



SAINT PAUL
MINNESOTA

2025 STORMWATER QUALITY AND QUANTITY MONITORING PROGRAM

CITY OF ST. PAUL

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Prepared for:
City of St. Paul
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TABLE OF CONTENTS

1. Introduction 1

2. Procedures and Methodology 3

 2.1. Infiltration Rate 3

 2.1.1 Data Collection 3

 2.1.2 Data Analysis..... 4

 2.2. Flow & Volume Reduction 4

 2.2.1 Data Collection 4

 2.2.2 Data Analysis..... 5

 2.3. Water Quality..... 5

 2.3.1 Data Collection 6

 2.3.2 Data Analysis..... 7

 2.4. Maintenance Inspections 8

 2.5. Pervious Surface Infiltration Rate..... 8

 2.5.1 Data Collection 8

3. Precipitation Summary..... 9

4. Bush-Desoto 12

 4.1. Volume Reduction Monitoring 12

 4.2. Pollutant Removal Monitoring 13

5. St. Albans Street 14

 5.1. Water Level and Infiltration Rate Monitoring 14

 5.2. Volume Reduction Monitoring 15

 5.3. Pollutant Removal Monitoring 16

 5.4. Maintenance Inspection 16

6. Hampden Park 18

 6.1. Water Level and Infiltration Rate Monitoring 19

 6.2. Volume Reduction Monitoring 19

 6.3. Pollutant Removal Monitoring 20

 6.4. Maintenance Inspection 21

7. Victoria Street 22

 7.1. Water Level and Infiltration Rate Monitoring 22

 7.2. Volume Reduction Monitoring 23

 7.3. Pollutant Removal Monitoring 23

 7.4. Maintenance Inspection 24

8. East Phalen..... 25

 8.1. Volume Monitoring 25

 8.2. Pollutant Loading **Error! Bookmark not defined.**

9. Allianz Field Soccer Stadium 27

 9.1. Water Level Monitoring 27

9.2. Volume and Pollutant Monitoring 27

10. River Level Monitoring 28

11. Pervious Surface Infiltration Assessment 29

 11.1. Victoria Street 29

 11.2. Jackson Street 30

12. City-wide Loading Assessment 37

 12.1. 2025 Pollutant Loading Calculations 37

13. 2025 Summary 44

 13.1. Underground Infiltration Systems/Outfall 44

 13.2. Pervious Pavement 45

 13.3. Recommendations for 2026 45

14. References 46

LIST OF FIGURES

1-1 2025 Monitoring Site Locations

4-1 Bush Desoto Infiltration BMP Drainage Areas

5-1 St. Albans Street Infiltration BMP Drainage Areas

6-1 Hampden Park Infiltration BMP Drainage Area

7-1 Victoria Street Infiltration BMP Drainage Area

8-1 East Phalen Drainage Area

9-1 Allianz Field Filter Chamber Pond Drainage Area

10-1 Jackson and Victoria Street Pervious Pavement Test Locations

APPENDICES

A. Infiltration/Water Level Charts

 A.1. St. Albans Water Level and Rainfall

 A.2. St. Albans Infiltration Rate

 A.3. St. Albans Infiltration Rate Trends

 A.4. Hampden Park Water Level and Rainfall

 A.5. Hampden Park Groundwater and Infiltration System Levels

 A.6. Hampden Park – Infiltration Rate

 A.7. Hampden Park – Infiltration Rate Trends

 A.8. Victoria Water Level and Rainfall

 A.9. Victoria Underground System Infiltration Rate (BMP Pipe)

 A.10. Victoria Underground System Infiltration Rate Trends

 A.11. Allianz Field Soccer Stadium Water Levels and Rainfall

B. Flow Rate Charts

 B.1. Bush Desoto Flow Rates and Rainfall

 B.2. St. Albans Flow Rates and Rainfall

 B.3. Hampden Park Flow Rates and Rainfall

 B.4. Victoria Flow Rates and Rainfall

 B.5. East Phalen Flow Rates and Rainfall

 B.6. Allianz Field Soccer Stadium Flow Rates and Rainfall

C. Water Quality Summary and Pollutant Load Calculations

 C.1. Bush Desoto Water Quality Summary

 C.2. Bush Desoto Volume and Pollutant Reduction Summary

 C.3. Saint Albans Water Quality Summary

 C.4. Saint Albans Volume and Pollutant Reduction Summary

 C.5. Hampden Park Water Quality Summary

- C.6. Hampden Park Volume and Pollutant Reduction Summary
- C.7. Victoria Water Quality Summary
- C.8. Victoria Volume and Pollutant Summary
- C.9. East Phalen Water Quality Summary
- C.10. Allianz Field Soccer Stadium Downstream Water Quality Summary
- C.11. Allianz Field Soccer Stadium Upstream Water Quality Summary

- D. Pervious Pavement Infiltration Charts
 - D.1. Jackson Street Infiltration Rate Trends Chart
 - D.2. Victoria Street Infiltration Rate Trends Chart

- E. Photolog

- F. 2025 Monitoring Protocols

- G. ASTM C1701 Procedures

LIST OF ABBREVIATIONS

BMP	Best Management Practices
CCB	Capital City Bikeway
CRWD	Capital Region Watershed District
Cu-ft	Cubic feet
DP	Dissolved phosphorus
EMC	Event mean concentration
FT	Feet
FWA	Flow-weighted average
HDPE	High-density polyethylene
In/hr.	Inches per hour
IR	In-rock
lbs.	Pounds
mg/L	Milligrams per liter
MS4	Municipal Separate Storm Sewer System
MSWM	Minnesota Stormwater Manual
MPCA	Minnesota Pollution Control Agency
MPN	Most probable number
MnDOT	Minnesota Department of Transportation
NPDES	National Pollutant Discharge Elimination System
OCS	Outlet control structure
SP	Poorly graded sand
SPCD	Saint Paul City Datum
SRP	Soluble reactive phosphorus
TP	Total phosphorus
TSS	Total suspended solids

1. Introduction

The purpose of this report is to present the findings of the City of Saint Paul's (City) 2025 Stormwater Monitoring Program. The monitoring was conducted to fulfill requirements of the City's National Pollutant Discharge Elimination System (NPDES) MS4 Phase I Permit. The data was collected, analyzed and used to quantify stormwater volumes and loads from the Municipal Separate Storm Sewer System (MS4). This data will support in the evaluation of efficacy of the City's Stormwater Management Program.

Since 2006, the Minnesota Pollution Control Agency (MPCA) has required the city to construct stormwater volume reduction Best Management Practices (BMPs) concurrent with City projects that generate or reconstruct impervious surfaces. The MPCA requirements stipulate that these BMPs must provide volume reduction for the runoff from a one-inch rainfall event over the impervious surfaces of the project. In 2015, the watershed updated their standard to require that the BMP provide volume reduction for the runoff from a 1.1-inch rainfall event over the impervious surface of the project. The city has typically achieved this by constructing infiltration BMPs.

The focus of the City's stormwater monitoring program has been to monitor the effectiveness and maintenance needs of stormwater BMPs. Outfall monitoring data, collected by Capitol Region Watershed District (CRWD), is used to evaluate pollutant loading from major sub-watersheds and to estimate City-wide pollutant loading from the MS4.

Four BMPs and two drainage areas monitored via storm pipe were monitored in 2025 to quantify progress toward meeting the City's stormwater management goals and to refine current design and maintenance practices. Rainfall was also measured at four locations in the city. The 2025 monitoring sites are shown in **Figure 1-1** and listed in **Table 1-1**. This effort focused on evaluating four major parameters during the monitoring period:

- Water level/infiltration rate
- Volume reduction
- Pollutant capture
- BMP maintenance

To evaluate these parameters, electronic monitoring equipment was used to continuously measure system water levels, inflow/outflow volumes, and rainfall amounts. In addition, visual inspections and measurements of sediment accumulation were conducted periodically for each system to assess maintenance needs.

Three of the monitored BMPs are pervious pavement sites, evaluated for infiltration performance. Long-term monitoring at these sites is completed to research the benefits, feasibility, and sustainability of pervious surface parking lanes, alleyways, and bike trails in the city.

This report describes the procedures and methods used to collect water quality and quantity data, provides background information for each site monitored, and presents the results of the monitoring that was completed.

Table 1-1: 2025 City of Saint Paul Monitoring Site Summary

BMP/Site Name	BMP/Site Type	Monitored Parameters¹
Bush Desoto	Infiltration Basin	Q, WQ
St. Albans Street	Underground Infiltration Gallery	WL, Q, WQ
Hampden Park	Underground Infiltration Gallery	WL, Q, WQ, GW
Victoria Street	Pervious Pavers & Underground Infiltration Gallery	WL, Q, WQ, Infiltration
East Phalen	Storm Pipe/Stormwater Pond	WL, Q, WQ
Allianz Field	Filtration Chamber	WL, Q, WQ
Jackson Street Pervious Bike Path	Pervious Asphalt	Infiltration
Capital Region Watershed District Office	Rainfall Monitoring Location	R
Trout Brook Nature Sanctuary	Rainfall Monitoring Location	R
Hampden Park Co-op	Rainfall Monitoring Location	R
Firehouse 18	Rainfall Monitoring Location	R
Victoria Park	Rainfall Monitoring Location	R

¹ WL- Water Level, Q – Flow Rate, WQ – Water Quality, GW – Groundwater, R – Rainfall

2. Procedures and Methodology

This section outlines the procedures and methods followed to perform monitoring and data analysis. For more detailed information related to the equipment use monitoring protocols followed for this monitoring program, see the 2024 Stormwater Monitoring Protocols document located in **Appendix F**.

2.1. Infiltration Rate

The infiltration rate was measured at applicable locations by collecting water level data on a continual basis. The data was analyzed to estimate the average infiltration rates observed during the monitoring period. The following provides a detailed description of this process. The water level data collected at those sites was reviewed to determine level fluctuation over the monitoring period and to compare against normal and high-water elevations.

2.1.1 Data Collection

Water levels were monitored using electronic level loggers. The loggers were configured at each site to log data at a minimum of one reading per hour for groundwater and once every 15 minutes for BMPs.

Enclosures for the infiltration gallery level loggers were installed at Beacon Bluff, St. Albans Street, and Hampden Park. These consisted of three-inch-diameter PVC pipes with four rows of half inch-diameter holes drilled along the pipe, achieving approximately twenty holes per foot. The enclosures were wrapped with a highly permeable geotextile fabric and secured with zip ties to protect the instrument from fine sediment accumulation. Enclosures were secured to the system floor and to the access riser wall (**Photo 2-1**). Groundwater and rain garden locations were monitored from permanent monitoring wells (**Photo 2-2**).



Photo 2-1:
Infiltration Gallery Level Monitoring Enclosure



Photo 2-2:
Sensor configuration in St. Albans elliptical pipe

2.1.2 Data Analysis

The data collected at each site reflected hydrograph-type curves resulting from the rise and fall of water within the systems during and after significant rainfall events. The data was analyzed in Microsoft Excel to develop stage/infiltration rate relationships for each system. Since the infiltration rates increase exponentially at higher depths in the systems, this relationship was developed by calculating the infiltration rate at each half foot height increment. These calculations also accounted for the volume of runoff entering the system while drawdown was occurring. Infiltration of water in the horizontal direction through the vertical surfaces of the trenches was not included in this analysis, as the policies of the watershed districts only recognize infiltration through the bottom horizontal surface. The infiltration rates calculated at each increment were averaged and plotted on a graph.

The following equation was used to perform these calculations at each half foot increment:

$$\text{Infiltration Rate} \left(\frac{\text{in}}{\text{hr}} \right) = \frac{0.5 \text{ ft} + \frac{V_{\text{in}}}{\text{WHSA}}}{\Delta t}$$

where:

V_{in} = Inflow Volume (cu-ft)
 WHSA = Wetted Horizontal Surface Area (sq-ft)
 Δt = Time it takes for water level to drop by 0.5 ft

Monitored Infiltration rates were evaluated against design infiltration rates and infiltration rates observed during pre-construction field testing.

2.2. Flow & Volume Reduction

Stormwater runoff volume was measured at Beacon Bluff, Victoria Street, St. Albans Street, Hampden Park, Allianz Field, and West Shepard Pond using continuous flow monitoring equipment. At BMP Sites, the data was utilized to determine the total volume of water draining to and captured by each system. Collected data was analyzed using Flowlink software and Microsoft Excel to quantify the volumes measured during each discrete rainfall event recorded during the monitoring periods. The following section provides brief descriptions of the methods and procedures used to quantify flow at each system.

2.2.1 Data Collection

Teledyne ISCO 2150 area velocity flow modules and sensors were used to monitor runoff volumes. These devices measure water level and flow velocity. Combining this information with a known conduit shape, the flow rate, and flow volume through the conduit were calculated. Each of the monitored systems received stormwater runoff from a diversion structure located along the storm sewer system. The 2150 flow sensors were positioned at the upstream and downstream pipes in these structures to measure the total volume draining to each BMP and the total volume that bypassed each BMP. **Photos 2-3** and **2-4** show the flow meters installation in West Shepard Pond and Victoria Street, respectively.

The flow modules were configured at each site to log data at one-minute intervals once the water level in the upstream pipe was greater than one-inch above the pipe invert to increase the resolution of the flow data.



Photo 2-3: Flow Monitoring Module Install Process



Photo 2-4: Flow Monitoring Equipment Install

2.2.2 Data Analysis

Flow data was regularly imported into Flowlink 5.1 for storage and analysis. Data was analyzed and validated using built-in velocity error checking parameters. The flow level and velocity data were converted to total flow volumes and exported to a Microsoft Excel spreadsheet for further analysis. Each rainfall event and associated inflow and outflow volumes were tabulated.

For the Bush Desoto, Saint Albans Street, and Hampden Park BMPs, runoff volume was estimated for un-monitored system inlets by taking monitored flow data and multiplying by the ratio of the respective drainage areas.

2.3. Water Quality

Water quality was monitored at Bush Desoto, Victoria Street BMP, Hampden Park, East Phalen, Allianz Field, and St. Albans Street. The following section provides a summary of the methods and procedures used to collect and test water quality samples and analyze the data.

2.3.1 Data Collection



Photo 2-5:
Kaposia Landing River Logger



Photo 2-6:
ISCO Bottle Configuration

ISCO 6712 automatic samplers were installed at all water quality locations. (**Photos 2-5 and 2-6**).

The automatic samplers were configured to collect 250 mL samples at constant volume intervals. The flow pacing intervals were initially estimated for each site to provide a minimum of six samples during a quarter-inch storm, but less than 120 samples for the three-inch storm. Flow pacing was refined during the monitoring period to achieve this objective.

Samples from sufficiently sized rainfall events were submitted to the Metropolitan Council Environmental Services (MCES) Laboratory for analysis. The samples were composed using a batch mixing technique to create one sample for the event. All water quality monitoring site composite samples were analyzed for the parameters listed in **Table 2-1** as volumes allowed, in accordance with the City's NPDES Permit. Grab samples were also collected during select storm events and analyzed for *E. Coli* and grease. The most probable number (MPN) procedure was used to determine the concentration of *E. Coli* in the stormwater runoff.

Table 2-1: Water Quality Parameters

Monitoring Parameters			
Parameters	Method	Sample Type	Frequency
Oil and Grease	SM 5210B	Grab	Quarterly
Chloride, Total	SM4500	Composite	10/year
Copper, Total (as Cu)	EPA 200.7	Composite	10/year
<i>E. coli</i>	MPN	Grab	Quarterly
Flow	NA	Measurement	NA
Hardness, Carbonate (as CaCo3)	SM 2340B	Composite	10/year
Lead, Total (as Pb)	EPA 200.7	Composite	10/year
Nitrite Plus Nitrate, Total (as N)	SM4500/NO3F	Composite	10/year
Nitrogen, Ammonia, Un-ionized (as N)	EPA 350.1	Composite	10/year
Nitrogen, Kjeldahl, Total	EPA 351.2	Composite	10/year
pH	EPA 9045D	Grab	Quarterly
Phosphate, total Dissolved or Ortho	EPA 365.1	Composite	10/year
Phosphorus, Total as P	EPA 365.1	Composite	10/year
Precipitation	NA	Measurement	1 x Day
Solids, Total Dissolved (TDS)	SM2540 C-97	Composite	10/year
Solids, Total Suspended (TSS)	ASTM D3977-97	Composite	10/year
Chemical Oxygen Demand (COD)	EPA 9056A	Composite	10/year
Organic Dissolved Carbon	EPA 9060A	Composite	10/year
Volatile Suspended Solids (VSS)	EPA 160.4	Composite	10/year
Zinc, Total (as Zn)	EPA 200.7	Composite	10/year

2.3.2 Data Analysis

The event means concentrations (EMCs) derived from sampling events were multiplied by the corresponding volume measurements taken at each site for every rainfall event sampled. For storm events with no sampling data, a flow weighted EMC concentration from that site's entire monitoring period was used. This information was tabulated and summed to determine the total amount of pollutants generated in the contributing drainage areas and the number of pollutants captured by the BMP, at applicable sites.

2.4. Maintenance Inspections

BMP inspections were conducted at Bush Desoto, St. Albans Street, Hampden Park, and Victoria Street sites periodically during the monitoring period. Pre-treatment structures were inspected for accumulated sediment depth and floatable debris. Underground chambers were inspected from the level monitoring location for accumulation of sediment, debris, and standing water. Inspection photos are included in the photo log (**Appendix E**).

2.5. Pervious Surface Infiltration Rate

The infiltration rate of the permeable surfaces was measured at Jackson Street pervious pavement and Victoria Street sites following the protocols outlined in ASTM method C1701 (**Appendix G**). The following section provides a summary of those methods.

2.5.1 Data Collection

Infiltration tests were conducted according to the modified ASTM C1701 methods for measuring infiltration rates (**Photo 2-7**). Eighteen locations at Jackson Street and ten locations along Victoria Street were evaluated to develop an average infiltration rate measurement for each site. Tests were taken at locations that remained consistent year to year and included a combination of high and low traffic areas. At each test location, a pre-wet test was conducted, followed by two infiltration tests. The two infiltration tests were averaged to generate the infiltration rate for each location. If after 15 minutes of monitoring during a pre-wet test no infiltration was observed, the test was concluded, and no subsequent tests were completed.



Photo 2-7: Permeable Pavement Infiltration Test

3. Precipitation Summary

As part of the City’s stormwater monitoring program, seasonal precipitation monitoring is conducted at the following locations: Capital Region Watershed District, Firehouse 18, Trout Brook Nature Sanctuary, Hampden Park Co-op and Victoria Park (**Figure 1-1**). The precipitation data collected at these locations provides localized rainfall totals which are utilized for calculating rainfall intensity and runoff yield at monitored BMP sites. Each station is equipped with an automated tipping bucket that records continuously throughout the season.

Precipitation data collected by MCES, Minnesota Climatology Working Group (MCWG), and the National Weather Service (NWS) is used to supplement the City’s data as needed. This includes any data gaps in seasonally monitored stations as well as parameters, such as snowfall and snowpack depth, which exceed the limitations of the City’s monitoring equipment. These stations also provide a longer period of recording which is valuable for analyzing rainfall trends.

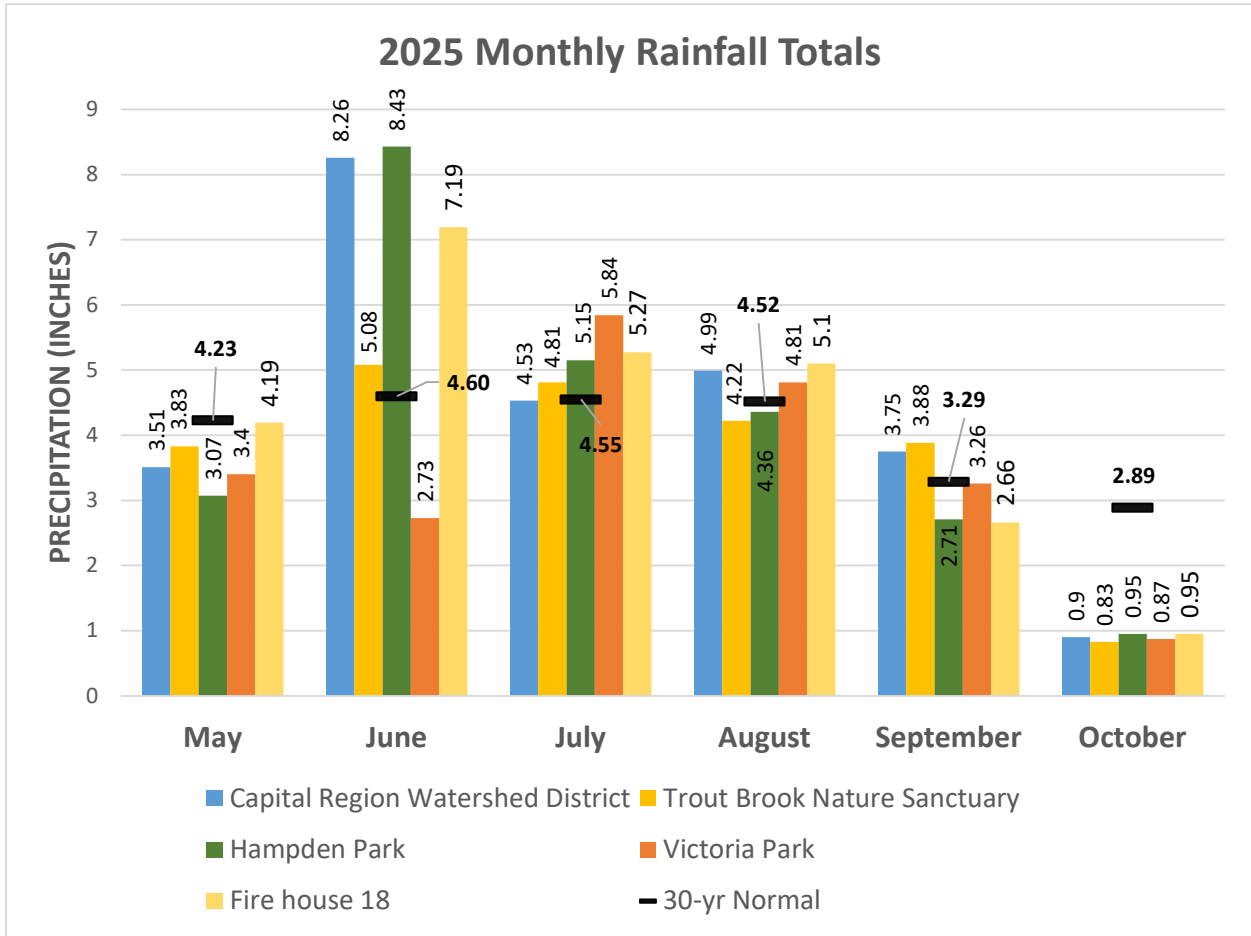
Table 3-1 and **Chart 3-1** show 2025 monthly precipitation totals for seasonally monitored sites compared to the 30-year normal. The 30-year normal reflect data collected from 1991-2020 by the U of MN St. Paul station.

May through October rainfall ranged from 21.62 inches at Victoria Park to 27.97 inches at Capital Region Watershed District. The City-wide seasonal total average was 23.91 inches which is 0.174 inches less than the 30-year normal. The greatest variability between stations was observed during the month of June with 5.70 inches more rainfall recorded at Capital Region Watershed District than at Victoria Park. The month of October saw the greatest departure from the 30-year normal (-1.99 inches).

Table 3-1: 2025 Seasonal Precipitation Summary

Month	Capital Region Watershed District	Firehouse 18	Trout Brook Nature Sanctuary	Hampden Park Co-op	Victoria Park	City-Wide Average	30-yr Normal	Departure from 30-yr Normal
May	3.51	4.19	3.83	3.07	3.40	3.60	4.23	-0.63
June	8.26	7.19	5.08	8.43	2.73	6.34	4.60	+1.74
July	4.53	5.27	4.81	5.15	5.84	5.12	4.55	+0.57
August	4.99	5.1	4.22	4.36	4.81	4.70	4.52	+0.18
September	3.75	2.66	3.88	2.71	3.26	3.25	3.29	-0.04
October	0.9	0.95	0.83	0.95	0.87	0.90	2.89	-1.99
Seasonal Total	27.97	25.67	22.96	25.17	21.62	23.91	24.08	-0.174

Chart 3-1



Major rainfall events from 2025 are provided in **Table 3-2** below:

Table 3-2: 2025 Significant Rainfall Events

Date	Duration (hr.)	Rainfall Total (in) ¹	Intensity (in/hr)	Event Category (precipitation frequency estimate)
5/20/25	12.4	1.74	0.14	1-year
8/9/25	1.1	1.42	1.29	2-year
8/15/25	1.3	0.86	0.69	2-year
8/16/25	3.9	1.21	0.31	1-year
8/17/25	3.6	1.27	0.35	1-year

1 - Rainfall event totals may not reflect total daily rainfall.

Table 3-3 below provides a nine-year monthly precipitation summary as recorded at the University of Minnesota Saint Paul Campus. In 2025 the annual precipitation exceeded the 30-year normal. Total precipitation in 2025 was 35.21 inches, 2.48 inches above normal. June had the greatest amount of precipitation at 8.38 inches, which was above the 30-year normal by 3.78 inches. June also had the most

variation from the 30-year normal but having 3.78 inches more precipitation compared to 4.60 inches in the 30-year normal.

Table 3-3: 9-year Precipitation Summary (UMN – Saint Paul Campus)

Month	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	30-yr Normal
January	0.28	0.93	1.07	0.36	0.81	0.62	0.54	1.78	0.10	0.11	0.68
February	0.79	0.70	1.24	2.31	0.53	0.41	0.48	2.19	0.65	0.49	0.75
March	2.15	0.58	1.38	2.09	2.76	2.94	3.19	1.84	2.55	2.75	1.61
April	3.66	3.68	2.37	3.37	1.67	2.46	3.57	3.84	3.85	2.24	3.02
May	2.05	6.54	3.52	6.44	4.43	3.36	4.89	1.50	5.54	3.65	4.23
June	3.65	3.16	4.64	2.85	4.15	1.57	0.80	2.02	7.99	8.38	4.60
July	5.97	2.45	4.07	4.75	2.20	1.57	1.37	3.90	4.81	5.92	4.55
August	9.90	8.89	2.91	6.88	3.70	6.56	4.58	5.72	7.06	3.77	4.52
September	5.19	1.25	7.19	4.88	1.05	1.82	0.29	5.66	0.66	4.12	3.29
October	3.32	4.84	3.4	4.93	2.25	2.29	0.24	3.96	1.20	1.07	2.89
November	2.70	0.42	1.41	1.67	1.37	0.97	2.04	0.09	2.32	1.28	1.53
December	2.01	0.62	1.32	2.42	0.88	1.94	1.80	2.40	1.22	1.43	1.06
Total	41.67	34.06	34.52	42.95	25.80	26.51	23.79	34.90	37.95	35.21	32.73
Departure from 30-yr Normal	+8.94	+1.33	+1.79	+10.22	-6.93	-6.22	-8.94	+2.17	+5.22	+2.48	N/A

4. Bush-Desoto

The Bush-Desoto Pond is an infiltration basin in the southern end of the Payne-Phalen Neighborhood. The stormwater inlet is on the east side and receives water from Bush Avenue. The outlet on the west side connects excess water back to the main storm sewer line. The pond was reconstructed in 2024 to enlarge the bottom of the pond by removing the top 8 inches other changes include the removal of a 48-inch RCP on the west side of the pond for 54-inch RCP and the 54-inch RCP on the east side of the pond was replaced with a 72-inch RCP. These changes in result have added a treatment value of 85,000 credits. The pond location is provided in **Figure 4-1**. A stormwater sampler was installed at the intersection on Bush and Desoto Ave.



Photo 4-1: Bush Desoto in 2023 Before Reconstruction



Photo 4-2: Bush Desoto in 2025 After Reconstruction

4.1. Volume Reduction Monitoring

One flow meter was installed inside of the 54-inch RCP pipe upstream of the infiltration basin. The metered drainage area consists of 38.0 acres of. The 2025 flow rates and daily rainfall are depicted on **Chart B.1** of **Appendix B**.

During the 2025 monitoring period, the total event volume moving through the system was 898,931 cu-ft (**Table 4-2**). The total water yield for the 38.0-acre drainage area is 23,739 cu-ft/acre. The greatest event-based volume moving through the system was 122,058 cu-ft because of a 1.60-inch rain event on September 21, 2025

Table 4-2: Bush-Desoto Pond Volume Summary

Monitoring Period	5/16/25 – 10/26/25	
Total Rainfall	16.01 in	
Bush-Desoto Pond Water Balance		
Total Volume	902,090	cu-ft
Maximum Event Volume	122,058	cu-ft

4.2. Pollutant Removal Monitoring

A water quality sampler was placed inside of the 54-inch RCP pipe upstream of the pond near the flow meter to collect samples during high flow/rain events. The sampler was paced to collect samples at equal volume intervals to provide a representative sampling of each storm event. Samples for each event were tested as a composite to provide EMCs for each event for each parameter analyzed. Grab samples were also collected in the stream, near the automated sampler and tested for *E. Coli*. See **Charts C.1** and **C.2** of **Appendix C** for the complete water quality summary and pollutant loading calculations.

Table 9-3 below provides a pollutant load summary for the loading parameters defined in NPDES Permit issued to the City in addition to ortho-phosphate. During monitoring period 9,145 pounds of TSS and 28.63 pounds of TP passed through the monitored area during storm events.

Table 9-3: Bush-Desoto Pond Pollutant Load Summary

Monitoring Period		5/16/26 – 10/26/25		
Total Rainfall		14.36		
Water Quality Parameter	Flow Weighted Average (mg/L)	Total Pollutant Load (lbs.)	Load Captured (lbs.)	Percent Reduction %
Total Suspended Solids	315.7	9,173	9,145	99.7
Volatile Suspended Solids	85.4	14,774	14,729*	99.6
Total Dissolved Solids	85.4	2,650	2,642*	99.7
Total Phosphorus	0.75	28.74	28.63	99.6
Orthophosphate	0.036	1.395	1.390	99.5
Chloride	8.7	487.5	486.5	99.8
Total Kjeldahl Nitrogen	2.71	150.47	149.87*	99.6
Nitrate + Nitrite as N	0.35	18.35	18.28	99.6
*Average of previous years monitoring (2021-2023)				

5. St. Albans Street

This system, shown in **Figure 5-1**, was constructed in 2010 to provide volume reduction along the Central Corridor light rail transit way. Volume and flow have been monitored at the site since 2012, with water quality monitored from 2014 through 2025.

A manhole structure positioned along the main storm sewer under Aurora Avenue diverts stormwater into the underground infiltration system (**Photo 5-1**) via a 30-inch elliptical pipe. The system is also connected to the University Avenue storm sewer system. Any runoff that does not get treated by infiltration trenches and tree planters along University Avenue is directed to this system (**Photo 5-1**). When the system reaches its storage capacity, water flows west through the existing storm sewer system. The system includes a pretreatment structure comprised of a grit chamber and baffled weir to provide settling for sediment and skimming. Rainfall monitoring for the site is conducted on the roof of Fire Station 18, located across the street from the BMP. The BMP system details are provided in **Table 5-1**.

Table 5-1: St. Albans Street BMP Details

Total Drainage Area to BMP	25.2 acres
Year Constructed	2010
Total Construction Cost	\$381,903
Storage Volume	31,189 cu-ft
Volume Reduction Credit Received by the City of Saint Paul	31,189 cu-ft



Photo 5-1: St. Albans 48” Perforated HDPE Installation

5.1. Water Level and Infiltration Rate Monitoring

BMP water level was monitored in the access manhole at the northwest corner of the system. The 2025 water elevations and daily rainfall are provided on **Chart A.5** of **Appendix A**. Water level monitoring indicated that the infiltration gallery reached 100% capacity ten times in 2025. The infiltration gallery drew down to empty in less than a 24-hour period after the conclusion of each rain event.

Infiltration rates are presented in **Chart A.6** of **Appendix A**. In 2025, the average infiltration rate of the BMP pipe was 10.2 in/hr. (**Table 5-2**), which is below the design infiltration rate of 26.0 in/hr. Infiltration rate trends for the St. Albans Street BMP pipe are depicted on **Chart A.7**.

Table 5-2: St. Albans Infiltration Rate

Location	Average Infiltration Rate (in/hr.)													
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
St. Albans Street BMP Pipe	38.3	35.7	64.8	55.3	36.2	20.6	21.2	11.0	9.9	11.8	14.0	11.7	10.0	10.2

5.2. Volume Reduction Monitoring

Two flow meters were installed in the storm sewer diversion manhole located in the intersection of St. Albans Street and Aurora Avenue. One meter was installed in the elliptical pipe to capture flows into the system from the south, and the other was installed in the downstream pipe to measure flows bypassing the system to the west. The difference in volume recorded by the two meters is assumed to be diverted into, and infiltrated by, the BMP. Flow entering the system from the 30-inch pipe at the corner of St. Albans Street and University Avenue was modeled using previous years. Flow rates and daily rainfall are depicted on **Chart B.2** of **Appendix B**.

In 2025, total runoff for the St. Albans Street system was 498,255 cu-ft. Of that volume, 370,787 cu-ft was captured and infiltrated by the system, resulting in a volume reduction of 85.2% (**Table 5-3**). 20 storm events caused water to bypass the BMP system, and 10 of those bypass events were above 500 cu-ft of water. The total water yield for the 25.2-acre drainage area is 19,772 cu-ft/acre which is equivalent to 5.5 inches of runoff resulting from 22.12 inches of rain (24.6%). The greatest volume infiltrated by the BMP was 79,781 cu-ft due to a 1.74-inch rain event, which represents 256% of the total storage capacity of the system. Storm-specific rainfall and volume reduction data is provided on **Chart C.4** of **Appendix C**.

Table 5-3: St. Albans Street Volume Reduction

Monitoring Period	5/20/25 – 11/01/25	
Total Rainfall	22.12 in	
System Water Balance		
Aurora Runoff Volume:	259,911	cu-ft
Aurora Bypassed Volume:	64,205	cu-ft
St. Albans and University Volume	174,138	cu-ft
St. Albans System Performance		
Total Runoff Volume	498,255	cu-ft
Runoff Yield	22.12	in/acre
Total Runoff Volume Captured	370,787	cu-ft
Percent of Runoff Volume Captured:	85.2	%
Maximum Volume Discharge to BMP	79,781	cu-ft
Maximum Percentage of Storage Volume Utilized ¹	256	%

¹ This is the maximum volume infiltrated by the BMP for a treatment event as a percentage of the total storage volume.

5.3. Pollutant Removal Monitoring

A water quality sampler was placed in the diversion structure at the intersection of St. Albans and Aurora Ave. to collect samples during runoff events. The sampler was paced to collect samples at equal volume intervals to provide a representative sampling of each storm event. Samples for each event were tested as a composite to provide EMC during each event for each parameter analyzed. Grab samples were collected in the diversions structure near the automated sampler quarterly and tested for *E. Coli*. See **Charts C.3** and **C.4** of **Appendix C** for the complete water quality summary and pollutant loading calculations.

Table 5-4 below provides a load reduction summary for the loading parameters defined in NPDES Permit issued to the City in addition to ortho-phosphate. During the monitoring period, 3,142 pounds of TSS and 9.69 pounds of TP were captured by the system.

Table 5-4: St. Albans Load/Capture Summary

Monitoring Period		5/20/2025 – 11/01/25		
Total Rain		22.12		
Water Quality Parameter	Flow Weighted Average (mg/L)	Total Pollutant Load (lbs.)	Load Captured (lbs.)	Percent Reduction %
Total Suspended Solids	45.4	1006	716	71.2
Volatile Suspended Solids*	51.5*	977*	597	61.1*
Total Dissolved Solids	119.6	2,609	1,782	68.3
Total Phosphorus	0.33	6.50	4.58	70.5
Ortho-phosphate	0.046	0.99	0.68	68.4
Chloride	5.1	106.5	71.57	67.2
Total Kjeldahl Nitrogen	0.65*	14.9	10.97	73.6
Nitrate + Nitrite as N	0.44	9.9	7.13	72.0
*Five-year average				

5.4. Maintenance Inspection

The pretreatment device and the underground infiltration system were inspected during site visits to evaluate maintenance needs of the BMP. As shown in **Table 5-5**, minimal sediment was observed in both the pretreatment device and the infiltration gallery. Garbage was observed in the pretreatment and infiltration gallery. Water level monitoring in the infiltration gallery confirms that the system is regularly drawn down to empty, which is consistent with no standing water observed during most BMP inspection visits. See **Appendix E** for the **Photolog**.

