilizing aggregate could help with utility placement in wet or saturated conditions in these soils.

# D. Recommendations

## D.1. Pavements

### D.1.a. Subgrade Preparation and Proofrolls

For preparation of any exposed subgrades prior to placement of new pavement sections or reclaimed aggregate (see below), we recommend proofrolling the subgrade soils with a loaded tandem-axle truck. This will assist in identifying any soft or weak areas that will require additional soil correction work. Areas that yield or rut more than 1 to 2 inches due to wheel traffic, depending on conditions, should be corrected. Failed areas should be compacted, or if too wet, we recommend that the upper 1 to 2 feet of the resulting subgrade be scarified, dried to a proper moisture content (see Table 6), and compacted to a 100 percent of its standard Proctor maximum dry density (ASTM D 698).

If there are areas that still cannot be compacted, we recommend subexcavating the unstable materials to a minimum depth of 1 to 2 feet, depending on the outcome of the proofroll and the replacement material. The soils should be replaced with suitable, properly compacted materials such as select granular material, aggregate base or larger diameter crushed aggregate ("3-inch minus").

### D.1.b. Backfill and Material Compaction

We recommend compacting soils used as backfill for subcuts or material replacement to a minimum of 100 percent of standard Proctor density within 3 feet of the top of the subgrade. For fills more than 3 feet below final subgrades, 95 percent compaction is sufficient. The moisture content of the fill and backfill should be as shown in the table below depending on the classification of the backfill soils.

**Table 6. Compaction Recommendations Summary**

| Reference | Relative Compaction, percent (ASTM D 698 – Standard Proctor) | Moisture Content Variance from Optimum, percentage Points |
|---|---|---|
| Below pavements, within 3 feet of subgrade elevations | 100 | -3/+3 (sandy soils)<br>-2/+1 (clayey soils) |
| Below pavements, more than 3 feet below subgrade elevations<br><br>Below utilities | 95 | -3/+3 (sandy soils)<br>-2/+3 (clayey soils) |

### D.1.c. Design Sections

Laboratory tests to determine an R-value for pavement design were not included in the scope of this project. Given the most common soils in the top 5 feet of pavement sections, which include poorly graded sand with silt and poorly graded sand, we recommend using an R-value of 50 for pavement thickness design on all three projects.

Based upon the assumed traffic loads and an R-value of 50, we recommend a new pavement section for the 2018-2019 Street Reconstruction Projects meet the minimum thicknesses presented in Table 7.

**Table 7. Recommended Bituminous Pavement Thickness Design (Areas A, B and C)**

| Layer | Thickness (in.) | MnDOT Specification/Designation |
|---|---|---|
| Bituminous Wear | 1 1/2 (1 lift) | SPWEA240C |
| Bituminous Non-wear | 2 (1 lift) | SPNWB230C* |
| Aggregate Base (Class 5 or 6) or Reclaim | 6 | 3138<br>3135 |

*For small quantities, SPWEA240C can be used for the entire thickness.

The above pavement design is based upon a 20-year performance life. This is the amount of time before major reconstruction is anticipated. This performance life assumes maintenance such as seal coating and crack sealing is routinely performed. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

### D.1.d. Materials and Compaction

We recommend specifying pavement materials as recommended in Table 6.

We recommend compacting the aggregate base or reclaim materials to meet the requirements of MnDOT specification 2211.3.D.2.c. (Penetration Index Method). We recommend compacting bituminous pavements to at least 92 percent of the maximum theoretical Rice density per the Maximum Density Method (specification 2360.3.D.1), with bituminous materials and placement practices meeting the requirements of MnDOT Specification 2360.

## D.2. Utilities

### D.2.a. Subgrades and Trench Backfill

The native and fill soils encountered at likely utility elevations generally appear suitable for pipe and utility structure support and we anticipate that utilities can be installed per manufacturer bedding requirements. However, we encountered some wet, clayey or silty soils in some borings; these soils may have limited stability and not be suitable for backfill or support of utilities if wet. We recommend providing a contingency for further subcutting and soil replacement of utility backfill soils in such soils.

