FEASIBILITY REPORT

ALPINE DRIVE RECONSTRUCTION

CITY IMPROVEMENT PROJECT NO. 17-01

January 19, 2017

Prepared By:

City of Ramsey
Engineering Department
7550 Alpine Drive
Ramsey, MN 55303
763-433-9820
763-433-9848 (Fax)

January 19, 2017

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

Re: Feasibility Report - City of Ramsey Improvement Project #17-01
Alpine Drive Reconstruction

Dear Mayor and City Council Members:

Transmitted herewith is a Feasibility Report for the proposed Alpine Drive Reconstruction project between Armstrong Boulevard/CSAH 83 and Variolite Street which examines the feasibility of reconstructing the bituminous street section and completing other appurtenant improvements.

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

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

Sincerely,
City of Ramsey

Bruce Westby, PE
City Engineer

Enclosure

C: Kurt Ulrich, City Administrator
Diana Lund, Finance Director
Grant Reimer, Public Works Superintendent
Leonard Linton, Civil Engineer IV

CERTIFICATION

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

Bruce Westby, PE

Date: January 19, 2017 License No. 40116

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

Leonard Linton, PE

Date: January 19, 2017 License No. 21112

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1. EXECUTIVE SUMMARY

City Improvement Project 17-01 proposes to reconstruct Alpine Drive between Armstrong Boulevard/CSAH 83 and Variolite Street which totals approximately 3,600 linear feet (0.68 miles) in length. A map showing the location and scope of the proposed improvements is included as ***Figure 1*** in ***Appendix A***.

Based on record plans, this segment of Alpine Drive was constructed in 2001 with 3.5 inches bituminous pavement, 6 inches class 5 aggregate base, B618 concrete curb and gutter, and concrete storm sewer. However, field observations show that the 6 inch class 5 aggregate base was substituted with roughly 5 inches of recycled crushed concrete base. No information on the reason for this substitution could be found. The street was constructed to a width of 32 feet from face-of-curb to face-of-curb in locations where parking is restricted, and to 38 feet from face-of-curb to face-of-curb in locations where parking is allowed along one side. Alpine Drive is centered within an 80 foot wide right-of-way. The storm sewer system consists of numerous catch basins which drain runoff from the street to adjacent low-lying areas using concrete storm sewer pipes.

City staff evaluates and rates the condition of pavement sections on all city streets on an annual basis using the Pavement and Surface Evaluation Rating (PASER) system. In the fall of 2016, the pavement section of the above-referenced street segment were rated with a PASER rating of 3 which indicates this street is past the point of applying mill and overlay improvements. The current condition of this street requires City staff to patch the street at least once per year, particularly before winter so the street can be plowed without tearing up the pavement in the process. Pictures of the street are located in ***Appendix A***.

Proposed improvements include removing and replacing damaged sections of concrete curb and gutter and reconstructing the existing bituminous pavement section using a process known as Full Depth Reclamation, or FDR. This process would involve reclaiming the entire existing bituminous pavement section along with the existing recycled concrete base material. A portion of this reclaimed (ground and mixed) material would then be spread and compacted on top of the reshaped and compacted subgrade. Then 3.5 inches of bituminous pavement would be placed, resulting in a 10-ton pavement design meeting current State Aid standards.

The existing storm sewer system is in good condition and generally meets current State Aid design standards and therefore requires only minimal improvements including three catch basins and about 100 feet of pipe. An off-street bike trail exists along the south side Alpine Drive but is in relatively good condition and is not proposed to be improved as part of this project.

The engineer's opinion of probable costs for completing the proposed improvements on Alpine Drive as outlined in this report is $463,000. Estimated costs include 23% indirect costs for administrative, engineering, finance and legal costs. A summary of the engineer's opinion of probable costs is included in ***Appendix B***.

No parcels have been identified as receiving special benefit from the improvements so the use of special assessments as a funding source for this project is not proposed.

A total of four pavement corings were completed by WSB and Associates (WSB) to assist with the preparation of this report. In addition, thirteen soil borings were completed by Northern Technologies, Inc. (NTI). Both firms offered pavement design recommendations which were considered and incorporated to varying degrees while preparing this report. Copies of WSB's and NTI's reports are attached in ***Appendix C***.

This improvement project, which is listed in the City's current Capital Improvement Program, is proposed to be funded using a combination of street reconstruction bond proceeds and stormwater utility funds.

Staff has not yet had an opportunity to discuss the proposed improvements with local property owners. However, upon Council acceptance of this report Staff will immediately contact local property owners for the purpose of explaining the proposed improvements and to request a meeting to discuss the proposed improvements in more detail and to gather their input on the project, including any information that should be explored in more detail during development of plans and specifications. Staff will then present this information to Council at the time plans and specifications are presented to Council for approval.

This project would best be constructed as a stand-alone project and is necessary, feasible, and cost-effective from an engineering standpoint, and can be constructed as proposed herein.

2. INTRODUCTION

2.1 Authorization

The preparation of this report was authorized by the Ramsey City Council on August 9, 2016. This project has been designated as City Improvement Project No. 17-01.

2.2 Program Overview

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

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

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

In the fall of 2016, City staff evaluated and rated the condition of the pavement along this segment of Alpine Drive. A PASER rating of 3 was determined for the segment of Alpine Drive between Armstrong Boulevard and Variolite Street.

2.3 Scope

City of Ramsey Improvement Project 17-01 proposes to reconstruct the existing bituminous pavement, to remove and replace damaged concrete curb and gutter sections, and to complete other appurtenant work on Alpine Drive between Armstrong Boulevard and Variolite Street which totals approximately 3,600 linear feet (0.68 miles) in length.

The existing bituminous pavement section is proposed to be reconstructed using the FDR process. This involves reclaiming the entire bituminous pavement section along with the existing recycled concrete base, hauling and disposing of excess reclaim material off site, spreading and compacting the reclaimed material on top of the reshaped and compacted subgrade, then placing 3.5 inches of new bituminous pavement on top. This results in a 10-ton pavement design meeting current State Aid standards.

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

3. EXISTING CONDITIONS

3.1 Existing Pavement and Soil Conditions

Based on record plans, this segment of Alpine Drive was constructed in 2001 with 3.5 inches bituminous pavement, 6 inches class 5 aggregate base, B618 concrete curb and gutter, and concrete storm sewer. However, field observations show that the 6 inch class 5 aggregate base was substituted with roughly 5 inches of recycled crushed concrete base. No information on the reason for this substitution could be found.

The street was constructed to a width of 32 feet from face-of-curb to face-of-curb in locations where parking is restricted, and to 38 feet from face-of-curb to face-of-curb in locations where parking is allowed along one side. The street is centered within an 80 foot right-of-way, and striping is used to delineate the parking lanes.

The only pavement maintenance treatment that has been applied to this segment of Alpine Drive was spot patching on an as-needed basis. In 2016, Staff observed a Pavement and Surface Evaluation Rating (PASER) of 3.

In 2011, MnDOT recorded a traffic volume of 1,100 average annual daily traffic (AADT). While truck counts are not available, Staff believes it is reasonable to assume less than 5 percent of vehicles using this street segment can be classified as truck traffic, and that the percentage of trucks using this corridor will not substantially increase over time. The posted speed is 45 mph.

Northern Technologies, Inc. (NTI) was employed to complete a Geotechnical Exploration and Engineering Review for this project, which included thirteen (13) soil borings that were spaced at approximately 200 feet along Alpine Drive. The locations of the borings are shown in the Boring Location Diagram in Appendix C of NTI's report, attached in ***Appendix C.***

The soil borings provide information on existing bituminous pavement and aggregate base course thicknesses, subsurface soil conditions, existing ground water elevations, and potential issues that may be encountered during construction. All borings terminated at a nominal depth of 11 feet below the existing ground surface. Groundwater was observed in two soil borings at depths ranging between 10 and 10.5 feet below the existing ground surface. Based on the work proposed and the recorded water level depths, groundwater is not anticipated to be a significant issue for work completed with this proposed project.

The soil borings generally indicate that existing bituminous pavement thicknesses range between 3.5 to 5.0 inches. Apparent aggregate base was observed in five boring locations. Previously placed fill soils, generally consisting of poorly graded sand with silt and poorly graded sand with silt and gravel (SP-SM), poorly graded sand with clay (SP-SC), and clayey sand (SC) are present at depths ranging from 3.0 to 9.5 feet below the top of the pavement. Native alluvial soils consisting of poorly graded sand (SP) and poorly graded sand with silt (SP-SM) generally extend to the bottom of the borings.

WSB and Associates (WSB) was employed to complete a total of four pavement corings. Their results showed an average bituminous pavement thickness of 4 inches, which was constructed over approximately 5 inches of recycled concrete base material.

3.2 Watermain

Watermain does not exist on site.

3.3 Sanitary Sewer

Sanitary sewer does not exist on site.

3.4 Storm Sewer/Drainage

Storm sewer exists along the entire segment of Alpine Drive. Based on design calculations completed by City staff, minor modifications are required to the existing storm sewer system to meet current State Aid standards. This will require the addition of three catch basins and approximately 100 feet of storm sewer pipe. Stormwater runoff is currently conveyed within the concrete curb and gutter along the outside edges of Alpine Drive, where it is then collected in concrete catch basins and routed through concrete storm sewer pipes to existing wetlands, stormwater drainage ditches, and ponding facilities.

3.5 Streets

3.5.1 Existing Typical Sections

The width of Alpine Drive varies between 32 feet from face-of-curb to face-of-curb in locations where parking is restricted, and 38 feet from face-of-curb to face-of-curb in areas where parking is allowed. The street is centered within an 80 foot wide City-owned right-of-way. The eight foot parking lanes are delineated with striping.

3.5.2 Maintenance History

This segment of Alpine Drive was originally constructed in 2001 and has not received any proactive pavement maintenance other than spot patching on an as-needed basis.

3.6 Land Use

The developed properties abutting the west end of this street segment are zoned residential.

A wetland complex exists along the south side of Alpine Drive.

4. PROPOSED IMPROVEMENTS

4.1 Street and Stormwater Improvements

The segment of Alpine Drive between Armstrong Boulevard and Variolite Street is part of the City's Municipal State Aid System (MSAS). The proposed improvements must therefore be designed and constructed in accordance with current Minnesota Department of Transportation (MnDOT) State Aid standards which are generally based on the street's functional classification, projected traffic volume, design speed, lane designations and widths, and proposed pedestrian facilities.

Based on the proposed design, Alpine Drive must be reconstructed in accordance with State Aid Rule 8820.9936 or 8820.9946. This will depend on the percentage of damaged curb and gutter that needs to be removed and replaced, which will be determined during final design.

The scope of the proposed surface improvements is shown in ***Figure 1*** in ***Appendix A***.

4.1.1 Street Improvements

Alpine Drive is proposed to be reconstructed with bituminous pavement matching the existing widths thereby permitting some on-street parking along the south side. This design will meet current State Aid standards. All damaged B618 concrete curb and gutter is proposed to be removed and replaced in kind. A typical section for the proposed pavement reconstruction improvements is shown in ***Figure 2*** in ***Appendix A.***

The proposed reconstructed pavement design must accommodate a 10-ton design in accordance with State Aid design standards. City staff is proposing a pavement section design of 1.5 inches bituminous wear course, 2 inches bituminous base course, and 6 inches of aggregate base composed of full depth reclamation material. This pavement section would be constructed over the existing subgrade after it is reshaped and compacted.

