Feasibility Report

Peterson Road Street Improvments

White Bear Township, Minnesota

TKDA Project No. 17727.002

June 1, 2020

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Saint Paul, MN 55101
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Peterson Road Street Improvments
Feasibility Report
White Bear Township, Minnesota

TKDA Project No. 17727.002

June 1, 2020

I hereby certify that this 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.

Larry Poppler, PE
Project Manager

Date: June 1, 2020 Lic. No.: 41005

TKDA
444 Cedar Street – Suite 1500
Saint Paul, MN 55101

Summary

Peterson Road Street Improvements Project

Improvements:

- Watermain extension
- Sanitary sewer extension
- Stormwater collection and treatment
- Bituminous surfacing
- Concrete curb and gutter
- Driveway aprons
- Pedestrian improvements
- Drainage improvements

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Feasibility Report

Peterson Road Street Improvments

Prepared for White Bear Township, Minnesota

1.0 Introduction

On December 12, 2019, the White Bear Township Town Board ordered the preparation of a feasibility report for Peterson Road street improvements. Peterson Road is located north of County Road H2 west of Interstate 35E. It intersects with Mehegan Lane to the West. Peterson Road is specifically located within Sections 4 and 9, Township 30, Range 22, as described on the following plats and Surveys: Section 9 Town 30 Range 22 The N 145 FT Of The S 300 FT Of The N 1/2 Of N 1/2 Of NE 1/4 Which Lies W Of I35-E And E Of The CL OF Peterson RD In Section 09 Town 30 Range 22, Section 9 Town 30 Range 22, The S 155 FT Of The N 1/2 Of N 1/2 Of NE 1/4 Lying W Of I-35E And Lying E Of The CL Of Peterson RD (Subject To Easements) In Section 9 Town 30 Range 22, Three Oaks Of White Bear Township, Walton Addition, Pine Ridge, Registered Land Survey 178 Tract A.

This report evaluates the feasibility of street and utility improvements in the project area. All existing infrastructure elements were evaluated, improvements recommended, cost estimates of the proposed improvements prepared, and funding strategies developed in this report.

2.0 Background

Peterson Road is the last remaining Township maintained gravel road. Gravel road maintenance is different than pavement maintenance and requires special maintenance efforts. Erosion of the gravel surface occurs occasionally and must be reviewed after larger storms. Gravel is added to maintain a suitable driving surface.

Figure 1: Peterson Road looking north from County Road H-2

Lot development of Three Oaks and the Mehegan Lane connection were built in 2018. Homes are currently being constructed within the Three Oaks development. As construction has been underway, the road connection has been closed. As the development project nears full buildout, the roadway will be opened and more traffic will use Peterson Road south of Mehegan Lane. Opening Mehegan lane to Peterson Road will be a change for the current residents who reside on Peterson Road as it will increase Peterson Road vehicle usage.

3.0 Existing Conditions

Streets: Peterson Road (Old Centerville Road) was constructed sometime before 1940 as primarily a farm road and driveway access. It currently serves 11 properties. The road width varies from 17 feet to 22 feet from edge of gravel to edge of gravel. The right of way (ROW) along Peterson Road varies from 47.3' to 60.1' and the existing road is not centered in the ROW in some locations. For the first 300' of Peterson Road north of County Road H-2, the existing centerline of the road is offset to the west about 15'-20' from the centerline of the ROW. The alignment of Peterson Road beyond 300' north of County Road H-2 is relatively straight and centered in the ROW.

Figure 2: Peterson Road (looking south) near pond (left) and wetland (right)

The road is constructed with fill comprised of silty sand with gravel in the upper 2-4 feet of road section over a section of sand with silt. Some areas of Peterson Road have been overlaid with approximately 6" of crushed limestone. The water table sits approximately 7' below surface grade on the north end of Peterson Road near the wetland. Some areas of the north end of Peterson Road have been identified as being located within the 20' wetland buffer. In addition to the north wetland, there is a small pond located on the east side of the road.

A woodland buffer exists along the east side of Peterson Road 800' north of County Road H-2. The woodland buffer includes a variety of vegetation from large trees (24"+) to brush and shrubs. Some steep slopes exist in the first 200' north of County Road H-2. On the north end of Peterson road, there is about 275' of woodland on both sides of the road and steep slopes on the west side of the road into the wetland.

The existing and proposed typical sections for the project areas are shown in Appendix B. The soil boring information is found in the geotechnical report in Appendix I.

Many factors account for roadway condition since original construction including the following:

- Drainage
- Underlying soil conditions
- Traffic volumes/loading
- Time/deterioration
- Maintenance
- Weather

Figure 3: Peterson Road surface condition example

Drainage: Peterson Road was constructed with ditch and surface drainage. There are two culverts running East-West under Peterson Road. Only one 12” culvert was located in the topographic survey near 5425 Peterson Road.

Underlying Soil Conditions: The soil borings and geotechnical report that the subsoil in the area is mostly comprised of silty sand and sand with silt. This soil is adequate to support a new bituminous section with minimal correction areas. Some excavation and embankment may need to take place to accommodate the larger proposed sections. This factor was considered in the cost estimates.

Utilities: There are currently no public utilities running parallel on Peterson road.

Sanitary sewer connections are located at County Road H-2 on the line that serves Provence Lane (manhole #944 from White Bear Township maps) and a manhole at Mehegan Lane with a rim to invert of approximately 19.5 feet (manhole #1276 from White Bear Township maps).

Water main connections are located at Mehegan Lane (8”-DIP, cap), County Road H-2 (16”-DIP, hydrant), and at the Provence Lane townhome driveways east of Peterson Road (8”-DIP, hydrant).

There is currently no storm sewer collection on Peterson Road. A FES was installed with the Three Oaks development on the South side of Mehegan Lane to collect run off from the West side of Peterson Road. The White Bear Township storm sewer maps indicate that 2 culverts exist along Peterson Road, only one culvert was located during the survey.

Private utilities include telecom and overhead power on the West side, with some underground telecom and power services on the east side.

4.0 Proposed Improvements

Proposed improvements to be studied were selected with several determining factors in mind such as utility service to residents, driver safety/drivability, pedestrian safety/walkability, environmental impact (tree removal, storm water treatment, etc.), ROW impact, and cost. This section of the report will compare the different options and discuss advantages and disadvantages of each. A variety of information was used to study the proposed layouts including GIS data, topographic surveys, plat information, public records, record plan sets, and record bid pricing.

The area north of Mehegan Lane would be difficult to improve at this time given the existing ROW configuration and the adjacent wetlands. The lots north of Mehegan Lane are four large acre lots (over 4 acres) and are subdividable. Subdivision in the future provides an opportunity to properly locate Peterson Road north of Mehegan Lane to provide a more beneficial location serving the most lots. An area map can be found in Appendix A. A rudimentary development concept can be seen in Appendix J. After further study of the area, it is recommended that Peterson Road north of Mehegan Lane be excluded from further study. The remaining feasibility report is limited to Peterson Road south of Mehegan Lane.

Streets: Considering the traffic loads existing conditions, soil borings, gravel surface condition, deterioration factors, geotechnical report, and coring evaluation, a 7-ton design bituminous section is recommended for Peterson Road. The sections would consist of 3” of bituminous, 4” of aggregate base, and 12” of granular base.

The opening of Mehegan Road will allow for access to Peterson Road for an additional 27 properties. However, it also provides for access of Peterson Road to Centerville Road. Depending on the destination of the driver and traffic on H2 and Centerville Road, it is thought that most of the properties within the Three Oaks development would use Centerville Road to enter and exit the development. While the additional 27 properties which will have access to Peterson Road is a large increase from current conditions, the roadway usage would still be considered quite low for a local Township street. If an accident occurs on Centerville Road or County Road H2, additional traffic my find their way to Peterson Road/Mehegan to drive around the area.

A number of street width options were reviewed and compared on the basis of several factors including utility service to residents, driver safety/drivability, pedestrian safety/walkability, environmental impact (tree removal, storm water treatment, etc.), ROW impact, and cost. Newly constructed developments in White Bear Township, including Three Oaks and Pine Hill developments, have utilized a width of 32’ back of curb (BOC) to back of curb section. Due to the light traffic loads, lower than average traffic volume, existing ROW, future development and park space, existing conditions and various other factors; several different options other than the typical 32’ BOC to BOC were analyzed.

A 26’ BOC to BOC section would be the minimal section to allow two 11’ travel lanes and desired D412 curb and gutter. Although this section is smaller than newly constructed roads in the area, the 26’ section would conform to Ramsey County standards and not constrict the light traffic along Peterson Road. A 28’ BOC to BOC section would provide for two 12’ travel lanes and the desired D412 curb and gutter. A 12’ lane is typically the standard size width. Lane widths over 12’ would provide drivers with extra reaction time to correct the vehicle in case of loss of control or distracted driving.

According to previous neighborhood meetings, residents along Peterson Road had little interest in creating a sidewalk or trail. However, no designated pedestrian area presents a safety concern for pedestrians using Peterson Road. Also a sidewalk or trail would provide links to existing sidewalk connections and parks. Because of this, this report recommends that the Township, at minimum, designate a portion of the corridor to pedestrian use. Three primary options including a 4’ concrete sidewalk with boulevard, a 6’ concrete sidewalk on the back of curb, or a 4’ designated walking lane were reviewed. Construction of a boulevard separated side walk would have higher yard impact, cost, and tree loss impacts, but would allow safe pedestrian travel.

In addition to varying drive lane widths and pedestrian facilities, the alignment of Peterson Road was studied to best suit each option. Narrower corridors follow closer to the center of the ROW, while wider corridors were shifted west to avoid steep tie in slopes, tree impact and retaining walls. Because of the established nature of Peterson Road south of Mehegan Lane, it was decided that a 28’ road section would be ideal to preserve the area and maintain driver safety. While a 28’ section preserves driver safety, it leaves no room for pedestrians to travel safely on the roadway. Because of this, a 6’ walk on the back of curb is proposed to allow safe pedestrian travel along Peterson Road. This option will allow driver and pedestrian safety while preserving the established look of the area.

The proposed and existing typical sections can be found in Appendix B. The pavement depths (section) recommendation can be found in Appendix I within the geotechnical report. The recommended option street layout can be found in Appendix E.

Curb and Gutter: It is recommended to add concrete curb and gutter throughout the entire project area. There are advantages concrete curb and gutter have on street network systems such as:

- Drainage improvement
- Water quality improvement
- Reduced edge failure
- Safety – defines the street, protects pedestrians
- Reduced plow damage to yards or pavement edge
- More defined street sweeping edge
- Mowing edge
- More rigid as compared to bituminous material that is flexible during summer temperatures
- Improved aesthetics/improved property values

The most important contributor in road deterioration is drainage. If surface water is not controlled properly and removed from the roadway as well as the roadway base, the street will begin to deteriorate at a pace much higher than a street with good drainage control. Water at the street surface can freeze which can break apart the roadway surface. In a similar manner, water that cannot drain beneath the street freezes and thaws, causing material to move beneath the street. The addition of curb and gutter and storm sewer pipe assists in the control of drainage.

It is proposed that surmountable curb and gutter (D412) be installed with this project. The profile of the street will match at elevations close to the existing conditions to avoid unnecessary excavation. This style of curb will provide adequate drainage, reduce excavation expense, provide street definition, allow vehicles to drive/park on the full width of the curb, allow driveway access in any location, and match other developed streets in the area.

Utilities: Utility improvement will be an essential part of improving service to residents, increasing property value, and allowing for future development of larger lot parcels.

