MINNEAPOLIS PARKS AND RECREATION BOARD
MINNEHAHA CREEK BIKE SKILLS PARK

Minneapolis, Minnesota

STORMWATER MANAGEMENT

WATERSHED SUBMITTAL

MPR25011

MARCH 23, 2026

Élan Design Lab, Inc.
Flour Exchange Building
310 4th Ave S
Suite 1006
Mpls, MN 55415

Prepared For

Minneapolis Parks and Recreation Board

Prepared By

Kally Haluptzok, EIT
612.260.7979
khaluptzok@elanlab.com

CERTIFICATION

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

Marcelle J. Weslock, PE
Registration # **42323**
March 23, 2026

Élan DESIGN LAB

Élan Design Lab, Inc.
Flour Exchange Building
310 4th Ave S
Suite 1006
Mpls, MN 55415

Introduction

The project site is located at the northeast corner of Minnehaha Creek Park at East 47th Street and South 34th Avenue in Minneapolis. The site was home to a tennis court, which had fallen into disrepair. The court was removed in 2024 to make way for the proposed bike skills park. The aggregate base was left in place after the court surfacing was removed. This former court area is considered impervious for this report.

Figure 1.0: Minnehaha Creek Park Aerial Imagery. Source: Google Earth 2023

Project Information

Table 1.0

Owner/Developer	Minneapolis Parks and Recreation Board		
Site Address	Minnehaha Creek Park, 3101 46th Street E, Minneapolis, MN 55406		
Site PID #	1802823220046		
Rainfall Intensity Atlas 14	2 yr. – 24 hr.	10 yr. – 24 hr.	100 yr. – 24 hr.
	2.8	4.2	7.5

Regulatory Requirements

In addition to the stormwater management requirements listed in table 2.0 below, the project design must comply with regulations of the shoreland overlay and floodplain overlay districts. There shall not be any fill within the 1% floodplain. Additional regulations include restrictions on removal of vegetation, and strict erosion and sediment control. See notes on the demolition plan, erosion and sediment control plan, and SWPPP.

Table 2.0

Agency/Contact	**Jurisdictional Threshold**	**Volume Control**	**Rate Control**	**Water Quality**
City of Minneapolis	Land disturbing activities of more than 0.5 acres.	Capture and retain 1.1 inches of runoff from the new and fully reconstructed impervious surfaces within the disturbed area for sites without restrictions.	No increase in the peak discharge over existing conditions for the 2-year, 10-year, and 100-year 24-hour storm event.	Seventy percent (70%) removal of total suspended solids (TSS) from a 1.25-inch storm event.
Minnehaha Creek Watershed District	Less than 1 acre of disturbance.	At least one BMP must be incorporated into the project.		

Design Overview

The construction of the proposed bike park will disturb 1.04 acres and introduce 10,876 square feet of new impervious surface. This is a reduction of 8,034 square feet from existing conditions. In the existing conditions the former tennis court area is modeled as impervious. 1.1 inches of runoff over the new impervious surfaces is equal to a water quality volume of 1,007 cubic feet. An infiltration basin is proposed at the southern edge of the park to manage this volume of runoff.

The site's existing and proposed drainage patterns are mapped as the Existing Drainage Map and Proposed Drainage Map. These are provided for reference in the attachments to this report. In existing conditions water runs off directly from the site and overland to Minnehaha Creek. In the proposed condition, a series of five Nyloplast catch basins are proposed to collect runoff in the green space areas between bike trails. Water will then flow through pipes to the proposed infiltration basin. The Nyloplast catch basin directly upstream of the infiltration basins, CB A2, will be equipped with a sump and an Envirohood Pretreatment device. The western and southern edges of the site, subcatchment 9S, is infeasible to route to the BMP. 680 square feet of new impervious surfaces bypasses treatment. To compensate for this, 1,667 square feet of existing impervious surfacing in subcatchment 1S and 2S will be directed to the Infiltration basin.

Two soil borings were analyzed in a geotechnical investigation by American Engineering Testing. The geotechnical report is included in the attachments of this report. The northernmost boring, B-1 is located in the former tennis court area. B-1 contained various inconsistent layers of fill. This fill consists of silty sands, some gravel, silts, and clays. Beneath the fill, at about 9.5 feet deep, sand with silt (SP-SM) soils were encountered with some clayey sand laminations. Infiltration is not a feasible option on the northern half of the site since extensive excavation would be necessary to reach suitable soils. Boring B-2 is located in the southern half of the project area. B-2 demonstrated primarily sand (SP) and sand with silt (SP-SM) below the upper horizons at 4.5 feet below the surface. Some clayey sand laminations were noted which should be removed if encountered during construction of infiltration BMPs. Groundwater was encountered at 810.5 feet, 8.5 feet below the surface of the boring. To maintain the minimum required 3' separation from groundwater, the infiltration basin bottom cannot be any lower than 813.5 feet.

Volume Control

The infiltration basin is named P1 in the HydroCAD model. The basin is adequately sized to meet the city of Minneapolis requirements. The storage at the primary outlet elevation, 1,020 cubic feet exceeds the required water quality volume (WQv) of 997 cubic feet. Due to the presence of SM soils, the soils are designated as HSG B, and the design infiltration rate is 0.45 inches/hour. The HydroCAD reports are included in the attachments of this report. See Table 3.0 for the summary of the design of this BMP.

Table 3.0: Infiltration Basin P1 Design Summary Table

Parameter	Value
Basin Bottom Elevation	813.5 feet
Groundwater Elevation	810.5 feet
Outfall Elevation	814.5 feet
Top of Berm Elevation	815.0 feet
WQv	997 cubic feet
WQv Elevation	814.5 feet
Storage Volume Below Primary Outlet	1,020 cubic feet
Draw Down Time: 100-Yr 24-Hr Storm	24 hours
HWL	815.0 feet

Rate Control

The primary outlet from infiltration basin P1 is a timber weir wall to be built into the basin berm. The wooden weir will be mounted onto a cast-in-place concrete footing that also functions as an anti-seep barrier. The weir is a 3-foot-wide gap at 814.5 feet. It will restrict flow in large storm events to meet the required rate control parameters. To prevent erosion at the outfall a Scourstop mat will be installed at the edge of the weir. Outflow from this basin will ultimately flow south overland to Minnehaha Creek. In the 100-yr 24-hr storm event the weir controls 4.4 cubic feet/second at 1.6 feet/second. The proposed peak rate of runoff from the site does not exceed that of existing conditions for the three storm events analyzed. Rate control is summarized in Table 4.0.

Table 4.0: Rate Control Summary

	2-yr 24-hr Storm Event Peak Runoff (CFS)	10-yr 24-hr Storm Event Peak Runoff (CFS)	100-yr 24-hr Storm Event Peak Runoff (CFS)
Existing	1.4	2.8	6.2
Proposed	0.7	1.3	5.5
Change	-0.7	-1.5	-0.7

Water Quality

The city requires 70% TSS removal from a 1.25 inch storm event. The site’s overall drainage area and infiltration basin P1 was modeled in MIDS with a 1.25 inch rainfall. The BMP provides an 81% reduction of TSS from the site. The MIDS Summary is included in the attachments of the report.

Pipe Sizing

See pipe sizing spread sheet for proposed on-site storm sewer.

Soil Erosion and Sedimentation Control

See SWPPP narrative sheet and Erosion Control Plan.

Conclusion

The stormwater management system for the proposed redevelopment of Minnehaha Creek Park appears to meet the regulatory requirements of the City of Minneapolis and Minnehaha Creek Watershed District. If you have any questions or need additional information regarding this report, please feel free to contact me at khaluptzok@elanlab.com.

Attachments

- City of Minneapolis Stormwater Summary Table
- Existing Drainage Map
- Proposed Drainage Map
- Existing HydroCAD Report
- Proposed HydroCAD Report
- Infiltration Basin Storage Table
- Infiltration Basin 100-yr-24-hr Hydrograph
- MIDS Summary
- Pipe Sizing Spreadsheet
- Geotechnical Report
- Operations and Maintenance Manual

SITE PLAN NO. ________________________ (filled in by City staff)

STORMWATER MANAGEMENT PLAN SUMMARY TABLE

Instructions:

1) When submitting plans for review and approval by the City, submit this Summary Table with existing and proposed columns filled and all relevant calculations, modeling and information for project review. Include details about all sub-basins and BMPs in the Stormwater Management Report.
2) After the project has been built, submit this Summary Table again with As-Built columns filled in and all relevant calculations, modeling and information based on the project record drawings. Include details about all sub-basins and BMPs in the Final Stormwater Management Report.

Project Name: Minnehaha Creek Bike Skills Park
Project Address: 3101 46th Street E, Minneapolis, MN 55406
Receiving Waterbody: Minnehaha Creek

Hydrologic Soil Group (HSG) Used – A, [✓ B] C, or D:
Description of Soil: Inconsistent layers of fill at old tennis courts.
Native soils are SP, SP-SM

	EXISTING	PROPOSED	AS-BUILT
1. IMPERVIOUS AREA SUMMARY	(Acres)	(Acres)	(Acres)
SITE ONLY	(This section must be filled in for all projects.)		
Impervious	0.50	0.32	
Pervious	0.54	0.72	
Total Site Area	1.040	1.040	
Impervious Area Draining to a BMP			
INCLUDES RUN-ON FROM OFF-SITE	(This section must be filled in if off-site stormwater runs onto the site; if none, write "none".)		
Impervious			
Pervious			
Total Site Area			
Impervious Area Draining to a BMP			
2. RATE CONTROL PEAK FLOW SUMMARY *	(Cubic Ft./Second)	(Cubic Ft./Second)	(Cubic Ft./Second)
SITE ONLY	(Only fill in one section for rate control, SITE ONLY or INCLUDES RUN-ON FROM OFF-SITE. If there is not any run-on from off-site, fill in SITE ONLY. If there is run-on from off-site, fill in INCLUDES RUN-ON FROM OFF-SITE. The rate control "no increase" requirement applies only to the site.)		
For 2.8 in. event (2-year)	1.4	0.7	
For 4.2 in. event (10-year)	2.8	1.3	
For 7.5 in. event (100-year)	6.2	5.5	
INCLUDES RUN-ON FROM OFF-SITE	(Only fill in one section for rate control, SITE ONLY or INCLUDES RUN-ON FROM OFF-SITE. If there is not any run-on from off-site, fill in SITE ONLY. If there is run-on from off-site, fill in INCLUDES RUN-ON FROM OFF-SITE. The rate control "no increase" requirement applies only to the site.)		
For 2.8 in. event (2-year)			
For 4.2 in. event (10-year)			
For 7.5 in. event (100-year)			
3. RUNOFF VOLUME SUMMARY *	Acre-Feet	Acre-Feet	Acre-Feet
SITE ONLY	(Only fill in one section for volume summary, SITE ONLY or INCLUDES RUN-ON FROM OFF-SITE. If there is not any run-on from off-site, fill in SITE ONLY. If there is run-on from off-site, fill in INCLUDES RUN-ON FROM OFF-SITE.)		
For 2.8 in. event (2-year)	0.083	0.025	
For 4.2 in. event (10-year)	0.163	0.086	
For 7.5 in. event (100-year)	0.377	0.278	
INCLUDES RUN-ON FROM OFF-SITE	(Only fill in one section for volume summary, SITE ONLY or INCLUDES RUN-ON FROM OFF-SITE. If there is not any run-on from off-site, fill in SITE ONLY. If there is run-on from off-site, fill in INCLUDES RUN-ON FROM OFF-SITE.)		
For 2.8 in. event (2-year)			
For 4.2 in. event (10-year)			
For 7.5 in. event (100-year)			
4. WATER QUALITY SUMMARY *	Removal Efficiency %	Removal Efficiency %	Removal Efficiency %
SITE ONLY	(All projects must calculate TSS removal efficiency. Only projects discharging to a lake, pond or wetland must also calculate for TP.)		
Total Phosphorus (TP) for 1.25", 24-hr event			
Total Suspended Solids (TSS) for 1.25", 24-hr event	0	81%	
INCLUDES RUN-ON FROM OFF-SITE	(This section is optional – not required.)		
Total Phosphorus (TP) for 1.25", 24-hr event			
Total Suspended Solids (TSS) for 1.25", 24-hr event			

* Use NOAA Atlas 14 events

STORMWATER MANAGEMENT PLAN ENGINEER'S CERTIFICATION

(The language below must be included in the Stormwater Management Plan)

I hereby certify to the best of my knowledge, information, and belief that this Post Construction Stormwater Management Plan complies with the rules, regulations, and standards as outlined under Chapter 54, Stormwater Management, Title 3 of the Minneapolis Code of Ordinances dated January 1, 2000. Specifically, the stormwater management facilities detailed in the referenced plan have been constructed to meet the minimum requirements for (check box for all that apply):

- ☒ **Water quality:** Seventy (70) percent removal of total suspended solids (TSS) from a 1.25-inch storm event AND for a site that discharges to a lake, pond, or wetland; total phosphorus (TP) pollutant load reduction is as specified City Council Resolution 2000R-042.
- ☒ **Rate control:** No increase in the peak discharge over existing conditions for the 2-year, 10-year, and 100-year 24-hour storm event, using the NRCS MN MSE3 distribution.

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.

Signature ______________________ Date 03/23/2026

Print name Marcelle Weslock, PE MN registration number 42323

AREA SUMMARY

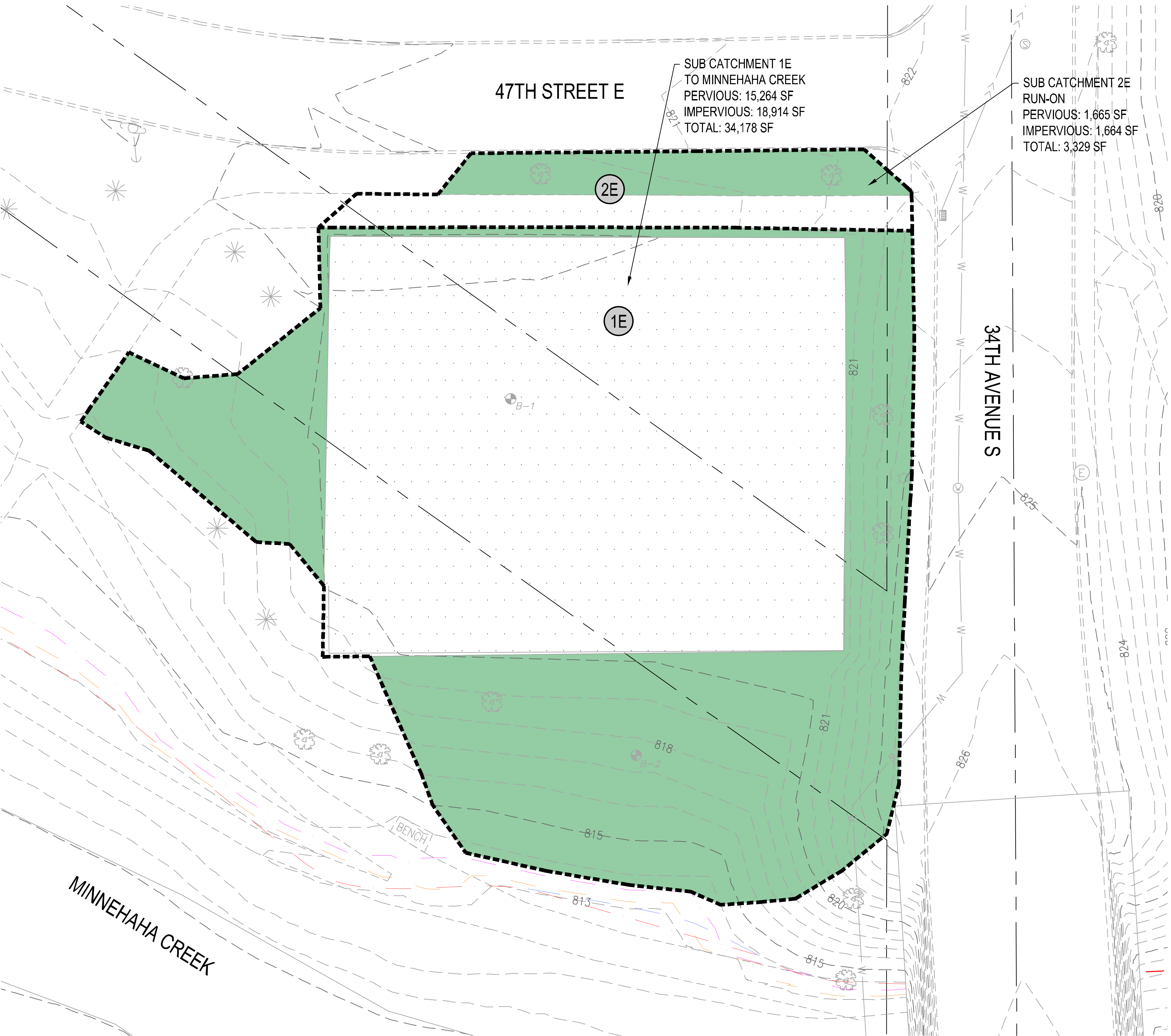
🟩 PERVIOUS AREA
16929 SF.

▨ IMPERVIOUS AREA
20,578 SF.

TOTAL 37,507 SF.

LEGEND

- - - - DRAINAGE BOUNDARY



SUB CATCHMENT 1E
TO MINNEHAHA CREEK
PERVIOUS: 15,264 SF
IMPERVIOUS: 18,914 SF
TOTAL: 34,178 SF

SUB CATCHMENT 2E
RUN-ON
PERVIOUS: 1,665 SF
IMPERVIOUS: 1,664 SF
TOTAL: 3,329 SF

30 60
SCALE IN FEET

MINNEHAHA BIKE SKILLS PARK

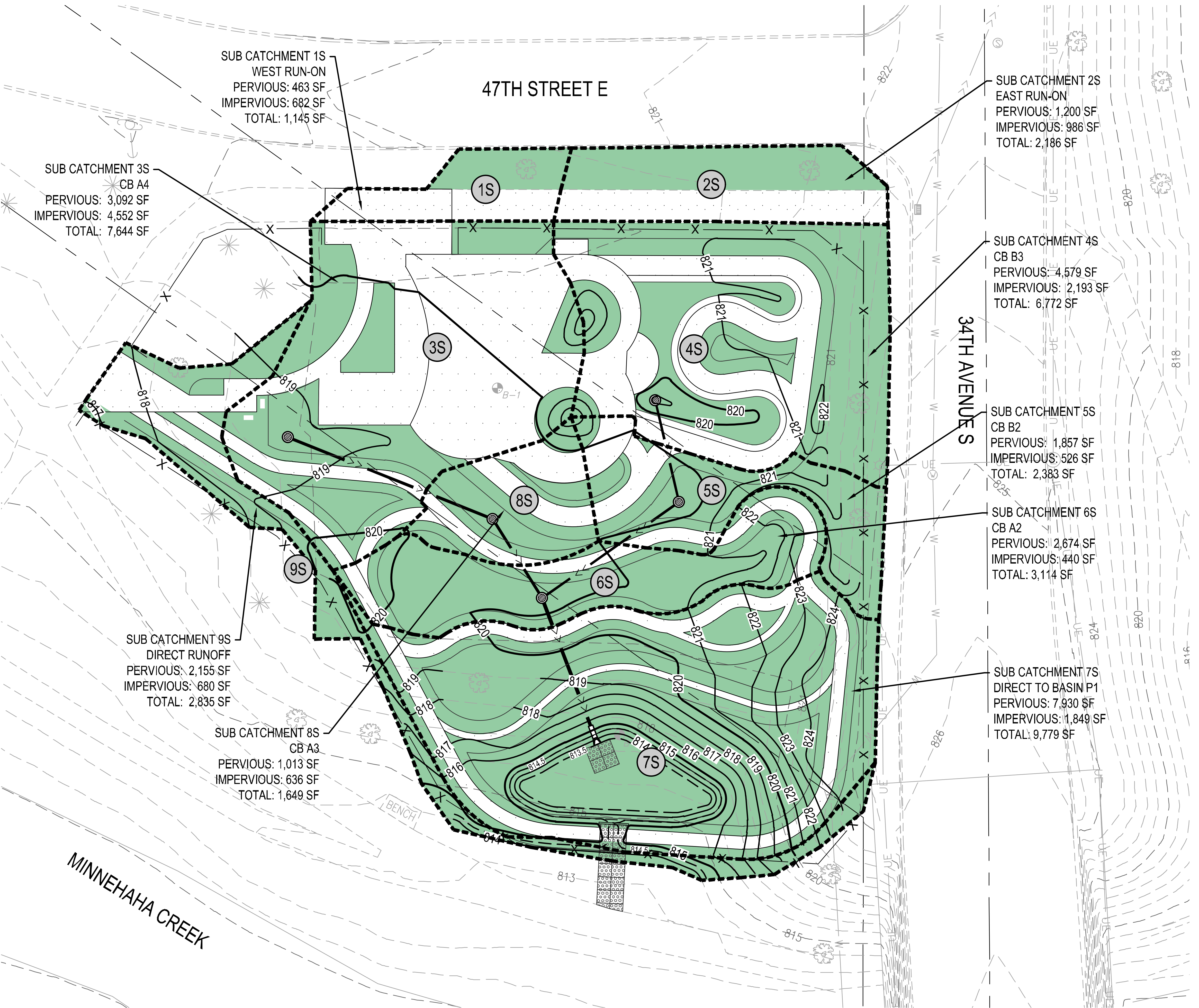
MINNEAPOLIS, MINNESOTA
MPR25011

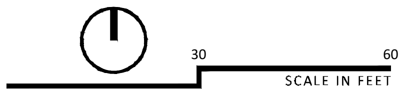
EXISTING DRAINAGE MAP

3/23/2026

310 4TH SOUTH, SUITE 1006
MINNEAPOLIS, MN 55415
p 612.260.7980
f 612.260.7990
www.elanlab.com

Élan
DESIGN LAB
CIVIL ENGINEERING | LANDSCAPE ARCHITECTURE





AREA SUMMARY

🟩	PERVIOUS AREA 24,963 SF.
▨	IMPERVIOUS AREA 12,544 SF.
	TOTAL 37,507 SF.