Table 5-5: St. Albans Maintenance Inspections

Date	Sediment Depth in Pre-treatment (ft)	Sediment Depth in Infiltration Gallery (ft)	Standing Water in Infiltration Gallery?	Observations
5/15/2025	0.1	0.2	Yes	Trash, organic debris
6/6/2025	0.1	0.3	Yes	Trash in east pipe, no trash in west pipe.
7/7/25	0.1	0.32	No	Trash
System cleaned on 8/7/2025				
8/21/25	0.0	0.0	No	trace debris
9/17/25	0.0	0.0	No	Some trash
10/9/2025	0.1	0.1	No	Trash

6. Hampden Park

The Hampden Park infiltration gallery, shown in **Figure 6-1**, was constructed in 2014. The system consists of eight parallel perforated pipes that are 5 ft in diameter, and range in length from 40 to 100 ft. Runoff is routed to the system via a 24-inch RCP from the storm sewer line near Hampden and Raymond Avenues. Prior to entering the infiltration gallery, stormwater passes through a Vortechs pre-treatment chamber for particle settling. The infiltration gallery receives flow from a second inlet location along Hampden Avenue, farther to the north. When the system reaches full capacity, stormwater is routed back to the storm sewer via a 24-inch pipe from the southeast side of the system. Rainfall monitoring is conducted on top of the Hampden Park Co-Op across the street from the park. Monitoring has been conducted at the site since 2014. The BMP system details are provided in **Table 6-1** below.



Photo 6-1: Hampden Park BMP Construction

Table 6-1 Hampden Park BMP Details

Total Drainage Area to BMP	7.8 acres
Year Constructed	2014
Total Construction Cost	\$687,132
Total Storage Volume	31,808 cu-ft
Volume Reduction Credit Received by the City of Saint Paul – Public Works	24,908 cu-ft
Volume Reduction Credit Received by the City of Saint Paul – Parks and Recreation	6,900 cu-ft

6.1. Water Level and Infiltration Rate Monitoring

Water levels were monitored within the underground infiltration system and groundwater (P2), using electronic water level loggers. Water levels and daily rainfall for 2025 are provided on **Chart A.8** and **A.9** of **Appendix A**. Water levels within the BMP ranged from 0 to 2.8 ft. The BMP water level must exceed 6.5 ft for the system to reach capacity and for water to be conveyed back to the sewer system. Based on the 2025 level data, no flow discharged back to the sewer system. In 2025, infiltration rates increased compared to 2024 but show a generally declining trend since 2023.

The 2025 infiltration rates are presented on **Chart A.10** of **Appendix A** and are adjusted for incremental volume flow. The adjusted average infiltration rate for the BMP was 10.98 in/hr., which is above the design infiltration rate of 1.8 in/hr. Infiltration rates at the base of site during construction were calculated to be, on average, 60 in/hr. using a Double Ring Infiltrometer (DRI). Infiltration rate trends are depicted on **Chart A.11**. Water level data shows that all 2025 events were infiltrated within 8 hours of a treatment event.

Table 6-2: Hampden Park Infiltration Rate

Location	Average Infiltration Rate (in/hr)									
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Hampden Park BMP	14.38	8.30	11.19	11.57	41.09	21.27	10.93	13.60	9.99	10.98

6.2. Volume Reduction Monitoring

One flow meter was installed within the 24-inch RCP diverting flow from the storm sewer to the BMP from the intersection of Hampden and Raymond Avenues. The metered drainage area consists of 6.7 acres of the total 7.8-acre drainage area to the BMP. The 2025 flow rates and daily rainfall are depicted in **Chart B.3** of **Appendix B**. No discharge was observed at the system outlet therefore that data is not plotted.

In 2025, the total monitored runoff was 330,055 cu-ft. Since the monitored level within the BMP did not reach the discharge outlet, 100% of the runoff was infiltrated by the system (**Table 6-3**). The total water yield for the 7.8-acre drainage area is 42,315 cu-ft/acre which is equivalent to 11.6 inches of runoff because of 23.67 inches of total rain (49%). The greatest volume received by the BMP was 31,578 cu-ft because of a 2.50-inch rain event on June 25th, 2025. This volume represents 99% of the total storage capacity of the system. Storm-specific rainfall and volume reduction data is provided on **Chart C.6** of **Appendix C**.

Table 6-3: Hampden Park Volume Reduction

Monitoring Period	5/15/25 – 10/31/25	
Total Rainfall	23.67	in
Hampden Park Water Balance		
Raymond/Hampden Runoff Volume ¹	330,055	cu-ft
System Bypass Volume	0	cu-ft
Hampden Park System Performance		
Total Runoff Volume	330,055	cu-ft
Runoff Yield	11.6	in/acre
Total Runoff Volume Captured	330,055	cu-ft
Percent of Runoff Volume Captured	100	%
Maximum Event Volume Captured by BMP	31,578	cu-ft
Maximum Percentage of Storage Volume Utilized ²	99	%

¹ – The second system inlet along Hampden Avenue is not monitored, and the volume discharged to the system from that location is estimated based on monitored data at Hampden/Raymond and the ratio of the drainage areas.

² - This is the maximum volume infiltrated by the BMP for a treatment event as a percentage of the total storage volume.

6.3. Pollutant Removal Monitoring

A water quality sampler was placed at the intersection of Hampden and Raymond Avenues to collect samples during runoff events. The sampler was paced to collect samples at equal volume intervals to provide a representative sampling of each storm event. Samples for each event were tested as a composite to provide EMC during each event for each parameter analyzed. Grab samples were collected in the 24 in RCP near the automated sampler quarterly and tested for *E. Coli*. See **Charts C.5** and **C.6** of **Appendix C** for the complete water quality summary and pollutant loading calculations.

Table 6-4 below provides a load reduction summary for the loading parameters defined in NPDES Permit issued to the City in addition to ortho-phosphate. During the monitoring period, 3,731 pounds of TSS and 26.84 pounds of TP were captured by the system. The percentage captured for all parameters was 100% in 2025.

Table 6-4: Hampden Park/Capture Summary

Monitoring Period		5/15/25 – 10/31/25		
Total Rain (in)		23.67		
Water Quality Parameter	Flow Weighted Average (mg/L)	Total Pollutant Load (lbs)	Load Captured (lbs)	Percent Reduction %
Total Suspended Solids	149.0	3,731	3,731	100
Volatile Suspended Solids*	31.86	652	652	100
Total Dissolved Solids	46.9	967	967	100
Total Phosphorus*	0.2	26.84	26.84	100
Orthophosphate	0.026	0.53	0.53	100
Chloride	6.1	126.1	126.1	100
Total Kjeldahl Nitrogen*	1.40	28.5	28.5	100
Nitrate + Nitrite as N	0.23	4.7	4.7	100

6.4. Maintenance Inspection

Sediment depths in the pretreatment structure and in the underground infiltration system were measured during site visits to determine performance and maintenance needs. As shown in **Table 6-5**, minimal sediment was observed in both the pretreatment device and infiltration gallery after maintenance was completed on July 18, 2024.

Table 6-5: Hampden Park BMP Maintenance Inspection

Date	Sediment Depth in Pre-treatment (ft)	Sediment Depth in Infiltration Gallery (ft)	Standing water in Infiltration Gallery?	Observations
5/15/25	0.2	0.2	No	Vegetation mats forming on surface of water.
6/6/25	0.2	0.2	No	Mat of vegetation on surface of water in pretreatment chamber
7/7/25	0.4	0.5	No	Trash and leaves in pretreatment chamber
Pretreatment chamber cleaned on 7/30/2025				
8/21/25	0.0	0.0	No	No deep spots of sediment present in pretreatment chamber
9/17/25	1.2	0.1	No	Some trash
10/9/25	3.6	0.3	No	Sheen in pre-treatment, vegetation and trash mix, about 3.6' of sediment accumulation in pretreatment.

7. Victoria Street

Victoria Street monitoring site is located just East of Orchard Recreation Center and includes a permeable paver parking lane. The northern cap of the BMP was damaged and replaced in 2024. Stormwater runoff within the 19.1-acre sub watershed is diverted from the main storm sewer to the underground system. When the system has reached its storage capacity, runoff continues to flow downstream through the storm sewer. The system includes a pretreatment structure consisting of a grit chamber for sediment capture and a baffled weir for skimming. In addition, the runoff from Victoria Street flows to the permeable paver parking lane, passes through a layer of stone aggregate below the pavers and is collected by a drain tile pipe. The drain tile discharges the runoff into the underground infiltration system. Rainfall monitoring is conducted on top of Fire Station 18. The BMP system details are provided in **Table 7-1** below.

Table 7-1 Victoria Street BMP Details

Total Drainage Area to BMP	19.1 acres
Year Constructed	2010
Total Construction Cost	\$174,000
Total Storage Volume	16,714 cu-ft
Volume Reduction Credit Received by the City of Saint Paul – Public Works	16,714 cu-ft

This system consists of one 384-foot-long, 60-inch-diameter perforated HDPE pipe located below a permeable paver parking lane. It was constructed to meet the volume reduction requirements for the Front/Victoria Residential Street Vitality Program (RSVP) project.

7.1. Water Level and Infiltration Rate Monitoring

In 2025, water levels were monitored continuously in the access manhole at the north end of the underground system along Victoria Street. Water levels were monitored within the underground infiltration using an electronic water level logger. Water levels and daily rainfall for 2025 are provided on **Chart A.12** of **Appendix A**. Water level within the BMP ranged from 0 to 7.7 ft. The BMP water level must exceed 5 ft for the system to reach capacity and for water to flow to the sewer system. Based on the 2025 level data, the system reached capacity 12 times.

The 2025 infiltration rates are presented in **Chart A.13** of **Appendix A** and are adjusted for incremental volume flow. The adjusted average infiltration rate for the BMP was 13.73 in/hr., which is greater than the design infiltration rate of 12.8 in/hr. Infiltration rates at the base of the system during construction were calculated to be, on average, 95.9 in/hr. using a Double Ring Infiltrometer (DRI). Infiltration rate trends are depicted in **Chart A.14**. Water level data shows that all 2025 events were infiltrated within 4 hours of a treatment event.

Table 7-2: Victoria Street Infiltration Rate
Average Infiltration Rate (in/hr)

Location	Average Infiltration Rate (in/hr)								
	2012	2013	2019	2020	2021	2022	2023	2024	2025
Victoria Street BMP	46.56	48.04	21.08	48.80	25.52	45.07	42.34	16.08	13.37

7.2. Volume Reduction Monitoring

One flow meter was installed upstream of the system and one flow meter downstream of the diversion structure located near the intersection of Victoria Street and Orchard Avenue. The metered drainage area consists of 19.1 acres and drains to the BMP. The 2025 flow rates and daily rainfall are depicted in **Chart B.4** of **Appendix B**.

In 2025, the total runoff to the Victoria Street system was 471,781 cu-ft. The system captured 82.8% of that volume (**Table 7-3**). The total water yield for the 19.1-acre drainage area is 24,701 cu-ft/acre which is equivalent to 6.8 inches of runoff because of 23.76 inches of rain (33%). The greatest volume infiltrated by the BMP was 45,309 cu-ft from a 1.76-inch rain event on May 20, 2025. This volume represents 271% of the total storage capacity of the system. Storm-specific rainfall and volume reduction data is provided on **Chart C.8** of **Appendix C**.

Table 7-3: Victoria Street Volume Reduction

Monitoring Period	5/15/25 – 10/31/25	
Total Rainfall	23.78	in
Victoria Street Water Balance		
Runoff Volume	535,797	
System Bypass Volume	81,257	
Victoria Street System Performance		
Total Runoff Volume	535,797	cu-ft
Runoff Yield	6.8	in/acre
Total Runoff Volume Captured	471,781	cu-ft
Percent of Runoff Volume Captured	82.8	%
Maximum Event Volume Captured by BMP	45,309	cu-ft
Maximum Percentage of Storage Volume Utilized ¹	271	%

¹ This is the maximum volume infiltrated by the BMP for a treatment event as a percentage of the total storage volume.

7.3. Pollutant Removal Monitoring

A water quality sampler was placed in the diversion structure to collect samples during runoff events. The sampler was paced to collect samples at equal volume intervals to provide a representative sampling of each storm event. Samples for each event were tested as a composite to provide EMC's for each event for each parameter analyzed. Grab samples were also collected in the diversion manhole near the automated sampler quarterly and tested for *E. Coli*. See **Charts C.7** and **C.8** of **Appendix C** for the complete water quality summary and pollutant loading calculations.

Table 7-4 below provides a load reduction summary for the loading parameters defined in NPDES Permit issued to the City in addition to orthophosphate. During the monitoring period, 3,903 pounds of TSS and 6.7 pounds of TP were captured by the system. The percentage captured for all parameters was 91.5 in 2024.

Table 7-4: Victoria Street Load/Capture Summary

Monitoring Period		5/15/25 – 10/31/25		
Total Rainfall		23.78		
Water Quality Parameter	Flow Weighted Average (mg/L)	Total Pollutant Load (lbs.)	Load Captured (lbs.)	Percent Reduction %
Total Suspended Solids	146.7	4,105	3,390.5	82.6
Volatile Suspended Solids*	50.7	1,457	1,236.2	84.8
Total Dissolved Solids	38.1	1,113	960.7	86.3
Total Phosphorus*	0.59	16.8	14.3	84.8
Orthophosphate	0.04	1.4	1.2	87.5
Chloride	5.1	145.8	123.9	84.9
Total Kjeldahl Nitrogen*	2.75	79.2	67.2	84.8
Nitrate + Nitrite as N	0.38	11.5	10.1	88.1

7.4. Maintenance Inspection

Sediment depths in the pretreatment structure and in the underground infiltration system were measured during site visits to determine performance and maintenance needs. As shown in **Table 7-5**, minimal sediment was observed in both the pretreatment device and infiltration gallery.

Table 7-5: Victoria Street BMP Maintenance Inspection

Date	Sediment Depth in Pre-treatment (ft)	Sediment Depth in Infiltration Gallery (ft)	Standing water in Infiltration Gallery?	Observations
5/15/25	0.2	1.0	No	Organic debris, some trash in infiltration gallery
6/6/25	0.25	1.9	No	Leafy debris in pretreatment, garbage in infiltration gallery.
7/7/25	0.3	2.0	No	Trash in pretreatment
System cleaned 8/11/2025				
8/21/25	0.0	0.0	No	Trace debris
9/17/25	0.1	0.1	No	Trash and organic debris
10/9/25	0.1	0.1	No	Leaves and grass

8. East Phalen

The East Phalen monitoring location is at the intersection of Clarence St. and Ivy Ave E. in Saint Paul, MN and is a part of the Upper Mississippi-Crow- Rum drainage basin, the City of St. Paul-Mississippi River watershed and the Lake Phalen sub watershed. Lake Phalen is the farthest downstream lake in the Phalen Chain of Lakes, while the direct tributary area to the lake is close to 2,000 acres, the total land area that ultimately drains through Lake Phalen is closer to 15,000 acres including the Keller Lake and Wakefield Lake sub-watersheds. Monitoring in the East Phalen region was initiated in 2025.



Photo 8-1: East Phalen Stormwater site monitoring

8.1. Volume Monitoring

A flow meter and ISCO auto-sampler were placed in the intersection of Clarence and Ivy Street. A flow sensor was placed in the south inlet. The 2025 flow rates, Phalen wetland water level data and daily rainfall are depicted in **Chart B.5** of **Appendix B**. The full monitoring season was unable to be captured due to the late selection of this location.

In 2025, the total runoff to this intersection was 341,30149 cf. The volume summary can be found below in Table **8-3**. The total water yield for the 48.0-acre drainage area is 6,459 cu-ft/acre which is equivalent to 1.78 inches of runoff because of 12.15 inches of rain (15%). The greatest volume recorded was 37,810 cu-ft from a 1.67-inch rain event on September 20, 2026. Water quality results can be found in **Appendix C.9**.

Table 8-2: East Phalen Volume Summary

Monitoring Period	7/25/26 – 10/24/26
Total Rainfall	12.15 in
East Phalen Pond Water Balance	
Runoff Volume	341,019 cu-ft
East Phalen System Performance	
Total Runoff Volume	314,019 cu-ft
Runoff Yield	1.78 in/acre
Maximum Event Volume	37,810 cu-ft

9. Allianz Field Soccer Stadium

The Allianz Field Soccer Stadium is a filtration chamber located on the north side of interstate 94, between Snelling Avenue and Pascal Street in the Midway neighborhood of Saint Paul, Minnesota. Allianz Field was designed with multiple “Shared Stacked Green Infrastructure” (SSGI) to collect, treat, and reuse stormwater from this area and protect the Mississippi River from storm water pollution. Beneath the Allianz Field parking lot lies four underground storage tanks, three tanks are dedicated to rate control and treatment and one dedicated to storm water reuse. The stormwater tank is a 90,000 cubic-foot Steel Reinforced Polyethylene (SRPE) pipe. The drainage area of this site is 11.18 acres and can be seen in **Figure 9-1**. Cleaning and inspections of the Allianz field BMP were done between 10/13/2025 through 10/28/2025.

9.1. Water Level Monitoring

Water level loggers were placed in tank C, and the filter cartridge chamber. Water levels and rainfall in tank C and the filter cartridge chamber can be found **Appendix A**.

9.2. Volume and Pollutant Monitoring

A flow meter and water quality sampler were installed in the manhole and pipe entering tank C to monitor flow and water quality entering the tank. Another flow meter placed downstream of the filter cartridge chamber. The monitoring conditions were challenging, so not enough data was collected to determine pollutant reductions. With a full monitoring season, we expect to have better data collection in 2026. The 2025 flow rates can be found in **Appendix B** and collected water quality data can be found in **Appendix C**.

During the 2025 monitoring period, the total event volume moving through the system downstream of the filter chamber was 290,273 cu-ft (**Table 9-2**). The total water yield for the 19.1-acre drainage area is 15,198 cu-ft/acre. The greatest event-based volume moving through the system was 20,369 cu-ft because of a 2.15-inch rain event on August 5, 2024.

Table 9-2: Allianz Field Volume Summary

Monitoring Period	5/9/2025 – 10/13/2025	
Total Rainfall	24.35	
Allianz Field Water Balance		
Total Volume	290,273	cu-ft
Maximum Event Volume	20,369	cu-ft

10. River Level Monitoring

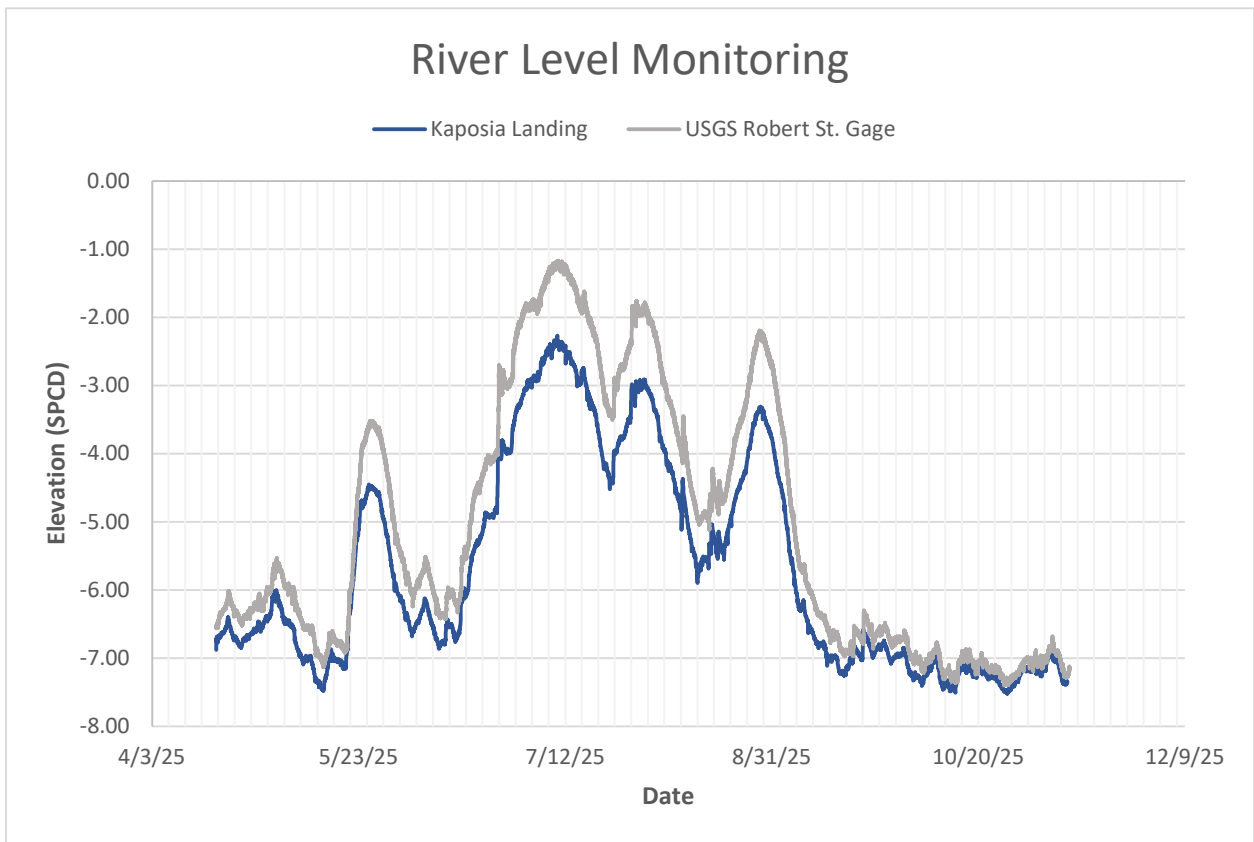
To determine elevations of the Mississippi River in relation to the United States Geological Survey (USGS) monitoring station at the Robert Street Bridge, a water level logger was installed within the Mississippi River located near an outfall at Kaposia Landing. A correlation between the two sites is difficult and seems to change based on the river height. The elevation at Kaposia Landing was 0.03 feet below the USGS monitoring station. A logger at Lilydale was lost during high-water. During this lower water period, the Kaposia and the USGS station were almost identical.

Table 10-1 depicts the difference between river monitoring locations as well as their approximate river mile location. **Chart 10-1** shows an estimation of river level based off the monitored water level measurements and compared to the continuous USGS monitoring station near Robert Street Bridge.

Table 10-1

	USGS	Kaposia Landing
Approximate River Mile	839.25	835.4
Mile Difference from USGS		Downstream 3.85 miles
Difference from USGS		-0.03 ft

Chart 10-1



11. Pervious Surface Infiltration Assessment

The city has been monitoring the performance of pervious pavement BMPs constructed in the city since 2012. Pervious pavement was constructed with substantial void space to allow for infiltration or filtration of stormwater through the pavement surface as a means of stormwater management. Pervious pavement BMPs monitored in the city include porous asphalt and permeable interlocking concrete pavers. The purpose of the infiltration testing is to monitor the change in site conditions and infiltration capability of the BMPs overtime. Pavement maintenance is also monitored to study the effect of routine and rehabilitative maintenance on these BMPs. The pervious pavement installed on Jackson and Victoria Street have both gradually become ineffective as an infiltration system since the installation in 2012. In 2025, only one location along Jackson Street infiltrated and no locations along Victoria were infiltrated.

Infiltration testing was completed at the Jackson Street Pervious Bike Path BMP in August and November in 2025. Victoria Street pervious surface was tested in November of 2025. The Infiltration testing methodologies are described in **Section 2.5**. A photolog of infiltration testing is provided in the **Appendix**.

11.1. Victoria Street

The Victoria Street pervious surface consists of a parking area completed with permeable concrete pavers designed to receive stormwater runoff from Victoria Street and the properties adjacent to it. The pavers themselves are non-permeable, and they are separated with aggregate fill (**Photo 11-1** and **11-2**). The spaces between the pavers allow stormwater runoff to infiltrate into the parking surface instead of running off and being collected by the storm sewer system. The pavers were installed in 2011, and infiltration rates have been monitored annually since 2012. The site and the infiltration test locations are provided on **Figure 11-1**. Street sweeping occurred on 4/22/2025, 9/30/2025 and 10/27/2025.



Photo 11-1: Victoria Street Pavers



Photo 11-2: Victoria Street Infiltration Testing

Infiltration Test Results and Observations

Five locations were tested for infiltration at the Victoria Street site. In 2025, the test locations are the same tested in November 2023, identified as A-E (these locations were used since 2016). Those locations are depicted in **Figure 10-1** and the results of the testing are presented in **Table 11-1** and **Chart D.2** in **Appendix D**.

A summary of the infiltration test results throughout the years are provided below.

Table 11-1: Victoria Street Infiltration Rate Summary

Infiltration Ring Location	2012 Infill Rate (in/hr)	2013 Infill Rate (in/hr)	2014 Infill Rate (in/hr)	2015 Infill Rate (in/hr)	2016 Infill Rate (in/hr)	2017 Infill Rate (in/hr)	2018 Infill Rate (in/hr)	2019 Infill Rate (in/hr)	2020 Infill Rate (in/hr)	2021 Infill Rate (in/hr)	2022 Infill Rate (in/hr)	2023 Infill Rate (in/hr)	2025 Infill Rate (in/hr)
IR-1 (E)	168.6	18.1	0.00	15.1	17.8	3.41	14.5	15.9	4.9	15.6	14.8	0.0	0.0
IR-2 (A)	266.6	75.7	12.9	0.0	19.4	3.8	11.5	4.1	4.7	8.8	7.0	9.7	0.0
IR-3 (B)	271.1	92.2	18.6	3.4	23.0	10.1	16.9	4.4	9.4	10.1	5.3	0.0	0.0
IR-4 (C)	69.1	24.0	9.7	0.0	6.6	28.9	6.3	4.0	3.7	0.0	9.5	5.4	0.0
IR-5 (D)	149.8	49.2	30.8	0.0	0.0	0.0	1.9	4.2	6.6	15.0	3.6	0.0	0.0
Average	185.04	51.84	14.40	3.71	13.33	9.23	10.21	6.51	5.84	9.91	8.04	3.02	0.0

- Average infiltration rate in 2025 was 0.0 in/hr. A significant decrease from previous years such as 2023 (3.02 in/hr.), 2022 (8.04 in/hr.) and 2021 (9.91 in/hr.).
- Infiltration rates dropped to 0 in/hr. at all locations in 2025.



Photo 11-3: Location D Pre-Test



Photo 11-4: Location D Infiltration Test

11.2. Jackson Street

The Jackson Street BMP (**Photo 11-5** and **11-6**) is a designated bike path constructed of pervious asphalt. It is a section of the Capital City Bikeway (CCB), a system of off-street bicycle trails in downtown Saint Paul. The BMP is eight blocks long, stretching from Kellogg Street to 11th Street, and consists of 2,750 square yards of pervious asphalt. Stormwater runoff filters through the asphalt and underlying media and is then conveyed to the storm sewer system via drain tile.

Monitoring locations JS-1 through JS-11 were established in November 2016 upon completion of the four-block stretch from Kellogg Boulevard to 7th Place East. Monitoring locations JS-12 through JS-18 were established in November 2017 upon completion of the four-block stretch from 7th Place East to 11th street. The monitoring locations were carefully selected to evaluate sediment loading and asphalt compaction from varying levels of pedestrian and vehicular traffic. Each site was characterized into one of three groups, identified in **Table 11-2**, based on their location and surroundings. The site and infiltration test locations are depicted in **Figure 11-2**. Site photos are provided in **Appendix E**. Jackson Street permeable pavement was swept on 4/18/2025.

Table 11-2: Monitoring Site Traffic Characterization

Site Traffic Characterization
Low: No driving and minimal foot traffic area. Adjacent to planter or minimal impervious surface.
Medium: Pedestrian cross walks or adjacent to large areas of impervious surface.
High: Driveways for parking or businesses, heavy vehicular traffic.



Photo 11-5: Capital City Bikeway (CCB) – Jackson Street/Kellogg Avenue



Photo 11-6: Jackson Street Infiltration Test

Infiltration Test Results and Observations

The site was tested for infiltration in August 2023. The infiltration test results from the 18 locations are summarized in **Chart 11-1** and **Chart D.2** in **Appendix D**, which includes all infiltration test results completed to-date. **Table 11-3** is color coded to identify the site traffic characterizations described above. The infiltration tests results are also summarized in **Table 11-3**, which presents an average infiltration rate based on the monitoring location traffic characterization. The infiltration test locations are depicted in **Figure 11-2**.

2025 STORMWATER QUALITY AND QUANTITY MONITORING PROGRAM

Table 11-3: Jackson Street Infiltration Rate Summary (in/hr)

Location	Test Location Description	Nov 2016 Infill Rate	Jun 2017 Infill Rate	Nov 2017 Infill Rate	Jul 2018 Infill Rate	Oct 2018 Infill Rate	Jul 2019 Infill Rate	Oct 2019 Infill Rate	Jul 2020 Infill Rate	Nov 2020 Infill Rate	Aug 2021 Infill Rate	Nov 2021 Infill Rate	Aug 2022 Infill Rate	Aug 2023 Infill Rate	Nov 2023 Infill Rate	Oct 2024 Infill Rate	Aug 2025 Infill Rate	Nov 2025 Infill Rate
JS-1	Northern half of Securian ramp entrance. Non-painted surface east of path center line.	572.6	9.3	3.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JS-2	Midline of Securian ramp entrance. Non-painted surface east of path center line.	750.4	6.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JS-3	Jackson Street pedestrian crosses south of 6th Street. Near midline of bike path.	1282.1	1069.0	793.8	642.2	247.1	67.1	30.4	7.0	0.0	0	0	0	0	0	0	0	0
JS-4	Midblock between 6th & 5th Street. North of skyway. Near midline of bike path.	2122.2	1520.1	1372.0	1026.7	733.7	1050.1	764.4	516.3	299.9	254.1	253.7	46.1	149.9	38.1	0	0	0
JS-5	345 parking ramp entrance. Non-painted surface just north of the midline of the entrance. Midline of bike path.	385.9	4.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2025 STORMWATER QUALITY AND QUANTITY MONITORING PROGRAM

JS-6	345 parking ramp entrance. Green painted stripe farthest south. West side of bike path.	118.7	12.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JS-7	Jackson Street pedestrian crosses north of 4th Street. Near midline of bike path.	533.7	353.9	181.7	73.7	29.4	0	0	0	0	0	0	0	0	0	0	0	0
JS-8	Midblock between 4th & Kellogg. Western edge of bike path (adjacent to concrete).	177.5	275.3	90.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JS-9	Midblock between 4th & Kellogg. Eastern side of bike path.	277.9	56.1	2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JS-10	In line with the southern wall of the US Courthouse (facing Kellogg). Western edge of bike path adjacent to concrete.	557.9	125.5	2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Location	Test Location Description	Nov 2016 Infill Rate	Jun 2017 Infill Rate	Nov 2017 Infill Rate	Jul 2018 Infill Rate	Oct 2018 Infill Rate	Jul 2019 Infill Rate	Oct 2019 Infill Rate	Jul 2020 Infill Rate	Nov 2020 Infill Rate	Aug 2021 Infill Rate	Nov 2021 Infill Rate	Aug 2022 Infill Rate	Aug 2023 Infill Rate	Nov 2023 Infill Rate	Oct 2024 Infill Rate	Aug 2025 Infill Rate	Nov 2025 Infill Rate

2025 STORMWATER QUALITY AND QUANTITY MONITORING PROGRAM

JS-11	In line with the southern wall of the US Courthouse (facing Kellogg). On the Eastern side of the bike path.	471.5	125.4	35.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JS-12	N of Credit Union Driveway between 11th St. and 10th St Midline of bike path, next to a planter.	NE	NE	843.3	827.2	877.1	710.5	633.3	620.4	572.0	442.7	432.0	274.3	0	0	0	0	0
JS-13	In front of Child Care Center between 11th St. and 10th St. Western edge of bike path, next to a planter.	NE	NE	1246.7	1696.9	1179.2	889.5	809.6	608.6	839.8	537.8	753.0	69.8	0	13.0	38.5	0	0
JS-14	S of 10th St. Adjacent to planter (2nd weir). Between Western edge and bike path midline.	NE	NE	464.4	575.1	447.5	323.3	211.4	207.8	195.4	148.9	128.7	7.9	10.4	0	0	0	0
JS-15	Firestone driveway, N of 2nd strip from the S.	NE	NE	100.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JS-16	Pedestrian cross, SW intersection of Jackson and 9 th .	NE	NE	1104.4	190.1	9.0	0	0	0	0	0	0	0	0	0	0	0	0

2025 STORMWATER QUALITY AND QUANTITY MONITORING PROGRAM

JS-17	Mid-block of 9th St. and 7th St. Adjacent to planter (southern-most tree). Just W of bike path midline.	NE	NE	1670.0	1605.0	1369.7	1329.5	1082.1	1343.2	640.1	1263.5	1194.5	1174.0	744.4	888.6	661.1	679.5	732.2
JS-18	Pedestrian cross, NW intersection of Jackson and 7th Pl. Adjacent to large concrete area.	NE	NE	665.4	589.6	521.5	215.7	327.7	160.4	115.5	33.0	0	0	0	0	0	0	0
Site Average:		659.1	323.4	476.5	401.5	300.8	254.8	214.4	192.4	147.9	148.9	153.4	87.3	50.3	52.2	38.9	37.7	40.7
Average of Sites JS-1 through JS-11 (established Nov 2016):				225.6	158.4	91.8	558.6	72.3	47.6	27.3	23.1	23.1	4.2	13.6	3.5	0.0	0.0	0.0
Average of Sites JS-12 through JS-18 (established Nov 2017):				870.6	783.4	629.1	693.7	437.7	420.1	337.5	346.6	358.3	218.0	107.8	128.8	99.9	97.1	104.6

NE – Not Established

Table 11-3: Jackson Street Infiltration Summary by Site Traffic Characterization

Site Traffic Characterization	Nov 16	Jun 17	Nov 17	Jul 18	Oct 18	Jul 19	Oct 19	Jul 20	Nov 20	Au 21	Nov 21	Aug 22	Aug 23	Nov 23	Oct 24	Aug 25	Nov 25
Low: No driving and minimal foot traffic area. Adjacent to planter or minimal impervious surface.	2122	1520	1119	1146	921	861	700	659	509	529	552	314	181	188	140	136	0
Medium: Pedestrian cross walks or adjacent to large areas of impervious surface.	550	334	360	187	101	35	45	21	14	4	0	0	0	0	0	0	92
High: Driveways for parking or businesses, heavy vehicular traffic.	457	8	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A summary of the 2025 infiltration testing completed at the Jackson Street Pervious Pavement Site is provided below:

- The overall site infiltration rate was 39.2 inches per hour (in/hr.) in 2025
 - 16 of 18 locations showed no infiltration rate in 2025.
 - Of the two locations where infiltration occurred, infiltrations rates ranged from 679.5 in/hr. to 732.2 in/hr.
- Low traffic areas had an average infiltration rate of 140 in/hr. in 2025.
- Medium traffic areas had an average infiltration rate of 91.5 in/hr. in 2025.
 - Locations JS-7 through JS-11 are within the first constructed section of the pervious pavement near the Jackson Street and Kellogg Boulevard intersection. These locations have not shown any infiltration since October 2018.
- High traffic areas had an infiltration rate of 0.0 in/hr. in 2025.
 - High traffic locations have not shown any infiltration since November 2017.

The permeable pavement systems installed in 2012 on Jackson Street and Victoria Street are no longer functioning effectively as infiltration systems. Over the past 13 years, infiltration capacity has significantly diminished, and 2025 monitoring results show infiltration at only one location on Jackson Street and none on Victoria Street.



Photo 11-7: Test Locations JS-1 and JS-2 (high traffic)

12. City-wide Loading Assessment

12.1. 2025 Pollutant Loading Calculations

Monitoring major outfalls within the City of Saint Paul was completed by the Capitol Region Watershed District (CRWD) in 2025. Annual and seasonal pollutant loads were estimated for each sub watershed within the city for the loading parameters identified in the City's MS4 permit which include chloride (Cl), Total Kjeldahl Nitrogen (TKN), Total Phosphorus (TP), Nitrate Plus Nitrite (NO₃+NO₂), Total Suspended Solids (TSS), and Volatile Suspended Solids (VSS). The sub watersheds within the city are included in **Table 12-1** below.

Monitoring data collected by CRWD from the following sub watersheds was utilized for this assessment: East Kittsondale, St. Anthony Park, and Trout Brook. Monitoring of each sub watershed was completed at or near the outfall. The stations were configured to collect continuous flow measurements, and water quality, in accordance with the City's MS4 Permit.