With the addition of concrete curb and gutter, it is recommended to add storm sewer and stormwater treatment. Storm sewer can reduce flooding in the street and help prevent water overflow that can be harmful to yards, driveways, the environment, and the street pavement. It can also reduce the risk of icy patches from water pooling and freezing. A storm sewer system can also minimize the spread of contaminants that can be found in stormwater. The storm sewer will be appropriate sized and designed to account for all runoff areas in the selected option. The storm sewer is proposed to drain north to the lot north of 1119 Mehegan Lane. This area is currently owned by White Bear Township and will serve as a open space in addition to a storm sewer treatment area.

Sanitary sewer improvements are proposed to serve the existing residents and potential future development of Peterson Road. Residents on the west side of Peterson Road will be served from the sanitary sewer stub constructed as part of the Three Oaks development on the west side of their properties. Easement will be needed along the back lot lines to allow for construction of sanitary sewer. Residents on the east side of Peterson Road will be served by extending the end of the sewer line on the east end of the Three Oaks development north and south approximately 75’ in each direction.

Water main will be connected in three location. Connections will be made at the Provence Lane townhomes hydrant, County Road H-2, and the plug from the Three Oaks development. In doing this, the watermain will be looped and more easily controlled and maintained by Township staff.

In addition to public utilities some private utility relocation may be necessary for the construction of the new Peterson Road. Between 3 and 5 (depending on corridor width) telephone poles will need to

be moved to the east to accommodate the new sections. Corresponding telecommunications lines and underground services may need to be relocated as well.

The exhibit showing optional locations of sanitary sewer, storm sewer, and watermain is shown in Appendix D.

Storm Water Treatment: Storm water treatment and rate control will be required by Vadnais Lake Area Water Management Organization (VLAWMO) to an extent for this linear project. There is some available area to the north of the Three Oaks development that is suitable for pond storage and treatment. This project also has partially-limited area for stormwater treatment, so sizing of storm sewer utilities and ponding area will also be a design variable. Areas with more impervious area will require more storage and treatment area. The exhibit showing optional locations of sanitary sewer, storm sewer, and watermain is shown in Appendix D.

Minimizing tree loss and ROW impact: In order to reduce ROW impact, tree removal, and to preserve the established look of Peterson Road, several factors were considered including typical section, alignment, pedestrian access, tie-in slopes, non-structural retaining walls and the proposed profile. ROW impact and tree loss will be reduced by utilizing the aforementioned tactics, however it is inevitable that proposed roadway options with larger sections and pedestrian improvements off the roadway will have greater impacts. Tree loss and ROW impact was considered heavily with the proposed options.

5.0 Project Funding

5.1 Estimated Costs

The following costs were prepared based upon an Engineer's Estimate (Appendix F) and are subject to change depending on the final design of the project, required easements and/or right of way, soil conditions, bids received, and actual work performed.

Table 1
Estimated Project Costs

Item	Construction Cost	Indirect Cost	Total Estimated Cost
Street Improvements	$ 475,000	$ 120,000	$ 595,000
Storm Water Improvements	$ 180,000	$ 45,000	$ 225,000
Sanitary Sewer Improvements	$ 80,000	$ 20,000	$ 100,000
Water Main Improvements	$ 144,000	$ 36,000	$ 180,000
TOTAL PROJECT COST	**$ 879,000**	**$ 221,000**	**$ 1,100,000**

Table Notes:
Township's Indirect Costs includes the following:
Engineering/Administration/Legal
Financing and Bonding

5.2 Assessment Policy

The Township assessment policy was drafted and approved on April 17, 2006 and revised on March 18, 2013. The policy was created for the purpose of establishing a stable and equitable method of cost sharing for repair and reconstruction of Township streets. In the past, the Township has consistently assessed 100% of the cost for street improvements. However, the Township can only assess up to the amount of benefit of the improvement to properties. Appraisal documents

provided by the Township Attorney were studied to help determine fair assessment rates for street, sanitary and water improvements. Parcels were only assessed for utilities and services being provided. For instance, a parcel adjacent to Peterson Road with an existing water connection would only be assessed for the street and sanitary improvements, and not the water. The interest rate has not yet been determined. The term of the assessment is typically 10 years for streets and 15 years for utility work. The recommended properties proposed for assessment are shown in the assessment roll and assessment map. See Appendix G for the preliminary assessment roll and Appendix H for the assessment map.

5.3 Assessment Amount

The improvement cost and assessable costs were computed for the project area. The assessments were computed as a residential equivalent unit assessment. Each standard residential property was assessed as one unit for street, water and sanitary if that unit was receiving benefit from the improvements. Per the assessment policy, corner lots were assessed one-half unit for each side that abuts the improvement. The Township believes that the improvement value of this project to the assessable properties exceeds this amount assessed.

Table 2
Assessment Summary

	2020 Street Improvement Area
Overall Project Costs	$ 1,100,000
Overall Assessable Costs	$ 412,500
Street Assessable Units	15 (6 units un-assessable and assigned to White Bear Township, plus 1 deferred)
Street Assessment Rate	$ 15,000
Street Assessment	$ 225,000
Sanitary Assessable Units	7 (1 deferred)
Sanitary Assessment Rate	$ 12,500
Sanitary Assessment	$ 87,500
Water Assessable Units	8 (1 deferred)
Water Assessment Rate	$ 12,500
Water Assessments	$ 100,000
Assessment Term Street	10 Years
Assessment Term Water and Sewer	15 Years
Interest Rate	Undetermined (2019 Rate 3.5%)

5.4 Funding Sources

Funding for this project is proposed to come from assessments, tax levy, water utility fund, sanitary sewer utility fund, and storm sewer utility fund. The table below shows the funding source breakdown for the three different assessment rates.

Table 3
Funding Table

Township Funds / Bonding	$ 460,000*
Assessments	$ 322,500
Township Water Fund	$ 80,000
Township Sanitary Fund	$ 12,500
Township Storm Fund	$ 225,000
Total	**$ 1,100,000**

*Includes 6 units of the street assessment

6.0 Preliminary Project Schedule

The following project schedule outlines an approach to complete the assessment process per MN Statutes 429 for this project in 2020. If additional discussion is needed for this project to move forward, construction would be shifted to 2021.

Activity	Date
Authorize Preparation of Feasibility Report	December 12, 2019
Town Board Discussions	Various Meetings
Township Accept Feasibility Report and Call for Public Hearing	June 1, 2020
Neighborhood Informational Meeting	June, 2020
Public Hearing / Order Improvements / Authorize Preparation of Plans and Specifications	June/July 2020
Neighborhood Informational Meeting	July 2020
Accept Plans and Specifications and Authorize Advertisement for Bids	August 2020
Bid Opening	September, 2020
Award Contract	September, 2020
Begin Construction	September, 2020
Substantial Construction Completion	October 2020
Authorize Amount to be Assessed	September, 2020
Assessment Hearing / Adopt Assessments	October, 2020
Construction Completion	Spring 2021

7.0 Conclusion and Recommendations

With the addition of concrete curb and gutter, sanitary sewer and water service, stormwater treatment, and bituminous surfacing, Peterson Road will serve the surrounding residents with safe and easy access, utilities, and drainage for many years. This report recommends a **28' road width with 6' walk** on back of curb for Peterson Road. This decision was mostly driven by the minimal impact to the established area and the function that this option will provide for present and future. The proposed improvement is necessary, cost effective, and feasible from an engineering standpoint and should be made as proposed.

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Appendix A

Peterson Road Street Improvement Area

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CENTERVILLE ROAD
PINE HILL LANE
COUNTY ROAD H-2 EAST
MEHEGAN LANE
MEHEGAN COURT
ANDERSON LANE
PETERSON ROAD
PROVENCE LANE
TH 35 E
WHITE BEAR TOWNSHIP
MICHAEL M PULLEN REV LIVING TRUST
NORTH OAKS FARMS INC
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SCALE IN FEET
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1080
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AREA MAP

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Appendix B

Typical Sections

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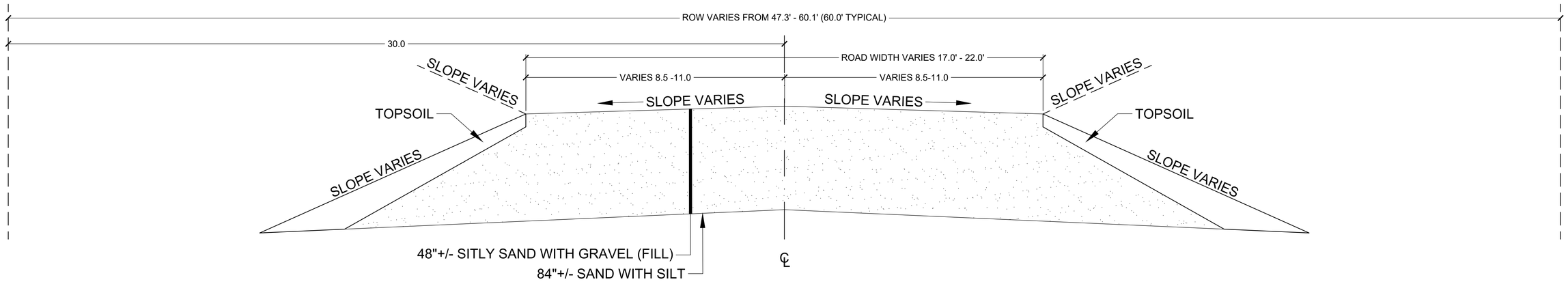
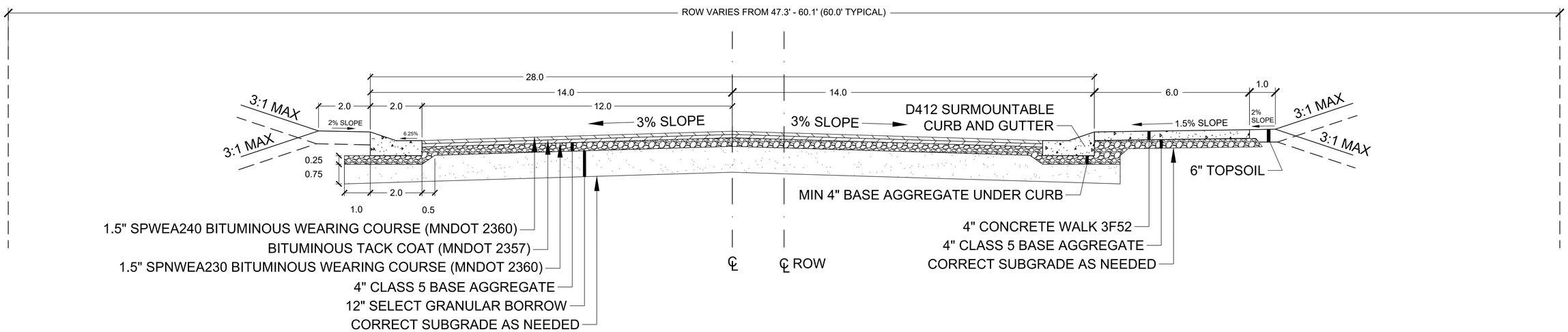


