Westwood

Stormwater Management Plan for

Walser Kia
Minnetonka, MN

15700-15724 Wayzata Boulevard

Prepared for:
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7700 France Avenue South
Suite 410 North
Edina, Minnesota 55437

Prepared by:
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Minnetonka, MN 55343
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Project Number: 0036502.00
Date: 03-07-2023

INTRODUCTION

This report summarizes the stormwater management design for the proposed Walser Kia redevelopment site is located at 15700-15724 Wayzata Boulevard in Minnetonka, MN. An existing commercial building is proposed to be removed and replaced with a new building, reconstructed pervious pavement customer parking lot, and an expanded pervious pavement car inventory parking lot to the north. The subject property contains 11.38 acres, with the proposed development/redevelopment area of 8.53 acres.

The site was modeled in HydroCAD to analyze existing and proposed conditions. Atlas 14 rainfall depths rainfall distribution data for this area were used in this analysis. Exhibit 1 shows the drainage areas for existing and proposed conditions within the site project redevelopment area and Attachments A for existing and proposed HydroCAD reports.

REGULATIONS

The proposed project is located within the jurisdictions of the City of Minnetonka and Minnehaha Creek Watershed District (MCWD). The stormwater regulations pertaining to this project are as follows:

MCWD

1. Rate Control - No increase in peak runoff rates going offsite for the 1-, 10-, and 100-year rainfall events and 10-day snowmelt event.
2. Volume Reduction - Provide abstraction of 1.0-inch from site’s net new and reconstructed impervious surface.
3. Water Quality - Decrease annual loading of TP and TSS by meeting volume reduction requirement.

The site is located within a DWSMA, limiting the feasibility of infiltration.

The site is also subject to floodplain and wetland regulations. The project must result in no net fill in the floodplain. Additionally, the City of Minnetonka requires a 10’ floodplain setback for parking and a 20’ floodplain setback for buildings. Wetland impacts and buffer requirements are addressed under a separate report.

EXISTING SITE AND DRAINAGE CONDITIONS

The existing site primarily drains to the ditches and wetlands located east and west of the existing building. The south portion of the parking lot drains to an existing catch basin which further flows via storm pipe to the western ditch. See Exhibit 1 for existing and proposed drainage areas.

PROPOSED PROJECT DEVELOPMENT

The proposed development/redevelopment area of 8.531 acres will include removal of the existing building and parking lot located on the south portion of the property, and construction of a new building, pervious concrete customer parking lot on the south portion of the property, a pervious concrete car inventory parking lot on the northerly portion of the site, and landscape improvements. See Table 1 below and Exhibit 2 attached for existing and proposed cover conditions.

Table 1: Project Area Information

Project Site	**Existing (acres)**	**Percent**	**Proposed (acres)**	**Percent**
Total Site Project Redevelopment Area	8.531		8.531	
Impervious Area	1.836	(21.5%)	0.757	(8.9%)
Total Pervious Area	6.695	(78.5%)	7.776	(91.1%)
Pervious Pavement			*3.057*	
Greenspace			*4.719*	

PROPOSED STORMWATER MANAGEMENT SYSTEM

Parking lot areas will be constructed with pervious concrete pavement with underdrains. Curb cuts at low points on the southern perimeter of the northern car inventory parking lot and along the perimeter of the south parking lot will provide overflow route for the pervious pavement to discharge into the existing ditch.

For the south customer parking lot, the existing storm catch basin will remain to act as an overflow into the easterly ditch for the pervious pavement stormwater BMP. A small portion of the parking lot will drain off site into existing city storm sewer.

Roof runoff for the proposed building roof will be collected in a rainwater cistern to be used to supplement the building's carwash system.

RATE CONTROL

The stormwater management system design was modeled to achieve no net increase in peak discharge rates for the proposed development from pre-development conditions for the 1-year, 2-year, 10-year and 100-year storm events and 10-day snowmelt. The total combined site predevelopment and proposed redevelopment peak discharge rates per discharge points are shown in Table 2.

Table 2: Project Area Peak Discharge Rates

Project Site	**1-Year Discharge (cfs)**	**10-Year Discharge (cfs)**	**100-Year Discharge (cfs)**	**10-Day Snowmet (cfs)**
Existing Conditions	12.69	29.04	59.23	1.39
Proposed Conditions	11.76	28.39	59.16	1.39

VOLUME CONTROL

The project site total new and reconstructed impervious area (including the building area, sidewalks and drive aprons) is 32,922 sf (0.757 acres). The required volume reduction equal to 1 inch of runoff from the site's new and reconstructed impervious is 2743 c.f.

Stormwater runoff from the roof of the proposed building roof will be collected in a rainwater cistern to be used to supplement the building's carwash system. It is intended that the water supply within the cistern will drawdown within 48 hours. Stormwater runoff from the building sidewalk will discharge to the pervious pavement section.

WATER QUALITY

The above ground cistern will abstract a volume of runoff equal to 1 inch of new and reconstructed impervious area.
The proposed parking lot areas will be constructed with pervious concrete pavement to reduce the runoff and allow for TSS and TP removal via filtration/infiltration.

FLOODPLAIN ANALYSIS

VOLUME

The proposed floodplain elevation for the site is 945.2' per City of Minnetonka modeling. No net fill in the floodplain is achieved through a combination of surface grading and underground pipe storage. The pipes also increases the hydrologic connectivity of the floodplain and wetland areas on the east and west sides of the upland area.

See Table 3. below for flood storage volumes within the floodplain analysis boundary.

Table 2. Existing and Proposed Flood Storage Volume

	Surface Storage (CY)	Piped Storage (CY)	Total (CY)
Existing	3,687		3,687
Proposed	3,389	376	3765

FREEBOARD

Freeboard requirements require a minimum building FFE of 2’ above the floodplain. The proposed FFE is set at 948.5’ which exceeds the 2’ requirement. Additionally, a 1’ freeboard is required for parking. The proposed low point of the southerly parking lot is 946.2’, which meets the 1’ requirement.

SETBACKS

The northern car inventory parking lot provides an excess of the required 10’ parking floodplain setback. The proposed building footprint also provides an excess of the required 20’ building floodplain setback. A variance request is underway regarding parking floodplain setbacks at the southerly portion of the site.

CONCLUSION

The stormwater design meets City of Minnetonka, Minnehaha Creek Watershed, and Riley Purgatory Bluff Creek Watershed District rules.

ATTACHMENTS

Exhibit 1 Existing & Proposed Drainage Area Map
Exhibit 2 Existing & Proposed Cover Conditions
Exhibit 3 Floodplain Storage – Existing & Proposed
Attachment A – Existing and Proposed HydroCAD Reports
Attachment B – DRAFT Geotechnical Report

Exhibit 1 Existing & Proposed Drainage Area Map

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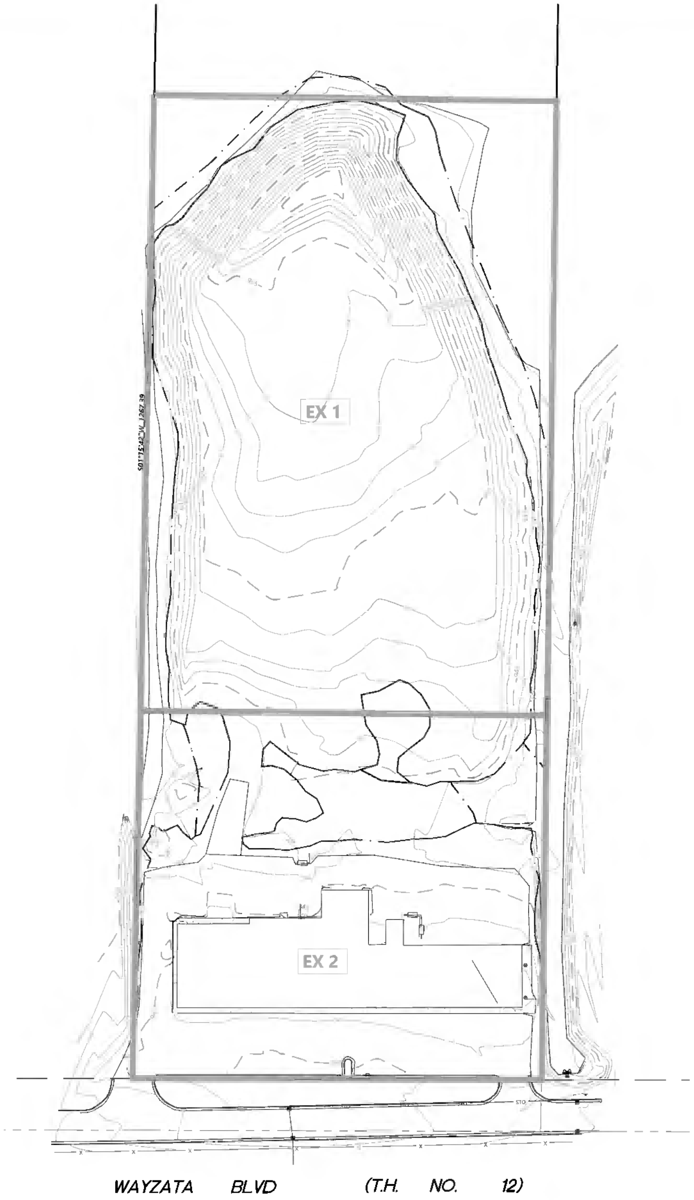
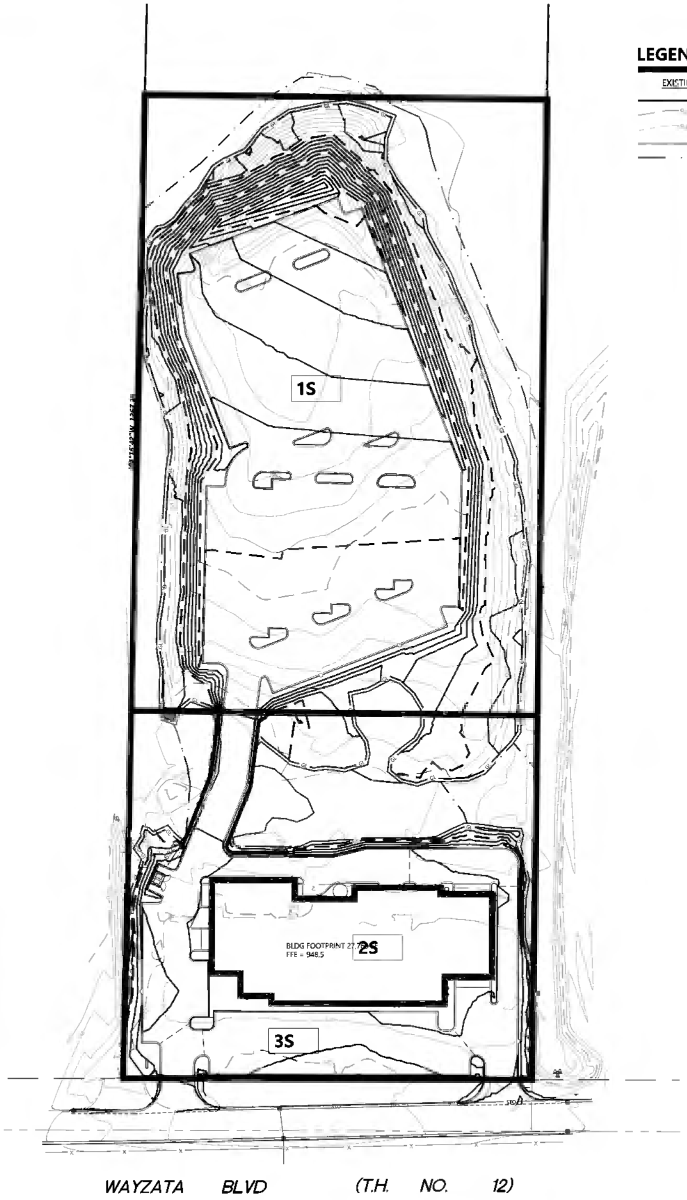


EXISTING DRAINAGE MAP



PROPOSED DRAINAGE MAP

Call 48 Hours before digging:
811 or call811.com
Common Ground Alliance

LEGEND

EXISTING	PROPOSED	
───	── ‒ ‒ ──	PROPERTY LINE
‒ ‒ ‒	‒ ‒ 980 ‒ ‒	INDEX CONTOUR
‒ ‒ ‒	── 982 ──	INTERVAL CONTOUR
───	───	AREA BOUNDARY
── · ──	── · ──	WETLAND LINE

1" = 60'
0' 60' 120' 180'

NOT FOR CONSTRUCTION

INITIAL ISSUE 10/05/2022
REVISIONS:
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DESIGNED:
CHECKED:
DRAWN:
HORIZONTAL SCALE 60'
VERTICAL SCALE:

PREPARED FOR:
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EXISTING & PROPOSED DRAINAGE MAPS

SHEET NUMBER:
1

DATE: 03/06/2023
PROJECT NUMBER: 0036502.00

WALSER KIA

Exhibit 2 Existing & Proposed Cover Conditions

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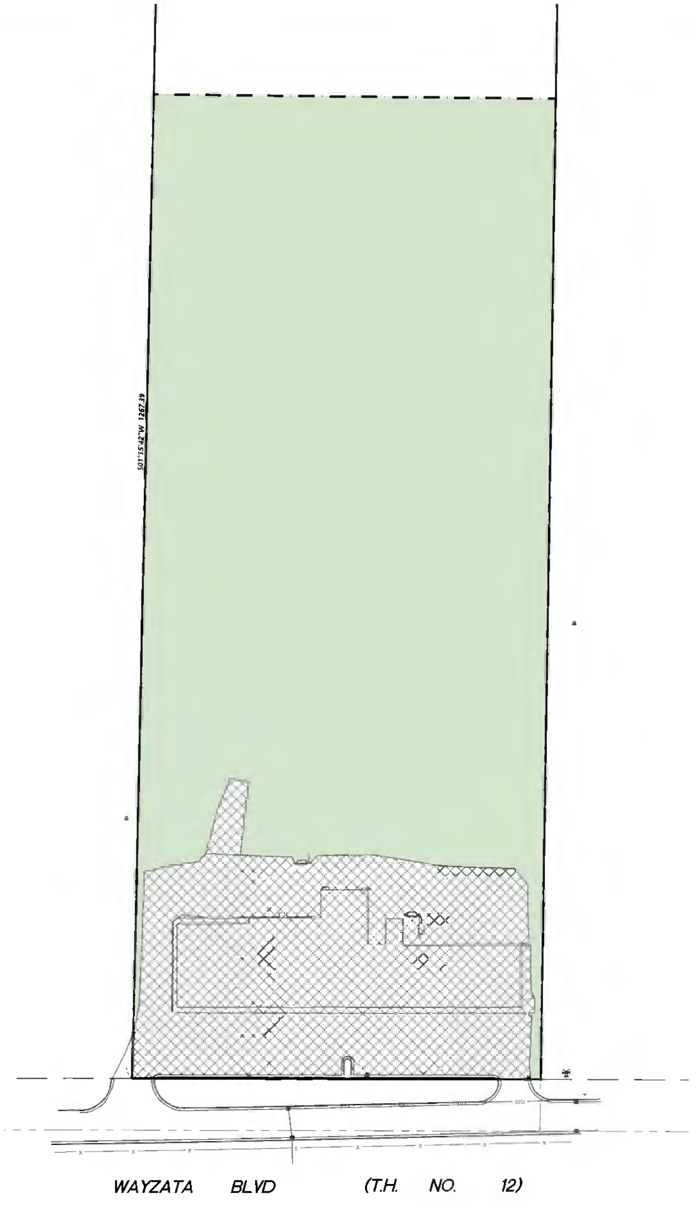
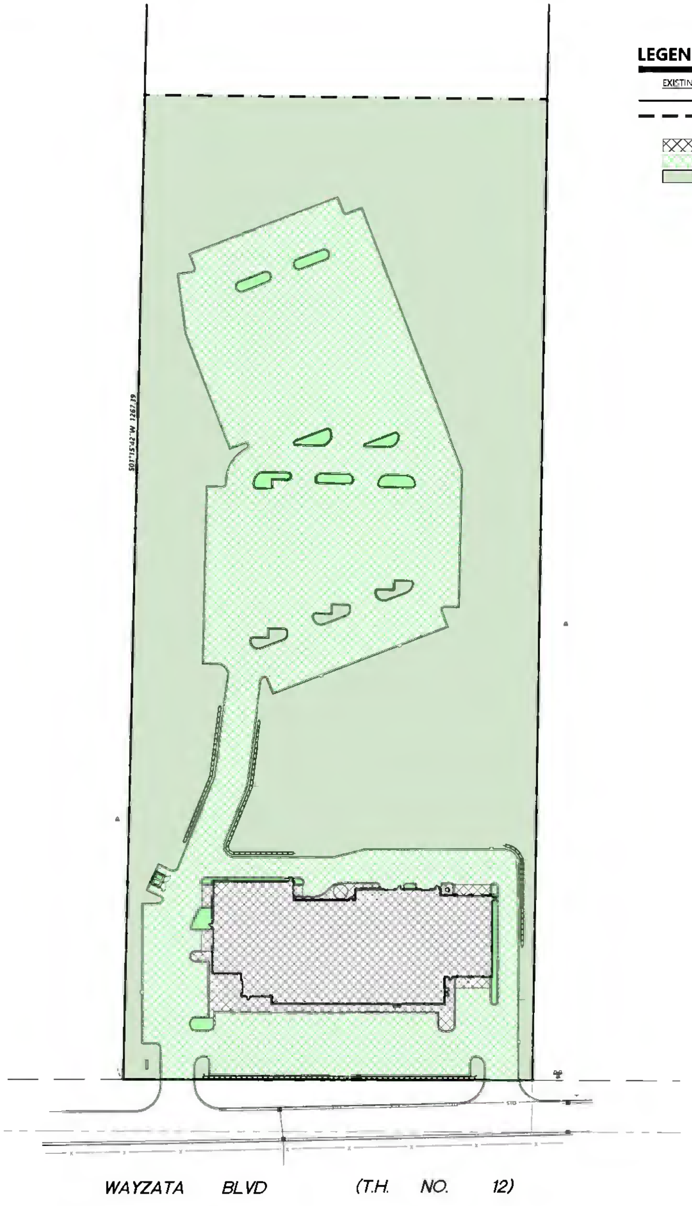


EXISTING COVER MAP



PROPOSED COVER MAP

Call 48 Hours before digging:
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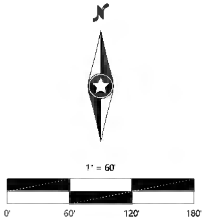
LEGEND