In addition, the swamp-deposited clays and silty sands (ST-C6, ST-C11) are not considered suitable backfill materials under any circumstances. These soils should be removed and replaced with suitable grading materials where encountered during excavation. At pipe elevations, we recommend a minimum subcut and replacement with crushed-faced rock that is free of material 1 inch in diameter or smaller.

A geotechnical engineer should observe all utility trench excavations and subcuts.

### D.2.b. Excavation Side Slopes

The project area soils appear to meet OSHA Type C requirements in most cases. We recommend constructing excavation side slopes to lie back at a horizontal to vertical slope of 1 1/2 to 1 or flatter. In significant depths of organic soils these side slopes may need to be made flatter, or supplemental support may be necessary.

All excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, “Excavations and Trenches.” This document states that excavation safety is the responsibility of the contractor. Reference to these OSHA requirements should be included in the project specifications.

Trenches deeper than 20 feet must be designed by a professional engineer.

### D.2.c. Selection, Placement and Compaction of Backfill

We recommend compacting backfill placed above and below utilities as shown in Table 6.

To achieve compaction over wet or waterbearing subgrades, we recommend the use of sands or gravel with MnDOT aggregate backfill material (Specification 3149.2E).

### D.2.d. Excavation Dewatering

We recommend removing groundwater from the utility excavations if encountered, and removing any water that seeps into excavations from sidewalls or the adjacent sitework. Sumps and pumps will generally be suitable for short-term, small-scale water removal under the soil conditions likely to be encountered for this project. Alternative approaches should be considered for long-term or large-scale groundwater removal, particularly in sands such as those encountered on the project, which can become unstable during dewatering with pumps from within excavations.

### D.2.e. Corrosion Potential

If founded in sandy soils, corrosion protection should not be required for ductile iron pipe. Type I cement may also be specified for concrete utilities.

Some clayey soils were present at likely utility depths, which are considered at least moderately corrosive to ductile iron pipe. We recommend corrosion protection or the use of corrosion-resistant pipe material if utilities will be bedded within such soils, particular if in close proximity to static groundwater. Soils with organic content should not be allowed as pipe support or as backfill around pipes.

## D.3. Construction Quality Control

### D.3.a. Excavation Observations

We recommend having a geotechnical engineer observe all excavations related to subgrade preparation, utility placement and pavement construction. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations and the adequacy of required excavation oversizing.

### D.3.b. Materials Testing

We recommend density tests be taken in excavation backfill and additional required fill placed below pavements and utilities. This includes DCP tests for aggregate base or reclaim and imported granular materials.

We recommend Gyratory tests on bituminous mixes to evaluate strength and air voids and density tests to evaluate compaction.

### D.3.c. Pavement Subgrade Proofroll

We recommend that proofrolling of the pavement subgrades be observed by a geotechnical engineer to determine if the results of the procedure meet project specifications and to delineate the extent of additional pavement subgrade preparation work that may be necessary.

#### D.3.d. 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 truck-mounted core and auger drill equipped with hollow-stem auger. The borings were performed in accordance with ASTM D 1586. Penetration test samples were taken at 2 1/2 foot intervals.

## 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.2.b. Laboratory Testing

The results of the laboratory tests performed on geologic material samples are noted on the appropriate attached exploration logs. The tests were performed in accordance with ASTM or AASHTO procedures.

## 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 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


**DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING**

60' 0 120'

SCALE: 1"= 120'


BRAUN INTERTEC
The Science You Build On.

