Minneapolis
City of Lakes

NPDES MS4 Phase I Permit No. MN0061018

Annual Report for 2022 Activities

City of Minneapolis and the Minneapolis Park & Recreation Board – Co-Permittees

June 30, 2023

Minneapolis
City of Lakes

NPDES MS4 Phase I Permit
Annual Report for 2022 Activities

June 30, 2023

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

Elizabeth Stout

Date 6/22/23 Registration No. 46328

NPDES PERMIT NO. MN0061018
Issued February 16, 2018

Resolution No. 2023R-177 **City of Minneapolis** **File No. 2023-00332**

Author: Johnson Committee: PWI Public Hearing: May 18, 2023

Passage: May 25, 2023 Publication: JUN 0 2 2023

RECORD OF COUNCIL VOTE				
COUNCIL MEMBER	AYE	NAY	ABSTAIN	ABSENT
Payne	X			
Wonsley	X			
Rainville	X			
Vetaw	X			
Ellison	X			
Osman	X			
Goodman				X
Jenkins	X			
Chavez	X			
Chughtai	X			
Koski	X			
Johnson	X			
Palmisano	X			

MAYOR ACTION

☑ APPROVED ☐ VETOED

MAYOR

MAY 3 1 2023

DATE

Certified an official action of the City Council

ATTEST:

CITY CLERK

Presented to Mayor: MAY 2 5 2023

Received from Mayor: MAY 3 1 2023

Adopting the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase I Permit Annual Report for 2022 Activities.

Whereas, the City of Minneapolis is committed to improving water quality in the lakes, wetlands, streams, and Mississippi River; and

Whereas, on February 16, 2018, the City of Minneapolis was issued National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit No. MN0061018 (Permit); and

Whereas, the STORMWATER MANAGEMENT PROGRAM, which was prepared in accordance with the Permit, was submitted to the Minnesota Pollution Control Agency (MPCA) in July 2019; and

Whereas, as required under the Permit, a public hearing was held on May 18, 2023; and

Whereas, the ANNUAL REPORT FOR 2022 ACTIVITIES will now be submitted to the Minnesota Pollution Control Agency;

Now, Therefore, Be It Resolved by The City Council of The City of Minneapolis:

That the Minneapolis City Council hereby adopts the NPDES MS4 ANNUAL REPORT ON 2022 ACTIVITIES.

NPDES MS4 Phase I Permit No. MN0061018
Annual Report for 2022 Activities

City of Minneapolis and the Minneapolis Park & Recreation Board
Co-Permittees

June 30, 2023

Table of Contents

Acronyms

BCWMC Bassett Creek Watershed Management Commission
BMP Best Management Practice
BOD_5 Biochemical Oxygen Demand of wastewater during decomposition over 5-day period
CIP Capital Improvement Program
CSO Combined Sewer Overflow
DNR Department of Natural Resources
EPA Environmental Protection Agency
ESC Erosion and Sediment Control
GIS Geographic Information Services
I & I Inflow and Infiltration
IPM Integrated Pest Management
MCES Metropolitan Council Environmental Services
MCM Minimal Control Measure
MCWD Minnehaha Creek Watershed District
MDA Minnesota Department of Agriculture
MDR Minneapolis Development Review
MIDS Minimal Impact Design Standards
MNDOT Minnesota Department of Transportation
MPCA Minnesota Pollution Control Agency
MPRB Minneapolis Park & Recreation Board
MS4 Municipal Separate Storm Sewer System
MWMO Mississippi Watershed Management Organization
NPDES National Pollutant Discharge Elimination System
PW-SWS Public Works – Surface Water and Sewers
PW-TMR Public Works – Transportation Maintenance and Repair
SCWMC Shingle Creek Watershed Management Commission
SMP Stormwater Management Practice
SOP Standard Operating Procedure
SSO Sanitary Sewer Overflow
SWMP Stormwater Management Program
SWPPP Stormwater Pollution Prevention Plan
TMDL Total Maximum Daily Load
TSI Trophic State Index
TSS Total Suspended Solids
VRS Vehicle Related Spills
WMO Watershed Management Organization

ACKNOWLEDGEMENTS

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Minneapolis Regulatory Services
Steve Kennedy

BACKGROUND

This report provides documentation and analysis of the Stormwater Management Program (SWMP) activities conducted during 2022. The City of Minneapolis and Minneapolis Park & Recreation Board (MPRB) both lead the implementation of the SWMP activities and are jointly responsible for the completion of the required Permit submittals.

This Annual Report is prepared in compliance with the requirements of National Pollutant Discharge Elimination System (NPDES) Permit No. MN0061018, a Municipal Separate Storm Sewer System (MS4) Phase I permit issued to City of Minneapolis and the Minneapolis Park & Recreation Board as co-permittees. Permit No. MN0061018 was initially issued in December 2000 and reissued in January 2011. An updated NPDES permit was reissued again in February 2018. Activities completed under the new permit and approved Stormwater Management Program (SWMP) have been reported in the 2022 Annual Report and will be submitted to the MPCA (Minnesota Pollution Control Agency) by June 30, 2023.

The NPDES program was created in 1990 by the United States Environmental Protection Agency (EPA) to safeguard public waters through the regulation of the discharge of pollutants to surface waters including lakes, streams, wetlands, and rivers. The MPCA is the local authority responsible for administering this program. Under the NPDES program, specific permits are issued to regulate different types of municipal, industrial, and construction activities. This report is related specifically to municipal stormwater activities.

The SWMP is based on an adaptive management system, as outlined in Part III of the Permit, by which the Permittees continuously monitor, analyze, and adjust the SWMP to achieve pollutant reductions. Using the adaptive management approach, revisions to the SWMP are made and submitted to the MPCA as necessary. A 2013 EPA/MPCA audit helped to identify opportunities for improvement regarding comprehensive training, written procedures and documentation, and availability of staff resources that have influenced subsequent revisions to the SWMP. The Permit requires the implementation of approved Stormwater Management Activities, referred to as SMPs, also known as Best Management Practices (BMPs).

Minneapolis Public Works, Surface Water & Sewer Division provides program management and completes each Annual Report. An annual opportunity for public input into the SWMP and city priorities is required under the permit, as is the adoption of a formal resolution by the Minneapolis City Council each year, adopting the Annual Report.

In February 2018, the City's most recent NPDES permit was reissued by the MPCA. In response to that permit update, the City's Stormwater Management Program (SWMP) was updated to reflect any new permit requirements or changes. The updates SWMP was approved by the Minneapolis City Council in 2019 for submittal to the MPCA.

CATEGORY ONE: PUBLIC EDUCATION AND OUTREACH

PROGRAM OBJECTIVES

The objective of this stormwater management practice is to educate the public regarding point and non-point source stormwater pollution.

PROGRAM OVERVIEW

A successful stormwater management program involves participation and good management from everyone in the City, including municipal staff, residents, business owners, park visitors, facility managers, contractors, developers, and all others who live and work in Minneapolis. Public education serves to provide information on the importance of water quality, the impacts of stormwater runoff, sources of pollutants in stormwater runoff, and activities that the public should adopt to fulfill their responsibilities towards improved water quality.

Many of the components of the program can be found at the City of Minneapolis Stormwater website or on the MPRB Water Resources website.

Program activities include hosting of educational events, distribution of educational materials, regular updates of web-based information and staff training. Some of the program activities are carried out directly by the co-permittees, the City, and the Minneapolis Park & Recreation Board (MPRB). Other activities are coordinated with and carried out by watershed management organizations, Hennepin County, and other entities.

PREVIOUS YEAR ACTIVITIES

Minneapolis Park and Recreation Board Education Activities

In 2022, the Minneapolis Park & Recreation Board's (MPRB) Environmental Management Naturalist staff offered 191 program hours of in-person programming and interacted with nearly 2,500 people in neighborhood and regional parks throughout the city. Figure 1-1 shows two participants for weekly free programing at Loring Park. Additionally, educational sign prompts, offered in both Spanish and English were placed in 7 park locations, and 8 local hardware stores were furbished with displays to educate customers about the use of salt for winter snow and ice management. All program locations are shown in Figure 1-2. Education staff utilized portable mini-golf, bean bag toss, an aerial photo floor graphic of the city and its watersheds, and other hands-on learning activities about stormwater and human impacts on the water quality in Minneapolis.

Figure 1-1 Two youth getting ready to safely canoe on Loring Pond with MPRB staff assisting

Minnehaha Park

A moveable water quality education exhibit was deployed at Minnehaha Park near the pavilion that houses the popular restaurant, Sea Salt Eatery. Spinning cubes on the installation can be rotated to provide information about watersheds, stormwater runoff, and actions people can take to positively impact water quality. This location was chosen because of the consistent captive audience of people standing in line waiting to order food. Intermittent staff observations throughout the season confirmed that many of the people waiting in line were reading from the exhibit.

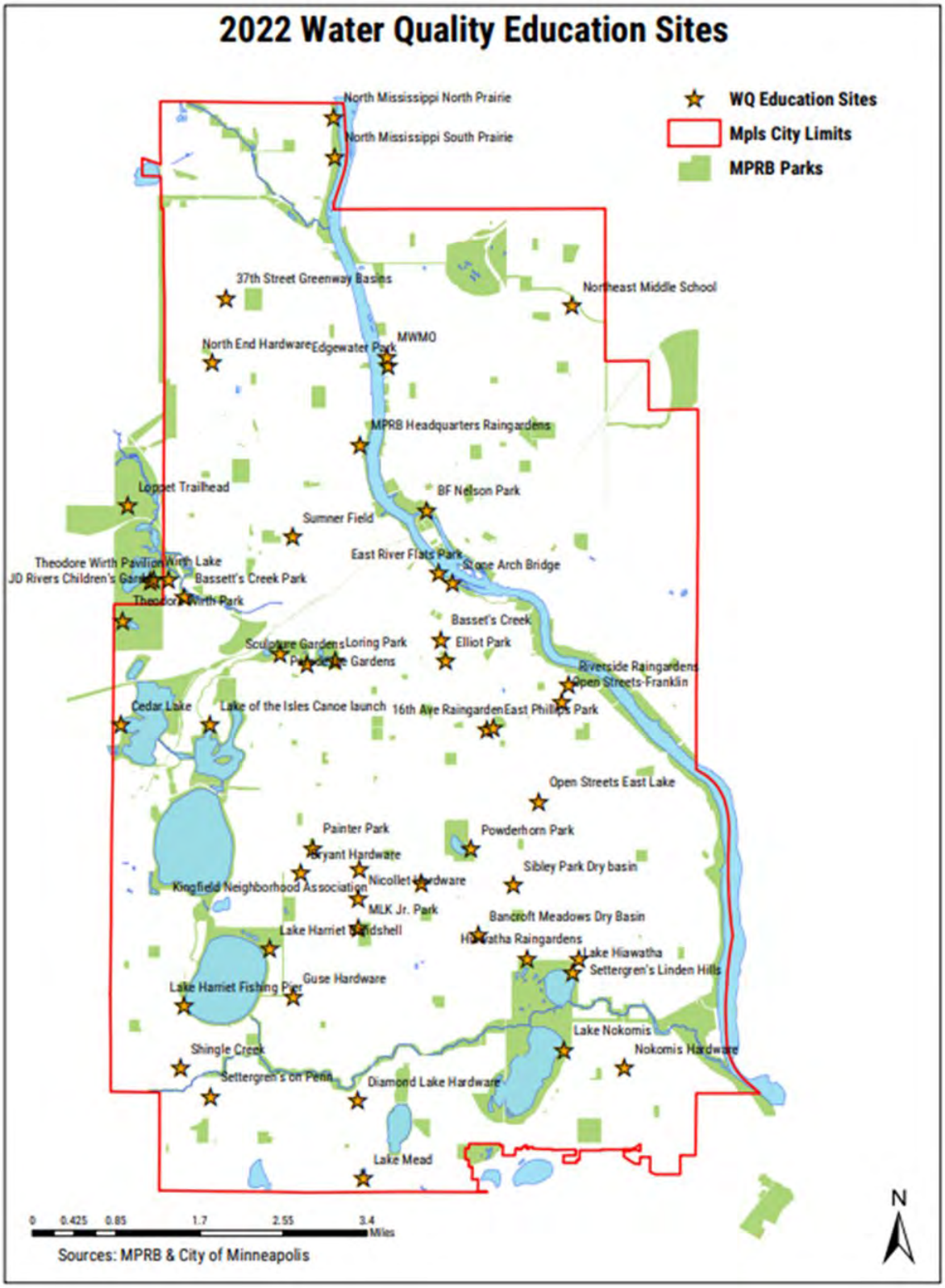


Figure 1-2 Map of water quality education sites in 2022

Water Quality Water Trail

In June, the Water Trail, which is a series of buoys designed to follow like a trail on the water, was deployed in the lagoon west of the bridge in Lake Nokomis. A set of 10 stand up paddleboard (SUP) yoga poses were designed to float above the waterline on buoys holding water quality education messages. Shoreline signs were also posted for the summer season, letting park visitors know about the new resource, see Figure 1-3. Figure 1-4 shows two adults engaging with one of the educational buoys.

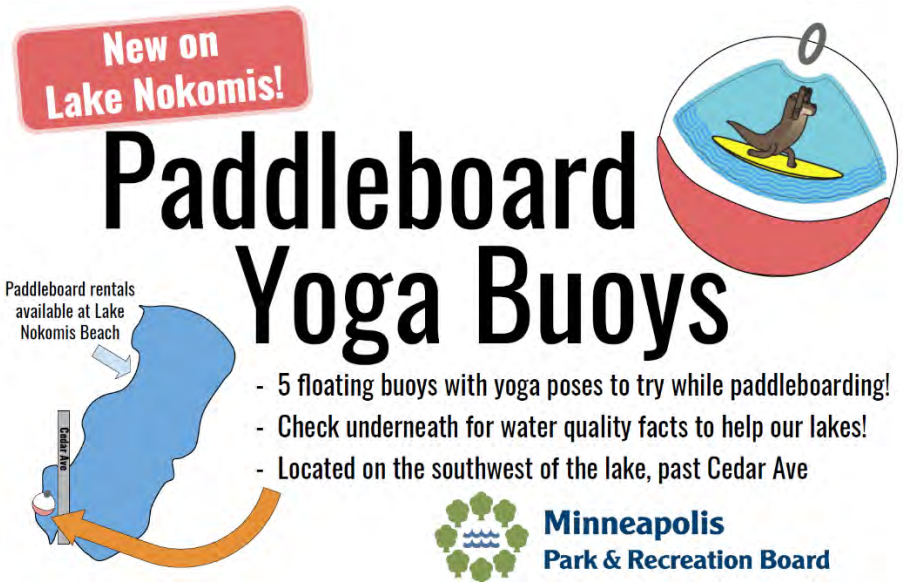


Figure 1-3 Shoreline sign posted around the Nokomis Lagoon to draw attention to this new resource

Figure 1-4 A small group testing out one stop on The Water Trail in the Lake Nokomis Lagoon

Aquatic Invasive Species Education

The MPRB continued its extensive Aquatic Invasive Species (AIS) Inspection & Education Program at the public boat launches located at Bde Maka Ska, Lake Harriet, and Lake Nokomis. The boat launches are staffed seven days a week from May 1 to December 1, and all trailered boats entering and leaving the lakes are inspected for AIS. In addition to providing watercraft inspections, staff are an information source for the park visitors. Staff directly interacted with 9,188 park visitors in 2022. Access to the Bde Maka Ska launch was impacted in the 2022 season by the construction project to rebuild the Bde Maka Ska Refectory building. The launch was only open for about 16% of the season due to the construction, which decreased the number of park visitor interactions with AIS Inspectors. Adjacent to the AIS booths are sandwich boards, see Figure 1-6, with action steps people can take to be a good water steward. The sandwich board messages can be changed out daily based on weather, time of year, etc. Annually, more than seven million people visit the Chain of Lakes, and more than one million visit Lake Nokomis.

Figure 1-5 Aquatic Invasive Species boat inspection and water quality education at boat launches.

Canines for Clean Water Campaign

According to US Census data, there were 188,017 households in Minneapolis in 2020. Using American Veterinary Medical Association ownership rates, an estimated 115,500 dogs live within Minneapolis city limits. The US Environmental Protection Agency has calculated the

Figure 1-6 Canines for Clean Water sandwich board

average dog produces 0.75 pounds of waste each day. That means Minneapolis dogs are

generating an estimated 87,000 pounds of solid waste each day. Initiated in 2009, Canines for Clean Water is a water quality education program targeting dog owners to build awareness of the impacts of this waste when it is not properly disposed of and empowering people to take action and make a difference.

In 2022, MPRB's seven dog parks were sites that received a series of six educational sign prompts about the importance of picking up dog droppings to protect Minneapolis water quality. **Figure 1-7** shows an example of one of these signs, all of which were offered in both Spanish and English.

Figure 1-7 An example of the signs posted in Minneapolis Dog Parks.

The Canines for Clean Water movie series returned for summer of 2022. Dogs and their humans were invited to enjoy a night out at the movies at a different park each Thursday evening in August. The movies shown were dog-themed, and some parks hosted fun pre-movie activities like neighborhood dog shows, as well as being joined by Water Quality Educators to learn about the importance of picking up their dog's poop. **Figure 1-8** shows staff setting up for the movie event at North Mississippi Regional Park.

Figure 1-8 MPRB staff and partner organizations setting up education tables before the Canines for Clean Water movie series

Both canines and humans were invited to sign the Canines for Clean Water Pledge. Dogs signed with a paw dipped in mud. Most humans preferred to sign their name with a pen, though the fingerprint-in-mud option was available for them as well. Dogs who took the pledge were rewarded with swag! We distributed attractive bandanas with the Canines for Clean Water logo on them, so that dogs could show their pride in making the commitment to having their owners clean up after them. **Figure 1-9** features one of the canine supporters ready to go with their brand-new bandana.

Figure 1-9 Dog who visited the educational table to sign the Canines for Clean Water pledge, wearing one of the free bandanas distributed at the event

Do Not Feed the Ducks Campaign

Based on a successful pilot program in 2016 that focused on persuading park patrons to not feed the ducks, the MPRB moved forward with fabrication of permanent education pieces in 2017. In 2022, our largest yellow duck ambassador continued the mission along the Lake Harriet shoreline, adjacent to the seasonal restaurant Bread & Pickle. See **Figure 1-10** for the scale of our giant buoy rubber duck ambassador.

Figure 1-10 Photo of the Lake Harriet rubber duck buoy of the Don't Feed the Ducks Campaign

The recently redesigned sandwich board signs asking park visitors to not feed the wildlife were also deployed at more locations, including Bde Maka Ska, Lake Harriet, Lake Nokomis, Loring Pond, and Powderhorn Lake. These signs encourage visitors to "photo don't feed" as an alternative way to connect with ducks and geese living around our lakes. See **Figure 1-11** for examples of these newly designed signs.

Figure 1-11 Example of goose sign posted at Bde Maka Ska, and duck sign at Lake Harriet encouraging people to take pictures rather than offer food to the wildlife with the hashtag #PhotoDontFeed

Earth Day Watershed Clean-up

Going back more than 25 years, the MPRB Earth Day Watershed Clean-up event has inspired more than 27,000 residents to remove an estimated 190,000 pounds of garbage from Minneapolis parks. Trash bags, gloves, and instructions were made available for pick up at participating park sites. **Figures 1-12** pictures volunteers removing garbage from East River Flats Park**.**

Figures 1-12 Photos from the 2022 Earth Day Watershed Clean-up

In 2022, this single-day event engaged 1,112 volunteers at 31 sites throughout the City of Minneapolis to remove trash that might otherwise have ended up in our water ways. See the complete list in **Table 1**.

Earth Day Clean-up Location	ZIP CODE	Earth Day Clean-up Location	ZIP CODE
Armitage Park	55410	Lake Nokomis	55417
Bassett's Creek	55404	Longfellow Park	55406
Bde Maka Ska East	55417	Loring Park	55403
Beltrami Park	55413	Lynnhurst Park	55419
Boom Island	55413	Mueller Park	55405
Bryant Square Park	55408	Pearl Park	55419
Cedar Lake	55416	Powderhorn Park	55407
Creekview Park	55430	Sibley Park	55407
E River Flats Park	55455	Sumner Field	55411
Elliot Park	55404	Theodore Wirth Park	55411
Father Henn Bluff Park	55414	Triangle Park	55417
Folwell Park	55412	W River Pkwy & 36th	55406
James I. Rice Park	55401	W River Pkwy & 44th	55406
Kenny Park	55419	Waite Park	55418
Lake Harriet	55409	Whittier Park	55405
Lake of the Isles East	55405		

Table 1 2022 Earth Day Watershed Clean-up locations

Mississippi River Green Team

The Mississippi River Green Team, as seen in **Figure 1-13,** is a conservation-based teen crew engaged in daily hands-on environmental work throughout the summer. The crew consists of up to 18 youth and two supervisors, who work mostly in the natural areas of the Minneapolis park system, and within the watershed of the Mississippi Watershed Management Organization (MWMO). Typical workdays included visiting such park sites, such as B. F. Nelson Park, East Phillips Park, Mill Ruins Park, Minneapolis Sculpture Gardens, Elliot Park, Parade Ice Garden, and North Mississippi Regional Park, to conduct invasive species removal, weed wrenching, planting, watering, and mulching.

The crew were scheduled for weekly career exposure days designed to provide them with a chance to meet professionals and have experience in a variety of green fields. They participated in activities such as stenciling storm drains and delivering literature to raise awareness of the connection between the stormwater in the street to the Mississippi River, studying macroinvertebrates and their connection to water quality, and surveying for invasive worms impacting forest ecosystems. They also completed several educational experiences including the Sustainable Land Training with MetroBlooms, the Stormwater 101 lesson with staff at the MWMO, learning about the history of the Mississippi River at several locations to explore how humans have impacted and depend on the river.

Figure 1-13 The 2022 Mississippi River Green Team standing outside of the Mississippi Watershed Management Organization building. Staff are wearing yellow shirts, Green Team members are wearing turquoise shirts

The Mississippi River Green Team is made possible through a partnership between the Minneapolis Park & Recreation Board and the Mississippi Watershed Management Organization.

The Green Team is also supported by City of Minneapolis Public Works through their contract with *Landbridge Ecological*, which manages vegetation at stormwater Best Management Practices (BMPs) throughout the city. Landbridge and the Green Team's work in 2022 focused on weed and invasive species management at 16th Ave Rain Garden, 37th Greenway Raingardens, Columbus Wet and Dry Basin, Bancroft Meadows Dry Basin, Heritage Park, Hiawatha Raingardens, Lake Mead, Lowell curve, Riverside Rain Garden at Svea Triangle, Sibley Park Dry Basin, Shingle Creek, and Sumner Field.

2022 Frog & Toad Surveys of Select Stormwater Ponds

The presence and abundance of frogs and toads are a useful indicator of water and habitat quality, as well as short and long-term environmental changes. Standard protocols using calling surveys during peak breeding activity have been used to determine distribution and population trends of frogs and toads by natural resource agencies nation-wide. The Minnesota Department of Natural Resources (DNR) Nongame Wildlife Program worked with citizen scientists to monitor frog and toad populations statewide from 1994-2017 using Minnesota Frog & Toad Calling Surveys (MFTCS). Out of concern for declining amphibian populations, The North American Amphibian Monitoring Program (NAAMP), coordinated by the United States Geological Survey (USGS), expanded and collaborated with states' efforts to collect data from 1997-2015.

The question has been raised whether or not stormwater ponds, constructed to intercept and treat runoff, can also function as a refuge for amphibians. Additionally, the public has voiced

concerns about the absence of formerly abundant frogs and toads calling from Hiawatha Golf Course and the surrounding area. To evaluate these concerns, the Minneapolis Park and Recreation Board (MPB) coordinated preliminary frog and toad listening surveys at Lake Hiawatha golf course in 2016 and 2017, and then formalized into ongoing surveys in 2018 to the present. Additional stormwater ponds were added to the surveys in 2018 and again in 2019 to reflect different types and locations of stormwater ponds with standing water throughout Minneapolis.

The purpose of these surveys is to:

1. Determine if any frog and toad species (anurans) are found in or near stormwater ponds.
2. Use the Minnesota Frog and Toad Calling Survey protocols adapted for Theodore Wirth Park to Identify species and abundance in stormwater ponds.
3. Generate ideas about why or why not species may use stormwater ponds.
4. Involve volunteers and concerned citizens in monitoring Hiawatha Golf Course ponds in a systematic way.

Key Findings
Seven species of frogs and toads - of the 14 species known in MN—have been reported from stormwater sites in Minneapolis since 2016. Not more than three species were found at any single location. American toads are the most commonly heard and widely distributed among stormwater ponds.

In 2022, two new records and at new locations were documented for Cope's gray treefrogs (*Hyla chrysoscelis):* at Robert's Bird Sanctuary and southwest of Nokomis in Amelia Pond. One or two gray treefrogs (*Hyla versicolor*) have been heard intermittently at different stormwater sites since 2016, except for Roberts Bird sanctuary. This is not surprising given the lack of woodlands around stormwater ponds.

Many green frogs (*Lithobates clamitans)* are found in the stormwater pond at Upton Ave N and 52nd Ave N (full choruses have been heard). Green frogs have been heard exclusively in the north pond and not anywhere else in the city, including in seven years of similar surveys at Theodore Wirth Park (2015-22).

Drought conditions in 2021 and 2022 reduced the period and intensity of breeding choruses throughout the city. Impacts of drought on amphibians in stormwater ponds are not known and likely vary on a pond-by-pond basis.

The full report can be found in ***Appendix A13 – 2022 Frog & Toad Calling Report***

Minneapolis Adopt-a-Drain Program

Since 2016, the Minneapolis Adopt-a-Drain program has empowered Minneapolis residents to take responsibility for storm drains and gutters in their neighborhoods by adopting and keeping them clean. In March 2019, the arrival of a metro-wide website (www.adopt-a-drain.org) was launched to serve all cities in the Twin Cities 7 county area.

Figure 1-14 Adopting a storm drain in Minneapolis

2022 Adopt-a-Drain Program Results

The Minneapolis Adopt-a-Drain Program posted significant numbers in 2022:

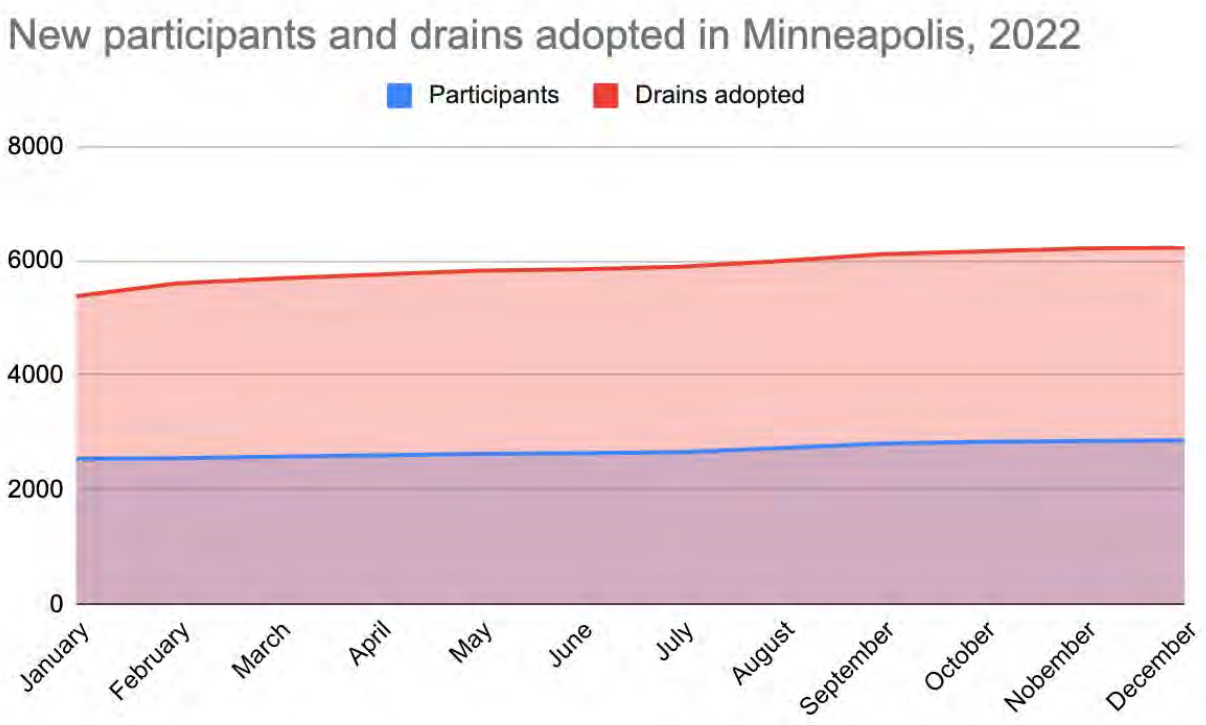
- Minneapolis led all cities in the metro area with 2,865 participants
- 324 new adopters
- 6,232 total storm drains adopted
- 889 Minneapolis participants reported cleanings (31% of all participants)
- Collected 40,576 pounds of debris
- 1,089 volunteer hours logged

Adopt-a-Drain Mailings and Signs

In 2022, 210 welcome packets were mailed to new program participants. In addition, 101 Minneapolis residents signed up at the Minnesota State Fair. The yard signs provide a secondary touchpoint away from the storm drain, helping to raise awareness and to encourage people to keep storm drains clean. Each program participant receives a welcome packet, which includes: waterbody-specific yard sign and stake, storm drain decals and adhesives, welcome card with safety tips and instructions, an Adopt-a-Drain trash bag, Adopt-a-Drain sticker, smart salting sticker, customized Minneapolis welcome letter, and drain decal application instructions.

Watershed	Packets Mailed
Mississippi River	102
Minnehaha Creek	35
Lake Hiawatha	20
Shingle Creek	20
Lake of the Isles	6
Bde Maka Ska	6
Lake Harriet	5
Diamond Lake	5
Powderhorn Lake	4
Bassett Creek	3
Lake Nokomis	2
Grass Lake	2
TOTAL	210

Figure 1-15 Adopt-a-Drain welcome packet for new participants


New participants and drains adopted in Minneapolis, 2022
Participants
Drains adopted
8000
6000
4000
2000
0
January
February
March
April
May
June
July
August
September
October
Nobember
December

Adopted Drains by Geographic Breakdown: Watershed and Sub-watershed:

Watershed	Drains adopted	Debris collected (lbs)	Time spent (hours)
Mississippi	2,934	16,404.3	428.3
Minnehaha Creek	2,655	20,621.1	550.7
Bassett Creek	338	1,541.5	40.7
Shingle Creek	304	1,712.6	50.1

Subwatershed	Drains adopted	Debris collected (lbs)	Time spent (hours)
Mississippi River (MWMO)	3337	18,200.3	474.8
Minnehaha Creek	983	9,968.2	286.4
Lake Hiawatha	359	1,738.5	44.4
Bde Maka Ska	217	2,314.8	45.5
Lake Harriet	196	1,994.0	45.4
Lake Nokomis	187	572.1	9.8
Shingle Creek	175	756.4	14.6
Lake of the Isles	157	503.8	12.7
Bassett Creek Main Stem (Downstream)	147	1,176.7	35.4
Diamond Lake	121	961.5	19.1
Crystal Lake (City of Robbinsdale)	120	926.2	31.5
Powderhorn Lake	82	207.1	7.4
Grass Lake	81	181.0	8.8
Cedar Lake	34	441.7	7.4
Brownie Lake	9	119.0	23.4
Richfield Lake	8		
Silver Lake (MWMO)	8	207.0	2.4
Spring Lake	6		
Grimes Lake	3	9.6	0.7
Hart Lake	1	1.6	0.1

Drains adopted: Cumulative total
Debris collected: 2022 data only

Adopted Drains - Geographic Breakdown by Neighborhood:

Neighborhood	Total participants	Total adoptions	New participants (2022)	New adoptions (2022)
Howe	109	241	10	23
Audubon Park	108	187	13	29
Linden Hills	94	148	9	11
Standish	93	161	13	23
Tangletown	91	186	5	11
King Field	90	173	10	13
Lynnhurst	83	160	10	14
Hiawatha	81	204	10	20
Fulton	78	134	14	20
Waite Park	74	140	8	8
Armatage	72	126	5	5
Seward	71	122	15	27
Cooper	66	136	3	4
Longfellow	65	145	5	9
Windom Park	64	126	6	11
Diamond Lake	61	137	7	11
Northrop	61	136	3	3
Ericsson	60	124	5	10
Powderhorn Park	55	129	14	33
Kenny	54	96	4	11
Victory	53	110	14	33
Minnehaha	48	95	7	11
Keewaydin	48	101	1	1
Hale	47	107	5	7
Wenonah	47	84	3	3
Prospect Park	45	116	4	5
Willard-Hay*	41	148	7	88*
Holland	41	87	5	5
Logan Park	40	64	5	5

Adopted Drains - Geographic Breakdown by Neighborhood (cont.)

Neighborhood	Total participants	Total adoptions	New participants (2022)	New adoptions (2022)
Page	38	69	7	8
Lowry Hill East	38	78	5	6
Whittier	37	87	5	6
East Harriet	37	63	3	3
Central	36	70	5	10
Bryn-Mawr	36	68	6	8
Windom	35	73	5	7
CARAG	35	66	4	4
Corcoran	35	70	2	2
Bancroft	33	68	6	7
Sheridan	33	50	4	7
Como	30	56	4	6
Cleveland	27	86	5	20
St. Anthony West	25	46	5	12
Lyndale	24	47	4	5
Morris Park	22	47	4	5
East Isles	21	51	4	13
Webber-Camden	21	33	7	9
ECCO	21	33	4	5
Bottineau	20	50	3	5
Field	20	41	2	2
St. Anthony East	20	30	1	1
Marcy Holmes	19	52	5	11
Beltrami	19	44	5	7
Columbia Park	18	38	3	8
Near-North*	17	181	5	126*
Cedar-Isles-Dean	17	35	3	10
Harrison	17	37	1	1
Folwell	17	49		

Adopted Drains - Geographic Breakdown by Neighborhood (cont.)

Neighborhood	Total participants	Total adoptions	New participants (2022)	New adoptions (2022)
Lowry Hill	16	99	3	9
Jordan	16	26	2	3
Regina	15	32	1	1
Bryant	14	34	3	8
Marshall Terrace	14	28	1	2
Loring Park	13	19	4	5
Kenwood	13	24	3	4
Lind - Bohanon	13	30		
Shingle Creek	12	29	4	9
Hawthorne	12	34	4	4
East Phillips	10	17	1	2
Elliot Park	10	15	1	1
North Loop	10	29	1	1
Downtown West	10	25		
Northeast Park	9	15	3	5
Steven's Square - Loring Heights	8	9	2	2
Phillips West	7	32	3	15
McKinley	7	21	1	1
Downtown East	6	10	2	6
Cedar Riverside	6	7	2	2
Ventura Village	5	8	1	4
University of Minnesota	5	7		
Sumner - Glenwood	4	8	1	1
Midtown Phillips	4	8		
West Calhoun	4	8		
Mid - City Industrial	3	3	1	1
Humboldt Industrial Area	3	3		
Nicollet Island-East Bank	2	11		

Highlighted neighborhoods received Adopt-a-Drain door-hangers in 2022. Participants who have adopted drains in multiple neighborhoods are counted for each, so total of participants may be slightly higher.

* 2022 Near-North and Willard-Hay neighborhoods adoption total includes drains adopted by the community group Seeds to Harvest.

Door Hanging

In September 2022, Clean Water Action staff distributed 7,760 doorhangers to 10 neighborhoods in Minneapolis. Across these neighborhoods, 36 new participants signed up and 63 additional storm drains were adopted. In some of these neighborhoods there were fewer single-family homes, duplexes and triplexes than estimated (particularly in North Loop, Loring Park, and Nicollet Island-East Bank), but doorhangers were distributed whenever possible. On the map, all neighborhoods in blue were completed in 2022. Neighborhoods in purple have been completed in past years. Of significant note, 2022 efforts completed door hanger distribution for all Minneapolis neighborhoods with significant residential areas, which started in 2016. All single-family homes within the City of Minneapolis have been doorhangered as part of this program.

Neighborhood	Homes	New Signups
Hawthorne	950	4
McKinley	870	1
Webber-Camden	1,400	7
Victory	1,600	14
Lind-Bonahan	1,400	0
Shingle Creek	930	4
North Loop	185	1
Nicollet Island - East Bank	203	0
Loring Park	72	4
Sumner-Glenwood	150	1
TOTAL	7,760	36

New Adopt-a-Drain Door / Storm Drain Stenciling Door Hangers

In 2022, the updated double-sided door hanger was used in multiple ways, including:

- Storm Drain Stenciling Program
- Adopt-a-Drain K-12 Outreach Program (in Minneapolis schools)
- Earth Day cleanup events
- National Night Out events
- Litter League clean up events
- Tabling events at neighborhood organizations

Figure 1-18 Adopt-a-Drain Program door hanger

Figure 1-19 Storm drain stenciling program door hanger

2022 Northeast Minneapolis Adopt-a-Drain Challenge

Figure 1-20 Adopt-a-Drain table for neighborhood events

For the 3rd year in a row, Minneapolis Public Works SWS staff worked with a Master Water Steward to organize a challenge involving all 13 Northeast Minneapolis neighborhoods to raise environmental awareness and increase storm drain adoption rates. It involved multi-level competitions where neighborhood organizations recognized monthly "winners" and posted data throughout the challenge.

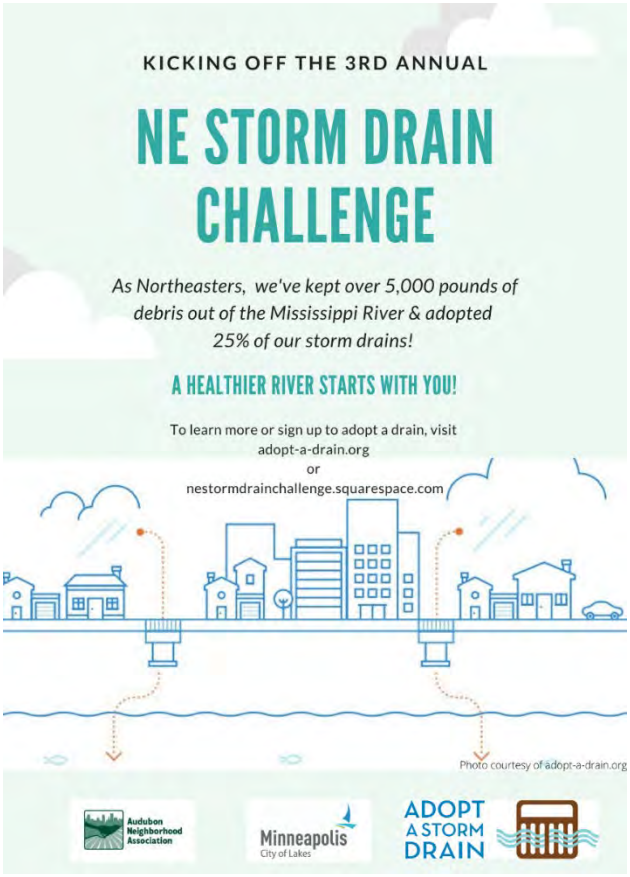
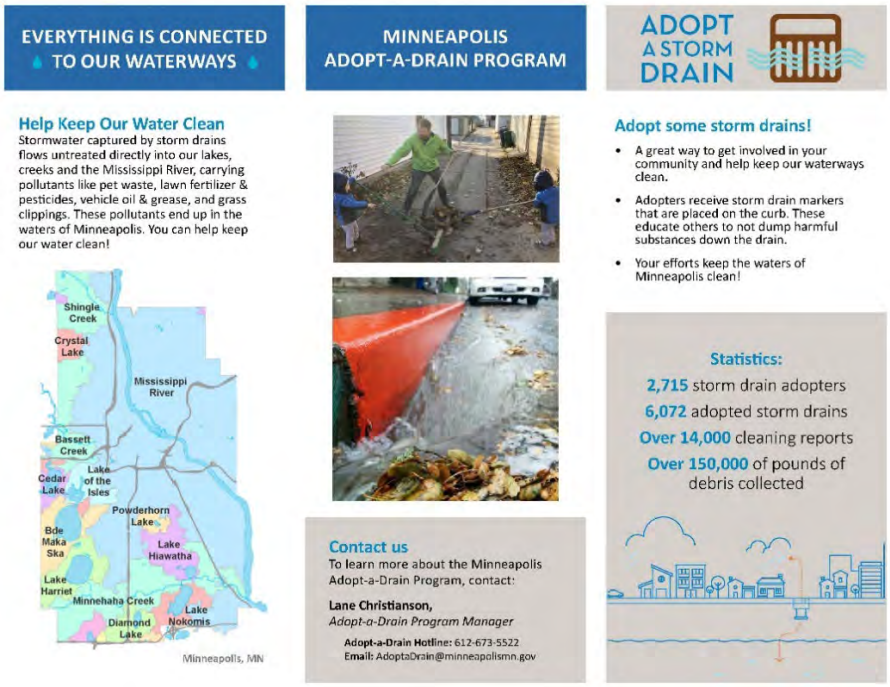


Figure 1-21 NE Adopt-a-Drain Challenge poster

Adopt-a-Drain Outreach Materials

The City of Minneapolis provided outreach materials to many organizations, including, all MPRB Recreation Centers, kiosks at Minneapolis lakes, Hennepin County libraries, neighborhood organizations.

