HAUGO GEOTECHNICAL SERVICES

October 1, 2021 Project Number: 21-0832

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

RE: Geotechnical Exploration Report, IP 22-01 Sunwood Drive and Waco Street Reconstruction, Ramsey, Minnesota

Dear Ms. Weidner:

We have completed the geotechnical exploration report for the IP 22-01 Sunwood Drive and Waco Street Reconstruction project in Ramsey, Minnesota.

Very briefly; 6 bituminous cores and 6 soil borings were advanced along the 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 22-01 Sunwood Drive and Waco 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: 21-0832

October 1, 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 include; the Sunwood Drive and Waco Street, the Autumn Heights Area and the West 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 6 soil borings and 6 bituminous cores obtained along Sunwood Drive and Waco Street.

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 slated for improvement include Sunwood Drive from its intersection with St. Francis Boulevard (aka Highway 47) to its intersection with Waco Street and Waco Street from its intersection with Sunwood Drive and extending north to about the intersection with 150th Avenue NW. Total length of the alignment was estimated to be about 2,500 feet.

Sunwood Drive and Waco Street are 2-lane bituminous surfaced, residential roadways that provide access to numerous single-family homes on the east side of St. Francis Boulevard. Because of the fairly large number of homes in the area it is possible the roadways could be classified as "collector" routes.

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 Sunwood Drive and Waco Street project included the following tasks:

- Performing 6 standard penetration test borings each to a nominal depth of 14 ½ feet.
- Coring the pavement at 6 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.

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. The boring location sketch is the figure provided in the RFP.

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 6 standard penetration test borings were advanced on September 13th and 14th, 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 diamond studded core barrel using wet coring techniques. Shallow hand auger borings were then advanced through the aggregate base or possible aggregate base to aid in measuring its thickness.

3.0 RESULTS

3.1 Pavement Section

Each of the 6 soil borings were taken within an existing bituminous surfaced roadway. The pavement sections consisted of varying thicknesses of bituminous and aggregate base or Possible aggregate base. The observed pavement section thicknesses are summarized in Table 1 below. Photographs of the pavement cores are included in the Appendix.

Table 1. Summary of Existing Roadway Section

Boring Number	Station	Approximate Bituminous Thickness (inches)†	Approximate Aggregate Base Thickness (inches)†	Subgrade Soil Type
Sunwood Drive				
SB-01	1+00	3 ¾	6	SP
SB-02	7+00	4 ¾	7	SP
SB-03	13+00	3 ¾	6 ½	SP
SB-04	18+29	5	7	SP
Waco Street				
SB-05	5+00	5	5 ½	SP
SB-06	8+85	6 ½	11	SP

SB = Soil Boring SP = Poorly Graded Sand

3.2 Soil Conditions

Beneath the pavement section the soil borings encountered native alluvial deposits that extended to the termination depths of the borings. The native alluvial deposits consisted of fine to coarse grained poorly graded sand that contained varying amounts of gravel. The sands generally correspond to the ASTM Classification SP.

N-Values within the native sands ranged from 1 to 24 bpf. These values indicate the sands had a very loose to medium dense relative density.

3.3 Groundwater

Groundwater was encountered in soil boring SB-2 at about 12 below the ground surface corresponding to about elevations 855 ½. Groundwater was not observed in the remaining borings. 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)*
SB-01	874.3	NE	-
SB-02	867.5	12	855 ½
SB-03	871.8	NE	-
SB-04	881.4	NE	-
SB-05	879.6	NE	-
SB-06	881.5	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

Six (6) laboratory moisture content tests and 6 percent passing the #200 sieve (P-200) tests were performed on selected samples of the aggregate base or possible aggregate base materials. Laboratory P-200 contents of the aggregate base materials ranged from about 6 ½ percent to 11 percent. It should be noted that the aggregate base materials appeared to contain very little "gravel" and for that reason the material was described as possible aggregate base. Table 3 below provides a summary of the laboratory testing. Laboratory moisture contents and P-200 contents are also shown on the boring logs adjacent to the samples tested.