Table 12-1 Watershed Inventory

Watershed	Area [acre]	Runoff Coefficient [.]	Rainfall Station
Battle Creek	1106	0.54	Trout Brook
Beaver Lake	192	0.33	Trout Brook
Belt Line	3014	0.55	Trout Brook
Crosby	1679	0.45	Hampden Park Co-op
Davern	1302	0.55	Hampden Park Co-op
Downtown	550	0.75	CWRD Office
East Kittsondale	1872	0.62	CWRD Office
Fish Creek	46	0.52	Trout Brook
Goodrich/Western	424	0.63	CWRD Office
Griffith/Pt. Douglas	460	0.61	Trout Brook
Hidden Falls	313	0.55	Hampden Park Co-op
Highwood	1123	0.50	Trout Brook
Lake Como	1294	0.47	Hampden Park Co-op
Lake Phalen	1013	0.42	Trout Brook
Mississippi River Blvd.	2391	0.58	Hampden Park Co-op
MRWMO	135	0.70	Hampden Park Co-op
Phalen Creek	1405	0.62	Trout Brook
Pigs Eye	3001	0.40	Trout Brook
Riverview	1017	0.57	Trout Brook
St. Anthony Hill	2651	0.64	CWRD Office
St. Anthony Park	2481	0.68	Hampden Park Co-op
Trout Brook	3963	0.62	Trout Brook
Urban	327	0.57	Trout Brook
West Kittsondale	1042	0.67	Hampden Park Co-op
West Seventh	451	0.60	CWRD Office

Monitored Subwatershed

Annual and seasonal city-wide flow-weighted averages were calculated for each of the loading pollutants from the monitored outfall data. TKN, TP, TSS and VSS loads were generated by CRWD in the WISKI data management program. This allowed for the extraction of baseflow and the associated load from the event load for those parameters. CI and NO₂+NO₃ loads were calculated for the event-based volume (baseflow volume extracted), although the base flow loading for those parameters was not extracted. The following formula was used to calculate the annual/seasonal flow weighted mean concentrations (**Table 12-2**):

$$C = \frac{\sum(F_i \times C_i)}{\sum(F_i)}$$

C = annual/seasonal flow weighted mean concentration [mg/L]*

F_i = the event-based flow for an individual event [cf]

C_i = the pollutant concentration for an individual event [mg/L]

*As described above, the flow-weighted mean concentration for TKN, TP, TSS, and VSS, was calculated from loads generated in the WISKI program, which extracted baseflow loading (not reflected in the formula above)

Table 12-2: City-wide Annual and Seasonal Flow-weighted Mean Concentrations

Parameter	CI	TKN	TP	NO ₂ +NO ₃	TSS	VSS
Units	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]
Annual	279.2	2.0	0.40	0.62	201.0	47.7
Q1 (Jan-Mar)	824.1	2.4	0.35	0.76	228.6	44.7
Q2 (Apr-Jun)	242.7	2.0	0.35	0.60	218.0	52.5
Q3 (Jul-Sep)	224.8	1.8	0.37	0.59	189.5	40.5
Q4 (Oct-Dec)	331.9	2.0	0.61	0.70	167.4	50.3

Based on these calculated flow-weighted mean concentrations, the Simple Method was used to calculate each sub watershed’s pollutant loading. Loads for the four monitored sub watersheds were generated using actual monitored loads. The Simple Method is shown below:

$$L = 2.72 \left(\frac{PP_j R_v}{12} \right) (CA)$$

L = pollutant loading for the year/season [lb.]

P = rainfall depth for the year/season [in]

P_j = correction factor for storms that produce no runoff [.]

R_v = runoff coefficient [.]

C = flow-weighted mean concentration [mg/L]

A = area of the watershed [acre]

Values used in loading calculations:

R_v and A = Table 1

C = Table 2

P = Table 3

P_j = 0.85

The annual/seasonal precipitation totals for four different rainfall monitoring locations in St. Paul are provided in **Section 3** the **Table 3-1**. Each sub watershed was assigned precipitation data from the nearest precipitation monitoring site (see **Table 12-1** for assignments). The rainfall data was used as an input to the Simple Method for load calculations, as described above. Rain data outside the seasonal monitoring period was supplemented with data from the University of Minnesota – St. Paul.

2025 STORMWATER QUALITY AND QUANTITY MONITORING PROGRAM

The annual and seasonal pollutant loads for each of the City’s sub watersheds are presented in **Tables 12-3 – 12-7**. Loads for the five monitored sites are actual totals calculated for each station. Those sites are highlighted blue.

Table 12-3. Annual Pollutant Loadings (lbs.)

Subwatershed	CI	TKN	Total P	NO2+NO3	TSS	VSS
Battle Creek	254401	7118	1785	147513	561900	175236
Beaver Lake	26989	755	189	15649	59611	18590
Belt Line	706117	19756	4955	409437	1559610	486384
Crosby	344551	9640	2418	199785	761014	237332
Davern	326560	9137	2291	189354	721278	224940
Downtown	191032	5345	1340	110769	421936	131586
East Kittsondale	275143	4940	1074	275277	340023	141588
Fish Creek	10189	285	71	5908	22505	7018
Goodrich/Western	123706	3461	868	71730	273230	85210
Griffith/Pt. Douglas	119525	3344	839	69306	263996	82331
Hidden Falls	78505	2196	551	45521	173395	54075
Highwood	239178	6692	1678	138686	528275	164749
Lake Como	277346	7760	1946	160817	612578	191040
Lake Phalen	181230	5071	1272	105085	400284	124834
Mississippi River Blvd.	632408	17694	4437	366698	1396808	435613
MRWMO	43094	1206	302	24988	95183	29684
Phalen Creek	371055	10382	2604	215154	819555	255589
Pigs Eye	511325	14306	3588	296488	1129369	352208
Riverview	246926	6909	1733	143178	545388	170086
St. Anthony Hill	785729	21984	5513	455600	1735450	541222
St. Anthony Park	769353	21526	5398	446104	1699280	529942
Trout Brook	191686	8313	2242	1429	704874	183804
Urban	79395	2221	557	46037	175361	54689
West Kittsondale	318370	8908	2234	184605	703188	219298
West Seventh	125317	3506	879	72664	276790	86320

Table 12-4: Q1 (Jan-Mar) Pollutant Loading (lbs)

Subwatershed	CI	TKN	Total P	NO2+NO3	TSS	VSS
Battle Creek	161065	1457	248	115100	49945	16047
Beaver Lake	17087	155	26	12211	5299	1702
Belt Line	447052	4043	688	319471	138628	44541
Crosby	203758	1843	313	145609	63184	20301
Davern	193120	1747	297	138006	59885	19241
Downtown	111244	1006	171	79497	34496	11083
East Kittsondale	188167	1427	227	188193	30986	14259
Fish Creek	6451	58	10	4610	2000	643
Goodrich/Western	72038	652	111	51479	22338	7177
Griffith/Pt. Douglas	75673	684	116	54077	23466	7539
Hidden Falls	46426	420	71	33177	14396	4626
Highwood	151427	1370	233	108212	46956	15087
Lake Como	164015	1483	252	117208	50860	16341
Lake Phalen	114739	1038	176	81994	35580	11432
Mississippi River Blvd.	373990	3382	575	267259	115972	37261
MRWMO	25485	230	39	18212	7903	2539
Phalen Creek	234920	2125	361	167878	72847	23406
Pigs Eye	323727	2928	498	231340	100386	32254
Riverview	156332	1414	240	111718	48478	15576
St. Anthony Hill	457554	4138	704	326976	141884	45587
St. Anthony Park	454976	4115	700	325133	141085	45330
Trout Brook	75454	957	178	194	50761	12007
Urban	50266	455	77	35921	15587	5008
West Kittsondale	188276	1703	290	134545	58383	18758
West Seventh	72976	660	112	52150	22629	7271

Table 12-5: Q2 (Apr-Jun) Pollutant Loading (lbs)

Subwatershed	CI	TKN	Total P	NO2+NO3	TSS	VSS
Battle Creek	66670	3361	758	45845	241638	99561
Beaver Lake	7073	357	80	4864	25635	10562
Belt Line	185049	9328	2103	127246	670691	276342
Crosby	105696	5328	1201	72681	383086	157841
Davern	100178	5050	1139	68886	363083	149600
Downtown	56364	2841	641	38758	204285	84171
East Kittsondale	73225	2423	471	13896	215926	101519
Fish Creek	2670	135	30	1836	9678	3988
Goodrich/Western	36499	1840	415	25098	132288	54506
Griffith/Pt. Douglas	31323	1579	356	21539	113528	46777
Hidden Falls	24083	1214	274	16560	87285	35964
Highwood	62680	3160	712	43101	227178	93603
Lake Como	85080	4289	967	58504	308365	127054
Lake Phalen	47494	2394	540	32659	172137	70925
Mississippi River Blvd.	194001	9780	2205	133402	703137	289711
MRWMO	13220	666	150	9090	47914	19742
Phalen Creek	97241	4902	1105	66866	352439	145214
Pigs Eye	134001	6755	1523	92143	485671	200109
Riverview	64711	3262	735	44497	234537	96635
St. Anthony Hill	231829	11687	2635	159414	840240	346200
St. Anthony Park	236011	11898	2682	162289	855398	352446
Trout Brook	33870	3403	840	361	221830	73588
Urban	20807	1049	236	14307	75412	31072
West Kittsondale	97665	4923	1110	67158	353977	145848
West Seventh	36975	1864	420	25425	134011	55216

Table 12-6: Q3 (Jul-Sep) Pollutant Loading

Subwatershed	CI	TKN	Total P	NO2+NO3	TSS	VSS
Battle Creek	37614	2277	586	3678	224281	57661
Beaver Lake	3990	242	62	390	23794	6117
Belt Line	104402	6319	1626	10208	622515	160045
Crosby	45041	2726	701	4404	268566	69047
Davern	42690	2584	665	4174	254544	65442
Downtown	26221	1587	408	2564	156346	40195
East Kittsondale	7539	559	111	3227	40408	13911
Fish Creek	1506	91	23	147	8983	2309
Goodrich/Western	16980	1028	264	1660	101244	26029
Griffith/Pt. Douglas	17672	1070	275	1728	105373	27091
Hidden Falls	10263	621	160	1003	61192	15732
Highwood	35363	2140	551	3458	210860	54211
Lake Como	36256	2194	565	3545	216183	55579
Lake Phalen	26796	1622	417	2620	159773	41077
Mississippi River Blvd.	82672	5004	1287	8083	492942	126732
MRWMO	5634	341	88	551	33591	8636
Phalen Creek	54862	3321	854	5364	327123	84101
Pigs Eye	75601	4576	1177	7392	450785	115894
Riverview	36509	2210	568	3570	217690	55967
St. Anthony Hill	107848	6528	1679	10545	643060	165327
St. Anthony Park	100574	6087	1566	9834	599686	154176
Trout Brook	78733	3864	1091	849	406602	94664
Urban	11739	711	183	1148	69995	17995
West Kittsondale	41619	2519	648	4069	248160	63800
West Seventh	17201	1041	268	1682	102563	26368

Table 12-7: Q4 (Oct-Dec) Pollutant Loading (lbs)

Subwatershed	CI	TKN	Total P	NO2+NO3	TSS	VSS
Battle Creek	29048	500	548	9005	136626	14767
Beaver Lake	3082	53	58	955	14494	1567
Belt Line	80625	1388	1521	24994	379218	40989
Crosby	36647	631	691	11361	172369	18631
Davern	34734	598	655	10767	163369	17658
Downtown	20008	344	377	6202	94106	10172
East Kittsondale	6212	159	218	6217	34901	3400
Fish Creek	1163	20	22	361	5472	591
Goodrich/Western	12956	223	244	4016	60940	6587
Griffith/Pt. Douglas	13648	235	257	4231	64191	6938
Hidden Falls	8350	144	157	2588	39274	4245
Highwood	27310	470	515	8466	128450	13884
Lake Como	29499	508	556	9145	138748	14997
Lake Phalen	72991	1257	1377	22627	343311	37107
Mississippi River Blvd.	67264	1158	1269	20852	316375	34196
MRWMO	4584	79	86	1421	21559	2330
Phalen Creek	42368	729	799	13134	199274	21539
Pigs Eye	58384	1005	1101	18099	274605	29681
Riverview	28194	485	532	8740	132611	14334
St. Anthony Hill	82294	1417	1552	25511	387066	41837
St. Anthony Park	10481	101	32	59	9343	3386
Trout Brook	3629	89	133	24	25681	3545
Urban	9065	156	171	2810	42639	4609
West Kittsondale	33863	583	639	10497	159271	17215
West Seventh	13125	226	248	4069	61734	6673

13. 2025 Summary

In 2025, six stormwater BMPs were monitored along with two locations that provide upstream stormwater data. All locations were evaluated for performance in 2025 to help the city meet its NPDES MS4 Permit monitoring requirements. The BMP systems that were monitored include underground infiltration systems, a rain garden, and pervious pavement. The systems were monitored to evaluate infiltration rates, volume reduction, and pollutant removal efficiencies. Long-term monitoring data has shown how the effectiveness of these systems change over time. Throughout the 2025 monitoring season, only one piece of equipment was lost, a rugged troll 100 water level logger in the Mississippi river at the Lilydale location. In addition, various water quality parameters were not captured in the 2025 season due to issues with the Chain of Custody (COC) form provided by the Metropolitan Council lab. This issue has since been resolved and will no longer be a problem in the 2026 monitoring season.

13.1. Underground Infiltration Systems/Outfall

Four underground infiltration BMPs (Bush Desoto, St. Albans, Hampden Park, and Victoria Street) were monitored for flow to evaluate runoff and volume reduction at BMP Sites. The runoff data for each site was normalized over the individual drainage areas to evaluate drainage characteristics that contribute to each Site. A summary of the 2025 runoff and volume reduction data is presented in **Table 13-1** below.

Table 13-1: Runoff Summary

BMP Site	Drainage Area (acres)	Total Monitored Runoff (cf)	% Runoff Captured	Water Yield (in/acre)	Water Yield (cu-ft/acre)
Bush Desoto	38.0	902,090	99.6	6.5	23,739
St. Albans	25.2	498,255	85.2	5.5	19,772
Hampden Park	7.8	330,055	100	11.6	42,315
Victoria Street	19.1	535,797	271	6.8	24,701

TSS and TP loads captured by the monitored BMPs are summarized in **Table 13-2**. TSS and TP loads were calculated using 2025 flow data and flow-weighted averages. Bush Desoto had the largest runoff volume and captured the largest amount of TSS and TP. The total TSS load and TP load captured by the four systems was 19,921 pounds and 71.86 pounds, respectively.

Table 13-2: Underground Infiltration System Pollutant Capture Summary

BMP Site	TSS Captured (pounds)	TP Captured (pounds)
Bush Desoto	9,145	28.63
St. Albans	3,142	9.69
Hampden Park	3,731	26.84
Victoria Street	3,903	6.7
Total	19,921	71.86

A summary of the 2025 infiltration rates for the underground infiltration systems is provided below.

- The 2025 St. Albans infiltration rate of 10.2 in/hr. is greater than the MSWM infiltration rate, but less than design rate of 26.0 in/hr. The St. Albans BMP system regularly drained to empty within 24 hours of a runoff event.
- The infiltration rate for the Hampden Park BMP was 11.0 in/hr., which exceeded the design rate of 1.8 in/hr. No overflow bypass was observed and 100% of the volume received by the BMP was infiltrated. The Hampden Park BMP system regularly drained to dry within 8 hours of a runoff event.
- The infiltration rate for the Victoria Street BMP was 13.7 in/hr., which is above the designed infiltration rate of 12.8 in/hr. The Victoria Street BMP regularly drained to empty within 10 hours of a runoff event.

13.2. Pervious Pavement

Infiltration testing was conducted at Jackson Street pervious asphalt and on Victoria Street in 2025. The average infiltration rate at Jackson Street was 39.2 in/hr. and no infiltration occurred on Victoria Street in 2025.

The 2025 infiltration rate at Jackson Street ranged from 0 to 732.17 in/hr., depending on the volume of traffic at that site. Of the 18 total sites, 16 sites showed no infiltration in 2025. Areas of high traffic have not shown any infiltration since 2017. Since installation in 2012, the permeable pavement systems on Jackson Street and Victoria Street have experienced a steady decline in performance. Monitoring data from 2025 indicates that infiltration now occurs at only one location on Jackson Street and at no locations on Victoria Street.

13.3. Recommendations for 2026

The recommendations for the 2026 Monitoring Program include:

- Continue to perform inspections and regular maintenance on BMP pre-treatment systems and infiltration galleries.
- Continue to notify of potential illicit discharges observed at flow monitoring locations.
- Discontinue infiltration testing at Jackson Street Pervious Bike Path and Victoria Street permeable Pavement.
- Continue river level monitoring within the Mississippi River in protected areas to capture more data during different river stages.
- According to the MPCA Minnesota Stormwater Manual, E. coli, oil and grease levels can vary greatly depending on the time of year, location, and land use. Based on sample results within the monitored watersheds, no further practices to reduce the amount of E. coli, oil and grease are recommended to be taken.
- Discontinue monitoring at a BMP site that has an established record such as St. Albans, Hampden Park or Victoria Street.

14. References

- City of Saint Paul, 2018. 2017 Water Quality and Quantity Monitoring Report. Saint Paul, MN.
- Erickson, Andrew J., John S. Gulliver, and Peter T. Weiss. "Capturing phosphates with iron enhanced sand filtration." *Water Research* 46.9 (2012): 3032-3042.
- Erickson, Andrew J., John S. Gulliver, and Peter T. Weiss. "Monitoring an Iron-Enhanced Sand Filter Trench for the Capture of Phosphate from Stormwater Runoff." Retrieved from the University of Minnesota Digital Conservancy, <http://hdl.handle.net/11299/175078>, 2015.
- Erickson, Andrew J. "Removing Dissolved Pollutants from Stormwater Runoff." St. Anthony Falls Laboratory, University of Minnesota. Presentation, October 3, 2012.
- Minnesota Climatology Working Group. St. Paul Campus Climatological Observatory: precipitation data. Saint Paul, MN. Accessed 2017. <http://mrcc.isws.illinois.edu>.
- Minnesota Pollution Control Agency 2008. Minnesota Stormwater Manual. Version 2. Accessed 2017. https://stormwater.pca.state.mn.us/index.php?title=Main_Page.
- Minnesota Department of Transportation, 2015. Study: "Permeable Pavements in Cold Climates: State of the Art and Cold Climate Case Studies". Accessed 2017. <https://lrrb.org/pdf/201530.pdf>.

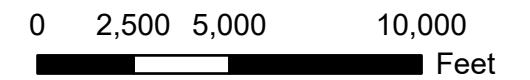
LIST OF FIGURES

City of St. Paul
 2025 Water Quantity &
 Quality Monitoring Program



SAINT PAUL
 MINNESOTA

**2025 Monitoring
 Site Locations**

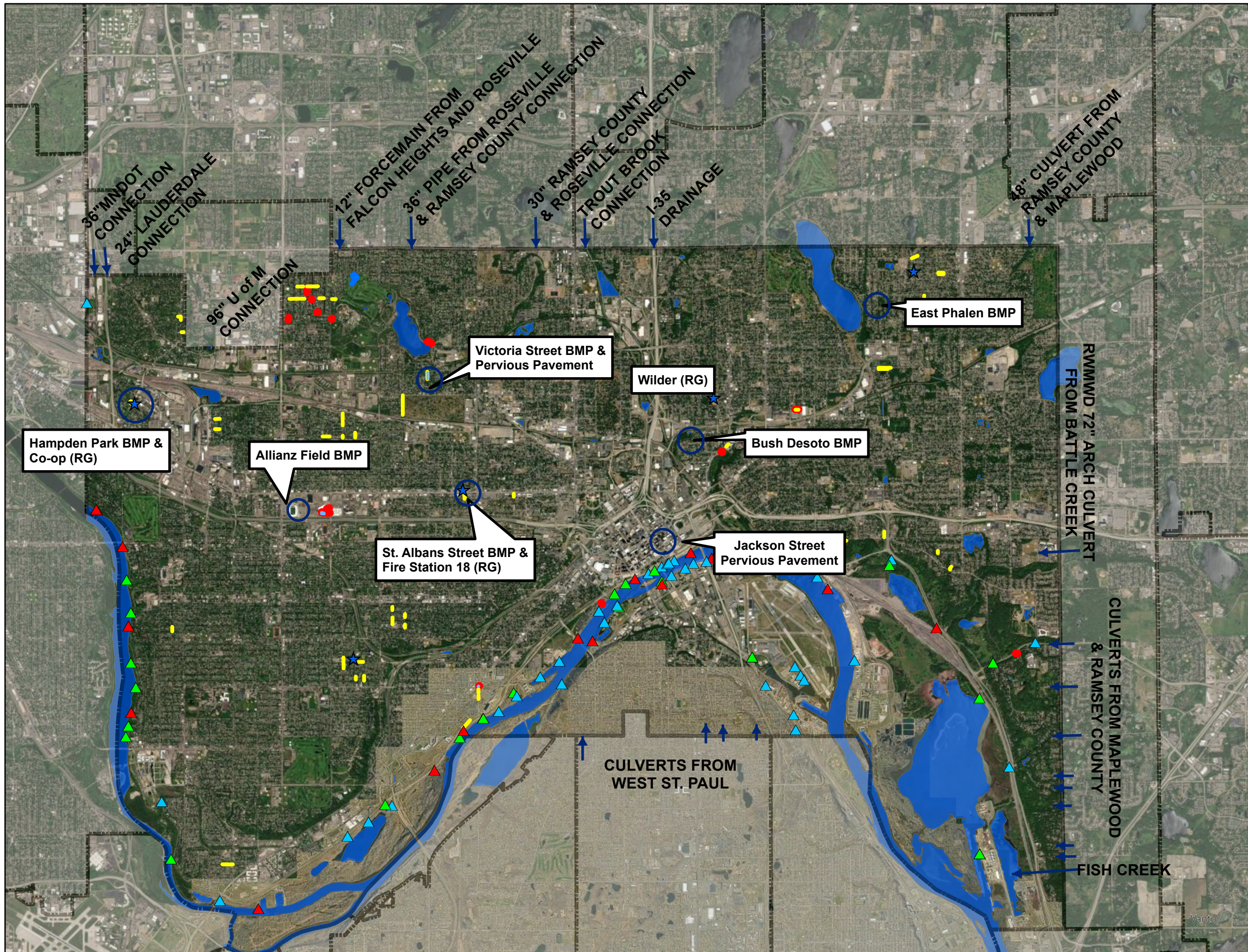


Legend

- ▬ Raingarden/Infiltration Basin
- ▬ Infiltration Trench
- ▬ Pervious Pavement
- ▭ Capitol Region Watershed District
- ▭ Lower Mississippi River WMO
- ▭ Mississippi WMO
- ▭ Ramsey/Washington/Metro WD
- 2025 Monitoring Locations
- ★ Rain Gauge Locations

Outfalls

- ▲ 30" - 48"
- ▲ 50" - 72"
- ▲ > 72"



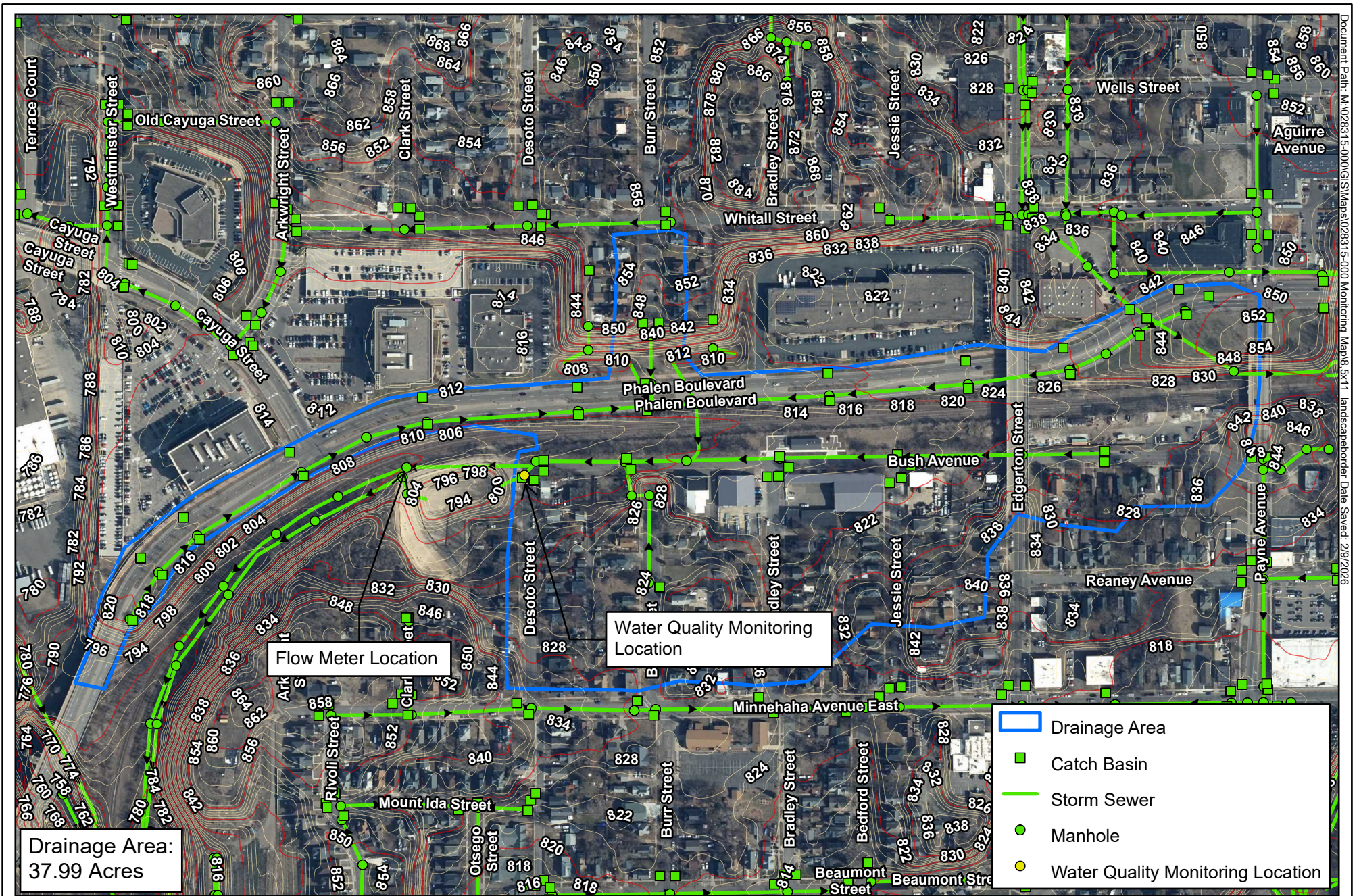


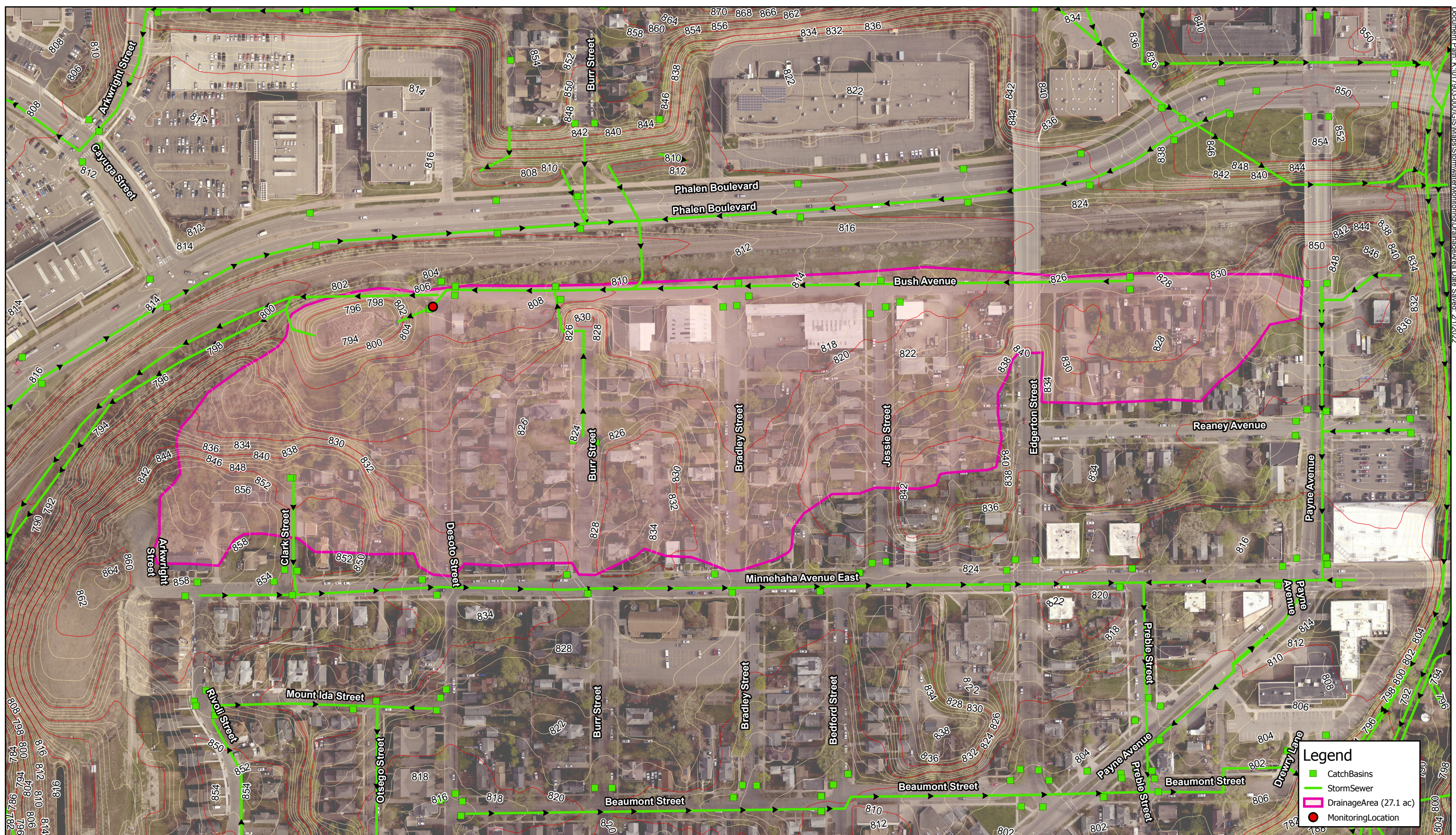
Figure 2 - Desoto St Drainage

2026 Stormwater Quality Monitoring
City of St. Paul

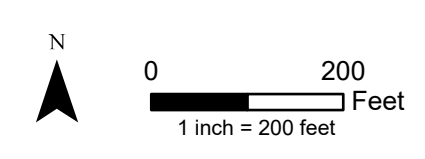


0 350
Feet
1 inch = 350 feet





Bush-Desoto Pond
2022 Water Quantity and Quality
Monitoring Program
Figure 9-1



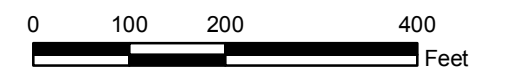
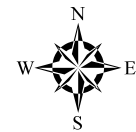
City of St. Paul

2025 Water Quantity and Quality Monitoring Program









FIGURE 5-1

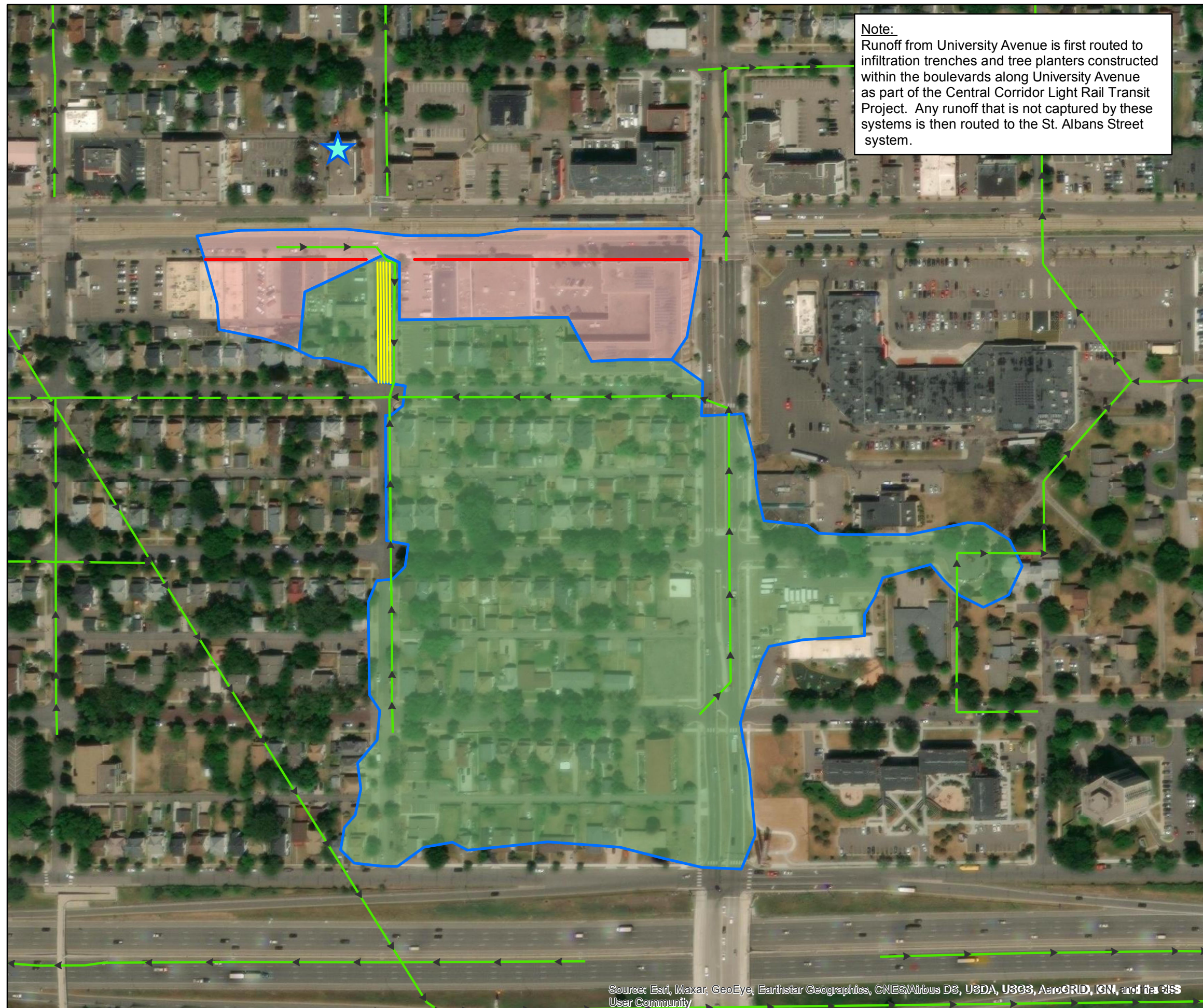
St. Albans Street Infiltration BMP Drainage Areas



Legend

-  Infiltration Trench
 -  CCLRT Infiltration Trench (Not monitored)
 -  Storm Pipe
 -  Rain Gauge Location
- Drainage Areas**
-  St. Albans Infiltration System (20.3 ac)
 -  CCLRT Infiltration Trenches (4.9 acres)

Note:
Runoff from University Avenue is first routed to infiltration trenches and tree planters constructed within the boulevards along University Avenue as part of the Central Corridor Light Rail Transit Project. Any runoff that is not captured by these systems is then routed to the St. Albans Street system.