The proposed pavement design should result in a minimum pavement life of 30 years, assuming that proactive, regular pavement maintenance treatments are performed during the life of the pavement. While a 60-year design life would typically be targeted for a reconstructed street, this project is not proposing a full reconstruction due to the good condition of the majority of existing 15 year old curb and gutter. Therefore, only the recycled concrete base and bituminous sections are proposed to be reconstructed now as it may make sense to replace the pavement section at the time the rest of the existing curb and gutter is replaced, which may be 40 or more years in the future.

4.1.2 Stormsewer Improvements

The existing storm sewer system is in good condition but will require the addition of three catch basins and 100 feet of storm sewer pipe to meet all current State Aid standards. In addition, several catch basin castings will require minor improvements. No stormwater quality treatment improvements are required for this project since the street is proposed to be reconstructed at its current width.

4.1.3 Geotechnical Considerations

Northern Technologies, Inc. (NTI) completed a Geotechnical Exploration and Engineering Review including thirteen (13) soil borings spaced at approximate 200 foot intervals along Alpine Drive. The locations of the borings are shown in the Boring Location Diagram in Appendix C of NTI's report, attached in ***Appendix C***. NTI recommends completing a full reconstruction with subgrade corrections and the removal and replacement of all concrete curb and gutter. This work would result in project costs approximately twice as much as the current estimate included in this report, and would result in significant traffic impacts during construction.

WSB completed four (4) pavement cores along Alpine Drive as shown in their Pavement Evaluations and Recommendations report, attached in ***Appendix C***. WSB recommends leaving all intact existing curb and gutter in place, which staff estimates accounts for over 80% of the existing curb and gutter, which is only 15 years old. WSB also recommends reconstructing only the recycled concrete base and bituminous pavement using a Full Depth Reclamation process. In total, this work is estimated to cost half as much as a total reconstruction yet would result in a pavement design life of 30-plus years. In considering that the remaining curb and gutter will likely need to be replaced in about 40 years, a total reconstruction could be evaluated at that time. Another benefit to this design is that it would result in minimal impacts to traffic during construction.

4.1.4 Other Considerations

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

Irrigation Systems:
Developed properties along the project corridor may have private irrigation systems. However, impacts to these systems would only occur if the existing curb and gutter is being removed and replaced. In the past, the City has typically repaired private irrigation systems that are damaged as part of a street reconstruction project. However, staff will be requesting Council permission to change this practice on all future projects by instead notifying property owners of pending construction at least 15 business days in advance to allow them time to move their irrigation systems out of harm's way before work begins.

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

4.2 Stormwater Treatment

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

4.3 Water Main Improvements

No watermain improvements are proposed with this project.

4.4 Sanitary Sewer Improvements

No sanitary sewer improvements are proposed with this project.

4.5 Construction Methods

The existing bituminous pavement section will be reconstructed using the FDR process outlined within this report. See WSB and Associates Pavement Evaluations and Recommendations report in ***Appendix C*** for additional details on the FDR process.

4.6 Private Utilities

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

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

4.7 Permits

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

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

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

4.8 Right-of-Ways/Easements

It is anticipated that all improvements will occur within existing City right-of-ways and/or easements, with the possible exception of tying into private driveways and yards. It is therefore not anticipated that the City will need to acquire additional permanent right-of-way or easements for this project. As such, costs for right-of-way or easement acquisitions are not included in the probable project costs.

City staff will obtain any required right of entries.

5. FINANCING

5.1 Opinion of Cost

A detailed opinion of probable costs for the proposed improvements can be found in ***Appendix B*** of this report. The opinion of probable costs incorporates anticipated 2017 construction costs for the proposed improvements plus 23% indirect costs for administrative, engineering, financing and legal costs. Construction contingency costs are not included in the estimated costs.

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

NTI prepared the Geotechnical Exploration and Engineering Review, included in ***Appendix C***, at a cost of $4,400. WSB and Associates, Inc. prepared the Pavement Evaluations and Recommendations included in ***Appendix C***, at the not-to-exceed cost of $2,687.50.

5.2 Funding

5.2.1 Assessments

The use of special assessments is not being proposed with this project.

5.2.2 City Contribution

The City will fund this project in its entirety. No funds have been budgeted for this project. The City's share of eligible project costs related to surface (street) improvements is proposed to come from the previously encumbered 5-year Street Reconstruction and Overlay Program bonds. Stormwater Utility Funds are proposed to pay for all storm sewer improvements.

Table 1 illustrates the proposed project funding based on the proposed design outlined within this report. This funding program assumes construction will occur in 2017.

TABLE 1
Proposed Project Funding

	ASSESSMENTS	CITY FUNDS	TOTAL
Estimated Costs	**$0**	**$463,000**	**$463,000**

Total Project Cost		**$463,000**
Less Special Assessments	-	$0
Subtotal	**=**	**$463,000**
Less City Bonding Funds	-	$420,065
Subtotal	**=**	**$42,355**
Less Stormwater Utility Funds	-	$42,355
TOTAL Remaining Cost	**=**	**$0**

6. PROJECT SCHEDULE

The proposed project schedule is as follows:

Council Orders Feasibility Report ..... August 9, 2016

Council Accepts Feasibility Report/Authorizes Plans and Specifications ..... January 24, 2017

Public Input Meetings ..... February/March, 2017

Staff Conducts Private Utility Coordination Meeting ..... February/March, 2017

Council Approves Plans and Specifications/Authorizes Ad for Bids ..... March 28, 2017

Staff Advertises for Bids ..... March 31 & April 7, 2017

Staff Receives Bids ..... April 27, 2017

Council Awards Contract ..... May 9, 2017

Contractor Begins Construction ..... May/June 2017

Contractor Completes Construction ..... September 8, 2017

7. CONCLUSIONS AND RECOMMENDATIONS

City of Ramsey Improvement Project 17-01 proposes to reconstruct the bituminous pavement section, to remove and replace damaged concrete curb and gutter, and to complete miscellaneous appurtenant work on Alpine Drive between Armstrong Boulevard and Variolite Street. This street segment measures approximately 3,600 linear feet (0.68 miles).

It is the recommendation of City staff that City Project No. 17-01 is feasible, necessary, and cost-effective from an engineering standpoint, and that this project would best be constructed as a stand-alone project as proposed herein.

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

1. Staff recommends reconstructing the segment of Alpine Drive between Armstrong Boulevard and Variolite Street as proposed herein in 2017 thereby meeting current State Aid design standards.

2. Staff recommends reconstructing the off-road bike trail along the south side of Alpine Drive at a later date pending adoption of the City's Trail Maintenance Policy/Program.

3. Staff recommends excluding private irrigation system work from this project, and from all future City Improvement Projects, and instead recommends notifying property owners of pending construction as far in advance as possible and instructing them to relocate the irrigation system(s) away from the construction area during construction, then allow replacement in or near the original location after construction is complete.

4. Staff recommends meeting with owners of all abutting properties to inform them of the proposed improvements and to gather their input prior to completing plans and specifications and requesting Council approval to advertise for bids.

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

1. Adopt Resolution #17-01-029 accepting this Feasibility Report and authorizing preparation of Plans and Specifications based on the design proposed herein.