11001 Hampshire Avenue S
Minneapolis, MN 55438
PH. (952) 995-2000
FAX (952) 995-2020


Base Dwg Provided By:

SOIL BORING LOCATION SKETCH - AREA A
GEOTECHNICAL EVALUATION
2018-2019 RECONSTRUCTION PROJECTS
NORTH FORTY, STANHOPE TERRACE AND FORD BROOK ESTATES SUBDIVISIONS
RAMSEY, MINNESOTA

| | |
|---|---|
| Project No: | B1705491 |
| Drawing No: | B1705491 |
| Scale: | 1"= 120' |
| Drawn By: | JAG |
| Date Drawn: | 6/28/17 |
| Checked By: | NGL |
| Last Modified: | 8/9/17 |
| Sheet: of | Fig: |

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**DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING**

75' 0 150'

SCALE: 1"= 150'

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BRAUN INTERTEC
The Science You Build On.
11001 Hampshire Avenue S
Minneapolis, MN 55438
PH. (952) 995-2000
FAX (952) 995-2020

Base Dwg Provided By:

# SOIL BORING LOCATION SKETCH - AREA B

GEOTECHNICAL EVALUATION
2018-2019 RECONSTRUCTION PROJECTS
NORTH FORTY, STANHOPE TERRACE AND FORD BROOK ESTATES SUBDIVISIONS
RAMSEY, MINNESOTA

| | |
|---|---|
| Project No: | B1705491 |
| Drawing No: | B1705491 |
| Scale: | 1"= 150' |
| Drawn By: | JAG |
| Date Drawn: | 6/28/17 |
| Checked By: | NGL |
| Last Modified: | 8/9/17 |
| Sheet: | Fig: |
| of | |


**DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING**

100' 0 200'

SCALE: 1"= 200'

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The Science You Build On.
11001 Hampshire Avenue S
Minneapolis, MN 55438
PH. (952) 995-2000
FAX (952) 995-2020

Base Dwg Provided By:

SOIL BORING LOCATION SKETCH - AREA C
GEOTECHNICAL EVALUATION
2018-2019 RECONSTRUCTION PROJECTS
NORTH FORTY, STANHOPE TERRACE AND FORD BROOK ESTATES SUBDIVISIONS
RAMSEY, MINNESOTA

Project No: B1705491

Drawing No: B1705491

| | |
|---|---|
| Scale: | 1"= 200' |
| Drawn By: | JAG |
| Date Drawn: | 6/28/17 |
| Checked By: | NGL |
| Last Modified: | 8/9/17 |

Sheet: of

Fig:

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-A1**

LOCATION: N: 184793, E: 447907 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 897.0 | 0.0 | | | | | |
| 896.3 | 0.7 | PAV | 3 inches of bituminous over 5 inches of aggregate base. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, trace Gravel, dark brown, moist. | 13 | | |
| 893.0 | 4.0 | SP | POORLY GRADED SAND, fine-grained, brown, moist, loose to medium dense. (Alluvium) | 6 | | No recovery. |
| | | | | 8 | | |
| 886.0 | 11.0 | | | 11 | | |
| | | | END OF BORING. Water not observed while drilling. Boring then backfilled. | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-A2**

LOCATION: N: 184814, E: 448514 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | P200 % | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 895.7 | 0.0 | | | | | | | |
| 895.0 | 0.7 | PAV | 3 inches of bituminous over 5 inches of aggregate base. | | | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, dark brown, moist. | | | | | |
| 892.7 | 3.0 | | | 11 | | 8 | 9 | |
| | | SP | POORLY GRADED SAND, fine-grained, brown, moist, loose to medium dense. (Alluvium) | 8 | | | | |
| | | | | 5 | | | | |
| 884.7 | 11.0 | | | 13 | | | | |
| | | | END OF BORING. Water not observed while drilling. Boring then backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-A3**

LOCATION: N: 185249, E: 448553 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 897.0 | 0.0 | | | | | |
| 896.7 | 0.3 | BIT | 3 inches of bituminous. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, trace Gravel, dark brown to brown, moist. | | | |
| 894.0 | 3.0 | | | 11 | | |
| | | SP | POORLY GRADED SAND, fine-grained, brown, moist, loose. (Alluvium) | 6 | | |
| | | | | 5 | | |
| 886.0 | 11.0 | | | 10 | | |
| | | | END OF BORING. | | | |
| | | | Water not observed while drilling. | | | |
| | | | Boring then backfilled. | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-A4**

