HAUGO GEOTECHNICAL SERVICES

September 27, 2021 Project Number: 21-0833

Ms. Marsha Weidner
City of Ramsey
City of Ramsey Municipal Center
7550 Sunwood Drive NW
Ramsey, MN 55303

RE: Geotechnical Exploration Report, IP 22-02 Autumn Heights Street Reconstructions Ramsey, Minnesota

Dear Ms. Weidner:

We have completed the geotechnical exploration report for the IP 22-02 Autumn Heights Street Reconstruction project in Ramsey, Minnesota.

Very briefly; 31 soil borings were advanced along the various roadway alignments to determine existing bituminous pavement section thicknesses and to characterize subsurface soil and groundwater conditions.

Specific details regarding our procedures, results and recommendations follow in the attached geotechnical exploration report.

Thank you for the opportunity to assist you on this project. If you have any questions or need additional information, please contact Lucas Mol or Paul Gionfriddo at 612-729-2959.

Sincerely,

Haugo GeoTechnical Services, LLC

Lucas Mol
Project Manager

Paul S. Gionfriddo, P.E.
Senior Engineer

GEOTECHNICAL EXPLORATION REPORT

PROJECT:

IP 22-02 Autumn Heights Street Reconstruction
Ramsey, Minnesota.

PREPARED FOR:

City of Ramsey
City of Ramsey Municipal Center
7550 Sunwood Drive NW
Ramsey, MN 55303

PREPARED BY:

Haugo GeoTechnical Services LLC
2825 Cedar Avenue S
Minneapolis, MN 55407

Haugo GeoTechnical Services Project: 21-0833

September 27, 2021

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

Paul Gionfriddo, P.E.
Senior Engineer
License Number: 23093

Table of Contents

1.0 INTRODUCTION

1.1 Project Description

The City of Ramsey (City) is preparing to complete roadway improvement projects within 3 general areas of the City during the 2022 construction season. These areas included; the Sunwood Drive and Waco Street Area, the Autumn Heights Area and the Wood Pond Hills 2nd - 5th Area. To aid in preparing design and construction documents the City solicited bids to perform a geotechnical exploration within each of the 3 areas.

Haugo GeoTechnical Services (HGTS), was the successful bidder for the 3 projects. This report presents the results of the 31 soil borings advanced along the various roadway alignments within the Autumn Heights area.

1.2 Purpose

The purpose of this geotechnical exploration was to determine existing bituminous pavement section thicknesses, characterize subsurface soil and groundwater conditions and provide recommendations for roadway design and construction.

1.3 Site Description

The streets with the Autumn Heights area are located on both sides of Armstrong Boulevard NW and are generally located between Tiger Street NW and Jackal Street NW. The streets slated for improvements included; 167th Lane NW, 168th Lane, Nutria Street, 168th Avenue NW, Rabbit Street and 169th Avenue NW. Each street is a 2-lane bituminous surfaced, rural residential roadway that provides access to single family homes.

Each of the streets slated for improvement was noted to contain numerous cracks, both longitudinal and transverse cracks as well as some "alligator" cracking. We also observed several patched areas.

1.4 Scope of Services

Our scope of services was performed in accordance with the City of Ramey REQUEST FOR PROPOSAL, PAVEMENT MANAGEMENT PROGRAM, 2022 PROJECTS issued on July 20, 2021. Our scope of service for the Autumn Heights project included the following tasks:

- Performing 31 standard penetration test borings each to a nominal depth of 10 feet.
- Coring the pavement at 31 locations to measure the thickness of the existing bituminous and aggregate base.
- Visually/manually classifying samples recovered from the soil borings.
- Performing laboratory tests on selected samples.
- Preparing soil boring logs describing the materials encountered and the results of groundwater level measurements.

- Preparing an engineering report describing soil and groundwater conditions and providing recommendations for roadway construction/reconstruction.

1.5 Documents Provided

We were provided with a 10-page Request for Proposal (RFP) prepared by the City of Ramsey. Very briefly, the RFP included but was not limited to; a description of the project, a scope of services, soil boring requirements, contractual requirements, schedule and a bid form. The RPF also included soil boring location sketches. The plan sheets showed the proposed streets slated for improvement and provided stationing at the proposed boring locations.

We were also provided 1-page document titled "IP 22-02 Autumn Heights Street Reconstructions Street Segment Summary". In general, the document provided a summary of street maintenance activities within the Autumn Heights area.

1.6 Locations and Elevations

The boring and core locations were selected by the City of Ramsey and marked in the field in advance our field work. The approximate boring and associated core locations are shown on the Figure in the appendix. This Figure was prepared and provided by the City of Ramsey.

HGTS obtained the GPS coordinates and ground surface elevations at the soil boring locations using GPS technology based on the Minnesota County Coordinate System. GPS coordinates and the ground surface elevations are shown on Figure 2 in the Appendix.

2.0 FIELD PROCEDURES

The 31 standard penetration test borings were advanced on August 31st thru September 2nd, 2021 by HGTS with a rotary drilling rig, using continuous flight augers to advance the boreholes. Representative samples were obtained from the borings, using the split-barrel sampling procedures in general accordance with ASTM Specification D-1586. In the split-barrel sampling procedure, a 2-inch O.D. split-barrel spoon is driven into the ground with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampling spoon the last 12 inches of an 18-inch penetration is recorded as the standard penetration resistance value, or "N" value. The results of the standard penetration tests are indicated on the boring logs. The samples were sealed in containers and provided to HGTS for testing and soil classification.

A field log for each boring was prepared by the HGTS drill crew. The logs contained visual classifications of the soil materials encountered during drilling, as well as the driller's interpretation of the subsurface conditions between samples and water observation notes. The final boring logs included with this report represent an interpretation of the field logs and include modifications based on visual/manual method observation of the samples.

The soil boring logs, general terminology for soil description and identification, and classification of soils for engineering purposes are also included in the appendix. The soil boring logs identify and describe the materials encountered, the relative density or consistency based on the Standard Penetration resistance (N-value, "blows per foot") and groundwater observations.

The strata changes were inferred from the changes in the samples and auger cuttings. The depths shown as changes between strata are only approximate. The changes are likely transitions, variations can occur beyond the location of the borings.

The bituminous cores were obtained on September 22, 2021 with a 4-inch diameter diamind core barrel using wet coring techniques.

3.0 RESULTS

3.1 Soil Conditions

The subsurface soils encountered at this site generally consist of three main stratigraphic units: (1) pavements (2) fill and buried topsoil (3) native alluvial deposits.

Each of the 31 soil borings and cores were taken within an existing bituminous surfaced roadway. The pavement sections consisted of varying thicknesses of bituminous and possible aggregate base. The observed pavement section thicknesses are summarized in Table 1 below.

Table 1. Summary of Existing Roadway Section

Boring Number	Station	Approximate Bituminous Thickness (inches)†	Approximate Aggregate Base Thickness (inches)†	Subgrade Soil Type
167th Lane NW				
SB-01	4+00	5	5	SM
SB-02	7+50	3 ½	3	SP-SM
SB-03	10+00	3	3	SP
SB-04	12+50	3 ¼	3	SP
SB-05	15+40	4	3 ½	SP
SB-06	19+00	4 ½	3	SP-SM
SB-07	21+50	4	4	SP
SB-08	24+00	3 ½	4	SP
SB-09	25+50	3	4	SP
SB-10	28+00	4	4	SP
SB-11	30+50	3	3 ½	SP-SM
SB-12	33+00	3 ¼	3 ½	SP-SM
SB-13	35+50	7	6 ½	SP
SB-14	38+00	3	3	SP-SM
SB-15	39+67	4 ½	3	SP-SM
168th Lane NW				
SB-16	6+50	4	3	SP-SM
SB-17	9+00	4 ½	2 ½	SP
SB-18	11+50	2	3	SP-SM
SB-19	14+00	3 ¼	3 ½	SP
SB-20	16+50	4 ¼	3	SP

Nutria Street				
SB-21	0+45	4	2	SP
SB-22	3+00	3	3	SP
SB-23	5+70	4	4	SP
168th Avenue				
SB-24	0+50	6	4	SP
SB-25	3+75	3 ½	3 ½	SP
SB-26	6+00	3 ½	3 ½	SP
SB-27	8+50	4 ½	3 ½	SP
SB-28	11+30	4 ½	3 ½	SP
Rabbit Street				
SB-29	3+25	3	3	SP
169th Avenue				
SB-30	3 + 50	3 ½	3	SP
SB-31	0 + 25	3 ¾	3	SP

SB = Soil Boring SP = Poorly Graded Sand SP-SM = Poorly Graded Sand with Silt

Fill

Below the pavement section soil borings SB-06, SB-09, SB-11, SB-12, and SB-15 encountered previously placed Fill that extended to depths ranging from 4 ½ to 9 ½ feet below the ground surface.

The Fill consisted of poorly graded sand, poorly graded sand with silt, silty sand and silty clayey sand that was brown, dark brown or black in color.

N-Values in the previously placed Fill ranged from 10 to 29 bpf. These values indicate the Fill had a loose to medium dense relative density.

Buried Topsoil

Soil boring SB-09 encountered an apparent buried topsoil layer at about 9 ½ feet below the ground surface. The apparent buried topsoil was composed of silty sand. Soil boring SB-12 encountered relatively thin layers of black silty sand or silty clayey sand at about 2 feet and 7 feet below the pavement surface which appears to be layer(s) of buried topsoil. Buried topsoil or other organic soil were not encountered in the remaining borings.