EXISTING	PROPOSED	
———	— - - —	PROPERTY LINE
— — —	— — —	ANALYSIS AREA BOUNDARY
		WETLAND LINE
▨	▨	IMPERVIOUS AREA
🟩	🟩	PERVIOUS CONCRETE AREA
🟩	🟩	PERVIOUS GREENSPACE AREA



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HORIZONTAL SCALE: 60'
VERTICAL SCALE:

INITIAL ISSUE	10/05/2022
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EXISTING & PROPOSED COVER

SHEET NUMBER:
1

DATE: 03/06/2023
PROJECT NUMBER: 0036502.00

WALSER KIA

Exhibit 3 Floodplain Storage – Existing & Proposed

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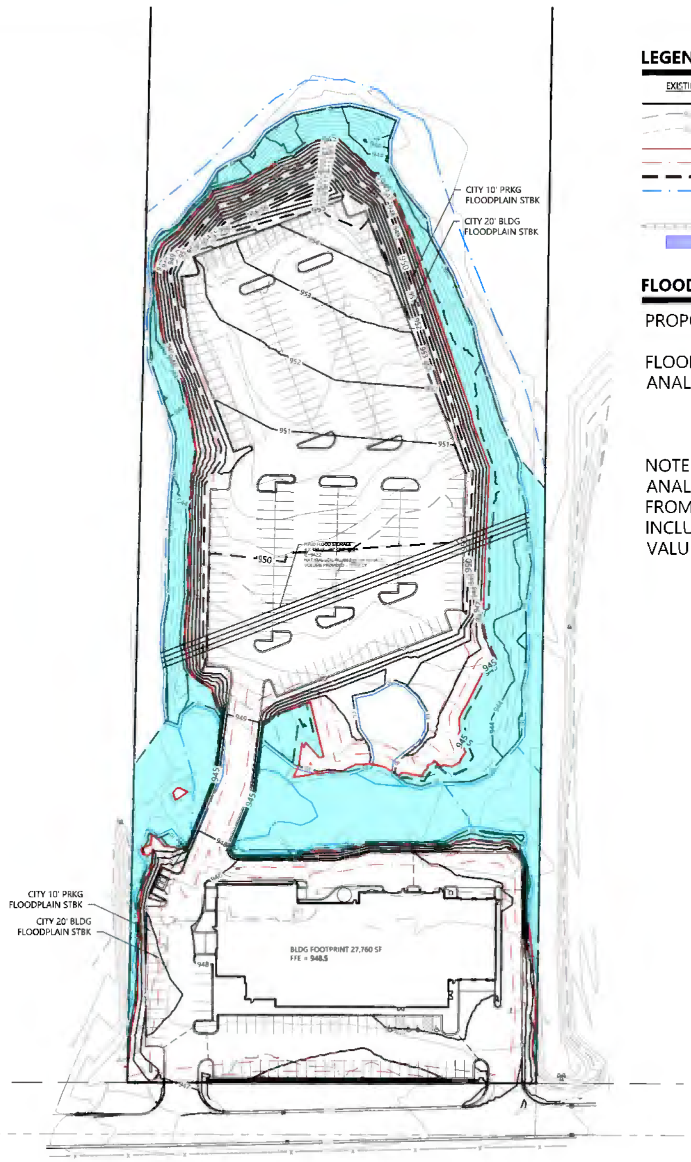
EXISTING FLOOD STORAGE



PROPOSED FLOOD STORAGE

Call 48 Hours before digging:
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LEGEND

EXISTING	PROPOSED	
		PROPERTY LINE
	980	INDEX CONTOUR
	982	INTERVAL CONTOUR
		CITY PROPOSED 945.2 FLOODPLAIN
		CITY FLOODPLAIN SETBACK
		PROJECT AREA ANALYSIS BOUNDARY
		WETLAND LINE
	GL	GRADING LIMITS
		RETAINING WALL
▨	▨	FLOODPLAIN AREA

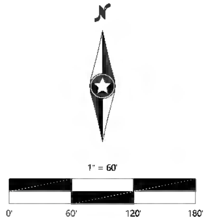
FLOOD STORAGE SUMMARY

PROPOSED CITY FLOODPLAIN ELEVATION = 945.2

FLOOD STORAGE WITHIN PROJECT AREA ANALYSIS BOUNDARY:

EXISTING	3,687 CY
PROPOSED	3,765 CY

NOTE FLOOD STORAGE OUTSIDE OF FLOOD ANALYSIS BOUNDARY WILL REMAIN UNCHANGED FROM EXISTING CONDITIONS AND IS NOT INCLUDED IN FLOOD STORAGE COMPARISON VALUES.



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DESIGNED:
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HORIZONTAL SCALE 60'
VERTICAL SCALE:

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FLOODPLAIN STORAGE ANALYSIS

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1

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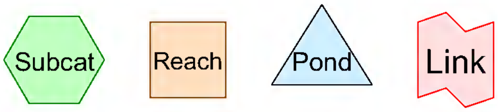
PROJECT NUMBER: 0036502.00

WALSER KIA

Attachment A – Existing and Proposed HydroCAD Reports



Routing Diagram for 23-03-06 Walser Kia Minnetonka_v4 8.53 AC total area
Prepared by j, Printed 3/7/2023
HydroCAD® 10.10-3a s/n 03363 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
11.414	80	>75% Grass cover, Good, HSG D (1S, 2S, EX1, EX2)
1.836	98	Paved parking, HSG D (EX2)
3.057	84	Pervious Pavement (1S, 2S)
0.637	98	Roofs, HSG A (3S)
0.120	98	Unconnected pavement, HSG D (2S)
17.064	**83**	**TOTAL AREA**

Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: North Parking Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=0.98"
Tc=15.0 min CN=82/0 Runoff=6.74 cfs 0.437 af

Subcatchment 2S: South Parking Runoff Area=2.561 ac 0.00% Impervious Runoff Depth=0.98"
Tc=10.0 min CN=82/0 Runoff=3.89 cfs 0.210 af

Subcatchment 3S: Building to Reuse Runoff Area=0.637 ac 100.00% Impervious Runoff Depth=2.25"
Tc=7.0 min CN=0/98 Runoff=2.23 cfs 0.119 af

Subcatchment EX1: Existing North Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=0.88"
Tc=15.0 min CN=80/0 Runoff=5.92 cfs 0.389 af

Subcatchment EX2: Existing South Runoff Area=3.196 ac 57.45% Impervious Runoff Depth=1.67"
Tc=10.0 min CN=80/98 Runoff=7.52 cfs 0.444 af

Reach EX: Existing Runoff Inflow=12.69 cfs 0.833 af
Outflow=12.69 cfs 0.833 af

Reach PROP: Proposed Runoff Inflow=11.76 cfs 0.703 af
Outflow=11.76 cfs 0.703 af

Pond 1P: Cistern Storage Peak Elev=966.26' Storage=2,811 cf Inflow=2.23 cfs 0.119 af
Outflow=1.84 cfs 0.056 af

Total Runoff Area = 17.064 ac Runoff Volume = 1.599 af Average Runoff Depth = 1.12"
85.51% Pervious = 14.591 ac 14.49% Impervious = 2.473 ac

Summary for Subcatchment 1S: North Parking

Runoff = 6.74 cfs @ 12.24 hrs, Volume= 0.437 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 1-Year Rainfall=2.48"

	Area (ac)	CN	Description
*	2.059	84	Pervious Pavement
	3.276	80	>75% Grass cover, Good, HSG D
	5.335	82	Weighted Average
	5.335	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Direct Entry - Estimate**

Summary for Subcatchment 2S: South Parking

Runoff = 3.89 cfs @ 12.18 hrs, Volume= 0.210 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 1-Year Rainfall=2.48"

	Area (ac)	CN	Description
	0.120	98	Unconnected pavement, HSG D
*	0.998	84	Pervious Pavement
	1.443	80	>75% Grass cover, Good, HSG D
	2.561	82	Weighted Average
	2.561	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Estimate**

Summary for Subcatchment 3S: Building to Reuse Cistern

Runoff = 2.23 cfs @ 12.14 hrs, Volume= 0.119 af, Depth= 2.25"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
0.637	98	Roofs, HSG A
0.637	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, Direct - Estimate**

Summary for Subcatchment EX1: Existing North

Runoff = 5.92 cfs @ 12.25 hrs, Volume= 0.389 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01 h
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
0.000	98	Paved parking, HSG D
5.335	80	>75% Grass cover, Good, HSG D
5.335	80	Weighted Average
5.335	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, direct**

Summary for Subcatchment EX2: Existing South

Runoff = 7.52 cfs @ 12.17 hrs, Volume= 0.444 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01 h
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
1.836	98	Paved parking, HSG D
1.360	80	>75% Grass cover, Good, HSG D
3.196	90	Weighted Average
1.360	80	42.55% Pervious Area
1.836	98	57.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, direct**

Summary for Reach EX: Existing Runoff

Inflow Area = 8.531 ac, 21.52% Impervious, Inflow Depth = 1.17" for 1-Year event
Inflow = 12.69 cfs @ 12.20 hrs, Volume= 0.833 af
Outflow = 12.69 cfs @ 12.20 hrs, Volume= 0.833 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach PROP: Proposed Runoff

Inflow Area = 8.533 ac, 7.47% Impervious, Inflow Depth = 0.99" for 1-Year event
Inflow = 11.76 cfs @ 12.20 hrs, Volume= 0.703 af
Outflow = 11.76 cfs @ 12.20 hrs, Volume= 0.703 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Cistern Storage

Inflow Area = 0.637 ac,100.00% Impervious, Inflow Depth = 2.25" for 1-Year event
Inflow = 2.23 cfs @ 12.14 hrs, Volume= 0.119 af
Outflow = 1.84 cfs @ 12.19 hrs, Volume= 0.056 af, Atten= 18%, Lag= 3.3 min
Primary = 1.84 cfs @ 12.19 hrs, Volume= 0.056 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 966.26' @ 12.19 hrs Surf.Area= 154 sf Storage= 2,811 cf

Plug-Flow detention time= 186.9 min calculated for 0.056 af (47% of inflow)
Center-of-Mass det. time= 95.6 min (852.8 - 757.2)

Volume	Invert	Avail.Storage	Storage Description
#1	948.00'	3,080 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
948.00	154	0	0
968.00	154	3,080	3,080

Device	Routing	Invert	Outlet Devices
#1	Primary	966.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.62 cfs @ 12.19 hrs HW=966.25' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 1.62 cfs @ 1.64 fps)

Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: North Parking Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=2.43"
Tc=15.0 min CN=82/0 Runoff=16.85 cfs 1.079 af

Subcatchment 2S: South Parking Runoff Area=2.561 ac 0.00% Impervious Runoff Depth=2.43"
Tc=10.0 min CN=82/0 Runoff=9.65 cfs 0.518 af

Subcatchment 3S: Building to Reuse Runoff Area=0.637 ac 100.00% Impervious Runoff Depth=4.02"
Tc=7.0 min CN=0/98 Runoff=3.88 cfs 0.214 af

Subcatchment EX1: Existing North Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=2.26"
Tc=15.0 min CN=80/0 Runoff=15.70 cfs 1.004 af

Subcatchment EX2: Existing South Runoff Area=3.196 ac 57.45% Impervious Runoff Depth=3.27"
Tc=10.0 min CN=80/98 Runoff=14.72 cfs 0.872 af

Reach EX: Existing Runoff Inflow=29.04 cfs 1.876 af
Outflow=29.04 cfs 1.876 af

Reach PROP: Proposed Runoff Inflow=28.39 cfs 1.747 af
Outflow=28.39 cfs 1.747 af

Pond 1P: Cistern Storage Peak Elev=966.49' Storage=2,848 cf Inflow=3.88 cfs 0.214 af
Outflow=3.87 cfs 0.150 af

Total Runoff Area = 17.064 ac Runoff Volume = 3.686 af Average Runoff Depth = 2.59"
85.51% Pervious = 14.591 ac 14.49% Impervious = 2.473 ac

Summary for Subcatchment 1S: North Parking

Runoff = 16.85 cfs @ 12.23 hrs, Volume= 1.079 af, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

	Area (ac)	CN	Description
*	2.059	84	Pervious Pavement
	3.276	80	>75% Grass cover, Good, HSG D
	5.335	82	Weighted Average
	5.335	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Direct Entry - Estimate**

Summary for Subcatchment 2S: South Parking

Runoff = 9.65 cfs @ 12.18 hrs, Volume= 0.518 af, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

	Area (ac)	CN	Description
	0.120	98	Unconnected pavement, HSG D
*	0.998	84	Pervious Pavement
	1.443	80	>75% Grass cover, Good, HSG D
	2.561	82	Weighted Average
	2.561	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Estimate**

Summary for Subcatchment 3S: Building to Reuse Cistern

Runoff = 3.88 cfs @ 12.14 hrs, Volume= 0.214 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
0.637	98	Roofs, HSG A
0.637	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, Direct - Estimate**

Summary for Subcatchment EX1: Existing North

Runoff = 15.70 cfs @ 12.23 hrs, Volume= 1.004 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
0.000	98	Paved parking, HSG D
5.335	80	>75% Grass cover, Good, HSG D
5.335	80	Weighted Average
5.335	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, direct**

Summary for Subcatchment EX2: Existing South

Runoff = 14.72 cfs @ 12.17 hrs, Volume= 0.872 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
1.836	98	Paved parking, HSG D
1.360	80	>75% Grass cover, Good, HSG D
3.196	90	Weighted Average
1.360	80	42.55% Pervious Area
1.836	98	57.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, direct**

Summary for Reach EX: Existing Runoff

Inflow Area = 8.531 ac, 21.52% Impervious, Inflow Depth = 2.64" for 10-Year event
Inflow = 29.04 cfs @ 12.20 hrs, Volume= 1.876 af
Outflow = 29.04 cfs @ 12.20 hrs, Volume= 1.876 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach PROP: Proposed Runoff

Inflow Area = 8.533 ac, 7.47% Impervious, Inflow Depth = 2.46" for 10-Year event
Inflow = 28.39 cfs @ 12.19 hrs, Volume= 1.747 af
Outflow = 28.39 cfs @ 12.19 hrs, Volume= 1.747 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Cistern Storage

Inflow Area = 0.637 ac,100.00% Impervious, Inflow Depth = 4.02" for 10-Year event
Inflow = 3.88 cfs @ 12.14 hrs, Volume= 0.214 af
Outflow = 3.87 cfs @ 12.15 hrs, Volume= 0.150 af, Atten= 0%, Lag= 0.4 min
Primary = 3.87 cfs @ 12.15 hrs, Volume= 0.150 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 966.49' @ 12.15 hrs Surf.Area= 154 sf Storage= 2,848 cf

Plug-Flow detention time= 128.0 min calculated for 0.150 af (70% of inflow)
Center-of-Mass det. time= 58.7 min (807.0 - 748.3)

Volume	Invert	Avail.Storage	Storage Description
#1	948.00'	3,080 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
948.00	154	0	0
968.00	154	3,080	3,080

Device	Routing	Invert	Outlet Devices
#1	Primary	966.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.14 cfs @ 12.15 hrs HW=966.49' (Free Discharge)
↑**1=Orifice/Grate** (Orifice Controls 4.14 cfs @ 3.38 fps)

Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: North Parking	Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=5.22" Tc=15.0 min CN=82/0 Runoff=35.50 cfs 2.319 af
Subcatchment 2S: South Parking	Runoff Area=2.561 ac 0.00% Impervious Runoff Depth=5.22" Tc=10.0 min CN=82/0 Runoff=20.18 cfs 1.113 af
Subcatchment 3S: Building to Reuse	Runoff Area=0.637 ac 100.00% Impervious Runoff Depth=7.08" Tc=7.0 min CN=0/98 Runoff=6.70 cfs 0.376 af
Subcatchment EX1: Existing North	Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=4.99" Tc=15.0 min CN=80/0 Runoff=34.18 cfs 2.219 af
Subcatchment EX2: Existing South	Runoff Area=3.196 ac 57.45% Impervious Runoff Depth=6.19" Tc=10.0 min CN=80/98 Runoff=27.51 cfs 1.649 af
Reach EX: Existing Runoff	Inflow=59.23 cfs 3.868 af Outflow=59.23 cfs 3.868 af
Reach PROP: Proposed Runoff	Inflow=59.16 cfs 3.745 af Outflow=59.16 cfs 3.745 af
Pond 1P: Cistern Storage	Peak Elev=967.24' Storage=2,963 cf Inflow=6.70 cfs 0.376 af Outflow=6.57 cfs 0.312 af

Total Runoff Area = 17.064 ac Runoff Volume = 7.676 af Average Runoff Depth = 5.40"
85.51% Pervious = 14.591 ac 14.49% Impervious = 2.473 ac

Summary for Subcatchment 1S: North Parking

Runoff = 35.50 cfs @ 12.23 hrs, Volume= 2.319 af, Depth= 5.22"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

	Area (ac)	CN	Description
*	2.059	84	Pervious Pavement
	3.276	80	>75% Grass cover, Good, HSG D
	5.335	82	Weighted Average
	5.335	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Direct Entry - Estimate**

Summary for Subcatchment 2S: South Parking

Runoff = 20.18 cfs @ 12.17 hrs, Volume= 1.113 af, Depth= 5.22"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

	Area (ac)	CN	Description
	0.120	98	Unconnected pavement, HSG D
*	0.998	84	Pervious Pavement
	1.443	80	>75% Grass cover, Good, HSG D
	2.561	82	Weighted Average
	2.561	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Estimate**

Summary for Subcatchment 3S: Building to Reuse Cistern

Runoff = 6.70 cfs @ 12.14 hrs, Volume= 0.376 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
0.637	98	Roofs, HSG A
0.637	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, Direct - Estimate**

Summary for Subcatchment EX1: Existing North

Runoff = 34.18 cfs @ 12.23 hrs, Volume= 2.219 af, Depth= 4.99"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
0.000	98	Paved parking, HSG D
5.335	80	>75% Grass cover, Good, HSG D
5.335	80	Weighted Average
5.335	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, direct**

Summary for Subcatchment EX2: Existing South

Runoff = 27.51 cfs @ 12.17 hrs, Volume= 1.649 af, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
1.836	98	Paved parking, HSG D
1.360	80	>75% Grass cover, Good, HSG D
3.196	90	Weighted Average
1.360	80	42.55% Pervious Area
1.836	98	57.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, direct**

Summary for Reach EX: Existing Runoff

Inflow Area = 8.531 ac, 21.52% Impervious, Inflow Depth = 5.44" for 100-Year event
Inflow = 59.23 cfs @ 12.20 hrs, Volume= 3.868 af
Outflow = 59.23 cfs @ 12.20 hrs, Volume= 3.868 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach PROP: Proposed Runoff