PETERSON ROAD - EXISTING CONDITIONS



PETERSON ROAD - PROPOSED 28' BOC TO BOC WIDTH WITH 6' WALK - 7 TON DESIGN

*ROAD NOT CENTERED IN ROW

TYPICAL SECTIONS

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Appendix C

Road Width & Right of Way

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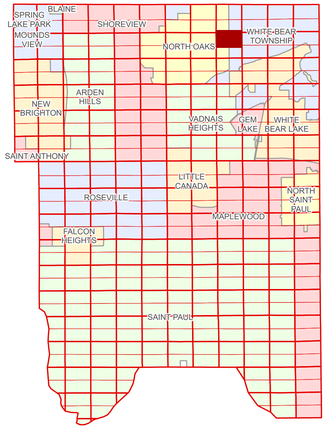
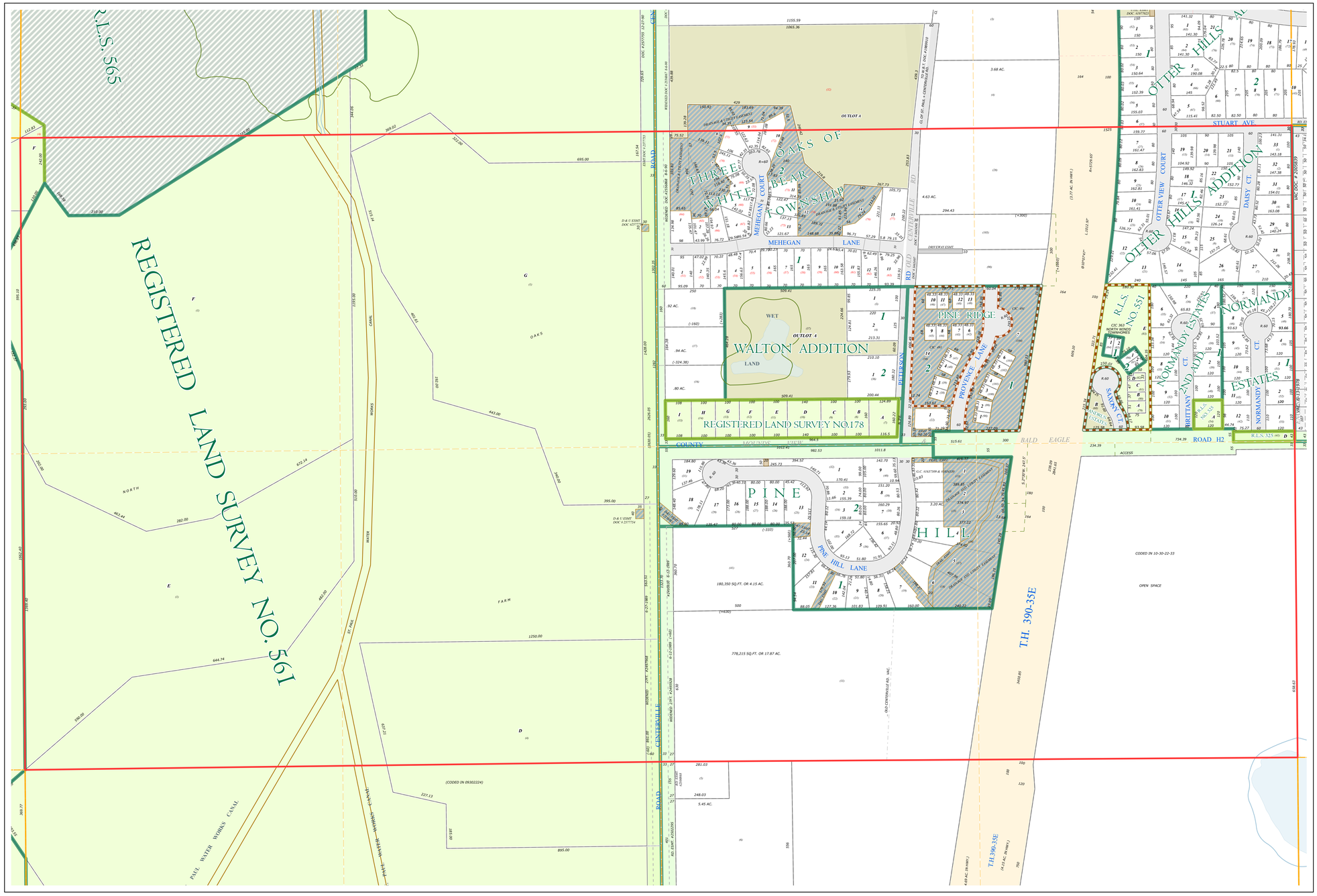
Ramsey County Minnesota Parcel Map

N Half
Section 9
T 30 N
R 22 W



Ramsey County
Section 8

Ramsey County
Section 4



Ramsey County
Section 10

Legend

- Section
- Quarter
- Quarter Quarter
- Federal Right of Way
- County Right of Way
- Municipal Right of Way

Subdivision Type

- Subdivision Plat
- Registered Land Survey
- Planned Community

Division Type

- Lot
- Outlot
- Tract
- Metes & Bounds

Tax Parcel Type

- Real Property
- County Ditch
- Water Line
- Wetland Line
- Construction Line
- Special Centerline
- Extension, Sidelot
- Historic Right of Way

Easement Type

- Conservation
- Private Driveway
- Utility, Unidentified
- Drainage & Utility
- Misc Easements

The information on this map is a compilation of Ramsey County Records. THE COUNTY DOES NOT WARRANT OR GUARANTEE THE ACCURACY OF THIS DATA. The County disclaims any liability for any injuries, time delays, or expenses you may suffer if you rely in any manner on the accuracy of this data.

Produced by Information Services Enterprise GIS Division
RCGISMetaData@Co.Ramsey.MN.US

NOTE: This is not an offical Ramsey County tax lot map. This is based on the data available in the Geographic Information System, which may vary from tax data officially recorded in the Tax System. For an official tax map, please contact the Office of Property Records and Revenue.

651-266-2000
AskPropertyTaxandRecords@co.ramsey.mn.us

Section 9
Ramsey County

RAMSEY COUNTY
Working with you to enhance our quality of life

N
W E
S

0 4590 180 270 360 Feet
1" = 200'
1:2,400

N093022
1/6/2020

ROW AND ROAD WIDTHS

Appendix D

Proposed Utilities

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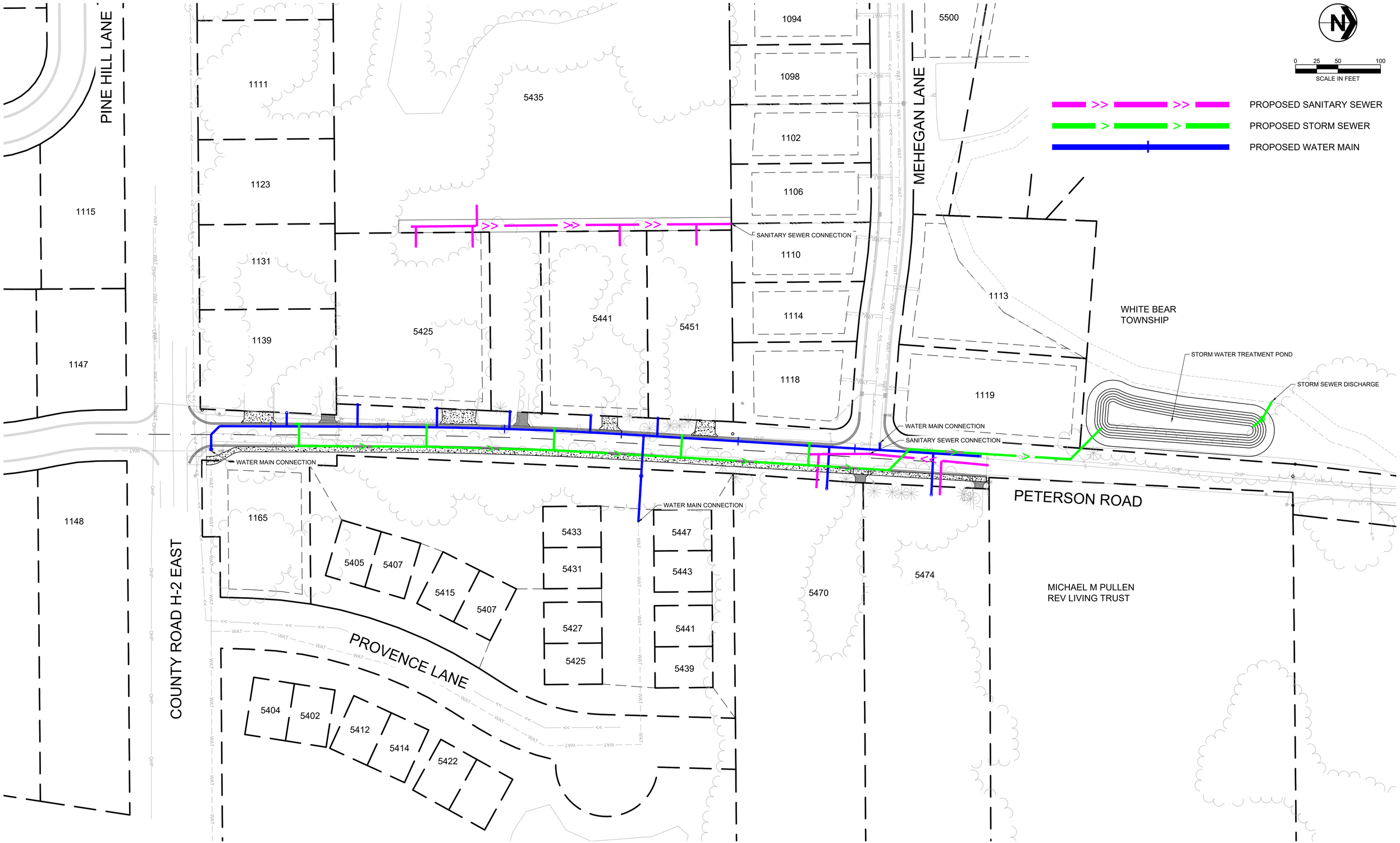