APPENDIX A

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

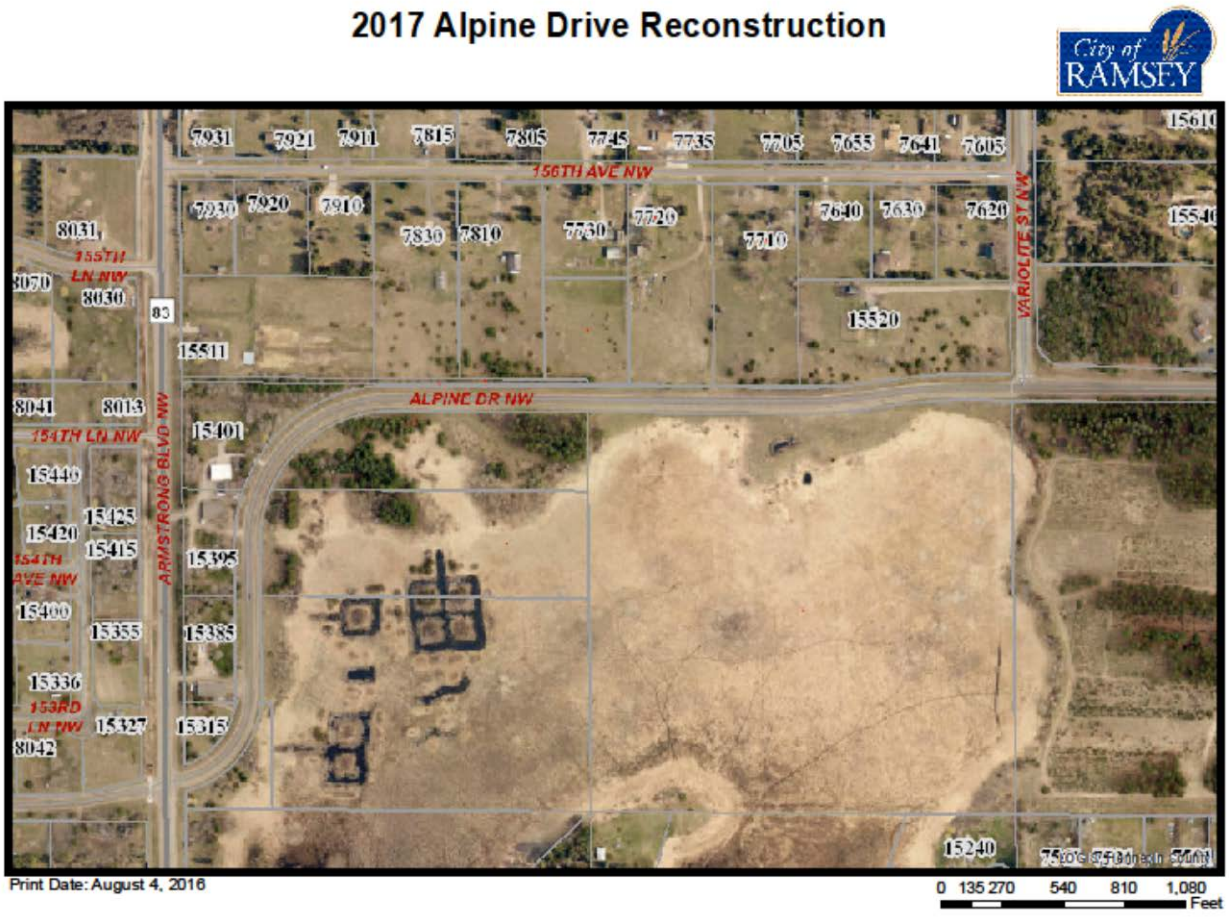

FIGURE 1
PROJECT SCOPE

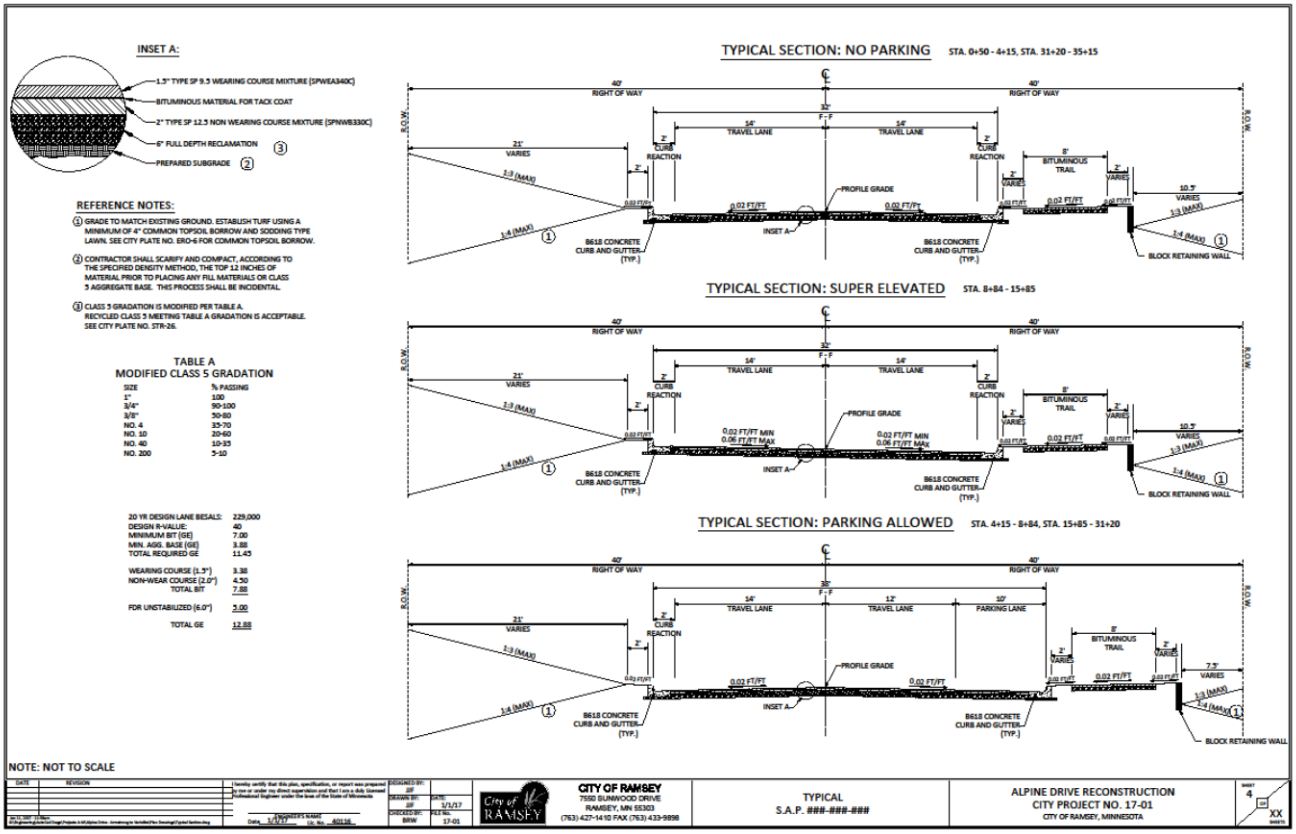

FIGURE 2
TYPICAL SECTION

PROJECT SITE PICTURES

APPENDIX B

Opinion of Probable Costs

17-01 ALPINE DRIVE RECONSTRUCTION: ARMSTRONG BLVD. to VARIOLITE STREET
ENGINEER"S ESTIMATES PER OPTION
1/11/2017

ITEM No.	MNDOT No.	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	COST EXTENSION
1	2021.501	MOBILIZATION	LS	1	$ 43,000.00	$ 43,000.00
2	2104.501	REMOVE CONCRETE CURB AND GUTTER	LF	1500	$ 6.00	$ 9,000.00
3	2104.501	REMOVE SEWER PIPE - STORM	LF	10	$ 15.00	$ 150.00
4	2104.503	REMOVE CONCRETE DRIVEWAY PAVEMENT	SF	82	$ 2.50	$ 205.00
5	2104.505	REMOVE BITUMINOUS PAVEMENT	SY	16	$ 4.50	$ 72.00
6	2104.509	REMOVE MANHOLE OR CATCH BASIN	EA	1	$ 500.00	$ 500.00
7	2104.511	SAWING CONCRETE PAVEMENT - FULL DEPTH	LF	64	$ 8.50	$ 544.00
8	2104.513	SAWING BITUMINOUS PAVEMENT - FULL DEPTH	LF	190	$ 5.50	$ 1,045.00
9	2105.522	SELECT GRANULAR BORROW (CV) - (TO POSSIBLY THIN OUT RECLAM)	CY	500	$ 12.50	$ 6,250.00
10	2105.601	UTILITY DEWATERING	LS	1	$ 2,000.00	$ 2,000.00
11	2112.501	SUBGRADE PREPARATION	RDST	36	$ 225.00	$ 8,100.00
12	2130.501	WATER	MGAL	70	$ 32.50	$ 2,275.00
13	*2215.501*	*BITUMINOUS PAVEMENT RECLAMATION (9.5" DEPTH)*	*SY*	*12740*	*$ 2.00*	$ 25,480.00
14	2232.501	MILL BITUMINOUS PAVEMENT (1.5" DEPTH)	SY	40	$ 15.00	$ 600.00
15	2331.607	HAUL BIT PAVEMENT RECLAMATION (LV)	CY	1610	$ 9.00	$ 14,490.00
16	2357.502	BITUMINOUS MATERIAL FOR TACK COAT	GAL	892	$ 2.36	$ 2,105.12
17	2360.502	TYPE SP 9.5 WEARING COURSE MIXTURE (SPWEA340C) (1.5")	TON	1261	$ 65.00	$ 81,965.00
18	2360.502	TYPE SP 12.5 NON WEARING COURSE MIXTURE (SPNWB330C) (2")	TON	1682	$ 61.00	$ 102,602.00
19	2503.541	15" RC PIPE SEWER, DESIGN 3006 CLASS III	LF	161	$ 35.00	$ 5,635.00
20	2503.602	CONNECT TO EXISTING STORM SEWER	EA	2	$ 1,200.00	$ 2,400.00
21	2506.501	CONSTRUCT DRAINAGE STRUCTURE DESIGN 48-4020	LF	10	$ 425.00	$ 4,250.00
22	2506.502	CONSTRUCT DRAINAGE STRUCTURE DESIGN 2X3 CATCH BASIN	EA	2	$ 1,500.00	$ 3,000.00
23	2506.516	CASTING ASSEMBLY	EA	4	$ 550.00	$ 2,200.00
24	2506.521	INSTALL CASTING	EA	4	$ 275.00	$ 1,100.00
25	2506.602	GROUT CATCH BASIN	EA	14	$ 300.00	$ 4,200.00
26	2506.602	ADJUST CATCH BASIN CASTING	EA	9	$ 1,000.00	$ 9,000.00
27	2521.501	6" CONCRETE WALK	SF	142	$ 7.00	$ 994.00
28	2531.501	CONCRETE CURB & GUTTER DESIGN B618	LF	1500	$ 13.00	$ 19,500.00
29	2531.507	6" CONCRETE DRIVEWAY PAVEMENT	SY	35	$ 55.00	$ 1,925.00
30	2531.618	TRUNCATED DOMES	SF	16	$ 40.00	$ 640.00
31	2563.601	TRAFFIC CONTROL	LS	1	$ 5,000.00	$ 5,000.00
32	2570.570	HYDRAULIC MATRIX TYPE MULCH	LBS	140	$ 2.00	$ 280.00
33	2573.503	SILT FENCE	LF	800	$ 3.00	$ 2,400.00
34	2573.530	STORM DRAIN INLET PROTECTION	EA	27	$ 200.00	$ 5,400.00
35	2574.508	FERTILIZER TYPE 3	LBS	14	$ 3.00	$ 42.00
36	2575.501	HYDROSEEDING MNDOT MIXTURE 25-131	ACRE	0.07	$ 6,000.00	$ 420.00
37	2575.502	MNDOT SEED MIXTURE 25-131	LBS	15	$ 5.00	$ 75.00
38	2575.525	COMMON TOPSOIL BORROW (LV)	CY	45	$ 30.00	$ 1,350.00
39	2582.502	4" DOUBLE SOLID LINE YELLOW - EPOXY	LF	1384	$ 1.00	$ 1,384.00
40	2582.502	4" BROKEN LINE YELLOW - EPOXY	LF	410	$ 0.50	$ 205.00
41	2582.502	4" SOLID LINE YELLOW - EPOXY	LF	350	$ 0.50	$ 175.00
42	2582.502	4" SOLID LINE WHITE - EPOXY	LF	6777	$ 0.50	$ 3,388.50
43	2582.503	CROSSWALK MARKINGS - EPOXY	SF	90	$ 5.00	$ 450.00

GENERAL BID ITEMS CONSTRUCTION COST	*$ 375,796.62*
23% INDIRECT COST	$ 86,433.22
TOTAL PROJECT COST	**$ 462,229.84**

APPENDIX C

Geotechnical Exploration and Engineering Review (NTI – 34 pages)
Pavement Evaluations and Recommendations (WSB & Associates – 8 pages)

NTI™
NORTHERN TECHNOLOGIES, LLC

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Inver Grove Heights, MN 55076
P: 651.389.4191 F: 651.389.4190

www.NTIgeo.com

Unearthing confidence™

November 23, 2016

City of Ramsey
Attention: Mr. Bruce Westby, P.E.
7550 Sunwood Drive NW
Ramsey, Minnesota 55303

Subject: Geotechnical Exploration and Engineering Review
Alpine Drive – Street Improvements
Ramsey, Minnesota
NTI Project No. 16.61770.100

Northern Technologies, LLC (NTI) has completed a total of thirteen (13) borings for the Alpine Drive project area in the City of Ramsey, Minnesota.

The scope of services included determining existing bituminous and aggregate base thicknesses, and subsurface conditions, and providing recommendations for site preparation, excavations, engineered fill and compaction, depths of unsuitable soils to be removed, groundwater management, potential difficulties during construction, utility installation, and pavement design.

Our services were performed in accordance with our proposal dated October 25, 2016.

PROJECT AND SITE DESCRIPTION

The project includes street and possibly utility improvements to a section of Alpine Drive between Armstrong Boulevard and Variolite Street in Ramsey, Minnesota.

The pavement sections are proposed to be designed using the average annual daily traffic (AADT) information and based on a 20-year design pavement life. The AADT information noted on the Mn/DOT Traffic Data webpage indicates an AADT of 1000 for the project section of Alpine Drive. NTI was not aware of invert elevations or other design details of the proposed utilities at the time this report was prepared.

SUBSURFACE EXPLORATION SUMMARY

NTI performed the subsurface exploration program on November 7 2016 with a two-person crew using a truck-mounted CME-55 drill rig. Samples were generally collected in accordance with ASTM D 1586 "Standard Test Method for Standard Penetration Testing (SPT) and Split-Barrel Sampling of Soils."