Inflow Area = 8.533 ac, 7.47% Impervious, Inflow Depth = 5.27" for 100-Year event
Inflow = 59.16 cfs @ 12.19 hrs, Volume= 3.745 af
Outflow = 59.16 cfs @ 12.19 hrs, Volume= 3.745 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Cistern Storage

Inflow Area = 0.637 ac,100.00% Impervious, Inflow Depth = 7.08" for 100-Year event
Inflow = 6.70 cfs @ 12.14 hrs, Volume= 0.376 af
Outflow = 6.57 cfs @ 12.15 hrs, Volume= 0.312 af, Atten= 2%, Lag= 0.8 min
Primary = 6.57 cfs @ 12.15 hrs, Volume= 0.312 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 967.24' @ 12.15 hrs Surf.Area= 154 sf Storage= 2,963 cf

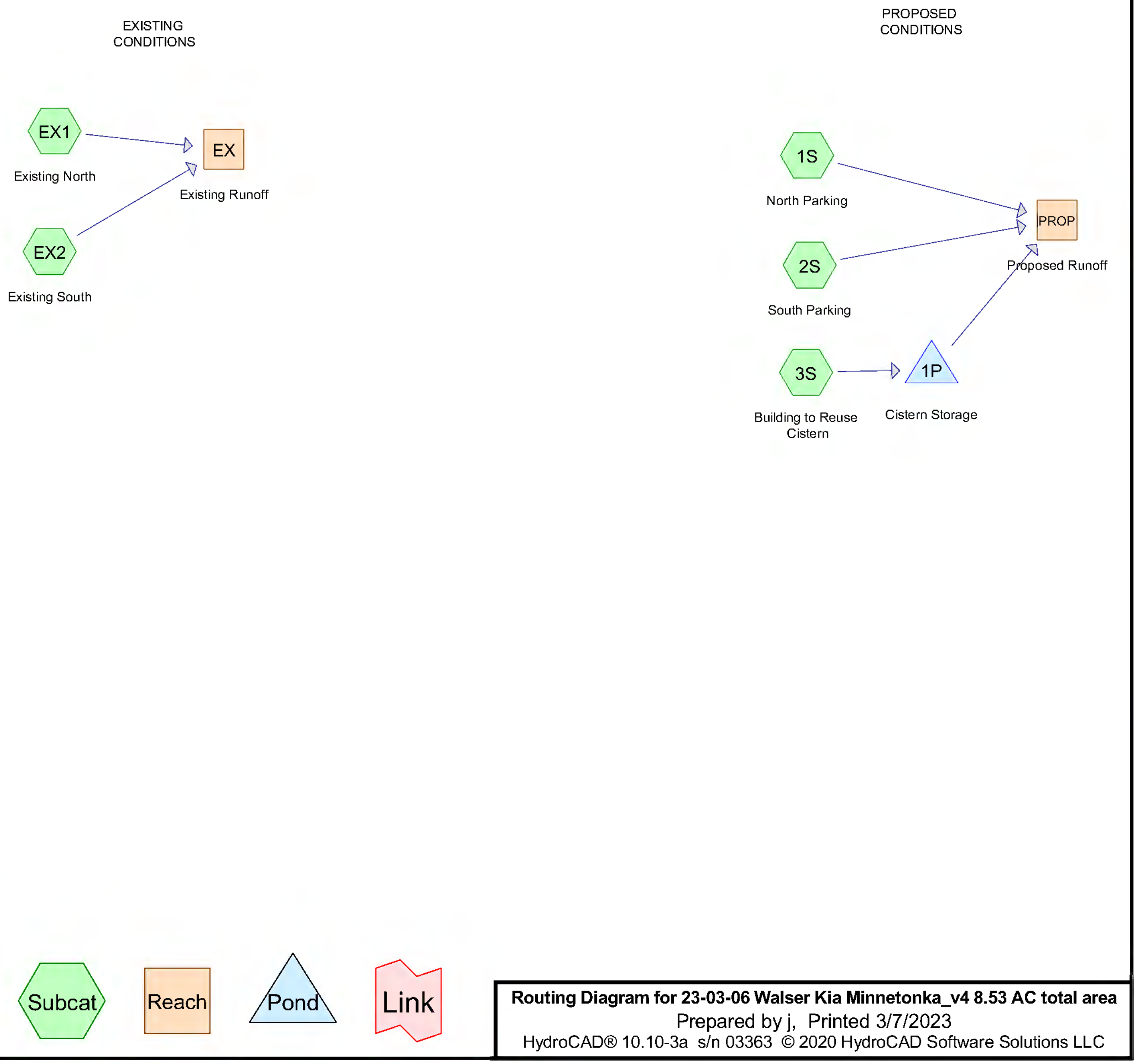
Plug-Flow detention time= 102.0 min calculated for 0.312 af (83% of inflow)
Center-of-Mass det. time= 46.7 min (788.2 - 741.5)

Volume	Invert	Avail.Storage	Storage Description
#1	948.00'	3,080 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
948.00	154	0	0
968.00	154	3,080	3,080

Device	Routing	Invert	Outlet Devices
#1	Primary	966.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.57 cfs @ 12.15 hrs HW=967.23' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 6.57 cfs @ 5.35 fps)



Routing Diagram for 23-03-06 Walser Kia Minnetonka_v4 8.53 AC total area
Prepared by j, Printed 3/7/2023
HydroCAD® 10.10-3a s/n 03363 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
11.414	80	>75% Grass cover, Good, HSG D (1S, 2S, EX1, EX2)
1.836	98	Paved parking, HSG D (EX2)
3.057	84	Pervious Pavement (1S, 2S)
0.637	98	Roofs, HSG A (3S)
0.120	98	Unconnected pavement, HSG D (2S)
17.064	**83**	**TOTAL AREA**

Time span=1.00-240.00 hrs, dt=0.01 hrs, 23901 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: North Parking Runoff Area=5.335 ac 0.00% Impervious Runoff Depth>5.10"
Tc=15.0 min CN=82/0 Runoff=0.86 cfs 2.268 af

Subcatchment 2S: South Parking Runoff Area=2.561 ac 0.00% Impervious Runoff Depth>5.10"
Tc=10.0 min CN=82/0 Runoff=0.41 cfs 1.089 af

Subcatchment 3S: Building to Reuse Runoff Area=0.637 ac 100.00% Impervious Runoff Depth>6.96"
Tc=7.0 min CN=0/98 Runoff=0.12 cfs 0.369 af

Subcatchment EX1: Existing North Runoff Area=5.335 ac 0.00% Impervious Runoff Depth>4.88"
Tc=15.0 min CN=80/0 Runoff=0.83 cfs 2.168 af

Subcatchment EX2: Existing South Runoff Area=3.196 ac 57.45% Impervious Runoff Depth>6.07"
Tc=10.0 min CN=80/98 Runoff=0.56 cfs 1.618 af

Reach EX: Existing Runoff Inflow=1.39 cfs 3.786 af
Outflow=1.39 cfs 3.786 af

Reach PROP: Proposed Runoff Inflow=1.39 cfs 3.663 af
Outflow=1.39 cfs 3.663 af

Pond 1P: Cistern Storage Peak Elev=966.02' Storage=2,775 cf Inflow=0.12 cfs 0.369 af
Outflow=0.12 cfs 0.306 af

Total Runoff Area = 17.064 ac Runoff Volume = 7.512 af Average Runoff Depth = 5.28"
85.51% Pervious = 14.591 ac 14.49% Impervious = 2.473 ac

Summary for Subcatchment 1S: North Parking

Runoff = 0.86 cfs @ 121.35 hrs, Volume= 2.268 af, Depth> 5.10"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

	Area (ac)	CN	Description
*	2.059	84	Pervious Pavement
	3.276	80	>75% Grass cover, Good, HSG D
	5.335	82	Weighted Average
	5.335	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Direct Entry - Estimate**

Summary for Subcatchment 2S: South Parking

Runoff = 0.41 cfs @ 121.30 hrs, Volume= 1.089 af, Depth> 5.10"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

	Area (ac)	CN	Description
	0.120	98	Unconnected pavement, HSG D
*	0.998	84	Pervious Pavement
	1.443	80	>75% Grass cover, Good, HSG D
	2.561	82	Weighted Average
	2.561	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Estimate**

Summary for Subcatchment 3S: Building to Reuse Cistern

Runoff = 0.12 cfs @ 121.26 hrs, Volume= 0.369 af, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

Area (ac)	CN	Description
0.637	98	Roofs, HSG A
0.637	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, Direct - Estimate**

Summary for Subcatchment EX1: Existing North

Runoff = 0.83 cfs @ 121.35 hrs, Volume= 2.168 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

Area (ac)	CN	Description
0.000	98	Paved parking, HSG D
5.335	80	>75% Grass cover, Good, HSG D
5.335	80	Weighted Average
5.335	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, direct**

Summary for Subcatchment EX2: Existing South

Runoff = 0.56 cfs @ 121.30 hrs, Volume= 1.618 af, Depth> 6.07"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

Area (ac)	CN	Description
1.836	98	Paved parking, HSG D
1.360	80	>75% Grass cover, Good, HSG D
3.196	90	Weighted Average
1.360	80	42.55% Pervious Area
1.836	98	57.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, direct**

Summary for Reach EX: Existing Runoff

Inflow Area = 8.531 ac, 21.52% Impervious, Inflow Depth > 5.33" for 10d-100yr-snowment event
Inflow = 1.39 cfs @ 121.32 hrs, Volume= 3.786 af
Outflow = 1.39 cfs @ 121.32 hrs, Volume= 3.786 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach PROP: Proposed Runoff

Inflow Area = 8.533 ac, 7.47% Impervious, Inflow Depth > 5.15" for 10d-100yr-snowment event
Inflow = 1.39 cfs @ 121.32 hrs, Volume= 3.663 af
Outflow = 1.39 cfs @ 121.32 hrs, Volume= 3.663 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Cistern Storage

Inflow Area = 0.637 ac,100.00% Impervious, Inflow Depth > 6.96" for 10d-100yr-snowment event
Inflow = 0.12 cfs @ 121.26 hrs, Volume= 0.369 af
Outflow = 0.12 cfs @ 121.26 hrs, Volume= 0.306 af, Atten= 0%, Lag= 0.0 min
Primary = 0.12 cfs @ 121.26 hrs, Volume= 0.306 af

Routing by Stor-Ind method, Time Span= 1.00-240.00 hrs, dt= 0.01 hrs
Peak Elev= 966.02' @ 121.26 hrs Surf.Area= 154 sf Storage= 2,775 cf

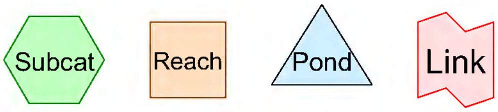
Plug-Flow detention time= 1,976.1 min calculated for 0.306 af (83% of inflow)
Center-of-Mass det. time= 966.7 min (8,348.3 - 7,381.6)

Volume	Invert	Avail.Storage	Storage Description
#1	948.00'	3,080 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
948.00	154	0	0
968.00	154	3,080	3,080

Device	Routing	Invert	Outlet Devices
#1	Primary	966.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 121.26 hrs HW=966.02' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 0.04 cfs @ 0.48 fps)



Routing Diagram for 23-03-06 Walser Kia Minnetonka_v4 8.53 AC total area
Prepared by j, Printed 3/7/2023
HydroCAD® 10.10-3a s/n 03363 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
11.414	80	>75% Grass cover, Good, HSG D (1S, 2S, EX1, EX2)
1.836	98	Paved parking, HSG D (EX2)
3.057	84	Pervious Pavement (1S, 2S)
0.637	98	Roofs, HSG A (3S)
0.120	98	Unconnected pavement, HSG D (2S)
17.064	**83**	**TOTAL AREA**

Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: North Parking Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=0.98"
Tc=15.0 min CN=82/0 Runoff=6.74 cfs 0.437 af

Subcatchment 2S: South Parking Runoff Area=2.561 ac 0.00% Impervious Runoff Depth=0.98"
Tc=10.0 min CN=82/0 Runoff=3.89 cfs 0.210 af

Subcatchment 3S: Building to Reuse Runoff Area=0.637 ac 100.00% Impervious Runoff Depth=2.25"
Tc=7.0 min CN=0/98 Runoff=2.23 cfs 0.119 af

Subcatchment EX1: Existing North Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=0.88"
Tc=15.0 min CN=80/0 Runoff=5.92 cfs 0.389 af

Subcatchment EX2: Existing South Runoff Area=3.196 ac 57.45% Impervious Runoff Depth=1.67"
Tc=10.0 min CN=80/98 Runoff=7.52 cfs 0.444 af

Reach EX: Existing Runoff Inflow=12.69 cfs 0.833 af
Outflow=12.69 cfs 0.833 af

Reach PROP: Proposed Runoff Inflow=11.76 cfs 0.703 af
Outflow=11.76 cfs 0.703 af

Pond 1P: Cistern Storage Peak Elev=966.26' Storage=2,811 cf Inflow=2.23 cfs 0.119 af
Outflow=1.84 cfs 0.056 af

Total Runoff Area = 17.064 ac Runoff Volume = 1.599 af Average Runoff Depth = 1.12"
85.51% Pervious = 14.591 ac 14.49% Impervious = 2.473 ac

Summary for Subcatchment 1S: North Parking

Runoff = 6.74 cfs @ 12.24 hrs, Volume= 0.437 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 1-Year Rainfall=2.48"

	Area (ac)	CN	Description
*	2.059	84	Pervious Pavement
	3.276	80	>75% Grass cover, Good, HSG D
	5.335	82	Weighted Average
	5.335	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Direct Entry - Estimate**

Summary for Subcatchment 2S: South Parking

Runoff = 3.89 cfs @ 12.18 hrs, Volume= 0.210 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 1-Year Rainfall=2.48"

	Area (ac)	CN	Description
	0.120	98	Unconnected pavement, HSG D
*	0.998	84	Pervious Pavement
	1.443	80	>75% Grass cover, Good, HSG D
	2.561	82	Weighted Average
	2.561	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Estimate**

Summary for Subcatchment 3S: Building to Reuse Cistern

Runoff = 2.23 cfs @ 12.14 hrs, Volume= 0.119 af, Depth= 2.25"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
0.637	98	Roofs, HSG A
0.637	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, Direct - Estimate**

Summary for Subcatchment EX1: Existing North

Runoff = 5.92 cfs @ 12.25 hrs, Volume= 0.389 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
0.000	98	Paved parking, HSG D
5.335	80	>75% Grass cover, Good, HSG D
5.335	80	Weighted Average
5.335	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, direct**

Summary for Subcatchment EX2: Existing South

Runoff = 7.52 cfs @ 12.17 hrs, Volume= 0.444 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
1.836	98	Paved parking, HSG D
1.360	80	>75% Grass cover, Good, HSG D
3.196	90	Weighted Average
1.360	80	42.55% Pervious Area
1.836	98	57.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, direct**

Summary for Reach EX: Existing Runoff

Inflow Area = 8.531 ac, 21.52% Impervious, Inflow Depth = 1.17" for 1-Year event
Inflow = 12.69 cfs @ 12.20 hrs, Volume= 0.833 af
Outflow = 12.69 cfs @ 12.20 hrs, Volume= 0.833 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach PROP: Proposed Runoff

Inflow Area = 8.533 ac, 7.47% Impervious, Inflow Depth = 0.99" for 1-Year event
Inflow = 11.76 cfs @ 12.20 hrs, Volume= 0.703 af
Outflow = 11.76 cfs @ 12.20 hrs, Volume= 0.703 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Cistern Storage

Inflow Area = 0.637 ac,100.00% Impervious, Inflow Depth = 2.25" for 1-Year event
Inflow = 2.23 cfs @ 12.14 hrs, Volume= 0.119 af
Outflow = 1.84 cfs @ 12.19 hrs, Volume= 0.056 af, Atten= 18%, Lag= 3.3 min
Primary = 1.84 cfs @ 12.19 hrs, Volume= 0.056 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 966.26' @ 12.19 hrs Surf.Area= 154 sf Storage= 2,811 cf

Plug-Flow detention time= 186.9 min calculated for 0.056 af (47% of inflow)
Center-of-Mass det. time= 95.6 min (852.8 - 757.2)

Volume	Invert	Avail.Storage	Storage Description
#1	948.00'	3,080 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
948.00	154	0	0
968.00	154	3,080	3,080

Device	Routing	Invert	Outlet Devices
#1	Primary	966.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.62 cfs @ 12.19 hrs HW=966.25' (Free Discharge)
↑**—1=Orifice/Grate** (Weir Controls 1.62 cfs @ 1.64 fps)

Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: North Parking Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=2.43"
Tc=15.0 min CN=82/0 Runoff=16.85 cfs 1.079 af

Subcatchment 2S: South Parking Runoff Area=2.561 ac 0.00% Impervious Runoff Depth=2.43"
Tc=10.0 min CN=82/0 Runoff=9.65 cfs 0.518 af

Subcatchment 3S: Building to Reuse Runoff Area=0.637 ac 100.00% Impervious Runoff Depth=4.02"
Tc=7.0 min CN=0/98 Runoff=3.88 cfs 0.214 af

Subcatchment EX1: Existing North Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=2.26"
Tc=15.0 min CN=80/0 Runoff=15.70 cfs 1.004 af

Subcatchment EX2: Existing South Runoff Area=3.196 ac 57.45% Impervious Runoff Depth=3.27"
Tc=10.0 min CN=80/98 Runoff=14.72 cfs 0.872 af

Reach EX: Existing Runoff Inflow=29.04 cfs 1.876 af
Outflow=29.04 cfs 1.876 af

Reach PROP: Proposed Runoff Inflow=28.39 cfs 1.747 af
Outflow=28.39 cfs 1.747 af

Pond 1P: Cistern Storage Peak Elev=966.49' Storage=2,848 cf Inflow=3.88 cfs 0.214 af
Outflow=3.87 cfs 0.150 af

Total Runoff Area = 17.064 ac Runoff Volume = 3.686 af Average Runoff Depth = 2.59"
85.51% Pervious = 14.591 ac 14.49% Impervious = 2.473 ac

Summary for Subcatchment 1S: North Parking

Runoff = 16.85 cfs @ 12.23 hrs, Volume= 1.079 af, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

	Area (ac)	CN	Description
*	2.059	84	Pervious Pavement
	3.276	80	>75% Grass cover, Good, HSG D
	5.335	82	Weighted Average
	5.335	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Direct Entry - Estimate**

Summary for Subcatchment 2S: South Parking

Runoff = 9.65 cfs @ 12.18 hrs, Volume= 0.518 af, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

	Area (ac)	CN	Description
	0.120	98	Unconnected pavement, HSG D
*	0.998	84	Pervious Pavement
	1.443	80	>75% Grass cover, Good, HSG D
	2.561	82	Weighted Average
	2.561	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Estimate**