Native Alluvium

Beneath the pavement section or Fill the soil borings encountered alluvial deposits that extended to the termination depths of the borings. The native alluvial deposits consisted predominantly of; poorly graded sand with silt, poorly graded sand and silty sand corresponding the ASTM Classifications SP-SM, SP and SM, respectively. Lesser amounts of clayey sand (SC) were encountered in soil borings SB-15 and SB-20. The clayey sand at soil boring SB-15 was encountered at about 9 ½ feet below the ground surface and extended to the termination depth of the boring. The clayey sand at boring SB-20 was about ½ foot thick and was noted at about 7 feet below the ground surface.

N-Values within the native sands ranged from 2 to 35 bpf. However, most of the values ranged from about 2 to 15 bpf. These values indicate the sands had a very loose to dense relative density but were generally very loose to medium dense. The higher N-Values (greater than about 30 bpf) were likely due to gravel or cobbles.

3.3 Groundwater

Groundwater was encountered in some of the borings while drilling and sampling or after removing the augers form the boreholes at depths ranging from about 5 to 10 ½ below the ground surface corresponding to elevations ranging from about 868 to 873. The observed water levels are summarized in Table 2.

Table 2. Summary of Groundwater Levels

Boring Number	Ground Surface Elevation (ft)	Approximate Depth to Groundwater (ft)*	Approximate Groundwater Elevation (ft)*
167th Lane NW			
SB-01	905.6	NE	-
SB-02	903.7	NE	-
SB-03	903.4	NE	-
SB-04	904.5	NE	-
SB-05	902.6	NE	-
SB-06	880.3	10 ½	870
SB-07	876.3	7 ½	869
SB-08	879.8	NE	-
SB-09	879.6	NE	-
SB-10	876.3	7	869 ½
SB-11	875.5	7 ½	868
SB-12	876.3	NE	-
SB-13	877.5	NE	-
SB-14	878.6	7 ½	871
SB-15	880.6	7 ½	873
168th Lane NW			
SB-16	877.7	5	872 ½
SB-17	877.7	7 ½	870
SB-18	876.6	5	871 ½
SB-19	875.7	5	870 ½
SB-20	877.3	5	872 ½
Nutria Street NW			
SB-21	898.5	NE	-
SB-22	889.0	NE	-
SB-23	889.9	NE	-
168th Avenue NW			
SB-24	906.9	NE	-
SB-25	906.6	NE	-
SB-26	906.7	NE	-
SB-27	906.1	NE	-
SB-28	909.8	NE	-

Rabbit Street NW			
SB-29	908.6	NE	-
169th Avenue NW			
SB-30	908.3	NE	-
SB-31	904.3	NE	-

* = Depths and Elevations were rounded to the nearest ½ foot. NE = Not Encountered

We made water level measurements in the borings at the times and under the conditions stated on the boring logs. The period of observation was relatively short and fluctuations in the groundwater level may occur due to rainfall, flooding, irrigation, spring thaw, drainage, and other seasonal and annual factors not evident at the time the observations were made. The intensity and duration of these events or factors can significantly impact groundwater levels. In addition, "extreme" weather events or other events, such as flooding, spring thaw, etc., could result in groundwater levels higher than estimated or anticipated.

Groundwater monitoring wells or piezometers in conjunction with deeper borings would be required to more accurately determine water levels.

3.4 Laboratory Tests

Thirty-one (31) laboratory moisture content tests and 31 percent passing the #200 sieve (P-200) tests were performed on selected samples of the aggregate base or possible aggregate base materials. Table 3 below provides a summary of the laboratory testing. Laboratory moisture contents are also shown on the boring logs adjacent to the samples tested.

Laboratory P-200 contents of the aggregate base materials ranged from about 2 ½ percent to 13 ½ percent with most of the P-200 contents between 5 and 12 percent. It should be noted that very little "gravel" was observed in the soil samples.

Table 3. Summary of Laboratory Analysis

Boring Number	Sample	Depth (feet)	Moisture Content (%)*	P-200 (%)*
167th Lane NW				
SB-01	AU-151	Possible Agg Base	4	10
SB-02	AU-101	Possible Agg Base	4 ½	9 ½
SB-03	AU-96	Possible Agg Base	4	7
SB-04	AU-91	Possible Agg Base	6 ½	13 ½
SB-05	AU-76	Possible Agg Base	6	2 ½
SB-06	AU-71	Possible Agg Base	8	8
SB-07	AU-66	Possible Agg Base	4	8
SB-08	AU-61	Possible Agg Base	3 ½	7 ½
SB-09	AU-1	Possible Agg Base	3	4
SB-10	AU-6	Possible Agg Base	3 ½	6 ½
SB-11	AU-11	Possible Agg Base	5 ½	6
SB-12	AU-16	Possible Agg Base	4	7
SB-13	AU-21	Possible Agg Base	6	5
SB-14	AU-26	Possible Agg Base	5 ½	6

SB-15	AU-31	Possible Agg Base	4 ½	6 ½
168th Lane NW				
SB-16	AU-36	Possible Agg Base	6	9
SB-17	AU-41	Possible Agg Base	4 ½	4
SB-18	AU-46	Possible Agg Base	4	7 ½
SB-19	AU-51	Possible Agg Base	10	6
SB-20	AU-56	Possible Agg Base	4 ½	4 ½
Nutria Street NW				
SB-21	AU-141	Possible Agg Base	6 ½	8
SB-22	AU-136	Possible Agg Base	4 ½	6 ½
SB-23	AU-146	Possible Agg Base	5	9
168th Avenue NW				
SB-24	AU-116	Possible Agg Base	12	14
SB-25	AU-111	Possible Agg Base	5 ½	11
SB-26	AU-106	Possible Agg Base	6	13 ½
SB-27	AU-81	Possible Agg Base	6 ½	10 ½
SB-28	AU-86	Possible Agg Base	6	4 ½
Rabbit Street NW				
SB-29	AU-121	Possible Agg Base	5 ½	9
169th Avenue NW				
SB-30	AU-126	Possible Agg Base	5 ½	11
SB-31	AU-131	Possible Agg Base	5	8 ½

*Moisture contents and P-200 contents were rounded to the nearest ½ percent

3.4 OSHA Soil Classification

The soil encountered in the borings consisted of granular soil composed of silty sand, poorly graded sand with silt or poorly graded sand corresponding to the ASTM Classifications SM, SP-SM or SP, respectively. The soils identified in the boring will generally be Type C soils under Department of Labor Occupational Safety and Health Administration (OSHA) guidelines.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Proposed Construction

This project will include improving the following streets within the Autumn Height area within the City of Ramsey; 167th Lane NW, 168th Lane NW, Nutria Street NW, 168th Avenue NW, Rabbit Street NW and 169th Avenue NW.

Based correspondence with the City of Ramsey we understand that street improvements could include completely removing and replacing the existing pavements or a full-depth reclamation. We further understand that no sanitary sewer or watermain utilities will be installed as part of this project. However, culvert and/or storm sewer installation or replacement will likely be included in the project.

We anticipate that site grading will consist of earthwork necessary for roadway reconstruction and we do not anticipate any significant changes in the roadway alignment or roadway grades. Cuts or fills involving permanent grade change, if any, are assumed to be less than 1 feet. Invert elevations or pipe burial depths for any storm sewer and/or culvert installation are anticipated to be on the order of 5 feet.

We were not provided any information regarding traffic volumes such as Average Annual Daily Traffic (AADT) counts or vehicle distribution for the roadways. We assumed these roadways will be utilized mainly by automobiles, light trucks and school buses with weekly use by heavier vehicles such as garbage trucks and UPS or FedEx type delivery vehicles. Based on the number of homes along the roadways we estimate the pavement will be subjected to less than 50,000 Equivalent Single Axle Loads (EASL's) over a design life of 20 years. The ESAL's estimated above have not been adjusted for any future growth.

Changes in the nature, design, or location of all or parts of this project may occur. Likewise, if the proposed traffic volumes exceed these values we should be informed. Additional analyses and revised recommendations may be necessary.

4.2 Discussion

Pavements Based on the maintenance history provided it appears that the pavements were initially constructed in the late 1970's thru the late 1980's. A maintenance program including seal coating and bituminous overlays occurred in the 1980's thru to about 2004. The roadways appear to be in excess of 30 years old but given their age they appear to have generally performed as designed and based on an assumed 20-year service life, the pavements have likely significantly exceeded their design life.

We observed longitudinal and transvers cracks with some "alligator" or fatigue cracking of the pavement surfaces. The cracking observed could be the result of a combination of factors including; inadequate pavement thickness, pavement age and possibly frost action/frost heave.

Longitudinal cracking are cracks parallel to the pavement centerline or laydown direction. These can be caused by poor joint construction, reflective cracking from an underlying layer, fatigue cracking or top-down cracking resulting from the age of the pavement or due to expansion and contraction of the pavement surface or increased loads/traffic on the pavements. Transverse

cracking are cracks perpendicular to the roadway centerline or laydown direction. These are often caused by shrinkage of the pavement surface, reflective cracking from an underlying layer or top-down cracking. Alligator or fatigue cracking can be symptomatic of poor subgrade soils and/or inadequate pavement thickness.

Photographs of the bituminous cores are presented in the Appendix.

Aggregate Base An apparent aggregate base layer was observed below the pavements at each boring location. The apparent aggregate base appeared to contain little gravel and because of that it is identified as Possible Aggregate Base on the boring logs. Based on our observations the aggregate base or Possible Aggregate Base may not meet MN/DOT gradation specifications for Class 5 aggregate base. It is possible that the Possible Aggregate base was initially placed as new or virgin Class 5 aggregate base but has degraded over time.