LEGEND

- - - - DRAINAGE BOUNDARY

MINNEHAHA BIKE SKILLS PARK

MINNEAPOLIS, MINNESOTA
MPR25011

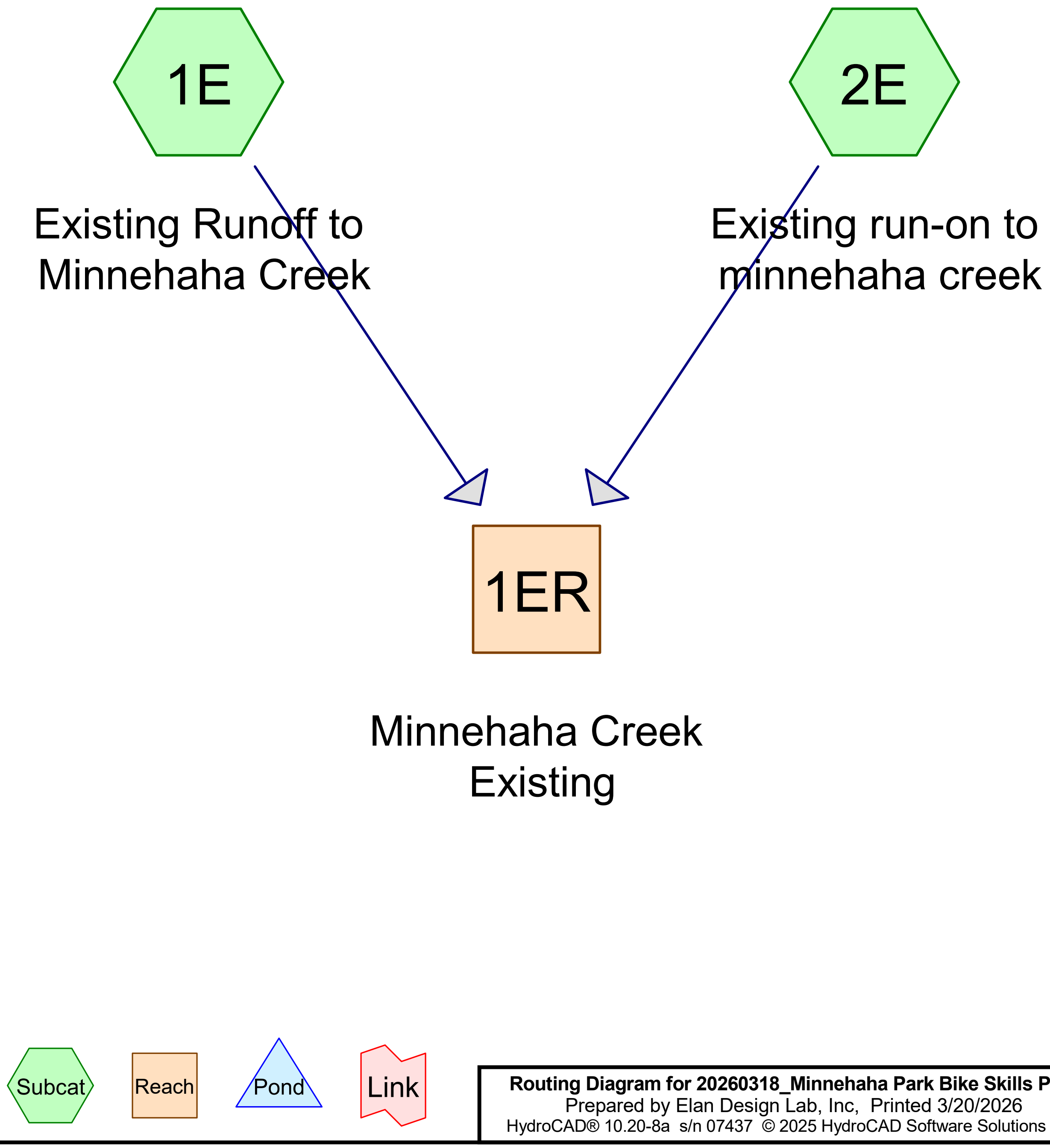
PROPOSED DRAINAGE MAP

03/23/2026

310 4TH SOUTH, SUITE 1006
MINNEAPOLIS, MN 55415
p 612.260.7980
f 612.260.7990
www.elanlab.com

Élan DESIGN LAB
CIVIL ENGINEERING | LANDSCAPE ARCHITECTURE

Existing



Routing Diagram for 20260318_Minnehaha Park Bike Skills Park
Prepared by Elan Design Lab, Inc, Printed 3/20/2026

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	MSE 24-hr	3	Default	24.00	1	2.80	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.20	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.50	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.389	61	(1E, 2E)
0.472	98	(1E, 2E)
0.861	**81**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.861	Other	1E, 2E
0.861		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	0.861	0.861		1E, 2E
0.000	**0.000**	**0.000**	**0.000**	**0.861**	**0.861**	**TOTAL AREA**	

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1E: Existing Runoff to	Runoff Area=34,178 sf 55.34% Impervious Runoff Depth=1.16" Flow Length=223' Tc=11.7 min CN=81 Runoff=1.31 cfs 0.076 af
Subcatchment 2E: Existing run-on to	Runoff Area=3,329 sf 49.98% Impervious Runoff Depth=1.04" Flow Length=58' Tc=4.7 min CN=79 Runoff=0.16 cfs 0.007 af
Reach 1ER: Minnehaha Creek Existing	Inflow=1.39 cfs 0.083 af Outflow=1.39 cfs 0.083 af

Total Runoff Area = 0.861 ac Runoff Volume = 0.083 af Average Runoff Depth = 1.15"
45.14% Pervious = 0.389 ac 54.86% Impervious = 0.472 ac

Summary for Subcatchment 1E: Existing Runoff to Minnehaha Creek

Runoff = 1.31 cfs @ 12.20 hrs, Volume= 0.076 af, Depth= 1.16"
Routed to Reach 1ER : Minnehaha Creek Existing

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	15,264	61	
*	18,914	98	
	34,178	81	Weighted Average
	15,264		44.66% Pervious Area
	18,914		55.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	20	0.1500	0.26		**Sheet Flow, Slope to Court** Grass: Short n= 0.150 P2= 2.80"
6.2	133	0.0007	0.36		**Sheet Flow, Tennis Court** Smooth surfaces n= 0.011 P2= 2.80"
4.2	70	0.0936	0.27		**Sheet Flow, Slope to Creek** Grass: Short n= 0.150 P2= 2.80"
11.7	223	Total			

Summary for Subcatchment 2E: Existing run-on to minnehaha creek

Runoff = 0.16 cfs @ 12.13 hrs, Volume= 0.007 af, Depth= 1.04"
Routed to Reach 1ER : Minnehaha Creek Existing

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	1,665	61	
*	1,664	98	
	3,329	79	Weighted Average
	1,665		50.02% Pervious Area
	1,664		49.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	39	0.0260	0.15		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.3	19	0.0300	1.09		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
4.7	58	Total			

Summary for Reach 1ER: Minnehaha Creek Existing

```
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =      0.861 ac,  54.86% Impervious,  Inflow Depth =   1.15"    for  2-Year event
Inflow      =       1.39 cfs @  12.20 hrs,  Volume=          0.083 af
Outflow     =       1.39 cfs @  12.20 hrs,  Volume=          0.083 af,  Atten= 0%,  Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
```

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1E: Existing Runoff to Runoff Area=34,178 sf 55.34% Impervious Runoff Depth=2.29"
Flow Length=223' Tc=11.7 min CN=81 Runoff=2.61 cfs 0.150 af

Subcatchment 2E: Existing run-on to Runoff Area=3,329 sf 49.98% Impervious Runoff Depth=2.13"
Flow Length=58' Tc=4.7 min CN=79 Runoff=0.32 cfs 0.014 af

Reach 1ER: Minnehaha Creek Existing Inflow=2.77 cfs 0.163 af
Outflow=2.77 cfs 0.163 af

Total Runoff Area = 0.861 ac Runoff Volume = 0.163 af Average Runoff Depth = 2.28"
45.14% Pervious = 0.389 ac 54.86% Impervious = 0.472 ac

Summary for Subcatchment 1E: Existing Runoff to Minnehaha Creek

Runoff = 2.61 cfs @ 12.20 hrs, Volume= 0.150 af, Depth= 2.29"
Routed to Reach 1ER : Minnehaha Creek Existing

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	15,264	61	
*	18,914	98	
	34,178	81	Weighted Average
	15,264		44.66% Pervious Area
	18,914		55.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	20	0.1500	0.26		**Sheet Flow, Slope to Court** Grass: Short n= 0.150 P2= 2.80"
6.2	133	0.0007	0.36		**Sheet Flow, Tennis Court** Smooth surfaces n= 0.011 P2= 2.80"
4.2	70	0.0936	0.27		**Sheet Flow, Slope to Creek** Grass: Short n= 0.150 P2= 2.80"
11.7	223	Total			

Summary for Subcatchment 2E: Existing run-on to minnehaha creek

Runoff = 0.32 cfs @ 12.12 hrs, Volume= 0.014 af, Depth= 2.13"
Routed to Reach 1ER : Minnehaha Creek Existing

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	1,665	61	
*	1,664	98	
	3,329	79	Weighted Average
	1,665		50.02% Pervious Area
	1,664		49.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	39	0.0260	0.15		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.3	19	0.0300	1.09		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
4.7	58	Total			

Summary for Reach 1ER: Minnehaha Creek Existing

```
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =      0.861 ac,  54.86% Impervious,  Inflow Depth =   2.28"    for  10-Year event
Inflow      =      2.77 cfs @   12.19 hrs,  Volume=          0.163 af
Outflow     =      2.77 cfs @   12.19 hrs,  Volume=          0.163 af,  Atten= 0%,  Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
```

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1E: Existing Runoff to	Runoff Area=34,178 sf 55.34% Impervious Runoff Depth=5.27" Flow Length=223' Tc=11.7 min CN=81 Runoff=5.86 cfs 0.345 af
Subcatchment 2E: Existing run-on to	Runoff Area=3,329 sf 49.98% Impervious Runoff Depth=5.04" Flow Length=58' Tc=4.7 min CN=79 Runoff=0.73 cfs 0.032 af
Reach 1ER: Minnehaha Creek Existing	Inflow=6.24 cfs 0.377 af Outflow=6.24 cfs 0.377 af

Total Runoff Area = 0.861 ac Runoff Volume = 0.377 af Average Runoff Depth = 5.25"
45.14% Pervious = 0.389 ac 54.86% Impervious = 0.472 ac

Summary for Subcatchment 1E: Existing Runoff to Minnehaha Creek

Runoff = 5.86 cfs @ 12.19 hrs, Volume= 0.345 af, Depth= 5.27"
Routed to Reach 1ER : Minnehaha Creek Existing

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	15,264	61	
*	18,914	98	
	34,178	81	Weighted Average
	15,264		44.66% Pervious Area
	18,914		55.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	20	0.1500	0.26		**Sheet Flow, Slope to Court** Grass: Short n= 0.150 P2= 2.80"
6.2	133	0.0007	0.36		**Sheet Flow, Tennis Court** Smooth surfaces n= 0.011 P2= 2.80"
4.2	70	0.0936	0.27		**Sheet Flow, Slope to Creek** Grass: Short n= 0.150 P2= 2.80"
11.7	223	Total			

Summary for Subcatchment 2E: Existing run-on to minnehaha creek

Runoff = 0.73 cfs @ 12.12 hrs, Volume= 0.032 af, Depth= 5.04"
Routed to Reach 1ER : Minnehaha Creek Existing

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	1,665	61	
*	1,664	98	
	3,329	79	Weighted Average
	1,665		50.02% Pervious Area
	1,664		49.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	39	0.0260	0.15		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.3	19	0.0300	1.09		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
4.7	58	Total			

Summary for Reach 1ER: Minnehaha Creek Existing

[40] Hint: Not Described (Outflow=Inflow)

```
Inflow Area =         0.861 ac,  54.86% Impervious,  Inflow Depth =   5.25"    for  100-Year event
Inflow       =        6.24 cfs @   12.18 hrs,  Volume=           0.377 af
Outflow      =        6.24 cfs @   12.18 hrs,  Volume=           0.377 af,  Atten= 0%,  Lag= 0.0 min
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2

Summary for Reach 1ER: Minnehaha Creek Existing

[40] Hint: Not Described (Outflow=Inflow)

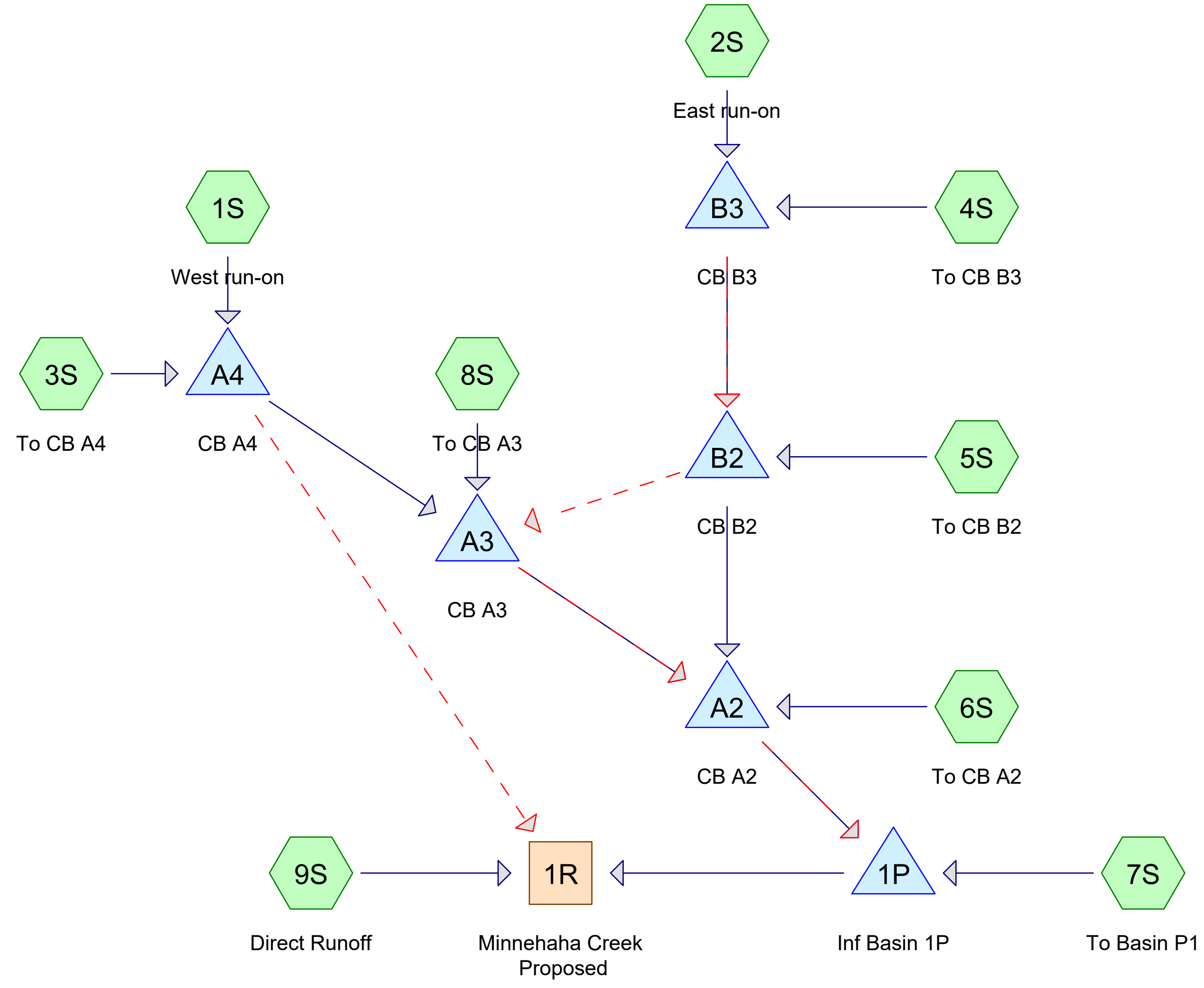
Inflow Area = 0.928 ac, 50.92% Impervious, Inflow Depth = 5.16" for 100-Year event
Inflow = 6.47 cfs @ 12.19 hrs, Volume= 0.399 af
Outflow = 6.47 cfs @ 12.19 hrs, Volume= 0.399 af, Atten= 0%, Lag= 0.0 min

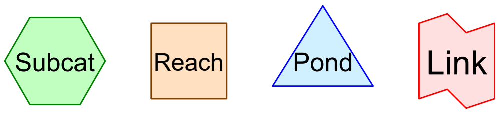
Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2

Proposed

NEW Impervious Area
=10,989 sf

Req'd Abstraction =
1007 cf





Routing Diagram for 20251208_Minnehaha Park Bike Skills Park
Prepared by Elan Design Lab, Inc, Printed 2/12/2026
HydroCAD® 10.20-8a s/n 07437 © 2025 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	MSE 24-hr	3	Default	24.00	1	2.80	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.20	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.50	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.637	61	(1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S)
0.238	98	(1S, 2S, 3S, 4S, 5S, 6S, 9S)
0.052	98	Undisturbed Impervious (7S, 8S)
0.928	**73**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.928	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S
0.928		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	0.876	0.876		1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S
0.000	0.000	0.000	0.000	0.052	0.052	Undisturbed Impervious	7S, 8S
0.000	**0.000**	**0.000**	**0.000**	**0.928**	**0.928**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	A2	813.83	813.50	66.0	0.0050	0.013	0.0	12.0	0.0	
2	A3	814.35	814.10	28.0	0.0089	0.010	0.0	10.0	0.0	
3	A4	814.88	814.35	67.0	0.0079	0.010	0.0	10.0	0.0	
4	B2	814.56	814.10	51.0	0.0090	0.010	0.0	8.0	0.0	
5	B3	814.81	814.56	32.0	0.0078	0.010	0.0	8.0	0.0	

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: West run-on Runoff Area=1,144 sf 59.53% Impervious Runoff Depth=1.29"
Flow Length=32' Tc=1.4 min CN=83 Runoff=0.08 cfs 0.003 af

Subcatchment 2S: East run-on Runoff Area=2,186 sf 45.11% Impervious Runoff Depth=0.99"
Flow Length=58' Tc=4.7 min CN=78 Runoff=0.10 cfs 0.004 af

Subcatchment 3S: To CB A4 Runoff Area=7,622 sf 59.68% Impervious Runoff Depth=1.29"
Flow Length=103' Tc=1.7 min CN=83 Runoff=0.49 cfs 0.019 af

Subcatchment 4S: To CB B3 Runoff Area=6,771 sf 32.37% Impervious Runoff Depth=0.74"
Flow Length=100' Tc=3.5 min CN=73 Runoff=0.24 cfs 0.010 af

Subcatchment 5S: To CB B2 Runoff Area=2,384 sf 22.11% Impervious Runoff Depth=0.57"
Flow Length=76' Slope=0.0600 '/' Tc=5.4 min CN=69 Runoff=0.05 cfs 0.003 af

Subcatchment 6S: To CB A2 Runoff Area=3,505 sf 21.97% Impervious Runoff Depth=0.57"
Flow Length=92' Tc=3.3 min CN=69 Runoff=0.09 cfs 0.004 af

Subcatchment 7S: To Basin P1 Runoff Area=9,389 sf 17.50% Impervious Runoff Depth=0.49"
Flow Length=134' Slope=0.0700 '/' Tc=5.8 min CN=67 Runoff=0.17 cfs 0.009 af

Subcatchment 8S: To CB A3 Runoff Area=1,657 sf 37.90% Impervious Runoff Depth=0.83"
Flow Length=66' Tc=3.6 min CN=75 Runoff=0.07 cfs 0.003 af

Subcatchment 9S: Direct Runoff Runoff Area=5,763 sf 11.80% Impervious Runoff Depth=0.42"
Tc=7.0 min CN=65 Runoff=0.08 cfs 0.005 af

Reach 1R: Minnehaha Creek Proposed Inflow=0.15 cfs 0.019 af
Outflow=0.15 cfs 0.019 af

Pond 1P: Inf Basin 1P Peak Elev=814.56' Storage=1,103 cf Inflow=1.23 cfs 0.053 af
Discarded=0.02 cfs 0.038 af Primary=0.13 cfs 0.015 af Outflow=0.15 cfs 0.053 af

Pond A2: CB A2 Peak Elev=814.56' Storage=1 cf Inflow=1.09 cfs 0.044 af
Primary=1.09 cfs 0.044 af Secondary=0.00 cfs 0.000 af Outflow=1.09 cfs 0.044 af

Pond A3: CB A3 Peak Elev=814.80' Storage=1 cf Inflow=0.63 cfs 0.024 af
Primary=0.63 cfs 0.024 af Secondary=0.00 cfs 0.000 af Outflow=0.63 cfs 0.024 af

Pond A4: CB A4 Peak Elev=815.30' Storage=1 cf Inflow=0.57 cfs 0.022 af
Primary=0.57 cfs 0.022 af Secondary=0.00 cfs 0.000 af Outflow=0.57 cfs 0.022 af

Pond B2: CB B2 Peak Elev=814.92' Storage=1 cf Inflow=0.38 cfs 0.016 af
Primary=0.38 cfs 0.016 af Secondary=0.00 cfs 0.000 af Outflow=0.38 cfs 0.016 af

Pond B3: CB B3 Peak Elev=815.18' Storage=1 cf Inflow=0.33 cfs 0.014 af
Primary=0.33 cfs 0.014 af Secondary=0.00 cfs 0.000 af Outflow=0.33 cfs 0.014 af

Total Runoff Area = 0.928 ac Runoff Volume = 0.058 af Average Runoff Depth = 0.75"
68.69% Pervious = 0.637 ac 31.31% Impervious = 0.291 ac

Summary for Subcatchment 1S: West run-on

Runoff = 0.08 cfs @ 12.10 hrs, Volume= 0.003 af, Depth= 1.29"
Routed to Pond A4 : CB A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	463	61	
*	681	98	
	1,144	83	Weighted Average
	463		40.47% Pervious Area
	681		59.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	21	0.2000	0.29		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.2	11	0.0200	0.83		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
1.4	32	Total			

Summary for Subcatchment 2S: East run-on

Runoff = 0.10 cfs @ 12.13 hrs, Volume= 0.004 af, Depth= 0.99"
Routed to Pond B3 : CB B3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	1,200	61	
*	986	98	
	2,186	78	Weighted Average
	1,200		54.89% Pervious Area
	986		45.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	39	0.0260	0.15		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.3	19	0.0300	1.09		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
4.7	58	Total			

Summary for Subcatchment 3S: To CB A4

Runoff = 0.49 cfs @ 12.10 hrs, Volume= 0.019 af, Depth= 1.29"
Routed to Pond A4 : CB A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	3,073	61	
*	4,549	98	
	7,622	83	Weighted Average
	3,073		40.32% Pervious Area
	4,549		59.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	69	0.0200	1.19		**Sheet Flow, Patio** Smooth surfaces n= 0.011 P2= 2.80"
0.7	34	0.0150	0.86		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
1.7	103	Total			

Summary for Subcatchment 4S: To CB B3

Runoff = 0.24 cfs @ 12.12 hrs, Volume= 0.010 af, Depth= 0.74"
Routed to Pond B3 : CB B3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	4,579	61	
*	2,192	98	
	6,771	73	Weighted Average
	4,579		67.63% Pervious Area
	2,192		32.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	36	0.1100	0.26		**Sheet Flow, Grass from East** Grass: Short n= 0.150 P2= 2.80"
1.2	64	0.0150	0.86		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
3.5	100	Total			

Summary for Subcatchment 5S: To CB B2

Runoff = 0.05 cfs @ 12.14 hrs, Volume= 0.003 af, Depth= 0.57"
Routed to Pond B2 : CB B2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	1,857	61	
*	527	98	
	2,384	69	Weighted Average
	1,857		77.89% Pervious Area
	527		22.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	76	0.0600	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment 6S: To CB A2

Runoff = 0.09 cfs @ 12.12 hrs, Volume= 0.004 af, Depth= 0.57"
Routed to Pond A2 : CB A2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	2,735	61	
*	770	98	
	3,505	69	Weighted Average
	2,735		78.03% Pervious Area
	770		21.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	25	0.0600	0.19		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
1.1	67	0.0200	0.99		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
3.3	92	Total			

Summary for Subcatchment 7S: To Basin P1

