FIVE POINTS DEVELOPMENT

Legal Description:

LOTS 1 THRU 11 INCL, BLK B WARDROBES' ADDN & PT LANDS IN SE1/4 SEC 2 T6N R19E COM PNT ON 1/4 LI 8 CHAINS 55 LINKS (564.25') N OFCNTR RD BEING NW CORWARDROBE'S SIX ACRE LOT; E ALG N LI 6 CHAINS (396'); N 2 CHAINS 50 LINKS (165'); W AND PARA 6 CHAINS (396'); S 2 CHAINS 50 LINKS(165') TO BEG; EXCEPT V137 DEEDS P105 3.77 AC M/LV946 DEEDS P333

Section 2, Township 6 North, Range 19 East,
City of Waukesha, Waukesha County, Wisconsin

STORM WATER MANAGEMENT PLAN

November 12, 2018

Owner & Developer: Responsible for installing and maintaining stormwater.
Five Points Development, LLC
433 Oakland Avenue
Waukesha, WI 53186

Project Engineer:
JAHNKE & JAHNKE ASSOCIATES INC.
Paul Jenswold, P.E.
711 W. Moreland Blvd.
Waukesha, WI 53188-2479
Telephone: 262-542-5797
Fax: 262-542-7698
Email: pjenswold@jahnkeandjahnke.com

STORMWATER MANAGEMENT PLAN NARRATIVE

FIVE POINTS DEVELOPMENT
CITY OF WAUKESHA

Executive Summary:

Five Points Development LLC is proposing develop a 3.53 acre parcel in the City of Waukesha as a residential development with 18 single family lots. The parcel is known as 433 Oakland Avenue and was the home of the former Aeroshade factory. The factory has since been razed. The project is located within the Upper Fox River Watershed. The existing soils on the site are predominantly Hochheim Loam (Type D) per the NRCS soil survey. The land has been rezoned from M-1 to Rm-1 (Mixed Residential).

This analysis will demonstrate that between the two wet ponds, the site complies with the City's Storm Water Management Ordinance.

Design Criteria:

This development is required to meet all the requirements found within the City of Waukesha Storm Water Management Ordinance, and the Wisconsin Department of Natural Resources NR 151 and NR 216.

Peak Flow Reduction: The site was analyzed for peak flow reduction under City of Waukesha Storm Water Management Ordinance in which the 100-year, 10-year and 2-year post-development runoff rates from site shall not exceed the corresponding pre-development rates.

Total Suspended Solids: This site is classified as partly redevelopment and partly new development. Prorating the TSS removal percentages yields a TSS removal target of 58% to satisfy Wisconsin NR 151 and the City's requirements.

Infiltration: The City's Storm Water Ordinance calls for the maximum extent practical to a maximum of 1% of the site or 90% of the pre-development infiltration volume.

Existing Conditions:

The site is 3.53 acres and was the home of the former Aeroshade factory. The factory was razed last year as part of this redevelopment. For modeling purposes, the existing site includes factory and parking lot. The existing soils on the site are predominantly Hochheim Loam (Type D) per the NRCS soil survey, which is reflected in the curve numbers used.

Post-Development Conditions:

The site is to be redeveloped as a residential subdivision with 18 residential lots. The site generally slopes to the railroad right-of-way to the north. An infiltration trench has been located in an outlot in the backyard swale before the water is released into the railroad right-of-way.

Soils Investigation:

Soil borings were conducted in July of 2017. Borings 1 and 2 near the infiltration trench show that the site is built on a sand / gravel mix. Giles gave these sand / gravel layers infiltration rates between 0.50 and 3.00 in/hr. The soils investigation report by Giles can be found in the Appendix.

Analysis Methods:

HydroCAD (Version 10.0) software has been used to analyze stormwater characteristics for this stormwater management plan. HydroCAD uses the accepted TR-55 methodology for determining peak discharge runoff rates. Rainfall depths for the 2-year through 100-year storm events are listed in the summary tables below.

The pre-development release rates are as follows:

Pre-Development Release Rates	
Recurrence Interval	Q, cfs
2-yr	6.71
10-yr	11.74
100-yr	18.07

The post-development release rates are as follows:

Post-Development Release Rates	
Recurrence Interval	Q, cfs
2-yr	6.14
10-yr	11.44
100-yr	17.80

Runoff Water Quality:

Post-developed water quality is obtained using an infiltration trench and grassy swales. The development has a mix of redevelopment and new development. Prorating the minimum TSS removal yields a target of 58% TSS removal.

1.94 ac * 40% + 1.61 ac * 80% / 3.55 ac = 58%

WinSLAMM (Version 10.3.4) was used for the analysis. By the combined effect of these control factors, 58% reduction was achieved.

Sediment Load Reduction				
Area	Area (AC)	Sediment Load (LB)	Sediment Discharge (LB)	Sediment Reduction
Modeled Area	3.564	174.2	82.70	60.03%

Infiltration:

Given that Giles found several layers of a sand/gravel mix near the surface at the north end of the site and that the ground water is about 12 feet down, the north end of is a viable location for an infiltration device. The infiltration rates in these sand/gravel layers vary between 0.50 and 3.00 in/hr.

Total infiltration volume based on an average annual rainfall for the existing site is 330874 cf and the infiltration volume for the proposed site is 375313 cf, or 113% of the existing infiltration volume. The increase in infiltration should not come as a surprise given that the existing site and the proposed site have about the same amount of impervious surface but the proposed site has an infiltration trench.

Pretreatment:

Runoff will flow through grassy swales in route to the infiltration trench which will provide an opportunity for sediment to settle out prior to entering the trench.

100-Year Flood in Railroad Right-of-Way:

A HydroCad model of the railroad right-of-way drainage has been completed and used to determine the 100-Year flood elevation along the drainage way. The model shows that after the grading improvements are complete, the 100-Year flood elevation will be 69.31, which stays within the railroad right-of-way. The HydroCad output can be found in the Appendix.

Installation Schedule of Stormwater Management Practices:

The infiltration trench will be installed early in the construction sequence and protected with sediment log.

Maintenance Plan and Cost Estimate

Infiltration Trench

The infiltration trench is relatively maintenance free. There will be the occasional wash out, silt build up, or shrub removal that will need to take place. It is estimated that one or more of these items will need to be address every 5 years at a present day cost of about $500. The stone media will need to be replaced completely if the trench as a whole silts up and stops draining. It is estimated that this will need to be done once every 20 years at a present day cost of about $2,000.

Grassy Swales

The Grassy Swales used in the WinSLAMM model are along property lines and will be part of home owner's yards. Maintenance beyond what the home owner does should be almost non-existent.

Well Head Protection:

There are no wells in the area.

Conclusion:

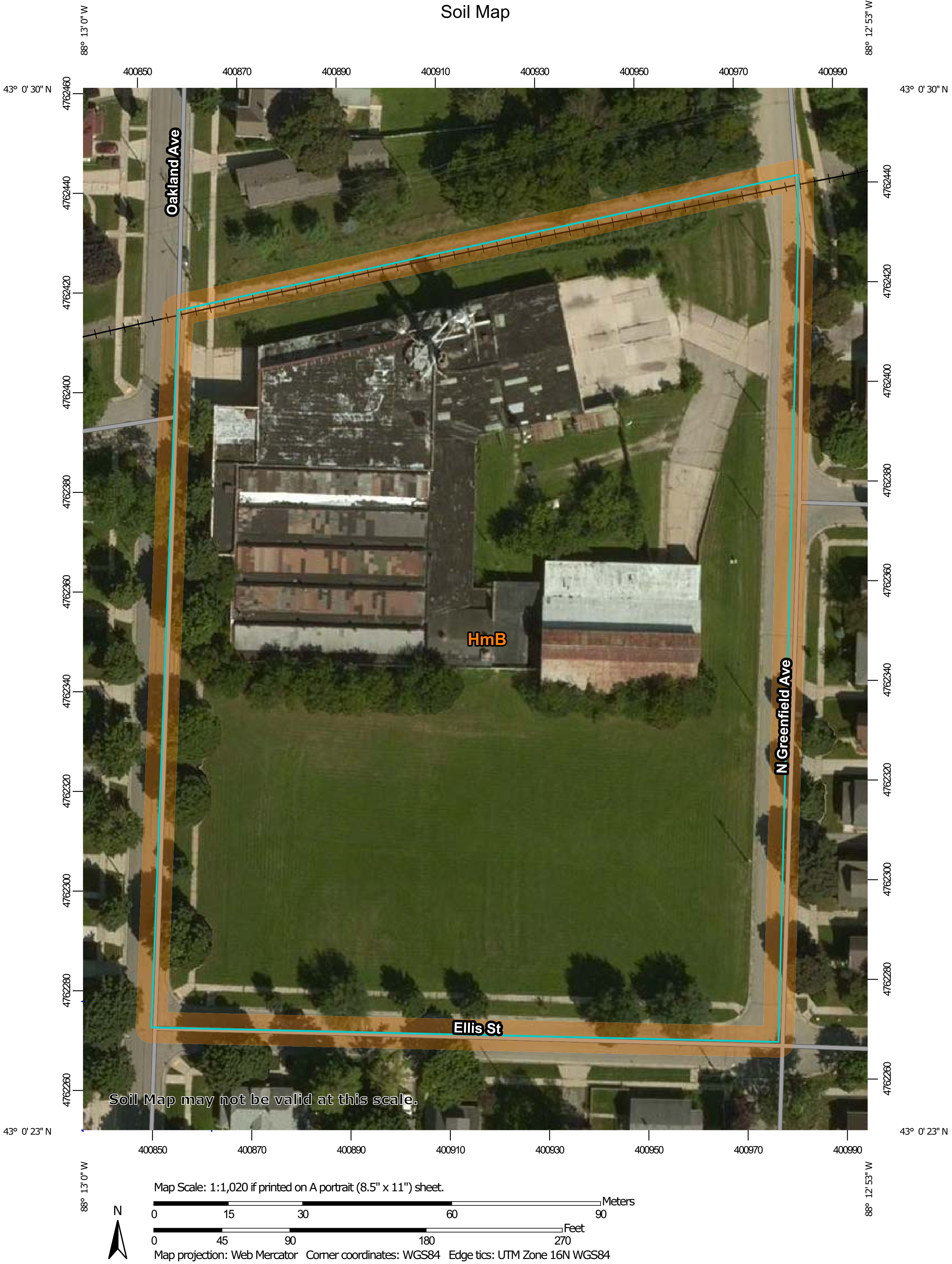
The storm water management features for the development have been designed to comply with the storm water goals set forth by the Wisconsin Department of Natural Resources and the City of Waukesha.

APPENDIX A

SOIL MAP

Custom Soil Resource Report

Soil Map

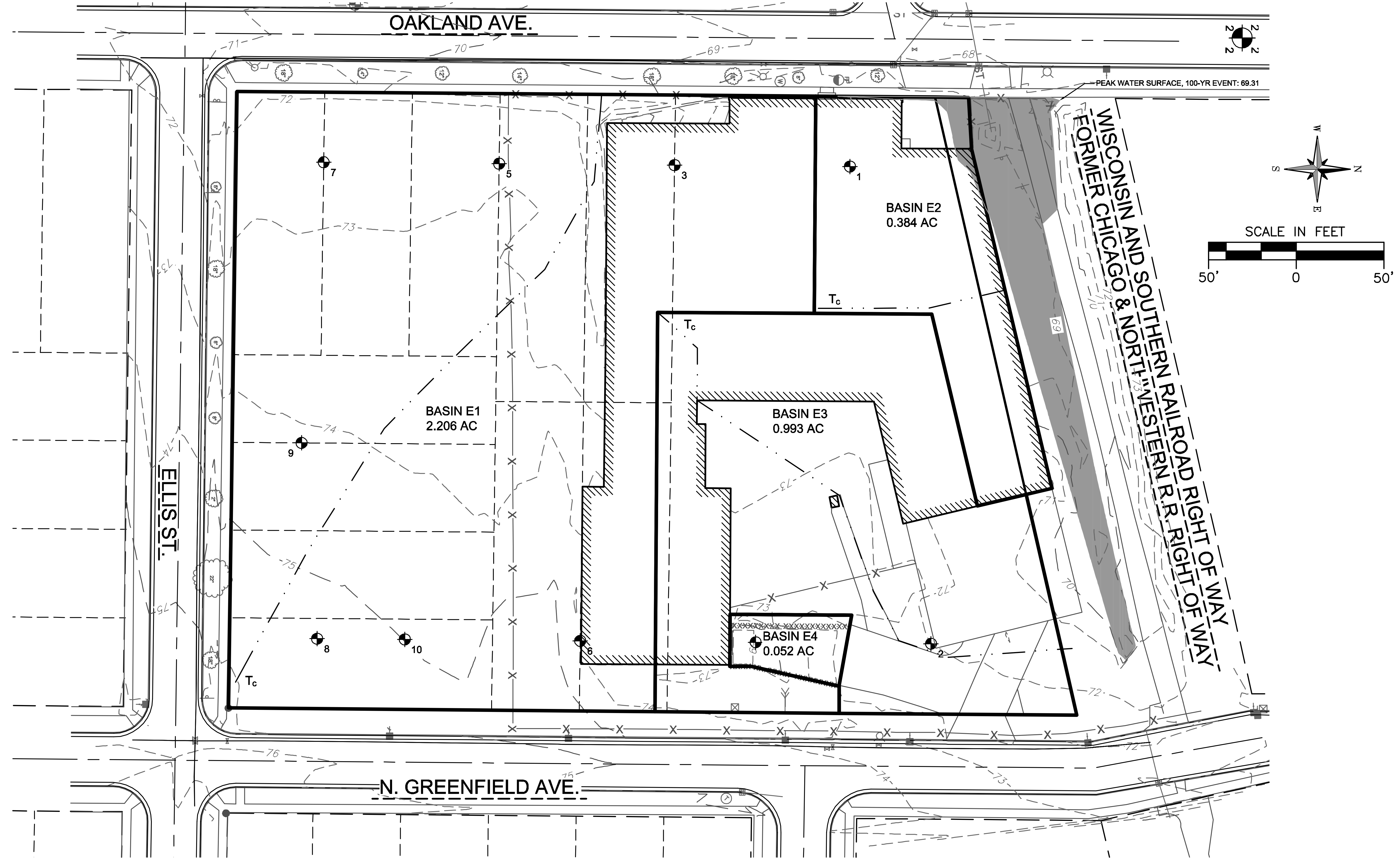


Map Scale: 1:1,020 if printed on A portrait (8.5" x 11") sheet.

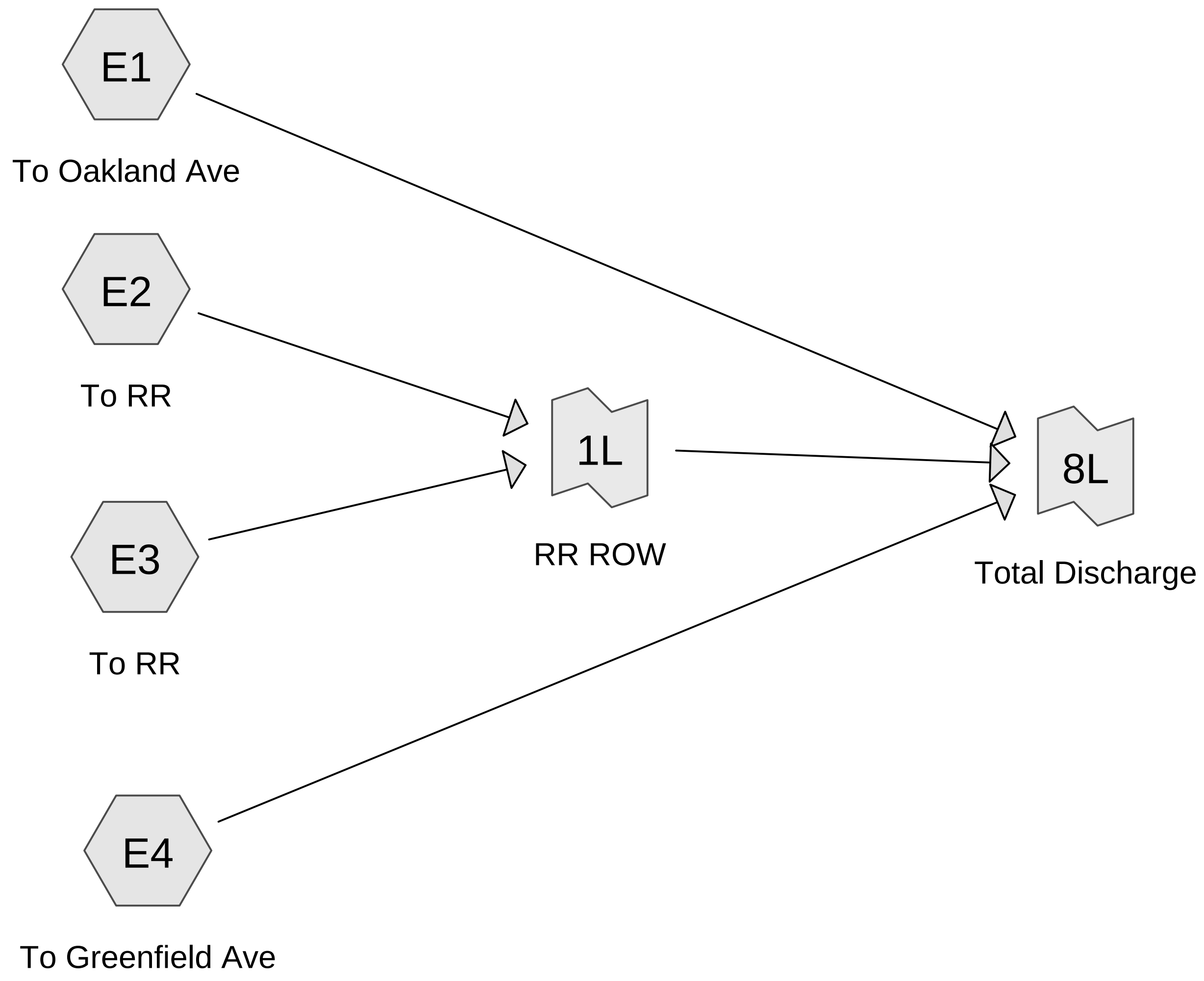
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

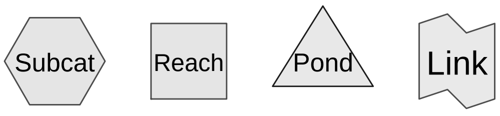
APPENDIX B

PRE-DEVELOPMENT FLOW DATA



EXISTING CONDITIONS
DRAINAGE MAP





Routing Diagram for S-8525 Aeroshade Existing Conditions
Prepared by Microsoft, Printed 10/24/2018

Summary for Subcatchment E1: To Oakland Ave

Runoff = 3.65 cfs @ 12.07 hrs, Volume= 0.234 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (ac)	CN	Description
	1.728	80	>75% Grass cover, Good, HSG D
*	0.478	98	Roof
	2.206	84	Weighted Average
	1.728		78.33% Pervious Area
	0.478		21.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0150	0.14		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
2.9	308	0.0140	1.77		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
14.9	408	Total			

