STORMWATER MANAGEMENT PLAN

Tommy's Express Car Wash Systems

200 West 98th Street
Bloomington, Minnesota
March 9, 2022

Prepared By:

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

Jeffrey A Prasch, PE Project Engineer	52706 License Number	03.09.22 Date

Table of Contents

1.0 Project Overview

A redevelopment of an existing commercial property is proposed at 200 West 98th Street in Bloomington, Minnesota. The existing buildings and parking lot will be removed, and a new car wash is proposed. The existing impervious area on the site is 39,762 square feet and surface flows toward both West 97th Street and West 98th Street. A small portion of the site drains to the easterly private property. There are catch basins adjacent the site in both streets. The stormwater runoff surface flows to the catch basins. There is no existing storm sewer on-site. The existing drainage conditions are shown in **Figure 1**.

The proposed site improvements will include a building and associated vehicle stalls for vacuuming vehicles. The proposed site improvements will include 36,073 square feet of impervious area, which is a net reduction of impervious area. Even though the impervious area is being reduced, volume control for the new impervious area will be required. The soils are sandy (USCS SP Classification) and allow infiltration. To meet the Watershed and City requirements, we are proposing an underground infiltration system. The proposed improvements will not increase the runoff rates to any discharge point from the site. The underground infiltration system will outlet to storm sewer in West 97th Street. The stormwater directed toward West 98th Street will be conveyed via surface flow. The site is not within a Drinking Water Supply Management Area (DWSMA). **Figure 2** shows the proposed drainage conditions.

The proposed stormwater improvements will include:

- Two Underground Infiltration Systems

2.0 Design Considerations

The City of Bloomington (City) and the Nine Mile Creek Watershed District (NMCWD) dictate the rate and volume requirements for this site. Per the watershed, since the proposed activity on the site disturbs more than 50 percent of the existing impervious surface, the volume and rate requirements of the NMCWD apply to the entire site. The on-site stormwater system design is based on their guidelines. The following design tools, methods, and considerations were used in the design of the on-site stormwater system:

- Rate and Volume Modeling Software – HydroCAD 10.10
- Rainfall Distribution – MSE 24-hour Type III
- Rainfall Data – Minneapolis-St. Paul Airport 24-hour NOAA Atlas 14 rainfall data as shown in Table 4-1 in **Figure 3** from Section 4.1.2 of the City's Surface Water Management Plan.
- Water Quality Modeling Software – MIDS version 4
- Soil Conditions – USCS SP Classification (Hydrologic Soil Group A) from Geotechnical Report provided by Haugo Geotechnical Services dated January 10, 2022. Hydrologic Soil Group A based on Web Soil Survey. **Appendix H.**
- Infiltration Rate = 0.8in/hr

3.0 Rate Control

The City and NMCWD regulate the rate of surface water discharged from the site. The requirement is that there be no increase in peak rate for a 50, 10, or 1% annual probability event (NOAA Atlas 14, 2-year, 10-year, or 100-year). **Table 3.1** shows the existing and proposed runoff rates for each discharge point from the site.

Table 3.1 – Discharge Rate Summary

Discharge Node	Discharge Rate [cfs]					
	2-Year Storm Event		10-Year Storm Event		100-Year Storm Event	
	Pre-	**Post-**	**Pre-**	**Post-**	**Pre-**	**Post-**
West 97th Street	3.21	1.08	4.84	2.61	8.64	8.23
West 98th Street	1.10	0.25	1.66	0.84	3.09	1.55
East Private Property	0.36	0.00	0.55	0.00	0.98	0.03
Total Offsite	4.67	1.20	7.05	3.21	12.71	9.79

From the table above, the proposed runoff rates do not exceed the existing runoff rates. This meets the rate control requirement. The HydroCAD results for the rate control are included in **Appendices B-G**.

4.0 Volume Control

The City and NMCWD regulate the volume of water discharged from the site. The requirement is that one point one (1.1) inches of runoff from the new contributing impervious surfaces must be abstracted. An Underground Infiltration System is proposed to meet the abstraction requirements. The site consists of Hydrologic Soil Group A soils, therefore, an infiltration rate of 0.80 in/hr was used in the design. The impervious area and volume control summary can be found in **Table 4.1**.

Table 4.1 – Volume Retention Summary

Retention Facility	Proposed Impervious Area (sq. ft)	Required 1.1" Retention Volume (cu. ft)	Actual Retention Volume (cu. ft)	Time to filtrate (hrs)
Underground Infiltration System (1P)	31,366	2,875	3,907	42
Underground Infiltration System (2P)	4,707	432	483	38
Total	**36,073**	**3,307**	**4,390**	-

As shown in the table above, the actual retention volume meets the required retention volume. See the HydroCAD Summary in **Appendices B-G**.

The City regulates the volume of water discharged from the site. The requirement is no net increases in stormwater discharge volume from pre-project conditions on an annual basis. **Table 4.2** summarizes the discharge volume for the site.

Table 4.2 – Discharge Volume Summary

Storm Event	Discharge Volume [cf]	
	Total Offsite	
	Pre-	Post-
2-year	10,959	3,999
10-year	16,930	9,246
100-year	31,185	22,490

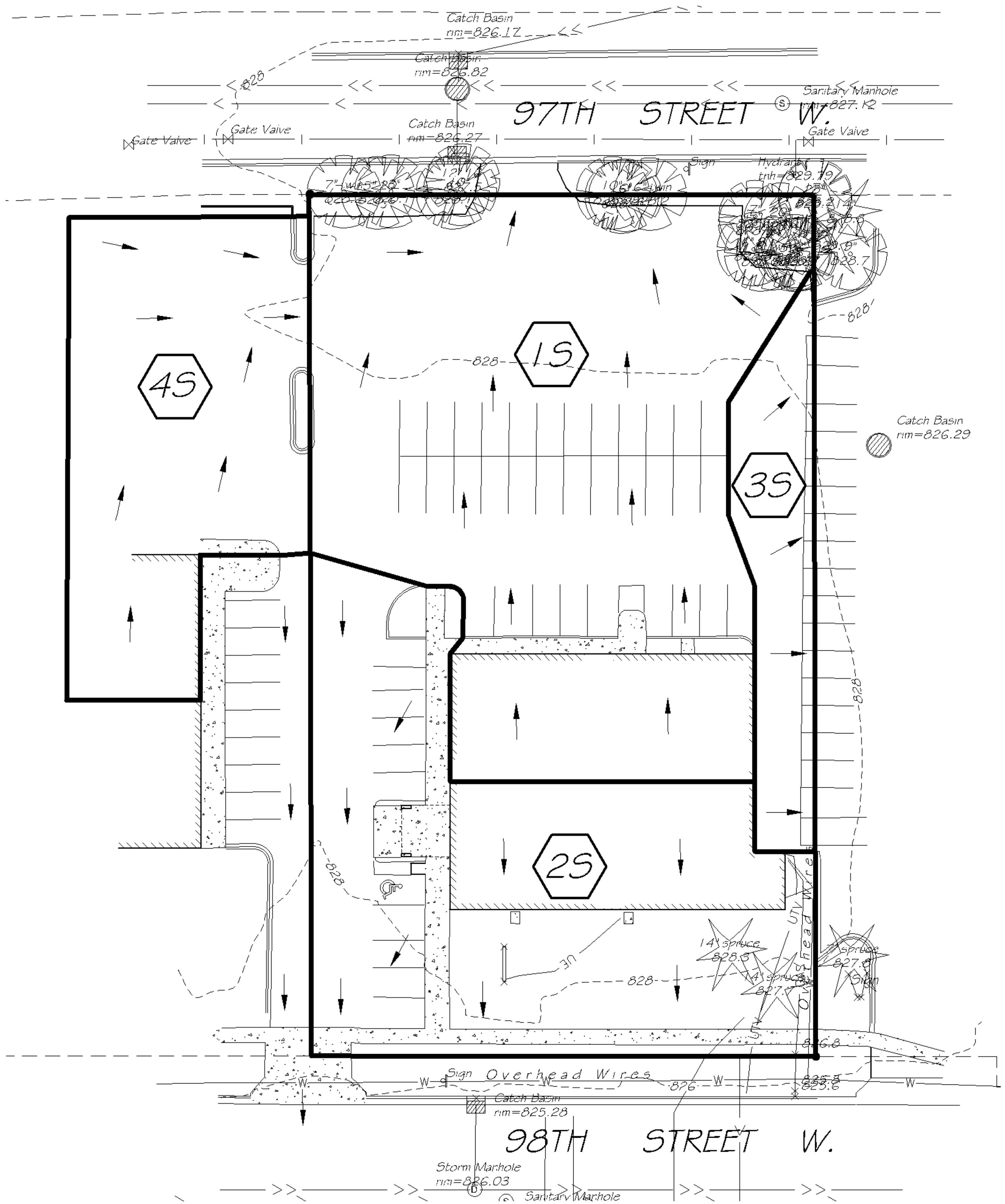
As shown in the table above, the proposed discharge volume is less than the existing discharge volume for each storm event which meets the City's discharge volume control requirements.

5.0 Water Quality

The NMCWD regulates the water quality requirements for this site. The requirement is to provide for at least 60% annual removal efficiency for total phosphorous (TP) and at least 90% annual removal efficiency for total suspended solids (TSS) from the impervious surface. Based on the MIDS calculations in **Appendix I**, the Underground Infiltration Systems provide 90% TP removal and 90% TSS removal on an annual basis. This meets the water quality requirements.

Appendix A

Figures



LEGEND

- 1S SUBCATCHMENT NUMBER
- 1P POND/CATCH BASIN NUMBER
- 1L LINK NUMBER
- 1R REACH NUMBER
- DRAINAGE ARROW

0 40 80
SCALE IN FEET

DEMARC
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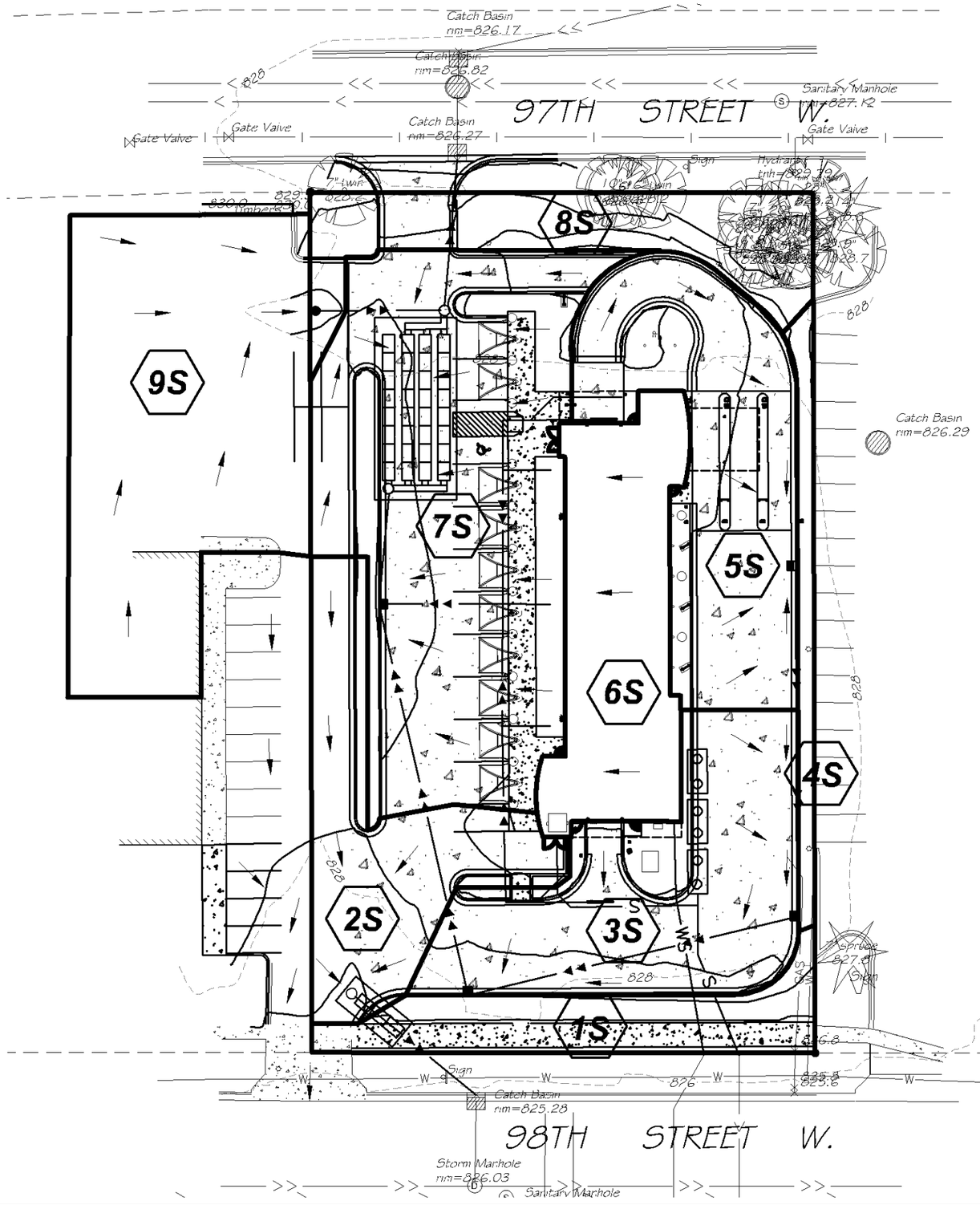
TOMMY'S EXPRESS CAR WASH SYSTEMS
200 WEST 98TH STREET
BLOOMINGTON, MN

DRAINAGE AREAS
EXISTING CONDITIONS

FIGURE 1

03.09.2022



LEGEND

- 1S — SUBCATCHMENT NUMBER
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DEMARC
LAND SURVEYING & ENGINEERING

TOMMY'S EXPRESS CAR WASH SYSTEMS
200 WEST 98TH STREET
BLOOMINGTON, MN

DRAINAGE AREAS
PROPOSED CONDITIONS

FIGURE 2

03.09.2022

4.1.2 Policies

Use of Best-Available Information for Flood-Protection Elevations

The City will define critical 1-percent annual-chance-event flood elevations using the best-available information. At the time of writing, the best-available information, by area, includes:

- **Minnesota River Floodplain:** The Federal Emergency Management Agency's (FEMA's) effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS); 100-year elevation information is provided in City Code Chapter 19 (Section 19.87.03) for FEMA-regulated areas.

- **Nine Mile Creek Floodplain:** Hydrologic and hydraulic model(s) (XP-SWMM) developed by the NMCWD and/or subsequent model updates; this model uses the Atlas 14 precipitation information shown in Table 4-1. Floodplain information is referenced in the Nine Mile Creek Watershed Management Plan at: https://www.ninemilecreek.org/wp-content/uploads/Nine-Mile-Creek-Fifth-Generation-Watershed-Management-Plan.pdf

- **All other areas of the City:** Hydrologic and hydraulic models (XP-SWMM) developed by the City in 2017 and/or subsequent model updates. These models use the Atlas 14 precipitation information shown in Table 4-1.

These 1-percent annual-chance-event flood elevations may be subject to change by periodic model updates that incorporate additional or more accurate information. At the time this Plan was written, some (a few) areas of the City had not been modeled. Models for these areas will most likely be developed during the lifespan of this LSWMP.

Table 4-1 Recurrence Interval Rainfall Depths, Minneapolis-St. Paul International Airport (24-hour Atlas 14 rainfall event)

Frequency	Annual-Exceedance Probability		
	50 percent	10 percent	1 percent
Rainfall	2.83 inches	4.24 inches	7.50 inches

To prevent flooding of principal structures, the City will implement the following standards in addition to the Floodplain Overlay Districts ordinance (City Code Chapter 21.208.01):

Figure 4: Rational Method Storm Sewer Calculations

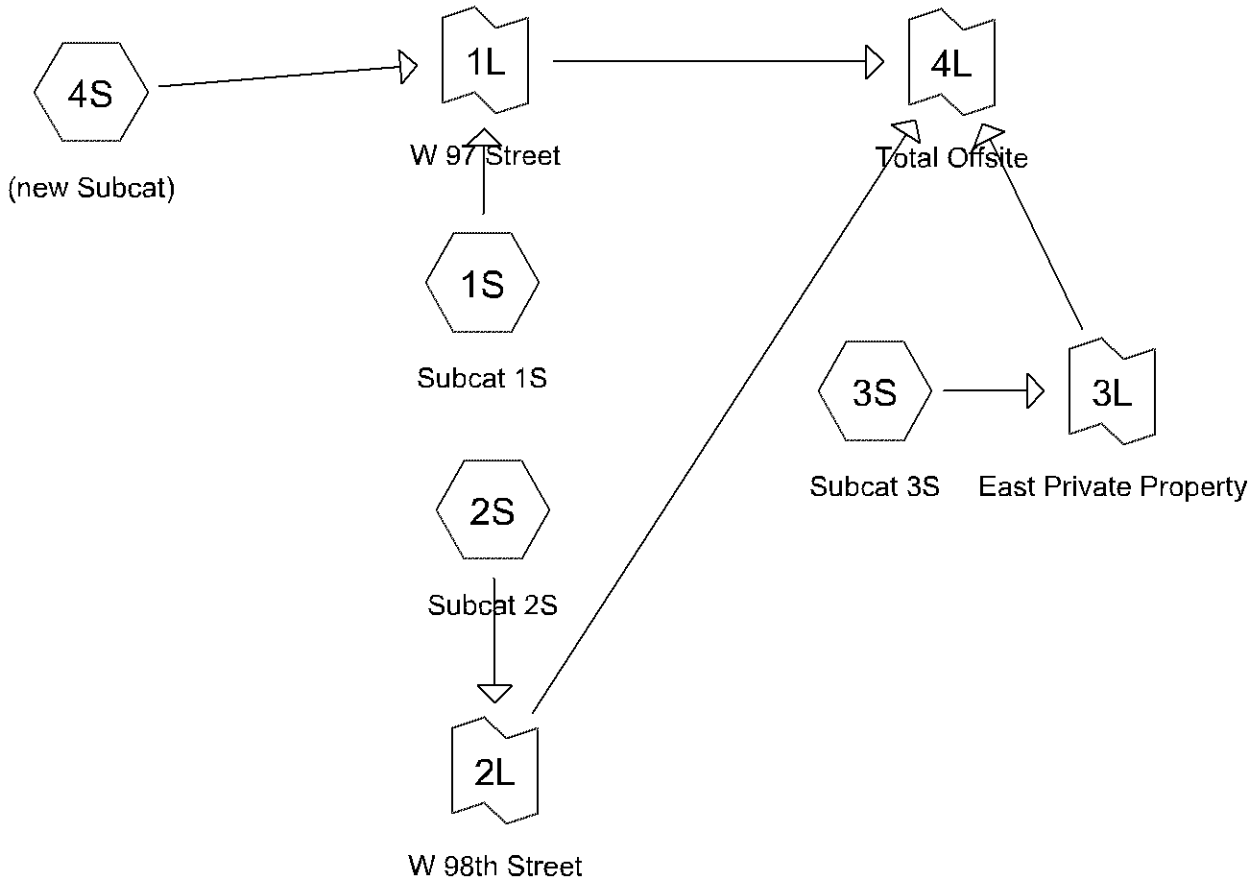
Tommy Car Wash - Bloomington, Minnesota

Storm Frequency:	10-Year
Atlas 14 MNDOT IDF Region:	Central
Type of Pipe:	RCP
Manning's Roughness Coefficient (n), RCP:	0.0120

	Structure		Pipe						Time of Concentration (min)								
Sewer Inlet	To Node	Subcatchment for T_{inlet}	Length, L (ft)	Slope (ft/ft)	Area of Subcatchment, A (acre)	Runoff Coefficient, C	C x A	Σ C x A	T_{inlet}	T_{pipe}	$T_{controlling}$ for Intensity	$T_{downstream\ node}$ [$T_{controlling}$ +T_{pipe}]	Intensity (in/hr)	**Runoff, Q (cfs)**	**Capacity Full (cfs)**	Minimum Required Pipe Diameter (in)	**Design Pipe Diameter (in)**	Velocity of Design Full Pipe, V (fps)
North Property to Underground Infiltration																		
CB 105	CB 104	5S	115	0.0038	0.12	0.90	0.11	0.11	7.00	0.63	7.00	7.63	7.23	**0.78**	**2.39**	7.90	**12**	3.04
CB 104	CB 103	3S	109	0.0038	0.10	0.90	0.09	0.20	7.00	0.60	7.63	8.23	6.99	**1.38**	**2.39**	9.79	**12**	3.04
CB 103	CB 102	3S	133	0.0038	0.10	0.90	0.09	0.29	7.00	0.73	8.23	8.96	6.77	**1.95**	**2.39**	11.14	**12**	3.04
CB 102	STMH 101	7S	64	0.0056	0.43	0.90	0.39	0.68	7.00	0.25	8.96	9.21	6.52	**4.40**	**5.25**	14.05	**15**	4.28
CB 100A to STMH 100																		
CB 100A	STMH 100	3S	40	0.0038	0.26	0.90	0.23	0.23	7.00	0.22	7.00	7.22	7.23	**1.69**	**2.39**	10.56	**12**	3.04
CB 106 to West 98th Street																		
CB 106	Ex. CB (W 98th Street)	3S	32	0.0380	0.12	0.90	0.11	0.11	7.00	0.06	7.00	7.06	7.23	**0.78**	**7.54**	5.13	**12**	9.61

Appendix B

Existing Conditions 2-Year Summary



Subcat Reach Pond Link

Routing Diagram for Existing Conditions
Prepared by Demarc, Printed 3/8/2022

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
7,154	39	>75% Grass cover, Good, HSG A (1S, 2S, 3S, 4S)
39,911	98	Paved parking, HSG A (1S, 2S, 3S, 4S)
10,689	98	Roofs, HSG A (1S, 2S, 4S)
57,754	**91**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcat 1S Runoff Area=25,200 sf 94.95% Impervious Runoff Depth=2.47"
Tc=7.0 min CN=39/98 Runoff=2.21 cfs 5,182 cf

Subcatchment 2S: Subcat 2S Runoff Area=17,708 sf 67.15% Impervious Runoff Depth=1.75"
Tc=7.0 min CN=39/98 Runoff=1.10 cfs 2,575 cf

Subcatchment 3S: Subcat 3S Runoff Area=3,951 sf 99.81% Impervious Runoff Depth=2.59"
Tc=7.0 min CN=39/98 Runoff=0.36 cfs 854 cf

Subcatchment 4S: (new Subcat) Runoff Area=10,895 sf 99.48% Impervious Runoff Depth=2.59"
Tc=7.0 min CN=39/98 Runoff=1.00 cfs 2,347 cf

Link 1L: W 97 Street Inflow=3.21 cfs 7,530 cf
Primary=3.21 cfs 7,530 cf

Link 2L: W 98th Street Inflow=1.10 cfs 2,575 cf
Primary=1.10 cfs 2,575 cf

Link 3L: East Private Property Inflow=0.36 cfs 854 cf
Primary=0.36 cfs 854 cf

Link 4L: Total Offsite Inflow=4.67 cfs 10,959 cf
Primary=4.67 cfs 10,959 cf

Total Runoff Area = 57,754 sf Runoff Volume = 10,959 cf Average Runoff Depth = 2.28"
12.39% Pervious = 7,154 sf 87.61% Impervious = 50,600 sf

Summary for Subcatchment 1S: Subcat 1S

Runoff = 2.21 cfs @ 12.14 hrs, Volume= 5,182 cf, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
1,272	39	>75% Grass cover, Good, HSG A
19,720	98	Paved parking, HSG A
4,208	98	Roofs, HSG A
25,200	95	Weighted Average
1,272	39	5.05% Pervious Area
23,928	98	94.95% Impervious Area