Summary for Subcatchment 3S: Building to Reuse Cistern

Runoff = 3.88 cfs @ 12.14 hrs, Volume= 0.214 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
0.637	98	Roofs, HSG A
0.637	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, Direct - Estimate**

Summary for Subcatchment EX1: Existing North

Runoff = 15.70 cfs @ 12.23 hrs, Volume= 1.004 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
0.000	98	Paved parking, HSG D
5.335	80	>75% Grass cover, Good, HSG D
5.335	80	Weighted Average
5.335	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, direct**

Summary for Subcatchment EX2: Existing South

Runoff = 14.72 cfs @ 12.17 hrs, Volume= 0.872 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
1.836	98	Paved parking, HSG D
1.360	80	>75% Grass cover, Good, HSG D
3.196	90	Weighted Average
1.360	80	42.55% Pervious Area
1.836	98	57.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, direct**

Summary for Reach EX: Existing Runoff

Inflow Area = 8.531 ac, 21.52% Impervious, Inflow Depth = 2.64" for 10-Year event
Inflow = 29.04 cfs @ 12.20 hrs, Volume= 1.876 af
Outflow = 29.04 cfs @ 12.20 hrs, Volume= 1.876 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach PROP: Proposed Runoff

Inflow Area = 8.533 ac, 7.47% Impervious, Inflow Depth = 2.46" for 10-Year event
Inflow = 28.39 cfs @ 12.19 hrs, Volume= 1.747 af
Outflow = 28.39 cfs @ 12.19 hrs, Volume= 1.747 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Cistern Storage

Inflow Area = 0.637 ac,100.00% Impervious, Inflow Depth = 4.02" for 10-Year event
Inflow = 3.88 cfs @ 12.14 hrs, Volume= 0.214 af
Outflow = 3.87 cfs @ 12.15 hrs, Volume= 0.150 af, Atten= 0%, Lag= 0.4 min
Primary = 3.87 cfs @ 12.15 hrs, Volume= 0.150 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 966.49' @ 12.15 hrs Surf.Area= 154 sf Storage= 2,848 cf

Plug-Flow detention time= 128.0 min calculated for 0.150 af (70% of inflow)
Center-of-Mass det. time= 58.7 min (807.0 - 748.3)

Volume	Invert	Avail.Storage	Storage Description
#1	948.00'	3,080 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
948.00	154	0	0
968.00	154	3,080	3,080

Device	Routing	Invert	Outlet Devices
#1	Primary	966.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.14 cfs @ 12.15 hrs HW=966.49' (Free Discharge)
↑**—1=Orifice/Grate** (Orifice Controls 4.14 cfs @ 3.38 fps)

Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: North Parking Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=5.22"
Tc=15.0 min CN=82/0 Runoff=35.50 cfs 2.319 af

Subcatchment 2S: South Parking Runoff Area=2.561 ac 0.00% Impervious Runoff Depth=5.22"
Tc=10.0 min CN=82/0 Runoff=20.18 cfs 1.113 af

Subcatchment 3S: Building to Reuse Runoff Area=0.637 ac 100.00% Impervious Runoff Depth=7.08"
Tc=7.0 min CN=0/98 Runoff=6.70 cfs 0.376 af

Subcatchment EX1: Existing North Runoff Area=5.335 ac 0.00% Impervious Runoff Depth=4.99"
Tc=15.0 min CN=80/0 Runoff=34.18 cfs 2.219 af

Subcatchment EX2: Existing South Runoff Area=3.196 ac 57.45% Impervious Runoff Depth=6.19"
Tc=10.0 min CN=80/98 Runoff=27.51 cfs 1.649 af

Reach EX: Existing Runoff Inflow=59.23 cfs 3.868 af
Outflow=59.23 cfs 3.868 af

Reach PROP: Proposed Runoff Inflow=59.16 cfs 3.745 af
Outflow=59.16 cfs 3.745 af

Pond 1P: Cistern Storage Peak Elev=967.24' Storage=2,963 cf Inflow=6.70 cfs 0.376 af
Outflow=6.57 cfs 0.312 af

Total Runoff Area = 17.064 ac Runoff Volume = 7.676 af Average Runoff Depth = 5.40"
85.51% Pervious = 14.591 ac 14.49% Impervious = 2.473 ac

Summary for Subcatchment 1S: North Parking

Runoff = 35.50 cfs @ 12.23 hrs, Volume= 2.319 af, Depth= 5.22"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

	Area (ac)	CN	Description
*	2.059	84	Pervious Pavement
	3.276	80	>75% Grass cover, Good, HSG D
	5.335	82	Weighted Average
	5.335	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Direct Entry - Estimate**

Summary for Subcatchment 2S: South Parking

Runoff = 20.18 cfs @ 12.17 hrs, Volume= 1.113 af, Depth= 5.22"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

	Area (ac)	CN	Description
	0.120	98	Unconnected pavement, HSG D
*	0.998	84	Pervious Pavement
	1.443	80	>75% Grass cover, Good, HSG D
	2.561	82	Weighted Average
	2.561	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Estimate**

Summary for Subcatchment 3S: Building to Reuse Cistern

Runoff = 6.70 cfs @ 12.14 hrs, Volume= 0.376 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
0.637	98	Roofs, HSG A
0.637	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, Direct - Estimate**

Summary for Subcatchment EX1: Existing North

Runoff = 34.18 cfs @ 12.23 hrs, Volume= 2.219 af, Depth= 4.99"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
0.000	98	Paved parking, HSG D
5.335	80	>75% Grass cover, Good, HSG D
5.335	80	Weighted Average
5.335	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, direct**

Summary for Subcatchment EX2: Existing South

Runoff = 27.51 cfs @ 12.17 hrs, Volume= 1.649 af, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
1.836	98	Paved parking, HSG D
1.360	80	>75% Grass cover, Good, HSG D
3.196	90	Weighted Average
1.360	80	42.55% Pervious Area
1.836	98	57.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, direct**

Summary for Reach EX: Existing Runoff

Inflow Area = 8.531 ac, 21.52% Impervious, Inflow Depth = 5.44" for 100-Year event
Inflow = 59.23 cfs @ 12.20 hrs, Volume= 3.868 af
Outflow = 59.23 cfs @ 12.20 hrs, Volume= 3.868 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach PROP: Proposed Runoff

Inflow Area = 8.533 ac, 7.47% Impervious, Inflow Depth = 5.27" for 100-Year event
Inflow = 59.16 cfs @ 12.19 hrs, Volume= 3.745 af
Outflow = 59.16 cfs @ 12.19 hrs, Volume= 3.745 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Cistern Storage

Inflow Area = 0.637 ac,100.00% Impervious, Inflow Depth = 7.08" for 100-Year event
Inflow = 6.70 cfs @ 12.14 hrs, Volume= 0.376 af
Outflow = 6.57 cfs @ 12.15 hrs, Volume= 0.312 af, Atten= 2%, Lag= 0.8 min
Primary = 6.57 cfs @ 12.15 hrs, Volume= 0.312 af

Routing by Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 967.24' @ 12.15 hrs Surf.Area= 154 sf Storage= 2,963 cf

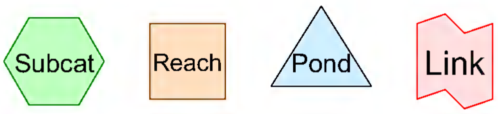
Plug-Flow detention time= 102.0 min calculated for 0.312 af (83% of inflow)
Center-of-Mass det. time= 46.7 min (788.2 - 741.5)

Volume	Invert	Avail.Storage	Storage Description
#1	948.00'	3,080 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
948.00	154	0	0
968.00	154	3,080	3,080

Device	Routing	Invert	Outlet Devices
#1	Primary	966.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.57 cfs @ 12.15 hrs HW=967.23' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 6.57 cfs @ 5.35 fps)



Routing Diagram for 23-03-06 Walser Kia Minnetonka_v4 8.53 AC total area
Prepared by j, Printed 3/7/2023
HydroCAD® 10.10-3a s/n 03363 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
11.414	80	>75% Grass cover, Good, HSG D (1S, 2S, EX1, EX2)
1.836	98	Paved parking, HSG D (EX2)
3.057	84	Pervious Pavement (1S, 2S)
0.637	98	Roofs, HSG A (3S)
0.120	98	Unconnected pavement, HSG D (2S)
17.064	**83**	**TOTAL AREA**

Time span=1.00-240.00 hrs, dt=0.01 hrs, 23901 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: North Parking Runoff Area=5.335 ac 0.00% Impervious Runoff Depth>5.10"
Tc=15.0 min CN=82/0 Runoff=0.86 cfs 2.268 af

Subcatchment 2S: South Parking Runoff Area=2.561 ac 0.00% Impervious Runoff Depth>5.10"
Tc=10.0 min CN=82/0 Runoff=0.41 cfs 1.089 af

Subcatchment 3S: Building to Reuse Runoff Area=0.637 ac 100.00% Impervious Runoff Depth>6.96"
Tc=7.0 min CN=0/98 Runoff=0.12 cfs 0.369 af

Subcatchment EX1: Existing North Runoff Area=5.335 ac 0.00% Impervious Runoff Depth>4.88"
Tc=15.0 min CN=80/0 Runoff=0.83 cfs 2.168 af

Subcatchment EX2: Existing South Runoff Area=3.196 ac 57.45% Impervious Runoff Depth>6.07"
Tc=10.0 min CN=80/98 Runoff=0.56 cfs 1.618 af

Reach EX: Existing Runoff Inflow=1.39 cfs 3.786 af
Outflow=1.39 cfs 3.786 af

Reach PROP: Proposed Runoff Inflow=1.39 cfs 3.663 af
Outflow=1.39 cfs 3.663 af

Pond 1P: Cistern Storage Peak Elev=966.02' Storage=2,775 cf Inflow=0.12 cfs 0.369 af
Outflow=0.12 cfs 0.306 af

Total Runoff Area = 17.064 ac Runoff Volume = 7.512 af Average Runoff Depth = 5.28"
85.51% Pervious = 14.591 ac 14.49% Impervious = 2.473 ac

Summary for Subcatchment 1S: North Parking

Runoff = 0.86 cfs @ 121.35 hrs, Volume= 2.268 af, Depth> 5.10"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

	Area (ac)	CN	Description
*	2.059	84	Pervious Pavement
	3.276	80	>75% Grass cover, Good, HSG D
	5.335	82	Weighted Average
	5.335	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Direct Entry - Estimate**

Summary for Subcatchment 2S: South Parking

Runoff = 0.41 cfs @ 121.30 hrs, Volume= 1.089 af, Depth> 5.10"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

	Area (ac)	CN	Description
	0.120	98	Unconnected pavement, HSG D
*	0.998	84	Pervious Pavement
	1.443	80	>75% Grass cover, Good, HSG D
	2.561	82	Weighted Average
	2.561	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Estimate**

Summary for Subcatchment 3S: Building to Reuse Cistern

Runoff = 0.12 cfs @ 121.26 hrs, Volume= 0.369 af, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

Area (ac)	CN	Description
0.637	98	Roofs, HSG A
0.637	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, Direct - Estimate**

Summary for Subcatchment EX1: Existing North

Runoff = 0.83 cfs @ 121.35 hrs, Volume= 2.168 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

Area (ac)	CN	Description
0.000	98	Paved parking, HSG D
5.335	80	>75% Grass cover, Good, HSG D
5.335	80	Weighted Average
5.335	80	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, direct**

Summary for Subcatchment EX2: Existing South

Runoff = 0.56 cfs @ 121.30 hrs, Volume= 1.618 af, Depth> 6.07"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 1.00-240.00 hrs, dt= 0.01
Snowmelt_10d_100yr_hcr 10d-100yr-snowment Rainfall=7.20"

Area (ac)	CN	Description
1.836	98	Paved parking, HSG D
1.360	80	>75% Grass cover, Good, HSG D
3.196	90	Weighted Average
1.360	80	42.55% Pervious Area
1.836	98	57.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, direct**

Summary for Reach EX: Existing Runoff

Inflow Area = 8.531 ac, 21.52% Impervious, Inflow Depth > 5.33" for 10d-100yr-snowment event
Inflow = 1.39 cfs @ 121.32 hrs, Volume= 3.786 af
Outflow = 1.39 cfs @ 121.32 hrs, Volume= 3.786 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach PROP: Proposed Runoff

Inflow Area = 8.533 ac, 7.47% Impervious, Inflow Depth > 5.15" for 10d-100yr-snowment event
Inflow = 1.39 cfs @ 121.32 hrs, Volume= 3.663 af
Outflow = 1.39 cfs @ 121.32 hrs, Volume= 3.663 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Cistern Storage

Inflow Area = 0.637 ac,100.00% Impervious, Inflow Depth > 6.96" for 10d-100yr-snowment event
Inflow = 0.12 cfs @ 121.26 hrs, Volume= 0.369 af
Outflow = 0.12 cfs @ 121.26 hrs, Volume= 0.306 af, Atten= 0%, Lag= 0.0 min
Primary = 0.12 cfs @ 121.26 hrs, Volume= 0.306 af

Routing by Stor-Ind method, Time Span= 1.00-240.00 hrs, dt= 0.01 hrs
Peak Elev= 966.02' @ 121.26 hrs Surf.Area= 154 sf Storage= 2,775 cf

Plug-Flow detention time= 1,976.1 min calculated for 0.306 af (83% of inflow)
Center-of-Mass det. time= 966.7 min (8,348.3 - 7,381.6)

Volume	Invert	Avail.Storage	Storage Description
#1	948.00'	3,080 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
948.00	154	0	0
968.00	154	3,080	3,080

Device	Routing	Invert	Outlet Devices
#1	Primary	966.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 121.26 hrs HW=966.02' (Free Discharge)
↳**1=Orifice/Grate** (Weir Controls 0.04 cfs @ 0.48 fps)

Stage-Area-Storage for Pond 1P: Cistern Storage

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
948.00	**154**	0
948.20	154	31
948.40	154	62
948.60	154	92
948.80	154	123
949.00	154	154
949.20	154	185
949.40	154	216
949.60	154	246
949.80	154	277
950.00	154	308
950.20	154	339
950.40	154	370
950.60	154	400
950.80	154	431
951.00	154	462
951.20	154	493
951.40	154	524
951.60	154	554
951.80	154	585
952.00	154	616
952.20	154	647
952.40	154	678
952.60	154	708
952.80	154	739
953.00	154	770
953.20	154	801
953.40	154	832
953.60	154	862
953.80	154	893
954.00	154	924
954.20	154	955
954.40	154	986
954.60	154	1,016
954.80	154	1,047
955.00	154	1,078
955.20	154	1,109
955.40	154	1,140
955.60	154	1,170
955.80	154	1,201
956.00	154	1,232
956.20	154	1,263
956.40	154	1,294
956.60	154	1,324
956.80	154	1,355
957.00	154	1,386
957.20	154	1,417
957.40	154	1,448
957.60	154	1,478
957.80	154	1,509
958.00	154	1,540
958.20	154	1,571
958.40	154	1,602
958.60	154	1,632
958.80	154	1,663
959.00	154	1,694
959.20	154	1,725
959.40	154	1,756
959.60	154	1,786
959.80	154	1,817
960.00	154	1,848
960.20	154	1,879
960.40	154	1,910
960.60	154	1,940
960.80	154	1,971
961.00	154	2,002
961.20	154	2,033
961.40	154	2,064
961.60	154	2,094
961.80	154	2,125
962.00	154	2,156
962.20	154	2,187
962.40	154	2,218
962.60	154	2,248
962.80	154	2,279
963.00	154	2,310
963.20	154	2,341
963.40	154	2,372
963.60	154	2,402
963.80	154	2,433
964.00	154	2,464
964.20	154	2,495
964.40	154	2,526
964.60	154	2,556
964.80	154	2,587
965.00	154	2,618
965.20	154	2,649
965.40	154	2,680
965.60	154	2,710
965.80	154	2,741
966.00	154	2,772
966.20	154	2,803
966.40	154	2,834
966.60	154	2,864
966.80	154	2,895
967.00	154	2,926
967.20	154	2,957
967.40	154	2,988
967.60	154	3,018
967.80	154	3,049
968.00	154	**3,080**

Attachment B – DRAFT Geotechnical Report

REPORT OF GEOTECHNICAL EXPLORATION

Walser Wayzata Kia
15700 Wayzata Boulevard
Wayzata, Minnesota

AET Project No. P-0019634

Date: March 1, 2023

Prepared for:

Walser Automotive Group

Geotechnical • Materials
Forensic • Environmental
Building Technology
Petrography/Chemistry

American Engineering Testing
550 Cleveland Avenue North
St. Paul, MN 55114-1804
TeamAET.com • 800.792.6364

AMERICAN
ENGINEERING TESTING

March 1, 2023

Walser Automotive Group
7700 France Avenue South
Edina, Minnesota 55435

Attn: Andrew Walser awalser@walser.com

RE: Report of Geotechnical Exploration
Walser Wayzata Kia
15700 Wayzata Boulevard
Wayzata, Minnesota
AET Report No. P-0019634

Dear Andrew:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for your Walser Wayzata Kia project in Wayzata, Minnesota. These services were performed according to our proposal to you dated January 18, 2023.

We are submitting one electronic (.pdf format) copy of the report to you. Additional copies are being sent on your behalf as noted below.

Please contact me if you have any questions about the report. I can also be contacted for arranging construction observation and testing services.

Sincerely,
American Engineering Testing, Inc.

Rob Flickinger
Senior Engineer
Manager Construction Services
rflickinger@teamAET.com
651-659-1301

Cc: Dave Phillips dphillips@phillipsarchitects.com
Shari Ahrens shari.ahrens@westwoodps.com
David Bade david.bade@westwoodps.com

SIGNATURE PAGE

Prepared for:

Walser Automotive Group
7700 France Avenue South
Edina, Minnesota 55435

Attn: Andrew Walser

Prepared by:

American Engineering Testing, Inc.
550 Cleveland Avenue North
St. Paul, Minnesota 55114
(651) 659-9001/www.amengtest.com

Authored by:

Robin L. Flickinger
Senior Engineer

Reviewed by:

Thomas P. Venema, PE (MN)
Vice President/Principal 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 Minnesota Statute Section 326.02 to 326.15

Name: Thomas P. Venema

Date: March 1, 2023 License #:13922

TABLE OF CONTENTS

1.0 INTRODUCTION

You are proposing to construct a new automotive dealership facility at a site in Wayzata, Minnesota. To assist with planning and design, you have authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal to Walser Automotive Group dated January 18, 2023, which was authorized by Andrew Walser on January 19, 2023. The authorized scope consisted of the following.