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



K:\01610-100\GIS\Maps\Figure6-1\Figure 6-1 - Hampden Park NEM.mxd



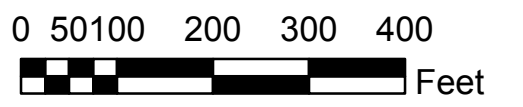
City of St. Paul

2025 Water Quantity and Quality Monitoring Program







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FIGURE 6-1 Hampden Park Infiltration BMP Drainage Area



Legend

-  Storm Pipe
-  Rain Gauge Location
-  Hampden Park BMP
-  Hampden Park BMP Drainage Area



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

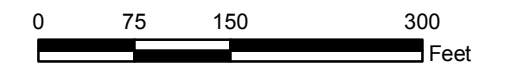
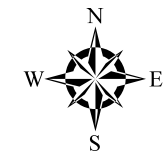
City of St. Paul

2025 Water Quantity and Quality Monitoring Program







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FIGURE 7-1 Victoria Street Infiltration BMP Drainage Areas





Legend

Infiltration BMPs

-  Infiltration Trench
-  Pervious Pavement
-  Storm Pipe
-  Rain Gauge Location

Drainage Areas

-  Infiltration Trench (19.1 ac)
-  Pervious Pavement (1.0 ac)



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



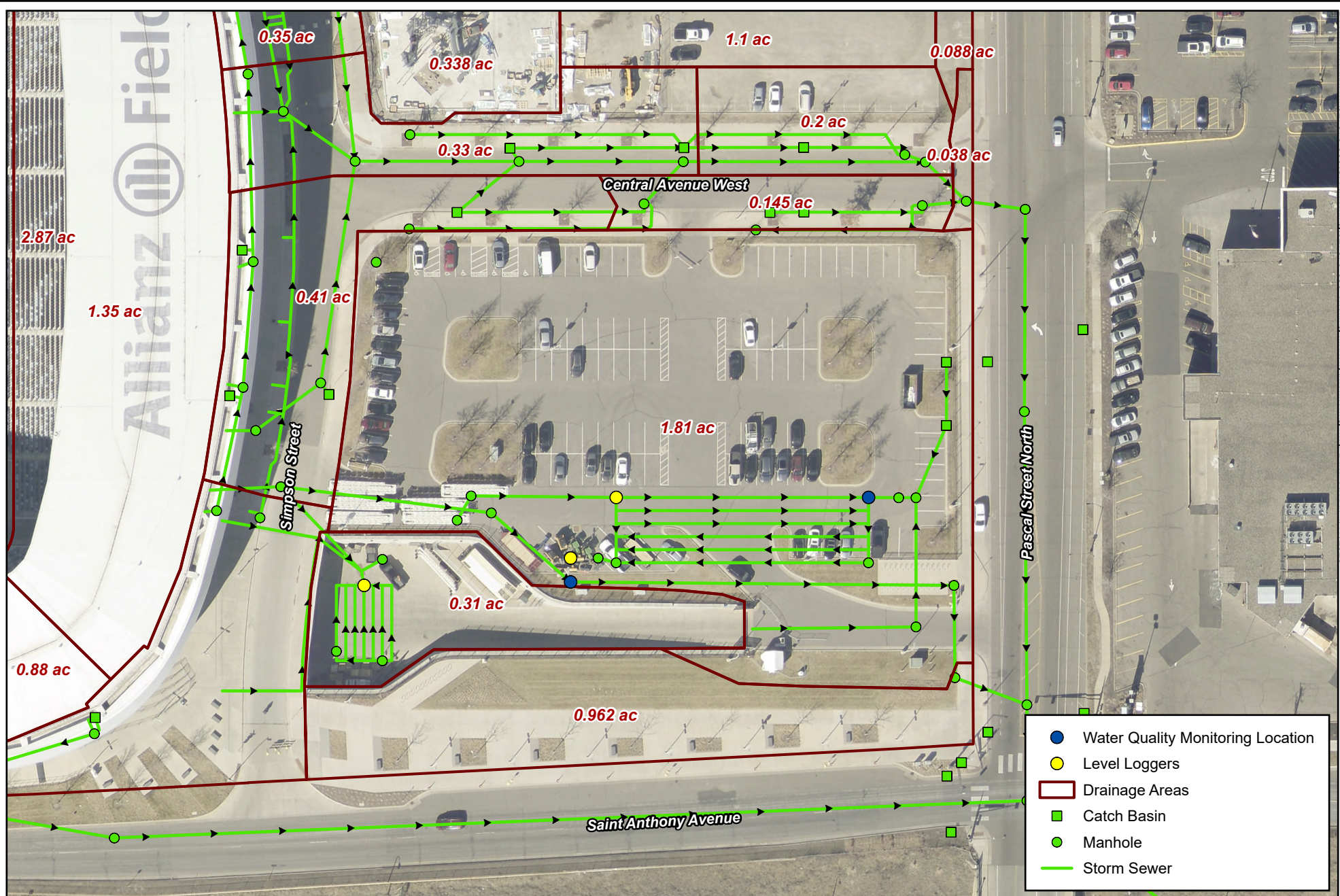
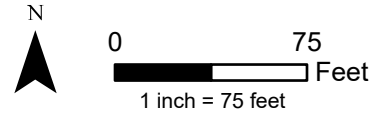


Figure 9-1 Snelling-Midway Drainage
2025 Stormwater Quality Monitoring
City of Saint Paul



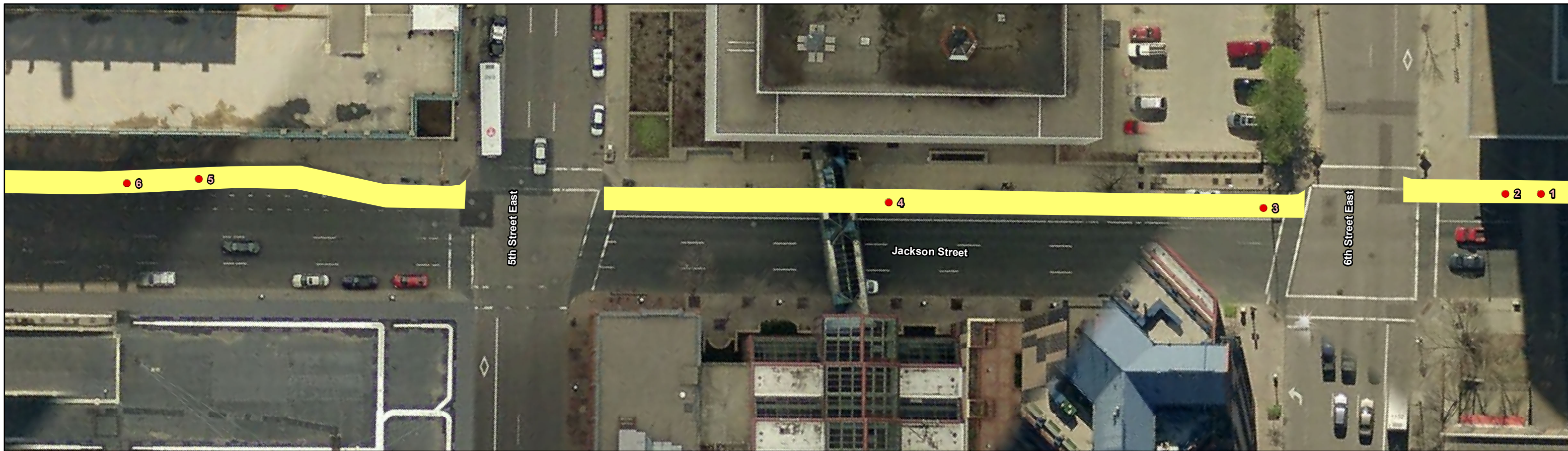


Figure 10-2 Jackson Street (pg 1of2)
JS-1 - JS-11 Pervious Test Locations
2024 Water Quantity and Quality Monitoring Program
City of Saint Paul, MN

● Pervious Pavement Testing Locations
■ Pervious Asphalt Bike Path



0 50 Feet
1 inch = 42 feet



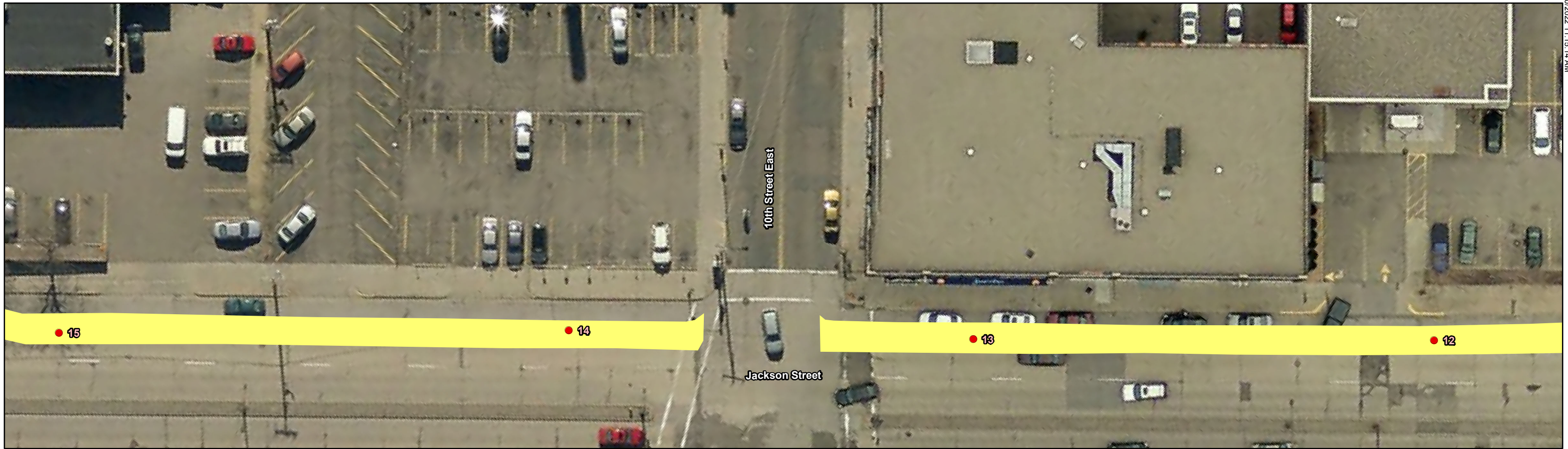
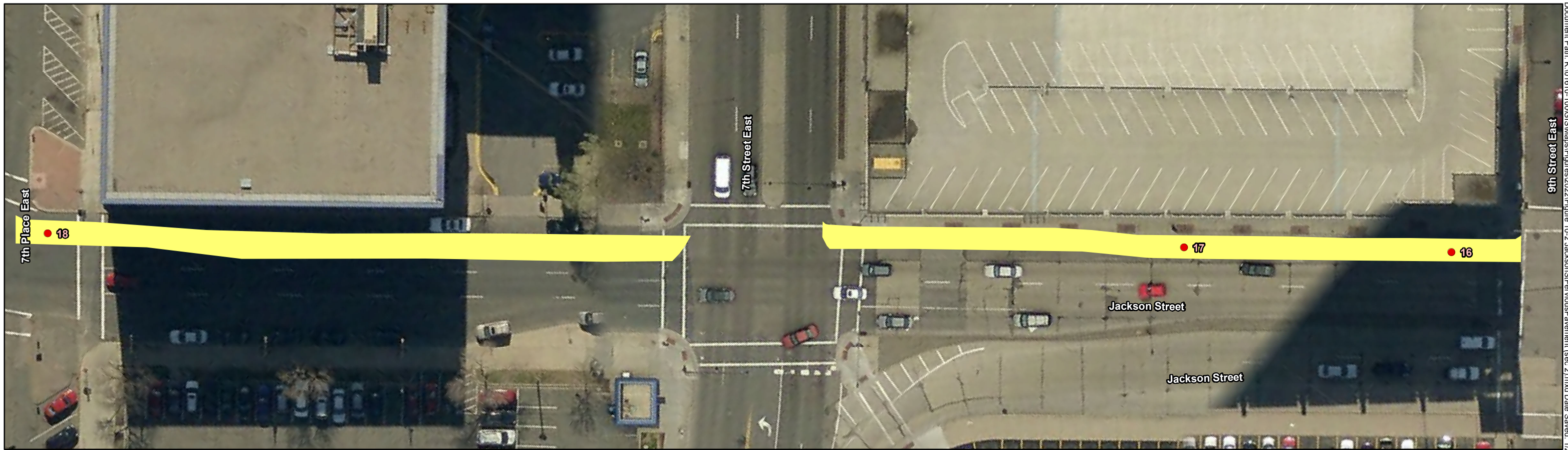
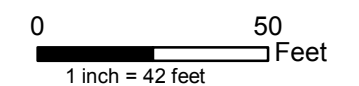


Figure 10-2 Jackson Street (pg 2of2)
JS-12 - JS-18 Pervious Test Locations

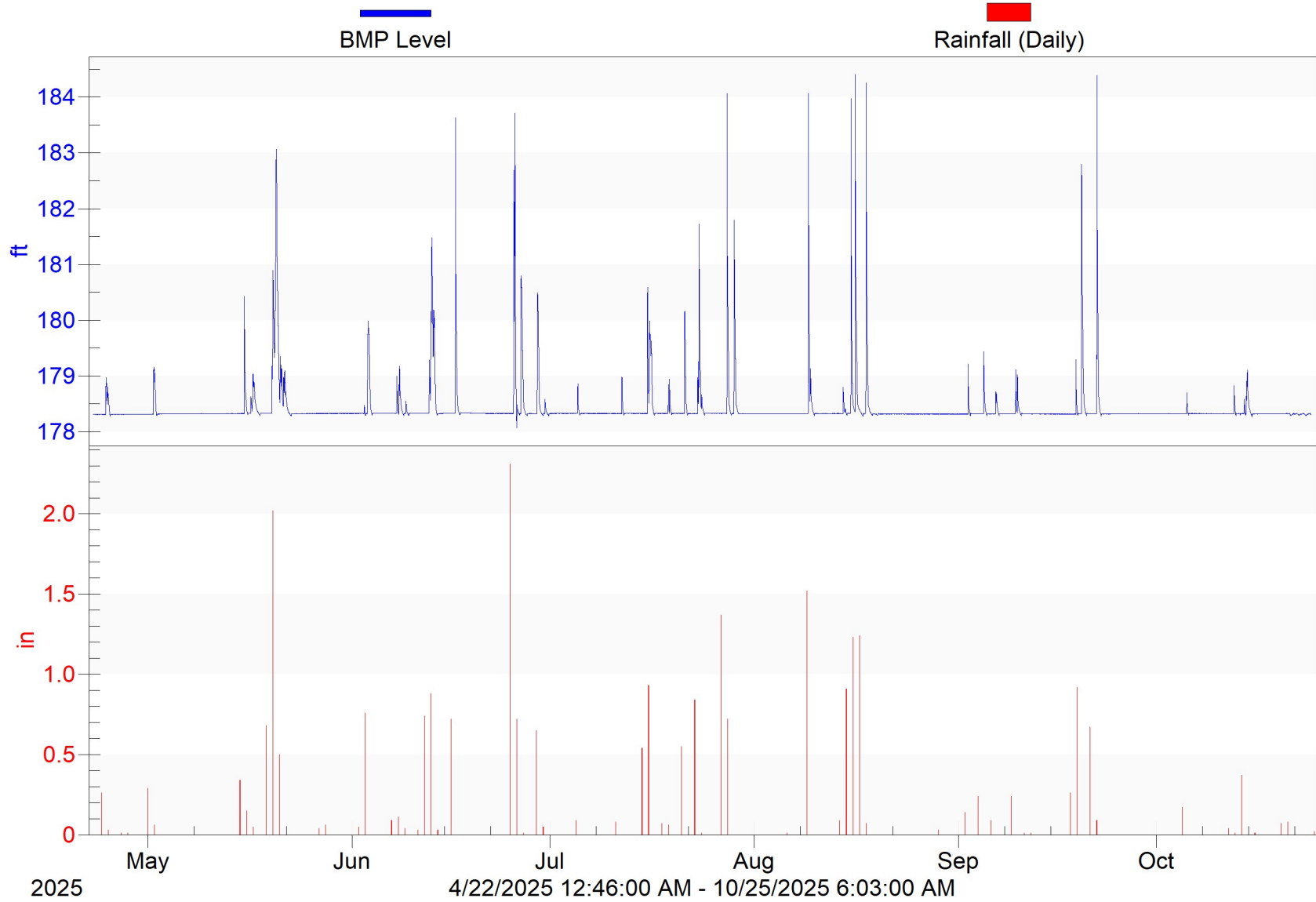
2024 Water Quantity and Quality Monitoring Program
 City of Saint Paul, MN

- Pervious Pavement Testing Locations
- Pervious Asphalt Bike Path



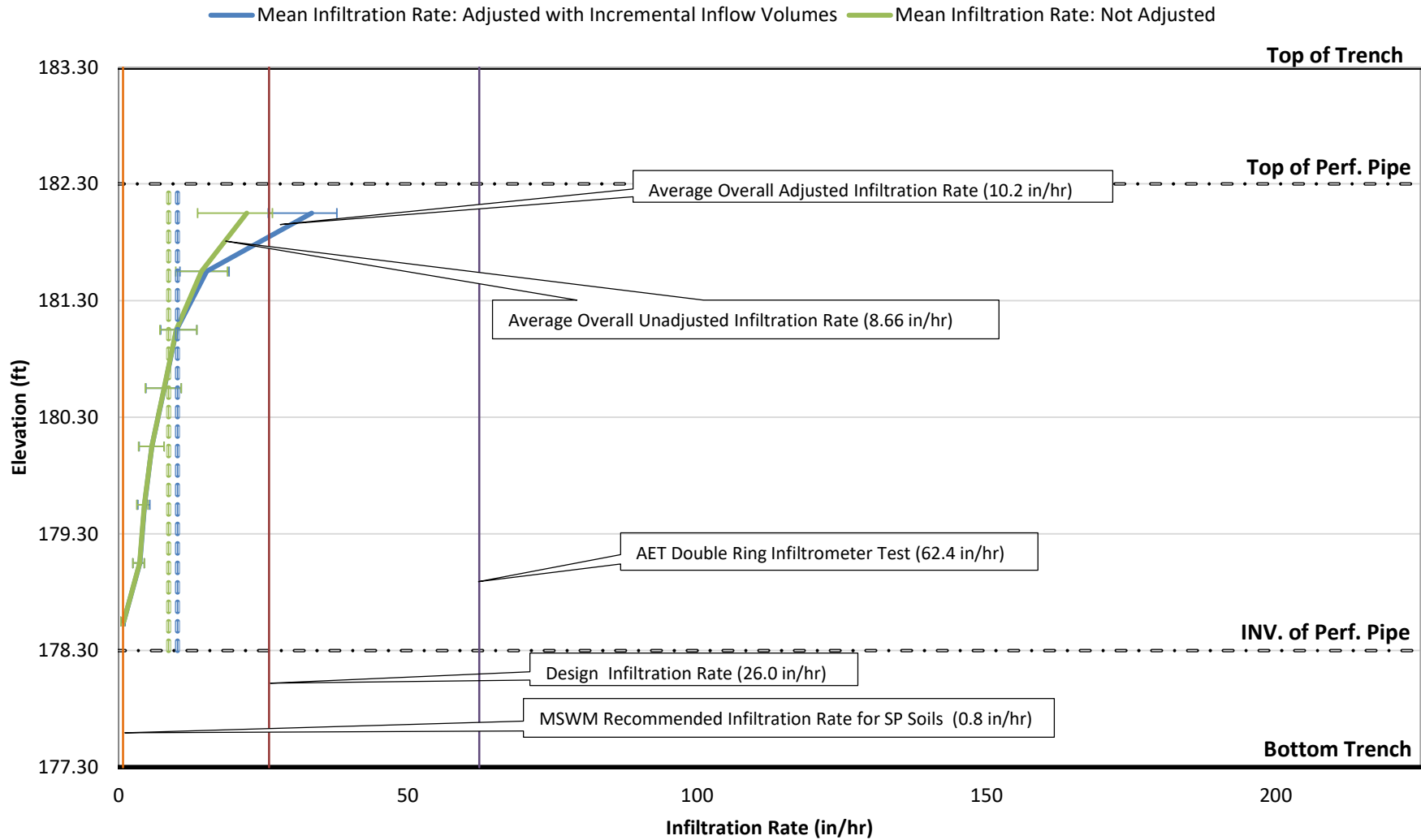
APPENDICES

Chart A.1 St. Albans
Water Level and Rainfall (SPCD)



St. Albans Street - Infiltration Rate Graph

(Observed 0.5 Foot Height Increments)



Note: Pipe Invert is 178.3'
 Error Bars Represent 25th and 75th Percentiles
 Pipe perforated w/ 2 rows of holes at Elev: 178.9' and 179.2'

Infiltration Rate Trends St. Albans Adjusted with Incremental Inflow Volumes

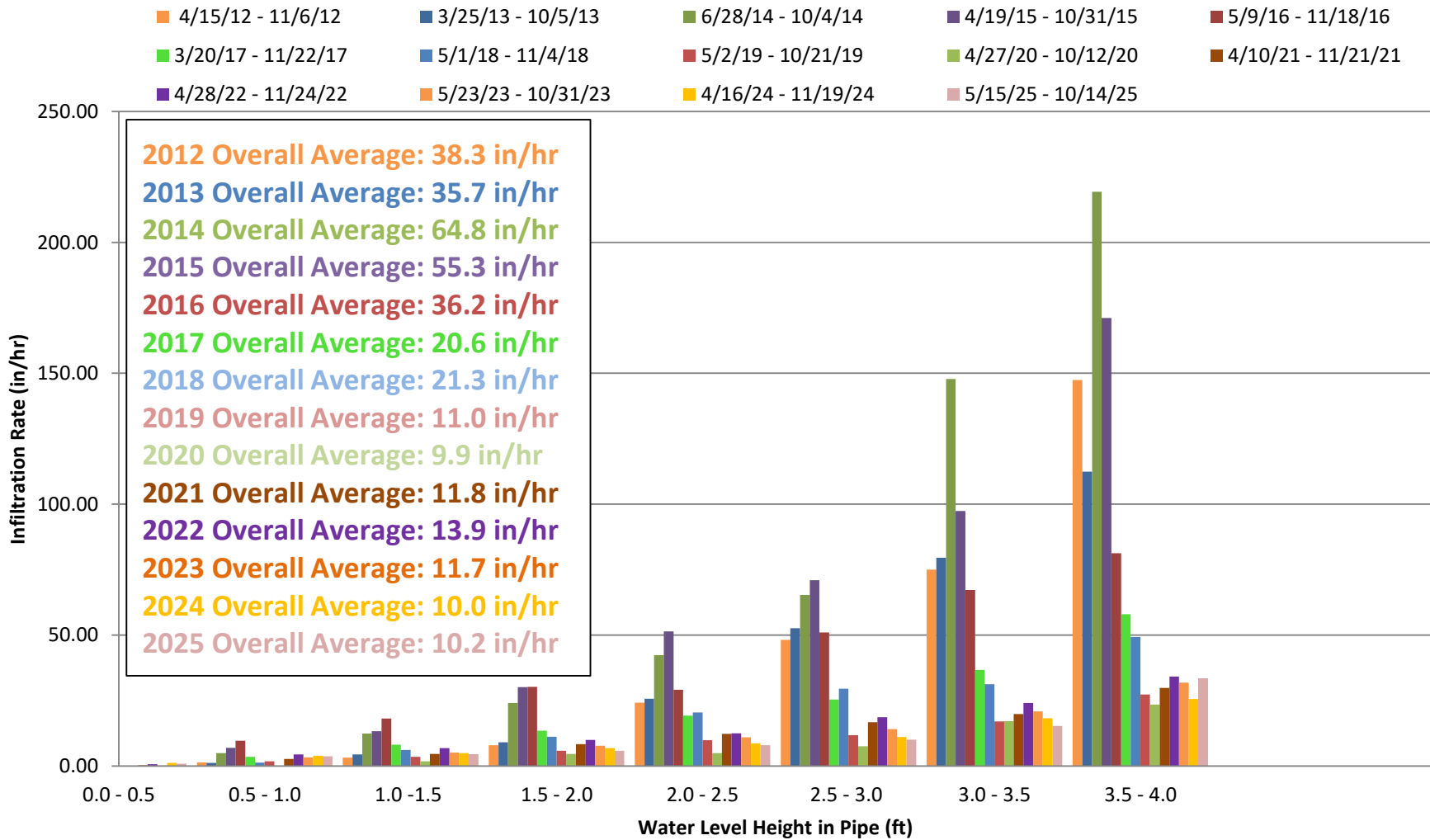
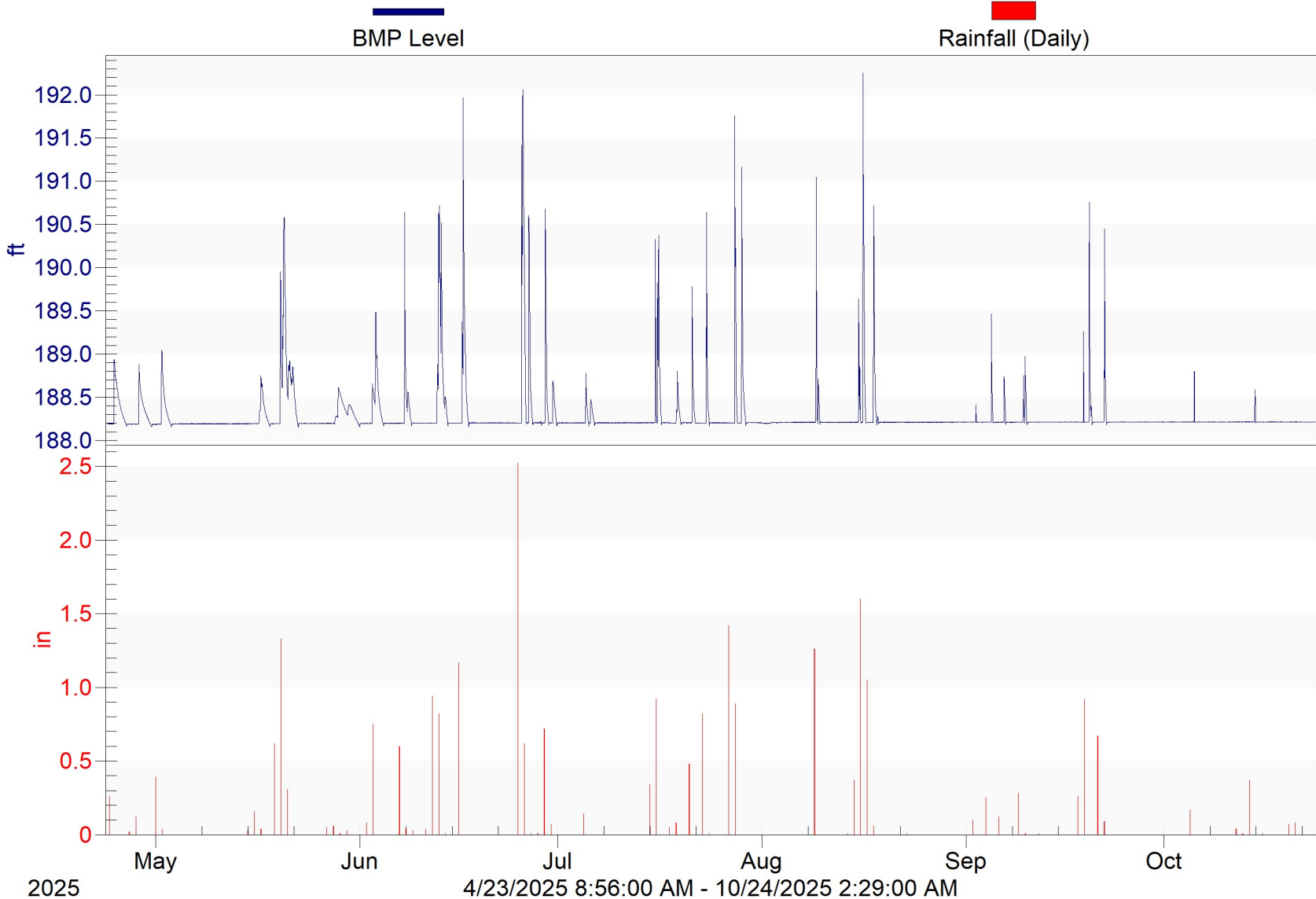
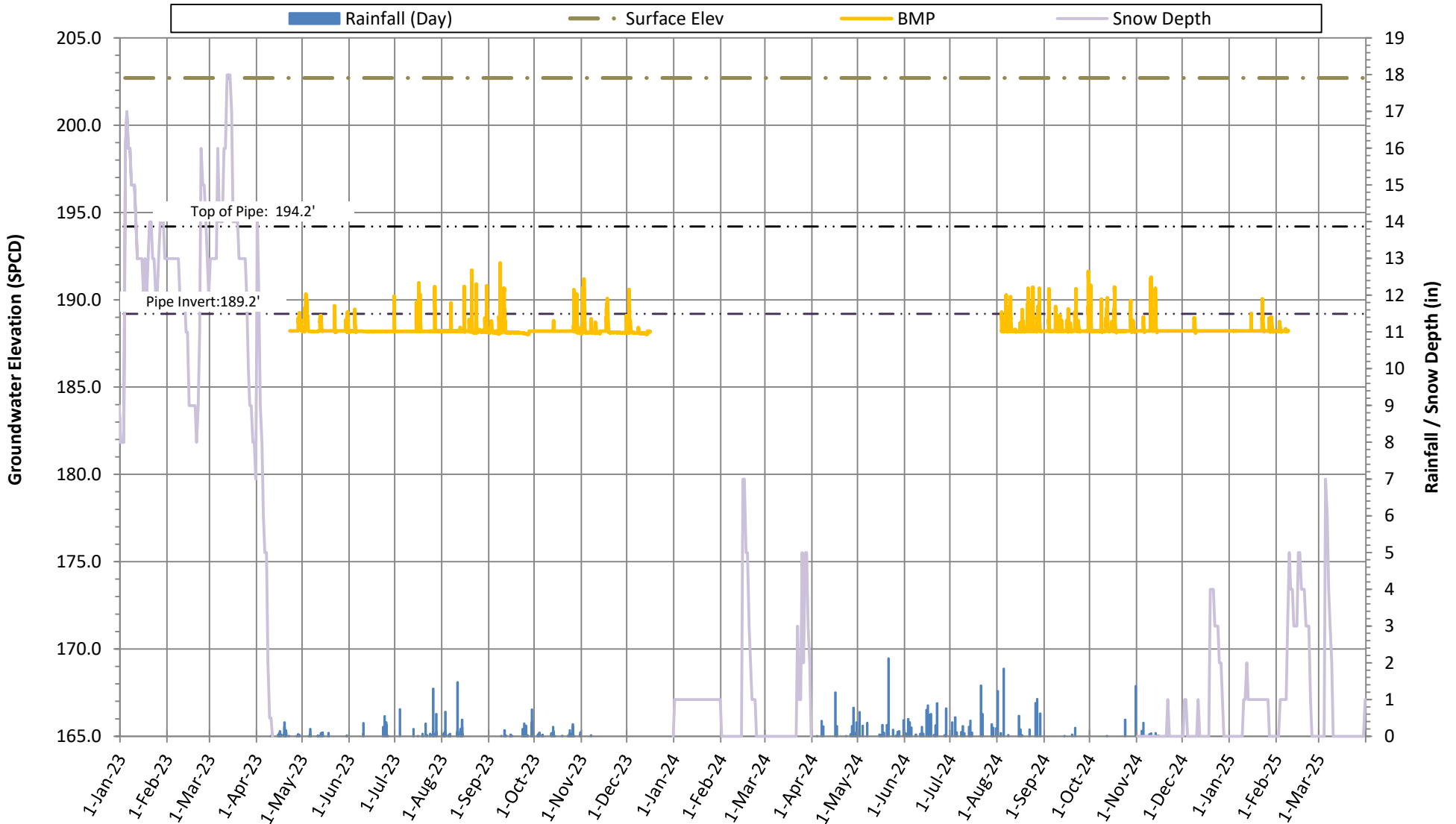


Chart A.4 Hampden Park

BMP Water Level and Rainfall

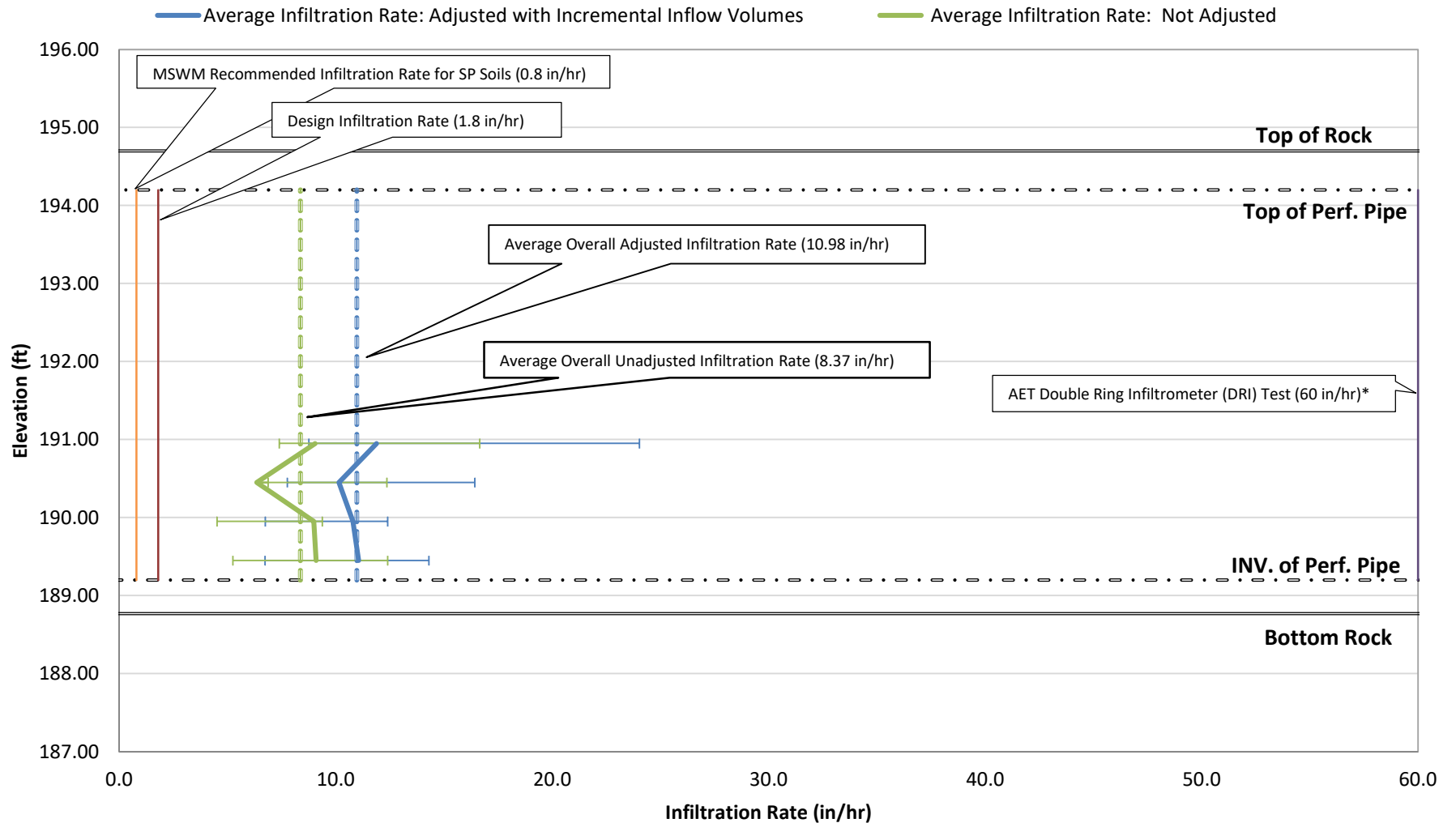


Hampden Park Groundwater and Infiltration System Level St. Paul, MN



Hampden Park - Infiltration Rate Graph

(Observed 0.5 Foot Height Increments)



Note: Pipe Invert is 189.2'

Error Bars Represent 25th and 75th Percentiles

* The DRI testing was completed on top of a 5 ft layer of fine filter aggregate that was constructed above the native soils, per the design.