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

Summary for Subcatchment 2S: Subcat 2S

Runoff = 1.10 cfs @ 12.14 hrs, Volume= 2,575 cf, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
5,817	39	>75% Grass cover, Good, HSG A
7,499	98	Paved parking, HSG A
4,391	98	Roofs, HSG A
17,708	79	Weighted Average
5,817	39	32.85% Pervious Area
11,890	98	67.15% Impervious Area

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

Summary for Subcatchment 3S: Subcat 3S

Runoff = 0.36 cfs @ 12.14 hrs, Volume= 854 cf, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
8	39	>75% Grass cover, Good, HSG A
3,944	98	Paved parking, HSG A
3,951	98	Weighted Average
8	39	0.19% Pervious Area
3,944	98	99.81% Impervious Area

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

Summary for Subcatchment 4S: (new Subcat)

Runoff = 1.00 cfs @ 12.14 hrs, Volume= 2,347 cf, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
57	39	>75% Grass cover, Good, HSG A
2,089	98	Roofs, HSG A
8,749	98	Paved parking, HSG A
10,895	98	Weighted Average
57	39	0.52% Pervious Area
10,838	98	99.48% Impervious Area

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

Summary for Link 1L: W 97 Street

Inflow Area = 36,095 sf, 96.32% Impervious, Inflow Depth = 2.50" for 2-Year event
Inflow = 3.21 cfs @ 12.14 hrs, Volume= 7,530 cf
Primary = 3.21 cfs @ 12.14 hrs, Volume= 7,530 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 2L: W 98th Street

Inflow Area = 17,708 sf, 67.15% Impervious, Inflow Depth = 1.75" for 2-Year event
Inflow = 1.10 cfs @ 12.14 hrs, Volume= 2,575 cf
Primary = 1.10 cfs @ 12.14 hrs, Volume= 2,575 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 3L: East Private Property

Inflow Area = 3,951 sf, 99.81% Impervious, Inflow Depth = 2.59" for 2-Year event
Inflow = 0.36 cfs @ 12.14 hrs, Volume= 854 cf
Primary = 0.36 cfs @ 12.14 hrs, Volume= 854 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 4L: Total Offsite

Inflow Area = 57,754 sf, 87.61% Impervious, Inflow Depth = 2.28" for 2-Year event
Inflow = 4.67 cfs @ 12.14 hrs, Volume= 10,959 cf
Primary = 4.67 cfs @ 12.14 hrs, Volume= 10,959 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Appendix C

Existing Conditions 10-Year Summary

Summary for Subcatchment 1S: Subcat 1S

Runoff = 3.33 cfs @ 12.14 hrs, Volume= 7,993 cf, Depth= 3.81"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
1,272	39	>75% Grass cover, Good, HSG A
19,720	98	Paved parking, HSG A
4,208	98	Roofs, HSG A
25,200	95	Weighted Average
1,272	39	5.05% Pervious Area
23,928	98	94.95% Impervious Area

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

Summary for Subcatchment 2S: Subcat 2S

Runoff = 1.66 cfs @ 12.14 hrs, Volume= 4,004 cf, Depth= 2.71"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
5,817	39	>75% Grass cover, Good, HSG A
7,499	98	Paved parking, HSG A
4,391	98	Roofs, HSG A
17,708	79	Weighted Average
5,817	39	32.85% Pervious Area
11,890	98	67.15% Impervious Area

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

Summary for Subcatchment 3S: Subcat 3S

Runoff = 0.55 cfs @ 12.14 hrs, Volume= 1,316 cf, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
8	39	>75% Grass cover, Good, HSG A
3,944	98	Paved parking, HSG A
3,951	98	Weighted Average
8	39	0.19% Pervious Area
3,944	98	99.81% Impervious Area

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

Summary for Subcatchment 4S: (new Subcat)

Runoff = 1.51 cfs @ 12.14 hrs, Volume= 3,617 cf, Depth= 3.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
57	39	>75% Grass cover, Good, HSG A
2,089	98	Roofs, HSG A
8,749	98	Paved parking, HSG A
10,895	98	Weighted Average
57	39	0.52% Pervious Area
10,838	98	99.48% Impervious Area

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

Summary for Link 1L: W 97 Street

Inflow Area = 36,095 sf, 96.32% Impervious, Inflow Depth = 3.86" for 10-Year event
Inflow = 4.84 cfs @ 12.14 hrs, Volume= 11,610 cf
Primary = 4.84 cfs @ 12.14 hrs, Volume= 11,610 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 2L: W 98th Street

Inflow Area = 17,708 sf, 67.15% Impervious, Inflow Depth = 2.71" for 10-Year event
Inflow = 1.66 cfs @ 12.14 hrs, Volume= 4,004 cf
Primary = 1.66 cfs @ 12.14 hrs, Volume= 4,004 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 3L: East Private Property

Inflow Area = 3,951 sf, 99.81% Impervious, Inflow Depth = 4.00" for 10-Year event
Inflow = 0.55 cfs @ 12.14 hrs, Volume= 1,316 cf
Primary = 0.55 cfs @ 12.14 hrs, Volume= 1,316 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 4L: Total Offsite

Inflow Area = 57,754 sf, 87.61% Impervious, Inflow Depth = 3.52" for 10-Year event
Inflow = 7.05 cfs @ 12.14 hrs, Volume= 16,930 cf
Primary = 7.05 cfs @ 12.14 hrs, Volume= 16,930 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Appendix D

Existing Conditions 100-Year Summary

Summary for Subcatchment 1S: Subcat 1S

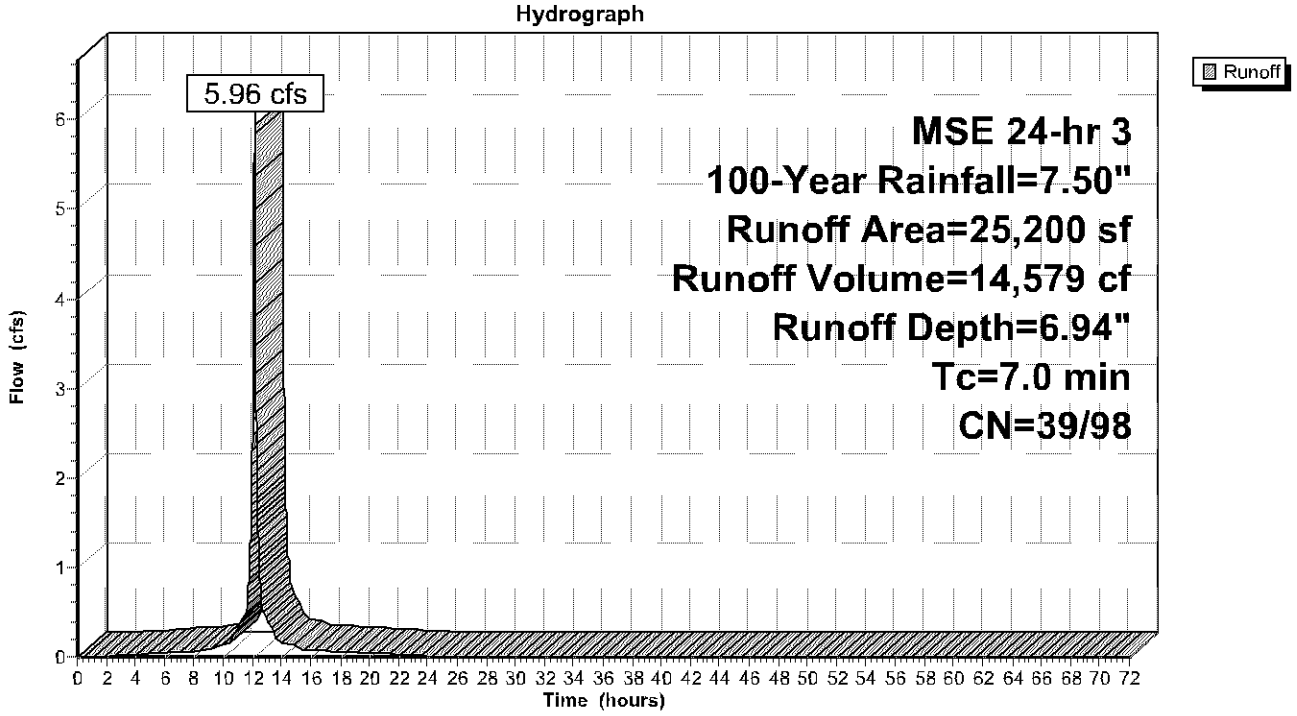
Runoff = 5.96 cfs @ 12.14 hrs, Volume= 14,579 cf, Depth= 6.94"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
1,272	39	>75% Grass cover, Good, HSG A
19,720	98	Paved parking, HSG A
4,208	98	Roofs, HSG A
25,200	95	Weighted Average
1,272	39	5.05% Pervious Area
23,928	98	94.95% Impervious Area

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

Subcatchment 1S: Subcat 1S



Summary for Subcatchment 2S: Subcat 2S

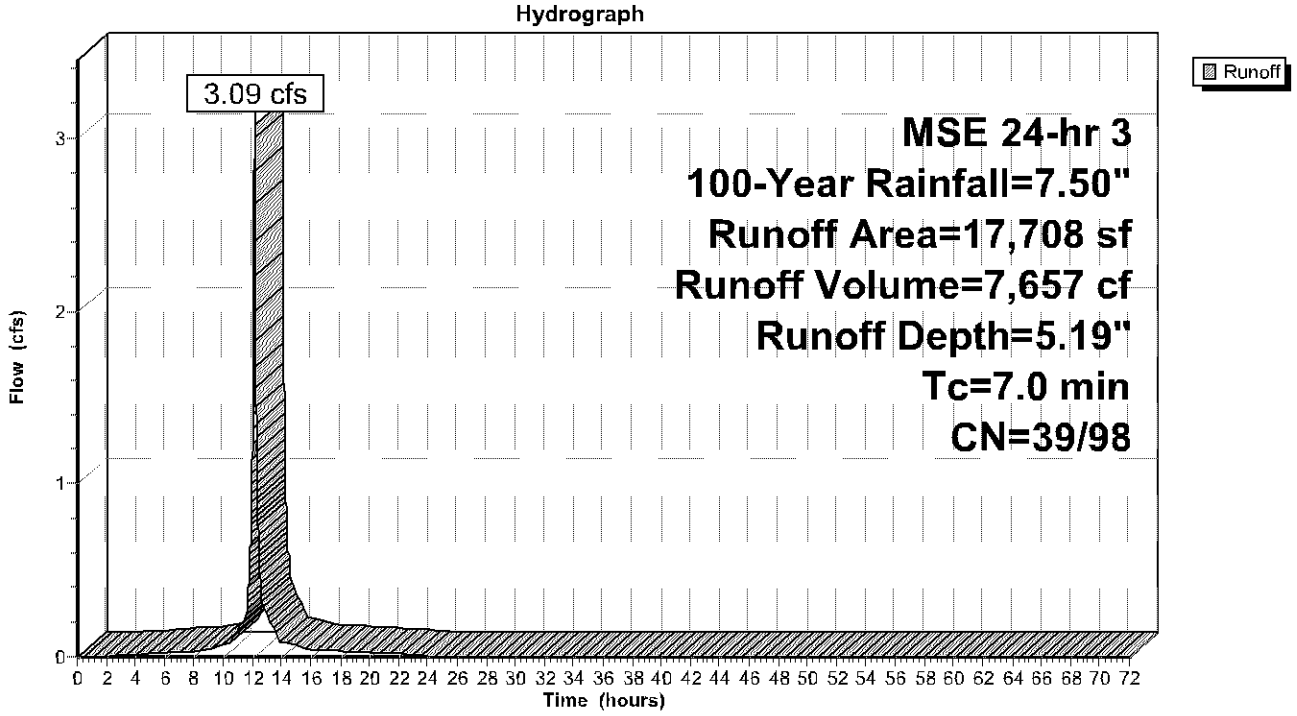
Runoff = 3.09 cfs @ 12.14 hrs, Volume= 7,657 cf, Depth= 5.19"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
5,817	39	>75% Grass cover, Good, HSG A
7,499	98	Paved parking, HSG A
4,391	98	Roofs, HSG A
17,708	79	Weighted Average
5,817	39	32.85% Pervious Area
11,890	98	67.15% Impervious Area

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

Subcatchment 2S: Subcat 2S



Summary for Subcatchment 3S: Subcat 3S

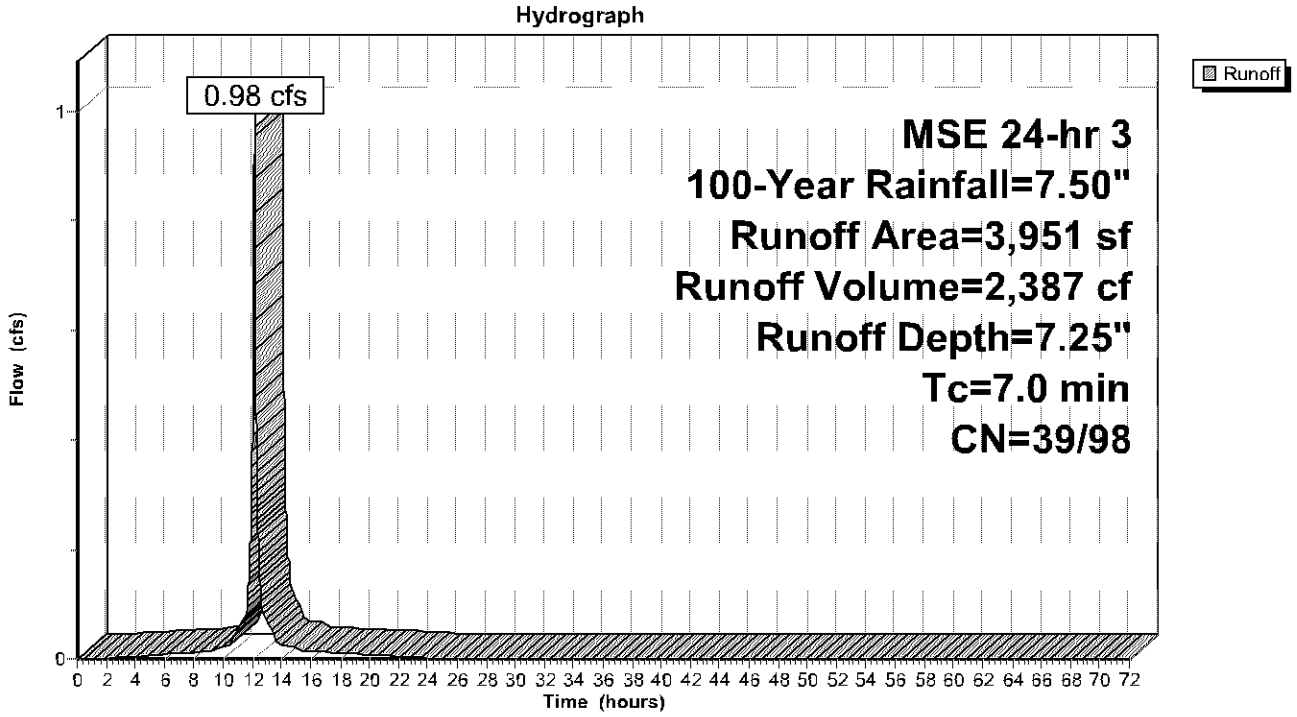
Runoff = 0.98 cfs @ 12.14 hrs, Volume= 2,387 cf, Depth= 7.25"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
8	39	>75% Grass cover, Good, HSG A
3,944	98	Paved parking, HSG A
3,951	98	Weighted Average
8	39	0.19% Pervious Area
3,944	98	99.81% Impervious Area

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

Subcatchment 3S: Subcat 3S



Summary for Subcatchment 4S: (new Subcat)

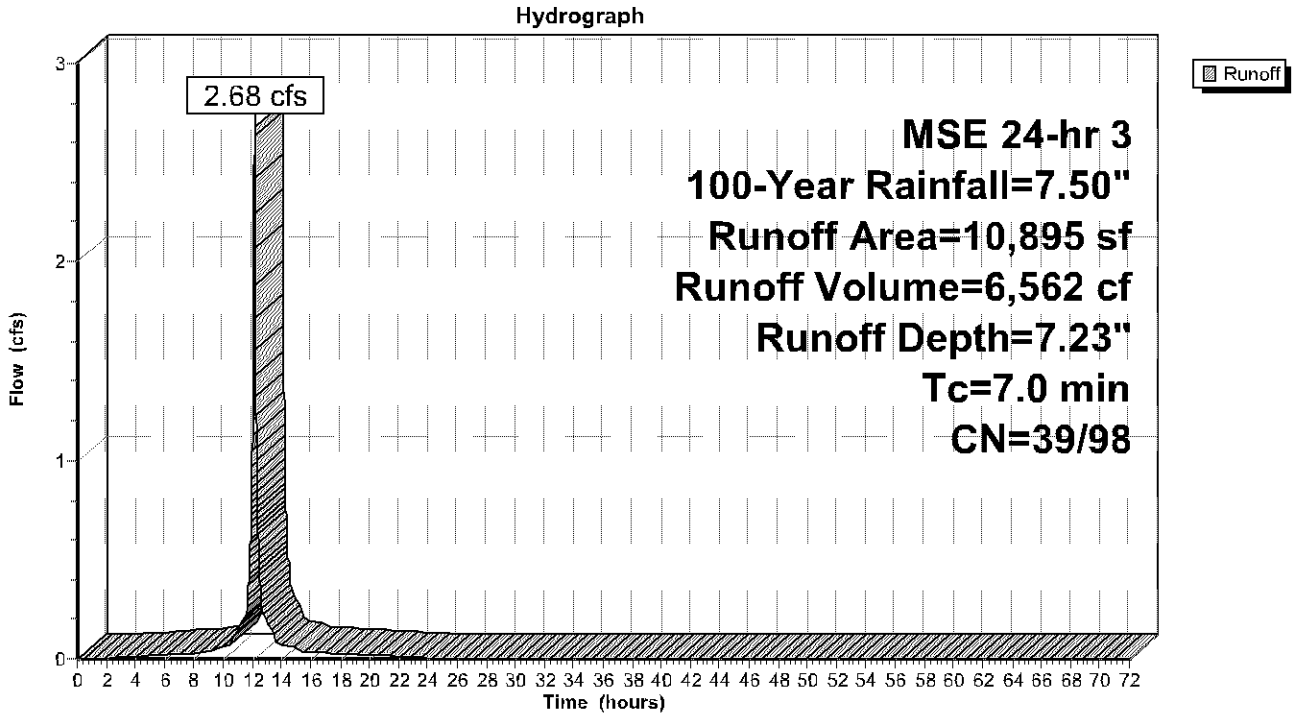
Runoff = 2.68 cfs @ 12.14 hrs, Volume= 6,562 cf, Depth= 7.23"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
57	39	>75% Grass cover, Good, HSG A
2,089	98	Roofs, HSG A
8,749	98	Paved parking, HSG A
10,895	98	Weighted Average
57	39	0.52% Pervious Area
10,838	98	99.48% Impervious Area

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

Subcatchment 4S: (new Subcat)

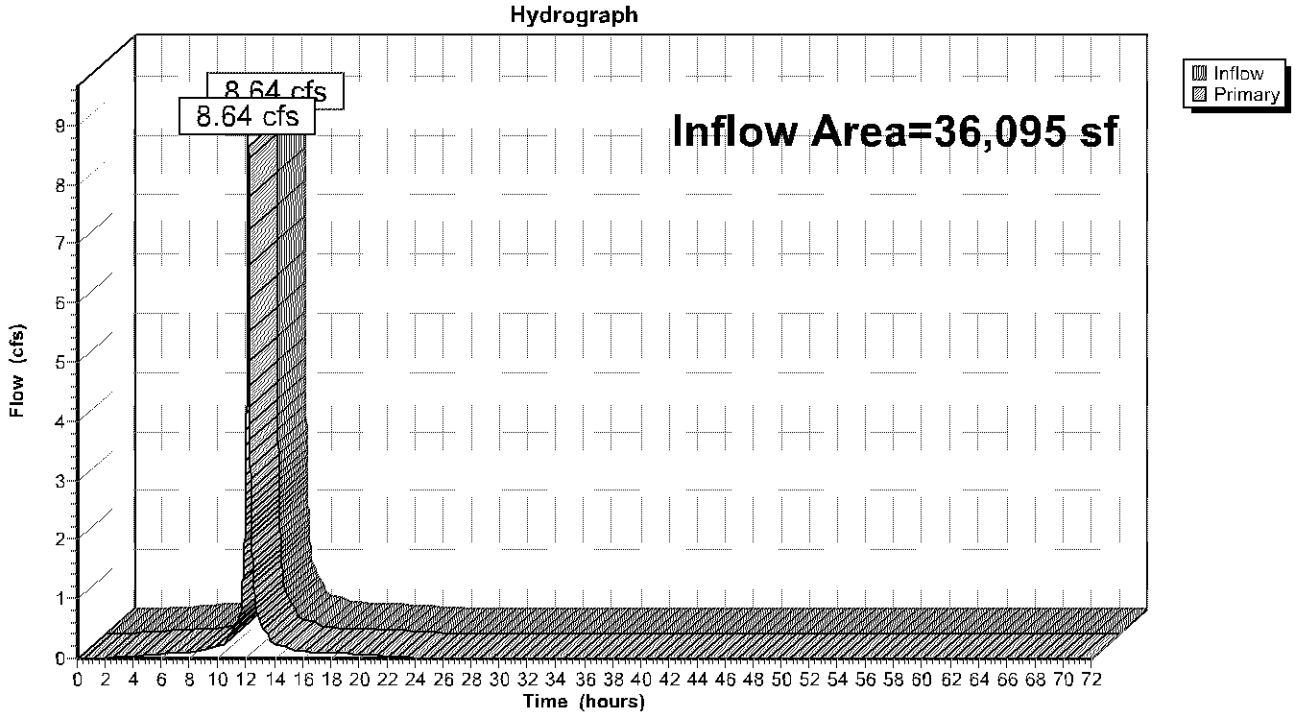


Summary for Link 1L: W 97 Street

Inflow Area = 36,095 sf, 96.32% Impervious, Inflow Depth = 7.03" for 100-Year event
Inflow = 8.64 cfs @ 12.14 hrs, Volume= 21,141 cf
Primary = 8.64 cfs @ 12.14 hrs, Volume= 21,141 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