- Performing 12 standard penetration test borings to depths ranging from 20 feet to 90 feet.
- Performing soil laboratory testing.
- Conducting a geotechnical engineering review and preparing this report.

These services are intended for geotechnical purposes only. The scope is not intended to explore for the presence or extent of environmental contamination in the soil or groundwater.

3.0 PROJECT INFORMATION

We understand the planned building will be a single story automobile dealership. The structure will have cast in place concrete or masonry block walls below grade with steel frame construction above grade. The floor slab will be at elevation 948.5 feet. Based on the type of structure, we assume wall loads will be on the order of 6 to 8 kips per lineal foot with column loads of up to 200 kips. Bituminous pavements will be constructed around the building with a large car parking area north of the building. A stormwater holding system may be needed below the parking area.

Our foundation design assumptions include a minimum factor of safety of 3 with respect to the ultimate bearing capacity. We assume the structure will be able to tolerate total settlements of up to 1 inch, and differential settlements over a 30-foot distance of up to ½ inch.

The above stated information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program conducted for the project consisted of 12 standard penetration test borings. The number of borings, locations and depths were as discussed with the design team. The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic origins, and moisture condition. A density description or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

The boring locations are shown on Figures 1 and 2 in Appendix A. The borings were located in the field by AET personnel by spotting them based on existing site features. We then obtained GPS coordinates at the final drilled locations using our GPS equipment. Surface elevations were measured in the field by AET personnel using an engineer's level. We the top nut of the hydrant near the middle of the site along the north side of Wayzata Boulevard as a benchmark. Based on the "Existing Conditions Plan" prepared by Westwood Professional Services and dated February 24, 2023, the top nut of that hydrant is at elevation 948.28 feet.

5.0 SITE CONDITIONS

5.1 Surface Observations

The southern portion of the site is occupied by a one story strip mall surrounded by bituminous pavement. The portion of the site that extends into the wetland to the north was snow covered at the time of our soil borings. Based on a review of a satellite photo from Google Earth, the northern portion was covered with grass, weeds, and scattered trees (some of the trees are large) with a wetland surrounding the planned parking area. The building site is fairly level with slopes away from the building down towards the north towards the wetland and down towards the ditch on the south side of the existing building. The parking area has a slope from a high point near the north end down towards the south and dropping off along the edges of the planned parking area down to the wetland.

5.2 Subsurface Soils/Geology

The site geology consists of fill over swamp deposited peat and organic soils over glacial till clays and dolostone bedrock. In general, the site is a wetland area that has a layer of surface fill. The estimates of strength, compressibility and drainage given in the sections below are subjective in nature and are meant to give a generalized view of the soil properties.

5.2.1 Fill

Fill soils are present at the surface of all of the borings. The fill soils are a mixture of silty sands, clayey sands, sandy lean clays, and fat clays all with varying gravel and organic contents. Bituminous pavement was present at the surface of Borings B-01 to B-04. The bituminous ranged from 3½ to 6½ inches in thickness. The fill had N-values ranging from 4 to 34 blows per foot (bpf). The fill is judged to have varying strength and compressibility. The fill ranged in depth from about 7 feet to over 20 feet at the boring locations. The fill soils are judged to be slow draining and susceptible to freeze-thaw movements and strength loss. The fill soils should be considered compressible because of the compressible swamp deposits below them.

We found pieces of wood, concrete, bituminous, metal and ashes and cinders in the fill for borings drilled for the parking area. Debris may also be present in the fill in the building area. Fill that contains debris is considered regulated by the Minnesota Pollution Control Agency (MPCA). The fill should be properly disposed of following MPCA guidelines or reused on site following MPCA Best Management Practices.

5.2.2 Swamp Deposits

Layers of swamp deposits are present below the fill except at Borings B-02 and P-01 where they appear to have been removed. The swamp deposits consist of peats, and organic clays with some pieces of wood. Based on the N-values, the swamp deposits range in consistency from soft to firm, although they are primarily soft. We judge the swamp deposits and fine alluvium to have low strength and high compressibility. These soils are slow draining and have moderately high to high frost susceptibility when exposed to freezing temperatures.

The peat extended to a depth of about 12 feet in the building area and was over 21 feet in most of the parking area borings. The borings in the parking area, P-02 to P-07, terminated in fill or organic soils; the fill and organic soil depth is greater than 21 feet. The depth of the organic soils (peat) is variable and could extend deeper or shallower away from the borings.

5.2.3 Fine and Mixed Alluvium

Layers of fine and mixed alluvial swamp deposits are present below the fill and swamp deposits in Borings B-1 and B-4. The fine and mixed alluvium consist of lean clays and silty sands. Based on the N-values, the fine alluvium ranges in consistency from soft to firm. The mixed alluvial silty sands range from loose to very loose. We judge the fine and mixed alluvium to have low to moderate strength and moderate to high compressibility. These soils are mostly slow draining and have moderately high to high frost susceptibility when exposed to freezing temperatures.

5.2.4 Glacial Till

Glacial till lean clays with sand, clayey sands, and sandy lean clays with varying gravel contents were encountered below the fill and swamp deposited soils in most of the borings. Based on the N-values, the till soils range in consistency from very soft to very stiff. The very soft till soils were generally found at the interface of the organic (peat) soils and extended to a depth of about 2 to 3 feet below the bottom of the peat. We judge the glacial till soils to have moderate to high strength and moderate to low compressibility. The softer till are considered to have low to moderate strength. The lean clays, clayey sands, and sandy lean clays are slow draining and have moderately high frost susceptibility when exposed to freezing temperatures.

5.2.4 Bedrock

Weathered dolostone judged to be from the Shakopee formation of the Prairie du Chien group was encountered below the till in Borings B-01, B-02, and B-03 at depths between 73½ and 85½ feet below grade. The weathered dolostone has high strength and low compressibility.

5.3 Groundwater

Water was measured in most of the borings during drilling at depths ranging from 4 to 16 feet below grade. Because of the layered soil profiles, consisting of slow draining silty and clayey soils or swamp deposits with some seams of faster draining sand and silty sand layers, perched water levels are likely. Water becomes trapped in faster draining soils between or above the slower draining clays and clayey sands. Groundwater may also become trapped in lenses and laminations of silts, silty sands, and sands which are present in some of the clayey layers.

The groundwater levels shown on the boring logs are estimated based on the measurements taken and from observations of the samples. More accurate readings of the groundwater levels can be obtained by installing and monitoring temporary piezometers for extended periods of time. Long term monitoring of water levels was not part of our scope of services. Typically, the hydrostatic groundwater level will fluctuate with the levels of the adjacent wetland, which appeared to have a similar water level to some of the borings. The ordinary high water elevation is at about 942.0 feet according to the Minnesota DNR Lake and Flood Elevations Database. Sambatek recorded the water level at 942.5 feet on August 11, 2017 according to their "Boundary Survey." And Westwood Professional Services measured the water level at 941.9 on December 8, 2016.

Groundwater levels fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors. The Twin Cities areas has been in a drought pattern for the last 3 years and groundwater levels may be lower than normal.

6.0 RECOMMENDATIONS

6.1 Discussion

Existing fill and peat soils are present at the surface of all borings, extending to variable depths at the boring locations; including some that are deeper than 21 feet. Based on our review of the soil conditions at the boring locations, and the soil boring samples, it is our opinion that the existing fill soils and the underlying swamp deposits and weak alluvial soils are not suitable to support the proposed building. Because of the considerable depths of these poor soils at some locations, it is our judgment that an excavation and refill operation would be difficult and cost prohibitive. Furthermore, much of the excavation will probably be conducted below the groundwater - adding additional difficulty and cost. Also due to the depth of the peat and the necessary oversize, the excavate and refill option may require shoring of the adjacent sidewalk and utilities on the south side. The borings indicated that the depth of organics could increase towards the north. We have presented this option for your consideration; but this is not our primary recommendation. We will also provide options for rigid inclusions, helical pile, and driven pile.

The present grading plans indicate that final grades around the new building will be higher than the existing grades, on the order of about 3 to 4 feet. The additional weight of the new fill needed to raise grades to those levels will initiate consolidation of the compressible swamp deposits and soft alluvial clays, as well as some of the fill soils. This consolidation will cause long-term settlements which could affect the performance of building stoops, sidewalks, pavements, and underground utilities. Transition from the structure, which will be designed to have normal settlement tolerances, to grade support over buried organics will need to be considered to accommodate differential settlement. Post-construction settlements in site areas such as these can be reduced if final grades are established as soon as possible during the construction process and the new fill is left in place as long as possible before construction is initiated. Depending on the length of time delay, this may not keep settlements at tolerable levels where significant grade increases are needed. Options of the use of lightweight fill, such as shredded tires, can be considered to reduce anticipated settlements.

We can provide additional recommendations regarding the stormwater holding system as the design progresses. Comments can be provided regarding potential settlement, buoyancy and support.

6.2 Building Grading – Excavate and Refill Option

6.2.1 Excavation

To prepare the building area for foundation and slab support, we recommend complete excavation of the fill, peat and soft alluvial or glacial till clays, thereby exposing the stiff to very stiff glacial till clays. This would result in excavation depths at the boring locations as shown in Table 6.2.1.

Table 6.2.1 – Recommended Excavation Depths

Boring Location	Surface Elevation (ft)	Excavation Depth (ft)	Approximate Excavation Elevation (ft)
B-01	945.1	12	933
B-02	946.2	9	937
B-03	946.1	12	934
B-04	945.2	12	933

The depths/elevations indicated in Table 6.2.1 are based on the soil conditions at the specific boring locations. Since conditions will vary away from the boring locations, we recommend that AET geotechnical personnel observe and confirm the competency of the soils in the entire excavation bottom prior to new fill or footing placement. The depths may be greater than the above table indicates if fine alluvium below the peat and fill is soft and requires additional excavation.

Where the excavation extends below foundation grade, the excavation bottom and resultant engineered fill system must be oversized laterally beyond the planned outside edges of the foundations to properly support the loads exerted by that foundation. Due to the soft nature of the peat this excavation/engineered fill lateral extension should at least be equal to one and one half times the vertical depth of fill needed to attain foundation grade at that location (i.e., 1½:1 horizontal to vertical lateral oversize).

6.2.2 Fill Placement and Compaction

Fill placed to attain grade for foundation and slab support should be compacted in thin lifts (less than 8 inches in thickness), such that the entire lift achieves a minimum compaction level of 98% of the standard maximum dry unit weight per ASTM: D698 (Standard Proctor test). The fill should be placed at a moisture content of ± 3% of optimum as defined by the Standard Proctor test.

Fill placed to attain grades for foundation and floor slab support should consist of non-organic sands, sands with silt having no more than 6% of the particles (by weight) finer than the #200 sieve. The fill should be free from miscellaneous rubble, debris, and gravel/cobbles larger than 3 inches in any dimension. It is not within our scope of services to determine the amount of existing fill that may be available for re-use, although based on our observations of the soil samples the majority of the excavated fill will not be acceptable. The fill will likely need to be imported. Fill should not be placed over frozen soils and frozen soils should not be used as fill.

The excavation should be dewatered prior to any fill placement. Based upon the soils encountered, peat and glacial till soils, this will likely need to be performed with sump pits and pumps. It is the contractor's responsibility to design the dewatering system and perform the dewatering in a manner to not cause settlement of adjacent streets, utilities, or structures.

The fill recommended above should be used above the anticipated long term ground water level of 942 feet. Fill placed below the anticipated long term groundwater level should consist of sand with less than 3% passing the #200 sieve (by weight) and less than 40% passing the #40 sieve (by weight). This type of sand (after proper compaction) does not experience significant post construction settlement when becoming saturated. The sand fill will become saturated as groundwater level restabilizes after the construction dewatering is stopped.

In areas where fill is placed on slopes, we recommend benching the sloped surface (benches cut parallel to the slope contour) prior to placing the fill. Benching is recommended where slopes are steeper than 4:1 (H: V).

6.3 Foundation Design

The structure can be supported on conventional spread foundations placed on the newly placed and compacted fill. We recommend perimeter foundations for heated building spaces be placed such that the bottoms are a minimum of 42 inches below exterior grades. We recommend foundations for unheated building spaces (such as stoop and canopy foundations) be extended to a minimum of 60 inches below exterior grades.

Based on the conditions encountered, it is our opinion the building foundations can be designed based on a net maximum allowable soil bearing pressure of 4,000 psf. It is our judgment this design pressure will have a factor of safety of at least 3 against the ultimate bearing capacity. We estimate that total settlements under this loading should not exceed 1 inch. We also estimate that differential settlements of conditions depicted by the borings should not exceed ½ inch.

6.4 Floor Slab Design

Fill that is placed around new foundations, in the underslab utility trenches, and below the floor slab, should consist of sands or sands with silt. The sand recommended for the building pad preparation would be suitable for the backfill. Because hand operated equipment will be needed to compact the fill in the aforementioned areas, the sands should be placed in loose lift thicknesses of no more than 6 inches. The sands should also be placed and compacted at moisture contents within ±2% of their respective optimum moisture contents based on the respective Standard Proctor tests. Sands or sands with silt (USCS soil classifications SP or SP-SM) would be the preferable backfill soils as they are easier to compact in a wider range of water contents. This is the fill type recommended for the soil correction. The fill below the slabs should not contain gravel larger than 3 inches in the largest dimension. Each lift should be compacted using manually-operated equipment to at least 95% of the maximum standard Proctor dry density (ASTM: D698) throughout each entire lift. If the fill depth exceeds 4 feet then the fill should be compacted to at least 98%.

The slab can be supported on grade by the properly compacted sand subgrade, and carefully placed and compacted trench backfill. The subgrade fill should be prepared as discussed in Section 6.2.2. For a sand subgrade as a governing condition, we recommend that the floor slab be designed using a modulus of subgrade reaction (k-value) of 200 pounds per cubic inch (pci). It is preferred that a 6 inch or thicker layer of crushed gravel or base aggregate (MnDOT Class 5) be placed immediately below the slabs to improve subgrade stability and workability. If this 6 inch thick gravel or base layer is used, the k-value for slab design can be increased to 225 pci.

6.5 Building Grading - Rigid Inclusion

As an alternate to an excavate/refill process, you can consider supporting the planned building on rigid inclusions, which would transfer loads through the soft soils into underlying stiff or dense strata using high modulus concrete or grout columns. These are designed and installed by specialty geotechnical contractors. There are a few such contractors, each with their own proprietary system. Since rigid inclusions are installed using a displacement tool, they produce little or no spoils, because the cuttings are pushed back into the surrounding soils. They typically are designed to support a load transfer platform at the ground surface made of compacted granular fill, and the building or embankment is then supported on the load transfer platform. In our opinion the use of the rigid inclusions would be suitable for supporting the building.

The final depths and layout of the rigid inclusions would be determined by the specialty design-build contractor. Additionally, the design-build contractor would estimate load carrying capacities and settlements. The building would be supported on spread footings similar to the excavate refill option. The floor slab and below grade utilities would also be supported on the load transfer platform. Backfill for utilities should be placed and compacted as discussed in section 6.4, Floor Slab Design.

As discussed earlier in this report, placing new loads on the site soils will cause settlement. Since the building is planned to be structurally supported on rigid inclusions, raising grade under the building will not cause settlement of the building (foundations, floor slab, and underslab utilities). However, raising site grades outside the building could cause settlement of the surrounding sidewalks and underground utilities. The grading should be completed as soon as possible during construction to allow the compressible soils to stabilize under the weight of the new fill for as long as possible and reduce post-construction settlement.

6.6 Building Grading – Helical Pile

Another option to consider is supporting the planned building on helical pile, which would transfer loads through the soft soils into underlying stiff or dense strata. Helical pile are designed and installed by specialty deep foundation contractors. There are several such contractors, each with their own proprietary system. Since helical pile are installed using a displacement tool, they produce little or no spoils, because the cuttings are pushed back into the surrounding soils. They typically are designed to support the foundation and slab on grade beams and pile caps. In our opinion the use of helical pile would be suitable for supporting the building.

The final depths and layout of the helical pile would be determined by the specialty design-build contractor. Additionally, the design-build contractor would estimate load carrying capacities and settlements.

We recommend the floor slab be supported structurally on helical pile. As discussed earlier in this report, placing new loads on the site soils will cause settlement. If the building is structurally supported on helical pile, raising grade under the building will not cause settlement of the building. However, raising site grades outside the building will cause settlement of the surrounding sidewalks and underground utilities. The grading should be completed as soon as possible during construction to allow the compressible soils to stabilize under the weight of the new fill for as long as possible and reduce post-construction settlement.

Settlement sensitive utilities should be hung from the slab with hangers per “Standard Guide for Installing Plastic DMV Piping Suspended from On-Grade Slabs” (ASTM: F2536). Special backfilling requirements for utilities hung below slabs will need to be performed so as to not place excessive load on the pipes if general ground subsidence occurs. This can cause breakage of the pipes. Utilities that are not settlement sensitive can be supported conventionally. Additional attention will be needed where the utilities shift from the slab support to bearing in the existing soils as the site soils will settle. Please contact us for further recommendations as plans progress.

6.7 Building Grading – Driven Pipe Pile

One more option to consider is supporting the planned building on driven pipe pile, which would transfer loads through the soft soils into underlying weathered bedrock. We recommend using closed end steel piles for structural support of the building foundations, floor slabs, and critical exterior slabs and stoops. The piles should be concrete filled after driving. If you wish to consider this option, and can choose a piling contractor, please contact us and we will reach out to the piling contractor to see what type and size of pile may be most economical. We assume the pile will be driven to the bedrock to achieve higher capacities. Due to the potential compressibility of the fill, swamp deposits and softer soils, negative loads (down drag) will act on the piles and reduce the total capacity available for structural loads. Nearby buildings are supported by 10¾ inch pile with 0.365 wall thickness using 100 tons of available load for structural support and 20 tons of down drag. We understand this pipe size may not be as economical as others currently available.

Based on our borings, we estimate that the pile would be driven to about an 85 foot depth at B-1, an 81 foot depth at B-2, and an 85 foot depth at B-3. The final layout of the pipe pile would be determined by the structural engineer of record based on the load carrying capability of the pile chosen.

We recommend the lowest level floor slab be supported structurally on the driven pile. As discussed earlier in this report, placing new loads on the site soils will cause settlement. Since the building is planned to be structurally supported on driven pile, raising grade under the building will not cause settlement of the building itself but the soils below the structural slab will settle. Also, raising site grades outside the building could cause settlement of the surrounding sidewalks and underground utilities. The grading should be completed as soon as possible during construction to allow the compressible soils to stabilize under the weight of the new fill for as long as possible and reduce post-construction settlement.