LOCATION: N: 185237, E: 447847 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | Tests or Notes |
|---|---|---|---|---|---|---|---|
| 893.3 | 0.0 | | | | | | |
| 892.4 | 0.9 | PAV | 3 inches of bituminous over 8 inches of aggregate base. | | | | |
| 891.3 | 2.0 | FILL | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, dark brown, moist. | | | | |
| | | SP | POORLY GRADED SAND, fine-grained, trace Gravel, brown, moist, loose to medium dense. (Alluvium) | 13 | | 3 | |
| | | | | 6 | | | |
| | | | | 16 | | | |
| 882.3 | 11.0 | | | 12 | | | |
| | | | END OF BORING. | | | | |
| | | | Water not observed while drilling. | | | | |
| | | | Boring then backfilled. | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-A5**

LOCATION: N: 185545, E: 447646 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 890.0 | 0.0 | | | | | |
| 889.4 | 0.6 | PAV / FILL | 3 inches of bituminous over 4 inches of aggregate base.<br>FILL: Poorly Graded Sand with Silt, fine- to medium-grained, trace Gravel, dark brown and brown, moist to wet. | 9<br>15<br>3<br>5 | | |
| 879.0 | 11.0 | | END OF BORING.<br>Water not observed while drilling.<br>Boring then backfilled. | | | |

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-B1**

LOCATION: N: 178200, E: 467663 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 888.4 | 0.0 | | | | | |
| 887.7 | 0.7 | PAV / FILL | 3 inches of bituminous over 5 inches of aggregate base.<br>FILL: Poorly Graded Sand with Silt, fine-grained, dark brown to brown, moist. | 19 | | |
| 884.4 | 4.0 | SP | POORLY GRADED SAND, fine- to medium-grained, brown, wet, loose to medium dense. (Alluvium) | 5 | | |
| | | | | 6 | | |
| 877.4 | 11.0 | | | 16 | | |
| | | | END OF BORING.<br>Water not observed while drilling.<br>Boring then backfilled. | | | |

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-B2**

LOCATION: N: 178670, E: 467672 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 884.6 | 0.0 | | | | | |
| 883.8 | 0.8 | PAV | 4 inches of bituminous over 6 inches of aggregate base. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, dark brown, moist. | | | |
| 882.6 | 2.0 | SP | POORLY GRADED SAND, fine- to medium-grained, trace Gravel, brown, moist, loose. (Alluvium) | 9 | | |
| | | | | 6 | | |
| | | | | 10 | | |
| | | | | 8 | | |
| 873.6 | 11.0 | | END OF BORING. | | | |
| | | | Water not observed while drilling. | | | |
| | | | Boring then backfilled. | | | |

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-B3**

LOCATION: N: 178780, E: 468035 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 878.3 | 0.0 | | | | | |
| 877.5 | 0.8 | PAV | 4 inches of bituminous over 5 inches of aggregate base. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, dark brown to brown, moist. | 9 | | |
| 872.3 | 6.0 | | | 14 | | |
| | | SP | POORLY GRADED SAND, fine-grained, brown, moist, loose. (Alluvium) | 9 | | |
| 867.3 | 11.0 | | | 7 | | |
| | | | END OF BORING. Water not observed while drilling. Boring then backfilled. | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-B4**

LOCATION: N: 179030, E: 467625 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | P200 % | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 891.2 | 0.0 | | | | | | | |
| 890.6 | 0.6 | PAV | 3 inches of bituminous over 4 inches of aggregate base. | | | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, dark brown and brown, moist. | 12 | | 4 | 6 | |
| 886.2 | 5.0 | SP | POORLY GRADED SAND, fine-grained, brown, moist, loose. (Alluvium) | 10 | | | | |
| | | | | 6 | | | | |
| 880.2 | 11.0 | | | 15 | | | | |
| | | | END OF BORING. Water not observed while drilling. Boring then backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-B5**