Subgrade Soils The borings generally encountered sandy subgrade soils including; poorly graded sand, poorly grades sand with silt and silty sand which correspond to the ASTM Classifications SP, SP-SM, SM, respectively. The sand soils (SP, SP-SM, SM) encountered in the borings are generally well suited for pavement and/or pipe support and the soil classified as SP and SP-SM are generally considered non-frost susceptible soils and are also free draining materials. The soil classified as SM can be moderately to highly frost susceptible. Frost susceptibility or frost heave refers to the soils ability to heave when frozen. Heave results from frost penetration and the formation of ice lenses within the soil. Heave can result in cracks in the pavement and reduced pavement life. The amount of heave depends, in-part on the available moisture in the subgrade and the subgrade soil type. Silt and clay rich soil are more likely to form ice lenses because of their high capillarity which enables them to draw up moisture. These soils are also slow draining materials and retain moisture. The frozen soil can also experience detrimental strength loss and settlement when they thaw.

Soil borings SB-09 and SB-12 encountered buried topsoil and/or relatively thin layers of buried topsoil. The "buried topsoil" is generally a poor-quality soil for pavement support and typically do not recommend supporting pavements on topsoil, buried topsoil or other organic soils.

The "buried topsoil" at soil boring SB-09 was encountered at a depth of about 9 ½ feet below the ground surface and the laboratory organic content test yielded an organic content of 1 percent. Organic contents less that 2 percent are generally considered non-organic. Based on the organic content result and the depth below the pavement surface, it our opinion that the buried topsoil need not necessarily be removed.

The apparent buried topsoil encountered near the surface in soil boring SB-12 may not necessarily need to be removed. However, if new storm sewer utilities will be installed in this area, we anticipate that the buried topsoil will be removed incidental to pipe installation. We do not recommend that the buried topsoil be reused as fill or backfill.

Groundwater Ground water was encountered in 11 of the soil borings at depths ranging from about 5 to 10 ½ feet below the ground surface. Groundwater was not encountered in the remaining borings while drilling and sampling or after removing the augers from the boreholes.

We generally do not anticipate that groundwater will be encountered during shallow utility construction or reconstruction and generally do not anticipate that dewatering will be required.

4.3 Utility Recommendations

We anticipate that new utilities will be installed as part of this project. We further anticipate that new utilities will bear at depths about 5 feet below the ground surface. At these depths, we anticipate that the pipes will bear on sandy alluvial soils or compacted engineered fill which in our opinion are suitable for pipe support. We recommend removing all vegetation, topsoil and any soft or otherwise unsuitable soils, if any, beneath utilities prior to placement.

We assume that open cut excavation techniques will be used for pipe installation. We further assume that typical excavations depths will be on the order of 5 feet below the ground surface. At typical 1:1 excavation backslopes, the excavation will extend about 5 feet beyond the edge of the excavation. The excavation may extend into/onto adjacent properties or the adjacent roadways posing a risk of undermining structures on those properties or roadways. In addition, the soils could slough as they are excavated resulting in side slopes flatter than 1:1 further increasing the horizontal limits of the excavation. If site constraints will limit the excavation, trench boxes or temporary shoring may be required.

Backfilling We understand that in most cases new pavements will be constructed over the top of the utility trench(s) and that soil excavated for pipe installation will be placed back in the excavations, to the greatest extent possible. We do not recommend re-using topsoil, buried topsoil, organic soils or soils that are black in color for pipe support or for fill or backfill below roadways. It may be possible to re-use these materials in "green areas" such as landscaping berms, if any.

We recommend bedding material be thoroughly compacted around the pipes. We recommend trench backfill above the pipes be compacted to a minimum of 95 percent beneath pavements, the exception being within 3 feet of the proposed pavement subgrade, where 100 percent of standard Proctor density is required. In landscaped areas we recommend a minimum compaction of 90 percent.

4.4 Pavement Recommendations

The City of Ramsey may have standard plates that dictate bituminous pavement design. If so, we assume the pavements be designed in accordance with the appropriate standard plates. The following paragraphs provide general pavement recommendations in the absence of standard plates.

Reconstruction In areas that will be reconstructed we recommend removing all vegetation and topsoil, if any, and all pavements, aggregate base, organic soils and any soft or otherwise unsuitable materials from beneath the pavement subgrade. Prior to placing the aggregate base (Class 5) we recommend compacting the subgrade soils to provide a more uniform surface and to identify soft, weak, loose or unstable areas that may require additional subcuts. Backfill, if needed, to attain pavement subgrade elevation can consist of any mineral soil provided it is free of organic material or other deleterious materials but recommend additional fill, if needed, consist of sandy soils similar to the on-site materials.

Granular fill classified as SP or SP-SM should be placed within 65 percent to 105 percent of its optimum moisture content as determined by the standard Proctor. Other fill soils should be placed with moisture contents within a range of 1 percentage point below and 3 percentage points

above its optimum moisture content. The upper 3 feet of fill and backfill should be compacted to a minimum of 100 percent of its standard Proctor maximum dry density.

Full Depth Reclamation For "Full Depth Reclamation" areas there may be instances where the recommended aggregate base thickness exceeds the existing aggregate base thickness. The preferred method of pavement repair would be to reclaim the existing bituminous, subcut the subgrade, replace the reclaim and add additional aggregate base as needed then construct the bituminous pavement. Subcutting the subgrade may not be feasible or cost effective. As an alternate it may be possible to use a thicker bituminous pavement along with the existing aggregate base or possibly subcutting some of the exiting aggregate base. Using MN/DOT granular equivalencies, one (1) inch of bituminous is equivalent to 2.25 inches of MN/DOT aggregate base.

R-Values Laboratory tests to determine the soils Hveem Stabilometer R-Value (R-Value) was beyond the scope of this project. Information provided in the State of Minnesota Department of Transportation, Geotechnical & Pavement Manual, Part II, indicates that R-Values for granular materials meeting the ASTM Classification SM, SP-SM and/or SP can range from 30 to 70. In areas where the subgrade soils consist of silty sand (SM) it is our opinion that an R-Value of 30 can be used for pavement design. In areas where the subgrade soils consist of poorly graded sand (SP) or poorly graded sand with silt (SP-SM) it is our opinion that an R-Value of 50 can be used for pavement design.

Recommended Pavement Section Thickness

It should be noted that the pavement sections presented below are not absolutes. Depending on serviceability expectations, material availability, and cost, there could be circumstances under which alternative sections will be more practicable.

Subgrade R-Value of 30 Based on an estimated R-value of 30 and a maximum of 50,000 ESAL's we recommend a pavement section consisting of a minimum of 4 inches of bituminous underlain by a minimum of 9 inches of Class 5 aggregate base.

Subgrade R-Value of 50 Based on an estimated R-value of 50 and a maximum of 50,000 ESAL's we recommend a pavement section consisting of a minimum of 4 inches of bituminous underlain by a minimum of 6 inches of Class 5 aggregate base.

4.4 Materials

We recommend aggregate base meeting MN/DOT specification 3138 for Class 5 aggregate base. We recommend the aggregate base be compacted to 100 percent of its maximum standard Proctor dry density.

We recommend that the bituminous wear and base courses meet the requirement of MN/DOT specification 2360. We recommend the bituminous pavements be compacted to at least 92% of the maximum theoretical density.

Pavement reconstruction could include installing concrete curb and gutter. We recommend specifying concrete that has a minimum 28-day compressive strength of 4,000 psi. We recommend specifying 5 to 8 percent entrained air for exposed concrete to provide resistance to freeze-thaw

deterioration. We recommend slump, air content and compressive strength test of Portland cement concrete.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Excavation

The soil encountered in the borings consisted of granular soil composed of silty sand, poorly graded sand with silt or poorly graded sand corresponding to the ASTM Classifications SM, SP-SM or SP, respectively. The soils identified in the boring will generally be Type C soils under Department of Labor Occupational Safety and Health Administration (OSHA) guidelines.
Temporary excavations in Type C soils should be constructed at a minimum of 1 ½ foot horizontal to every 1 foot vertical within excavations. Slopes constructed in this manner may still exhibit surface sloughing. If site constraints do not allow the construction of slopes with these dimensions, then temporary shoring may be required.

5.2 Observations

A geotechnical engineer or qualified engineering technician should observe the excavation subgrade to evaluate if the subgrade soils are similar to those encountered in the borings and adequate to support the proposed construction.

5.3 Backfill and Fills

Site soils that will be excavated and reused as backfill and fill appear to be below their assumed optimum moisture content. We anticipate it may be necessary to moisture condition (wet) these soils to achieve the recommended compaction. We recommend that fill and backfill be placed in lifts not exceeding 4 to 12 inches, depending on the size of the compactor and materials used.

5.4 Testing

We recommend density tests of backfill and fills placed for the proposed roadway and utilities. Samples of the proposed materials should be submitted to our laboratory prior to placement for evaluation of their suitability and to determine their optimum moisture content and maximum dry density (Standard Proctor).

5.5 Winter Construction

If site grading and construction is anticipated to proceed during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading and placement of fill. No fill should be placed on frozen soil and no frozen soil should be used as fill or backfill.

Concrete delivered to the site should meet the temperature requirements of ASTM and/or ACI. Concrete should not be placed on frozen soil. Concrete should be protected from freezing until the necessary strength is obtained.