Settlement sensitive utilities should be hung from the slab with hangers per “Standard Guide for Installing Plastic DMV Piping Suspended from On-Grade Slabs” (ASTM: F2536). Special backfilling requirements for utilities hung below slabs will need to be performed so as to not place excessive load on the pipes if general ground subsidence occurs. This can cause breakage of the pipes. Utilities that are not settlement sensitive can be supported conventionally. Additional attention will be needed where the utilities shift from the slab support to bearing in the native soils as the site soils will settle. Please contact us for further recommendations as plans progress.

6.8 Methane Vent System Below Floor Slabs

The project environmental consultant may recommend an active methane vent system because there are buried organic soils that upon decomposing can create methane gas. For the soil correction option and Ridged Inclusions ground improvement option the system can be designed to be supported on grade. Vent pipes are typically placed in a gravel bed below a vapor membrane which becomes the floor slab aggregate base. For the helical pile and driven pile options the vent system can include the gravel bed, or the vent system can make use of a designed void space below the structural slabs. The venting system will tend to dry the underlying soils. This must be considered in the design. The design of the methane venting system will be by the environmental consultant.

6.9 Moisture/Vapor Membranes Below Floor Slabs

The use of certain types of flooring (such as tile, carpet, etc.) may require the installation of a moisture/vapor membrane below the floor slabs. In areas where these types of flooring are used, a moisture/vapor membrane should be installed below them. For recommendations pertaining to moisture and vapor protection of interior floor slabs, we refer you to the standard sheet entitled "Floor Slab Moisture/Vapor Protection" at the end of this report. For warranty purposes, most floor covering manufacturers and installers may require the concrete be placed directly over the vapor membrane. Where the concrete is placed directly on the vapor barrier, care must be taken when curing the concrete to prevent slab curling. This could require altering the concrete mix design. The vapor membrane design should be incorporated into the menthane vent system design.

6.10 Exterior Building Backfilling

Many of the on-site soils near surface silty and clayey sands are at least moderately frost susceptible. Because of this, certain design considerations are needed to mitigate these frost effects. We recommend the sidewalks in front of fire doors and entrance doors be supported on stoops to prevent frost related movement of the slabs which could make the doors inoperable. The stoops would be supported by the ground improvement system or over the soils correction. For details, we refer you to the attached sheet entitled "Freezing Weather Effects on Building Construction." This sheet also discusses tapered transition zones with non-frost susceptible sand from stoops to adjacent sidewalks. This reduces the potential for differential heave that can create tripping hazards. As previously discussed, transitions for the building to grade supported features should be designed to accommodate differential movement. This can be flexible utility connections and structural hinge slabs transitioning from stoops.

6.11 Pavements

6.11.1 Subgrade Preparation

Because fill will be added over the site to establish final grades, the weight of this additional fill will cause settlement of the weaker fill, peat, and soft clay soils. This settlement could occur for several months to years, depending on how much new fill is added and will be ongoing after that to a reduced degree. To reduce the amounts of post-construction settlement in pavement areas (which will also affect underground utilities) we recommend final grades be established as soon as possible and construction of the pavements be delayed as long as possible. The amounts of settlement can be monitored by installing a series of settlement plates at strategic locations. The elevations of the settlement plates should be measured on a regular basis to monitor the amounts of settlement that has taken place, as well as to predict the amounts of future settlement that can be expected after construction. Some periodic grading of the aggregate surfacing and repaving of bituminous surfaces should be anticipated.

To prepare the pavement subgrades, we recommend removing all surficial vegetation and organic fill and any existing pavement. Any underlying soft or disturbed soils should also be removed and should be evaluated by AET geotechnical personnel. The soils exposed in the subgrade excavations are likely clayey soils. We recommend these soils be evaluated before any fill is placed. If soft or unstable soils are observed, then correction should be performed as needed by subcutting and replacing the inferior soils, or by in-place scarification, drying, and recompaction.

Following preparation and compaction of existing soils, fill can be placed as needed to re-attain subgrade elevation. We recommend using silty sands (SM) or clayey sands (SC), similar to the onsite soils to reduce the risk of differential frost heave in the pavement areas. Frozen soils should not be used as fill and new fill soils should not be placed over frozen subgrades. All existing fill soils should be placed/graded following MPCA Best Management Practices guidelines.

The excavations required to remove the inferior soils should extend beyond the pavement edges or the backs of the curbs at least 1-foot for each vertical foot of fill needed to establish subgrade elevations in order to provide support of lateral loads through the fill.

All fill should be placed and compacted per the requirements of MnDOT Specification 2105.3F1 (Specified Density Method). This specification requires soils placed within the upper 3 feet of the subgrade be compacted to a minimum of 100% of its standard Proctor maximum dry unit weight (as defined in ASTM: D698) at water contents of 65% to 102% of their respective optimum water contents. A reduced minimum compaction level of 95% can be used below the upper 3 feet of the subgrade zone.

6.11.2 Subgrade Stability and Test Roll

Subgrade stability within the upper 3 feet of the pavement subgrade is important for pavement support, construction, and performance. Stability of the subgrade soils should be evaluated using the test roll procedure before placement of the aggregate base layer. The test roll procedure should be conducted by having a loaded, tandem-axle dump truck make repeated passes over the soils at subgrade elevation. The test roll will help to delineate any unstable soils that will not be acceptable as pavement subgrade soils. These unstable soils should be removed and replaced; or aerated, dried and recompacted back into place as recommended by AET geotechnical personnel. After the subgrade soils pass a test roll procedure, the aggregate base can be placed and compacted.

6.11.3 Sand Subbase Layer

In our opinion, the pavement life and performance can be increased, and maintenance costs can be decreased, if a drained sand subbase layer is placed immediately below the aggregate base layer and pavements. The sand subbase provides a better pavement subgrade, improves aggregate base and upper subgrade drainage, reduces freeze-thaw affects, and provides more stability than the more cohesive soils which are at this site. Although initial costs may be higher, the sand subbase will extend pavement life while reducing maintenance issues. The sand subbase layer is usually at least 12 inches thick; however, a thicker sand subbase layer will provide more benefit, especially in heavy traffic areas or in heavy duty pavement zones.

If the sand subbase layer is incorporated into the pavement subgrade design, the materials should preferably consist of Modified Select Granular Borrow, meeting MnDOT Specification 3149.2B2 but modified to have no more than 6% of the particles (by weight) finer than the #200 sieve and no more than 50% of the particles (by weight) finer than the #40 sieve.

The sand subbase layer should be provided with a means of subsurface drainage to prevent build-up of water within the sand. This can be accomplished by placing short segments of properly engineered drainage lines (“finger drains”) which are connected to catch basins and/or manholes in low elevation areas. Where paved areas are relatively level, and if finger drains are not used, longer parallel drainage lines can be placed throughout the pavement areas or behind the curbs as edge drains, to remove any infiltrating water. The drainage pipes should be placed just below the bottom of the sand subbase layer, embedded in the sand or a drainage filter rock, and wrapped with geotextile fabric to prevent clogging. The top of the clayey soil layer should be graded and shaped to promote subsurface flow of the water to the drain tiles.

6.11.4 Estimated R-value

After completion of the subgrade preparation as presented above, and assuming the soils in the upper 3 feet of the subgrade will consist of well compacted silty sands or clayey sands, we estimate a subgrade R-value of 20 can be used for pavement design.

6.11.5 Section Thicknesses

We are presenting pavement designs based on two potential traffic situations (light and heavy duty) and two potential subgrade approaches (with and without a sand subbase). The light duty design refers to parking areas which are intended only for automobiles and passenger truck/vans. The heavy duty design is intended for drive lanes and pavements which will experience heavier truck traffic (9-ton to 10-ton design load). The recommended pavement thicknesses, based on an R-value of 20, are shown in Table 6.9.5 below:

Table 6.11.5 – Pavement Thickness Designs

Material	Section Thickness without Sand Subbase		Section Thickness with Sand Subbase	
	Light Duty	Heavy Duty	Light Duty	Heavy Duty
Bituminous Wear	2 inches	2 inches	1½ inches	2 inches
Bituminous Non-Wear	2 inches	3 inches	2 inches	2½ inches
Class 5 Aggregate Base*	6 inches	10 inches	6 inches	10 inches
Sand Subbase	0	0	12 inches	12 inches

*100% crushed aggregate

We recommend the non-wear layer be a mix meeting MnDOT SPWEB330-F using a 58V-34 oil, the wear course should meet MnDOT SPWEA330-F using a 58V-34 oil.

The above recommended section thicknesses should provide a minimum thickness of 3½ inches for light duty and 4½ inches for the heavy duty, accounting for industry placement methods and allowed tolerances of ¼ inch per lift. In our opinion, for long term performance, the pavement structure should not have less than the given minimum thicknesses.

Imported aggregate base should meet the gradation and quality requirements for Class 5, 5Q, or 6 per MnDOT Spec. 3138. The base can be crushed limestone or recycled material. Aggregate base placement and compaction should be performed according to MnDOT Spec. 2211. All aggregate base material should be tested for compaction using the Penetration Index Method per MnDOT Spec. 2211.3.D.2.c.

After the aggregate base course has been placed, compacted, and tested, it is the Contractor's responsibility to maintain the base in a suitable condition for paving. If the subgrade becomes saturated after testing, it may be rendered unsuitable for paving due to softness and instability. This would require remedial action before the pavement can be placed.

The bituminous materials should meet appropriate MnDOT 2360 specifications. The bituminous pavement materials should be compacted to the specified density. The use of Recycled Asphalt Products (RAP) is a cost saving measure that is often suggested, however there will be a higher probability of pavement thermal cracking when RAP is used. We recommend limiting RAP within the upper wear course to a maximum of 10% and in lower courses to a maximum of 20% to reduce thermal cracking.

Minimizing the number of mixes and binder oils (PG grades) used on a project is generally more economical. The use of an F-binder oil (PG 58V-34) in the wear layers will reduce rutting caused by turning movements, slow speeds, and starting/stopping traffic. It will also result in less thermal cracking of the pavement and subsequently less maintenance and better long-term pavement performance than mixes that have B-binder oil (PG 58S-28).

6.11.6 Bituminous Pavement Comments

The bituminous pavement sections given above would have an estimated life of 20 years. However, the Owner should not expect that the pavements would last 20 years without maintenance. Even if placed and compacted properly on stable subgrade conditions, bituminous pavements will likely experience cracking in 1 to 3 years, primarily due to temperature-related expansion and shrinkage. Each of the designs given above assumes that a regularly scheduled maintenance program consisting of patching cracks and repairing of locally distressed areas would be implemented. Seal coating of the pavement surface after 3 to 5 years often helps prolong pavement life.

The buried organic soils will likely settle at differing rates and amounts, as this stratum is not uniform in strength or thickness. This could create “birdbaths” or an uneven pavement surfaces which could disrupt drainage. The pavement should be designed with adequate slopes to promote drainage to catch basins and drains in the sand subbase. Periodic overlays may be required to maintain pavement drainage and proper sloping. Areas that area distressed should be repaired in a timely manner.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Potential Difficulties

7.1.1 Runoff Water in Excavation

Water can be expected to collect in the excavation bottom during times of inclement weather or snow melt. To allow observation of the excavation bottom, to reduce the potential for soil disturbance, and to facilitate filling operations, we recommend water be removed from within the excavation during construction. Based on the soils encountered, we anticipate the groundwater can be handled with conventional sump pumping.

7.1.2 Disturbance of Soils

The on-site soils can be disturbed under construction traffic, especially if the soils are wet. If soils become disturbed, they should be subcut to the underlying undisturbed soils. The subcut soils can then be dried and recompacted back into place, or they should be removed and replaced with drier imported fill.

7.2 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or sloughing which could require slope maintenance.

7.3 Observation and 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/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

8.0 ASTM STANDARDS

When we refer to an ASTM Standard in this report, we mean that our services were performed in general accordance with that standard. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

9.0 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.

Important information regarding risk management and proper use of this report is given in Appendix B entitled “Geotechnical Report Limitations and Guidelines for Use.”

FLOOR SLAB MOISTURE/VAPOR PROTECTION

Floor slab design relative to moisture/vapor protection should consider the type and location of two elements, a granular layer and a vapor membrane (vapor retarder, water resistant barrier or vapor barrier). In the following sections, the pros and cons of the possible options regarding these elements will be presented, such that you and your specifier can make an engineering decision based on the benefits and costs of the choices.

GRANULAR LAYER

In American Concrete Institute (ACI) 302.1R-15, a "base material" is recommended over the vapor membrane, rather than the conventional clean "sand cushion" material. The base layer should be a minimum of 4 inches (100 mm) thick, trimmable, compactable, granular fill (not sand), a so-called crusher-run material. Usually graded from 1½ inches to 2 inches (38 to 50 mm) down to rock dust is suitable. Following compaction, the surface can be choked off with a fine-grade material. We refer you to ACI 302.1R-15 for additional details regarding the requirements for the base material.

In cases where potential static water levels or significant perched water sources appear near or above the floor slab, an under floor drainage system may be needed wherein a draintile system is placed within a thicker clean sand or gravel layer. Such a system should be properly engineered depending on subgrade soil types and rate/head of water inflow.

VAPOR MEMBRANE

The need for a vapor membrane depends on whether the floor slab will have a vapor sensitive covering, will have vapor sensitive items stored on the slab, or if the space above the slab will be a humidity controlled area. If the project does not have this vapor sensitivity or moisture control need, placement of a vapor membrane may not be necessary. Your decision will then relate to whether to use the ACI base material or a conventional sand cushion layer. However, if any of the above sensitivity issues apply, placement of a vapor membrane is recommended. Some floor covering systems (adhesives and flooring materials) require installation of a vapor membrane to limit the slab moisture content as a condition of their warranty.

VAPOR MEMBRANE/GRANULAR LAYER PLACEMENT

A number of issues should be considered when deciding whether to place the vapor membrane above or below the granular layer. The benefits of placing the slab on a granular layer, with the vapor membrane placed **below** the granular layer, include **reduction** of the following:

- Slab curling during the curing and drying process.
- Time of bleeding, which allows for quicker finishing.
- Vapor membrane puncturing.
- Surface blistering or delamination caused by an extended bleeding period.
- Cracking caused by plastic or drying shrinkage.

The benefits of placing the vapor membrane over the granular layer include the following:

- A lower moisture emission rate is achieved faster.
- Eliminates a potential water reservoir within the granular layer above the membrane.
- Provides a "slip surface", thereby reducing slab restraint and the associated random cracking.

If a membrane is to be used in conjunction with a granular layer, the approach recommended depends on slab usage and the construction schedule. The vapor membrane should be placed above the granular layer when:

- Vapor sensitive floor covering systems are used or vapor sensitive items will be directly placed on the slab.
- The area will be humidity controlled, but the slab will be placed before the building is enclosed and sealed from rain.
- Required by a floor covering manufacturer's system warranty.

The vapor membrane should be placed below the granular layer when:

- Used in humidity controlled areas (without vapor sensitive coverings/stored items), with the roof membrane in place, and the building enclosed to the point where precipitation will not intrude into the slab area. Consideration should be given to slight sloping of the membrane to edges where draintile or other disposal methods can alleviate potential water sources, such as pipe or roof leaks, foundation wall damp proofing failure, fire sprinkler system activation, etc.

There may be cases where membrane placement may have a detrimental effect on the subgrade support system (e.g., expansive soils). In these cases, your decision will need to weigh the cost of subgrade options and the performance risks.

BASEMENT/RETAINING WALL BACKFILL AND WATER CONTROL

DRAINAGE

Below grade basements should include a perimeter backfill drainage system on the exterior side of the wall. The exception may be where basements lie within free draining sands where water will not perch in the backfill. Drainage systems should consist of perforated or slotted PVC drainage pipes located at the bottom of the backfill trench, lower than the interior floor grade. The drain pipe should be surrounded by properly graded filter rock. A geosynthetic "filter fabric" should then envelope the filter rock. The drain pipe should be connected to a suitable means of disposal, such as a sump basket or a gravity outfall. A storm sewer gravity outfall would be preferred over exterior daylighting, as the latter may freeze during winter. For non-building, exterior retaining walls, weep holes at the base of the wall can be substituted for a drain pipe.

BACKFILLING

Prior to backfilling, damp/water proofing should be applied on perimeter basement walls. The backfill materials placed against basement walls will exert lateral loadings. To reduce this loading by allowing for drainage, we recommend using free-draining sands for backfill. The zone of sand backfill should extend outward from the wall at least 2 feet, and then upward and outward from the wall at a 30° or greater angle from vertical. The free-draining sand backfill should contain no more than 40% by weight passing the #40 sieve and no greater than 5% by weight passing the #200 sieve. The sand backfill should be placed in lifts and compacted with portable compaction equipment. This compaction should be to the specified levels if slabs or pavements are placed above. Where slab/pavements are not above, we recommend capping the sand backfill with a layer of clayey soil to minimize surface water infiltration. Positive surface drainage away from the building should also be maintained. If surface capping or positive surface drainage cannot be maintained, then the trench should be filled with more permeable soils, such as the Fine Filter or Coarse Filter Aggregates defined in MnDOT Specification 3149. You should recognize that if the backfill soils are not properly compacted, settlements may occur which may affect surface drainage away from the building.

Backfilling with silty or clayey soil is possible but not preferred. These soils can build-up water which increases lateral pressures and results in wet wall conditions and possible water infiltration into the basement. If you elect to place silty or clayey soils as backfill, we recommend you place a prefabricated drainage composite against the wall which is hydraulically connected to a drainage pipe at the base of the backfill trench. High plasticity clays should be avoided as backfill due to their swelling potential.

LATERAL PRESSURES

Lateral earth pressures on below grade walls vary, depending on backfill soil classification, backfill compaction and slope of the backfill surface. Static or dynamic surcharge loads near the wall will also increase lateral wall pressure. For design, we recommend the following ultimate lateral earth pressure values (given in equivalent fluid pressure values) for a drained soil compacted to 95% of the Standard Proctor density and a level ground surface.

	Equivalent Fluid Density	
Soil Type	**Active (pcf)**	**At-Rest (pcf)**
Sands (SP or SP-SM)	35	60
Silty Sands (SM)	45	65
Fine Grained Soils (SC, CL or ML)	70	90

Basement walls are normally restrained at the top which restricts movement. In this case, the design lateral pressures should be the "at-rest" pressure situation. Retaining walls which are free to rotate or deflect should be designed using the active case. Lateral earth pressures will be significantly higher than that shown if the backfill soils are not drained and become saturated.

FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

GENERAL

Because water expands upon freezing and soils contain water, soils which are allowed to freeze will heave and lose density. Upon thawing, these soils will not regain their original strength and density. The extent of heave and density/strength loss depends on the soil type and moisture condition. Heave is greater in soils with higher percentages of fines (silts/clays). High silt content soils are most susceptible, due to their high capillary rise potential which can create ice lenses. Fine grained soils generally heave about 1/4" to 3/8" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs.

DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 40% by weight passing a #40 sieve and no more than 5% by weight passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded polystyrene insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

The possible effects of adfreezing should be considered if clayey or silty soils are used as backfill. Adfreezing occurs when backfill adheres to rough surfaced foundation walls and lifts the wall as it freezes and heaves. This occurrence is most common with masonry block walls, unheated or poorly heated building situations and clay backfill. The potential is also increased where backfill soils are poorly compacted and become saturated. The risk of adfreezing can be decreased by placing a low friction separating layer between the wall and backfill.

Adfreezing can occur on exterior piers (such as deck, fence, or other similar pier footings), even if a smooth surface is provided. This is more likely in poor drainage situations where soils become saturated. Additional footing embedment and/or widened footings below the frost zones (which include tensile reinforcement) can be used to resist uplift forces. Specific designs would require individual analysis.

CONSTRUCTION CONSIDERATIONS

Foundations, slabs and other improvements which may be affected by frost movements should be insulated from frost penetration during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement or compaction. This should be considered in the project scheduling, budgeting and quantity estimating. It is usually beneficial to perform cold weather earthwork operations in small areas where grade can be attained quickly rather than working larger areas where a greater amount of frost stripping may be needed. If slab subgrade areas freeze, we recommend the subgrade be thawed prior to floor slab placement. The frost action may also require reworking and recompaction of the thawed subgrade.

BITUMINOUS PAVEMENT SUBGRADE PREPARATION AND DESIGN

GENERAL

Bituminous pavements are considered layered “flexible” systems. Dynamic wheel loads transmit high local stresses through the bituminous/base onto the subgrade. Because of this, the upper portion of the subgrade requires high strength/stability to reduce deflection and fatigue of the bituminous/base system. The wheel load intensity dissipates through the subgrade such that the high level of soil stability is usually not needed below about 2 feet to 4 feet (depending on the anticipated traffic and underlying soil conditions). This is the primary reason for specifying a higher level of compaction within the upper subgrade zone versus the lower portion. Moderate compaction is usually desired below the upper critical zone, primarily to avoid settlements/sags of the roadway. However, if the soils present below the upper 3 feet subgrade zone are unstable, attempts to properly compact the upper 3 feet zone to the 100% level may be difficult or not possible. Therefore, control of moisture just below the 3 feet level may be needed to provide a non-yielding base upon which to compact the upper subgrade soils.

Long-term pavement performance is dependent on the soil subgrade drainage and frost characteristics. Poor to moderate draining soils tend to be susceptible to frost heave and subsequent weakening upon thaw. This condition can result in irregular frost movements and “pop-outs,” as well as an accelerated softening of the subgrade. Frost problems become more pronounced when the subgrade is layered with soils of varying permeability. In this situation, the free-draining soils provide a pathway and reservoir for water infiltration which exaggerates the movements. The placement of a well-drained sand subbase layer as the top of subgrade can minimize trapped water, smooth frost movements and significantly reduce subgrade softening. In wet, layered and/or poor drainage situations, the long-term performance gain should be significant. If a sand subbase is placed, we recommend it be a “Select Granular Borrow” which meets Mn/DOT Specification 3149.2B2.

PREPARATION

Subgrade preparation should include stripping surficial vegetation and organic soils; where the exposed soils are within the upper “critical” subgrade zone (generally 2 feet deep for “auto only” areas and 3 feet deep for “heavy duty” areas), they should be evaluated for stability. Excavation equipment may make such areas obvious due to deflection and rutting patterns. Final evaluation of soils within the critical subgrade zone should be done by test rolling with heavy rubber-tired construction equipment, such as a loaded dump truck. Soils which rut or deflect 1" or more under the test roll should be corrected by either subcutting or replacement; or by scarification, drying, and recompaction. Reworked soils and new fill should be compacted per the “Specified Density Method” outlined in Mn/DOT Specification 2105.3F1 (a minimum of 100% of Standard Proctor density in the upper 3 feet subgrade zone, and a minimum of 95% below this).

Subgrade preparation scheduling can be an important consideration. Fall and Spring seasons usually have unfavorable weather for soil drying. Stabilizing non-sand subgrades during these seasons may be difficult, and attempts often result in compromising the pavement quality. Where construction scheduling requires subgrade preparation during these times, the use of a sand subbase becomes even more beneficial for constructability reasons.

SUBGRADE DRAINAGE

If a sand subbase layer is used, it should be provided with a means of subsurface drainage to prevent water build-up. This can be in the form of draintile lines which dispose into storm sewer systems, or outlets into ditches. Where sand subbase layers include sufficient sloping and water can migrate to lower areas, draintile lines can be limited to finger drains at the catch basins. Even if a sand layer is not placed, strategically placed draintile lines can aid in improving pavement performance. This would be most important in areas where adjacent non-paved areas slope towards the pavement. Perimeter edge drains can aid in intercepting water which may infiltrate below the pavement.

Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations Site Plan
Figure 2 – Boring Locations Google Earth
Subsurface Boring Logs

Appendix A
Geotechnical Field Exploration and Testing
Report No. P-0019634

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling twelve (12) standard penetration test borings. The locations of the borings appear on Figures 1 and 2, preceding the Subsurface Boring Logs in this appendix.

A.2 SAMPLING METHODS

A.2.1 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-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches 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.

The most recent 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 inches. 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 deviation of the N-values using this method is significantly better than the standard ASTM Method.

A.2.2 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.

A.2.3 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.

Determining the thickness of "topsoil" layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

A.3 CLASSIFICATION METHODS

Soil descriptions 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 descriptions 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.

A.4 WATER LEVEL MEASUREMENTS

The groundwater 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.

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM: D2216 and AASHTO: T265.

A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 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	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]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[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]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[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 <0.75 Liquid limit – not dried	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 <0.75 Liquid limit – not dried	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]

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, soil 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.

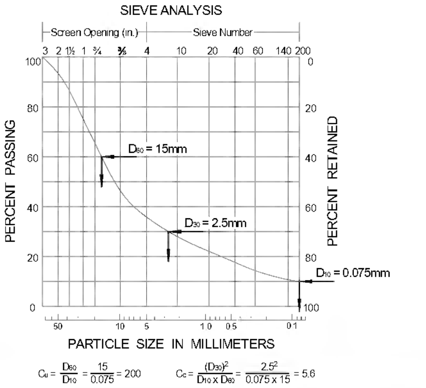
[N] PI≥4 and plots on or above "A" line.

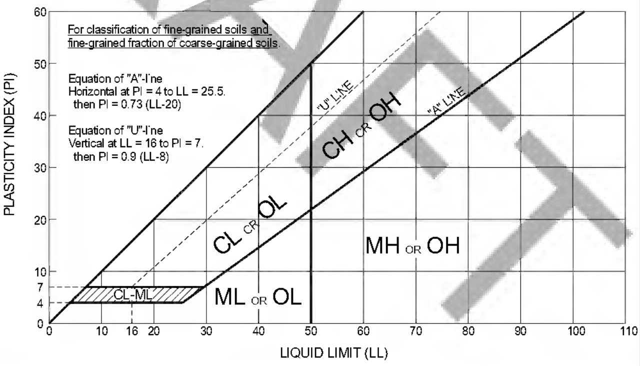
[O] PI<4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

[R] Fiber Content description shown below.





Plasticity Chart

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.

AMERICAN
ENGINEERING TESTING

Project:
Proposed Walser Wayzata Kia, 15700 Wayzata Boulevard, Wayzata, Minnesota

AET Report No.:
P-0019634

Subject: Soil Boring Locations

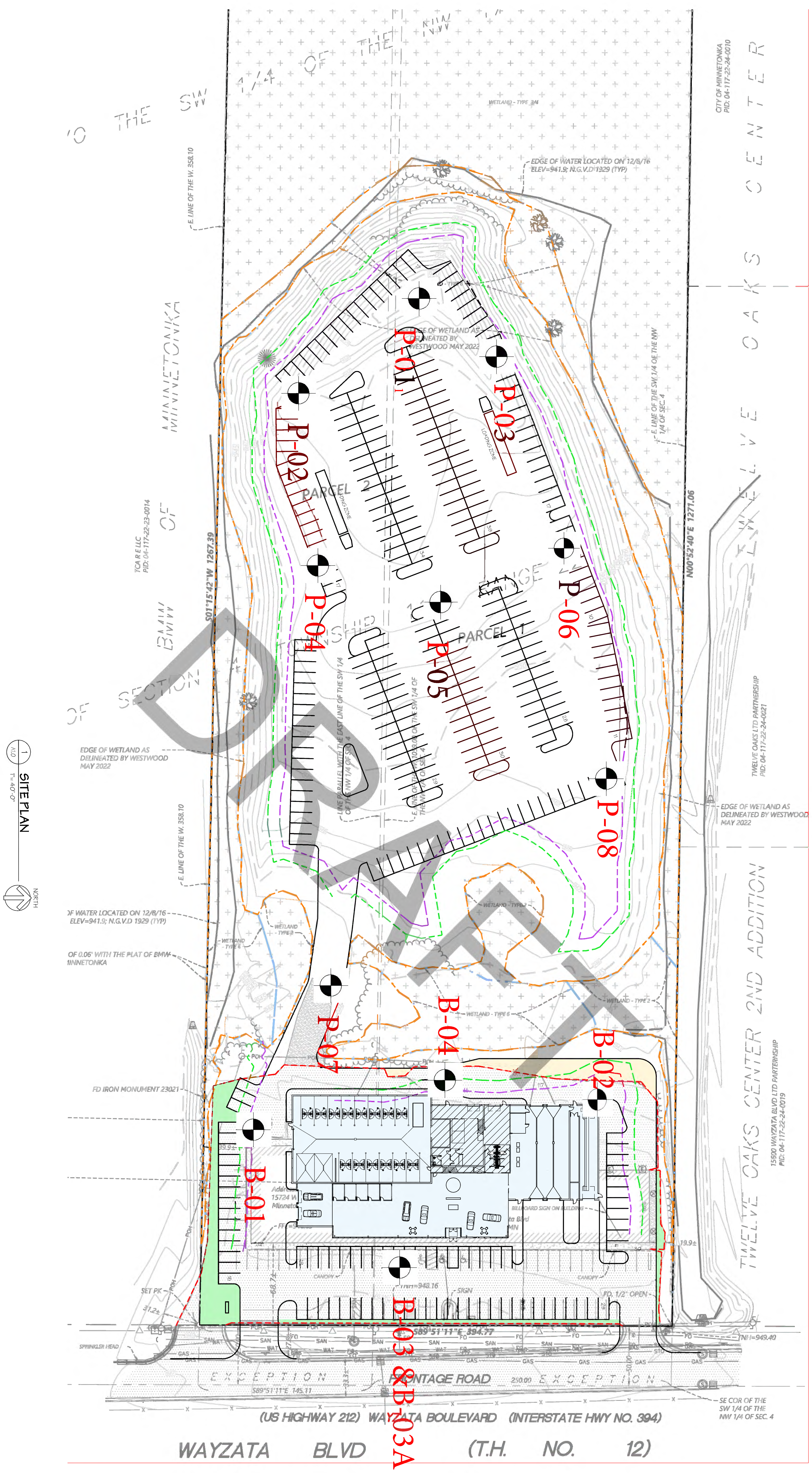
Date: 2/21/2023

Scale: Shown

Drawn By: Google Earth

Checked By: RF

Figure 2



PROPOSED NEW BUILDING FOR:

WALSER KIA

HIGHWAY 394
MINNETONKA, MINNESOTA

PHILLIPS ARCHITECTS & CONTRACTORS, LTD.

401 North Third Steet,
Suite 450
Minneapolis, MN 55401
Ph. (612) 868-1261
www.phillipsarchitects.com

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 ARCHITECT UNDER THE LAWS OF THE STATE OF MINNESOTA.

David A. Phillips

DATE LICENSE # 17387

ISSUE/REVISION:
2022 REVIEW

DRAWN BY:
CHECKED BY: DAP
PROJECT NO.:

PRELIMINARY
SITE PLAN

C

A1.0

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634** LOG OF BORING NO. **B-01 (p. 1 of 3)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **945.1** LATITUDE: **44.9718828** LONGITUDE: **-93.47805499**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	6.5" Bituminous	FILL									
1	FILL, mostly silty sand, a little gravel, brown, frozen			F			10				
2	FILL, mostly gravelly clayey sand, brown, frozen										
3				F/M	SS	24					
4	FILL, mostly silty sand, a little gravel, dark brown, frozen to 3'										
5	FILL, mostly sandy lean clay, a little sapric peat and gravel, gray and dark brown		9	▼ M	SS	18	27				
6											
7	SAPRIC PEAT, dark brown (PT)	SWAMP DEPOSIT									
8			4	M	SS	20	399				
9											
10							47				
11	LEAN CLAY, gray, soft, laminations of silt (CL)	FINE ALLUVIUM	4	M	SS	16	23				
12	SILTY SAND, a little gravel, gray, loose (SM)	MIXED ALLUVIUM									
13			6	M/W	SS	16					
14											
15	LEAN CLAY, gray, soft to firm, lenses and laminations of silty sand (CL)	FINE ALLUVIUM	4	W	SS	16	22				
16											
17											
18											
19											
20			6	W	SS	20	32				
21											
22											
23	CLAYEY SAND, a little gravel, gray, stiff (SC)	TILL									
24											
25			11	W	SS	16	15				
26											
27											
28											
29											
30			13	W	SS	1	24				
31											

DEPTH:	DRILLING METHOD
0-15'	**3.25" HSA**
15-89½'	**RD w/DM**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/27/23	**9:15**	**15.0**	**12.0**	**11.8**		**9.3**
1/27/23	**9:25**	**14.0**	**12.0**	**11.3**		**5.6**

BORING COMPLETED: **1/27/23**

DR: **RG** LG: **ZR** Rig: **41**

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

AET_CORP W-LAT-LONG P-0019634.GPJ AET+CPT+WELL.GDT 2/27/23

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634** LOG OF BORING NO. **B-01 (p. 2 of 3)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

LATITUDE: **44.9718828** LONGITUDE: **-93.47805499**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
33	CLAYEY SAND, a little gravel, gray, stiff (SC) *(continued)*	TILL *(continued)*									
34	SANDY LEAN CLAY, a little gravel, gray, stiff to very stiff (CL)										
35 36			12	W	SS	20	24				
37											
38											
39											
40 41			12	W	SS	22	27				
42											
43											
44											
45 46			16	W	SS	20	25				
47											
48											
49											
50 51			15	W	SS	22	24				
52											
53											
54											
55 56			17	W	SS	22					
57											
58											
59											
60 61			21	W	SS	12	25				
62											
63											
64											
65 66			19	W	SS	0					
67											
68 69	CLAYEY SAND, a little gravel, brownish gray, stiff to very stiff to fine (SC)										

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **B-01 (p. 3 of 3)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

LATITUDE: **44.9718828** LONGITUDE: **-93.47805499**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
71	CLAYEY SAND, a little gravel, brownish gray, stiff to very stiff to fine (SC) *(continuea)*		12	W	SS	24	17				
72											
73											
74											
75			23	W	SS	14	13				
76											
77											
78											
79											
80			5	W	SS	24	13				
81											
82											
83											
84	WEATHERED DOLOSTONE, brown and gray	PRAIRIE DU CHIEN GROUP SHAKOPEE FORMATION									
85			109	W	SS	10					
86											
87											
88											
89											
	END OF BORING Obstructed to split spoon at 89.6'		100/.01	W	SS	1					

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **B-02 (p. 1 of 3)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **946.2** LATITUDE: **44.97183461** LONGITUDE: **-93.47681831**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	5" Bituminous	FILL									
1	FILL, mostly silty sand with gravel, dark brown, frozen			F			18				
2											
3	FILL, mostly sandy lean clay, a little gravel, dark brown, frozen to 3'			F/M	SS	20	26				
4											
5	FILL, mostly sandy lean clay, a little gravel, gray		6	M	SS	14	28				
6											
7											
8			4	M	SS	10	17				
9	CLAYEY SAND, a little gravel, brown to gray, stiff to very stiff (SC)	TILL									
10			13	M	SS	22	13				
11											
12											
13			11	M	SS	18	14				
14				▼							
15			9	M	SS	12	17				
16											
17											
18			13	W	SS	16	19				
19											
20			14	W	SS	18	13				
21											
22											
23											
24											
25			15	W	SS	16	14				
26											
27											
28											
29											
30			14	W	SS	16	14				
31											

DEPTH:	DRILLING METHOD
0-19½'	3.25" HSA
19½-84½'	RD w/DM

BORING COMPLETED: 1/30/23

DR: **RG** LG: **ZR** Rig: **41**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/30/23	9:10	19.0	17.0	18.3		17.4
1/30/23	9:20	19.0	17.0	18.3		14.2

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

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **B-02 (p. 2 of 3)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

LATITUDE: **44.97183461**

LONGITUDE: **-93.47681831**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
33	CLAYEY SAND, a little gravel, brown to gray, stiff to very stiff (SC) *(continued)*	TILL *(continued)*									
34											
35			16	W	SS	18	17				
36											
37											
38											
39											
40			25	W	SS	0					
41											
42											
43											
44											
45			25	W	SS	0					
46											
47											
48											
49											
50			26	W	SS	16	18				
51											
52											
53											
54											
55			23	W	SS	20	21				
56											
57											
58	SANDY LEAN CLAY, a little gravel, gray, very stiff (CL)										
59											
60			24	W	SS	6	27				
61											
62											
63											
64											
65			30	M	SS	22	23				
66											
67											
68	CLAYEY SAND, a little gravel, gray, very stiff (SC)										
69											

AET_CORP W-LAT-LONG P-0019634.GPJ AET+CPT+WELL.GDT 2/27/23

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **B-02 (p. 3 of 3)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

LATITUDE: **44.97183461** LONGITUDE: **-93.47681831**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
71	CLAYEY SAND, a little gravel, gray, very stiff (SC) *(continuea)*		36	W	SS	18	15				
72											
73	SILTY SAND, a little gravel, brownish gray, dense, lenses and laminations of clayey sand (SM)										
74											
75			46	W	SS	14	12				
76											
77											
78											
79	WEATHERED DOLOSTONE, light brown and gray	PRAIRIE DU CHIEN GROUP SHAKOPEE FORMATION									
80			64	W	SS	12					
81											
82											
83											
84											
85			165	W	SS	18					
86											
	END OF BORING Obstructed to Split Spoon at 86.4'										