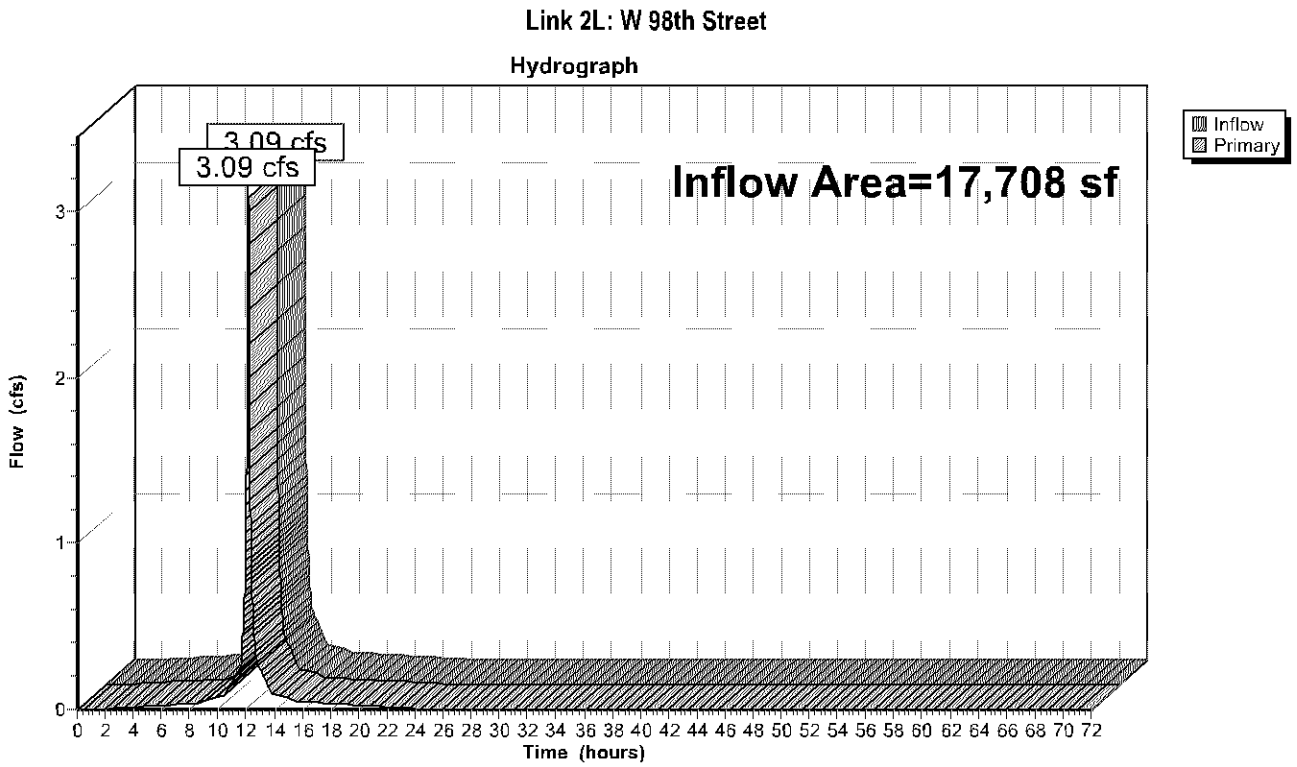
Link 1L: W 97 Street



Summary for Link 2L: W 98th Street

Inflow Area = 17,708 sf, 67.15% Impervious, Inflow Depth = 5.19" for 100-Year event
Inflow = 3.09 cfs @ 12.14 hrs, Volume= 7,657 cf
Primary = 3.09 cfs @ 12.14 hrs, Volume= 7,657 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

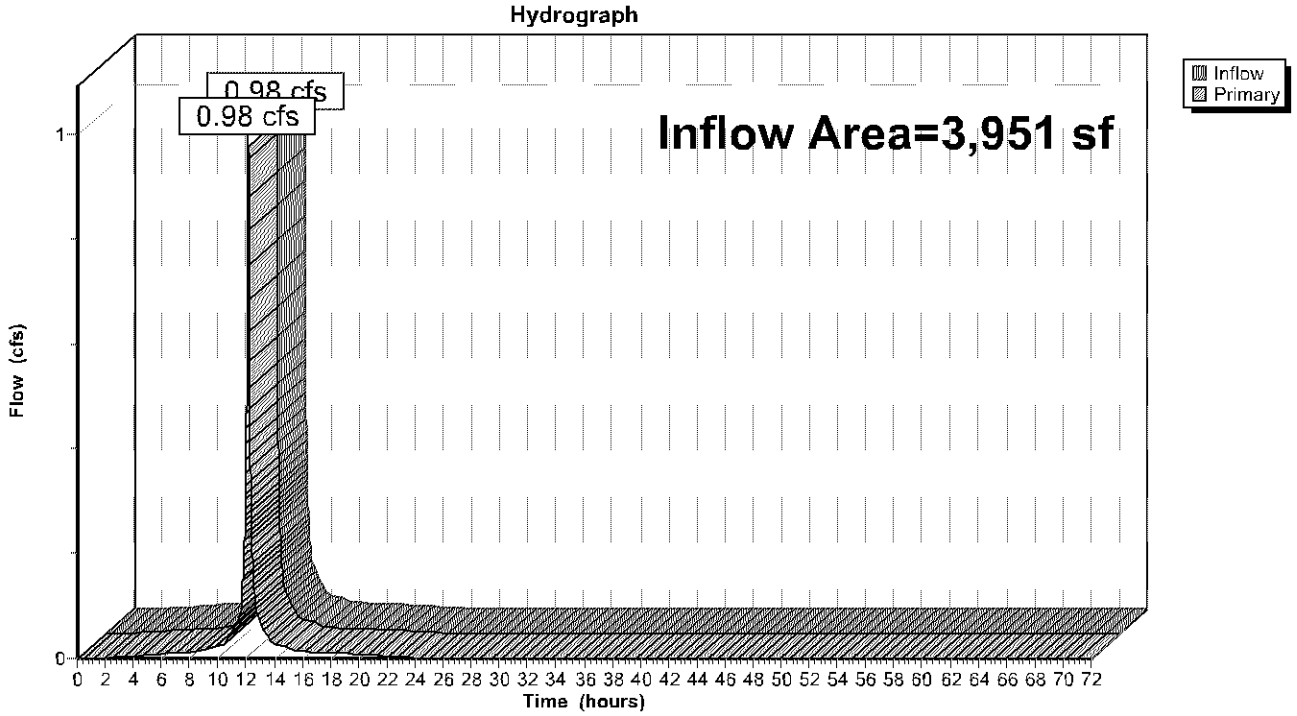


Summary for Link 3L: East Private Property

Inflow Area = 3,951 sf, 99.81% Impervious, Inflow Depth = 7.25" for 100-Year event
Inflow = 0.98 cfs @ 12.14 hrs, Volume= 2,387 cf
Primary = 0.98 cfs @ 12.14 hrs, Volume= 2,387 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 3L: East Private Property

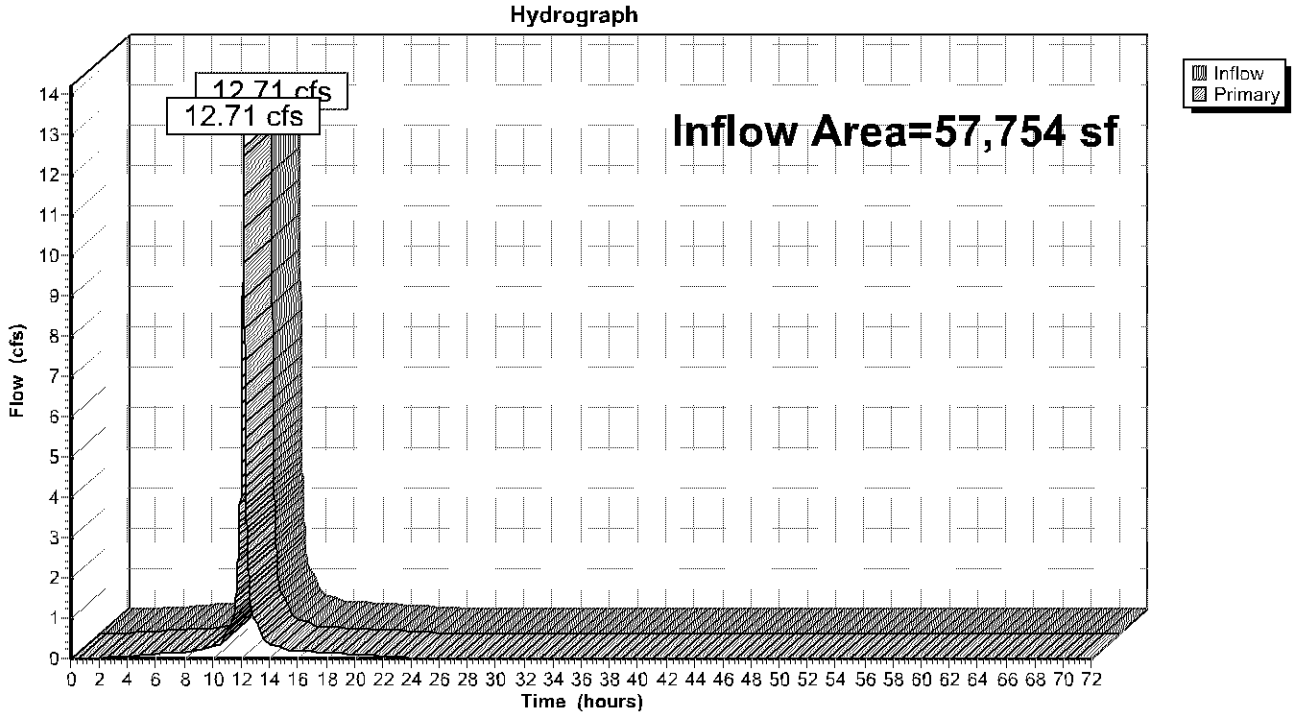


Summary for Link 4L: Total Offsite

Inflow Area = 57,754 sf, 87.61% Impervious, Inflow Depth = 6.48" for 100-Year event
Inflow = 12.71 cfs @ 12.14 hrs, Volume= 31,185 cf
Primary = 12.71 cfs @ 12.14 hrs, Volume= 31,185 cf, Atten= 0%, Lag= 0.0 min

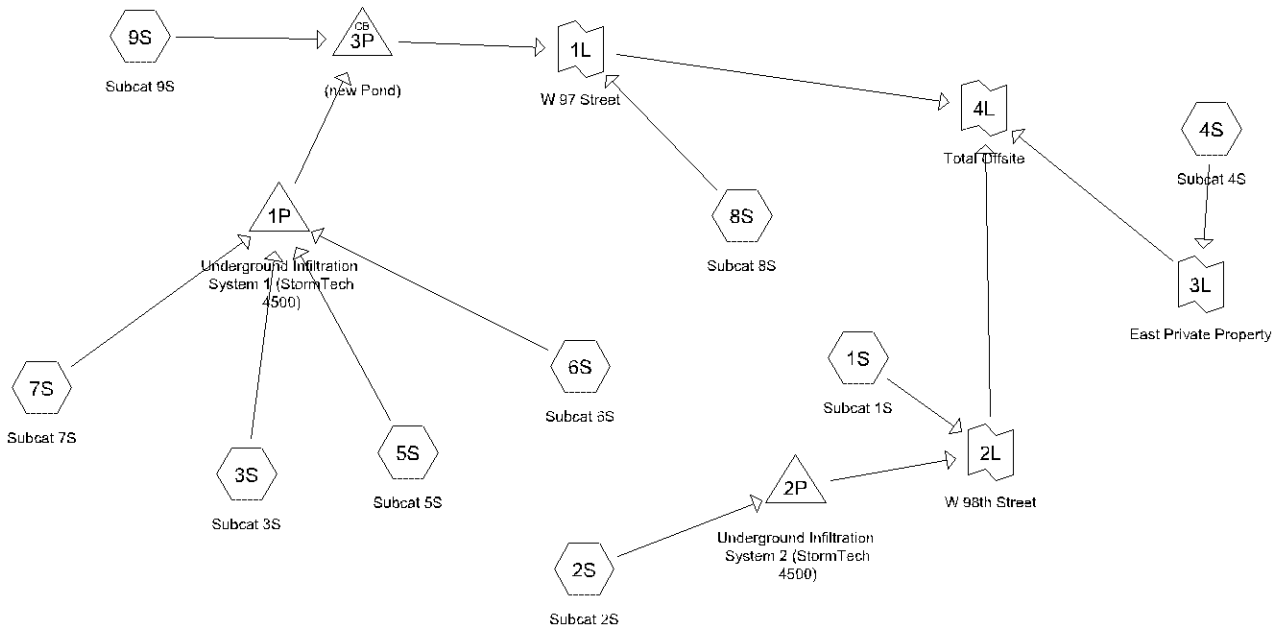
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 4L: Total Offsite



Appendix E

Proposed Conditions 2-Year Summary



Subcat Reach Pond Link

Routing Diagram for Proposed Conditions
Prepared by Demarc, Printed 3/8/2022

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
10,848	39	>75% Grass cover, Good, HSG A (1S, 2S, 3S, 4S, 5S, 7S, 8S, 9S)
39,592	98	Paved parking, HSG A (1S, 2S, 3S, 5S, 7S, 8S, 9S)
7,330	98	Roofs, HSG A (5S, 6S, 9S)
57,769	**87**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcat 1S Runoff Area=3,148 sf 44.49% Impervious Runoff Depth=1.16"
Tc=7.0 min CN=39/98 Runoff=0.13 cfs 303 cf

Subcatchment 2S: Subcat 2S Runoff Area=5,207 sf 90.40% Impervious Runoff Depth=2.35"
Tc=7.0 min CN=39/98 Runoff=0.43 cfs 1,019 cf

Subcatchment 3S: Subcat 3S Runoff Area=7,237 sf 89.16% Impervious Runoff Depth=2.32"
Tc=7.0 min CN=39/98 Runoff=0.60 cfs 1,398 cf

Subcatchment 4S: Subcat 4S Runoff Area=1,128 sf 0.00% Impervious Runoff Depth=0.00"
Tc=7.0 min CN=39/0 Runoff=0.00 cfs 0 cf

Subcatchment 5S: Subcat 5S Runoff Area=7,111 sf 85.99% Impervious Runoff Depth=2.23"
Tc=7.0 min CN=39/98 Runoff=0.56 cfs 1,324 cf

Subcatchment 6S: Subcat 6S Runoff Area=5,241 sf 100.00% Impervious Runoff Depth=2.60"
Tc=7.0 min CN=0/98 Runoff=0.48 cfs 1,135 cf

Subcatchment 7S: Subcat 7S Runoff Area=13,647 sf 83.08% Impervious Runoff Depth=2.16"
Tc=7.0 min CN=39/98 Runoff=1.05 cfs 2,456 cf

Subcatchment 8S: Subcat 8S Runoff Area=4,140 sf 19.77% Impervious Runoff Depth=0.51"
Tc=7.0 min CN=39/98 Runoff=0.08 cfs 177 cf

Subcatchment 9S: Subcat 9S Runoff Area=10,911 sf 99.43% Impervious Runoff Depth=2.58"
Tc=7.0 min CN=39/98 Runoff=1.00 cfs 2,350 cf

Pond 1P: Underground Infiltration System 1 (StormTech 4500) Peak Elev=822.95' Storage=4,134 cf Inflow=2.69 cfs 6,313 cf
Discarded=0.03 cfs 5,458 cf Primary=0.14 cfs 854 cf Outflow=0.17 cfs 6,313 cf

Pond 2P: Underground Infiltration System 2 (StormTech 4500) Peak Elev=822.94' Storage=510 cf Inflow=0.43 cfs 1,019 cf
Discarded=0.00 cfs 704 cf Primary=0.19 cfs 315 cf Outflow=0.20 cfs 1,019 cf

Pond 3P: (new Pond) Peak Elev=820.28' Inflow=1.00 cfs 3,204 cf
12.0" Round Culvert n=0.013 L=48.0' S=0.0069 '/' Outflow=1.00 cfs 3,204 cf

Link 1L: W 97 Street Inflow=1.08 cfs 3,381 cf
Primary=1.08 cfs 3,381 cf

Link 2L: W 98th Street Inflow=0.25 cfs 618 cf
Primary=0.25 cfs 618 cf

Link 3L: East Private Property Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 4L: Total Offsite Inflow=1.20 cfs 4,000 cf
Primary=1.20 cfs 4,000 cf

Total Runoff Area = 57,769 sf Runoff Volume = 10,162 cf Average Runoff Depth = 2.11"
18.78% Pervious = 10,848 sf 81.22% Impervious = 46,921 sf

Summary for Subcatchment 1S: Subcat 1S

Runoff = 0.13 cfs @ 12.14 hrs, Volume= 303 cf, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
1,748	39	>75% Grass cover, Good, HSG A
1,401	98	Paved parking, HSG A
3,148	65	Weighted Average
1,748	39	55.51% Pervious Area
1,401	98	44.49% Impervious Area

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

Summary for Subcatchment 2S: Subcat 2S

Runoff = 0.43 cfs @ 12.14 hrs, Volume= 1,019 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
500	39	>75% Grass cover, Good, HSG A
4,707	98	Paved parking, HSG A
5,207	92	Weighted Average
500	39	9.60% Pervious Area
4,707	98	90.40% Impervious Area

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

Summary for Subcatchment 3S: Subcat 3S

Runoff = 0.60 cfs @ 12.14 hrs, Volume= 1,398 cf, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
784	39	>75% Grass cover, Good, HSG A
6,453	98	Paved parking, HSG A
7,237	92	Weighted Average
784	39	10.84% Pervious Area
6,453	98	89.16% Impervious Area

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

Summary for Subcatchment 4S: Subcat 4S

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
1,128	39	>75% Grass cover, Good, HSG A
1,128	39	100.00% Pervious Area

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

Summary for Subcatchment 5S: Subcat 5S

Runoff = 0.56 cfs @ 12.14 hrs, Volume= 1,324 cf, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
996	39	>75% Grass cover, Good, HSG A
6,114	98	Paved parking, HSG A
0	98	Roofs, HSG A
7,111	90	Weighted Average
996	39	14.01% Pervious Area
6,115	98	85.99% Impervious Area

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

Summary for Subcatchment 6S: Subcat 6S

Runoff = 0.48 cfs @ 12.14 hrs, Volume= 1,135 cf, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
5,241	98	Roofs, HSG A
5,241	98	100.00% Impervious Area

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

Summary for Subcatchment 7S: Subcat 7S

Runoff = 1.05 cfs @ 12.14 hrs, Volume= 2,456 cf, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
2,309	39	>75% Grass cover, Good, HSG A
11,338	98	Paved parking, HSG A
13,647	88	Weighted Average
2,309	39	16.92% Pervious Area
11,338	98	83.08% Impervious Area

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

Summary for Subcatchment 8S: Subcat 8S

Runoff = 0.08 cfs @ 12.14 hrs, Volume= 177 cf, Depth= 0.51"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
3,322	39	>75% Grass cover, Good, HSG A
819	98	Paved parking, HSG A
4,140	51	Weighted Average
3,322	39	80.23% Pervious Area
819	98	19.77% Impervious Area

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

Summary for Subcatchment 9S: Subcat 9S

Runoff = 1.00 cfs @ 12.14 hrs, Volume= 2,350 cf, Depth= 2.58"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
62	39	>75% Grass cover, Good, HSG A
8,760	98	Paved parking, HSG A
2,089	98	Roofs, HSG A
10,911	98	Weighted Average
62	39	0.57% Pervious Area
10,849	98	99.43% Impervious Area

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

Summary for Pond 1P: Underground Infiltration System 1 (StormTech 4500)

Inflow Area = 33,235 sf, 87.70% Impervious, Inflow Depth = 2.28" for 2-Year event
Inflow = 2.69 cfs @ 12.14 hrs, Volume= 6,313 cf
Outflow = 0.17 cfs @ 13.13 hrs, Volume= 6,313 cf, Atten= 94%, Lag= 59.7 min
Discarded = 0.03 cfs @ 8.79 hrs, Volume= 5,458 cf
Primary = 0.14 cfs @ 13.13 hrs, Volume= 854 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 822.95' @ 13.13 hrs Surf.Area= 1,475 sf Storage= 4,134 cf

Plug-Flow detention time= 1,116.6 min calculated for 6,312 cf (100% of inflow)
Center-of-Mass det. time= 1,116.8 min (1,871.7 - 754.8)

Volume	Invert	Avail.Storage	Storage Description
#1B	819.00'	2,481 cf	**28.50'W x 51.74'L x 6.75'H Field B** 9,954 cf Overall - 3,751 cf Embedded = 6,203 cf x 40.0% Voids
#2B	819.75'	3,751 cf	**ADS_StormTech MC-4500 b +Cap** x 33 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap

		33 Chambers in 3 Rows Cap Storage= +39.5 cf x 2 x 3 rows = 237.0 cf
	6,232 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	819.00'	**0.800 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	822.73'	**12.0" Round 12" Culvert** L= 5.0' Ke= 0.500 Inlet / Outlet Invert= 822.73' / 822.70' S= 0.0060 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 8.79 hrs HW=819.07' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.14 cfs @ 13.13 hrs HW=822.95' (Free Discharge)
↑**2=12" Culvert** (Barrel Controls 0.14 cfs @ 1.67 fps)

Summary for Pond 2P: Underground Infiltration System 2 (StormTech 4500)

Inflow Area = 5,207 sf, 90.40% Impervious, Inflow Depth = 2.35" for 2-Year event
Inflow = 0.43 cfs @ 12.14 hrs, Volume= 1,019 cf
Outflow = 0.20 cfs @ 12.25 hrs, Volume= 1,019 cf, Atten= 55%, Lag= 6.8 min
Discarded = 0.00 cfs @ 7.99 hrs, Volume= 704 cf
Primary = 0.19 cfs @ 12.25 hrs, Volume= 315 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 822.94' @ 12.25 hrs Surf.Area= 202 sf Storage= 510 cf

Plug-Flow detention time= 809.5 min calculated for 1,019 cf (100% of inflow)
Center-of-Mass det. time= 809.7 min (1,564.5 - 754.8)

Volume	Invert	Avail.Storage	Storage Description
#1B	819.00'	386 cf	**10.33'W x 19.54'L x 6.75'H Field B** 1,363 cf Overall - 398 cf Embedded = 965 cf x 40.0% Voids
#2B	819.75'	398 cf	**ADS_StormTech MC-4500 b +Cap** x 3 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap Cap Storage= +39.5 cf x 2 x 1 rows = 79.0 cf
		784 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	819.00'	**0.800 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	822.73'	**12.0" Round 12" Culvert** L= 32.0' Ke= 0.500 Inlet / Outlet Invert= 822.73' / 821.51' S= 0.0381 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 7.99 hrs HW=819.07' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.19 cfs @ 12.25 hrs HW=822.94' (Free Discharge)
↑**2=12" Culvert** (Inlet Controls 0.19 cfs @ 1.56 fps)

Summary for Pond 3P: (new Pond)

Inflow Area = 44,146 sf, 90.60% Impervious, Inflow Depth = 0.87" for 2-Year event
Inflow = 1.00 cfs @ 12.14 hrs, Volume= 3,204 cf
Outflow = 1.00 cfs @ 12.14 hrs, Volume= 3,204 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.00 cfs @ 12.14 hrs, Volume= 3,204 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Peak Elev= 820.28' @ 12.14 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	819.70'	**12.0" Round RCP_Round 12"** L= 48.0' Ke= 0.500 Inlet / Outlet Invert= 819.70' / 819.37' S= 0.0069 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=1.00 cfs @ 12.14 hrs HW=820.28' (Free Discharge)
↑—**1=RCP_Round 12"** (Barrel Controls 1.00 cfs @ 3.08 fps)

Summary for Link 1L: W 97 Street

Inflow Area = 48,286 sf, 84.52% Impervious, Inflow Depth = 0.84" for 2-Year event
Inflow = 1.08 cfs @ 12.14 hrs, Volume= 3,381 cf
Primary = 1.08 cfs @ 12.14 hrs, Volume= 3,381 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 2L: W 98th Street

Inflow Area = 8,355 sf, 73.10% Impervious, Inflow Depth = 0.89" for 2-Year event
Inflow = 0.25 cfs @ 12.25 hrs, Volume= 618 cf
Primary = 0.25 cfs @ 12.25 hrs, Volume= 618 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 3L: East Private Property

Inflow Area = 1,128 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 4L: Total Offsite

Inflow Area = 57,769 sf, 81.22% Impervious, Inflow Depth = 0.83" for 2-Year event
Inflow = 1.20 cfs @ 12.14 hrs, Volume= 4,000 cf
Primary = 1.20 cfs @ 12.14 hrs, Volume= 4,000 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Appendix F