Summary for Subcatchment E2: To RR

```
Runoff      =          1.46 cfs @   11.97 hrs,  Volume=           0.079 af,  Depth=  2.47"
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (ac)	CN	Description
*	0.384	98	
	0.384		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Roof (min. Tc)**

Summary for Subcatchment E3: To RR

Runoff = 2.25 cfs @ 12.07 hrs, Volume= 0.148 af, Depth= 1.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (sf)	CN	Description
	15,984	80	>75% Grass cover, Good, HSG D
*	27,250	98	Roof & pavement
	43,234	91	Weighted Average
	15,984		36.97% Pervious Area
	27,250		63.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	100	0.0100	0.12		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
0.8	112	0.0125	2.27		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	60	0.0100	2.03		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
15.4	272	Total			

Summary for Subcatchment E4: To Greenfield Ave

Runoff = 0.20 cfs @ 11.97 hrs, Volume= 0.011 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (sf)	CN	Description
*	2,265	98	
	2,265		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Dock (min. Tc)**

Summary for Link 1L: RR ROW

```
Inflow Area =          1.377 ac,  73.34% Impervious,  Inflow Depth =   1.98"    for  2-Yr event
Inflow       =         3.22 cfs @   12.00 hrs,  Volume=            0.227 af
Primary      =         3.22 cfs @   12.00 hrs,  Volume=            0.227 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Link 8L: Total Discharge

```
Inflow Area =      3.635 ac,  42.36% Impervious,  Inflow Depth =   1.56"    for  2-Yr event
Inflow      =       6.71 cfs @   12.04 hrs,  Volume=          0.472 af
Primary     =       6.71 cfs @   12.04 hrs,  Volume=          0.472 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1: To Oakland Ave

Runoff = 6.79 cfs @ 12.07 hrs, Volume= 0.436 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (ac)	CN	Description
	1.728	80	>75% Grass cover, Good, HSG D
*	0.478	98	Roof
	2.206	84	Weighted Average
	1.728		78.33% Pervious Area
	0.478		21.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0150	0.14		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
2.9	308	0.0140	1.77		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
14.9	408	Total			

Summary for Subcatchment E2: To RR

Runoff = 2.18 cfs @ 11.97 hrs, Volume= 0.120 af, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (ac)	CN	Description
*	0.384	98	
	0.384		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Roof (min. Tc)**

Summary for Subcatchment E3: To RR

Runoff = 3.71 cfs @ 12.07 hrs, Volume= 0.250 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (sf)	CN	Description
	15,984	80	>75% Grass cover, Good, HSG D
*	27,250	98	Roof & pavement
	43,234	91	Weighted Average
	15,984		36.97% Pervious Area
	27,250		63.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	100	0.0100	0.12		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
0.8	112	0.0125	2.27		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	60	0.0100	2.03		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
15.4	272	Total			

Summary for Subcatchment E4: To Greenfield Ave

Runoff = 0.30 cfs @ 11.97 hrs, Volume= 0.016 af, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (sf)	CN	Description
*	2,265	98	
	2,265		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Dock (min. Tc)**

Summary for Link 1L: RR ROW

```
Inflow Area =        1.377 ac, 73.34% Impervious, Inflow Depth =   3.23"    for 10-Yr event
Inflow      =        5.15 cfs @  12.01 hrs, Volume=          0.370 af
Primary     =        5.15 cfs @  12.01 hrs, Volume=          0.370 af, Atten= 0%, Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Link 8L: Total Discharge

```
Inflow Area =         3.635 ac,  42.36% Impervious,  Inflow Depth =   2.71"    for  10-Yr event
Inflow      =        11.74 cfs @   12.04 hrs,  Volume=            0.822 af
Primary     =        11.74 cfs @   12.04 hrs,  Volume=            0.822 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1: To Oakland Ave

Runoff = 10.81 cfs @ 12.07 hrs, Volume= 0.703 af, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (ac)	CN	Description
	1.728	80	>75% Grass cover, Good, HSG D
*	0.478	98	Roof
	2.206	84	Weighted Average
	1.728		78.33% Pervious Area
	0.478		21.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0150	0.14		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
2.9	308	0.0140	1.77		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
14.9	408	Total			

Summary for Subcatchment E2: To RR

Runoff = 3.06 cfs @ 11.97 hrs, Volume= 0.172 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (ac)	CN	Description
*	0.384	98	
	0.384		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Roof (min. Tc)**

Summary for Subcatchment E3: To RR

Runoff = 5.49 cfs @ 12.07 hrs, Volume= 0.378 af, Depth= 4.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (sf)	CN	Description
	15,984	80	>75% Grass cover, Good, HSG D
*	27,250	98	Roof & pavement
	43,234	91	Weighted Average
	15,984		36.97% Pervious Area
	27,250		63.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	100	0.0100	0.12		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
0.8	112	0.0125	2.27		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.5	60	0.0100	2.03		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
15.4	272	Total			

Summary for Subcatchment E4: To Greenfield Ave

Runoff = 0.41 cfs @ 11.97 hrs, Volume= 0.023 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (sf)	CN	Description
*	2,265	98	
	2,265		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Dock (min. Tc)**

Summary for Link 1L: RR ROW

```
Inflow Area =       1.377 ac,  73.34% Impervious,  Inflow Depth >   4.79"    for  100-Yr event
Inflow      =       7.52 cfs @   12.01 hrs,  Volume=          0.549 af
Primary     =       7.52 cfs @   12.01 hrs,  Volume=          0.549 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

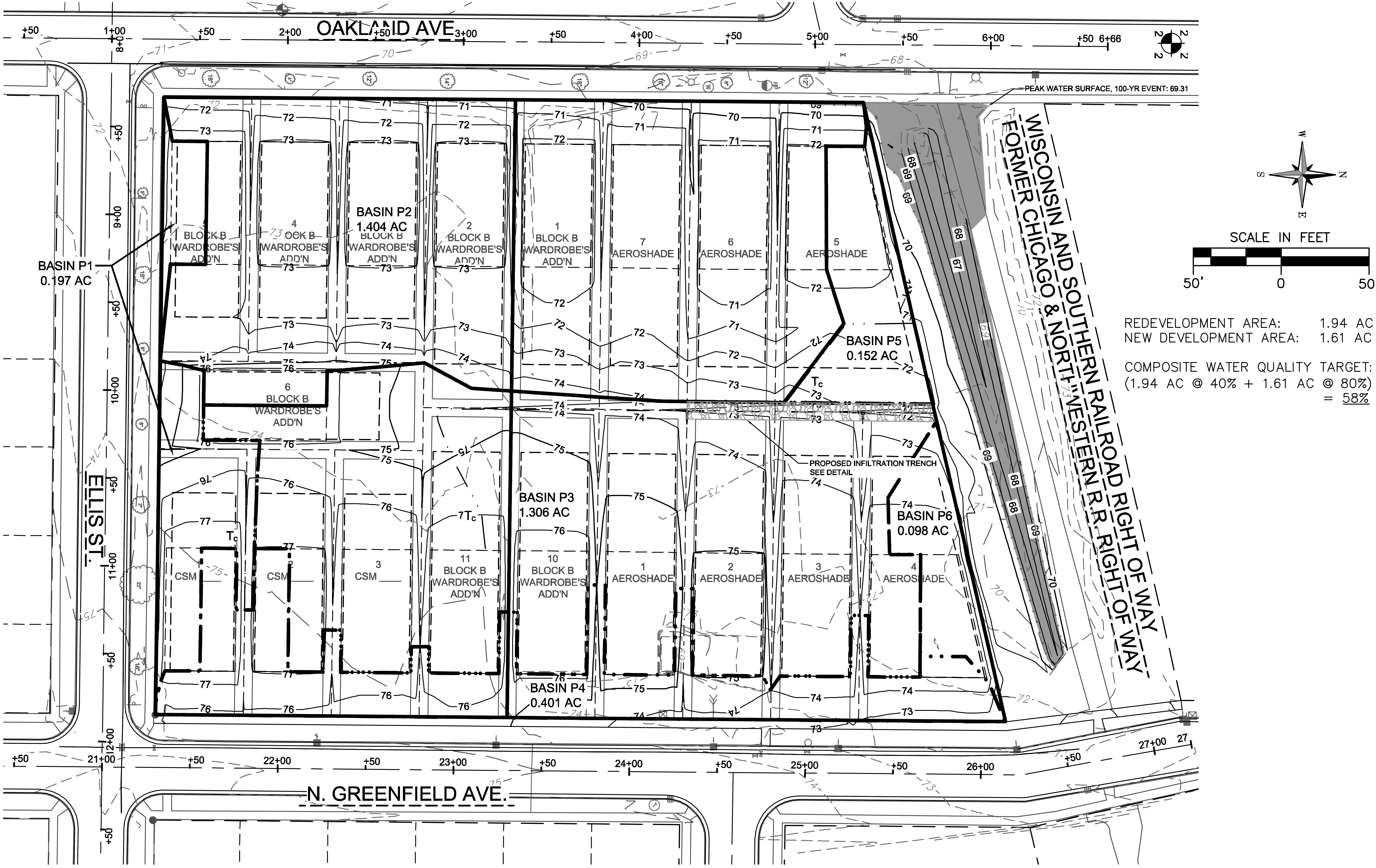
Summary for Link 8L: Total Discharge

```
Inflow Area =          3.635 ac,  42.36% Impervious,  Inflow Depth >   4.21"    for  100-Yr event
Inflow       =        18.07 cfs @   12.04 hrs,  Volume=            1.275 af
Primary      =        18.07 cfs @   12.04 hrs,  Volume=            1.275 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

APPENDIX C

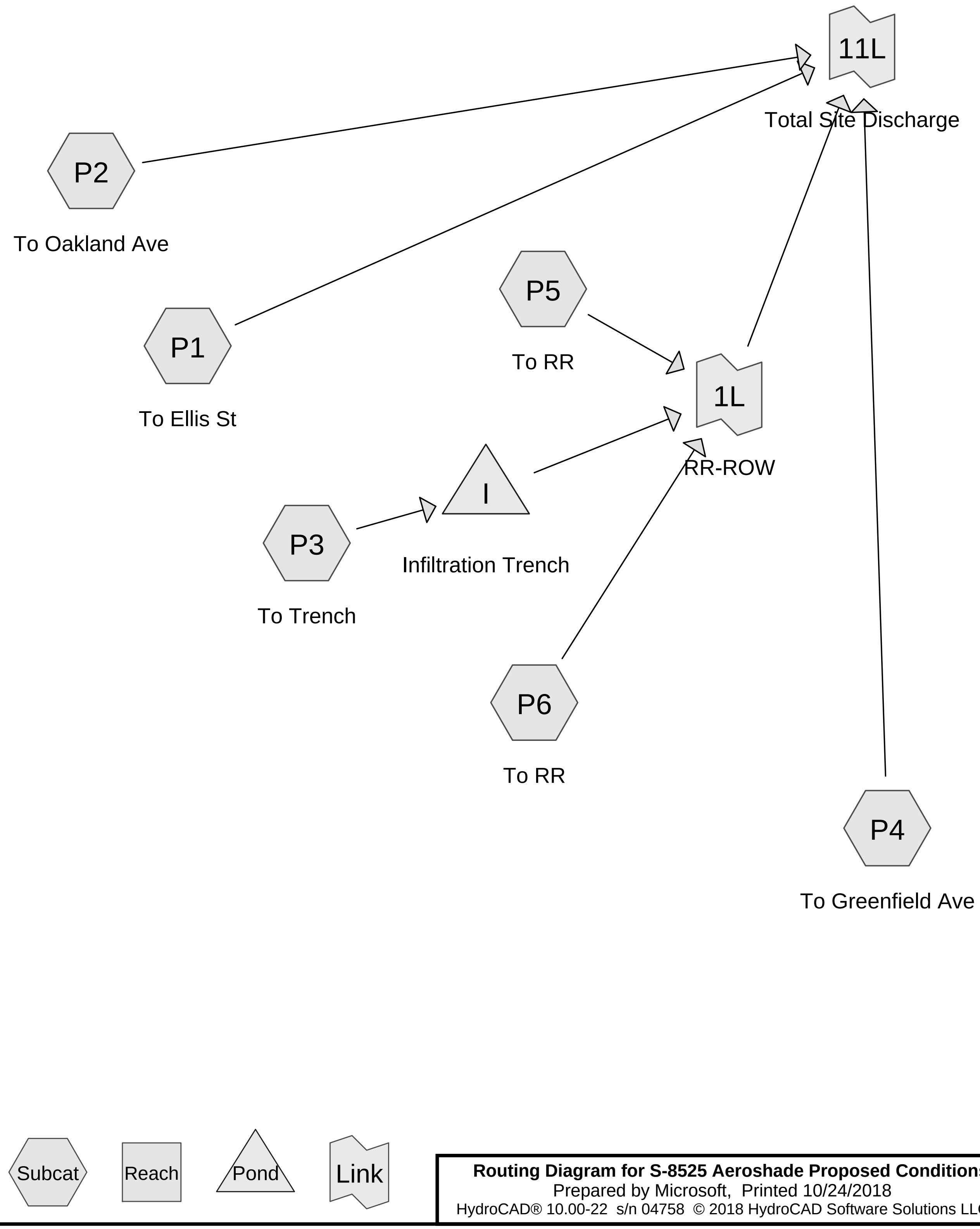
POST-DEVELOPMENT FLOW DATA



REDEVELOPMENT AREA: 1.94 AC
NEW DEVELOPMENT AREA: 1.61 AC

COMPOSITE WATER QUALITY TARGET:
(1.94 AC @ 40% + 1.61 AC @ 80%)
= 58%

PROPOSED CONDITIONS
DRAINAGE MAP



Routing Diagram for S-8525 Aeroshade Proposed Conditions
Prepared by Microsoft, Printed 10/24/2018
HydroCAD® 10.00-22 s/n 04758 © 2018 HydroCAD Software Solutions LLC

Summary for Subcatchment P1: To Ellis St

Runoff = 0.34 cfs @ 12.11 hrs, Volume= 0.024 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (sf)	CN	Description
	5,449	80	>75% Grass cover, Good, HSG D
*	1,300	98	Houses
*	400	98	Garages
*	1,440	98	Driveways
	8,589	87	Weighted Average
	5,449		63.44% Pervious Area
	3,140		36.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	91	0.0110	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	50	0.0220	2.39		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
18.6	141	Total			

Summary for Subcatchment P2: To Oakland Ave

Runoff = 3.08 cfs @ 12.04 hrs, Volume= 0.182 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (sf)	CN	Description
	35,514	80	>75% Grass cover, Good, HSG D
*	9,750	98	Houses
*	3,200	98	Garages
*	12,672	98	Driveways
	61,136	88	Weighted Average
	35,514		58.09% Pervious Area
	25,622		41.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	60	0.0160	0.09		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
1.1	125	0.0100	1.90	0.95	**Channel Flow, B-C** Area= 0.5 sf Perim= 2.1' r= 0.24' n= 0.030 Short grass
12.4	185	Total			

Summary for Subcatchment P3: To Trench

Runoff = 2.32 cfs @ 12.08 hrs, Volume= 0.153 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (sf)	CN	Description
	36,634	80	>75% Grass cover, Good, HSG D
*	9,750	98	Houses
*	3,600	98	Garages
*	6,912	98	Driveways
	56,896	86	Weighted Average
	36,634		64.39% Pervious Area
	20,262		35.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	85	0.0240	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
3.1	290	0.0100	1.56	0.94	**Channel Flow, C-D** Area= 0.6 sf Perim= 3.4' r= 0.18' n= 0.030
15.8	375	Total			

Summary for Subcatchment P4: To Greenfield Ave

Runoff = 1.01 cfs @ 11.97 hrs, Volume= 0.047 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (sf)	CN	Description
	11,278	80	>75% Grass cover, Good, HSG D
*	1,300	98	Houses
*	0	98	Garages
*	4,896	98	Driveways
	17,474	86	Weighted Average
	11,278		64.54% Pervious Area
	6,196		35.46% Impervious Area

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

Summary for Subcatchment P5: To RR

Runoff = 0.23 cfs @ 12.07 hrs, Volume= 0.015 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Yr Rainfall=2.70"

	Area (sf)	CN	Description
	5,959	80	>75% Grass cover, Good, HSG D
*	650	98	Houses
*	0	98	Garages
	6,609	82	Weighted Average
	5,959		90.16% Pervious Area
	650		9.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	100	0.0240	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"

Summary for Subcatchment P6: To RR

```
Runoff       =        0.21 cfs @   11.98 hrs,  Volume=          0.010 af,  Depth=  1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr  2-Yr Rainfall=2.70"

      Area (sf)   CN   Description
      3,620   80   >75% Grass cover, Good, HSG D
*       650   98   Houses
*         0   98   Garages
      4,270   83   Weighted Average
      3,620        84.78% Pervious Area
        650        15.22% Impervious Area

    Tc  Length   Slope  Velocity  Capacity  Description
 (min)  (feet)  (ft/ft)  (ft/sec)     (cfs)
   6.0                                       Direct Entry, Min. Tc
```

Summary for Pond I: Infiltration Trench

Inflow Area = 1.306 ac, 35.61% Impervious, Inflow Depth = 1.41" for 2-Yr event
Inflow = 2.32 cfs @ 12.08 hrs, Volume= 0.153 af
Outflow = 2.31 cfs @ 12.10 hrs, Volume= 0.153 af, Atten= 1%, Lag= 0.9 min
Discarded = 0.14 cfs @ 12.10 hrs, Volume= 0.101 af
Primary = 2.17 cfs @ 12.10 hrs, Volume= 0.052 af

Routing by Stor-Ind method, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 71.49' @ 12.10 hrs Surf.Area= 2,009 sf Storage= 1,261 cf

Plug-Flow detention time= 81.2 min calculated for 0.153 af (100% of inflow)
Center-of-Mass det. time= 81.1 min (917.2 - 836.1)

Volume	Invert	Avail.Storage	Storage Description
#1	68.90'	572 cf	**5.28'W x 135.30'L x 2.00'H Media** 1,429 cf Overall x 40.0% Voids
#2	70.90'	1,008 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
		1,579 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.90	1,028	0	0
71.73	1,400	1,008	1,008

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.90'	**2.500 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 62.00'
#2	Primary	71.40'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.14 cfs @ 12.10 hrs HW=71.49' (Free Discharge)
↑└─**1=Exfiltration** (Controls 0.14 cfs)

Primary OutFlow Max=2.15 cfs @ 12.10 hrs HW=71.49' (Free Discharge)
↑└─**2=Broad-Crested Rectangular Weir** (Weir Controls 2.15 cfs @ 0.76 fps)

Summary for Link 1L: RR-ROW