Infiltration Rate Trends Hampden Park Adjusted with Incremental Inflow Volumes

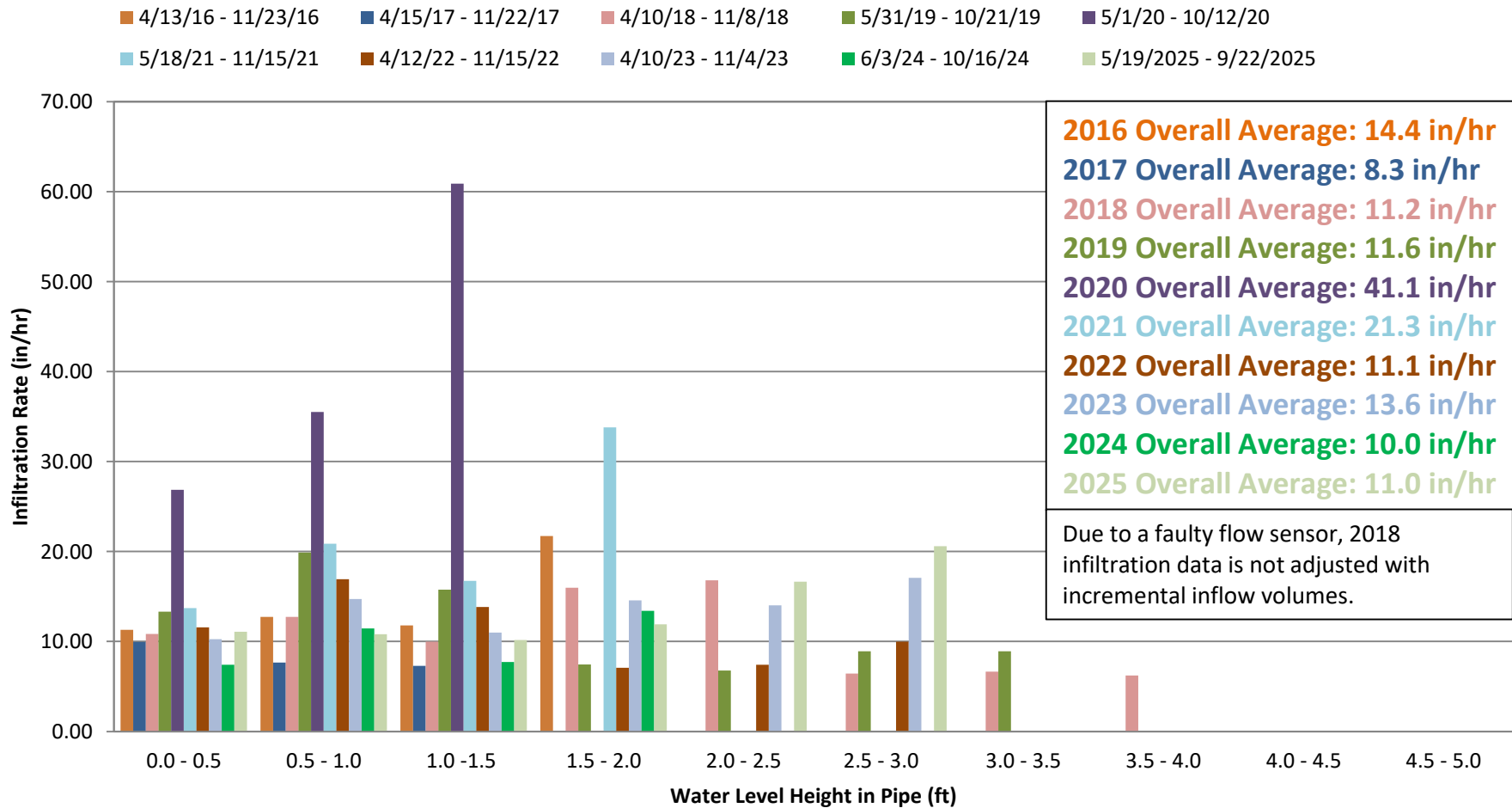
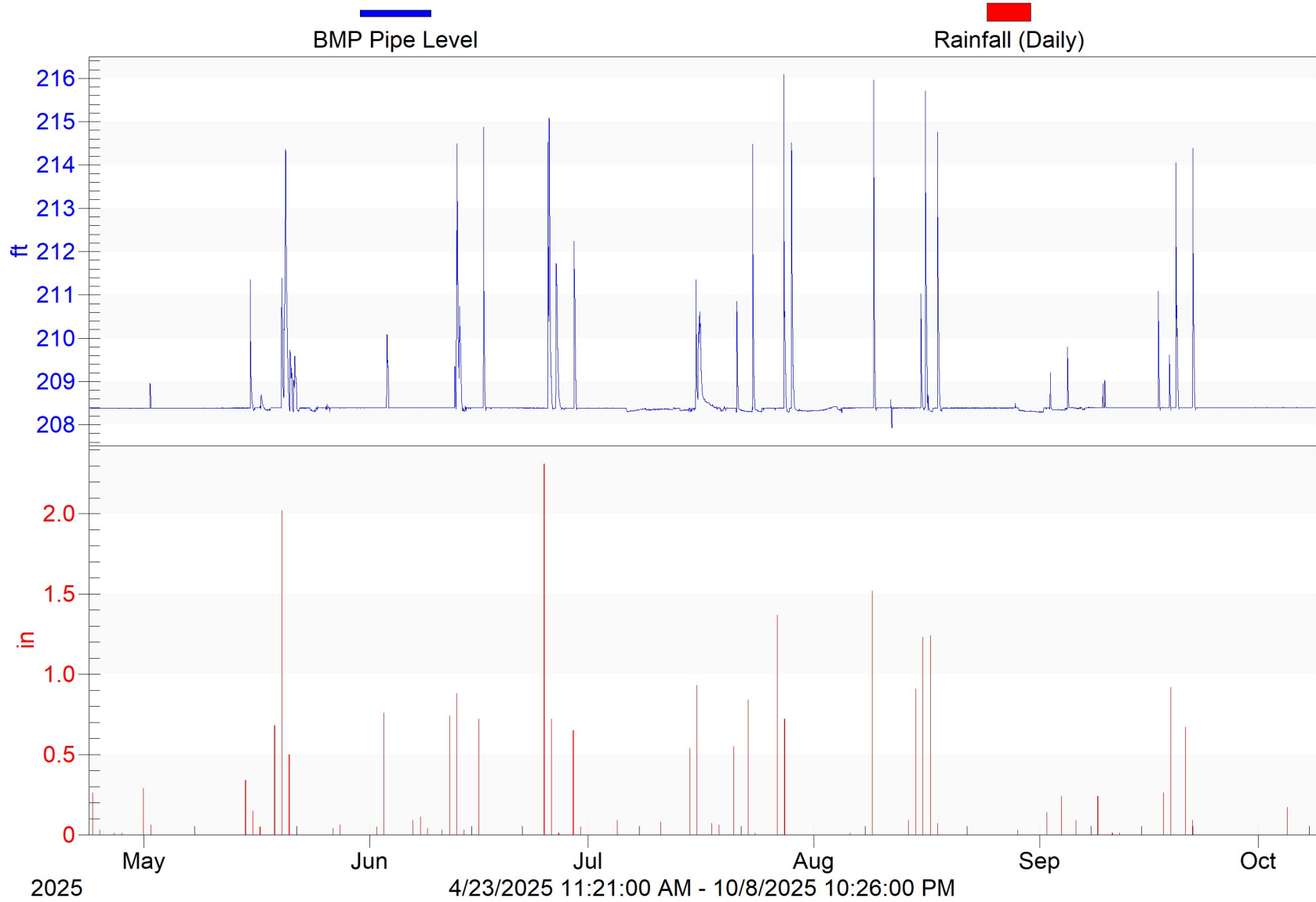
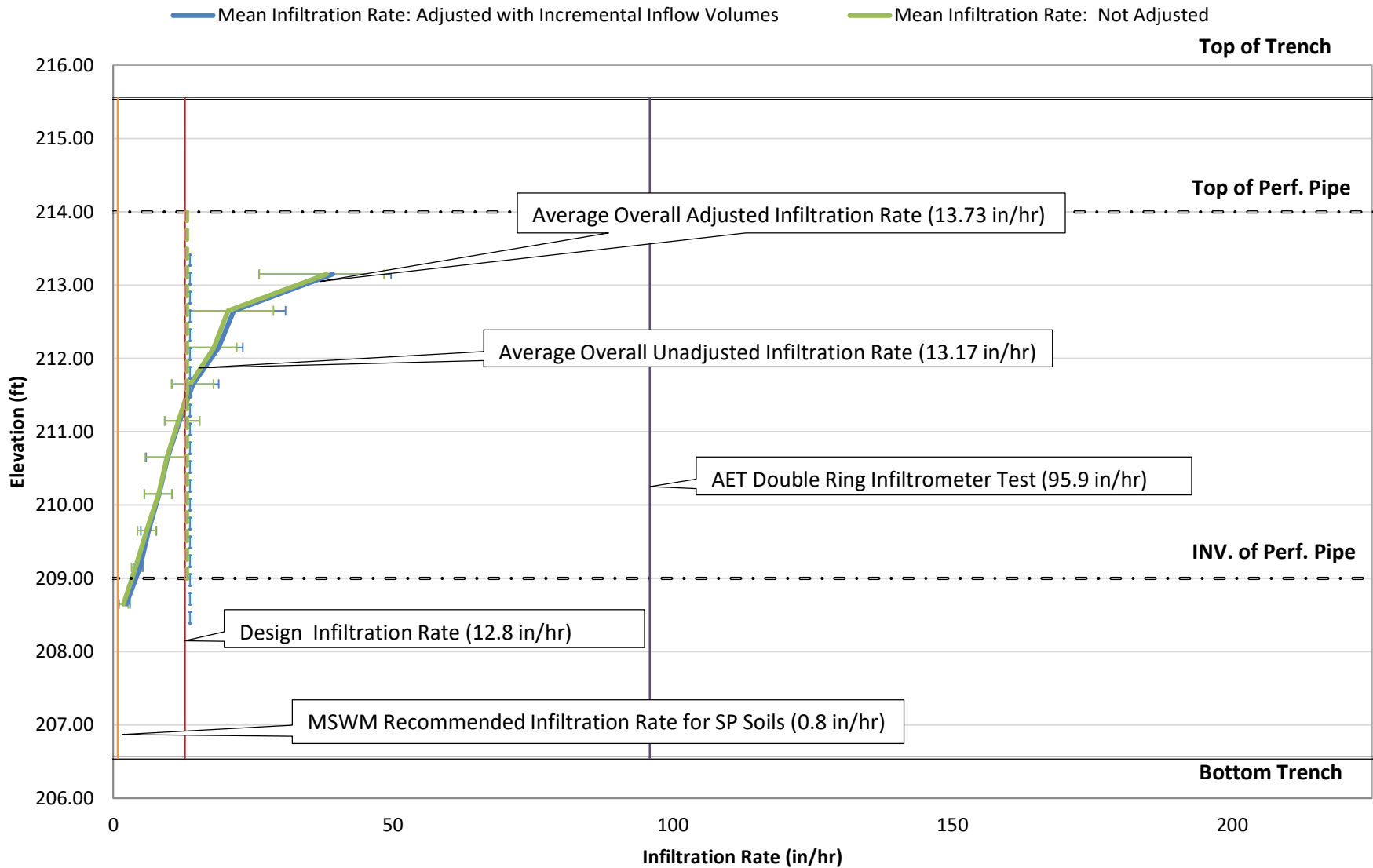


Chart A.8 Victoria
Water Level and Rainfall (SPCD)



Victoria Stage Infiltration Rate Graph (Observed 0.5 Foot Height Increments)



Pipe Invert is 209
 Error Bars Represent 25th and 75th Percentiles

Infiltration Rate Victoria Adjusted with Incremental Inflow Volumes

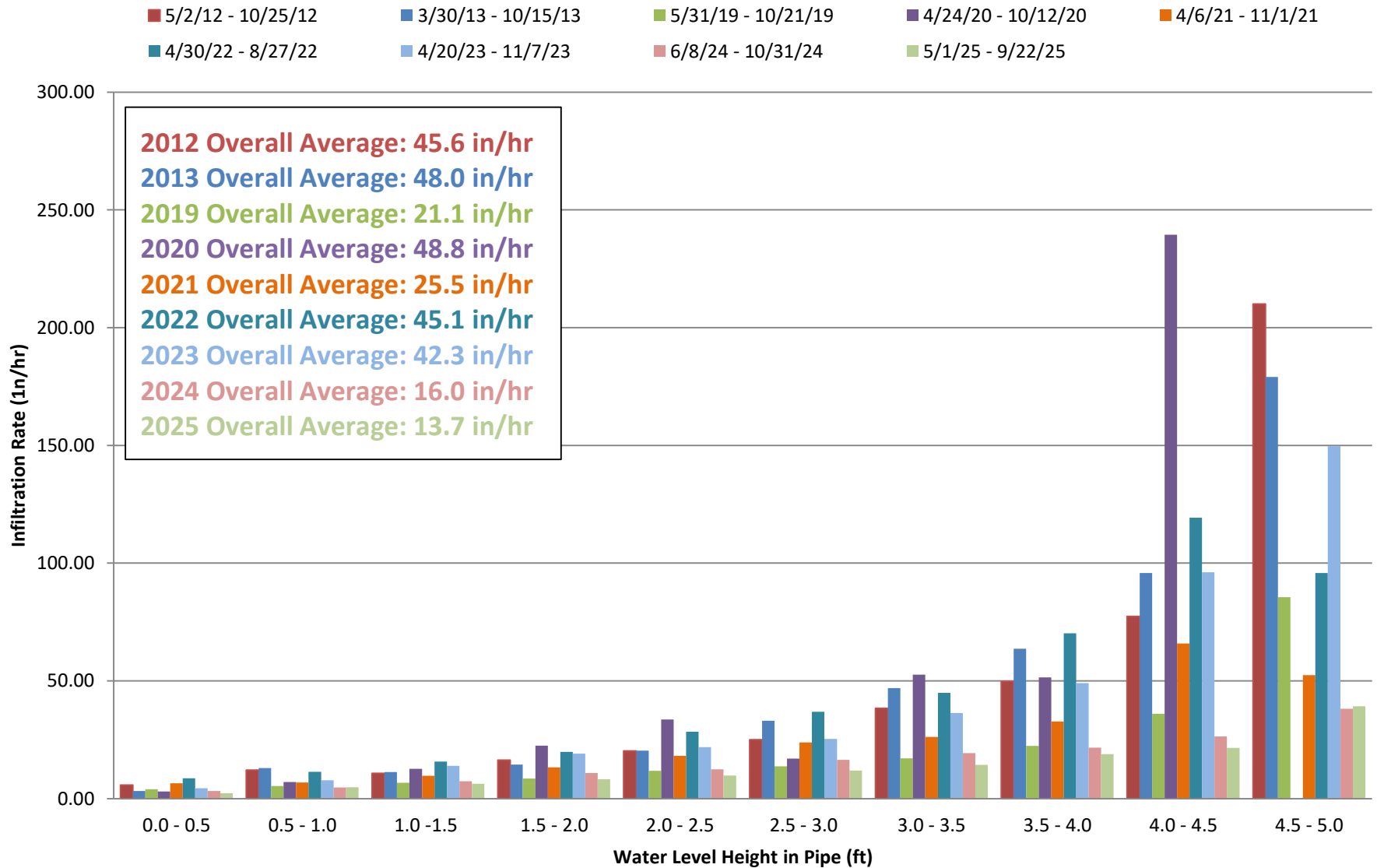


Chart A.11 Allianz Field Soccer Stadium

Water Levels and Rainfall (SPCD)

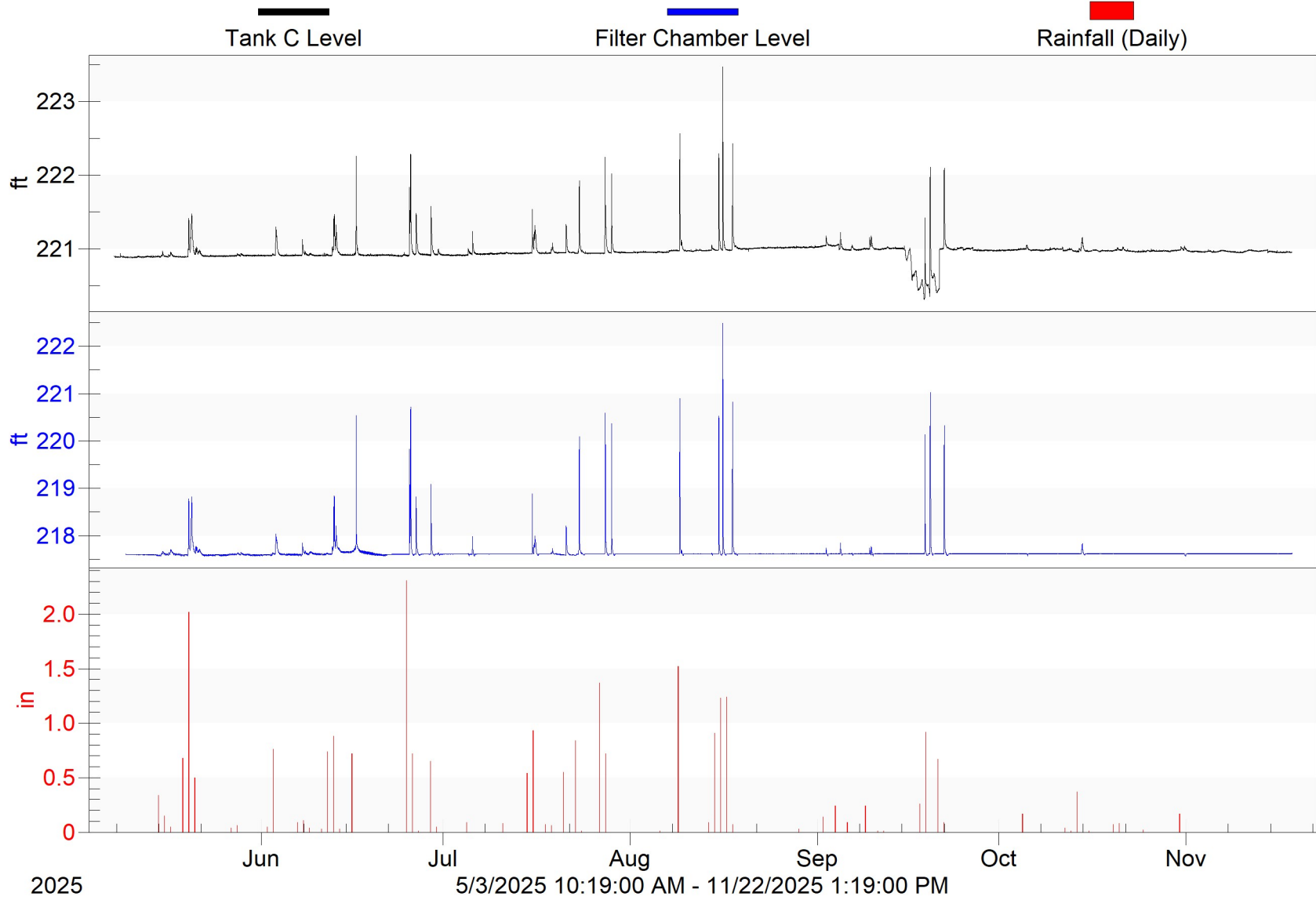


Chart B.1 Bush Desoto

Flow Rates and Rainfall

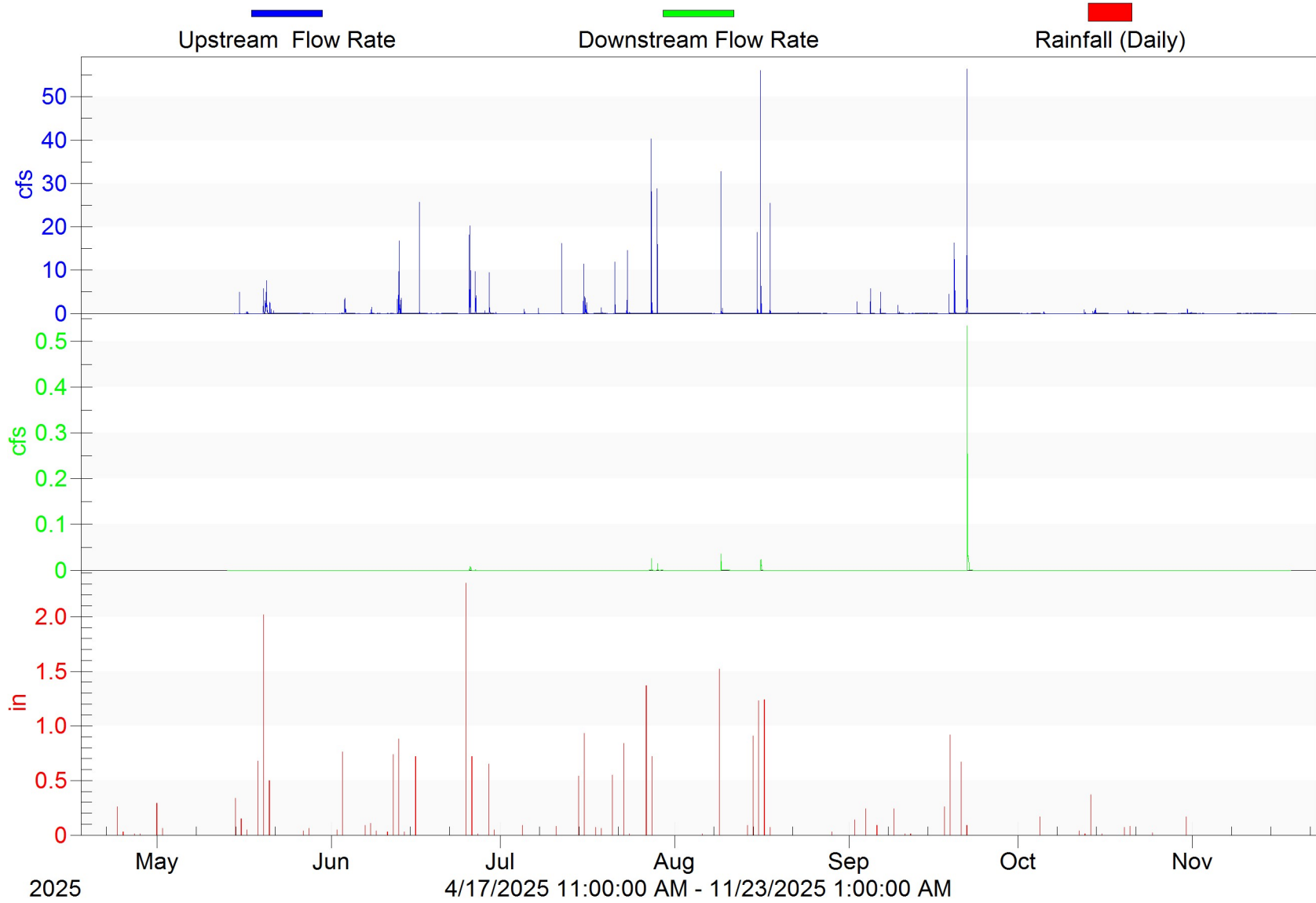


Chart B.2 St. Albans

Flow Rates and Rainfall

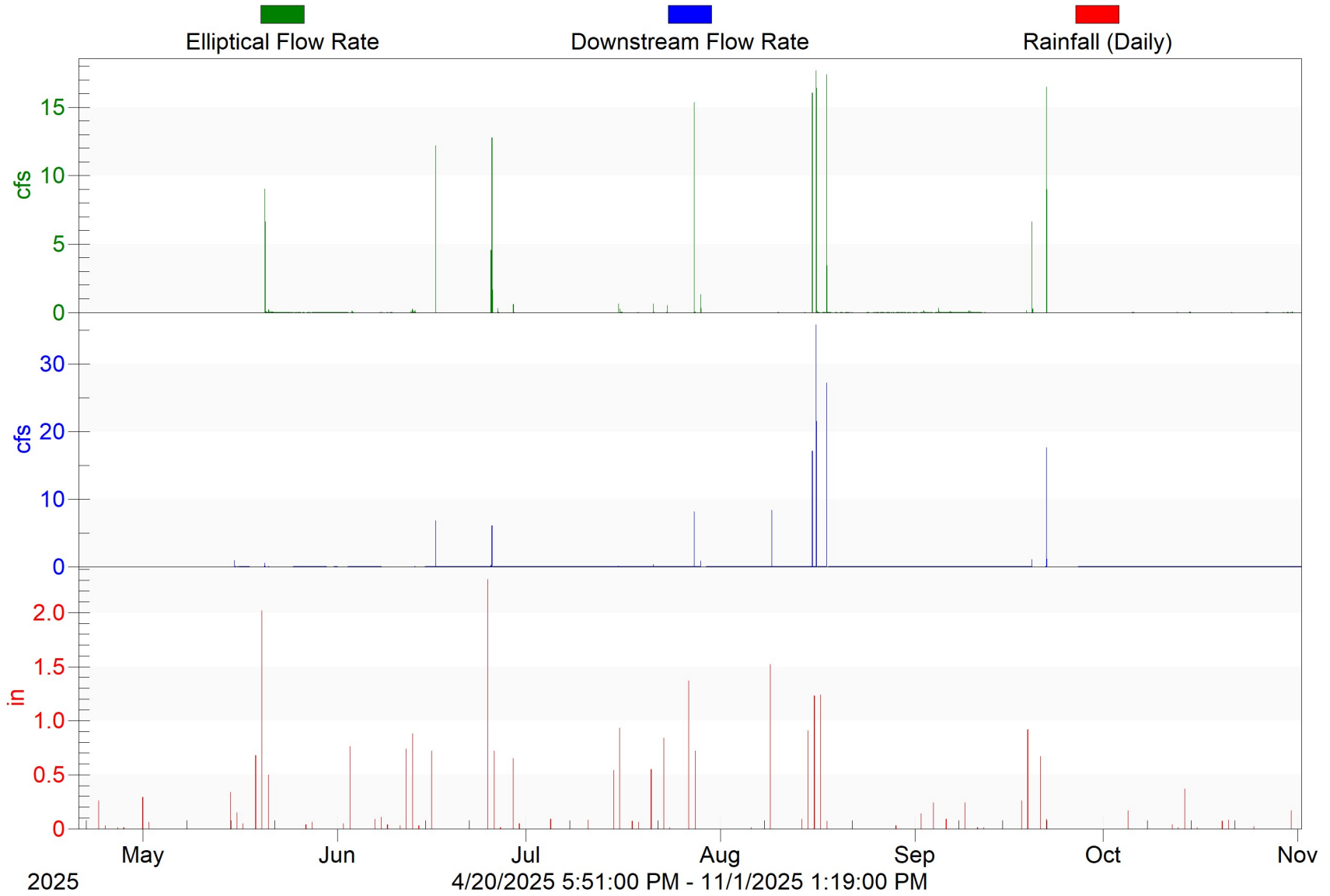


Chart B.3 Hampden Park

Flow Rates and Rainfall

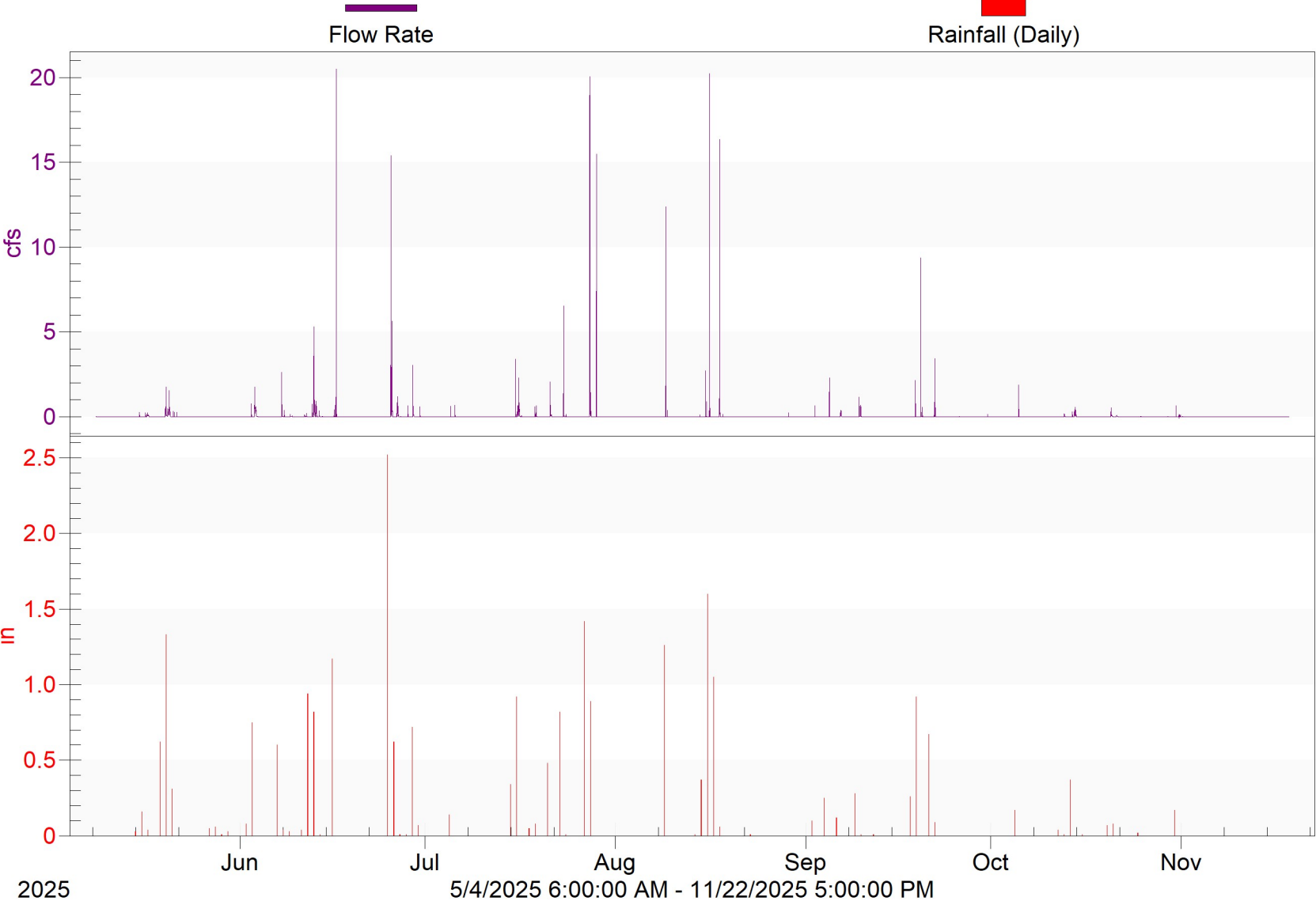


Chart B.4 Victoria

Flow Rates and Rainfall

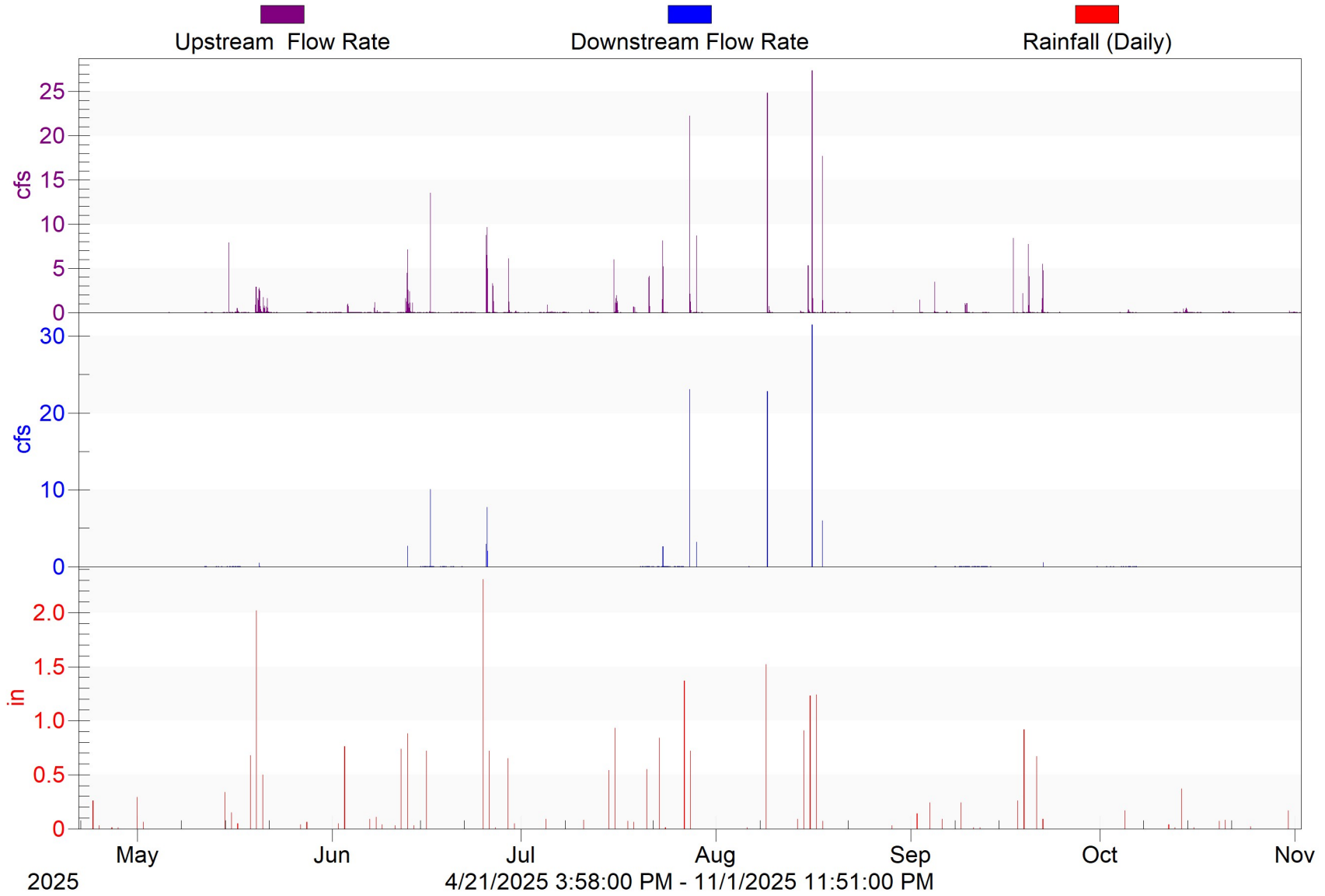


Chart B.5 East Phalen Flow Rate

Flow Rates, level and Rainfall

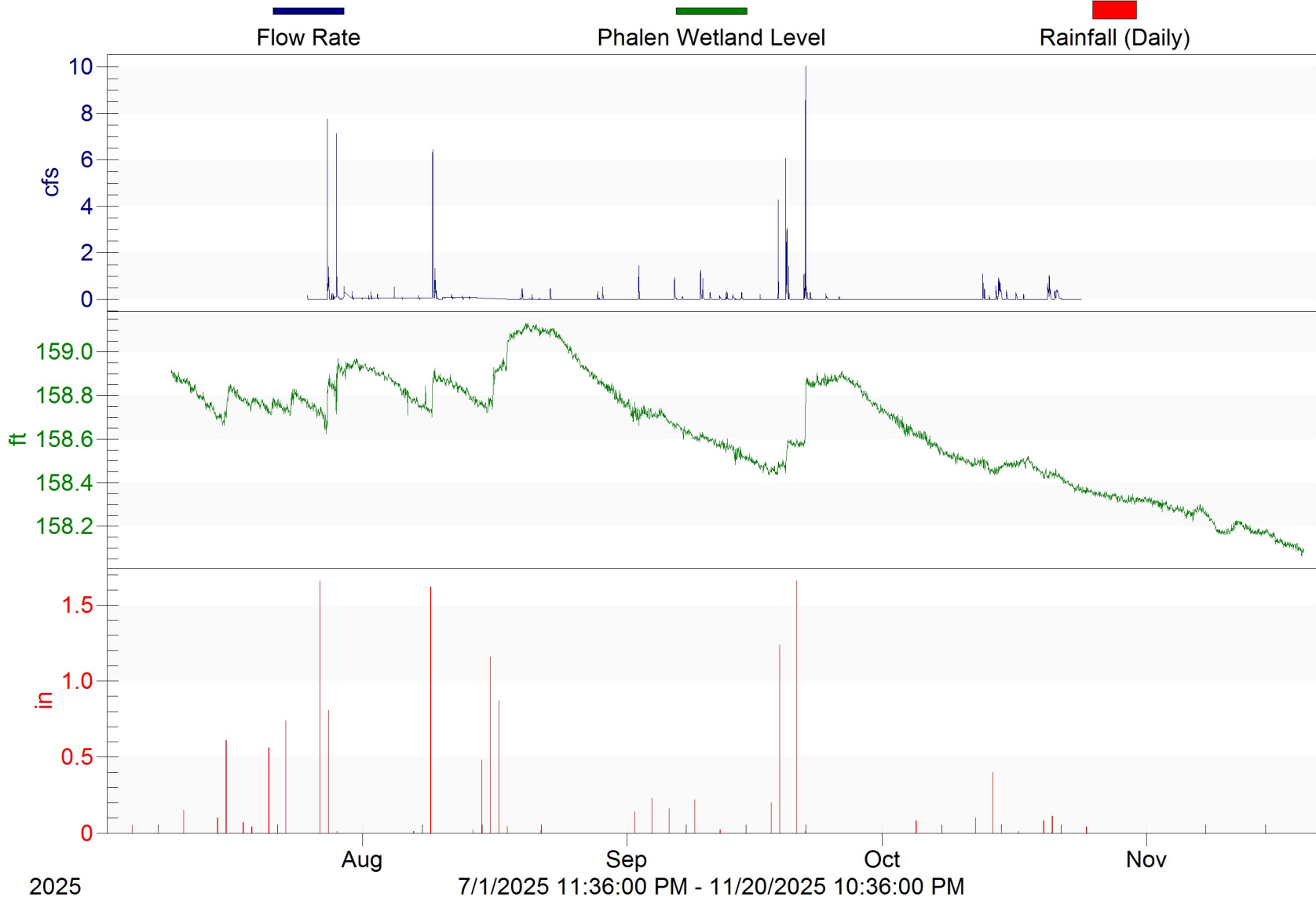
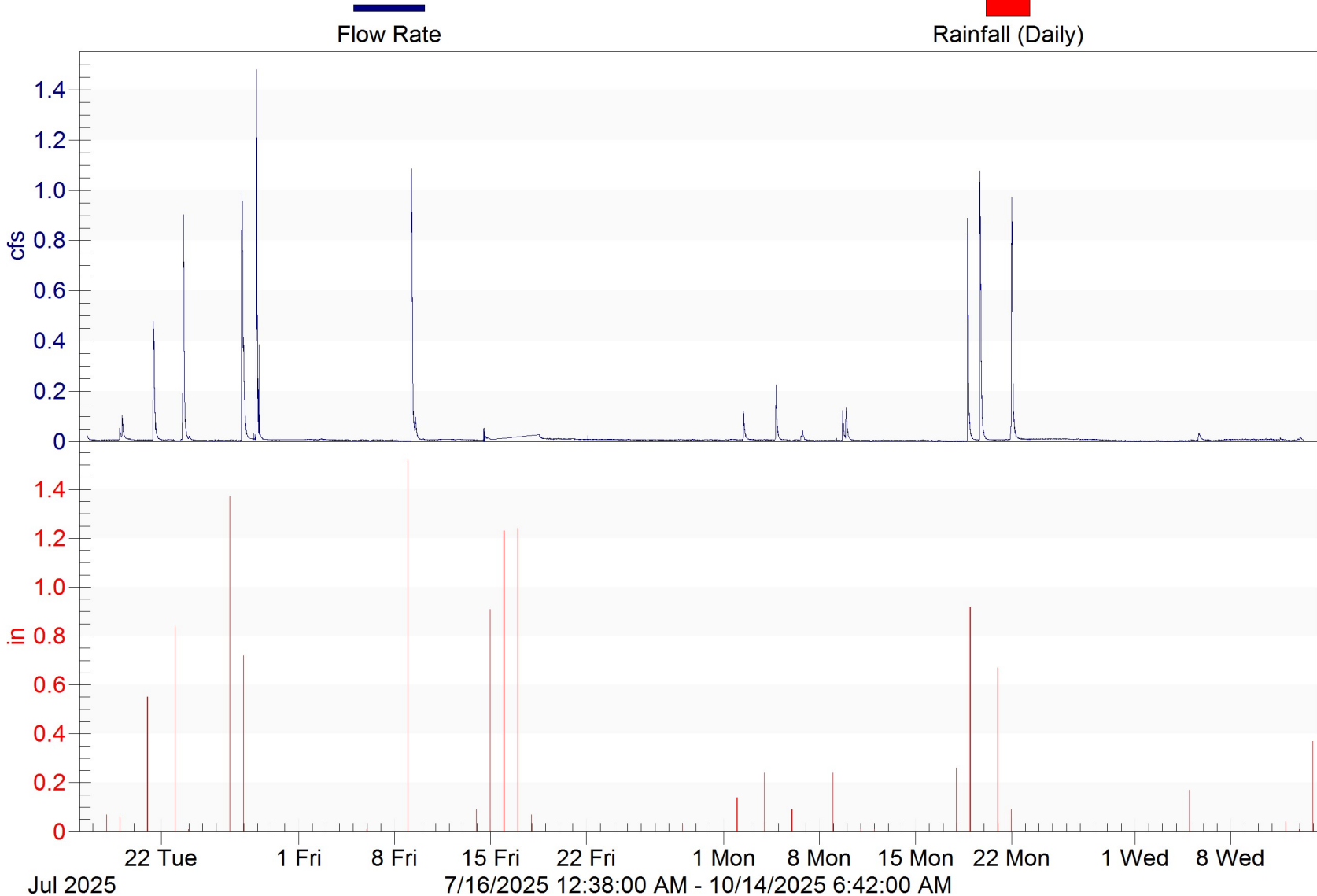