In 2022, the Adopt-a-Drain tri-fold was updated with new photos and information. These tri-folds and other educational items were distributed to neighborhood organizations, water quality partners and at tabling events. This tri-fold includes a QR code to allow program access from a smartphone or tablet.



Minneapolis Storm Drain Stenciling Program

- 39 storm drain stenciling events
- 609 volunteers participating
- 1,198 storm drains stenciled
- 2,487 doorhangers distributed
- 236 bags of trash collected
- 7,000 pounds of trash, leaves, and debris removed from storm drain system
- Over 6.3 pounds of phosphorus removed from lakes, creeks, and the Mississippi River

Storm drain stenciling not only educates volunteers who paint environmentally friendly messages like “FLOWS TO RIVER/LAKE/CREEK – KEEP DRAIN CLEAN” on the storm drains, but also engages residents and people passing by. It’s a great team-building exercise that helps people learn what they can do to improve the quality of the lakes, creeks, and the Mississippi River. The program provides stencils in English, as well as Spanish and Somali languages for certain neighborhoods.

Figure 1-22 Volunteer cleans storm drain

Figure 1-23 Volunteer stencils “FLOWS TO CREEK” storm drain

Organizations who participated in storm drain stenciling in 2022 included two eagle scout projects, schools, higher learning institutes, neighborhood organizations, block clubs, and individual residents and houses of worship.

Before:

After:

Figure 1-24 Spanish Stencil

Figure 1-25 Minneapolis Step Up interns cleaning up storm drains

Storm Drain Stenciling Tri-Fold

In 2022, the Storm drain stenciling tri-fold was updated with new photos and information about how the stenciling process works and why it is important to do. These tri-folds and other educational items were distributed to neighborhood organizations, water quality partners and at tabling events. This tri-fold includes a QR code to allow program access from a smartphone or tablet.

Metro Blooms Training and Engagement Programs

In 2022, the City of Minneapolis funded and provided project management and oversight for the non-profit Metro Blooms Resilient Yards Workshops, Sustainable Landcare Training Program - Neighborhood Rain Garden Program and the Boulevard Bioswale Program.

Metro Blooms partners with communities to create resilient landscapes and foster clean watersheds, embracing the values of equity and inclusion to solve environmental challenges. Working with public and private partners to address long-term sustainability of constructed BMPs Metro Blooms has really made a real difference in our management of these devices.

Figure 1-26 Metro Blooms staff

Staff from Metro Blooms uses sustainable landscape management practices, prioritizing non-chemical methods and battery-operated landscaping equipment to maintain these practices. Metro Blooms provides maintenance and inspections for approximately nearly 100 private and public BMPs in Minneapolis. This support helps the property owners maintain BMPs, to stay in compliance with Chapter 54 requirements and preserve their stormwater utility credit.

2022 Blue Thumb Resilient Yard, Bee Lawns, and Pollinator Yards Workshops

An estimated 1,407 Minneapolis residents took part in a Resilient Yards, Turf Alternatives, Pollinator Lawns, or Pollinator Plantings workshops in 2022.

Resilient Yards

Host	Date	Thinkific Registration	Zoom Attendance
RCWD, RWMWD, & VLAWMO	3/29/22	30	22
Minneapolis	3/31/22	36	25
St. Louis Park	4/6/22	40	23
Minnetonka	4/7/22	30	24
RCWD and Anoka SCWD	4/12/22	23	13
Plymouth	4/14/22	40	19

Edina	4/19/22	10	5
Champlin	4/26/22	15	13
Mendota Heights	4/28/22	14	6
Minneapolis	5/3/22	44	40
RCWD, RWMWD, & VLAWMO	5/5/22	19	15
Minneapolis	5/10/22	20	12
Crystal	5/19/22	37	30
Rochester	10/20/22	29	25

Turf Alternatives, Pollinator Lawns

Host	Date	Thinkific Registration	Zoom Attendance
St. Louis Park: Pollinator Lawn	4/13/22	53	16
Minneapolis: Pollinator Lawn	4/20/22	27	19
Edina: Pollinator Lawn	4/21/22	10	9
Minnetonka: Turf Alternatives	4/28/22	21	8
Sherburne: Turf Alternatives	10/27/22	15	7

Pollinator Plantings

Host	Date	Thinkific Registration	Zoom Attendance
RCWD, RWMWD & VLAWMO	4/5/22	29	13

These workshops continue to adapt to meet new and upcoming issues and remain a successful part of education and engagement programs in the City of Minneapolis.

Minneapolis Neighborhood Rain Garden Program

Metro Blooms worked with the Conservation Corps of Minnesota to install 67 new rain gardens on residential properties in 2022. Partnering with 5 neighborhood organizations (Armatage, Kenwood, Lynnhurst, Waite Park, Windom Park neighborhoods), the successful program yielded these results:

- 8,999 sq. ft. new pollinator habitat (4,579 new plants)
- 693,356 gallons runoff captured per year
- 316 lbs. total suspended solids captured per year
- 1.75 lbs. total phosphorus removed per year

Figure 1-27 Conservation Corps crew working on one of the 100 raingardens installed

2022 Sustainable Landcare Training Program

The below table shows the cohorts and dates of our 2022 in-person SLC trainings. Each cohort was sent content for the online learning modules that accompany the in-person training. The Northside Safety Net cohort and the MWMO Green Team cohort received our updated online content which is now on *Thinkific*. The in-person trainings for the Northside Safety Net cohort and the All Nations Church cohort each included an insect survey that was co-developed and led by entomologist Jessica Miller, which was a new addition added to the training in 2022.

Organization	Date(s)	# of trainees
All Nations Church	12/15/22, 5/23/22, 5/27/22, 5/29/22, 9/27/22	37
Bayfield	6/10/22-6/12/22	14
Northside Safety Net	7/11/22, 7/18/22, 7/25/22	7
MWMO's Green Team	8/8/22	15

Lawns to Legumes (L2L) Demonstration Neighborhoods

Minneapolis Public Works contract with Metro Blooms also provided matching funds for BWSR's (Minnesota Board of Water and Soil Resources) LCCMR (Legislative-Citizen Commission on Minnesota Resources) funded Lawns to Legumes Program.

The below table shows the dates and attendance of the workshops we held for L2L grant

recipients, Hennepin County Master Gardeners, and L2L program coaches. The workshops that we held for L2L grant recipients either focused on program information or gardening tips that would ensure their planting projects would be as successful as possible.

Type of L2L workshop	Date	Zoom Attendance
HCMG Train the Trainer (Minneapolis)	3/10/22	40
L2L Coaches (Hennepin Master Gardeners)	3/17/22	2
L2L Coaches (Regional Master Gardener)	3/30/22	53
L2L Grantees: Program info	4/6/2022	150
L2L Grantees: Gardening tips	4/20/22	100
L2L Grantees: Gardening tips	8/4/22	90
L2L Coach training	8/10/2022	30
L2L Grantees: Program info	8/30/22	164
L2L Grantees: Fall gardening tips	9/8/2022	100

L2L outcomes

2022 marked the completion of the Lawns to Legumes Pilot Phase. Interest in the program came from audiences across the state and country, including more than 17,000 residents from all 87 of Minnesota's counties apply to participate in the program:

- 1,195 grant recipients installed projects and received cost share assistance. We estimate that thousands of additional individuals used the program's DIY resources to create projects inspired by Lawns to Legumes.
- 3.5 million square feet of area was planted as part of 2,252 projects.
- Participants contributed about 145% match for their projects.
- Nearly 8,000 people participated in educational webinars, workshops, and our online learning series.
- Over 130 volunteer coaches were involved.
- 336,852 visits to program webpages.

In the Pilot Phase of L2L, Minneapolis had 2,635 residents who applied to receive funding, 601 who were awarded, and 273 who successfully completed a project. L2L Projects resulted in:

- 59,362 sq. ft. of native pocket plantings and meadows
- 348 native trees and shrubs
- 26,403 square feet of bee lawn

Seed Saving Workshop

In 2022, Metro Blooms held two in-person Seed Saving workshops led by experts at MN Horticultural Society. The videos, photos, and information provided at workshops were used to develop a Seed Saving workshop on *Thinkific*, which will be available to MN residents in 2023.

Workshop Location	Date	# of attendees
NE Middle School	9/10/22	36

Minneapolis Boulevard Bioswale Program

The Minneapolis Boulevard project is a collaboration and partnership with community leaders and organizations, including Metro Blooms, Metro Blooms Design and Build, Jordan Area Community Council, Sunnyside Peace and Prayer Coalition, Northside Residents Redevelopment Council, and the Liberty Healing Space. These groups conducted transformed 32 boulevards into pollinator gardens that capture runoff.

Four Metro Blooms Environmental Justice advocates door knocked in North Minneapolis, explaining the opportunity to have boulevards redesigned into sustainable, vibrant gardens. Interested residents had a consultation with a landscape architect, and detailed information was provided about the boulevards and the healing properties they provide. The advocates would take in participant preferences to decide what to plant, and all residents were invited to join in the planting. After planting, details on watering and maintenance were provided, residents were asked about satisfaction and feedback.

- 32 properties in North Minneapolis, including 3 community sites and 4 faith-based organizations
- 9,625 sq. ft. of native plantings and bioswales
- 25 projects planting pollinator gardens, native trees and shrubs in people's yards and at community demonstration sites
- Annual Capture
    - 444,000 gallons runoff
    - 1.6 lbs. total phosphorus
    - 377 pounds sediment
- 25 youth, young adults and community elders participated in Sustainable Landcare training. From that group, environmental and social justice advocates planted and provided training and maintenance support to care for boulevards
- 200 residents directly engaged through door knocking, community plantings and outreach. Additional residents showed interested in participating in the future.

Metro Blooms Survey Results

Metro Blooms sent a survey to all participants who attended one or more of workshops:

- 73% of respondents installed a native plan, bee lawn, or some other planting or clean water practice after attending a workshop. Out of those respondents:
    - 85% installed a native planting
    - 46% installed a bee lawn or a tree/shrub
    - 8% installed a raingarden
- 71% of the respondents that did not install a project said that they plan to install native planting in the future.
- 52% of respondents knew of someone who installed a planting using information they shared with them from the workshop.
- When asked about why they installed a native planting:
    - 96% wanted to create native habitat for pollinators
    - 48% wanted to reduce stormwater runoff

  - 82% wanted to beautify their property
  - 56% wanted to be a leader in their neighborhood for environmental issues
  - 22% wanted to participate in a local community program
- When asked about why they attended a workshop
  - 74% wanted to learn how to create a climate resilient yard
  - 61% wanted to establish an alternative to turf
  - 46% wanted to speak 1-on-1 with a Landscape Designer
  - 30% wanted to learn how to excavate and plant a raingarden

59.5% of respondents applied for Lawns to Legumes funding.

Interpretive Signage Program

Stormwater BMPs by design blend into the community and are passively enjoyed as parks, gardens, and neighborhood ponds. Residents and businesses that benefit from these BMPs are often unaware of their own contributions to the problem, and, more importantly, their potential to be an active part of the solution. Locally designed artwork and online tools were used to create an engaging, visually compelling, and interactive story about the City's network of BMPs.

The City of Minneapolis and HDR developed engaging, site-specific artwork for 26 BMPs, as well as a companion website to supplement and link the signs together. These tools allow viewers to engage with individual sites and how they function, as well as to explore ways which each site connects with and protects our creeks, lakes, and the Mississippi River.

Figure 1-28 Interpretive sign at stormwater pond

Phase 2 was completed in 2022 adding 22 more signs on 15 more stormwater pond sites. The final project included 40 signs on 26 stormwater pond sites promoting the City's stormwater management

efforts. The signs raise awareness about how these ponds, infiltration basins and rain gardens help protect our waterbodies by improving water quality and reducing flooding.

Local artist Ashley Rades designed the interpretive signs, which integrated with an interactive website (https://stormwater.minneapolismn.gov/) where users can explore all of the stormwater sites and learn more about how they work. The website was launched in the fall of 2022 and will be updated with new content to keep visitors engaged.

Figure 1-29 Interpretive sign

City of Minneapolis Salt Mini-Course Program

The City of Minneapolis Salt Mini-Course was launched in 2021 as an educational resource for residents, small businesses and organizations. This online program aims to increase awareness of the negative environmental impacts associated with winter de-icing salt, while providing best practices for snow and ice removal. Upon completion of the course, users take a "*Salt Stewardship Pledge*" to demonstrate their commitment to local clean water and receive a sticker to display their knowledge to their communities.

City of Minneapolis Staff Training

Surface Water & Sewers Employee Training

In 2022, SWS employees attended the following training:

- 10 staff members certified for Erosion & Sediment Control training
- 105 attended HAZWOPER refresher training
- 25 staff members certified for Wastewater Collection System license
- 16 staff members certified for NASSCO PACP/MACP
- 105 staff members attended Confined Space training
- 27 staff members attended GSI training

Green Stormwater Infrastructure (GSI) Training

Staff from road construction inspection and Surface Water & Sewers collaborated over the winter construction slow down to develop tools for inspectors to use on green infrastructure installations. The results of that collaboration included a training session on what to look for at critical inspection points during construction of Green Stormwater Infrastructure (GSI). The guidance was developed as a printable pdf and rolled out to Public Works staff from various divisions. The rollout training was recorded for those who could not attend. The guidance document is in draft form to use during the 2023 construction season where feedback will be collected to finalize in winter of 2023-24.

City Snow and Ice Management

City maintenance supervisors and equipment operators are trained in appropriate winter maintenance practices and procedures. Specific topics covered include guidelines for sand and salt application rates that are based on weather conditions, application techniques, and spreader calibration. All Public Works staff who perform snow and ice control typically attend a pre-winter season, annual review of procedures and best practices. In 2022, the City is working with the MPCA Smart Salting Trainers to present to all winter staff in the Fall. Annual HAZWOPER refresher training covers the recognition and response to hazardous materials or situations. The Division Director is active with the APWA Winter Maintenance Subcommittee and was a contributor and a trainer for the APWA's Supervisor's Winter Maintenance Certificate course.

- 32 staff members attended eight-hour refresher for 40-hour hazardous materials training class
- 201 staff members attended training on the use of salt as presented by watershed organizations

In the fall of 2022 over four days of training, the City hosted a MPCA Smart Salting for Roads Certification training. Snowplow operators, winter maintenance staff and others learned the impacts of salt on local freshwater, best practices for salt application on roads and storage, and how to balance public safety and environmental health. There were about 140 attendees across three public works divisions:

- Transportation Maintenance and Repair
- Paving
- Parking Ramps and Lots

Attendees who passed the exam became certified for 5 years through the MPCA. MPCA feedback showed 96% of attendees felt the training was useful, identified opportunities for salt reduction, and provided recommendations for future salt trainings.

MPRB Staff Training

MPRB Snow and Ice Management Training

The MPRB has 35 staff that hold the MPCA's Road Salt Applicators Training Certificate. Individuals who hold this certificate have attended a voluntary training, completed, and passed an associated test, and agreed to voluntarily apply best management practices to reduce chloride impacts. Attendees chose trainings that focused on the type of work they do at MPRB, either application to roads or to small sites (parking lots and sidewalks).

MPRB Integrated Pest Management Training

Golf course foremen, most horticulture staff as well as other MPRB staff, attend the annual Northern Green Expo each January, where they receive updated information on the newest turf and other related research as it applies to fertilizers, pesticides, bio-controls, and other topics. This annual industry event focuses on professional development and networking of outdoor professionals. Topics range from turf management to invasive species updates to landscape design.

All new hires for full-time positions of park keeper, mobile equipment operator (MEO), gardener, golf course park keeper, arborist, service area crew leaders, arborist crew leaders, park operations managers and forestry foreman are required to obtain their Minnesota Non-Commercial Pesticide Applicator license within 6 months of being hired. Every two years, as mandated by the Minnesota Department of Agriculture, staff attends re-certification training, that is offered and coordinated by the University of Minnesota. This effort is in conjunction with the Minnesota Department of Agriculture.

Other Education Partners

The City of Minneapolis has an official arrangement, through joint power agreements, with the BCWMC and SCWMC to provide financial contributions to the watersheds through an annual assessment. This assessment provides funding for the commissions' administrative operations and their public education programs.

Education-related activities of the BCWMC are guided by their 2015 Watershed Management Plan, specifically its education and outreach policies (Section 4.2.9), and education and outreach plan. The specific activities of the BCWMC public outreach and education program are set annually by the Commission after recommendations are forwarded by the BCWMC Education and Outreach Committee. The SCWMC also conducts education and public outreach activities on behalf of its member cities. SCWMC and BCWMC, along with other west-metro watershed management organizations, are a part of a cooperative education organization known as the West Metro Water Alliance (WMWA). 2022 water education activities for BCWMC, SCWMC, and WMWA can be found in Appendix A2.

CATEGORY TWO: PUBLIC PARTICIPATION AND INVOLVEMENT

PROGRAM OBJECTIVE

The objective of this stormwater management program is to maximize the effectiveness of the City's NPDES program by seeking input from the public.

PROGRAM OVERVIEW

The City of Minneapolis and the MPRB are the joint holders of the NPDES MS4 Permit, and this Annual Report is a coordinated effort by the City and the MPRB. The Permit requires an opportunity for public input in the development of the priorities and programs necessary for compliance.

The Permit requires the implementation of approved stormwater management activities, referred to as Best Management Practices (BMPs). The Stormwater Management Program (SWMP) is based on an adaptive management system by which the Permittees continuously monitor, analyze, and adjust the Program to achieve pollutant reductions. Using the adaptive management approach, revisions to the SWMP are submitted along with the Annual Report.

Each year, the City holds a public hearing at a meeting, prior to submission of the Annual Report. The hearing provides an opportunity for public testimony regarding the Program and Annual Report prior to report submittal to the Minnesota Pollution Control Agency (MPCA). The hearing is officially noticed in the Finance and Commerce publication and publicized through public service announcements on the City cable television channel. This year's public hearing date was at the Public Works and Infrastructure (PWI) Committee meeting on May 18, 2023.

A copy of the presentation, a list of public notice recipients, public comment received, and the staff letter can be found in the City's Legislation Management System (LIMS).

All testimony presented at the public hearing, and all written comments received, are recorded, and given consideration. The comments are included with the Annual Report as Appendix C. A copy of the City Council resolution adopting the Stormwater Management Program and Annual Report Activities is included each year with the submission to the Minnesota Pollution Control Agency. The Stormwater Management Program and the Annual Reports are available for viewing or downloading.

PREVIOUS YEAR ACTIVITIES

The Public Hearing was held on May 18, 2023, which was noticed 30 days in advance. The public was offered an opportunity to speak and provide comments on the SWMP and Annual Report. All public comments received are included in Appendix C of this report.

CATEGORY THREE: ILLICIT DISCHARGE DETECTION AND ELIMINATION

PROGRAM OBJECTIVE

The objective of this program is to minimize the discharge of pollutants to lakes, creeks, wetlands, and the Mississippi River by appropriately responding to spills and to detect, investigate and resolve illegal dumping, and disposal of unpermitted, non-stormwater flows in the City's stormwater drainage system including pavement, gutters, storm drains, catch basins, swales, permitted connections to the storm drain, and other conveyance infrastructure. Illicit discharges may be random, frequent, infrequent, accidental, or other, and may occur anywhere along the stormwater drainage pathways.

PROGRAM OVERVIEW

Dry Weather Flow Screening

In 2022, 141 outfalls were inspected for dry weather flow. Dry weather flow was identified from one (1) of the outfalls inspected. For more information, please see Appendix B-9.

Typical Hazardous Spill Response

The immediate goals of hazardous spill response are safety, containment of the spill, recovery of hazardous materials, and collection of data for use in assessment of site impacts. Motor vehicle collisions and electrical transformer overloads are examples of accidental releases, and results can include untreated waste and hazardous materials including heavy metals, toxics and solvents.

The life cycle of an event requires personnel from within the City and outside agencies to work as a team, utilizing resources to protect people, the environment, and property. Training and response procedures are coordinated by Regulatory Services, Public Works, and the Fire Department. The Regulatory Services Fire Inspection Specialist III is responsible for coordinating recovery efforts. Events are followed by post-action debriefings to determine the causes of the events, to identify measures to improve the City's response, and to determine the means to limit future occurrences. As the assessment of the event progresses, other departments and/or outside agencies or contractors may become involved. Full procedures are documented in the City of Minneapolis Emergency Action Plan.

For small spills of petroleum products or other vehicle fluids, personnel are dispatched with appropriate equipment to apply sand or floor-dry. Once the spill has been absorbed, it is removed and deposited in a leak-proof container. For large or extremely hazardous spills, a Hazardous Materials Response Team is mobilized and augmented with staff from additional departments, outside agencies and/or contractors if warranted as the event progresses. For spills that reach the Mississippi River or Minneapolis lakes, boats are available for spill response and personnel are trained in boom deployment.

Spills are reported to the MPCA Public Safety Duty Officer, 911 Emergency Communications and, for qualified spills, to the State Duty Officer as required by law.

The protocol used by the Street Maintenance section for handling spills is documented in Appendix A4: Standard Operating Procedure for Vehicle Related Spills.

Emergency Response Program

Minneapolis Regulatory Services utilizes a boat to respond to spills that could impact water resources. A properly equipped boat facilitates addressing these events on the Mississippi River as well as on City lakes. Regulatory Services and Public Works staff are trained in the river deployment of booms, have field experience in placement of both containment and absorbent types of booms, and years of experience on the water. These skills, coupled with an extensive level of knowledge of the Mississippi River, City lakes, landings, and outfalls, provide a high level of protection for our precious natural resources.

Boom Deployment Drill

Additionally, the boat is used for placement of monitoring and sampling equipment for tracking water quality, identifying points of illegal discharges, outfall assessment, and investigation of complaints that are inaccessible from shore. The City assists the Mississippi Watershed Management Organization (MWMO) in conducting a sampling program of the storm drainage system that drains to the Mississippi River to detect illegal discharges, and establish a baseline of chemical, physical, and biological parameters.

Unauthorized Discharges

City Environmental personnel carry out pollution prevention and control activities. Results are achieved through educational efforts, inspections, and coordinated outreach events. These activities include enforcement pursuant to applicable City codes, and coordination with other regulatory agencies at county, state and federal levels. Enforcement yields identification of the responsible party, documentation of clean-up activities, and endeavors to reduce the flow of pollutants from illegal dumping and disposal. Response is made to reports of unauthorized discharges and illicit connections.

Complaints are received from various sources, including Minneapolis residents, private contractors, City staff, the State Duty Officer and other government agencies. People with environmental concerns within Minneapolis are directed to contact 311 directly.

Minneapolis Public Works also provides site investigation and mapping assistance for MPCA permit enforcement and compliance programs for other types of discharges.

Facility Inspection Program - Stormwater Pollution Prevention Plans (SWPPP)

The City of Minneapolis has developed a facility inspection program for private, City owned, and other public facilities that store large quantities of both regulated and hazardous materials. Inspectors perform site visits of these facilities to review handling, storage, and transfer procedures as they relate to the site, spill response plans and equipment on site. Minneapolis Fire Inspection Services participates in most of the inspections, reviewing spill response strategies.

As per Fire Inspection Manager, six facilities were inspected in 2022. 340 facilities are self-reporting, which are reviewed, filed, and maintained by Fire Inspection Services. Based on latest information from Minnesota Homeland Security, 340 hazardous material facilities are inclusive to the City's Fire Commercial (FCOM) building permit. Hazmat registrations and inspections are based on FCOM cyclical rotations. 340 Emergency Response plans for TIER II Hazardous Materials Facilities were reviewed, including hazardous materials storage and spill response plans.

PREVIOUS YEAR ACTIVITIES

Spill Response

City of Minneapolis Fire Inspection Services responded to 58 Emergency Response requests. In addition, the Minneapolis Fire Department also responds to a number of these requests. Response time varies between 5 to 20 minutes depending on Fire Department response and type of Emergency Response request. The City responded to three spill incidents on the Mississippi River and lakes where a containment boom was deployed. Minneapolis Fire Inspection Services, Minneapolis Public Works (Surface Water & Sewers Division) participated in these efforts.

SPILL RESPONSE TRAINING

Waterworks Drill/Training

A Waterworks Drill/Training meeting took place with Minneapolis Public Works, Minneapolis Fire, and Minneapolis Fire Inspections Services. Existing Standard Operation Procedures to respond to a Spill Response/Boom deployment scenario at Minneapolis Waterworks were reviewed. Due to low water conditions, a hands-on Spill Response did not take place in 2022. Plans are in place for Spill Response training in 2023.

CATEGORY FOUR: CONSTRUCTION RELATED EROSION & SEDIMENT CONTROL

PROGRAM OBJECTIVE

The objective of this stormwater management program is to minimize pollutant discharge through the regulation of construction projects. Regulation addresses erosion and sediment control for private development and redevelopment projects and for public projects completed by the City and the MPRB. Minneapolis Code of Ordinances Air Pollution and Environmental Protection, Chapter 52 Erosion and Sediment Control and Drainage contains erosion and sediment control requirements and other pollution control requirements related to construction site management.

PROGRAM OVERVIEW

Ordinance

In 1996, the Minneapolis City Council amended Title 3 of the Minneapolis Code of Ordinances relating to Air Pollution and Environmental Protection by adding Chapter 52, entitled *Erosion and Sediment Control for Land* Disturbance Activities (now Erosion and Sediment Control and Drainage).

Requirements

The City's Erosion and Sediment Control ordinance addresses development sites, demolition projects, and other land disturbing activities. Sites disturbing more than five cubic yards, or 500 sq ft, are required to have an erosion control permit. Erosion and Sedimentation Control (ESC) Permits must be acquired before work starts and must be obtained before a building permit will be issued for the site.

For all disturbances greater than 5,000 sq ft, an approved erosion control plan is also required for demolition and construction projects before the ESC Permit can be issued.

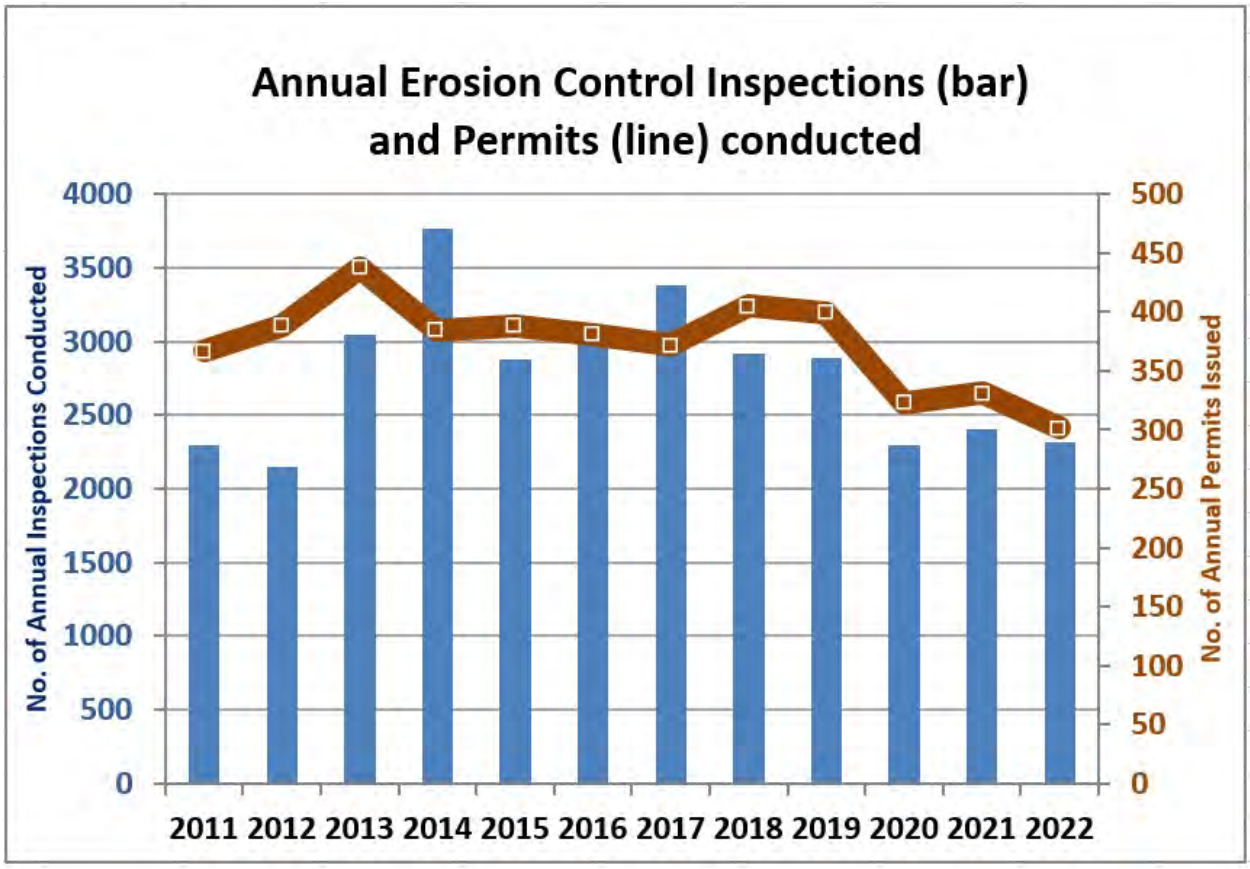
Enforcement

Ongoing site inspections are performed by City Environmental Services inspectors. Inspectors may issue citations and fines. Failure by the permittee to comply with the ordinance will constitute a violation pursuant to Section 52.300. If there is a demonstrated failure to comply, the City reserves the right to terminate an ESC permit at any time. The City then has the option of proceeding with the necessary restoration of the site. This restoration would be done at the expense of the owner/permittee.

PREVIOUS YEAR ACTIVITIES

Generally, since 2011 the number of sediment and erosion control permits issue has remained relatively consistent. While the number of permits issued by the City has been consistent, the number of inspections increased. Minneapolis normally employs four environmental inspectors that address sediment and erosion control enforcement, and the City hires four additional seasonal technicians to help increase inspection frequency during the busy summer months. Budget cuts in 2020 brought the number of FTE inspectors to 3. In 2022, 2 new inspectors were hired, and Minneapolis had 2 seasonal technicians employed from May-August.

Year	Permits Issued	Inspections	Citations
2022	302	2,317	19



CATEGORY FIVE: POST-CONSTRUCTION STORMWATER MANAGEMENT

PROGRAM OBJECTIVE

The objective of this stormwater management program is to reduce the discharge of pollutants and stormwater runoff from public and private development and redevelopment projects, as compared to conditions prior to construction. Redevelopment of existing sites can lessen the impacts of urbanization of the waters of Minneapolis, since most present land uses were created prior to regulation under the Clean Water Act.

Regulation includes approval of stormwater management including ongoing operation and maintenance commitments. Minneapolis Code of Ordinances Title 3 Air Pollution and Environmental Protection, Chapter 54 - Stormwater Management, contains stormwater management requirements for developments and other land-disturbing construction activities.

PROGRAM OVERVIEW

Stormwater Management Ordinance

In 1999, the Minneapolis City Council amended Title 3 of the Minneapolis Code of Ordinances (relating to Air Pollution and Environmental Protection) by adding the Chapter 54 Ordinance Stormwater Management Ordinance, which required stormwater management plans utilizing permanent stormwater practices for all construction projects disturbing sites greater than 1 acre in size, at that time.

These plans are reviewed through the Minneapolis Development Review (MDR) process and approved by the Surface Water & Sewers Division. Operation and Maintenance Plans for BMPs are also required as part of the approval process. Inspections of constructed BMPs are required and performed by the property owner or manager. These annual inspections are reviewed and approved by city staff, before being registered with Environmental Services, which includes a Pollution Control Annual Registration fee.

Pollinator friendly plants at Sanford Middle School infiltration basin

In 2018, City staff began updating Chapter 54 to be in compliance with the current NPDES MS4 permit and watershed management organization requirements. The ordinance was approved by Council on March 3, 2021 and went into effect on January 1, 2022.

The ordinance update integrated all the new NPDES and WMO requirements and best practices, while maintaining the flexibility developers and project advocates appreciated about the previous ordinance. To facilitate a robust stakeholder engagement process, City staff implemented a stakeholder engagement and outreach plan (SE&O Plan) and is managed as a living document and updated as new engagement opportunities surfaced.

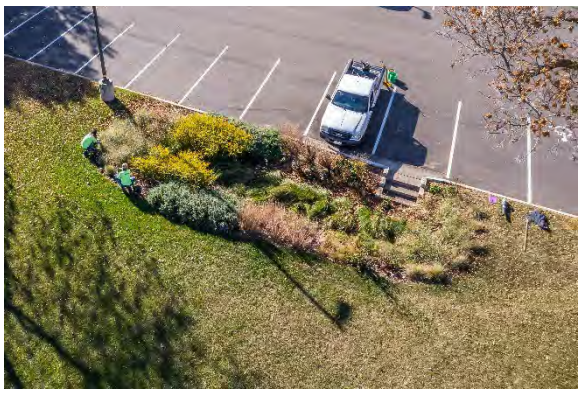
PREVIOUS YEAR ACTIVITIES

The City of Minneapolis tracks and manages compliance for nearly 900 private stormwater management systems that include over 1,500 BMPs on over 600 properties under Chapter 54 of the Minneapolis Code of Ordinances. Chapter 54 implementation has been very effective at seeing BMPs installed as properties develop in Minneapolis. The numbers of the total BMPs installed with the City expected to grow in 2023.

During 2022, Minneapolis Public Works reviewed 170 private development projects, approving 132 of these projects. 21 of these approved projects were required to comply with Chapter 54 stormwater requirements, with 47 BMPs proposed. 7 non-Chapter 54 projects proposed 7 BMPs. These BMPs will provide rate control, volume control and water quality for approximately 91 acres of land, including 62 acres of impervious area.

As of January 1, 2022, the City's Chapter 54 ordinance began requiring implementation of stormwater management facilities on public linear projects that disturb at least half an acre. During 2022, two City of Minneapolis linear street reconstruction projects that required compliance with Chapter 54 stormwater requirements were reviewed and approved. These project proposed approximately 100 BMPs along the project corridors. These BMPs will provide rate control, volume control and water quality for approximately 22 acres of land, including 18 acres of impervious area.

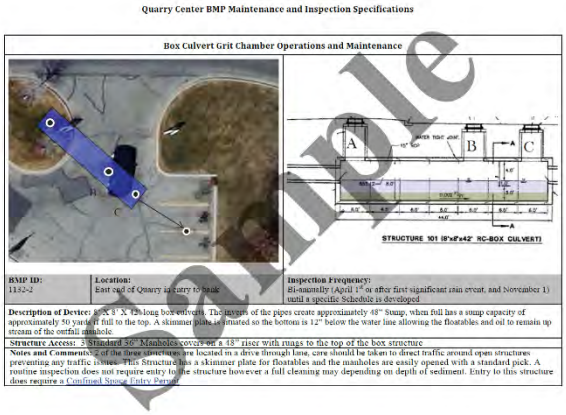
Operations, Maintenance and Reporting



Timely and frequent maintenance on a Chapter 54 rain garden provides spectacular results

All stormwater management devices are required to be inspected by the owner or responsible party as specified in the approved plan. Inspection reports determine and recommend maintenance types, activities, and frequencies to restore the BMP's original design function. Inspection process must lead to a maintenance recommendation including taking no actions if BMP found in full compliance.

Site inspections and maintenance by the property owner are important to the long-term sustainability of any stormwater BMP. With limited staffing to inspect an ever-growing private BMP inventory, it is important to have a site and BMP specific *Operations and Maintenance Plan.* Minneapolis staff recognized this need and developed self-inspection forms. These were paired with onsite training for property owners to better maintain and inspect BMPs with limited regulatory oversight. As better plans are developed using templates and property owners are trained to self-inspections, the hope to increase reporting numbers (currently less than 30% annually).



Quarry Center BMP Maintenance and Inspection Specifications

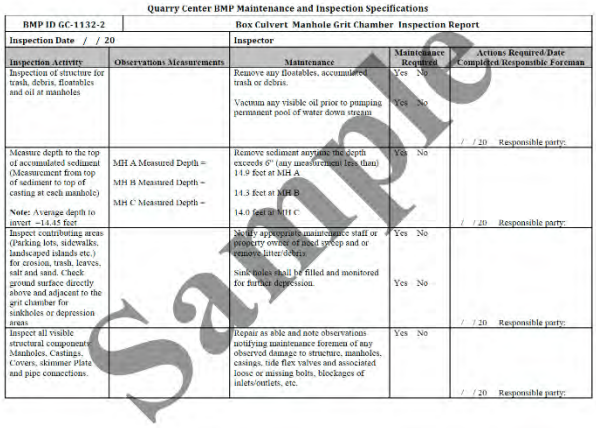
Box Culvert Grit Chamber Operations and Maintenance

BMP ID:	Location:	Inspection Frequency:
1132-2	East end of Quarry in entry to Bank	Bi-annually (April 1st or after first significant rain event, and November 1) until a specific Schedule is developed

Description of Device: 8'X 8' X 42' long box culverts. The invert of the pipes create approximately 48" Sump, when full has a sump capacity of approximately 50 yards if full to the top. A skimmer plate is situated so the bottom is 12" below the water line allowing the floatables and oil to remain up stream of the outfall manhole.

Structure Access: 3 Standard 36" Manholes covers on a 48" riser with rungs to the top of the box structure

Notes and Comments: If the three structures are located in a drive through lane, care should be taken to direct traffic around open structures preventing any traffic issues. This Structure has a skimmer plate for floatables and the manholes are easily opened with a standard pick. A routine inspection does not require entry to the structure however a full cleaning may depending on depth of sediment. Entry to this structure does require a Confined Space Entry Permit.



Quarry Center BMP Maintenance and Inspection Specifications

BMP ID GC-1132-2 — **Box Culvert Manhole Grit Chamber Inspection Report**

Inspection Date / / 20 — **Inspector**

Inspection Activity	Observations Measurements	Maintenance	Maintenance Required	Actions Required/Date Completed Responsible Foreman
Inspection of structure for trash, debris, floatables and oil at manholes		Remove any floatables, accumulated trash or debris. Vacuum any visible oil prior to pumping permanent pool of water down stream	Yes No Yes No	/ / 20 Responsible party:
Measure depth to the top of accumulated sediment (Measurement from top of sediment to top of casting at each manhole) **Note:** Average depth to invert =14.45 feet	MH A Measured Depth = MH B Measured Depth = MH C Measured Depth =	Remove sediment anytime the depth exceeds 6" (any measurement less than) 14.9 feet at MH A 14.3 feet at MH B 14.0 feet at MH C	Yes No	/ / 20 Responsible party:
Inspect contributing areas (Parking lots, sidewalks, landscaped islands etc.) for erosion, trash, leaves, salt and sand. Check ground surface directly above and adjacent to the grit chamber for sinkholes or depression areas		Notify appropriate maintenance staff or property owner of need sweep and or remove litter/debris Sink holes shall be filled and monitored for further depression.	Yes No Yes No	/ / 20 Responsible party:
Inspect all visible structural components. Manholes, Castings, Covers, skimmer Plate and pipe connections.		Repair as able and note observations notifying maintenance foreman of any observed damage to structure, manholes, casings, tide flex valves and associated loose or missing bolts, blockages of inlets/outlets, etc.	Yes No	/ / 20 Responsible party:

Current program support is critical as the number of existing private BMP's and additional BMPs in the future, the program's sustainability is challenged by when relying on small site BMP's. Maintenance, regulation, and performance of small site BMP's may not be sustainable or cost effective in the long run. Regional BMPs or pay in-lieu programs that contribute to public BMP's should be examined to efficiently provide stormwater treatment in a fully developed urban environment.