```
Inflow Area =          1.556 ac,  31.81% Impervious,  Inflow Depth =   0.59"    for  2-Yr event
Inflow       =          2.46 cfs @   12.09 hrs,  Volume=            0.077 af
Primary      =          2.46 cfs @   12.09 hrs,  Volume=            0.077 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Link 11L: Total Site Discharge

```
Inflow Area =      3.558 ac, 36.47% Impervious, Inflow Depth =  1.11"   for 2-Yr event
Inflow      =      6.14 cfs @  12.07 hrs, Volume=         0.330 af
Primary     =      6.14 cfs @  12.07 hrs, Volume=         0.330 af, Atten= 0%, Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1: To Ellis St

Runoff = 0.60 cfs @ 12.11 hrs, Volume= 0.043 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (sf)	CN	Description
	5,449	80	>75% Grass cover, Good, HSG D
*	1,300	98	Houses
*	400	98	Garages
*	1,440	98	Driveways
	8,589	87	Weighted Average
	5,449		63.44% Pervious Area
	3,140		36.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	91	0.0110	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	50	0.0220	2.39		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
18.6	141	Total			

Summary for Subcatchment P2: To Oakland Ave

Runoff = 5.31 cfs @ 12.04 hrs, Volume= 0.319 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (sf)	CN	Description
	35,514	80	>75% Grass cover, Good, HSG D
*	9,750	98	Houses
*	3,200	98	Garages
*	12,672	98	Driveways
	61,136	88	Weighted Average
	35,514		58.09% Pervious Area
	25,622		41.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	60	0.0160	0.09		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
1.1	125	0.0100	1.90	0.95	**Channel Flow, B-C** Area= 0.5 sf Perim= 2.1' r= 0.24' n= 0.030 Short grass
12.4	185	Total			

Summary for Subcatchment P3: To Trench

Runoff = 4.17 cfs @ 12.08 hrs, Volume= 0.277 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (sf)	CN	Description
	36,634	80	>75% Grass cover, Good, HSG D
*	9,750	98	Houses
*	3,600	98	Garages
*	6,912	98	Driveways
	56,896	86	Weighted Average
	36,634		64.39% Pervious Area
	20,262		35.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	85	0.0240	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
3.1	290	0.0100	1.56	0.94	**Channel Flow, C-D** Area= 0.6 sf Perim= 3.4' r= 0.18' n= 0.030
15.8	375	Total			

Summary for Subcatchment P4: To Greenfield Ave

Runoff = 1.78 cfs @ 11.97 hrs, Volume= 0.085 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (sf)	CN	Description
	11,278	80	>75% Grass cover, Good, HSG D
*	1,300	98	Houses
*	0	98	Garages
*	4,896	98	Driveways
	17,474	86	Weighted Average
	11,278		64.54% Pervious Area
	6,196		35.46% Impervious Area

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

Summary for Subcatchment P5: To RR

```
Runoff       =          0.44 cfs @   12.06 hrs,  Volume=           0.028 af,  Depth=  2.20"
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (sf)	CN	Description
	5,959	80	>75% Grass cover, Good, HSG D
*	650	98	Houses
*	0	98	Garages
	6,609	82	Weighted Average
	5,959		90.16% Pervious Area
	650		9.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	100	0.0240	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"

Summary for Subcatchment P6: To RR

Runoff = 0.40 cfs @ 11.97 hrs, Volume= 0.019 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Yr Rainfall=4.00"

	Area (sf)	CN	Description
	3,620	80	>75% Grass cover, Good, HSG D
*	650	98	Houses
*	0	98	Garages
	4,270	83	Weighted Average
	3,620		84.78% Pervious Area
	650		15.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Min. Tc**

Summary for Pond I: Infiltration Trench

Inflow Area = 1.306 ac, 35.61% Impervious, Inflow Depth = 2.55" for 10-Yr event
Inflow = 4.17 cfs @ 12.08 hrs, Volume= 0.277 af
Outflow = 4.16 cfs @ 12.09 hrs, Volume= 0.277 af, Atten= 0%, Lag= 0.5 min
Discarded = 0.14 cfs @ 12.09 hrs, Volume= 0.135 af
Primary = 4.02 cfs @ 12.09 hrs, Volume= 0.142 af

Routing by Stor-Ind method, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 71.54' @ 12.09 hrs Surf.Area= 2,030 sf Storage= 1,324 cf

Plug-Flow detention time= 61.0 min calculated for 0.277 af (100% of inflow)
Center-of-Mass det. time= 61.0 min (880.2 - 819.2)

Volume	Invert	Avail.Storage	Storage Description
#1	68.90'	572 cf	**5.28'W x 135.30'L x 2.00'H Media** 1,429 cf Overall x 40.0% Voids
#2	70.90'	1,008 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
		1,579 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.90	1,028	0	0
71.73	1,400	1,008	1,008

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.90'	**2.500 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 62.00'
#2	Primary	71.40'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.14 cfs @ 12.09 hrs HW=71.54' (Free Discharge)
└─**1=Exfiltration** (Controls 0.14 cfs)

Primary OutFlow Max=4.00 cfs @ 12.09 hrs HW=71.54' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 4.00 cfs @ 0.94 fps)

Summary for Link 1L: RR-ROW

Inflow Area = 1.556 ac, 31.81% Impervious, Inflow Depth = 1.45" for 10-Yr event
Inflow = 4.61 cfs @ 12.08 hrs, Volume= 0.188 af
Primary = 4.61 cfs @ 12.08 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Link 11L: Total Site Discharge

```
Inflow Area =       3.558 ac, 36.47% Impervious,  Inflow Depth =   2.14"    for  10-Yr event
Inflow      =      11.44 cfs @  12.04 hrs,  Volume=          0.636 af
Primary     =      11.44 cfs @  12.04 hrs,  Volume=          0.636 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1: To Ellis St

Runoff = 0.92 cfs @ 12.11 hrs, Volume= 0.068 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.60"

	Area (sf)	CN	Description
	5,449	80	>75% Grass cover, Good, HSG D
*	1,300	98	Houses
*	400	98	Garages
*	1,440	98	Driveways
	8,589	87	Weighted Average
	5,449		63.44% Pervious Area
	3,140		36.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	91	0.0110	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	50	0.0220	2.39		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
18.6	141	Total			

Summary for Subcatchment P2: To Oakland Ave

Runoff = 8.08 cfs @ 12.04 hrs, Volume= 0.496 af, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.60"

	Area (sf)	CN	Description
	35,514	80	>75% Grass cover, Good, HSG D
*	9,750	98	Houses
*	3,200	98	Garages
*	12,672	98	Driveways
	61,136	88	Weighted Average
	35,514		58.09% Pervious Area
	25,622		41.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	60	0.0160	0.09		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
1.1	125	0.0100	1.90	0.95	**Channel Flow, B-C** Area= 0.5 sf Perim= 2.1' r= 0.24' n= 0.030 Short grass
12.4	185	Total			

Summary for Subcatchment P3: To Trench

Runoff = 6.49 cfs @ 12.07 hrs, Volume= 0.439 af, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.60"

	Area (sf)	CN	Description
	36,634	80	>75% Grass cover, Good, HSG D
*	9,750	98	Houses
*	3,600	98	Garages
*	6,912	98	Driveways
	56,896	86	Weighted Average
	36,634		64.39% Pervious Area
	20,262		35.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	85	0.0240	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
3.1	290	0.0100	1.56	0.94	**Channel Flow, C-D** Area= 0.6 sf Perim= 3.4' r= 0.18' n= 0.030
15.8	375	Total			

Summary for Subcatchment P4: To Greenfield Ave

Runoff = 2.75 cfs @ 11.97 hrs, Volume= 0.135 af, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.60"

	Area (sf)	CN	Description
	11,278	80	>75% Grass cover, Good, HSG D
*	1,300	98	Houses
*	0	98	Garages
*	4,896	98	Driveways
	17,474	86	Weighted Average
	11,278		64.54% Pervious Area
	6,196		35.46% Impervious Area

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

Summary for Subcatchment P5: To RR

Runoff = 0.72 cfs @ 12.06 hrs, Volume= 0.046 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.60"

	Area (sf)	CN	Description
	5,959	80	>75% Grass cover, Good, HSG D
*	650	98	Houses
*	0	98	Garages
	6,609	82	Weighted Average
	5,959		90.16% Pervious Area
	650		9.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	100	0.0240	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"

Summary for Subcatchment P6: To RR

Runoff = 0.63 cfs @ 11.97 hrs, Volume= 0.030 af, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.60"

	Area (sf)	CN	Description
	3,620	80	>75% Grass cover, Good, HSG D
*	650	98	Houses
*	0	98	Garages
	4,270	83	Weighted Average
	3,620		84.78% Pervious Area
	650		15.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Min. Tc**

Summary for Pond I: Infiltration Trench

Inflow Area = 1.306 ac, 35.61% Impervious, Inflow Depth = 4.03" for 100-yr event
Inflow = 6.49 cfs @ 12.07 hrs, Volume= 0.439 af
Outflow = 6.48 cfs @ 12.08 hrs, Volume= 0.439 af, Atten= 0%, Lag= 0.4 min
Discarded = 0.14 cfs @ 12.08 hrs, Volume= 0.169 af
Primary = 6.34 cfs @ 12.08 hrs, Volume= 0.269 af

Routing by Stor-Ind method, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 71.59' @ 12.08 hrs Surf.Area= 2,053 sf Storage= 1,391 cf

Plug-Flow detention time= 47.2 min calculated for 0.439 af (100% of inflow)
Center-of-Mass det. time= 47.3 min (853.4 - 806.2)

Volume	Invert	Avail.Storage	Storage Description
#1	68.90'	572 cf	**5.28'W x 135.30'L x 2.00'H Media** 1,429 cf Overall x 40.0% Voids
#2	70.90'	1,008 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
		1,579 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.90	1,028	0	0
71.73	1,400	1,008	1,008

Device	Routing	Invert	Outlet Devices
#1	Discarded	68.90'	**2.500 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 62.00'
#2	Primary	71.40'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.14 cfs @ 12.08 hrs HW=71.59' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.14 cfs)

Primary OutFlow Max=6.33 cfs @ 12.08 hrs HW=71.59' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 6.33 cfs @ 1.09 fps)

Summary for Link 1L: RR-ROW

Inflow Area = 1.556 ac, 31.81% Impervious, Inflow Depth = 2.67" for 100-yr event
Inflow = 7.30 cfs @ 12.07 hrs, Volume= 0.346 af
Primary = 7.30 cfs @ 12.07 hrs, Volume= 0.346 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

Summary for Link 11L: Total Site Discharge

```
Inflow Area =          3.558 ac,  36.47% Impervious,  Inflow Depth =   3.52"    for  100-yr event
Inflow       =        17.80 cfs @   12.03 hrs,  Volume=             1.044 af
Primary      =        17.80 cfs @   12.03 hrs,  Volume=             1.044 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs

APPENDIX D

WINSLAMM DATA

```
Data file name:  P:\WinSLAMM v10\S-8525 - Aeroshade\S-8525 Aeroshade BIO3b.mdb
WinSLAMM Version 10.3.4
Rain file name:  C:\WinSLAMM Files\Rain Files\WisReg - Milwaukee WI 1969.RAN
Particulate Solids Concentration file name:  C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name:  C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Residential Street Delivery file name:  C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name:  C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name:  C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name:  C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name:  C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name:  C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance:  False
Pollutant Relative Concentration file name:  C:\WinSLAMM Files\WI_GEO03.ppdx
Source Area PSD and Peak to Average Flow Ratio File:  C:\WinSLAMM Files\NURP Source Area PSD Files.csv
Cost Data file name:
Seed for random number generator:  -42
Study period starting date:  03/28/69      Study period ending date:  12/06/69
Date:  10-24-2018                          Time:  15:06:47
Site information:

LU# 1 - Residential:  Basin P1     Total area (ac):  0.197
    1 - Roofs 1:  0.030 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    2 - Roofs 2:  0.009 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    25 - Driveways 1:  0.033 ac.    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    45 - Large Landscaped Areas 1:  0.125 ac.    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz



LU# 2 - Residential:  Basin P2     Total area (ac):  1.404
    1 - Roofs 1:  0.224 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    2 - Roofs 2:  0.074 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    25 - Driveways 1:  0.291 ac.    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    45 - Large Landscaped Areas 1:  0.815 ac.    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz



LU# 3 - Residential:  Basin P3     Total area (ac):  1.312
    1 - Roofs 1:  0.224 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    2 - Roofs 2:  0.083 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    25 - Driveways 1:  0.159 ac.    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    45 - Large Landscaped Areas 1:  0.846 ac.    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz



LU# 4 - Residential:  Basin P4     Total area (ac):  0.401
    1 - Roofs 1:  0.030 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    25 - Driveways 1:  0.112 ac.    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    45 - Large Landscaped Areas 1:  0.259 ac.    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz



LU# 5 - Residential:  Basin P5     Total area (ac):  0.152
    1 - Roofs 1:  0.015 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    45 - Large Landscaped Areas 1:  0.137 ac.    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
```

```
LU# 6 - Residential:  Basin P6     Total area (ac):  0.098
    1 - Roofs 1:  0.015 ac.    Pitched    Disconnected    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
    45 - Large Landscaped Areas 1:  0.083 ac.    Normal Silty    Source Area PSD File: C:\WinSLAMM Files\NURP.cpz




     Control Practice 1:  Biofilter CP# 1 (DS) - DS Biofilters # 1
       1.  Top area (square feet) =  1400
       2.  Bottom aea (square feet) =  714
       3.  Depth (ft):   2.6
       4.  Biofilter width (ft) - for Cost Purposes Only:   10
       5.  Infiltration rate (in/hr) =  2.5
       6.  Random infiltration rate generation?  No
       7.  Infiltration rate fraction (side):   1
       8.  Infiltration rate fraction (bottom):   1
       9.  Depth of biofilter that is rock filled (ft) 0
       10.  Porosity of rock filled volume =  0
       11.  Engineered soil infiltration rate:   40
       12.  Engineered soil depth (ft) =  2
       13.  Engineered soil porosity =  0.32
       14. Percent solids reduction due to flow through engineered soil =  0
       15. Biofilter peak to average flow ratio =  3.8
       16. Number of biofiltration control devices =  1
       17. Particle size distribution file:  Not needed - calculated by program
       18. Initial water surface elevation (ft):   0
       Soil Data                         Soil Type Fraction in Eng. Soil
          Coarse Sand & Gravel           1.000
           Saturation water content percent (Porosity) =   0
           Field capacity (%) =   0
           Permanent Wilting Point (%) =   0
           Infiltration rate (in/hr) =   40
       Biofilter Outlet/Discharge Characteristics:
          Outlet type:  Broad Crested Weir
                 1.  Weir crest length (ft):   10
                 2.  Weir crest width (ft):   4
                 3.  Height of datum to bottom of weir opening:   2.5


     Control Practice 2:  Grass Swale CP# 1 (DS) - DS Grass Swales # 1
       Total drainage area (acres)= 1.404
       Fraction of drainage area served by swales (ac) = 0.97
       Swale density (ft/ac) = 668.19
       Total swale length (ft) = 910
       Average swale length to outlet (ft)= 130
       Typical bottom width (ft) = 0.0
       Typical swale side slope (_H:1V) = 4.0
       Typical longitudinal slope (ft.H/ft.V) = 0.010
       Swale retardance factor:  D
```

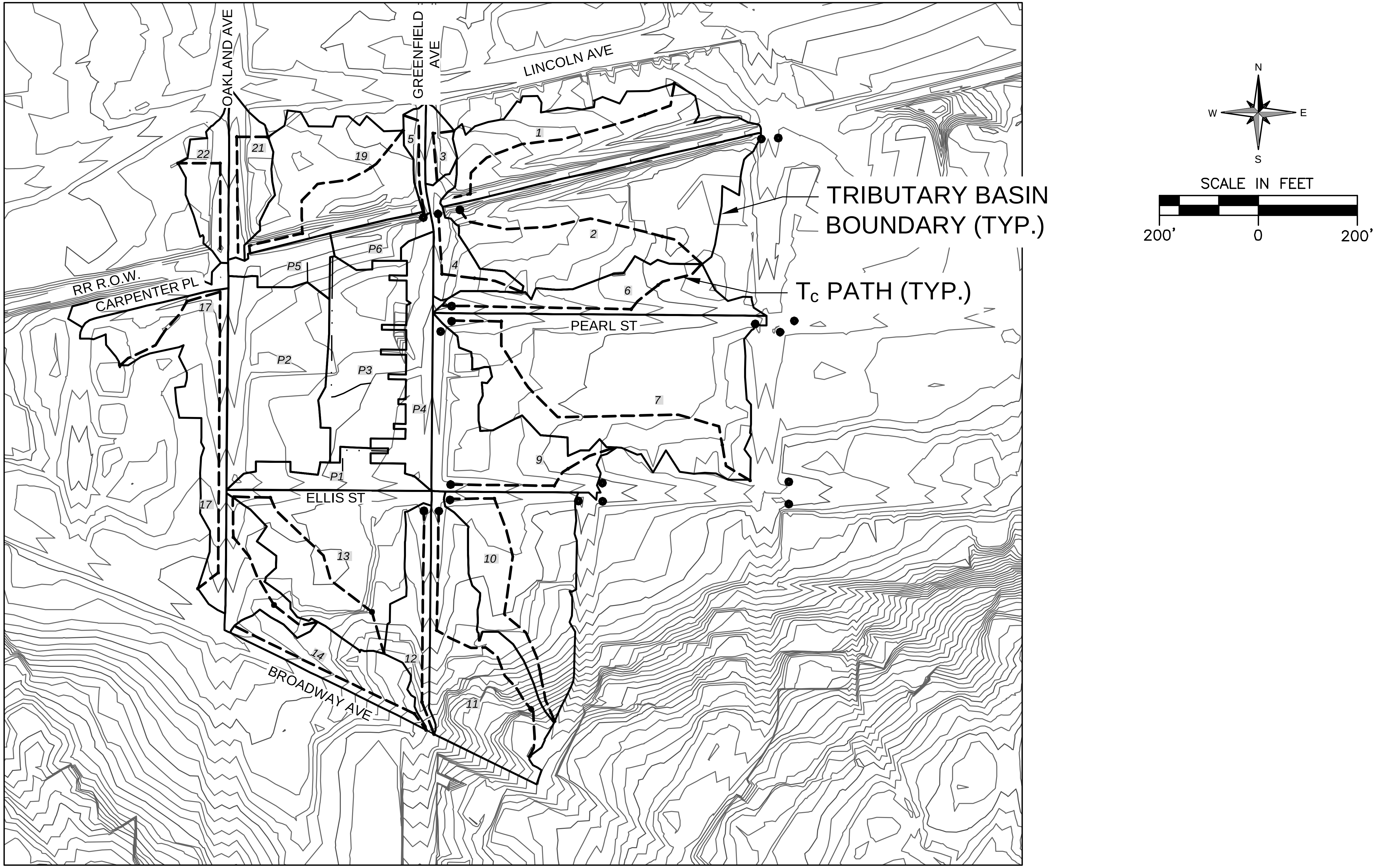
Typical grass height (in) = 4.0
Swale dynamic infiltration rate (in/hr)= 0.150
Typical swale depth (ft) for cost analysis (optional) = 0.0
Particle size distribution file name: Not needed - calculated by program
Use total swale length instead of swale density for infiltration calculations: True

```
SLAMM for Windows Version 10.3.4
(c) Copyright Robert Pitt and John Voorhees 2012
All Rights Reserved

Data file name:  P:\WinSLAMM v10\S-8525 - Aeroshade\S-8525 Aeroshade BIO3b.mdb
Data file description:
Rain file name:  C:\WinSLAMM Files\Rain Files\WisReg - Milwaukee WI 1969.RAN
Particulate Solids Concentration file name:  C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name:  C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Residential Street Delivery file name:  C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name:  C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name:  C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name:  C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name:  C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name:  C:\WinSLAMM Files\Freeway Dec06.std
Pollutant Relative Concentration file name:  C:\WinSLAMM Files\WI_GEO03.ppdx
Model Run Start Date:  03/28/69    Model Run End Date:  12/06/69
Date of run:  10-24-2018    Time of run:  15:06:08
Total Area Modeled (acres):  3.564
Years in Model Run:  0.67

                                          Runoff    Percent Particulate Particulate    Percent
                                          Volume     Runoff     Solids      Solids Particulate
                                         (cu ft)     Volume      Conc.       Yield     Solids
                                                  Reduction     (mg/L)       (lbs)  Reduction

Total of all Land Uses without Controls:      18691        -      177.3      206.9         -
Outfall Total with Controls:                   7607   59.30%      174.2      82.70    60.03%
Annualized Total After Outfall Controls:      11426                          124.2
```