Proposed Conditions 10-Year Summary

Summary for Subcatchment 1S: Subcat 1S

Runoff = 0.20 cfs @ 12.14 hrs, Volume= 478 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
1,748	39	>75% Grass cover, Good, HSG A
1,401	98	Paved parking, HSG A
3,148	65	Weighted Average
1,748	39	55.51% Pervious Area
1,401	98	44.49% Impervious Area

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

Summary for Subcatchment 2S: Subcat 2S

Runoff = 0.66 cfs @ 12.14 hrs, Volume= 1,574 cf, Depth= 3.63"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
500	39	>75% Grass cover, Good, HSG A
4,707	98	Paved parking, HSG A
5,207	92	Weighted Average
500	39	9.60% Pervious Area
4,707	98	90.40% Impervious Area

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

Summary for Subcatchment 3S: Subcat 3S

Runoff = 0.90 cfs @ 12.14 hrs, Volume= 2,158 cf, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
784	39	>75% Grass cover, Good, HSG A
6,453	98	Paved parking, HSG A
7,237	92	Weighted Average
784	39	10.84% Pervious Area
6,453	98	89.16% Impervious Area

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

Summary for Subcatchment 4S: Subcat 4S

Runoff = 0.00 cfs @ 13.26 hrs, Volume= 7 cf, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
1,128	39	>75% Grass cover, Good, HSG A
1,128	39	100.00% Pervious Area

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

Summary for Subcatchment 5S: Subcat 5S

Runoff = 0.85 cfs @ 12.14 hrs, Volume= 2,047 cf, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
996	39	>75% Grass cover, Good, HSG A
6,114	98	Paved parking, HSG A
0	98	Roofs, HSG A
7,111	90	Weighted Average
996	39	14.01% Pervious Area
6,115	98	85.99% Impervious Area

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

Summary for Subcatchment 6S: Subcat 6S

Runoff = 0.73 cfs @ 12.14 hrs, Volume= 1,749 cf, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
5,241	98	Roofs, HSG A
5,241	98	100.00% Impervious Area

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

Summary for Subcatchment 7S: Subcat 7S

Runoff = 1.58 cfs @ 12.14 hrs, Volume= 3,798 cf, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
2,309	39	>75% Grass cover, Good, HSG A
11,338	98	Paved parking, HSG A
13,647	88	Weighted Average
2,309	39	16.92% Pervious Area
11,338	98	83.08% Impervious Area

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

Summary for Subcatchment 8S: Subcat 8S

Runoff = 0.11 cfs @ 12.14 hrs, Volume= 294 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
3,322	39	>75% Grass cover, Good, HSG A
819	98	Paved parking, HSG A
4,140	51	Weighted Average
3,322	39	80.23% Pervious Area
819	98	19.77% Impervious Area

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

Summary for Subcatchment 9S: Subcat 9S

Runoff = 1.51 cfs @ 12.14 hrs, Volume= 3,621 cf, Depth= 3.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
62	39	>75% Grass cover, Good, HSG A
8,760	98	Paved parking, HSG A
2,089	98	Roofs, HSG A
10,911	98	Weighted Average
62	39	0.57% Pervious Area
10,849	98	99.43% Impervious Area

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

Summary for Pond 1P: Underground Infiltration System 1 (StormTech 4500)

Inflow Area = 33,235 sf, 87.70% Impervious, Inflow Depth = 3.52" for 10-Year event
Inflow = 4.06 cfs @ 12.14 hrs, Volume= 9,752 cf
Outflow = 1.81 cfs @ 12.25 hrs, Volume= 9,752 cf, Atten= 55%, Lag= 6.9 min
Discarded = 0.03 cfs @ 6.27 hrs, Volume= 5,740 cf
Primary = 1.79 cfs @ 12.25 hrs, Volume= 4,012 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 823.62' @ 12.25 hrs Surf.Area= 1,475 sf Storage= 4,793 cf

Plug-Flow detention time= 768.7 min calculated for 9,752 cf (100% of inflow)
Center-of-Mass det. time= 768.6 min (1,517.7 - 749.1)

Volume	Invert	Avail.Storage	Storage Description
#1B	819.00'	2,481 cf	**28.50'W x 51.74'L x 6.75'H Field B** 9,954 cf Overall - 3,751 cf Embedded = 6,203 cf x 40.0% Voids
#2B	819.75'	3,751 cf	**ADS_StormTech MC-4500 b +Cap** x 33 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap

		33 Chambers in 3 Rows Cap Storage= +39.5 cf x 2 x 3 rows = 237.0 cf
	6,232 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	819.00'	**0.800 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	822.73'	**12.0" Round 12" Culvert** L= 5.0' Ke= 0.500 Inlet / Outlet Invert= 822.73' / 822.70' S= 0.0060 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 6.27 hrs HW=819.07' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.78 cfs @ 12.25 hrs HW=823.62' (Free Discharge)
↑**2=12" Culvert** (Barrel Controls 1.78 cfs @ 3.19 fps)

Summary for Pond 2P: Underground Infiltration System 2 (StormTech 4500)

Inflow Area = 5,207 sf, 90.40% Impervious, Inflow Depth = 3.63" for 10-Year event
Inflow = 0.66 cfs @ 12.14 hrs, Volume= 1,574 cf
Outflow = 0.65 cfs @ 12.15 hrs, Volume= 1,574 cf, Atten= 1%, Lag= 0.7 min
Discarded = 0.00 cfs @ 5.75 hrs, Volume= 738 cf
Primary = 0.64 cfs @ 12.15 hrs, Volume= 836 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 823.13' @ 12.15 hrs Surf.Area= 202 sf Storage= 534 cf

Plug-Flow detention time= 554.6 min calculated for 1,574 cf (100% of inflow)
Center-of-Mass det. time= 554.5 min (1,303.5 - 748.9)

Volume	Invert	Avail.Storage	Storage Description
#1B	819.00'	386 cf	**10.33'W x 19.54'L x 6.75'H Field B** 1,363 cf Overall - 398 cf Embedded = 965 cf x 40.0% Voids
#2B	819.75'	398 cf	**ADS_StormTech MC-4500 b +Cap** x 3 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap Cap Storage= +39.5 cf x 2 x 1 rows = 79.0 cf
		784 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	819.00'	**0.800 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	822.73'	**12.0" Round 12" Culvert** L= 32.0' Ke= 0.500 Inlet / Outlet Invert= 822.73' / 821.51' S= 0.0381 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 5.75 hrs HW=819.07' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.64 cfs @ 12.15 hrs HW=823.13' (Free Discharge)
↑**2=12" Culvert** (Inlet Controls 0.64 cfs @ 2.16 fps)

Summary for Pond 3P: (new Pond)

Inflow Area = 44,146 sf, 90.60% Impervious, Inflow Depth = 2.07" for 10-Year event
Inflow = 2.55 cfs @ 12.22 hrs, Volume= 7,632 cf
Outflow = 2.55 cfs @ 12.22 hrs, Volume= 7,632 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.55 cfs @ 12.22 hrs, Volume= 7,632 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Peak Elev= 820.76' @ 12.22 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	819.70'	**12.0" Round RCP_Round 12"** L= 48.0' Ke= 0.500 Inlet / Outlet Invert= 819.70' / 819.37' S= 0.0069 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=2.55 cfs @ 12.22 hrs HW=820.76' (Free Discharge)
↑—**1=RCP_Round 12"** (Barrel Controls 2.55 cfs @ 3.80 fps)

Summary for Link 1L: W 97 Street

Inflow Area = 48,286 sf, 84.52% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 2.61 cfs @ 12.22 hrs, Volume= 7,926 cf
Primary = 2.61 cfs @ 12.22 hrs, Volume= 7,926 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 2L: W 98th Street

Inflow Area = 8,355 sf, 73.10% Impervious, Inflow Depth = 1.89" for 10-Year event
Inflow = 0.84 cfs @ 12.15 hrs, Volume= 1,314 cf
Primary = 0.84 cfs @ 12.15 hrs, Volume= 1,314 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 3L: East Private Property

Inflow Area = 1,128 sf, 0.00% Impervious, Inflow Depth = 0.07" for 10-Year event
Inflow = 0.00 cfs @ 13.26 hrs, Volume= 7 cf
Primary = 0.00 cfs @ 13.26 hrs, Volume= 7 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link 4L: Total Offsite

Inflow Area = 57,769 sf, 81.22% Impervious, Inflow Depth = 1.92" for 10-Year event
Inflow = 3.21 cfs @ 12.20 hrs, Volume= 9,247 cf
Primary = 3.21 cfs @ 12.20 hrs, Volume= 9,247 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Appendix G

Proposed Conditions 100-Year Summary

Summary for Subcatchment 1S: Subcat 1S

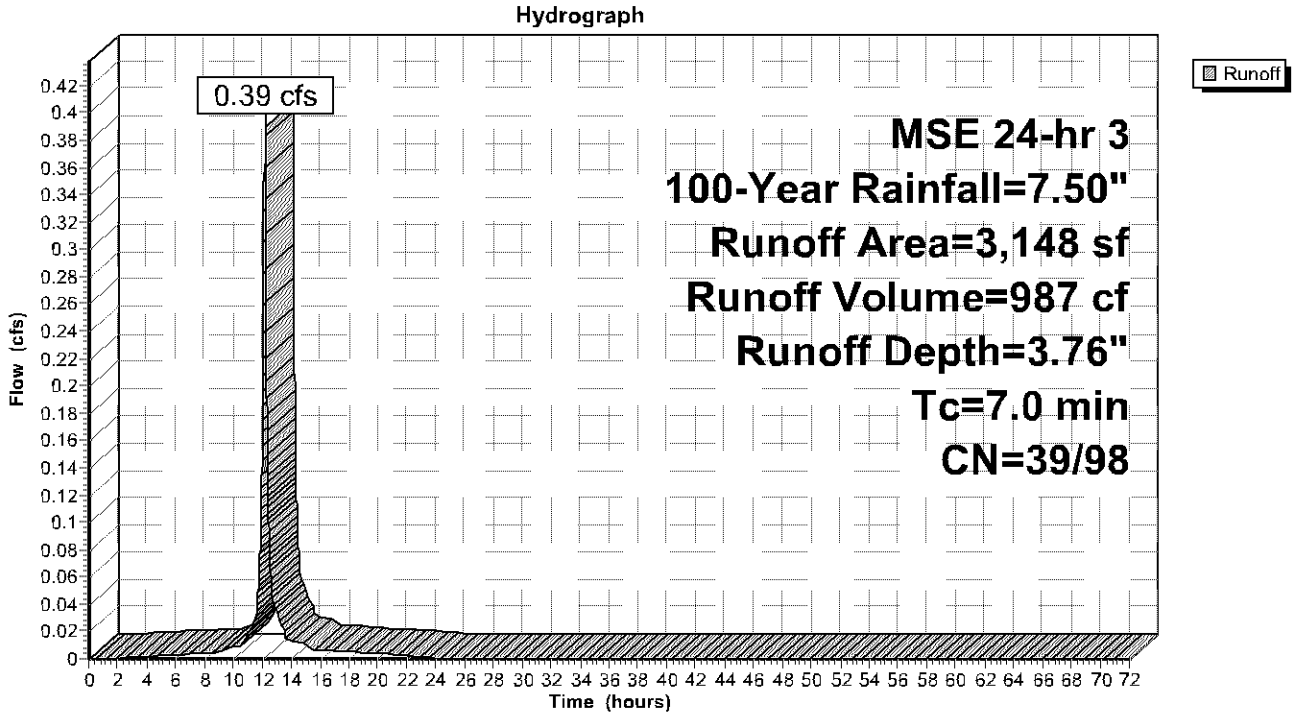
Runoff = 0.39 cfs @ 12.14 hrs, Volume= 987 cf, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
1,748	39	>75% Grass cover, Good, HSG A
1,401	98	Paved parking, HSG A
3,148	65	Weighted Average
1,748	39	55.51% Pervious Area
1,401	98	44.49% Impervious Area

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

Subcatchment 1S: Subcat 1S



Summary for Subcatchment 2S: Subcat 2S

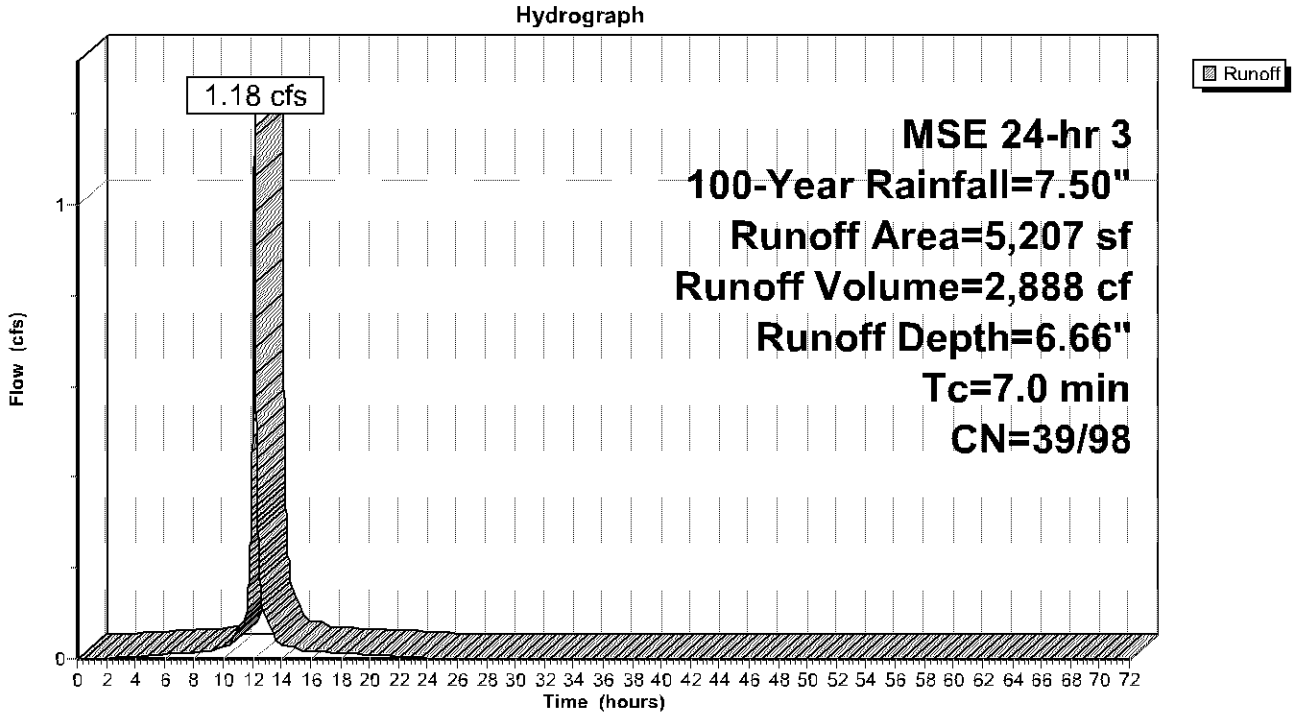
Runoff = 1.18 cfs @ 12.14 hrs, Volume= 2,888 cf, Depth= 6.66"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
500	39	>75% Grass cover, Good, HSG A
4,707	98	Paved parking, HSG A
5,207	92	Weighted Average
500	39	9.60% Pervious Area
4,707	98	90.40% Impervious Area

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

Subcatchment 2S: Subcat 2S



Summary for Subcatchment 3S: Subcat 3S

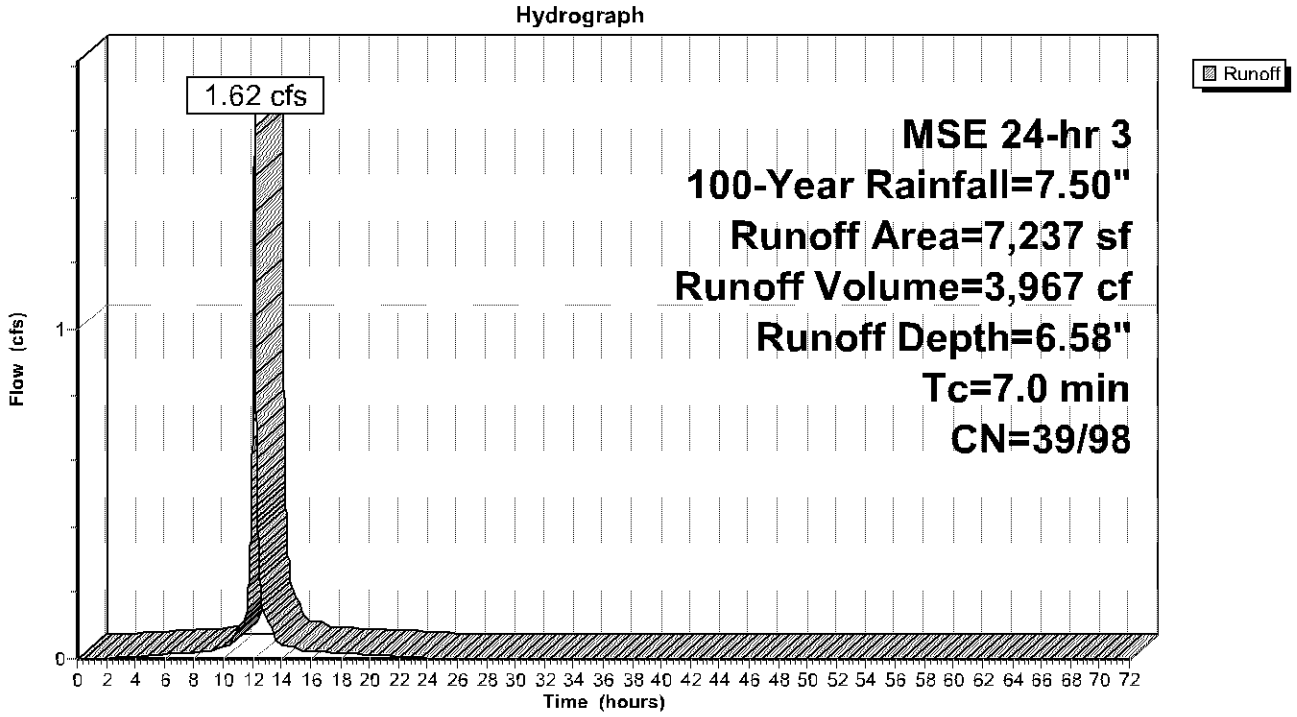
Runoff = 1.62 cfs @ 12.14 hrs, Volume= 3,967 cf, Depth= 6.58"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
784	39	>75% Grass cover, Good, HSG A
6,453	98	Paved parking, HSG A
7,237	92	Weighted Average
784	39	10.84% Pervious Area
6,453	98	89.16% Impervious Area

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

Subcatchment 3S: Subcat 3S



Summary for Subcatchment 4S: Subcat 4S

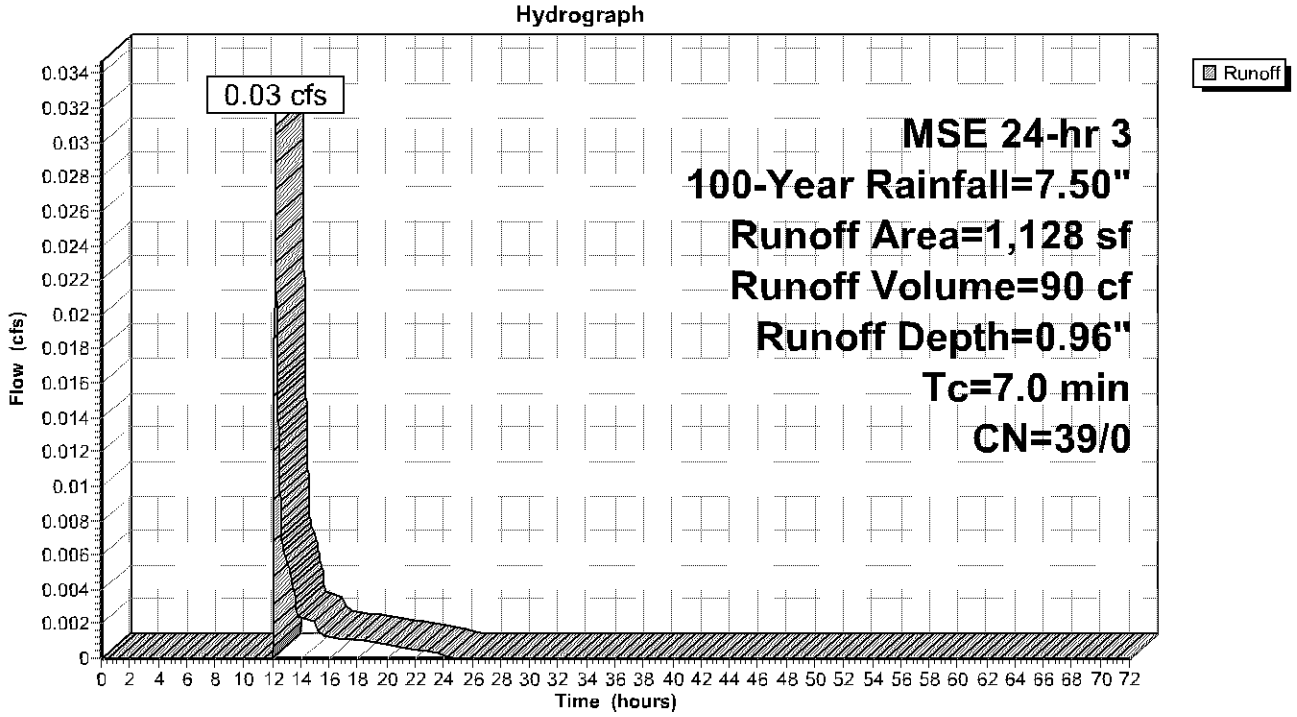
Runoff = 0.03 cfs @ 12.16 hrs, Volume= 90 cf, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
1,128	39	>75% Grass cover, Good, HSG A
1,128	39	100.00% Pervious Area