Table 2. Summary of Laboratory Analysis

Boring Number	Sample	Depth (feet)	Moisture Content (%)*	P-200 (%)*
SB-01	AU-1	Possible Agg Base	3 ½	11
SB-02	AU-8	Possible Agg Base	3	7 ½
SB-03	AU-15	Possible Agg Base	4	7
SB-04	AU-22	Possible Agg Base	7	6 ½
SB-05	AU-29	Possible Agg Base	3	7
SB-06	AU-37	Possible Agg Base	3	7

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

3.5 OSHA Soil Classification

The soil encountered in the borings consisted of poorly graded sand corresponding to the ASTM Classifications SP. 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 Sunwood Drive from its intersection with St. Francis Boulevard (aka Highway 47) to its intersection with Waco Street and Waco Street from its intersection with Sunwood Drive and extending north to about the intersection with 150th Avenue NW. Total length of the alignment was estimated to be about 2,500 feet.

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, the city is assessing the existing sanitary sewer and storm sewer pipes for damage and is anticipating that some repairs will likely be required. Fixes, if any, will likely be spot fixes and not wholesale replacement of the pipe networks.

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 storm sewer sanitary sewer or watermain utilities are anticipated to be on the order of 5 to 10 feet.

We were not provided any information regarding traffic volumes such as Average Annual Daily Traffic (AADT) counts or vehicle distribution for the roadways. Information obtained from the Minnesota Department of Transportation Traffic Mapping Application website indicates that the 2019 traffic count(s) along Sunwood Drive was 1750 vehicles per day. Information regarding vehicle distribution was not provided. For the purposes of this evaluation, we assumed these roadways are used mainly by automobiles, light trucks and school buses with some heavier vehicles such as garbage trucks and UPS or FedEx type delivery vehicles. Based on an AADT of 1750 vehicles we estimate the pavement are subjected to about 265,000 to 270,000 Equivalent Single Axle Loads (ESAL's) over a design life of 20 years. Please note the estimated ESAL's were based on 2019 traffic data and 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

Roadways Based on a brief review of historical aerial photographs available on Google Earth and the Anoka County GIS website it appears that the streets were originally built sometime around 1990 thru about 1997 and based on that they appear to be approaching or have exceeded their assumed 20-year design life.

Observations of the bituminous cores appears to indicate that the roadways were seal coated/chip coated as evidence by smaller sized aggregate at the surface of the cores. It further appears that some of the roadways may have been overlaid, especially near soil boring /core 06. The core at SB-06 was about 6 ½ inches thick or about 1 ½ inches thicker, or more, that the cores at soil borings SB-01 thru SB-05 .

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.

Aggregate Base An apparent aggregate base layer was observed below the pavements at each boring location. The 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 due to traffic or possibly due to frost action.

Soils The borings encountered sandy subgrade soils consisting of poorly graded sand corresponding to the ASTM Classification SP. These soils are considered non-frost susceptible and are also free draining materials and are well suited for pavement support and.

Where spot fixes of the utilities will occur, we anticipate that the soils excavated for utility repairs will be reused to the greatest extent possible. The soils encountered in the borings in our opinion is suitable for reuse. We recommend that any unsuitable materials such as buried topsoil, organic soils and any soft or otherwise unsuitable materials, if encountered, be removed and replaced with suitable compacted engineered fill.

Groundwater Ground water was encountered in one of the sol borings (SB-02) at about 12 feet below the ground surface. With pipe inverts anticipated to bear about 7 to 10 feet below the ground surface we do not anticipate that groundwater will be encountered during spot utility repairs and do not anticipate that dewatering will be required.

4.3 Utility Recommendations

Spot utility repairs could be included in this project. We anticipate that the existing utilities bear at depths ranging from about 5 to 10 feet below the ground surface and at these depths the pipes likely bear on sandy alluvial soils or compacted engineered fill which in our opinion are suitable for pipe support. We recommend removing all vegetation, topsoil, organic soils and any soft or otherwise unsuitable soils, if any, beneath utilities prior to repair or 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 to 10 feet below the ground surface. At typical 1:1 excavation backslopes, the excavation will extend about 5 to 10 feet beyond the edges of the excavation. The excavation may extend into/onto adjacent properties posing a risk of undermining structures on those properties. 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 **N**ew pavements will be constructed over the top of the utility trench(s) and the soil excavated for pipe installation will likely be placed back in the excavations, to the greatest extent possible. As noted above, the soils encountered in the borings in our opinion is suitable for reuse. We recommend that any buried topsoil, organic soils and any soft or otherwise unsuitable materials, if encountered, be removed and replaced with suitable compacted engineered fill.