Chart B.6 Allianz Field Soccer Stadium

Flow Rates and Rainfall



BUSH DESOTO WATER QUALITY SUMMARY																		
LAB ID	Date Composite Sampling Started	Date Composite Sampling Ended	TSS (mg/L)	TDS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chloride (mg/L)	Ammonia as N (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite as N (mg/L)	Hardness as CaCO3 (mg/L)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	Total Organic Carbon (mg/L)	pH	COD (mg/L)	E. Coli (MPN/100 mL)
3349775	4/2/2025 14:40	4/2/2025 14:40								0.200						7.4		
3362574	5/20/2025 10:50	5/20/2025 10:50	21.0	37.0	0.09	0.033	6.7	0.11	0.39	0.200 <	15	5.0	4.9	35.9	2.1	7.0	20.0	770
3373674	6/25/2025 11:17	6/25/2025 15:19	198.0	70.0		0.010 <	13.9			0.320 <	60	16.1	15.9	120.0	10.9		128.0	
3375010	6/29/2025 1:27	6/29/2025 6:02	191.0	66.0		0.010 <	13.4			0.200	62	2.7	14.5	90.5	8.4		65.0	
3376858	7/5/2025 5:27	7/5/2025 8:47	166.0			0.021	14.0			0.200 <	70	19.1	8.8	144.0				
3379674	7/16/2025 9:38	7/16/2025 9:38	11.0	48.0 <		0.034	5.0 <			0.200 <	17	4.0	1.8	25.9	3.4	7.8	19.0	2420
3380079	7/15/2025 19:22	7/15/2025 20:07	358.0	59.0		0.010 <	9.3			0.470 <	39	15.1	9.5	89.7	11.5		73.0	
3380081	7/16/2025 0:37	7/16/2025 3:47	312.0	47.0		0.011	8.0			0.350	32	9.2	7.6	58.2	6.4		47.0	
3381616	7/21/2025 9:42	7/21/2025 12:12	76.0	51.0		0.026	9.1				30	10.9	8.7	74.7	9.7		68.0	
3382644	7/23/2025 10:12	7/23/2025 15:07								0.340								
3384058	7/28/2025 22:07	7/28/2025 23:57	56.0	25.0		0.026	5.0 <				27	8.2	11.4	50.2	3.8		29.0	
3396920	9/9/2025 15:47	9/9/2025 21:36	43.0															
3400266	9/21/2025 22:22	9/22/2025 0:18	114.0	31.0		0.039	5.0 <				40	11.3	22.8	64.5	3.5		47.0	
3407643	10/14/2025 17:17	10/14/2025 22:42	242.0	57.0		0.037	9.9				39	14.2	8.6	95.5	11.7		95.0	
MINIMUM			11.0	25.0	0.09	0.010	5.0	0.11	0.39	0.20	14.9	2.7	1.8	25.9	2.1	7.0	19.0	770.0
AVERAGE			149.0	49.1	0.09	0.023	9.0	0.11	0.39	0.28	39.1	10.5	10.4	77.2	7.1	7.4	59.1	1595.0
MEDIAN			140.0	49.5	0.09	0.026	9.1	0.11	0.39	0.20	38.8	10.9	8.8	74.7	7.4	7.4	56.0	1595.0
MAXIMUM			358.0	70.0	0.09	0.039	14.0	0.11	0.39	0.47	70.0	19.1	22.8	144.0	11.7	7.8	128.0	2420.0

Laboratory analysis was completed by Metroplian Council Environmental Services

Grab Sample Duplicate

< - Analyte not detected above the Method Detection Limit (MDL), MDL value reported

J - Result reported as estimated between the MDL and Reporting Limit (RL)

> - Analyte exceeded the maximum detection level (was not fully diluted prior to analysis)

SAINT ALBANS WATER QUALITY SUMMARY																		
LAB ID	Date Composite Sampling Started	Date Composite Sampling Ended	TSS (mg/L)	TDS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chloride (mg/L)	Ammonia as N (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite as N (mg/L)	Hardness as CaCO3 (mg/L)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	Total Organic Carbon (mg/L)	pH	COD (mg/L)	E. Coli (MPN/100 mL)
3349768	4/2/2025 15:39	4/2/2025 15:39					5.0 <									7.20		133
3362568	5/20/2025 10:33	5/20/2025 10:33	27.0	28.0	0.14		5.0 <	0.13	0.63	0.20 <	11	11.2	10.8	38.9		8.0	24.0	1120
3366908	6/3/2025 7:25	6/3/2025 13:10	282.0	266.0	0.41	0.064	5.0 <		2.83	0.78	44	42.9	17.2	110.0	7.5		85.0	
3372126	6/16/2025 15:15	6/16/2025 15:29					5.0 <			0.44	76	42.1	67.2	214.0	3.0			
3375006	6/29/2025 1:18	6/29/2025 3:46	206.0	39.0		0.016	5.0 <			0.43	37	20.5	23.3	117.0	5.1		32.0	
3379670	7/16/2025 10:02	7/16/2025 10:02	23.0	44.0		0.061	5.5			0.28	22	27.3	10.2	55.4	5.6	7.6	40.0	2420
3380075	7/15/2025 19:06	7/15/2025 19:31	342.0	57.0		0.146	5.0 <			0.28	42	34.5	23.4	131.0	14.0		100.0	
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3383575	7/27/2025 20:15	7/28/2025 1:06	56.0	33.0		0.061	5.0 <			0.62	23	15.0	14.0	67.5	5.5		53.0	
3384054	7/28/2025 22:00	7/28/2025 22:54	112.0	24.0 <		0.025	5.0 <			0.37	26	13.8	15.4	76.6	4.6		58.0	
3394407	9/2/2025 10:17	9/2/2025 10:47	146.0			0.198	18.0			0.84	64	41.9	11.9	176.0				
3395509	9/4/2025 18:34	9/5/2025 1:58	75.0	69.0		0.143	5.0 <			0.67	34	23.7	9.6	111.0	13.3		101.0	
3400254	9/21/2025 22:05	9/21/2025 23:39	45.0	353.0		0.030	5.3			0.68	32	18.6	8.7	72.4	13.3		62.0	
3407639	10/14/2025 15:49	10/14/2025 20:25	723.0	76.0		0.031	5.0 <			0.86	70	45.4	42.3	215.0				
AVERAGE			23.0	24.0	0.1	0.0	5.0	0.1	0.6	0.2	10.5	11.2	6.9	38.9	3.0	7.2	24.0	133
MEDIAN			189.5	83.1	0.3	0.1	5.9	0.1	1.7	0.5	37.5	26.5	20.0	108.3	7.5	7.6	61.3	1224
MAXIMUM			110.0	39.0	0.3	0.1	5.0	0.1	1.7	0.4	34.2	23.7	15.4	110.0	5.6	7.6	58.5	1120
MAXIMUM			723.0	353.0	0.4	0.2	18.0	0.1	2.8	0.9	75.9	45.4	67.2	215.0	14.0	8.0	101.0	2420

Laboratory analysis was completed by Metroplian Council Environmental Services
 Grab Sample Duplicate
 < - Analyte not detected above the Method Detection Limit (MDL), MDL value reported
 J - Result reported as estimated between the MDL and Reporting Limit (RL)
 > - Analyte exceeded the maximum detection level (was not fully diluted prior to analysis)

SAINT ALBANS INFILTRATION SYSTEM VOLUME REDUCTION AND POLLUTANT LOADING																								
Event Time Interval		Sampling Data										Event Loading and Volume Data												
		TSS	TDS	VSS	TP	Ortho-P	Chloride	Ammonia as N	Total Kjeldahl Nitrogen	Nitrate + Nitrite as N	Interval Rain	Eliptical Volume (1)	University 1 Volume (2)	Bypass Volume (3)	Volume Captured by BMP (1+2-3)	Captured TSS	Captured TDS	Captured VSS	Captured TP	Captured Ortho-P	Captured Chloride	Captured Total Kjeldahl Nitrogen	Captured Nitrate + Nitrite as N	
Start	End	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	In.	cu-ft	cu-ft	cu-ft	cu-ft	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
5/20/25 10:01	5/20/25 22:47	27.0	28.0	51	0.14	0.05	5.0	< 0.13	0.63	0.20	1.74	47773	32008	942	79781	93.4	82.3	42.4	0.57	0.137	13.6	3.0	1.0	
5/21/25 0:49	5/21/25 4:04	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.17	642	430	0	1072	3.0	8.0	3.4	0.02	0.003	0.3	0.0	0.0	
5/21/25 4:15	5/21/25 8:11	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.09	377	253	0	630	1.8	4.7	2.0	0.01	0.002	0.2	0.0	0.0	
5/21/25 12:20	5/21/25 14:19	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.06	170	114	0	283	0.8	2.1	0.9	0.01	0.001	0.1	0.0	0.0	
5/21/25 16:04	5/21/25 20:15	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.09	360	241	0	601	1.7	4.5	1.9	0.01	0.002	0.2	0.0	0.0	
5/27/25 19:45	5/28/25 4:16	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.07	254	170	0	424	1.2	3.2	1.4	0.01	0.001	0.1	0.0	0.0	
5/28/25 12:59	5/28/25 18:46	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.03	276	185	423	38	0.1	0.3	0.1	0.00	0.000	0.0	0.0	0.0	
6/3/25 7:02	6/3/25 10:31	282.0	266.0	51	0.41	0.064	5.0	< 0.2	2.83	0.78	0.53	479	321	0	800	14.1	13.3	2.6	0.02	0.003	0.2	0.1	0.0	
6/3/25 12:46	6/3/25 13:46	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.07	22	15	0	37	0.1	0.3	0.1	0.00	0.000	0.0	0.0	0.0	
6/7/25 18:05	6/7/25 18:35	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.09	17	12	0	29	0.1	0.2	0.1	0.00	0.000	0.0	0.0	0.0	
6/8/25 1:55	6/8/25 2:16	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.04	11	7	0	18	0.1	0.1	0.1	0.00	0.000	0.0	0.0	0.0	
6/8/25 3:46	6/8/25 4:18	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.06	55	37	0	92	0.3	0.7	0.3	0.00	0.000	0.0	0.0	0.0	
6/9/25 2:21	6/9/25 18:00	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.04	4	3	16	-9	0.0	-0.1	0.0	0.00	0.000	0.0	0.0	0.0	
6/12/25 16:22	6/12/25 16:48	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.13	63	42	0	105	0.3	0.8	0.3	0.00	0.000	0.0	0.0	0.0	
6/12/25 21:21	6/12/25 23:02	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.44	389	260	2	647	1.8	4.8	2.1	0.01	0.002	0.2	0.0	0.0	
6/12/25 23:54	6/13/25 2:01	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.52	638	428	0	1066	3.0	8.0	3.4	0.02	0.003	0.3	0.0	0.0	
6/13/25 6:45	6/13/25 7:27	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.17	121	81	0	202	0.6	1.5	0.7	0.00	0.001	0.1	0.0	0.0	
6/13/25 7:40	6/13/25 8:31	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.16	151	101	0	253	0.7	1.9	0.8	0.01	0.001	0.1	0.0	0.0	
6/13/25 9:33	6/13/25 10:01	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.12	103	69	30	142	0.4	1.1	0.5	0.00	0.000	0.0	0.0	0.0	
6/16/25 15:07	6/16/25 16:16	45	120	51	0.3	0.05	5.0	< 0.2	0.7	0.44	0.72	13773	9228	2466	20535	58.2	153.3	66.0	0.42	0.060	6.4	0.8	0.6	
6/25/25 11:16	6/25/25 12:22	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.75	4252	2849	0	7100	20.1	53.0	22.8	0.14	0.021	2.3	0.3	0.2	
6/25/25 12:40	6/25/25 13:16	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.13	77	52	19	110	0.3	0.8	0.4	0.00	0.000	0.0	0.0	0.0	
6/25/25 14:16	6/25/25 15:11	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.43	1529	1024	0	2553	7.2	19.1	8.2	0.05	0.007	0.8	0.1	0.1	
6/25/25 15:16	6/25/25 17:36	45	120	51	0.3	0.05	5	0.2	0.7	0.44	1	43205	28947	7681	64472	182.7	481.4	207.1	1.31	0.187	20.5	2.6	1.8	
6/26/25 13:03	6/26/25 14:56	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.58	760	509	6	1263	3.6	9.4	4.1	0.03	0.004	0.4	0.1	0.0	
6/26/25 15:07	6/26/25 15:49	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.09	44	30	0	74	0.2	0.6	0.2	0.00	0.000	0.0	0.0	0.0	
6/26/25 16:34	6/26/25 16:46	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.04	9	6	0	14	0.0	0.1	0.0	0.00	0.000	0.0	0.0	0.0	
6/29/25 1:08	6/29/25 3:46	206.0	39.0	51	0.3	0.016	5.0	< 0.2	0.7	0.43	0.63	574	385	0	959	12.3	2.3	3.1	0.02	0.001	0.3	0.0	0.0	
7/11/25 21:51	7/11/25 22:01	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.08	7	5	0	13	0.0	0.1	0.0	0.00	0.000	0.0	0.0	0.0	
7/15/25 18:59	7/15/25 19:33	342.0	57.0	51	0.3	0.146	5.0	< 0.2	0.7	0.28	0.51	563	377	6	934	19.9	3.3	3.0	0.02	0.009	0.3	0.0	0.0	
7/16/25 1:30	7/16/25 5:31	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.63	227	152	0	379	1.1	2.8	1.2	0.01	0.001	0.1	0.0	0.0	
7/16/25 7:46	7/16/25 8:46	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.24	57	38	3544	-3449	-9.8	-25.7	-11.1	-0.07	-0.010	-1.1	-0.1	-0.1	
7/21/25 9:17	7/21/25 11:16	108.0	27.0	51	0.3	0.056	5.0	< 0.2	0.7	0.52	0.54	384	257	0	641	4.3	1.1	2.1	0.01	0.002	0.2	0.0	0.0	
7/23/25 9:46	7/23/25 10:01	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.06	4	3	0	7	0.0	0.1	0.0	0.00	0.000	0.0	0.0	0.0	
7/23/25 12:15	7/23/25 15:16	78.0	30.0	51	0.3	0.051	5.0	< 0.2	0.7	0.31	0.74	636	426	0	1062	5.2	2.0	3.4	0.02	0.003	0.3	0.0	0.0	
7/27/25 20:08	7/28/25 1:11	56.0	33.0	51	0.3	0.061	5.0	< 0.2	0.7	0.62	1.41	21847	14637	4936	31548	110.3	65.0	101.3	0.64	0.120	9.8	1.3	1.2	
7/28/25 21:52	7/28/25 23:01	112.0	24.0	< 51	0.3	0.025	5.0	< 0.2	0.7	0.37	0.68	1198	803	7	1994	13.9	3.0	6.4	0.04	0.003	0.6	0.1	0.0	
8/9/25 4:32	8/9/25 5:38	45	120	51	0.3	0.05	5	0.2	0.7	0.44	1.42	0	0	5	-5	0.0	0.0	0.0	0.00	0.000	0.0	0.0	0.0	
8/14/25 11:38	8/14/25 11:46	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.06	3	2	0	5	0.0	0.0	0.0	0.00	0.000	0.0	0.0	0.0	
8/15/25 15:52	8/15/25 17:31	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.86	13722	9194	10	22906	64.9	171.0	73.6	0.47	0.066	7.3	0.9	0.6	
8/15/25 19:07	8/15/25 19:31	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.04	14	10	0	24	0.1	0.2	0.1	0.00	0.000	0.0	0.0	0.0	
8/16/25 6:46	8/16/25 12:01	45	120	51	0.3	0.05	5	0.2	0.7	0.44	1.21	28845	19326	15887	32285	91.5	241.1	103.7	0.66	0.094	10.3	1.3	0.9	
8/17/25 21:30	8/18/25 9:22	45	120	51	0.3	0.05	5	0.2	0.7	0.44	1.27	37887	25384	15813	47459	134.5	354.4	152.5	0.97	0.138	15.1	1.9	1.3	
8/18/25 9:44	8/18/25 11:32	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.03	50	33	0	83	0.2	0.6	0.3	0.00	0.000	0.0	0.0	0.0	
8/29/25 3:35	8/30/25 15:15	45	120	51	0.3	0.05	5	0.2	0.7	0.44	0.03	204	137	0	340	1.0	2.5	1.1	0.01	0.001	0.1	0.0	0.0	
9/2/25 10:01	9/2/25 11:01	146.0	120	51	0.3	0.198	18.0	0.2	0.7	0.84	0.14	153	103	0	256	2.3	1.9	0.8	0.01	0.003	0.3	0.0	0.0	
9/4/25 16:45	9/5/25 18:38	75.0	69.0	51	0.3	0.143	5.0	< 0.2	0.7	0.67	0.23	991	664	0	1656	7.8	7.1	5.3	0.03	0.015	0.5	0.1	0.1	

HAMPDEN WATER QUALITY SUMMARY																		
LAB ID	Date Composite Sampling Started	Date Composite Sampling Ended	TSS (mg/L)	TDS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chloride (mg/L)	Ammonia as N (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite as N (mg/L)	Hardness as CaCO3 (mg/L)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	Total Organic Carbon (mg/L)	pH	COD (mg/L)	E. Coli (MPN/100 mL)
3362576	5/20/2025 10:09	5/20/2025 10:09	127.0	32.0	0.32	0.037	5.0 <	0.13	0.87	0.20 <	35	10.3	14.8	78.8	2.2	7.40	102.0	1203
3372130	6/12/2025 23:58	6/13/2025 0:17					5.0 <			0.24 <	26	4.6	5.9	36.0	1.6			
3373676	6/25/2025 11:02	6/25/2025 15:39	307.0	67.0		0.010 <	8.2			0.20	79	20.5	15.1	198.0	12.8		155.0	
3376860	7/5/2025 4:52	7/5/2025 5:32	95.0				52.0			0.20 <								
3380083	7/15/2025 18:52	7/16/2025 10:34	405.0	73.0		0.010 <	5.0 <			0.20 <	59	14.7	10.6	125.0	10.5		71.0	
3383579	7/27/2025 19:57	7/27/2025 22:46	88.0	35.0		0.035	5.0 <			0.28 <	27	7.1	17.0	69.6	2.9		37.0	
3384060	7/28/2025 21:46	7/28/2025 22:55	41.0	24.0 <		0.026	5.0 <			0.27	13	3.8	11.4	32.6	2.8		18.0	
3390434	8/16/2025 6:59	8/16/2025 7:31	95.0	24.0 <		0.041	5.0 <			0.20	20	6.0	25.8	56.6	1.5		39.0	
3395511	9/4/2025 18:45	9/4/2025 19:38	148.0	84.0		0.054	7.2			0.25 <	69	22.3	21.8	232.0	15.8		163.0	
3396922	9/9/2025 15:13	9/9/2025 22:37	35.0	67.0		0.023	5.0			0.27	31	7.8	4.2	65.9	9.3		57.0	
MINIMUM			26.0	24.0	0.3	0.0	5.0	0.1	0.9	0.2	13.1	3.8	3.6	32.6	1.5	7.4	18.0	82.0
AVERAGE			136.7	59.4	0.3	0.0	14.0	0.1	0.9	0.2	37.5	10.4	13.0	95.2	6.3	8.0	75.7	642.5
MEDIAN			95.0	67.0	0.3	0.0	5.0	0.1	0.9	0.2	29.2	7.5	13.1	67.8	3.3	8.0	57.0	642.5
MAXIMUM			405.0	129.0	0.3	0.1	52.1	0.1	0.9	0.3	78.5	22.3	25.8	232.0	15.8	8.6	163.0	1203.0

Laboratory analysis was completed by Metroplian Council Environmental Services

Grab Sample Duplicate

< - Analyte not detected above the Method Detection Limit (MDL), MDL value reported

J - Result reported as estimated between the MDL and Reporting Limit (RL)

> - Analyte exceeded the maximum detection level (was not fully diluted prior to analysis)

HAMPDEN PARK VOLUME AND POLLUTANT REDUCTION SUMMARY

Event Time Interval		Sampling Data									Event Loading and Volume Data																
		TSS	TDS	VSS	TP	Ortho-P	Chloride	Ammonia as N	Total Kjeldahl Nitrogen	Nitrate + Nitrite as N	Interval Rain	Hampden/Raymond Inflow Volume (1)	Eastern Hampden Modeled Inflow Volume ² (2)	Bypass Volume ² (3)	Volume Captured by BMP (1+2-3)	Percent Captured	Captured TSS	Captured TDS	Captured VSS	Captured TP	Captured Ortho-P	Captured Chloride	Captured Total Kjeldahl Nitrogen	Captured Nitrate + Nitrite as N			
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	In.	cu-ft	cu-ft	cu-ft	cu-ft		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.			
Start	End																										
5/15/25 14:32	5/15/25 14:59	181	47	32	0.2	0.03	6	0.2	1.4	0.03	213	35	0	248	100%	2.8	0.7	0.5	0.00	0.000	0.09	0.02	0.00				
5/16/25 13:09	5/16/25 14:53	181	47	32	0.2	0.03	6	0.2	1.4	0.05	572	94	0	666	100%	7.5	2.0	1.3	0.01	0.001	0.25	0.06	0.01				
5/16/25 19:59	5/17/25 3:15	181	47	32	0.2	0.03	6	0.2	1.4	0.14	1695	280	0	1975	100%	22.3	5.8	3.9	0.02	0.003	0.75	0.17	0.03				
5/19/25 19:25	5/19/25 23:46	181	47	32	0.2	0.03	6	0.2	1.4	0.62	5999	990	0	6989	100%	79.0	20.5	13.8	0.09	0.011	2.67	0.61	0.10				
5/20/25 3:35	5/20/25 15:15	127.0	32.0	32	32.00	0.037	5.0	<	0.13	0.87	0.20	<	1.27	9822	1621	0	11442	100%	90.7	22.9	22.6	22.86	0.026	3.57	0.62	0.14	
5/21/25 1:42	5/21/25 2:13	181	47	32	0.2	0.03	6	0.2	1.4	0.10	383	63	0	446	100%	5.0	1.3	0.9	0.01	0.001	0.17	0.04	0.01				
5/21/25 5:32	5/21/25 6:28	181	47	32	0.2	0.03	6	0.2	1.4	0.08	486	80	0	566	100%	6.4	1.7	1.1	0.01	0.001	0.22	0.05	0.01				
5/21/25 16:34	5/21/25 20:47	181	47	32	0.2	0.03	6	0.2	1.4	0.05	255	42	0	297	100%	3.4	0.9	0.6	0.00	0.000	0.11	0.03	0.00				
6/2/25 18:34	6/2/25 20:28	181	47	32	0.2	0.03	6	0.2	1.4	0.08	1576	260	0	1836	100%	20.8	5.4	3.6	0.02	0.003	0.70	0.16	0.03				
6/3/25 6:30	6/3/25 16:07	181	47	32	0.2	0.03	6	0.2	1.4	0.75	13158	2171	0	15329	100%	173.3	44.9	30.3	0.19	0.025	5.86	1.34	0.22				
6/7/25 17:25	6/7/25 20:03	181	47	32	0.2	0.03	6	0.2	1.4	0.60	5238	864	0	6103	100%	69.0	17.9	12.1	0.08	0.010	2.33	0.53	0.09				
6/8/25 3:43	6/8/25 5:14	181	47	32	0.2	0.03	6	0.2	1.4	0.04	502	83	0	585	100%	6.6	1.7	1.2	0.01	0.001	0.22	0.05	0.01				
6/9/25 2:19	6/9/25 11:31	181	47	32	0.2	0.03	6	0.2	1.4	0.03	795	131	0	926	100%	10.5	2.7	1.8	0.01	0.001	0.35	0.08	0.01				
6/11/25 10:38	6/11/25 12:22	181	47	32	0.2	0.03	6	0.2	1.4	0.01	246	41	0	287	100%	3.2	0.8	0.6	0.00	0.000	0.11	0.03	0.00				
6/11/25 17:10	6/11/25 19:10	181	47	32	0.2	0.03	6	0.2	1.4	0.03	448	74	0	522	100%	5.9	1.5	1.0	0.01	0.001	0.20	0.05	0.01				
6/12/25 16:10	6/12/25 18:59	181	47	32	0.2	0.03	6	0.2	1.4	0.12	1666	275	0	1941	100%	21.9	5.7	3.8	0.02	0.003	0.74	0.17	0.03				
6/12/25 21:05	6/13/25 3:51	181	47	32	0.2	0.03	5.0	<	0.2	1.29	16579	2736	0	19315	100%	218.3	56.6	38.2	0.24	0.031	6.03	1.69	0.29				
6/13/25 6:36	6/13/25 10:25	181	47	32	0.2	0.03	6	0.2	1.4	0.32	5123	845	0	5968	100%	67.5	17.5	11.8	0.07	0.010	2.28	0.52	0.08				
6/13/25 18:36	6/13/25 21:31	181	47	32	0.2	0.03	6	0.2	1.4	0.03	930	153	0	1083	100%	12.3	3.2	2.1	0.01	0.002	0.41	0.09	0.02				
6/16/25 4:33	6/16/25 5:21	181	47	32	0.2	0.03	6	0.2	1.4	0.01	74	12	0	86	100%	1.0	0.3	0.2	0.00	0.000	0.03	0.01	0.00				
6/16/25 6:35	6/16/25 7:56	181	47	32	0.2	0.03	6	0.2	1.4	0.02	543	90	0	632	100%	7.1	1.9	1.2	0.01	0.001	0.24	0.06	0.01				
6/16/25 11:33	6/16/25 13:24	181	47	32	0.2	0.03	6	0.2	1.4	0.13	1619	267	0	1886	100%	21.3	5.5	3.7	0.02	0.003	0.72	0.16	0.03				
6/16/25 14:57	6/16/25 16:11	181	47	32	0.2	0.03	6	0.2	1.4	1.01	15616	2577	0	18192	100%	205.7	53.3	35.9	0.23	0.029	6.95	1.59	0.26				
6/25/25 10:58	6/25/25 18:13	307.0	67.0	32	0.2	0.010	<	8.2	0.2	1.4	0.20	<	2.50	27106	4472	0	31578	100%	605.2	132.1	62.4	0.39	0.020	16.17	2.76	0.39	
6/26/25 9:21	6/26/25 11:29	181	47	32	0.2	0.03	6	0.2	1.4	0.03	742	122	0	865	100%	9.8	2.5	1.7	0.01	0.001	0.33	0.08	0.01				
6/26/25 12:53	6/26/25 17:33	181	47	32	0.2	0.03	6	0.2	1.4	0.58	5530	913	0	6443	100%	72.8	18.9	12.7	0.08	0.010	2.46	0.56	0.09				
6/28/25 6:06	6/28/25 7:52	181	47	32	0.2	0.03	6	0.2	1.4	0.01	658	109	0	766	100%	8.7	2.2	1.5	0.01	0.001	0.29	0.07	0.01				
6/29/25 0:54	6/29/25 6:20	181	47	32	0.2	0.03	6	0.2	1.4	0.72	7385	1219	0	8604	100%	97.3	25.2	17.0	0.11	0.014	3.29	0.75	0.12				
6/30/25 4:36	6/30/25 7:31	181	47	32	0.2	0.03	6	0.2	1.4	0.07	1414	233	0	1647	100%	18.6	4.8	3.3	0.02	0.003	0.63	0.14	0.02				
7/5/25 4:45	7/5/25 6:20	95.0	47	32	0.2	0.03	52.0	0.2	1.4	0.20	<	0.10	1223	202	0	1425	100%	8.5	4.2	2.8	0.02	0.002	4.63	0.12	0.02		
7/5/25 21:42	7/6/25 0:20	181	47	32	0.2	0.03	6	0.2	1.4	0.02	756	125	0	881	100%	10.0	2.6	1.7	0.01	0.001	0.34	0.08	0.01				
7/15/25 18:50	7/16/25 13:06	405.0	73.0	32	0.2	0.010	<	5.0	<	0.2	1.4	0.20	<	1.24	15729	2595	0	18325	100%	463.3	83.5	36.2	0.23	0.011	5.72	1.60	0.23
7/16/25 17:14	7/16/25 17:47	181	47	32	0.2	0.03	6	0.2	1.4	0.01	45	7	0	52	100%	0.6	0.2	0.1	0.00	0.000	0.02	0.00	0.00				
7/18/25 22:11	7/18/25 23:35	181	47	32	0.2	0.03	6	0.2	1.4	0.05	904	149	0	1053	100%	11.9	3.1	2.1	0.01	0.002	0.40	0.09	0.01				
7/19/25 2:38	7/19/25 5:10	181	47	32	0.2	0.03	6	0.2	1.4	0.08	1134	187	0	1321	100%	14.9	3.9	2.6	0.02	0.002	0.50	0.12	0.02				
7/21/25 9:08	7/21/25 13:18	181	47	32	0.2	0.03	6	0.2	1.4	0.47	4522	746	0	5268	100%	59.5	15.4	10.4	0.07	0.008	2.01	0.46	0.08				
7/21/25 13:30	7/21/25 14:34	181	47	32	0.2	0.03	6	0.2	1.4	0.01	246	41	0	287	100%	3.2	0.8	0.6	0.00	0.000	0.11	0.03	0.00				
7/23/25 12:10	7/23/25 13:38	181	47	32	0.2	0.03	6	0.2	1.4	0.17	1495	247	0	1741	100%	19.7	5.1	3.4	0.02	0.003	0.67	0.15	0.02				
7/23/25 13:40	7/23/25 16:06	181	47	32	0.2	0.03	6	0.2	1.4	0.60	6815	1124	0	7940	100%	89.8	23.3	15.7	0.10	0.013	3.03	0.69	0.11				
7/23/25 23:15	7/24/25 0:20	181	47	32	0.2	0.03	6	0.2	1.4	0.02	288	48	0	336	100%	3.8	1.0	0.7	0.00	0.001	0.13	0.03	0.00				
7/27/25 19:59	7/28/25 1:52	88.0	35.0	32	0.2	0.035	5.0	<	0.2	1.45	0.28	<	1.45	22178	3659	0	25838	100%	141.9	56.5	51.0	0.32	0.056	8.07	2.26	0.45	
7/28/25 21:47	7/28/25 23:12	41.0	24.0	<	32	0.2	0.026	5.0	<	0.2	1.4	0.27	<	0.85	10838	1788	0	12626	100%	32.3	18.9	24.9	0.16	0.020	3.94	1.10	0.21
8/9/25 4:28	8/9/25 5:54	181	47	32	0.2	0.03	6	0.2	1.4	0.18	10338	1706	0	12044	100%	136.2	35.3	23.8	0.15	0.019	4.60	1.05	0.17				
8/9/25 11:28	8/9/25 12:31	181	47	32	0.2	0.03	6	0.2	1.4	0.08	709	117	0	826	100%	9.3	2.4	1.6	0.01	0.001	0.32	0.07	0.01				
8/14/25 17:45	8/14/25 17:59	181	47	32	0.2	0.03	6	0.2	1.4	0.01	25	4	0	29	100%	0.3	0.1	0.1	0.00	0.000	0.01	0.00	0.00				
8/15/25 16:09	8/15/25 16:54	181	47	32	0.2	0.03	6	0.2	1.4	0.26	1601	264	0	1865	100%	21.1	5.5	3.7	0.02	0.003	0.71	0.16	0.03				
8/15/25 18:54	8/15/25 20:08	181	47	32	0.2	0.03	6	0.2	1.4	0.10	1126	186	0	1312	100%	14.8	3.8	2.6	0.02	0.002	0.50	0.11	0.02				
8/16/25 6:19	8/16/25 10:36	95.0	24.0	<	32	0.2	0.041	5.0	<	0.2	1.4	0.20	<	1.58	20619	3402	0	24021	100%	142.5	36.0	47.4	0.30	0.061	7.50	2.10	0.30
8/17/25 21:01	8/18/25 0:39	181	47	32	0.2	0.03	6	0.2	1.4	1.05	11151	1840	0	12991	100%	146.9	38.1	25.7	0.16	0.021	4.9						

VICTORIA WATER QUALITY SUMMARY																		
LAB ID	Date Composite Sampling Started	Date Composite Sampling Ended	TSS (mg/L)	TDS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chloride (mg/L)	Ammonia as N (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite as N (mg/L)	Hardness as CaCO3 (mg/L)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	Total Organic Carbon (mg/L)	pH	COD (mg/L)	E. Coli (MPN/100 mL)
3349770	4/2/2025 15:41	4/2/2025 15:41	1080.0	39.0		0.099	5.0 <	0.19		0.200 <	72	16.2	45.0	103.0	5.4	7.2	201.0	206
3362572	5/20/2025 10:23	5/20/2025 10:23	54.0	24.0 <	0.13	0.045	5.0 <	0.12	0.51	0.200 <	5	2.0	7.2	11.8	2.7	7.4	29.0	2420
3372128	6/12/2025 17:53	6/13/2025 1:23					5.0 <			0.390 <	27	9.0	14.4	54.9	4.8			
3375008	6/29/2025 0:53	6/29/2025 5:53	146.0	79.0		0.037	5.0 <			0.200	41	10.5	16.9	51.1	8.0		32.0	
3375012	6/25/2025 10:52	6/25/2025 15:44	178.0	30.0		0.051	5.0 <			0.200 <	29	11.4	24.4	61.2	5.3		82.0	
3376856	7/5/2025 4:45	7/5/2025 8:04	93.0				16.1			0.200 <								
3379672	7/16/2025 10:17	7/16/2025 10:17	15.0	48.0 <		0.102	5.0 <			0.200 <	25	3.1	2.3	25.3	6.8	8.1	36.0	2420
3380077	7/16/2025 0:06	7/16/2025 11:08	109.0	45.0		0.023	5.0 <			2.000 <	19	5.3	5.3	23.3	9.0		43.0	
3382641	7/23/2025 12:01	7/23/2025 15:48	152.0	32.0		0.010 <	5.0 <			0.200 <	25	10.4	23.7	53.8	9.5		191.0	
3383577	7/27/2025 19:55	7/27/2025 23:03	214.0	30.0		0.022	5.0 <			0.290 <	17	6.9	18.4	34.7	11.2		91.0	
3384056	7/28/2025 21:46	7/28/2025 22:53	110.0	24.0 <		0.043	5.0 <			0.200	27	13.2	28.2	64.7	4.2		54.0	
3400264	9/19/2025 15:38	9/19/2025 19:58	26.0	45.0		0.110	5.0 <			0.200 <	16	4.3	7.7	26.5	4.7		26.0	
3407641	10/14/2025 7:53	10/14/2025 22:53	35.0	59.0		0.338	5.0 <			0.260 <	31	6.0	5.4	28.4	15.3		80.0	
MINIMUM			15.0	24.0	0.1	0.0	5.0	0.1	0.5	0.2	5.2	2.0	2.3	11.8	2.7	7.2	26.0	206.0
AVERAGE			184.3	41.4	0.1	0.1	5.9	0.2	0.5	0.4	27.8	8.2	16.6	44.9	7.2	7.6	78.6	1682.0
MEDIAN			109.5	39.0	0.1	0.0	5.0	0.2	0.5	0.2	25.8	7.9	15.7	42.9	6.1	7.4	54.0	2420.0
MAXIMUM			1080.0	79.0	0.1	0.3	16.1	0.2	0.5	2.0	71.9	16.2	45.0	103.0	15.3	8.1	201.0	2420.0