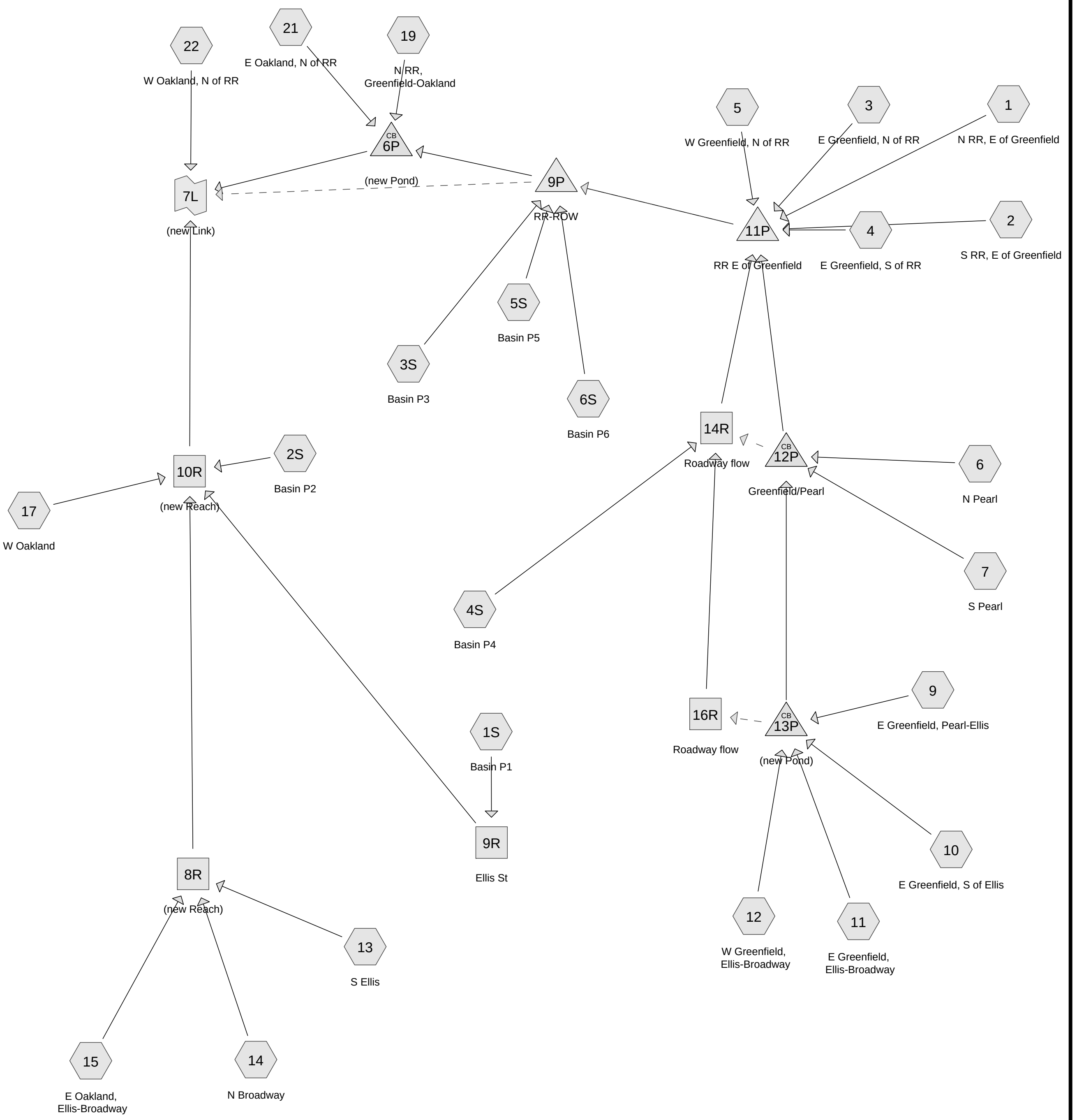
APPENDIX E

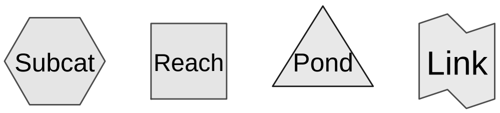
RAILROAD RIGHT-OF-WAY

100-YEAR FLOOD DETERMINATION



RR R.O.W. CAPACITY STUDY
DRAINAGE MAP





Routing Diagram for S-8525 Aeroshade Proposed Conditions RR Ditch
Prepared by Microsoft, Printed 11/12/2018
HydroCAD® 10.00-22 s/n 04758 © 2018 HydroCAD Software Solutions LLC

Summary for Subcatchment 1: N RR, E of Greenfield

Runoff = 5.60 cfs @ 12.21 hrs, Volume= 0.501 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
1.758	80	>75% Grass cover, Good, HSG D
1.758		100.00% Pervious Area

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

Summary for Subcatchment 1S: Basin P1

Runoff = 0.96 cfs @ 12.10 hrs, Volume= 0.071 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (sf)	CN	Description
	4,298	80	>75% Grass cover, Good, HSG D
*	1,300	98	Houses
*	400	98	Garages
*	2,592	98	Driveways
	8,590	89	Weighted Average
	4,298		50.03% Pervious Area
	4,292		49.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	91	0.0110	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	50	0.0220	2.39		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
18.6	141	Total			

Summary for Subcatchment 2: S RR, E of Greenfield

Runoff = 9.53 cfs @ 12.13 hrs, Volume= 0.735 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
2.577	80	>75% Grass cover, Good, HSG D
2.577		100.00% Pervious Area

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

Summary for Subcatchment 2S: Basin P2

```
Runoff      =       7.93 cfs @  12.04 hrs,  Volume=        0.484 af,  Depth=  4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr  100-Yr Rainfall=5.60"

      Area (sf)   CN   Description
  ---------------------------------------------------------------------
         36,866   80   >75% Grass cover, Good, HSG D
*         9,750   98   Houses
*         3,000   98   Garages
*        11,520   98   Driveways
  ---------------------------------------------------------------------
         61,136   87   Weighted Average
         36,866        60.30% Pervious Area
         24,270        39.70% Impervious Area

    Tc  Length    Slope  Velocity  Capacity  Description
 (min)  (feet)   (ft/ft)  (ft/sec)     (cfs)
  ---------------------------------------------------------------------
  11.3      60   0.0160      0.09            Sheet Flow, A-B
                                             Grass: Dense   n= 0.240   P2= 2.70"
   1.1     125   0.0100      1.90      0.95  Channel Flow, B-C
                                             Area= 0.5 sf  Perim= 2.1'  r= 0.24'
                                             n= 0.030  Short grass
  ---------------------------------------------------------------------
  12.4     185   Total
```

Summary for Subcatchment 3: E Greenfield, N of RR

Runoff = 1.39 cfs @ 11.97 hrs, Volume= 0.078 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
0.174	98	Paved roads w/curbs & sewers, HSG D
0.174		100.00% Impervious Area

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

Summary for Subcatchment 3S: Basin P3

Runoff = 6.06 cfs @ 12.07 hrs, Volume= 0.410 af, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (sf)	CN	Description
	35,148	80	>75% Grass cover, Good, HSG D
*	8,450	98	Houses
*	2,600	98	Garages
*	6,912	98	Driveways
	53,110	86	Weighted Average
	35,148		66.18% Pervious Area
	17,962		33.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	85	0.0240	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
3.1	290	0.0100	1.56	0.94	**Channel Flow, C-D** Area= 0.6 sf Perim= 3.4' r= 0.18' n= 0.030
15.8	375	Total			

Summary for Subcatchment 4: E Greenfield, S of RR

Runoff = 2.22 cfs @ 12.10 hrs, Volume= 0.184 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
0.411	98	Paved roads w/curbs & sewers, HSG D
0.411		100.00% Impervious Area

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

Summary for Subcatchment 4S: Basin P4

Runoff = 3.41 cfs @ 11.97 hrs, Volume= 0.168 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (sf)	CN	Description
	12,955	80	>75% Grass cover, Good, HSG D
*	2,600	98	Houses
*	800	98	Garages
*	4,896	98	Driveways
	21,251	87	Weighted Average
	12,955		60.96% Pervious Area
	8,296		39.04% Impervious Area

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

Summary for Subcatchment 5: W Greenfield, N of RR

```
Runoff       =          1.10 cfs @   11.98 hrs,  Volume=            0.059 af,  Depth=  4.79"
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
0.148	93	Paved roads w/open ditches, 50% imp, HSG D
0.074		50.00% Pervious Area
0.074		50.00% Impervious Area

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

Summary for Subcatchment 5S: Basin P5

Runoff = 0.72 cfs @ 12.06 hrs, Volume= 0.046 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (sf)	CN	Description
	5,757	80	>75% Grass cover, Good, HSG D
*	650	98	Houses
*	200	98	Garages
	6,607	82	Weighted Average
	5,757		87.13% Pervious Area
	850		12.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	100	0.0240	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"

Summary for Subcatchment 6: N Pearl

Runoff = 3.99 cfs @ 12.15 hrs, Volume= 0.322 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
0.933	87	1/4 acre lots, 38% imp, HSG D
0.578		62.00% Pervious Area
0.355		38.00% Impervious Area

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

Summary for Subcatchment 6S: Basin P6

Runoff = 0.65 cfs @ 11.97 hrs, Volume= 0.031 af, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

	Area (sf)	CN	Description
	3,421	80	>75% Grass cover, Good, HSG D
*	650	98	Houses
*	200	98	Garages
	4,271	84	Weighted Average
	3,421		80.10% Pervious Area
	850		19.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Min. Tc**

Summary for Subcatchment 7: S Pearl

Runoff = 13.71 cfs @ 12.19 hrs, Volume= 1.222 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
3.546	87	1/4 acre lots, 38% imp, HSG D
2.199		62.00% Pervious Area
1.347		38.00% Impervious Area

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

Summary for Subcatchment 9: E Greenfield, Pearl-Ellis

Runoff = 6.29 cfs @ 12.10 hrs, Volume= 0.468 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
1.359	87	1/4 acre lots, 38% imp, HSG D
0.843		62.00% Pervious Area
0.516		38.00% Impervious Area

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

Summary for Subcatchment 10: E Greenfield, S of Ellis

Runoff = 10.33 cfs @ 12.02 hrs, Volume= 0.602 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
1.747	87	1/4 acre lots, 38% imp, HSG D
1.083		62.00% Pervious Area
0.664		38.00% Impervious Area

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

Summary for Subcatchment 11: E Greenfield, Ellis-Broadway

Runoff = 11.52 cfs @ 11.98 hrs, Volume= 0.588 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
1.705	87	1/4 acre lots, 38% imp, HSG D
1.057		62.00% Pervious Area
0.648		38.00% Impervious Area

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

Summary for Subcatchment 12: W Greenfield, Ellis-Broadway

```
Runoff      =        4.15 cfs @   11.96 hrs,  Volume=          0.198 af,  Depth=  4.14"
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
0.574	87	1/4 acre lots, 38% imp, HSG D
0.356		62.00% Pervious Area
0.218		38.00% Impervious Area

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

Summary for Subcatchment 13: S Ellis

Runoff = 10.15 cfs @ 12.04 hrs, Volume= 0.632 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
1.833	87	1/4 acre lots, 38% imp, HSG D
1.136		62.00% Pervious Area
0.697		38.00% Impervious Area

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

Summary for Subcatchment 14: N Broadway

Runoff = 5.20 cfs @ 11.96 hrs, Volume= 0.248 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
0.720	87	1/4 acre lots, 38% imp, HSG D
0.446		62.00% Pervious Area
0.274		38.00% Impervious Area

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

Summary for Subcatchment 15: E Oakland, Ellis-Broadway

Runoff = 2.43 cfs @ 12.11 hrs, Volume= 0.186 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
0.539	87	1/4 acre lots, 38% imp, HSG D
0.334		62.00% Pervious Area
0.205		38.00% Impervious Area

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

Summary for Subcatchment 17: W Oakland

Runoff = 6.77 cfs @ 12.07 hrs, Volume= 0.462 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
1.340	87	1/4 acre lots, 38% imp, HSG D
0.831		62.00% Pervious Area
0.509		38.00% Impervious Area

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

Summary for Subcatchment 19: N RR, Greenfield-Oakland

```
Runoff      =       6.67 cfs @   12.11 hrs,  Volume=          0.510 af,  Depth=  4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr  100-Yr Rainfall=5.60"

 Area (ac)   CN   Description
     1.480   87   1/4 acre lots, 38% imp, HSG D
     0.918        62.00% Pervious Area
     0.562        38.00% Impervious Area

   Tc  Length    Slope  Velocity  Capacity  Description
 (min)  (feet)   (ft/ft)  (ft/sec)     (cfs)
  20.0                                       Direct Entry,
```