CATEGORY SIX: POLLUTION PREVENTION AND GOOD HOUSEKEEPING FOR MUNICIPAL OPERATIONS

PROGRAM OBJECTIVE

The City of Minneapolis operates its public works systems in a manner that maintains efficient and effective operability, ensures structural integrity, complies with regulatory requirements, and safeguards the ability to prevent impacts to health, safety, property infrastructure, and the environment. This is accomplished through the proper operation and maintenance of structural stormwater management practices, public streets, bridges, and alleys, parks and golf courses, municipal properties, municipal parking lots, and municipal equipment yards.

STORM DRAIN SYSTEM OPERATIONAL MANAGEMENT AND MAINTENANCE

PROGRAM OBJECTIVE

The objective of this NPDES stormwater management program is to minimize the discharge of pollutants through the proper operational management and maintenance of the City's storm drain system, streets, alleys, and municipal property. The City of Minneapolis contributes stormwater runoff to various receiving waters both inside and outside of City boundaries, including Minnehaha Creek, Bassett Creek, Shingle Creek, several lakes, and the Mississippi River. Maps of the drainage areas that have been delineated according to topographic contours and the storm drain system are included in Appendix B. The 2020 population, size of drainage area, and land use percentages by body of receiving water are listed in Appendix A5.

PROGRAM OVERVIEW

The City's storm drain system is managed and maintained by the Operations section of the Public Works Department Surface Water & Sewers (PW-SWS) Division. Design engineering and regulatory issues are managed by the division's Capital and Regulatory sections, respectively.

The City utilizes Maximo™ to compile assets, track work orders, and assist in work scheduling and purchasing.

Brick Egg-type Sewer

Maximo™ identifies the current state of assets and asset attributes (e.g., age, condition, etc.) and utilizing a standardized rating process for assets and asset attributes (e.g., National Association of Sewer Services Companies (NASSCO) Pipeline Assessment and Certification Program (PACP)).

PW-SWS Operations identifies risk areas, criticality of system, and life-cycle costs. This improves future decision making because of data and analysis (e.g., succession planning, level of maintenance response, Capital Improvement Project prioritization), improve documentation and recordkeeping of assets (e.g., Maximo software),

improve coordination and communication, lower long-term operation and maintenance costs, improve regulatory compliance. This is used as a communication tool for staff and regulators for effective information transfer and knowledge retention.

The current staffing level of the PW-SWS Operations section is approximately 105 full-time employees and are key components for achieving the City's overall management goals. This decrease is anticipated to result in a more reactive approach. In the PW-SWS Operations, there are currently 61 permanent, full-time employees working directly within Sewer Maintenance (includes both storm and sanitary personnel), and the remainder work within rehabilitation. General maintenance efforts include checking hours at pump stations, performing pump station maintenance, pipe inspections, pipe cleaning, system repairs, rehabilitation or reconstruction of existing infrastructure, inspection and operation of control structures, operation of pump stations, cleaning of water quality structures, and operational management of stormwater detention ponds.

The table below shows the base operational functions along with the corresponding staffing:

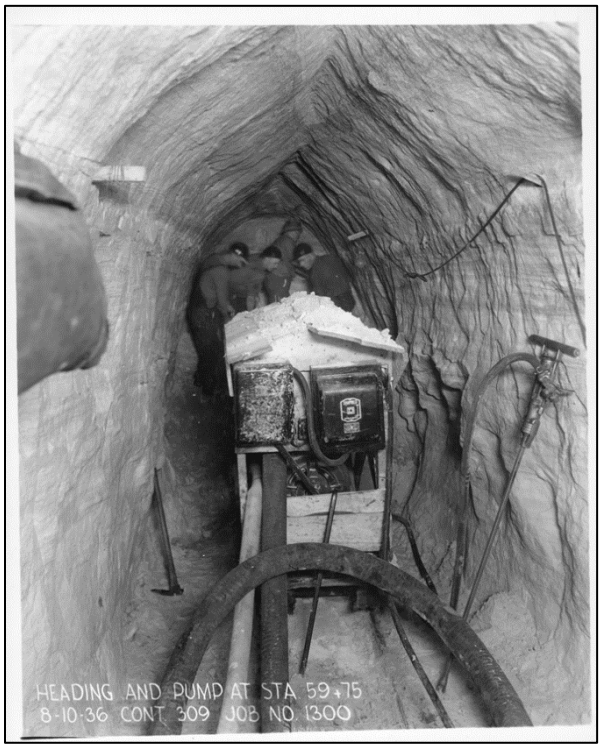
Crews	Staff/crew	Type	Tasks
4	2	Route Truck	Daily pipeline system inspections, complaint response, and resolution to minor system operational problems
5	2	Jet Truck	"As-requested" cleaning of storm system components, routine cleaning of sanitary system pipes, and "as-requested" cleaning of pump/lift stations. Hydro jet-wash technique.
4	2	Jet-Vac Truck	Routine cleaning of storm system infrastructure. Hydro jet-wash technique. Storm sewer cleaning by vacuum removal of sludge and debris build-up.
3	2	TV Truck	Televise and inspect storm drain and sanitary sewer system components. Log and assess condition of televised lines to determine and prioritize rehabilitation and/or repair needs to storm drain and sanitary sewer system components.
0	0	Repairs	Perform medium-sized repairs, requiring minimum excavation, to storm drain and sanitary sewer system pipeline components. May assist in the repair or reconstruction of larger repair/ reconstruction jobs. (This work is contracted out)
2	2	Vac Truck	Vacuum-cleaning of water quality structures, manholes, and catch basins within the storm drain system. Assist in sanitary sewer cleaning by vacuum removal of sludge and debris build-up. Assist in repair/ construction activities using vacuum excavation process. Assist in erosion control compliance using vacuum cleanup of eroded soils and/or cleaning of erosion control structures.

1	0	Rod Truck	Remove roots and foreign objects from sanitary sewer system. Remove large debris from storm drain-pipes and free ice from frozen catch basin leads. (City forces currently do not have enough staff to operate this vehicle)
1	6	Pond & Pump	Operate, maintain, and repair sanitary lift station and stormwater pump stations. Operate and maintain stormwater detention basins.
1	1	Shop	Perform general maintenance and repair to specialty use vehicles and emergency response equipment. Fabricate, as needed, custom metal and wood objects for sewer and storm drain operations. Provide field deliveries of materials, tools, and equipment. Maintain material inventory and fleet management data.

PREVIOUS YEAR ACTIVITIES

2022 Storm Drain Infrastructure cleaning and repair information data

- Completed repairs on 213 catch basins
- Cleaned 2.83 miles of storm drain utilizing hydro-jet washing
- Televised and condition assessed 12.82 miles of storm drain-pipes
- Continued repairs of 2,215 feet of storm tunnel
- Continued work on the Central City tunnel, which is constructing a new parallel tunnel downtown in order to handle the increased amount of stormwater that has been directed into the tunnel system
- Tracked 877 repairs for catch basins via Maximo asset management system



WATER RESOURCE FACILITIES OPERATIONAL MANAGEMENT AND MAINTENANCE

PROGRAM OBJECTIVE

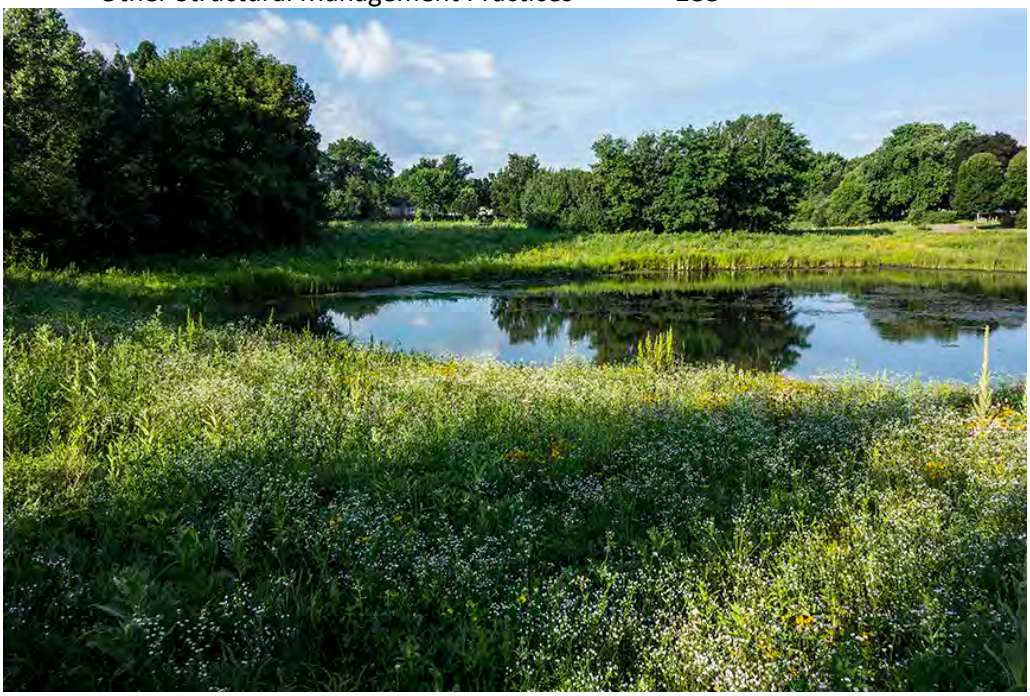
The objective of this NPDES stormwater management program is to minimize the discharge of pollutants through the proper operational management and maintenance of water resource facilities (stormwater

practices) within the City's storm drain system that affect system flow, rates, quantity, and water quality discharges.

Maintenance

Minneapolis Surface Water & Sewers maintains approximately 428 public BMP systems, including:

- Storm Drains 29,150
- Storm Manholes 18,150
- Grit Chambers 140
- Other Structural Management Practices 288



PROGRAM OVERVIEW

Stormwater management facilities are part of the City's overall storm drainage system and are managed and maintained by Surface Water & Sewers Operations. These components are routinely inspected and maintained to ensure proper operation and reliability. Frequency of inspections and assigned maintenance efforts are based on both operational experience and incurred environmental events.

By agreement with the City of Minneapolis and the MPRB, the Minnehaha Creek Watershed District monitors the design capacity of several stormwater ponds in Minneapolis and performs dredging and restoration as needed including testing for proper disposal. The MPRB also maintains small scale Park

Vegetated Swale at 25th Ave. SE

Board stormwater devices including ponds, rain gardens, and pervious pavement.

Water resource facilities for water quality improvement are separated into five separate categories:

Pre-Treatment Practices

Pretreatment is an integral part of BMP application. In many applications (infiltration and stormwater ponds) the practice would not function properly if pre-treatment is ignored. Pre-treatment techniques are used to keep a BMP from being overloaded, primarily by sediment. Pre-treatment can also be used to dampen the effects of high or rapid inflow, dissipate energy, and provide additional storage. These benefits help overall BMP performance. Types of pre-treatment practices include:

- Settling devices (grit chambers)
- Sump manholes
- Storm Drains – sometimes enhanced with SAFL baffles, forebays, oil / water separators, and vegetated filter strips

Filtration Practices

Filtration BMPs treat urban stormwater runoff as it flows through a filtering medium like sand or an organic material. They are generally used on small drainage areas and are designed for pollutant removal. They are effective at removing TSS, particulate phosphorus, metals, and most organics. They are less effective for soluble pollutants such as dissolved phosphorus, chloride, and nitrate. Most filtration BMPs will achieve some volume reduction, depending on the design and the use of vegetation to promote evapotranspiration. Filtration practices used in the City include rain gardens with underdrains and iron enhanced sand filters.

Vegetated Swale at Redeemer Church

Infiltration Practices

Infiltration BMPs treat urban stormwater runoff as it flows through a filtering medium and into underlying soil, where water percolates into groundwater. This removes pollutants from the runoff, either by being trapped within the practice, or broken down by chemical processes within the first few feet of soil. The filtering media is typically coarse-textured and may contain organic material, as in the case of bio-infiltration BMPs. These practices are primarily designed for removal of stormwater runoff volume and pollutants in that runoff. They are effective at removing TSS, particulate phosphorus, metals, bacteria, nitrogen, and most organics. Soluble pollutants such as chloride and nitrate typically percolate through these BMPs and into underlying groundwater. These BMPs, when designed with no underdrain, include rain gardens, tree trenches (including Silva Cell systems), underground infiltration, and infiltration trenches including dry wells.

12x10 Infiltration Box Culvert Installation

Sedimentation Practices

Sedimentation is the process by which solids are removed from the water column by settling. Sedimentation BMPs include:

- Dry ponds
- Wet ponds
- Wet vaults
- Proprietary devices

Infiltration Box Culvert – inside view

Proprietary hydrodynamic devices are limited to treating small tributary areas while constructed ponds and wetlands can be designed to treat runoff from a larger tributary area. These BMPs provide temporary storage of stormwater runoff and allow suspended solids to settle and be retained by the BMP. These BMPs are effective at removing TSS and any pollutants adsorbed to the solids but that are not effective in removing soluble pollutants or in providing any volume reduction.

Chemical Practices

Stormwater BMPs that employ chemical treatment are typically designed for treatment of a specific pollutant. Phosphorus is the most common pollutant of concern, but chemical treatment may also be employed for nitrogen, metals, and organic pollutants. The City has installed iron-enhanced sand filters which chemically bind phosphorus. Between 1998 and 2001, MPRB treated Cedar Lake, Lake of the Isles, Lake Harriet, and Bde Maka Ska with alum to reduce internal loading of phosphorus in those waterbodies.

Voluntary Green Infrastructure Installation

The City recently updated their GI website, which includes information about what GSI is, types and benefits of GSI, different GSI projects (both completed and under construction) in Minneapolis, and training and guidance documents on effectively implementing GSI.

The City installed green infrastructure projects voluntarily on road projects that were not subject to the stormwater management ordinance. The projects include both sustainable landscaping (SL) and green stormwater infrastructure:

Near North Safe Routes to School (SRTS)

- Incorporated 8 bioretention facilities into safety bump-outs
- Added 5 traffic circles vegetated with native plantings
- Converted a total of 3,000 SF to green infrastructure including GSI and SL features

Whittier School (SRTS)

- Added 3 bioretention facilities into bump-outs in front of an elementary school
- Converted approximately 600 SF to green infrastructure

LaSalle & 14th Ave Pedestrian Improvements

- Incorporated sustainable landscaping at 5 bump-outs in the downtown intersection
- Converted approximately 1,000 SF to green infrastructure

Luella Anderson Neighborhood Concrete Rehabilitation Program

- Added 12 bump-outs planted with native plantings at intersections throughout neighborhood
- Converted approximately 2,000 SF to green infrastructure
- Reduces impervious areas throughout the neighborhood by approximately 0.4 acres

American Rescue Plan Act (AARPA) Traffic Circles

- 17 traffic circles that will be planted with native plantings
- Converted approximately 3,400 SF of impervious area to sustainable landscaping

Queen Ave N Bike Boulevard

- Added 5 traffic circles vegetated with native plantings
- Converted a total of 1,000 SF to sustainable landscaping

Grand Ave Reconstruction Phase II

- Added approximately 60 bioretention facilities into bump-outs, chicanes, and boulevard spaces along the corridor (70 additional facilities built in 2021)
- Reduced impervious area by approximately 0.9 acres
- Provides treatment for approximately 5.3 acres of right-of-way
- Provides approximately 33,000 CF of storage in bioretention facilities

4th St N Reconstruction Phase II

- Added three bioretention cells (2 constructed in 2021, 1 in 2022)

Structural Controls

The City also employs structural controls to manage stormwater runoff that are not directly related to water quality, including:

Storm Drain Outfall Inspections

Storm drain outfalls are the structural ends of system pipelines where conveyance of stormwater runoff is discharged into a receiving water bodies. Outfalls are inspected on a 5-year schedule, and evaluate the general condition of structures, determine if any significant erosion has occurred and observe any contaminant discharges. If indications of illicit or contaminated discharges are found, they are reported to Minneapolis Environmental Services for reporting to the Minnesota State Duty Officer for further investigation and resolution. Any identified structural repair or maintenance work is prioritized and scheduled considering available personnel, budget funding, and coordination with other essential operations.

Grit Chamber Construction at Dean Pkwy

18 days of Mississippi River outfall sampling were conducted, including visual inspections of outfalls, and developing spill response strategies by boat. Participating agencies included Minneapolis Fire, Minneapolis Public Works (Surface Water & Sewers Division), and Mississippi Watershed Management Organization (MWMO).

Outfall inspections by staff from Surface Water & Sewer Operations, Environmental Services, and Regulatory Services help to detect contaminated flows in the storm drain system, and maintenance crews routinely inspect and clean storm drain structures. In addition, inspections of flows that generate unusual odors, stains, and deposits are included in the annual tunnel inspection, outfall inspection, and grit chamber inspection and cleaning programs. Suspect flows are reported to Environmental Services inspectors for further investigation. Environmental Services personnel also receive reports of alleged illicit discharges to the storm drain system from the public, other City departments, and various agencies. In 2022, City staff inspected 118 outfall structures for condition. For more detailed information, see Appendix A7. In 2020, the City created an Outfall Working Group that meets monthly, and has:

- Compiled all past outfall inspections reports and data bases into one site
- Adopted Survey123 software and provided training on it to use for conducting outfall inspection
- Developed a uniform inspection form for various City staff to use for outfall inspections
- Has developed a protocol for reporting spills, suspected dry flows, and illicit discharges

Pumps & Weirs

These structural devices mechanically affect the flow of stormwater runoff through the storm drain system. Pump stations are inspected regularly for routine operational checks and are annually for detailed condition assessment. Maintenance and/or repairs are performed with routine items being completed as needed and larger items being coordinated into a budgeted pump station operation program. Weirs and outlet structures are inspected and repaired as needed to facilitate their proper operational working order.

Storm Drains

These structural devices located along the City's street system and provide entrance of stormwater runoff into the storm drainage system. Public Works crews look for plugged or damaged structures. Reported damages and / or plugs are given a priority for repair and / or cleaning. Cleaning storm drains, while ensuring proper runoff conveyance from City streets, also removes accumulated sediments, trash, and debris. Augmenting this effort is the street sweeping program that targets the pick-up of street sands, leaves, and debris prior to their reaching storm drains. Repair of damaged storm drains is also a priority, given their location in City streets and ultimate impact to the traveling public. Residents or businesses can adopt storm drains through the Adopt-a-Drain Program, which helps to keep leaves, sediment and garbage out of the storm drain system and local waters.

PREVIOUS YEAR ACTIVITIES

- Monitored and maintained 23 pump stations

DISPOSAL OF REMOVED SUBSTANCES

PROGRAM OBJECTIVE

A key component of the MS4 stormwater management program is collection and disposal of materials removed from the storm drain system and structural controls in a manner that will prevent pollution and that will comply with applicable regulations.

PROGRAM OVERVIEW

Accumulated materials are removed from grit removal structures, storm drains, system piping, and deep drainage tunnels during the process of inspection and cleaning. Removed substances are screened for visual or olfactory indications of contamination. If contamination is suspected, the City's Engineering Laboratory will select representative samples for an environmental analysis. Contaminated substances are disposed of at a MPCA approved landfill or site. Non-contaminated targeted pollutants are disposed of the same way as street sweepings. During cleaning and disposal operations, erosion control measures are applied when needed to prevent removed material from re-entering the storm drain system.

The process for accumulated materials dredged from stormwater ponds is similar. The materials to be dredged from stormwater ponds are tested in advance and disposed of properly according to MPCA guidance.

PREVIOUS YEAR ACTIVITIES

In 2022, Minneapolis Public Works crews removed accumulated sediment and debris from grit chambers, and approximately 310 cubic yards from storm drains during hydro-jet washing operations.

Storm Sewer Pipe Jetted

In 2022, Minneapolis Sewer Forces removed material from 121 segments of pipe, totaling 15,118 LF (2.83 miles) using jetting and jet / vac equipment. Additionally, as part of our contracted televising contract and additional 0 LF (0 miles) of storm pipes were cleaned in order accomplish the televising. This totals 15,118 LF (2.83 miles) of City of Minneapolis directed work for jetting of the storm system.

Catch Basin (Storm Drain) Repair

In 2022, 213 catch basin repairs were completed. Currently, there are 877 catch basin repairs that are needed in our asset management system.

Storm Sewer Pipe Televised

In 2022, Minneapolis Sewer Forces televised 37,711 LF of storm sewer, and contracted the televising of 30,000 LF of storm sewers, totaling 67,711 LF (12.82 miles) of storm sewer televised.

FACILITY MANAGEMENT

PROGRAM OBJECTIVE

The stormwater management objective of these activities is to prevent or reduce the discharge of pollutants generated at City and MPRB owned facilities. Facilities include but are not limited to:

- Composting sites
- Equipment storage and maintenance
- Hazardous waste disposal
- Hazardous waste handling and transfer
- Landfills
- Solid waste handling and transfer
- Parks
- Pesticide storage
- Public parking lots and ramps
- Public golf courses
- Public swimming pools
- Public works yards
- Recycling sites
- Salt storage yards
- Vehicle storage at maintenance yards
- Materials storage yards

PROGRAM OVERVIEW

Pollutant control is managed through proper storage of materials, routine maintenance, effective application of winter salt and deicers, and installation of structural stormwater management practices. Operations are performed to address public safety while balancing those needs with environmental and cost considerations.

PREVIOUS YEARS ACTIVITIES

In 2016, the City began developing Stormwater Pollution Prevention Plans (SWPPPs) for City and MPRB-owned facilities to reduce the discharge of pollutants into the storm sewer system from municipal and MPRB operations. An inventory of municipal operations facilities has been created which includes over 70 facilities:

- Vehicle and Equipment Maintenance Facilities
- Fleet Services
- Parking Lots and Ramps
- Fire Stations

- Police Stations
- Water Services Facilities
- Stockyards
- MPRB Service Centers
- MPRB Dog Parks

Site specific plans are being developed for each facility which include site maps, operations specific Best Management Practices, and inspection and reporting requirements.

These facility plans will be used to facilitate regular site inspections that will document and correct potential sources of pollution or illicit discharge to the storm sewer system from City or MPRB-owned properties. Inspection frequency will be evaluated based on site specific needs such as continuing or ongoing issues, seasonal site usage, or change in property use. Implementation of the facility management plans will be prioritized based on the highest pollutant potential.

ROADWAYS

PROGRAM OBJECTIVE

The objective of this stormwater management program is to minimize the discharge of pollutants through the proper operation and maintenance of public streets and alleys.

PROGRAM OVERVIEW

Street Sweeping

Minneapolis Public Works employs several street sweeping approaches. Some are citywide, and some vary by area or land use. Curb-to-curb sweeping operations occur citywide in the spring and fall when all city streets are swept systematically (alleys are included in the spring), and temporary parking bans are enforced to aid with sweeping operations.

Operational routines and special methods are employed to address seasonal conditions, and to optimize cleaning. Flusher trucks apply pressurized water to the streets to push sediment and debris to the gutters. Street sweepers follow behind the flusher trucks and clean the gutters. During the fall, leaves are first bunched into piles, and then the leaves are picked up before flushing and sweeping occurs. During the summer, between the spring and fall sweep events, sweepers are assigned to maintenance districts for periodic area sweeping. Downtown and other high traffic commercial areas are swept at night on a weekly basis. In addition, summer sweeping in the Chain of Lakes drainage areas has occurred since 1995 as part of the Clean Water Partnership project. Two sweepers are dedicated to cleaning drainage areas around the Chain of Lakes, and one sweeper is devoted to the Minneapolis Parkway System.

The materials collected from street sweeping are received at two different locations, depending on time of the year and nature of the material. The inorganic materials go to a landfill site in Becker, MN, to be used as daily cover. The Mulch Store in Chaska, MN, receives the City's organics each fall.

New Street Sweeping Signs

In the fall of 2021, the Minneapolis Safety/LMC Committee came up with an idea for different colored street sweeping signs. Numerous color options were considered, and pink ended up being the

consensus. A QR code was also incorporated into the rough design. Staff from Public Works, Surface Water & Sewers division supplied additional ideas and messaging regarding the Adopt-a-Drain Program and sweeping up in Minneapolis streets.

Minneapolis Communications was involved for final approval of the new design, with the goal being better visibility and communication for street sweeping. Citywide, Minneapolis deploys over 4,000 signs daily during the 4-week comprehensive sweep. Due to high visibility of the new street sweeping signs, compliance with residents had noticeably improved.

Downtown Improvement Districts

Special service districts are defined areas in Minneapolis where increased levels of service are provided and paid for by the commercial or industrial property owners in the district. One of these special service districts, the Downtown Improvement District (DID) is a business-led non-profit organization with “a

mission to make downtown Minneapolis a vibrant and attractive place for recruiting and retaining businesses, employees, residents, shoppers, students, and visitors. This is accomplished by providing services that make the 120-block district cleaner, greener, and safer." The organization is an important partner to the City, carrying out maintenance activities in the downtown public realm that minimize the discharge of pollutants through the proper maintenance of public right-of-way areas. The DID removes trash from sidewalks and operates sweepers for gutters and sidewalks throughout the 120-block district.

Snow and Ice Control

The Minneapolis Transportation, Maintenance, & Repair Division applies salt and sand to City roadways every winter for snow and ice control. Efficient application of de-icing materials appropriately balances three primary concerns: public safety, cost control, and environmental protection.

Reduced material amounts provide a cost savings and are the best practice available for reducing harmful impacts on the environment. Sand harms lakes and streams by disturbing the ecosystems, and in depositing pollutants that bind to sand particles in lake bottoms and streambeds. An accumulation of sand calls for more frequent cleaning of storm drains and grit chambers. Salt (chloride) is harmful to aquatic life, groundwater, and to most plant and tree species. Salt causes corrosive damage to bridges, reinforcement rods in concrete streets, metal structures and pipes in the street, and vehicles.

Within Minneapolis, the following lakes and creeks do not meet standards for concentrations of chlorides set by the MPCA and are considered impaired:

- Bassett Creek
- Brownie Lake
- Diamond Lake
- Loring Lake
- Minnehaha Creek
- Powderhorn Lake
- Shingle Creek
- Spring Lake
- Wirth Lake

Reducing usage of salt was the focus of the Shingle Creek Chloride TMDL Report, which was approved by the EPA in 2007. It placed limits on chlorides (salt) discharged to Shingle Creek**.** Consequently, the City developed improved snow and ice control practices**,** and they are being implemented not only in the Shingle Creek drainage area, but also citywide. These practices are in line with the 2016 Twin Cities Metropolitan Area Chloride Management Plan completed by the MPCA.

Material spreaders are calibrated annually before the winter season. Maintenance yard housekeeping practices are designed to minimize salt/sand runoff, and materials used are tallied daily. Salt stockpiles are stored under cover to minimize potential groundwater contamination and runoff to surface waters.

PREVIOUS YEAR ACTIVITIES

The 2022-2023 winter season was the third snowiest on record with several freeze-thaw cycles which required more granular material usage along with a heavy December snowfall that formed ice in the alleys and side streets especially with the cold December through February range. There were 31 notable events with 90 inches for the season, as compared to an average of 50 inches. The most

snowfall was observed in January. There were six declared snow emergencies, compared to the annual average of four, and there were 156 days of temperatures at or below freezing by late of April. January and February saw around 2.25 inches of moisture compared to one-half to three-quarters of an inch the years before along with two rain events in February and three notable freezing rain events in 2022-2023. The quantities of salt and sand used in snow and ice control are tracked by recording amounts that are delivered by suppliers, and by estimating the quantities that are on-hand daily. Street sweepings are scaled at the disposal site and reported to the City for record purposes only. Leaves picked up are weighed at the contractor's transfer facility in Minneapolis. The statistics for last year's program are as follows:

- 11,293 tons of salt applied to roadways
- 10,683 tons of sand applied to roadways
- 11,563 tons of materials reclaimed during spring and summer street sweeping operations
- 4,626 tons of leaves collected for composting during the fall Citywide sweeping

The City has been tracking the amount of salt applied within the City since 2001, and Minneapolis has continuously reduced the use of salt by 40%.

Figure 6-1 shows the tons of salt applied annually. Figure 6-2 shows the amount of sand and salt applied in the City relative to the days below freezing. Figure 6-3 shows the amount of sand and salt applied in the City relative to the total amount of snowfall. These figures show that there has been an overall reduction in the amount of salt applied in the City. There has also been a reduction in the amount of salt applied relative to both the days below freezing and the inches of snowfall in the City.

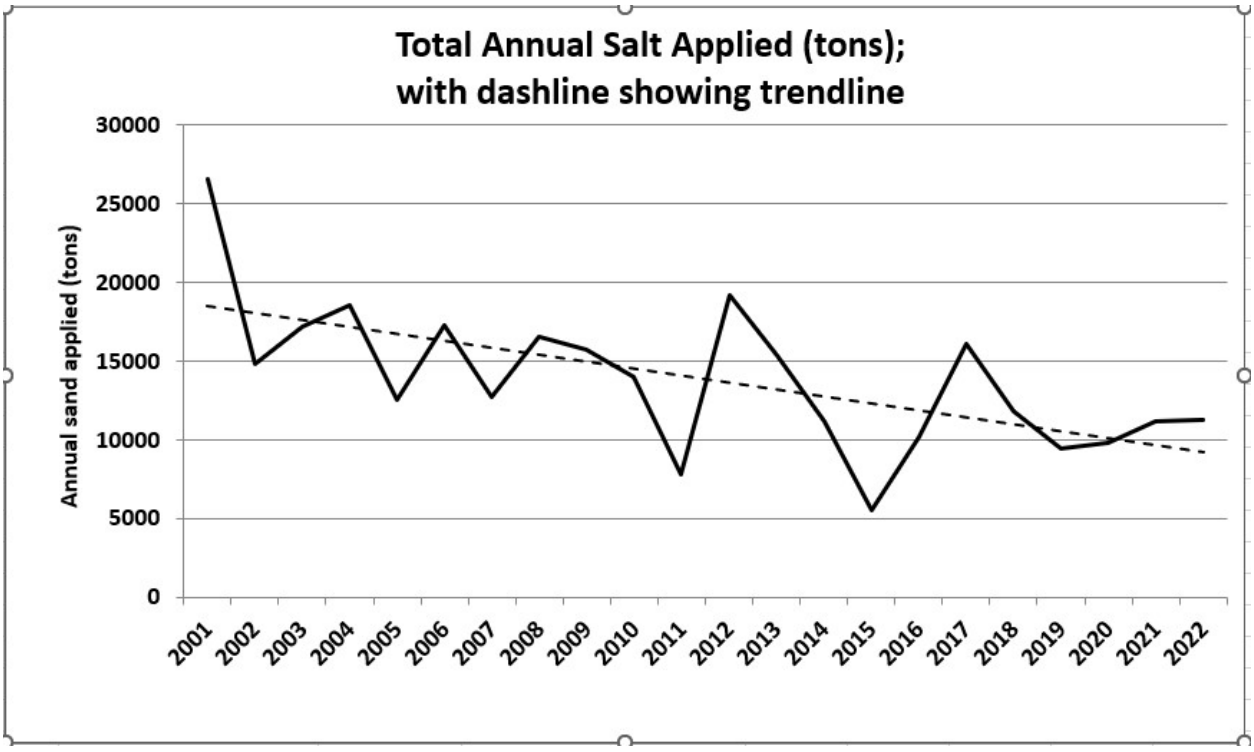


Figure 6.1 Tons of salt applied annually

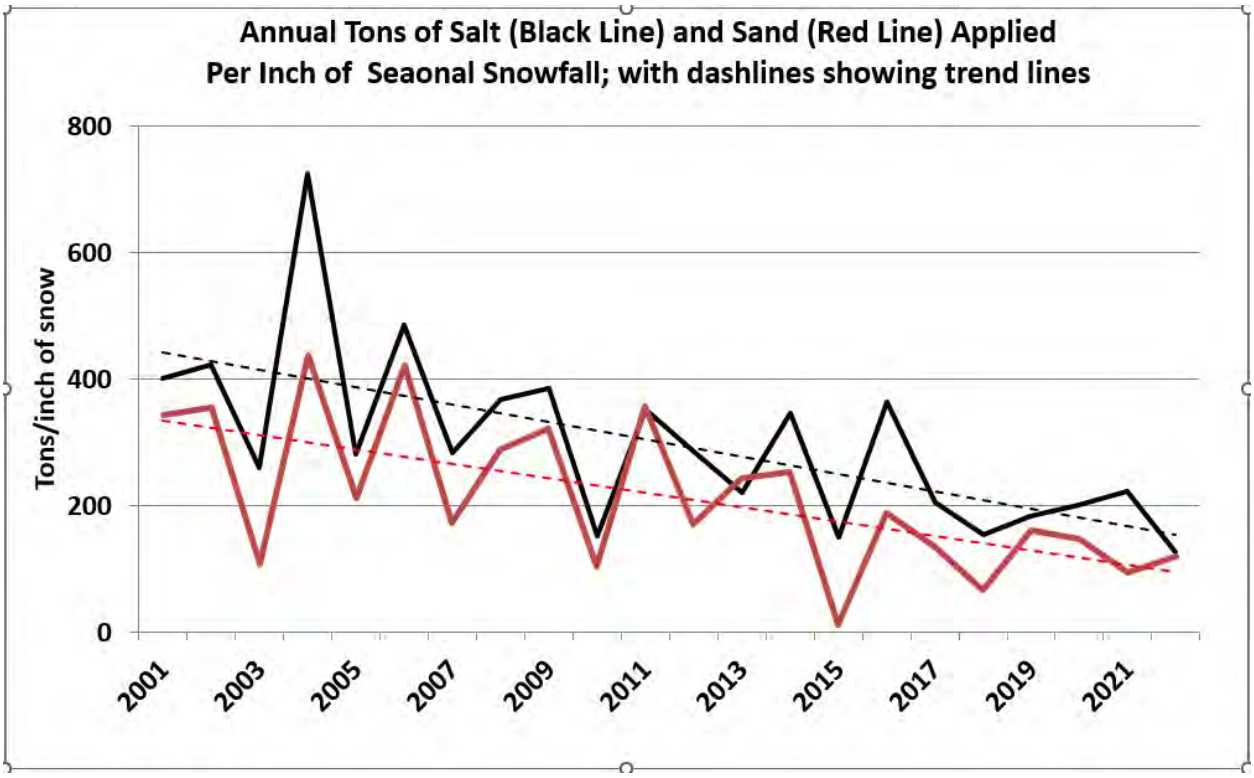


Figure 6.2 Amount of sand and salt applied relative to the days below freezing

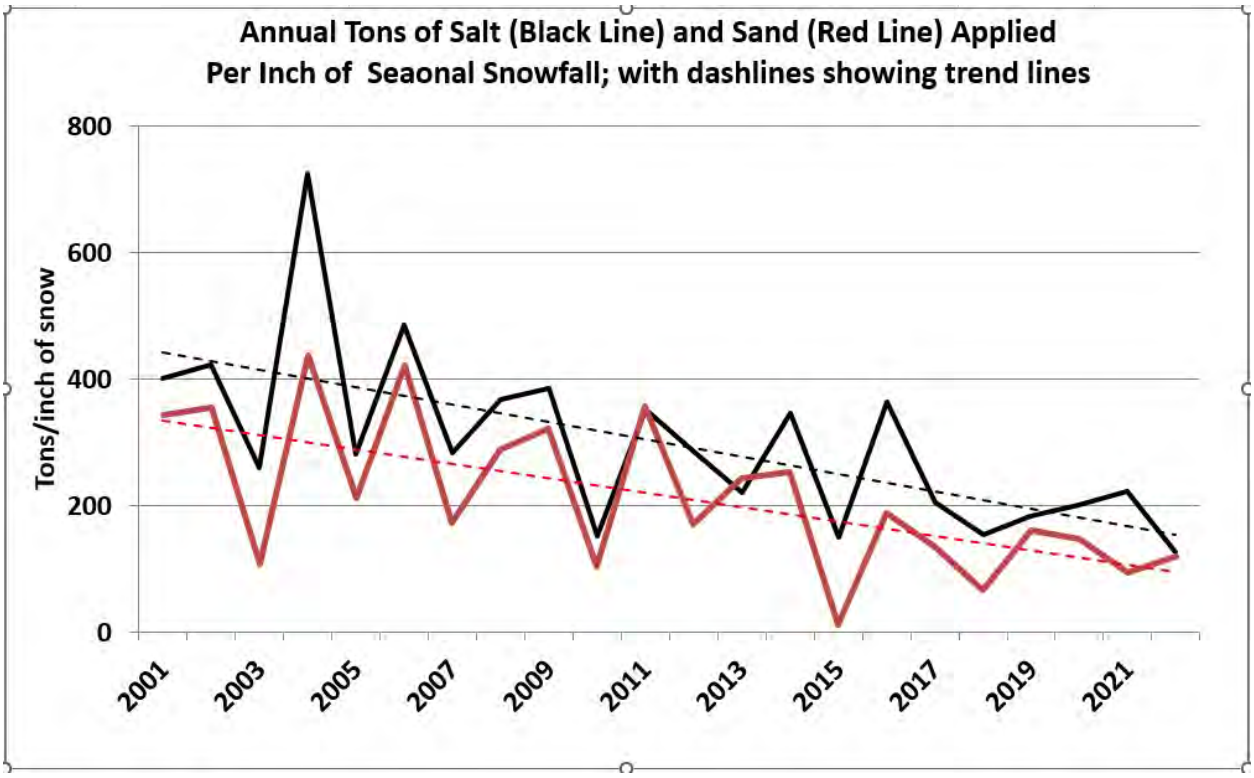


Figure 6.3 Amount of sand and salt applied relative to the total amount of snowfall

Performance Measures

- Amount of materials recovered as a percentage of materials applied: 74 %
- Amount of salt and sand applied relative to total snowfall: 244 tons/inch

VEGETATION MANAGEMENT: PESTICIDES AND FERTILIZER CONTROL

PROGRAM OBJECTIVE

The objective of the Vegetation Management program is to minimize the discharge of pollutants by utilizing appropriate vegetation management techniques and by controlling the application of pesticides and fertilizers.

The City of Minneapolis manages vegetation on 30 sites with over 40 acres, while the MPRB manages 185 park properties totaling 7,089 acres of parkland and water. In addition to providing native vegetation with deep roots that can tolerate both drought and inundation, this vegetation also allows for high infiltration capacity and erosion control protection. High-quality native vegetation also provides invaluable habitat and food to pollinators and other insects, amphibians, and reptiles, as well as birds and small mammals.

PROGRAM OVERVIEW – MPRB PROPERTIES

Integrated Pest Management (IPM) Policy and Procedures

The Minneapolis Park and Recreation Board's Integrated Pest Management policy is included in the MPRB's General Operating Procedures. The IPM Policy establishes thresholds utilized to determine appropriate course of corrective action for a variety of landscape types including formal gardens, athletic fields, golf courses, and managed natural areas.

Pesticides Use on Park Lands

The MPRB manages 6,817 acres of park land and water in the City of Minneapolis (approximately 18% of the City's 35,244 total land acres). MPRB also owns land outside of the City of Minneapolis.

The use of pesticide products on general park lands is not a routine maintenance practice. Landscape pesticide products may be used during park renovations, to repair athletic fields and golf courses, to control invasive species and noxious weeds, or to address plant health concerns within formal gardens. No cosmetic use of pesticide products is performed on general parkland. In 2016, MPRB banned the use of glyphosate in neighborhood parks. In 2018, the Board of Commissioners placed a moratorium on the use of glyphosate on all MPRB lands.

Invasive Species Control

Conservation Corp working on invasive species control at the Quaking Bog and leafy spurge control at North Mississippi Prairie.

MPRB Environmental Management (Natural Resources) staff use a variety of management techniques to control invasive plants in park natural areas. These techniques include mowing, weed whipping, hand pulling, and the use of biological controls. Invasive plant control within the Minneapolis Park System focuses on the species listed in the Minnesota Department of Agriculture's Noxious Weed List. The current State Prohibited Noxious Weed of greatest priority for control are Round Leaf Bittersweet, Canada Thistle, Leafy Spurge and Japanese Knotweed of which control efforts are underway.

Biological control agents have been used in the park system to control purple loosestrife, spotted knapweed, and leafy spurge. Biological control agents are insects or pathogens that are native to the invasive plant's country of origin. They are introduced after extensive research has been done by the scientific community. The MPRB partners with Minnesota Department of Agriculture (MDA) and Minnesota Department of Natural Resources (MnDNR), to control invasive plants with biological control agents.

Purple Loosestrife is a major invasive species problem in Minnesota wetlands. Working with the MnDNR the MPRB began a biocontrol program in the early 1990s. Leaf feeding beetles were reared and released into several sites throughout the City. Currently these populations are self-sustaining.

Partnering with MDA, spotted knapweed and leafy spurge biological controls were released in the Cedar Lake Regional Trail Prairie in 2003. Insects that specifically feed on these plants are being used in conjunction with mechanical methods to control spotted knapweed and leafy spurge in the planted prairie.