```
Runoff       =        0.17 cfs @   12.14 hrs,  Volume=          0.009 af,  Depth=  0.49"
    Routed to Pond 1P : Inf Basin 1P

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3  2-Year Rainfall=2.80"

          Area (sf)    CN   Description
*            7,746     61
*            1,643     98   Undisturbed Impervious
             9,389     67   Weighted Average
             7,746          82.50% Pervious Area
             1,643          17.50% Impervious Area

      Tc   Length    Slope   Velocity   Capacity   Description
   (min)   (feet)   (ft/ft)  (ft/sec)      (cfs)
     5.8      134   0.0700       0.39              Sheet Flow, Across trails & grass
                                                     n= 0.100   P2= 2.80"
```

Summary for Subcatchment 8S: To CB A3

Runoff = 0.07 cfs @ 12.12 hrs, Volume= 0.003 af, Depth= 0.83"
Routed to Pond A3 : CB A3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	1,029	61	
*	628	98	Undisturbed Impervious
	1,657	75	Weighted Average
	1,029		62.10% Pervious Area
	628		37.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	39	0.0400	1.41		**Sheet Flow, Across trails** Smooth surfaces n= 0.011 P2= 2.80"
3.1	27	0.0300	0.14		**Sheet Flow, grass swale** Grass: Short n= 0.150 P2= 2.80"
3.6	66	Total			

Summary for Subcatchment 9S: Direct Runoff

Runoff = 0.08 cfs @ 12.16 hrs, Volume= 0.005 af, Depth= 0.42"
Routed to Reach 1R : Minnehaha Creek Proposed

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	5,083	61	
*	680	98	
	5,763	65	Weighted Average
	5,083		88.20% Pervious Area
	680		11.80% Impervious Area

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

Summary for Reach 1R: Minnehaha Creek Proposed

[40] Hint: Not Described (Outflow=Inflow)

```
Inflow Area =         0.928 ac,  31.31% Impervious,  Inflow Depth =   0.25"    for  2-Year event
Inflow       =         0.15 cfs @   12.57 hrs,  Volume=            0.019 af
Outflow      =         0.15 cfs @   12.57 hrs,  Volume=            0.019 af,  Atten= 0%,  Lag= 0.0 min
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: Inf Basin 1P

[80] Warning: Exceeded Pond A2 by 0.05' @ 24.73 hrs (0.28 cfs 0.088 af)

Inflow Area = 0.796 ac, 34.55% Impervious, Inflow Depth = 0.80" for 2-Year event
Inflow = 1.23 cfs @ 12.11 hrs, Volume= 0.053 af
Outflow = 0.15 cfs @ 12.58 hrs, Volume= 0.053 af, Atten= 88%, Lag= 28.6 min
Discarded = 0.02 cfs @ 12.58 hrs, Volume= 0.038 af
Primary = 0.13 cfs @ 12.58 hrs, Volume= 0.015 af
Routed to Reach 1R : Minnehaha Creek Proposed

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 814.56' @ 12.58 hrs Surf.Area= 1,241 sf Storage= 1,103 cf

Plug-Flow detention time= 551.3 min calculated for 0.053 af (100% of inflow)
Center-of-Mass det. time= 551.3 min (1,380.2 - 828.9)

Volume	Invert	Avail.Storage	Storage Description
#1	813.50'	2,462 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
813.50	846	0	0	846
814.00	1,036	470	470	1,044
815.00	1,417	1,222	1,691	1,444
815.50	1,668	770	2,462	1,705

Device	Routing	Invert	Outlet Devices
#1	Discarded	813.50'	**0.450 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 810.50'
#2	Primary	814.50'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.02 cfs @ 12.58 hrs HW=814.56' (Free Discharge)
└─**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=0.13 cfs @ 12.58 hrs HW=814.56' TW=0.00' (Dynamic Tailwater)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.13 cfs @ 0.78 fps)

Summary for Pond A2: CB A2

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=68)

Inflow Area = 0.580 ac, 40.89% Impervious, Inflow Depth = 0.92" for 2-Year event
Inflow = 1.09 cfs @ 12.11 hrs, Volume= 0.044 af
Outflow = 1.09 cfs @ 12.11 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min
Primary = 1.09 cfs @ 12.11 hrs, Volume= 0.044 af
Routed to Pond 1P : Inf Basin 1P
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 1P : Inf Basin 1P

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 814.56' @ 12.56 hrs Surf.Area= 2 sf Storage= 1 cf

Plug-Flow detention time= 0.8 min calculated for 0.044 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (823.3 - 822.7)

Volume	Invert	Avail.Storage	Storage Description
#1	819.35'	456 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	813.83'	10 cf	**1.50'D x 5.52'H Vertical Cone/Cylinder**
		466 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.35	4	0	0
820.00	1,400	456	456

Device	Routing	Invert	Outlet Devices
#1	Primary	813.83'	**12.0" Round Culvert** L= 66.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 813.83' / 813.50' S= 0.0050 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	819.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 Width (feet) 0.00 30.00

Primary OutFlow Max=1.08 cfs @ 12.11 hrs HW=814.48' TW=814.04' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.08 cfs @ 2.81 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=813.83' TW=813.50' (Dynamic Tailwater)
└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond A3: CB A3

```
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=14)

Inflow Area =        0.239 ac,  56.20% Impervious,  Inflow Depth =   1.22"    for  2-Year event
Inflow      =        0.63 cfs @   12.10 hrs,  Volume=          0.024 af
Outflow     =        0.63 cfs @   12.10 hrs,  Volume=          0.024 af,  Atten= 0%,  Lag= 0.0 min
Primary     =        0.63 cfs @   12.10 hrs,  Volume=          0.024 af
    Routed to Pond A2 : CB A2
Secondary =          0.00 cfs @    0.00 hrs,  Volume=          0.000 af
    Routed to Pond A2 : CB A2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 814.80' @ 12.11 hrs   Surf.Area= 2 sf   Storage= 1 cf

Plug-Flow detention time= 0.2 min calculated for 0.024 af (100% of inflow)
Center-of-Mass det. time= 0.2 min ( 810.6 - 810.4 )
```

Volume	Invert	Avail.Storage	Storage Description
#1	819.00'	502 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.35'	8 cf	**1.50'D x 4.65'H Vertical Cone/Cylinder**
		510 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.00	4	0	0
820.00	1,000	502	502

Device	Routing	Invert	Outlet Devices
#1	Primary	814.35'	**10.0" Round Culvert** L= 28.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.35' / 814.10' S= 0.0089 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Secondary	818.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 Width (feet) 0.00 58.00

```
Primary OutFlow  Max=0.62 cfs @ 12.10 hrs  HW=814.80'  TW=814.47'   (Dynamic Tailwater)
└─1=Culvert  (Outlet Controls 0.62 cfs @ 3.00 fps)

Secondary OutFlow  Max=0.00 cfs @ 0.00 hrs  HW=814.35'  TW=813.83'   (Dynamic Tailwater)
└─2=Custom Weir/Orifice  ( Controls 0.00 cfs)
```

Summary for Pond A4: CB A4

```
Inflow Area =         0.201 ac, 59.66% Impervious, Inflow Depth =   1.29"    for  2-Year event
Inflow      =        0.57 cfs @  12.10 hrs,  Volume=          0.022 af
Outflow     =        0.57 cfs @  12.10 hrs,  Volume=          0.022 af,  Atten= 0%,  Lag= 0.0 min
Primary     =        0.57 cfs @  12.10 hrs,  Volume=          0.022 af
    Routed to Pond A3 : CB A3
Secondary =          0.00 cfs @   0.00 hrs,  Volume=          0.000 af
    Routed to Reach 1R : Minnehaha Creek Proposed

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 815.30' @ 12.10 hrs   Surf.Area= 2 sf   Storage= 1 cf

Plug-Flow detention time= 0.1 min calculated for 0.022 af (100% of inflow)
Center-of-Mass det. time= 0.1 min ( 808.0 - 807.9 )

Volume      Invert    Avail.Storage   Storage Description
   #1      818.37'           171 cf   Custom Stage Data (Prismatic)Listed below (Recalc)
   #2      814.88'             6 cf   1.50'D x 3.49'H Vertical Cone/Cylinder
                             177 cf   Total Available Storage

 Elevation        Surf.Area        Inc.Store        Cum.Store
    (feet)          (sq-ft)     (cubic-feet)     (cubic-feet)
    818.37                4                0                0
    820.00               87               74               74
    820.50              300               97              171

Device   Routing        Invert   Outlet Devices
   #1    Primary       814.88'   10.0"  Round Culvert
                                 L= 67.0'   RCP, sq.cut end projecting,  Ke= 0.500
                                 Inlet / Outlet Invert= 814.88' / 814.35'   S= 0.0079 '/'   Cc= 0.900
                                 n= 0.010  PVC, smooth interior,  Flow Area= 0.55 sf
   #2    Secondary     818.50'   Custom Weir/Orifice, Cv= 2.62 (C= 3.28)
                                 Head (feet)  0.00  0.50
                                 Width (feet)  0.00  37.00

Primary OutFlow  Max=0.57 cfs @ 12.10 hrs  HW=815.30'  TW=814.80'   (Dynamic Tailwater)
└─1=Culvert  (Outlet Controls 0.57 cfs @ 3.01 fps)

Secondary OutFlow  Max=0.00 cfs @ 0.00 hrs  HW=814.88'  TW=0.00'   (Dynamic Tailwater)
└─2=Custom Weir/Orifice  ( Controls 0.00 cfs)
```

Summary for Pond B2: CB B2

Inflow Area = 0.260 ac, 32.67% Impervious, Inflow Depth = 0.75" for 2-Year event
Inflow = 0.38 cfs @ 12.12 hrs, Volume= 0.016 af
Outflow = 0.38 cfs @ 12.12 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.0 min
Primary = 0.38 cfs @ 12.12 hrs, Volume= 0.016 af
Routed to Pond A2 : CB A2
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond A3 : CB A3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 814.92' @ 12.12 hrs Surf.Area= 2 sf Storage= 1 cf

Plug-Flow detention time= 0.1 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (834.9 - 834.8)

Volume	Invert	Avail.Storage	Storage Description
#1	819.52'	208 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.56'	9 cf	**1.50'D x 4.96'H Vertical Cone/Cylinder**
		217 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.52	4	0	0
820.00	50	13	13
820.60	600	195	208

Device	Routing	Invert	Outlet Devices
#1	Primary	814.56'	**8.0" Round Culvert** L= 51.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.56' / 814.10' S= 0.0090 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf
#2	Secondary	819.70'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.30 Width (feet) 0.00 28.00

Primary OutFlow Max=0.38 cfs @ 12.12 hrs HW=814.92' TW=814.48' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.38 cfs @ 2.86 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=814.56' TW=814.35' (Dynamic Tailwater)
└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond B3: CB B3

Inflow Area = 0.206 ac, 35.48% Impervious, Inflow Depth = 0.80" for 2-Year event
Inflow = 0.33 cfs @ 12.12 hrs, Volume= 0.014 af
Outflow = 0.33 cfs @ 12.12 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min
Primary = 0.33 cfs @ 12.12 hrs, Volume= 0.014 af
Routed to Pond B2 : CB B2
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond B2 : CB B2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 815.18' @ 12.12 hrs Surf.Area= 2 sf Storage= 1 cf

Plug-Flow detention time= 0.1 min calculated for 0.014 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (831.9 - 831.8)

Volume	Invert	Avail.Storage	Storage Description
#1	818.72'	437 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.81'	7 cf	**1.50'D x 3.91'H Vertical Cone/Cylinder**
		444 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
818.72	2	0	0
819.00	10	2	2
820.00	240	125	127
820.50	1,000	310	437

Device	Routing	Invert	Outlet Devices
#1	Primary	814.81'	**8.0" Round Culvert** L= 32.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.81' / 814.56' S= 0.0078 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf
#2	Secondary	820.04'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.96 Width (feet) 0.00 52.00

Primary OutFlow Max=0.34 cfs @ 12.12 hrs HW=815.18' TW=814.92' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.34 cfs @ 2.47 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=814.81' TW=814.56' (Dynamic Tailwater)
└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: West run-on Runoff Area=1,144 sf 59.53% Impervious Runoff Depth=2.46"
Flow Length=32' Tc=1.4 min CN=83 Runoff=0.14 cfs 0.005 af

Subcatchment 2S: East run-on Runoff Area=2,186 sf 45.11% Impervious Runoff Depth=2.05"
Flow Length=58' Tc=4.7 min CN=78 Runoff=0.20 cfs 0.009 af

Subcatchment 3S: To CB A4 Runoff Area=7,622 sf 59.68% Impervious Runoff Depth=2.46"
Flow Length=103' Tc=1.7 min CN=83 Runoff=0.91 cfs 0.036 af

Subcatchment 4S: To CB B3 Runoff Area=6,771 sf 32.37% Impervious Runoff Depth=1.67"
Flow Length=100' Tc=3.5 min CN=73 Runoff=0.54 cfs 0.022 af

Subcatchment 5S: To CB B2 Runoff Area=2,384 sf 22.11% Impervious Runoff Depth=1.40"
Flow Length=76' Slope=0.0600 '/' Tc=5.4 min CN=69 Runoff=0.15 cfs 0.006 af

Subcatchment 6S: To CB A2 Runoff Area=3,505 sf 21.97% Impervious Runoff Depth=1.40"
Flow Length=92' Tc=3.3 min CN=69 Runoff=0.24 cfs 0.009 af

Subcatchment 7S: To Basin P1 Runoff Area=9,389 sf 17.50% Impervious Runoff Depth=1.27"
Flow Length=134' Slope=0.0700 '/' Tc=5.8 min CN=67 Runoff=0.51 cfs 0.023 af

Subcatchment 8S: To CB A3 Runoff Area=1,657 sf 37.90% Impervious Runoff Depth=1.82"
Flow Length=66' Tc=3.6 min CN=75 Runoff=0.14 cfs 0.006 af

Subcatchment 9S: Direct Runoff Runoff Area=5,763 sf 11.80% Impervious Runoff Depth=1.15"
Tc=7.0 min CN=65 Runoff=0.26 cfs 0.013 af

Reach 1R: Minnehaha Creek Proposed Inflow=2.10 cfs 0.087 af
Outflow=2.10 cfs 0.087 af

Pond 1P: Inf Basin 1P Peak Elev=814.83' Storage=1,459 cf Inflow=2.72 cfs 0.116 af
Discarded=0.02 cfs 0.041 af Primary=1.84 cfs 0.075 af Outflow=1.86 cfs 0.116 af

Pond A2: CB A2 Peak Elev=815.23' Storage=2 cf Inflow=2.27 cfs 0.093 af
Primary=2.27 cfs 0.093 af Secondary=0.00 cfs 0.000 af Outflow=2.27 cfs 0.093 af

Pond A3: CB A3 Peak Elev=815.39' Storage=2 cf Inflow=1.19 cfs 0.047 af
Primary=1.19 cfs 0.047 af Secondary=0.00 cfs 0.000 af Outflow=1.19 cfs 0.047 af

Pond A4: CB A4 Peak Elev=815.65' Storage=1 cf Inflow=1.05 cfs 0.041 af
Primary=1.05 cfs 0.041 af Secondary=0.00 cfs 0.000 af Outflow=1.05 cfs 0.041 af

Pond B2: CB B2 Peak Elev=815.50' Storage=2 cf Inflow=0.89 cfs 0.037 af
Primary=0.90 cfs 0.037 af Secondary=0.00 cfs 0.000 af Outflow=0.90 cfs 0.037 af

Pond B3: CB B3 Peak Elev=815.75' Storage=2 cf Inflow=0.75 cfs 0.030 af
Primary=0.75 cfs 0.030 af Secondary=0.00 cfs 0.000 af Outflow=0.75 cfs 0.030 af