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

Subcatchment 4S: Subcat 4S



Summary for Subcatchment 5S: Subcat 5S

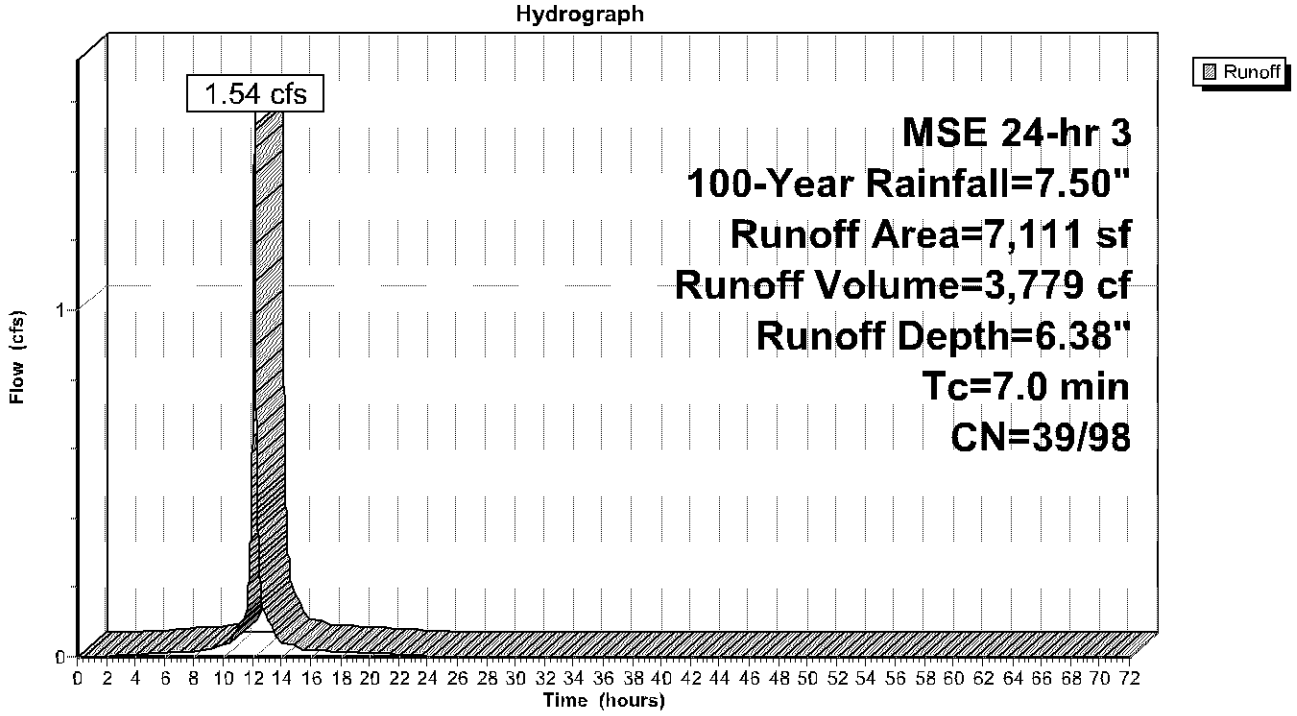
Runoff = 1.54 cfs @ 12.14 hrs, Volume= 3,779 cf, Depth= 6.38"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
996	39	>75% Grass cover, Good, HSG A
6,114	98	Paved parking, HSG A
0	98	Roofs, HSG A
7,111	90	Weighted Average
996	39	14.01% Pervious Area
6,115	98	85.99% Impervious Area

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

Subcatchment 5S: Subcat 5S



Summary for Subcatchment 6S: Subcat 6S

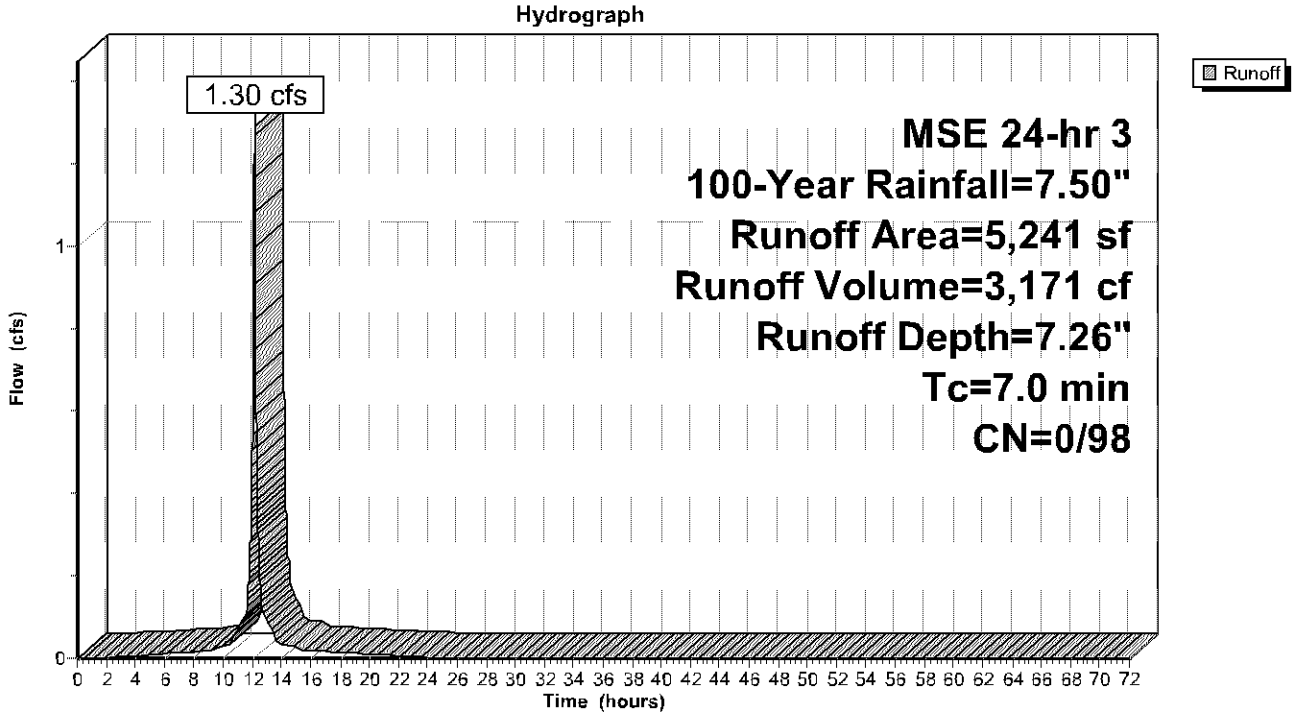
Runoff = 1.30 cfs @ 12.14 hrs, Volume= 3,171 cf, Depth= 7.26"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
5,241	98	Roofs, HSG A
5,241	98	100.00% Impervious Area

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

Subcatchment 6S: Subcat 6S



Summary for Subcatchment 7S: Subcat 7S

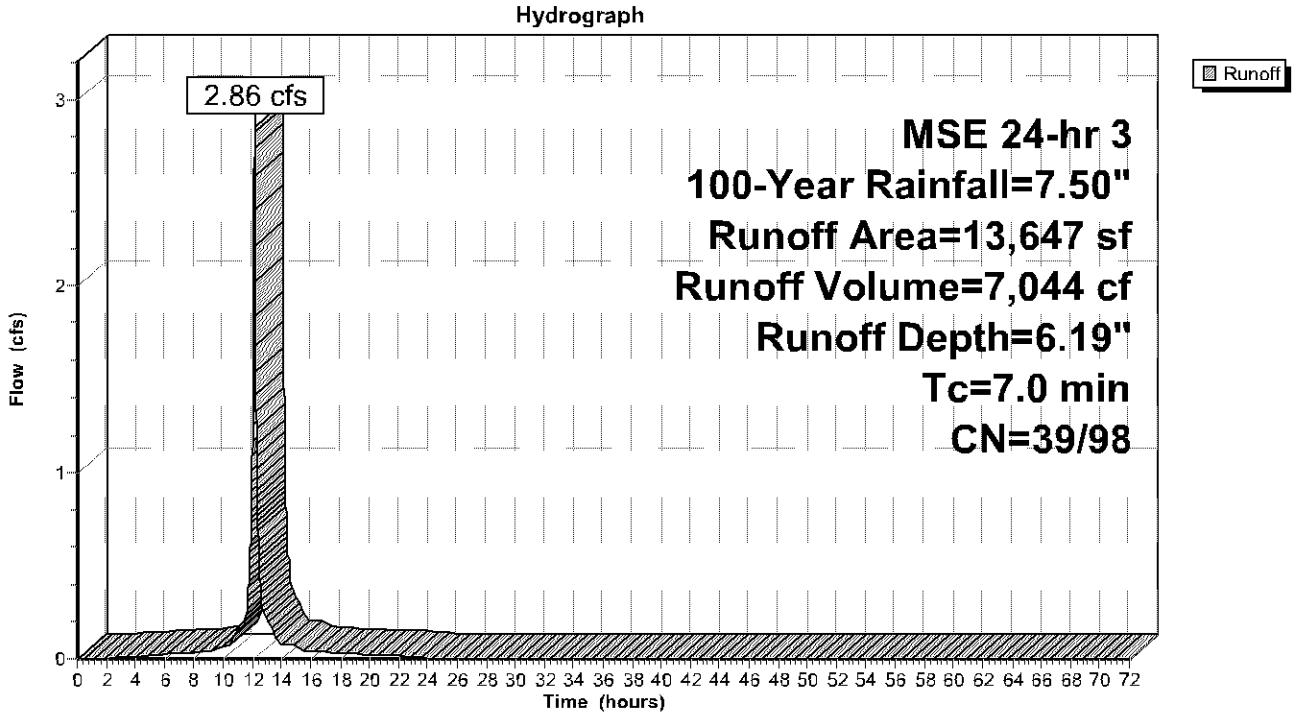
Runoff = 2.86 cfs @ 12.14 hrs, Volume= 7,044 cf, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
2,309	39	>75% Grass cover, Good, HSG A
11,338	98	Paved parking, HSG A
13,647	88	Weighted Average
2,309	39	16.92% Pervious Area
11,338	98	83.08% Impervious Area

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

Subcatchment 7S: Subcat 7S



Summary for Subcatchment 8S: Subcat 8S

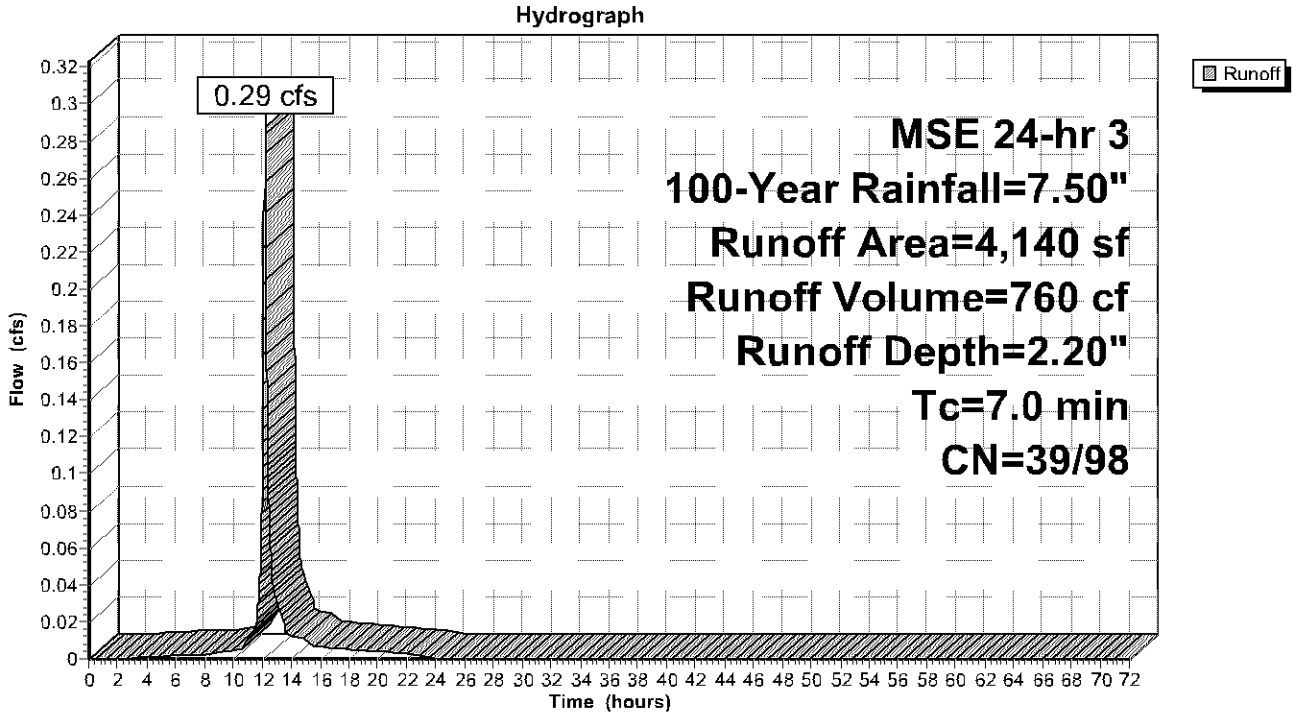
Runoff = 0.29 cfs @ 12.15 hrs, Volume= 760 cf, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
3,322	39	>75% Grass cover, Good, HSG A
819	98	Paved parking, HSG A
4,140	51	Weighted Average
3,322	39	80.23% Pervious Area
819	98	19.77% Impervious Area

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

Subcatchment 8S: Subcat 8S



Summary for Subcatchment 9S: Subcat 9S

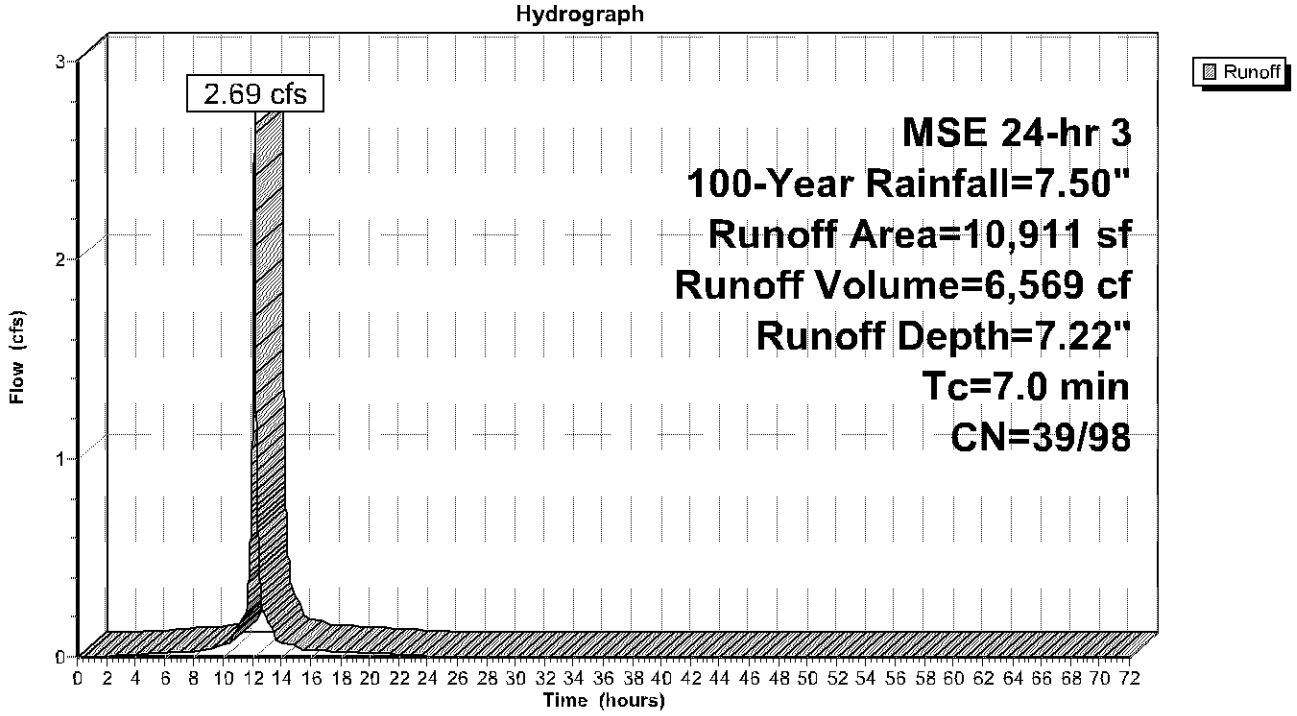
Runoff = 2.69 cfs @ 12.14 hrs, Volume= 6,569 cf, Depth= 7.22"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
62	39	>75% Grass cover, Good, HSG A
8,760	98	Paved parking, HSG A
2,089	98	Roofs, HSG A
10,911	98	Weighted Average
62	39	0.57% Pervious Area
10,849	98	99.43% Impervious Area

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

Subcatchment 9S: Subcat 9S



Summary for Pond 1P: Underground Infiltration System 1 (StormTech 4500)

Inflow Area = 33,235 sf, 87.70% Impervious, Inflow Depth = 6.48" for 100-Year event
Inflow = 7.32 cfs @ 12.14 hrs, Volume= 17,960 cf
Outflow = 5.61 cfs @ 12.19 hrs, Volume= 17,960 cf, Atten= 23%, Lag= 3.1 min
Discarded = 0.03 cfs @ 3.92 hrs, Volume= 5,995 cf
Primary = 5.58 cfs @ 12.19 hrs, Volume= 11,966 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 825.41' @ 12.19 hrs Surf.Area= 1,475 sf Storage= 6,029 cf

Plug-Flow detention time= 450.4 min calculated for 17,958 cf (100% of inflow)
Center-of-Mass det. time= 450.7 min (1,194.3 - 743.6)

Volume	Invert	Avail.Storage	Storage Description
#1B	819.00'	2,481 cf	**28.50'W x 51.74'L x 6.75'H Field B** 9,954 cf Overall - 3,751 cf Embedded = 6,203 cf x 40.0% Voids
#2B	819.75'	3,751 cf	**ADS_StormTech MC-4500 b +Cap** x 33 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 33 Chambers in 3 Rows Cap Storage= +39.5 cf x 2 x 3 rows = 237.0 cf
		6,232 cf	Total Available Storage

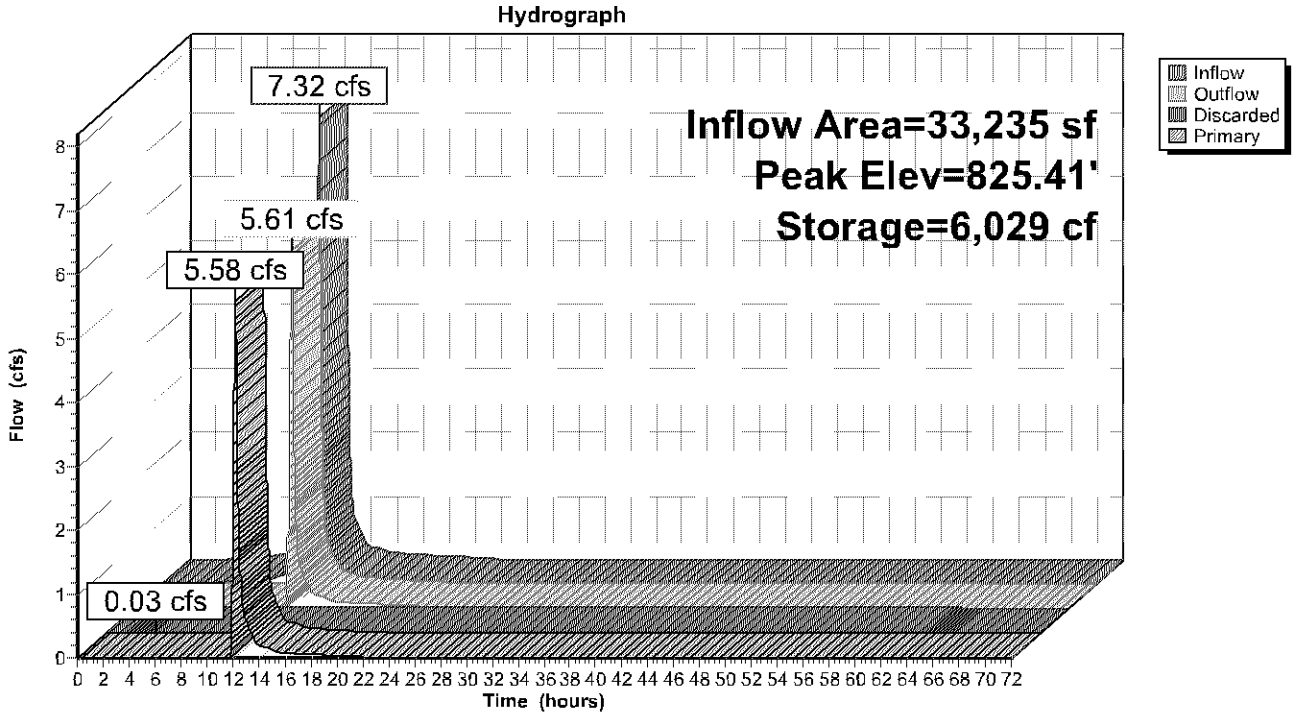
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	819.00'	**0.800 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	822.73'	**12.0" Round 12" Culvert** L= 5.0' Ke= 0.500 Inlet / Outlet Invert= 822.73' / 822.70' S= 0.0060 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 3.92 hrs HW=819.07' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=5.58 cfs @ 12.19 hrs HW=825.40' (Free Discharge)
↑**2=12" Culvert** (Inlet Controls 5.58 cfs @ 7.10 fps)

Pond 1P: Underground Infiltration System 1 (StormTech 4500)



Stage-Area-Storage for Pond 1P: Underground Infiltration System 1 (StormTech 4500)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
819.00	**1,475**	0	822.40	1,475	3,554
819.05	1,475	29	822.45	1,475	3,609
819.10	1,475	59	822.50	1,475	3,662
819.15	1,475	88	822.55	1,475	3,716
819.20	1,475	118	822.60	1,475	3,769
819.25	1,475	147	822.65	1,475	3,823
819.30	1,475	177	822.70	1,475	3,875
819.35	1,475	206	822.75	1,475	3,928
819.40	1,475	236	822.80	1,475	3,980
819.45	1,475	265	822.85	1,475	4,032
819.50	1,475	295	822.90	1,475	4,084
819.55	1,475	324	822.95	1,475	4,135
819.60	1,475	354	823.00	1,475	4,186
819.65	1,475	383	823.05	1,475	4,237
819.70	1,475	413	823.10	1,475	4,288
819.75	1,475	442	823.15	1,475	4,338
819.80	1,475	504	823.20	1,475	4,387
819.85	1,475	565	823.25	1,475	4,437
819.90	1,475	627	823.30	1,475	4,486
819.95	1,475	688	823.35	1,475	4,534
820.00	1,475	749	823.40	1,475	4,582
820.05	1,475	811	823.45	1,475	4,630
820.10	1,475	872	823.50	1,475	4,677
820.15	1,475	933	823.55	1,475	4,724
820.20	1,475	994	823.60	1,475	4,771
820.25	1,475	1,055	823.65	1,475	4,817
820.30	1,475	1,115	823.70	1,475	4,862
820.35	1,475	1,176	823.75	1,475	4,907
820.40	1,475	1,237	823.80	1,475	4,952
820.45	1,475	1,297	823.85	1,475	4,995
820.50	1,475	1,358	823.90	1,475	5,039
820.55	1,475	1,418	823.95	1,475	5,081
820.60	1,475	1,478	824.00	1,475	5,123
820.65	1,475	1,539	824.05	1,475	5,164
820.70	1,475	1,599	824.10	1,475	5,205
820.75	1,475	1,659	824.15	1,475	5,245
820.80	1,475	1,718	824.20	1,475	5,283
820.85	1,475	1,778	824.25	1,475	5,320
820.90	1,475	1,838	824.30	1,475	5,356
820.95	1,475	1,897	824.35	1,475	5,390
821.00	1,475	1,957	824.40	1,475	5,424
821.05	1,475	2,016	824.45	1,475	5,456
821.10	1,475	2,075	824.50	1,475	5,488
821.15	1,475	2,134	824.55	1,475	5,520
821.20	1,475	2,193	824.60	1,475	5,551
821.25	1,475	2,252	824.65	1,475	5,582
821.30	1,475	2,310	824.70	1,475	5,613
821.35	1,475	2,369	824.75	1,475	5,642
821.40	1,475	2,427	824.80	1,475	5,672
821.45	1,475	2,485	824.85	1,475	5,701
821.50	1,475	2,543	824.90	1,475	5,731
821.55	1,475	2,601	824.95	1,475	5,760
821.60	1,475	2,658	825.00	1,475	5,790
821.65	1,475	2,716	825.05	1,475	5,819
821.70	1,475	2,773	825.10	1,475	5,849
821.75	1,475	2,830	825.15	1,475	5,878
821.80	1,475	2,887	825.20	1,475	5,908
821.85	1,475	2,944	825.25	1,475	5,937
821.90	1,475	3,000	825.30	1,475	5,967
821.95	1,475	3,057	825.35	1,475	5,996
822.00	1,475	3,113	825.40	1,475	6,026
822.05	1,475	3,169	825.45	1,475	6,055
822.10	1,475	3,225	825.50	1,475	6,085
822.15	1,475	3,280	825.55	1,475	6,114
822.20	1,475	3,335	825.60	1,475	6,144
822.25	1,475	3,390	825.65	1,475	6,173
822.30	1,475	3,445	825.70	1,475	6,203
822.35	1,475	3,500	825.75	1,475	**6,232**