SCUBA hand harvesting at Wirth Lake

Eurasian watermilfoil, an invasive aquatic plant, is harvested mechanically at Cedar Lake, Lake of the Isles, Bde Maka Ska, and Lake Harriet and harvested by hand via SCUBA at Lake Nokomis and Wirth Lake. Permits for managing Eurasian watermilfoil are obtained annually from the Minnesota Department of Natural Resources. The Environmental Stewardship Division coordinates the Eurasian watermilfoil control program.

The MPRB Integrated Pest Management Policy sets a threshold of 100% for aquatic weeds. It states that no chemical applications will be made to aquatic areas including natural lakes and ponds, artificial ponds, and creeks. When a new aquatic invasive species is newly introduced, whether to our region or to a specific area, MPRB staff evaluate management solutions using an integrated pest management approach.

In fall 2021, MPRB began managing Phragmites australis spp. australis, an invasive species of wetland grass found around the Chain of Lakes. Invasive Phragmites can overtake shoreline areas and create unsuitable habitat for desirable plant and animal species. Invasive Phragmites was elevated from the "restricted" category to the "control" category of the Minnesota Department of Agriculture's Noxious Weed List in 2021, meaning that MPRB was legally obligated to manage it for the first time in 2021. To manage five existing sites of invasive Phragmites in Minneapolis parks, MPRB utilized a strategy recommended by the University of Minnesota that involves alternating imazapyr herbicide treatments and mowing. Mowing alone would not have been an effective management strategy, according to the University of Minnesota. A first round of follow-up mowing and herbicide treatments took place in 2022 with an additional round planned for 2023. The sites will be surveyed each year and will be revegetated with native species in 2024.

Fertilizer Use

In September 2001, the Minneapolis City Council amended Title 3 of the Minneapolis Code of Ordinances (relating to Air Pollution and Environmental Protection) by adding Chapter 55 regarding Lawn Fertilizer in January 1, 2002. The retail sale of fertilizer containing any amount of phosphorus or

other compound containing phosphorus, such as phosphates, is prohibited in Minneapolis. The Minnesota Statute allows the use of phosphorus turf fertilizer if an approved and recent test indicates that the level of available phosphorus in the soil is insufficient or if the fertilizer is being applied to newly established turf, but only during the first growing season.

Under certain conditions specified in the Statute, fertilizer use is allowed on golf courses. Fertilization of turf on Minneapolis Park & Recreation Board Property is performed for golf courses, around athletic fields, and in areas of heavy traffic. MPRB staff are required to complete a report for every turf fertilizer application. These records are maintained for a period of 5 years, per state law.

Recordkeeping

MPRB staff who apply pesticides and fertilizers keep records of their applications, as required by the Minnesota Department of Agriculture. Pesticide application records are kept that record the applicator's license number, pesticide's trade name, pesticide's EPA registration number, application rate, application area and environmental conditions at time of application.

Since the 1980s, golf course foremen and park maintenance staff have documented the type, amount, and locations of the chemicals that are stored at park storage facilities. These chemical inventories provide detailed information to emergency responders in the event of a compromised storage facility. The inventories identify how the fires are best extinguished and how to protect surface water in the surrounding area. The chemical inventories were put into place in the early 1980s, following a chemical company fire in north Minneapolis that resulted in the contamination of Shingle Creek. Updated Emergency Action Plans for pesticide products stored at the South Side Operations Center and Lyndale Park have been completed, while remaining MPRB facilities are continuing to be developed.

Audubon Cooperative Sanctuary Program (ACSP) for Golf Courses

Audubon International provides comprehensive conservation and environmental education assistance to golf course superintendents and industry professionals through collaborative efforts with the United States Golf Association. The ACSP for golf courses seeks to provide open space benefits by addressing environmental concerns while maximizing golf course opportunities.

Participation in the program requires that golf course staff address environmental concerns related to the potential impacts of water consumption, and chemical use on local water sources, wildlife species, and native habitats. The program also aids in comprehensive environmental management, enhancement and protection of existing wildlife habitats, and recognition for those who are engaged in environmentally responsible projects.

Audubon International provides information to help golf courses with:

- Site Assessment and Environmental Planning
- Outreach and Education
- Water Quality and Conservation
- Resource Management
- Wildlife and Habitat Management

Rain Garden at Riverside and 8th St. S

By completing projects in each of the above, the golf course receives national recognition as a Certified Audubon Cooperative Sanctuary. MPRB Golf Course foremen are expected to maintain the ACSP certification for courses. MPRB water resources staff conduct yearly water quality and wetland vegetation monitoring at the courses. All MPRB golf courses except for Columbia, Hiawatha and Fort Snelling have current Audubon Certification. The MPRB is currently in the process of obtaining certification for Columbia and Hiawatha Golf Courses.

PREVIOUS YEAR ACTIVITIES

Currently around 200 MPRB employees hold pesticide applicator licenses, through the Minnesota Department of Agriculture (MDA). MPRB staff continues to reduce the use of pesticides through a variety of initiatives including improved design, plant selection, increased use of mechanical techniques and biological controls.

Turf fertilizer containing phosphorus is only purchased in accordance with the 2002 City and State regulation changes. Regulations require a soil or plant tissue test indicating a phosphorus deficiency or when new turf is being established during its first season.

PROGRAM OVERVIEW – CITY OF MINNEAPOLIS PROPERTIES

The City of Minneapolis maintains vegetation on its properties, including on stormwater management sites for a variety of reasons. These include public safety, preventing erosion, protecting, and improving water quality and ecological function, and creating wildlife habitat. Proper vegetation management will slow water movement, hold or convert pollutants, and enhance infiltration and evapotranspiration within stormwater management facilities like rain gardens and grass swales.

Integrated Pest Management (IPM)

The City uses integrated pest management when addressing pest management on the sites that the City maintains. IPM is a pest management strategy that focuses on long-term prevention or suppression of pest problems with minimum impact on human health, the environment and non-target organisms. In most cases, IPM is directed at controlling pests that have an economic impact on commercial crops. However, in the instance of mosquito control, IPM is used to control nuisance and potentially dangerous mosquito populations. The guiding principles, management techniques and desired outcomes are similar in all cases.

The City complies with the Minneapolis Code of Ordinances Title 11 - Health and Sanitation, Chapter 230 - Pesticide Control and Minnesota Department of Agriculture rules regarding pesticide application by posting plant protectant applications and maintaining the necessary records of all pest management

activities completed by the City. The City's specific IPM goals, procedures, and guidelines can be found in Appendix A8.

CATEGORY SEVEN: STORMWATER RUNOFF MONITORING AND ANALYSIS

PROGRAM OBJECTIVES

The purposes of monitoring and analysis under the MS4 permit are to understand and improve stormwater management program effectiveness through adaptive management, characterize pollutant event mean concentrations, estimate effectiveness of devices and practices, and calibrate and verify stormwater models.

PROGRAM OVERVIEW

The MPRB monitors stormwater within Minneapolis to comply with the federal National Pollutant Discharge Elimination System (NPDES) permit. The purpose of this monitoring is to gain knowledge that can be used to improve the effectiveness of treatment best management practices (BMPs). BMPs include procedures and structures designed to help reduce and capture pollutants in stormwater runoff. In 2022, quarterly grab samples, including snowmelt and rainfall, were collected at seven stormwater sites. Three inlets to Camden Pond as well as the outlet were monitored to examine internal phosphorus release and the effectiveness of stormwater ponds initially built for flood control. Stormwater from four subwatersheds draining to Powderhorn Lake were monitored to gather information that will be used in a diagnostic study for the lake. Monitoring occurred downstream of continuous deflection separation (CDS) units. Two green stormwater infrastructure (GSI) sites, Hoyer and Windom, were monitored for plant health, soil chemistry, and pretreatment basin functionality. This section describes work done in the 2022 monitoring season, Appendix A12 contains full reports on each stormwater monitoring project.

In addition to stormwater monitoring, the Minneapolis Park & Recreation Board executes an extensive lake monitoring program. See the MPRB's Water Resources Report for detailed results. All lakes in the monitoring program are sampled twice per month during summer, and once each in winter, spring, and fall. *Escherichia coli (E. coli)* monitoring per the MPCA's standard is also carried out at the MPRB's 12 official beaches located on six lakes. This monitoring is important for public health and provides indications of elevated bacteria issues. See Chapter 18, Public Beach Monitoring, of the MPRB's Water Resources Report. *E. coli* is a bacterium used to indicate the potential presence of waterborne pathogens that can be harmful to human health. Elevated bacteria levels generally occur in aquatic environments after rain events, when bacteria from various sources are washed into the lakes in stormwater runoff. This section describes work done in the 2022 monitoring season, Appendix A12 contains additional information on the Lakes data.

In 2022, the MPRB monitored for blue-green algae during open-water beach monitoring and year-round lake sampling. Blue-green algae is monitored by reviewing lake risk factor data including chlorophyll-a, Secchi readings, and pH, using a Visual Monitoring Index (VMI) and total algae probe, and sending water samples to a contracted lab for cyanotoxin analysis of microcystin, cylindrospermopsin, and anatoxin-a. Blue-green algae blooms, otherwise known as harmful algal blooms (HABs), are caused by a photosynthetic microorganism called cyanobacteria. Certain taxa of cyanobacteria have the capability to produce cyanotoxins that can be harmful to wildlife, pets, and humans if ingested. While the process of nutrient loading promotes cyanobacteria growth, warmer temperatures, more intense precipitation events, and longer stratification periods due to climate change will stimulate more intense and frequent future harmful algal bloom events. See Chapter 19, Blue-green algae/Cyanotoxin Monitoring.

PREVIOUS YEARS ACTIVITIES

Quarterly Grab Sampling

The City/MPRB NPDES permit requires quarterly grab samples for NPDES chemistry, pH, *E. coli*, and a pilot project to monitor Fat, Oils, and Grease (FOG). The purpose of this monitoring is to characterize the seasonality of runoff for parameters that cannot be collected with flow-weighted composite auto-monitoring (e.g., pH, *E. coli*, FOG). Criteria for snowmelt sample collection was a winter snowpack melt event. Criteria for spring, summer, and fall rainfall grab sample collection was a precipitation event greater than 0.10" separated by at least 8 hours from other precipitation.

The NPDES permit requires quarterly grab stormwater event monitoring to be attempted, but it is not always possible to carry out. Rain events must occur when staff are working, and the laboratory is open to receive samples. Ideally, annual quarterly grab monitoring includes two snowmelt grab samples, and one rainfall grab sample during spring, summer and fall. Quarterly grab monitoring includes pH, *E. coli*, NPDES water chemistry, and a Fat Oil and Grease (FOG) sample. The grab water chemistry samples are analyzed for the chemistry parameters outlined in the NPDES permit.

MPRB staff collecting winter snowmelt samples at Powderhorn Lake.

Grab sampling characterizes a point in time of a snowmelt or rain event. The first snowmelt event in a year usually has higher pollutant concentration than subsequent snowmelt events. The chemical concentrations can change over time throughout the storm event as the rising limb of the hydrograph usually mobilizes fine particles and FOG material previously deposited on hard surfaces first. Chemical concentrations can vary not only throughout the individual storm event but also from storm to storm, largely driven by the time passed since the last precipitation event. It can be helpful to think of stormwater runoff pollution in a watershed as behaving like dust. It accumulates over time and then washes off in a melt or rain event. The longer the time between snowmelt or rain, the more pollutants that accumulate.

As part of the NPDES permit, a study of quarterly FOG grab sampling was conducted along with regular grab sample monitoring with the intent to sample six sites. The latest NPDES permit prescribed that if a

FOG sample was measured greater than 15 mg/L at a site, then that site would continue to be monitored throughout the permit cycle. FOG in stormwater can come from a variety of sources such as: vehicles, industry, food waste, gas stations, etc. Elevated levels of hydrocarbons can be harmful to aquatic plants and animals. It is important to minimize FOG in stormwater through best practices in industry, public education about vehicle maintenance, and the prevention of improper waste disposal.

*Table 7-3. MPRB quarterly grab monitoring sites from 2018-2022. * The 61st & Lyndale site had limited access in the summer of 2018 and all of 2019 due to stormwater pipe replacement and road construction. ** The Pershing site was inaccessible in the summer of 2018 due to lack of manhole access.*

2018	2019	2020	2021	2022
14th & Park	14th & Park	24th & Elm In N	24th & Elm N	61st & Lyndale
22nd & Aldrich	22nd & Aldrich	24th & Elm In S	24th & Elm S	Camden In NNW
61st & Lyndale*	24th & Elm In N	24th & Elm N Out	61st & Lyndale	Camden In SNW
Pershing**	24th & Elm In S	61st & Lyndale	Powderhorn In S	Camden In SW
	61st & Lyndale*	Powderhorn In S	Powderhorn In SE	Powderhorn In S
	Pershing	Powderhorn In SE	Powderhorn In W	Powderhorn In SE
	Winter Basin In S	Powderhorn In W		Powderhorn In W
	Winter Basin In W			

In 2022, grab sampling included seven sites: three Powderhorn Lake inlets (W, SE, S), three Camden Pond inlets (NNW, SNW, SW), and the 61st & Lyndale site. Due to a lack of significant storm events in the summer and fall, a grab sample in the fall quarter was unable to be collected in 2022.

Detailed monitoring methods and results are listed in **Appendix A-12**.

Camden Pond Monitoring

Camden Pond was constructed by the City of Minneapolis in 2007 for flood control. Later, the space around the pond was redesigned as a scenic location for recreators to enjoy by adding plants, benches, and a walking path. Camden Pond is 4.09 acres with a maximum depth of 6.4 ft and accumulates sediment at a rate of around 0.44% of its volume per year (Stantec Consulting Services, 2021). As of 2020, only 6.2% of the pond volume was had filled with sediment, so the pond has never needed to be dredged. The pond is classified as polymictic. The drainage area of Camden Pond is 235 acres of mainly park and residential land uses, with 75 of those acres being impervious surfaces.

Camden Pond, summer of 2022

Camden Pond was part of the 2020-2021 Minneapolis Park and Recreation Board (MPRB) pond monitoring study and was selected for further monitoring in 2022 based on the study results. Camden Pond was one of the older ponds in the study and showed the highest potential internal phosphorus loading out of all ponds in the study. A more comprehensive study of Camden Pond's inlets and outlet was started in 2022 with the goal of determining more definitive mass balance, removal efficiency, and nutrient loads. This study aims to provide insight into whether a pond originally intended for flood control purposes could have or be modified to have positive water quality impacts.

The purpose of monitoring the stormwater inlets and outlet of Camden Pond was to:

1. Measure the pollutant loads of the main tributary pipes entering Camden Pond and compare with pollutant loads at the pond outlet.
2. Assess how a pond originally intended for flood control is affecting stormwater quality.
3. Measure the true storage capacity of the pond and compare to its designed capacity.
4. Comply with the National Pollutant Discharge Elimination System (NPDES) Permit provision to monitor stormwater BMPs for the purpose of adaptive management.

Powderhorn Lake Inlet Monitoring

The City of Minneapolis Public Works (MPW) and the Minneapolis Park and Recreation Board (MPRB) developed a major restoration plan for Powderhorn Lake in 1999. In 2001, five continuous deflective separation (CDS) grit chambers were installed to remove solids from stormwater inflow.

Powderhorn Lake, summer of 2022

Despite this and other restoration work, the lake was listed as impaired and placed on the Environmental Protection Agency (EPA) 303(d) list based on eutrophication and biological indicators in 2001. Powderhorn Lake later trended towards better water quality and met state standards for several years and was subsequently removed from the 303(d) list in 2012. After relapsing to poor water quality, Powderhorn was relisted on the EPA 303(d) list as impaired for nutrients in 2018.

The purpose of monitoring the stormwater inlets into Powderhorn Lake was to:

1. Measure the pollutant load of the main tributaries to Powderhorn Lake. This information can be used to assist in any future external load reduction plans.
2. Trouble shoot the CDS unit functionality, since 2020 work done in 2020 discovered that the CDS units were not functioning as designed.
3. Comply with the National Pollutant Discharge Elimination System (NPDES) Permit provision to monitor stormwater BMPs for the purpose of adaptive management.

In 2022, four of the largest Powderhorn Lake watershed inlets were auto-monitored downstream of their CDS units. Current watershed monitoring work at Powderhorn began in 2019. Refer to the Water Resources Report from 2019, 2020, and 2021 (report can be found here) for more information on Powderhorn Lake inlet monitoring. The MPRB also studied CDS and sump units at Powderhorn Lake from 2002-2004 and neighborhood rain garden effectiveness in 2009.
Detailed monitoring methods and results are listed in **Appendix A-12**.

Hoyer and Windom Green Stormwater Infrastructure Monitoring

The purpose of the Hoyer and Windom Green Stormwater Infrastructure (GSI) monitoring is to better understand how effective these structures are at flood control and reducing the impacts of stormwater

runoff. A secondary goal is to assess the performance of different GSI site designs in natural conditions and use that information to enhance future designs. Due to an ordinance change, the City of Minneapolis is building numerous small-footprint infiltration/filtration basins throughout the city. Many of these GSI Best Management Practices (BMPs) treat less than 1 acre of impervious surface.

In 2022, the City of Minneapolis expanded the number from two to four GSI monitoring sites at Hoyer and Windom. This was the second year this project was conducted. See location map below.

The Hoyer GSI basin in fall of 2021 in Northeast Minneapolis

The main goals of the projects were to evaluate three (3) methods of infiltration measurement, establish acceptable testing, and to develop protocols for future GSI basins. The 2022 monitoring project proved to be very successful where we learned:

- Using surface infiltration tests (such as MODIFIED PHILIP DUNNE - MPDs) were different than measuring sub-surface infiltration rates.
- Visual inspection and MPDs are the simplest, fastest, and most cost-effective tools to indicate basins or sites that need maintenance
- Synthetic Runoff Testing (flooding the basin) and measuring the runoff-soil moisture (using a soil moisture sensor) are cost effective ways to better understand drawdown time and moisture dynamics
- Proper use of underdrains (a bypass for the excess runoff in a basin) in GSIs have the largest impact on their proper function. Underdrains should be capped where they may be needed or eliminated if feasible.

In 2023, efforts will focus on developing improved methods for subsurface infiltration rates and the impact of underdrains.

The Hoyer GSI site is in Northeast Minneapolis and includes three different basins located in the same neighborhood, shown below. They drain approximately 0.072 acres of a residential watershed, of which 0.0407 acres are impervious, and were designed primarily for flood control. Hoyer site A is at the southeast corner of 36 ½ Ave NE & Fillmore St NE and has been monitored since 2021. Two additional sites were added to the project in 2022: Hoyer site B at the northwest corner of that same intersection, and Hoyer site C as at the southeast corner of 36 ½ Ave NE & Buchanan St SE. All sites had underdrain caps and boots installed on July 19th, 2022. Each site has a brick-filtered splash pad pretreatment basin and an overflow inlet.

The Hoyer B GSI site during the summer of 2022. Hoyer sites A and C have a very similar design to Hoyer B.

The Windom GSI site, shown in below, is in Southwest Minneapolis at West 62nd St & Dupont Ave South. It drains approximately 3.67 acres of a residential watershed, of which 0.506 acres are impervious. The Windom site has a capped underdrain and was designed for stormwater infiltration. The site includes five Rain Guardian Bunker pretreatment basins along a main bioretention channel.

The Windom GSI site during the summer of 2022. One of five rain guardian bunker pretreatment systems are pictured.

This project is a partnership between the City of Minneapolis, Saint Anthony Falls Hydrology Laboratory (SAFL) at the University of Minnesota, the Mississippi Watershed Management Organization (MWMO), and the Minneapolis Park and Recreation Board (MPRB). The funding, survey, and GIS data used in the project were supplied by the City of Minneapolis. Monitoring of rainfall, flow, infiltration tests, and flood functionality tests were the responsibility of both the City and SAFL. Public outreach and education were the responsibility of MWMO. Confined space entry, soil sampling/testing, and monthly observational field inspection data were the responsibility of the MPRB.

Detailed monitoring methods and results are listed in **Appendix A-12.**

Lake Monitoring

In 2022, MPRB scientists monitored 12 of the city's most heavily used lakes. The data collected were used to calculate a Trophic State Index (TSI) score for each of the lakes. Lower TSI scores indicate high water clarity, low levels of algae in the water column, and/or low phosphorus concentrations. Changes in lake water quality can be tracked by looking for trends in TSI scores over time. A negative slope indicates improving water quality, while a positive slope indicates declining water quality. These values are especially important for monitoring long-term trends (10+ years). Historical trends in TSI scores are used by lake managers to assess improvement or degradation in water quality. Trends are also used by the Minnesota Pollution Control Agency to assess non-degradation goals.

Deep water samples collected on Lake Hiawatha, 2022

Most of the lakes in Minneapolis fall into either the mesotrophic or eutrophic category. Bde Maka Ska, Cedar, and Wirth Lake are mesotrophic having moderately clear water and potential for hypolimnetic anoxia during the summer. Brownie Lake, Lake of the Isles, Harriet, and Hiawatha are eutrophic having an anoxic hypolimnion and potential for nuisance growth of aquatic plants. Nokomis and Loring are also eutrophic with high algal productivity. Powderhorn Lake is hypereutrophic having dense algae. Blue-green algae dominates the phytoplankton community on both Lake Nokomis and Powderhorn Lake, resulting in periodic appearance of algal scum on these lakes. Spring Lake is also classified as hypereutrophic with very high nutrient concentrations but was not sampled in 2022. Scores for Diamond and Grass Lake are not included since these lakes are too shallow to calculate the Secchi portion of the TSI index.

Long term trends in lake water quality can be seen by using the annual average TSI since the early 1990s, **Table 1**. Restoration activities have improved water quality indicators at Bde Maka Ska and Wirth Lake. When data from the last 10 years is looked at for Minneapolis lakes, shown in **Table 2**, Lake Hiawatha and Lake Nokomis have an increasing trend, signifying declining water quality indicators for those lakes. Lake Hiawatha is heavily influenced by inflow from Minnehaha Creek and the lake has poorer water quality during drought years when residence time increases. In 2021 and 2022 there was less precipitation compared to previous years and the lake had a significant increase in chlorophyll-*a* and total phosphorus, and water clarity has become increasingly shallower since 2018. In recent years Lake Nokomis has had higher algal concentrations and has had higher chlorophyll-*a* concentrations and shallower water clarity. In 2021, the water quality trends on Cedar Lake over the past 10 years indicated that the water quality was declining, mainly due to poor water quality noted in the previous 5 years, but in 2022 the lake was listed as having a stable trend since the water clarity was significantly deeper and chlorophyll-*a* concentrations were lower.

Lakes with Improving Water Quality Indicators	Lakes with Stable Trends	Lakes with Declining Water Quality Indicators
Bde Maka Ska	Brownie Lake	No lakes with declining trend
Wirth Lake	Cedar Lake	
	Lake Harriet	
	Lake Hiawatha	
	Lake of the Isles	
	Lake Nokomis	
	Loring Pond	
	Powderhorn Lake	
	Spring Lake	

Table 1. Water quality trends in Minneapolis lakes from 1991-2022.

Lakes with Improving Water Quality Indicators	Lakes with Stable Trends	Lakes with Declining Water Quality Indicators
No lakes with improving trend	Bde Maka Ska	Lake Hiawatha
	Brownie Lake	Lake Nokomis
	Cedar Lake	
	Lake Harriet	
	Lake of the Isles	
	Loring Pond	
	Powderhorn Lake	
	Spring Lake	
	Wirth Lake	

Table 2. Water quality trends in Minneapolis lakes from 2013-2022.

Green Infrastructure Monitoring

The purpose of the Hoyer and Windom Green Stormwater Infrastructure (GSI) monitoring is to better understand the Hoyer and Windom basins' ability to minimize the impacts of stormwater runoff. Due to an ordinance change, the City of Minneapolis is building numerous small-footprint infiltration/filtration basins throughout the City. Many of these GSI Best Management Practices (BMPs) treat less than 1 acre of impervious surface. The City of Minneapolis chose two GSI sites to be monitored in 2021, Hoyer and Windom.

The Hoyer GSI site in Northeast Minneapolis at the SE corner of 36 ½ Avenue NE and Fillmore Street NE drains approximately 0.072 acres of a residential watershed (0.0407 acres impervious). The GSI has an uncapped underdrain which flows to the storm sewer system. The Hoyer GSI site was built for flood control.

Hoyer GSI basin, Fall of 2021

The Windom GSI site in SW Minneapolis on W 62nd Street and Dupont Avenue S drains approximately 3.67 acres of a residential watershed (0.506 acres impervious). The Windom site has a capped underdrain and is built for stormwater infiltration.

Windom GSI basin, Fall 2021

The Hoyer Windom GSI monitoring project is a partnership between the City of Minneapolis, Saint Anthony Falls Hydrology Laboratory (SAFL) at the University of Minnesota, and the Minneapolis Park and Recreation Board (MPRB). The funding, survey, and GIS data used in the project were supplied by the City of Minneapolis. Monitoring of rainfall, flow, infiltration tests, and flood functionality tests were the responsibility of both the City and SAFL. Confined space entry, soil sampling/testing, and monthly observational field inspection data were the responsibility of the MPRB.

Detailed monitoring methods and results are listed in **Appendix A-12**

CATEGORY EIGHT: PROGRESS TOWARD WASTE LOAD ALLOCATION FOR APPROVED TMDLS

PROGRAM OBJECTIVES

Total maximum daily loads (TMDLs) are one of the many tools Congress authorized in the Clean Water Act to "restore and maintain the chemical, physical, and biological integrity of the nation's water." The goal of the City's TMDL program is to work closely with the MPCA and other water resource agencies during the study and implementation phases of each TMDL Study which is being conducted for a waterbody that receives stormwater runoff from the Minneapolis MS4 system. Additionally, this program aims to develop and maintain a tracking system to assess and report on the progress towards compliance with TMDL established maximum pollutant discharges.

PROGRAM OVERVIEW

The City of Minneapolis is subject to the following TMDLs:

TMDL project name	Waste Load Allocation type	Percent reduction	Pollutant of concern
Crystal Lake Nutrient TMDL	Categorical		Phosphorus
Minnehaha Creek Lake Hiawatha TMDL	Categorical	N/A	*E. coli*
Minnehaha Creek/Lake Hiawatha TMDL	Individual	31%	Phosphorus
Minnehaha Creek Watershed District Lakes TMDL – Lake Nokomis	Individual	38%	Phosphorus
Silver Lake TMDL	Categorical	17%	Phosphorus
Shingle Creek Aquatic Life, Chloride, *E. Coli* bacteria, Low Dissolved Oxygen TMDL	Categorical	67%	Chloride
Shingle Creek and Bass Creek Biota and Dissolved Oxygen TMDL	Categorical		Nitrogenous biochemical oxygen demand
South Metro Mississippi River TMDL (Metro)	Categorical	0%	TSS
TCMA Chloride TMDL Study	Categorical	N/A	Chloride
Upper Mississippi River: Bacteria	Categorical		*E. coli*
Wirth Lake: Excess Nutrients TMDL	Categorical		Nutrients

CRYSTAL LAKE TMDL: NUTRIENTS

- Membership and Participation in the West Metro Watershed Alliance education campaigns
- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works Street Sweeping program
- Monitoring Program with MPRB
- XPSWMM Systemwide Storm Sewer Model Completed

- Water Quality Model completed
- Implementation of Green Stormwater Infrastructure Program
- Implementation of Chapter 54: Stormwater Management Ordinance for development and redevelopment
- Public Works Storm Sewer Maintenance and Repair Program

MINNEHAHA CREEK - LAKE HIAWATHA TMDL: BACTERIA, NUTRIENTS

- Membership and Participation in the West Metro Watershed Alliance education campaigns
- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works Street Sweeping program
- Monitoring Program with MPRB
- XPSWMM Systemwide Storm Sewer Model completed
- Water Quality Model completed
- Implementation of Green Stormwater Infrastructure Program
- Implementation of Chapter 54: Stormwater Management Ordinance for development and redevelopment
- Implementation of Green Stormwater Infrastructure Program
- Public Works Storm Sewer Maintenance and Repair Program
- Leadership, membership, and participation in Minnesota pathogen Task force
- Development of Stormwater Pathogen Investigation and Prevention Toolbox to identify, prevent, and remediate pathogens in stormwater runoff

MINNEHAHA CREEK WATERSHED DISTRICT LAKES – LAKE NOKOMIS TMDL: PHOSPHORUS

- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works Street Sweeping program
- Monitoring Program with MPRB
- XPSWMM Systemwide Storm Sewer Model completed
- Water Quality Model completed
- Implementation of Green Stormwater Infrastructure Program
- Implementation of Chapter 54: Stormwater Management Ordinance for development and redevelopment
- Public Works Storm Sewer Maintenance and Repair Program

SILVER LAKE TMDL: PHOSPHORUS

- Membership and Participation in the West Metro Watershed Alliance education campaigns
- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works Street Sweeping program

- Monitoring Program with MPRB
- XPSWMM Systemwide Storm Sewer Model completed
- Water Quality Model completed
- Implementation of Green Stormwater Infrastructure Program
- Implementation of Chapter 54: Stormwater Management Ordinance for development and redevelopment
- Public Works Storm Sewer Maintenance and Repair Program

SHINGLE CREEK TMDL: AQUATIC LIFE, CHLORIDE, *E. COLI* BACTERIA, LOW DISSOLVED OXYGEN

- Membership and Participation in the West Metro Watershed Alliance education campaigns
- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works equipment upgrades, advancements in de-icing technologies, and staff training
- Public Works Street Sweeping program
- Stormwater Utility Credit program participation requires a chloride management plan

SHINGLE CREEK AND BASS CREEK TMDL: BIOTA AND DISSOLVED OXYGEN

- Membership and Participation in the West Metro Watershed Alliance education campaigns
- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works Street Sweeping program
- XPSWMM Systemwide Storm Sewer Model completed
- Water Quality Model completed

SOUTH METRO MISSISSIPPI RIVER TMDL (METRO): TSS

- Membership and Participation in the West Metro Watershed Alliance education campaigns
- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works Street Sweeping program
- Monitoring Program with MPRB
- Public Works Storm Sewer Maintenance and Repair Program

TWIN CITIES METRO AREA (TCMA) TMDL: CHLORIDE

- Membership and Participation in the West Metro Watershed Alliance education campaigns
- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works equipment upgrades, advancements in de-icing technologies, and staff training
- Public Works Street Sweeping program

- Monitoring Program with MPRB
- Stormwater Utility Credit program participation requires a chloride management plan

UPPER MISSISSIPPI RIVER TMDL: BACTERIA

- Participation in the Adopt-a-Drain Program
- Participation in Storm Drain Stenciling Program
- Membership and Participation in Watershed Partners and Clean Water MN Public Education Programs
- Public Works Street Sweeping program
- Monitoring Program with MPRB
- Implementations of the 2019 Minnehaha Creek Bacterial Source Identification Study
- Leadership, membership, and participation in the MN Pathogen Task Force
- Developing a toolbox for identification, prevention, and remediation of pathogens in stormwater runoff
- Public Works Storm Sewer Maintenance and Repair Program
- MPRB nuisance goose management program

CATEGORY NINE: COORDINATION AND COOPERATION WITH OTHER ENTITIES

PROGRAM OBJECTIVE

The objective of this Stormwater Management Program is to maximize stormwater management efforts through coordination and partnerships with other governmental entities.

PROGRAM OVERVIEW

Coordination and partnerships of the City and the MPRB with other governmental entities include the four watershed organizations in Minneapolis: BCWMC, MWMO, MCWD and SCWMC. Coordination activities and partnerships with other governmental entities also include MnDOT, Hennepin County, MPCA, Minnesota Board of Water and Soil Resources (BWSR), MnDNR, neighboring cities, the Metropolitan Council, the University of Minnesota, and various other entities.

The coordination and partnership activities can include the joint review of projects, joint studies, joint water quality projects, stormwater monitoring, water quality education, and investigation or enforcement activities.

Coordination with the Bassett Creek Water Management Commission (BCWMC)

In 2015, the BCWMC adopted its Third Generation Watershed Management Plan, with Minneapolis and the other eight-member cities as active partners. Minneapolis provides yearly financial contributions to the BCWMC annual operations budget. The City and the MPRB are also stakeholders with other BCWMC joint power cities in development of several Total Maximum Daily Load (TMDL) studies and implementation plans. Currently Minneapolis and MPRB are coordinating with BCWMC on projects in Bryn Mawr Meadows and the Main Stem of Bassett Creek in Wirth Park.

Coordination with the Minnehaha Creek Watershed District (MCWD)

The MCWD receives revenue through direct taxation against properties within its jurisdiction. MCWD's fourth Generation Watershed Management Plan was adopted on January 11, 2018 and sets priorities for the organization for the period from 2018-2027. The City of Minneapolis and the MPRB are stakeholders in development of TMDL studies and implementation plans, in collaboration with the MCWD and other stakeholders. Minneapolis and MPRB are working together on a more detailed memo of understanding on how the three entities will work together to implement projects in the Minnehaha Creek watershed within Minneapolis.

Coordination with the Mississippi Watershed Management Organization (MWMO)

In 2021, the MWMO adopted its Fourth Generation Watershed Management Plan (2021-2031). The City and MPRB participated in its review. The MWMO delegates stormwater management requirements for new developments and redevelopments to its member cities and does not provide separate project review and approval. The MWMO receives revenue through direct taxation against properties within its jurisdiction. The City and the MPRB partner with the MWMO on many studies and projects. Additionally, MWMO conducted 35 educational events with a total of 853 participants.

Coordination with the Shingle Creek Watershed Management Commission (SCWMC)

In April 2022, the SCWMC began drafting its Fourth Generation Watershed Management Plan, with Minneapolis and the other member cities as active partners in plan review. Minneapolis provides yearly financial contributions to the SCWMC annual operations budget. The City of Minneapolis and the MPRB are stakeholders with other SCWMC joint power cities in development of TMDL studies and implementation plans.

Coordination with Hennepin County

In 2016, Hennepin County adopted the Natural Resources Strategic Plan (2015-2020), the plan is currently in the process of being updated. The intent of the plan is to guide the county and its partners, including the City, in responding to natural resource issues and developing internal and external policies, programs, and partnerships that improve, protect, and preserve natural resources.

Coordination with the Minnesota Pollution Control Agency (MPCA)

Minneapolis Fire Inspection Services coordinates with the MPCA on Spill Response incidents and investigations and enforcement for incidents of illegal dumping or illicit discharges to the storm drain system.

Minneapolis Public Works coordinates with the MPCA on the various work groups, including the Minnesota Stormwater Manual and surface water/groundwater interactions.

Minneapolis Park & Recreation Board coordinates with the MPCA on various research and data collection efforts on Minneapolis lakes.

Coordination with the US Coast Guard and WAKOTA CARE

Minneapolis Fire Inspection Services coordinates with these agencies on spill response issues, training, and spill response drills. Due to low water conditions and scheduling issues, a Spill Drill did not take place in 2022. Discussions have taken place to coordinate a Spill Drill in 2023 with Minneapolis Fire Department and Minneapolis Public Works.

Coordination with the Minneapolis Park & Recreation Board (MPRB)

In 2020, Minneapolis Park & Recreation board adopted an Ecological Systems Plan. This plan included input from Minneapolis Public Works to ensure that the two entities mutual water quality and environmental management goals can be achieved. This plan now serves as the MPRB's principal policy document regarding environmental performance and provides a framework for how environmental considerations can be addressed in ongoing planning, operations, and management efforts at the MPRB. In 2021, MPRB adopted a new comprehensive plan, Parks for All (2021-2036). The plan's environmental sustainability focus area outlines how MPRB will work independently and with Minneapolis and other partners on preservation of parklands, natural areas, waters, and the urban forest as well as management, design, operations and programming of parks through practices that mitigate and adapt to climate change.

PREVIOUS YEAR ACTIVITIES AND ONGOING COORDINATION EFFORTS

MPRB and the City of Minneapolis coordinate stormwater management efforts and coordinate with the watershed management organizations, the watershed district, and other governmental agencies on several water quality projects. Minneapolis Public Works maintains communications with all watershed management organizations and the watershed district within the City boundaries.

Interactions take several forms to facilitate communication and provide support:

- Attend selected local board and special issues meetings
- Attend selected education and public outreach committee meetings
- Take part in Technical Advisory Committee meetings
- Inform organizations of upcoming City capital projects to identify projects that may benefit from partnerships
- Provide developers who submit projects for site plan review with information and contacts to meet watershed requirements
- Share information and data regarding storm drainage system infrastructure, watershed characteristics, flooding problems, modeling data, etc.
- The MPRB and the City coordinate and partner with watershed management organizations and state agencies on capital projects and water quality programs. For example:
- A feasibility study began in 2019 for a proposed project that will improve water quality and habitat and increase flood storage in Bassett Creek by dredging accumulated sediment that has collected in the “lagoons” created within the creek in Theodore Wirth Park between Golden Valley Road and Trunk Highway 55. The City of Minneapolis and the MPRB are cooperating with BCWMC on the study. The feasibility study was completed in the spring of 2020 and the BCWMC approved the implementation of the project to dredge 3 of the lagoons to a 6-foot depth. Clean Water Funding was also awarded from the MN Board of Soil and Water Resources in 2020. A Hennepin County Opportunity Grant was awarded in 2021. The project has achieved 50% design and an EAW was completed. Implementation of this project began in the winter of 2022/23.
- MPRB and City of Minneapolis along with BCWMC are working towards implementation of a stormwater project in Bryn Mawr Meadows. The project will be designed and constructed in conjunction with the MPRB's master planning process for this area. The project includes diverting runoff from a 45.1-acre residential area west of the park and low flows from MnDOT’s Penn Pond discharge into new stormwater ponds within the park for a total phosphorus reduction of 30 pounds per year. Additional funding for this project has been contributed by Hennepin County and BWSR. Concept plans were completed in 2021. Construction began in 2022.
- MPRB and City of Minneapolis along with MWMO are collaborating on common water quality, flood control and habitat improvement goals in MWMO’s 1NE project area. The overall goal of the project is to reduce flooding and reduce pollution to the Mississippi River. Projects are planned on the MPRB’s Colombia Golf Course, MPRB Parkland, and integrated with City of

Minneapolis street projects. Preferred projects have been chosen, and construction started in 2020 and is expected to be completed in 2022.

- A phase of the overall project, the Northern Colombia Golf Course and Park BMP project began construction in 2020 with funding from MWMO, BWSR, City of Minneapolis, and Hennepin County. Due to unexpected high-water levels, BMP designs were altered in 2022.
- Collaboration between MPRB, MCWD, and Minneapolis continued via the master planning process for the Minnehaha Regional Trail corridor along Minnehaha Creek. If preliminary plans are fully implemented, 1.7 miles would be added to the length of the creek, runoff from 1,400 acres of land would be treated, 22 acre-feet of flood storage would be created, and over 400 pounds of phosphorus would be removed from the creek annually. The plan was adopted by the MPRB Board in 2020 laying out priorities for the Minnehaha Creek Corridor within Minneapolis and how the three entities can collaborate to meet common goals of managing stormwater, flooding, streambank stability, and ecology in a heavily used recreation corridor. Community engagement and design for the first project focus area is expected in 2021. Construction led by MPRB in 2022 focused on trail and pedestrian infrastructure improvements as well as a raingarden.
- Collaboration between MPRB, MCWD, and Minneapolis occurred via the master planning process for the Cedar Lake and Lake of the Isles parks. The Masterplan was completed in 2022 and was distributed for agency and public comment. Adoption is expected in 2023 after comments are compiled and incorporated. The City's Environmental Services section coordinates with the MPCA regarding investigations and enforcement for incidents of illegal dumping or illicit discharges to the storm drain system.
- Public Works and MPRB staff coordinate with the MPCA, the watershed management organizations and other stakeholders for Total Maximum Daily Load (TMDL) studies and implementation plans.
- Public Works engages with MPRB, MnDOT, Hennepin County, Metropolitan Council, and watershed management organizations on those entities' capital projects and infrastructure maintenance within the City regarding compliance with NPDES issues.
- Finally, other sections of this NPDES Annual Report provide additional information about other projects or issues on which the permittees have cooperated with other governmental entities.