Summary for Subcatchment 21: E Oakland, N of RR

```
Runoff      =        3.10 cfs @   12.01 hrs,  Volume=          0.175 af,  Depth=  4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr  100-Yr Rainfall=5.60"

  Area (ac)    CN   Description
      0.507    87   1/4 acre lots, 38% imp, HSG D
      0.314         62.00% Pervious Area
      0.193         38.00% Impervious Area

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

Summary for Subcatchment 22: W Oakland, N of RR

Runoff = 2.34 cfs @ 12.07 hrs, Volume= 0.155 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=5.60"

Area (ac)	CN	Description
0.450	87	1/4 acre lots, 38% imp, HSG D
0.279		62.00% Pervious Area
0.171		38.00% Impervious Area

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

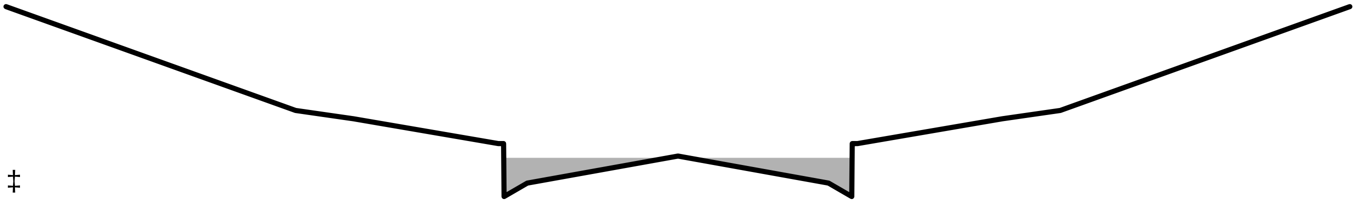
Summary for Reach 8R: (new Reach)

Inflow Area = 3.092 ac, 38.00% Impervious, Inflow Depth = 4.14" for 100-Yr event
Inflow = 15.49 cfs @ 12.00 hrs, Volume= 1.066 af
Outflow = 15.38 cfs @ 12.02 hrs, Volume= 1.066 af, Atten= 1%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.67 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 2.5 min

Peak Storage= 1,046 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.83' Flow Area= 114.6 sf, Capacity= 1,509.61 cfs

Custom cross-section, Length= 250.0' Slope= 0.0136 '/' (102 Elevation Intervals)
Constant n= 0.013
Inlet Invert= 76.05', Outlet Invert= 72.64'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-58.00	1.44	0.00
-33.00	0.44	1.00
-28.00	0.36	1.08
-15.50	0.12	1.32
-15.05	0.12	1.32
-15.00	-0.39	1.83
-13.00	-0.26	1.70
0.00	0.00	1.44
13.00	-0.26	1.70
15.00	-0.39	1.83
15.05	0.12	1.32
15.50	0.12	1.32
28.00	0.36	1.08
33.00	0.44	1.00
58.00	1.44	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
0.13	0.3	4.3	66	0.54
0.39	4.7	30.8	1,174	17.89
0.51	8.3	31.9	2,077	45.11
0.75	18.7	56.9	4,686	119.31
0.83	23.6	66.9	5,906	157.51
1.83	114.6	117.0	28,656	1,509.61

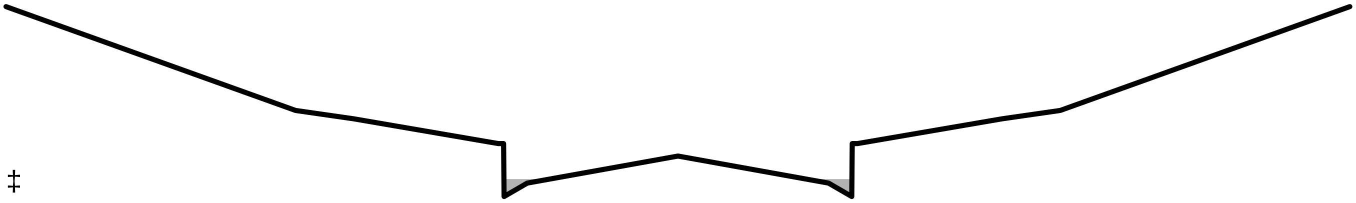
Summary for Reach 9R: Ellis St

Inflow Area = 0.197 ac, 49.97% Impervious, Inflow Depth = 4.35" for 100-Yr event
Inflow = 0.96 cfs @ 12.10 hrs, Volume= 0.071 af
Outflow = 0.92 cfs @ 12.15 hrs, Volume= 0.071 af, Atten= 4%, Lag= 2.6 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 1.90 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.88 fps, Avg. Travel Time= 6.6 min

Peak Storage= 167 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 1.83' Flow Area= 114.6 sf, Capacity= 1,397.02 cfs

Custom cross-section, Length= 345.0' Slope= 0.0117 '/' (102 Elevation Intervals)
Constant n= 0.013 Asphalt, smooth
Inlet Invert= 76.67', Outlet Invert= 72.64'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-58.00	1.44	0.00
-33.00	0.44	1.00
-28.00	0.36	1.08
-15.50	0.12	1.32
-15.05	0.12	1.32
-15.00	-0.39	1.83
-13.00	-0.26	1.70
0.00	0.00	1.44
13.00	-0.26	1.70
15.00	-0.39	1.83
15.05	0.12	1.32
15.50	0.12	1.32
28.00	0.36	1.08
33.00	0.44	1.00
58.00	1.44	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
0.13	0.3	4.3	91	0.50
0.39	4.7	30.8	1,620	16.55
0.51	8.3	31.9	2,866	41.74
0.75	18.7	56.9	6,467	110.41
0.83	23.6	66.9	8,151	145.76
1.83	114.6	117.0	39,546	1,397.02

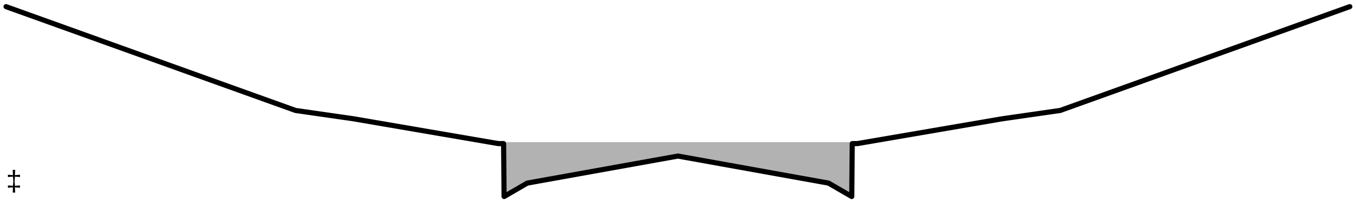
Summary for Reach 10R: (new Reach)

Inflow Area = 6.033 ac, 38.79% Impervious, Inflow Depth = 4.14" for 100-Yr event
Inflow = 30.30 cfs @ 12.04 hrs, Volume= 2.083 af
Outflow = 29.51 cfs @ 12.07 hrs, Volume= 2.083 af, Atten= 3%, Lag= 1.8 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.37 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 6.4 min

Peak Storage= 4,005 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.52'
Bank-Full Depth= 1.83' Flow Area= 114.6 sf, Capacity= 931.78 cfs

Custom cross-section, Length= 458.0' Slope= 0.0052 '/' (102 Elevation Intervals)
Constant n= 0.013
Inlet Invert= 71.64', Outlet Invert= 69.26'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-58.00	1.44	0.00
-33.00	0.44	1.00
-28.00	0.36	1.08
-15.50	0.12	1.32
-15.05	0.12	1.32
-15.00	-0.39	1.83
-13.00	-0.26	1.70
0.00	0.00	1.44
13.00	-0.26	1.70
15.00	-0.39	1.83
15.05	0.12	1.32
15.50	0.12	1.32
28.00	0.36	1.08
33.00	0.44	1.00
58.00	1.44	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
0.13	0.3	4.3	121	0.33
0.39	4.7	30.8	2,150	11.04
0.51	8.3	31.9	3,805	27.84
0.75	18.7	56.9	8,586	73.64
0.83	23.6	66.9	10,820	97.22
1.83	114.6	117.0	52,498	931.78

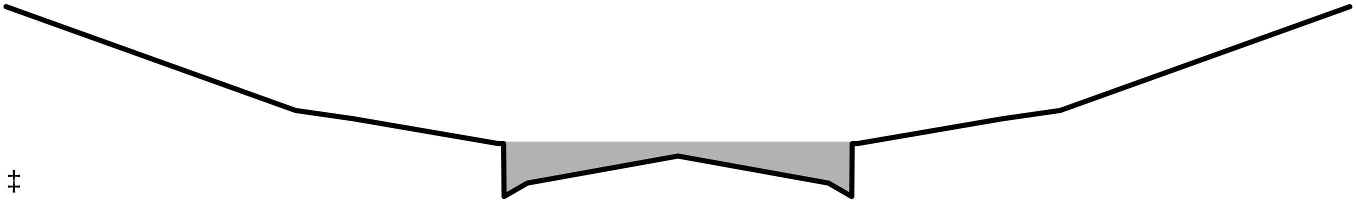
Summary for Reach 14R: Roadway flow

Inflow Area = 0.488 ac, 39.04% Impervious, Inflow Depth = 42.32" for 100-Yr event
Inflow = 39.67 cfs @ 12.05 hrs, Volume= 1.720 af
Outflow = 39.55 cfs @ 12.06 hrs, Volume= 1.720 af, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.44 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.06 fps, Avg. Travel Time= 3.1 min

Peak Storage= 1,736 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 1.83' Flow Area= 114.6 sf, Capacity= 1,224.51 cfs

Custom cross-section, Length= 195.0' Slope= 0.0090 '/' (102 Elevation Intervals)
Constant n= 0.013 Asphalt, smooth
Inlet Invert= 75.00', Outlet Invert= 73.25'



‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-58.00	1.44	0.00
-33.00	0.44	1.00
-28.00	0.36	1.08
-15.50	0.12	1.32
-15.05	0.12	1.32
-15.00	-0.39	1.83
-13.00	-0.26	1.70
0.00	0.00	1.44
13.00	-0.26	1.70
15.00	-0.39	1.83
15.05	0.12	1.32
15.50	0.12	1.32
28.00	0.36	1.08
33.00	0.44	1.00
58.00	1.44	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
0.13	0.3	4.3	51	0.44
0.39	4.7	30.8	916	14.51
0.51	8.3	31.9	1,620	36.59
0.75	18.7	56.9	3,655	96.77
0.83	23.6	66.9	4,607	127.76
1.83	114.6	117.0	22,352	1,224.51

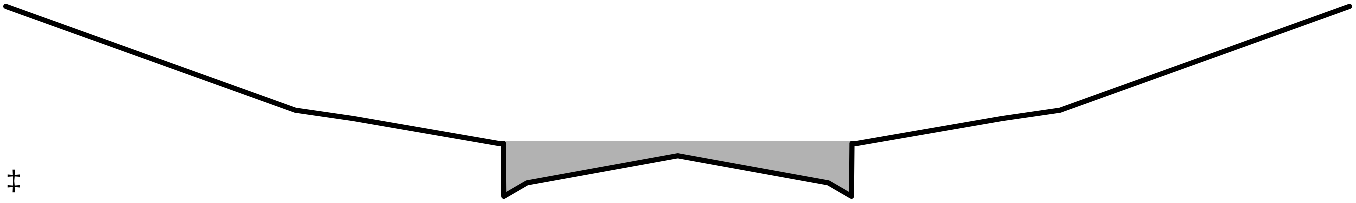
Summary for Reach 16R: Roadway flow

Inflow	=	27.07 cfs @	11.99 hrs, Volume=	0.775 af	
Outflow	=	25.06 cfs @	12.03 hrs, Volume=	0.775 af,	Atten= 7%, Lag= 2.3 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.79 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.74 fps, Avg. Travel Time= 12.8 min

Peak Storage= 5,097 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.53'
Defined Flood Depth= 1.44' Flow Area= 73.2 sf, Capacity= 410.50 cfs
Bank-Full Depth= 1.83' Flow Area= 114.6 sf, Capacity= 767.68 cfs

Custom cross-section, Length= 567.0' Slope= 0.0035 '/' (102 Elevation Intervals)
Constant n= 0.013 Asphalt, smooth
Inlet Invert= 78.00', Outlet Invert= 76.00'



‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-58.00	1.44	0.00
-33.00	0.44	1.00
-28.00	0.36	1.08
-15.50	0.12	1.32
-15.05	0.12	1.32
-15.00	-0.39	1.83
-13.00	-0.26	1.70
0.00	0.00	1.44
13.00	-0.26	1.70
15.00	-0.39	1.83
15.05	0.12	1.32
15.50	0.12	1.32
28.00	0.36	1.08
33.00	0.44	1.00
58.00	1.44	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
0.13	0.3	4.3	149	0.27
0.39	4.7	30.8	2,662	9.10
0.51	8.3	31.9	4,710	22.94
0.75	18.7	56.9	10,629	60.67
0.83	23.6	66.9	13,396	80.10
1.83	114.6	117.0	64,993	767.68

Summary for Pond 6P: (new Pond)

Inflow Area = 18.876 ac, 30.75% Impervious, Inflow Depth = 3.02" for 100-Yr event
Inflow = 22.07 cfs @ 12.07 hrs, Volume= 4.753 af
Outflow = 22.07 cfs @ 12.07 hrs, Volume= 4.753 af, Atten= 0%, Lag= 0.0 min
Primary = 22.07 cfs @ 12.07 hrs, Volume= 4.753 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 67.66' @ 12.07 hrs
Flood Elev= 69.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	64.32'	**24.0" Round Culvert** L= 70.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 64.32' / 64.07' S= 0.0036 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=22.06 cfs @ 12.07 hrs HW=67.66' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 22.06 cfs @ 7.02 fps)

Summary for Pond 9P: RR-ROW

Inflow Area = 16.889 ac, 29.90% Impervious, Inflow Depth = 3.99" for 100-Yr event
Inflow = 65.41 cfs @ 12.08 hrs, Volume= 5.611 af
Outflow = 65.41 cfs @ 12.08 hrs, Volume= 5.611 af, Atten= 0%, Lag= 0.3 min
Primary = 15.78 cfs @ 12.69 hrs, Volume= 4.069 af
Secondary = 52.15 cfs @ 12.08 hrs, Volume= 1.542 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 69.31' @ 12.08 hrs Surf.Area= 7,109 sf Storage= 8,224 cf

Plug-Flow detention time= 2.6 min calculated for 5.611 af (100% of inflow)
Center-of-Mass det. time= 2.4 min (810.9 - 808.5)

Volume	Invert	Avail.Storage	Storage Description
#1	66.07'	9,677 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
66.07	2	0	0
67.00	670	312	312
68.00	2,767	1,719	2,031
69.00	5,683	4,225	6,256
69.50	8,000	3,421	9,677

Device	Routing	Invert	Outlet Devices
#1	Primary	66.07'	**18.0" Round Culvert** L= 38.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 66.07' / 64.57' S= 0.0395 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Secondary	69.06'	**Overtop sidewalk, C= 3.27** Offset (feet) -145.00 -95.00 -53.60 0.00 40.00 93.00 155.00 Height (feet) 0.44 0.21 0.00 0.00 0.07 0.15 0.44

Primary OutFlow Max=14.72 cfs @ 12.69 hrs HW=69.06' TW=67.02' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 14.72 cfs @ 8.33 fps)

Secondary OutFlow Max=52.15 cfs @ 12.08 hrs HW=69.31' TW=0.00' (Dynamic Tailwater)
└─**2=Overtop sidewalk** (Weir Controls 52.15 cfs @ 1.15 fps)

Summary for Pond 11P: RR E of Greenfield

Inflow Area = 15.420 ac, 29.82% Impervious, Inflow Depth = 3.99" for 100-Yr event
Inflow = 58.41 cfs @ 12.08 hrs, Volume= 5.124 af
Outflow = 58.40 cfs @ 12.08 hrs, Volume= 5.124 af, Atten= 0%, Lag= 0.1 min
Primary = 15.63 cfs @ 11.93 hrs, Volume= 3.786 af
Secondary = 42.94 cfs @ 12.08 hrs, Volume= 1.338 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 72.61' @ 12.08 hrs Surf.Area= 2,485 sf Storage= 1,729 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.3 min (808.6 - 808.3)

Volume	Invert	Avail.Storage	Storage Description
#1	68.39'	4,766 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.39	4	0	0
70.80	4	10	10
71.40	86	27	37
72.40	2,266	1,176	1,213
72.81	2,698	1,018	2,230
73.70	3,000	2,536	4,766

Device	Routing	Invert	Outlet Devices
#1	Primary	68.39'	**18.0" Round Outfall** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 68.39' / 68.01' S= 0.0095 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Secondary	72.31'	**Overtop Curb, C= 3.27** Offset (feet) -111.00 -83.00 0.00 42.00 Height (feet) 0.50 0.08 0.00 0.50

Primary OutFlow Max=15.61 cfs @ 11.93 hrs HW=72.51' TW=69.09' (Dynamic Tailwater)
↰**1=Outfall** (Inlet Controls 15.61 cfs @ 8.83 fps)

Secondary OutFlow Max=42.94 cfs @ 12.08 hrs HW=72.61' TW=69.31' (Dynamic Tailwater)
↰**2=Overtop Curb** (Weir Controls 42.94 cfs @ 1.21 fps)

Summary for Pond 12P: Greenfield/Pearl

Inflow Area = 9.864 ac, 38.00% Impervious, Inflow Depth = 3.19" for 100-Yr event
Inflow = 19.82 cfs @ 12.17 hrs, Volume= 2.625 af
Outflow = 19.82 cfs @ 12.17 hrs, Volume= 2.625 af, Atten= 0%, Lag= 0.0 min
Primary = 3.45 cfs @ 12.78 hrs, Volume= 1.847 af
Secondary = 17.01 cfs @ 12.17 hrs, Volume= 0.777 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 76.37' @ 12.17 hrs
Flood Elev= 76.44'

Device	Routing	Invert	Outlet Devices
#1	Primary	71.20'	**12.0" Round St Sewer** L= 567.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 71.20' / 69.40' S= 0.0032 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	76.00'	**31.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=3.44 cfs @ 12.78 hrs HW=76.09' TW=70.43' (Dynamic Tailwater)
↰**1=St Sewer** (Outlet Controls 3.44 cfs @ 4.38 fps)

Secondary OutFlow Max=17.01 cfs @ 12.17 hrs HW=76.37' TW=75.49' (Dynamic Tailwater)
↰**2=Broad-Crested Rectangular Weir** (Weir Controls 17.01 cfs @ 1.50 fps)

Summary for Pond 13P: (new Pond)

Inflow Area = 5.385 ac, 38.00% Impervious, Inflow Depth = 4.14" for 100-Yr event
Inflow = 29.46 cfs @ 11.99 hrs, Volume= 1.856 af
Outflow = 29.46 cfs @ 11.99 hrs, Volume= 1.856 af, Atten= 0%, Lag= 0.0 min
Primary = 2.40 cfs @ 11.97 hrs, Volume= 1.081 af
Secondary = 27.07 cfs @ 11.99 hrs, Volume= 0.775 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 79.00' @ 12.00 hrs
Flood Elev= 79.44'

Device	Routing	Invert	Outlet Devices
#1	Primary	75.20'	**12.0" Round St Sewer** L= 567.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 75.20' / 72.20' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	78.50'	**30.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=2.40 cfs @ 11.97 hrs HW=78.98' TW=76.23' (Dynamic Tailwater)
└─**1=St Sewer** (Outlet Controls 2.40 cfs @ 3.05 fps)

Secondary OutFlow Max=27.03 cfs @ 11.99 hrs HW=78.99' TW=78.52' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 27.03 cfs @ 1.82 fps)

Summary for Link 7L: (new Link)

```
Inflow Area =        25.359 ac,  32.79% Impervious,  Inflow Depth =   4.04"    for  100-Yr event
Inflow       =      105.99 cfs @   12.08 hrs,  Volume=            8.533 af
Primary      =      105.99 cfs @   12.08 hrs,  Volume=            8.533 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 1.00-80.00 hrs, dt= 0.01 hrs

APPENDIX F

SOILS INVESTIGATION

IMPORTANT

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GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

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- Milwaukee, WI

July 10, 2017

Five Points Development, LLC
1242 Lincoln Avenue
Waukesha, WI 53186

Attention: Ms. Judy Fuller

Subject: Groundwater Elevation Evaluation
Proposed Residential Development
433 Oakland Avenue
Waukesha, Wisconsin
Project No. 1G-1706002

Dear Ms. Fuller:

Giles Engineering Associates, Inc. ("Giles") has completed the Groundwater Elevation Evaluation for the above referenced project. This report includes a description of the subsurface conditions encountered in the test borings and estimated groundwater conditions at the test boring locations. Additionally, a description of Giles' field and laboratory services is also provided in this report. Geotechnical engineering recommendations regarding design and construction the proposed residential development is beyond Giles scope of services for this project. Environmental engineering services are also beyond Giles scope of services for this project.

SITE DESCRIPTION

The site of the proposed residential development is located at and near the address of 433 Oakland Avenue in Waukesha, Wisconsin. The site is bordered by Ellis Street to the south, North Greenfield Avenue to the east, Oakland Avenue to the west, and the former railroad right-of-way to the north. Based on aerial photography, it is understood that an industrial building previously occupied the northern portion of the site. The building was being razed at the time the test borings were conducted. Topographically, the site was relatively flat, generally sloping gradually down to the north/northeast. Ground surface elevations at the test borings ranged between El. 851.8 and El. 855.8, relative to the benchmark shown on the attached Figure 1 (*Test Boring Location Plan*).

GEOTECHNICAL SUBSURFACE EXPLORATION

The purpose of the Geotechnical Subsurface Exploration was to explore the subsurface conditions by performing ten test borings. The test borings were advanced using 3¼-inch diameter hollow-stem augers. Test Borings 1, 2, and 7 were drilled to a depth of ±16 feet below the surface. Test borings 3 through 6, 9, and 10 were drilled to a depth of ±11 feet below the surface. Test Boring 8 was planned to extend ±16 feet below the surface; however, the test boring was terminated at ±14½ feet due to auger refusal, likely caused by cobbles and boulders.

The test boring locations were positioned in the field relative to the approximate property lines and by estimating right angles. The approximate test boring locations are shown on the *Test Boring Location Plan* (Figure 1) enclosed with this letter.

The ground surface elevations at the test borings were determined using differential leveling methods referenced to the temporary benchmark shown on the *Test Boring Location Plan*. The benchmark was at El. 852.16 and the elevation was provided by the project civil engineer (Jahnke & Jahnke Associates, Inc.). The test boring elevations are noted on the *Test Boring Logs* enclosed in Appendix A. The ground surface elevations are considered accurate within approximately one foot.

Samples were collected from the test borings, at certain depths, using a split-barrel sampler during Standard Penetration Testing (SPT), which is described in Appendix B, along with descriptions of other field procedures. Sampling was performed at intervals ranging between 2½± and 5± feet, throughout the test borings, as requested. Immediately after sampling, select portions of the SPT samples were retained in clean jars that were labeled at the site for identification. The retained samples were transported to Giles' geotechnical laboratory as part of the Geotechnical Subsurface Exploration Program.

The boreholes were backfilled upon completion. However, settlement and/or expansion of backfill materials will likely occur, possibly creating a hazard that can cause injury to people and animals. Borehole areas should, therefore, be carefully and routinely monitored by the property owner or others; settlement and/or expansion of backfill materials should be expected, and should be repaired immediately. Giles will not monitor or repair boreholes.

GEOTECHNICAL LABORATORY TESTING

The retained samples were classified using the descriptive terms and particle-size criteria shown on the *General Notes* in Appendix D, and by using the Unified Soil Classification System (ASTM D 2488-75) as a general guide. Classifications are shown on the *Test Boring* Logs, along with horizontal lines that show estimated depths of material change. Field-related information pertaining to the test borings is also on the *Test Boring Logs*. For simplicity and abbreviation, terms and symbols are used on the *Test Boring Logs;* the terms and symbols are defined on the *General Notes*.

The soil samples obtained from the test borings were also visually classified using the USDA textural classification system, in general accordance with the guidelines provided in the *Field Book for Describing and Sampling Soils* (USDA, Sept. 2012), by a State of Wisconsin Certified Soil Tester (CST). The USDA classifications of the retained samples are shown on the Wisconsin DSPS *Soil Evaluation – Storm* logs, enclosed in Appendix A. Supplemental information regarding soil classifications, including the USDA and USCS soil classification systems, is included in the *Soil Classification Notes* enclosure within Appendix D.

SOIL CONDITIONS

As material sampling at the test borings was discontinuous, it was necessary for *Giles* to estimate conditions between sample intervals. The estimated conditions at the test borings are briefly discussed in this section and are described in more detail on the *Test Boring Logs*.

<u>Surface Materials</u>: Approximately 6± to 18± inches of topsoil were at the surface of Test Borings 5, 7, 8, 9, and 10. In general, the topsoil consisted of lean clay with variable amounts of sand and organic matter. Material classified as fill (described below) was at the surface of Test Borings 1, 2, and 4. Native soil (described below) was at the surface of Test Borings 2 and 6.