PROPOSED UTILITY LAYOUT

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Appendix E

Street Layout

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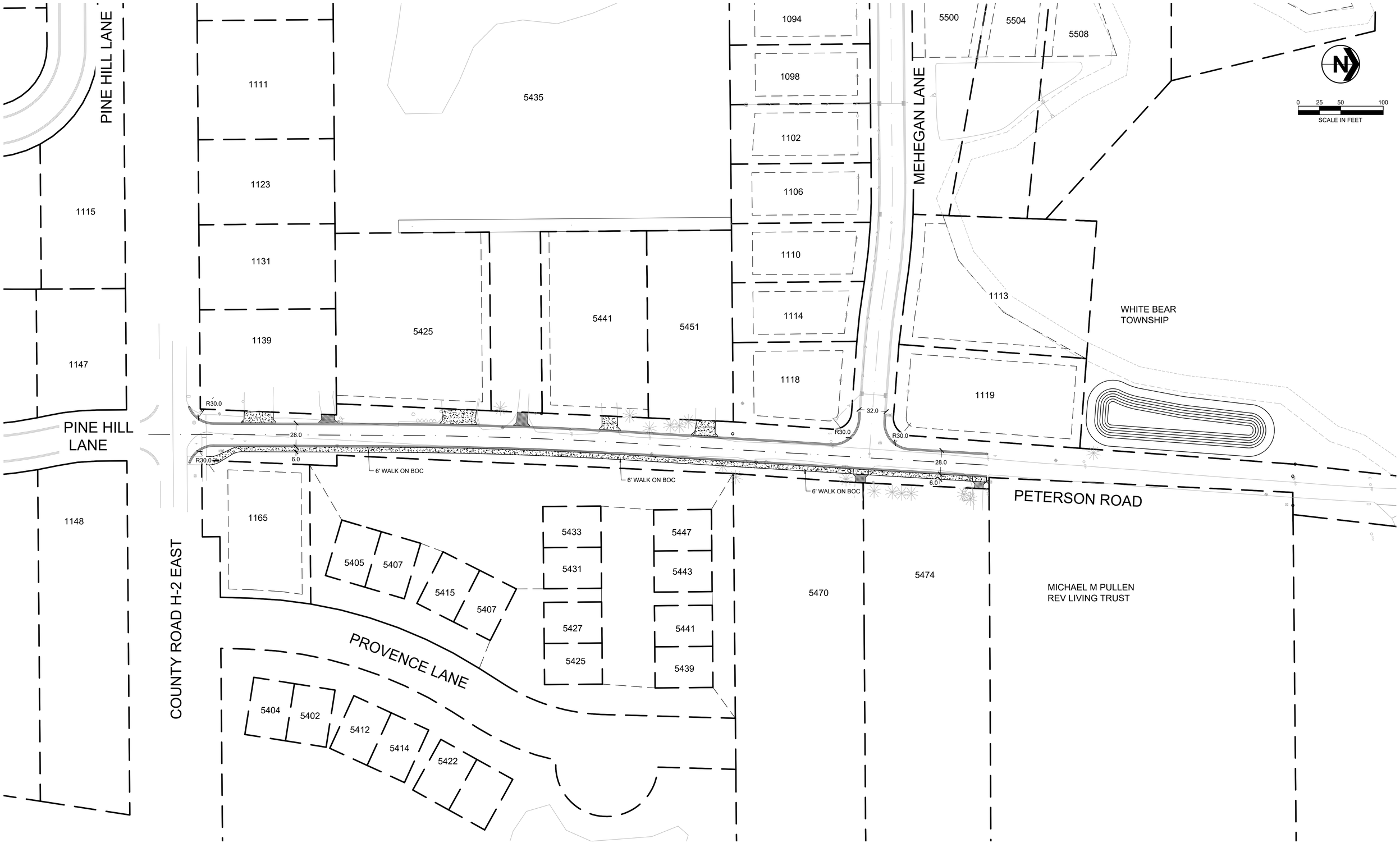

PROPOSED STREET LAYOUT

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Appendix F

Cost Estimate

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ESTIMATED COSTS AND QUANTITIES					
STREET CONSTRUCTION COST ESTIMATE					
	DESCRIPTION	UNITS	EST. QUANTITY	EST. UNIT COST	EST. TOTAL COST
1	MOBILIZATION	LUMP SUM	1	$ 35,000.00	$ 35,000.00
2	DEWATERING	LUMP SUM	1	$ 5,000.00	$ 5,000.00
3	TRAFFIC CONTROL	LUMP SUM	1	$ 10,000.00	$ 10,000.00
4	WATER	M GALLON	60	$ 50.00	$ 3,000.00
5	CLEARING	TREE	45	$ 300.00	$ 13,500.00
6	GRUBBING	TREE	45	$ 75.00	$ 3,375.00
7	REMOVE SIGN TYPE C	EACH	5	$ 35.00	$ 175.00
8	REMOVE SIGN TYPE SPECIAL	EACH	4	$ 20.00	$ 80.00
9	SALVAGE SIGN TYPE C	EACH	2	$ 35.00	$ 70.00
10	SALVAGE SIGN TYPE SPECIAL	EACH	2	$ 20.00	$ 40.00
11	SAWING BIT PAVEMENT (FULL DEPTH)	LIN FT	150	$ 2.25	$ 337.50
12	SAWING CONCRETE PAVEMENT (FULL DEPTH)	LIN FT	150	$ 5.00	$ 750.00
13	REMOVE CURB AND GUTTER	LIN FT	50	$ 6.00	$ 300.00
14	REMOVE BITUMINOUS PAVEMENT	SQ YD	100	$ 15.00	$ 1,500.00
15	REMOVE BITUMINOUS DRIVEWAY PAVEMENT	SQ YD	50	$ 15.00	$ 750.00
16	REMOVE CONCRETE WALK	SQ YD	50	$ 15.00	$ 750.00
17	REMOVE CONCRETE DRIVEWAY PAVEMENT	SQ YD	50	$ 20.00	$ 1,000.00
18	REMOVE SEWER PIPE (STORM)	LIN FT	60	$ 15.00	$ 900.00
19	REMOVE WATERMAIN	LIN FT	25	$ 30.00	$ 750.00
20	SALVAGE CASTING	EACH	2	$ 250.00	$ 500.00
21	MODULAR BLOCK RETAINING WALL	SQ FT	200	$ 45.00	$ 9,000.00
22	COMMON EXCAVATION	CU YD	1655	$ 35.00	$ 57,925.00
23	SUBGRADE EXCAVATION	CU YD	130	$ 25.00	$ 3,250.00
24	SELECT GRANULAR BORROW	TON	1770	$ 25.00	$ 44,250.00
25	CRUSHED ROCK (1" CLEAR)	TON	20	$ 30.00	$ 600.00
26	CRUSHED ROCK (3" MINUS)	TON	50	$ 25.00	$ 1,250.00
27	STREET SWEEPER (WITH PICKUP BROOM)	HOUR	30	$ 175.00	$ 5,250.00
28	AGGREGATE BASE (CV) CLASS 5	TON	885	$ 21.00	$ 18,585.00
29	DRILL & GROUT REINF BAR (EPOXY COATED)	EACH	15	$ 20.00	$ 300.00
30	TYPE SP 9.5 WEARING COURSE MIXTURE (2,B)	TON	240	$ 80.00	$ 19,200.00
31	TYPE SP 12.5 NON WEARING COURSE MIXTURE (2,B)	TON	240	$ 65.00	$ 15,600.00
32	4" CONCRETE WALK	SQ FT	5600	$ 15.00	$ 84,000.00
33	CONCRETE CURB & GUTTER DESIGN D412	LIN FT	1920	$ 30.00	$ 57,600.00
34	6" CONCRETE DRIVEWAY PAVEMENT	SQ YD	170	$ 75.00	$ 12,750.00
35	TRUNCATED DOMES	SQ FT	37	$ 60.00	$ 2,220.00
36	INSTALL CASTING	EACH	2	$ 750.00	$ 1,500.00
37	STABILIZED CONSTRUCTION EXIT	LUMP SUM	1	$ 5,000.00	$ 5,000.00
38	STORM DRAIN INLET PROTECTION	EACH	5	$ 150.00	$ 750.00
39	SEDIMENT CONTROL LOG TYPE COMPOST	LIN FT	750	$ 3.00	$ 2,250.00
40	SILT FENCE, TYPE MS	LIN FT	750	$ 2.00	$ 1,500.00
41	COMMON TOPSOIL BORROW	CU YD	778	$ 50.00	$ 38,900.00
42	FERTILIZER	POUND	194	$ 1.00	$ 194.00
43	EROSION CONTROL BLANKET	SQ YD	994	$ 2.00	$ 1,988.00
44	SEEDING	ACRE	0.97	$ 5,000.00	$ 4,850.00
45	SEED	POUND	117	$ 10.00	$ 1,170.00
46	HYDRAULIC STABILIZED FIBER MATRIX	POUND	2350	$ 2.00	$ 4,700.00
47	SIGN TYPE C	SF	25	$ 40.00	$ 1,000.00
48	SIGN TYPE SPECIAL	SF	25	$ 75.00	$ 1,875.00
49	4" SOLID LINE MULTI COMPONENT	LIN FT	150	$ 0.50	$ 75.00
50	24" SOLID LINE MULTI COMPONENT	LIN FT	50	$ 10.00	$ 500.00
51	4" DOUBLE SOLID LINE MULTI COMPONENT	LIN FT	950	$ 1.00	$ 950.00
52	PAVEMENT MESSAGE MULTI COMPONENT GROUND IN	SQ FT	50	$ 15.00	$ 750.00
				TOTAL STREET CONSTRUCTION COST	**$ 477,509.50**

STORM SEWER COST ESTIMATE					
	DESCRIPTION	UNITS	EST. QUANTITY	EST. UNIT COST	EST. TOTAL COST
53	COMMON EXCAVATION	CU YD	750	$ 35.00	$ 26,250.00
54	GEOTEXTILE FABRIC	SQ YD	380	$ 2.00	$ 760.00
55	15" RC PIPE APRON	EACH	2	$ 1,400.00	$ 2,800.00
56	4" PERF TP PIPE DRAIN	LIN FT	200	$ 20.00	$ 4,000.00
57	15" RC PIPE SEWER DES 3006 CL V	LIN FT	1175	$ 60.00	$ 70,500.00
58	CONSTRUCT DRAINAGE STRUCTURE DESIGN SPECIAL 1 (CB)	EACH	6	$ 2,500.00	$ 15,000.00
59	CONSTRUCT DRAINAGE STRUCTURE DESIGN SPECIAL 2 (CB/MH)	EACH	9	$ 3,500.00	$ 31,500.00
60	CONSTRUCT DRAINAGE STRUCTURE DESIGN SPECIAL 3 (pond overflow)	EACH	1	$ 10,000.00	$ 10,000.00
61	CONSTRUCT RAIN GARDEN	SQ YD	100	$ 150.00	$ 15,000.00
62	RANDOM RIPRAP CLASS III	TON	50	$ 85.00	$ 4,250.00
				TOTAL STORM SEWER CONSTRUCTION COST	**$ 180,060.00**

WATER MAIN COST ESTIMATE					
	DESCRIPTION	UNITS	EST. QUANTITY	EST. UNIT COST	EST. TOTAL COST
63	ADJUST GATE VALVE & BOX	EACH	3	$ 500.00	$ 1,500.00
64	CONNECT TO EXISTING WATERMAIN	EACH	3	$ 2,000.00	$ 6,000.00
65	8" GATE VALVE	EACH	3	$ 3,000.00	$ 9,000.00
66	1" CORPORATION STOP	EACH	7	$ 1,100.00	$ 7,700.00
67	1" CP WATER SERVICE	LIN FT	200	$ 85.00	$ 17,000.00
68	CURB STOP AND BOX	EACH	7	$ 500.00	$ 3,500.00
69	2" INSULATION	SQ YD	150	$ 40.00	$ 6,000.00
70	DUCTILE IRON FITTINGS	POUND	1500	$ 10.00	$ 15,000.00
71	8" DIP WATERMAIN	LIN FT	1030	$ 75.00	$ 77,250.00
				TOTAL WATER MAIN CONSTRUCTION COST	**$ 142,950.00**

SANITARY SEWER COST ESTIMATE					
	DESCRIPTION	UNITS	EST. QUANTITY	EST. UNIT COST	EST. TOTAL COST
72	CONNECT TO EXISTING SANITARY STRUCTURE	EACH	3	$ 750.00	$ 750.00
73	SANITARY MAN HOLE	EACH	3	$ 7,500.00	$ 22,500.00
74	8"PVC SANITARY PIPE	LIN FT	585	$ 80.00	$ 46,800.00
75	4" PVC SANITARY SEWER SERVICE	LIN FT	185	$ 40.00	$ 7,400.00
76	4"x8" WYE	EACH	6	$ 150.00	$ 900.00
				TOTAL SANITARY SEWER CONSTRUCTION COST	**$ 78,350.00**