INTEGRATED INFRASTRUCTURE MANAGEMENT

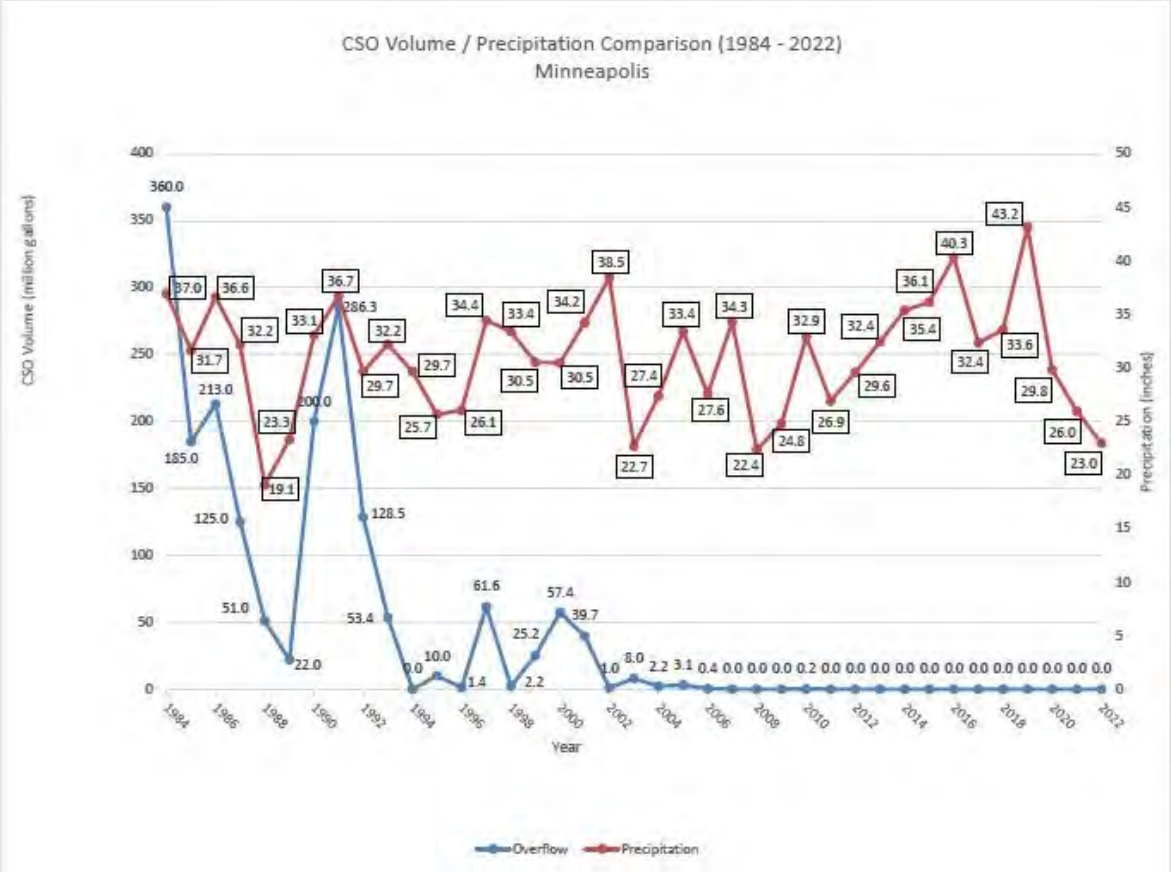
PROGRAM OBJECTIVE

The objective of this program is to prevent the unintentional discharge of untreated sewage from the Minneapolis sanitary sewer system at the regulators located on Metropolitan Council Environmental Services (MCES) Interceptors.

BACKGROUND

Transition to Integrated Infrastructure Management

In 2019**,** Minneapolis transitioned from a Combined Sewer Overflow (CSO) permit to an Integrated MS4 permit. This transition is possible because of the success of the efforts of the City of Minneapolis and MCES to reduce the risk of CSO events through storm drain separation, improvements to hydraulic performance and programs to reduce Inflow & Infiltration (I & I). The chart below shows a dramatic decrease in overflow volume from 1984-2022.



Storm drain separation can add significant flow to the stormwater system where capacity might be limited. Minneapolis is working to address stormwater capacity through the Flood Mitigation and Storm Tunnel Programs mentioned in this report. The addition of stormwater from separation projects has

contributed to capacity problems in these systems. The integrated permit allows the City to prioritize work and investment in projects to improve water quality and meet the requirements of the Clean Water Act.

Cooperation with Metropolitan Council Environmental Services (MCES)

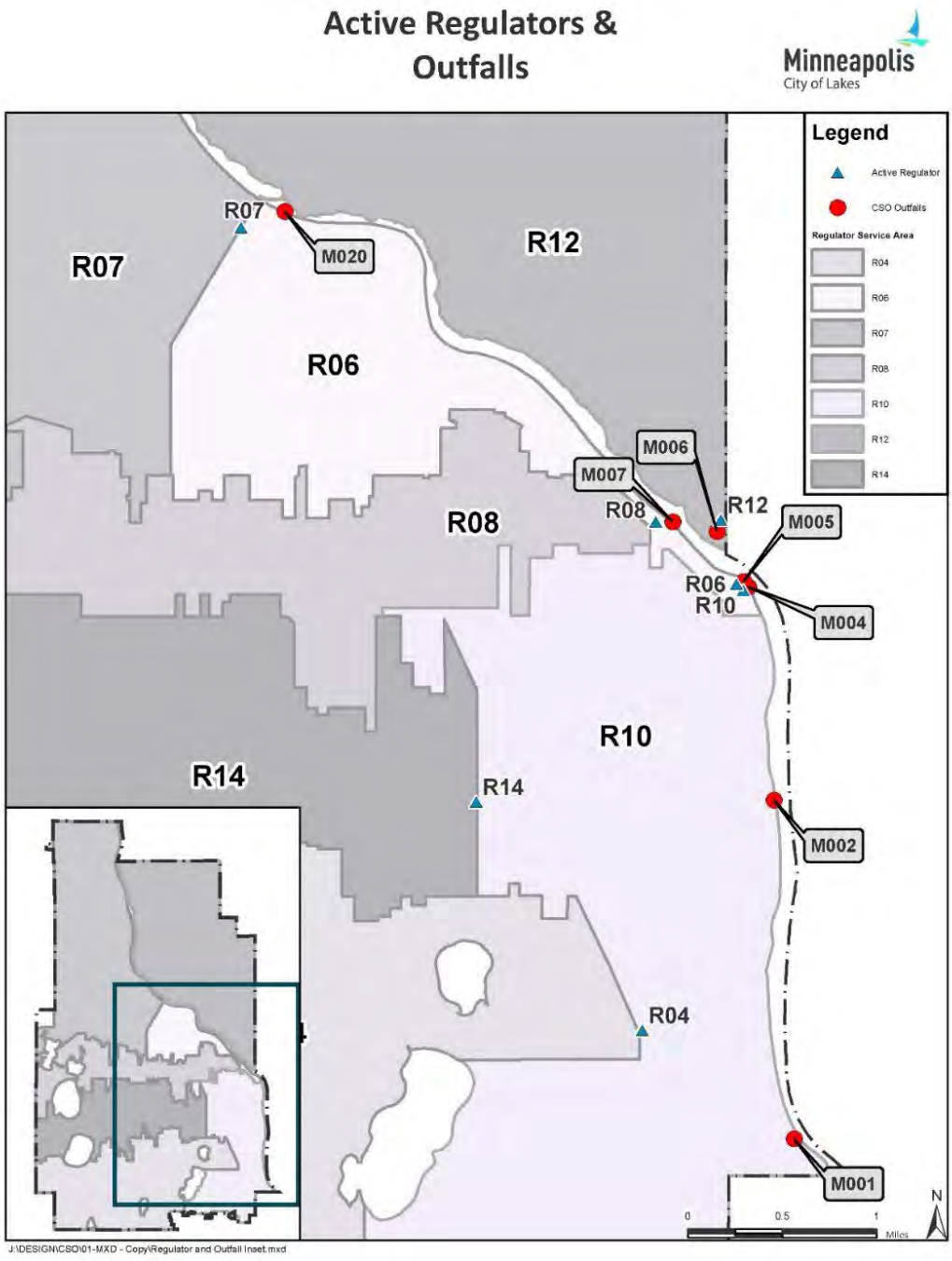
The sanitary sewer system from Minneapolis discharges to the Metropolitan Wastewater Plant, which is owned by the Metropolitan Council. Release events from the sanitary or combined sewer system can occur during periods of hydraulic overload caused by extraordinary rainfall or snowmelt events. Release events of this type occur at regulator structures owned by the Metropolitan Council. Each regulator has an associated stormwater outfall to the Mississippi River. Most of these stormwater outfalls are part of a larger storm water network owned and maintained by the City of Minneapolis. Outfalls that bypass directly from the interceptor system are owned by Metropolitan Council.

MCES and the City of Minneapolis entered into a cooperative agreement to coordinate ongoing responsibilities for release events with the termination of the joint CSO permit. The cooperative agreement was executed on March 27, 2018. It provides an inventory of regulators and outfalls and clarifies the commitments of each party to invest in, operate and maintain, and reduce Inflow & Infiltration (I & I) in each system. The following tables and map include the locations of active regulators and outfalls.

REGULATOR (Historic CSO Permit)	NAME AND LOCATION	X COORDINATE	Y COORDINATE
R04	Minnehaha Pkwy and 39th Ave S	543110.618	145799.774
R14	East 38th St and 26th Ave S	538476.110	152176.124
R10	Southwest Meters Diversion	545947.525	158095.063
R06	Northwest Meters Diversion	545745.715	158269.413
R12	East Meters Diversion	545309.317	160067.832
R08	East 26th St and Seabury Ave	543494.387	160010.412
R07	Portland Ave S and Washington Ave	531898.897	168232.605

MINNEAPOLIS NPDES OUTFALL	OUTFALL (Historic CSO Permit)	NAME AND LOCATION	X COORDINATE	Y COORDINATE
10-720	M001 (R04)	Minnehaha Tunnel	547368.436	142760.471
10-680	M002 (R14)	East 38th St	546801.334	152225.749
*	M004 (R10)	Southwest Interceptor	546085.529	158191.394
*	M005 (R06)	Northwest Interceptor	545955.556	158342.521
*	M006 (R12)	Eastside Interceptor	545208.244	159734.115
10-610	M007 (R08)	East 26th St	543969.672	160010.388
10-410	M020 (R07)	Chicago Ave S	533124.589	168689.291

**Owned by Metropolitan Council*


Active Regulators &
Outfalls
Minneapolis
City of Lakes
Legend
Active Regulator
CSO Outfalls
Regulator Service Area
R04
R06
R07
R08
R10
R12
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R07
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PROGRAM OVERVIEW

Studies, Investigations and Monitoring Activities

Studies, investigations, and monitoring activities provide information about inflow and infiltration in the sanitary sewer system. These efforts are accomplished through the I & I Program and Operation & Maintenance of the sanitary sewer system. Studies include flow monitoring, smoke testing of cross connection, manhole and sewer assessments. Since 2007, 838 miles of sewer smoke testing have been completed.

Capital Improvement Projects

Inflow from the public sewer system is addressed through projects included in the City of Minneapolis Capital Improvement Program, which includes:

- Combined Sewer Overflow Program – projects to reduce inflow by separating storm drains from the sanitary sewer system
- Inflow & Infiltration Removal Program – rehabilitation and repair projects to reduce I & I
- Sanitary Tunnel & Sewer Rehab Program – projects to repair and rehabilitate sanitary sewers, lift stations, tunnels, and access structures.

Since 2002, 200 storm drain separations projects have been identified for the Combined Sewer Overflow Program. Of the identified projects, 155 were completed, separating 627.1 acres of drainage from the sanitary sewer system. The Combined Sewer Overflow Program is a continuation of the 1980s program that separated 4,600 acres of drainage from the sewer system.

Inflow from the private sewer system is addressed through the Rainleader Disconnection Program. Since 2003, 7,532 of 7,606 rainleader violations have been resolved.

PREVIOUS YEAR ACTIVITIES AND ONGOING COORDINATION EFFORTS

Release Events from the Sanitary or Combined Sewer System

MCES continues to monitor overflow duration and volume at each of the regulators. In 2022, there were zero reported releases to the Mississippi River from the monitored regulators.

Studies, Investigations and Monitoring Activities

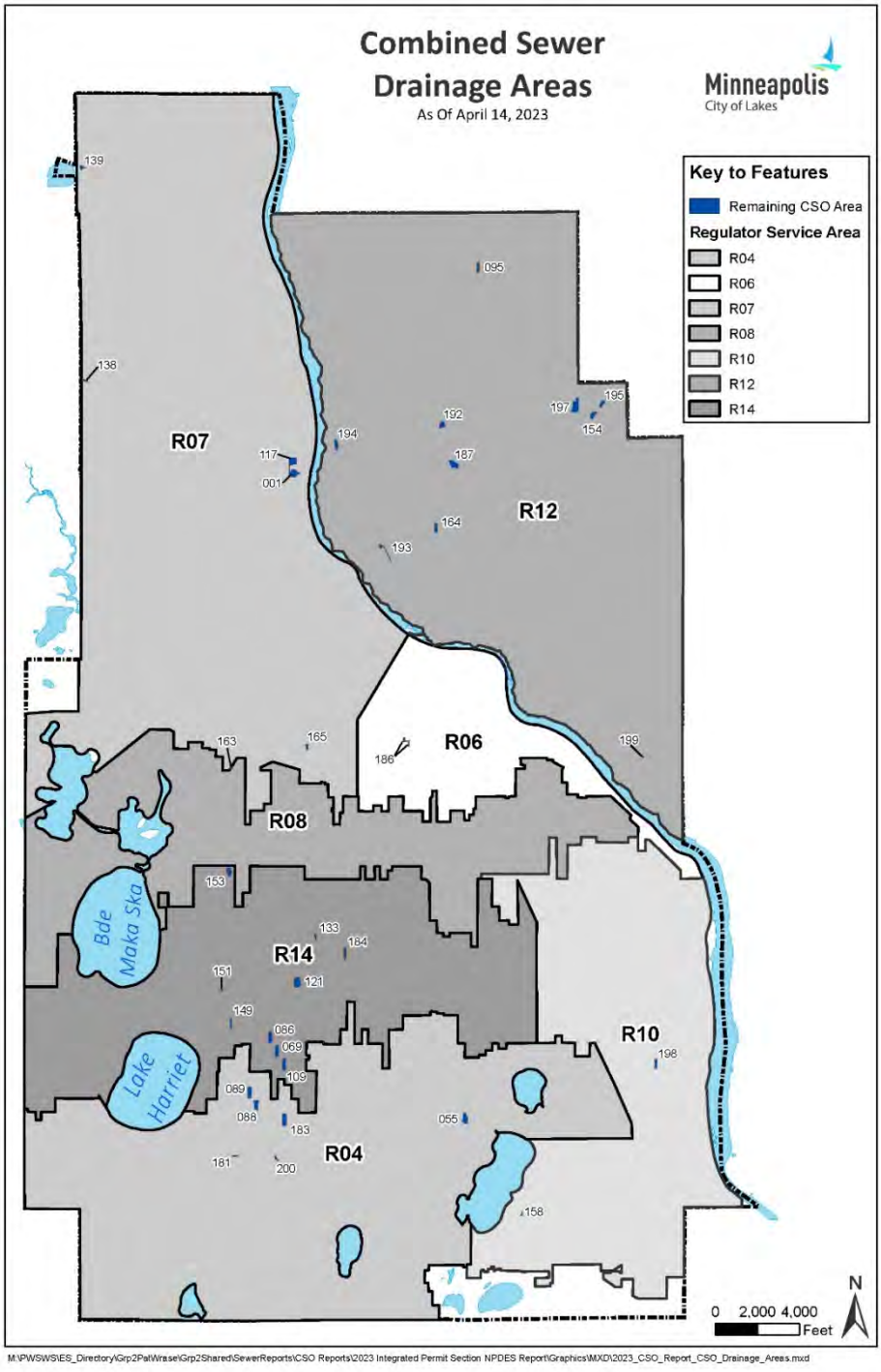
In 2022, Minneapolis continued to invest in studies, investigations, and monitoring activities aimed at identifying sources of inflow and infiltration. These efforts included the following:

- Flow Monitoring: 46 sanitary sewers and 5 rain gages were monitored in 2022. Sewer metering data was reviewed for rainfall dependent inflow and infiltration.
- Smoke Testing: 30.6 miles of sanitary sewer were smoke tested in 2022.
- Suspected Cross Connection Investigations: 3 investigations were completed in 2022. These include suspected connections identified from record drawings, GIS work and routine maintenance of the sewer system.

- Sewer Condition assessments: Televising and NASSCO condition assessments were completed on 8.9 miles of large diameter sanitary sewers, and 8.3 miles of small to mid diameter sanitary sewers

Identified Inflow to the Sanitary Sewer System

An inventory of the drainage areas and sewersheds of the remaining 34 combined sewer areas is provided in the following map and table:



CSO AREA ID	SEWER SHED	AREA [acres]	LOCATION
1	R07	2.77	22nd Ave N & 2nd St N
55	R04	2.45	Alley west of Cedar Ave & south of 47th St E
69	R14	2.29	Alley west of Pillsbury Ave & north of 43rd St W
86	R14	2.49	Alley east of Grand Ave & north of 42nd St W
88	R04	2.14	Alley west of Harriet Ave & south of 46th St W
89	R04	2.23	Alley west of Garfield Ave & north of 46th St W
95	R12	1.50	Alley north of 33rd Av NE & east of Tyler St NE
109	R14	2.17	Alley east of Pillsbury Ave & south of 43rd St W
117	R07	3.30	2nd St N & 23rd Ave N
121	R14	3.43	Alley north of W 38th St & east of Blaisdell Ave S
133	R14	0.76	Stevens Ave S & 35th St E
138	R07	0.47	Xerxes Ave N & Lowry Ave N
139	R07	0.76	Washburn Ave N & Osseo Rd
149	R14	1.25	Bryant Ave S & 40th St W
151	R14	0.30	38th St W & Dupont Ave S
153	R14	2.00	Alley south of 29th St W, east of Colfax Ave S
154	R12	1.51	Coolidge St NE & 19th Ave NE
158	R10	0.21	24th Ave S & 54½ St E
163	R08	0.23	Hennepin Ave S & Franklin Ave W
164	R12	1.35	Alley south of Spring St NE east of Madison St NE
165	R07	1.23	South of I-94 & 1st Ave S
181	R04	0.51	50th St W & Aldrich Ave S
183	R04	2.66	Alley south of 47th St W, west of Wentworth Ave S
184	R14	1.47	4th Ave S & 36th St E
186	R06	1.13	17th St E & 11th Ave S
187	R12	2.69	14th Ave NE & Van Buren St NE
192	R12	67	Monroe St NE & 19th Ave NE
193	R12	41	Main St NE & 4th Ave NE
194	R12	72	Marshall St NE & 16th Ave NE
195	R12	1.11	Coolidge St NE & 22nd Ave NE
197	R12	4.11	Stinson Blvd & 22nd Ave NE
198	R10	1.6	4300 block of 42nd Av S
199	R12	0.18	Arthur Ave SE & Franklin Ave SE
200	R04	0.55	Alley east of Gladstone Ave S & south of 50th St W

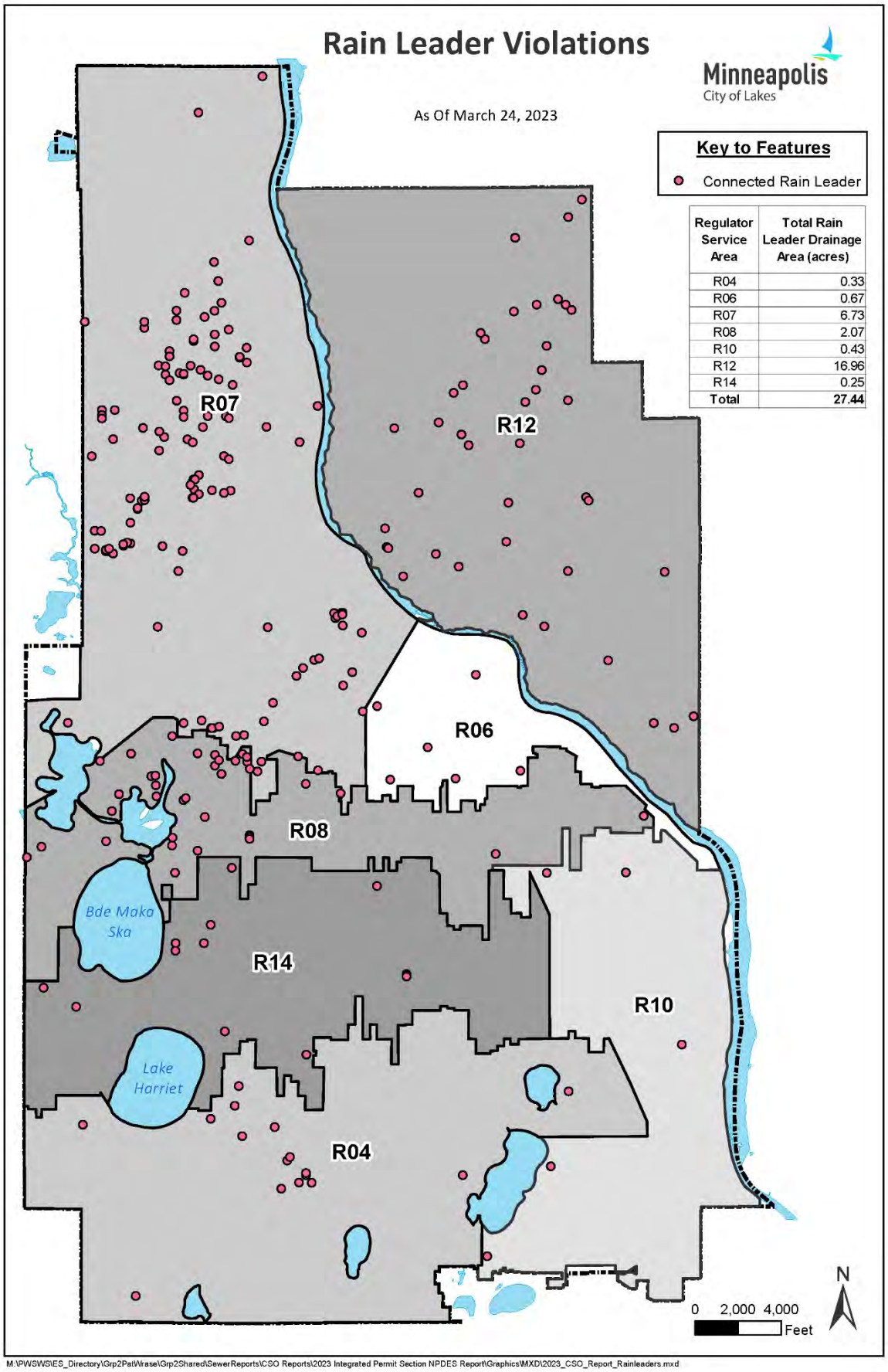
Combined Sewer Overflow / I & I Reduction Projects

One storm drain separation project was completed in 2022, eliminating 2.32 acres of direct drainage.

PROJECT NAME	PROJECT LOCATION	DRAINAGE AREA [acres]
CSO 172	33rd Ave N & Irving Ave N	2.32
	Total:	2.32

Rainleader Disconnection Program

Inflow from private property through roof drains, area drains, sump pumps, and open standpipes are tracked by parcel. The following map and table summarize parcels with open rainleader violations by sewershed. In 2022, 38 rainleaders were disconnected.



Regulator Service Area	Total Rain Leader Drainage Area (acres)
R04	0.33
R06	0.67
R07	6.73
R08	2.07
R10	0.43
R12	16.96
R14	0.25
Total	**27.44**

Combined Sewer Drainage Area Percentage

The drainage areas for the storm drain connections to sanitary sewer system and total sewershed areas are compared in the table below. The comparison shows these areas are a small fraction of the tributary areas to each regulator and associated outfall.

OUTFALL NUMBER	REGULATOR NUMBER	TOTAL SEWER SHED AREA [acres]	COMBINED SEWER DRAINAGE AREA [acres]	PERCENT COMBINED SEWER AREA [%]
1	R04	5,881.04	10.87	0.18
2	R14	3,973.96	16.41	0.41
4	R10	4,239.58	2.24	0.05
5	R06	1,459.49	1.81	0.12
6	R12	8,322.38	34.21	0.41
7	R08	3,019.47	2.3	0.08
20	R07	8,571.93	15.26	0.18
	Total	**35,467.85**	**83.09**	**0.23**

Sanitary Tunnel & Sewer Rehabilitation Program

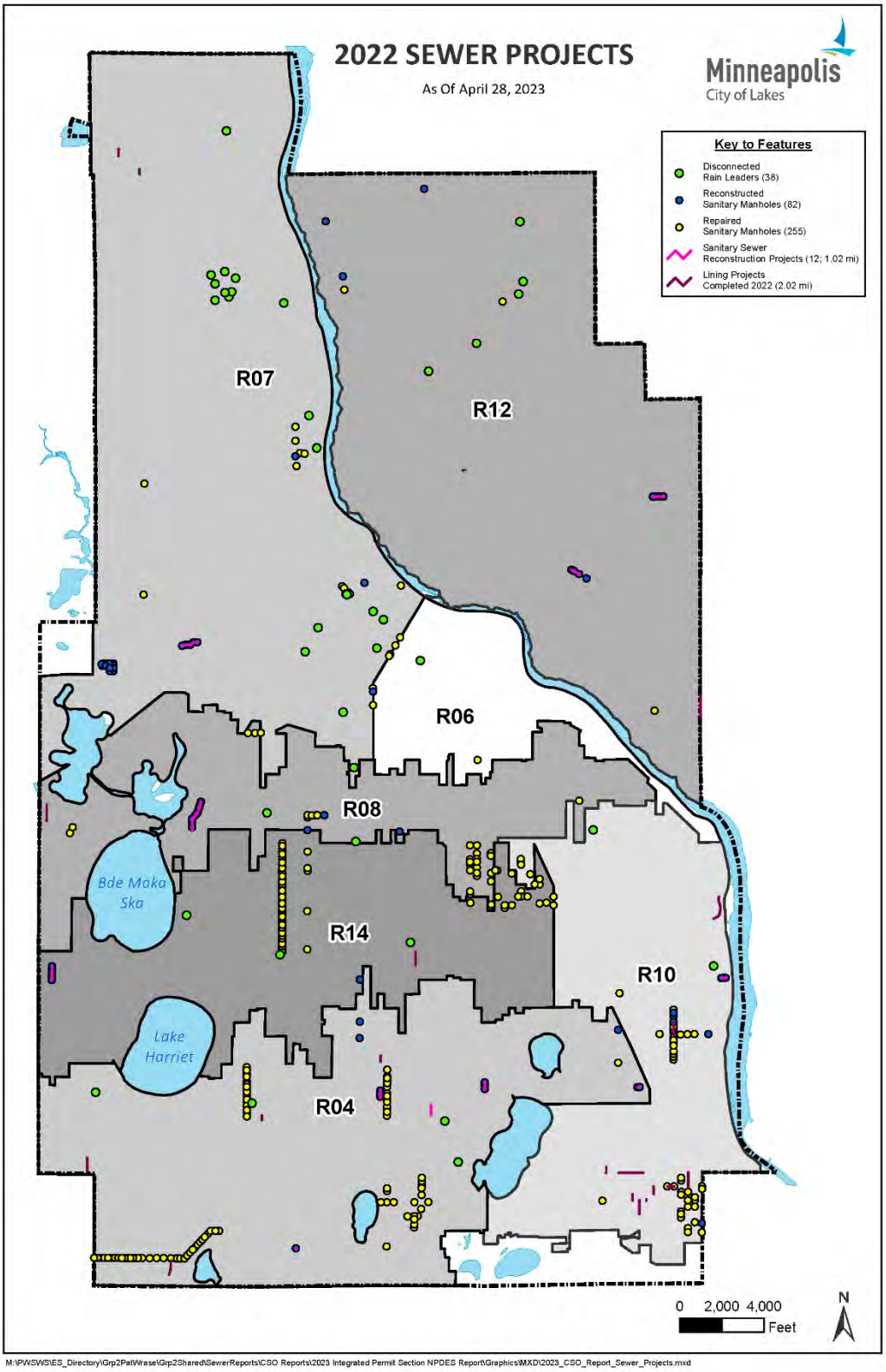
Sewer condition assessment data is used to develop this program. Repairs are prioritized based on structural and maintenance scores, paired with the likelihood and consequence of failure of each sewer. This condition assessment also determines if a sewer should be lined or reconstructed. Reconstruction is needed when sewers have collapsed or are deformed.

- Sewer Lining: Cured-In-Place-Pipe lining (CIPP) is a process to rehabilitate existing sewer pipes, due to age, cracks, or leaks. Sewers are lined by inserting a fiberglass sock that is inverted and cured to an outer pipe with steam. In 2022, 3.88 of sanitary sewer were lined.
- Sewer Reconstruction: Full replacement of a sewer through an open excavation or tunneling for mainline is utilized when that sewer can no longer be rehabilitated. In 2022, 12 sewer construction projects were completed, replacing 1.02 miles of sewer and 82 manholes.
- Manhole Repairs: Includes a range of repairs from mortar work to partial or full reconstruction of manholes. In 2022, 255 repairs to sanitary manholes were completed.

Summary of Annual Expenditures for Program Activities

Sanitary Rehab Projects – Repair and Replacement	$11,554,558
CIPP Lining Projects	$2,536,312
Sewer Separation Projects *	**$**0
Rainleader Disconnect Work	$139,000
Flow Metering	$477,077
Smoke Testing	$374,199
Other I & I Studies	$167,642
Total	**$15,248,788**

**Sewer separation project included in repairs total*


2022 SEWER PROJECTS
As Of April 28, 2023
Minneapolis
City of Lakes
Key to Features
Disconnected Rain Leaders (38)
Reconstructed Sanitary Manholes (82)
Repaired Sanitary Manholes (255)
Sanitary Sewer Reconstruction Projects (12; 1.02 mi)
Lining Projects Completed 2022 (2.02 mi)
R07
R12
R06
R08
Bde Maka Ska
R14
R10
Lake Harriet
R04
0 2,000 4,000
Feet
N
M:\PWSWS\ES_Directory\Grp2PatWrase\Grp2Shared\SewerReports\CSO Reports\2023 Integrated Permit Section NPDES Report\Graphics\MXD\2023_CSO_Report_Sewer_Projects.mxd

Collaboration with External Partners

MCES and the City of Minneapolis share a commitment to minimize the risk of overflows. A 5-year joint study of the regional wastewater system within Minneapolis was initiated in 2018. The purpose of the study, which is being led by MCES, is to develop a work plan to address hydraulic capacity and provide for continued system reliability and reduced risk of system overflow. The goals of the study include:

- Identify areas within Minneapolis with high rates of I & I
- Identify areas of the MCES system with highest risk of sanitary sewer overflow
- Identify areas where hydraulic capacity is limited in the MCES system
- Identify projects that could lower risks of sewer overflow and increase needed capacity, including consideration of regulator closures
- Reduce I & I contributions to wastewater flows to recover interceptor capacity
- Maximize conveyance and storage capacity in the existing interceptor system
- Identify areas of the City where insufficient storm sewer capacity affects MCES system capacity and reliability
- Develop feasible alternatives to reduce risk of sewer overflows, including evaluation of cost-effectiveness, for capital projects that address the hydraulic capacity, risk of sewer overflow, and sources of I & I identified in the study

Minneapolis also participates in the Metropolitan Councils I & I Surcharge Program. The Surcharge Program is aimed at reducing peak flows from I & I that would require the MCES to construct additional capacity.

APPENDIX A

APPENDIX A2	2022 WMMA / BCWMC / SCWMC EDUCATION & PUBLIC OUTRACH PROGRAM
APPENDIX A4	VEHICLE RELATED SPILLS SOP
APPENDIX A5	STORM DRAINAGE AREAS BY RECEIVING WATER BODY
APPENDIX A8	INTEGRATED PEST MANAGEMENT POLICY
APPENDIX A9	2022 UTILITY RATE RESOLUTION
APPENDIX A10	STORMWATER UTILITY FEE FAQ
APPENDIX A11	2022 GRIT CHAMBER REPORT
APPENDIX A12	MPRB 2022 STORMWATER MONITORING RESULTS & DATA ANALYSIS
APPENDIX A13	2022 FROG & TOAD REPORT

APPENDIX B

APPENDIX C

Appendix A

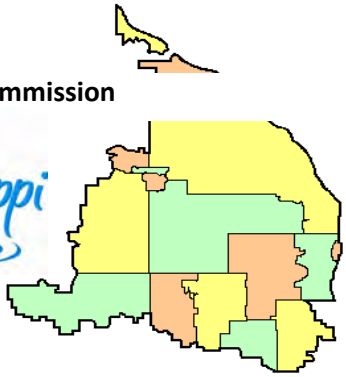
Minneapolis

City of Lakes

Shingle Creek Watershed Management Commission

West Mississippi Watershed Management Commission

3235 Fernbrook Lane N • Plymouth, MN 55447
Tel: 763.553.1144 • Fax: 763.553.9326
Email: judie@jass.biz • Website: www.shinglecreek.org



National Pollutant Discharge Elimination System (NPDES) Phase II Education and Public Outreach Program 2022 Annual Report

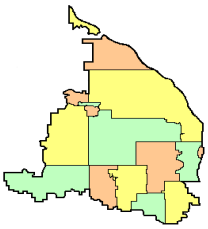
The Shingle Creek and West Mississippi Watershed Management Commissions conducted education and public outreach activities in 2022 in fulfillment of their Third Generation Watershed Management Plan Watershed Education and Public Outreach Program goals. Since 2020, many of these activities have been modified to meet in-person guidelines, were conducted virtually, or were curtailed altogether, due to the COVID-19 pandemic.

EDUCATION AND PUBLIC OUTREACH PROGRAM GOALS

1. All members of the community become knowledgeable about the water resources in the watersheds and take positive action to protect and improve them.
2. All members of the community have a general understanding of watersheds and water resources and the organizations that manage them.
3. All members of the community have a general understanding of the Impaired Waters in the watersheds and take positive actions to implement TMDL requirements.

The Commissions began development of their Fourth Generation Watershed Management Plan in the fall of 2021,and are currently in the final stages of reviewing and finalizing the draft plan. This report is in response to the following general education and outreach strategies identified by the Commissioners in their Third Generation Watershed Management Plan. More detailed educational goals by stakeholder groups may be found in Appendix E of the Third Generation Plan.

- Maintain an active Education and Outreach Committee (EPOC) with representatives from all member cities to advise the Commissions and to assist in program development and implementation
- Participate in the West Metro Water Alliance (WMWA) to promote interagency cooperation and collaboration, pool resources to undertake activities in a cost-effective manner, and promote consistency of messages
- Use the Commissions', member cities', and educational partners' websites and newsletters, and local newspapers and cable TV to share useful information to stakeholders on ways to improve water quality
- Prominently display the Commissions' logos on information and outreach items, project and interpretive signs, and other locations to increase visibility
- Provide opportunities for the public to learn about and participate in water quality activities
- Provide cost-share funding to assist in the installation of small BMPs and demonstration projects
- Educate elected and appointed officials and other decision-makers
- Enhance education opportunities for youth
- Each year review and modify or develop and prioritize education and outreach activities and strategies for the coming biennium



PROGRAM: WATERSHED PREP (PROTECTION, RESTORATION, EDUCATION, AND PREVENTION)

Audience: Fourth grade students, educators, families, the general public

Program Goals:

a. Engage elementary students in hands-on learning about the water cycle and how the built environment influences stormwater runoff and downstream water quality.
b. Provide general watershed and water quality education to citizens, lake associations, other civic organizations, youth groups, etc.

Educational Goals:

a. Have a general understanding of watersheds, water resources and the organizations that manage them.
b. Understand the connection between actions and water quality and water quantity.

Specific Activities to Reach Goals:

Watershed PREP is a program of the West Metro Water Alliance (WMWA), a consortium of four WMOs including the Shingle Creek and West Mississippi WMOs, and stands for **P**rotection, **R**estoration, **E**ducation, and **P**revention. 2022 marked the eleventh year of the program (the tenth year of actual classroom participation). An individual with a science education background serves as a contract educator to be shared between the member WMOs. (Her contract has been extended through August of 2023.) The focus of the program is two-fold - to present water resource-based classes to fourth grade students and to provide education and outreach to citizens, lake associations, civic organizations, youth groups, etc.

Fourth Grade Program. Three individual classes meeting State of Minnesota education standards have been developed. **Lesson 1*, What is a Watershed and Why do we care?,*** provides an overview of the watershed concept and is specific to each school's watershed. It describes threats to the watershed. **Lesson 2, *The Incredible Journey,*** describes the movement and status of water as it travels through the water cycle. **Lesson 3, *Stormwater Walk,*** investigates movement of surface water on school grounds.

Pilot classes on native plants were also provided at 17 classrooms in three schools in 2022.
Classroom Lesson #1 has been converted into a virtual, on-line learning experience. The lesson is posted to the WMWA website and to YouTube where it is available to educators, students, for home school or classroom viewing, and the general public. A link to the video has also been sent out to the teachers the educators have worked with in the classroom. It can be viewed at westmetrowateralliance.org/. The video has had 222 views as of December 31, 2022. The ultimate goal is to make this program available to all fourth graders in the four WMWA watersheds (Shingle Creek, West Mississippi, Bassett Creek, and Elm Creek), and to other schools as contracted. The program is offered to public, private, parochial, magnet and charter schools.

Community Education and Outreach. The PREP educator provides outreach at community and school events. Because of the nature of these events, it is usually difficult to keep a tally of the number of contacts made and citizens engaged. WMWA tabled at four outreach events – two in Plymouth and one each in Maple Grove and Robbinsdale - with a total reach of 760 people.

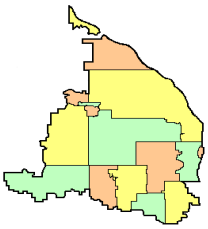


Table 1. Watershed PREP Program participation.

Year	# Classrooms	# Students	# and Type of Schools
Lesson 1			
2013	63	1,679	13 in six districts; one charter school; one parochial school
2014	116	3,469	30 in seven districts; one magnet school; one parochial school
2015	122	3,183	36 in nine districts; two charter schools; five parochial schools
2016	107	2,850	29 in seven districts, one charter school, 5 parochial schools
2017	121	3,249	12 in seven districts, one charter school, one parochial school
2018	143	3,593	32 in seven districts, one charter school, 2 parochial schools
2019	103	2,681	27 in six districts, two magnet schools; one parochial school
2020*	20	572	6 in four districts, two magnet schools
2021*	4	80	4 in one district
2022*	51	1,551	11 in 6 districts
Lesson 2			
2013	14	390	Three in three districts; one charter school; one parochial school
2014	22	645	Five in three districts
2015	27	859	Six in five districts
2016	20	524	Five in three districts, one parochial school
2017	38	1,072	Seven in three districts, one parochial school
2018	69	1,755	16 in five districts, one parochial school
2019	58	1,516	16 in five districts, one magnet school
2020*	7	172	2 in two districts
2021*			This lesson was not taught in 2021
2022*	55	1,557	10 in 6 districts, one immersion school

* Watershed PREP classes were limited by the constraints of the COVID-19 pandemic. In some cases, classes were conducted virtually.

Other Classes

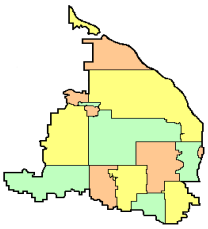
Date	School	District	City	Watershed	Classes	Students
6/1/2022	Woodland Elementary	Osseo	Brooklyn Park	W Miss	4	100
6/2022	Summer school (??)				3	74
11/16-18/2022	Robbinsdale MS	Robbinsdale	Robbinsdale	Bassett	10	242
				Totals	**17**	**416**

Events

Date	Event	Location		Watershed		Attendees
4/23/2022	Discover Plymouth	Plymouth		BC/EC/SC		160
5/7/2022	Arbor Day	Maple Grove		EC/SC		150
8/4/2022	Kids Fest	Plymouth		BC/EC/SC		400
9/25/2022	Elim Church	Robbinsdale		BC/SC		50
					Total	**760**

Evaluation:

The success of the Fourth Grade Program is evaluated by surveying students and teachers about the quality of the program, the learning that was observed, and the performance of the educators. Much of the feedback occurs during and right after the presentations in spontaneous comments.



PROGRAM: DISTRIBUTE EDUCATIONAL MATERIALS

Audience: Multiple

Program Goals:

a. Inform various stakeholders about the watershed organizations and their programs.
b. Provide useful information to a variety of stakeholders on priority topics.
c. Engage stakeholders and encourage positive, water-friendly behaviors.

Educational Goals:

a. Property owners maintain properties and best management practices (BMPs) to protect water resources.
b. Property owners adopt practices that protect water resources.
c. Stakeholders support and engage in protection and restoration efforts.