Summary for Pond 2P: Underground Infiltration System 2 (StormTech 4500)

Inflow Area = 5,207 sf, 90.40% Impervious, Inflow Depth = 6.66" for 100-Year event
Inflow = 1.18 cfs @ 12.14 hrs, Volume= 2,888 cf
Outflow = 1.17 cfs @ 12.15 hrs, Volume= 2,888 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.00 cfs @ 3.64 hrs, Volume= 768 cf
Primary = 1.16 cfs @ 12.15 hrs, Volume= 2,120 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 823.29' @ 12.15 hrs Surf.Area= 202 sf Storage= 553 cf

Plug-Flow detention time= 325.9 min calculated for 2,887 cf (100% of inflow)
Center-of-Mass det. time= 326.1 min (1,069.2 - 743.1)

Volume	Invert	Avail.Storage	Storage Description
#1B	819.00'	386 cf	**10.33'W x 19.54'L x 6.75'H Field B** 1,363 cf Overall - 398 cf Embedded = 965 cf x 40.0% Voids
#2B	819.75'	398 cf	**ADS_StormTech MC-4500 b +Cap** x 3 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap Cap Storage= +39.5 cf x 2 x 1 rows = 79.0 cf
		784 cf	Total Available Storage

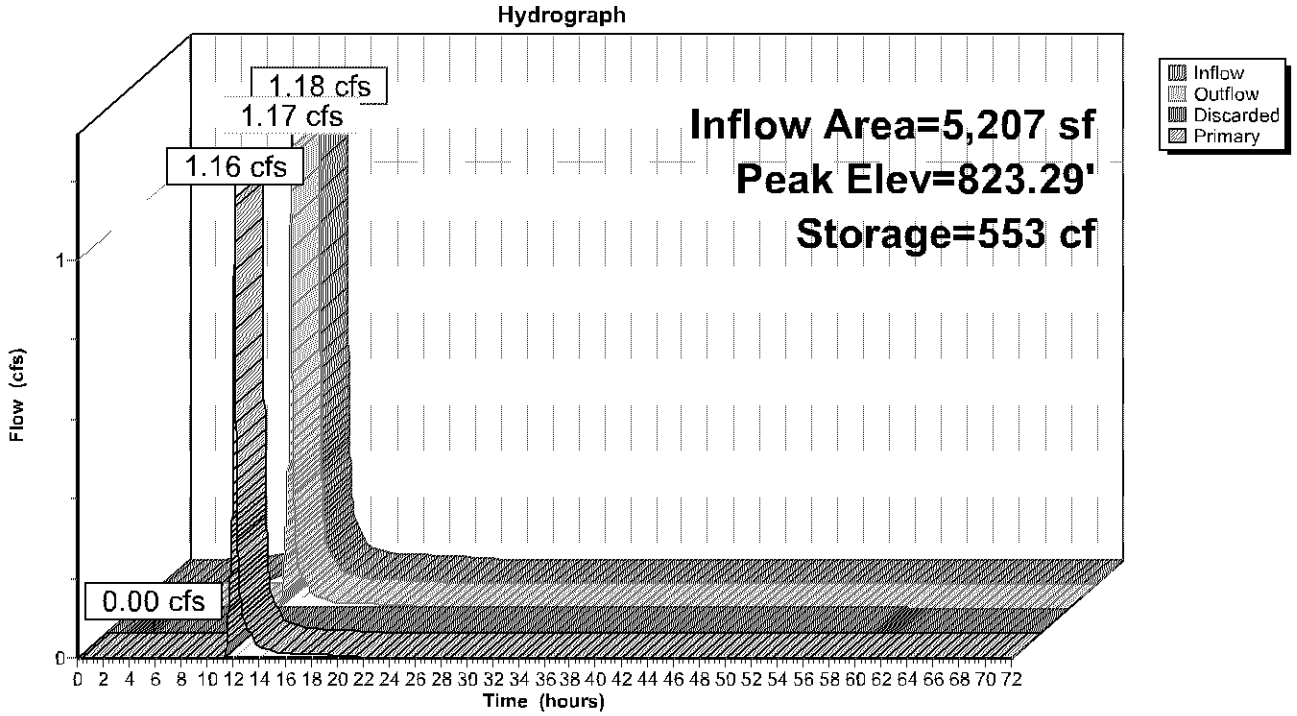
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	819.00'	**0.800 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	822.73'	**12.0" Round 12" Culvert** L= 32.0' Ke= 0.500 Inlet / Outlet Invert= 822.73' / 821.51' S= 0.0381 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 3.64 hrs HW=819.07' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.16 cfs @ 12.15 hrs HW=823.29' (Free Discharge)
↑**2=12" Culvert** (Inlet Controls 1.16 cfs @ 2.55 fps)

Pond 2P: Underground Infiltration System 2 (StormTech 4500)



Stage-Area-Storage for Pond 2P: Underground Infiltration System 2 (StormTech 4500)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
819.00	**202**	0	822.40	202	439
819.05	202	4	822.45	202	446
819.10	202	8	822.50	202	452
819.15	202	12	822.55	202	459
819.20	202	16	822.60	202	466
819.25	202	20	822.65	202	472
819.30	202	24	822.70	202	479
819.35	202	28	822.75	202	485
819.40	202	32	822.80	202	492
819.45	202	36	822.85	202	498
819.50	202	40	822.90	202	504
819.55	202	44	822.95	202	511
819.60	202	48	823.00	202	517
819.65	202	53	823.05	202	523
819.70	202	57	823.10	202	530
819.75	202	61	823.15	202	536
819.80	202	68	823.20	202	542
819.85	202	75	823.25	202	548
819.90	202	83	823.30	202	554
819.95	202	90	823.35	202	560
820.00	202	98	823.40	202	566
820.05	202	105	823.45	202	572
820.10	202	113	823.50	202	578
820.15	202	120	823.55	202	584
820.20	202	127	823.60	202	590
820.25	202	135	823.65	202	596
820.30	202	142	823.70	202	602
820.35	202	149	823.75	202	607
820.40	202	157	823.80	202	613
820.45	202	164	823.85	202	618
820.50	202	171	823.90	202	624
820.55	202	179	823.95	202	629
820.60	202	186	824.00	202	635
820.65	202	193	824.05	202	640
820.70	202	201	824.10	202	645
820.75	202	208	824.15	202	650
820.80	202	215	824.20	202	655
820.85	202	222	824.25	202	660
820.90	202	230	824.30	202	665
820.95	202	237	824.35	202	670
821.00	202	244	824.40	202	674
821.05	202	251	824.45	202	678
821.10	202	258	824.50	202	683
821.15	202	266	824.55	202	687
821.20	202	273	824.60	202	691
821.25	202	280	824.65	202	695
821.30	202	287	824.70	202	699
821.35	202	294	824.75	202	704
821.40	202	301	824.80	202	708
821.45	202	308	824.85	202	712
821.50	202	315	824.90	202	716
821.55	202	322	824.95	202	720
821.60	202	329	825.00	202	724
821.65	202	336	825.05	202	728
821.70	202	343	825.10	202	732
821.75	202	350	825.15	202	736
821.80	202	357	825.20	202	740
821.85	202	364	825.25	202	744
821.90	202	371	825.30	202	748
821.95	202	378	825.35	202	752
822.00	202	385	825.40	202	756
822.05	202	392	825.45	202	760
822.10	202	399	825.50	202	764
822.15	202	405	825.55	202	768
822.20	202	412	825.60	202	772
822.25	202	419	825.65	202	776
822.30	202	426	825.70	202	780
822.35	202	432	825.75	202	**784**

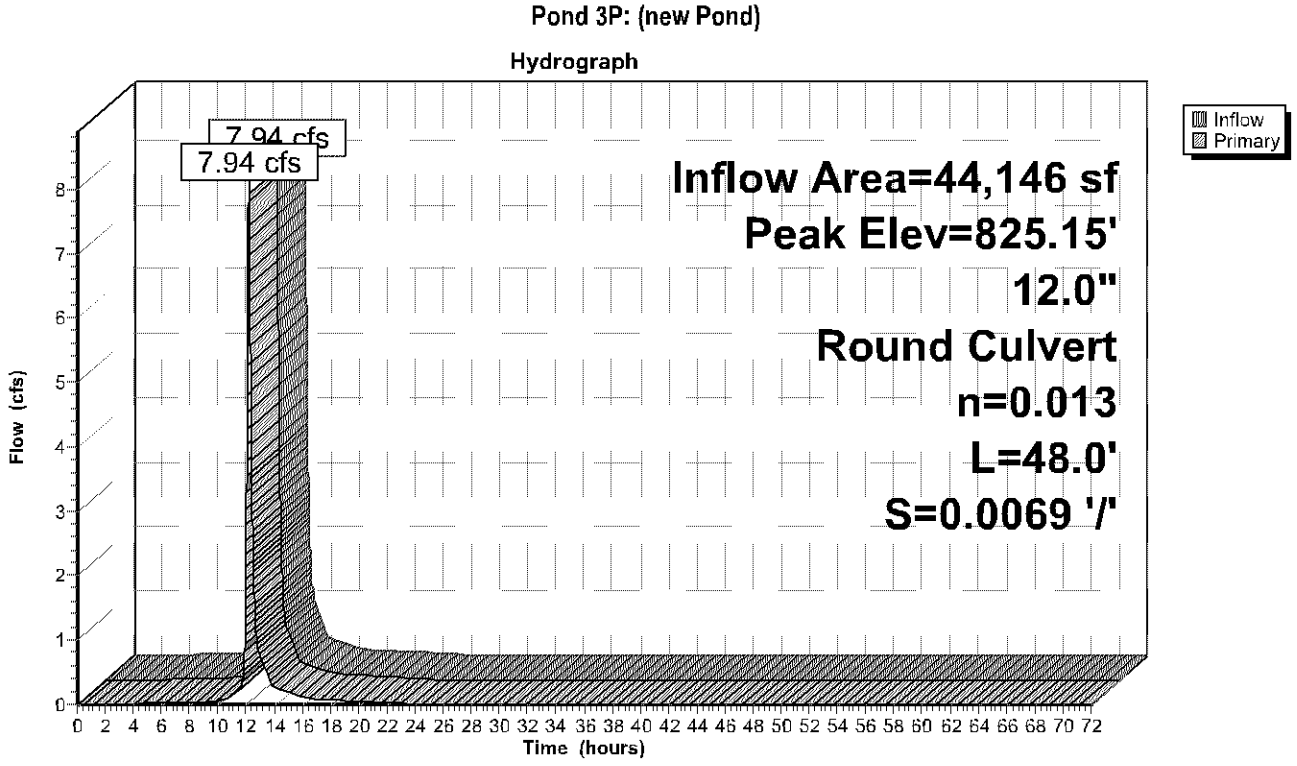
Summary for Pond 3P: (new Pond)

Inflow Area = 44,146 sf, 90.60% Impervious, Inflow Depth = 5.04" for 100-Year event
Inflow = 7.94 cfs @ 12.16 hrs, Volume= 18,535 cf
Outflow = 7.94 cfs @ 12.16 hrs, Volume= 18,535 cf, Atten= 0%, Lag= 0.0 min
Primary = 7.94 cfs @ 12.16 hrs, Volume= 18,535 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 825.15' @ 12.16 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	819.70'	**12.0" Round RCP_Round 12"** L= 48.0' Ke= 0.500 Inlet / Outlet Invert= 819.70' / 819.37' S= 0.0069 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=7.94 cfs @ 12.16 hrs HW=825.14' (Free Discharge)
↑**1=RCP_Round 12"** (Barrel Controls 7.94 cfs @ 10.11 fps)



Stage-Area-Storage for Pond 3P: (new Pond)

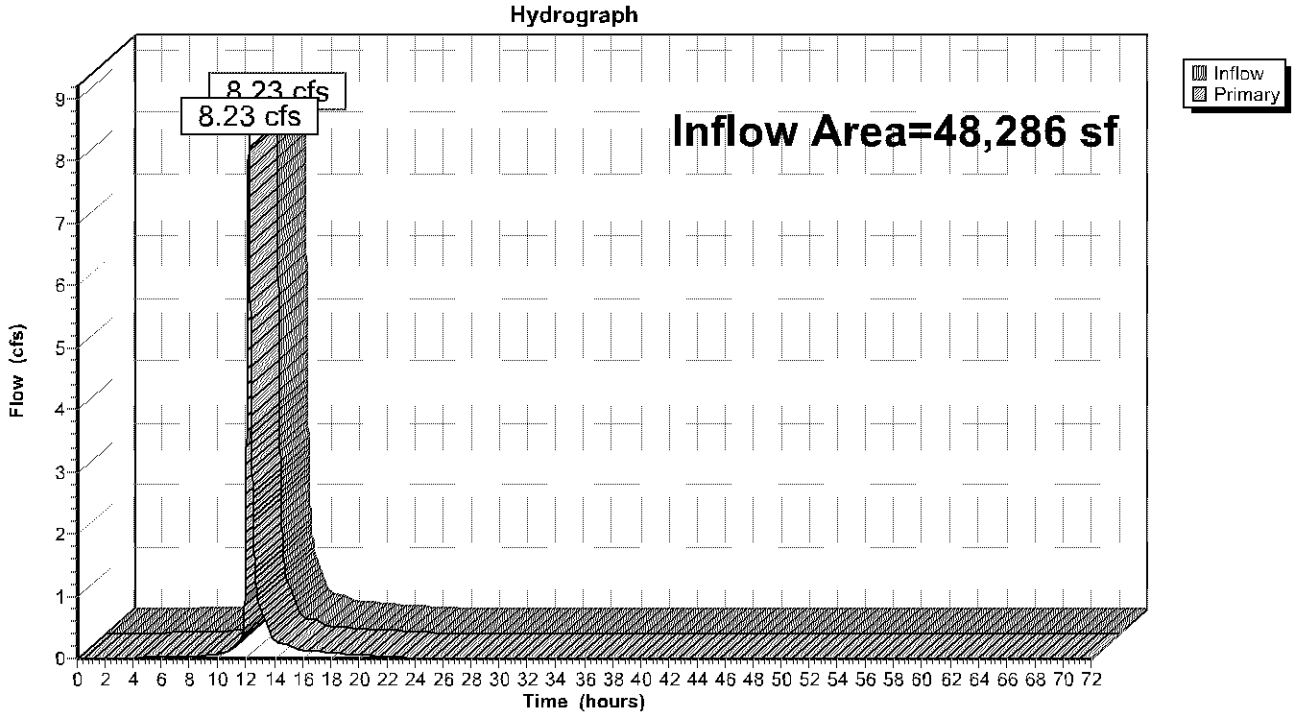
Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
819.70	0	821.06	0	822.42	0	823.78	0	825.14	0
819.72	0	821.08	0	822.44	0	823.80	0	825.16	0
819.74	0	821.10	0	822.46	0	823.82	0	825.18	0
819.76	0	821.12	0	822.48	0	823.84	0		
819.78	0	821.14	0	822.50	0	823.86	0		
819.80	0	821.16	0	822.52	0	823.88	0		
819.82	0	821.18	0	822.54	0	823.90	0		
819.84	0	821.20	0	822.56	0	823.92	0		
819.86	0	821.22	0	822.58	0	823.94	0		
819.88	0	821.24	0	822.60	0	823.96	0		
819.90	0	821.26	0	822.62	0	823.98	0		
819.92	0	821.28	0	822.64	0	824.00	0		
819.94	0	821.30	0	822.66	0	824.02	0		
819.96	0	821.32	0	822.68	0	824.04	0		
819.98	0	821.34	0	822.70	0	824.06	0		
820.00	0	821.36	0	822.72	0	824.08	0		
820.02	0	821.38	0	822.74	0	824.10	0		
820.04	0	821.40	0	822.76	0	824.12	0		
820.06	0	821.42	0	822.78	0	824.14	0		
820.08	0	821.44	0	822.80	0	824.16	0		
820.10	0	821.46	0	822.82	0	824.18	0		
820.12	0	821.48	0	822.84	0	824.20	0		
820.14	0	821.50	0	822.86	0	824.22	0		
820.16	0	821.52	0	822.88	0	824.24	0		
820.18	0	821.54	0	822.90	0	824.26	0		
820.20	0	821.56	0	822.92	0	824.28	0		
820.22	0	821.58	0	822.94	0	824.30	0		
820.24	0	821.60	0	822.96	0	824.32	0		
820.26	0	821.62	0	822.98	0	824.34	0		
820.28	0	821.64	0	823.00	0	824.36	0		
820.30	0	821.66	0	823.02	0	824.38	0		
820.32	0	821.68	0	823.04	0	824.40	0		
820.34	0	821.70	0	823.06	0	824.42	0		
820.36	0	821.72	0	823.08	0	824.44	0		
820.38	0	821.74	0	823.10	0	824.46	0		
820.40	0	821.76	0	823.12	0	824.48	0		
820.42	0	821.78	0	823.14	0	824.50	0		
820.44	0	821.80	0	823.16	0	824.52	0		
820.46	0	821.82	0	823.18	0	824.54	0		
820.48	0	821.84	0	823.20	0	824.56	0		
820.50	0	821.86	0	823.22	0	824.58	0		
820.52	0	821.88	0	823.24	0	824.60	0		
820.54	0	821.90	0	823.26	0	824.62	0		
820.56	0	821.92	0	823.28	0	824.64	0		
820.58	0	821.94	0	823.30	0	824.66	0		
820.60	0	821.96	0	823.32	0	824.68	0		
820.62	0	821.98	0	823.34	0	824.70	0		
820.64	0	822.00	0	823.36	0	824.72	0		
820.66	0	822.02	0	823.38	0	824.74	0		
820.68	0	822.04	0	823.40	0	824.76	0		
820.70	0	822.06	0	823.42	0	824.78	0		
820.72	0	822.08	0	823.44	0	824.80	0		
820.74	0	822.10	0	823.46	0	824.82	0		
820.76	0	822.12	0	823.48	0	824.84	0		
820.78	0	822.14	0	823.50	0	824.86	0		
820.80	0	822.16	0	823.52	0	824.88	0		
820.82	0	822.18	0	823.54	0	824.90	0		
820.84	0	822.20	0	823.56	0	824.92	0		
820.86	0	822.22	0	823.58	0	824.94	0		
820.88	0	822.24	0	823.60	0	824.96	0		
820.90	0	822.26	0	823.62	0	824.98	0		
820.92	0	822.28	0	823.64	0	825.00	0		
820.94	0	822.30	0	823.66	0	825.02	0		
820.96	0	822.32	0	823.68	0	825.04	0		
820.98	0	822.34	0	823.70	0	825.06	0		
821.00	0	822.36	0	823.72	0	825.08	0		
821.02	0	822.38	0	823.74	0	825.10	0		
821.04	0	822.40	0	823.76	0	825.12	0		

Summary for Link 1L: W 97 Street

Inflow Area = 48,286 sf, 84.52% Impervious, Inflow Depth = 4.79" for 100-Year event
Inflow = 8.23 cfs @ 12.16 hrs, Volume= 19,294 cf
Primary = 8.23 cfs @ 12.16 hrs, Volume= 19,294 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: W 97 Street

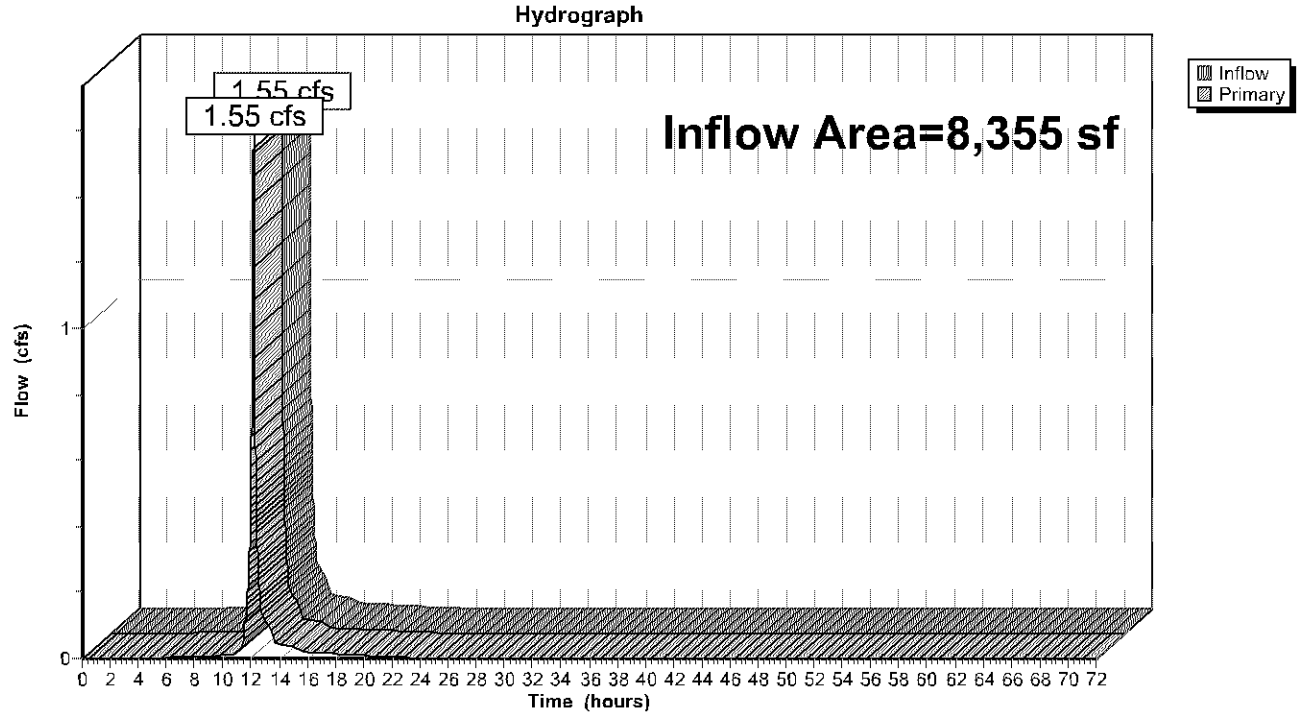


Summary for Link 2L: W 98th Street

Inflow Area = 8,355 sf, 73.10% Impervious, Inflow Depth = 4.46" for 100-Year event
Inflow = 1.55 cfs @ 12.15 hrs, Volume= 3,106 cf
Primary = 1.55 cfs @ 12.15 hrs, Volume= 3,106 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: W 98th Street