STREET COST	$ 477,509.50
25% INDIRECT	$ 119,377.38
TOTAL	$ 596,886.88
ROUNDED TOTAL	$ 595,000.00

STORM SEWER COST	$ 180,060.00
25% INDIRECT	$ 45,015.00
TOTAL	$ 225,075.00
ROUNDED TOTAL	$ 225,000.00

WATER MAIN COST	$ 142,950.00
25% INDIRECT	$ 35,737.50
TOTAL	$ 178,687.50
ROUNDED TOTAL	$ 180,000.00

SANITARY SEWER COST	$ 78,350.00
25% INDIRECT	$ 19,587.50
TOTAL	$ 97,937.50
ROUNDED TOTAL	$ 100,000.00

TOTAL PROJECT CONSTRUCTION COST	$ 878,869.50
25% INDIRECT	$ 219,717.38
TOTAL	$ 1,098,586.88
ROUNDED TOTAL	$ 1,100,000.00

Appendix G

Assessment Roll

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Description: Peterson Road Improvements

STREET ASSESSMENT RATE	$	15,000	PER UNIT
UTILITY ASSESSMENT WATER RATE	$	12,500	PER UNIT
UTILITY ASSESSMENT SEWER RATE	$	12,500	PER UNIT
INTEREST RATE			
TERM		10	YEARS
TERM - UTILITY		15	YEARS
INITIAL YEAR		2020	

NUMBER	PARCEL ADDRESS	PARCEL NUMBER	LEGAL DESCRIPTION	PRIMARY OWNER	JOINT OWNER	OWNER ADDRESS	CITY AND ZIP	ASSESSABLE STREET UNITS	STREET ASSESSMENT/UNIT	STREET ASSESSMENT TOTAL	ASSESSABLE SANITARY UNITS	SANITARY ASSESSMENT/UNIT	SANITARY ASSESSMENT TOTAL	ASSESSABLE WATER MAIN UNITS	WATER MAIN ASSESSMENT/UNIT	WATER MAIN ASSESSMENT TOTAL	TOTAL ASSESSMENT
1	5474 Peterson Road	93022110105	SECTION 9 TOWN 30 RANGE 22 THE N 145 FT OF THE S 300 FT OF THE N 1/2 OF N 1/2 OF NE 1/4 WHICH LIES W OF I35-E AND E OF THE CL OF PETERSON RD IN SEC 09 TN 30 RN 22	DENNIS J PETERSON	PATRICIA A PETERSON	5474 PETERSON RD	WHITE BEAR TOWN MN 55127-6712	1	$ 15,000	$ 15,000	1	$ 12,500.00	$ 12,500.00	1	$ 12,500.00	$ 12,500.00	$ 40,000.00
2	5470 Peterson Road	93022110090	SECTION 9 TOWN 30 RANGE 22, THE S 155 FT OF THE N 1/2 OF N 1/2 OF NE 1/4 LYING W OF I-35E AND LYING E OF THE C L OF PETERSON RD (SUBJ TO ESMTS) IN SEC 9 TN 30 RN 22	PATRICK M HAGEN		1741 GERVAIS AVE UNIT 6	MAPLEWOOD MN 55109-2182	1	$ 15,000	$ 15,000	1	$ 12,500.00	$ 12,500.00	1	$ 12,500.00	$ 12,500.00	$ 40,000.00
3	1119 Mehegan Lane	93022120077	THREE OAKS OF WHITE BEAR TOWNSHIP LOT 15 BLK 2	NORTH OAKS FARMS INC		5959 CENTERVILLE RD UNIT 200	ST PAUL MN 55127-6812	0.5	$ 15,000	$ 7,500	0	$ 12,500.00	$ -	0	$ 12,500.00	$ -	$ 7,500.00
4	1118 Mehegan Lane	93022120063	THREE OAKS OF WHITE BEAR TOWNSHIP LOT 13 BLK 1	NORTH OAKS FARMS INC		5959 CENTERVILLE RD UNIT 200	ST PAUL MN 55127-6812	0.5	$ 15,000	$ 7,500	0	$ 12,500.00	$ -	0	$ 12,500.00	$ -	$ 7,500.00
5	5451 Peterson Road	93022120003	WALTON ADDITION LOT 1 BLK 1	LEIF E EISCHEN	MICHELLE E EISCHEN	5451 PETERSON ROAD	ST PAUL MN 55127-6713	1	$ 15,000	$ 15,000	1	$ 12,500.00	$ 12,500.00	1	$ 12,500.00	$ 12,500.00	$ 40,000.00
6	5541 Peterson Road	93022120004	WALTON ADDITION LOT 2 BLK 1	STEPHEN E PASKET	CAROLYN M PASKET	5441 PETERSON RD	WHITE BEAR TOWN MN 55127-6713	1	$ 15,000	$ 15,000	1	$ 12,500.00	$ 12,500.00	1	$ 12,500.00	$ 12,500.00	$ 40,000.00
7	5435 Peterson Road	93022120037	WALTON ADDITION OUTLOT A	EDWIN M PRUDHON	SANDRA M PRUDHON	5435 PETERSON RD	ST PAUL MN 55127-6713	1	$ 15,000	$ 15,000	1	$ 12,500.00	$ 12,500.00	1	$ 12,500.00	$ 12,500.00	$ 40,000.00
8	5425 Peterson Road	93022120036	WALTON ADDITION LOT 1 BLK 2	GERALD J PRICE	LINDA PRICE	5425 PETERSON RD	ST PAUL MN 55127-6713	2	$ 15,000	$ 30,000	2	$ 12,500.00	$ 25,000.00	2	$ 12,500.00	$ 25,000.00	$ 80,000.00
9	1165 County Road H-2 E	93022120022	PINE RIDGE LOT 1 BLK 2	DANIEL M EWALD		PO BOX 2262	STILLWATER MN 55082-3262	0.5	$ 15,000	$ 7,500	0	$ 12,500.00	$ -	0	$ 12,500.00	$ -	$ 7,500.00
10	1139 County Road H-2 E	93022120007	REGISTERED LAND SURVEY 178 TRACT A	DEBORAH J KEEFE		13408 EUROPA CT N UNIT 1	HUGO MN 55038-4479	0.5	$ 15,000	$ 7,500	0	$ 12,500.00	$ -	1	$ 12,500.00	$ 12,500.00	$ 20,000.00
11	Provence Lane Townhomes			WHITE BEAR TOWNSHIP				6	$ 15,000	$ 90,000	0	$ 12,500.00	$ -	0	$ 12,500.00	$ -	$ 90,000.00
								15	TOTAL	$ 225,000.00	7	TOTAL	$ 87,500.00	8	TOTAL	$ 100,000.00	$ 412,500.00

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Appendix H

Assessment Map

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ASSESSMENT MAP

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Appendix I

Geotechnical Report

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AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

February 25, 2020

TKDA
444 Cedar Street, Suite 1500
St. Paul, MN 55101

Attn: James Studenski, PE

RE: Geotechnical Exploration
Peterson Road Improvements, North of County Road H2 E
White Bear Township, Minnesota
AET No. 01-20739

Dear Mr. Studenski:

This letter report presents the results of the geotechnical exploration performed at the referenced site and presents our opinions and recommendations pertaining to street subgrade preparation, pavement design, and utility installation. This work is being performed per our January 22, 2020 proposal, which was subsequently accepted by you on January 23. The authorized scope consists of three standard penetration test borings, soil laboratory testing, and preparation of this report.

1.0 Project Information

Peterson Road is currently gravel surfaced. The street will be converted to a bituminous paved road with curb and gutter. We assume the new pavement final grade will be at or close to that which currently exists. The roadway serves a residential area with no through traffic. Accordingly, traffic loads are expected to be relatively light.

Watermain and storm sewer will also be extended through the project. Invert depths are likely to be no more than 8 feet below the surface.

2.0 Site Exploration and Testing

Three standard penetration test borings were drilled and sampled at the site on February 7, 2020. The logs of the test borings are attached. The boring locations graphically appear on attached Figure 1. The Ramsey County coordinates determined by GPS appear on the logs. The boring surface elevations were not obtained.

The boring logs contain information concerning soil layering, soil classification, geologic description, and moisture condition. Relative density or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value). We refer you to the

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standard sheet entitled "Exploration/Classification Methods" for details on the drilling and sampling methods, the classification methods, and the water level measurement methods. Data sheets concerning the Unified Soils Classification System, the AASHTO Soil Classification System, the descriptive terminology, and the symbols used on the boring logs are also attached.

The laboratory test program included two sieve analysis tests and two water content tests. The test results appear on the individual boring logs adjacent to the samples upon which they were performed and/or on the data sheet following the boring logs.

3.0 Conditions Encountered

3.1 Soils

The general geologic profile consists of fill over granular alluvium (water deposited soils). The apparent fill is about 2 to 4 feet thick and is mostly silty sand having an A-2-4 AASHTO Soil Group classification. The sieve analysis tests indicate that they meet a Granular Material specification (MnDOT 3149.2B.1). Surficial zones include more gravel and represent the aggregate base layer placed, although actual base thickness was difficult to ascertain due to the frozen condition.

The alluvium consists of silty sand (SM) and sand with silt (SP-SM). The sand particle size is mostly fine grained, making them on the slower permeability end of the silty sand and sand with silt permeability ranges. The sand density is mostly medium dense.

3.2 Groundwater

No groundwater entered Borings B-1 and B-2 at the time of drilling; although the bottom sample at Boring B-2 was wet and appeared to be approaching a possible water level. A water level was measured at a depth of 7.2 feet at Boring B-3 and the overlying sample was somewhat wet suggesting the water level could have risen higher if given more time. Groundwater levels will fluctuate both seasonally and annually.

4.0 Opinions/Recommendations

4.1 Definitions

Refer to the attached sheet entitled "Definitions Relating to Pavement Construction" for definition of the italicized words in the remainder of this report.

4.2 Pavement Subgrade Preparation

Current practice is to incorporate a *sand subbase* layer of *Select Granular Material* beneath the aggregate base layer for bituminous pavement systems. The purpose is to provide improved drainage for the aggregate base and upper zone of the subgrade which better controls frost heaving/pop outs and thaw weakening effects. The placement of a one-foot thick *Select Granular Material* layer would provide improved long-term performance.

The borings indicate that the subgrade soils present should meet a *Granular Material* specification (less than 20% by weight passing the #200 sieve). Considering the function of the

road, you could consider eliminating the imported *Select Granular Material* subbase as a less costly approach, if the township is willing to accept reduced long-term performance.

The final subgrade should have proper stability within the *critical subgrade zone*. As sandy soils are anticipated, we recommend surface compacting the exposed sandy subgrade with a vibratory roller compactor (at least 4 passes with a self-propelled vibratory roller). This process should be observed to evaluate whether buried *unstable soils* may exist within the subgrade. If deflections are noted under the compaction process, the *unstable soils* should be removed. Any *organic soils* found should also be removed where present within the *critical subgrade zone*.

Where new fill is needed to reattain subgrade elevation, it should be placed per the requirements of MnDOT Specification 2105.3F.1 (Specified Density Method). In ASTM terms, this specification requires soils placed within the *critical subgrade zone* be compacted to a minimum of 100% of the *standard maximum dry unit weight* defined in ASTM: D698 (Standard Proctor test). A reduced minimum compaction level of 95% of the *standard maximum dry unit weight* can be used below the *critical subgrade zone*.

4.3 Subgrade R-value/Pavement Thickness Design

The limiting on-site soils are the silty sands (A-2-4). These soils are estimated to have an R-value of 50. If the *Granular Material* soils are overlain by a 1-foot thick *sand subbase* of *Select Granular Material*, we estimate a slightly improved design R-value of 60. However, both R-values are relatively high and result in the same recommended pavement section.