The boring locations and depths were determined by a representative with the City of Ramsey. The boring locations were staked in the field by NTI. The borings terminated at nominal depths 11.0 feet below the existing pavement surface. .

Elevations were not provided to NTI, therefore, NTI has assumed a ground surface elevation of 100.0 feet for each of the boring locations. Please refer to the Boring Location Diagram, the Boring Logs in Appendix C, and the Pavement Core Photographs in Appendix D.

Alpine Drive – (Borings A-1 through A-13)

Bituminous pavement thickness within this roadway area ranged from approximately 3.5 to 5.0 inches at the boring locations. Apparent aggregate base was not observed at the majority of the borings. As exceptions, apparent aggregate base was observed at Boring A-2, A-4, A-5, A-7, and A-10 locations and varied in thickness from approximately 2.5 to 24.0 inches. Occasional cobbles and hard drilling conditions were encountered at Boring A-6, A-7, A-9, A-10, A-12 and A-13 locations.

Previously placed fill soils, generally consisting of poorly graded sand with silt and poorly graded sand with silt and gravel (SP-SM), poorly graded sand with clay (SP-SC) and clayey sand (SC), were encountered extending to depths ranging from approximately 3.0 to 9.5 feet below the top of pavement.

Native alluvial soils consisting of poorly graded sand (SP) and poorly graded sand with silt (SP-SM) were commonly observed extending to the boring termination depths. Varying amounts of gravel were encountered throughout the boring locations.

Groundwater was observed in the boreholes at Borings A-5 and A-9 locations at the time of drilling at depths of 10.0 and 10.5 feet respectively. Please refer to the boring logs included in the appendices.

Table 1 summarizes the encountered subsurface conditions for this project area.

Table 1: Pavement and Subgrade Summary[1]
Alpine Drive

Boring No.	Bituminous Pavement Thickness[2] (inches)	Apparent Aggregate Base Thickness[3] (inches)	Fill Subgrade Material[4]	Native Subgrade Material
A-1	3.5	None	SP-SM	SP-SM
A-2	3.5	20.0	SP-SM	SP-SM
A-3	4.5	None	SP-SM	SP-SM
A-4[5]	4.8	24.0	SP-SM	SP-SM
A-5	4.8	4.5	SP-SC, SC	SP-SM
A-6	4.5	None	SP-SM	SP-SM
A-7	3.8	2.5	SP-SM	SP-SM
A-8	4.0	None	SP-SM	SP
A-9	3.5	None	SP-SM	SP-SM
A-10[5]	5.0	3.0	SP-SM	SP-SM
A-11	4.5	None	SP-SM	SP-SM
A-12	4.5	None	SP-SM	SP-SM
A-13	4.8	None	SP-SM	SP-SM

1. Table summary is a generalization of subsurface conditions at the individual soil boring locations only. They may not reflect variations in subsurface strata occurring on site between boring locations. The general geologic origin of retained soil samples is listed on the boring logs.
2. Measured thickness of the pavement core.
3. Apparent aggregate base thickness, at time of our fieldwork, by visual inspection only and is not meant to confer conformance with DOT specifications.
4. Undocumented fill soils.
5. Pavement core thickness may not be representative due to crumbling during coring process.

GROUNDWATER AND GROUNDWATER CONTROL

Groundwater was observed in the boreholes at Borings A-5 and A-9 locations at the time of drilling at depths of 10.0 and 10.5 feet respectively.

Depending upon elevations of underground utilities, groundwater may be an issue during construction. It should be noted that if excavations are proposed below the groundwater level, the granular nature of the majority of the on-site soils will likely result in significant volumes of water entering the excavations unless proper dewatering measures are implemented. Well points embedded into the underlying sands will likely be the most suitable method for controlling excess water in deeper excavations. If dewatering is needed during construction, we recommend that the groundwater be maintained a minimum of 2 feet below the bottom of the excavation.

LABORATORY TEST PROGRAM

Our analysis and recommendations of this report are based upon our interpretation of the standard penetration test resistance determined while sampling soils, laboratory test results and experience with similar soils from other sites near the project. The results of such tests are summarized on the boring logs or attached laboratory test reports.

UTILITY LINE CONSTRUCTION

The native sand soils observed in soil borings were generally suitable for utility support and utility backfill. Due to the encountered groundwater levels and depending on the installation depth of the utilities, temporary dewatering may be required during the utility trench excavations. Stabilization of the trench subgrade may be required in order to provide a stable platform for construction. Stabilization could consist of a one half to one foot layer of crushed rock or sand with a maximum 5 percent material passing the No. 200 sieve and 50 percent passing the No. 40 sieve.

In addition, as noted above, hard drilling in possible cobbles were encountered within the Alpine Drive project area at select boring locations. Dependent upon the depth of utility installation, pipe bedding may be required to provide a uniform bearing stratum and for protection of the utility piping when bearing upon the underlying gravel laden soils.

The Geotechnical Engineer of Record or their designated representative should observe the project excavations to determine that unsuitable materials have been properly removed and adequate bearing support is provided by the exposed soils. The exposed soil at the base should be compacted to no less than 95 percent standard Proctor maximum dry density (ASTM D698). Such observations and testing should be performed prior to backfilling.

The on-site non-organic soils are anticipated to be suitable for reuse if properly moisture conditioned and compacted. Replacement backfill required in utility trenches should consist of non-organic material similar to the surrounding soil. All import fill should be approved by NTI or the City's representative.

It is especially important that trench backfill for utility construction within paved areas be thoroughly compacted to minimize future pavement damage. We recommend that such soils be compacted in accordance with the recommendations noted in the "Placement and Compaction of Engineered Fill" section in Appendix B of this report.

The stability of embankments along utility excavations is dependent on soil strength, site geometry, moisture content, and any surcharge load for excavated soils and equipment. We present cautionary remarks concerning stability of excavation sideslopes in the "Excavation Stability" section of this report.

The Contractor is solely responsible for assessing the stability of and executing underground utility and project excavations using safe methods. The contractor is also responsible for naming the "competent individual" as per Subpart P of 29 CFR 1926.6 (Federal Register - OSHA).

The Geotechnical Engineer of Record or their designated representative should observe the project excavations to determine that conditions are similar to those encountered in the borings, and that adequate bearing support is provided by the exposed soils.

Excavation Stability

Excavation depth and sidewall inclination should not exceed those specified in local, state or federal regulations. Excavations may need to be widened and sloped, or temporarily braced, to maintain or develop a safe work environment. Contractors must comply with local, state, and federal safety regulations including current OSHA excavation and trench safety standards. Temporary shoring must be designed in accordance with applicable regulatory requirements.

Excavations that penetrate the groundwater surface will require dewatering with sand points or wells. We recommend that the groundwater surface be maintained a minimum of 2 feet below the bottom of the exposed excavation.

Engineered Fill and Winter Construction

The clayey sand soils on this site will be susceptible to frost action if not provided adequate drainage, insulation or coverage. Frozen soil should not be used as backfill. When the ambient air temperature falls below freezing for an extended period of time, frost forms, and soil near the surface grade expands. Settlement of the fill may occur as the frozen soils thaw.

If frost penetrates the soil prior to paving, soils must be thawed, scarified, and re-compacted as recommended in this report. Subgrade soils should be inspected prior to paving to verify frozen conditions are not present.

PAVEMENT RECOMMENDATIONS

Mill and Overlay Recommendations

Consideration could be made to milling and overlaying the existing pavement. The roadway sections appear to have a sufficiently thick in place pavement section, over a majority of the project alignment, which would lend itself to rehabilitation via mill and overlay techniques.

In general, pavement sections consisting of 3 inches or less of bituminous asphalt can be difficult to effectively mill and overlay as often times the entire pavement section is reclaimed during the attempted partial section milling process. Additionally, in locations where the existing pavement thickness is less than the recommended thickness, a mill and overlay would not be recommended unless a structural overlay were applied to increase the overall thickness.

Pavement Reconstruction

If the pavement section is to be removed and replaced in its entirety, the most conservative method of subgrade preparation would be remove the undocumented fill soils and replace them in their entirety with properly compacted engineered fill. This method of subgrade preparation would provide the most uniform subgrade but would also be the most costly method of construction and would be relatively a-typical method of subgrade preparation for improvements to existing municipal roadways.

If the City is willing to accept some risk in potential long term detrimental performance for the significant upfront savings, the roadway can be reconstructed over the existing fill. NTI recommends that prior to installing the aggregate base, the existing subgrade should be scarified and re-compacted to a depth of at least 12 inches. A proof roll test should then be performed to determine soft or unstable subgrade areas. The proof roll should be performed with a tandem axle dump truck loaded to gross capacity (at least 20 tons). Acceptance criteria of the proof roll shall be limited to rut formation no more than one inch depth (front or rear axles) and no pumping (rolling) observed during the visual inspection. Proof roll tests should be observed by an experienced technician or geotechnical engineer prior to placement of the aggregate base course to verify the subgrade will provide adequate pavement support.

If rutting or localized unstable subgrade areas are observed, those areas should be subcut, moisture-conditioned, and re-compacted or removed to a stable depth.

If imported fill is required in paved areas it should consist of debris free, non-organic, mineral soil similar in composition to the subgrade soils encountered in the surrounding areas. If sand is imported into areas that are underlain by relatively impervious fine grained soils the sand layer must be drained with drain tile in order to prevent frost heave from water trapped within the imported sand layer during freezing temperatures. Individual lifts of engineered fill should be tempered for moisture content, placed and compacted as noted in the "Placement and Compaction of Engineered Fill" section in Appendix B of this report.

The performance of stabilometer or similar tests, were beyond the scope of this report; however, they may be performed, upon request, for an additional fee. Based on the encountered soil conditions, we estimate that a properly prepared poorly graded sand with silt (SP-SM) and poorly graded sand clay (SP-SC) soils will have an average stabilometer R-Value of 40.

For a 20-year design pavement life, Table 3 presents our thickness recommendations for flexible (bituminous) pavement. These recommendations were based upon the encountered subgrade conditions, estimated R-value for the existing subgrade soils, the assumed AADT volumes, and the City of Ramsey's typical pavement section for the respective project area.

Table 3: Flexible Pavement Thickness Design[1]
Alpine Drive

Pavement Section	Calculated Required Pavement Section	City's Typical Pavement Section[2]
Bituminous Wear Course (inches)	1.5	1.5
Bituminous Base Course (inches)	2.0	2.0
Class 5 or 7 Aggregate Base (inches)	6.0	4.0

1. Assumed AADT volume of 1000 and an average R-value of 40.
2. The calculated required section was greater than the City's typical section for residential streets, thus NTI recommends that the Calculated Required Pavement Section be implemented.

Pavement recommendations assume the subgrade soils and aggregate section below paved surfaces will drain to subsurface piping for eventual discharge into storm sewer, or above grade to ditching, or similar acceptable systems. Lack of surface and subsurface drainage will significantly reduce the capacity and longevity of the pavement systems indicated above.

We recommend pavements receive annual maintenance, as a minimum, to correct damages to the pavement structure, clean and infill cracks which develop, and repair or resurface areas which exhibit reduced subgrade performance. The lack of maintenance can lead to moisture infiltration of the pavement structure and softening of the subgrade soils. This, in turn, can degrade the performance of the pavement system and result in poorly performing pavements with shortened life expectancy.