Laboratory analysis was completed by Metroplan Council Environmental Services

Grab Sample Duplicate

< - Analyte not detected above the Method Detection Limit (MDL), MDL value reported

J - Result reported as estimated between the MDL and Reporting Limit (RL)

> - Analyte exceeded the maximum detection level (was not fully diluted prior to analysis)

Event Time Interval		Sampling Data											Rain	Event Loading and Volume Data										
		TSS	TDS	VSS	TP	Ortho-P	Chloride	Ammonia as N	Total Kjeldahl Nitrogen	Nitrate + Nitrite as N	Amount	Interval Rain	Runoff Volume (1)	Bypassed Volume (2)	Volume Captured by BMP (1-2)	Captured TSS	Captured TDS	Captured VSS	Captured TP	Captured Ortho-P	Captured Chloride	Captured Ammonia as N	Captured Total Kjeldahl Nitrogen	Captured Nitrate + Nitrite as N
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	(in)	In.	cu-ft	cu-ft	cu-ft	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
5/15/2025 14:37	5/15/2025 15:42	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.32	0.32	3687	0	3687	33.8	8.8	11.7	0.1	0.010	1.2	0.09	0.6	0.1
5/16/2025 13:30	5/16/2025 15:07	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.04	0.04	130	0	130	1.2	0.3	0.4	0.0	0.000	0.0	0.00	0.0	0.0
5/16/2025 20:00	5/17/2025 3:22	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.15	0.15	2121	0	2121	19.4	5.0	6.7	0.1	0.006	0.7	0.05	0.4	0.1
5/19/2025 19:28	5/20/2025 1:46	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.68	0.68	12937	0	12937	118.5	30.8	40.9	0.5	0.035	4.1	0.30	2.2	0.3
5/20/2025 4:24	5/20/2025 20:02	147	38	51	0.6	0.04	5	0.4	2.8	0.38	1.76	1.76	45539	231	45309	414.9	107.7	143.4	1.7	0.124	14.3	1.07	7.8	1.1
5/21/2025 0:48	5/21/2025 8:00	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.26	0.26	7102	0	7102	65.0	16.9	22.5	0.3	0.019	2.2	0.17	1.2	0.2
5/21/2025 11:51	5/21/2025 15:58	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.07	0.07	2101	0	2101	19.2	5.0	6.7	0.1	0.006	0.7	0.05	0.4	0.1
5/21/2025 16:03	5/21/2025 20:20	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.09	0.09	4245	0	4245	38.9	10.1	13.4	0.2	0.012	1.3	0.10	0.7	0.1
5/21/2025 20:22	5/21/2025 22:38	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.03	0.03	257	0	257	2.4	0.6	0.8	0.0	0.001	0.1	0.01	0.0	0.0
5/27/2025 22:59	5/28/2025 2:40	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.07	0.07	380	0	380	3.5	0.9	1.2	0.0	0.001	0.1	0.01	0.1	0.0
5/28/2025 12:58	5/28/2025 15:47	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.03	0.03	244	0	244	2.2	0.6	0.8	0.0	0.001	0.1	0.01	0.0	0.0
6/3/2025 11:26	6/3/2025 15:10	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.16	0.16	69135	0	69135	633.0	164.4	218.8	2.5	0.189	21.9	1.63	11.9	1.7
6/7/2025 17:48	6/7/2025 19:53	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.09	0.09	2354	0	2354	21.6	5.6	7.5	0.1	0.006	0.7	0.06	0.4	0.1
6/8/2025 1:43	6/8/2025 5:00	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.09	0.09	438	0	438	4.0	1.0	1.4	0.0	0.001	0.1	0.01	0.1	0.0
6/9/2025 2:27	6/9/2025 3:34	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.03	0.03	64	0	64	0.6	0.2	0.2	0.0	0.000	0.0	0.00	0.0	0.0
6/11/2025 11:15	6/11/2025 18:35	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.03	0.03	131	0	131	1.2	0.3	0.4	0.0	0.000	0.0	0.00	0.0	0.0
6/12/2025 16:18	6/13/2025 4:20	147	38	51	0.6	0.04	5.0	0.4	2.8	0.390	1.14	1.14	36066	1156	34910	319.7	83.0	110.5	1.3	0.095	10.9	0.82	6.0	0.8
6/13/2025 6:20	6/13/2025 11:07	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.45	0.45	8940	0	8940	81.9	21.3	28.3	0.3	0.024	2.8	0.21	1.5	0.2
6/16/2025 15:02	6/16/2025 16:35	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.72	0.72	12308	4344	7964	72.9	18.9	25.2	0.3	0.022	2.5	0.19	1.4	0.2
6/25/2025 11:00	6/25/2025 18:27	178.0	30.0	51	0.6	0.051	5.0	0.4	2.8	0.200	2.31	2.31	49221	13179	36042	400.5	67.5	114.1	1.3	0.115	11.3	0.85	6.2	0.5
6/26/2025 9:45	6/26/2025 18:04	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.72	0.72	15432	0	15432	141.3	36.7	48.8	0.6	0.042	4.9	0.36	2.7	0.4
6/29/2025 1:00	6/29/2025 5:09	146.0	79.0	51	0.6	0.037	5.0	0.4	2.8	0.200	0.64	0.64	13357	0	13357	121.7	65.9	42.3	0.5	0.031	4.2	0.31	2.3	0.2
6/30/2025 4:42	6/30/2025 6:13	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.05	0.05	486	0	486	4.4	1.2	1.5	0.0	0.001	0.2	0.01	0.1	0.0
7/5/2025 4:53	7/5/2025 6:52	93.0	38	51	0.6	0.04	16.1	0.4	2.8	0.200	0.07	0.07	1259	0	1259	7.3	3.0	4.0	0.0	0.003	1.3	0.03	0.2	0.0
7/11/2025 21:47	7/11/2025 23:05	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.08	0.08	411	0	411	3.8	1.0	1.3	0.0	0.001	0.1	0.01	0.1	0.0
7/15/2025 18:54	7/15/2025 20:22	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.51	0.51	5127	0	5127	46.9	12.2	16.2	0.2	0.014	1.6	0.12	0.9	0.1
7/16/2025 0:00	7/16/2025 11:15	109.0	45.0	51	0.6	0.023	5.0	0.4	2.8	0.200	0.96	0.96	16729	0	16729	113.8	47.0	52.9	0.6	0.024	5.2	0.39	2.9	2.1
7/18/2025 22:16	7/19/2025 2:30	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.07	0.07	781	0	781	7.2	1.9	2.5	0.0	0.002	0.2	0.02	0.1	0.0
7/19/2025 2:45	7/19/2025 14:45	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.06	0.06	695	0	695	6.4	1.7	2.2	0.0	0.002	0.2	0.02	0.1	0.0
7/21/2025 9:17	7/21/2025 12:30	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.54	0.54	9887	3	9885	90.5	23.5	31.3	0.4	0.027	3.1	0.23	1.7	0.2
7/21/2025 13:45	7/21/2025 21:15	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.01	0.01	57	7	50	0.5	0.1	0.2	0.0	0.000	0.0	0.00	0.0	0.0
7/23/2025 9:45	7/23/2025 16:09	152.0	32.0	51	0.6	0.010	5.0	0.4	2.8	0.200	0.80	0.80	13626	699	12926	122.7	25.8	40.9	0.5	0.008	4.0	0.30	2.2	0.2
7/23/2025 23:00	7/24/2025 9:30	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.05	0.05	188	10	179	1.6	0.4	0.6	0.0	0.000	0.1	0.00	0.0	0.0
7/27/2025 20:03	7/28/2025 2:09	214.0	30.0	51	0.6	0.022	5.0	0.4	2.8	0.200	1.41	1.41	36423	20818	15605	208.5	29.2	49.4	0.6	0.021	4.9	0.37	2.7	0.2
7/28/2025 21:45	7/29/2025 0:20	110.0	24.0	51	0.6	0.043	5.0	0.4	2.8	0.200	0.68	0.68	11556	1412	10144	69.7	15.2	32.1	0.4	0.027	3.2	0.24	1.7	0.1
8/9/2025 4:27	8/9/2025 9:25	147	38	51	0.6	0.04	5	0.4	2.8	0.38	1.42	1.42	28700	15700	13000	119.0	30.9	41.1	0.5	0.036	4.1	0.31	2.2	0.3
8/9/2025 11:31	8/9/2025 13:51	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.07	0.07	1430	0	1430	13.1	3.4	4.5	0.1	0.004	0.5	0.03	0.2	0.0
8/14/2025 11:36	8/15/2025 5:45	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.08	0.08	544	0	544	5.0	1.3	1.7	0.0	0.001	0.2	0.01	0.1	0.0
8/15/2025 16:02	8/15/2025 21:37	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.91	0.91	7150	0	7150	65.5	17.0	22.6	0.3	0.020	2.3	0.17	1.2	0.2
8/16/2025 6:15	8/16/2025 13:56	147	38	51	0.6	0.04	5	0.4	2.8	0.38	1.21	1.21	32781	19138	13644	124.9	32.4	43.2	0.5	0.037	4.3	0.32	2.3	0.3
8/17/2025 21:30	8/18/2025 2:30	147	38	51	0.6	0.04	5	0.4	2.8	0.38	1.27	1.27	18390	4385	14005	128.2	33.3	44.3	0.5	0.038	4.4	0.33	2.4	0.3
8/18/2025 7:15	8/19/2025 12:30	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.04	0.04	463	0	463	4.2	1.1	1.5	0.0	0.001	0.1	0.01	0.1	0.0
8/29/2025 3:29	8/29/2025 13:15	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.03	0.03	345	0	345	3.2	0.8	1.1	0.0	0.001	0.1	0.01	0.1	0.0
9/2/2025 10:02	9/2/2025 16:58	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.14	0.14	2478	0	2478	22.7	5.9	7.8	0.1	0.007	0.8	0.06	0.4	0.1
9/4/2025 18:19	9/4/2025 21:15	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.23	0.23	3623	0	3623	33.2	8.6	11.5	0.1	0.010	1.1	0.09	0.6	0.1
9/6/2025 14:47	9/6/2025 19:10	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.09	0.09	326	0	326	3.0	0.8	1.0	0.0	0.001	0.1	0.01	0.1	0.0
9/9/2025 15:07	9/10/2025 1:48	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.24	0.24	5864	10	5854	53.6	13.9	18.5	0.2	0.016	1.9	0.14	1.0	0.1
9/11/2025 11:45	9/12/2025 17:30	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.01	0.01	0	27	-27	-0.2	-0.1	-0.1	0.0	0.000	0.0	0.00	0.0	0.0
9/12/2025 17:45	9/13/2025 23:45	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.01	0.01	160	28	133	1.2	0.3	0.4	0.0	0.000	0.0	0.00	0.0	0.0
9/18/2025 18:21	9/18/2025 22:33	147	38	51	0.6	0.04	5	0.4	2.8	0.38	0.26	0.26	4774	0	4774	43.7	11.4	15.1	0.2	0.013	1.5	0.11	0.8	0.1
9/19/2025 15:42	9/19/2025 23:24	26.0	45.0	51																				

EAST PHALEN WATER QUALITY SUMMARY														
LAB ID	Date Composite Sampling Started	Date Composite Sampling Ended	TSS (mg/L)	TDS (mg/L)	Ortho-P (mg/L)	Chloride (mg/L)	Nitrate + Nitrite as N (mg/L)	Hardness as CaCO3 (mg/L)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	Total Organic Carbon (mg/L)	pH	COD (mg/L)
3396926	9/9/2025 15:27	9/9/2025 21:36	70.0				0.220							
3400268	9/21/2025 19:14	9/21/2025 23:37	85.0	35.0	0.054	5.0 <		19	7.1	5.9	39.8	4.8		48.0
MINIMUM			70.0	35.0	0.1	5.0	0.2	19.2	7.1	5.9	39.8	4.8	0.0	48.0
AVERAGE			77.5	35.0	0.1	5.0	0.2	19.2	7.1	5.9	39.8	4.8	####	48.0
MEDIAN			77.5	35.0	0.1	5.0	0.2	19.2	7.1	5.9	39.8	4.8	####	48.0
MAXIMUM			85.0	35.0	0.1	5.0	0.2	19.2	7.1	5.9	39.8	4.8	0.0	48.0

Laboratory analysis was completed by Metroplian Council Environmental Services

Grab Sample Duplicate

< - Analyte not detected above the Method Detection Limit (MDL), MDL value reported

J - Result reported as estimated between the MDL and Reporting Limit (RL)

> - Analyte exceeded the maximum detection level (was not fully diluted prior to analysis)

ALLIANZ FIELD FILTER CHAMBER INFLUENT WATER QUALITY SUMMARY													
LAB ID	Date Composite Sampling Started	Date Composite Sampling Ended	TSS (mg/L)	Ortho-P (mg/L)	Chloride (mg/L)	Nitrate + Nitrite as N (mg/L)	Hardness as CaCO3 (mg/L)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	pH	E. Coli (MPN/100 mL)	
3366603	6/3/2025 11:19	6/3/2025 11:19	7.0	0.115		1.800					8.50	2420	
3396924	9/9/2025 16:35	9/10/2025 1:20	6.0	0.045	351.0		231	3.9	0.5	27.9			
MINIMUM			6.0	0.0	351.0	1.8	231.0	3.9	0.5	27.9	8.5	2420.0	
AVERAGE			6.5	0.1	351.0	1.8	231.0	3.9	0.5	27.9	8.5	2420.0	
MEDIAN			6.5	0.1	351.0	1.8	231.0	3.9	0.5	27.9	8.5	2420.0	
MAXIMUM			7.0	0.1	351.0	1.8	231.0	3.9	0.5	27.9	8.5	2420.0	

Laboratory analysis was completed by Metroplian Council Environmental Services

Grab Sample Duplicate

- < - Analyte not detected above the Method Detection Limit (MDL), MDL value reported
- J - Result reported as estimated between the MDL and Reporting Limit (RL)
- > - Analyte exceeded the maximum dection level (was not fully diluted prior to analysis)

ALLIANZ FIELD FILTER CHAMBER EFFLUENT WATER QUALITY SUMMARY

LAB ID	Date Composite Sampling Started	Date Composite Sampling Ended	TSS (mg/L)	TDS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chloride (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Hardness as CaCO3 (mg/L)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	Total Organic Carbon (mg/L)	pH	COD (mg/L)	E. Coli (MPN/100 mL)
3366601	6/3/2025 11:25	6/3/2025 11:25	5.0											8.00		1733
3366910	6/3/2025 7:42	6/3/2025 18:33	9.0	480.0	0.16	0.024	273.0	0.75	176	3.9	1.4	40.8	2.8		19.0	
3372132	6/12/2025 17:31	6/13/2025 20:27					150.0		111	3.1	0.6	22.9	3.2			
3373678	6/25/2025 11:24	6/25/2025 19:23	10.0	256.0		0.065	116.0		83	2.9	0.5 <	32.2	3.2		15.0 <	
3375014	6/29/2025 1:14	6/29/2025 6:47	7.0	237.0		0.040	81.5		65	2.3	0.5 <	24.2	2.3		15.0 <	
3381618	7/21/2025 9:22	7/21/2025 12:54	15.0	447.0		0.051	201.0		143	4.7	1.2	35.3	3.8		25.0	
3382645	7/23/2025 12:40	7/23/2025 19:12	7.0	244.0		0.043	99.4		76	3.6	0.6	26.3	3.2		15.0 <	
3383581	7/27/2025 20:14	7/28/2025 2:26	7.0	243.0		0.027	96.7		70	2.7	5.0 <	23.1	5.0		15.0 <	
3384062	7/28/2025 21:55	7/29/2025 2:31	8.0	130.0		0.019	55.5		43	2.2	0.5	20.2	2.4		15.0 <	
3400270	9/19/2025 15:42	9/19/2025 22:40	4.0	215.0		0.040	88.8		63	2.2	5.0 <	14.8	2.5		15.0 <	
MINIMUM			4.0	130.0	0.2	0.0	55.5	0.8	42.6	2.2	0.5	14.8	2.3	8.0	15.0	1733.0
AVERAGE			8.0	281.5	0.2	0.0	129.1	0.8	92.1	3.1	1.7	26.6	3.2	8.0	16.8	1733.0
MEDIAN			7.0	243.5	0.2	0.0	99.4	0.8	75.8	2.9	0.6	24.2	3.2	8.0	15.0	1733.0
MAXIMUM			15.0	480.0	0.2	0.1	273.0	0.8	176.0	4.7	5.0	40.8	5.0	8.0	25.0	1733.0

Laboratory analysis was completed by Metroplian Council Environmental Services

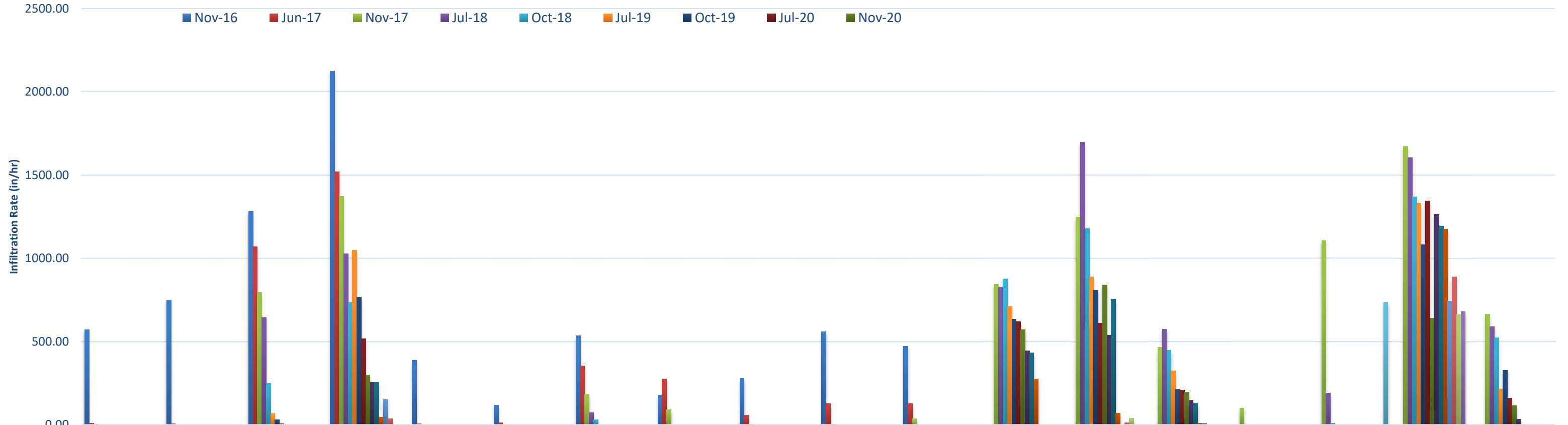
Grab Sample Duplicate

< - Analyte not detected above the Method Detection Limit (MDL), MDL value reported

J - Result reported as estimated between the MDL and Reporting Limit (RL)

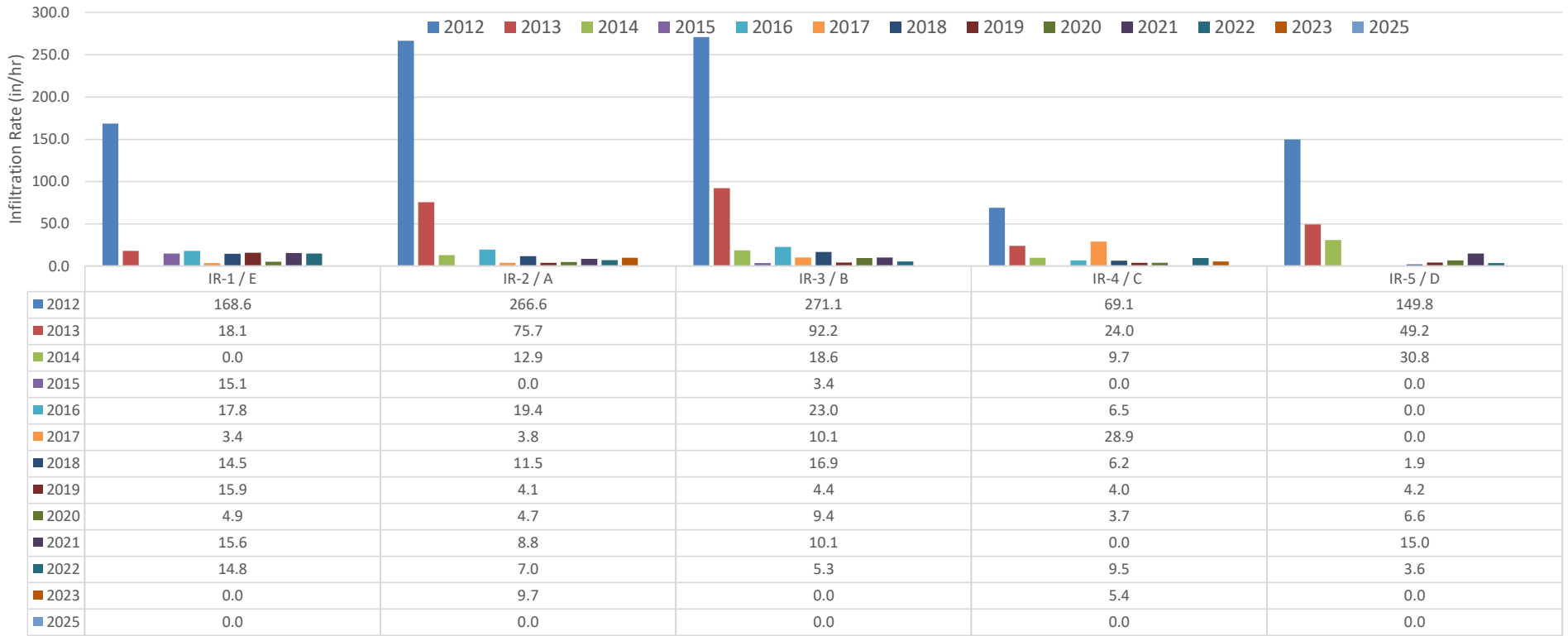
> - Analyte exceeded the maximum detection level (was not fully diluted prior to analysis)

Jackson Street Infiltration Rates

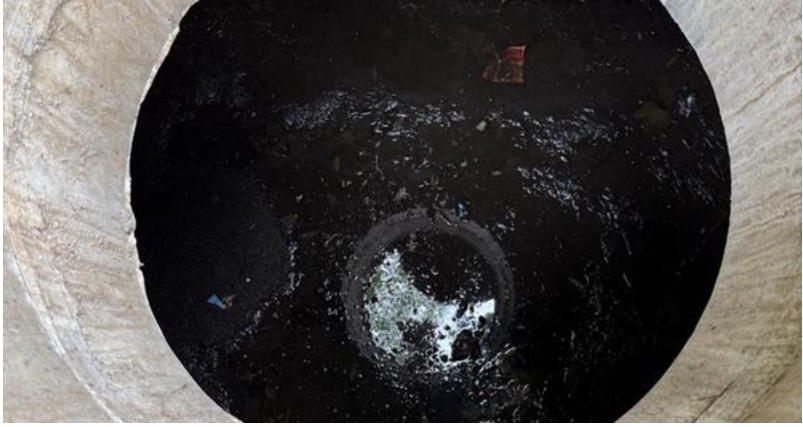


	JS-1	JS-2	JS-3	JS-4	JS-5	JS-6	JS-7	JS-8	JS-9	JS-10	JS-11	JS-12	JS-13	JS-14	JS-15	JS-16	JS-17	JS-18
Nov-16	572.60	750.40	1282.07	2122.21	385.88	118.70	533.72	177.47	277.93	557.90	471.54							
Jun-17	9.29	6.30	1069.04	1520.13	4.49	12.12	353.94	275.34	56.12	125.46	125.40							
Nov-17	3.86	0.00	793.76	1371.96	0.00	0.00	181.73	90.77	2.38	2.07	35.49	843.29	1246.74	464.43	99.97	1104.44	1669.95	665.40
Jul-18	0.00	0.00	642.24	1026.71	0.00	0.00	73.71	0.00	0.00	0.00	0.00	827.22	1696.93	575.13	0.00	190.07	1604.98	589.63
Oct-18	0.00	0.00	247.09	733.69	0.00	0.00	29.44	0.00	0.00	0.00	0.00	877.09	1179.25	447.48	0.00	9.02	1369.65	521.52
Jul-19	0.00	0.00	67.07	1050.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	710.52	889.49	323.26	0.00	0.00	1329.45	215.70
Oct-19	0.00	0.00	30.35	764.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	633.28	809.62	211.40	0.00	0.00	1082.13	327.70
Jul-20	0.00	0.00	7.05	516.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	620.41	608.65	207.81	0.00	0.00	1343.21	160.40
Nov-20	0.00	0.00	0.00	299.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	572.01	839.81	195.40	0.00	0.00	640.06	115.47
Aug-21	0.00	0.00	0.00	254.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	442.70	537.80	148.90	0.00	0.00	1263.50	33.00
Nov-21	0.00	0.00	0.00	253.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	432.00	753.00	128.70	0.00	0.00	1194.50	0.00
Aug-22	0	0	0	46.13	0	0	0	0	0	0	0	274.28	69.76	7.885	0	0	1173.965	0
Aug-23	0	0	0	149.9	0	0	0	0	0	0	0	0	0	10.4	0	0	744.4	0
Nov-23	0	0	0	38.1	0	0	0	0	0	0	0	0	13	0	0	0	888.6	0
Oct-24	0	0	0	0	0	0	0	0	0	0	0	0	38.5	0	0	0	661.1	0
Aug-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	679.46	0
Nov-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	732.17	0	0

Victoria Street Infiltration Rates



Monitoring Location



Hampden Park 6/6



Hampden Park 10/9



Saint Albans 6/6



Saint Albans 10/9



Victoria 6/6



Victoria 10/9



Bush Desoto 6/19



Bush Desoto 6/27



Bush Desoto 7/12



Bush Desoto 10/9



Allianz Field Filtration Array



Kaposia River Logger



Lilydale River Logger

Victoria Street Pervious Pavement Testing



Jackson Street Pervious Pavement testing



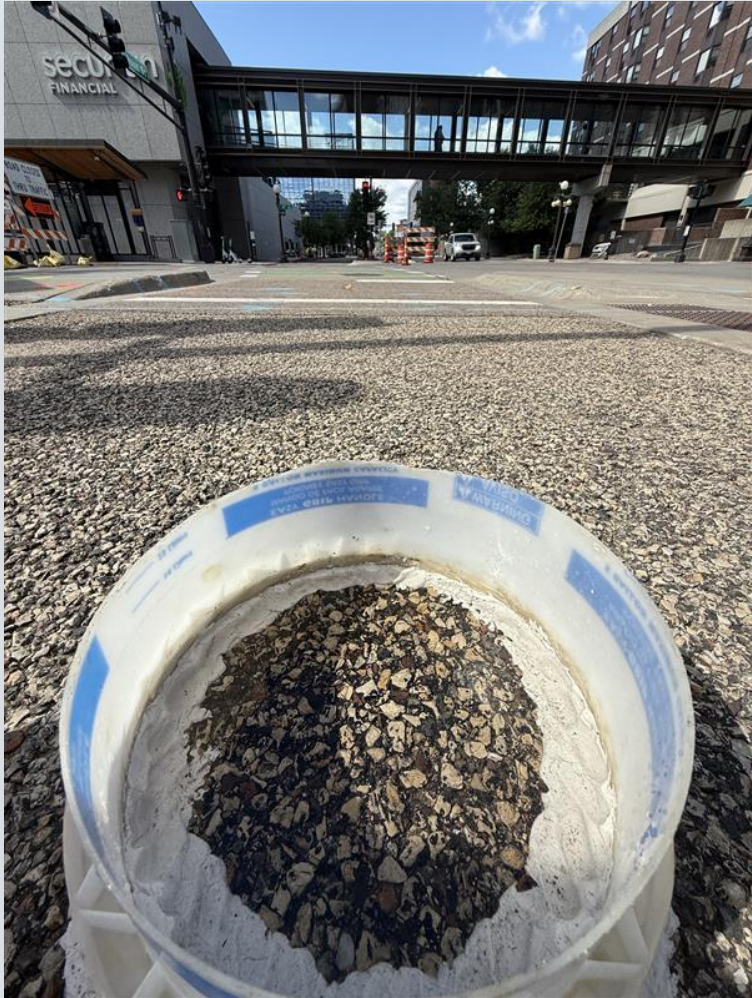


Jackson Street Pervious Pavement Testing



Jackson Street Pervious Pavement Testing

Jackson Street Pervious Pavement Testing



STORMWATER MONITORING PROTOCOL

**2025 Stormwater Monitoring Program
Field Standard Operating Procedures**

**FOR THE CITY OF
ST. PAUL, MINNESOTA**



TABLE OF CONTENTS

TITLE PAGE

TABLE OF CONTENTS

I. Contents

I.	Objectives.....	1
II.	Safety Overview	2
II.1	Adverse Weather Conditions:	2
II.2	Working in the street:.....	2
II.3	Confined Space Entry.....	2
III.	Monitoring Sites.....	4
III.1	Bush Desoto:.....	4
III.2	East Phalen Drainage:.....	4
III.3	St. Albans:	4
III.4	Allianz Field Soccer Stadium:.....	5
III.5	Hampden Park	5
III.6	Victoria Street.....	6
IV.	Preparation and Logistics.....	6
IV.1	Storm Selection Criteria for Water Quality Sampling.....	6
IV.2	Portable Sampler (ISCO 6712) Preparation	7
V.	Visual Inspection and Manual Data Collection	8
V.1	Pervious Pavement Infiltration Tests	8
VI.	Sample Collection, Preservation, and Laboratory Analysis	10
VI.1	Composite Sampling Using Automated Sampler:.....	10
VI.2	Grab Sample Collection	11
VI.3	Analytical Parameters:.....	11
VI.4	Sample Preservation.....	12
VI.5	Cleaning of Sample Equipment and Bottles	13
VI.6	Quality Assurance/Quality Control:.....	13
VII.	Operation and Maintenance of Monitoring Equipment.....	14
VII.1	Flow Meters (ISCO 2150) and Interface Modules (ISCO 2105/2103):.....	14
VII.2	Portable Sampler (ISCO 6712):	17
VII.3	Data Logging Rain Gauge:.....	19

TABLE OF CONTENTS

VII.4 Water Level Logger (Level Troll 500): 20

Attachments:

WSB Confined Space Entry Permit

Metropolitan Council Environmental Services Laboratory Chain-of-Custody (BMP Infiltration Sites)

I. Objectives

This section provides a summary of objectives for this monitoring effort. These objectives are presented in question form anticipating that the answers will be obtained through analysis of the data collected as part of this monitoring program.

- a) How do team members maintain a safe work environment?
- b) How much stormwater runoff volume reduction is achieved by each BMP on an event and annual basis?
- c) What is the average measured infiltration rate of each BMP?
- d) How often does each BMP require maintenance?
- e) How many volume reduction credits are available at each BMP? Do they perform in accordance with or exceed watershed district rules?
- f) What is the cost per cubic-foot of volume reduction actually being achieved by each BMP?
- g) What is the mass of pollutants (TP, TSS, chlorides, etc.) removed from the stormwater system by each BMP on an average annual basis?

II. Safety Overview

The following safety guidelines have been developed to ensure that all WSB team members are providing and maintaining a safe work environment. Proper planning and situational awareness can help team members identify and eliminate potentially dangerous situations. Every team member has stop work authority if they feel endangered by unsafe working conditions. All team members are encouraged to report unsafe acts or unsafe working conditions to their supervisor as soon as possible. The following sections describe potentially hazardous working conditions and hazard mitigation procedures.

II.1 Adverse Weather Conditions:

Field team members will likely encounter a wide range of weather conditions during field duties. Field staff should be aware of the weather conditions and take proper measures to protect themselves from the elements.

- During excessive heat and sun conditions, field staff should stay hydrated, don skin protective clothing, and apply sunscreen .During excessive cold conditions, field staff should dress in layers and avoid perspiration
- During lightning producing conditions, field staff must seek shelter in a work vehicle or other safe location if a lightning strike or thunder is observed. The field staff should wait at least 30 minutes from the last lightning strike before resuming outdoor activities. Lightning safety is especially important due to the likelihood of thunderstorms during stormwater sampling events
- Field staff should be aware of the signs of heat exhaustion, heat stroke, hypothermia, and frostbite, and have an understanding of basic first aid procedures

II.2 Working in the street:

At times, it will be necessary for team members to access manholes in roadways.

- While working in roadways, field staff should be visible to traffic, don reflective vests and hardhats, and utilize vehicle hazard lights
- Field staff should park close to the manhole and encompass work area with safety cones
- Field staff should be aware of any unauthorized entry into the work area by untrained personnel or the public
- Ensure that all MH lids and access points are secured prior to leaving site.

II.3 Confined Space Entry¹

Only staff with OSHA Confined Space Entry training can complete a confined space entry. When entry to confined spaces is required for monitoring activities, the following checklist must be reviewed and adhered to:

Permits/Notifications:

- Execute a confined space entry permit form and follow appropriate protocols (**Confined Space Entry Permit Attached**). See WSB's safety office, Trent Noeker, for a copy of the form
- Obtain a no fee lane use right-of-way permit if work is to be done in the street:

¹ Review Entering and Working in Confined Spaces, Confined Space Entry Program for WSB & Associates, Inc. for WSB's confined space entry protocols prior to entering a confined space.

-
- St. Paul ROW: 651-266-6151
 - Notify City staff
 - St. Paul Sewer Maintenance: 651-266-9836
 - Notify local fire department of planned confined space entry

Required Safety Gear:

- Hard hat
- Sturdy boots
- Reflective safety vest
- 4-Gas Monitor
- Tripod
- 3-way lifeline winch
- Body harness
- Air ventilation blower and generator
- 28" reflective traffic cones and vehicle hazard lighting

Gear Maintenance:

- Calibrate 4-gas monitor every 180 days:** The 4-gas monitor will indicate when calibration is needed. Viking Safety Products will calibrate the device free of charge. Call Viking for more information: 651-646-6374.
- Inspect the tripod for wear and damage annually:** Viking Safety Products will inspect the equipment and provide a formal certificate of inspection. Call Viking for more information: 651-646-6374

General Confined Space Entry Procedures:

- Never complete a confined space entry during a rain event. Check the weather forecast and ensure clear conditions for the duration of the entry.
- Prior to leaving the office, confirm all equipment is functioning and that monitoring equipment is in compliance with the calibration schedule.
- Secure the area from untrained personnel and pedestrians.
- Ensure team members are knowledgeable of the roles and responsibilities of the confined space entrant, attendant, and supervisor.
- Complete air monitoring prior to, and for the duration of the confined space entry. Ensure team members are knowledgeable of the 4-gas monitor alarms and unsafe gas levels that prompt an evacuation of the confined space.
- Utilize a rope and bucket to deliver equipment to the entrant.
- Ensure there is a reliable method of communication between all team members completing the confined space entry.

III. Monitoring Sites

Below is a summary of sites which are included in this monitoring effort. Equipment and methods used and monitoring parameters analyzed for each site are provided for quick reference. (See Figures for site locations and monitoring configuration.)

III.1 Bush Desoto:

Bush Desoto drains 38.0 acres of mixed industrial and residential areas. In 2024, the pond was excavated and stormwater BMP was installed just upstream of the pond.