Total Runoff Area = 0.928 ac Runoff Volume = 0.128 af Average Runoff Depth = 1.66"
68.69% Pervious = 0.637 ac 31.31% Impervious = 0.291 ac

Summary for Subcatchment 1S: West run-on

Runoff = 0.14 cfs @ 12.10 hrs, Volume= 0.005 af, Depth= 2.46"
Routed to Pond A4 : CB A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	463	61	
*	681	98	
	1,144	83	Weighted Average
	463		40.47% Pervious Area
	681		59.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	21	0.2000	0.29		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.2	11	0.0200	0.83		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
1.4	32	Total			

Summary for Subcatchment 2S: East run-on

Runoff = 0.20 cfs @ 12.12 hrs, Volume= 0.009 af, Depth= 2.05"
Routed to Pond B3 : CB B3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	1,200	61	
*	986	98	
	2,186	78	Weighted Average
	1,200		54.89% Pervious Area
	986		45.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	39	0.0260	0.15		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.3	19	0.0300	1.09		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
4.7	58	Total			

Summary for Subcatchment 3S: To CB A4

Runoff = 0.91 cfs @ 12.10 hrs, Volume= 0.036 af, Depth= 2.46"
Routed to Pond A4 : CB A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	3,073	61	
*	4,549	98	
	7,622	83	Weighted Average
	3,073		40.32% Pervious Area
	4,549		59.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	69	0.0200	1.19		**Sheet Flow, Patio** Smooth surfaces n= 0.011 P2= 2.80"
0.7	34	0.0150	0.86		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
1.7	103	Total			

Summary for Subcatchment 4S: To CB B3

Runoff = 0.54 cfs @ 12.11 hrs, Volume= 0.022 af, Depth= 1.67"
Routed to Pond B3 : CB B3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	4,579	61	
*	2,192	98	
	6,771	73	Weighted Average
	4,579		67.63% Pervious Area
	2,192		32.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	36	0.1100	0.26		**Sheet Flow, Grass from East** Grass: Short n= 0.150 P2= 2.80"
1.2	64	0.0150	0.86		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
3.5	100	Total			

Summary for Subcatchment 5S: To CB B2

Runoff = 0.15 cfs @ 12.13 hrs, Volume= 0.006 af, Depth= 1.40"
Routed to Pond B2 : CB B2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	1,857	61	
*	527	98	
	2,384	69	Weighted Average
	1,857		77.89% Pervious Area
	527		22.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	76	0.0600	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment 6S: To CB A2

Runoff = 0.24 cfs @ 12.11 hrs, Volume= 0.009 af, Depth= 1.40"
Routed to Pond A2 : CB A2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	2,735	61	
*	770	98	
	3,505	69	Weighted Average
	2,735		78.03% Pervious Area
	770		21.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	25	0.0600	0.19		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
1.1	67	0.0200	0.99		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
3.3	92	Total			

Summary for Subcatchment 7S: To Basin P1

Runoff = 0.51 cfs @ 12.14 hrs, Volume= 0.023 af, Depth= 1.27"
Routed to Pond 1P : Inf Basin 1P

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	7,746	61	
*	1,643	98	Undisturbed Impervious
	9,389	67	Weighted Average
	7,746		82.50% Pervious Area
	1,643		17.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	134	0.0700	0.39		**Sheet Flow, Across trails & grass** n= 0.100 P2= 2.80"

Summary for Subcatchment 8S: To CB A3

```
Runoff       =          0.14 cfs @   12.11 hrs,  Volume=            0.006 af,  Depth=  1.82"
    Routed to Pond A3 : CB A3
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	1,029	61	
*	628	98	Undisturbed Impervious
	1,657	75	Weighted Average
	1,029		62.10% Pervious Area
	628		37.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	39	0.0400	1.41		**Sheet Flow, Across trails** Smooth surfaces n= 0.011 P2= 2.80"
3.1	27	0.0300	0.14		**Sheet Flow, grass swale** Grass: Short n= 0.150 P2= 2.80"
3.6	66	Total			

Summary for Subcatchment 9S: Direct Runoff

Runoff = 0.26 cfs @ 12.15 hrs, Volume= 0.013 af, Depth= 1.15"
Routed to Reach 1R : Minnehaha Creek Proposed

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	5,083	61	
*	680	98	
	5,763	65	Weighted Average
	5,083		88.20% Pervious Area
	680		11.80% Impervious Area

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

Summary for Reach 1R: Minnehaha Creek Proposed

[40] Hint: Not Described (Outflow=Inflow)

```
Inflow Area =          0.928 ac,  31.31% Impervious,  Inflow Depth =   1.13"    for  10-Year event
Inflow       =         2.10 cfs @   12.15 hrs,  Volume=             0.087 af
Outflow      =         2.10 cfs @   12.15 hrs,  Volume=             0.087 af,  Atten= 0%,  Lag= 0.0 min
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: Inf Basin 1P

```
[80] Warning: Exceeded Pond A2 by 0.05' @ 24.73 hrs (0.33 cfs 0.103 af)

Inflow Area =       0.796 ac, 34.55% Impervious, Inflow Depth =  1.75"   for 10-Year event
Inflow      =       2.72 cfs @  12.11 hrs, Volume=          0.116 af
Outflow     =       1.86 cfs @  12.15 hrs, Volume=          0.116 af, Atten= 32%, Lag= 2.5 min
Discarded   =       0.02 cfs @  12.15 hrs, Volume=          0.041 af
Primary     =       1.84 cfs @  12.15 hrs, Volume=          0.075 af
    Routed to Reach 1R : Minnehaha Creek Proposed

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 814.83' @ 12.15 hrs   Surf.Area= 1,349 sf   Storage= 1,459 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 275.6 min ( 1,087.9 - 812.3 )

Volume      Invert    Avail.Storage   Storage Description
  #1       813.50'         2,462 cf   Custom Stage Data (Conic)Listed below (Recalc)

 Elevation       Surf.Area        Inc.Store        Cum.Store        Wet.Area
    (feet)         (sq-ft)     (cubic-feet)     (cubic-feet)         (sq-ft)
    813.50             846                0                0             846
    814.00           1,036              470              470           1,044
    815.00           1,417            1,222            1,691           1,444
    815.50           1,668              770            2,462           1,705

Device   Routing        Invert   Outlet Devices
   #1    Discarded     813.50'   0.450 in/hr Exfiltration over Wetted area
                                 Conductivity to Groundwater Elevation = 810.50'
   #2    Primary       814.50'   3.0' long Sharp-Crested Rectangular Weir  2 End Contraction(s)

Discarded OutFlow  Max=0.02 cfs @ 12.15 hrs  HW=814.83'   (Free Discharge)
└─1=Exfiltration  ( Controls 0.02 cfs)

Primary OutFlow  Max=1.83 cfs @ 12.15 hrs  HW=814.83'  TW=0.00'   (Dynamic Tailwater)
└─2=Sharp-Crested Rectangular Weir (Weir Controls 1.83 cfs @ 1.88 fps)
```

Summary for Pond A2: CB A2

[80] Warning: Exceeded Pond A3 by 0.03' @ 23.46 hrs (0.02 cfs 0.000 af)

Inflow Area = 0.580 ac, 40.89% Impervious, Inflow Depth = 1.92" for 10-Year event
Inflow = 2.27 cfs @ 12.11 hrs, Volume= 0.093 af
Outflow = 2.27 cfs @ 12.11 hrs, Volume= 0.093 af, Atten= 0%, Lag= 0.0 min
Primary = 2.27 cfs @ 12.11 hrs, Volume= 0.093 af
Routed to Pond 1P : Inf Basin 1P
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 1P : Inf Basin 1P

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 815.23' @ 12.11 hrs Surf.Area= 2 sf Storage= 2 cf

Plug-Flow detention time= 0.5 min calculated for 0.093 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (807.7 - 807.5)

Volume	Invert	Avail.Storage	Storage Description
#1	819.35'	456 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	813.83'	10 cf	**1.50'D x 5.52'H Vertical Cone/Cylinder**
		466 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.35	4	0	0
820.00	1,400	456	456

Device	Routing	Invert	Outlet Devices
#1	Primary	813.83'	**12.0" Round Culvert** L= 66.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 813.83' / 813.50' S= 0.0050 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	819.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 Width (feet) 0.00 30.00

Primary OutFlow Max=2.25 cfs @ 12.11 hrs HW=815.21' TW=814.75' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 2.25 cfs @ 2.87 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=813.83' TW=813.50' (Dynamic Tailwater)
└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond A3: CB A3

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=3)

Inflow Area = 0.239 ac, 56.20% Impervious, Inflow Depth = 2.36" for 10-Year event
Inflow = 1.19 cfs @ 12.10 hrs, Volume= 0.047 af
Outflow = 1.19 cfs @ 12.10 hrs, Volume= 0.047 af, Atten= 0%, Lag= 0.0 min
Primary = 1.19 cfs @ 12.10 hrs, Volume= 0.047 af
Routed to Pond A2 : CB A2
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond A2 : CB A2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 815.39' @ 12.11 hrs Surf.Area= 2 sf Storage= 2 cf

Plug-Flow detention time= 0.1 min calculated for 0.047 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (797.1 - 797.0)

Volume	Invert	Avail.Storage	Storage Description
#1	819.00'	502 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.35'	8 cf	**1.50'D x 4.65'H Vertical Cone/Cylinder**
		510 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.00	4	0	0
820.00	1,000	502	502

Device	Routing	Invert	Outlet Devices
#1	Primary	814.35'	**10.0" Round Culvert** L= 28.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.35' / 814.10' S= 0.0089 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Secondary	818.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 Width (feet) 0.00 58.00

Primary OutFlow Max=0.98 cfs @ 12.10 hrs HW=815.31' TW=815.17' (Dynamic Tailwater)
↰**1=Culvert** (Inlet Controls 0.98 cfs @ 1.79 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=814.35' TW=813.83' (Dynamic Tailwater)
↰**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond A4: CB A4

```
Inflow Area =        0.201 ac,  59.66% Impervious,  Inflow Depth =   2.46"    for  10-Year event
Inflow      =       1.05 cfs @   12.10 hrs,  Volume=           0.041 af
Outflow     =       1.05 cfs @   12.10 hrs,  Volume=           0.041 af,  Atten= 0%,  Lag= 0.0 min
Primary     =       1.05 cfs @   12.10 hrs,  Volume=           0.041 af
    Routed to Pond A3 : CB A3
Secondary =         0.00 cfs @    0.00 hrs,  Volume=           0.000 af
    Routed to Reach 1R : Minnehaha Creek Proposed

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 815.65' @ 12.11 hrs   Surf.Area= 2 sf   Storage= 1 cf

Plug-Flow detention time= 0.3 min calculated for 0.041 af (100% of inflow)
Center-of-Mass det. time= 0.1 min ( 794.8 - 794.7 )
```

Volume	Invert	Avail.Storage	Storage Description
#1	818.37'	171 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.88'	6 cf	**1.50'D x 3.49'H Vertical Cone/Cylinder**
		177 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
818.37	4	0	0
820.00	87	74	74
820.50	300	97	171

Device	Routing	Invert	Outlet Devices
#1	Primary	814.88'	**10.0" Round Culvert** L= 67.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.88' / 814.35' S= 0.0079 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Secondary	818.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 Width (feet) 0.00 37.00

Primary OutFlow Max=1.01 cfs @ 12.10 hrs HW=815.61' TW=815.30' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.01 cfs @ 2.66 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=814.88' TW=0.00' (Dynamic Tailwater)
└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond B2: CB B2

[90] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.260 ac, 32.67% Impervious, Inflow Depth = 1.69" for 10-Year event
Inflow = 0.89 cfs @ 12.12 hrs, Volume= 0.037 af
Outflow = 0.90 cfs @ 12.12 hrs, Volume= 0.037 af, Atten= 0%, Lag= 0.0 min
Primary = 0.90 cfs @ 12.12 hrs, Volume= 0.037 af
Routed to Pond A2 : CB A2
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond A3 : CB A3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 815.50' @ 12.11 hrs Surf.Area= 2 sf Storage= 2 cf

Plug-Flow detention time= 0.2 min calculated for 0.037 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (816.4 - 816.3)

Volume	Invert	Avail.Storage	Storage Description
#1	819.52'	208 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.56'	9 cf	**1.50'D x 4.96'H Vertical Cone/Cylinder**
		217 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.52	4	0	0
820.00	50	13	13
820.60	600	195	208

Device	Routing	Invert	Outlet Devices
#1	Primary	814.56'	**8.0" Round Culvert** L= 51.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.56' / 814.10' S= 0.0090 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf
#2	Secondary	819.70'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.30 Width (feet) 0.00 28.00

Primary OutFlow Max=0.82 cfs @ 12.12 hrs HW=815.46' TW=815.19' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.82 cfs @ 2.35 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=814.56' TW=814.35' (Dynamic Tailwater)
↑—**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond B3: CB B3

```
Inflow Area =       0.206 ac, 35.48% Impervious, Inflow Depth =  1.76"   for 10-Year event
Inflow      =       0.75 cfs @  12.12 hrs, Volume=          0.030 af
Outflow     =       0.75 cfs @  12.12 hrs, Volume=          0.030 af, Atten= 0%, Lag= 0.1 min
Primary     =       0.75 cfs @  12.12 hrs, Volume=          0.030 af
    Routed to Pond B2 : CB B2
Secondary =         0.00 cfs @   0.00 hrs, Volume=          0.000 af
    Routed to Pond B2 : CB B2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 815.75' @ 12.12 hrs   Surf.Area= 2 sf   Storage= 2 cf

Plug-Flow detention time= 0.3 min calculated for 0.030 af (100% of inflow)
Center-of-Mass det. time= 0.1 min ( 814.1 - 814.1 )

Volume      Invert    Avail.Storage   Storage Description
   #1       818.72'          437 cf   Custom Stage Data (Prismatic)Listed below (Recalc)
   #2       814.81'            7 cf   1.50'D x 3.91'H Vertical Cone/Cylinder
                             444 cf   Total Available Storage

 Elevation        Surf.Area        Inc.Store       Cum.Store
    (feet)          (sq-ft)     (cubic-feet)    (cubic-feet)
    818.72                2                0               0
    819.00               10                2               2
    820.00              240              125             127
    820.50            1,000              310             437

Device   Routing          Invert   Outlet Devices
   #1    Primary         814.81'   8.0"  Round Culvert
                                   L= 32.0'   RCP, sq.cut end projecting,  Ke= 0.500
                                   Inlet / Outlet Invert= 814.81' / 814.56'   S= 0.0078 '/'   Cc= 0.900
                                   n= 0.010  PVC, smooth interior,  Flow Area= 0.35 sf
   #2    Secondary       820.04'   Custom Weir/Orifice, Cv= 2.62 (C= 3.28)
                                   Head (feet)  0.00  0.96
                                   Width (feet)  0.00  52.00

Primary OutFlow  Max=0.87 cfs @ 12.12 hrs  HW=815.73'  TW=815.47'   (Dynamic Tailwater)
└─1=Culvert  (Inlet Controls 0.87 cfs @ 2.48 fps)

Secondary OutFlow  Max=0.00 cfs @ 0.00 hrs  HW=814.81'  TW=814.56'   (Dynamic Tailwater)
└─2=Custom Weir/Orifice  ( Controls 0.00 cfs)
```

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: West run-on Runoff Area=1,144 sf 59.53% Impervious Runoff Depth=5.50"
Flow Length=32' Tc=1.4 min CN=83 Runoff=0.29 cfs 0.012 af

Subcatchment 2S: East run-on Runoff Area=2,186 sf 45.11% Impervious Runoff Depth=4.93"
Flow Length=58' Tc=4.7 min CN=78 Runoff=0.47 cfs 0.021 af

Subcatchment 3S: To CB A4 Runoff Area=7,622 sf 59.68% Impervious Runoff Depth=5.50"
Flow Length=103' Tc=1.7 min CN=83 Runoff=1.93 cfs 0.080 af

Subcatchment 4S: To CB B3 Runoff Area=6,771 sf 32.37% Impervious Runoff Depth=4.37"
Flow Length=100' Tc=3.5 min CN=73 Runoff=1.38 cfs 0.057 af

Subcatchment 5S: To CB B2 Runoff Area=2,384 sf 22.11% Impervious Runoff Depth=3.93"
Flow Length=76' Slope=0.0600 '/' Tc=5.4 min CN=69 Runoff=0.41 cfs 0.018 af

Subcatchment 6S: To CB A2 Runoff Area=3,505 sf 21.97% Impervious Runoff Depth=3.93"
Flow Length=92' Tc=3.3 min CN=69 Runoff=0.66 cfs 0.026 af

Subcatchment 7S: To Basin P1 Runoff Area=9,389 sf 17.50% Impervious Runoff Depth=3.71"
Flow Length=134' Slope=0.0700 '/' Tc=5.8 min CN=67 Runoff=1.50 cfs 0.067 af

Subcatchment 8S: To CB A3 Runoff Area=1,657 sf 37.90% Impervious Runoff Depth=4.59"
Flow Length=66' Tc=3.6 min CN=75 Runoff=0.35 cfs 0.015 af

Subcatchment 9S: Direct Runoff Runoff Area=5,763 sf 11.80% Impervious Runoff Depth=3.49"
Tc=7.0 min CN=65 Runoff=0.82 cfs 0.039 af

Reach 1R: Minnehaha Creek Proposed Inflow=6.43 cfs 0.289 af
Outflow=6.43 cfs 0.289 af

Pond 1P: Inf Basin 1P Peak Elev=815.22' Storage=2,007 cf Inflow=6.37 cfs 0.294 af
Discarded=0.02 cfs 0.044 af Primary=5.65 cfs 0.250 af Outflow=5.67 cfs 0.294 af

Pond A2: CB A2 Peak Elev=817.42' Storage=6 cf Inflow=4.95 cfs 0.228 af
Primary=4.98 cfs 0.228 af Secondary=0.00 cfs 0.000 af Outflow=4.98 cfs 0.228 af

Pond A3: CB A3 Peak Elev=818.23' Storage=7 cf Inflow=2.49 cfs 0.106 af
Primary=2.49 cfs 0.106 af Secondary=0.00 cfs 0.000 af Outflow=2.49 cfs 0.106 af

Pond A4: CB A4 Peak Elev=818.59' Storage=8 cf Inflow=2.22 cfs 0.092 af
Primary=2.15 cfs 0.092 af Secondary=0.21 cfs 0.000 af Outflow=2.27 cfs 0.092 af

Pond B2: CB B2 Peak Elev=818.63' Storage=7 cf Inflow=2.27 cfs 0.095 af
Primary=2.27 cfs 0.095 af Secondary=0.00 cfs 0.000 af Outflow=2.27 cfs 0.095 af

Pond B3: CB B3 Peak Elev=819.85' Storage=100 cf Inflow=1.85 cfs 0.077 af
Primary=1.94 cfs 0.077 af Secondary=0.00 cfs 0.000 af Outflow=1.94 cfs 0.077 af

Total Runoff Area = 0.928 ac Runoff Volume = 0.333 af Average Runoff Depth = 4.31"
68.69% Pervious = 0.637 ac 31.31% Impervious = 0.291 ac

Summary for Subcatchment 1S: West run-on

```
Runoff       =        0.29 cfs @   12.10 hrs,  Volume=         0.012 af,  Depth=  5.50"
    Routed to Pond A4 : CB A4
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	463	61	
*	681	98	
	1,144	83	Weighted Average
	463		40.47% Pervious Area
	681		59.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	21	0.2000	0.29		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.2	11	0.0200	0.83		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
1.4	32	Total			

Summary for Subcatchment 2S: East run-on

Runoff = 0.47 cfs @ 12.12 hrs, Volume= 0.021 af, Depth= 4.93"
Routed to Pond B3 : CB B3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	1,200	61	
*	986	98	
	2,186	78	Weighted Average
	1,200		54.89% Pervious Area
	986		45.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	39	0.0260	0.15		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
0.3	19	0.0300	1.09		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 2.80"
4.7	58	Total			

Summary for Subcatchment 3S: To CB A4

Runoff = 1.93 cfs @ 12.10 hrs, Volume= 0.080 af, Depth= 5.50"
Routed to Pond A4 : CB A4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	3,073	61	
*	4,549	98	
	7,622	83	Weighted Average
	3,073		40.32% Pervious Area
	4,549		59.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	69	0.0200	1.19		**Sheet Flow, Patio** Smooth surfaces n= 0.011 P2= 2.80"
0.7	34	0.0150	0.86		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
1.7	103	Total			

Summary for Subcatchment 4S: To CB B3

Runoff = 1.38 cfs @ 12.11 hrs, Volume= 0.057 af, Depth= 4.37"
Routed to Pond B3 : CB B3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	4,579	61	
*	2,192	98	
	6,771	73	Weighted Average
	4,579		67.63% Pervious Area
	2,192		32.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	36	0.1100	0.26		**Sheet Flow, Grass from East** Grass: Short n= 0.150 P2= 2.80"
1.2	64	0.0150	0.86		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
3.5	100	Total			

Summary for Subcatchment 5S: To CB B2