CLOSURE

As the widely spaced, small diameter borings provide only a limited amount of data regarding the existing fill, the existing fill may contain soft zones, debris or significantly greater amounts of unsuitable materials than could be reasonably inferred from the boring information. Unsuitable materials may not be discovered during construction and may remain buried within the fill below the slabs and pavements, resulting in greater than anticipated settlements of the slabs and pavements. These risks cannot be eliminated without completely removing the fill, but can be reduced by thorough exploration and testing during site preparation and construction.

Our conclusions and recommendations are predicated on observation and testing of the earthwork directed by Geotechnical Engineer of Record. Our opinions are based on data assumed representative of the site. However, the area coverage of borings in relation to the entire project is very small. For this and other reasons, we do not warrant conditions below the depth of our borings, or that the strata logged from our borings are necessarily typical of the site. Deviations from our recommendations by plans, written specifications, or field applications shall relieve us of responsibility unless our written concurrence with such deviations has been established.

The scope of services for this project does not include either specifically or by implication any environmental or biological assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of The City of Ramsey and its agents for specific application to the proposed Alpine Drive – Street Improvements project in the City of Ramsey, Minnesota. Northern Technologies, LLC has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Northern Technologies, LLC makes no other warranty, express or implied.

Northern Technologies, LLC

Debra A. Schroeder, P.E.
Senior Engineer

Steven D. Gerber, P.E.
Senior Engineer

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

Debra A. Schroeder
Date: 11/23/2016 Reg. No. 52743

Attachments
Appendix A - General Notes
Appendix B - Groundwater Issues, Compaction and Placement of Fill
Appendix C - Attachments: Boring Location Diagram (1), Soil Boring Logs (13)
Appendix D - Photographs (13 cores)

APPENDIX A

GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

FIELD EXPLORATION PROCEDURES

GENERAL NOTES

WATER LEVEL SYMBOL

DESCRIPTIVE TERMINOLOGY

RELATIVE PROPORTIONS

PARTICLE SIZES

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

We visually examined recovered soil samples to estimate distribution of grain sizes, plasticity, consistency, moisture condition, color, presence of lenses and seams, and apparent geologic origin. We then classified the soils according using the Unified Soil Classification System (ASTM D2488). A chart describing this classification system and general notes explaining soil sampling procedures are presented within appendices attachments.

The stratification depth lines between soil types on the logs are estimated based on the available data. In-situ, the transition between type(s) may be distinct or gradual in either the horizontal or vertical directions. The soil conditions have been established at our specific boring locations only. Variations in the soil stratigraphy may occur between and around the borings, with the nature and extent of such change not readily evident until exposed by excavation. These variations must be properly assessed when utilizing information presented on the boring logs.

We request that you, your design team or contractors contact NTI immediately if local conditions differ from those assumed by this report, as we would need to review how such changes impact our recommendations. Such contact would also allow us to revise our recommendations as necessary to account for the changed site conditions.

FIELD EXPLORATION PROCEDURES

Soil Sampling – Standard Penetration Boring:

Soil sampling was performed according to the procedures described by ASTM D-1586. Using this procedure, a 2 inch O.D. split barrel sampler is driven into the soil by a 140 pound weight falling 30 inches. After an initial set of six inches, the number of blows required to drive the sampler an additional 12 inches is recorded (known as the penetration resistance (i.e. “N-value”) of the soil at the point of sampling. The N-value is an index of the relative density of cohesionless soils and an approximation of the consistency of cohesive soils.

Soil Sampling – Power Auger Boring:

The boring(s) was/were advanced with a 6 inch nominal diameter continuous flight auger. As a result, samples recovered from the boring are disturbed, and our determination of the depth, extend of various stratum and layers, and relative density or consistency of the soils is approximate.

Soil Classification:

Soil samples were visually and manually classified in general conformance with ASTM D-2488 as they were removed from the sampler(s). Representative fractions of soil samples were then sealed within respective containers and returned to the laboratory for further examination and verification of the field classification. In addition, select samples were submitted for laboratory tests. Individual sample information, identification of sampling methods, method of advancement of the samples and other pertinent information concerning the soil samples are presented on boring logs and related report attachments.

GENERAL NOTES

DRILLING and SAMPLING SYMBOLS		*LABORATORY TEST SYMBOLS*	
SYMBOL	**DEFINITION**	**SYMBOL**	**DEFINITION**
C.S.	Continuous Sampling	W	Moisture content-percent of dry weight
P.D.	2-3/8" Pipe Drill	D	Dry Density-pounds per cubic foot
C.O.	Cleanout Tube	LL, PL	Liquid and plastic limits determined in accordance with ASTM D 423 and D 424
3 HSA	3 ¼" I.D. Hollow Stem Auger	Q_U	Unconfined compressive strength-pounds per square foot in accordance with ASTM D 2166-66
4 FA	4" Diameter Flight Auger		
6 FA	6" Diameter Flight Auger		
2 ½ C	2 ½" Casing		
4 C	4" Casing		
D.M.	Drilling Mud	Pq	Penetrometer reading-tons/square foot
J.W.	Jet Water	S	Torvane reading-tons/square foot
H.A.	Hand Auger	G	Specific Gravity – ASTM D 854-58
NXC	Size NX Casing	SL	Shrinkage limit – ASTM 427-61
BXC	Size BX Casing	Ph	Hydrogen ion content-meter method
AXC	Size AX casing	O	Organic content-combustion method
SS	2" O.D. Split Spoon Sample	M.A.	Grain size analysis
2T	2" Thin Wall Tube Sample	C*	One dimensional consolidation
3T	3" Thin Wall Tube Sample	Q_C	Triaxial Compression
		* See attached data Sheet and/or graph	

WATER LEVEL SYMBOL

Water levels shown on the boring logs were determined at the time and under the conditions indicated. In sand, the indicated levels can be considered relatively reliable for most site conditions. In clay soils, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious water bearing soil are present; and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed soils may not indicate the true level of the ground water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

RELATIVE DENSITY		*CONSISTENCY*	
TERM	**N_{60} Value** (corrected)	**TERM**	**N_{60} Value** (corrected)
Very Loose	0 – 4	Soft	0 – 4
Loose	5 – 8	Medium	5 – 8
Medium Dense	9 – 16	Rather Stiff	9 – 15
Dense	16 – 30	Stiff	16 – 30
Very Dense	Over 30	Very Stiff	Over 30

RELATIVE PROPORTIONS

TERMS	**RANGE**
Trace	0 – 5%
A little	5 – 15%
Some	15 – 30%

PARTICLE SIZES

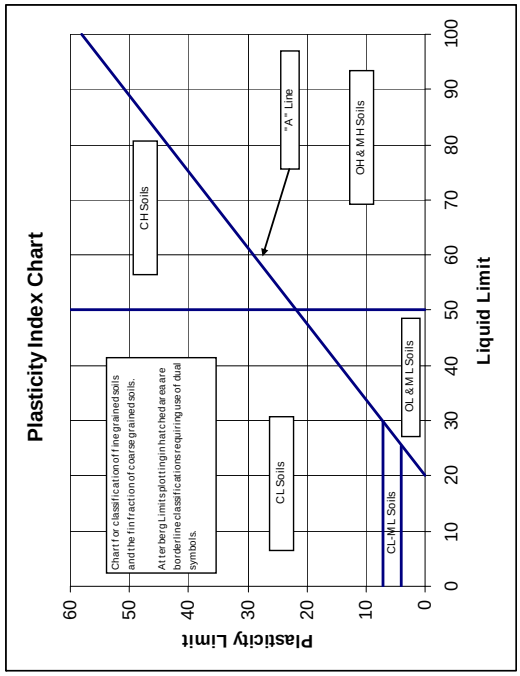
MATERIAL	**DESCRIPTION**	**U.S. SIEVE SIZE**
Boulders		Over 3"
Gravel	Coarse	3" to ¾"
	Medium	¾" to #4
Sand	Coarse	#4 to #10
	Medium	#10 to #40
	Fine	#40 to #200
Silt and Clay	Determined by Hydrometer Test	

CLASSIFICATION of SOILS for ENGINEERING PURPOSES

ASTM Designation D-2487 and D2488 (Unified Soil Classification System)

Major Divisions			Group Symbol	Typical Name	Classification Criteria
Course Grained Soils More than 50% retained on No. 200 sieve *	Gravels 50% or more of coarse fraction retained on No. 4 sieve.	Clean Gravels	GW	Well –graded gravels and gravel-sand mixtures, little or no fines.	Cu = D60 / D10 greater than 4. Cz = (D30)2 / (D10 x D60) between 1 & 3.
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.	Not meeting both criteria for GW materials.
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures.	Atterberg limits below "A" line, or P.I. less than 4. / Atterberg limits above "A" line with P.I. greater than 7. — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			GC	Clayey gravels, gravel-sand-clay mixtures.	
	Sands More than 50% of coarse fraction passes No 4 sieve.	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines.	Cu = D60 / D10 greater than 6. Cz = (D30)2 / (D10 x D60) between 1 & 3.
			SP	Poorly-graded sands and gravelly sands, little or no fines.	Not meeting both criteria for SW materials.
		Sands with Fines	SM	Silty sands, sand-silt mixtures.	Atterberg limits below "A" line, or P.I. less than 4. / Atterberg limits above "A" line with P.I. > 7. — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures.	
Fine Grained Soils More than 50% passes No. 200 sieve *	Silts and Clays Liquid Limit of 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	
			OL	Organic silts and organic silty clays of low plasticity.	
	Silts and Clays Liquid Limit greater than 50%.		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.	
			CH	Inorganic clays of high plasticity, fat clays.	
			OH	Organic clays of medium to high plasticity.	
	Highly Organic Soils		Pt	Peat, muck and other highly organic soils.	

Classification on basis of percentage of fines.
Less than 5% passing No. 200 Sieve: GW, GP, SW, SP
More than 12% passing No. 200 Sieve: GM, GC, SM, SC
From 5% to 12% passing No. 200 Sieve: Borderline Classification requiring use of duel symbols.



APPENDIX B

GROUNDWATER ISSUES

PLACEMENT and COMPACTION OF ENGINEERED FILL

GROUNDWATER ISSUES

The following presents additional comment and soil specific issues related to measurement of groundwater conditions at your project site.

Note that our groundwater measurements, or lack thereof, will vary depending on the time allowed for equilibrium to occur in the borings. Extended observation time was not available during the scope of the field exploration program and, therefore, groundwater measurements as noted on the borings logs may or may not accurately reflect actual conditions at your site.

Seasonal and yearly fluctuations of the ground water level, if any, occur. Perched groundwater may be present within sand and silt lenses bedded within cohesive soil formations. Groundwater typically exists at depth within cohesive and cohesionless soils.

We anticipate that a system of sump pits and pumps located outside of the excavation areas would be suitable for control if groundwater were to be encountered. However, a well point system would be more suitable for control of groundwater if excavations were to be advanced into the ground water table at depth in free draining granular soils. Additionally, we caution such seepage from such formations and any water entry from excavations below the groundwater table may be heavy and will vary based on seasonal and annual precipitation, and ground related impacts in the vicinity of the project. The groundwater surface should be maintained a minimum of 2 feet below the bottom of the excavation at all times.