6.0 PROCEDURES

6.1 Soil Classification

The drill crew chief visually and manually classified the soils encountered in the borings in general accordance with ASTM D 2488, "Description and Identification of Soils (Visual-Manual Procedure)". Soil terminology notes are included in the Appendix. The samples were returned to our laboratory for review of the field classification by a soils engineer. Samples will be retained for a period of 30 days.

6.2 Groundwater Observations

Immediately after taking the final samples in the bottom of the borings, the holes were checked for the presence of groundwater. Immediately after removing the augers from the borehole the holes were once again checked and the depth to water and cave-in depths were noted.

7.0 GENERAL

7.1 Subsurface Variations

The analyses and recommendations presented in this report are based on data obtained from a limited number of soil borings. Variations can occur away from the borings, the nature of which may not become apparent until additional exploration work is completed or construction is conducted. A reevaluation of the recommendations in this report should be made after performing on-site observations during construction to note the characteristics of any variations. The variations may result in additional foundation costs and it is suggested that a contingency be provided for this purpose.

It is recommended that we be retained to perform the observation and testing program during construction to 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, specifications and construction methods. This will allow correlation of the soil conditions encountered during construction to the soil borings and will provide continuity of professional responsibility.

7.2 Review of Design

This report is based on the design of the proposed structure as related to us for preparation of this report. It is recommended that we be retained to review the geotechnical aspects of the design and specifications. With the review we will evaluate whether any changes have affected the validity of the recommendations and whether our recommendations have been correctly interpreted and implemented in the design and specifications.

7.3 Groundwater Fluctuations

We made water level measurements in the borings at the times and under the conditions stated on the boring logs. The data was interpreted in the text of this report. The period of observation was relatively short and fluctuations in the groundwater level may occur due to rainfall, flooding, irrigation, spring thaw, drainage, and other seasonal and annual factors not evident at the time the observations were made. Design drawings and specifications and construction planning should recognize the possibility of fluctuations.

7.4 Use of Report

This report is for the exclusive use of City of Ramsey and their design team to use to design the proposed structure and prepare construction documents. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. The data, analysis and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

7.5 Level of Care

Haugo GeoTechnical Services, LLC has used the degree of skill and care ordinarily exercised under similar circumstance by members of the profession currently practicing in this locality. No warranty expressed or implied is made.

APPENDIX

IMPROVEMENT PROJECT 22-02
AUTUMN HEIGHTS
SOIL BORING LOCATION MAP

0 1/10 2/10 3/10

SCALE (FEET)

N

City of RAMSEY

HGTS# 21-0833

Figure 2: GPS Boring Locations

Boring Number	Elevation (US Survey Feet)	Northing Coordinate	Easting Coordinate
SB-01	905.6	187386.1	442350
SB-02	903.7	187368.1	442700.7
SB-03	903.4	187408.1	442941.3
SB-04	904.5	187502.6	443170.8
SB-05	902.6	187668.6	443420.8
SB-06	880.3	187355.7	443578.7
SB-07	876.3	187268.9	443804
SB-08	879.8	187270.9	444047.9
SB-09	879.6	187317.4	444191.4
SB-10	876.3	187367.2	444437.2
SB-11	875.5	187489.1	444645.8
SB-12	876.3	187671.6	444821.6
SB-13	877.5	187891.3	444864
SB-14	878.6	188018.6	444650.2
SB-15	880.6	188180.3	444600.9
SB-16	877.7	188210.2	444873.5
SB-17	877.7	188135.3	445106.2
SB-18	876.6	188120	445354.3
SB-19	875.7	188131	445605.8
SB-20	877.3	188289.1	445750.3
SB-21	898.5	187803.9	444231.6
SB-22	889.0	188059	444230.7
SB-23	889.6	188328.1	444239.5
SB-24	906.9	187922.2	442577.7
SB-25	906.6	187899	442901.5
SB-26	906.7	187903.4	443126.6
SB-27	906.1	187874.4	443377.2
SB-28	909.8	187762.6	443633.4
SB-29	908.6	188233.3	442934.3
SB-30	908.3	188366.6	442647.9
SB-31	904.3	188419.5	442339

Referencing Minnesota County Coordinates Basis – Anoka County

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BORING NUMBER SB-01

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/26/21 **COMPLETED** 9/26/21
GROUND ELEVATION 905.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY MS **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 4+00 167th Lane NW
AFTER DRILLING --- Not Encountered with Cave-In Depth of 3 Feet

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 5 inches of Bituminous Asphalt	AU 151			4.5	
		Approximately 5 Inches of Possible Aggregate Base P-200=10%					
		(SM) Silty Sand, fine grained, dark brown to about 5 Feet then brown, moist, loose. (Alluvium)					
2.5			SS 152		3-4-5 (9)		
5.0			SS 153		2-2-3 (5)		
7.5		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose. (Alluvium)	SS 154		2-3-4 (7)		
10.0			SS 155		3-3-4 (7)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-02

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 903.7 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING --- Not Encountered
NOTES 7+50 167th Lane NW
AFTER DRILLING --- Not Encountered with Cave-In Depth of 4 Feet

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3.5 Inches of Bituminous Asphalt					
		Approximately 3 Inches of Possible Aggregate Base P-200=9.5%	AU 101			4.5	
		(SP-SM) Poorly Graded Sand with Silt, fine grained, brown, moist, medium dense. (Alluvium)					
2.5			SS 102		5-6-5 (11)		
		(SP) Poorly Graded Sand, fine to medium grianed, trace Gravel, brown, moist, loose. (Alluvium)					
5.0			SS 103		6-4-5 (9)		
7.5			SS 104		2-3-6 (9)		
10.0			SS 105		3-4-6 (10)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-03

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 903.4 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 10+00 16th Lane NW
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3 Inches of Bituminous Asphalt					
		Approximately 3 Inches of Possible Aggregate Base. P-200=7%					
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose to medium dense. (Alluvium)	AU 96			4	
2.5			SS 97		4-4-4 (8)		
5.0			SS 98		2-4-5 (9)		
7.5			SS 99		2-4-7 (11)		
10.0			SS 100		2-4-5 (9)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-04

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 904.5 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 12+50 167th Lane NW
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3.25 Inches of Bituminous Asphalt					
		Approximately 3 Inches of Possible Aggregate Base P-200 13.5%				6.5	
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, very loose to medium dense. (Alluvium)	AU 91				
2.5			SS 92		3-5-6 (11)		
5.0			SS 93		2-2-4 (6)		
7.5			SS 94		1-1-2 (3)		
10.0		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose. (Alluvium)	SS 95		2-2-4 (6)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-05

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 902.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 15+40 167th Lane NW
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4 Inches of Bituminous Asphalt					
		Approximately 3.5 Inches of Possible Aggregate Base P-200=2.5% Poorly Graded Sand, dark brown, moist. (Fill)	AU 76			6	
2.5		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, very loose to medium dense. (Alluvium)	SS 77		6-7-8 (15)		
5.0			SS 78		1-1-1 (2)		
7.5			SS 79		1-1-2 (3)		
10.0			SS 80		1-1-3 (4)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-06

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 880.3 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 19+00 167th Lane NW
AFTER DRILLING 10.50 ft / Elev 869.80 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4.5 Inches of Bituminious Asphalt					
		Approximately 3 Inches of Possible Aggregate Base P-200=8%	AU 71			8	
		(SP-SM) Poorly Graded Sand with Silt, dark brown, moist. (Fill)					
2.5			SS 72		7-8-7 (15)		
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist to waterbearing, loose to medium dense. (Alluvium)					
5.0			SS 73		2-2-4 (6)		
7.5			SS 74		7-6-7 (13)		
10.0			SS 75		3-3-4 (7)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-07

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 876.3 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 21-50 167th Lane NW
AFTER DRILLING 7.50 ft / Elev 868.80 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approxiately 4 Inches of Bituminous Asphalt					
		Approximately 4 Inches of Possible Aggregate Base P-200=8%	AU 66			4	
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, medium dense. (Alluvium)					
2.5			SS 67		6-13-13 (26)		
5.0			SS 68		6-8-8 (16)		
7.5		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, waterbearing, very loose. (Alluvium)	SS 69		1-2-2 (4)		
10.0		(SP) Poorly Graded Sand, fine to medium grained, brown, waterbearing, very loose. (Alluvium)	SS 70		1-1-1 (2)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-08

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 879.8 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 24+00 167th Lane NW
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3.5 Inches of Bituminous Asphalt	AU 61			3.5	
		Approximately 4 Inches of Possible Aggregate Base					
		P-200=7.5%					
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, medium dense. (Alluvium)					
2.5			SS 62		5-9-11 (20)		
5.0			SS 63		4-8-8 (16)		
7.5		(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, brown and gray, moist, medium dense. (Alluvium)	SS 64		7-10-10 (20)		
10.0		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, gray, moist, medium dense. (Alluvium)	SS 65		6-10-11 (21)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-09

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 879.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 25+50 167th Lane NW
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3 Inches of Bituminous Asphalt				3	
		Approxiately 4 Inches of Possible Aggregate Base					
		P-200=4%					
		Poorly Graded Sand, brown, moist. (Fill)	AU 1				
2.5			SS 2		3-5-7 (12)		
		Poorly Graded Sand with Silt, dark brown, moist. (Fill)					
5.0			SS 3		2-5-5 (10)		
		Poorly Graded Sand, brown, moist. (Fill)					
7.5			SS 4		6-9-8 (17)		
		Silty Sand, black, moist. (Fill/Buried Topsoil)					
10.0		Organic Content=1%	SS 5		6-7-8 (15)	12	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-10