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**
LOG OF BORING NO. **B-03 (p. 1 of 2)**
PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**
SURFACE ELEVATION: **946.1** LATITUDE: **44.97159907** LONGITUDE: **-93.4773321**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
	5.5" Bituminous	FILL									
1	FILL, mostly silty sand with gravel, dark brown, frozen			F			14				
2											
3	FILL, mostly clayey sand, a little gravel, dark brown to gray, frozen to 2'		9	M	SS	18	15				
4											
5											
6			5	M	SS	18	17				
7											
8			6	M	SS	14	18 254				
9											
10	SAPRIC PEAT, dark brown (PT)	SWAMP DEPOSIT		▼							
11			5	M	SS	20	95				
12	CLAYEY SAND, a little gravel, gray, firm (SC)	TILL									
13			5	W	SS	22	18				
14											
15	SANDY LEAN CLAY, a little gravel, gray, firm to stiff (CL)										
16			8	W	SS	16	25				
17											
18											
19											
20											
21			8	W	SS	20	27				
22											
23											
24											
25											
26			10	W	SS	20	25				
27											
28											
29											
30											
31			9	W	SS	20	25				

DEPTH:	DRILLING METHOD
0-14½'	3.25" HSA
14½-37'	4.25" HSA

BORING COMPLETED: **1/31/23**

DR: **RG** LG: **ZR** Rig: **41**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/31/23	9:07	14.0	12.0	11.6		11.6
1/31/23	9:20	14.0	12.0	11.6		10.1

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

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **B-03 (p. 2 of 2)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

LATITUDE: **44.97159907** LONGITUDE: **-93.4773321**

DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
								WC	DEN	LL	PL	%-#200
33	SANDY LEAN CLAY, a little gravel, gray, firm to stiff (CL) *(continuea)*	▨										
34		▨										
35		▨		10	W	SS	20	23				
36		▨										
37	**END OF BORING** Obstructed to split spoon at 37'											

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634** LOG OF BORING NO. **B-03A (p. 1 of 3)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **946.1** LATITUDE: **44.97158646** LONGITUDE: **-93.47733436**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	No Samples from 0-39½;										
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											

DEPTH:	DRILLING METHOD
0-14½'	**3.25" HSA**
14½-89½'	**RD w/DM**

BORING COMPLETED: **2/1/23**

DR: **RG** LG: **ZR** Rig: **41**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/1/23						**None**

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

AET_CORP W-LAT-LONG P-0019634.GPJ AET+CPT+WELL.GDT 2/27/23

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634** LOG OF BORING NO. **B-03A (p. 2 of 3)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

LATITUDE: **44.97158646** LONGITUDE: **-93.47733436**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
	No Samples from 0-39½; *(continued)*										
33											
34											
35											
36											
37											
38											
39											
40	SANDY LEAN CLAY, a little gravel, gray, stiff to very stiff (CL)	TILL	13	W	SS	0					
41											
42											
43											
44											
45			20	W	SS	20	17				
46											
47											
48	CLAYEY SAND, a little gravel, gray to grayish-brown, very stiff to hard (SC)										
49											
50			20	W	SS	20	14				
51											
52											
53											
54											
55			23	W	SS	18	15				
56											
57											
58											
59											
60			25	W	SS	24	15				
61											
62											
63											
64											
65			24	W	SS	4	17				
66											
67											
68											
69											

AET_CORP W-LAT-LONG P-0019634.GPJ AET+CPT+WELL.GDT 2/27/23

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**
LOG OF BORING NO. **B-03A (p. 3 of 3)**
PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**
LATITUDE: **44.97158646** LONGITUDE: **-93.47733436**

DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
								WC	DEN	LL	PL	%-#200
	CLAYEY SAND, a little gravel, gray to grayish brown, very stiff to hard (SC) *(continued)*	▨		24	W	SS	4	13				
71		▨										
72		▨										
73	SILTY SAND, a little gravel, grayish brown, dense (SM)	⛆										
74												
75												
76				41	W	SS	12					
77												
78	CLAYEY SAND, a little gravel, brownish gray, very stiff (SC/SM)	▨										
79		▨										
80		▨										
81		▨		22	W	SS	16	12				
82		▨										
83		▨										
84		▨										
85		▨										
86	WEATHERED DOLOSTONE, brown and gray	▧	PRAIRIE DU CHIEN GROUP SHAKOPEE FORMATION	131	W	SS	10	16				
87		▧										
88		▧										
89		▧										
				100/.2	W	SS	2					
	END OF BORING Obstructed to split spoon at 89.7'											

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**
LOG OF BORING NO. **B-04 (p. 1 of 1)**
PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**
SURFACE ELEVATION: **945.2** LATITUDE: **44.97194572** LONGITUDE: **-93.47724777**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
	3.5" Bituminous	FILL									
1	FILL, mostly silty sand with gravel, dark brown, frozen			F			18				
3	FILL, mostly silty sand, a little gravel, brown to dark brown, frozen			F/M	SS	24	23				
4	FILL, mostly sandy lean clay, a little gravel, brownish gray										
6	FILL, mostly clayey sand, a little gravel, gray		9	M	SS	14	13				
8	HEMIC PEAT, dark brown (PT)	SWAMP DEPOSIT	5	M	SS	22	457				
10	SAPRIC PEAT, dark brown (PT)		3	M	SS	20	208				
12	SILTY SAND, a little gravel, gray, very loose, lenses and laminations of clayey sand (SM)	MIXED ALLUVIUM									
13	LEAN CLAY, gray, firm (CL)	FINE ALLUVIUM	8	W	SS	10	22				
15	SILTY SAND, a little gravel, gray, loose to very loose (SM)	MIXED ALLUVIUM	6	W	SS	20					
21			1	W	SS	20					
	END OF BORING										

DEPTH:	DRILLING METHOD
0-19½'	**3.25" HSA**

BORING COMPLETED: **1/31/23**

DR: **RG** LG: **ZR** Rig: **41**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/31/23	**1:30**	**14.0**	**12.0**	**12.8**		**9.5**
1/31/23	**1:40**	**14.0**	**12.0**	**10.9**		**5.9**
1/31/23	**1:33**	**21.5**	**19.5**	**16.3**		**8.5**

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

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**
LOG OF BORING NO. **P-01 (p. 1 of 1)**
PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**
SURFACE ELEVATION: **958.0**
LATITUDE: **44.97375086**
LONGITUDE: **-93.47752468**

DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
								WC	DEN	LL	PL	%-#200
1	FILL, mostly sandy lean clay, slightly organic, trace roots, dark brown		FILL	8	M	SS	12	33				
2 3 4	FILL, mostly clayey sand, a little gravel, trace roots, brown and dark brown			31	M	SS	16	7				
5 6				21	M	SS	14	10				
7 8 9	FILL, mixture of fat clay and sandy lean clay, a little gravel, brown			9	M	SS	12	18				
10 11	FILL, mixture of sandy lean clay and clayey sand, a little sand and gravel, brown, grayish brown and dark brown			13	M	SS	12	20				
12 13 14	SANDY LEAN CLAY, a little gravel, gray, a little brown, firm to stiff, laminations of silty sand (CL) (possible fill)	▨	TILL OR FILL	6	M	SS	16	19				
15 16 17 18 19		▨		13	M	SS	14	18				
20 21		▨		14	M	SS	14	14				
	END OF BORING											

DEPTH:	DRILLING METHOD
0-19½'	**3.25" HSA**

WATER LEVEL MEASUREMENTS						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/8/23	**12:00**	**21.5**	**19.5**	**21.2**		**None**

BORING COMPLETED: **2/8/23**

DR: **SD** LG: **RG** Rig: **69C**

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

AET_CORP W-LAT-LONG P-0019634.GPJ AET+CPT+WELL.GDT 2/27/23

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **P-02 (p. 1 of 1)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **953.0**

LATITUDE: **44.9735599**

LONGITUDE: **-93.47802046**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
1	FILL, mostly sandy lean clay, slightly organic, trace roots, dark brown	FILL	7	M	SS	12	33				
2											
3	FILL, mostly clayey sand, a little silty sand and gravel, trace roots, dark brown and brown		34	M	SS		11				
4											
5	FILL, mostly sandy lean clay, a little gravel, grayish brown to gray		15	M	SS	16	22				
6											
7											
8			10	M	SS	16	19				
9											
10			9	M	SS	16	22				
11											
12											
13	FILL, mostly clayey sand, a little gravel, ashes/cinders, gray and black		11	M	SS	16	16				
14											
15	FILL, mostly lean clay, a little sapric peat and gravel, gray, light brown and dark brown		8	▼ M	SS	14	23				
16											
17											
18	FILL, mostly sandy lean clay, a little gravel, pieces of wood, gray and dark brown		10	M	SS	22	24				
19											
20	FILL, mostly pieces of wood, brown			W	SS	4					

END OF BORING
OBSTRUCTED TO SPLIT SPOON AT 20'

DEPTH:	DRILLING METHOD
0-19½'	**3.25" HSA**

BORING COMPLETED: **2/8/23**

DR: **SD** LG: **RG** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/8/23	**10:50**	**20.0**	**19.5**	**19.2**		**15.8**

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

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **P-03 (p. 1 of 1)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **946.5** LATITUDE: **44.97369859** LONGITUDE: **-93.47715862**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
1 2	FILL, mostly clayey sand with organic fines, a little gravel, pieces of concrete, trace roots, dark brown	FILL	8	M	SS	10	19				
3 4	FILL, mostly clayey sand, a little gravel, trace roots, brown and dark brown		7	M ▼	SS	8	13				
5 6 7	FILL, mostly sandy lean clay, a little gravel, dark brown, brown, and gray		8	M	SS	8	19				
8 9			10	M	SS	14	17				
10 11	PIECES OF WOOD, dark brown (PT)	SWAMP DEPOSIT	10	W	SS	4					
12 13 14	HEMIC PEAT, dark brown (PT)		6	W	SS	2	161				
15 16			3	W	SS	0					
17 18 19	SAPRIC PEAT, black (PT)		4	W	SS	10	191				
20 21	ORGANIC CLAY, trace shells and roots, dark grayish brown, soft (OL/OH)		3	W	SS	8	111				
	END OF BORING										

DEPTH:	DRILLING METHOD
0-19½'	**3.25" HSA**

BORING COMPLETED: **2/8/23**

DR: **SD** LG: **RG** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/8/23	**1:00**	**11.5**	**9.5**	**9.5**		**4.1**
2/8/23	**1:05**	**11.5**	**9.5**	**9.5**		**3.9**
2/8/23	**1:10**	**21.5**	**19.5**	**17.5**		**9.5**

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

SUBSURFACE BORING LOG

AET JOB NO:	**P-0019634**	LOG OF BORING NO.	**P-04 (p. 1 of 1)**
PROJECT:	**Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**		

SURFACE ELEVATION: **946.8** LATITUDE: **44.97291368** LONGITUDE: **-93.4780169**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
1 2	FILL, mostly sandy lean clay, slightly organic, trace roots, dark brown	FILL	8	M	SS	12	36				
3 4	FILL, mostly sandy lean clay, a little gravel, trace roots, dark brown to grayish brown		12	M	SS	6	20				
5 6 7			11	M	SS	20	19				
8 9			5	M	SS	16	21				
10 11 12	FILL, mixture of lean clay and lean clay with sand and organic fines, trace roots, dark brown and gray		6	M	SS	16	42				
13 14	FILL, mostly sandy lean clay, slightly organic, trace shells and roots, a little gravel, dark brown		7	M	SS	8	51				
15 16 17			7	M	SS	6	33				
18 19			4	M	SS	4	25				
20 21	SAPRIC PEAT, trace shells, dark brown (PT)	SWAMP DEPOSIT	4	M	SS	22	118				
	END OF BORING										

DEPTH:	DRILLING METHOD
0-19½'	**3.25" HSA**

BORING COMPLETED: **2/8/23**

DR: **SD** LG: **RG** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/8/23	**9:20**	**21.5**	**19.5**	**19.3**		**None**

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

AET_CORP W-LAT-LONG P-0019634.GPJ AET+CPT+WELL.GDT 2/27/23

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **P-05 (p. 1 of 1)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **951.5** LATITUDE: **44.97288211** LONGITUDE: **-93.47748318**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1 2	FILL, mostly clayey sand, a little gravel, trace roots, brown and dark brown	FILL	9	M	SS	10	19				
3 4			21	M	SS	14	10				
5 6 7	FILL, mostly sandy lean clay, a little gravel, dark grayish brown and gray		11	M	SS	16	15				
8 9			8	M ▼	SS	18	15				
10 11			7	M	SS	14	15				
12 13 14	FILL, mostly clayey sand with organic fines, a little gravel, trace roots, dark brown and gray		17	M	SS	8	20				
15 16	FILL, mostly pieces of wood and metal, dark brown		15	W	SS	2					
17 18 19	SAPRIC PEAT, dark grayish brown (PT)	SWAMP DEPOSIT	7	W	SS	22	218				
20 21	ORGANIC CLAY, trace shells and roots, dark brownish gray, firm (OL/OH)		5	M	SS	18	81				
	END OF BORING										

DEPTH:	DRILLING METHOD
0-19½'	**3.25" HSA**

BORING COMPLETED: **2/9/23**

DR: **SD** LG: **RG** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/9/23	**8:30**	**16.5**	**14.5**	**14.4**		**9.0**
2/9/23	**8:40**	**16.5**	**14.5**	**14.4**		**9.0**
2/9/23	**8:52**	**21.5**	**19.5**	**19.1**		**15.0**

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

AET_CORP W-LAT-LONG P-0019634.GPJ AET+CPT+WELL.GDT 2/27/23

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634** LOG OF BORING NO. **P-06 (p. 1 of 1)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **950.9** LATITUDE: **44.97310334** LONGITUDE: **-93.47693819**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand with organic fines, trace roots, dark brown	FILL	8	M	SS	12	19				
2											
3	FILL, mostly clayey sand, a little gravel, trace roots, brown and gray		29	M	SS	18	10				
4											
5			11	M	SS	12	15				
6											
7											
8	FILL, mostly sandy lean clay, a little gravel, gray and brown		6	▼	SS	12	22				
9											
10			13	M	SS	18	19				
11											
12											
13	FILL, mostly lean clay with sand, pieces of wood, gray and dark brown		20	M	SS	16	25				
14											
15	FILL, mostly pieces of wood, grayish brown		13	W	SS	4					
16											
17											
18	SAPRIC PEAT, dark brown (PT)	SWAMP DEPOSIT	7	M	SS	24	198				
19											
20	ORGANIC CLAY, trace shells and roots, gray, soft, laminations of sand (OL/OH)		4	M	SS	18	77				
21											
	END OF BORING										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-19½'	**3.25" HSA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		2/9/23	**9:40**	**16.5**	**14.5**	**14.6**		**8.7**	
		2/9/23	**9:50**	**21.5**	**19.5**	**19.5**		**15.5**	
BORING COMPLETED: **2/9/23**									
DR: **SD** LG: **RG** Rig: **69C**									

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **P-07 (p. 1 of 1)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **944.9** LATITUDE: **44.97221294** LONGITUDE: **-93.47789173**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
1	FILL, mostly silty sand with gravel, trace roots, dark brown, frozen	FILL		F	SU						
2	FILL, mostly clayey sand, a little gravel, pieces of bituminous, gray and dark brown										
3			20	M	SS	18	16				
4				▼							
5	FILL, mostly sandy lean clay, a little gravel, gray and dark brown										
6			13	M	SS	6	22				
7											
8			18	M	SS	16	20				
9											
10	FILL, mostly clayey sand, a little silty sand and gravel, trace roots, pieces of wood, gray and dark brown										
11			18	M	SS	18	19				
12	HEMIC PEAT, dark brown (PT)	SWAMP DEPOSIT									
13			4	M	SS	14	449				
14											
15											
16			3	M	SS	18	357				
17											
18			2	M	SS	20	274				
19											
20	SAPRIC PEAT, dark brown (PT)										
21			2	M	SS	22	149				
	END OF BORING										

DEPTH:	DRILLING METHOD
0-19½'	**3.25" HSA**

WATER LEVEL MEASUREMENTS						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/9/23	**11:20**	**6.5**	**4.5**	**4.9**		**4.0**

BORING COMPLETED: **2/9/23**

DR: **SD** LG: **RG** Rig: **69C**

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

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0019634**

LOG OF BORING NO. **P-08 (p. 1 of 1)**

PROJECT: **Proposed Walser Wayzata Kia; 15700 Wayzata Boulevard; Wayzata, MN**

SURFACE ELEVATION: **949.0** LATITUDE: **44.97255681** LONGITUDE: **-93.47697636**

DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
								WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand, a little gravel, trace roots, brown and dark brown		FILL	7	M	SS	12	11				
2												
3				14	M	SS	12	10				
4												
5												
				6	M	SS	10	11				
6												
7	FILL, mostly sandy lean clay, a little gravel, pieces of wood, gray and brown											
8				24	M	SS	18	19				
9					▼							
10	FILL, mostly clayey sand with organic fines, a little gravel, trace roots, dark brown											
				6	W	SS	6	16				
11												
12	SAPRIC PEAT, dark brown (PT)		SWAMP DEPOSIT									
13				6	M	SS	18	386				
14												
15												
				5	M	SS	12	206				
16												
17												
18	SANDY LEAN CLAY, a little gravel, gray, soft (CL)	▨	TILL									
19												
20												
				3	M	SS	12	19				
21												
	END OF BORING											

DEPTH:	DRILLING METHOD
0-19½'	**3.25" HSA**

WATER LEVEL MEASUREMENTS						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/9/23	**10:35**	**11.5**	**9.5**	**9.5**		**9.4**
2/9/23	**10:50**	**29.5**	**19.5**	**19.2**		**Wet**

BORING COMPLETED: **2/9/23**

DR: **SD** LG: **RG** Rig: **69C**

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

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Report No. P-0019634

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by GBA[1], of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Understand the Geotechnical Engineering Services Provided for this Report

Geotechnical engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical engineering services is typically a geotechnical engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

B.2.2 Geotechnical Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client.

Likewise, geotechnical engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

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[1] Geoprofessional Business Association, 15800 Crabbs Branch Way Suite 300, Rockville, MD 20855
Telephone: 301/565-2733: www.geoprofessional.org, 2019

B.2.3 Read the Full Report

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. Read and refer to the report in full.

B.2.4 You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, always inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

B.2.5 Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

B.2.6 This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.

B.2.7 This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

B.2.8 Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical engineering report, along with any attachments or appendices, with your contract documents, but be certain to note conspicuously that you've included the material for information purposes only. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and be sure to allow enough time to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

B.2.9 Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.10 Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical engineering study. For that reason, a geotechnical engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated subsurface environmental problems have led to project failures. If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

B.2.11 Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. Geotechnical engineers are not building-envelope or mold specialists.