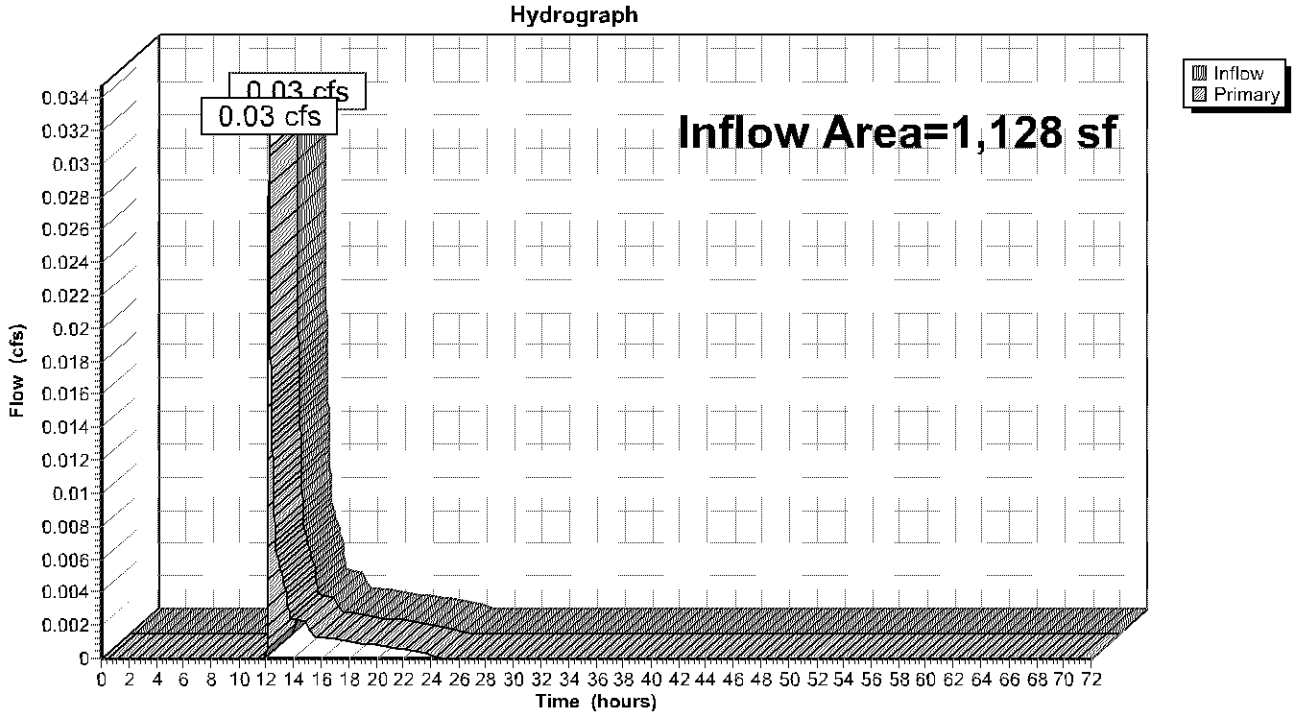


Summary for Link 3L: East Private Property

Inflow Area = 1,128 sf, 0.00% Impervious, Inflow Depth = 0.96" for 100-Year event
Inflow = 0.03 cfs @ 12.16 hrs, Volume= 90 cf
Primary = 0.03 cfs @ 12.16 hrs, Volume= 90 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 3L: East Private Property

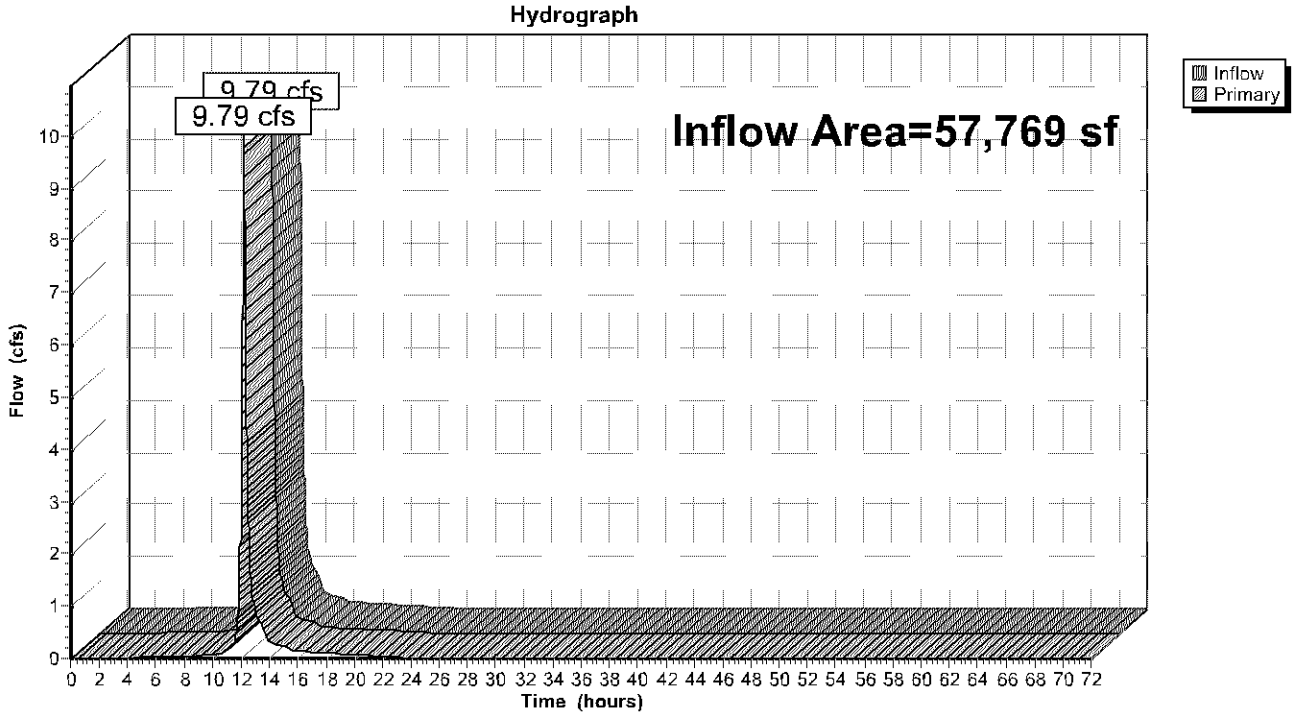


Summary for Link 4L: Total Offsite

Inflow Area = 57,769 sf, 81.22% Impervious, Inflow Depth = 4.67" for 100-Year event
Inflow = 9.79 cfs @ 12.16 hrs, Volume= 22,490 cf
Primary = 9.79 cfs @ 12.16 hrs, Volume= 22,490 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 4L: Total Offsite



Appendix H

Soils Data

HAUGO GEOTECHNICAL SERVICES

January 10, 2022 HGTS Project Number: 21-1245

Mr. Tanner Brandt
Christianson Companies
4609 33rd Avenue South, Suite 400
Fargo, ND 58104

Re: Geotechnical Exploration Report, Proposed Tommy's Express Carwash, 200 West 98th Street, Bloomington, Minnesota

Dear Mr. Brandt:

We have completed the geotechnical exploration report for the proposed Car Wash in Bloomington, Minnesota. A brief summary of our results and recommendations is presented below. Specific details regarding our procedures, results and recommendations follow in the attached geotechnical exploration report.

Five (5) soil borings were completed for this project which encountered a pavement section at the surface that was underlain by topsoil or Fill that extended to about 4 ½ feet below the ground surface. Below the topsoil or Fill, the soil borings encountered glacial outwash sands that extended to the termination depths of the borings. Groundwater was not encountered in the soil borings while drilling and sampling or after removal of the auger from the boreholes. We do not anticipate that groundwater will be encountered during construction.

The existing pavement section, topsoil and Fill are not suitable for building foundation support and will need to be removed from within the proposed building and oversize areas and replaced, as needed, with suitable compacted engineered fill in order to provide adequate foundation support. The underlying glacial outwash sand soils are generally suitable for foundation support.

Thank you for the opportunity to assist you on this project. If you have any questions or need additional information, please contact Paul Gionfriddo at 612-729-2959.

Sincerely,
Haugo GeoTechnical Services

Jesse Miller, E.I.T.
Staff Engineer

Paul Gionfriddo, P.E.
Senior Engineer

GEOTECHNICAL EXPLORATION REPORT

PROJECT:

Proposed Tommy's Express Car Wash
200 West 98th Street
Bloomington, MN

PREPARED FOR:

Christianson Companies
4609 33rd Avenue South, Suite 400
Fargo, ND 58104

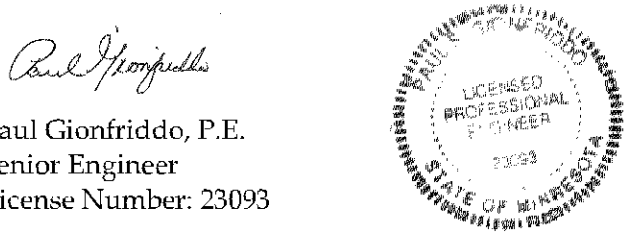
PREPARED BY:

Haugo GeoTechnical Services
2825 Cedar Avenue South
Minneapolis, Minnesota 55407

Haugo GeoTechnical Services Project: 21-1245

January 10, 2022

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



Paul Gionfriddo, P.E.
Senior Engineer
License Number: 23093

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1.0 INTRODUCTION

1.1 Project Description

Christianson Companies is proposing to construct a new car wash, along with the associated bituminous parking and drive lanes at 200 West 98th Street in Bloomington, Minnesota and retained Haugo GeoTechnical Services (HGTS) to perform a geotechnical exploration to evaluate the suitability of site soil conditions to support the proposed car wash.

1.2 Purpose

The purpose of this geotechnical exploration was to characterize subsurface soil and groundwater conditions and provide recommendations for foundation design and construction of the proposed car wash.

1.3 Site Description

The project site is located at 200 West 98th Street in Bloomington, Minnesota. At the time of our exploration, the project site contained an office building along with the associated bituminous parking areas.

Topography of the site is relatively flat with elevations at the soil boring locations ranging from about 826 ½ to 829 ½ feet above mean sea level (MSL).

1.4 Scope of Services

Our services were performed in accordance with the Haugo GeoTechnical Services proposal 21-1245 dated January 27, 2021. Our scope of services was performed under the terms of our General Conditions and limited to the following tasks:

- Completing five (5) standard penetration test (SPT) soil borings, three within the building area extending each to nominal depths of 20 feet and two in the parking/drive areas extending to nominal depths of 8 feet.
- Sealing the borings in accordance with Minnesota Department of Health requirements.
- Obtaining GPS coordinates and ground surface elevations at the soil boring locations.
- Visually/manually classifying samples recovered from the soil borings.
- Performing laboratory tests on selected samples.
- Preparing soil boring logs describing the materials encountered and the results of groundwater level measurements.
- Preparing an engineering report describing soil and groundwater conditions and providing recommendations for foundation design and construction.

1.5 Documents Provided

We were provided a plan sheet titled "Geotechnical/Soils Report Guidelines" last revised May 2018. The plan sheet did not identify the preparer. The plan sheet showed the proposed car wash layout and recommended soil boring locations.

We were also provided a plan sheet titled; "Tommy Car Wash" prepared by Design Resources Group dated September 27, 2021. The plan sheet showed an aerial image of the site with the proposed car wash superimposed onto the site.

In addition, we were provided with a Request for Proposal (RFP) prepared by Design Resources Group. The document identified a requested scope of services for the project including a Phase 1 ESA (Environmental Site Assessment).

Other than these documents, specific architectural, structural or civil plans were not available at the time of this geotechnical evaluation.

1.6 Locations and Elevations

The soil boring locations were selected by Christianson Companies which we assume were based on the proposed locations of the car wash and associated parking and drive lanes. As noted in Section 1.3, an office building existed on the project site and because of that soil borings SB-3 and SB-5 were off set from their intended locations. The approximate locations of the soil borings are shown on Figure 1, "Soil Boring Location Sketch," in the Appendix. The sketch was prepared by HGTS using an aerial image from Google Earth as a base.

HGTS obtained the GPS coordinates and ground surface elevations at the boring locations using GPS technology based on the U. S State Plane Coordinate System. The GPS coordinates and ground surface elevations are shown on Figure 2 in the Appendix.

Our GPS unit could not capture a stable satellite signal at soil boring SB-3 which we assume was due to the proximity to the building. We therefore estimated the ground surface elevation at soil boring SB-3 based on topographic information from MnTOPO.

1.7 Environmental

HGTS completed a Phase I Environmental site Assessment (Phase I ESA) in conjunction with this geotechnical exploration. Results of that assessment are presented under a separate cover (HGTS project number 21-1244). Please refer to that report for specific procedures, results and conclusions.

2.0 FIELD PROCEDURES

Five (5) standard penetration test borings were advanced on December 14th, 2021 by HGTS with a rotary drilling rig, using continuous flight augers to advance the boreholes. Representative samples were obtained from the borings, using the split-barrel sampling procedures in general accordance with ASTM Specification D-1586. In the split-barrel sampling procedure, a 2-inch O.D. split-barrel spoon is driven into the ground with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampling spoon the last 12 inches of an 18-inch penetration is recorded as the standard penetration resistance value, or "N" value. The results of the standard penetration tests are indicated on the boring log. The samples were sealed in containers and provided to HGTS for testing and soil classification.

A field log of each boring was prepared by HGTS. The logs contain visual classifications of the soil materials encountered during drilling, as well as the driller's interpretation of the subsurface conditions between samples and water observation notes. The final boring logs included with this report represent an interpretation of the field logs and include modifications based on visual/manual method observation of the samples.

The soil boring logs, general terminology for soil description and identification, and classification of soils for engineering purposes are also included in the appendix. The soil boring logs identify and describe the materials encountered, the relative density or consistency based on the Standard Penetration resistance (N-value, "blows per foot") and groundwater observations.

The strata changes were inferred from the changes in the samples and auger cuttings. The depths shown as changes between strata are only approximate. The changes are likely transitions, variations can occur beyond the location of the boring.

3.0 RESULTS

3.1 Soil Conditions

At the surface, the soil borings encountered a pavement section consisting of about 2 ½ to 6 inches of bituminous over about 2 to 3 inches of apparent aggregate base.

Below the pavement section, the soil borings encountered topsoil (buried topsoil) and Fill that extended to about 4 ½ feet below the ground surface. The topsoil at soil borings SB-1 and SB-3 thru SB-5 consisted of sandy lean clay, and silty clayey sand that was black or dark brown in color and contained traces of roots. The Fill consisted of silty sand that was black in color and contained some pieces of glass shards.

Penetration resistance values (N-Values), shown as blows per foot (bpf) on the boring logs, within the Fill and buried topsoil ranged from 7 to 14 bpf, indicating a loose to medium dense relative or medium to rather stiff consistency.

Below the Fill and buried topsoil, the soil borings encountered glacial outwash sand soils that extended to the termination depths of the borings. The glacial outwash soils consisted of fine to coarse-grained poorly graded sand and poorly graded sand with silt that contained varying amounts of gravel and were brown in color.

N-Values within the native glacial outwash sand soils ranged from 5 to 28 bpf. These N-Values indicated the glacial outwash soils had a loose to medium dense relative density.

3.2 Groundwater

Groundwater was not encountered in the soil borings while drilling and sampling or after removal of the auger from the boreholes. Groundwater appears to be below the depths explored by our borings. We do not anticipate that groundwater will be encountered during construction.

Water levels were measured on the dates as noted on the boring logs and the period of water level observations was relatively short. Groundwater monitoring wells or piezometers would be required to more accurately determine water levels. Seasonal and annual fluctuations in the groundwater levels should be expected.

3.3 Laboratory Testing

Laboratory moisture content and organic content tests were performed on selected samples recovered from the soil borings. Table 2 below summarizes the results of the laboratory tests. Results of the moisture content and organic contents tests are also shown on the boring logs adjacent to the sample tested.

Table 2. Summary of Laboratory Tests

Boring Number	Sample Number	Depth (feet)	Moisture Content (%) *	Organic Content (%) *
SB-1	SS-10	2 ½	11 ½	4
SB-1	SS-12	7 ½	11	-
SB-2	SS-3	5	5	-
SB-3	SS-18	2 ½	14 ½	4
SB-3	SS-19	5	5	-
SB-4	SS-32	7 ½	5	-
SB-5	SS-28	7 ½	7 ½	-

*Moisture content and organic content values rounded to the nearest ½ percent.

3.4 OSHA Soil Classification

The soils encountered in the borings consisted of; sandy lean clay, silty sand, silty clayey sand, poorly graded sand, and poorly graded sand with silt corresponding to the ASTM Classifications of CL, SC-SM, SM, SP, and SP-SM, respectively. The sandy lean clay (CL) will generally be Type B soils under Department of Labor Occupational Safety and Health Administration (OSHA) guidelines, and the sandy soils (SC-SM, SM, SP, and SP-SM) will generally be Type C soils.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Proposed Construction

We understand the project will include constructing a new car wash building along with the associated parking areas and drive lanes. We further understand that the car wash will include several utility lines and water reclamation tanks that will be installed at depths of about 7 to 10 feet below the ground surface.

Based on the documents provided we anticipate the proposed building will be a single-story, slab-on-grade structure encompassing a footprint of approximately 5,241 square feet. We were not provided any structural design information but assume the structure will be constructed with a structural steel frame and concrete or masonry block exterior perimeter walls supported on concrete spread footings. We assume the roof system could include pre-cast concrete planks or steel roof trusses, metal decking and a ballasted rubber membrane roof. Based on the assumed construction we estimate wall loadings will be less than 4 kips (4,000 pounds) per lineal foot and column loads, if any will be less than 150 kips (150,000 pounds).

We assume that the car wash will be constructed at or near existing site grades so that cuts and fills for permanent grade changes will be less than 5 feet.

If the proposed loads exceed these values the proposed grades differ by more than 2 feet from the assumed values or if the design or location of the proposed building changes, we should be informed. Additional analyses and revised recommendations may be necessary.

4.2 Discussion

An office building existed on the project site at the time of our exploration which we assume will be removed/demolished to make way for the new car wash. We recommend that all remnants of the structures including footings, foundation walls, floor slabs and underground utilities be removed from within the proposed car wash footprint and oversize areas.

The existing pavements are not suitable for foundation support and will need to be removed from within the proposed building and oversize areas. Pavements should be properly disposed of off-site or recycled.

The topsoil (buried topsoil) encountered in borings was black in color and laboratory tests indicated that it was slightly organic. The topsoil is generally compressible and is not suitable for foundation, pavement or utility support and will need to be removed from within these areas and oversize areas and replaced as needed with suitable compacted engineered fill to attain design grades.

The Fill encountered in soil boring SB-2 was also black in color and in addition contained some glass debris. The Fill is likewise not suitable for foundation, pavement or utility support and will need to be removed and replaced as needed with suitable compacted engineered fill.

It is our opinion that the underlying glacial outwash sand soils are suitable for engineered fill and foundation support. Any loose soils or soils disturbed during excavation and construction activities will need to be surface compacted to increase their density prior to engineered fill or foundation support.

Groundwater was not encountered in the soil borings while drilling and sampling or after removal of the auger from the boreholes. We do not anticipate groundwater will be encountered during construction.

The following sections provide recommendations for foundation design and construction of the proposed car wash.

4.3 Site Grading Recommendations

Excavation We recommend that all pavements, Fill, topsoil/buried topsoil and any soft or otherwise unsuitable soils, if encountered, be removed from below the proposed building, utility pavements and oversize areas. Structure(s) existed on the property that will be removed/demolished to make way for the proposed car wash. We recommend that all building remnants such as footings, floor slabs, foundation walls and/or underground utilities be removed from within the building and oversize area. Table 3 below summarizes the anticipated excavation depths at the soil boring locations. Excavation depths may vary and could be deeper.

Table 3. Anticipated Excavation Depths

Boring Number	Estimated Surface Elevation (feet)	Anticipated Excavation Depth (feet)*	Anticipated Excavation Elevation (feet)*
SB-1	827.9	4 ½	823 ½
SB-2	827.0	4 ½	822 ½
SB-3	828 (Estimated)	4 ½	823 ½
SB-4	826.7	4 ½	822
SB-5	829.4	4 ½	825

* = Excavation and groundwater elevations were rounded to nearest ½ foot.

Oversizing In areas where the excavations extend below the proposed footing elevations, the excavations require oversizing. We recommend the perimeter of the excavation be extended a foot outside the proposed footprint for every foot below footing grade (1H:1V oversizing). The purpose of the oversizing is to provide lateral support of the foundation.

Fill Material Fill required to attain site grades may consist of any debris-free, non-organic mineral soil. However, we recommend using sand soils similar the on-site glacial outwash soils for consistency and ease of compaction.

The Fill and buried topsoil, excavated during soil corrections and/or foundation construction were black in color, contained some glass debris and were slightly organic. The Fill and buried topsoil will not be suitable for reuse as structural fill or backfill.

The on-site glacial outwash sands, in our opinion, are suitable for reuse as fill or backfill material, however, some moisture conditioning (wetting) of these soils could be required to achieve the recommend compaction levels.

Backfilling We recommend that and loose soil and any soils disturbed during excavation activities be surface compacted to increase their density and uniformity prior to placing additional fill and/or footings.

We recommend that backfill placed to attain site grades be compacted to a minimum of 95 percent of its standard Proctor density (ASTM D 698). Granular fill classified as SP or SP-SM should be placed within 65 percent to 105 percent of its optimum moisture content as determined by the standard Proctor. Other fill soils should be placed within 3 percentage points above and 1 percentage point below its optimum moisture content as determined by the standard Proctor. All fill should be placed in thin lifts and be compacted with a large self-propelled vibratory compactor operating in vibratory mode.

Foundations We recommend the perimeter footings bear a minimum of 42 inches below the exterior grade for frost protection. Interior footings may be placed immediately below the slab provided construction does not occur during below freezing weather conditions. Foundation elements in unheated areas, such as canopy footings, should bear at least 5 feet below exterior grade for frost protection.

We anticipate the foundations and floor slabs will bear on compacted engineered fill or glacial outwash sand soils. With the building pad prepared as recommended, it is our opinion the footings can be designed for a net allowable bearing pressure up to 3,000 pounds per square foot (psf).

We anticipate total and differential settlement of the foundations will be less than 1 inch and ½ inch, respectively, across a 30-foot span.

4.4 Dewatering

Groundwater was not encountered in the soil borings while drilling and sampling or after removal of the auger from the boreholes. We do not anticipate that groundwater will be encountered and do not anticipate that dewatering will be required.

4.5 Interior Slabs

The anticipated floor subgrade will consist of compacted engineered fill or glacial outwash sand soils. It is our opinion a modulus of subgrade reaction, k, of 100 pounds per square inch per inch of deflection (psi/inch) may be used for sand soils to design the floor.

If floor coverings or coatings less permeable than the concrete slab will be used, we recommend that a vapor retarder or vapor barrier be placed immediately beneath the slab. Some contractors prefer to bury the vapor barrier or vapor retarder beneath a layer of sand to reduce curling and shrinkage, but this practice often traps water between the slab and vapor retarder or barrier. Regardless of where the vapor retarder or vapor barrier is placed, we recommend consulting the floor covering manufacturer regarding the appropriate type, use and installation of the vapor retarder or vapor barrier to preserve the warranty.

We recommend following all state and local building codes with regards to a radon mitigation plan beneath interior slabs.

4.6 Below Grade Walls

We understand the car wash will be a slab on grade structure with no below grade or basement levels. Recommendations and estimated soil parameters for below grade wall design and construction can be provided if requested.

4.7 Exterior Slabs

Exterior slabs could be underlain by silty and clayey soils which are considered moderately to highly frost susceptible. If these soils become saturated and freeze, frost heave may occur. This heave can be a nuisance in front of doors and at other critical grade areas. One way to help reduce the potential for heaving is to remove the frost-susceptible soils below the slabs down to bottom of footing grades and replace them with non-frost-susceptible backfill consisting of sand having less than 5 percent of the particles by weight passing the number 200 sieve.

If this approach is used and the excavation bottoms terminate in non-free draining granular soil, we recommend a drain tile be installed along the bottom outer edges of the excavation to collect and remove any water that may accumulate within the sand. The bottom of the excavation should be graded away from the building.