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 876.3 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 28+00 167th Lane NW
AFTER DRILLING 7.00 ft / Elev 869.30 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approxiately 4 Inches of Bituminous Asphalt					
		Approximately 4 Inches of Possible Aggregate Base P-200=6.5%				3.5	
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, medium dense. (Alluvium)	AU 6				
2.5			SS 7		3-9-10 (19)		
5.0		(SP-SM) Poorly Graded Sand with Silt, brown, moist, medium dense. (Alluvium)	SS 8		6-9-10 (19)		
7.5		(SP-SM) Poorly Graded Sand with Silt, gray, moist, medium dense. (Alluvium)	SS 9		6-13-13 (26)		
10.0		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, gray, waterbearing, medium dense. (Alluvuim)	SS 10		5-6-7 (13)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-11

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 875.5 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 30+50 167th Lane NW
AFTER DRILLING 7.50 ft / Elev 868.00 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Appoximately 3 Inches of Bituminous Base Approximately 3.5 Inches of Possible Aggregate Base P-200=6% Poorly Graded Sand with Silt, dark brown and brown, moist. (Fill)	AU 11			5.5	
2.5			SS 12		4-11-12 (23)		
5.0			SS 13		10-13-14 (27)		
7.5		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, waterbearing, very loose to loose. (Alluvium)	SS 14		5-7-7 (14)		
10.0			SS 15		1-1-1 (2)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-12

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 876.3 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 33+00 167th Lane NW
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3.25 Inches of Bituminous Asphalt					
		Approximately 3.5 Inches of Possible Aggregate Base				4	
		P-200=7%					
		Poorly Graded Sand with Silt, brown, moist. (Fill)	AU 16				
2.5		Silty Sand, black, moist. (Fill)					
		Poorly Graded Sand, moist. (Fill)	SS 17		7-12-17 (29)		
5.0			SS 18		10-12-17 (29)		
7.5		Silty Clayey Sand, black, moist. (Fill)					
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown and gray, loost to medium dense. (Alluvium)	SS 19		3-3-4 (7)		
10.0			SS 20		4-5-6 (11)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-13

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 877.5 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 35+50 167th Lane NW
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 7 Inches of Bituminous Asphalt					
		Approximately 6.5 Inches of Possible Aggregate Base P-200=5%	AU 21			6	
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, medium dense. (Alluvium)					
2.5			SS 22		3-5-8 (13)		
5.0			SS 23		3-7-7 (14)		
7.5		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, gray, waterbearing, loose. (Alluvium)	SS 24		2-3-3 (6)		
10.0			SS 25		2-3-5 (8)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-14

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 878.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 38+00 167th Lane NW
AFTER DRILLING 7.50 ft / Elev 871.10 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3 Inches of Bituminous Asphalt				5.5	
		Approximately 3 Inches of Possible Aggregate Base					
		P-200=6%	AU 26				
		(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, brown, moist, medium dense. (Alluvium)					
2.5			SS 27		6-7-6 (13)		
5.0			SS 28		4-5-7 (12)		
7.5		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, waterbearing, loose. (Alluvium)	SS 29		1-2-6 (8)		
10.0			SS 30		2-4-6 (10)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-15

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 880.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 39+67 167th Lane
AFTER DRILLING 7.50 ft / Elev 873.10 ft

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0	Approximately 4.5 Inches of Bituminous Asphalt					
	Approximately 3 Inches of Possible Aggregate Base	AU 31			4.5	
	P-200=6.5% Poorly Graded Sand with Silt, brown and dark brown, moist. (Fill)					
2.5		SS 32		9-12-9 (21)		
5.0	(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, waterbearing, very loose to medium dense. (Alluvium)	SS 33		4-1-6 (7)		
7.5		SS 34		3-2-2 (4)		
10.0	(SC) Clayey Sand, fine to medium grained, brown, wet, loose. (Alluvium)	SS 35		3-3-3 (6)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-16

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 877.7 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 6+50 168th Lane
AFTER DRILLING 5.00 ft / Elev 872.70 ft

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0	Approxiately 4 Inches of Bituminous Asphalt					
	Approximately 3 Inches of Possible Aggregate Base				6	
	P-200=9%					
	(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, brown, moist, loose. (Alluvium)	AU 36				
2.5		SS 37		4-5-4 (9)		
	(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, gray, waterbearing, very loose. (Alluvuim)					
5.0		SS 38		1-1-1 (2)		
	(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, gray, waterbearing, loose to medium dense. (Alluvium)					
7.5		SS 39		4-5-6 (11)		
10.0		SS 40		3-3-4 (7)		

SPT N VALUE
20 40 60 80
PL MC LL
20 40 60 80
FINES CONTENT (%)
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-17

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 877.7 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 9+00 168th Lane
AFTER DRILLING 7.50 ft / Elev 870.20 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4.5 Inches of Bituminous Asphalt				4.5	
		Approximately 2.5 Inches of Possible Aggregate Base					
		P-200=4%	AU 41				
		(SP) Poorly Graded Sand, fine grained, trace Gravel, brown, moist, medium dense. (Alluvium)					
2.5			SS 42		3-5-6 (11)		
		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, waterbearing, very losoe to loose. (Alluvium)					
5.0			SS 43		1-2-2 (4)		
7.5			SS 44		1-1-1 (2)		
10.0			SS 45		3-3-3 (6)		

SPT N VALUE
20 40 60 80
PL MC LL
20 40 60 80
FINES CONTENT (%)
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-18

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 876.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 11+50 168 Lane
AFTER DRILLING 5.00 ft / Elev 871.60 ft

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0	Approximately 2 Inches of Bituminous Asphalt Approximately 3 Inches of Possible Aggregate Base P-200=7.5% (SP-SM) Poorly Graded Sand with Silt, fine to medium grained, trace Gravel, brown and gray, moist, loose. (Alluvium)	AU 46			4	
2.5		SS 47		3-4-5 (9)		
5.0	(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, waterbearing, very loose. (Alluvium)	SS 48		2-2-2 (4)		
7.5		SS 49		1-1-1 (2)		
10.0		SS 50		1-1-1 (2)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-19

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 875.7 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 14+00 168th Lane
AFTER DRILLING 5.00 ft / Elev 870.70 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3.25 Inches of Bituminous Asphalt					
		Approximately 3.5 Inches of Possible Aggregate Base				10	
		P-200=6%					
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, gray and brown, moist to waterbearing, loose. (Alluvium)	AU 51				
2.5			SS 52		5-5-5 (10)		
5.0			SS 53		3-4-5 (9)		
7.5		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, waterbearing, very loose. (Alluvium)	SS 54		1-1-1 (2)		
10.0			SS 55		3-1-1 (2)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-20

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 8/31/21 **COMPLETED** 8/31/21
GROUND ELEVATION 877.3 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 16+50 168th Lane
AFTER DRILLING 5.00 ft / Elev 872.30 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4.25 Inches of Bituminous Asphalt					
		Approximately 3 Inches of Possible Aggregate Base					
		P-200=4.5%				4.5	
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist to waterbearing, loose. (Alluvium)	AU 56				
2.5			SS 57		3-5-5 (10)		
5.0		▼	SS 58		1-3-4 (7)		
7.5		(SC) Clayey Sand, fine to medium grained, trace Gravel, gray, waterbearing, medium dense. (Alluvium)	SS 59		9-10-6 (16)		
		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, gray, waterbearing, medium dense. (Alluvium)					
10.0			SS 60		3-5-8 (13)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-21

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 898.5 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 0+45 Nutria Street
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4 Inches of Bituminous Asphalt					
		Approximately 2 Inches of Possible Aggregate Base				6.5	
		P-200=8%	AU 141				
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, very loose to loose. (Alluvium)					
2.5			SS 142		2-3-5 (8)		
5.0			SS 143		1-3-4 (7)		
7.5			SS 144		1-1-1 (2)		
10.0			SS 145		1-1-3 (4)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-22

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 889 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 3+00 Nutria Street
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3 Inches of Bituminous Asphalt					
		Approximately 3 Inches of Possible Aggregate Base					
		P-200=6.5%					
		(SP) Poorly Graded Sand, fine grained, trace Gravel, brown, moist, loose to dense. (Alluvium)	AU 136			4.5	
2.5			SS 137		3-6-6 (12)		
5.0			SS 138		2-3-4 (7)		
7.5			SS 139		1-2-3 (5)		
10.0			SS 140		5-25-10 (35)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-23

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 889.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 5+70 Nutria Street
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4 Inches of Bituminous Asphalt					
		Approximately 4 Inches of Aggregate Base					
		P-200=9%	AU 146			5	
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose to medium dense. (Alluvium)					
2.5			SS 147		2-6-6 (12)		
5.0			SS 148		1-2-3 (5)		
7.5			SS 149		1-2-4 (6)		
10.0			SS 150		2-4-7 (11)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-24

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 906.9 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 0+50 168th Avenue
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 6 Inches of Bituminous Asphalt					
		Approximately 4 Inches of Possible Aggregate Base	AU 116			12	
		P-200=14% (SP) Poorly Graded Sand, fine grained, brown, moist, loose. (Alluvium)					
2.5			SS 117		3-3-5 (8)		
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose to medium dense. (Alluvium)	SS 118		2-5-6 (11)		
7.5			SS 119		1-2-7 (9)		
10.0			SS 120		3-8-9 (17)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-25