PLACEMENT and COMPACTION OF ENGINEERED FILL

Unless otherwise superseded within the body of the Geotechnical Exploration Report, the following criteria shall be utilized for placement of engineered fill on project. This includes, but is not limited to earthen fill placement to improve site grades, fill placed below structural footings, fill placed interior of structure, and fill placed as backfill of foundations.

Engineered fill placed for construction, if necessary should consist of natural, non-organic, competent soils native to the project area. Such soils may include, but are not limited to gravel, sand, or clays with Unified Soil Classification System (ASTM D2488) classifications of GW, SP, or SM. Use of silt or clayey silt as project fill will require additional review and approval of project Geotechnical Engineer of Record. Such soils have USCS classifications of ML, MH, ML-CL, MH-CH. Use of topsoil, marl, peat, other organic soils construction debris and/or other unsuitable materials as fill is not allowed. Such soils have USCS classifications of OL, OH, Pt.

Engineered fill, classified as clay, should be tempered such that the moisture content at the time of placement is equal to and no more than 3 percent above the optimum content for as defined by the appropriate proctor test. Likewise, engineered fill classified as gravel or sand should be tempered such that the moisture content at the time of placement is within 3 percent of the optimum content.

All engineered fill for construction should be placed in individual 8 inch maximum depth lifts. Each lift of fill should be compacted by large vibratory equipment until the in-place soil density is equal to or greater than the criteria established within the following tabulation.

	Compaction Criteria (% respective Proctor)[1]	
Type of Construction	**Clay**	**Sand or Gravel**
General Embankment Fill	Min. 95	Min. 95
Engineered Fill below Foundations	NA	Min. 98
Engineered Fill below Floor Slabs	NA	Min. 98
Engineered Fill placed as Pavement Aggregate Base	NA	Min. 100
Engineered Fill placed to within 3 feet of pavement aggregate base	Min. 95	Min. 95
Engineered Fill placed within 3 feet of pavement aggregate base	Min. 100	Min. 100

1 Unless otherwise required, compaction shall be based on the Standard Proctor Test (ASTM D698).

Density tests should be taken during engineered fill placement to document earthwork has achieved necessary compaction of the material(s). Recommendations for interior fill placement and backfill of foundation walls are presented within other sections of this report.

APPENDIX C

BORING LOCATION DIAGRAM

SOIL BORING LOGS

N

Boring Location Diagram

Completed Soil Borings:

Alpine and Sunwood Drive – Street Improvements – Alpine Drive

Ramsey, Minnesota

NTI Project #: 16.61770.100

NOTE: Boring locations are approximate.

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BORING NUMBER A-1

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.3 BITUMINOUS PAVEMENT (3.5 inches) 99.7	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, moist, little gravel (Fill) NOTE: Brown to dark brown below 2.0 feet.	SS 2	100	15-20-16 (36)			6				8
5			SS 3	100	25-16-15 (31)							
		7.0 93.0 POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, medium dense, trace gravel (Alluvial)	SS 4	100	11-7-7 (14)							
10			SS 5	83	7-5-4 (9)							
		11.0 89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-2

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.3 BITUMINOUS PAVEMENT (3.5 Inches) 99.7 APPARENT AGGREGATE BASE (20.0 Inches) 2.0 98.1	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to medium grained, moist, trace gravel, occasional cobbles (Fill)	SS 2	100	24-22-18 (40)			6				
5			SS 3	100	21-25-28 (53)							
		NOTE: Dark brown below 7.0 feet.	SS 4	100	15-16-18 (34)							
		9.5 90.5										
10		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, loose, trace gravel (Alluvial) 11.0 89.0	SS 5	100	7-4-3 (7)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-3

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 5 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4.5 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) dark brown to black, fine to medium grained, moist, trace gravel (Fill)	SS 2	89	4-4-4 (8)							
5			SS 3	83	4-5-6 (11)			11				12
		8.0 92.0	SS 4	94	3-3-4 (7)							
10		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, loose, trace gravel (Alluvial)	SS 5	83	3-3-4 (7)							
		11.0 89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-4

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.3 BITUMINOUS PAVEMENT (4.8 Inches) 99.7 APPARENT AGGREGATE BASE (24.0 Inches) 2.3 97.7	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to medium grained, moist, trace gravel (Fill)	SS 2	89	8-9-9 (18)			7				
5			SS 3	100	7-6-6 (12)							
		7.0 93.0 POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, medium dense to loose, trace gravel (Alluvial)	SS 4	100	4-5-6 (11)							
10			SS 5	100	4-3-4 (7)							
		11.0 89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-5

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
▽ **AT TIME OF DRILLING** 10.00 ft / Elev 90.00 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 6 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4.8 Inches)	99.6	AU 1									
		0.8 APPARENT AGGREGATE BASE (4.5 Inches)	99.2										
		POORLY GRADED SAND WITH CLAY, (SP-SC) brown to dark brown, fine to medium grained, moist, trace gravel (Fill)		SS 2	89	5-5-6 (11)			7				9
		4.5	95.5										
5		CLAYEY SAND, (SC) dark brown to black, fine to medium grained, moist, trace gravel, occasional bituminous debris, trace organics (Fill)		SS 3	78	8-11-14 (25)			8				15
		7.0 NOTE: Organic content at 4.5 feet = 1.5%.	93.0	SS 4	67	6-5-5 (10)							
10		POORLY GRADED SAND WITH SILT, (SP-SM) brown to, fine to medium grained, moist to saturated, medium dense to loose, trace gravel ▽ (Alluvial)		SS 5	89	3-4-3 (7)							
		11.0	89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-6

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 3.5 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4.5 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel, possible cobbles (Fill)	SS 2	94	6-8-7 (15)			7				
5		NOTE: Brown to dark brown below 4.5 feet.	SS 3	89	7-8-10 (18)							
			SS 4	100	14-22-10 (32)							
		9.5 90.5										
10		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, dense, trace gravel (Alluvial) 11.0 89.0	SS 5	89	12-11-14 (25)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-7

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4.5 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.3 BITUMINOUS PAVEMENT (3.8 Inches)	99.7	AU 1									
		0.5 APPARENT AGGREGATE BASE (2.5 Inches)	99.5										
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel, possible cobbles (Fill) NOTE: Occasional bituminous debris below 2.0 feet. NOTE: Brown to dark brown below 4.5 feet.		SS 2	50	7-9-8 (17)							
5				SS 3	72	7-6-7 (13)			8				
				SS 4	67	11-17-20 (37)							
		9.5	90.5										
10		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, medium dense, trace gravel (Alluvial)		SS 5	83	8-5-6 (11)							
		11.0	89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-8

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.3 BITUMINOUS PAVEMENT (4.0 Inches) 99.7	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, moist, trace gravel (Fill) 2.0 98.0	SS 2	89	7-8-9 (17)			3				2
5		POORLY GRADED SAND, (SP) brown to light brown, fine to medium grained, moist, loose to dense, trace gravel (Alluvial)	SS 3	100	6-4-4 (8)							
			SS 4	100	6-5-5 (10)							
10		11.0 89.0	SS 5	89	6-8-10 (18)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-9

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
▽ **AT TIME OF DRILLING** 10.50 ft / Elev 89.50 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.3 BITUMINOUS PAVEMENT (3.8 Inches) 99.7	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) light brown to dark brown, fine to medium grained, moist, trace gravel, possible cobbles (Fill)	SS 2	22	8-5-4 (9)							
5		NOTE: Brown to dark brown with occasional bituminous debris below 4.5 feet.	SS 3	89	13-12-12 (24)							
		7.0 93.0 POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist to saturated, loose to medium dense, trace gravel (Alluvial)	SS 4	100	5-5-3 (8)			6				5
10		11.0 ▽ 89.0	SS 5	78	5-4-6 (10)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-10

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 3.5 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (5.0 Inches)	99.6	AU 1									
		0.7 APPARENT AGGREGATE BASE (3.0 Inches)	99.3										
		POORLY GRADED SAND WITH SILT, (SP-SM) light brown, fine to medium grained, moist, trace gravel, possible cobbles (Fill)		SS 2	83	14-20-18 (38)			7				
		4.5 NOTE: Brown to dark brown below 2.0 feet.	95.5										
5		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, dense to medium dense, trace gravel (Alluvial)		SS 3	100	6-8-12 (20)							
				SS 4	100	4-5-4 (9)							
10				SS 5	100	4-5-5 (10)							
		11.0	89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-11

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4.5 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel (Fill)	SS 2	89	12-5-8 (13)							
		3.0 97.0										
5		POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, loose, trace gravel (Alluvial)	SS 3	94	3-4-4 (8)							
			SS 4	100	4-3-3 (6)							
10			SS 5	100	4-3-4 (7)			6				2
		11.0 89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-12

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4.5 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, trace gravel, possible cobbles (Fill) NOTE Brown to dark brown below 2.0 feet.	SS 2	67	13-15-16 (31)							
5			SS 3	89	8-15-24 (39)							
			SS 4	100	15-18-22 (40)			6				10
10		9.5 90.5 POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, medium dense, trace gravel (Alluvial) 11.0 89.0	SS 5	100	5-5-8 (13)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER A-13

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/7/16 **COMPLETED** 11/7/16
GROUND ELEVATION 100 ft **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

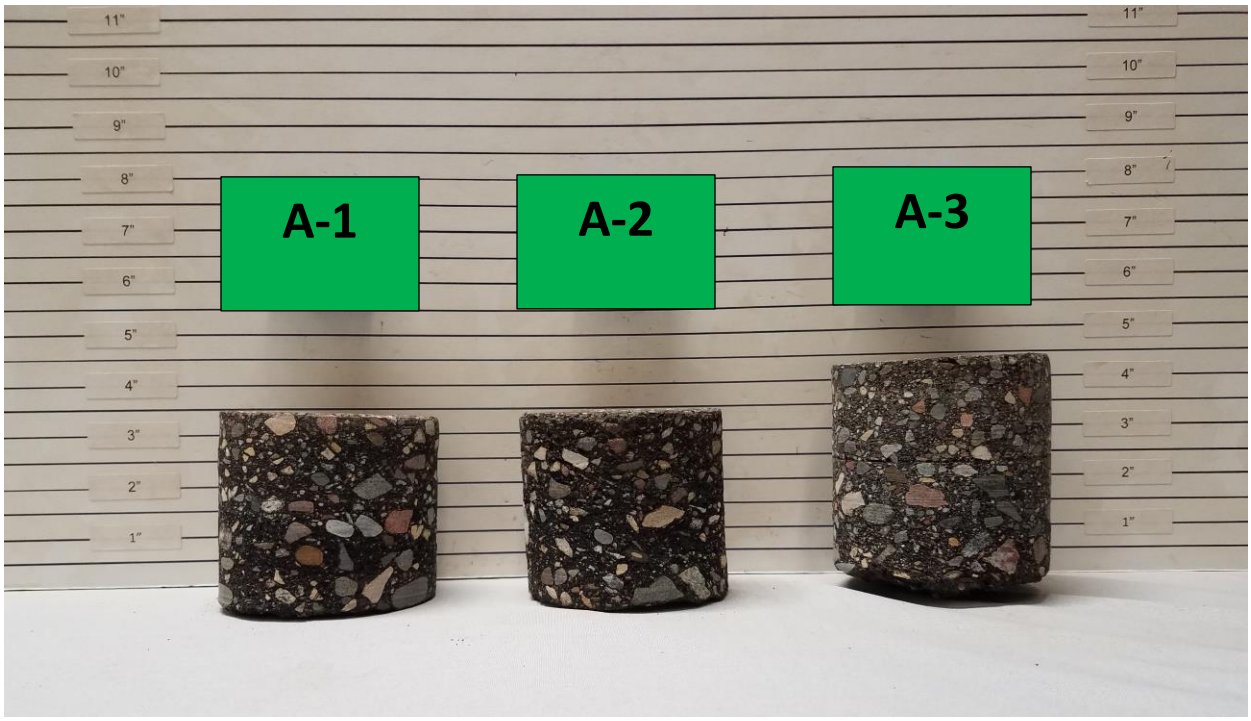
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4.8 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) brown to dark brown, fine to medium grained, moist, possible cobbles (Fill)	SS 2	83	12-15-20 (35)							
5			SS 3	100	15-24-32 (56)			6				7
		NOTE: Occasional bituminous debris below 7.0 feet.	SS 4	100	13-22-16 (38)							
		9.5 90.5										
10		POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, medium dense, trace gravel (Alluvial) 11.0 89.0	SS 5	100	4-4-5 (9)							

Bottom of borehole at 11.0 feet.