```
Runoff      =       0.41 cfs @  12.13 hrs,  Volume=          0.018 af,  Depth=  3.93"
    Routed to Pond B2 : CB B2
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	1,857	61	
*	527	98	
	2,384	69	Weighted Average
	1,857		77.89% Pervious Area
	527		22.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	76	0.0600	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment 6S: To CB A2

Runoff = 0.66 cfs @ 12.11 hrs, Volume= 0.026 af, Depth= 3.93"
Routed to Pond A2 : CB A2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	2,735	61	
*	770	98	
	3,505	69	Weighted Average
	2,735		78.03% Pervious Area
	770		21.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	25	0.0600	0.19		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 2.80"
1.1	67	0.0200	0.99		**Shallow Concentrated Flow, Grass swale** Short Grass Pasture Kv= 7.0 fps
3.3	92	Total			

Summary for Subcatchment 7S: To Basin P1

Runoff = 1.50 cfs @ 12.13 hrs, Volume= 0.067 af, Depth= 3.71"
Routed to Pond 1P : Inf Basin 1P

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	7,746	61	
*	1,643	98	Undisturbed Impervious
	9,389	67	Weighted Average
	7,746		82.50% Pervious Area
	1,643		17.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	134	0.0700	0.39		**Sheet Flow, Across trails & grass** n= 0.100 P2= 2.80"

Summary for Subcatchment 8S: To CB A3

Runoff = 0.35 cfs @ 12.11 hrs, Volume= 0.015 af, Depth= 4.59"
Routed to Pond A3 : CB A3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	1,029	61	
*	628	98	Undisturbed Impervious
	1,657	75	Weighted Average
	1,029		62.10% Pervious Area
	628		37.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	39	0.0400	1.41		**Sheet Flow, Across trails** Smooth surfaces n= 0.011 P2= 2.80"
3.1	27	0.0300	0.14		**Sheet Flow, grass swale** Grass: Short n= 0.150 P2= 2.80"
3.6	66	Total			

Summary for Subcatchment 9S: Direct Runoff

```
Runoff       =          0.82 cfs @   12.15 hrs,  Volume=            0.039 af,  Depth=  3.49"
    Routed to Reach 1R : Minnehaha Creek Proposed
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

	Area (sf)	CN	Description
*	5,083	61	
*	680	98	
	5,763	65	Weighted Average
	5,083		88.20% Pervious Area
	680		11.80% Impervious Area

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

Summary for Reach 1R: Minnehaha Creek Proposed

[40] Hint: Not Described (Outflow=Inflow)

```
Inflow Area =          0.928 ac,  31.31% Impervious,  Inflow Depth =   3.74"    for  100-Year event
Inflow       =          6.43 cfs @   12.13 hrs,  Volume=            0.289 af
Outflow      =          6.43 cfs @   12.13 hrs,  Volume=            0.289 af,  Atten= 0%,  Lag= 0.0 min
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: Inf Basin 1P

[80] Warning: Exceeded Pond A2 by 0.05' @ 25.38 hrs (0.33 cfs 0.117 af)

Inflow Area = 0.796 ac, 34.55% Impervious, Inflow Depth = 4.44" for 100-Year event
Inflow = 6.37 cfs @ 12.11 hrs, Volume= 0.294 af
Outflow = 5.67 cfs @ 12.12 hrs, Volume= 0.294 af, Atten= 11%, Lag= 1.1 min
Discarded = 0.02 cfs @ 12.12 hrs, Volume= 0.044 af
Primary = 5.65 cfs @ 12.12 hrs, Volume= 0.250 af
Routed to Reach 1R : Minnehaha Creek Proposed

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 815.22' @ 12.12 hrs Surf.Area= 1,522 sf Storage= 2,007 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 117.6 min (912.0 - 794.4)

Volume	Invert	Avail.Storage	Storage Description
#1	813.50'	2,462 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
813.50	846	0	0	846
814.00	1,036	470	470	1,044
815.00	1,417	1,222	1,691	1,444
815.50	1,668	770	2,462	1,705

Device	Routing	Invert	Outlet Devices
#1	Discarded	813.50'	**0.450 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 810.50'
#2	Primary	814.50'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.02 cfs @ 12.12 hrs HW=815.21' (Free Discharge)
↰**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=5.63 cfs @ 12.12 hrs HW=815.21' TW=0.00' (Dynamic Tailwater)
↰**2=Sharp-Crested Rectangular Weir** (Weir Controls 5.63 cfs @ 2.76 fps)

Summary for Pond A2: CB A2

[90] Warning: Qout>Qin may require smaller dt or Finer Routing
[80] Warning: Exceeded Pond A3 by 0.01' @ 25.20 hrs (0.01 cfs 0.001 af)

Inflow Area = 0.580 ac, 40.89% Impervious, Inflow Depth = 4.71" for 100-Year event
Inflow = 4.95 cfs @ 12.10 hrs, Volume= 0.228 af
Outflow = 4.98 cfs @ 12.11 hrs, Volume= 0.228 af, Atten= 0%, Lag= 0.1 min
Primary = 4.98 cfs @ 12.11 hrs, Volume= 0.228 af
Routed to Pond 1P : Inf Basin 1P
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 1P : Inf Basin 1P

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 817.42' @ 12.11 hrs Surf.Area= 2 sf Storage= 6 cf

Plug-Flow detention time= 0.1 min calculated for 0.228 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (790.4 - 790.2)

Volume	Invert	Avail.Storage	Storage Description
#1	819.35'	456 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	813.83'	10 cf	**1.50'D x 5.52'H Vertical Cone/Cylinder**
		466 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.35	4	0	0
820.00	1,400	456	456

Device	Routing	Invert	Outlet Devices
#1	Primary	813.83'	**12.0" Round Culvert** L= 66.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 813.83' / 813.50' S= 0.0050 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	819.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 Width (feet) 0.00 30.00

Primary OutFlow Max=4.90 cfs @ 12.11 hrs HW=817.35' TW=815.19' (Dynamic Tailwater)
↰**1=Culvert** (Outlet Controls 4.90 cfs @ 6.24 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=813.83' TW=813.50' (Dynamic Tailwater)
↰**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond A3: CB A3