If the banks of the excavations to remove the frost-susceptible soils are not sloped, abrupt transitions between the frost-susceptible and non-frost-susceptible backfill will exist along which unfavorable amounts of differential heaving may occur. Such transitions could exist between exterior slabs and sidewalks, between exterior slabs and pavements and along the slabs themselves if the excavations are confined to only the building entrances. To address this issue, we recommend sloping the excavations to remove frost-susceptible soils at a minimum 3:1 (horizontal:vertical) gradient.

Another alternative for reducing frost heave is to support the slabs on frost depth footings. A void space of at least 4 inches should be provided between the slab and the underlying soil to allow the soil to heave without affecting the slabs.

4.7 Site Grading and Drainage

We recommend the site be graded to provide positive run-off away from the proposed house. We recommend landscaped areas be sloped a minimum of 6 inches within 10 feet of the building and slabs be sloped a minimum of 2 inches. In addition, we recommend downspouts with long splash blocks or extensions.

4.8 Utilities

Pipes We anticipate that the utilities will be supported on compacted engineered fill following soil corrections or native glacial outwash sands which in our opinion are suitable for pipe support. We recommend removing all pavements, Fill, buried topsoil, and any soft or otherwise unsuitable soil, if encountered, beneath utilities prior to placement.

We recommend bedding material be thoroughly compacted around the pipes. We recommend trench backfill above the pipes be compacted to a minimum of 95 percent beneath slabs and pavements, the exception being within 3 feet of the proposed pavement subgrade, where 100 percent of standard Proctor density is required. In landscaped areas we recommend a minimum compaction of 90 percent.

Tanks We understand that a series of water reclamation tanks will be installed at depths ranging from about 7 to 10 feet, or more, below the ground surface. We anticipate the tanks will bear on the native glacial outwash sands which in our opinion is suitable for tank support.

We recommend that the tanks be designed and constructed in accordance with the tank manufacturer's requirements. In the absence of tank manufacturer's requirements, we recommend the following:

We recommend the tanks be supported on granular soil (sand) and the tank walls backfilled with sand having less than 50 percent of the particles by weight passing the #40 sieve and less than 5 percent of the particles by weight passing the #200 sieve. The sand backfill should extend a minimum of 1 foot horizontally of the tank walls and 1 foot below the bottom of the tank. The on-site glacial outwash sand will likely meet these requirements.

Groundwater was not encountered in the soil borings while drilling and sampling or after removal of the auger from the boreholes. We do not anticipate groundwater will be encountered during construction.

The on-site glacial outwash sand consisted of poorly graded sand and poorly graded sand with silt. These are generally considered "free draining" materials and that being the case we do not anticipate that a perimeter drain tile at the base of the tank will be required, unless required by the tank manufacturer.

4.9 Pavements

General The Fill and buried topsoil encountered in the borings consisted of silty and clayey soil that were black in color, slightly organic and contained some glass debris. The Fill and buried topsoil are generally poor-quality soils for pavement support and we recommend they be removed from below the new pavement and oversize areas and replaced with suitable compacted engineered fill.

However, soil corrections below a depth of about 3 feet below the pavement section are often not cost effective for the benefit gained and because of that you may wish to limit the soil correction depths in the parking areas. If this option is selected you must be aware that some settlement of the pavements could occur and should be expected. This settlement could

result in "bird baths" and cracked pavements. In addition, some increased maintenance of the pavements could also be required and should be expected.

Traffic We were not provided any information regarding estimated traffic volumes, vehicle types, vehicle distribution or projected growth rates. We anticipate that parking spaces and drive lanes will be used predominately by automobiles and light trucks. Based on the assumed traffic types we estimate the pavements will be subjected to Equivalent Single Axle Loads (ESAL's) of up to 50,000 over a design life of 20 years.

Subgrade Preparation We recommend that all pavements, existing Fill and any soft or otherwise unsuitable soils be removed from below the proposed building, pavement and oversize areas. Prior to placing the aggregate base (Class 5) we recommend compaction tests, dynamic cone penetrometer tests or proof rolling the pavement subgrade to identify soft, weak, loose or unstable areas that may require additional sub-cuts.

Fill required to attain site grades may consist of any debris-free, non-organic mineral soil. As discussed above organic soils or soils that are black in color are generally not suitable for reuse as fill or backfill in the pavement areas.

Estimated R-Value R-Value testing was beyond the scope of this project. The near surface soil immediately below the existing pavements section consisted of sandy lean clay, silty clayey sand and silty sand meeting the ASTM Classifications of CL, SC-SM and SM, respectively. Soils meeting these classifications can have R-Values ranging from 10 to 30 or more. It is our opinion an R-Value of 10 can be used for pavement design.

Pavements Based on an assumed subgrade R-Value of 10 and a maximum of 50,000 ESAL's we recommend a minimum of 4 inches of bituminous underlain by a minimum of 8 inches of Class 5 aggregate base.

Materials We recommend aggregate base meeting MN/DOT specification 3138 for Class 5 aggregate base. We recommend the aggregate base be compacted to 100 percent of its maximum standard Proctor dry density.

We recommend that the bituminous wear and base courses meet the requirement of MN/DOT specification 2360. We recommend the bituminous pavements be compacted to at least 92% of the maximum theoretical density.

We recommend specifying concrete that has a minimum 28-day compressive strength of 4,000 psi, and a modulus of rupture of at least 600 psi. We recommend Type I cement meeting the requirements of ASTM C150. We recommend specifying 5 to 7 percent entrained air for exposed concrete to provide resistance to freeze-thaw deterioration. We also recommend using a water/cement ratio of 0.45 or less for concrete exposed to deicers.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Excavation

The soils encountered in the borings consisted of; sandy lean clay, silty sand, silty clayey sand, poorly graded sand, and poorly graded sand with silt corresponding to the ASTM Classifications of CL, SC-SM, SM, SP, and SP-SM, respectively. The sandy lean clay (CL) will generally be Type B soils under Department of Labor Occupational Safety and Health Administration (OSHA) guidelines, and the sandy soils (SC-SM, SM, SP, and SP-SM) will generally be Type C soils.

Temporary excavations in Type B soils should be constructed at a minimum of 1 foot horizontal to every 1-foot vertical within excavations. Temporary excavations in Type C soils should be constructed at a minimum of 1 ½ foot horizontal to every 1-foot vertical within excavations. Slopes constructed in this manner may still exhibit surface sloughing. If site constraints do not allow the construction of slopes with these dimensions, then temporary shoring may be required.

5.2 Observations

A geotechnical engineer or qualified engineering technician should observe the excavation subgrade to evaluate if the subgrade soils are similar to those encountered in the borings and adequate to support the proposed construction.

5.3 Backfill and Fills

We recommend moisture conditioning (drying or wetting) all soils that will be used as fill or backfill in accordance with Section 4.3 above. We recommend that fill and backfill be placed in lifts not exceeding 4 to 12 inches, depending on the size of the compactor and materials used.

5.4 Testing

We recommend density tests of backfill and fills placed for the proposed house foundations. Samples of the proposed materials should be submitted to our laboratory prior to placement for evaluation of their suitability and to determine their optimum moisture content and maximum dry density (Standard Proctor).

5.5 Winter Construction

If site grading and construction is anticipated to proceed during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading and placement of fill. No fill should be placed on frozen soil and no frozen soil should be used as fill or backfill.

Concrete delivered to the site should meet the temperature requirements of ASTM and/or ACI. Concrete should not be placed on frozen soil. Concrete should be protected from freezing until the necessary strength is obtained. Frost should not be permitted to penetrate below the footings.

6.0 PROCEDURES

6.1 Soil Classification

The drill crew chief visually and manually classified the soils encountered in the borings in general accordance with ASTM D 2488, "Description and Identification of Soils (Visual-Manual Procedure)." Soil terminology notes are included in the Appendix. The samples were returned to our laboratory for review of the field classification by a soils engineer. Samples will be retained for a period of 30 days.

6.2 Groundwater Observations

Immediately after taking the final samples in the bottom of the boring, the hole was checked for the presence of groundwater. Immediately after removing the augers from the borehole the hole was once again checked and the depth to water and cave-in depths were noted.

7.0 GENERAL

7.1 Subsurface Variations

The analyses and recommendations presented in this report are based on data obtained from a limited number of soil borings. Variations can occur away from the borings, the nature of which may not become apparent until additional exploration work is completed, or construction is conducted. A reevaluation of the recommendations in this report should be made after performing on-site observations during construction to note the characteristics of any variations. The variations may result in additional foundation costs and it is suggested that a contingency be provided for this purpose.

It is recommended that we be retained to perform the observation and testing program during construction to evaluate whether the design is as expected, if any design changes have affected the validity of our recommendations, and if our recommendations have been correctly interpreted and implemented in the designs, specifications and construction methods. This will allow correlation of the soil conditions encountered during construction to the soil borings and test pits and will provide continuity of professional responsibility.

7.2 Review of Design

This report is based on the design of the proposed structures as related to us for preparation of this report. It is recommended that we be retained to review the geotechnical aspects of the design and specifications. With the review, we will evaluate whether any changes have affected the validity of the recommendations and whether our recommendations have been correctly interpreted and implemented in the design and specifications.

7.3 Groundwater Fluctuations

We made water level measurements in the borings at the times and under the conditions stated on the boring logs. The data was interpreted in the text of this report. The period of observation was relatively short and fluctuations in the groundwater level may occur due to

rainfall, flooding, irrigation, spring thaw, drainage, and other seasonal and annual factors not evident at the time the observations were made. Design drawings and specifications and construction planning should recognize the possibility of fluctuations.

7.4 Use of Report

This report is for the exclusive use of Christianson Companies and their design team to use to design the proposed structures and prepare construction documents. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. The data, analysis and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

7.5 Level of Care

Haugo GeoTechnical Services has used the degree of skill and care ordinarily exercised under similar circumstance by members of the profession currently practicing in this locality. No warranty expressed or implied is made.

APPENDIX

Legend

Approximate Soil Boring Location

N
W
E
S

Disclaimer: Map and parcel data are believed to be accurate, but accuracy is not guaranteed.
This is not a legal document and should not be substituted for a title search, appraisal, survey, or for zoning verification.

Haugo GeoTechnical Services, LLC 2825 Cedar Avenue S. Minneapolis, MN 55407	Soil Boring Location Sketch Tommy Wash 200 W 98th Street Bloomington, MN	Figure #: 1 Drawn By: EC Date: 12/20/2021 Scale: None Project #: 21-1245

Figure 2: GPS Boring Locations

Boring Number	Elevation (US Survey Feet)	Northing Coordinate	Easting Coordinate
SB-1	827.9	2810955.42587464	994934.079684933
SB-2	827.0	2810918.12023536	994851.742995499
SB-3	828 (Estimated)	2810869.35455173	994850.205016859
SB-4	826.7	2810850.78757927	994941.305119666
SB-5	829.4	2810976.02627037	994796.254152609

Referencing U. S. State Plane Coordinate System

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

BORING NUMBER SB-1

CLIENT Christianson Companies
PROJECT NAME Tommy Wash
PROJECT NUMBER 21-1245
PROJECT LOCATION Bloomington, MN
DATE STARTED 12/14/21 **COMPLETED** 12/14/21
GROUND ELEVATION 827.9 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY MS **CHECKED BY** PG
AT END OF DRILLING --- Not Encountered
NOTES
AFTER DRILLING --- Not Encountered

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0	Approximately 2.5 Inches of Bituminous Asphalt Approximately 3 Inches of Aggregate Base Sandy Lean Clay, trace Roots, dark brown, moist. (Buried Topsoil)	AU 9				
	Organic Content: 4%	SS 10		5-5-6 (11)	11.5	
5	(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, moist, medium dense. (Glacial Outwash)	SS 11		3-5-7 (12)		
	(SP-SM) Poorly Graded Sand with Silt, fine grained, brown, moist, loose. (Glacial Outwash)	SS 12		3-3-3 (6)	11	
10	(SP) Poorly Graded Sand, fine grained, brown, moist, loose to medium dense. (Glacial Outwash)	SS 13		4-4-4 (8)		
		SS 14		4-5-10 (15)		
15	(SP) Poorly Graded Sand, fine to coarse grained, brown, moist, medium dense. (Glacial Outwash)	SS 15		4-9-13 (22)		
20		SS 16		5-8-16 (24)		

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

Bottom of borehole at 21.0 feet.

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

BORING NUMBER SB-2

CLIENT Christianson Companies
PROJECT NAME Tommy Wash
PROJECT NUMBER 21-1245
PROJECT LOCATION Bloomington, MN
DATE STARTED 12/14/21 **COMPLETED** 12/14/21
GROUND ELEVATION 827 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY MS **CHECKED BY** PG
AT END OF DRILLING --- Not Encountered
NOTES
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0		Approximately 6 Inches of Bituminous Asphalt	AU 1			5	
		Approximately 3 Inches of Aggregate Base					
		Silty Sand, trace Gravel, pieces of glass, black, moist. (Fill)	SS 2		4-4-5 (9)		
5		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, moist, medium dense. (Glacial Outwash)	SS 3		4-5-6 (11)		
			SS 4		3-6-9 (15)		
10			SS 5		5-6-6 (12)		
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, loose to medium dense. (Glacial Outwash)	SS 6		4-4-5 (9)		
15			SS 7		4-6-15 (21)		
20		(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, moist, medium dense. (Glacial Outwash)	SS 8		9-9-13 (22)		

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

Bottom of borehole at 21.0 feet.

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

BORING NUMBER SB-3

CLIENT Christianson Companies
PROJECT NAME Tommy Wash
PROJECT NUMBER 21-1245
PROJECT LOCATION Bloomington, MN
DATE STARTED 12/14/21 **COMPLETED** 12/14/21
GROUND ELEVATION 828 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY MS **CHECKED BY** PG
AT END OF DRILLING --- Not Encountered
NOTES Ground Surface Elevation Estimated
AFTER DRILLING --- Not Encountered with Cave-In Depth of 7 Feet

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0	Approximately 2.5 Inches of Bituminous Asphalt Approximately 2 Inches of Aggregate Base Silty Clayey Sand, black, moist. (Buried Topsoil)	AU 17				
	Organic Content: 4%	SS 18		3-7-7 (14)	14.5	
5	Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, medium dense. (Glacial Outwash)	SS 19		3-6-5 (11)	5	
		SS 20		4-5-8 (13)		
10		SS 21		4-4-7 (11)		
		SS 22		4-5-8 (13)		
15	(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, moist, medium dense. (Glacial Outwash)	SS 23		7-14-14 (28)		
20		SS 24		7-11-12 (23)		

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

Bottom of borehole at 21.0 feet.

GEOTECH BH PLOTS - GINT STD US LAB GDT - 1/10/22 15:26 - C:\USERS\HGTS 3\DROPBOX (HGTS)\HAUGO GEOTECHNICAL SERVICES\GINT PROJECT BACKUP\PROJECTS\21-1245 TOMMY WASH.GPJ

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BORING NUMBER SB-4

CLIENT Christianson Companies
PROJECT NAME Tommy Wash
PROJECT NUMBER 21-1245
PROJECT LOCATION Bloomington, MN
DATE STARTED 12/14/21 **COMPLETED** 12/14/21
GROUND ELEVATION 826.7 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY MS **CHECKED BY** PG
AT END OF DRILLING --- Not Encountered
NOTES
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0		Approximately 2.5 Inches of Bituminous Asphalt					
		Approximately 2 Inches of Aggregate Base					
		Sandy Lean Clay, black, wet. (Buried Topsoil)	AU 29				
			SS 30		2-3-4 (7)		
5		(SP) Poorly Graded Sand, fine to coarse, trace Gravel, brown, moist, loose. (Glacial Outwash)	SS 31		5-4-6 (10)		
			SS 32		1-2-3 (5)	5	

Bottom of borehole at 8.5 feet.

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

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BORING NUMBER SB-5

CLIENT Christianson Companies
PROJECT NAME Tommy Wash
PROJECT NUMBER 21-1245
PROJECT LOCATION Bloomington, MN
DATE STARTED 12/14/21 **COMPLETED** 12/14/21
GROUND ELEVATION 829.4 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY MS **CHECKED BY** PG
AT END OF DRILLING --- Not Encountered
NOTES
AFTER DRILLING --- Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0		Approximately 2.5 Inches of Bituminous Asphalt Approximately 3 Inches of Aggregate Base Silty Clayey Sand, black, moist. (Buried Topsoil)	AU 25				
			SS 26		3-4-5 (9)		
5		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, brown, moist, loose. (Glacial Outwash)	SS 27		3-4-5 (9)		
			SS 28		1-3-4 (7)	7.5	

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

Bottom of borehole at 8.5 feet.

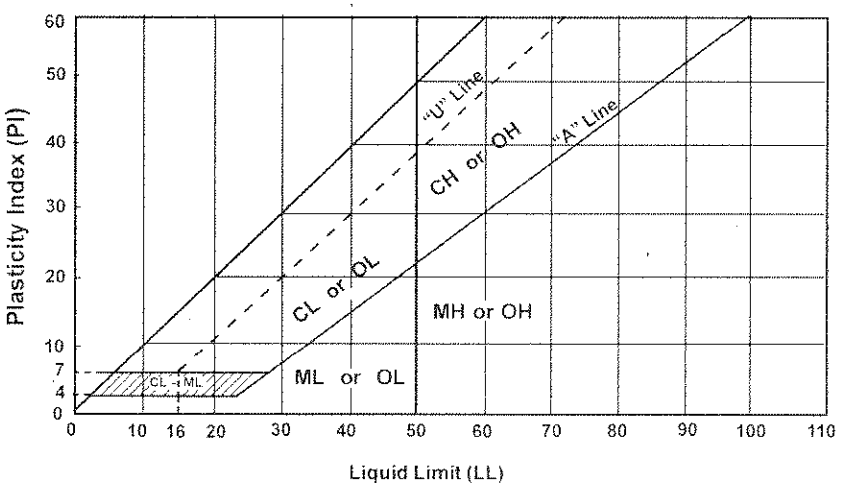
HAUGO GEOTECHNICAL SERVICES

Descriptive Terminology of Soil

Standard D 2487 - 00
Classification of Soils for Engineering Purposes
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soils Classification	
				Group Symbol	Group Name [b]
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels 5% or less fines [e]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [c]	GW	Well-graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$ [c]	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [e]	Fines classify as ML or MH	GM	Silty gravel [d f g]
			Fines classify as CL or CH	GC	Clayey gravel [d f g]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands 5% or less fines [i]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [c]	SW	Well-graded sand [h]
			$C_u < 6$ and/or $1 > C_c > 3$ [c]	SP	Poorly graded sand [h]
		Sands with Fines More than 12% [i]	Fines classify as ML or MH	SM	Silty sand [f g h]
			Fines classify as CL or CH	SC	Clayey sand [f g h]
Fine-grained Soils 50% or more passed the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [j]	CL	Lean clay [k l m]
			PI < 4 or plots below "A" line [j]	ML	Silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [k l m n]
				OL	Organic silt [k l m o]
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [k l m]
			PI plots below "A" line	MH	Elastic silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [k l m p]
				OH	Organic silt [k l m q]
Highly Organic Soils		Primarily organic matter, dark in color and organic odor		PT	Peat

a Based on the material passing the 3-in (75mm) sieve.
b If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c $C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
d If soil contains ≥15% sand, add "with sand" to group name
e Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
f If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g If fines are organic, add "with organic fines" to group name.
h If soil contains ≥ 15% gravel, add "with gravel" to group name.
i Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
j If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name
m If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name
n PI ≥ 4 and plots on or above "A" line.
o PI < 4 or plots below "A" line.
p PI plots on or above "A" line.
q PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	OC	Organic content, %
WD	Wet density, pcf	S	Percent of saturation, %
MC	Natural moisture content, %	SG	Specific gravity
LL	Liquid limit, %	C	Cohesion, psf
PL	Plastic limit, %	∅	Angle of internal friction
PI	Plasticity index, %	qu	Unconfined compressive strength, psf
P200	% passing 200 sieve	qp	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders	over 12"
Cobbles	3" to 12"
Gravel	
Coarse	3/4" to 3"
Fine	No. 4 to 3/4"
Sand	
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Silt	< No. 200, PI < 4 or below "A" line
Clay	< No. 200, PI ≥ 4 and on or above "A" line

Relative Density of Cohesionless Soils

Very loose	0 to 4 BPF
Loose	5 to 10 BPF
Medium dense	11 to 30 BPF
Dense	31 to 50 BPF
Very dense	over 50 BPF

Consistency of Cohesive Soils

Very soft	0 to 1 BPF
Soft	2 to 3 BPF
Rather soft	4 to 5 BPF
Medium	6 to 8 BPF
Rather stiff	9 to 12 BPF
Stiff	13 to 16 BPF
Very stiff	17 to 30 BPF
Hard	over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube). All samples were taken with the standard 2" OD split-tube sampler, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous-flight, solid-stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface and are, therefore, somewhat approximate. Power auger borings are designated by the prefix "B."

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn. Hand auger borings are indicated by the prefix "H."

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.

Appendix I

Water Quality Summary

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Tommy's Car Wash
User Name / Company Name:	Demarc
Date:	03/09/22
Project Description:	Proposed Conditions
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55420
Annual Rainfall (inches):	31.5
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed	0.2476				0.2476
				Impervious Area (acres)	0.8281
				Total Area (acres)	1.0757

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed	0.1708				0.1708
				Impervious Area (acres)	0.7772
				Total Area (acres)	0.948

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	3307	ft3
Volume removed by BMPs towards performance goal:	3103	ft^3
Percent volume removed towards performance goal	**94**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	1.9463	acre-ft
Annual runoff volume removed by BMPs:	1.7424	acre-ft
Percent annual runoff volume removed:	**90**	**%**
Post development annual particulate P load:	0.8735	lbs
Annual particulate P removed by BMPs:	0.782	lbs
Post development annual dissolved P load:	0.715	lbs
Annual dissolved P removed by BMPs:	0.64	lbs
Total P removed by BMPs	1.422	lbs
Percent annual total phosphorus removed:	**90**	**%**
Post development annual TSS load:	288.5	lbs
Annual TSS removed by BMPs:	258.3	lbs
Percent annual TSS removed:	**90**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Underground infiltration	3907	2672	2672	0	100
2 - Underground infiltration	483	432	432	0	100
1 - Swale Side Slope	15	0	0	0	0

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Underground infiltration	1.535	0	1.5016	0.0333999999	98
2 - Underground infiltration	0.2467	0	0.2353	0.0114	95
1 - Swale Side Slope	0.0232	0	0.0054	0.0178	23

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Underground infiltration	0.6889	0	0.6739	0.015	98
2 - Underground infiltration	0.1107	0	0.1056	0.0051	95
1 - Swale Side Slope	0.0104	0	0.0024	0.008	23

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Underground infiltration	0.5636	0	0.5513	0.0123	98
2 - Underground infiltration	0.0906	0	0.0864	0.0042	95
1 - Swale Side Slope	0.0085	0	0.002	0.0065	24

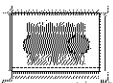
Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Underground infiltration	1.2525	0	1.2252	0.0273	98
2 - Underground infiltration	0.2013	0	0.192	0.0093	95
1 - Swale Side Slope	0.0189	0	0.0044	0.0145	24

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Underground infiltration	227.55	0	222.6	4.9500000000	98
2 - Underground infiltration	36.57	0	34.89	1.68	95
1 - Swale Side Slope	3.44	0	0.81	2.63	24

BMP Schematic



1 - Underground infiltration

1 - Swale Side Slope

2 - Underground infiltration