Specific Activities to Reach Goals:

Maintain Your Property the Watershed Friendly Way

This handbook is targeted to small businesses, multi-family housing properties, and common ownership communities such as homeowners' associations. It contains tips for specifying and hiring turf and snow maintenance contractors and includes checklists for BMP inspections. Electronic copies have been provided to Shingle Creek and West Mississippi cities for their use and to be displayed on their websites. The handbook also appears on the WMWA website. Print copies are available for distribution.

10 Things You Can Do

The very popular *10 things you can do to protect Minnesota's lakes, rivers, and streams* brochure was revised and updated in 2019 and was printed at no cost to WMWA members by the Hennepin County Department of Environment and Energy. New emphasis was placed on salting sparingly and on conserving water. The brochure can also be downloaded from the WMWA website.

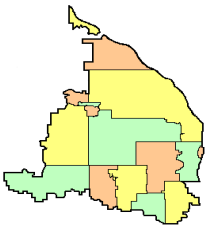
Roots Displays

In 2020 WMWA partnered with other groups to design and commission fabrication of a new, lighter-weight version of a popular interactive display highlighting native plants, comparing their long roots to the shorter-rooted turf grasses. The new displays are available for use by members and partners at educational and promotional events.

Press Releases and Newspaper Articles

Northwest Community Television currently provides services as CCX Media. CCX Media provides a Connected Community Experience for the northwest Hennepin County suburbs, offering daily televised news, and coverage of city council meetings, local events, and high school sports.

- Meadow Lake Almost Full Again After Winter Drawdown - CCX Media
- Metro briefs: Carp harvest aims to clean up Robbinsdale's Crystal Lake (startribune.com)
- Brook Gardens: Clean Water + Livability – Environmental Initiative Awards (environmental-initiative-awards.org)



Flyers

WMWA worked with the cities in the four watersheds to create or update informational flyers on three topics that are the focus of education and outreach in the 2022 General Stormwater Permit: pet waste and chloride management, and proper use and maintenance of water softeners.

Web Site

The Commissions maintained a joint web site, shinglecreek.org, which includes information about the watersheds, the Commissions, and the water resources in the watersheds. In 2022, the website had 2,509 unique visitors for a total of 5,916 page views. The most common landing page was the home page, followed by the Commission and TAC meeting materials pages and the project review pages. While the website is used mainly to access meeting and application materials, it is a good forum for sharing specific project information and gets decent traffic on other more general interest pages.

Social Media

The Commission established a Facebook page in 2016. In 2022 the Facebook page had a total of 183 likes 212 followers. In 2022 there were 57 posts resulting in 522 engagements.

Evaluation:

Evaluation measures are as noted above: number of brochures and handbooks distributed; number of website hits; social media engagement. The website uses Google Analytics to better track page views and unique visitors.

PROGRAM: PUBLIC OUTREACH

Audience: Residents, youth

Program Goals:

a. Provide opportunities for people of all ages to participate in hands-on activities to protect and improve waters.
b. Provide opportunities for people to learn about ways they can protect and improve waters.

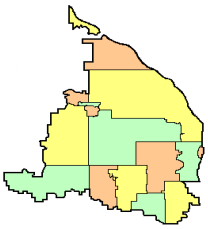
Educational Goals:

a. Maintain their properties and best management practices (BMPs) to protect water resources.
b. Adopt practices that protect water resources.
c. Support and engage in protection and restoration efforts.
d. Participate in volunteer activities.

Specific Activities to Reach Goals:

The *Pledge to Plant Campaign* was developed by Metro Blooms/Blue Thumb to encourage residents to replace impervious surface and turf grass with native plantings to benefit clean water by reducing stormwater runoff. The project includes the additional benefit of creating habitat for pollinators. In past years, the project was promoted in the Blue Thumb space at the State Fair where the public voted to name the campaign, *Pledge to Plant for Clean Water and Pollinators.*

Phase two of the project included a roll out of the Pledge campaign on the Metro Blooms and WMWA websites where citizens entered the square footage of their new plantings, creation of a *Pledge to Plant* banner to be displayed at events, and a social media campaign that began in 2016. COVID-19 limited in-person engagement, cancelling most area events in 2022.



At December 31, 2018, over 630 people had submitted the Pledge online covering over 417 acres. The total includes a handful of larger prairie restoration projects; the median pledge covers 250 square feet. Most of the Pledges came from the metro area, but Pledges have been received from more than 20 states. The *Pledge to Plant* campaign was also promoted during the Watershed PREP classes. Pledges were not tallied in the past four years.

Rain Garden Workshops

The Commissions partnered with WMWA to sponsor workshops through Metro Blooms. Metro Blooms is a non-profit organization whose mission is to promote and celebrate gardening, to beautify our communities and help heal and protect our environment.

Since the start of the pandemic, all workshops have been held virtually. In 2022workshops were conducted in Plymouth on April 14 with 40 participants; on April 26 in Champlin with 15 registrants; in Minneapolis on May 3 with 40 participants; and in Crystal on May 19 with 35 registrants.

Since the pandemic precluded holding in-person workshops, a new Blue Thumb training program has been implemented to teach participants skills in inspecting and caring for raingardens and other green infrastructure, all within a framework of eco-friendly landscaping practices. People who take part in the full session will receive a Sustainable Landcare Certificate. Participants in the program first receive Stormwater Basics, learning about watersheds and how water travels in our urban environment. They also learn how raingardens are built, how they work, and how to inspect them to ensure they function properly. An important part of the program is weedy plant identification and vegetation management (a major culprit of dysfunctional raingardens) to avoid the need for chemical use, when possible.

Lawns to Legumes

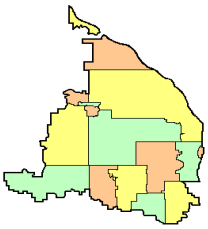
"Lawns to Legumes," a program for residents to seed their lawns with a bee lawn mix, targeting habitat for endangered species., is a collaboration between Blue Thumb and the Minnesota Board of Water and Soil Resources (BWSR), providing cost-share funding and other resources to help Minnesota residents establish pollinator habitat in their yards. The Commissions support this program with membership in Blue Thumb and links to their website. Funding is provided by the Environment and Natural Resources Trust Fund (ENRTF) and is targeted in priority areas to benefit the Rusty patched bumblebee and other at-risk species.

NPDES Permit Requirements

Continuing as members of the West Metro Water Alliance (WMWA), along with the Bassett Creek and Elm Creek WMOs, to develop materials in response to the new NPDES Permit Requirements, concentrating on educational content regarding pet waste, chlorides/salt, and illicit discharge. In 2022 WMWA and its member WMOs partnered with Hennepin County and the Richfield-Bloomington WMO to develop a shared education and outreach coordinator position funded by Watershed-Based Implementation Funding (WBIF) and WMWA special projects budget. This two-year limited duration position will focus on engaging with various stakeholder groups in the five watersheds on clean water and chloride management issues. WMWA also drafted a long-term vision for the organization to help transition from a part-time to a full-time coordinator.

Hennepin County Chloride Initiative (HCCI)

Eleven WMOs in Hennepin County previously elected to set aside 10 percent ($101,800) of the BWSR Watershed-Based Funding from the 2018 Pilot Program specifically for joint, countywide chloride



reduction initiatives. With about half of the grant funds remaining, HCCI extended the grant period through 2022 to continue work on the initiatives and maximize the grant funding.

Research was previously completed by HCCI and the U of M. This survey-based research identified that salting practices on private and commercial property are primarily driven by client demand and liability concerns, not a lack of knowledge from the winter maintenance contractor. For more information, you can read the full report at https://rpbcwd.org/application/files/9416/6196/2339/HCCI_-_Chloride_Barriers_Report_Feb_2020.pdf This research found that clients are mainly the ones driving the demand for oversalting. With the remaining grant funding, HCCI developed an outreach campaign framework and a toolbox of resources to help engage with property managers, HOA boards, and faith-based communities.

HCCI hired a marketing consultant who developed the *Low Salt, No Salt Minnesota* campaign in 2022. This outreach campaign is targeted toward homeowner associations, property managers, and communities of faith. These groups are accessible and tend to make decisions about winter maintenance for large areas including hiring of contractors. To better understand attitudes and other factors that affect willingness to adopt best salting practices, a series of market-research interviews were conducted with these groups. This research helped identify key messages about reducing chloride that best resonated with these groups. You can review the full market research report at https://rpbcwd.org/application/files/2316/5948/3817/HCCI_Research_Report_Draft_02_28_22.pdf for more details.

HCCI and the marketing firm worked together to develop a brand and design materials. The "*Low Salt, No Salt Minnesota"* campaign was developed to clear a path to safety, savings, and sustainability. The primary goal of the effort was to provide a toolbox of materials that local units of government (LGUs) may use during conversations with local residents and businesses about best practices related to winter maintenance. The toolbox materials include three videos, facilitator guide, PowerPoint presentation, recruitment letter, FAQ handout, winter maintenance plan templates, and a pledge form. All these resources are intended for LGUs to use and customize to fit their own local program and outreach efforts. The toolbox is located on the new Lot Salt No Salt website. https://rpbcwd.org/low-salt-no-salt

With the completion of this work, the HCCI grant funds are now expended, but there is interest from many HCCI participants in continuing collaboration in some format moving forward.

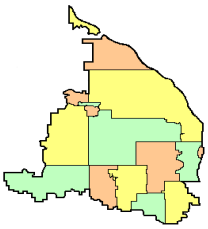
Shingle Creek Cleanup

The 22nd Annual Great Shingle Creek Cleanup was scheduled to be held during Earth Week, April 18-22, 2022. Each city sponsors its own cleanup. While most cities cancelled the event in 2022, others held abbreviated versions to limit in-person contact.

Volunteer Monitoring

The Commissions provide opportunities for high school students and adults to gain hands-on experience monitoring lakes, streams, and wetlands.

Lakes. Volunteer lake monitoring is performed through the Met Council's Citizen Assisted Lake Monitoring Program (CAMP). The Met Council provides the monitoring equipment and the laboratory work and data analysis while the Shingle Creek Commission staff recruit and train volunteers to perform sampling, collect the volunteers' water quality samples, and get them to the Met Council. Bass Lake and the three basins of Twin Lake were monitored by volunteers in 2022.



Streams. Routine stream macroinvertebrate monitoring in both watersheds is conducted by volunteers through Hennepin County's RiverWatch program. This program was initiated in 1995 to provide hands-on environmental education for high school and college students, promote river stewardship, and obtain water quality information on the streams in Hennepin County. Hennepin County coordinates student and adult volunteers who use the RiverWatch protocols to collect physical, chemical, and biological data to help determine the health of streams in the watershed. No sites on Shingle Creek were monitored as part of RiverWatch in 2022.

Wetlands. In past years, sites in the Shingle Creek and West Mississippi watersheds were monitored through the Hennepin County Environmental Services' Wetland Health Evaluation Program (WHEP). WHEP uses trained adult volunteers to monitor and assess wetland plant and animal communities in order to score monitored wetlands on an Index of Biological Integrity for macro-invertebrates and vegetation. This program has been discontinued and, thus, no sites were monitored in 2022.

Evaluation:
Evaluation of these programs is based on participation.

Program: Collaborative Efforts

Audience: Multiple

Program Goals:

a. Promote interagency cooperation and collaboration, pool resources to undertake activities in a cost-effective manner, and promote consistency of messages.
b. Share information and ideas with other partners.

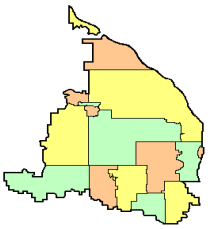
Educational Goals:

a. All people have a general understanding of watersheds, water resources and the organizations that manage them.
b. All people understand the connection between actions and water quality and water quantity.

Specific Activities to Reach Goals:

<u>WMWA</u>
The Commissions partner with the Bassett Creek WMO and the Elm Creek WMO and other interested parties as the West Metro Water Alliance (WMWA). Other participating parties have included other WMOs, Hennepin County Environment and Energy, and cities outside the four-watershed area. Each member watershed organization contributes funds to WMWA, which sponsors programs such as Watershed PREP, standardized brochures and booklets, and the *Planting for Clean Water Program.* WMWA publishes an annual report on its activities.

<u>Other Partnerships</u>
The Commissions are also members of:



WaterShed Partners, a coalition of agencies, educational institutions, WMOs, Watershed Districts, and Soil and Water Conservation Districts that coordinate water resources education and public outreach planning in the Metro area; and

Blue Thumb, a consortium of agencies and vendors partnering to increase outreach and awareness

Evaluation:
No specific evaluation of this programing has been completed.

Program: Continuing Education

Audience: Commissioners, Technical Advisory Committee (TAC)

Program Goals:

a. Effectively and efficiently manage the water resources in the watershed.
b. Increase awareness and knowledge of broader water resources issues and trends.

Educational Goals:

a. Commissioners and TAC understand watershed management, water quality and quantity conditions and issues in the watershed, regulatory requirements and the current standards and practices.

b. Commissioners and TAC aware of broader water management issues and trends in Minnesota and elsewhere.

Specific Activities to Reach Goals:

Staff Presentations
All of the Staff presentations were project-related, none were for "Commissioner education."

Guest Speakers
In February, Laura Scholl, Metro Blooms, Project Manager for the **Brooks Gardens Apartments** and Townhomes Community in Brooklyn Park, and her team presented a visual tour of the community. Together with the residents, they have created 4,282 square feet of new habitat and annually capture 1.17 million gallons of runoff, 2,000 lbs. of solids and 4.5 lbs. of total phosphorus. The Shingle Creek Commission provided $30,000 cost-share funding for the $86,107 project. At the April meeting, the Commission learned that the Brook Gardens project was awarded the Local Sustainability Impact award from the Environmental Initiative.

In July, James Fallon, Data Chief, Minnesota portion of Upper Midwest Water Science Center of the U.S. Geological Survey (USGS), presented an **update on USGS activities in Shingle Creek** and nearby watersheds. Links to the new USGS National Water Dashboard interactive map, https://dashboard.waterdata.usgs.gov/app/nwd/en/?aoi=default allow viewers to access *real-time* water data from over 13,500 stations nationwide.

Evaluation:

No specific evaluation of this programming has been completed.

CITY OF MINNEAPOLIS

Public Works - Street Maintenance Division

Standard Operating Procedure for Vehicle Related Spills (VRS)

March 28, 2022

The purpose of this document is to provide detailed standard operating procedures for the clean-up of VRS sites and the management/disposal of the impacted spill debris.

DEFINITION OF TERMS

9-1-1 : Minneapolis 9-1-1 Dispatch Center for Minneapolis Fire Department

FIS/MES: Fire Inspection Service / Minneapolis Environmental Service

MDO: Minnesota Duty Officer: The MDO Program provides a single answering point for local and state agencies to request state-level assistance for emergencies, serious accidents or incidents, or for reporting hazardous materials and petroleum spills. The MDO is available 24 hours per day, seven days per week.

MPCA: Minnesota Pollution Control Agency

MSMD: Minneapolis Street Maintenance Division (Minneapolis Public Works)

NRC: The National Response Center provided for assistance for non-vehicle related spills when a federal notification is required as directed by FIS/MES / MDO

SWLRT: Southwest Light Rail Transit

VRM: Vehicle Related Material: Petroleum products or other vehicle fluids that are inherently related to vehicular operations. This does not include materials that are being transported by a vehicle, unless the material is clearly labeled as being one of the aforementioned products.

VT: Volumetric Threshold: Minnesota has a 5-gallon minimum quantity for reporting petroleum spills. Spill of all other chemicals or materials in any quantity is reportable.

Spill debris: Sand that has been placed to absorb VRM and subsequently recovered for disposal.

Scenario 1: MPCA informs FIS/MES of VRM spill

The driver of a vehicle involved in a VRM spill is responsible for notifying the MDO at 651-649-5451. If the VT is exceeded, 9-1-1 should also be contacted. The MDO will notify the MPCA Emergency Response Unit and other agencies as required. If the spill is of the size and nature that the Emergency Response Unit determines should be handled by FIS/MES, then the MPCA will notify FIS/MES and provide them with incident details. The FIS/MES representative will decide based on the information how to proceed, and if appropriate (typically VRM in manageable quantities), they would contact MSMD.

The MSMD will dispatch personnel with appropriate equipment to apply sand to the spill site. The sand will be given time to absorb the sand and spill debris (VRM), and then will then be removed by a street sweeper. The VRM will then be deposited at the established disposal site in a designated VRM spill debris pile.

If a secondary sand application is required, the procedure would remain the same. Since the volume of the spill is greater than 5 gallons, a Hazardous Material Spill Data form (see below) must be completed as soon as possible (i.e. within 24 hours or the next business day). The completed form will be sent to the FIS/MES as soon as possible. A final report on the actions taken will be sent to the MPCA from FIS/MES.

Spill Debris Pile Management

Arrangements for disposal of the spill debris pile will be a collaborative effort by the MSMD and the City of Minneapolis Engineering Laboratory. After the spill debris pile reaches a size that becomes difficult to manage within the disposal container, the Engineering Laboratory will be contacted. The spill debris pile will be mechanically blended, and the Engineering Laboratory will select representative samples for laboratory analysis, as per MPCA regulations. The sampling and testing will require approximately one week to complete. After receiving the laboratory analysis data, the spill debris will be disposed of in a manner pre-approved by the MPCA and the Minneapolis Procurement Division.

Scenario II: The MSMD discovers a VRM spill

MSMD personnel discover a spill or are informed of a potential VRM spill from sources other than FIS/MES or MPCA. After arriving at the scene, they determine if the incident is a VRM spill, (possibly from a vehicle collision, a spill from a labeled container, etc.) and determine if the volume of the spill:

- **Less than 5 gallons**: If the spill quantity is judged to be less than 5 gallons, no contact with FIS/MES is necessary. Sand is applied and the procedure will continue as described in Scenario I (i.e. subsequent sanding/sweeping and stockpiling into the spill debris pile). A Hazardous Materials Spill Data form must be completed for record and documentation purposes and retained at MSMD, but is not to be sent to FIS/MES.

- **5 gallons or more**: If the MSMD representative determines that the spill volume is more than 5 gallons of VRM, MSMD must contact FIS/MES, the MDO and 9-1-1. The same procedures for clean up and reporting (using the Hazardous Material Spill Data form) as in Scenario I will be followed. This form must be sent to FIS/MES.

For both cases, the disposal of the VRM spill debris pile is as detailed in Scenario I.

Possible Modifications to Scenario I and II

Regulatory officials may require separate stockpiling of spill debris from specific spill incidents. Separate sampling and laboratory analysis will be required in these cases. This may also be requested to create a distinct tracking mechanism of a given spill of significant quantities and/or from a billable source. This scenario will be determined on a case-by-case basis. The process for disposal will be the same as previous scenarios.

Scenario III: The MSMD becomes aware of a spill of unknown material or composition, non-VRM Spill or material labeled as required reporting to the NRC for spill/release.

The MSMD shall contact 9-1-1, the MDO and FIS/MES before taking any action to clean up a spill of unknown composition. FIS/MES will manage these spills through their contracts with private entities specializing in these activities, or manage and coordinate the cleanup with the MSMD. If FIS/MES cannot be contacted, the MDO should be contacted immediately. FIS/MES and/or the MDO will determine if NRC is to be called.

ADDITIONAL INFORMATION

1. Currently the disposal site for spill debris is behind 198 Aldrich Ave N, Minneapolis MN 55405 during SWLRT construction. The material shall be placed in two 20 cubic-yard leak-proof roll-off containers with a counter-balanced lockable lids at the City site.

2. List of Potential Contacts:
   - **MN Duty Officer - Minnesota Department of Public Safety, Bureau of Criminal Apprehension (BCA):** 651-649-5451 (24 hours a day, 7 days a week)
   - **Fire Inspection Service / Minneapolis Environmental Service (FIS/MES)**

     Steve Kennedy: 612-685-8528 (work)
     Tom Frame: 612-685-8501 (work cell - call, leave a message or text)
     Emergency after-hours contacts:
     Tom Frame: 612-685-8501 (work-cell - call, leave a message or text)
   - **City of Minneapolis Engineering Laboratory**

     Paul Ogren: 612-673-2456
     Chris DeDene: 612-673-2823
   - **Minneapolis Street Maintenance Division (MSMD)**

     Steve Collin: 612-673-5720 (work)
     Gary Long, Jr: 612-673-5720 (work)
     After hours: 612-673-5720 (24 hours a day, 7 days a week)
   - **National Response Center** 800-424-8802

3. MSMD will be responsible for any billing of outside parties for services rendered for the clean-up and disposal of a spill event. The MSMD, FIS/MES and the Engineering Laboratory will develop a system for tracking costs associated with these operations. This information will be distributed as it becomes available.

4. This is a statement of policies and procedures, which will be revised and updated as new information becomes available.

CITY OF MINNEAPOLIS - STREET DEPARTMENT - OIL AND HAZARDOUS MATERIAL SPILL DATA FORM

DATE OF REPORT:	TIME OF REPORT:	NAME & ADDRESS OF RESPONSIBLE PARTY:
DATE OF INCIDENT:	TIME OF INCIDENT:	
POLLUTANT TYPE:	QUANTITY (Units):	CAUSE OF SPILL:
LOCATION:		NAME & NUMBER PERSON OF MAKING REPORT:
AREAS AFFECTED:		
PROBABLE FLOW DIRECTION:		PARTY REPORTING SPILL TO STREET DEPARMENT:
SOIL TYPE:		
WATERS POTENTIALLY AFFECTED:		**CONTACTED: Check and list name/number**
EFFECTS OF SPILL, WAS THERE IMMEDIATE DANGER TO HUMAN LIFE OR PROPERTY:		☐ MN Duty Officer 651-649-5451 ☐ 911 ☐ FIS ☐ MPCA ☐ FIRE ☐ POLICE ☐ OTHER
ACTION TAKEN:		PROXIMITY OF WELLS, SEWERS, BASEMENTS:
CONTAINMENT OF SPILL:		IS THIS FIRST NOTICE REGARDING SPILL?
CONTACT NAME & NUMBER FOR MORE INFORMATION:		

	CLEAN-UP TO DATE	**COMMENTS:**
USED	MATERIALS:	
	LOADERS:	
	TRUCKS:	
	PICK-UP TRUCKS:	
	MACHINE SWEEPERS:	
LABOR	FOREMAN HOURS:	
	MAINTENANCE CREW LEADER:	
	CONSTRUCTION LABORER:	
	OTHER:	

ORIGINAL TO: When job is completed, send original to Street Accounting with daily time when labor/equipment first used.

COPY TO: MPCA NOTIFICATION COPY - send (interoffice or email) to Steve Kennedy (Stephen.kennedy@minneapolismn.gov), FIS, PSC Room 401 and Environmental Services (envservicesinfo@minneapolismn.gov), PSC Room 414

STREET JOB #:	LABOR COST $	
	EQUIPMENT COST $	
	MATERIAL COST $	
	TOTAL COST $	

MINNESOTA DUTY OFFICER

BCA Operations Center

651-649-5451 **1-800-422-0798**

TDD: 1-800-627-3529 **Satellite Phone: 1-254-543-6490**

About the Duty Officer

The Minnesota Duty Officer Program provides a single answering point for local and state agencies to request state-level assistance for emergencies, serious accidents or incidents, or for reporting hazardous materials and petroleum spills. The duty officer is available 24 hours per day, seven days per week.

If there is an immediate threat to life or property, call 911 first.

When to Call the Duty Officer

Examples of incidents the duty officer can assist with include (but are not limited to):

- Natural disasters (tornado, fire, flood etc)
- Requests for National Guard
- Hazardous materials incidents
- Search and rescue assistance
- AMBER Alerts
- Requests for Civil Air Patrol
- Radiological incidents
- Aircraft accidents/incidents
- Pipeline leaks or breaks
- Substances released into the air

Agency Resources Available

State Agencies

- Department of Agriculture
- Department of Commerce
- Department of Education
- Department of Health
- Department of Human Services
- Department of Military Affairs
- Department of Natural Resources
- Department of Transportation
- Minnesota Office of Enterprise Technology
- Minnesota Pollution Control Agency
- Department of Public Safety
  - Bureau of Criminal Apprehension
  - Homeland Security and Emergency Management
  - Minnesota Joint Analysis Center
  - Minnesota State Patrol
  - Office of Pipeline Safety
  - State Fire Marshal
- Other state agencies not listed

Other Resources

- Minnesota Arson Hotline
- Local bomb squads
- Chemical assessment teams
- Emergency response teams
- Fire and rescue mutual aid
- Amateur radio (ARES/RACES)
- Minnesota voluntary organizations
- Fire chiefs assistance teams
- Search-and-rescue dogs
- Interagency Fire Center
- U.S. Air Force Search and Rescue Center

MINNESOTA DUTY OFFICER

BCA Operations Center

1-800-422-0798 **FAX: (651) 296-2300** **(651) 649-5451**

Satellite Phone: 1-254-543-6490

Emergency Notification

If there is a spill of a hazardous material or a petroleum product in Minnesota, you must call:

Local Authorities	**Call 9-1-1 FIRST,** *when there is a threat to life or property*
Minnesota Duty Officer	*If there is a public safety or environmental threat and/or if state agency notification for reportable spills is required*
The National Response Center 1-800-424-8802	*When a federal notification is required*

The following information (if available) will be requested by the Minnesota Duty Officer:

- Name of caller
- Date, time and location of the incident
- Telephone number for call-backs at the scene or facility
- Whether local officials (fire, police, sheriff) have been notified of incident

Additional information will be requested in the following special circumstances:

Making Notification of Spills/Incidents

- Materials and quantity involved in incident
- Incident location (physical address, intersection, etc.)
- Responsible party of incident (property/business owner)
- Telephone number of responsible party
- Any surface waters or sewers impacted
- What has happened and present situation

Requesting State Assistance for Incidents

- Type of assistance requested (informational, specialized team **a**ssets, etc).
- Name of requesting agency/facility
- Materials, quantity and personnel involved in the incident
- Whether all local, county, mutual aid resources been utilized

Storm Drainage Areas by Receiving Waterbody
(within Minneapolis city limits)

Receiving Water	Area (acres)	Impervious %	Population 2020	Agricultural	Airport or Airstrip	Golf Course	Industrial or Utility	Institutional	Major Railway	Mixed Use Commercial	Mixed Use Industrial	Mixed Use Residential	Multifamily	Office	Open Water	Park, Recreational, or Preserve	Retail and Other Commercial	Right of Way	Seasonal/Vacation	Single Family Attached	Single Family Detached	Undeveloped
Mississippi River	20,315.3	57.6%	273,735	0.1%	0.0%	0.9%	9.0%	7.5%	2.3%	0.8%	1.4%	0.9%	5.3%	1.4%	0.1%	7.0%	3.8%	28.8%	0.0%	6.0%	22.7%	1.9%
Minnehaha Creek	3,340.3	38.6%	34,508	0.0%	0.0%	0.7%	0.1%	5.8%	0.0%	0.0%	0.1%	0.2%	0.6%	0.2%	0.0%	13.7%	1.1%	24.3%	0.0%	3.1%	49.8%	0.2%
Bassett Creek	1,630.8	40.8%	17,165	0.1%	0.0%	0.0%	3.8%	3.4%	1.7%	0.1%	0.2%	0.5%	1.1%	0.9%	0.0%	19.9%	0.9%	24.1%	0.0%	4.5%	36.1%	2.8%
Shingle Creek	1,457.7	44.8%	12,662	0.0%	0.0%	0.0%	8.2%	13.1%	3.6%	0.1%	0.0%	0.1%	1.0%	0.1%	0.3%	12.0%	0.8%	19.6%	0.0%	2.5%	37.6%	1.0%
Lake Hiawatha	1,246.7	43.1%	16,617	0.0%	0.0%	10.4%	0.0%	3.1%	0.0%	0.0%	0.0%	0.4%	2.4%	0.1%	0.0%	4.2%	1.7%	27.4%	0.0%	6.7%	43.2%	0.1%
Bde Maka Ska	1,246.0	45.1%	17,273	0.0%	0.0%	12.5%	0.1%	2.6%	0.0%	0.4%	0.0%	1.7%	7.7%	0.6%	0.0%	14.3%	4.0%	20.5%	0.0%	6.7%	28.6%	0.4%
Lake Harriet	1,120.2	39.4%	10,662	0.0%	0.0%	0.0%	0.1%	16.5%	0.0%	0.1%	0.0%	0.3%	1.5%	0.0%	1.1%	12.4%	1.1%	20.3%	0.0%	3.6%	42.8%	0.1%
Lake of the Isles	769.8	44.6%	13,231	0.0%	0.0%	0.0%	0.0%	2.0%	0.0%	0.4%	0.0%	0.9%	9.8%	0.1%	0.3%	17.0%	2.7%	23.8%	0.0%	9.5%	33.1%	0.3%
Lake Nokomis	695.8	35.1%	6,180	0.0%	0.1%	0.0%	0.0%	2.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%	26.5%	0.3%	23.1%	0.0%	2.2%	45.3%	0.1%
Diamond Lake	670.9	48.3%	6,966	0.0%	0.0%	0.0%	7.2%	4.9%	0.0%	0.0%	0.6%	0.0%	4.1%	0.2%	0.0%	5.0%	3.5%	29.1%	0.0%	3.3%	41.4%	0.7%
Crystal Lake	421.3	41.8%	6,126	0.1%	0.0%	0.0%	0.0%	3.1%	0.0%	0.0%	0.0%	0.4%	1.4%	0.0%	0.0%	1.4%	0.7%	31.1%	0.0%	2.1%	58.9%	0.9%
Grass Lake	324.7	43.3%	2,928	0.0%	0.0%	0.0%	0.0%	3.1%	0.0%	0.0%	1.8%	0.0%	0.1%	0.0%	0.6%	4.7%	0.4%	29.9%	0.0%	2.1%	57.0%	0.1%
Powderhorn Lake	322.5	43.5%	6,356	0.1%	0.0%	0.0%	0.0%	4.0%	0.0%	0.1%	0.0%	0.3%	4.9%	0.3%	0.1%	17.5%	0.9%	27.4%	0.0%	15.0%	29.2%	0.3%
Cedar Lake	287.8	31.5%	1,804	0.0%	0.0%	0.0%	0.0%	1.9%	0.7%	0.0%	0.0%	0.0%	1.1%	0.1%	1.3%	37.6%	0.3%	18.7%	0.0%	3.8%	34.3%	0.2%
Taft Lake	131.7	42.3%	1,200	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	44.3%	0.0%	3.0%	52.1%	0.4%
Brownie Lake	93.9	40.3%	321	0.0%	0.0%	0.0%	0.0%	0.0%	3.1%	0.0%	0.0%	0.0%	0.2%	28.5%	0.6%	17.6%	0.3%	18.6%	0.0%	5.0%	26.1%	0.0%
Ryan Lake	60.6	42.2%	450	0.0%	0.0%	0.0%	2.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	10.9%	0.0%	28.3%	0.0%	0.3%	50.0%	7.3%
Richfield Lake	57.6	65.1%	372	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	0.0%	0.0%	0.0%	28.8%	40.4%	0.0%	0.0%	27.3%	0.0%
Spring Lake	50.0	32.6%	237	0.0%	0.0%	0.0%	0.0%	6.5%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.2%	37.6%	0.0%	15.7%	0.0%	10.4%	28.8%	0.4%
Wirth Lake	40.6	6.1%	32	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	99.8%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Birch Pond	38.8	10.3%	5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mother Lake	30.5	45.4%	140	0.0%	8.7%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	64.2%	0.0%	2.0%	23.3%	0.3%
Loring Pond	25.4	13.0%	26	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	99.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%
Silver Lake	25.0	41.3%	224	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	0.0%	0.0%	0.0%	2.2%	28.3%	0.0%	0.8%	65.3%	0.0%
Hart Lake	3.3	50.3%	18	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.2%	52.7%	0.0%	0.0%	24.8%	3.3%
Legion Lake	2.1	43.0%	22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	40.0%	0.0%	0.0%	60.0%	0.0%
	34,409.3	**50.9%**	**429,260**	**0.1%**	**0.0%**	**1.5%**	**6.0%**	**6.8%**	**1.6%**	**0.5%**	**0.9%**	**0.7%**	**4.1%**	**1.0%**	**0.2%**	**10.0%**	**2.9%**	**26.8%**	**0.0%**	**5.3%**	**30.3%**	**1.4%**

2022 NPDES Outfall Inspection Report

Facility ID	Outfall ID	Date Inspected	Water Body
568854	81-010	10/18/2022	Birch Pond
441049	51-010 (C)	10/7/2022	Brownie Lake
441286	51-020	10/7/2022	Brownie Lake
562704	51-030	10/14/2022	Brownie Lake
441661	52-010	10/18/2022	Cedar Lake
441591	52-030	10/18/2022	Cedar Lake
441582	52-050	10/18/2022	Cedar Lake
441584	52-070	10/18/2022	Cedar Lake
441647	52-075	10/18/2022	Cedar Lake
441646	52-080	10/18/2022	Cedar Lake
441599	52-100	10/18/2022	Cedar Lake
441648	52-110	10/18/2022	Cedar Lake
441663	52-120	10/18/2022	Cedar Lake
441052	63-010	10/20/2022	Crystal Lake
568856	85-020	10/18/2022	Ewing Av Unnamed Wetland
568857	85-030	10/18/2022	Ewing Av Unnamed Wetland
568855	85-010	10/18/2022	Ewing Av Unnamed Wetland
441640	83-012	10/27/2022	Grass Lake
441569	83-015	10/27/2022	Grass Lake
557085	83-020	10/27/2022	Grass Lake
441625	83-020 (B)	10/27/2022	Grass Lake
441719	83-030	10/27/2022	Grass Lake
441718	83-040	10/27/2022	Grass Lake
441626	83-060	10/27/2022	Grass Lake
441471	83-070	10/27/2022	Grass Lake
441641	83-080	10/27/2022	Grass Lake
441595	52-020	10/18/2022	Kenilworth Lagoon
540558	53-030 (B)	10/13/2022	Kenilworth Lagoon
441757	54-010	10/12/2022	Lagoon
441755	54-215	10/12/2022	Lagoon
441758	54-040	10/5/2022	Lake Bde Maka Ska
441586	54-050 (A)	10/5/2022	Lake Bde Maka Ska
441765	54-050 (B)	10/5/2022	Lake Bde Maka Ska
441585	54-052	10/5/2022	Lake Bde Maka Ska
441597	54-055 (A)	10/5/2022	Lake Bde Maka Ska
441596	54-060	10/5/2022	Lake Bde Maka Ska
441651	54-070	10/6/2022	Lake Bde Maka Ska
441763	54-080	10/6/2022	Lake Bde Maka Ska
441656	54-090	10/6/2022	Lake Bde Maka Ska
441764	54-095	10/6/2022	Lake Bde Maka Ska
441576	54-100	10/6/2022	Lake Bde Maka Ska
441655	54-110	10/6/2022	Lake Bde Maka Ska
441657	54-120	10/6/2022	Lake Bde Maka Ska
441594	54-140 (A)	10/6/2022	Lake Bde Maka Ska
441750	54-140 (B)	10/6/2022	Lake Bde Maka Ska

2022 NPDES Outfall Inspection Report

441751	54-150	10/5/2022	Lake Bde Maka Ska
441575	54-170	10/5/2022	Lake Bde Maka Ska
441753	54-190	10/5/2022	Lake Bde Maka Ska
441767	54-210	10/5/2022	Lake Bde Maka Ska
441654	54-015	10/5/2022	Lake Bde Maka Ska
441756	54-017	10/5/2022	Lake Bde Maka Ska
441653	54-180	10/5/2022	Lake Bde Maka Ska
441699	57-020	10/13/2022	Lake Harriet
441674	57-030	10/13/2022	Lake Harriet
441694	57-040	10/13/2022	Lake Harriet
441666	57-060	10/13/2022	Lake Harriet
441733	57-070	10/5/2022	Lake Harriet
441732	57-080	10/5/2022	Lake Harriet
441695	57-090 (A)	10/5/2022	Lake Harriet
441673	57-090 (B)	10/5/2022	Lake Harriet
441691	57-095	10/5/2022	Lake Harriet
441704	57-100 (A)	10/5/2022	Lake Harriet
441672	57-100 (B)	10/5/2022	Lake Harriet
441698	57-120	10/13/2022	Lake Harriet
441697	57-170	10/6/2022	Lake Harriet
599998		10/13/2022	Lake Harriet
441581	53-020	10/13/2022	Lake of the Isles
441600	53-040	10/13/2022	Lake of the Isles
441743	53-050	10/12/2022	Lake of the Isles
441601	53-060	10/12/2022	Lake of the Isles
441744	53-070	10/12/2022	Lake of the Isles
441745	53-080	10/12/2022	Lake of the Isles
441660	53-090	10/12/2022	Lake of the Isles
441083	53-100	10/12/2022	Lake of the Isles
441664	53-110	10/12/2022	Lake of the Isles
441659	53-120	10/6/2022	Lake of the Isles
441579	53-130	10/6/2022	Lake of the Isles
441746	53-140	10/6/2022	Lake of the Isles
441748	53-150	10/6/2022	Lake of the Isles
545847	53-160	10/6/2022	Lake of the Isles
441578	53-170	10/6/2022	Lake of the Isles
441652	53-180	10/13/2022	Lake of the Isles
441658	53-190	10/13/2022	Lake of the Isles
441400	70-520	10/6/2022	Minnehaha Creek
441431	70-525	10/6/2022	Minnehaha Creek
441378	70-530	10/6/2022	Minnehaha Creek
584337	70-535	10/6/2022	Minnehaha Creek
441380	70-540	10/6/2022	Minnehaha Creek
441387	70-545	10/6/2022	Minnehaha Creek
441388	70-550	10/6/2022	Minnehaha Creek
441443	70-555	10/6/2022	Minnehaha Creek
441381	70-560	10/6/2022	Minnehaha Creek

2022 NPDES Outfall Inspection Report

NA	NA	10/6/2022	Minnehaha Creek
441382	70-570	10/6/2022	Minnehaha Creek
441406	70-575	10/6/2022	Minnehaha Creek
441396	70-576	10/6/2022	Minnehaha Creek
NA	NA	10/6/2022	Minnehaha Creek
NA	NA	10/6/2022	Minnehaha Creek
441383	70-578	10/6/2022	Minnehaha Creek
NA	NA	10/6/2022	Minnehaha Creek
441374	70-579	10/6/2022	Minnehaha Creek
NA	NA	10/6/2022	Minnehaha Creek
441505	70-580	10/6/2022	Minnehaha Creek
540746	10-715	10/6/2022	Mississippi River
568860	82-030	10/13/2022	Powderhorn Park Pond
568858	82-010	10/13/2022	Powderhorn Park Pond
568862	82-015	10/13/2022	Powderhorn Park Pond
568861	82-020	10/13/2022	Powderhorn Park Pond
441227	21-010	10/26/2022	Ryan Lake
441071	20-140	10/6/2022	Shingle Creek
441256	20-150	10/6/2022	Shingle Creek
441075	20-180	10/6/2022	Shingle Creek
441056	20-190	10/6/2022	Shingle Creek
441780	20-200	10/6/2022	Shingle Creek
441259	20-210 (A)	10/6/2022	Shingle Creek
568852	43-010	10/13/2022	Spring Lake
568853	43-020	10/13/2022	Spring Lake
441050	42-030	10/19/2022	Wirth Lake

Integrated Pest Management (IPM)
Vegetation Management Policy

Goals

- Public safety
- Prevent erosion
- Protect and improve water quality and ecological function
- Slow water movement, hold or convert pollutants, and enhance infiltration and evapotranspiration
- Conduct preventive maintenance for longevity of infrastructure
- Control invasive species (non-native and selected native species) growth and prevent the production and dispersal of seed
- Create wildlife habitat
- Provide a neat appearance

Herbicide Policy

Public Works – Surface Water & Sewers Division (PW-SWS) has adopted the Integrated Pest Management (IPM) Policy formulated by the Minneapolis Park and Recreation Board (MPRB) to guide the use of herbicides on public lands under their charge. Herbicide use shall be limited as directed in this document.

Management Guidelines

- Perpetuate the original intent of the species planted. On many sites the original intent was to establish a simplified native grassland community. Plant species were selected for their resilience, habitat value and beauty. These plants shall be managed for their proliferation.

- Control [1] all species listed on the MN Noxious Weed List and comply with the MN Noxious Weed Law.

- Control invasive species in order to prevent Public Works sites from becoming sources of invasive weed seed that can disperse and establish on neighboring properties. An example is Canada thistle, which produces copious amounts of wind-blown seed that can easily become a problem on nearby public and private lands.