LOCATION: N: 175086, E: 468267 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 891.2 | 0.0 | | | | | |
| 890.6 | 0.6 | PAV | 3 inches of bituminous over 4 inches of aggregate base. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, dark brown, moist. | | | |
| 888.2 | 3.0 | | | 7 | | |
| | | SP | POORLY GRADED SAND, fine-grained, trace Gravel, brown and light brown, moist, very loose to loose. (Alluvium) | 9 | | |
| | | | | 4 | | |
| 880.2 | 11.0 | | | 12 | | |
| | | | END OF BORING. | | | |
| | | | Water not observed while drilling. | | | |
| | | | Boring then backfilled. | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C1**

LOCATION: N: 195376, E: 462823 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | P200 % | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 897.2 | 0.0 | | | | | | | |
| 896.4 | 0.8 | PAV | 4 inches of bituminous over 5 inches of aggregate base. | | | | | |
| 895.2 | 2.0 | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, with Gravel, dark brown, moist. | | | | | |
| | | FILL | FILL: Poorly Graded Sand with SILT, fine- to coarse-grained, with Gravel, brown, moist. | 14 | | | | |
| | | | | 10 | | 4 | 6 | |
| 890.2 | 7.0 | SP | POORLY GRADED SAND, fine- to medium-grained, trace Gravel, light brown, moist, medium dense. (Alluvium) | 12 | | | | |
| 886.2 | 11.0 | | | 28 | | | | |
| | | | END OF BORING. | | | | | |
| | | | Water not observed while drilling. | | | | | |
| | | | Boring then backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C2**

LOCATION: N: 195624, E: 463131 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 894.5 | 0.0 | | | | | |
| 893.7 | 0.8 | PAV | 5 inches of bituminous over 5 inches of aggregate base. | | | |
| 892.5 | 2.0 | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, trace Gravel, dark brown, moist. | | | |
| 890.5 | 4.0 | FILL | FILL: Poorly Graded Sand, fine-grained, brown, moist. | 28 | | |
| | | SP | POORLY GRADED SAND, fine-grained, brown, moist, loose to medium dense. (Alluvium) | 10 | | |
| | | | | 19 | | |
| 883.5 | 11.0 | | | 19 | | |
| | | | END OF BORING. Water not observed while drilling. Boring then backfilled. | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C3**

LOCATION: N: 195609, E: 463651 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | Tests or Notes |
|---|---|---|---|---|---|---|---|
| 881.8 | 0.0 | | | | | | |
| 881.1 | 0.7 | PAV | 3 inches of bituminous over 5 inches of aggregate base. | | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, brown to dark brown, wet. | 16 | | | |
| | | | | 4 | | 18 | |
| 874.8 | 7.0 | | | | ▽ | | |
| | | CL | LEAN CLAY, gray, moist, rather soft. (Alluvium) | 4 | | | An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling. Groundwater levels fluctuate. |
| 872.3 | 9.5 | | | | | | |
| | | SP | POORLY GRADED SAND, fine- to coarse-grained, gray, waterbearing, very loose. (Alluvium) | 3 | | | |
| 870.8 | 11.0 | | END OF BORING. | | | | |
| | | | Water observed at 7 feet with 9 1/2 feet of hollow-stem auger in the ground. | | | | |
| | | | Boring then backfilled. | | | | |

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C4**

LOCATION: N: 195602, E: 464086 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 883.0 | 0.0 | | | | | |
| 882.4 | 0.6 | PAV / FILL | 3 inches of bituminous over 4 inches of aggregate base.<br>FILL: Poorly Graded Sand with Silt, fine-grained, dark brown, moist to wet. | 11 | | |
| 879.0 | 4.0 | SP-SM | POORLY GRADED SAND with SILT, fine-grained, brown, wet, loose to medium dense. (Alluvium) | 11 | | |
| | | | | 12 | ▽ | |
| | | | Waterbearing at 9 feet. | | | |
| 872.0 | 11.0 | | Intermixed with gray, Lean Clay at sampler tip. | 6 | | |
| | | | END OF BORING.<br>Water observed at 9 feet with 9 1/2 feet of hollow-stem auger in the ground.<br>Boring then backfilled. | | | |