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 recommended. In landscaped areas, if any, 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. However, we 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 existing aggregate base. Using MN/DOT granular equivalencies, one (1) inch of bituminous is equivalent to 2.25 inches of MN/DOT Class 5 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 SP can range from 50 to 70. 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 section presented below is not absolute. Depending on serviceability expectations, material availability, and cost, there could be circumstances under which alternative sections will be more practicable.

Based on an estimated R-value of 50 and a maximum of 270,000 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.

4.5 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 will likely 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 poorly graded sand corresponding to the ASTM Classifications SP. 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.

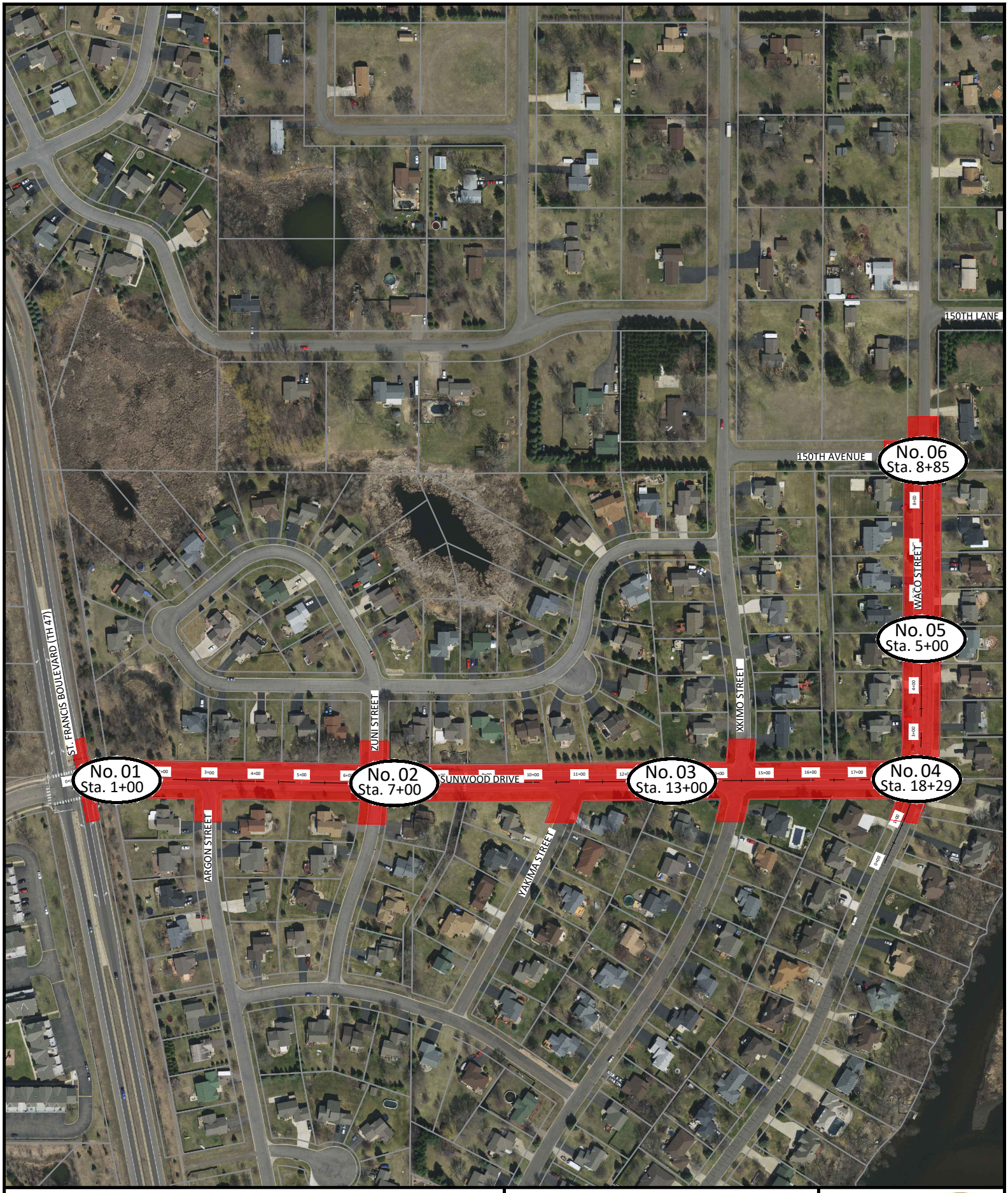
7.4 Use of Report

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 22-01
SUNWOOD DRIVE & WACO STREET
SOIL BORING LOCATION MAP

0 1/20 2/20 3/20
SCALE (MILE)

N

City of RAMSEY

Figure 2: GPS Boring Locations

Boring Number	Elevation (US Survey Feet)	Northing Coordinate	Easting Coordinate
SB-01	874.3	175074.4	465325.1
SB-02	867.5	175086.0	465927.1
SB-03	871.8	175077.2	466524.4
SB-04	881.4	175093.2	467052.0
SB-05	879.6	175392.9	467068.0
SB-06	881.5	175776.6	467066.7

Referencing Minnesota County Coordinates Basis – Anoka County

HAUGO GEOTECHNICAL SERVICES
Haugo GeoTechnical Services
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959
Fax: 763-445-2238

BORING NUMBER SB-01

CLIENT City of Ramsey
PROJECT NAME IP 22-01 Sunwood Drive & Waco Street Reconstruction