Equipment:

- 2 – ISCO 2150 Area velocity sensors (Upstream and Downstream of pond)
- 1 – ISCO 6712 Portable Water Quality Sampler

Monitoring Parameters:

- Rainfall
- Flow Rate/Volume
- Water Quality (**NPDES Permit Required Parameters**)

III.2 East Phalen Drainage:

This drainage area is 48.0 acres and it mostly residential areas. A water quality monitoring station is situated at the intersection of Ivy Avenue and Clarence Street. A water level logger is installed in a wooded area downstream to measure water fluctuations from storm events.

Equipment:

- 1 – ISCO 2150 Area Velocity Sensors
- 1 – Level Troll 500
 Located in the Phalen Wetland
- 1 – ISCO 712 Portable Water Quality Sampler

Monitoring Parameters:

- Rainfall
- Flow Rate/Volume
- Water Level
- Water Quality (**NPDES Permit Required Parameters**)

III.3 St. Albans:

The St. Albans Street infiltration system was constructed in 2010 to provide volume reduction along the Central Corridor. The system was constructed in an offline configuration. When the system reaches its storage capacity, water stops flowing into the system and continues through the storm sewer. The system includes a pretreatment structure which consists of box culvert sections and baffled weirs to provide skimming and settling of runoff prior to entering the infiltration chamber.

Equipment:

- 3 – ISCO 2150 Area Velocity Sensors (Upstream, Downstream)
- 1 – ISCO 6712 Portable Water Quality Sampler
- 1 - Level Troll 500
BMP Pipe

Monitoring Parameters:

- Rainfall
- Flow Rate/Volume
- Water Level/Infiltration Rate
- Water Quality (**NPDES Permit Required Parameters**)

III.4 Allianz Field Soccer Stadium:

The Allianz Field Soccer Stadium is a filtration chamber located on the north side of interstate 94, between Snelling Avenue and Pascal Street in the Midway neighborhood of Saint Paul, Minnesota. Allianz field was designed with multiple “Shared Stacked Green Infrastructure” (SSGI) to collect, treat, and reuse stormwater from this area and protect the Mississippi River from storm water pollution. Beneath the Allianz field parking lot lies four underground storage tanks, three tanks are dedicated to rate control and treatment and one dedicated to storm water reuse. The stormwater tank is a 90,000 cubic-foot Steel Reinforced Polyethylene (SRPE) pipe. The drainage area of this site is 11.18 acres

Equipment:

- 2 – ISCO 2150 Area Velocity Sensor (influent and effluent)
- 2 – ISCO 6712 Portable Water Quality Sampler (influent and effluent)
- 3- Level Troll 500 Water Level Loggers

Monitoring Parameters:

- Rainfall
- Flow Rate/Volume
- Water Quality (**NPDES Permit Required Parameters**)

III.5 Hampden Park

The Hampden Park infiltration gallery was constructed in 2014. The system consists of eight parallel perforated pipes that are five feet in diameter and range in length from 40 to 100 feet. Runoff is routed to the pretreatment system via a 24" RCP from main storm sewer near Hampden and Raymond Avenues. From that location, stormwater enters a pretreatment structure which consists of a box culvert section and baffled weir to provide skimming and settling of runoff prior to entering the infiltration chamber. The infiltration gallery receives flow from a second inlet location along Raymond Avenue, farther to the north. When the system reaches full capacity, stormwater is routed back to the storm sewer via a 24" pipe from the southeast side of the system.

Equipment:

-
- 1 – ISCO 2150 Area Velocity Sensor (Upstream)
 - 1 – ISCO 6712 Portable Water Quality Sampler
 - 1 – Rugged Troll 100
BMP

Monitoring Parameters:

- Rainfall
- Water level/Infiltration rate
- Flow Rate
- Water Quality (**NPDES Permit Required Parameters**)

III.6 Victoria Street

This site was constructed in an offline configuration. Flow is diverted from the main storm sewer to the system. When the system has reached its storage capacity, water stops flowing into the system and continues through the storm sewer. The system includes a pretreatment structure which consists of a box culvert section and a baffled weir to provide skimming and settling of runoff prior to entering the infiltration chamber. A permeable paver parking area is located above this system and discharges filter stormwater into it via an 8-inch drain tile.

Equipment (Complete set at each of the three ponds) :

- 2 – ISCO 2150 Area velocity sensors (Upstream and Downstream)
- 1 – ISCO 6712 Portable Water Quality Sampler
- 1 – Rugged Troll 100
BMP

Monitoring Parameters:

- Rainfall
- Water Level
- Flow Rate
- Water Quality (**NPDES Permit Required Parameters**)

IV. Preparation and Logistics

Preparedness is crucial to successful implementation of this monitoring program. Anticipation of target storm events, readiness with field equipment, and understanding of confined space entry procedures play a role in this process. This section provides essential information related to these items.

IV.1 Storm Selection Criteria for Water Quality Sampling

The activities below should be completed at least weekly to determine the potential need to prepare sampling equipment and mobilize crews to undertake water quality samplings:

- Track storms using local ALERT systems and by accessing National Weather Service forecasts: www.nws.noaa.gov
- Determine Quantity of Precipitation Forecast (QPF) for an impending storm
- If QPF is greater than 0.1-inches initiate sample collection preparation procedures (see **Section VI**)

IV.2 Portable Sampler (ISCO 6712) Preparation

This is to be done after all sampling events and or when receive a low battery alarm.

- Change out samples bottles in automated sampler with clean bottles
- Reset automated sampler for a new event. Update the sample flow volume interval if more or less samples need to be collected based on lab requirements, storm event size, or modification to protocols
- Ensure that batteries are adequately charged and positioned
- Make sure clean grab sample bottles are on hand

V. Visual Inspection and Manual Data Collection

Routine BMP inspections conducted on a visual basis will provide information related to specific maintenance needs and provide information that may be pertinent to any anomalies in the water quality sampling results. Additionally, the pervious pavement infiltration studies will consist of manual data collection in accordance with ASTM method C1701. The following section provides field guidance for those tasks.

Infiltration Systems Frequency:

- Once per month

Visual Inspection:

- Identify significant obstructions present in the source pipes
- Indicate whether there is standing water in the infiltration system
- Indicate whether there is evidence of illicit discharges
- Identify any structural issues in the system
- Describe other observations
- Sketch inspection observations as appropriate

Manual Data Collection:

- Take digital photos of all visual inspection parameters
- Quantify the amount of sediment present in the system's:
 - Sump manhole
 - Pretreatment device
 - Stormwater storage area
- Quantify the amount of floatables present in the system's:
 - Sump manhole
 - Pretreatment device
 - Stormwater storage area

Required Equipment:

- Measuring rod
- Digital camera

Required Forms:

- Infiltration BMP Inspection and Maintenance Form

V.1 Pervious Pavement Infiltration Tests

Frequency:

- Once per year

Visual Inspection:

- Identify number and location of missing pavers (if present)
- Identify significant cracking, chips, or other damage
- Identify location and approximate depth of deflection

Manual Data Collection:

- Take digital photos of all visual inspection parameters
- Record depth of aggregate at six (6) locations (if pavers)
- Measure infiltration rate in six (6) locations
 - Follow the modified ASTM method C1701
 - Locations should be marked by a drill hole or a nail so that the same locations can be tested each time
 - 3 locations should be within 1 foot of the concrete strip separating the permeable surface from the roadway

Equipment:

- Infiltration measurement apparatus
- Water tank and feeder hose
- Digital camera
- Scale
- 12" PVC Pipe
- Plumbers putty

Required Forms:

- Permeable paver inspection form

Monitoring Parameters:

- Infiltration rate
- BMP visual inspection

VI. Sample Collection, Preservation, and Laboratory Analysis

The following procedures must be followed to maintain a consistent approach for obtaining composite water quality samples and to reduce the risk of cross contamination when retrieving and transporting samples to the laboratories:

VI.1 Composite Sampling Using Automated Sampler:

Estimating pollutant loads as part of this monitoring program will include determination of the event mean concentration (EMC) for the target storm events using composite samples. To obtain composite samples that are representative of the storm events analyzed, the following minimum number of aliquots and percent capture values should be met:

Total Event Precipitation (in.)	Minimum Acceptable Number of Aliquots	Percent Capture Requirement ²
0 – 0.25	6	85
0.25 – 0.50	8	80
0.50 – 1.0	10	80
> 1.0	12	75

To meet these requirements the automatic samplers should be programmed to collect samples at flow-paced intervals. Determination of the flow volume between sampling events should be based on the following information:

Total Event Precipitation (in.)	Robie Street Outfall	Beacon Bluff
	Runoff Volume (cu-ft)	Runoff Volume (cu-ft)
0.10-0.15"	30,840	4,500
0.25"	51,400	20,986
0.5"	102,800	63,000
1.0"	205,600	156,756
2.0"	411,200	373,550
3.0"	616,800	657,879

Program Automated Sampling Parameters:

Based on the information above and other considerations, the following provides the parameters that should be used for programming the automated samplers:

- **Start Time:** Begin sampling at specific water level depths
 - Hampden Park: 0.75-inches
 - Beacon Bluff: 1.25-inches
 - Saint Albans: 1.1-inches

$$^2 \text{ Percent storm capture} = \frac{\text{flow volume that passed during sample collection}}{\text{total flow that passed during the entire monitoring event}}$$

-
- Victoria: 1.15-inches
 - Sackett: 3.5-inches
 - Battle Creek: 4-inches
- Pacing:** Set sampler to collect samples at constant flow volume intervals
 - Beacon Bluff: minimum 1,500 cu-ft
 - Saint Albans: 200 cu-ft
 - Victoria: 175 cu-ft
 - Hampden Park: 300 cu-ft
 - Sackett: 250 cu-ft
 - Battle Creek: 1,500 cu-ft
 - Distribution:** Multiple samples per bottle - sample aliquot volume should be no less than 200 mL

Multiple bottles will be collected for each event. The testing laboratory should be directed to develop a composite sample with the collection of bottles by either batch mixing or by combining equal fractions of each bottle into a single bottle or container.

VI.2 Grab Sample Collection

Grab samples will be collected for E coli analysis at all monitoring locations. Samples will be collected from the influent stormwater stream prior to entering the systems. The purpose of E. coli analysis is to ensure that human effluent is not contaminating the water. The following provides the process for obtaining the grab samples:

Sampling Locations:

- Man holes up stream of the automatic samplers

Procedures:

- Collect 3 samples (one every 10 minutes for composite testing) while it is raining.
- Use sterile sample bottles with an unbroken seal when testing for e-coli
- Place sample bottle directly below or in outfall water stream to collect the sample

Required Equipment:

- Personal rain gear
- Powder-free nitrile gloves
- 1-Liter plastic sample bottles and lids
- Sterile bacteria sample bottles and lids from laboratory
- Bottle labels and water proof pen
- Chain of custody forms for laboratory
- Manhole pick
- Cooler with ice
- Grab sample collection rod

VI.3 Analytical Parameters:

The following table provides a list of parameters and the sampling frequency as established by Permit No. MN0061263. Samples collected from the automated samplers

will be analyzed for the water quality parameters in Table 1 of the City of St. Paul's MS4 permit (when volumes allow).

Monitoring Parameters		
Parameters	Sample Type	Frequency
BOD, Carbonaceous 5-Day (20 Deg C)	Composite or Grab	Quarterly
Chloride, Total	Composite or Grab	As noted for loading calculations (Par V.C7.f)
Copper, Total (asCu)	Composite or Grab	Monthly
E. coli	Grab	Quarterly
Flow	Measurement	
Hardness, Carbonate (as CaCo3)	Composite or Grab	Monthly
Lead, Total (as Pb)	Composite or Grab	Monthly
Nitrite Plus Nitrate, Total (asN)	Composite	As noted for loading calculations (Par V.C7.f)
Nitrogen, Ammonia, Un-ionized (as N)	Composite	Quarterly
Nitrogen, Kjeldahl, Total	Composite	As noted for loading calculations (Par V.C7.f)
pH	Composite or Grab	Quarterly
Phosphorus, total Dissolved or Ortho	Composite	Quarterly
Phosphorus, Total as P	Composite	As noted for loading calculations (Par V.C7.f)
Precipitation	Measurement	1 x Day
Solids, Total Dissolved (TDS)	Composite	Quarterly
Solids, Total Suspended (TSS)	Composite	As noted for loading calculations (Par V.C7.f)
Sulfate	Composite or Grab	2 x Year
Volatile Suspended Solids (VSS)	Composite	As noted for loading calculations (Par V.C7.f)
Zinc, Total (as Zn)	Composite or Grab	Monthly

VI.4 Sample Preservation

- Collect samples from automated sampler within 24 hours
- Composite individual sample containers from the autosampler into one, clean, 4-liter jug, provided by MCES Lab
 - If the storm event produced volume in excess of 4 liters, the sample volume shall be composited in the churn sampler splitter.
 - Fill the churn will all samples collected from the event. One staff shall provide constant mixing using the paddle, while the other staff shall open the spicket, gradually filling the lab container with the mixed sample
 - The churn sampler splitter shall be cleaned between uses
- The sample containers shall be labeled with the relevant Site and sample information which shall include:

-
- Site Name [See attached Chain of Custody (CoC) examples for Site IDs].
 - The composite start and end time, as indicated on the autosampler
 - Name of staff collecting the sample
 - The sampler shall complete a CoC form to submit with the sampler or communicate sample information to the Project Manager to complete the form electronically, and submit to the lab
 - Place all samples to be analyzed in a cooler with ice
 - Target holding temperature for samples is 4°C
 - Deliver samples to lab

VI.5 Cleaning of Sample Equipment and Bottles

- **Clean sample bottles and churn splitter after every use:** wash them with a brush and soapy water or use a dishwasher
- **Clean the suction line, strainer, and pump tubes twice per year:** Place the end of the suction line in a cleaning solution and pump it through the system. Rinse with clean water

VI.6 Quality Assurance/Quality Control:

- Before samples are collected, make sure that all sampling equipment and bottles are cleaned using the appropriate cleaning procedures
- Wear powder-free nitrile gloves when handling bottles, lids, tubing, or strainers.
- Never touch the inside surface or exposed end of a sample bottle or lid, even with a gloved hand
- Never let any material other than sample water touch the inside surface or exposed end of sample bottle
- Avoid allowing rain water to drip from rain gear or other surfaces into sample bottles

VII. Operation and Maintenance of Monitoring Equipment

The following provides a summary of procedures to follow for operating and maintaining monitoring equipment for collection of flow, rainfall, water level, and sampling data. These procedures should be followed when the devices are initially setup and during routine data dumps and maintenance activities.

VII.1 Flow Meters (ISCO 2150)³ and Interface Modules (ISCO 2105/2103)⁴:

Setup/Initialization:

- Software Required:** Flowlink
- Quick Connect:** Connect the device to a laptop using the communication cable. Start Flowlink and select Quick Connect Icon in the tool bar. Use “Direct” Type Connection and check “Create New Site” for new instillation. Click on the large *2100 Instruments* button to connect
- Site Info Tab:** Add applicable information and “Synchronize Site’s Time to Computer’s”
- Devices Tab:** Change Module Names for Area Velocity Meters to reflect location
- Data Tab:** Setup parameter list as shown below

The top list box shows the storage locations while the bottom list box shows the measurements that are recording data.

Data Storage Name	Max Readings	Utilization	Oldest Reading	Data Storage Fields
DownStream::Data Storage	10 of 31
Upstream::Data Storage	10 of 31
2105 Interface Module::Data Storage	2 of 31

Measurement	Primary	Secondary	Recent Reading	Readings	Quality
DownStream::Input Voltage	24 hr	Off	...	...	...
DownStream::Level	15 min	1 min	...	...	...
DownStream::Velocity	15 min	1 min	...	...	...
DownStream::Flow Rate	15 min	1 min	...	...	...
DownStream::Total Flow	24 hr	Off	...	...	...
DownStream::Temperature	15 min	Off	...	...	...
DownStream::Velocity Signal	15 min	Off	...	...	...
DownStream::Velocity Spectrum	15 min	Off	...	...	...
DownStream::Vel Spectrum Ratio	15 min	Off	...	...	...

Buttons: Calculated Flow, Measurement Details, Set Up Data Storage..., Delete All Data, Pushed Data

- Measurement Details:** Set units for all measurements (in, cfs, or cf)
 - Level:** If flow is present, measure the water depth from the water surface to the channel bottom. Enter the value on the *Level*

³ See [2150 Area Velocity Flow Module and Sensor – Installation and Operation Guide](#), Teledyne ISCO, Rev. March 9, 2011.

⁴ See [2105 Interface Module – Installation and Operation Guide](#), Teledyne ISCO, Rev. July 8, 2010.

measurement tab in Flowlink. If no flow is present, enter a value of zero. (Level measurements may drift over time, so it is important to do this routinely.)

- **Velocity Measure Tab:**
 - **No Velocity Data:** Uncheck the “*Set flow rate to zero if no velocity data*” checkbox on the *Velocity* measurement tab in Flowlink. Data can be post processed to remove low level velocity noise
 - **Synchronize Velocity Measurements:** Check the *Prevent interference box* on the *Velocity* measurement tab in Flowlink to prevent velocity signal interference at sites with multiple modules
- **Flow Rate Tab:** Input pipe shape and diameter.
- **Data Storage Rates:** Click on *Set Up Data Storage...* button on a measurement tab in Flowlink to set storage rate.
 - Level, Velocity, Flow Rate, Total flow: Primary = 15 min, Secondary = 1 min (Flow Depth > 1in)
 - Temperature, Velocity Signal, Velocity Spectrum, Velocity Spectrum Ratio: Primary = 15 min
 - Input Voltage, Wireless Signal: Primary = 24 hours
Note: In “Condition Builder” set Hysteresis to 0.5” and Duration to 5 min for all Sampler Level Triggers.
- **Pushed Data Capability:** Click the Pushed Data button to set up a schedule for the data to be pushed
 - **Set IP address:** 207.173.231.99, Port 1700
 - Use Primary Data Transmission interval of 4 hours
- **Alarms Tab:**
 - **Alarm Condition:** Define alarm condition using Equation Builder
 - Low Battery: When Modem Input voltage drops below 10V

Site Info | Devices | Measurements | Data | Level | Alarms | Wireless Power Control | ADFM | Modbus | Modem

Alarm number:

Alarm Configuration

Define the alarm condition.

Alarm Condition

Trigger alarm when: is true

Alarm Notification

Alarm type: Message:

Retry time: minutes Retry time:

Phone number list

Enter the phone number(s) to call when alarmed, followed by optional information.

	Phone Number
1st contact:	<input type="text" value="6122964573"/>
2nd contact:	<input type="text" value="6125186785"/>
3rd contact:	<input type="text" value="6123601319"/>
4th contact:	<input type="text"/>
5th contact:	<input type="text"/>

- Sampler Interface:**
 - Set Up Data Storage:** Select "Enable Logging"
 - Sampler enable:** Enable on Trigger - using equation builder to specify level threshold to enable sampler

Note: In "Condition Builder" set Hysteresis to 0.5" and Duration to 5 min for all Sampler Level Triggers

- Sampler Pacing:** input desired flow pulsing interval in cubic feet

Routine Data Retrieval and Re-initialization:

- Frequency:** Once per month
- Quick Connect:** Connect the device to a laptop using the communication cable Start Flowlink and click on the large *2100 Instruments* button to connect
- Download data and transfer to WSB server folder K:\01610-100\WR\Flow Data
- Set water level to zero. (Make sure to annotate date and time of level reset)

Routine Maintenance:

The following maintenance activities must be completed routinely and during every field visit:

- Check desiccant cartridges:** When entire length of the cartridge turns pink or green, the desiccant needs to be replaced
- Check battery voltage:** Replace both batteries when voltage is below 10
- Check hydrophobic filter:** Rinse and dry if the filter is plugged
- Check connector O-rings:** Replace or lubricate as needed
- Check flow sensor:** Remove debris and clean sensor as needed
- Check sensor cable for damage:** Replace if needed. Loose cable should be fastened to the structure

VII.2 Portable Sampler (ISCO 6712)⁵:

Setup/Initialization:

- Software Required:** Flowlink
- Measure length of suction hose:** Length will be a required input during Program setup. Cut hose to whole ft. Increments if required. Hose should generally slope downward toward the sampling probe
- Use Standard Program:** Follow Steps in Table 4-2 of the operation guide for flow pacing. Make the corresponding deviations listed below. Standard Programing Flow Charts can also be found in Appendix A in the operation guide (Figures A-2 & A-3)
 - (3) Set appropriate Site Description (i.e. Robie Street, Beacon Bluff)
 - (8) Select 1 pulse between sample events
 - (9) Samples/Bottle
 - (11) 5 Samples/Bottle (200 mL each)
 - (12) No Delay to Start
- Automatically index to next bottle when sampler is enabled:** This will allow each storm event to be composited separately, but may decrease the overall available sampling volume during multiple events
 - From home screen, enter 6712.9 and hit enter
 - Enter Code: 1199 and hit enter (Sampler should report Code Accepted)
- Calibration:** The Sampler delivers accurate sample volumes without calibration. If you find that sample volumes vary significantly from the programmed values, first check the suction line for proper installation. Be sure it slopes continuously downhill to the liquid source and drains completely after each sampling cycle. Refer to Section 4.12 of the operation guide for additional calibration notes
 - Note: If sampler does not disable when the program is set to run, check all cable connections and then make sure the 2105 is configured correctly. If the water level is below the trigger threshold, the 2105 should be indicating that the Sampler is disabled. If the sampler is still not disabling, the cable or the sampler may be malfunctioning. The cable can be diagnosed by removing the sampler cable and using a paper clip to short pins “B” and “F” on the back of the sampler control head

Routine Data Retrieval and Re-initialization:

- Frequency:** Once per month
- Interrupt Program:** Press the Stop button once to pause the program. Scroll down to “VIEW DATA” and check for errors with sampling. See page 4-19 in the operators guide for more information. When complete, select “RESUME PROGRAM”

Routine Maintenance:

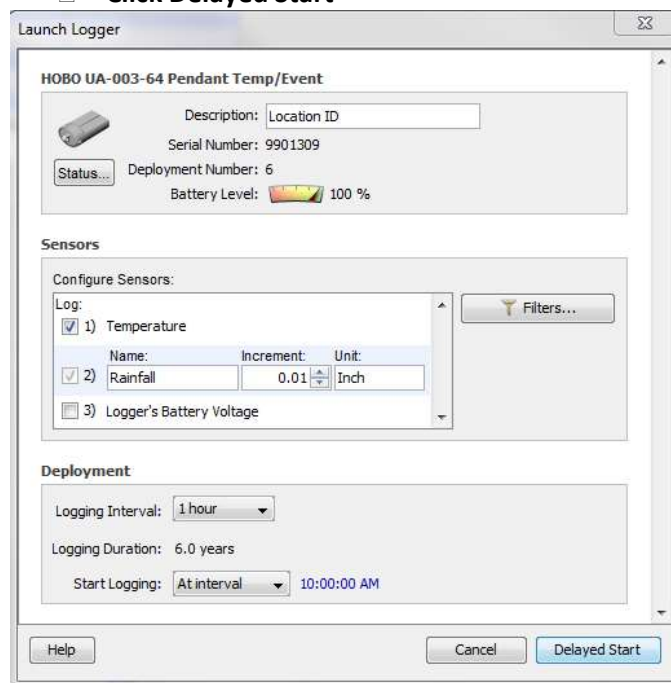
⁵ See 6712 Portable Samplers – Installation and Operation Guide, Teledyne ISCO, Rev. April 11, 2011.

-
- Check the pump tube for wear:** Replace if necessary
 - Check the pump tubing housing:** Clean if necessary
 - Check the suction line:** Change if necessary
 - Check the humidity indicator:** Desiccant should be replaced when all indicator areas turn light pink or white
 - Check the controller's internal battery status:** Replace the battery every five years
 - Check the keypad label:** If it has bubbles under it, the air inside the controller has expanded, and pressure can be released by unscrewing the flow meter cable or connector cap on the back of the controller

VII.3 Data Logging Rain Gauge:

Setup/Initialization:

- Software Required:** Onset HOBOWare.
- Connect Rain Gauge:** Open HOBOWare and select Launch Device.
- Configure Sensors:**
 - Log 1) Temperature
 - Log 2) Rainfall
 - Name: Rainfall
 - Increment: 0 .01
 - Unit: Inch
- Deployment**
 - Logging Interval: 1 hour
 - Start Logging: At Interval
- Click Delayed Start**



Routine Data Retrieval and Re-initialization:

- Frequency:** Once per month
- Connect to device using HOBOWare:**
- Download data using readout device and transfer to WSB server folder K:\01610-100\WR\Exported Data. (Do not stop logging before reading out the logger until the end of the season)

Routine Maintenance:

- Check the filter screen, funnel, and tipping mechanism for debris** (dirt, bugs, bird droppings, etc.): Clean with mild soap and water
- Check the needle bearings and apply light oil annually**

VII.4 Water Level Logger (Level Troll 500)⁶:

Setup/Initialization:

- Software Required:** Win-Situ 5
- Piezometer Specifications:** 3" PVC Pipe should be used as a Piezometer for underground stormwater structures. Drill ½" holes on four sides of the pipe so that there are approximately 20 holes per foot of length in the pipe. Holes do not need to be drilled above top of BMP structure. Wrap section expected to be submerged in highly permeable geotextile fabric, and secure with zip ties. Secure the pipe to the floor, the manhole, and the overhead casting wall
- Hang the Logger from the eye bolt installed inside of PVC pipe piezometer. This will allow a more accurate set up of the reference elevation
- Stabilization Time:** Allow the Level TROLL to stabilize to the water conditions for *about an hour* before logging data. A generous stabilization time is always desirable, especially in long-term deployments. Even though the cable is shielded, temperature stabilization, stretching, and unkinking can cause apparent changes in the probe reading. If you expect to monitor water levels to the accuracy of the probe, it's worth allowing the extra time for the probe to stabilize to its environment
- Connection:** With the Troll Com plugged into a USB port, launch Win-Situ Software
- Win-Situ Launches:** the screen shows the "My Data Tab".
 - On first connection, be sure to select the correct COM port for a USB connection
 - Then connect to the device
- When Connected, the focus shifts to the Home tab. Readings are shown in "meter" view. Values in gray are not being updated in real time
- Set up a site:** Click the Site Button, select the Default Site or Click the New button to set up a custom site. The site name can have up to 32 characters. Location coordinates are optional
- Set up a data log:** follow the steps in the logging setup wizard.
 - **Log Name:** Site_2017
 - **Log Parameters:** Pressure (PSI), Temperature (F), Elevation (ft.)
 - **Choose Logging Method:** Long-Term Monitoring – Event
 - **Choose Event Parameter:**
 - Check event parameter every 1 min
 - Log all parameters when the event is greater than 0.25 ft. above BMP invert, or normal water level elevation (sites with standing water in the BMP should utilize a threshold that will prevent the "event" setting from being continuously triggered)
 - Default record data every 60 measurements
 - **Schedule Start time:** on Next Hour
 - **Output:** Depth (BMP Sites) Depth to water (Groundwater Sites)

⁶ See Level TROLL – Operator's Manual, In-Situ Inc., March 2010.

-
- Be sure to note the casting invert reference elevation used, and the calculated elevation of the bottom of the sensor probe in the Notes option in the Site Data Folder for future reference
 - **Specific Gravity Value:** Custom 0.999
 - **Finished Programing:** Disconnect the Troll Com and reattach the desiccant

Routine Data Retrieval and Re-initialization:

- **Frequency:** Once per month
- **Connect to device using Win-Situ 5:**
- Download data and transfer to WSB server folder K:\01610-100\WR\Exported Data. (Do not stop logging until the end of the season)
- Re-reference water level elevation
 - Select “Sensor Tab” then click on calibrate sensor.
 - **Adjust Level Reference:** input the New Reference if required

Routine Maintenance:

- **Check desiccant cartridge:** When entire length of the cartridge changes color, the desiccant needs to be replaced
- **Check minimum cable bend radius:** Half the cable diameter = Approx. 0.54”.
- **Check the holes in the nose cone:** If they are plugged, swish the Level TROLL in a bucket of water, rinse under a tap, or soak in a mild acidic solution such as vinegar overnight
 - DON’T dig or scrape in the pressure sensor openings!
 - DON’T touch the pressure sensor diaphragm when the nose cone is removed!
- **Check twist-lock connectors:** Keep pins on all connectors free of dirt and moisture
- **Field Recalibration:** Sensor should be factory recalibrated every 12-18 months. The following procedure may be used, **with caution**, to “zero” the offset of a vented pressure sensor to correct for electronic drift. The drifted offset is visible when the sensor is in air and reading other than zero. It is recommended you **do not** zero the offset if it is outside the specified accuracy of your pressure sensor (30 PSI Sensor: ± 0.03 PSI). If the reading in air deviates from zero by more than this amount, you may want to consider a factory recalibration

Attachments

WSB Confined Space Entry Permit

Metropolitan Council Environmental Services Laboratory Chain-of-Custody (BMP Infiltration Sites)



Standard Test Method for Infiltration Rate of In Place Pervious Concrete¹

This standard is issued under the fixed designation C1701/C1701M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the field water infiltration rate of in place pervious concrete.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 The text of this standard references notes that provide explanatory material. These notes shall not be considered as requirements of the standard.

2. Referenced Documents

2.1 *ASTM Standards:*²

C125 Terminology Relating to Concrete and Concrete Aggregates

C920 Specification for Elastomeric Joint Sealants

2.2 *Other Standards*

Federal Specification A-A-3110 (TT-P-1536A) Plumbing Fixture Setting Compound³

3. Terminology

3.1 *Definitions:*

3.1.1 The terms used in this test method are defined in Terminology **C125**.

4. Summary of Test Method

4.1 An infiltration ring is temporarily sealed to the surface of a pervious pavement. After prewetting the test location, a

given mass of water is introduced into the ring and the time for the water to infiltrate the pavement is recorded. The infiltration rate is calculated in accordance with **9.1**.

5. Significance and Use

5.1 Tests performed at the same location across a span of years may be used to detect a reduction of infiltration rate of the pervious concrete, thereby identifying the need for remediation.

5.2 The infiltration rate obtained by this method is valid only for the localized area of the pavement where the test is conducted. To determine the infiltration rate of the entire pervious pavement multiple locations must be tested and the results averaged.

5.3 The field infiltration rate is typically established by the design engineer of record and is a function of the design precipitation event.

5.4 This test method does not measure the influence on in-place infiltration rate due to sealing of voids near the bottom of the pervious concrete slab. Visual inspection of concrete cores is the best approach for determining sealing of voids near the bottom of the pervious concrete slab.

6. Apparatus

6.1 *Infiltration Ring*—A cylindrical ring, open at both ends (See **Fig. 1**). The ring shall be watertight, sufficiently rigid to retain its form when filled with water, and shall have a diameter of 300 ± 10 mm [12.0 ± 0.5 in.] with a minimum height of 50 mm [2.0 in.]. The bottom edge of the ring shall be even. The inner surface of the ring shall be marked or scored with two lines at a distance of 10 and 15 mm [0.40 and 0.60 in.] from the bottom of the ring. Measure and record the inner diameter of the ring to the nearest 1 mm [0.05 in.].

NOTE 1—Ring materials that have been found to be suitable include steel, aluminum, rigid plastic, and PVC.

6.2 *Balance*—A balance or scale accurate to 10 g [0.02 lb].

6.3 *Container*—A cylindrical container typically made of plastic having a volume of at least 20 L [5 gal], and from which water may be easily poured at a controlled rate into the infiltration ring.

6.4 *Stop Watch*—Accurate to 0.1 s.

6.5 *Plumbers Putty (Non-Hardening)*—Meeting Specification **C920** or **Federal Specification A-A-3110**.

6.6 *Water*—Potable water.

¹ This test method is under the jurisdiction of ASTM Committee **C09** on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee **C09.49** on Pervious Concrete.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ <http://www.everyspec.com>

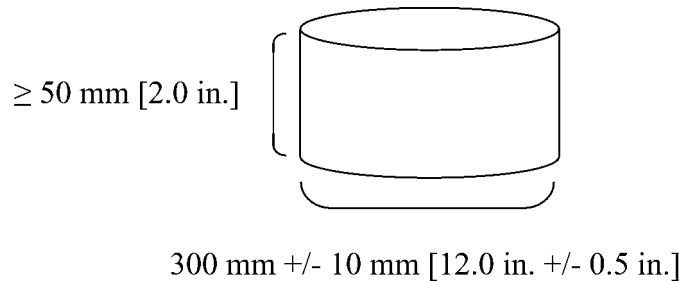


FIG. 1 Dimensions of Infiltration Ring

7. Test Locations

7.1 Perform tests at multiple locations at a site as requested by the purchaser of testing services. Unless otherwise specified, use the following to determine the number of tests to perform:

7.1.1 Three test locations for areas up to 2,500 m² [25,000 ft²].

7.1.2 Add one test location for each additional 1,000 m² [10,000 ft²] or fraction thereof.

7.2 Provide at least 1 m [3 ft] clear distance between test locations, unless at least 24 h have elapsed between tests.

7.3 Do not test if there is standing water on top of the pervious concrete. Do not test within 24 h of the last precipitation.

8. Procedure

8.1 *Infiltration Ring Installation*—Clean the pavement surface by only brooming off trash, debris, and other non-seated material. Apply plumbers putty around the bottom edge of the ring and place the ring onto the pervious concrete surface being tested. Press the putty into the surface and around the bottom edge of the ring to create a watertight seal. Place additional putty as needed

NOTE 2—In a hot environment where the surface temperature is over 38 °C [100 °F] plumbers putty may not adhere to the concrete surface easily. Therefore it is advisable to perform this test during cooler temperature.

8.2 *Prewetting*—Pour water into the ring at a rate sufficient to maintain a head between the two marked lines. Use a total of 3.60 ± 0.05 kg [8.0 ± 0.1 lb] of water. Begin timing as soon as the water impacts the pervious concrete surface. Stop timing when free water is no longer present on the pervious surface. Record the amount of elapsed time to the nearest 0.1 s.

8.3 *Test*—The test shall be started within 2 min after the completion of the prewetting. If the elapsed time in the prewetting stage is less than 30 s, then use a total of 18.00 ± 0.05 kg [40.00 ± 0.1 lb] of water. If the elapsed time in the prewetting stage is greater than or equal to 30 s, then use a total of 3.60 ± 0.05 kg [8.0 ± 0.1 lb] of water. Record the weight of water to the nearest 10 g [0.02 lb] (M). Pour the water into the ring at a rate sufficient to maintain a head between the two marked lines and until the measured amount of water has been used. Begin timing as soon as the water impacts the pervious concrete surface. Stop timing when free water is no longer present on the pervious surface. Record the testing duration (t) to the nearest 0.1 s.

NOTE 3—If a sloped pavement is being measured, maintain head between the two marked lines at the lowest point of the slope.

8.4 If a test is repeated at the same location, the repeat test does not require pre-wetting if conducted within 5 min after completion of the first test. If more than one test is conducted at a location on a given day, the infiltration rate at that location on that day shall be calculated as the average of the two tests. Do not repeat this test more than twice at the same location on a given day.

9. Calculation

9.1 Calculate the infiltration rate (*I*) using consistent units as follows:

$$I = \frac{KM}{(D^2 * t)}$$

where:

I = Infiltration rate, mm/h [in./h],

M = Mass of infiltrated water, kg [lb],

D = Inside diameter of infiltration ring, mm [in.],

t = time required for measured amount of water to infiltrate the concrete, s, and

K = 4 583 666 000 in SI units or 126 870 in [inch-pound] units.

NOTE 4—The factor *K* has units of (mm³s)/(kgh) [(in.³s)/(lbh)] and is needed to convert the recorded data (*W*, *D*, and *t*) to the infiltration rate *I* in mm/h [in./h].

10. Report

10.1 Report the following information:

10.1.1 Identification number,

10.1.2 Location,

10.1.3 Date of test,

10.1.4 Age and thickness of concrete (label Unknown if not known),

10.1.5 Time elapsed during prewetting, s,

10.1.6 Amount of rain during last event, if known, mm [in.],

10.1.7 Weight of infiltrated water, kg [lb],

10.1.8 Inside diameter of infiltration ring, mm [in.],

10.1.9 Time elapsed during infiltration test, s,

10.1.10 Infiltration rate, mm/h [in./h], and

10.1.11 Number of tests performed at each location, if applicable.

11. Precision and Bias

11.1 Repeatability testing was performed by a single laboratory by making 2 replicate measurements at three locations on a newly placed pervious concrete pavement. The replicate measurements were repeated daily from day 1 to day 10. The single-operator coefficient of variation of the infiltration rate at one test location was found to be 4.7 %.

11.2 The multi-operator variability data has not been developed. The reproducibility of this test method is being determined and will be available on or before October 1, 2014.

11.3 This test method has no bias because the infiltration rate of in-place pervious concrete is defined only in terms of this test method.

12. Keywords

12.1 concrete; infiltration; pervious; water

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