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 906.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 3+75 168th Avenue
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3.5 Inches of Bituminous Asphalt					
		Approximately 3.5 Inches of Possible Aggregate Base				5.5	
		P-200=11.4 (SP) Poorly Graded Sand, fine grained, brown, moist, medium dense. (Alluvium)	AU 111				
2.5			SS 112		3-6-7 (13)		
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, very loose to loose. (Alluvium)	SS 113		2-3-4 (7)		
7.5			SS 114		1-1-3 (4)		
10.0			SS 115		3-5-5 (10)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-26

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 906.7 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 6+00 168th Avenue
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3.5 Inches of Bituminous Asphalt					
		Approximately 3.5 Inches of Possible Aggregate Base				6	
		P-200=13.5%					
		(SP) Poorly Graded Sand, fine grained, brown, moist, loose. (Alluvium)	AU 106				
2.5			SS 107		3-3-3 (6)		
5.0			SS 108		2-4-5 (9)		
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, very loose to loose. (Alluvium)					
7.5			SS 109		3-2-3 (5)		
10.0			SS 110		1-1-3 (4)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-27

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 906.1 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 8+50 168th Avenue
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4.5 Inches of Bituminous Asphalt					
		Approximately 3.5 Inches of Possible Aggregate Base				6.5	
		P-200=10.5%	AU 81				
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose to medium dense. (Alluvium)					
2.5			SS 82		3-5-6 (11)		
5.0			SS 83		3-3-3 (6)		
7.5			SS 84		3-3-3 (6)		
10.0			SS 85		3-3-5 (8)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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Fax: 763-445-2238

BORING NUMBER SB-28

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/1/21 **COMPLETED** 9/1/21
GROUND ELEVATION 909.8 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 11+30 168th Avenue
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4.5 Inches of Bituminous Asphalt					
		Approximately 3.5 Inches of Possible Aggregate Base				6	
		P-200=4.5%	AU 86				
		(SP) Poorly Graded Sand, fine grained, brown, moist, loose. (Alluvium)					
2.5			SS 87		1-3-3 (6)		
5.0			SS 88		2-3-4 (7)		
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose. (Alluvium)					
7.5			SS 89		1-3-4 (7)		
10.0			SS 91		2-3-3 (6)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

HAUGO GEOTECHNICAL SERVICES
Haugo GeoTechnical Services
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BORING NUMBER SB-29

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 908.6 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 3+25 Rabbit Street
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3 Inches of Bituminous Asphalt					
		Approximately 3 Inches of Possible Aggregate Base				5.5	
		P-200=9%					
		(SP) Poorly Graded Sand, fine grained, brown, moist, medium dense. (Alluvium)	AU 121				
2.5			SS 122		4-8-5 (13)		
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, very loose to medium dense. (Alluvium)	SS 123		2-3-5 (8)		
7.5			SS 124		2-1-8 (9)		
10.0			SS 125		1-2-1 (3)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-30

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 908.3 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 3+50 169th Avenue
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 3.5 Inches of Bituminous Asphalt					
		Approximate 3 Inches of Possible Aggreagte Base				5.5	
		P-200=11%					
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose. (Alluvium)	AU 126				
2.5			SS 127		3-4-5 (9)		
5.0			SS 128		1-4-4 (8)		
7.5			SS 129		2-2-4 (6)		
10.0		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, moist, very loose. (Alluvium)	SS 130		1-1-1 (2)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

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BORING NUMBER SB-31

CLIENT City of Ramsey
PROJECT NAME IP 22-02 Autumn Heights Street Recon
PROJECT NUMBER 21-0833
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/2/21 **COMPLETED** 9/2/21
GROUND ELEVATION 904.3 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 120
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY GD **CHECKED BY** PG
AT END OF DRILLING ---
NOTES 0+25 169th Avenue
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approxiately 3.75 Inches of Bituminous Asphalt					
		Approximately 3 Inches of Possible Aggregate Base				5	
		P-200=8.5%					
		(SP) Poorly Graded Sand, fine grained, trace Gravel, brown, moist, loose. (Alluvium)	AU 131				
2.5			SS 132		1-2-3 (5)		
5.0			SS 133		2-2-4 (6)		
7.5		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose. (Alluvium)	SS 134		3-4-5 (9)		
10.0			SS 135		1-1-4 (5)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Bottom of borehole at 11.0 feet.

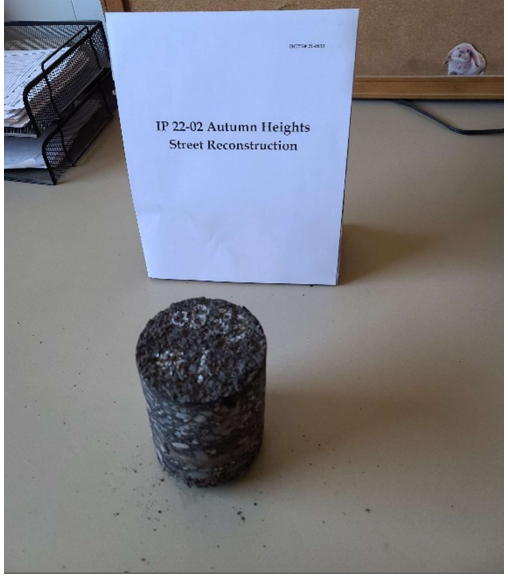


Photo # 1. Core SB-01, 4+00 167th Lane NW

Photo # 2. Core SB-02, 7+50 167th Lane NW

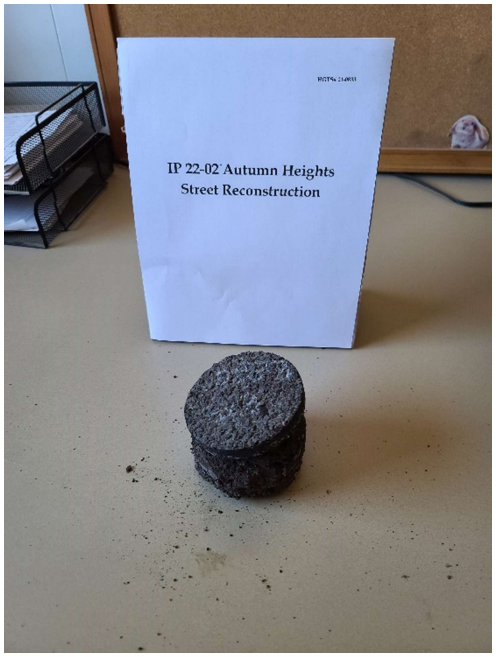


Photo # 3. Core SB-03, 10+00 67th Lane NW

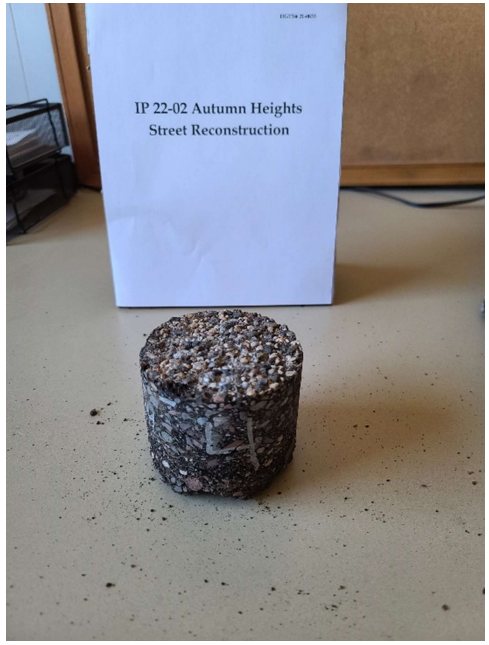


Photo # 4. Core SB-04, 12+50 167th Lane NW

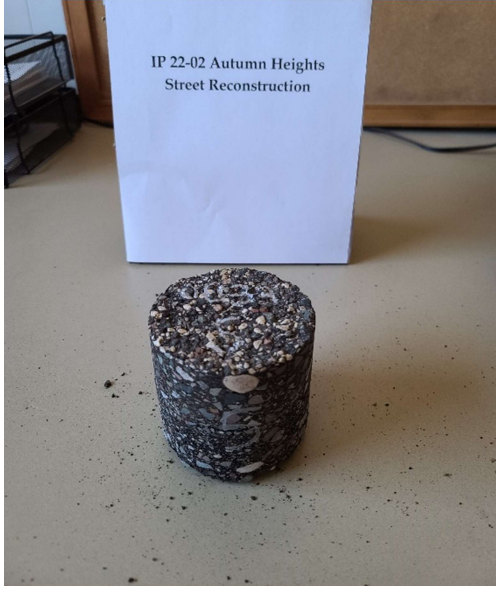


Photo # 5. Core SB-05, 15+40 167th Lane NW.

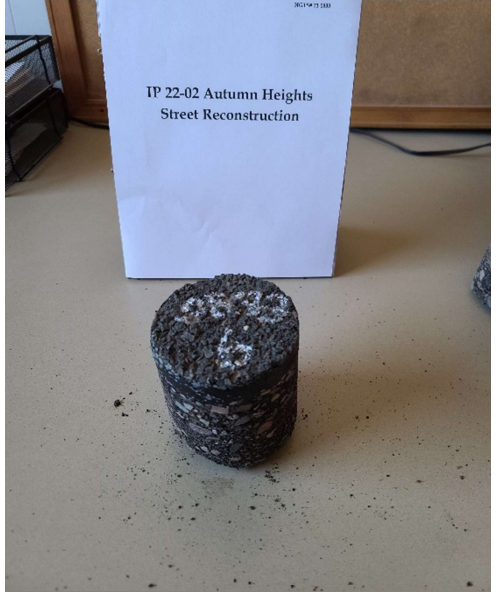


Photo # 6. Core SB-06, 19+00 167th Lane NW.