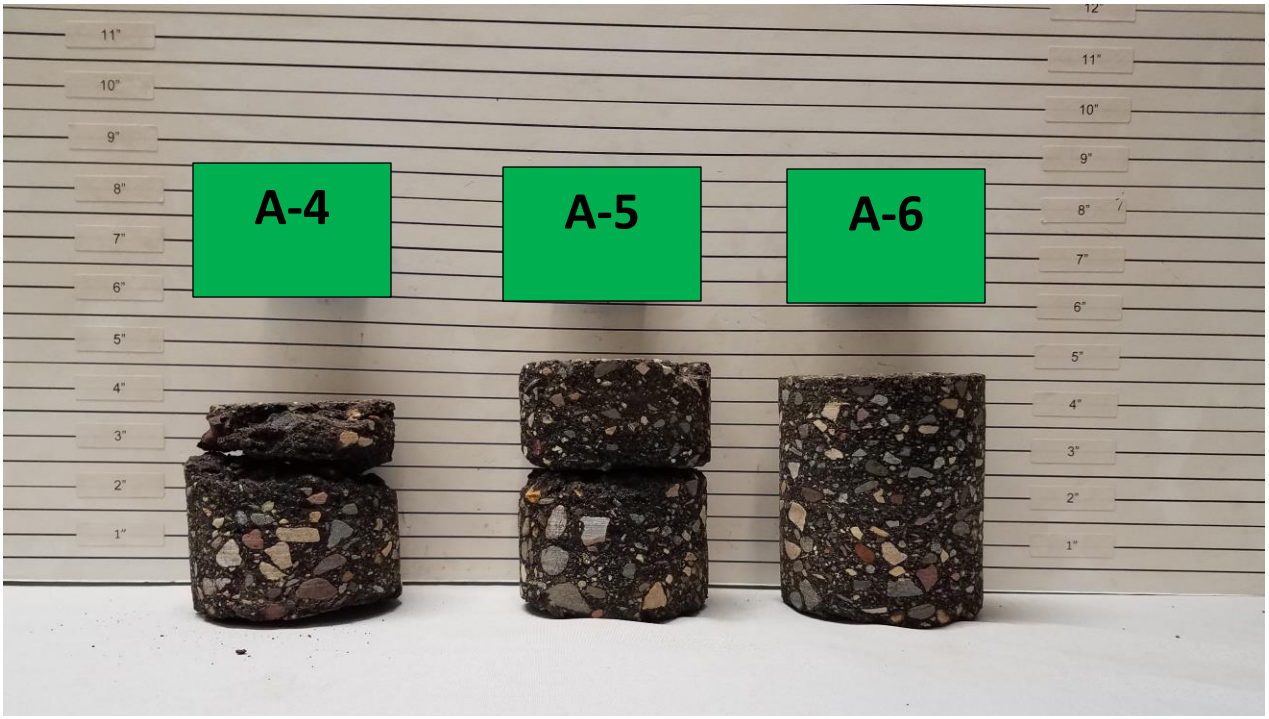
APPENDIX D

PAVEMENT CORE PHOTOGRAPHS

Bituminous Pavement Cores, A-1: 3 ½ Inches, A-2: 3 ½ Inches, A-3: 4 ½ Inches.

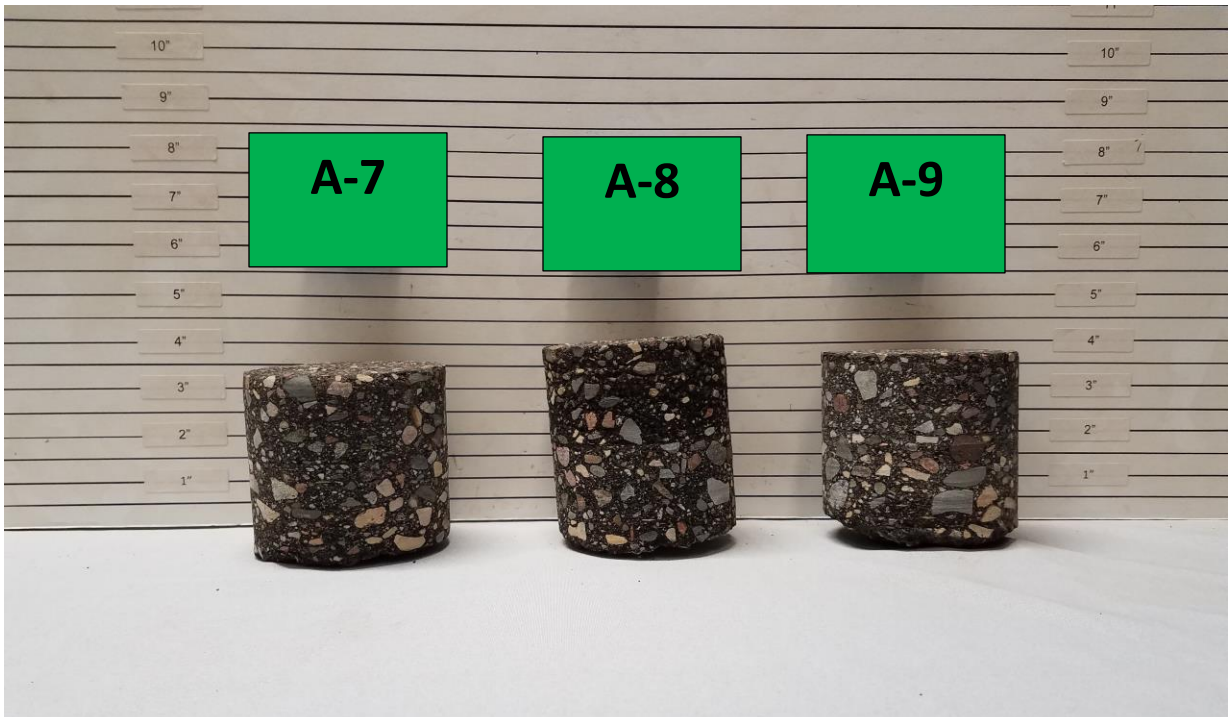


Bituminous Pavement Cores, A-4: 3 ¾ Inches*, A-5: 4 ¾ Inches*, A-6: 4 ½ Inches.

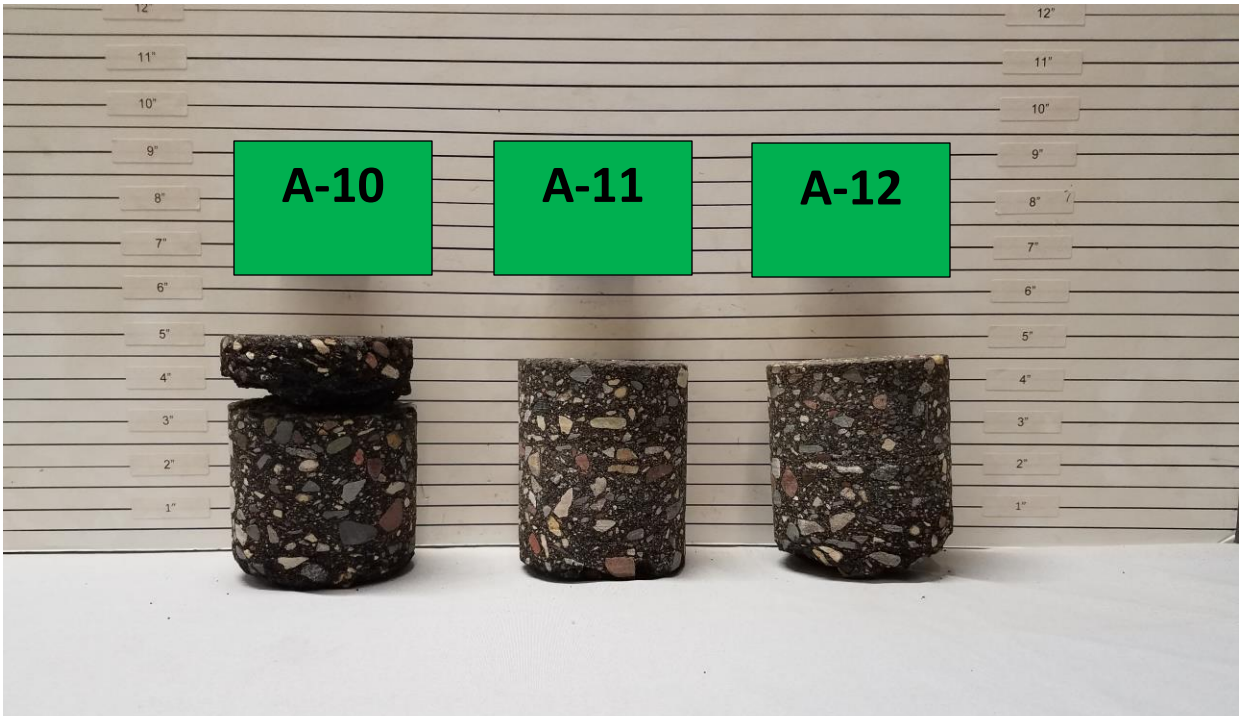


*Core height not representative due to crumbling during coring process.

Bituminous Pavement Cores, A-7: 3 ¾ Inches, A-8: 4 Inches, A-9: 3 ¾ Inches.



Bituminous Pavement Cores, A-10: 5 Inches*, A-11: 4 ½ Inches, A-12: 4 ½ Inches.



*Core height not representative due to crumbling during coring process.

Bituminous Pavement Cores, A-13: 4 ¾ Inches.