PROJECT NUMBER 21-0832
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/13/21 **COMPLETED** 9/13/21
GROUND ELEVATION 874.3 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** JM
AT END OF DRILLING --- Not Encountered
NOTES 1+00 Sunwood Drive
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 3.75 Inches of Bituminous Asphalt					
		Approximately 6 Inches of Possible Aggregate Base					
		P-200=11%	AU 1			3.5	
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, loose to medium dense. (Glacial Outwash)					
2.5			SS 2		5-5-6 (11)		
5.0			SS 3		2-2-3 (5)		
7.5			SS 4		2-2-3 (5)		
10.0			SS 5		4-2-4 (6)		
12.5			SS 6		5-5-6 (11)		
			SS 7		4-5-8 (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 14.5 feet.

HAUGO GEOTECHNICAL SERVICES
Haugo GeoTechnical Services
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959
Fax: 763-445-2238

BORING NUMBER SB-02

CLIENT City of Ramsey
PROJECT NAME IP 22-01 Sunwood Drive & Waco Street Reconstruction
PROJECT NUMBER 21-0832
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/13/21 **COMPLETED** 9/13/21
GROUND ELEVATION 867.5 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** 12.30 ft / Elev 855.20 ft
LOGGED BY GD **CHECKED BY** JM
▼ **AT END OF DRILLING** 12.10 ft / Elev 855.40 ft
NOTES 7+00 Sunwood Drive
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0.0		Approximately 4.75 Inches of Bituminous Asphalt					
		Approximately 7 Inches of Possible Aggregate Base	AU 8			3	
		P-200=7.5%					
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, loose to medium dense. (Glacial Outwash)					
2.5			SS 9		6-5-6 (11)		
5.0			SS 10		3-3-3 (6)		
7.5		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, waterbearing, very loose to loose. (Glacial Outwash)	SS 11		2-2-2 (4)		
10.0			SS 12		2-1-2 (3)		
12.5	▼▽		SS 13		3-3-6 (9)		
			SS 14		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 14.5 feet.