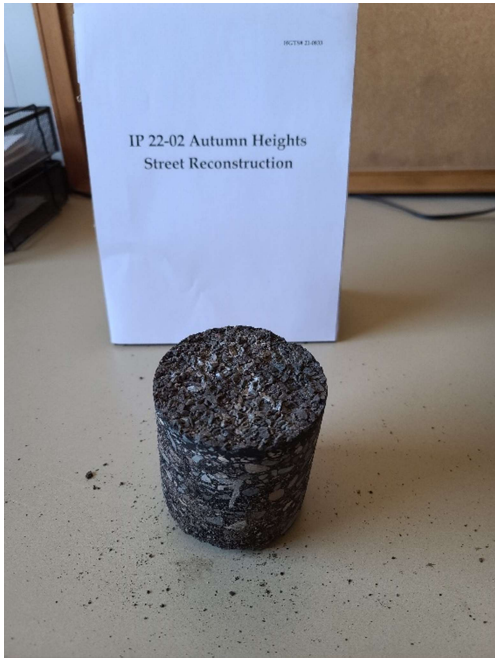


Photo # 7. Core SB-07, 21+50 167th Lane NW.

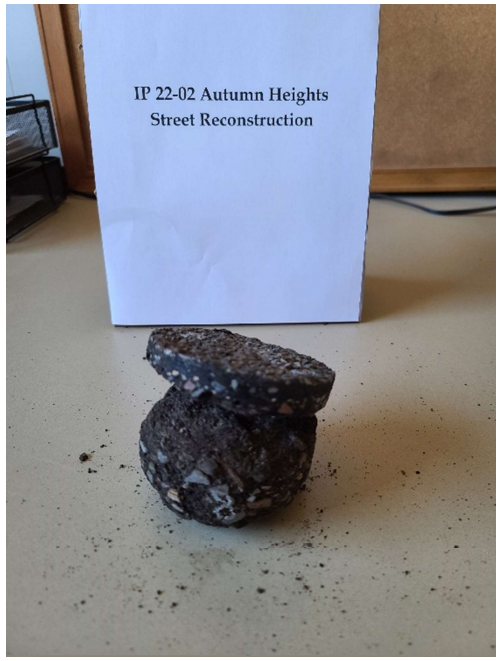


Photo # 8. Core SB-08, 24+00 167th Lane NW.

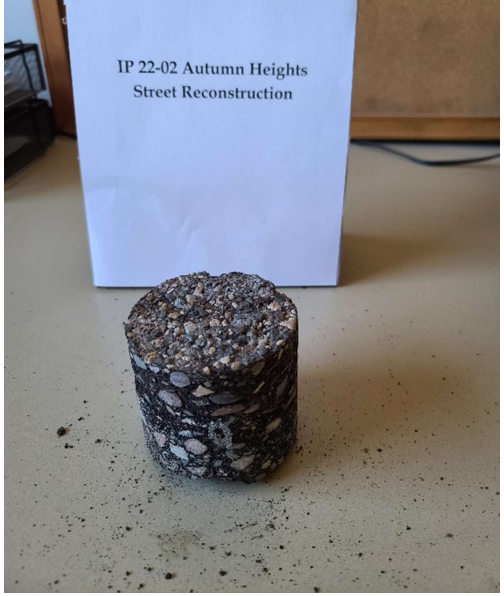


Photo # 9. Core SB-09, 25+50 167th Lane NW.

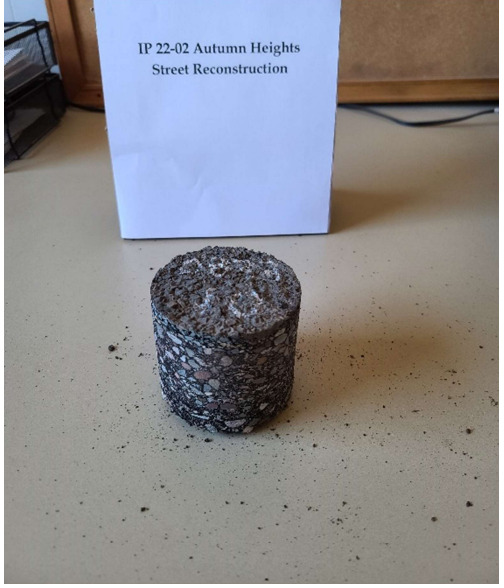


Photo # 10. Core SB-10, 28+00 167th Lane NW.

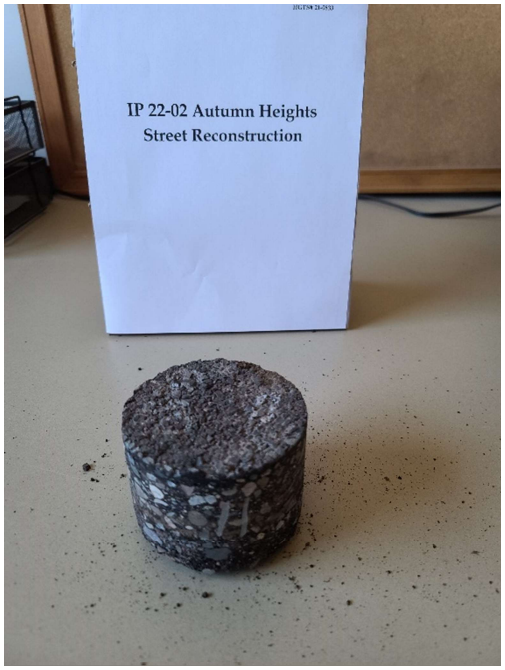


Photo # 11. Core SB-11, 30+50 167th Lane NW.

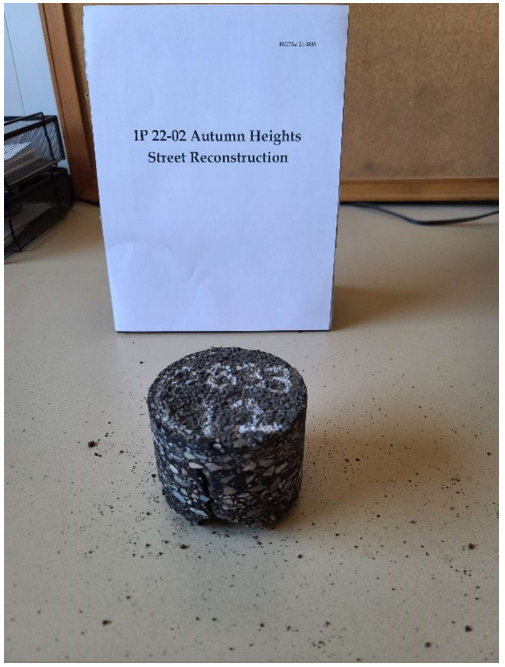


Photo # 12. Core SB-12, 33+00 167th Lane NW.

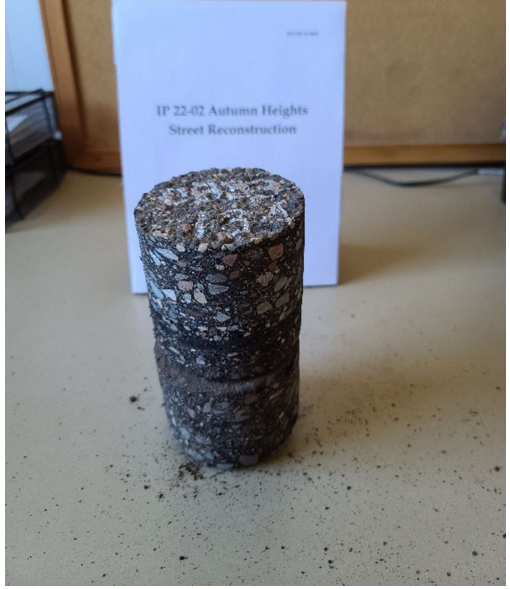


Photo # 13. Core SB-13, 35+50 167th Lane NW.

Photo # 14. Core SB-14 38+00 167th Lane NW.

Photo # 15. Core SB-15, 39+67 167th Lane NW.

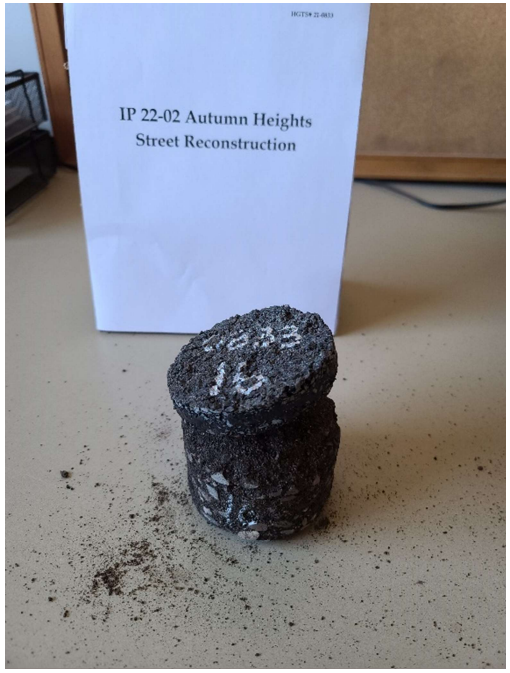


Photo # 16. Core SB-16, 6+50 168th Lane.

Photo # 17. Core SB-17, 9+00 168th Lane.

Photo # 18. Core SB-18, 11+50 168th Lane.