Fill Material: Material classified as fill was encountered at the surface of Test Borings 1, 3, and 4, and was present to approximately1½ to 5½ feet below the surface. In general, the fill material consisted of lean clay with variable amounts of sand and gravel. At Test Boring 4 the fill material consisted of sand with silt and gravel. Fill was not encountered at the other test borings during sampling. However, it should be noted that because of the relatively widely spaced sampling intervals at shallow depths, it is possible that existing fill materials are present in other locations and not detected during sampling.

Buried Topsoil: Buried topsoil material was encountered below the fill material at Test Borings 3 and 4, and was estimated to be approximately ±24 and ±18 inches thick, respectively. The buried topsoil consisted of lean clay with sand and organic matter.

Native Soils: Native soil was below the fill and buried topsoil, or at the surface of the test borings. At several test borings, lean clay with variable amounts of sand and gravel was encountered between the test boring surface and approximately 3 feet below grade. At Test Boring 3, the lean clay was encountered to the 11-foot test boring termination depth. Sand (variable gradations) with variable amounts of gravel was present below the lean clay, or the surface and fill materials at some test borings, to the test boring termination depths. Cobbles and/or boulders were encountered in the native sand and gravel at several test borings.

GROUNDWATER CONDITIONS

Water was encountered in Test Borings 1, 2, and 7 at depths ranging between 12 and 13 feet below-grade. Groundwater conditions encountered at the test borings, along with the estimated depth and elevation of the seasonal high groundwater table, is shown in the summary table below.

ESTIMATED GROUNDWATER DEPTHS/ELEVATIONS

Test Boring	Depth/Elevation of Water Encountered During Drilling (1) (feet)		Depth/Elevation of Estimated Seasonal High Groundwater Table (2) (feet)	
	Depth	Elevation	Depth	Elevation
1	12	839.8	10	841.8
2	13	839.6	11	841.6
3	> 11	< 841	8.5	843.5
4	> 11	< 841.8	> 9	< 843.8
5	> 11	< 842.6	> 9	< 844.6
6	> 11	< 842.5	> 9	< 844.5
7	13	840.3	11	842.3
8	> 14.5	< 841.4	> 12.5	< 843.4
9	> 11	< 843.8	> 9	< 845.8
10	> 11	< 844.4	> 9	< 846.4

(1) Depth is referenced to the ground surface at the test boring location
(2) Elevation is referenced to the temporary benchmark (assumed El. = 852.16).

Groundwater conditions will fluctuate and perched water conditions could develop at shallower depths, especially within fill materials, depending on precipitation, surface run-off, and other factors.

A more precise estimate of the groundwater conditions could be determined by installing and monitoring observation wells at the site.

The estimated groundwater conditions discussed above is only an approximation based on the depths of encountered water during drilling, the relative moisture contents and redoximorphic features of the retained soil samples and other characteristics of the soil samples. The actual water table elevation might be higher or lower than estimated. If a precise determination of the groundwater conditions is needed, groundwater observation wells are recommended to be installed and monitored at the site. Giles can install and monitor observation wells, if it is decided that a precise determination of the groundwater conditions at the site is necessary.

CLOSURE

We appreciate the opportunity to be of service on this project. If there are any questions, or if we may be of further service should geotechnical problems develop during construction or observation of construction be desired, please do not hesitate to call at any time. General comments and limitations of this letter are given in the appendix.

Very truly yours,

GILES ENGINEERING ASSOCIATES, INC.

D M. Cornale

David M. Cornale, P.E.
Sr. Geotechnical Consultant

Benjamin M. Stark, EIT
Staff Professional I

Enclosures: Appendix A – Figures (1); Test Boring Logs (10); Soil Evaluation – Storm (4 pgs.)
Appendix B – Field Procedures
Appendix C – Laboratory Procedures
Appendix D – General Information

Distribution: Five Points Development, LLC
Attn: Ms. Judy Fuller (2 via USPS; 1 via email: jafw4444@aol.com)

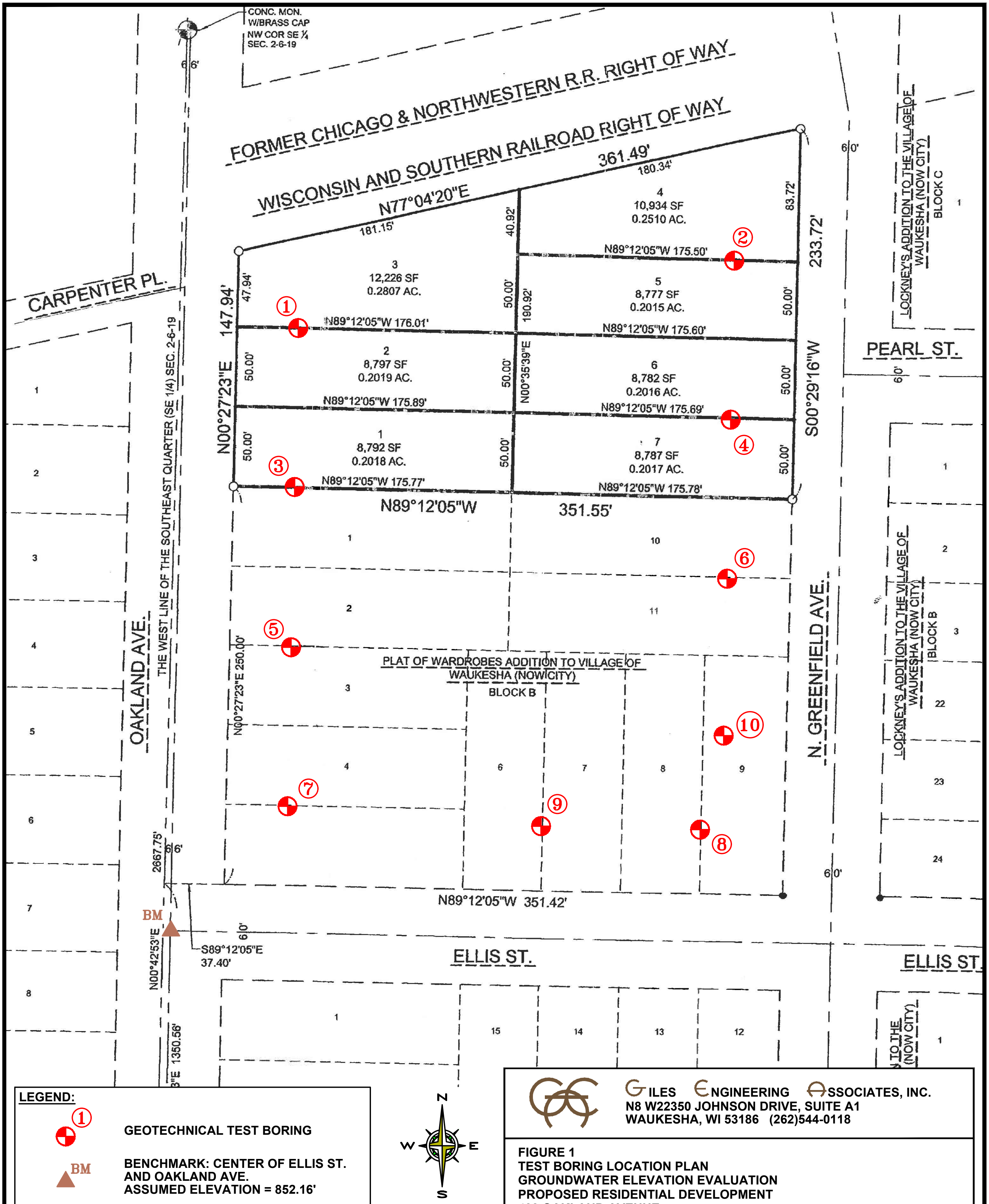
1G-1706002-Letter/17Geo02/bms/bjh

APPENDIX A

FIGURES AND TEST BORING LOGS

The Test Boring Location Plan contained herein was prepared based upon information supplied by *Giles'* client, or others, along with *Giles'* field measurements and observations. The diagram is presented for conceptual purposes only and is intended to assist the reader in report interpretation.

The Test Boring Logs and related information enclosed herein depict the subsurface (soil and water) conditions encountered at the specific boring locations on the date that the exploration was performed. Subsurface conditions may differ between boring locations and within areas of the site that were not explored with test borings. The subsurface conditions may also change at the boring locations over the passage of time.



LEGEND:

①	GEOTECHNICAL TEST BORING
BM	BENCHMARK: CENTER OF ELLIS ST. AND OAKLAND AVE. ASSUMED ELEVATION = 852.16'

NOTES:

1.) TEST BORING LOCATIONS ARE APPROXIMATE.

2.) BASE MAP DEVELOPED FROM THE "AEROSHADE SUBDIVISION" SURVEY", DATED 3-31-17, PREPARED BY JOHN R. STIGLER.

GILES ENGINEERING ASSOCIATES, INC.
N8 W22350 JOHNSON DRIVE, SUITE A1
WAUKESHA, WI 53186 (262)544-0118

FIGURE 1
TEST BORING LOCATION PLAN
GROUNDWATER ELEVATION EVALUATION
PROPOSED RESIDENTIAL DEVELOPMENT
433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

DESIGNED	DRAWN	SCALE	DATE	REVISED
DMC	JSZ	approx. 1"=80'	07-10-17	--

PROJECT NO.: 1G-1706002

CAD No. 1g1706002-blp

BORING NO. & LOCATION: 1

SURFACE ELEVATION: 851.8 feet

COMPLETION DATE: 06/07/17

FIELD REP: JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Fill: Brown lean Clay, trace to little Sand and Gravel - Moist			1-SS	5						(a)
		850								
Brown Silty fine to coarse Sand, some Gravel - Moist			2-SS	11						(b)
Yellow-Brown and Brown fine to coarse Sand and Gravel, trace Silt - Damp to Moist (includes Cobbles)	5		3-SS	21						
		845	4-SS	24						
	10		5-SS	14						
	▽	840								
Brown fine to coarse Sand and Gravel - Wet	15		6-SS	16						

Boring Terminated at about 16 feet (EL. 835.8')

	Water Observation Data
▽	Water Encountered During Drilling: 12 ft.
▼	Water Level At End of Drilling:
░	Cave Depth At End of Drilling:
▼	Water Level After Drilling:
▒	Cave Depth After Drilling:

Remarks:

(a) Poor Sample Recovery

(b) No SPT Sample Recovery; Auger Sample Obtained

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:	SURFACE ELEVATION:	COMPLETION DATE:	FIELD REP:
2	852.6 feet	06/07/17	JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Dark Brown lean Clay, trace Sand - Moist			1-SS	12						
Brown Silty fine to medium Sand, some Gravel - Moist										
Yellow-Brown and Brown fine to coarse Sand, some Gravel - Damp		850	2-SS	33						
Yellow-Brown fine to coarse Sand and Gravel - Damp to Moist (includes Cobbles)	5		3-SS	45						
		845	4-SS	44						
	10		5-SS	45						
	▽	840								
Brown fine to coarse Sand and Gravel - Wet (includes Cobbles)	15		6-SS	36						

Boring Terminated at about 16 feet (EL. 836.6')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling: 13 ft.	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
3

SURFACE ELEVATION:
851.9 feet

COMPLETION DATE:
06/07/17

FIELD REP:
JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Fill: Brown and Dark Brown Sandy lean Clay, trace to little Gravel - Moist			1-SS	10						(a)
		850	2-SS	5						
	5		3-SS	8						
Buried Topsoil: Black Silty Clay, little fine Sand and Organic Matter - Moist		845								
Gray-Brown lean Clay, trace fine Sand - Moist			4-SS	8						
Gray-Brown and Yellow-Brown lean Clay, trace fine Sand - Moist	10		5-SS	9						

Boring Terminated at about 11 feet (EL. 840.9')

	Water Observation Data	**Remarks:**
▽	Water Encountered During Drilling:	(a) No SPT Sample Recovery; Auger Sample Obtained
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION: 4	# TEST BORING LOG	**GILES ENGINEERING ASSOCIATES, INC.**
SURFACE ELEVATION: 852.8 feet	RESIDENTIAL DEVELOPMENT 433 OAKLAND AVENUE WAUKESHA, WISCONSIN PROJECT NO: 1G-1706002	
COMPLETION DATE: 06/07/17		
FIELD REP: JAMES BLAIR		

MATERIAL DESCRIPTION	**Depth (ft)**	**Elevation**	**Sample No. & Type**	**N**	**Q$_u$ (tsf)**	**Q$_p$ (tsf)**	**Q$_s$ (tsf)**	**W (%)**	**PID**	**NOTES**
Fill: Brown fine to medium Sand, little Gravel and Silt - Moist			1-SS	5						
Buried Topsoil: Dark Gray-Brown to Black lean Clay, trace to little Organic Matter - Moist		850	2-SS	5						
Orange-Brown fine to medium Sand, little Silt and Gravel - Moist										
Yellow-Brown to Brown fine to coarse Sand and Gravel - Damp to Moist (includes Cobbles/Boulders)	5		3-SS	9						
		845	4-SS	27						
	10		5-SS	59						

Boring Terminated at about 11 feet (EL. 841.8')

	Water Observation Data	**Remarks:**
▽	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
5

SURFACE ELEVATION:
853.6 feet

COMPLETION DATE:
06/07/17

FIELD REP:
JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Topsoil: Brown lean Clay, little fine Sand and Organic Matter - Moist			1-SS	4						
Brown lean Clay, trace fine Sand - Moist										
Yellow-Brown to Brown fine to coarse Sand and Gravel - Damp (includes Cobbles/Boulders)			2-SS	48						
		850								
	5		3-SS	48						
			4-SS	64						
		845								
	10		5-SS	50/4"						

Boring Terminated at about 11 feet (EL. 842.6')

	Water Observation Data	**Remarks:**
∇	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
6

SURFACE ELEVATION:
853.5 feet

COMPLETION DATE:
06/07/17

FIELD REP:
JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION		Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Brown lean Clay, little Sand and Gravel - Moist	▨			1-SS	5						
Light Brown to Brown fine to coarse Sand, some Gravel, trace to little Silt - Moist	░										
Yellow-Brown to Brown fine to coarse Sand and Gravel - Damp (includes Cobbles/Boulders)	░			2-SS	50						
			850								
		5		3-SS	76						
				4-SS	50/5"						(a)
			845								
		10		5-SS	97						

Boring Terminated at about 11 feet (EL. 842.5')

GILES LOG REPORT 1G1706002.GPJ GILES.GDT 7/10/17

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling:	(a) Poor Sample Recovery
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
7

SURFACE ELEVATION:
853.3 feet

COMPLETION DATE:
06/07/17

FIELD REP:
JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Topsoil: Black lean Clay, little fine Sand and Organic Matter - Moist			1-SS	4						
Brown lean Clay, trace fine Sand - Moist										
Brown Sandy lean Clay - Moist			2-SS	7						
Brown Silty fine to medium Sand - Moist		850								
Yellow-Brown and Brown fine to coarse Sand and Gravel - Damp to Moist (includes Cobbles/Boulders)	5		3-SS	52						
			4-SS	60						
		845								
	10		5-SS	45						
Brown fine to coarse Sand and Gravel - Wet	▽	840								
	15		6-SS	15						

Boring Terminated at about 16 feet (EL. 837.3')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling: 13 ft.	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
8

SURFACE ELEVATION:
855.8 feet

COMPLETION DATE:
06/07/17

FIELD REP:
JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Topsoil: Dark Brown to Black lean Clay, trace Sand - Moist		855	1-SS	5						
Brown lean Clay, trace fine Sand - Moist										
Brown Silty fine to medium Sand, some Gravel - Moist			2-SS	21						
Yellow-Brown and Brown fine to coarse Sand and Gravel - Damp (includes Cobbles/Boulders)	5	850	3-SS	58						
			4-SS	50/2"						(a)
	10	845	5-SS	53						
			6-SS	50/0"						

Boring Terminated at about 14.5 feet (EL. 841.3')

	Water Observation Data	**Remarks:**
▽	Water Encountered During Drilling:	(a) No Sample Recovery
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
9

SURFACE ELEVATION:
854.8 feet

COMPLETION DATE:
06/07/17

FIELD REP:
JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Topsoil: Black lean Clay, little Sand and Organic Matter - Moist Gray-Brown and Brown lean Clay, trace fine Sand - Moist			1-SS	5						
Yellow-Brown fine to coarse Sand, little Gravel, trace Silt - Moist			2-SS	22						
Yellow-Brown and Brown fine to coarse Sand and Gravel - Damp (includes Cobbles/Boulders)	5	850	3-SS	52						
			4-SS	42						
	10	845	5-SS	42						

Boring Terminated at about 11 feet (EL. 843.8')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
10

SURFACE ELEVATION:
855.3 feet

COMPLETION DATE:
06/07/17

FIELD REP:
JAMES BLAIR

TEST BORING LOG

RESIDENTIAL DEVELOPMENT

433 OAKLAND AVENUE
WAUKESHA, WISCONSIN

PROJECT NO: 1G-1706002

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
Topsoil: Black lean Clay, trace to little fine Sand and Organic Matter - Moist		855	1-SS	5						
Brown lean Clay, trace fine Sand - Moist			2-SS	19						
Brown Silty fine to medium Sand, little Gravel - Moist										
Yellow-Brown to Brown fine to coarse Sand and Gravel - Damp (includes Cobbles/Boulders)	5	850	3-SS	30						
			4-SS	53						
	10	845	5-SS	57						

Boring Terminated at about 11 feet (EL. 844.3')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▒	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

Wis. Dept. of Safety and Professional Services
Division of Safety and Buildings

SOIL EVALUATION - STORM

in accordance with SPS 382.365 and 385,, Wis. Adm. Code

Attach complete site plan on paper not less than 8½ x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s, 15.04 (1) (m)).

County
Parcel I.D.
Reviewed by　　Date

Property Owner
C/O Five Points Development, LLC

Property Location
Govt. Lot　　SE ¼　　S 2　　T 6N　　R 19E

Property Owner's Mailing Address
1242 Lincoln Avenue

Lot #　　Block #　　Subd. Name or CSM#
Address: 433 Oakland Avenue

City: Waukesha　　State: WI　　Zip Code: 53186　　Phone Number: (　)

x City　　Village　　Town　　Nearest Road
Waukesha　　　　　　Oakland Avenue

Drainage area __________________ sq. ft. acres
Optional:
Test Site Suitable for (check all that apply)

Irrigation　　Bioretention trench　　Trench(es)
Rain garden　　Grassed swale　　Reuse
Infiltration trench　　SDS (>15' wide)　　Other ________

Hydraulic Application Test Method:

X Morphological Evaluation
Double-Ring Infiltrometer
Other (specify) ______________________

x Boring
1 Obs. #　　☐ Pit　　Ground surface elev. 851.8 ft.　　Depth to limiting factor 144 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
Fill	0-24	10YR 3/3		SICL	MA	M, FI	C, S	10	0.04
B_1	24.48	10YR 5/3		SL	0,3, GR	M, FI	G, W	30	0.50
B/C	48-144	10YR 5/4		S	SG	M, VFI	C, W	50	3.60
C	144-192	10YR 4/4		S	SG	M, FI	--	50	--

Note: Water encountered at 12 feet during drilling.

x Boring
2 Obs. #　　☐ Pit　　Ground surface elevation 852.6 ft.　　Depth to limiting factor 156 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
B_1	0-6	10YR 3/2		SICL	2,2, SBK	M, FI	A, S	<5	0.04
B_2	6-13	10YR 4/2		LS	1,1, GR	M, FI	C, W	35	1.63
B/C	18-48	10YR 5/3		S	1,3, GR	M, VFI	G, W	40	3.60
C_1	48-156	10YR 5/4		S	SG	M, VFI	C, W	50	3.60
C_2	156-192	10YR 4/4		S	SG	M, VFI	--	50	--

Note: Water encountered at 13± feet during drilling.