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C5**

LOCATION: N: 195599, E: 464519 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 890.3 | 0.0 | | | | | |
| 889.6 | 0.7 | PAV | 4 inches of bituminous over 4 inches of aggregate base. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, dark brown, moist. | | | |
| 888.3 | 2.0 | FILL | FILL: Clayey Sand, brown, moist. | 8 | | |
| 887.3 | 3.0 | FILL | FILL: Poorly Graded Sand, fine-grained, brown, moist. | | | |
| 885.3 | 5.0 | CL | LEAN CLAY, with Sand, brown, moist, rather soft. (Alluvium) | 5 | | |
| 883.3 | 7.0 | SC | CLAYEY SAND, trace Gravel, brown to gray, moist, rather stiff to stiff. (Alluvium) | 13 | | |
| 879.3 | 11.0 | | | 12 | | |
| | | | END OF BORING. | | | |
| | | | Water not observed while drilling. | | | |
| | | | Boring then backfilled. | | | |

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C6**

LOCATION: N: 195594, E: 464693 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 885.7 | 0.0 | | | | | |
| 884.3 | 1.4 | PAV | 6 inches of bituminous over 4 inches of aggregate base over 3 inches of bituminous over 4 inches of aggregate base. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, trace Gravel, dark brown to brown, moist. | 13 | | |
| 880.7 | 5.0 | SM | SILTY SAND, fine-grained, organic, trace wood pieces, black, wet, very loose. (Swamp Deposit) | 1 | | |
| | | | | 7 | | |
| 876.7 | 9.0 | SM | SILTY SAND, fine- to medium-grained, dark gray, wet, loose. (Alluvium) | 6 | | |
| 874.7 | 11.0 | | END OF BORING. | | | |
| | | | Water not observed while drilling. | | | |
| | | | Boring then backfilled. | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C7**

LOCATION: N: 195304, E: 463197 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | Tests or Notes |
|---|---|---|---|---|---|---|---|
| 899.4 | 0.0 | | | | | | |
| 898.7 | 0.7 | PAV | 3 inches of bituminous over 5 inches of aggregate base. | | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, with Gravel, dark brown, moist. | | | | |
| 897.4 | 2.0 | SP | POORLY GRADED SAND, fine- to medium-grained, brown, moist, very loose to medium dense. (Alluvium) | 13 | | | |
| | | | | 9 | | | |
| | | | | 3 | | 8 | |
| 888.4 | 11.0 | | Fine- to coarse-grained, with Gravel, wet at 10 feet. | 2 | | | |
| | | | END OF BORING. | | | | |
| | | | Water not observed while drilling. | | | | |
| | | | Boring then backfilled. | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C8**

LOCATION: N: 195252, E: 463659 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 887.7 | 0.0 | | | | | |
| 887.1 | 0.6 | PAV / FILL | 3 inches of bituminous over 4 inches of aggregate base. | | | |
| | | | FILL: Poorly Graded Sand, fine-grained, dark brown to brown, moist. | 24 | | |
| | | | | 10 | | |
| 880.7 | 7.0 | SP | POORLY GRADED SAND, fine-grained, brown, moist to wet, very loose to loose. (Alluvium) | 10 | | |
| | | | | 2 | | |
| 876.7 | 11.0 | | END OF BORING. | | | |
| | | | Water not observed while drilling. | | | |
| | | | Boring then backfilled. | | | |

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C9**

LOCATION: N: 195286, E: 464075 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 886.4 | 0.0 | | | | | |
| 885.7 | 0.7 | PAV | 3 inches of bituminous over 5 inches of aggregate base. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, dark brown, moist. | 15 | | |
| 882.4 | 4.0 | SP | POORLY GRADED SAND, fine-grained, brown, wet, loose. (Alluvium) | 7 | | |
| | | | | 7 | | |
| 875.4 | 11.0 | | | 8 | | |
| | | | END OF BORING. Water not observed while drilling. Boring then backfilled. | | | |