- Control aggressive species that if allowed to exist on a site will quickly spread and overwhelm the site. Aggressive native species include but are not limited to Canada goldenrod, sandbar willow and cottonwood. Non-native species include but are not limited to Canada thistle,

[1] **Control means manage or prevent the maturation and spread of propagating parts of noxious weeds from one area to another by a lawful method that does not cause unreasonable adverse effects on the environment.** *MN Noxious Weed Law 2013 MS 18.75-18.91*

crown vetch, bird's-foot trefoil, reed canary grass, *Phragmites australis*, spotted knapweed, smooth brome, sweet clover, purple loosestrife, Siberian elm, buckthorn, and Tartarian honeysuckle.

- Control non-native cattails (hybrid and narrow-leaf). They are common weeds in stormwater treatment facilities that may clog inlet and outlet structures, and they reduce habitat function. They are to be controlled when a threat to structures occurs, primarily by cutting the plant below the water surface. Where this is not feasible, as a last resort wick application of an aquatic-safe herbicide may be warranted, however herbicide application over water shall be avoided where practicable.

- Control fast growing, rank, woody species such as willow, Siberian elm and box elder that can quickly establish and form a thicket around stormwater treatment facilities or can cause a public safety issue.

- Control species that are allelopathic [2]. These include but are not limited to spotted knapweed, garlic mustard, and leafy spurge.

Invasive Plant Management Tools (where feasible, use mechanical means such as pulling and mowing, in order to minimize chemical usage)

- Herbaceous Plantings
    - Pulling (preferred)
    - Mowing (preferred)
        - Flail mowing
        - Spot mowing
    - Herbicide application
        - Spot spraying
        - Wick application
- Woody Plants
    - Pulling (preferred)
    - Cutting with stump application of herbicide

[2] **Allelopathic means to produce a chemical in plant tissue that releases into the soil and prevents the growth of most other species**

INTEGRATED PEST MANAGEMENT – ADAPTED FROM MINNEAPOLIS PARK AND RECREATION BOARD POLICY (Revised July 24, 2008)

Integrated Pest Management (IPM) is a pest management strategy that focuses on long-term prevention or suppression of pest problems with minimum impact on human health, the environment and non-target organisms. In most cases, IPM is directed at controlling pests that have an economic impact on commercial crops; however, in the instance of mosquito control, IPM is used to control nuisance and potentially dangerous mosquito populations. The guiding principles, management techniques and desired outcomes are similar in all cases.

A number of concepts are vital to the development of a specific IPM policy goal:

1. Integrated pest management is not a predetermined set of practices, but a gradual stepwise process for improving pest management.
2. Integrated pest management programs use a combination of approaches, incorporating the judicious application of ecological principles, management techniques, cultural and biological controls, and chemical methods to keep pests below levels where they cause economic damage. (Laws of MN, 1989)
3. Implementing an integrated pest management program requires a thorough understanding of pests, their life histories, their environmental requirements and natural enemies, as well as establishment of a regular, systematic program for surveying pests, their damage and/or other evidence of their presence. When treatments are necessary, the least toxic and most target-specific plant protectants are chosen.

The four basic principles of IPM used in designing a specific program are:

1. Know your key pests
2. Plan ahead
3. Scout regularly
4. Implement management practices

Selection of Management Strategies

Selection of Management Strategies pest management techniques include:

- Encouraging naturally occurring biological control
- Adoption of cultural practices that include cultivating, pruning, fertilizing, maintenance and irrigation practices that reduce pest problems
- Changing the habitat to make it incompatible with pest development
- Using alternate plant species or varieties that resist pests
- Limiting monoculture plantings where possible
- Selecting plant protectants with a lower toxicity to humans or non-target organisms

The criteria used for selecting management options include:

- Minimization of health risk to employees and users
- Minimization of environmental impacts (e.g. water quality, non-target organisms)
- Risk reduction (losses to pests, or nuisance/threshold level)
- Ease with which the technique can be incorporated into existing management approaches
- Cost-effectiveness of the management technique

Posting of Plant Protectant Applications

Comply with the City of Minneapolis ordinance regarding pesticide application (Minneapolis Code of Ordinances Title 11 [Health and Sanitation] Chapter 230 [Pesticide Control])

Recordkeeping

Produce and maintain the necessary records of all pest management activities as required by the Minnesota Department of Agriculture.

Weed Control in Upland Plantings, Shrub Beds and Around Trees

Plants are selected and/or replaced in order to provide disease and insect resistant plantings, thereby reducing plant protectant applications. Weeds listed on the State of Minnesota's Noxious Weed List must be controlled as per state statute, and species will be controlled as listed in Management Guidelines above. Mechanical or manual means of weed control will be tried first when feasible. However, due to global climate change, increasing populations of tap-rooted and other perennial weeds are being transported by birds and other means. Pulling or digging of these weeds is usually not successful. Spot spraying of these tap-rooted weeds with a low toxicity herbicide will help prevent flowering, seeding and further dispersal of these pest weeds. Appropriate mulching of upland plantings, shrub beds and around trees will help decrease the number of pest weeds. If control of annual weeds in pathway or mulched areas is required, the proper pre- or post-emergent low toxicity herbicide will be applied on a spot spray basis. Posting of any plant protectant applications will be carried out according to City ordinance.

Turf Areas

PW-SWS follows the Minneapolis Park and Recreation Board's General Parks and Parkways threshold of 50% for broadleaf and/or grassy weeds in turf areas. When it has been determined that this percentage has been reached or exceeded, the appropriate post emergent or pre-emergent herbicide may be applied, preferably on a spot spray basis. Selection of the appropriate herbicide of choice will be determined by trained staff after evaluating the site, the hazard rating of the product and the specific location.

Future Pest Control Issues

With changes in climate, the environment will be subject to many changes, including the arrival of additional pests within open space areas. Following IPM principles, the City will refer to updates in MPRB policy and practice and will work with the appropriate local, state or national agencies to determine the best control approach for these new pests.

Resolution No. 2022R-314 **City of Minneapolis** **File No. 2022-00788**

Author: Koski Committee: Budget Public Hearing: Dec 6, 2022

Passage: Dec 6, 2022 Publication: DEC 16 2022

RECORD OF COUNCIL VOTE				
COUNCIL MEMBER	AYE	NAY	ABSTAIN	ABSENT
Payne	X			
Wonsley	X			
Rainville	X			
Vetaw	X			
Ellison	X			
Osman	X			
Goodman	X			
Jenkins	X			
Chavez	X			
Chughtai	X			
Koski	X			
Johnson	X			
Palmisano	X			

MAYOR ACTION

☑ APPROVED ☐ VETOED

MAYOR

12/08/22
DATE

Certified an official action of the City Council

ATTEST:
CITY CLERK

Presented to Mayor: DEC 07 2022

Received from Mayor: DEC 08 2022

Designating the utility rates for water, sewer, stormwater, and solid waste services effective with water meters read on and after January 1, 2023.

Resolved by The City Council of The City of Minneapolis:

Water Rate
Charges commence when the street valve is turned on for water service.

1. Three dollars and seventy-two cents ($3.72) per one hundred (100) cubic feet for customers not otherwise mentioned.

2. Three dollars and eighty-seven cents ($3.87) per one hundred (100) cubic feet to municipalities, municipal corporations, villages and customers outside the corporate limits of the city where water service is furnished through individual customer meters.

3. Rates for municipalities, municipal corporations and villages, which are established by contract, shall continue the existing contract basis.

4. In addition to the above rates a fixed charge based on meter size will be billed each billing period or fraction thereof as follows:

Meter Size	Fixed Charge
5/8-inch	$7.50
3/4-inch	$11.25
1-inch	$18.75
1 1/2-inch	$37.50
2-inch	$60.00
3-inch	$120.00
4-inch	$187.50
6-inch	$375.00
8-inch	$600.00
10-inch	$862.50
12-inch	$2,475.00

5. The fixed charge for a property serviced by a combined fire/general water service line shall be based on the small side register of the combined meter, provided the volume of water used on the large side register does not exceed 45,000 gallons per year. The volume of water used on the large side register in the previous year will be used to establish the fixed rate in the current year.

   The fixed charge for a property serviced by a combined fire/general water service line shall be based on the large side register of the combined meter, when the volume of water used on the large side register exceeds 45,000 gallons per year. The volume of water used on the large side register in the previous year will be used to establish the fixed rate in the current year.

   The fixed charge for a combined fire/general water service line shall remain in place for the entire year.

6. Fees for the service and inspection of fire protection pipes and meters are based on the size of the service connection as follows:

Fire Line Pipe Size	Annual Fee (1/12 of the annual fee is billed monthly)
1½ inch pipe connection	$40.00
2-inch pipe connection	$40.00
3-inch pipe connection	$50.00
4-inch pipe connection	$70.00
6-inch pipe connection	$140.00

8-inch pipe connection	$230.00
10-inch pipe connection	$330.00
12-inch pipe connection	$950.00

Broken fire protection pipes valve seals will be resealed by the Minneapolis Water Treatment and Distribution Services Division.

7. Rates for other services and materials shall be as follows:

Description	Materials	Hourly Servicing Fee	Flat Rate
Replacement of lost or damaged equipment or installation of new equipment requested by the customer			
Water meters and communication devices			
• 5/8" Water meter	$50	$65	N/A
• 3/4" Water meter	$70	$65	N/A
• 1" Water meter	$90	$65	N/A
• 1 1/2" Water meter	$220	$65	N/A
• 2" Water meter	$290	$65	N/A
• 3" Water meter	$1,090	$65	N/A
• 4" Water meter	$1,470	$65	N/A
• 6" Water meter	$2,420	$65	N/A
• Encoder Receiver Transmitter (ERT)	$80	$65	N/A
Meter spacer and couplings or flanges as required for a meter set			
• 5/8" Water meter	$30	N/A	N/A
• 3/4" Water meter	$30	N/A	N/A
• 1" Water meter	$50	N/A	N/A
• 1 1/2" Water meter	$90	N/A	N/A
• 2" Water meter	$100	N/A	N/A
Services			
Remove or drain a water meter	N/A	$65	N/A
Water meter testing	N/A	$65	N/A
Water meter reading	N/A	$65	N/A
Posting water service turn-off - tenant notice	N/A	$65	N/A
Shut off valve flushing	N/A	$65	N/A
Water turn-on or turn-off	N/A	$65	N/A
Water main shut down			
• 12" and smaller	N/A	N/A	$540
• 16" and larger	N/A	N/A	$960
Water service line repair/replacement assistance	N/A	N/A	$50
Hydrant sanitation for potable water usage	N/A	N/A	$250

Penalties			
Missed appointment	N/A	N/A	$65
Water meter tampering	N/A	N/A	$200
Water meter bypass valve tampering	N/A	N/A	$500
Unauthorized water service turn-on	N/A	N/A	$500
Water system valve tampering	N/A	N/A	$500
Water emergency declaration violation	N/A	N/A	$90
Equipment Deposits			
Hydrant meter and backflow preventer	N/A	N/A	$3,200
Temporary water supply meter	N/A	N/A	$3,200
Permits			
Meter set	N/A	N/A	$50
Water hydrant	N/A	N/A	$350
Temporary water meter	N/A	N/A	$350
Small water main tap by size *			
• 5/8x3/4" (copper)	N/A	N/A	$250
• 3/4x3/4" (copper)	N/A	N/A	$250
• 3/4x1" (copper)	N/A	N/A	$250
• 1x1" (copper)	N/A	N/A	$280
• 1x1" (pitometer)	N/A	N/A	$270
• 1x1 1/4" (copper)	N/A	N/A	$290
Large water main tap by size			
• 6x4"	N/A	N/A	$1,980
• 6x6"	N/A	N/A	$2,200
• 8x4"	N/A	N/A	$2,100
• 8x6"	N/A	N/A	$2,240
• 8x8"	N/A	N/A	$2,950
• 10x4"	N/A	N/A	$2,050
• 10x6"	N/A	N/A	$2,490
• 10x8"	N/A	N/A	$2,810
• 12x4"	N/A	N/A	$2,200
• 12x6"	N/A	N/A	$2,460
• 12x8"	N/A	N/A	$3,150
• 12x12"	N/A	N/A	$5,070
• 16x4"	N/A	N/A	$2,330
• 16x6"	N/A	N/A	$2,520
• 16x8"	N/A	N/A	$3,330
• 16x12"	N/A	N/A	$5,370

• 24x4"	N/A	N/A	$2,990
• 24x6"	N/A	N/A	$3,210
• 24x8"	N/A	N/A	$4,080
• 24x12"	N/A	N/A	$6,150
• 30x4"	N/A	N/A	$3,490
• 30x6"	N/A	N/A	$3,600
• 30x8"	N/A	N/A	$4,680
• 36x4"	N/A	N/A	$4,420
• 36x6"	N/A	N/A	$4,530
• 36x8"	N/A	N/A	$5,080
• 36x12"	N/A	N/A	$7,790
Water main tap discontinue by size *			
• 6x2"	N/A	N/A	$1,090
• 6x3"	N/A	N/A	$1,090
• 6x4"	N/A	N/A	$1,850
• 6x6"	N/A	N/A	$1,850
• 8x2"	N/A	N/A	$1,110
• 8x3"	N/A	N/A	$1,110
• 8x4"	N/A	N/A	$1,130
• 8x6"	N/A	N/A	$1,990
• 8x8"	N/A	N/A	$1,990
• 10x2"	N/A	N/A	$1,130
• 10x3"	N/A	N/A	$1,130
• 10x4"	N/A	N/A	$1,130
• 12x2"	N/A	N/A	$1,130
• 12x3"	N/A	N/A	$1,130
• 12x4"	N/A	N/A	$1,130
• 12x6"	N/A	N/A	$1,130
• 12x8"	N/A	N/A	$1,780
• 12x12"	N/A	N/A	$1,780
• 16x2"	N/A	N/A	$1,810
• 16x3"	N/A	N/A	$1,810
• 16x4"	N/A	N/A	$1,810
• 16x6"	N/A	N/A	$1,810
• 16x8"	N/A	N/A	$2,820
• 16x12"	N/A	N/A	$2,940
• 16x16"	N/A	N/A	$2,940
• 24x2"	N/A	N/A	$3,490
• 24x3"	N/A	N/A	$3,490
• 24x4"	N/A	N/A	$3,490

• 24x6"	N/A	N/A	$3,490
• 24x8"	N/A	N/A	$3,490
• 24x12"	N/A	N/A	$3,490

** (a) When standard methods cannot be used, the City will charge an adjusted fee based on the specific circumstances (b) This schedule does not include inspection and excavation and pavement restoration fees; and (c) Modifications may cause additional costs to be incurred by the customer; and (d) Sales taxes will be added as applicable.*

Water/Sewer Service Line Repairs Assessment Duration

Property Owners choosing to finance water service line, sanitary service lateral, or storm sewer service lateral repairs and replacements by adding these costs to their property taxes as a special assessment may choose from the following payment terms:

	Payment terms available			
Special Assessment Amount:	5 years	10 years	15 years	20 years
Up to $10,000	Yes	Yes	No	No
Between $10,001 and $15,000	Yes	Yes	Yes	No
Greater than $15,001	Yes	Yes	Yes	Yes

Sanitary Sewer Rate

The sanitary sewer rates to be charged properties within and outside the City of Minneapolis that are served directly by the City of Minneapolis sewer system and that are all served either directly or indirectly by the sewage disposal system constructed, maintained and operated by the Metropolitan Council Environmental Services under and pursuant to Minnesota Statutes Sections 473.517, 473.519 and 473.521, Sub. 2, are hereby set as follows:

1. The sanitary sewer rate applicable inside the City of Minneapolis is five dollars and seventeen cents ($5.17) per one hundred (100) cubic feet.

2. In addition, a fixed charge based on water meter size will be billed each billing period or fraction thereof as follows:

Meter Size	Fixed Charge
5/8-inch	$7.80
3/4-inch	$11.70
1-inch	$19.50
1 1/2-inch	$39.00
2-inch	$62.40
3-inch	$124.80
4-inch	$195.00
6-inch	$390.00
8-inch	$624.00
10-inch	$897.00
12-inch	$2,574.00

3. The sanitary sewer rate applicable outside the City of Minneapolis for all sewage flow generated is five dollars and seventeen cents ($5.17) per one hundred (100) cubic feet when the City of

Minneapolis also provides water. In addition, the fixed charge sanitary sewer rate shall be based on meter size per section (b).

4. Sanitary sewer only service outside the City of Minneapolis shall be thirty-eight dollars and eighty-two cents ($38.82) per month.

5. The sanitary sewer charge for residential property not exceeding three (3) residential units shall be based on the volume of water used during the winter season which is defined as a four (4) month period between December 1 and March 31.

6. The sanitary sewer charge for residential property exceeding three (3) residential units and all other commercial and industrial property shall be based on measured sewage volume or the total water volume used during the billing period as is appropriate.

Stormwater Rate

The stormwater rate, subject to the provisions in Chapter 510, of the Minneapolis Code of Ordinances, is imposed on each and every Single-Family Residential Developed Property, Other Residential Developed Property, Non-Residential Developed Property, and Vacant Property, other than Exempt Property, and the owner and non-owner users, and is hereby set as follows:

1. The Equivalent Stormwater Unit (ESU) rate is fourteen dollars and forty-five cents ($14.45). The ESU measurement is 1,530 square feet of impervious area.

2. The stormwater rate imposed on Single-Family Residential Developed Properties shall be categorized into three tiers based on the estimated amount of impervious area as follows:

   High – Single-Family Residential Developed Property – greater than one thousand five hundred and seventy-eight (1,578) square feet of estimated impervious area. The ESU shall be 1.25 and the stormwater rate set at eighteen dollars and six cent ($18.06).

   Medium – Single-Family Residential Developed Property – equal to or greater than one thousand four hundred and eighty-five (1,485) square feet and less than or equal to one thousand five hundred and seventy-eight (1,578) square feet of estimated impervious area. The ESU shall be 1.00 and the stormwater rate set fourteen dollars and forty-five cents ($14.45).

   Low – Single-Family Residential Developed Property – less than one thousand four hundred and eighty-five (1,485) square feet of estimated impervious area. The ESU shall be .75 and the stormwater rate set at ten dollars and eighty-four cents ($10.84).

3. Stormwater charges for all other properties will be based on the following calculation:

   (Gross Lot Size in sq.ft. X Runoff Coefficient) ÷ 1,530 sq. ft.= # of ESU

   # of ESU X $ 14.45 = Monthly Fee

   The runoff coefficient assumed for each land use category is shown below.

Land Use	Coefficient Applied
Bar-Restaurant-Entertainment	.75
Car Sales Lot	.95

Cemetery w/Monuments	.20
Central Business District	1.00
Common Area	.20
Garage or Misc. Res.	.55
Group Residence	.75
Ind. Warehouse-Factory	.90
Industrial railway	.85
Institution-Sch.-Church	.90
Misc. Commercial	.90
Mixed Comm.-Res-Apt	.75
Multi-Family Apartment	.75
Multi-Family Residential	.40
Office	.91
Parks & Playgrounds	.20
Public Accommodations	.91
Retail	.91
Single Family Attached	.75
Single Family Detached	ESU
Sport or Rec. Facility	.60
Utility	.90
Vacant Land Use	.20
Vehicle Related Use	.90

Solid Waste Rate

1. The base unit charge shall be twenty-seven dollars and ninety-two cents ($27.92) per dwelling unit per month.

2. The cart disposal charge shall be two dollars ($2.00) per month for each small garbage cart assigned to a dwelling unit

3. The cart disposal charge shall be five dollars ($5.00) per month for each large garbage cart assigned to a dwelling unit.

Minneapolis
City of Lakes

Stormwater Frequently Asked Questions

Stormwater Utilities

1. **Why do we need to manage stormwater?**
   Stormwater runoff is water that flows over our yards, streets, sidewalks, buildings, parking lots and other surfaces due to rainfall, snowmelt or irrigation. Stormwater runoff flows into the nearest waters and eventually ends up in our local streams, ponds, lakes and rivers. Stormwater management is essential to maintain the quality of water entering the local water bodies, mitigate flooding and prevent property damage and comply with the federal Clean Water Act regulations.

2. **Why do we have a stormwater utility charge?**
   The Stormwater utility charge (stormwater charge) is used to operate and maintain the City's storm sewer system, mitigate flooding and to implement practices to protect the water quality of receiving waterbodies from the impact of urbanization. The City also has to comply with the regulatory requirements of the City's National Pollutant Discharge Elimination System (NPDES) and Municipal Separate Storm Sewer System (MS4) permit under the Clean Water Act.

3. **What is the basis of my stormwater charge?**
   The stormwater charge is based on the impervious area square footage that is calculated for your parcel.

4. **Is my stormwater charge based on my water consumption?**
   The stormwater charge is NOT based on your monthly Water Consumption. The stormwater charge is based on the ***Impervious Area*** calculated for your parcel.

5. **How is the impervious area calculated for my property?**
   Your property's Impervious Area is calculated as the total area (square feet) of any hard surface area, including buildings, any attached or detached structures, and paved or hardscaped areas, that either prevents or restricts the volume of stormwater, snowmelt or irrigation that can enter into the soil, and thereby causes water to run off the surface. Currently, the City measures impervious area for properties using one of these two approaches:

- **Actual Impervious Area Measurement:** For most of the properties in the City, the impervious area square footage of each property is determined based on actual measurements of impervious surface areas using multiple technologies including aerial imagery and Geographical Information System (GIS) tools.

- **Estimated Impervious Area Using Runoff Coefficient:** For some parcels, the impervious area square footage is estimated by multiplying the property's lot size square footage by a runoff coefficient factor that corresponds with the current land use of the property.

6. **How is the Stormwater rate defined?**
The monthly stormwater rate is defined as a monthly rate per Equivalent Stormwater Unit (i.e. $/ESU). Currently, one ESU equates to 1,530 square feet of impervious area. The City's Fiscal Year 2022 monthly ESU rate is $14.03/ESU. The ESU and ESU rate are established by ordinance or resolution of the City Council and may be amended from time to time by the City Council.

7. **How is the Stormwater Charge calculated?**
The monthly stormwater charge is determined as follows, depending on whether the property is a Single Family Residential Developed property or not.

a. **Single Family Residential Developed Property:** If the property belongs to the Single Family Residential Property class, then the monthly charge is determined as follows:

- First, the parcel's impervious area (in square feet) is determined using one of the two approaches described in Question 5.
- The property is then designated an impervious area tier of Low, Medium, or High, based on the impervious area that is determined for that property.
- The ESUs are then designated based on the impervious area tier.
- Table 1 presents the impervious area tiers, the corresponding range, and the ESUs for each tier.

Table 1: Residential ESUs

Class	Impervious Area (Square Feet)	ESU
Low	<1,485	0.75 ESU
Medium	1,485 to 1,578	1.00 ESU
High	>1,578	1.25 ESU

b. **All Other Properties:** For all other properties in the City, the monthly stormwater charge is determined as follows:

- First, the parcel's impervious area (in square feet) is determined using one of the two approaches described in Question 5.
- Second, the ESU is calculated by dividing the parcel's impervious area by 1,530 square feet
- Third, the Stormwater Charge is calculated by multiplying the ESU by the monthly ESU Rate of $14.03/ESU.

Example (Single Family Residential):

- The Impervious Area of a single family residential property is 2,000 Square Feet
- The designated tier for this property based on impervious area is "High" and therefore the designated ESU **= 1.25 ESUs**
- The calculated monthly stormwater charge is **1.25 X $14.03 = $17.54**

Example (Commercial):

Using an example of a Retail Store:

- The Impervious Area of the store 3,500 Square Feet
- The calculated ESU is **3,500 ÷ 1,530 = 2.29 ESUs**
- The calculated monthly stormwater charge is **2.29 X $14.03 = $32.13**

8. **My property is tax exempt. Do I still have to pay the stormwater charge?**
   Yes. The stormwater charge is a "User Fee" similar to your water, sewer, and electric charges. The stormwater charge is not a tax. Therefore, all tax-exempt parcels that are within the City limits have to pay the stormwater charge.

9. **If my stormwater runoff does not flow into the City's stormwater infrastructure, am I still charged the stormwater?**
   Yes. The City is responsible for the stormwater management of its MS4 system and for maintaining water quality in the surface waters under its NPDES permit. The City's stormwater management program benefits everyone in the City by protecting the City streets and properties from flooding, erosion, pollution problems, property damage, and protects the City and its local surface waters. It also enables the City to comply with federal and state regulatory requirements. Therefore, all parcels in the City are required to pay a stormwater charge.

10. **What can I do to reduce my stormwater charge?**
    You can reduce your stormwater charge by applying for the stormwater credits. Your property may be eligible for a stormwater credit if you apply for stormwater credits and provide supporting requisite documentation to affirm that stormwater runoff or a portion of it from your parcel is managed on-site, consistent with the City's requirements for a property area meeting the standard. See questions 11 through 18 for further information on stormwater credits.

Stormwater Credits

11. **Is there a credit for rain barrels?**
    No. Rain barrels are not considered sufficient stormwater Best Management Practices (BMPs).

12. **Can I get credit for installing a BMP (rain garden, etc.) in the Right-Of-Way/boulevard?**
    Yes. A credit may be granted to properties that employ structural or non-structural best management practices (BMPs) or other stormwater management practices on-site or, if permitted, in the right-of-way, that significantly reduce the quantity or significantly improve the quality of stormwater run-off from their property and the sidewalk that enters the system.

13. **Can I get credit for treating runoff from other properties with my BMP?**
    No. Credit cannot be given for treating impervious area on parcels that you do not own.

14. **If I lost a credit but am now compliant, can I get my credit back?**
    If you once were receiving a credit and that credit was removed, you must ensure that any BMP(s) with which you wish to apply for a credit are functioning properly, that you are compliant with Chapter 54 (if applicable), and that you are current on your utility bills.

    Once you have met these eligibility requirements, you are able to apply for a credit under current Program rules. Depending on when you originally had your credit, and the BMPs and/or area that you are now treating, your credit award amount may differ from the original credit amount.

15. **Can I get my credit awarded retroactively to the date I lost the credit?**
    No. Credit will not be awarded before the date of the most current, complete application submittal, including all necessary documents and materials. Any stormwater utility fees charged during the time a credit was not on the account will not be forgiven or reimbursed.

    Note that you must be current on your utility bill(s) to apply for a credit.

16. **How does the recertification process work?**
    Recertification is required every 5 years for commercial credits. Residential Credits are exempt from recertification.

    The City will send notification to properties that are due for recertification in the year the recertification is due. For more information on the recertification process, please see the recertification section of the Commercial Applicant Guide.

17. **Do credits transfer with ownership change?**
    No, credits do not transfer upon ownership change. However, you are able to apply for credit under current Program rules as long as you meet the requirements and supply all the necessary information and documents in your application submittal. For more information on commercial credit eligibility and application requirements, please see the Commercial Applicant Guide. For more information on

residential credit eligibility and application requirements, please see the webpage: **https://www.minneapolismn.gov/resident-services/utility-services/stormwater/residential-stormwater-credits/**

18. **What does it mean that a credit will apply to "property area meeting the standard"?**
"Property area meeting the standard" means that only those impervious areas on the property where the runoff is being treated in the way that meets the credit type will be eligible for a credit.
For example, if you treat 50% of your impervious area for above and beyond volume reduction credit of 20%, you will be eligible for a 20% credit on 50% of the impervious area on your property. If you treat 100% of the impervious area on your property for this credit type, you would be eligible for a 20% credit on 100% of the impervious area on your property.

Additional details on stormwater credits program are available on the City's website.

2022 CU YDs removed from Grit Chambers			
Grit Chamber ID	Location	Volume of Sediment Removed	Date Maintained / Inspected
GC 1	UPTON AVE N & 53RD AVE N	1	6/6/22
GC 2	RUSSELL AVE N & 53RD AVE N	1	6/7/22
GC 3	SHERIDAN AVE N, N OF 52ND AVE N	1	6/29/22
GC 4	RUSSELL AVE N NORTH OF 52ND AVE N	1	6/1/22
GC 5	PENN AVE N & 52ND AVE SO OF CREEK IN STREET	1	5/24/22
GC 6	PENN AVE N & 52ND AVE NO OF CREEK IN GRASS	1.5	7/1/22
GC 8	NEWTON AVE N & SHINGLE CREEK	1	6/1/22
GC 10	MORGAN AVE N & 51ST AVE N	1	6/22/22
GC 11	KNOX AVE N & 51ST AVE N	4	6/30/22
GC 14	JAMES AVE N NORTH OF 49TH AVE N	1	6/22/22
GC 18	MORGAN AVE N & CHESTNUT AVE	3	6/28/22
GC 21	LAKE OF THE ISLES PKWY & LOGAN AVE	10	7/15/22
GC 22	W 22ND ST & JAMES AVE S	5	7/8/22
GC 26	W LAKE ST & ALDRICH AVE S	2.5	9/29/22
GC 28	W 33RD ST & HOLMES AVE S	5	7/26/22
GC 30	YORK AVE S & W BDE MAKA SKA PKWY	2	6/14/22
GC 31	CHOWEN AVE S & W 41ST ST (LOG)	0	8/4/22
GC 35	E 44TH ST & OAKLAND AVE S	4	5/9/22
GC 36	E 46TH ST. & 31ST AVE S	4	8/4/22
GC 37	46TH AVE S & GODFREY RD (log)	0	8/8/22
GC 38	W 47TH ST & YORK AVE S	2	5/18/22
GC 42	QUEEN AVE S & LAKE HARRIET PKWY (LOG)	0	8/4/22
GC 43	16TH AVE S & E MINNEHAHA PKWY	0	8/5/22
GC 47	E 55TH ST & PORTLAND AVE S	2	5/17/22
GC 48	E 56TH ST & PORTLAND AVE S	5	6/29/22
GC 49	E 57TH ST & PORTLAND AVE S	2.5	7/1/22
GC 50	E 58TH ST & PORTLAND AVE S	3	7/6/22
GC 51	5912 GIRARD AVE S BETWEEN W 59TH ST & W 60TH ST	4	5/16/22
GC 52	E 59TH ST & 12TH AVE S	6	8/26/22

GC 53	GIRARD AVE S & W 60TH ST	2	5/11/22
GC 55	GRASS LAKE TERRACE BETWEEN GIRARD & JAMES	6	8/9/22
GC 56	GRASS LAKE SERVICE ROAD BEHIND #6035 JAMES AVE S	1.5	5/10/22
GC 57	GRASS LAKE SERVICE ROAD BEHIND #6077 JAMES AVE S	1	5/10/22
GC 58	GRASS LAKE SERVICE ROAD BEHIND #1416 W 61ST ST	1	5/9/22
GC 59	W 61ST ST & GRASS LAKE SERVICE ROAD	2	5/9/22
GC 60	IRVING AVE S & W 61ST ST Use two Vacs	46	8/11/22
GC 62	HIAWATHA PARK REFECTORY TURN-A-ROUND	2	7/25/22
GC 65	SOUTH TRANSFER STATION	4	7/25/22
GC 66	MAPLE PLACE & EAST ISLAND	2	7/11/22
GC 67	DELASALLE DRIVE & EAST ISLAND	1	7/8/22
GC 71	THE MALL & E LK OF THE ISLES Use two Vacs	0	8/8/22
GC 80	WOODLAWN BLVD & E 50TH ST	3	8/2/22
GC 81	WOODLAWN BLVD & E 53RD ST	4	10/28/22
GC 82	12TH AVE S & POWDERHORN TERRACE	4	10/6/22
GC 84	3421 15TH AVE S (180' W OF CL)	10	9/22/22
GC 85	3329 14TH AVE S	2	10/4/22
GC 86	13TH AVE S & E 35TH ST	10	10/19/22
GC 87	3318 10TH AVE S [LOG]	2.5	5/10/22
GC 90	10TH AVE. NO. & ALDRICH AVE. NO. (S.W.C.)	1	9/14/22
GC 91	SO. BD. VAN WHITE BLVD., 200' SO. OF 8TH AVE. NO.	0.5	9/30/22
GC 93	SO. BD. VAN WHITE BLVD, 250' SO. OF 10TH AVE. NO.	4.5	9/21/22
GC 95	WEST SIDE OF ALDRICH AVE. NO. & 9TH AVE. NO.	1	10/4/22
GC 96	8TH AVE. NO. & NO. BD. VAN WHITE BLVD. (N.E.C.)	5.5	9/12/22
GC 97	29TH AVE. & LOGAN AVE. - NO. STORM WATER DET. POND (E & W)	5	5/19/22
GC 110	W. CALHOUN PARKWAY (approx. 100' no. of richfield rd./e. blvd)	2	6/16/22
GC 111	RICHFIELD RD. (near w. corner of pkg. lot no. of wm berry pkwy)	2	6/16/22
GC 112	W. 36TH ST. (30' w. of e. calhoun pkwy.	4	6/22/22
GC 113	20' EAST OF VAN WHITE MEM. BLVD (N.B.) AND 5TH AVE N (1016 - 5TH AVE N)	2.5	9/28/22
GC 114	DUPONT AVE N AND 4TH AVE N	4	6/21/22
GC 120	VAN WHITE MEM. BLVD (S.B.) (160' SO. OF FREMONT AVE NO. ON THE E. SIDE OF TH	0.5	9/19/22
GC 121	50' NORTH (EAST SIDE) OF VAN WHITE MEM. BLVD (S.B.) AND FREMONT AVE N	1.5	9/19/22
GC 122	MINNEHAHA PARKWAY @ 39TH AVE S NORTH SIDE OF PKWY	4	8/25/22
GC 128	W. 27TH ST AND LAKE OF THE ISLES PKWY - no as-builts	3.5	7/20/22
GC 134	W 22ND ST @ E LAKE OF THE ISLES BLVD, no as-builts	8	7/12/22
GC 137	W 44TH ST & W LAKE HARRIET PKWY EAST (Installed on existing 54" Concrete Pipe	16	7/28/22
GC 138	EWING AVE S BETWEEN W. FRANKLIN AVE AND W 22ND ST - pending as-built info	1	11/17/22
GC 139	EWING AVE S @ W FRANKLIN AVE - pending as-built info	3	11/10/22
GC 142	18TH AVE S SOUTH OF E LAKE ST (Hennepin County const. Lake St.)	2	9/16/22

GC 143	LONGFELLOW AVE S SOUTH OF E LAKE ST (Hennepin County const. Lake St.) (added 9/	3	10/12/22
GC 144	31ST AVE S NORTH OF E LAKE ST (Hennepin County const.. Lake St.)POSTED	2.5	9/26/22
GC 145	CEDAR AVE S AND E MINNEHAHA PARKWAY (20' S. of S. curb line of Minnehaha & 5' W.	12	8/24/22
GC 146	4522 LAKE ST. (HENN CO)	1.5	9/15/22
GC 147	4610 LAKE ST. (HENN CO)	2.5	9/12/22
GC 148	42ND LAKE ST. (HENN CO)	4	8/31/22
GC 149	W 44TH ST AND ALDRICH AVE S (SWC) (added 11/28/07)	6	7/13/22
GC 151	DIAMOND LAKE ROAD & CLINTON AVE SO. HENN CO	0	8/5/22
GC 153	W. LAKE ST AND BLAISDELL AVE S (west curbline) Hennepin County	6	10/5/22
GC 154	W LAKE ST AND DUPONT AVE S (east of east curbline) Hennepin County	2	9/29/22
GC 155	PLEASANT AVE S AND LAKE ST (south of south curbline) Hennepin County	0	8/18/22
GC 156	W. 43RD ST & EAST LAKE HARRIET PARKWAY	3	7/21/22
GC 158	E. 61ST ST. & COLUMBUS AVE. S.	5	6/8/22
GC 166	THOMAS AVE S & DEAN PARKWAY (to Kenilworth lagoon)	6	6/23/22
GC 168	Dowling ave n. &between Newton ave and Morgan ave n. by alley	0.5	9/27/22
GC 169	DOWLING AVE N & between Oliver ave and Newton ave n by alley	0.5	9/27/22
GC 170	DOWLING AVE N @ Oliver Ave N	3	6/2/22
GC 171	NEWTON AVE N @ DOWLING AVE N sump MH	0.5	9/27/22
GC 175	2707 W. 54TH St. S. CDS Unit	3	9/26/22
	Total Volume Removed (CU. Yds)	310	

NPDES Report - APPENDIX A12

STORMWATER AND LAKE MONITORING RESULTS AND DATA ANALYSIS

Stormwater Quarterly Grab Monitoring

Background

As part of the federal Clean Water Act, the Minneapolis Park and Recreation Board (MPRB) and the City of Minneapolis are co-signatories on the Environmental Protection Agency (EPA) issued National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit.

The purpose of monitoring via grab samples is to characterize the seasonality of runoff for parameters that cannot be collected with flow-weighted composite auto-monitoring, such as pH, *Escherichia coli* (*E. coli*), and Fat Oil & Grease (FOG). Criteria for snowmelt sample collection was a winter snowpack melt event. Criteria for spring, summer, and fall grab sample collection was precipitation event greater than 0.10 inches separated by at least 8 hours from other rain events.

Grab samples can be challenging to obtain, as specific timing of rain events in relation to MPRB and lab working hours are required for samples to be collected and analyzed. Ideally, annual quarterly grab monitoring includes: two snowmelt grab samples, and one grab sample each in spring, summer, and fall, but the NPDES permit allows for some flexibility. Quarterly grab monitoring includes pH measurement, and samples analyzed for *E. coli*, NPDES water chemistry, and Fat Oil and Grease (FOG). The latest NPDES permit prescribed that if a FOG sample was measured greater than 15 mg/L at a site, then that site would continue to be monitored throughout the permit cycle. Chemistry parameters that are analyzed from grab samples, as required by the NPDES permit, are outlined in **Table 1**.

Grab sampling characterizes a point in time of a snowmelt or rain event. The first snowmelt event in a year usually has higher pollutant concentration than subsequent snowmelt events. The chemical concentrations can change over time throughout a storm event. The beginning of a storm mobilizes fine particles and FOG material previously deposited on hard surfaces. Chemical concentrations can have significant variance between storm events depending on the amount of time since the last precipitation event, since pollutants accumulate on surfaces over time and then wash off into the stormwater in a melt or rain event.

In 2018 quarterly grabs were collected at sites representing different land use types. Following snowmelt, grab samples could not be collected from the Pershing Park land use site since auto-monitoring equipment was housed in an equipment box on top of the manhole. 61st and Lyndale had extensive road construction and stormwater pipe replacement beginning mid-summer 2018 that restricted access.

In 2019, the grab sites were changed to the Powderhorn Lake Inlets: SE, S, and W and the 24th Ave. SE & Elm St. SE infiltration basin Inlets: N and S. The intention was to continue sampling at

the 61st and Lyndale site, but the site was again inaccessible due to the stormwater pipe replacement and road reconstruction.

In 2020, the quarterly grab sites were, 24th Ave. SE & Elm St. SE Inlets: N and S and Powderhorn Inlets: SE, S, and W, and 61st & Lyndale. In 2020, after several unsuccessful attempts were made, the Powderhorn Inlet N site was deemed physically inaccessible to collect grab samples and dropped from grab sampling. 2020 was also a difficult year for field work with the COVID-19 pandemic restrictions.

In 2021, grab sampling was completed at six sites: Powderhorn Lake Inlets SE, S, and W, 24th Ave SE & Elm St SE infiltration basin N and S Inlets, and 61st and Lyndale were all successfully monitored.

In 2022, grab sampling included seven sites: three Powderhorn Lake inlets (W, SE, S), three Camden Pond inlets (NNW, SNW, SW), and the 61st & Lyndale site. Due to a lack of significant storm events in the summer and fall, a grab sample in the fall quarter was unable to be collected in 2022.

Methods

Grab Sampling

Grab samples are either taken directly from the stormsewer using a modified pool skimmer pole, or from an aliquot taken in a clean white 5-gallon bucket on a rope. If adequate flow was not available to use the pool skimmer, a bucket was lowered into the stormsewer and rinsed once before the aliquot was collected to be sub-sampled. Per sampling protocol, water chemistry sample bottles were rinsed once before sample collection, whereas E. coli and FOG sample bottles were not rinsed. FOG samples were collected in amber glass bottles. All samples were stored and transported on ice to the laboratory, along with a field blank. **Table 1** shows the NPDES chemistry parameters analyzed in each sample collected. **Table 2** shows approved methods, reporting limits, and holding times for each parameter as reported by the contract laboratory Instrumental Research, Inc. (IRI).

The pH measurement was analyzed in the field by a hand-held Oakton pH meter. The pH meter was calibrated prior to sampling using a two-point calibration. The pH probe was rinsed with the grab sample water and the pH measurement was taken directly from the aliquot.

Samples could only be collected when enough flow was present to collect a sample. Snowmelt and precipitation needed to produce at least 1 inch of stage in the pipe to be sampled. Precipitation events needed to be greater than 0.10 inches to produce enough runoff.