Haugo GeoTechnical Services
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959
Fax: 763-445-2238

BORING NUMBER SB-03

CLIENT City of Ramsey
PROJECT NAME IP 22-01 Sunwood Drive & Waco Street Reconstruction
PROJECT NUMBER 21-0832
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/13/21 **COMPLETED** 9/13/21
GROUND ELEVATION 871.8 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** JM
AT END OF DRILLING --- Not Encountered
NOTES 13+00 Sunwood Drive
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 3.75 Inches of Bituminous Asphalt					
		Approximately 6.5 Inches of Possible Aggregate Base				4	
		P-200=7%	AU 15				
		(SP) Poorly Graded Sand, fine grained, brown, moist, very loose to medium dense. (Glacial Outwash)					
2.5			SS 16		1-2-2 (4)		
		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, moist, very loose to medium dense. (Glacial Outwash)					
5.0			SS 17		6-8-6 (14)		
7.5			SS 18		2-2-2 (4)		
10.0			SS 19		1-1-1 (2)		
			SS 20		4-4-3 (7)		
12.5		(SP) Poorly Graded Sand, fine coarse, light brown, moist, loose. (Glacial Outwash)	SS 21		4-4-5 (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 14.5 feet.

HAUGO GEOTECHNICAL SERVICES
Haugo GeoTechnical Services
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959
Fax: 763-445-2238

BORING NUMBER SB-04

CLIENT City of Ramsey
PROJECT NAME IP 22-01 Sunwood Drive & Waco Street Reconstruction
PROJECT NUMBER 21-0832
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/13/21 **COMPLETED** 9/13/21
GROUND ELEVATION 881.4 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** JM
AT END OF DRILLING --- Not Encountered
NOTES 18+29 Sunwood Drive
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 5 Inches of Bituminous Asphalt (No Apparent Aggregate Base)					
		Approximately 7 Inches of Possible Aggregate Base	AU 22			4.5	
		P-200=6.5%					
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, very loose to medium dense. (Glacial Outwash)					
2.5			SS 23		5-6-6 (12)		
5.0			SS 24		3-3-2 (5)		
7.5			SS 25		2-1-1 (2)		
10.0			SS 26		2-0-1 (1)		
12.5			SS 27		1-1-1 (2)		
			SS 28		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 14.5 feet.

HAUGO GEOTECHNICAL SERVICES
Haugo GeoTechnical Services
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959
Fax: 763-445-2238

BORING NUMBER SB-05

CLIENT City of Ramsey
PROJECT NAME IP 22-01 Sunwood Drive & Waco Street Reconstruction
PROJECT NUMBER 21-0832
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/14/21 **COMPLETED** 9/14/21
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** JM
AT END OF DRILLING --- Not Encountered
NOTES 5+00 Waco 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 5 Inches of Bituminous Asphalt					
		Approximately 5.5 Inches of Possible Aggregate Base	AU 29			3	
		P-200=7%					
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, very loose to medium dense. (Glacial Outwash)					
2.5			SS 30		4-4-4 (8)		
5.0			SS 31		2-1-1 (2)		
7.5			SS 32		3-5-5 (10)		
10.0			SS 33		3-4-5 (9)		
12.5			SS 34		4-6-6 (12)		
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, medium dense. (Glacial Outwash)	SS 35		7-11-13 (24)		

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

Bottom of borehole at 14.5 feet.

HAUGO GEOTECHNICAL SERVICES
Haugo GeoTechnical Services
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959
Fax: 763-445-2238

BORING NUMBER SB-06

CLIENT City of Ramsey
PROJECT NAME IP 22-01 Sunwood Drive & Waco Street Reconstruction
PROJECT NUMBER 21-0832
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/14/21 **COMPLETED** 9/14/21
GROUND ELEVATION 881.5 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** JM
AT END OF DRILLING --- Not Encountered
NOTES 8+85 Waco Drive
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 5 Inches of Bituminous Asphalt					
		Approximately 11 Inches of Possible Aggregate Base P-200=7%	AU 36			3	
		(SP) Poorly Graded Sand, fine grained, trace Gravel, brown, moist, medium dense. (Glacial Outwash)					
2.5			SS 37		4-7-5 (12)		
5.0		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, moist, loose to medium dense. (Glacial Outwash)	SS 38		3-3-3 (6)		
7.5			SS 39		2-1-4 (5)		
10.0			SS 40		2-4-4 (8)		
12.5			SS 41		4-5-6 (11)		
			SS 42		4-6-6 (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 14.5 feet.