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C10**

LOCATION: N: 195282, E: 464524 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/6/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | P200 % | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 888.8 | 0.0 | | | | | | | |
| 888.4 | 0.4 | BIT | 5 inches of bituminous. | | | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, dark brown and brown, moist. | 8 | | | | |
| 884.8 | 4.0 | SP-SM | POORLY GRADED SAND with SILT, fine-grained, brown, wet, very loose to loose. (Alluvium) | 4 | | 10 | 12 | |
| | | | | 7 | ▽ | | | |
| 877.8 | 11.0 | | Waterbearing at 10 feet. | 10 | | | | |
| | | | END OF BORING. | | | | | |
| | | | Water observed at 8 1/2 feet with 9 1/2 feet of hollow-stem auger in the ground. | | | | | |
| | | | Boring then backfilled. | | | | | |

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C11**

LOCATION: N: 195903, E: 464272 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | Tests or Notes |
|---|---|---|---|---|---|---|---|
| 881.7 | 0.0 | | | | | | |
| 880.9 | 0.8 | PAV | 3 inches of bituminous over 6 inches of aggregate base. | | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, dark brown, moist to wet. | | | | |
| 878.7 | 3.0 | | | 12 | | | |
| | | SM | SILTY SAND, fine-grained, slightly organic, black, wet, loose. (Swamp Deposit) | 7 | | 15 | OC=2% |
| 873.7 | 8.0 | | | 3 | | | |
| | | CH | FAT CLAY, trace fibers and roots, gray, wet, soft. (Swamp Deposit) | | | | |
| 870.7 | 11.0 | | | 3 | | | |
| | | | END OF BORING. | | | | |
| | | | Water not observed while drilling. | | | | |
| | | | Boring then backfilled. | | | | |

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C12**

LOCATION: N: 195998, E: 464525 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 893.2 | 0.0 | | | | | |
| 892.4 | 0.8 | PAV | 3 inches of bituminous over 6 inches of aggregate base. | | | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine-grained, brown, moist. | 15 | | |
| 889.2 | 4.0 | SP | POORLY GRADED SAND, fine-grained, brown, moist to wet, medium dense. (Alluvium) | 11 | | |
| | | | | 18 | | |
| 882.2 | 11.0 | | Reddish brown Silty Sand lenses at 10 feet. | 22 | | |
| | | | END OF BORING. | | | |
| | | | Water not observed while drilling. | | | |
| | | | Boring then backfilled. | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C13**

LOCATION: N: 195813, E: 463033 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | Tests or Notes |
|---|---|---|---|---|---|---|---|
| 889.6 | 0.0 | | | | | | |
| 888.8 | 0.8 | PAV | 4 inches of bituminous over 5 inches of aggregate base. | | | | |
| | | FILL | | | | | |
| 887.6 | 2.0 | | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, with Gravel, dark brown, moist. | | | | |
| | | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, trace Gravel, brown, moist, loose to medium dense. (Alluvium) | 13 | | 9 | |
| | | | | 15 | | | |
| | | | | 9 | | | |
| 878.6 | 11.0 | | | 5 | | | |
| | | | END OF BORING. | | | | |
| | | | Water not observed while drilling. | | | | |
| | | | Boring then backfilled. | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\05491.GPJ BRAUN_V8_CURRENT.GDT 8/11/17 16:36

BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C14**

LOCATION: N: 495994, E: 462578 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | P200 % | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 884.7 | 0.0 | | | | | | | |
| 883.9 | 0.8 | PAV | 5 inches of bituminous over 5 inches of aggregate base. | | | | | |
| | | FILL | FILL: Lean Clay with Sand, slightly organic, dark brown, moist. Poorly Graded Sand with Silt layer at 2 feet. | 6 | | 15 | | OC=2% |
| 880.7 | 4.0 | CL | LEAN CLAY, gray, moist, soft to medium. (Alluvium) | 3 | | 37 | 98 | |
| | | | | 7 | | | | |
| 875.7 | 9.0 | SP | POORLY GRADED SAND, fine-grained, brown, moist, loose. (Alluvium) | 8 | | | | |
| 873.7 | 11.0 | | END OF BORING. Water not observed while drilling. Boring then backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1705491**
**GEOTECHNICAL EVALUATION**
**City of Ramsey 2018-2019 Reconstruction Projects**
**Ramsey, Minnesota**

BORING: **ST-C15**

LOCATION: N: 195692, E: 462332 See attached sketch.