[80] Warning: Exceeded Pond A4 by 0.06' @ 12.20 hrs (0.48 cfs 0.001 af)

```
Inflow Area =        0.239 ac,  56.20% Impervious,  Inflow Depth =   5.33"    for  100-Year event
Inflow      =        2.49 cfs @   12.10 hrs,  Volume=          0.106 af
Outflow     =        2.49 cfs @   12.10 hrs,  Volume=          0.106 af,  Atten= 0%,  Lag= 0.1 min
Primary     =        2.49 cfs @   12.10 hrs,  Volume=          0.106 af
    Routed to Pond A2 : CB A2
Secondary =          0.00 cfs @    0.00 hrs,  Volume=          0.000 af
    Routed to Pond A2 : CB A2
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 818.23' @ 12.10 hrs Surf.Area= 2 sf Storage= 7 cf

Plug-Flow detention time= 0.1 min calculated for 0.106 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (781.1 - 781.0)

Volume	Invert	Avail.Storage	Storage Description
#1	819.00'	502 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.35'	8 cf	**1.50'D x 4.65'H Vertical Cone/Cylinder**
		510 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.00	4	0	0
820.00	1,000	502	502

Device	Routing	Invert	Outlet Devices
#1	Primary	814.35'	**10.0" Round Culvert** L= 28.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.35' / 814.10' S= 0.0089 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Secondary	818.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 Width (feet) 0.00 58.00

Primary OutFlow Max=2.39 cfs @ 12.10 hrs HW=818.17' TW=817.34' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 2.39 cfs @ 4.38 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=814.35' TW=813.83' (Dynamic Tailwater)
└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond A4: CB A4

[90] Warning: Qout>Qin may require smaller dt or Finer Routing
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=8)

Inflow Area = 0.201 ac, 59.66% Impervious, Inflow Depth = 5.50" for 100-Year event
Inflow = 2.22 cfs @ 12.10 hrs, Volume= 0.092 af
Outflow = 2.27 cfs @ 12.10 hrs, Volume= 0.092 af, Atten= 0%, Lag= 0.0 min
Primary = 2.15 cfs @ 12.10 hrs, Volume= 0.092 af
Routed to Pond A3 : CB A3
Secondary = 0.21 cfs @ 12.09 hrs, Volume= 0.000 af
Routed to Reach 1R : Minnehaha Creek Proposed

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 818.59' @ 12.09 hrs Surf.Area= 17 sf Storage= 8 cf

Plug-Flow detention time= 0.3 min calculated for 0.092 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (778.7 - 778.7)

Volume	Invert	Avail.Storage	Storage Description
#1	818.37'	171 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.88'	6 cf	**1.50'D x 3.49'H Vertical Cone/Cylinder**
		177 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
818.37	4	0	0
820.00	87	74	74
820.50	300	97	171

Device	Routing	Invert	Outlet Devices
#1	Primary	814.88'	**10.0" Round Culvert** L= 67.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.88' / 814.35' S= 0.0079 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Secondary	818.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 Width (feet) 0.00 37.00

Primary OutFlow Max=1.52 cfs @ 12.10 hrs HW=818.57' TW=818.20' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.52 cfs @ 2.78 fps)

Secondary OutFlow Max=0.21 cfs @ 12.09 hrs HW=818.59' TW=0.00' (Dynamic Tailwater)
└─**2=Custom Weir/Orifice** (Weir Controls 0.21 cfs @ 0.77 fps)

Summary for Pond B2: CB B2

Inflow Area = 0.260 ac, 32.67% Impervious, Inflow Depth = 4.38" for 100-Year event
Inflow = 2.27 cfs @ 12.17 hrs, Volume= 0.095 af
Outflow = 2.27 cfs @ 12.17 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min
Primary = 2.27 cfs @ 12.17 hrs, Volume= 0.095 af
Routed to Pond A2 : CB A2
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond A3 : CB A3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 818.63' @ 12.10 hrs Surf.Area= 2 sf Storage= 7 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.1 min (797.0 - 796.9)

Volume	Invert	Avail.Storage	Storage Description
#1	819.52'	208 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
#2	814.56'	9 cf	**1.50'D x 4.96'H Vertical Cone/Cylinder**
		217 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
819.52	4	0	0
820.00	50	13	13
820.60	600	195	208

Device	Routing	Invert	Outlet Devices
#1	Primary	814.56'	**8.0" Round Culvert** L= 51.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 814.56' / 814.10' S= 0.0090 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf
#2	Secondary	819.70'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.30 Width (feet) 0.00 28.00

Primary OutFlow Max=2.24 cfs @ 12.17 hrs HW=818.23' TW=816.23' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 2.24 cfs @ 6.42 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=814.56' TW=814.35' (Dynamic Tailwater)
└─**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Hydrograph for Pond 1P: Inf Basin 1P

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	813.50	0.00	0.00	0.00
2.00	0.00	0	813.50	0.00	0.00	0.00
4.00	0.00	0	813.50	0.00	0.00	0.00
6.00	0.00	0	813.50	0.00	0.00	0.00
8.00	0.01	0	813.50	0.01	0.01	0.00
10.00	0.04	57	813.57	0.01	0.01	0.00
12.00	**3.32**	**1,589**	**814.93**	**2.68**	**0.02**	**2.66**
14.00	**0.20**	**1,119**	**814.57**	**0.20**	**0.02**	**0.18**
16.00	0.10	1,084	814.54	0.10	0.02	0.08
18.00	0.08	1,075	814.53	0.08	0.02	0.06
20.00	0.06	1,065	814.53	0.06	0.02	0.04
22.00	0.04	1,053	814.52	0.04	0.02	0.02
24.00	0.01	1,036	814.50	0.02	0.02	0.00
26.00	0.00	924	814.41	0.02	0.02	0.00
28.00	0.00	814	814.32	0.01	0.01	0.00
30.00	0.00	710	814.22	0.01	0.01	0.00
32.00	0.00	610	814.13	0.01	0.01	0.00
34.00	0.00	516	814.04	0.01	0.01	0.00
36.00	0.00	426	813.96	0.01	0.01	0.00
38.00	0.00	341	813.87	0.01	0.01	0.00
40.00	0.00	260	813.79	0.01	0.01	0.00
42.00	0.00	184	813.71	0.01	0.01	0.00
44.00	0.00	112	813.63	0.01	0.01	0.00
46.00	0.00	44	813.55	0.01	0.01	0.00
48.00	0.00	0	813.50	0.00	0.00	0.00
50.00	0.00	0	813.50	0.00	0.00	0.00
52.00	0.00	0	813.50	0.00	0.00	0.00
54.00	0.00	0	813.50	0.00	0.00	0.00
56.00	0.00	0	813.50	0.00	0.00	0.00
58.00	0.00	0	813.50	0.00	0.00	0.00
60.00	0.00	0	813.50	0.00	0.00	0.00
62.00	0.00	0	813.50	0.00	0.00	0.00
64.00	0.00	0	813.50	0.00	0.00	0.00
66.00	0.00	0	813.50	0.00	0.00	0.00
68.00	0.00	0	813.50	0.00	0.00	0.00
70.00	0.00	0	813.50	0.00	0.00	0.00
72.00	0.00	0	813.50	0.00	0.00	0.00
74.00	0.00	0	813.50	0.00	0.00	0.00
76.00	0.00	0	813.50	0.00	0.00	0.00
78.00	0.00	0	813.50	0.00	0.00	0.00
80.00	0.00	0	813.50	0.00	0.00	0.00
82.00	0.00	0	813.50	0.00	0.00	0.00
84.00	0.00	0	813.50	0.00	0.00	0.00
86.00	0.00	0	813.50	0.00	0.00	0.00
88.00	0.00	0	813.50	0.00	0.00	0.00
90.00	0.00	0	813.50	0.00	0.00	0.00
92.00	0.00	0	813.50	0.00	0.00	0.00
94.00	0.00	0	813.50	0.00	0.00	0.00
96.00	0.00	0	813.50	0.00	0.00	0.00

Stage-Area-Storage for Pond 1P: Inf Basin 1P

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)
813.50	816	816	0
813.55	835	836	41
813.60	855	856	84
813.65	874	876	127
813.70	894	897	171
813.75	914	918	216
813.80	935	939	262
813.85	955	960	310
813.90	976	981	358
813.95	997	1,003	407
814.00	1,018	1,025	458
814.05	1,039	1,047	509
814.10	1,061	1,069	561
814.15	1,082	1,092	615
814.20	1,104	1,114	670
814.25	1,126	1,137	725
814.30	1,149	1,160	782
814.35	1,171	1,183	840
814.40	1,194	1,207	899
814.45	1,217	1,231	960
814.50	1,240	1,255	1,021
814.55	1,262	1,277	1,084
814.60	1,284	1,300	1,147
814.65	1,306	1,323	1,212
814.70	1,328	1,347	1,278
814.75	1,351	1,370	1,345
814.80	1,373	1,394	1,413
814.85	1,396	1,417	1,482
814.90	1,419	1,441	1,553
814.95	1,443	1,466	1,624
815.00	1,466	1,490	1,697
815.05	1,490	1,515	1,771
815.10	1,513	1,539	1,846
815.15	1,537	1,564	1,922
815.20	1,561	1,589	2,000
815.25	1,586	1,615	2,078
815.30	1,610	1,640	2,158
815.35	1,635	1,666	2,239
815.40	1,660	1,692	2,322
815.45	1,685	1,718	2,405
815.50	**1,710**	**1,744**	**2,490**

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	MPR25011-Minnehaha Bike Skills Park
User Name / Company Name:	Elan Design Lab
Date:	03/23/2026
Project Description:	An old tennis court is being replaced with a bike skills park. This work will reduce impervious surfaces onsite by 8,034 square feet, and introduce 10,876 square feet of new impervious surface. The City of Minneapolis requres 70% removal of TSS from a 1.25" storm event.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.25
Site's Zip Code:	55406
Annual Rainfall (inches):	31.7
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		0.573			0.573
			Impervious Area (acres)		0.288
			Total Area (acres)		0.861

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		0.524			0.524
			Impervious Area (acres)		0.272
			Total Area (acres)		0.796

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	1307	ft3
Volume removed by BMPs towards performance goal:	1025	ft^3
Percent volume removed towards performance goal	**78**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	0.9229	acre-ft
Annual runoff volume removed by BMPs:	0.7443	acre-ft
Percent annual runoff volume removed:	**81**	**%**
Post development annual particulate P load:	0.4142	lbs
Annual particulate P removed by BMPs:	0.334	lbs
Post development annual dissolved P load:	0.339	lbs
Annual dissolved P removed by BMPs:	0.273	lbs
Total P removed by BMPs	0.607	lbs
Percent annual total phosphorus removed:	**81**	**%**
Post development annual TSS load:	136.8	lbs
Annual TSS removed by BMPs:	110.3	lbs
Percent annual TSS removed:	**81**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
Infiltration Basin P1	1025	1234	1025	209	83

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 (%)
Infiltration Basin P1	0.8635	0	0.7443	0.1192	86

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Infiltration Basin P1	0.3875	0	0.334	0.0535	86

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Infiltration Basin P1	0.3171	0	0.2733	0.0438	86

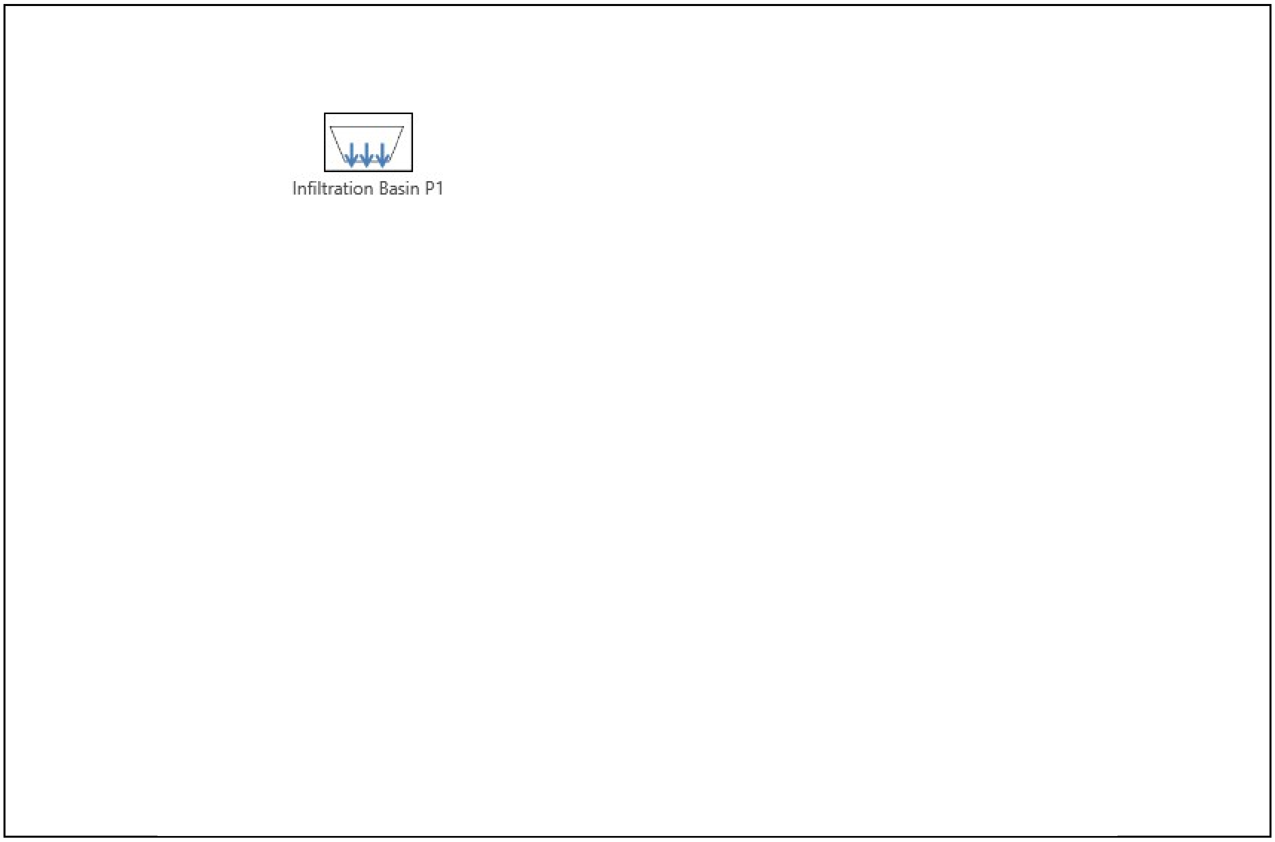
Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Infiltration Basin P1	0.7046	0	0.6073	0.0973	86

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Infiltration Basin P1	128.01	0	110.34	17.67	86

BMP Schematic


Infiltration Basin P1

Élan DESIGN LAB

310 4th Ave S
Suite 1006
Minneapolis, MN 55415
(612) 260-7980
www.elanlab.com

Project: MPR25011

Storm Sewer Design Calculations

Project No.: MPR25011
Location: Minneapolis, MN
Date: 12/09/25

Storm Frequency: 10 years
Calculations By: KQH

Printed:
12/16/25
5:14 PM

Segment		A - Trib. Areas	C - Coef.	Tc - Time of Conc.			- Intensi	Q - Rate		Pipe								Upstream Structure						Downstream Structure					Notes
From	To	CB Ac.	CB Indiv.	CB Min.	Pipe Min.	Total Min.	CB In/Hr	CB CFS	Pipe CFS	Len. Ft.	Dia. In.	Grade %	Mat'l.	Man's. n	Vel. Ft/S	Cap. CFS	Excess Cap.	STRUCT	RIM ELEV	INVERT	BUILD	COVER	TYPE	Structure	Rim Elev	Inlet	Build	Cover	
A4	A3	0.20	0.69	5.0	0.2	5.2	7.55	1.0	1.0	67	10	0.80	PVC	0.010	4.7	2.5	1.5	A4	818.37	814.75	3.62	2.79	CB	A3	819.00	814.22	4.78	3.95	
A3	A2	0.04	0.55	5.2	0.1	5.3	7.55	0.2	1.2	28	10	0.90	PVC	0.010	5.0	2.7	1.5	A3	819.00	814.22	4.78	3.95	CB	A2	819.35	813.96	5.39	4.55	
A2	A1	0.08	0.44	5.3	0.3	5.7	7.55	0.3	2.4	66	12	0.50	RCP	0.013	3.2	2.5	0.1	A2	819.35	813.83	5.52	4.52	CB	A1	-	813.50	-	-	
B3	B2	0.20	0.52	5.0	0.1	5.1	7.55	0.8	0.8	32	8	0.80	PVC	0.010	4.0	1.4	0.6	B3	818.72	814.81	3.91	3.24	CB	B2	819.52	814.56	4.96	4.30	
B2	A2	0.05	0.44	5.1	0.2	5.3	7.55	0.2	1.0	51	8	0.90	PVC	0.010	4.3	1.5	0.5	B2	819.52	814.56	4.96	4.30	CB	A2	819.35	814.10	5.25	4.59	

REPORT OF GEOTECHNICAL EXPLORATION

Minnehaha Creek Park Improvements
3301 47th Street East
Minneapolis, Minnesota 55406

AET Project No. P-0040246

Date: April 14, 2025

Prepared for:
Minneapolis Park and Recreation Board
2117 West River Road
Minneapolis, MN 55411

Geotechnical • Materials
Forensic • Environmental
Building Technology
Petrography/Chemistry

American Engineering Testing
550 Cleveland Avenue North
St. Paul, MN 55114-1804
TeamAET.com • 800.972.6364

April 14, 2025

Tom Johnson – Owner Representative
Minneapolis Park and Recreation Board
2117 West River Road
Minneapolis, MN 55411

RE: Report of Geotechnical Exploration
Minnehaha Creek Park Improvements
3301 47th Street East
Minneapolis, Minnesota 55406
AET Report No. P-0040246

Dear Mr. Johnson:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for your Minnehaha Creek Park Improvements project in Minneapolis, Minnesota. These services were performed according to our proposal to you dated January 24, 2025.

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

Sincerely,
American Engineering Testing, Inc.

Khada Dhungana, EIT
Engineer I
kdhungana@teamAET.com
Mobile: (651) 442-1357

SIGNATURE PAGE

Prepared for:	Prepared by:
Minneapolis Park and Recreation Board 2117 West River Road Minneapolis, Minnesota 55411	American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, Minnesota 55114 (651) 659-9001/www.teamAET.com

Attn: Tom Johnson – Owner Representative
tjohnson@minneapolisparks.org

Authored by:	Reviewed by:
	Thomas Evans
Khada Dhungana, EIT Engineer I kdhungana@teamaet.com (651) 442-1357	Thomas Evans, PE (MN) Senior Engineer tevans@teamAET.com (701) 690-9732

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.

Signature: Thomas Evans
Typed or Printed Name: Thomas Evans
Date: 4/14/2025 License Number: 55092

TABLE OF CONTENTS

Page
1.0 INTRODUCTION 1
2.0 SCOPE OF SERVICES 1
3.0 PROJECT INFORMATION 1
4.0 SUBSURFACE EXPLORATION AND TESTING 2
  4.1 Field Exploration Program 2
  4.2 Laboratory Testing 2
5.0 SITE CONDITIONS 2
  5.1 Surface Observations 2
  5.2 Subsurface Soils/Geology 2
  5.3 Groundwater 3
  5.4 Subgrade Properties 3
6.0 BIKE RAMPS RECOMMENDATIONS 3
  6.1 Discussion 3
  6.2 Excavation 4
  6.3 Fill Placement and Compaction 5
  6.4 Foundations 6
7.0 PAVEMENT RECOMMENDATIONS 6
  7.1 Definitions 6
  7.2 Removals and Excavation 7
  7.3 Subgrade Preparation 7
  7.4 Fill and Compaction 8
  7.5 Subgrade Stability 8
  7.6 Aggregate Base 8
  7.7 Trail Pavement Designs 9
  7.8 Bituminous Mixes 9
  7.9 Bituminous Pavement Comments 10
  7.10 Gravel Section Design 10
8.0 CONSTRUCTION CONSIDERATIONS 10
  8.1 Potential Difficulties 10
  8.2 Excavation Backsloping 11
  8.3 Observation and Testing 11
9.0 ASTM STANDARDS 11
10.0 LIMITATIONS 11

TABLE OF CONTENTS - CONTINUED

APPENDIX A – Geotechnical Field Exploration and Testing
- Boring Log Notes
- Unified Soil Classification System
- Boring Location Map
- Subsurface Boring Logs
- Atterberg Limits Results

APPENDIX B – Geotechnical Report Limitations and Guidelines for Use

1.0 INTRODUCTION

We understand Minneapolis Park and Recreation Board is proposing improvements at Minnehaha Creek Park at 3301 47th Street East in Minneapolis, Minnesota. To assist planning and design, you have authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal to you dated January 24, 2025. The authorized scope consists of the following:

- Perform 2 Standard Penetration Test (SPT) borings to a depth of 11 feet the locations you have requested.
- Perform review and classification of samples and soil laboratory testing.
- Geotechnical engineering review based on the data and preparation of this report.

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

3.0 PROJECT INFORMATION

We understand Minneapolis Park and Recreation Board is proposing improvements at Minnehaha Creek Park at 3301 47th Street East in Minneapolis, Minnesota. Improvements include the construction of a new bicycle park. The proposed construction consists of gravel/soft surfaced trails, paved trails, and wood and metal ramps. These ramp features will be supported with shallow depth footing/pad placed about 12 inches below grade. Additionally, bike ramps weigh 300 to 2500 pounds with a minimum of two footings per structure.

A grading plan for the proposed Bike Skills Park has not been provided. However, we assume cut and fill depths at these locations will be within three feet of existing grade.

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

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program conducted for the project consisted of two standard penetration test borings performed on March 18, 2025. Minneapolis Park and Recreation Board determined the number and locations of the soil borings, while AET determined the depths

The approximate boring locations are shown on the Boring Location Map in Appendix A. The borings were located in the field by AET personnel using GPS equipment. Coordinates of the boring locations were determined by AET personnel using GPS equipment with submeter accuracy. Surface elevations were estimated using MnTOPO (http://arcgis.dnr.state.mn.us/maps/mntopo/).

The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic origins, and moisture condition. A density description or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

4.2 Laboratory Testing

The laboratory test program included visual/manual classification of the soil samples, water content tests, and Atterberg Limits test. The lab test results are shown on the subsurface boring logs adjacent to the samples upon which they were performed.

5.0 SITE CONDITIONS

5.1 Surface Observations

The development is proposed at Minnehaha Creek Park at 3301 47th Street East in Minneapolis, Minnesota. The site appears to have been previously graded. The proposed construction site is surrounded by residential properties, and the south side is adjacent to the Minnehaha Creek. The elevation at the boring locations ranges from 819 feet to 821 feet.

5.2 Subsurface Soils/Geology

Based on our borings, the site geology consists of fill soils to depths of up to 9.5 feet underlain by coarse alluvium that extended to the final drilling depths of 11.5 feet.

The fill soils consist of sandy lean clay, silty sand, lean clay, sand with silt, and clayey sand with variable gravel content. The coarse alluvial soils consist of loose to medium dense sand and sand with silt.

5.3 Groundwater

The borings were observed for the presence of groundwater during drilling and upon reaching the planned termination depth. At the time of our exploration, groundwater was observed at boring B-2 at a depth of 8.5 feet below existing grade. Water levels can take hours, days, or longer to stabilize within the surficial silty and clayey soils encountered at this site, which would require the installation and monitoring of groundwater monitoring wells. However, the borings terminated within relatively free-draining sandy soils where groundwater stabilizes rather quickly. Therefore, the measured groundwater levels or lack thereof are likely indicative of the groundwater levels at the time of the exploration.

Groundwater levels at other times and locations may vary from the groundwater levels observed at the time of our exploration. Additionally, groundwater levels will fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors.

5.4 Subgrade Properties

5.4.1 Fill

The fill materials generally consisted of sandy lean clay, silty sand, lean clay, sand with silt, and clayey sand. We judge these soils to have moderately low strength and stability under the assumed structure and pavement loads, slow to fast draining characteristics, and low to high frost susceptibility.

5.4.2 Coarse Alluvium

We judge the sand and sand with silt coarse alluvial soils have moderate strength and stability, fast draining characteristics, and low frost susceptibility.

6.0 BIKE RAMPS RECOMMENDATIONS

6.1 Discussion

Undocumented fill and possible fill soils were encountered to depths of up to 9.5 feet below grade. Some level of observation and testing may have been done during the placement of the fill, but we are not aware of any records. If any records are available, please contact us to review our recommendations. The N-values of the fill soils ranged from 4 to 11, indicating variations in strength and compressibility. Our general recommendation for structural foundations is to excavate fill soils to expose the naturally deposited materials. However, due to the lightly-loaded nature of these structures, it is our opinion that the proposed bike ramps may be supported by the existing fill soils if the Owner is willing to accept some risk that greater than normal amounts of settlement could occur after construction. These risks are due to the potential that zones of looser soils or construction debris exist between boring locations, and the potential that zones of compressible organic soils may exist within or below the fill soils. Soil zones such as these may lead to differential settlements that exceed normally accepted amounts of 1-inch total and ½-inch differential. These risks can be reduced by careful observation of the soils during excavation, by excavating random test holes, and by performing numerous hand auger borings and hand cone penetrometer readings in the excavation bottoms. If the owner does not want to accept the risk, we recommend you excavate the fill soils within the proposed ramp foundation areas, thereby exposing the natural alluvial soils.