Our recommended pavement designs appear in Table 4.3. We are providing both 7-ton and 9-ton designs.

Table 4.3 – Bituminous Pavement Thickness Design

Material	Section Thicknesses	
	7-ton Design	**9-ton Design**
Bituminous	1.5" SPWEA330C	2.0" SPWEA330C
Bituminous	1.5" SPWEA330C	2.0" SPWEA330C or SPWEB330C
Class 5 or 6 Aggregate Base	4"	5"

The bituminous design has been based on a “20-year” pavement life, although does require on-going maintenance. Even if placed and compacted properly on stable subgrade conditions, bituminous pavements typically experience cracking in 1 to 3 years, primarily due to temperature-related expansion and shrinkage. We recommend that a regularly scheduled maintenance program consisting of patching of cracks and local distressed areas be implemented. Seal coating of the pavement surface after 3 to 5 years also helps prolong the pavement life.

4.4 Utility Installation

Where utility installation takes place, we recommend trenching, installation, and backfilling be performed prior to final roadway subgrade preparation.

The new utility system should be supported on the granular soils. Where the system is above the groundwater level, the soils should be stable. In this case, conventional granular bedding should provide adequate foundation support. Thicker foundation bedding may be needed in cases of trench bottom instability (e.g., extending into wet/waterbearing soils). We refer you to the attached sheets entitled "Bedding/Foundation Support of Buried Pipe" and "Utility Excavation Backfilling" for standard recommendations on utility bedding and for utility backfilling.

Where groundwater entering the trench results in a standing water condition, we recommend dewatering be performed such that bedding placement and pipe installation can be performed in a non-standing water condition.

5.0 Construction Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer or technician during construction to evaluate these potential changes. Sieve analysis tests should be conducted on *Select Granular Material* and on aggregate base materials to evaluate compliance with the project material specifications. Soil density and Proctor testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

6.0 Limitations

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, express or implied, is intended.

Authored By,
American Engineering Testing, Inc.

Jeffery K. Voyen, PE
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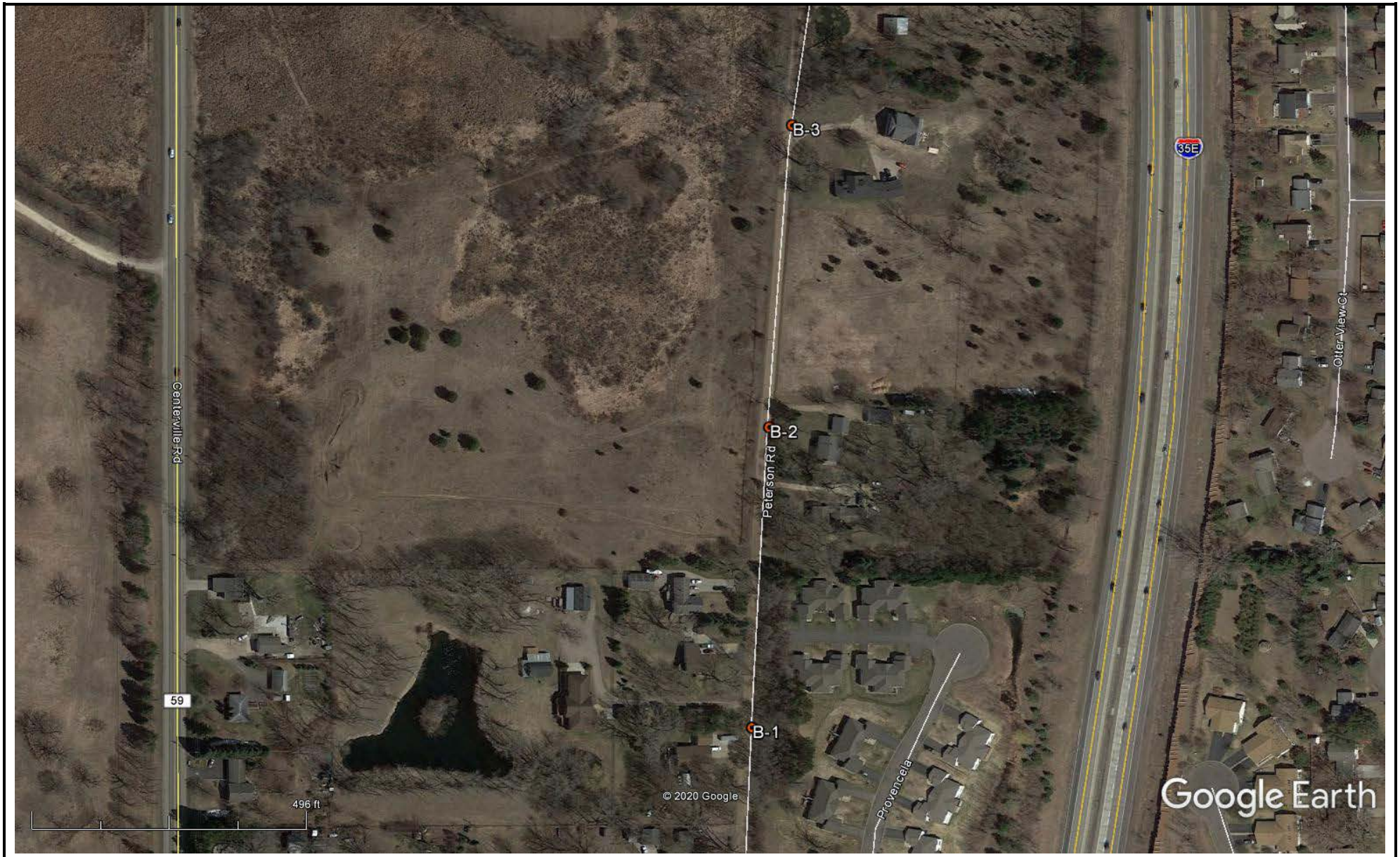
Reviewed By,
American Engineering Testing, Inc.

Jacob O. Michalowski, PE
Senior Engineer

Attachments:

- Figure 1 – Boring Locations
- Subsurface Boring Logs
- Sieve Analysis Test Results
- Exploration/Classification Methods
- Boring Log Notes
- Unified Soil Classification System
- AASHTO Soil Classification System
- Definitions Relating to Pavement Construction
- Bedding/Foundation Support of Buried Pipe
- Utility Excavation Backfilling



AMERICAN ENGINEERING TESTING, INC.	**Project:** Peterson Road Improvements, North of County Road H2 E White Bear Township, Minnesota			**AET No.:** 01-20739
	Subject: Boring Locations			**Date:** 2/25//2020
	Scale: 1" = 246'±	**Prepared By:** AS	**Checked By:** JV	**Figure 1**

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20739** Log of Boring No. **B-1 (p. 1 of 1)**

Project: **Peterson Road Improvements; White Bear Township, MN**

Surface Elevation _____ Ramsey Co. Coordinates: N **214848** E **585476**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	FILL, mostly silty sand with gravel, trace roots, dark brown, frozen (A-1-b)	FILL		F	SU						
1	FILL, mostly silty sand, a little gravel, brown, frozen (A-2-4)			F	SU						
2	FILL, mixture of silty sand and clayey sand, a little gravel, brown, frozen to 3.5' (A-2-4)			F	SS	16	10				14.2
3											
4	SAND WITH SILT, a little gravel, fine grained, light grayish brown, moist, medium dense (SP-SM) (A-3)	COARSE ALLUVIUM									
5			25	M	SS	12					
6											
7											
8			21	M	SS	18					
9											
10			20	M	SS	16					
11	**END OF BORING**										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9½'	**3.25" HSA**	**2/7/20**	**9:20**	**11.0**	**9.5**	**11.0**		**None**
BORING COMPLETED: **2/7/20**								
DR: **SG** LG: **JM** Rig: **91C**								

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-COORDINATES 01-20739.GPJ AET+CPT+WELL_20181012_JG.GDT 2/25/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20739** Log of Boring No. **B-2 (p. 1 of 1)**

Project: **Peterson Road Improvements; White Bear Township, MN**

Surface Elevation _____ Ramsey Co. Coordinates: N **215389** E **585505**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	7" FILL, mostly silty sand with gravel, dark brown, frozen (A-1-b)	FILL		F	SU						
1	FILL, mostly silty sand, a little gravel, dark brown to brown, frozen to 3.5' (A-2-4)			F	SU						
2											
3				F	SS	18					
4	SAND WITH SILT, a little gravel, fine to medium grained, brown, moist, medium dense (SP-SM) (A-3)	COARSE ALLUVIUM									
5			11	M	SS	18					
6											
7	SAND WITH SILT, fine grained, light grayish brown, moist, dense (SP-SM) (A-3)										
8			35	M	SS	16					
9	SAND WITH SILT, a little gravel, fine to medium grained, brown, wet, dense (SP-SM) (A-3)										
10			40	M/W	SS	16					
11	**END OF BORING**										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9½'	**3.25" HSA**	**2/7/20**	**10:05**	**11.0**	**9.5**	**11.0**		**None**

BORING COMPLETED: **2/7/20**

DR: **SG** LG: **JM** Rig: **91C**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-COORDINATES 01-20739.GPJ AET+CPT+WELL_20181012_JG.GDT 2/25/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20739** Log of Boring No. **B-3 (p. 1 of 1)**

Project: **Peterson Road Improvements; White Bear Township, MN**

Surface Elevation _____ Ramsey Co. Coordinates: N **215933** E **585544**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	5.5" Crushed limestone base, light brown, frozen (A-1-b)	FILL		F	SU						
1	FILL, mostly silty sand, a little gravel, dark brown, frozen (A-2-4)			F	SU		9				16.3
2	SILTY SAND, fine grained, brown, frozen to 3.5' (SM) (A-2-4) (possible fill)	COARSE ALLUVIUM OR FILL		F	SS	18					
3											
4	SILTY SAND, fine grained, brown, wet, loose to medium dense (SM) (A-2-4)	COARSE ALLUVIUM									
5			10	W	SS	16					
6											
7				▼							
8			14	W	SS	12					
9											
10			12	W	SS	14					
11	**END OF BORING**										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9½'	**3.25" HSA**	**2/7/20**	**10:30**	**8.5**	**7.0**	**8.3**		**None**
		2/7/20	**10:40**	**8.5**	**7.0**	**8.2**		**7.2**
BORING COMPLETED:	**2/7/20**	**2/7/20**	**10:50**	**11.0**	**9.5**	**9.9**		**9.4**
DR: **SG**	LG: **JM** Rig: **91C**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-COORDINATES 01-20739.GPJ AET+CPT+WELL_20181012_JG.GDT 2/25/20

SIEVE ANALYSIS TEST RESULTS

PROJECT:
Peterson Road Improvements
White Bear Township, Minnesota

AET NO.: 01-20739

DATE: February 25, 2020

TEST METHOD: General Conformance with ASTM:D6913, Method A

RESULTS:

Boring Number	B-1	B-3
Sample Depth	2'-3½´	5½"-2'
Dry Sample Weight (gms)	172.75	183.38
Sieve Size or Number	**Percent Passing by Weight**	
5/8"	100	100
1/2"	100	97
3/8"	99	97
#4	94	96
#10	83	94
#20	67	91
#40	55	83
#100	25	36
#200	14.2	16.3

Note: The small sample size limits the accuracy of the test, and the sample may not necessarily be representative of the entire layer shown on the boring log.

EXPLORATION/CLASSIFICATION METHODS

SAMPLING METHODS

Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2" O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30". The sampler is driven a total of 18" into the soil. After an initial set of 6", the number of hammer blows to drive the sampler the final 12" is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

AET's drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30". The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviations of the N-values using this method are significantly better than the standard ASTM Method.

Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

CLASSIFICATION METHODS

Soil classifications shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil classifications shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
AR:	Sample of material obtained from cuttings blown out the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in inches
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
DP:	Direct push drilling; a 2.125 inch OD outer casing with an inner 1½ inch ID plastic tube is driven continuously into the ground.
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RDA:	Rotary drilling with compressed air and roller or drag bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
SS:	Standard split-spoon sampler (steel; 1.5" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
▽:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q_p:	Pocket Penetrometer strength, tsf (approximate)
q_c:	Static cone bearing pressure, tsf
q_u:	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES
(Calibrated Hammer Weight)

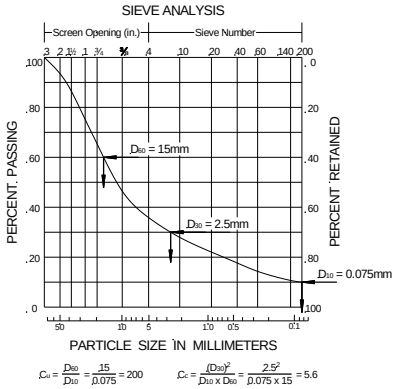
The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide N_{60} values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

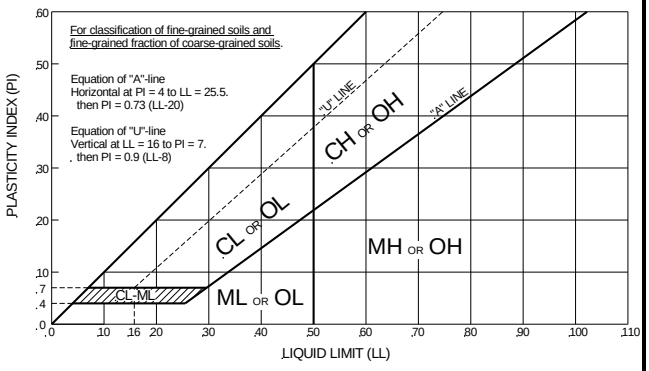
The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu≥4 and 1≤Cc≤3[E]	GW	Well graded gravel[F]
			Cu<4 and/or 1>Cc>3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F.G.H]
			Fines classify as CL or CH	GC	Clayey gravel[F.G.H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	Cu≥6 and 1≤Cc≤3[E]	SW	Well-graded sand[I]
			Cu<6 and/or 1>Cc>3[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G.H.I]
			Fines classify as CL or CH	SC	Clayey sand[G.H.I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	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] 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] Organic silt[K.L.M.Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]





Plasticity Chart

Notes

[A]Based on the material passing the 3-in (75-mm) sieve.
[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C]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

[D]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

[E]$Cu = D_{60} / D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.
[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H]If fines are organic, add "with organic fines" to group name.
[I]If soil contains ≥15% gravel, add "with gravel" to group name.
[J]If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.
[K]If soil contains 15 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.
[R]Fiber Content description shown below.

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition

(MC Column)

- D (Dry): Absence of moisture, dusty, dry to touch.
- M (Moist): Damp, although free water not visible. Soil may still have a high water content (over "optimum").
- W (Wet/ Waterbearing): Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.
- F (Frozen): Soil frozen

Layering Notes

- Laminations: Layers less than ½" thick of differing material or color.
- Lenses: Pockets or layers greater than ½" thick of differing material or color.

Peat Description

Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the Liquid Limit properties. *Slightly organic* used for borderline cases.

Root Inclusions

- With roots: Judged to have sufficient quantity of roots to influence the soil properties.
- Trace roots: Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.

AASHTO SOIL CLASSIFICATION SYSTEM

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

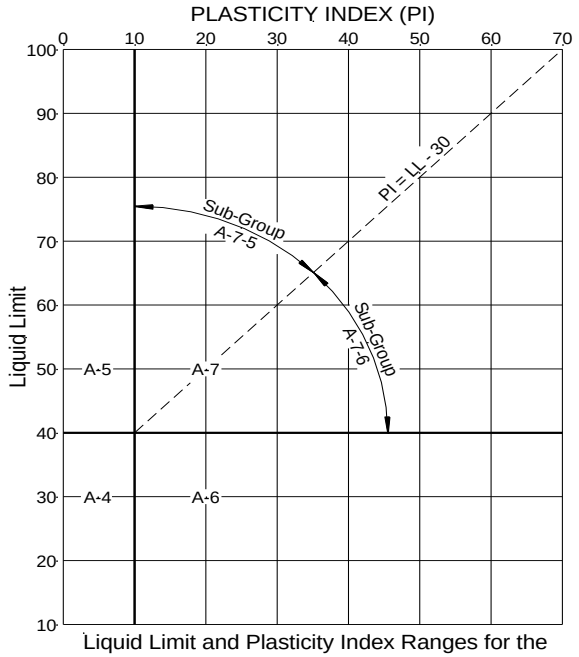
Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35% or less passing No. 200 sieve)							Silt-Clay Materials (More than 35% passing No. 200 sieve)			
Group Classification	A-1			A-2							A-7
	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5 A-7-6
Sieve Analysis, Percent passing:											
No. 10 (2.00 mm)	50 max.	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .
No. 40 (0.425 mm)	30 max.	50 max.	51 min.	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .
No. 200 (0.075 mm)	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of Fraction Passing No. 40 (0.425 mm)											
Liquid limit	. . . .		. . . .	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index	6 max.		N.P.	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.
Usual Types of Significant Constituent Materials	Stone Fragments, Gravel and Sand		Fine Sand	Silty or Clayey Gravel and Sand				Silty Soils		Clayey Soils	
General Ratings as Subgrade	Excellent to Good							Fair to Poor			

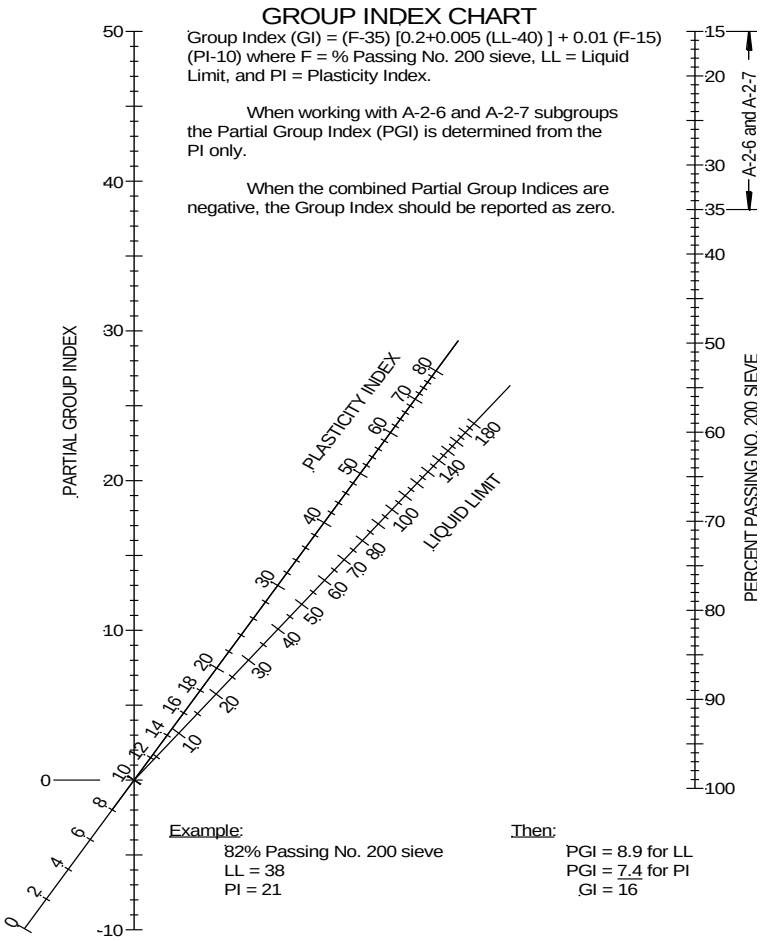
The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.

Group A-8 soils are organic clays or peat with organic content >5%.



Liquid Limit and Plasticity Index Ranges for the A-4, A-5, A-6 and A-7 Subgroups



Definitions of Gravel, Sand and Silt-Clay

The terms "gravel", "coarse sand", "fine sand" and "silt-clay", as determinable from the minimum test data required in this classification arrangement and as used in subsequent word descriptions are defined as follows:

GRAVEL - Material passing sieve with 3-in. square openings and retained on the No. 10 sieve.

COARSE SAND - Material passing the No. 10 sieve and retained on the No. 40 sieve.

FINE SAND - Material passing the No. 40 sieve and retained on the No. 200 sieve.

COMBINED SILT AND CLAY - Material passing the No. 200 sieve

BOULDERS (retained on 3-in. sieve) should be excluded from the portion of the sample to which the classificaiton is applied, but the percentage of such material, if any, in the sample should be recorded.

The term "silty" is applied to fine material having plasticity index of 10 or less and the term "clayey" is applied to fine material having plasticity index of 11 or greater.

DEFINITIONS RELATING TO PAVEMENT CONSTRUCTION

Top of subgrade: Grade which contacts the bottom of the aggregate base layer.

Sand subbase: Uniform thickness sand layer placed as the top of subgrade which is intended to improve the frost and drainage characteristics of the pavement system by increasing drainage of excess water in the aggregate base and subbase, by reducing and "bridging" frost heaving, and by reducing spring thaw weakening effects.

Critical subgrade zone: The subgrade portion beneath and within three vertical feet of the top of subgrade. A sand subbase, if placed, would be considered the upper portion of the critical subgrade zone.

Suitable Grading Material: Mineral soil materials, typically from the project site, excluding the following: 1) soils which have an organic content exceeding 3%, 2) cohesive soils having a Liquid Limit exceeding 50%, 3) soils which include debris, cobbles, and/or boulders, and 4) soils which are considered acceptable from an environmental standpoint. The soil must also be capable of attaining the specified compaction level at its current water content or at a water content that can be reasonably scarified, blended, and moisture conditioned to a uniform water content in order to uniformly meet compaction requirements.

Granular Material: Soils meeting MnDOT Specification 3149.2B.1. This refers to granular soils which, of the portion passing the 1" sieve, contain less than 20% by weight passing the #200 sieve.

Select Granular Material: Soils meeting MnDOT Specification 3149.2B.2. This refers to granular soils which, of the portion passing the 1" sieve, contain less than 12% by weight passing the #200 sieve.

Select Granular Material (Super Sand): Soils meeting MnDOT Specification 3149.2B.3. This material is cleaner and coarser than Select Granular Material (see specification for specific requirements).

Compaction Subcut: Construction of a uniform thickness subcut below a designated grade to provide uniformity and compaction within the subcut zone. Replacement fill can be the materials subcut, although the reused soils should be blended to a uniform soil condition, moisture conditioned as needed to meet MnDOT Specification 2105.F; and re-compacted per the Specified Density Method defined in MnDOT Specification 2105.3F.1.

Test Roll: A means of evaluating the near-surface stability of subgrade soils (usually non-granular). Suitability is determined by the depth of rutting or deflection caused by passage of heavy rubber-tired construction equipment, such as a loaded dump truck, over the test area. Yielding of less than 1" is normally considered acceptable, although engineering judgment may be applied depending on the equipment used, soil conditions present, and/or depth below final grade.