CST/PSS Name (Please Print): David M. Cornale
Signature
CST/PSS Number: 984619

Address: 520 S. East Avenue, Waukesha, WI
Date Evaluation Conducted: 6/7/2017
Telephone Number: 262-544-0118

3 Obs. #
x Boring
☐ Pit Ground surface elevation 851.9 ft. Depth to limiting factor 102 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
Fill	0-66	10YR 3/2		CL	MA	M, FI	A, S	10	0.03
A	66-90	10YR 2/1		SICL	1,2, SBK	M, FR	C, S	<5	0.04
B_1	90-102	10YR 5/2		SICL	2,Z, SRK	M, FI	C, S	<5	0.04
B_2	102-132	10YR 5/4	M, 2, D 10YR 5/2	SICL	Z, Z, SBK	M, FI	--		--

4 Obs. #
x Boring
☐ Pit Ground surface elevation 852.8 ft. Depth to limiting factor ________ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
FILL	0-18	10YR 5/3		LS	MA	M, FI	A, S	15	1.63
A	18-36	10YR 3/2		SICL	1,2, SBK	M, FR	A, S	<5	0.04
B	36-60	10YR 5/6		LS	1,1, GR	M, FI	G, W	25	1.63
C	60-132	10YR 5/4		S	SG	M, VFI	--	50	3.60

5 Obs. #
x Boring
☐ Pit Ground surface elevation 853.6 ft. Depth to limiting factor ________ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
A	0-16	10YR 2/1		SICL	1, 2, SBK	M, FR	A, S	<5	0.04
B	16-30	10YR 4/3		SICL	2, 2, SBK	M, FI	C, S	<5	0.04
C	30-132	10YR 5/4		S	SG	M, VFI	--	50	3.60

6 Obs. #

x Boring
☐ Pit Ground surface elevation 853.5 ft. Depth to limiting factor ________ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
B	0-18	10YR 4/4		SICL	1,1 SBK	M, FI	C, S	15	0.04
B/C	18-30	10YR 5/3		S	SG	M, FI	G, W	35	3.60
C	30-132	10YR 5/4		S	SG	M, VFI		50	3.60

7 Obs. #

x Boring
☐ Pit Ground surface elevation 853.3 ft. Depth to limiting factor 156 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
A	0-16	10YR 2/1		SICL	1,2 SBK	M, FR	A, S	<5	0.04
B_1	16-30	10YR 4/4		SICL	2,2, SBK	M, FI	C, S	<5	0.04
B_2	30-36	10YR 4/4		SCL	2,1, ABK	M, FI	G, W	<5	0.04
B_2	36-48	10YR 4/6		LS	1,1, GR	M, FI	C, S	<5	1.63
C_1	48-156	10YR 5/4		S	SG	M, VFI	C, S	50	3.60
C_2	156-192	10YR 5/3		S	SG	M, VFI	--	50	--

Note: Water encountered at 13± feet during drilling.

8 Obs. #

x Boring
☐ Pit Ground surface elevation 853.3 ft. Depth to limiting factor 156 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
A	0-16	10YR 2/1		SICL	1,2 SBK	M, FR	A, S	<5	0.04
B_1	16-30	10YR 4/4		SICL	2,2, SBK	M, FI	C, S	<5	0.04
B_2	30-36	10YR 4/4		SCL	2,1, ABK	M, FI	G, W	20	1.63
C	36-174	10YR 5/4		S	SG	M, VFI	--	50	3.60

9 Obs. #
x Boring
☐ Pit Ground surface elevation 854.8 ft. Depth to limiting factor ________ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
A	0-6	10YR 2/1		SICL		M, FR	A, S	<5	0.04
B_1	6-24	10YR 4/2		SICL		M, FI	C, W	<5	0.04
B_2	24-48	10YR 5/6		S		M, FI	G, W	15	3.60
C	48-132	10YR 5/4		S	SG	M, FI	--	50	3.60

10 Obs. #
x Boring
☐ Pit Ground surface elevation 853.3 ft. Depth to limiting factor 156 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr.
A	0-18	10YR 2/1		SICL	1,2 SBK	M, FR	A, S	<5	0.04
B_1	18-36	10YR 4/4		SICL	2,2, SBK	M, FI	C, S	<5	0.04
B_2	3648	10YR 5/4		LS	1,1, ABK	M, FI	G, W	20	1.63
C	48-132	10YR 6/4		S	SG	M, VFI	--	50	--

Note: Water encountered at 13± feet during drilling.

Test Results and/or Summary Comments

APPENDIX B

FIELD PROCEDURES

The field operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) designation D

420 entitled "Standard Guide for Sampling Rock and Rock" and/or other relevant specifications. Soil samples were preserved and transported to *Giles'* laboratory in general accordance with the procedures recommended by ASTM designation D 4220 entitled "Standard Practice for Preserving and Transporting Soil Samples." Brief descriptions of the sampling, testing and field procedures commonly performed by *Giles* are provided herein.

GENERAL FIELD PROCEDURES

Test Boring Elevations

The ground surface elevations reported on the Test Boring Logs are referenced to the assumed benchmark shown on the Boring Location Plan (Figure 1). Unless otherwise noted, the elevations were determined with a conventional hand-level and are accurate to within about 1 foot.

Test Boring Locations

The test borings were located on-site based on the existing site features and/or apparent property lines. Dimensions illustrating the approximate boring locations are reported on the Boring Location Plan (Figure 1).

Water Level Measurement

The water levels reported on the Test Boring Logs represent the depth of "free" water encountered during drilling and/or after the drilling tools were removed from the borehole. Water levels measured within a granular (sand and gravel) soil profile are typically indicative of the water table elevation. It is usually not possible to accurately identify the water table elevation with cohesive (clayey) soils, since the rate of seepage is slow. The water table elevation within cohesive soils must therefore be determined over a period of time with groundwater observation wells.

It must be recognized that the water table may fluctuate seasonally and during periods of heavy precipitation. Depending on the subsurface conditions, water may also become perched above the water table, especially during wet periods.

Borehole Backfilling Procedures

Each borehole was backfilled upon completion of the field operations. If potential contamination was encountered, and/or if required by state or local regulations, boreholes were backfilled with an "impervious" material (such as bentonite slurry). Borings that penetrated pavements, sidewalks, etc. were "capped" with Portland Cement concrete, asphaltic concrete, or a similar surface material. It must, however, be recognized that the backfill material may settle, and the surface cap may subside, over a period of time. Further backfilling and/or re-surfacing by *Giles'* client or the property owner may be required.

FIELD SAMPLING AND TESTING PROCEDURES

Auger Sampling (AU)

Soil samples are removed from the auger flights as an auger is withdrawn above the ground surface. Such samples are used to determine general soil types and identify approximate soil stratifications. Auger samples are highly disturbed and are therefore not typically used for geotechnical strength testing.

Split-Barrel Sampling (SS) – (ASTM D-1586)

A split-barrel sampler with a 2-inch outside diameter is driven into the subsoil with a 140-pound hammer free-falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the “Standard Penetration Resistance” or N-value is an index of the relative density of granular soils and the comparative consistency of cohesive soils. A soil sample is collected from each SPT interval.

Shelby Tube Sampling (ST) – (ASTM D-1587)

A relatively undisturbed soil sample is collected by hydraulically advancing a thin-walled Shelby Tube sampler into a soil mass. Shelby Tubes have a sharp cutting edge and are commonly 2 to 5 inches in diameter.

Bulk Sample (BS)

A relatively large volume of soils is collected with a shovel or other manually-operated tool. The sample is typically transported to *Giles’* materials laboratory in a sealed bag or bucket.

Dynamic Cone Penetration Test (DC) – (ASTM STP 399)

This test is conducted by driving a 1.5-inch-diameter cone into the subsoil using a 15-pound steel ring (hammer), free-falling a vertical distance of 20 inches. The number of hammer-blows required to drive the cone 1¾ inches is an indication of the soil strength and density, and is defined as “N”. The Dynamic Cone Penetration test is commonly conducted in hand auger borings, test pits and within excavated trenches.

- Continued -

Ring-Lined Barrel Sampling – (ASTM D 3550)

In this procedure, a ring-lined barrel sampler is used to collect soil samples for classification and laboratory testing. This method provides samples that fit directly into laboratory test instruments without additional handling/disturbance.

Sampling and Testing Procedures

The field testing and sampling operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the field testing (i.e. N-values) are reported on the Test Boring Logs. Explanations of the terms and symbols shown on the logs are provided on the appendix enclosure entitled “General Notes”.

APPENDIX C

LABORATORY TESTING AND CLASSIFICATION

The laboratory testing was conducted under the supervision of a geotechnical engineer in accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Brief descriptions of laboratory tests commonly performed by *Giles* are provided herein.

LABORATORY TESTING AND CLASSIFICATION

Photoionization Detector (PID)

In this procedure, soil samples are “scanned” in *Giles’* analytical laboratory using a Photoionization Detector (PID). The instrument is equipped with an 11.7 eV lamp calibrated to a Benzene Standard and is capable of detecting a minute concentration of **certain** Volatile Organic Compound (VOC) vapors, such as those commonly associated with petroleum products and some solvents. Results of the PID analysis are expressed in HNu (manufacturer’s) units rather than actual concentration.

Moisture Content (w) (ASTM D 2216)

Moisture content is defined as the ratio of the weight of water contained within a soil sample to the weight of the dry solids within the sample. Moisture content is expressed as a percentage.

Unconfined Compressive Strength (qu) (ASTM D 2166)

An axial load is applied at a uniform rate to a cylindrical soil sample. The unconfined compressive strength is the maximum stress obtained or the stress when 15% axial strain is reached, whichever occurs first.

Calibrated Penetrometer Resistance (qp)

The small, cylindrical tip of a hand-held penetrometer is pressed into a soil sample to a prescribed depth to measure the soils capacity to resist penetration. This test is used to evaluate unconfined compressive strength.

Vane-Shear Strength (qs)

The blades of a vane are inserted into the flat surface of a soil sample and the vane is rotated until failure occurs. The maximum shear resistance measured immediately prior to failure is taken as the vane-shear strength.

Loss-on-Ignition (ASTM D 2974; Method C)

The Loss-on-Ignition (L.O.I.) test is used to determine the organic content of a soil sample. The procedure is conducted by heating a dry soil sample to 440°C in order to burn-off or “ash” organic matter present within the sample. The L.O.I. value is the ratio of the weight loss due to ignition compared to the initial weight of the dry sample. L.O.I. is expressed as a percentage.

Particle Size Distribution (ASTB D 421, D 422, and D 1140)

This test is performed to determine the distribution of specific particle sizes (diameters) within a soil sample. The distribution of coarse-grained soil particles (sand and gravel) is determined from a “sieve analysis,” which is conducted by passing the sample through a series of nested sieves. The distribution of fine-grained soil particles (silt and clay) is determined from a “hydrometer analysis” which is based on the sedimentation of particles suspended in water.

Consolidation Test (ASTM D 2435)

In this procedure, a series of cumulative vertical loads are applied to a small, laterally confined soil sample. During each load increment, vertical compression (consolidation) of the sample is measured over a period of time. Results of this test are used to estimate settlement and time rate of settlement.

Classification of Samples

Each soil sample was visually-manually classified, based on texture and plasticity, in general accordance with the Unified Soil Classification System (ASTM D-2488-75). The classifications are reported on the Test Boring Logs.

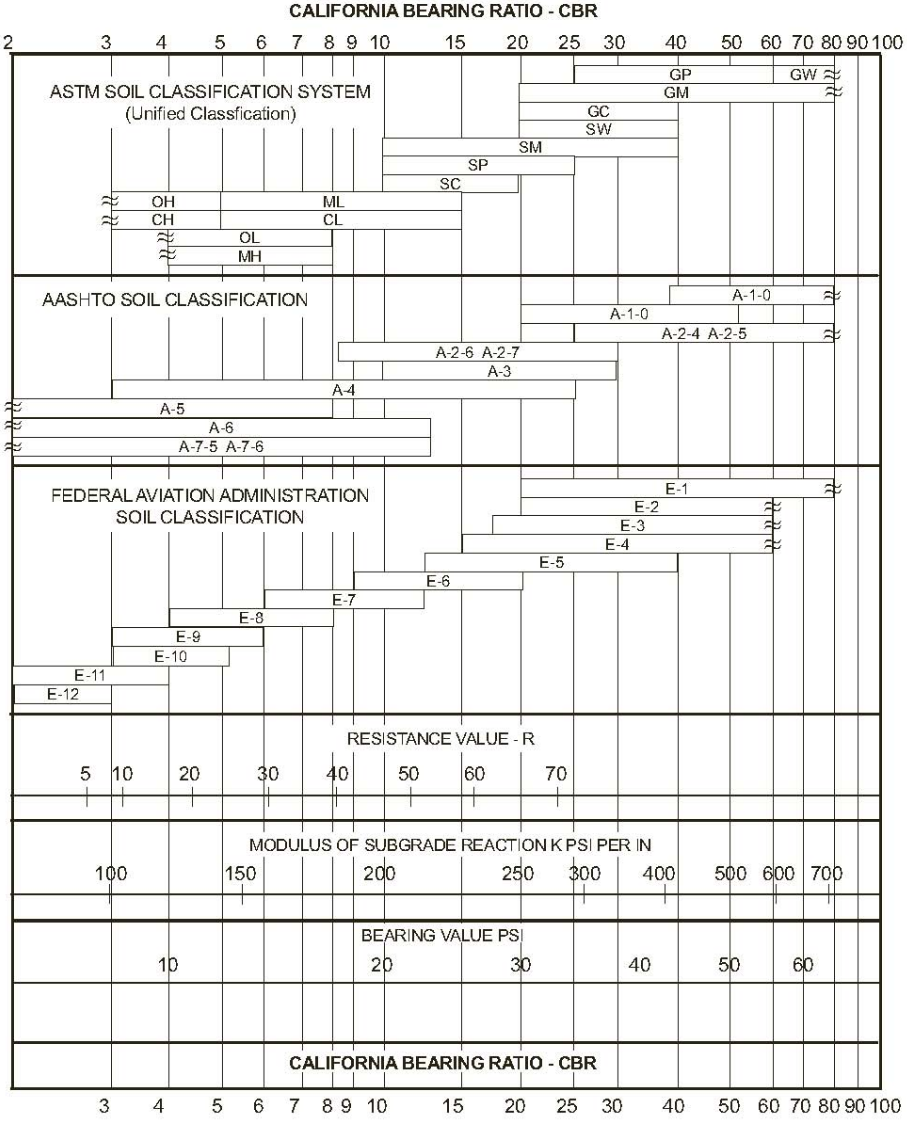
Laboratory Testing

The laboratory testing operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the laboratory tests are provided on the Test Boring Logs or other appendix enclosures. Explanation of the terms and symbols used on the logs is provided on the appendix enclosure entitled “General Notes.”

California Bearing Ratio (CBR) Test ASTM D-1833

The CBR test is used for evaluation of a soil subgrade for pavement design. The test consists of measuring the force required for a 3-square-inch cylindrical piston to penetrate 0.1 or 0.2 inch into a compacted soil sample. The result is expressed as a percent of force required to penetrate a standard compacted crushed stone.

Unless a CBR test has been specifically requested by the client, the CBR is estimated from published charts, based on soil classification and strength characteristics. A typical correlation chart is below.



APPENDIX D

GENERAL INFORMATION

GUIDE SPECIFICATIONS FOR SUBGRADE AND GRADE PREPARATION FOR FILL, FOUNDATION, FLOOR SLAB AND PAVEMENT SUPPORT; AND SELECTION, PLACEMENT AND COMPACTION OF FILL SOILS USING STANDARD PROCTOR PROCEDURES

1. Construction monitoring and testing of subgrades and grades for fill, foundation, floor slab and pavement; and fill selection, placement and compaction shall be performed by an experienced soils engineer and/or his representatives.

2. All compaction fill, subgrades and grades shall be (a) underlain by suitable bearing material; (b) free of all organic, frozen, or other deleterious material, and (c) observed, tested and approved by qualified engineering personnel representing an experienced soils engineer. Preparation of subgrades after stripping vegetation, organic or other unsuitable materials shall consist of (a) proof-rolling to detect soil, wet yielding soils or other unstable materials that must be undercut, (b) scarifying top 6 to 8 inches, (c) moisture conditioning the soils as required, and (d) recompaction to same minimum in-situ density required for similar materials indicated under Item 5. Note: compaction requirements for pavement subgrade are higher than other areas. Weather and construction equipment may damage compacted fill surface and reworking and retesting may be necessary to assure proper performance.

3. In overexcavation and fill areas, the compacted fill must extend (a) a minimum 1 foot lateral distance beyond the exterior edge of the foundation at bearing grade or pavement subgrade and down to compacted fill subgrade on a maximum 0.5(H):1(V) slope, (b) 1 foot above footing grade outside the building, and (c) to floor subgrade inside the building. Fill shall be placed and compacted on a 5(H):1(V) slope or must be stepped or benched as required to flatten if not specifically approved by qualified personnel under the direction of an experienced soil engineer.

4. The compacted fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as “contaminated”, and shall be low-expansive with a maximum Liquid Limit (ASTM D-423) and Plasticity Index (ASTM D-424) of 30 and 15, respectively, unless specifically tested and found to have low expansive properties and approved by an experienced soils engineer. The top 12 inches of compacted fill should have a maximum 3-inch-particle diameter and all underlying compacted fill a maximum 6-inch-diameter unless specifically approved by an experienced soils engineer. All fill materials must be tested and approved under the direction of an experienced soils engineer prior to placement. If the fill is to provide non-frost susceptible characteristics, it must be classified as a clean GW, GP, SW or SP per the Unified Soil Classification System (ASTM D-2487).

5. For structural fill depths less than 20 feet, the density of the structural compacted fill and scarified subgrade and grades shall not be less than 95 percent of the maximum dry density as determined by Standard Proctor (ASTM-698) with the exception of the top 12 inches of pavement subgrade which shall have a minimum in-situ density of 100 percent of maximum dry density, or 5 percent higher than underlying fill materials. Where the structural fill depth is greater than 20 feet, the portions below 20 feet should have a minimum in-place density of 100 percent of its maximum dry density of 5 percent greater than the top 20 feet. The moisture content of cohesive soil shall not vary by more than -1 to +3 percent and granular soil ±3 percent of the optimum when placed and compacted or recompacted, unless specifically recommended/approved by the soils engineer monitoring the placement and compaction. Cohesive soils with moderate to high expansion potentials (PI>15) should, however, be placed, compacted and maintained prior to construction at a moisture content 3±1 percent above optimum moisture content to limit further heave. The fill shall be placed in layers with a maximum loose thickness of 8 inches for foundations and 10 inches for floor slabs and pavement, unless specifically approved by the soils engineer taking into consideration the type of materials and compaction equipment being used. The compaction equipment should consist of suitable mechanical equipment specifically designed for soil compaction. Bulldozers or similar tracked vehicles are typically not suitable for compaction.