Because the foundations will be placed above the frost depth, heaving of the underlying soils is likely unless proper site preparation is performed. Fine grained soils generally heave about ¼" to ⅜" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs. We assume this is acceptable based on the type of structure.

6.2 Excavation

To prepare the proposed ramp foundations for support, we recommended removing all surficial topsoil and fill soils with organics, thereby exposing the silty sand and/or sand fill soils. This would result in excavation depths at the boring locations as shown in Table 6.2-1.

Table 6.2-1 – Recommended Excavation Depths – Option 1

Boring Number	Surface Elevation (ft)	Excavation Depth (ft, below existing grade)	Approximate Excavation Elevation (ft) ^{A}
B-1	821	1	820
B-2	819	4½	814½

Notes: A - Rounded to the nearest ½ foot.

As stated earlier, if the owner does not want to accept the added risk of settlement by supporting the proposed ramps on the existing fill soils, we recommend the fill soils be removed within the proposed ramps areas. This would result in excavation depths at the boring locations as shown in Table 6.2-2.

Table 6.2-2 – Recommended Excavation Depths – Option 2

Boring Number	Surface Elevation (ft)	Excavation Depth (ft, below existing grade)	Approximate Excavation Elevation (ft) ^{A}
B-1	821	9½	811½
B-2	819	4½	814½

Notes: A - Rounded to the nearest ½ foot.

Following excavation and where sandy soils are encountered, we recommend the soils in the excavation bottoms be surface compacted with a large, self-propelled vibratory roller. The roller should make at least 5 passes over the entire excavation bottom. This process should then be repeated in the perpendicular direction.

The estimated excavation depths in Tables 6.2-1 and 6.2-2 are based on the soil conditions at the specific boring locations. These depths will need to be evaluated during construction. Because conditions will vary away from the boring locations, we recommend that AET geotechnical personnel observe and evaluate the competency of the soils in the excavation bottom prior to new fill or footing placement. If soft or wet soils are encountered at the base of the excavation, they should be subcut and replaced or scarified and recompacted.

If the excavation extends below foundation grade, the excavation bottom must be oversized laterally beyond the planned outside edges of the foundations to properly support the lateral loads exerted by that foundation. This excavation oversizing should equal the vertical depth of fill needed to re-attain foundation grade at that location (i.e., 1H:1V oversizing).

Groundwater was encountered at the time of our exploration at boring B-2 at elevation of 810½ feet. Therefore, it is unlikely groundwater is encountered within the recommended excavations. If groundwater is observed in the required excavations, it should be removed. Based on the relatively high permeability of many of the site soils, more intricate dewatering methods, such as well points, may be needed. Dewatering means and methods are the responsibility of the contractor.

6.3 Fill Placement and Compaction

The existing non-organic, debris-free soils are suitable for reuse as structural fill below the proposed ramps. Fill placed to attain grade for foundation support should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 98% of the standard maximum dry unit weight per ASTM: D698 (Standard Proctor test). Fill should be placed within 2% of optimum moisture by standard Proctor.

If additional fill is needed, it should consist of soils substantially matching the existing soils in moisture content and composition: sand, sand with silt, and silty sand. If the contractor proposes a different type of fill, a sample should be submitted to the Geotechnical Engineer for approval.

All fill should be free of debris, rubble, organics, and other unsuitable materials. All fill soils should be compacted with equipment which will densify the entire lift of fill. Fill should not be placed over frozen soils, and frozen soils should not be used as fill.

If earthwork operations take place during freezing weather, all frozen soils, snow, and ice should be stripped from the areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement, or compaction. We refer you to the attached sheet entitled “Freezing Weather Effects on Building Construction” for additional information.

6.4 Foundations

It is our opinion that the proposed bike ramps structures can be supported on shallow depth footings/pads on the fill or recompacted fill soils and/or the naturally-deposited coarse alluvium.

Based on the conditions encountered, it is our opinion the proposed ramp foundations can be designed based on a net maximum allowable soil bearing pressure of up to 750 psf bearing on the existing fill soils. Additionally, it is our opinion the proposed ramp can be designed on a net maximum allowable soil bearing pressure of up to 3,000 psf if the existing fill soils are completely excavated and the proposed structures are supported on the recompacted fill. It is our judgment this design pressure will have a factor of safety of at least 3 with respect to the ultimate bearing capacity. We estimate that total settlements under these loadings should not exceed 1-inch and differential settlements over a 30-foot distance should not exceed ½-inch if the existing fill soils are excavated. If these fill soils are left in place, total settlements of up to 2 inches are possible.

The bottoms of all foundation excavations should be free of water and loose soil prior to placing structural fill or concrete. Structural fill should be placed soon after excavating to reduce bearing soil disturbance, and concrete should be placed soon after excavating or completion of the structural fill placement. If the materials at bearing level become excessively dry, disturbed, saturated, or frozen, the affected material should be removed and replaced prior to placing concrete.

7.0 PAVEMENT RECOMMENDATIONS

7.1 Definitions

This report references the 2020 MnDOT Standard Specifications for Construction (MnDOT Spec.). The ensuing sections reference the following words, which are defined below:

Grading grade is the bottom of the aggregate base layer.

Granular Material should meet the requirements of MnDOT Specification 3149, including Table 3149.2-1, which requires 0% to 20% for the ratio of the percent passing the No. 200 sieve/1-inch sieve.

Select Granular Material should meet the requirements of MnDOT Specification 3149, including Table 3149.2-1, which requires 0% and 12% for the ratio of the percent passing the No. 200 sieve/1-inch sieve.

Select Grading Material is mineral soil, excluding organic soils (>5% organic material by weight), silt (soil containing 80 percent or more silt-sized particles), and marl (soil consisting of clay and lime or unconsolidated sedimentary rock).

Top of Subgrade is the surface of material immediately beneath a granular material layer meeting MnDOT Spec. 3149, which is usually placed as a sand subbase layer. If there is no granular material layer, then the top of subgrade is the grading grade.

7.2 Removals and Excavation

We recommend the excavation of all surficial topsoil and fill soils with organics. This would result in excavation depths at the boring locations as shown in Table 7.2.

Table 7.2 – Recommended Excavation Depths

Boring Number	Surface Elevation (ft)	Excavation Depth (ft, below existing grade)	Approximate Excavation Elevation (ft) ^{A}
B-1	821	1	820
B-2	819	4½	814½

Notes: A - Rounded to the nearest ½ foot.

7.3 Subgrade Preparation

The soils exposed at the top of subgrade should be prepared per MnDOT Spec. 2112, Subgrade Preparation. This includes scarification, moisture conditioning, and compaction of the top 6 inches of the subgrade.

If subgrade preparation encounters unstable soils or soils which do not meet the requirements for Select Grading Material, we recommend removing these unsuitable materials and replacing them with Select Grading Material. Unstable soils typically have a water content exceeding the standard optimum water content as defined in ASTM D698 (Standard Proctor test). We caution that instability of soils presents beneath the soils being reworked and compacted may limit the ability to compact the upper soils; therefore, greater depths of subcutting and stability improvement may be needed.

7.4 Fill and Compaction

All new fill and reworked soils for pavement support should be placed and compacted per MnDOT Spec. 2106, including the moisture content and compaction requirements shown in MnDOT Tables 2106.3-1 and 2106.3-4, respectively. In ASTM terms, this specification requires soils placed within 3 feet of grading grade be compacted to a minimum of 100% of the standard maximum dry unit weight defined in ASTM D 698 (Standard Proctor test). A reduced minimum compaction level of 95% of the standard maximum dry unit weight can be used below the critical subgrade zone for non-granular materials (those which do not meet MnDOT Spec 3149.2B).

Fill soils used to re-attain pavement subgrade may consist of on-site, non-organic, debris-free soils, and they should be moisture conditioned for compaction. If additional fill is needed, it should consist of soils substantially matching the existing soils in moisture content and composition: sand, sand with silt, and silty sand.

7.5 Subgrade Stability

The final subgrade should have proper stability within the critical subgrade zone. Where clayey soils are exposed, stability should be evaluated using the test roll procedure. Where unstable soils are found using the test roll process, these soils should be improved by means of scarification, drying, and recompaction; or by subcutting and replacement. If highly variable conditions are present (either stability-wise or soil type), a compaction subcut should be performed to provide a more consistent subgrade condition. We recommend the final soil remaining in place be capable of passing a test roll prior to placing the aggregate base.

Where clayey soils are exposed, stability should be evaluated using the test roll procedure. Where unstable soils are found using the test roll process, these soils should be improved by means of scarification, drying, and recompaction; or by subcutting and replacement. If highly variable conditions are present (either stability-wise or soil type), a compaction subcut should be performed to provide a more consistent subgrade condition. We recommend the final soil remaining in place be capable of passing a test roll prior to placing the aggregate base.

7.6 Aggregate Base

Aggregate base placed for pavement support should meet the gradation and quality requirements for Class 5 or 6 per MnDOT Spec. 3138. Aggregate base placement and compaction should be performed according to MnDOT Spec. 2211. All aggregate base material (including existing, imported, or reclaimed) should be tested for compaction using the Penetration Index Method per the requirements of MnDOT Table 2211.3-3.

After the aggregate base has been placed, compacted, and tested, it is the contractor's responsibility to maintain the base in a suitable condition for paving. If the subgrade or aggregate base materials become saturated or contaminated by clayey or silty soils, after testing, it may be rendered unsuitable for paving due to softness and pumping. This action would require remedial action before pavement can be placed.

7.7 Trail Pavement Designs

We assume the trails will be used by pedestrian and bicycle traffic, as well as the occasional maintenance or snow removal vehicles. Table 7.7 below presents our recommended bituminous trail section.

In our opinion, the limiting subgrade soils encountered at the site is lean clay. We estimate these soils exhibit an R-value of 10. Our R-value estimates are based on Table 5-3.3(a) and 5-3.3(b) within the *MnDOT Pavement Manual (2007)* and on our experience. R-value laboratory testing was not performed.

Table 7.7 – Bituminous Pavement Thickness Design

Layer	MnDOT Material	Thickness
Bituminous Wear-Upper	SPWEA230C (PG 58H-34)	1.5"
Bituminous Wear-Lower	SPWEA230C (PG 58H-34)	1.5"
Aggregate Base	Class 5 or 6, 3138	9.0"
Total Frost-Free Thickness		**12"**

Please note that the pavement thickness designs recommended above are minimum thicknesses, not average thicknesses. They should be noted as such on the project plans and specifications.

7.8 Bituminous Mixes

The use of recycled asphalt pavement (RAP) in the bituminous mix is a cost saving measure that is often suggested; however, there will be a higher probability of pavement thermal cracking when RAP is used. We recommend a maximum of 10% RAP in the upper wear course and a maximum of 20% RAP in the lower courses to reduce thermal cracking. If bituminous mixes are utilized other than those recommended, a lower percentage of RAP may be needed.

The bituminous mixtures should meet the most current MnDOT Spec. 2360 (Plant-Mixed Asphalt Pavement) requirements. Compaction of all bituminous mixtures should be by the Maximum Density Method per MnDOT Spec. 2360.3D.1.

7.9 Bituminous Pavement Comments

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

7.10 Gravel Section Design

A summary of our recommended gravel-surfaced pavement thickness design is presented in Table 7.10, based on our estimated subgrade R-value, a 20-year design life, and the assumed traffic information.

Table 7.10 – Gravel-surfaced Pavement Thickness Design

Pavement Course	MnDOT Material Type (Spec.)	Thickness
Aggregate Surfacing	Class 1, 3138	4"
Aggregate Base	Class 5 or 6, 3138	8"
	Total Frost-Free Thickness	**12"**

8.0 CONSTRUCTION CONSIDERATIONS

8.1 Potential Difficulties

8.1.1 Runoff Water in Excavation

Water can be expected to collect in the excavation bottom during times of inclement weather or snow melt. To allow observation of the excavation bottom, to reduce the potential for soil disturbance, and to facilitate filling operations, we recommend water be removed from within the excavation during construction.

8.1.2 Disturbance of Soils

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

8.1.3 Cobbles and Boulders

The fill and alluvial soils at this site can include cobbles and boulders. This may make excavating procedures somewhat more difficult than normal if they are encountered.

8.2 Excavation Backsloping

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

8.3 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

9.0 ASTM STANDARDS

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

10.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, express or implied, is intended. Important information regarding risk management and proper use of this report is given in Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use."

Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Boring Location Map
Subsurface Boring Logs
Atterberg Limits Results

Appendix A
Geotechnical Field Exploration and Testing
Report No. P-0040246

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling two standard penetration tests borings. The locations of the borings appear on the Boring Location Map, preceding the Subsurface Boring Logs in this appendix.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS)

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

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

A.2.3 Sampling Limitations

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

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

A.3 CLASSIFICATION METHODS

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

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

A.4 WATER LEVEL MEASUREMENTS

The groundwater level measurements are shown at the bottom of the boring logs. The following information appears under “Water Level Measurements” on the logs:

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

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

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

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

A.5.2 Atterberg Limits Tests

Conducted per AET Procedure 01-LAB-030, which is performed in general accordance with ASTM: D4318 and AASHTO: T89, T90.

A.6 TEST STANDARD LIMITATIONS

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

A.7 SAMPLE STORAGE

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

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
B,H,N:	Size of flush-joint casing
CA:	Crew Assistant (initials)
CAS:	Pipe casing, number indicates nominal diameter in inches
CC:	Crew Chief (initials)
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RD:	Rotary drilling with fluid and roller or drag bit
REC:	In split-spoon (see notes) and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
REV:	Revert drilling fluid
SS:	Standard split-spoon sampler (steel; 1-3/8” is inside diameter; 2” outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after “falling” through drilling fluid
WH:	Sampler advanced by static weight of drill rod and 140-pound hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
∇:	Estimated water level based solely on sample appearance

TEST SYMBOLS

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

STANDARD PENETRATION TEST NOTES

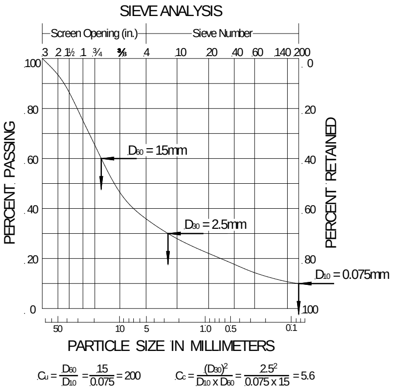
The standard penetration test consists of driving the sampler with a 140 pound hammer and counting the number of blows applied in each of three 6” increments of penetration. If the sampler is driven less than 18” (usually in highly resistant material), permitted in ASTM:D1586, the blows for each complete 6” increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

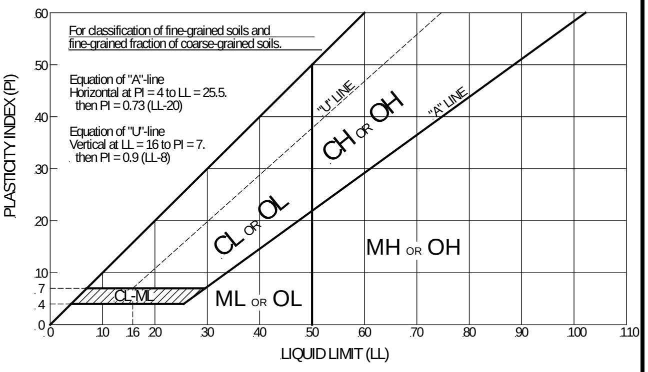
The length of sample recovered, as shown on the “REC” column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6” set (unless partial penetration defined in ASTM:D1586 is encountered) whereas the length of sample recovered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

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel[F.G.H]
			Fines classify as CL or CH	GC	Clayey gravel[F.G.H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand[G.H.I]
			Fines classify as CL or CH	SC	Clayey sand[G.H.I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above “A” line[J]	CL	Lean clay[K.L.M]
			$PI < 4$ or plots below “A” line[J]	ML	Silt[K.L.M]
		organic	$\frac{\text{Liquid limit–oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OL	Organic clay[K.L.M.N] Organic silt[K.L.M.O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above “A” line	CH	Fat clay[K.L.M]
			PI plots below “A” line	MH	Elastic silt[K.L.M]
		organic	$\frac{\text{Liquid limit–oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OH	Organic clay[K.L.M.P] Organic silt[K.L.M.Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]





Plasticity Chart

Notes

[A] Based on the material passing the 3-in (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

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

[F] If soil contains $\geq$15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains $\geq$15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot is hatched area, soil is a CL-ML silty clay.