DRILLER: SC | METHOD: 3 1/4" HSA, Autohammer | DATE: **7/5/17** | SCALE: **1" = 4'**

| Elev. feet | Depth feet | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | Tests or Notes |
|---|---|---|---|---|---|---|
| 887.1 | 0.0 | | | | | |
| 886.3 | 0.8 | PAV | 4 inches of bituminous over 5 inches of aggregate base. | | | |
| | | FILL | FILL: Silty Sand, fine- to medium-grained, with Gravel, dark brown, moist. | | | |
| 885.1 | 2.0 | CL | LEAN CLAY, gray, moist, medium. (Alluvium) | 7 | | |
| 883.1 | 4.0 | SP | POORLY GRADED SAND, fine-grained, brown, moist, loose to medium dense. (Alluvium) | 11 | | |
| | | | | 8 | | |
| 876.1 | 11.0 | | | 7 | | |
| | | | END OF BORING. | | | |
| | | | Water not observed while drilling. | | | |
| | | | Boring then backfilled. | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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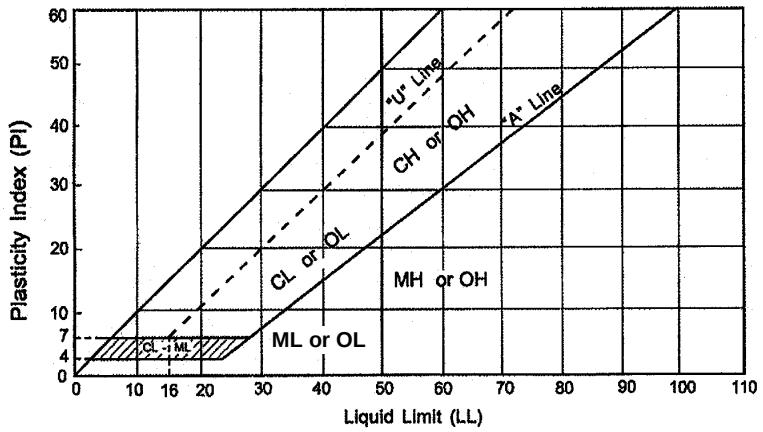
BRAUN INTERTEC

# Descriptive Terminology of Soil

Standard D 2487
Classification of Soils for Engineering Purposes
(Unified Soil Classification System)

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

a. Based on the material passing the 3-inch (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60}/D_{10}$ $C_c = \frac{(D30)^2}{D_{10} \times D_{60}}$
d. If soil contains ≥15% sand, add "with sand" to group name.
e. 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
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines: to group name.
h. If soil contains ≥15% gravel, add "with gravel" to group name.
i. 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
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI < 4 or plots below "A" line.
p. PI plots on or above "A" lines.
q. PI plots below "A" line.




## Laboratory Tests

| | | | |
|---|---|---|---|
| **DD** | Dry density, pcf | **OC** | Organic content, % |
| **WD** | Wet density, pcg | **S** | Percent of saturation, % |
| **MC** | Natural moisture content, % | **SG** | Specific gravity |
| **LL** | Liquid limit, % | **C** | Cohesion, psf |
| **PL** | Plastic limits, % | **Ø** | Angle of internal friction |
| **PI** | Plasticity index, % | **qu** | Unconfined compressive strength, psf |
| **P200** | % passing 200 sieve | **qp** | 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 ≥ 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 PPF
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.