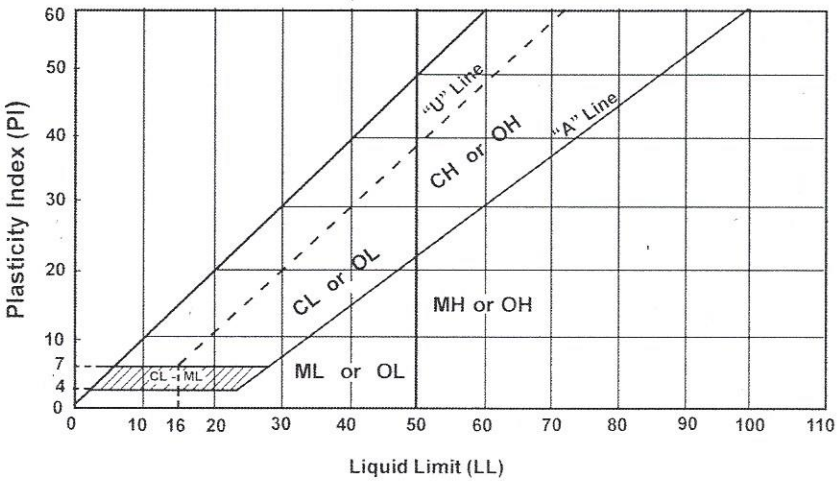
HAUGO GEOTECHNICAL SERVICES

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.

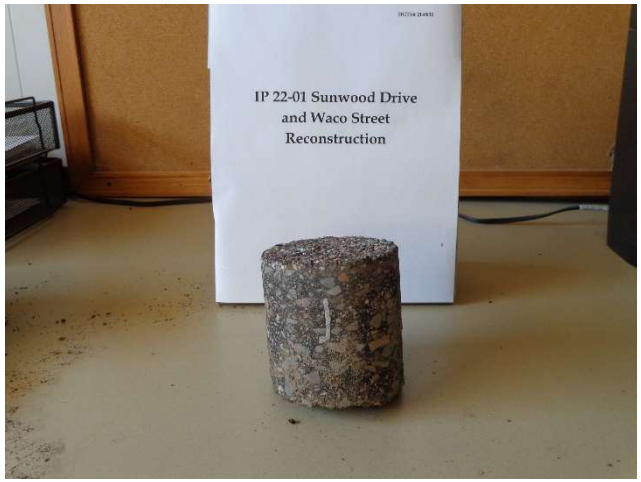


Photo # 1. Core SB-01, 1+00 Sunwood Drive.

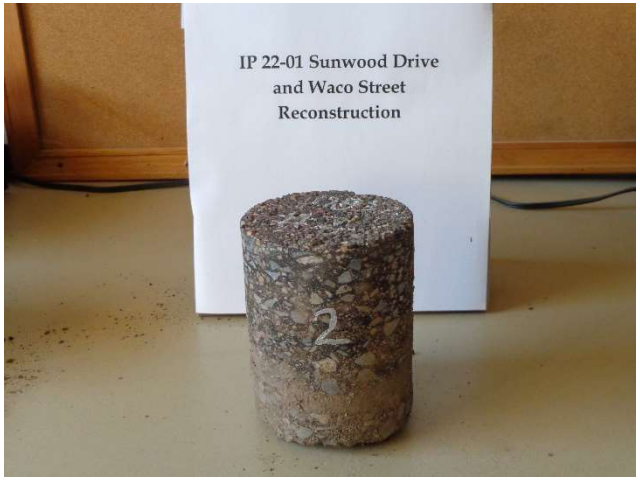


Photo # 2. Core SB-02, 7+00 Sunwood Drive.

Photo # 3. Core SB-03, 13+00 Sunwood Drive.

Photo # 4. Core SB-04, 18+29 Sunwood Drive.

Photo # 5. Core SB-05, 5+00 Waco Street.

Photo # 6. Core SB-06, 8+85 Waco Street.