[K] If soil contains 15 to 29% plus No. 200 add “with sand” or “with gravel”, whichever is predominant.

[L] If soil contains $\geq$30% plus No. 200, predominantly sand, add “sandy” to group name.

[M] If soil contains $\geq$30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] $PI \geq 4$ and plots on or above “A” line.

[O] $PI < 4$ or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.

[R] Fiber Content description shown below.

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

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

Gravel Percentages

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

Consistency of Plastic Soils

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

Relative Density of Non-Plastic Soils

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

Moisture/Frost Condition
(MC Column)

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

Layering Notes

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

Peat Description

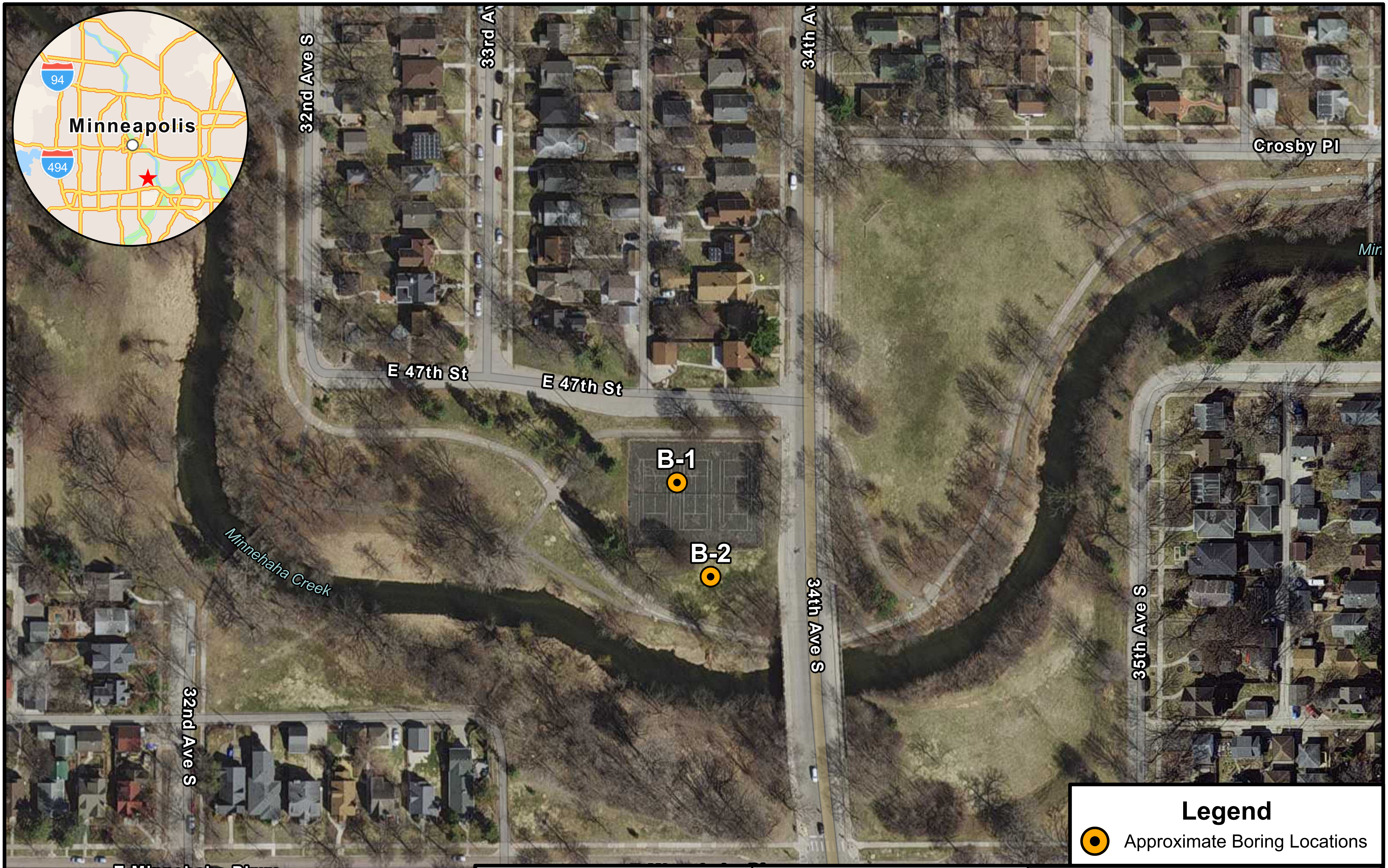
Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic Description (if no lab tests)

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

Root Inclusions

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



Legend

● Approximate Boring Locations

AMERICAN
ENGINEERING TESTING

Map Reference:
MnGeo 2023

Figure 1

Boring Location Map

Minnehaha Creek
Park Improvements
Minneapolis, MN

Date: 3/18/2025

AET Project No. P-0040246

AMERICAN
ENGINEERING TESTING

SUBSURFACE BORING LOG

AET JOB NO: **P-0040246**

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

PROJECT: **Minnehaha Creek Park Improvements; Minneapolis, MN**

SURFACE ELEVATION: **821**

LATITUDE: **44.917613**

LONGITUDE: **-93.223509**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
821.0	FILL, mostly sandy lean clay, trace roots, dark brown	FILL					25				
1	FILL, mostly silty sand with gravel, brown		5	M	SS	24					
819.0 1P BASIN BOTTOM 2	FILL, mostly lean clay, grayish brown										
3			9	M	SS	24	34		45	13	
4											
5	FILL, mostly silty sand, a little gravel, brown										
6			7	M	SS	24					
7	FILL, mostly sand with silt, brown										
8			11	M	SS	24					
9											
10	SAND WITH SILT, medium to fine grained, brown, moist, loose, laminations of clayey sand (SP-SM)	COARSE ALLUVIUM	6	M	SS	24					
11											
	END OF BORING										

DEPTH:	DRILLING METHOD
0-9½'	**3.25" HSA**

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
3/18/25	**10:30**	**11.5**	**9.5**	**11.5**		**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **3/18/25**

DR: **SD** LG: **JM** Rig: **1C**

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

AET_CORP W-LAT-LONG P-0040246 MINNEHAHA CREEK PARK IMPROVEMENTS.GPJ AET+CPT+WELL.GDT 4/3/25

SUBSURFACE BORING LOG

AET JOB NO: **P-0040246**　　LOG OF BORING NO. **B-2 (p. 1 of 1)**

PROJECT: **Minnehaha Creek Park Improvements; Minneapolis, MN**

SURFACE ELEVATION: **819**　　LATITUDE: **44.917324**　　LONGITUDE: **-93.223363**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
819.0 1 2	SLIGHTLY ORGANIC CLAYEY SAND, trace roots, dark brown, moist, soft, lens of slightly organic silty sand (SC) (possible fill)	TOPSOIL OR FILL	4	M	SS	6	33				
3 4	SILTY SAND WITH ORGANIC FINES, medium to fine grained, black, moist, loose, laminations of sandy lean clay (SM) (possible fill)	COARSE ALLUVIUM OR FILL	5	M	SS	24	18				
5 813.5 basin bottom 6	SAND, medium to fine grained, brown, moist, medium dense, laminations of clayey sand (SP)	COARSE ALLUVIUM	12	M	SS	24					
7 8 810.5 groundwater 9	SAND WITH SILT, medium to fine grained, brown, moist, loose (SP-SM)		5	M ▼	SS	24					
10 11	SAND, a little gravel, medium to fine grained, brown, waterbearing, loose (SP)		7	W	SS	24					
	END OF BORING										

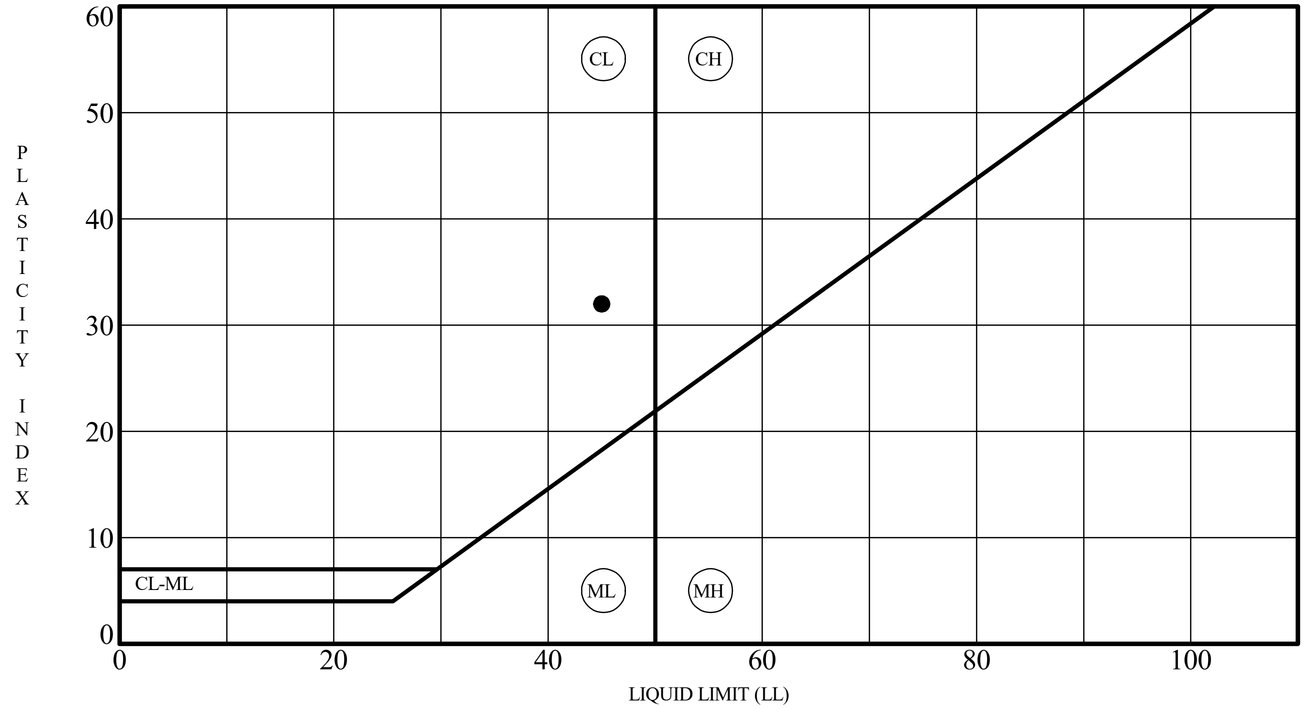
DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9½'	**3.25" HSA**							
		3/18/25	**9:31**	**11.5**	**9.5**	**9.4**		**8.5**
		3/18/25	**9:36**	**11.5**	**9.5**	**9.4**		**8.5**

BORING COMPLETED: **3/18/25**

DR: **SD**　LG: **JM**　Rig: **1C**

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

AET_CORP W-LAT-LONG P-0040246 MINNEHAHA CREEK PARK IMPROVEMENTS.GPJ AET+CPT+WELL.GDT 4/3/25



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-1**	**2.0'**	**45**	**13**	**32**		**Lean clay, fill**

PROJECT **Minnehaha Creek Park Improvements;**
Minneapolis, MN

AET JOB NO. **P-0040246**
DATE **3/18/25**

American Engineering Testing
550 Cleveland Avenue North
St. Paul, MN 55114
Telephone: (651) 659-9001
Fax: (651) 659-1347

ATTERBERG LIMITS RESULTS

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Report No. P-0040246

B.1 REFERENCE

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

B.2 RISK MANAGEMENT INFORMATION

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

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

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

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

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

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

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

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

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

---

[1] Geoprofessional Business Association, 1300 Piccard Drive, LL14, Rockville, MD 20850
Telephone: 301/565-2733: www.geoprofessional.org, 2019

B.2.3 Read the Full Report

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

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

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

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

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

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

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

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

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

B.2.7 This Report Could Be Misinterpreted

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

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

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

B.2.8 Give Constructors a Complete Report and Guidance

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

B.2.9 Read Responsibility Provisions Closely

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

B.2.10 Geoenvironmental Concerns Are Not Covered

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

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

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

MINNEAPOLIS PARKS AND RECREATION BOARD
MINNEHAHA CREEK BIKE SKILLS PARK

Minneapolis, Minnesota

OPERATIONS AND MAINTENANCE MANUAL

MPR25011

JANUARY 16, 2026

Élan Design Lab, Inc.
Flour Exchange Building
310 4th Ave S
Suite 1006
Mpls, MN 55415

Stormwater Management System
Operations and Maintenance Manual

For Minneapolis Parks and Recreation Board

At 3101 46th St. E Minneapolis, MN 55406

Information

Owner

Minneapolis Parks and Recreation Board
Contact: Andrew Schilling
(612) 541-7142

Design Engineer

Élan Design Lab
(612) 260-7980
mweslock@elanlab.com

Contractor

Contractor - TBD
(###) ###-####
contractoremail@xxxxx.com

Contents

Introduction 3

Routine Maintenance 4

Infiltration Basin 5

Infiltration Maintenance Guide 5

Infiltration Basin Inspection and Maintenance Form 6

Appendix A – BMP Location Map & Details 7

Appendix B – ADS Envirohood Maintenance Guide 10

Introduction

This Operations and Maintenance Manual (O&M) provides guidance and criteria for the perpetual care and preservation of the stormwater management system (SWMS) at 3101 46th St. E in Minneapolis, MN. The Minneapolis Parks and Recreation Board is responsible for arranging regular housekeeping, inspection, and maintenance of the SWMS facilities discussed herein. Record-keeping of inspection and maintenance activity shall be executed at prescribed intervals. Record-keeping responsibilities include maintaining completed copies of inspection and maintenance forms, and disclosing records to the City of Minneapolis.

The City of Minneapolis requires the SWMS be inspected after construction has been completed. The completed inspection form shall be saved and submitted to the City alongside record drawings and final SWMP.

The SWMS is made up of a series of best management practices (BMPs) designed to provide volume reduction, water quality improvements, and control of peak rate of runoff from the site per local and state regulations. A properly maintained SWMS provides reduction of pollutants for downstream receiving water bodies and reduces likelihood of urban flooding and overloading of municipal storm sewer systems.

A BMP location map is provided within the appendix of this manual for identification of each BMP's location on the site. A section on routine maintenance summarizes maintenance practices that will reduce the frequency of non-routine maintenance. Both routine and non-routine maintenance are preventative measures for reducing the likelihood of a BMP needing major maintenance. Major maintenance is labor intensive and expensive rehabilitation or reconstruction of the BMP.

An informational section is provided for each BMP. This includes a brief description of the BMP's purpose and function for stormwater management followed by a blank inspection and maintenance form. Blank copies of these forms shall be saved for record keeping use in future inspection and maintenance activities.

Visual inspections can be completed in a half hour or less and can be used to identify problems in a SWMS. Inspection and maintenance forms should be used to guide visual inspections. Photographs should be taken to illustrate findings and accompany completed forms. Inspections are best completed within 24-48 hours of a significant rainfall event. Visual inspections can help identify whether higher levels of inspection or maintenance are required. For example, if a BMP designed to draw down water in a specific time frame has standing water beyond the time period specified in the form, maintenance shall be performed on the BMP. If the problem persists the design engineer should be contacted to identify next steps.

Routine Maintenance

The following maintenance items should be completed as prescribed in the table below. Within the first year of operations, visual inspections should take place frequently and include detailed notes with the goal of detecting seasonal variables that will drive the schedule in future years. All visual inspections are recommended to be recorded with attached BMP inspection forms.

Activity	Recommended Frequency
Pavement and Sidewalk Sweeping	After spring snow melt, significant wind storms and autumn during and after leaf drop. Grass clippings shall be blown or swept into lawn.
Litter Control	Pick up litter on a weekly basis and after large events.
Trash / Recycling Area	Pick up and sweep debris as observed, do not wash into storm sewer system
Ice Control	Limit use of salt and sand on pavement and walks
Turf	Sweep or blow clippings from impervious surfaces. Test soil before applying fertilizer to minimize nutrient loads on downstream water resources. Revegetate bare spots to minimize erosion.
Vegetation	Prune and weed to maintain appearance. Remove and replace diseased or dead plants. Provide irrigation as needed during periods of drought. Replace vegetation whenever percent cover of acceptable vegetation in filtration basin falls below 90 percent of original design. If vegetation suffers for no apparent reason consult with horticulturist and/or test soil as needed.
Organic Mulch	Renew mulch to replace that which has decomposed.
Noxious Weeds and invasive species.	Noxious weeds and invasive species shall be controlled on an annual basis to prevent the introduction into stormwater facilities

SWMS Maintenance can result in removal of debris and sediment. Adhere to the following recommendations for disposal of these materials.

- Debris must be disposed offsite in licensed landfill or another appropriate site where it will not create an environmental hazard.
- Sediment must be disposed of offsite at a location where it will not create an environmental hazard. Follow state regulation for testing and disposal of sediment.

Infiltration Basin

An infiltration basin provides abstraction and treatment of stormwater by filtering runoff through an engineered filtration media constructed over naturally sandy and uncompacted soils and ultimately infiltrating into the earth. Properly maintained vegetation in the basin provides some evapotranspiration of stormwater and makes the BMP visually pleasing. In larger storm events water that exceeds the basin's infiltration capacity will flow out of the system through a wooden overflow weir.

Infiltration Maintenance Guide

Inspection Item	**Recommended Inspection Frequency**	**Condition Requiring Maintenance**	**Actions**
Water Level	After rainfall events greater than 0.5"	Standing water in basin or saturated soil 48 hours or more after the end of storm.	Contact Engineer who will assist in determining cause and proposing solution
Visual inspection for trash and debris in basin	Monthly and after major storms	Any accumulation	Remove debris
Visual inspection for sediment and debris accumulation in basin	Following spring snowmelt and before first frost.	Any accumulation that prevents water from infiltrating, or impacts vegetation	Remove accumulated sediment by hand methods, replace damaged plants and mulch. Perform inspection and maintenance on upstream pretreatment devices.
Visual inspection of inlets, outlet control structures and/or spillways.	Following spring snowmelt and before first frost.	Clogs, accumulated sediment and/or debris. Damaged structure(s) pipe(s) and/or grate(s). Erosion or washed-out soil and/or riprap.	Remove clogs, sediment, and/or debris. Restore and re-stabilize washed out areas. Contact design engineer regarding damaged infrastructure.
Basin bottom and embankments.	Following spring snowmelt, After major storms, and before first frost.	Eroded banks, animal burrows.	Fill in erosion and gullies with topsoil; re-seed as necessary. Replace mulch. Protect newly seeded areas from erosion with an erosion control blanket or mulch.
Vegetation	Annually	Bare patches, dead vegetation, noxious weeds or invasive species.	Remove dead vegetation. Reestablish vegetation by seeding and/or planting bare areas. Consult with Landscape Architect for persistent vegetation issues.

Infiltration Basin Inspection and Maintenance Form

Minnehaha Bike Skills Park - 3101 46th St. E Minneapolis, MN 55406

Inspector Name ____________________________

Date________ Time since last rainfall __________

Quantity of last rainfall _______________________

Has a visual inspection of the site been conducted at this location before? **Y** **N**

If yes enter date _____________________________

Based on previous inspections, have corrective actions been taken? **Y** **N**

Has it rained within the last 48 hours? **Y** **N**

Is there standing water in the basin? **Y** **N**

This basin is designed to draw down within 48 hours. Standing water over 48 hours after the end of a storm event is indication for maintenance of the BMP.

Comments

Is the bottom of the infiltration basin covered with a layer of silts and/or clays? **Y** **N**

Is the wood weir wall free of debris/sediment and/or clogs on grate and inside structure? **Y** **N**

Is the wood weir wall showing signs of deterioration or rot? Is all hardware present and free of rust? **Y** **N**

Is the there erosion at inlet(s) and/or weir? **Y** **N**

Are there any of the following present in the basin? Check any applicable.

- ○ Sediment deposition
- ○ Erosion or channelization
- ○ Excessive or undesirable vegetation
- ○ Litter or debris
- ○ Poorly vegetated areas
- ○ Illicit discharges
- ○ Other ____________

If sediment deposition is evident, what is the source? ____

Is maintenance needed? **Y** **N** If so, list maintenance items. ____

____

Attach photographs of BMP, inlets, outlets, overflows, and any areas requiring maintenance to this form.

Appendix A – BMP Location Map & Details

MINNEHAHA BIKE SKILLS PARK

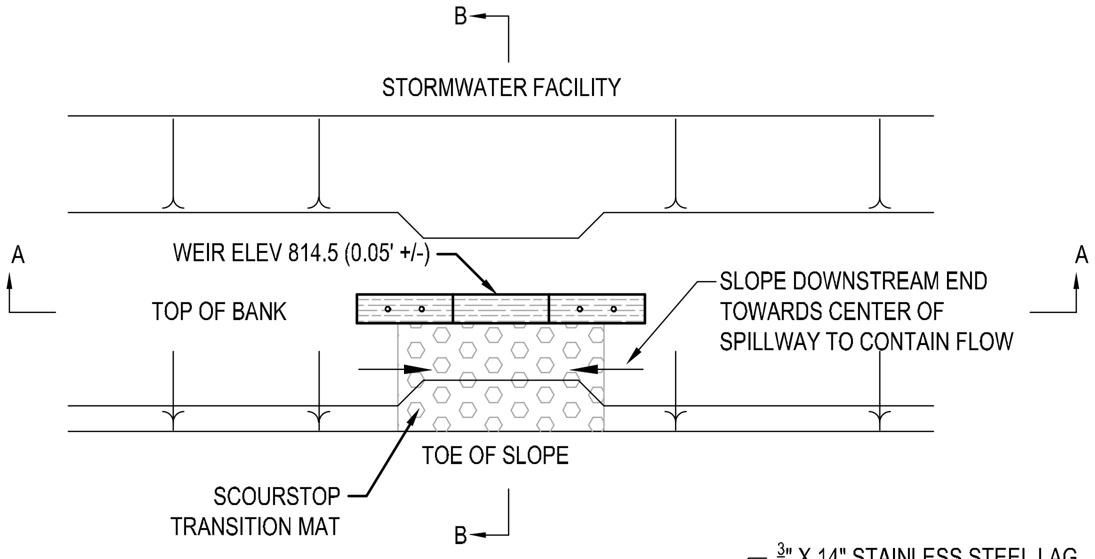
MINNEAPOLIS, MINNESOTA
MPR25011

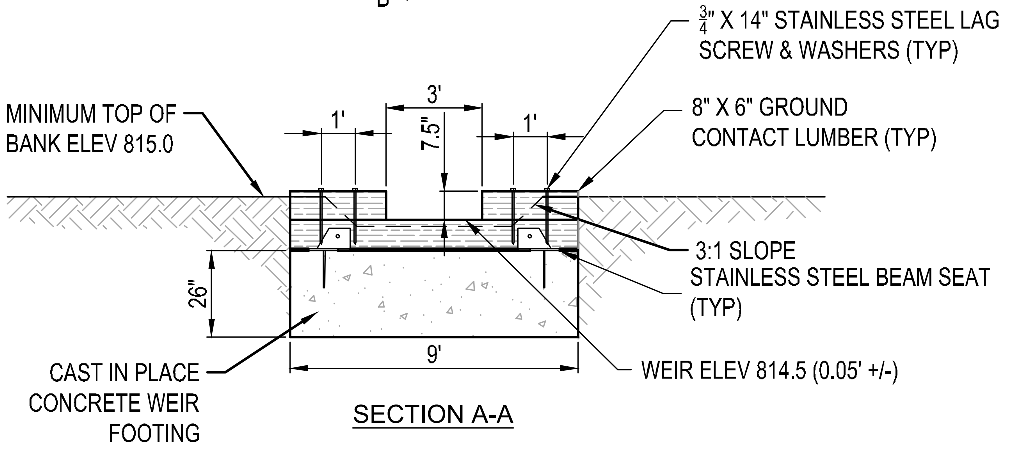
BMP LOCATION MAP

3/23/2026

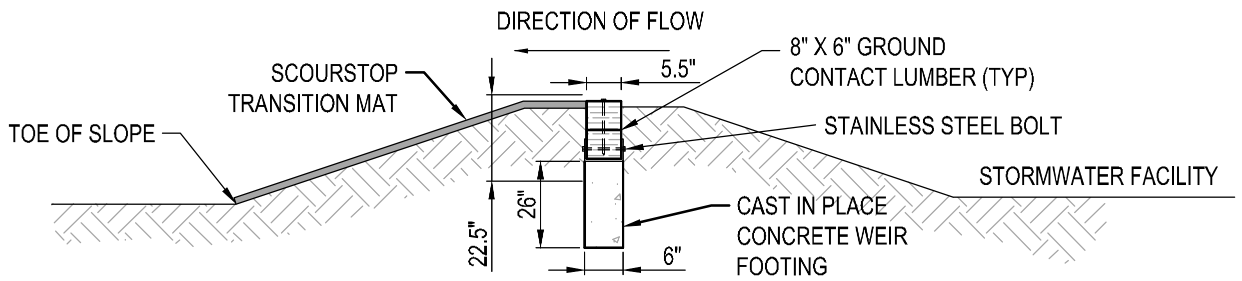
310 4TH SOUTH, SUITE 1006
MINNEAPOLIS, MN 55415
p 612.260.7980 | www.elanlab.com
f 612.260.7990

Élan DESIGN LAB
CIVIL ENGINEERING | LANDSCAPE ARCHITECTURE





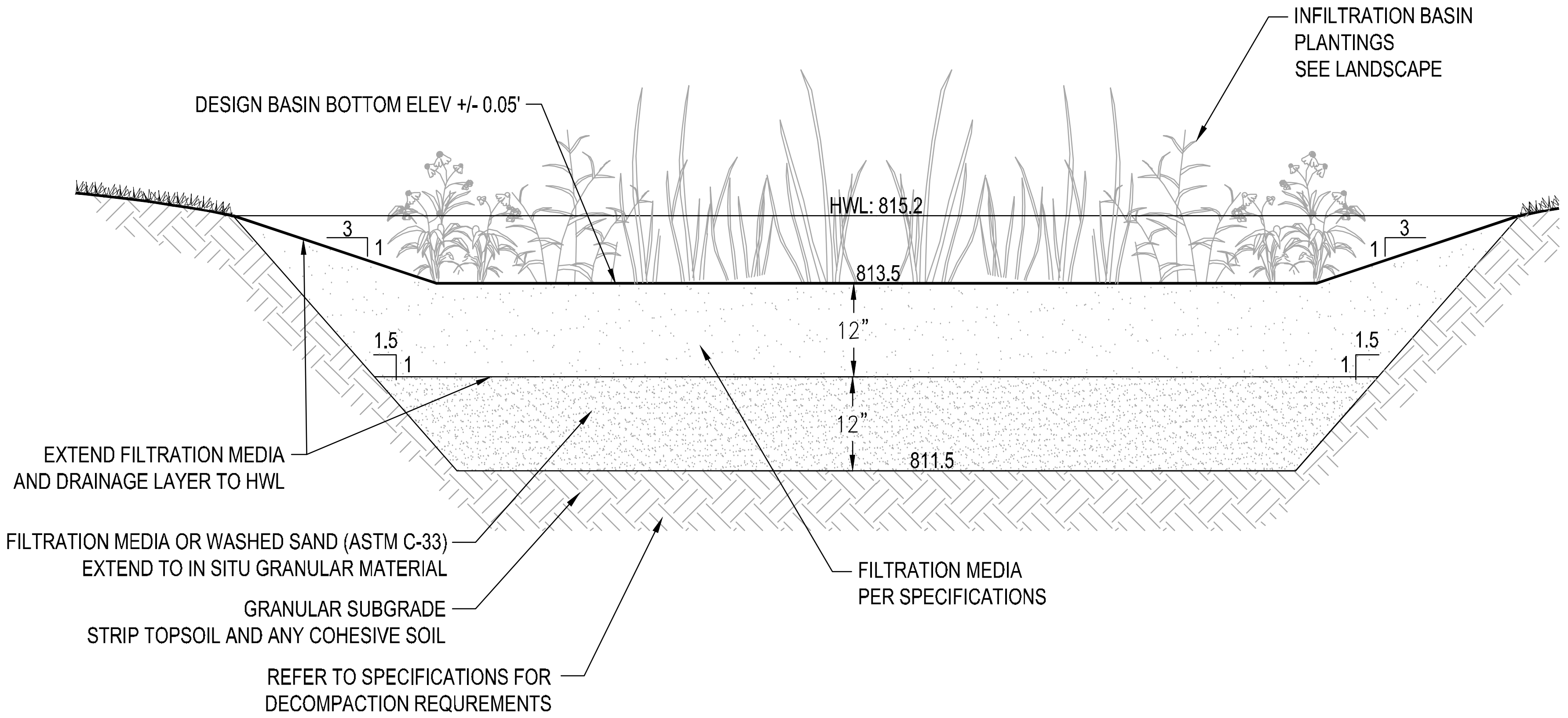
SECTION A-A



SECTION B-B

TIMBER OVERFLOW WEIR

NO SCALE



INFILTRATION BASIN

NO SCALE

MINNEHAHA BIKE SKILLS PARK
MINNEAPOLIS, MINNESOTA
MPR25011

BMP DETAILS
3/23/2026

310 4TH SOUTH, SUITE 1006
MINNEAPOLIS, MN 55415
p 612.260.7980
f 612.260.7990
www.elanlab.com

Élan DESIGN LAB
CIVIL ENGINEERING | LANDSCAPE ARCHITECTURE

Appendix B – ADS Envirohood Maintenance Guide

ADS® Nyloplast® EnviroHood®

Maintenance Guide

The Nyloplast EnviroHood is an innovative stormwater quality device attached to the inside of a catch basin or manhole designed to prevent the outflow of floating debris and oil. It's a great device for course particle separation and ideal for a rough pretreatment device. The need for cleaner stormwater has caused municipal leaders to demand forward-thinking solutions to improve their overall water quality. The EnviroHood offers lower installed costs and less intrusive installations than competitive devices. These units come preinstalled in Nyloplast basins for fast, easy, hassle free, job site installation.

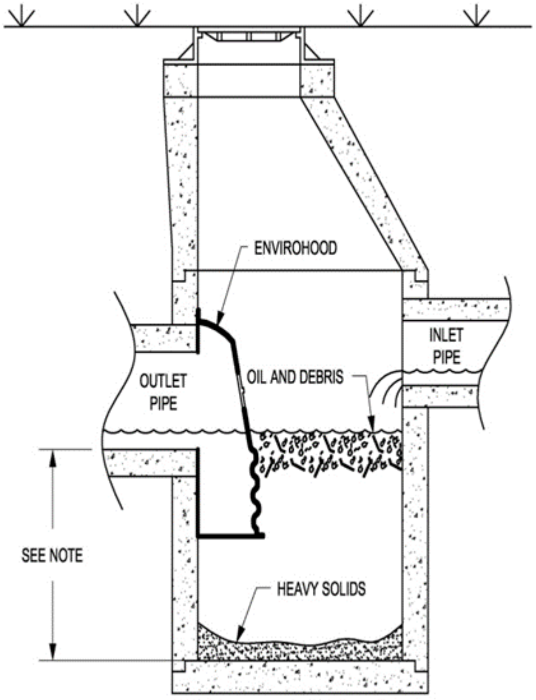
Installation shall be in accordance with Nyloplast installation procedures and those issues by local building/ construction regulations. The required minimum sump located in the typical installation is to allow for sediment to accumulate in the sump and allow the EnviroHood to properly function. Any sump larger than the recommended depth will allow more sediment to settle and require less maintenance due to the higher capacity below the EnviroHood structure.

Maintenance Recommendations

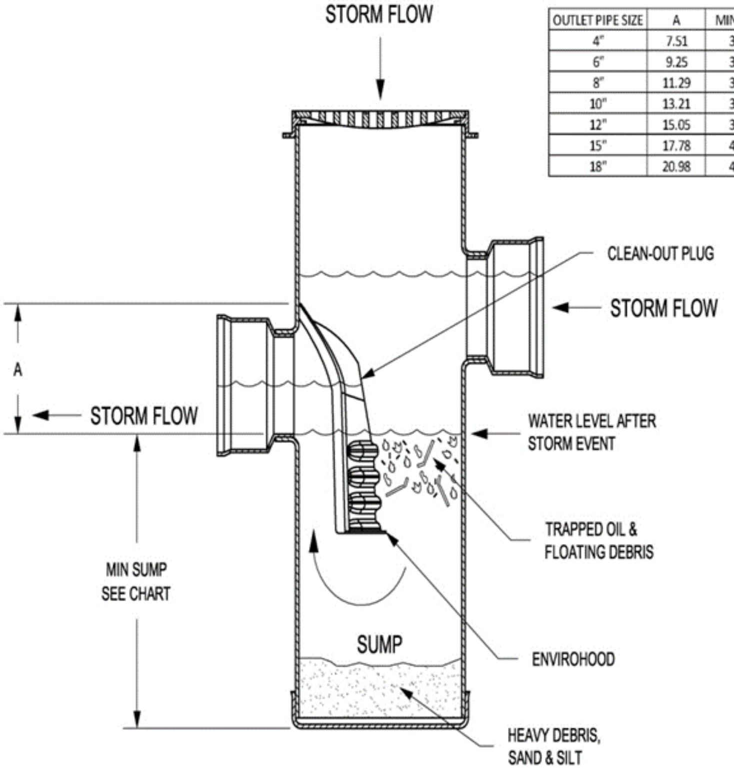
- Over the span of the first year of a new installation, monthly monitoring is recommended once the site has stabilized.
- Measurements should be taken using some sort of probe or other device as it may be difficult to determine how much sediment has accumulated.
- During the monitoring and removal process, check for evidence of restricted flow such as a high water level or clogging debris.
- After the monitoring period, it is best to continually schedule maintenance based on the amount of sediment accumulating in the sump of the structure and how much oil and debris is visible on the surface of the water over time.
- In case of a spill or other occasions where an abnormal amount of pollutants may accumulate in the structure, it is best to clean out the structure as quickly as possible.
- If another device that assists in the removal of pollutants and coarse debris is used, such as a Flexstorm product, it is best to follow the maintenance considerations for that product as their maintenance requirements may be stricter.
- A vacuum truck is best for the removal of debris and pollutants when necessary. After the collection of the waste, it shall be disposed of according to the local environment requirements.
- Once the waste has been removed, check seals and mounting hardware to ensure the EnviroHood can function properly.

adspipe.com
1-800-821-6710

TYPICAL INSTALLATIONS



NOTE: SUMP DEPTH OF 36" MIN. FOR 12" OR SMALLER DIAM. OUTLET. FOR 15" AND LARGER OUTETS USE 2.5-3X OUTLET DIAMETER



OUTLET PIPE SIZE	A	MIN SUMP
4"	7.51	36.00
6"	9.25	36.00
8"	11.29	36.00
10"	13.21	36.00
12"	15.05	36.00
15"	17.78	42.00
18"	20.98	48.00

adspipe.com

1-800-821-6710