Unstable Soils: Subgrade soils which do not pass a test roll. Unstable soils typically have water content exceeding the *standard optimum water content* defined in ASTM:D698 (Standard Proctor test).

Organic Soils: Soils which have sufficient organic content such that the soils engineering properties are negatively affected (typically more than 3% organic content). These soils are usually black to dark brown in color. These soils should be removed from the critical subgrade zone.

BEDDING/FOUNDATION SUPPORT OF BURIED PIPE

GENERAL

This page addresses soil bedding and foundation support of rigid pipe, such as reinforced concrete, and flexible pipe, such as steel and plastic. This does not address selection of pipe based on loads and allowable deflections, but rather addresses the geotechnical/soil aspects of uniform pipe support. Bedding/foundation support needs relate to local conditions directly beneath and to the sides of the pipe zone, which may be influenced by soft in-situ ground conditions or by soil disturbance due to soil sensitivity or ground water. Bedding relates to granular materials placed directly beneath the bottom of the pipe (usually 4" to 6" thick), which is intended to provide increased support uniformity. We refer to foundation soils as thicker layers of sands and/or gravels (beneath the bedding zone) intended to provide increased foundation strength support, usually needed due to soft, unstable and/or waterbearing conditions.

GRANULAR BEDDING

With circular pipes, high local loads (approaching point loads) develop if pipes are placed on hard surfaces. Load distribution is improved by placing granular bedding materials beneath the pipe, which are either shaped to match the pipe bottom or are placed without compaction to allow “settling in.” The bedding should be placed in such a manner that the pipe will be at the proper elevation and slope when the pipe is laid on the bedding. Common bedding material is defined in MnDOT Specification 3149.2F, Granular Bedding. Published documents recommend rigid pipes having a diameter of 12" to 54" be placed on a bedding thickness of 4", which increases to 6" of bedding for pipe diameters ranging from 54" to 72". Beyond a 72" diameter, the bedding thickness can be equal to the pipe outside diameter divided by 12. Typically, the need for bedding under small diameter pipes (less than 12") depends on the pipe designer’s specific needs, although in obvious point loads situations (bedrock, cobbles, significant coarse gravel content), bedding is recommended. Note that bedding should also account for larger diameter bells at joints.

FOUNDATION FILL

Positive uniform strength is usually compromised in soft or unstable trench bottom conditions. In this case, deeper subcuts and foundation fill placement is needed beneath the pipe. In moderate instability conditions, improvement can likely be accomplished with a thicker bedding layer. However, in more significant instability situations, particularly where ground water is present, coarser materials may be needed to provide a stronger foundation. Thicker gravel layers can also be a favorable media from which to dewater. The following materials would be appropriate for stability improvement, with the coarser materials being appropriate for higher instability/ground water cases.

- Fine Filter Aggregate – MnDOT Specification 3149.2J.2
- Coarse Filter Aggregate –MnDOT Specification 3149.2H

When using a coarser material which includes significant void space, we highly recommend enveloping the entire gravel layer within a geotextile separation fabric. The gravel material includes open void space, and the fabric acts as a separator which minimizes the intrusion of fines into the open void space. If additional granular bedding sand is used above foundation gravel, the fabric would also prevent downward infiltration of bedding sand into the rock void space.

Although it is preferred to not highly compact thin granular bedding zones directly beneath the pipe center, it is desirable to compact the foundation materials to prevent more significant pipe settlement. We recommend foundation fill be compacted to a minimum of 95% of the Standard Proctor density (ASTM: D698). It is not possible to test coarse rock fill, although this material should still be well compacted/ tamped.

Often, pipes entering structures such as catch basins, lift stations, etc., enter the structure at a higher elevation than the structure bottom, and are therefore placed on the structure backfill. Fill beneath these pipes should be considered foundation fill. Depending on the flexibility of the connection design, it may be necessary to increase the minimum compaction level to reduce differential settlements, particularly with thicker fills.

SIDE FILL SUPPORT

If the pipe designer requires support from the side fill, granular bedding should also be placed along the sides of the pipe. In poor soil conditions, the sand fill may need to be placed laterally up to two pipe diameters on both sides of the pipe. With rigid pipe, compacted sand placement up to the spring line (within the haunch area) is usually sufficient. With flexible pipe, side fill should be placed and compacted at least to the top of the pipe. For positive support, it is very important to properly compact the sands within the haunch area.

UTILITY EXCAVATION BACKFILLING

GENERAL

Clayey and silty soils are often difficult to compact, as they may be naturally wet or dry, or may become wet due to ground water or runoff water during construction. Soils will need to be placed within a certain range of water (moisture) content to attain desired compaction levels. Moisture conditioning to within this range can be time consuming and labor intensive, and will require favorable weather.

The degree of compaction and the soil type used for backfill within open cut utility excavations depends on the eventual function of the overlying land surface. Details are as follows:

ROADWAYS

Where trenches are located below roadways, we recommend using inorganic fill and compacting these soils per MnDOT Specification 2105.3F.1 (Specified Density Method). On MnDOT funded roads, the 2016 Specification requires 100% compaction over the entire trench depth. On non-MnDOT funded roads, we feel the specification can be relaxed to the previous version of achieving 100% of the Standard Proctor density in the upper 3-foot subgrade zone, and 95% below this depth. Note that this specification also includes moisture content range requirements which are important for proper subgrade stability.

Where available soils are wet or of poor quality, it may be possible to use the “Quality Compaction Method” (MnDOT Specification 2105.3F.2) for soils below the upper 3-foot subgrade zone if you can tolerate some subsidence. However, a high level of stability is still important within the upper subgrade zone and recommend that the “Specified Density Method" be used in this upper subgrade area. We caution that if backfill soils in the lower trench area are significantly unstable, it may be difficult or even impossible to properly compact soils within the upper 3-foot subgrade zone. In this case, road subgrade stability can be improved by placing a geotextile reinforcement fabric directly over the unstable soils followed by properly drained granular fill placement.

STRUCTURAL AREAS

If fill is placed beneath or within the significant zone of influence of a structure (typically a 1:1 lateral oversize zone), the soil type and minimum compaction level will need to be evaluated on an individual basis. Because trenches result in variable fill depths over a short lateral distance, higher than normal compaction levels and/or more favorable (sandy) soil fill types may be needed. If this situation exists, it is important that special geotechnical engineering review be performed.

NON-STRUCTURAL AREAS

In grass/ditch areas, backfill soils should be placed in reasonable lift thicknesses and compacted to a minimum of 90% of the Standard Proctor density (ASTM: D698) and/or per the MnDOT “Quality Compaction Method.” If lower compaction levels are accepted, more noticeable subsidence at the surface can occur. Steep or high slopes require special consideration, and if this situation exists, it is important that special geotechnical engineering review be performed.

SPECIAL CASES

Structural retention systems are often used to reduce impacts on adjacent streets/improvements. If localized excavations/pits or annular spaces are created which need to be backfilled, it may not be possible to place and compact soils by the conventional means of backfilling. Retraction of structural systems can also leave soils loosened. Significant settlement can occur in areas where backfill cannot be compacted. If these situations are located in non-structural or non-paved areas, it may be reasonable to accept the settlements and associated follow-up maintenance in order avoid the high cost of trying to compact the soil or placing flowable lean concrete fill. However, there may be areas where fill settlement needs to be avoided, especially as the settlement will be differential from the surrounding surface, or differential from a buried structure in the case of higher piping entering the structure. Where settlement needs to be avoided, the specification should require that the contractor submit a backfill compaction plan along with the retention plan. Improper sequencing of retention system removal and backfilling of the pits could result in excessive settlement and/or lateral movement of nearby improvements.

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Appendix J

Future Subdivision Concept

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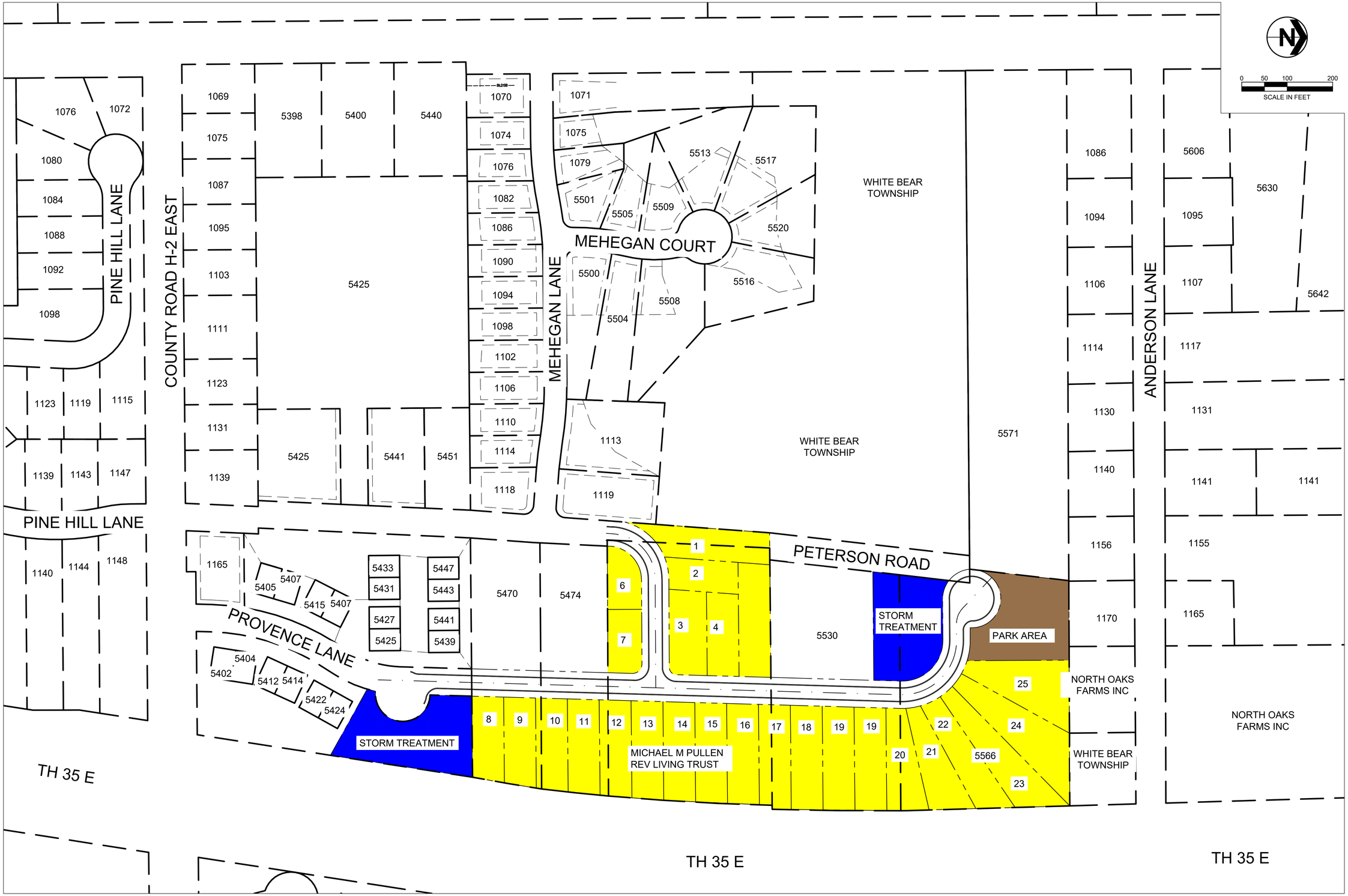

POTENTIAL FUTURE PETERSON ROAD ALIGNMENT AND DEVELOPMENT

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