701 Xenia Avenue South | Suite 300 | Minneapolis, MN 55416 | (763) 541-4800

December 27, 2016

Mr. Bruce Westby P.E.
City Engineer
7550 Sunwood Drive NW.
Ramsey, MN 55303

Re: Pavement Evaluations and Recommendations for City of Ramsey Improvement Project #17-01
2017 Alpine Drive Reconstruction

Observation: On December 20, 2016 WSB & Associates cored Alpine Drive from Variolite Street to Armstrong Blvd in the City of Ramsey, MN. This pavement was constructed in the early 1990s and suffers from severe cracking and tenting during cold weather. A geotechnical report had been completed earlier and did not clearly define the cause of the cracking and tenting. The goal of the additional coring was to try to determine why the pavement cracked and tents so severely and to make recommendations on what to do to reconstruct the pavement. As we cut thru the hot mix asphalt (HMA) at the first core site we observed a white to cream color slurry coming out of the core hole. Once the core was removed we observed in the bottom of the core hole what appeared to be concrete material. We were able to core another 4 inches deeper and remove an intact core out of the base aggregate material. This material seemed like a lean concrete material. Photos of the cores are provided in Appendix B of this report. Base on the finding of the first core location we move to an area that the City personnel stated tented the worst and cut another core. We observed similar results to the first core location. We then cored two more locations evenly spaced to make sure that similar materials were used the length of the project. All the cores taken had similar base materials observed under the HMA.

It appears that when the pavement was originally constructed the contractor used crushed recycled concrete for the Class 5 base materials. Based on observations, it appears that not enough sand was blended into the recycled concrete to keep it from rehydrating and forming a weak concrete pavement. This type of material can be prone to swelling when permeated with water causing abnormal cracking and a very rough driving surface when below freezing.

All of the Hot Mix Asphalt (HMA) cored were approximately 4 inches in thickness.

Recommendations: Based on the information above, our recommendation would be to do full depth reclamation (FDR) of all the HMA pavement into the Class 5 recycled concrete material to lean out the existing recycled concrete materials to make it less prone to cracking and swelling. Once the FDR has been completed then 4 or 5 inches of the newly reclaimed materials would be removed and hauled off to make room to repave the HMA over newly compacted recycled aggregate base materials. Based on the traffic levels we would recommend paving it with 4 to 5 inches of SPWEA340C Super Pave. We would recommend priming the reclaimed materials with penetration emulsion prime to help reduce water infiltration into HMA.

Please let me know if you have any other questions of comments regarding this report.

Sincerely,

WSB & Associates, Inc.

Thomas J. Wood
Project Manager

Appendix A

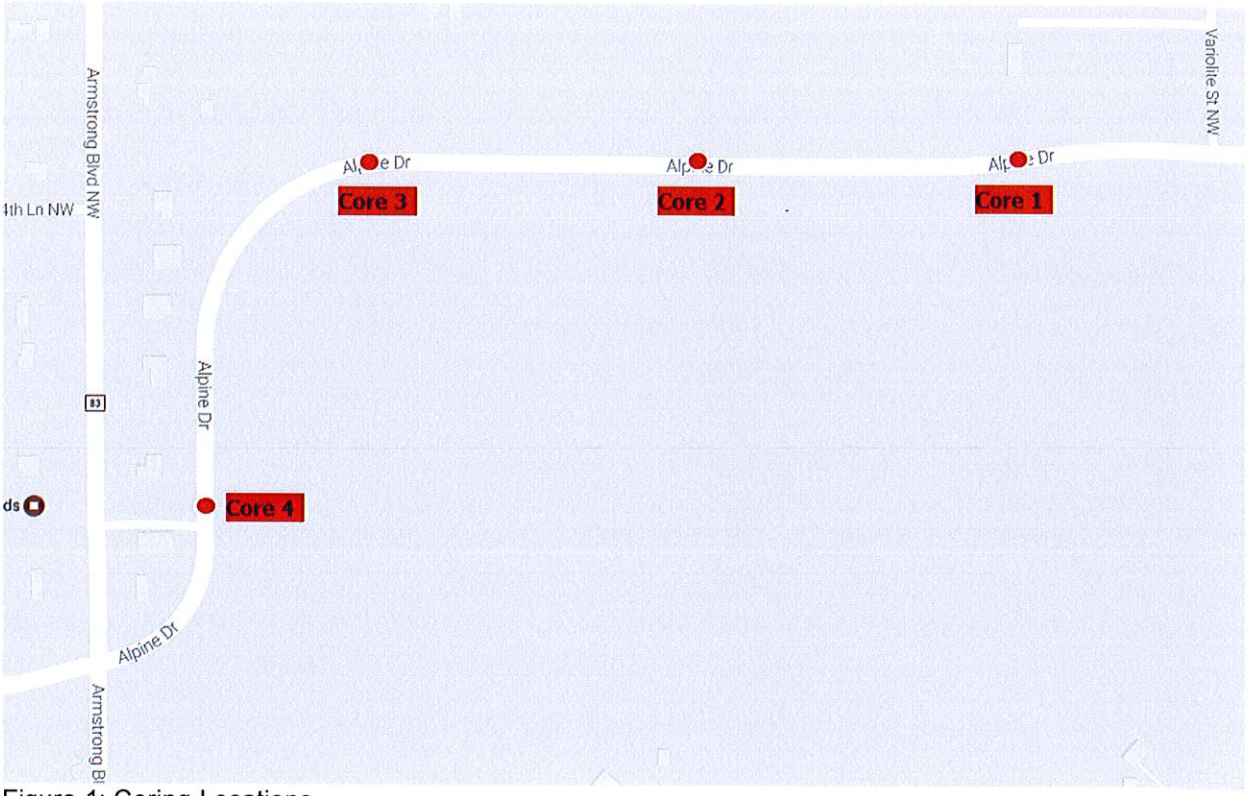
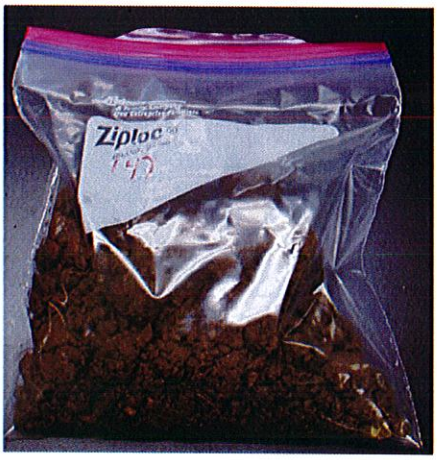


Figure 1: Coring Locations

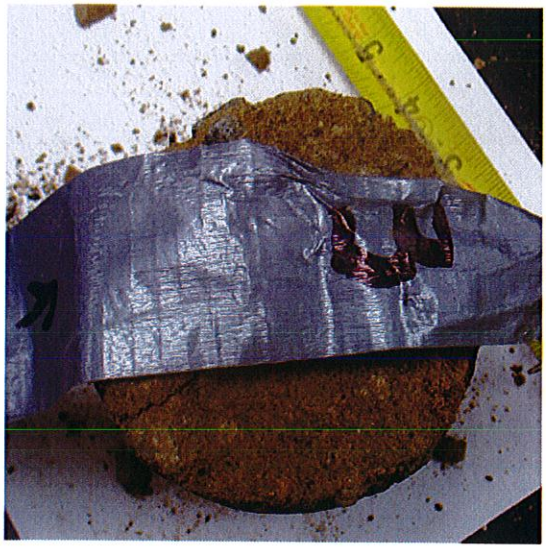
Appendix B

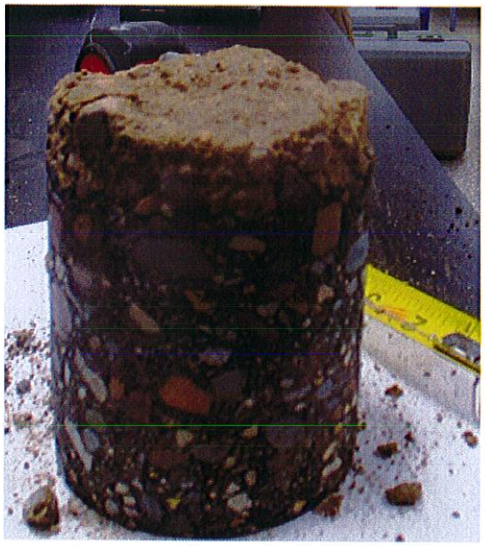
Core 1

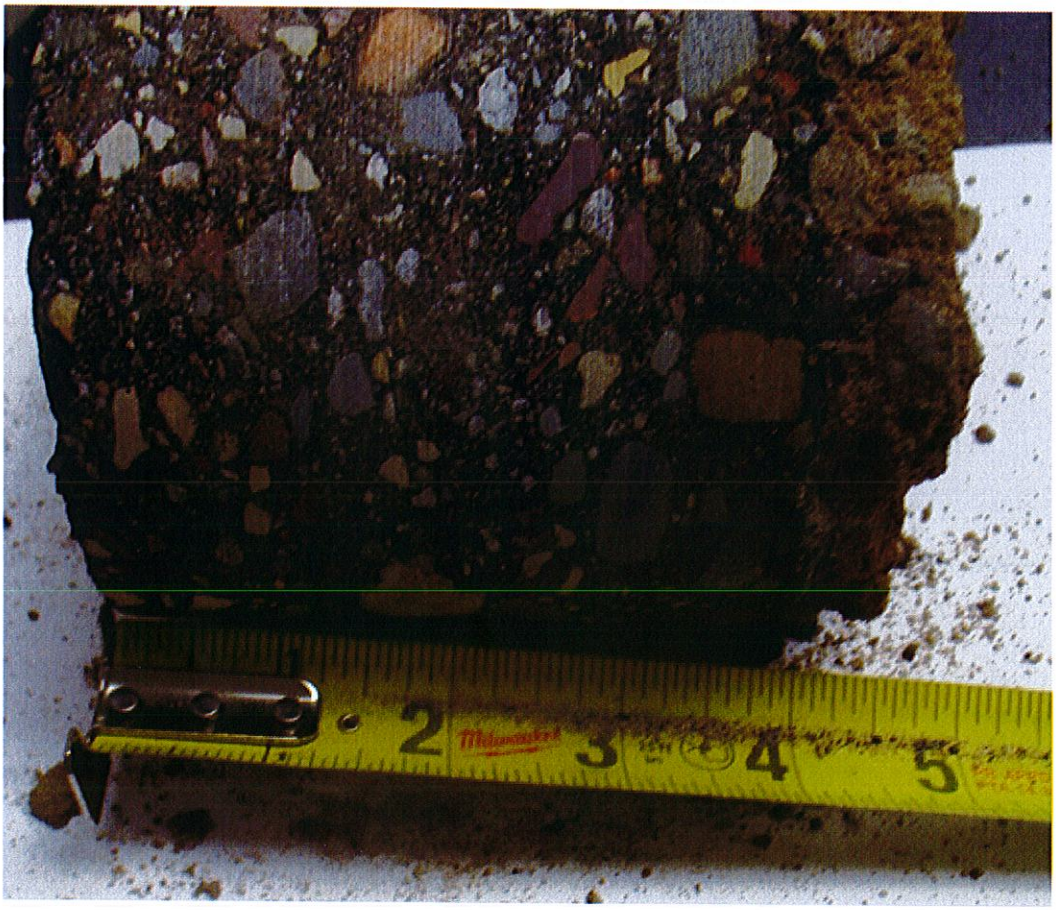


Core 2

Core 3







Core 4