6. Excavation, filling, subgrade and grade preparation shall be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs and seepage water encountered shall be pumped or drained to provide a suitable working platform. Springs or water seepage encountered during grading/foundation construction must be called to the soil engineer’s attention immediately for possible construction procedure revision or inclusion of an underdrain system.

7. Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below-grade walls (i.e. basement walls and retaining walls) must be properly tested and approved by an experienced soils engineer with consideration for the lateral pressure used in the wall design.

8. Whenever, in the opinion of the soils engineer or the Owner’s Representatives, an unstable condition is being created either by cutting or filling, the work shall not proceed into that area until an appropriate geotechnical exploration and analysis has been performed and the grading plan revised, if found necessary.

GENERAL COMMENTS

The soil samples obtained during the subsurface exploration will be retained for a period of thirty days. If no instructions are received, they will be disposed of at that time.

This report has been prepared exclusively for the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. Copies of this report may be provided to contractor(s), with contract documents, to disclose information relative to this project. The report, however, has not been prepared to serve as the plans and specifications for actual construction without the appropriate interpretation by the project architect, structural engineer, and/or civil engineer. Reproduction and distribution of this report must be authorized by the client and *Giles*.

This report has been based on assumed conditions/characteristics of the proposed development where specific information was not available. It is recommended that the architect, civil engineer and structural engineer along with any other design professionals involved in this project carefully review these assumptions to ensure they are consistent with the actual planned development. When discrepancies exist, they should be brought to our attention to ensure they do not affect the conclusions and recommendations provided herein. The project plans and specifications may also be submitted to *Giles* for review to ensure that the geotechnical related conclusions and recommendations provided herein have been correctly interpreted.

The analysis of this site was based on a subsoil profile interpolated from a limited subsurface exploration. If the actual conditions encountered during construction vary from those indicated by the borings, *Giles* must be contacted immediately to determine if the conditions alter the recommendations contained herein.

The conclusions and recommendations presented in this report have been promulgated in accordance with generally accepted professional engineering practices in the field of geotechnical engineering. No other warranty is either expressed or implied.

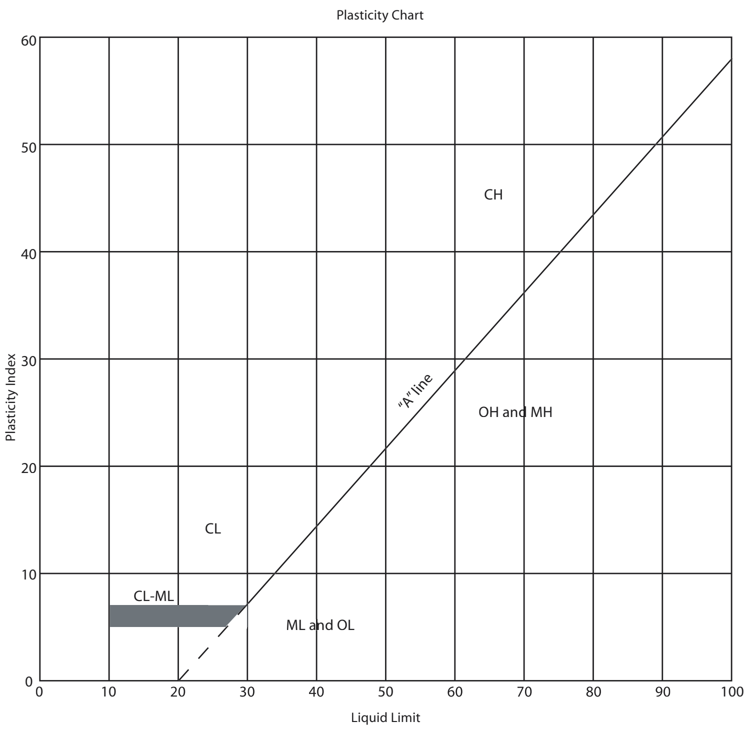
CHARACTERISTICS AND RATINGS OF UNIFIED SOIL SYSTEM CLASSES FOR SOIL CONSTRUCTION *

Class	Compaction Characteristics	Max. Dry Density Standard Proctor (pcf)	Compressibility and Expansion	Drainage and Permeability	Value as an Embankment Material	Value as Subgrade When Not Subject to Frost	Value as Base Course	Value as Temporary Pavement	
								With Dust Palliative	With Bituminous Treatment
GW	Good: tractor, rubber-tired, steel wheel or vibratory roller	125-135	Almost none	Good drainage, pervious	Very stable	Excellent	Good	Fair to poor	Excellent
GP	Good: tractor, rubber-tired, steel wheel or vibratory roller	115-125	Almost none	Good drainage, pervious	Reasonably stable	Excellent to good	Poor to fair	Poor	
GM	Good: rubber-tired or light sheepsfoot roller	120-135	Slight	Poor drainage, semipervious	Reasonably stable	Excellent to good	Fair to poor	Poor	Poor to fair
GC	Good to fair: rubber-tired or sheepsfoot roller	115-130	Slight	Poor drainage, impervious	Reasonably stable	Good	Good to fair **	Excellent	Excellent
SW	Good: tractor, rubber-tired or vibratory roller	110-130	Almost none	Good drainage, pervious	Very stable	Good	Fair to poor	Fair to poor	Good
SP	Good: tractor, rubber-tired or vibratory roller	100-120	Almost none	Good drainage, pervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SM	Good: rubber-tired or sheepsfoot roller	110-125	Slight	Poor drainage, impervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SC	Good to fair: rubber-tired or sheepsfoot roller	105-125	Slight to medium	Poor drainage, impervious	Reasonably stable	Good to fair	Fair to poor	Excellent	Excellent
ML	Good to poor: rubber-tired or sheepsfoot roller	95-120	Slight to medium	Poor drainage, impervious	Poor stability, high density required	Fair to poor	Not suitable	Poor	Poor
CL	Good to fair: sheepsfoot or rubber-tired roller	95-120	Medium	No drainage, impervious	Good stability	Fair to poor	Not suitable	Poor	Poor
OL	Fair to poor: sheepsfoot or rubber-tired roller	80-100	Medium to high	Poor drainage, impervious	Unstable, should not be used	Poor	Not suitable	Not suitable	Not suitable
MH	Fair to poor: sheepsfoot or rubber-tired roller	70-95	High	Poor drainage, impervious	Poor stability, should not be used	Poor	Not suitable	Very poor	Not suitable
CH	Fair to poor: sheepsfoot roller	80-105	Very high	No drainage, impervious	Fair stability, may soften on expansion	Poor to very poor	Not suitable	Very poor	Not suitable
OH	Fair to poor: sheepsfoot roller	65-100	High	No drainage, impervious	Unstable, should not be used	Very poor	Not suitable	Not suitable	Not suitable
Pt	Not suitable		Very high	Fair to poor drainage	Should not be used	Not suitable	Not suitable	Not suitable	Not suitable

* "The Unified Classification: Appendix A - Characteristics of Soil, Groups Pertaining to Roads and Airfields, and Appendix B - Characteristics of Soil Groups Pertaining to Embankments and Foundations," Technical Memorandum 357, U.S. Waterways Ixperiment Station, Vicksburg, 1953.

** Not suitable if subject to frost.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

Major Divisions			*Group Symbols*		*Typical Names*	*Laboratory Classification Criteria*		
Coarse-grained soils (more than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent: GW, GP, SW, SP More than 12 percent: GM, GC, SM, SC 5 to 12 percent: *Borderline* cases requiring dual symbols[b]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtrues, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		Pt		Peat and other highly organic soils			

[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits, suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u is used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group sympols. For example GW-GC, well-graded gravel-sand mixture with clay binder.

GENERAL NOTES

SAMPLE IDENTIFICATION

All samples are visually classified in general accordance with the Unified Soil Classification System (ASTM D-2487-75 or D-2488-75)

DESCRIPTIVE TERM (% BY DRY WEIGHT)

Trace:	1-10%
Little:	11-20%
Some:	21-35%
And/Adjective	36-50%

PARTICLE SIZE (DIAMETER)

Boulders:	8 inch and larger
Cobbles:	3 inch to 8 inch
Gravel:	coarse - ¾ to 3 inch
	fine – No. 4 (4.76 mm) to ¾ inch
Sand:	coarse – No. 4 (4.76 mm) to No. 10 (2.0 mm)
	medium – No. 10 (2.0 mm) to No. 40 (0.42 mm)
	fine – No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt:	No. 200 (0.074 mm) and smaller (non-plastic)
Clay:	No 200 (0.074 mm) and smaller (plastic)

SOIL PROPERTY SYMBOLS

Dd:	Dry Density (pcf)
LL:	Liquid Limit, percent
PL:	Plastic Limit, percent
PI:	Plasticity Index (LL-PL)
LOI:	Loss on Ignition, percent
Gs:	Specific Gravity
K:	Coefficient of Permeability
w:	Moisture content, percent
qp:	Calibrated Penetrometer Resistance, tsf
qs:	Vane-Shear Strength, tsf
qu:	Unconfined Compressive Strength, tsf
qc:	Static Cone Penetrometer Resistance (correlated to Unconfined Compressive Strength, tsf)
PID:	Results of vapor analysis conducted on representative samples utilizing a Photoionization Detector calibrated to a benzene standard. Results expressed in HNU-Units. (BDL=Below Detection Limit)
N:	Penetration Resistance per 12 inch interval, or fraction thereof, for a standard 2 inch O.D. (1⅜ inch I.D.) split spoon sampler driven with a 140 pound weight free-falling 30 inches. Performed in general accordance with Standard Penetration Test Specifications (ASTM D-1586). N in blows per foot equals sum of N-Values where plus sign (+) is shown.
Nc:	Penetration Resistance per 1¾ inches of Dynamic Cone Penetrometer. Approximately equivalent to Standard Penetration Test N-Value in blows per foot.
Nr:	Penetration Resistance per 12 inch interval, or fraction thereof, for California Ring Sampler driven with a 140 pound weight free-falling 30 inches per ASTM D-3550. Not equivalent to Standard Penetration Test N-Value.

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon
ST:	Shelby Tube – 3 inch O.D. (except where noted)
CS:	3 inch O.D. California Ring Sampler
DC:	Dynamic Cone Penetrometer per ASTM Special Technical Publication No. 399
AU:	Auger Sample
DB:	Diamond Bit
CB:	Carbide Bit
WS:	Wash Sample
RB:	Rock-Roller Bit
BS:	Bulk Sample
Note:	Depth intervals for sampling shown on Record of Subsurface Exploration are not indicative of sample recovery, but position where sampling initiated

SOIL STRENGTH CHARACTERISTICS

COHESIVE (CLAYEY) SOILS

COMPARATIVE CONSISTENCY	**BLOWS PER FOOT (N)**	**UNCONFINED COMPRESSIVE STRENGTH (TSF)**
Very Soft	0 - 2	0 - 0.25
Soft	3 - 4	0.25 - 0.50
Medium Stiff	5 – 8	0.50 - 1.00
Stiff	9 – 15	1.00 - 2.00
Very Stiff	16 – 30	2.00 - 4.00
Hard	31+	4.00+

NON-COHESIVE (GRANULAR) SOILS

RELATIVE DENSITY	**BLOWS PER FOOT (N)**
Very Loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	51+

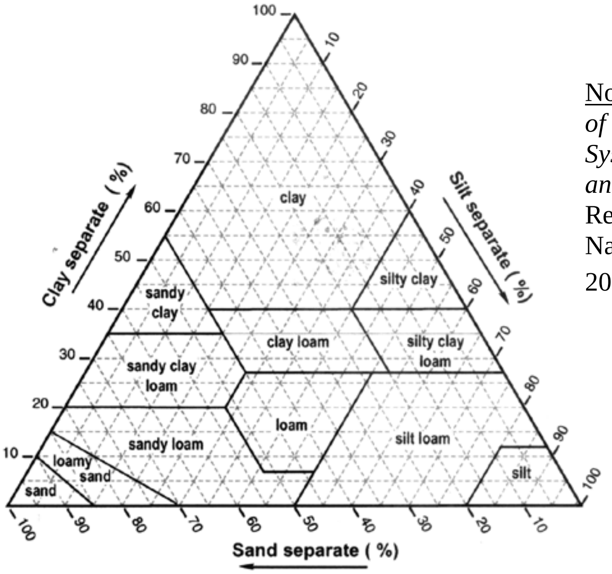
DEGREE OF PLASTICITY	**PI**
None to Slight	0 - 4
Slight	5 - 10
Medium	11 - 30
High to Very High	31+

DEGREE OF EXPANSIVE POTENTIAL	**PI**
Low	0 - 15
Medium	15 - 25
High	25+

SOIL CLASSIFICATION NOTES

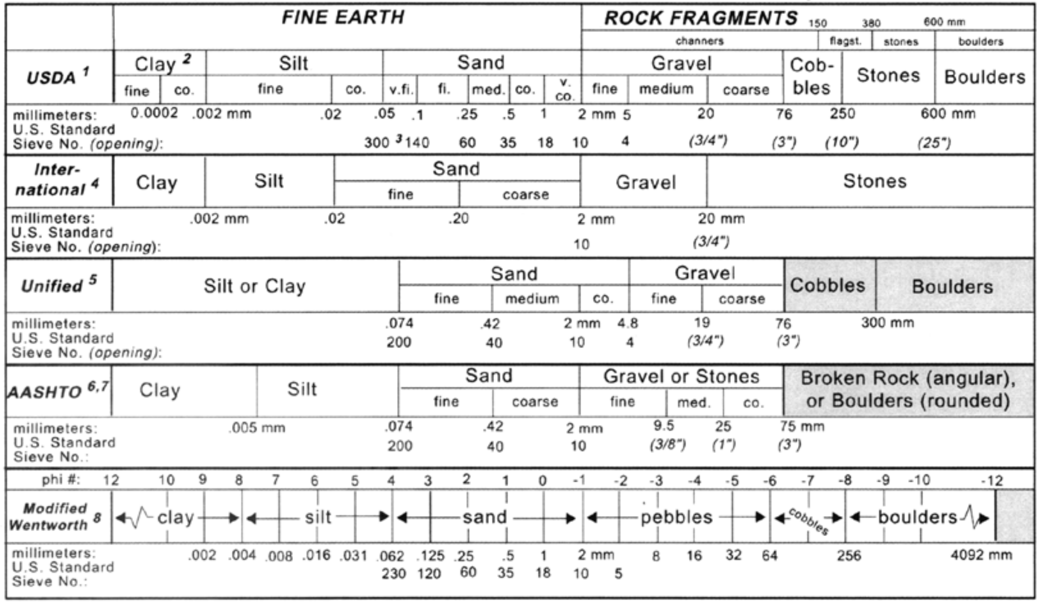
Texture Triangle:

Fine Earth Texture Classes (——)



Note: *Texture Triangle* and *Comparison of Particle Size Classes in Different Systems* from *Field Book for Describing and Sampling Soil*, USDA Natural Resources Conservation Service National Soil Survey Center (September 2002).

Comparison of Particle Size Classes in Different Systems



	FINE EARTH										ROCK FRAGMENTS				
											channers			flagst.	stones	boulders
USDA[1]	Clay[2]		Silt		Sand					Gravel			Cob-bles	Stones	Boulders
	fine	co.	fine	co.	v.fi.	fi.	med.	co.	v. co.	fine	medium	coarse			

ROCK FRAGMENTS: 150 380 600 mm

millimeters: 0.0002 .002 mm .02 .05 .1 .25 .5 1 2 mm 5 20 76 250 600 mm
U.S. Standard Sieve No. *(opening)*: 300[3] 140 60 35 18 10 4 *(3/4")* *(3")* *(10")* *(25")*

International[4]	Clay	Silt	Sand		Gravel	Stones
			fine	coarse		

millimeters: .002 mm .02 .20 2 mm 20 mm
U.S. Standard Sieve No. *(opening)*: 10 *(3/4")*

Unified[5]	Silt or Clay	Sand			Gravel		Cobbles	Boulders
		fine	medium	co.	fine	coarse		

millimeters: .074 .42 2 mm 4.8 19 76 300 mm
U.S. Standard Sieve No. *(opening)*: 200 40 10 4 *(3/4")* *(3")*

AASHTO[6,7]	Clay	Silt	Sand		Gravel or Stones			Broken Rock (angular), or Boulders (rounded)
			fine	coarse	fine	med.	co.	

millimeters: .005 mm .074 .42 2 mm 9.5 25 75 mm
U.S. Standard Sieve No.: 200 40 10 *(3/8")* *(1")* *(3")*

phi #: 12 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -12

Modified Wentworth[8]: clay | silt | sand | pebbles | cobbles | boulders

millimeters: .002 .004 .008 .016 .031 .062 .125 .25 .5 1 2 mm 8 16 32 64 256 4092 mm
U.S. Standard Sieve No.: 230 120 60 35 18 10 5

1. Soil Survey Staff. 1995. Soil survey Laboratory information manual. USDA, Natural Resources Conservation Service, Soil Survey Investigations Report No. 45, Version 1.0, National Soil Survey Center, Lincoln, NE. 305 p.
2. Soil Survey Staff. 1995. Soil Survey Lab information manual. USDA-NRCS, Soil Survey Investigation Report #45, version 1.0, National Soil Survey Center, Lincoln, NE. Note: Mineralogy studies may subdivide clay into three size ranges; fine (<0.08µm), medium (0.08-0.2µm), and coarse (0.2-2µm); Jackson, 1969.
3. The Soil Survey Lab (Lincoln, NE) uses a no. 300 sieve (0.047 mm opening) for the USDA-sand/silt measurement. A no. 270 sieve (0.053 mm opening) is more readily available and widely used.
4. International Soil Science Society. 1951. *In*: Soil Survey Manual. Soil Survey Staff, USDA-Soil Conservation Service, Agricultural Handbook No. 18, U.S. Gov. Print. Office, Washington, D.C. 214 p.
5. ASTM. 1993. Standard classification of soils for engineering purposes (Unified Soil Classification System). ASTM designation D2487-92. *In*: Soil and rock; dimension stone; geosynthetics. Annual book of ASTM standards-Vol. 04.08.
6. AASHTO. 1986a. Recommended practice for the classification of soils and soil-aggregate mixtures for highway construction purposes. AASHTO designation M145-82. *In*: Standard specifications for transportation materials and methods of sampling and testing; Part 1: Specifications (14th ed.). American Association of State Highway and Transportation Officials, Washington, D.C.
7. AASHTO. 1986b. Standard definitions of terms relating to subgrade, soil-aggregate, and fill materials. AASHTO designation M146-70 (1980). *In*: sampling and testing; Part 1: Specifications (14th ed.). American Association of State Highway and Transportation Officials, Washington, D.C.
8. Ingram, R.L. 1982. Modified Wentworth scale. *In*: Grain-size scales. AGI Date Sheet 29.1. *In*: Dutro, J.T., Dietrich, R.V., and Foose, R.M. 1989. AGI data sheets for geology in the field, laboratory, and office, 3rd edition. American Geological Institute, Washington, D.C.

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of 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.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
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