Photo # 19. Core SB-19, 14+00 168th Lane.

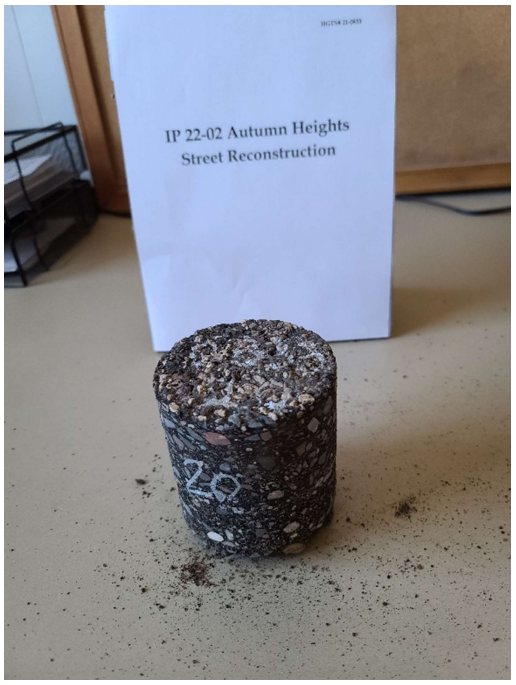


Photo # 20. Core SB-20, 16+50 168th Lane.

Photo # 21. Core SB-21, 0+42 Nutria Street.

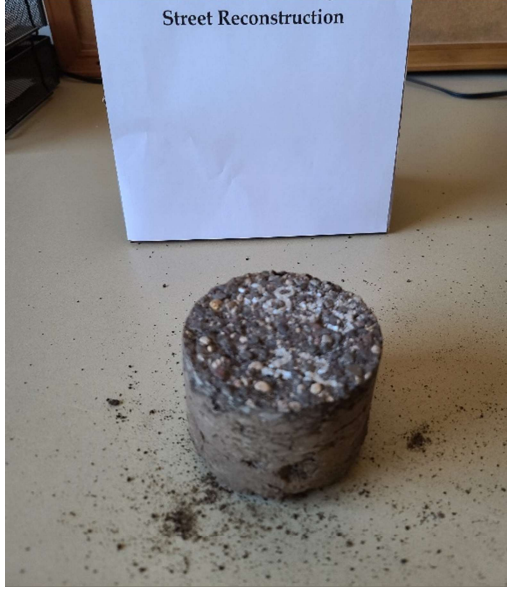


Photo # 22. Core SB-22, 3+00 Nutria Street.

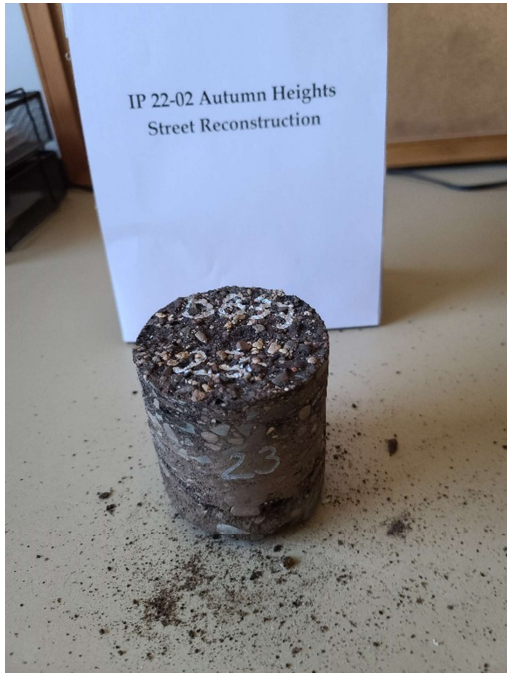


Photo # 23. Core SB-23, 5+70 Nutria Street.

Photo # 24. Core SB-24, 0+50th Avenue.

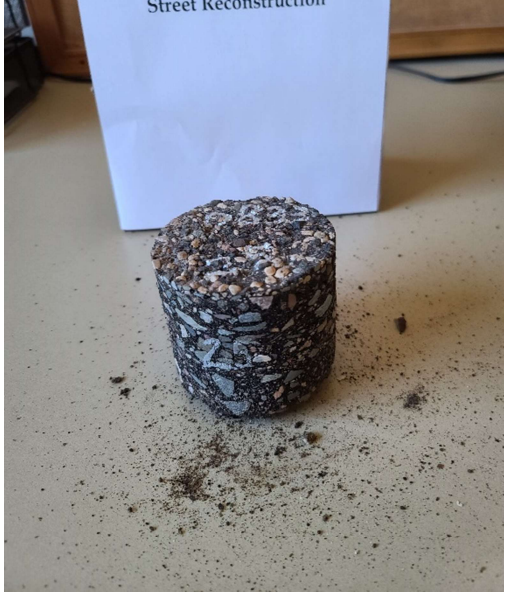


Photo # 25. Core SB-25, 3+75 168th Avenue.

Photo # 26. Core SB-26, 6+00 168th Avenue.

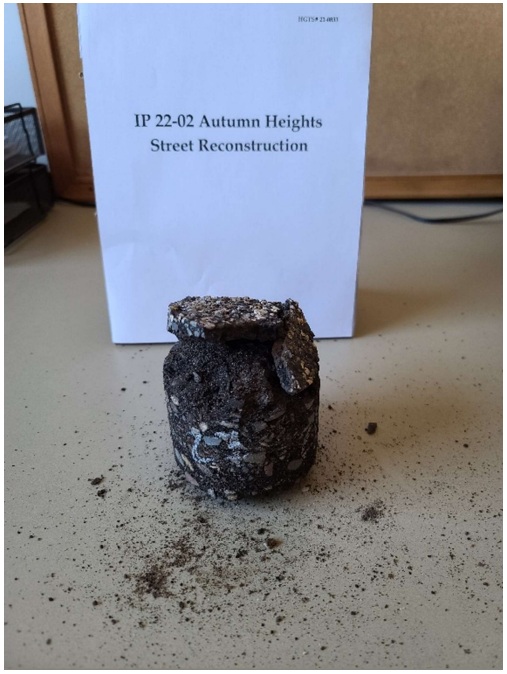


Photo # 27. Core SB-27, 8+50 168th Avenue.

Photo # 28. Core SB-28, 11+30 168th Avenue .

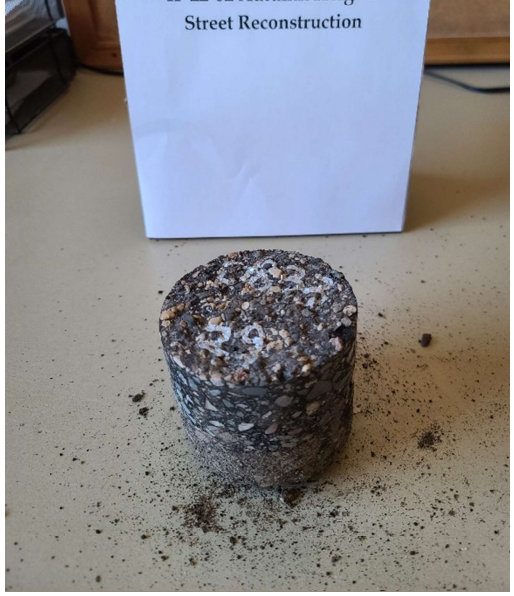


Photo # 29. Core SB-29, 3+25 Rabbit Street.

Photo # 30. Core SB-30, 3+50 169th Avenue.

Photo # 31. Core SB-31, 0+25 169th Avenue.

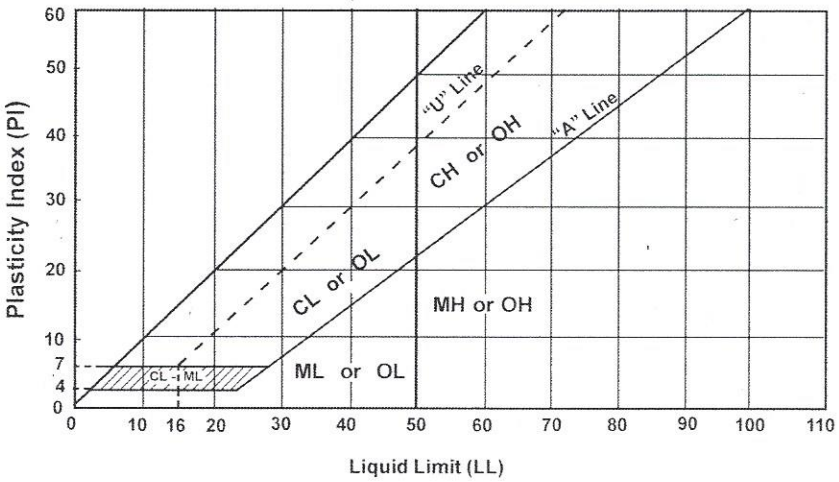
HAUGO GEOTECHNICAL SERVICES

Descriptive Terminology of Soil

Standard D 2487 - 00
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 5% or less 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 5% or less 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-in (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
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. Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
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" line.
q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	OC	Organic content, %
WD	Wet density, pcf	S	Percent of saturation, %
MC	Natural moisture content, %	SG	Specific gravity
LL	Liquid limit, %	C	Cohesion, psf
PL	Plastic limit, %	∅	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 above "A" line

Relative Density of Cohesionless Soils

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

Consistency of Cohesive Soils

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

Drilling Notes

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

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

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. Hand auger borings are indicated by the prefix "H."

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 indicates thin-walled (undisturbed) tube sample.

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