Staff attempted to collect quarterly rainfall grab samples on 4/5/22, 5/25/22, 6/13/22, and 8/12/22, shown in **Table 5**. Not every site was able to be sampled with each precipitation event due to limited flow, but samples were collected wherever possible. Additionally, parameters with short holding times such as *E. coli* could not be analyzed if collected on Friday due to lab hours.

All FOG, NPDES water chemistry, and *E. coli* samples were analyzed at Instrumental Research Incorporated (IRI) Laboratory in Fridley, Minnesota. Metals (copper, zinc, lead) and DOC samples were analyzed by Pace Laboratory in Minneapolis, MN.

Table 1. Chemistry parameters monitored as required by the NPDES permit.

Parameter	Abbreviation	Units
Chemical Oxygen Demand	COD	mg/L
Dissolved Organic Carbon	DOC	mg/L
Chloride, Total	Cl	mg/L
***E. coli* (*Escherichia Coli*)**	*E. coli*	MPN/100mL
Hardness	Hard	mg/L
Copper, Total	Cu	µg/L
Lead, Total	Pb	µg/L
Zinc, Total	Zn	µg/L
Nitrite/Nitrate, Total as N	NOx	mg/L
Total Nitrogen	TN	mg/L
pH	pH	standard unit
Fat, Oil, and Grease (FOG)	FOG	mg/L
Phosphorus, Total Dissolved	TDP	mg/L
Phosphorus, Total	TP	mg/L
Solids, Total Dissolved	TDS	mg/L
Solids, Total Suspended	TSS	mg/L
Solids, Volatile Suspended	VSS	mg/L

Table 2. Analysis method, reporting limit, and holding times for parameters used by Instrumental Research, Inc. and Pace Laboratories.

Parameter	Method	Reporting Limit	Holding Times
COD	SM 5220-D	20 mg/L	28 days
DOC	SM 5310-C-00	1.5 mg/L	28 days
Chloride, Total	SM 4500-Cl^- B	2.0 mg/L	28 days
***E. coli* (*Escherichia Coli*)**	SM 9223 B	1 MPN per 100mL	< 24hrs
Hardness	SM 2350 C	5.0 mg/L	6 months
Copper, Total	EPA 200.8	1 µg/L	6 months
Lead, Total	EPA 200.8	0.10 µg/L	6 months
Zinc, Total	EPA 200.7	20 µg/L	6 months
Nitrite/Nitrate, Total as N	SM 4500-NO_3 E	0.030 mg/L	28 days
Total Nitrogen	Alk Persulfate Oxidation method	0.500 mg/L	28 days
pH	SM 4500 H^+ B	0.01 units	15 minutes
Fat, Oil, and Grease (FOG)	EPA 1664A	5.0 mg/L	28 days
Phosphorus, Total Dissolved	SM 4500-PE	0.010 mg/L	48 hours
Phosphorus, Total	SM 4500-PE	0.010 mg/L	48 hours
Solids, Total Dissolved	SM 2540 C	5.0 mg/L	7 days
Solids, Total Suspended	SM 2540 D	1.0 mg/L	7 days
Solids, Volatile Suspended	EPA 160.4	2.0 mg/L	7 days

The 2022 grab sampling sites are shown below. **Figure 1** shows the location of the 61st & Lyndale site. **Figure 2** shows the location of the Camden Pond inlets NNW, SNW, and SW. **Figure 3** shows the location of the Powderhorn Lake inlets SE, S, and W. **Table 3** shows the land use and drainage area for the sample sites at the Powderhorn inlets and 61st & Lyndale. **Table 4** shows land use and drainage area for the sample sites at the Camden inlets.

Figure 1. Aerial photo of the 61st & Lyndale stormwater quarterly grab monitoring site.

Figure 2. Aerial photo of Camden Pond quarterly grab monitoring sites.

Figure 3. Aerial photo of the Powderhorn quarterly grab monitoring sites.

Table 3. The Powderhorn Inlets SE, S, and W and 61st & Lyndale sites monitored quarterly for NPDES chemistry, *E. coli*, pH, and FOG, and their location, main land uses, drainage area, and percent impervious surfaces.

Site ID	Powderhorn Inlet SE	Powderhorn Inlet S	Powderhorn Inlet W	61st & Lyndale
Location	3421 15th Ave S.	13th Ave S. and E. 35th St.	3318 19th Ave S.	335 ft. east of 61st St and Harriet Ave S.
Land Use	Single family, right of way, park	Single family, right of way	Single family, right of way	Commercial/Industrial
Drainage Area	70.0 acres	81.2 acres	99.4 acres	34.9 acres
Imperviousness	43.9%	49.6%	51.5%	

Table 4. The Camden Central Pond sites monitored for NPDES chemistry, *E. coli*, pH, and FOG.

Site ID	Camden Inlet N NW	Camden Inlet S NW	Camden Inlet SW
Location	4200 Newton Ave N	4200 Newton Ave N	4200 Newton Ave N
Land Use	Single family, right of way	Single family, right of way	Institutional (cemetery)
Drainage Area	10.5	127.8	84.2
Imperviousness	48.0%	44.9%	9.9%

Quality Assurance Practices

A variety of quality assurance and quality control measures (QA/QC) were taken to ensure defensible data. Ten percent of the samples were laboratory quality assurance samples e.g., duplicates, spikes. A field blank was also generated for each sampling trip and was analyzed for all NPDES chemical parameters. Field blanks consisted of deionized water which accompanied samples from the field sites to the analytical laboratory. All field blank parameters were below the reporting limits in 2022. As part of the overall QA/QC program, blind monthly performance samples of known concentration were made for all monitored parameters and delivered to IRI. If any parameter failed that month all the data for that parameter were flagged for the entire month. COD was flagged during the month of February in 2022. This was the only flag of the year.

Field measurements were recorded on a Field Measurement Form in the 2022 Field Logbook. Electronic data from the laboratory were forwarded to the MPRB in preformatted Excel spreadsheets via email. Electronic data from the laboratory were checked and passed laboratory quality assurance procedures. Protocols for data validity followed those defined in the Stormwater Monitoring Program Manual (MPRB, 2001). For statistical calculations data reported below the reporting limit, the reporting limit value was divided in half.

Manual transcription of data was minimized to reduce error introduction. A minimum of 10% of the final data were checked by hand against the raw data sent by the laboratory to ensure there were no errors entering, manipulating, or transferring the data.

A Chain of Custody form accompanied each set of sample bottles delivered to the lab. Each sample container was labeled indicating the date and time of collection, the site location, and the field personnel initials. Samples were transported to the laboratory on ice in a cooler. The time that each grab sample was collected was recorded onto field sheets. A complete description of methods can be found in the Stormwater Monitoring Program Manual (MPRB, 2001). Common statistics were calculated using Microsoft Excel.

Results and Discussion

The 2022 quarterly snowmelt grab sampling schedule is shown in **Table 5**. The 2022 quarterly precipitation grab sampling schedule and associated precipitation event data are shown in **Table 6**.

The 2022 quarterly grab chemistry results are shown in **Table 7**. The snowmelt samples show higher concentrations of pollutants as compared to summer samples, but lower *E. coli* levels. This is expected, as snowmelt is the release of 4-5 months of deposition and debris from the watershed. *E. coli* bacteria do not survive well in colder conditions, and thus tend to have low concentrations in snowmelt samples. The pH ranged from 5.5 to 9.0 across all quarterly grab monitoring sites, with most sites generally measuring a higher pH in the colder months.

The 2022 grab sampling statistics of geometric mean, arithmetic mean, maximum value, minimum value, standard deviation, number of samples collected, and the standard deviation are shown in **Table 8**. The geometric mean is a valuable statistic as it accurately controls for data with a wide range and outliers.

Table 5. Snowmelt grab samples collected in 2022. X = Grab sample collected. NS = No sample collected.

Date	Powderhorn In S	Powderhorn In SE	Powderhorn In W	Camden In N NW	Camden In S NW	Camden In SW	61s & Lyndale
2/28/22	X	X	X	NS	X	X	X
3/8/22	X	X	X	NS	NS	NS	X
3/15/22	NS	NS	NS	X	X	X	NS
4/5/22	X	X	X	NS	X	NS	X

Table 6. Stormwater precipitation grab samples collected with event precipitation data in 2022. Pow = Powderhorn. X = Grab sample collected. NS = No sample collected.

Start Date	Start Time	End Date	End Time	Rain (inches)	Duration (hours)	Intensity (in/hour)	Hours since last rain	Pow In S	Pow In SE	Pow In W	Camden In N NW	Camden In S NW	Camden In SW	61st & Lyndale
4/5/2022	10:15	04/06/22	5:45	0.5	19.5	0.026	34.75	X	X	X	NS	X	NS	X
5/25/2022	0:30	05/25/22	12:45	0.58	12.25	0.047	113.25	X	X	X	X	X	X	NS
6/13/2022	6:00	06/13/22	8:00	0.10	2.00	0.045	47.75	NS	NS	NS	NS	NS	NS	X
8/12/2022	4:00	08/12/22	7:45	0.84	3.75	0.224	101	X	X	X	X	X	X	X

Table 7. The 2022 quarterly NPDES chemistry grab sample results. COD data in red were flagged as a result of the blind monthly performance checks with the contracting laboratory. FOG data in red are greater than 15 mg/L.

Date	Time	Site Location	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. coli MPN	pH Unit	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
2/28	12:25	61st & Lyndale	1.50	0.26	0.23	13.0	6.75	7398	410	760	98	11854	521.0	24.7	10	9.90	68.1	17.9	356	31.3
2/28	14:00	Camden In S NW	0.75	0.12	0.08	4.33	0.38	3799	120	182.5	67	6190	333.3	26.1	323	7.90	43.8	18.4	262	18.0
2/28	14:15	Camden In SW	0.16	0.10	0.08	2.18	0.93	38.0	252	18.8	6.6	363	<20.0	<5.0	73	8.30	8.40	0.81	<20.0	9.0
2/28	13:30	Pow In S	1.02	0.20	0.12	6.42	0.49	3599	110	254	106	5653	448.5	35.5	583	7.90	48.7	37.3	320	26.3
2/28	12:50	Pow In SE	1.05	0.15	0.08	7.09	0.39	5098	160	258	106	8132	454.6	33.7	97	8.20	46.0	37.5	322	32.1
2/28	13:15	Pow In W	1.17	0.09	0.07	5.23	0.14	3699	160	472	250	5875	520.6	43.5	97	8.10	65.5	65.6	460	26.2
3/8	12:05	61st & Lyndale	0.68	0.15	0.04	2.76	0.88	1949	164	303	40	3144	198.5	9.9	24	9.80	28.4	6.7	155	12.6
3/8	12:40	Pow In S	0.64	0.19	<0.003	6.38	0.45	1450	76	116	48	2443	236.1	14.3	190	8.10	31.0	17.3	133	19.4
3/8	12:30	Pow In SE	0.58	0.17	0.05	5.74	0.36	2199	120	78	33	3813	236.1	15.8	137	8.30	25.0	11	112	22.0
3/8	12:55	Pow In W	0.55	0.21	0.18	4.42	0.51	1300	84	67	29	2043	170.8	7.6	83.9	8.00	20.9	10.3	116	15.9
3/15	12:50	Camden NW N	0.57	0.41	<0.003	4.07	0.41	410.0	48	15.2	10	742	48.30	<5.0	313	6.40	12.8	1.9	48.4	14.2
3/15	12:38	Camden NW S	0.44	0.25	0.07	3.33	0.53	610.0	132	22.3	12.3	1188	61.90	<5.0	1986	6.40	12.0	2.4	42	16.9
3/15	13:05	Camden SW	0.73	0.35	0.09	3.33	0.41	44.0	56	94.7	44.7	188	163.2	6.53	>2420	5.50	43.6	3.7	43.6	27.3
4/5	12:50	61st & Lyndale	0.67	0.12	0.11	3.30	0.69	120.0	68	318	70.0	300	152.0	<5.0	816	8.60	34.9	62	267	11.2
4/5	14:00	Camden in SW	0.05	0.05	0.04	1.62	1.15	11.0	292	2.2	<2.0	373	7.45	<5.0	20	7.60	3.90	<0.1	<20.0	4.0

4/5	**13:15**	**Pow in S**	0.28	0.06	0.06	2.13	0.54	60.0	26.0	46.7	19.3	173	75.60	<5.0	1439	7.30	22.2	13.8	72.7	15.1
4/5	**13:10**	**Pow in SE**	0.25	0.07	0.06	2.43	0.46	20.0	21.0	38.7	16.7	105	43.60	<5.0	703	7.50	15.3	10.0	58.8	13.8
4/5	**13:25**	**Pow in W**	0.33	0.06	0.04	2.34	0.41	80.0	32.0	79.3	28.7	180	103.0	<5.0	776	7.01	27.8	23.6	94.8	12.9

Table 7. (continued) The 2022 quarterly NPDES chemistry grab sample results. NS = no sample.

Date	Time	Site	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NO3NO2 mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	pH Unit	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
5/25	9:30	Cam in S NW	0.39	0.17	0.12	1.38	0.31	10.0	38.0	30.7	16.7	92.5	53.9	<5.0	3448	7.00	16.9	4.1	54.9	9.7
5/25	9:45	Cam in SW	0.18	0.10	0.07	1.25	0.72	4.0	140.0	12.0	6.7	222.5	20.7	<5.0	1354	7.30	7.0	0.9	<20	5.9
5/25	8:50	Pow in S	0.43	0.16	0.11	1.66	0.17	8.0	28.0	38.7	26.0	62.5	75.2	<5.0	2987	7.30	17.0	8.8	66.3	13.8
5/25	8:40	Pow in SE	0.37	0.18	0.14	1.53	0.28	6.0	30.0	20.7	14.7	77.5	58.8	<5.0	4106	7.50	24.8	4.4	45.0	15.1
5/25	9:00	Pow in W	0.42	0.19	0.13	1.54	0.24	10.0	26.0	48.0	36.0	67.5	58.3	<5.0	1935	7.10	19.8	21.4	103.0	13.4
6/13	8:30	61st & Lyndale	1.30	1.05	0.20	4.01	0.24	45.0	66.0	112.0	50.0	217.5	263.4	<5.0	NS	7.60	39.0	5.2	165.0	52.7
8/12	8:15	61st & Lyndale	0.33	0.13	NS	0.87	0.25	4.5	26.0	79.2	10.0	57.5	55.7	<5.0	NS	9.00	15.0	6.8	68.7	4.2
8/12	9:20	Cam in N NW	0.13	0.07	NS	0.78	0.18	<2.0	8.0	8.4	2.6	35.0	10.0	<5.0	NS	6.90	11.2	2.4	25.0	2.2
8/12	9:15	Cam in S NW	0.21	0.14	NS	1.35	0.75	3.0	28.0	13.2	5.2	60.0	25.8	<5.0	NS	7.30	7.9	1.6	26.7	4.0
8/12	9:30	Cam in SW	0.06	0.05	NS	0.98	0.34	<2.0	24.0	4.8	<2.0	32.5	29.0	<5.0	NS	6.60	4.3	<0.6	<20	4.0
8/12	8:40	Pow in S	0.18	0.11	0.09	0.83	0.26	<2.0	14.0	18.0	8.0	40.0	48.6	<5.0	NS	7.10	7.7	4.3	39.0	4.9
8/12	8:35	Pow in SE	0.19	0.11	0.09	0.96	0.22	<2.0	16.0	14.4	5.6	40.0	32.8	<5.0	NS	7.50	7.4	3.3	32.9	4.7
8/12	8:50	Pow in W	0.17	0.11	0.09	0.98	0.21	2.5	12.0	14.2	7.6	25.0	25.7	<5.0	NS	7.10	8.1	4.1	33.5	4.3

Table 8. The 2022 quarterly stormwater grab sampling statistics.

	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NO3NO2 mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	pH Std Unit	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
MEAN (geometric)	0.379	0.142	0.075	2.39	0.409	58.3	54.5	46.7	18.5	331	82.2	4.87	444	7.54	18.2	5.58	71.0	11.4
MEAN (arithmetic)	0.504	0.180	0.093	3.13	0.631	1000	87.8	111	37.1	1683	147	8.81	2005	7.59	23.7	12.8	116	14.8
MAX	1.50	1.05	0.229	13.0	6.75	7398	410.0	760.0	250.0	11854	521	43.5	24200	9.90	68.1	65.6	460	52.7
MIN	0.055	0.045	0.002	0.783	0.136	1.00	8.00	2.20	1.00	25.0	7.45	2.15	10.0	5.50	3.90	0.050	10.0	2.20
MEDIAN	0.403	0.142	0.085	2.26	0.402	41.0	52.0	42.7	18.0	203	61.9	2.50	643	7.50	18.4	5.95	66.3	13.6
STDEV	0.370	0.179	0.051	2.57	1.14	1821	92.0	164	49.2	2884	157	11.5	4875	0.923	17.2	16.6	118	10.9
NUMBER	32	32	27	32	32	32	32	32	32	32	31	31	24	32	32	32	31	32
COV	0.734	0.991	0.545	0.820	1.81	1.82	1.05	1.47	1.32	1.71	1.07	1.31	2.43	0.121	0.727	1.29	1.02	0.734

FOG (Fat, Oil, and Grease) Pilot Study

The FOG study was initially a 2-year study to gather FOG data over the course of the NPDES permit. If no FOG values were found to be greater than 15 mg/L, then the study would end. If a FOG value exceeded 15 mg/L that site would continue FOG monitoring, so monitoring has continued. All sites except Camden Inlets NNW and SW registered FOG values greater than 15 mg/L in 2022.

Each year of FOG sampling data is shown below. **Table 9** contains FOG data from 2022. **Table 10** contains FOG data from the entirety of the study from 2018 to 2022.

In 2018, none of the FOG data were above 15 mg/L. In 2019, the only FOG data above 15 mg/L were 2 samples from 61st & Lyndale snowmelt. In 2020, the data reported above 15 mg/L were from snowmelt samples collected at Powderhorn Inlets S and W. In 2021, the samples above 15 mg/L were from 24th & Elm Inlet S, 61st & Lyndale, and the Powderhorn Inlets S, SE, and W snowmelt samples. In 2022, samples above 15 mg/L were collected from 61st & Lyndale, Powderhorn Inlets S, SE, and W, and Camden Inlet SNW. Camden Inlet NNW was not sampled for snowmelt and Camden Inlet SW showed low levels of FOG throughout the year.

Table 9. FOG results in mg/L from grab samples collected in 2022. Samples over 15 mg/L are in red.

2022	2/28	3/8	3/15	4/5	5/25	6/13	8/12
61st & Lyndale	24.7	9.9		<5.0		<5.0	<5.0
CAM IN NNW			<5.00		<5.0		<5.0
CAM IN SNW	26.1		<5.00		<5.0		<5.0
CAM IN SW	<5.00		6.53	<5.0	<5.0		<5.0
POW IN S	35.5	14.3		<5.0	<5.0		<5.0
POW IN SE	33.7	15.8		<5.0	<5.0		<5.0
POW IN W	43.5	7.6		<5.0	<5.0		<5.0

Table 10. FOG event dates and grab samples collected from 2018-2022. Data greater than 15 mg/L is in red.

2018 Sites	10-Jan	19-Jan	26-Jan	19-Mar	26-Mar	12-Jul	13-Jul	1-Oct
14th & Park	<5.00	6				<5.00		<5.00
22nd & Aldrich	8	8		6			<5.00	<5.00
61st & Lyndale		<5.00	9					
Pershing				<5.00	<5.00			
2019 Sites	**12-Mar**	**13-Mar**	**19-Mar**	**20-Mar**	**8-May**	**27-Jun**	**26-Aug**	**12-Sep**
14th & Park	9	10						
22nd & Aldrich		7						
24th & Elm In N					<5.00	<5.00	<5.00	<5.00
24th & Elm In S					<5.00	<5.00	<5.00	<5.00
61st & Lyndale	21	19						
Pershing			<5.00	<5.00				
Winter Basin In S					<5.00	<5.00	6	6
Winter Basin In W					5	5	5	<5.00
2020 Sites	**24-Feb**	**3-Mar**	**4-Mar**	**7-Jul**	**14-Jul**	**21-Jul**		
24th & Elm In N		<5.00	<5.00		<5.00	<5.00		
24th & Elm In S		<5.00	<5.00		<5.00	<5.00		
24th & Elm N Out					7			
61st & Lyndale				6		<5.00		
POW IN S	31	14		3		<5.00		
POW IN SE		6	6	5		<5.00		
POW IN W	109	13		4		<5.00		
2021 Sites	**22-Feb**	**23-Feb**	**24-Feb**	**25-Feb**	**8-Apr**	**27-May**	**14-Jul**	**24-Aug**
24th & Elm N	11	<5.00			<5.00	<5.00	<5.00	<5.00
24th & Elm S	14	31			<5.00	<5.00	NS	<5.00
61st & Lyndale	16	14.8			6	<5.00	<5.00	<5.00
POW IN S			23	18	5	<5.00	14.7	<5.00
POW IN SE			14	17	5	11	<5.00	<5.00
POW IN W	63	85			<5.00	<5.00	9	<5.00
2022 Sites	**28-Feb**	**8-Mar**	**15-Mar**	**5-Apr**	**25-May**	**13-Jun**	**12-Aug**	
61st & Lyndale	24.7	9.9		<5.00		<5.00	<5.00	
CAM IN NNW			<5.00		<5.00		<5.00	
CAM IN SNW	26.1		<5.00		<5.00		<5.00	
CAM IN SW	<5.00		6.53	<5.00	<5.00		<5.00	
POW IN S	35.5	14.3		<5.00	<5.00		<5.00	
POW IN SE	33.7	15.8		<5.00	<5.00		<5.00	
POW IN W	43.5	7.6		<5.00	<5.00		<5.00	

Conclusions

Grab samples of stormwater represent event chemistry at a point in time. Following sample handling protocol, some parameters can only be characterized by a grab sample, e.g., pH, *E. coli*, and FOG. Timing of a runoff event is critical for grab sample collection. Flow must occur when staff are available, travel between sites during a storm is possible, and the laboratory is available to receive samples with short holding times like *E. coli*.

In 2022, seven sites were successfully monitored quarterly for NPDES water chemistry, *E. coli*, pH, and FOG. The sites included:

- Camden Pond Inlets N NW, S NW, and SW
- 61st & Lyndale
- Powderhorn Inlets SE, S, and W

The 2022 quarterly grab sampling data show that snowmelt generally had high values for all chemical parameters when compared to runoff at other times of the year. Phosphorus, solids, metals, and FOG data were much higher during snowmelt. The *E. coli* levels were low for snowmelt and higher in the warmer months. This was expected since *E. coli* are temperature-dependent organisms. All chloride concentrations were high during snowmelt and were lower the rest of the year. The chloride source is likely road salt application over the winter months.

The 2022 pH values ranged between 5.5 and 9.0. The pH values were consistently high at 61st & Lyndale compared to the other sites. High pH values at 61st and Lyndale were likely due to the cement plant located across the street from the sampling location, which produces alkaline runoff.

FOG data have been collected from 2018 - 2022. The only FOG samples that were greater than 15 mg/L were seen during the 2019 - 2022 snowmelt events. The only non-snowmelt FOG sample that approached the 15 mg/L threshold was on 7/14/21 where the Powderhorn Inlet S sample was 14.7 mg/L. It appears that FOG values greater than 15 mg/L generally do not occur outside of snowmelt. Snowmelt is a unique event that contributes pollution from 4-5 months over a few low-flow events. Snowmelt samples are polluted from material deposited in the watershed over the winter, and it is common to see an oily sheen on a snowmelt grab sample. Powderhorn Inlet W registers the highest levels of FOG compared to the other sites. It is unknown why this is occurring, as the land use type for this site is comparable to the other Powderhorn Inlets, but similar levels of FOG are not seen there.

Camden Pond Monitoring

Background

Camden Pond was constructed by the City of Minneapolis in 2007 for flood control. Later, the space around the pond was redesigned as a scenic location by adding plants, benches, and a walking path. Camden Pond is 4.09 acres with a maximum depth of 6.4 ft and accumulates sediment at a rate of around 0.44% of its volume per year (Stantec Consulting Services, 2021). As of 2020, only 6.2% of the pond volume had filled with sediment, so the pond has never needed to be dredged. The pond is classified as polymictic. The drainage area of Camden Pond is 235 acres of mainly park and residential land uses, with 75 of those acres being impervious surfaces.

Camden Pond, shown in **Figure 1**, was part of the 2020-2021 Minneapolis Park and Recreation Board (MPRB) pond monitoring study and was selected for further monitoring in 2022 based on the study results. Camden Pond was one of the older ponds in the study and showed the highest potential internal phosphorus loading out of all ponds in the study. A study of Camden Pond's inlets and outlet was started in 2022 with the goal of determining more definitive mass balance, removal efficiency, and nutrient loads. This study aims to provide insight into whether a pond originally intended for flood control purposes could have or be modified to have positive water quality impacts. Monitoring sites are pictured in **Figure 2**.

Figure 1. Camden Outlet stormwater monitoring site located northeast of Camden Pond.

The purpose of monitoring the stormwater inlets and outlet of Camden Pond was to:

1. Measure the pollutant loads of the tributary pipes entering Camden Pond and compare with pollutant loads at the pond outlet.
2. Assess how a pond originally intended for flood control is affecting stormwater quality.
3. Measure the true storage capacity of the pond and compare to its designed capacity.
4. Comply with the National Pollutant Discharge Elimination System (NPDES) Permit provision to monitor stormwater BMPs for the purpose of adaptive management.

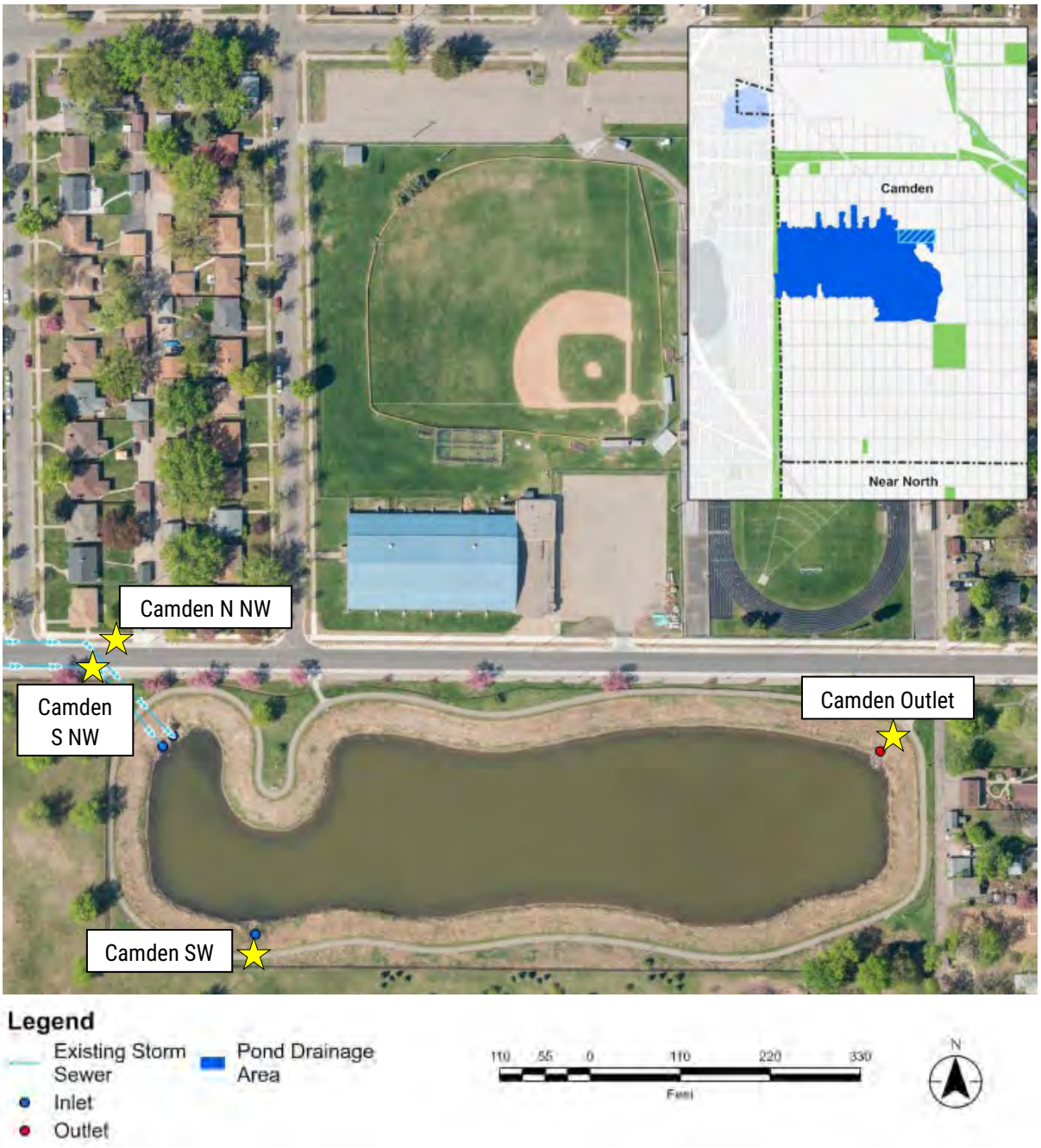


Figure 2. Aerial view of Camden Pond with the four inlet and outlet locations (Stantec Consulting Services, 2021). MPRB monitoring sites are marked with yellow stars.

Methods

Site Installation

Monitoring equipment at each of the sites included: ISCO 2150 datalogger, 2105ci LTE combined interface module/modem, low-profile area velocity (AV) probe, and a 3700 ISCO sampler complete with tubing and intake strainer. Cables and tubing were anchored with zip-ties to the sidewall eyebolts. AV probes and intake strainers were pointed upstream and fastened to the pipe. For sites with potential for standing water, Camden Inlet N NW and S NW, the strainer and probe were attached to the pipe using a steel spring ring, **Figure 3**. The equipment at these sites were hung from eyebolts below grade in the manhole with an above grade antenna. The other two sites, Camden Inlet SW and Camden Outlet, had above grade monitoring boxes with access holes for tubing and cables. Monitoring boxes were rectangular 4 ft x 3 ft x 3 ft locking wooden boxes which safely protected and housed both the sampler and datalogger equipment. Camden Outlet had an additional 2150 datalogger and AV probe that measured the water level of the pond. The probe was aligned at the same elevation as the invert (bottom) of the outlet pipe. Images of each site can be found in **Figure 4**.

The dataloggers used cell phone modems to remotely upload data to the MPRB ISCO database server from Monday through Friday. An antenna was installed at each site to allow for remote communication with the datalogger. The datalogger could also be remotely programmed to turn the samplers on/off, adjust the level, pacing, or triggers, or to download data.

Camden site installs were delayed in 2022 because of supply chain issues and scheduling difficulties with the MPRB Cement Shop. The amount of standing water that would be present in the pipes was not known prior to installs, so spring rings were later deemed necessary and did not arrive until May 25, 2022. Additionally, due to the busy nature of the spring/summer season, finding time for the Cement Shop to install anchor points and antennas delayed installs further. Equipment was installed in late June and began sampling during a storm event on July 12, 2022.

Figure 3. Photo of the AV probe and intake strainer on a spring ring at Camden Inlet N NW in November. The blue arrow points in the direction of water flow.

Sample Collection

The samplers were equipped with 24 one-liter bottles, 3/8-inch inner-diameter vinyl tubing, and an intake strainer that filtered out large particulates. Samplers were multiplexed and collected four flow-weighted samples per 1-L bottle, allowing a maximum of 96 samples to be collected over a storm event. A storm event is defined as a storm with greater than 0.10 inches of precipitation separated by eight or more hours from other storms. Some sites were programmed to pulse the samplers at a level trigger threshold after a set volume or pacing had passed. Other sites required a more complex program using hysteresis and flow rate as the trigger. More information about sampler programming can be found in the discussion section of this chapter.

Figure 4. The four Camden Pond monitoring sites: Camden Inlet N NW (A), Camden Inlet S NW (B), Camden Inlet SW (C), and Camden Outlet (D).

Monitoring Parameters and Methods

A list of the chemical parameters required by the NPDES permit for analysis of auto-monitored composite stormwater samples is shown in **Table 1**. NPDES permit-required chemistry methods, reporting limits and holding times for auto-monitored composite samples used in this project are also shown in this table. For more information on grab sampling parameters see **Chapter 24**.

Table 1. The list of required NPDES permit parameters to be monitored. This table shows analysis method, reporting limit, and holding times for parameters analyzed by Instrumental Research Inc. and Pace Laboratories.

Parameter	Abbreviation	Units	Method	Reporting Limit	Holding Time
Chemical Oxygen Demand	COD	mg/L	SM 5220-D	20 mg/L	28 days
Dissolved Organic Carbon	DOC	mg/L	SM 5310-C-00	1.5 mg/L	28 days
Chloride, Total	Cl	mg/L	SM 4500-Cl^- B	2.0 mg/L	28 days
Hardness	Hard	mg/L	SM 2350 C	5.0 mg/L	6 months
Copper, Total	Cu	µg/L	EPA 200.8	1 µg/L	6 months
Lead, Total	Pb	µg/L	EPA 200.8	0.10 µg/L	6 months
Zinc, Total	Zn	µg/L	EPA 200.7	20 µg/L	6 months
Nitrate/Nitrite, Total as N	NOx	mg/L	SM 4500-NO_3 E	0.030 mg/L	28 days
Total Nitrogen	TN	mg/L	Alkaline Persulfate Oxidation	0.500 mg/L	28 days
Phosphorus, Total Dissolved	TDP	mg/L	SM 4500-PE	0.010 mg/L	48 hours
Phosphorus, Total	TP	mg/L	SM 4500-PE	0.010 mg/L	48 hours
Solids, Total Dissolved	TDS	mg/L	SM 2540 C	5.0 mg/L	7 days
Solids, Total Suspended	TSS	mg/L	SM 2540 D	1.0 mg/L	7 days
Solids, Volatile Suspended	VSS	mg/L	EPA 160.4	2.0 mg/L	7 days

Results

Sample Collection

In 2022, rainfall grab and flow-weighted composite samples were collected from storm events ranging from 0.25 to 0.84 inches of precipitation. The MPRB defines a storm event as having greater than 0.10 inches of precipitation and separated by eight hours or more from other storm events. Due to the drought this year, samples from storms having less than 0.10 inches of precipitation were included in the data analysis. Snowmelt grab samples were collected from four snowmelt events at the pond inlets. **Table 2** shows the snowmelt grab samples collected. **Table 3** shows the rainfall grab samples collected, along with precipitation data. Precipitation was measured by a rain gauge at MPRB's Southside Operations Center. The Camden Outlet site was not a grab sample site. See **Chapter 24** for more information on grab sampling.

The 2022 NPDES chemical concentrations and statistics for flow-weighted composite samples the Camden Inlets N NW, S NW, SW, and the Outlet site can be seen in **Table 4** through **Table 7**. If less than values were present, half the value was used for statistical calculations. The statistics calculated for each site were the geometric mean (GEOMEAN), arithmetic mean, maximum (MAX), minimum (MIN), median, standard deviation (STDEV), number of samples, and coefficient of variation (COV). The geometric means from **Tables 4** through **Table 7** were calculated using only composite data and used in nutrient load calculations, shown in **Table 8**.

Table 2. The 2022 snowmelt events sampled or attempted to sample at the three Camden Inlets via grabs. X = grab sample. NS = No Sample.

Date	Camden Inlet N NW	Camden Inlet S NW	Camden Inlet SW
2/28/22	X	X	X
3/8/22	NS	NS	NS
3/15/22	X	X	X

Table 3. The 2022 precipitation events sampled or attempted to be sampled at the three Camden Inlets via grabs. X = quarterly grab sample, X/C = Quarterly grab samples with a flow-paced composite. NS = No Sample. Precipitation data was measured by the MPRB weather station located at SSOC.

Start Date	Start Time	End Date	End Time	Rain (inches)	Duration (hours)	Intensity (in/hour	Hours since last rain	Camden In N NW	Camden In S NW	Camden In SW
4/5/2022	10:15	04/06/22	5:45	0.50	19.5	0.026	34.8	NS	X	NS
5/25/2022	0:30	05/25/22	12:45	0.58	12.3	0.047	113	X	X	X
6/13/2022	6:00	06/13/22	8:00	0.09	2.00	0.045	47.8	NS	NS	NS
8/12/2022	4:00	08/12/22	7:45	0.84	3.75	0.224	101	X/C	X/C	X/C

Stormwater Chemistry

Table 4. Camden Inlet N NW 2022 chemistry and statistics. Grab samples are denoted with a * by Date Sampled. NS = no sample, TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride, TSS = Total Suspended Solids, VSS = Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, FOG = Fat Oil and Grease, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

Date Sampled	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
3/15/2022*	0.57	0.41	<0.00	4.07	0.409	410	48	15	10	742	48	2.15	313	13	2	48	14
5/25/2022*	0.358	0.169	0.063	1.88	0.137	13	24	23	12	70	27	<5.0	>24200	13	2	39	7
7/12/2022	0.507	0.217	0.114	3.24	0.249	30	44	8	4	NS	42	NS	NS	NS	NS	NS	NS
8/12/2022	0.210	0.077	0.061	1.70	0.343	3	14	40	17	25	29	NS	NS	12	6	43	4
8/12/2022*	0.134	0.071	NS	0.783	0.180	<2.0	8	8	3	35	<20	<5.0	NS	11	2	25	2
8/18/2022	0.225	0.064	NS	1.55	0.933	5	14	58	20	47	41	NS	NS	9	9	71	4
GEOMEAN (composite only)	0.288	0.102	0.083	2.04	0.430	8.32	20.5	26.5	11.3	34.5	36.5	-	-	10.2	6.96	55.5	3.90
ARITHMETIC MEAN (all samples)	0.334	0.168	0.060	2.20	0.375	77	25	25	11	184	33	2.4	12257	12	4	45	6
MAX	0.570	0.413	0.114	4.07	0.933	410	48	58	20	742	48	2.5	>24200	13	9	71	14
MIN	0.134	0.064	0.002	0.783	0.137	1	8	8	3	25	10	2.2	313	9	2	25	2
MEDIAN	0.292	0.123	0.062	1.79	0.296	9	19	19	11	47	35	2.5	12257	12	2	43	4
STDEV	0.175	0.135	0.046	1.21	0.291	163	17	20	7	313	14	0.2	16891	2	3	17	5
NUMBER	6	6	4	6	6	6	6	6	6	5	6	3.0	2	5	5	5	5
COV	0.525	0.800	0.769	0.551	0.776	2.11	0.666	0.785	0.619	1.70	0.421	0.085	1.38	0.145	0.700	0.372	0.762

Table 5. Camden Inlet S NW 2022 chemistry and statistics. Grab samples are denoted with a * by Date Sampled. Values in red were flagged during monthly blind performance checks with the contracting laboratory. NS = no sample, TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride, TSS = Total Suspended Solids, VSS = Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, FOG = Fat Oil and Grease, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

Date Sampled	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
2/28/2022*	0.752	0.115	0.085	4.33	0.381	3799	120	183	67	6190	333	26	323	44	18	262	18
3/15/2022*	0.440	0.254	0.070	3.33	0.533	610	136	22	12	1188	62	4.7	1986	12	2	42	17
5/25/2022*	0.387	0.173	0.124	1.38	0.311	10	38	31	17	92	54	<5.0	3448	17	4	55	10
7/13/2022	0.604	0.335	0.225	NS	NS	35	NS	52	34	NS	NS	NS	NS	NS	NS	NS	NS
8/12/2022	0.267	0.158	0.150	1.74	1.064	10	42	24	10	95	29	NS	NS	9	3	33	6
8/12/2022*	0.206	0.137	NS	1.35	0.750	3	28	13	5	60	26	<5.0	NS	8	2	27	4
GEOMEAN (composite only)	0.403	0.182	0.120	2.16	0.550	54	59	36	17	329	61	-	-	14	4	56	9
ARITHMETIC MEAN (all samples)	0.443	0.195	0.131	2.43	0.608	744	73	54	24	1525	101	9	1919	18	6	84	11
MAX	0.75	0.335	0.225	4.332	1.064	3799	136	182.5	67	6190	333	26	3448	44	18	262	18
MIN	0.206	0.115	0.070	1.352	0.311	3.0	28	13.2	5	60	26	3	323	8	2	27	4
MEDIAN	0.414	0.166	0.124	1.74	0.533	22.5	42	27	15	95	54	4	1986	12	3	42	10
STDEV	0.206	0.083	0.061	1.34	0.306	1515	51	64	23	2651	131	11	1564	15	7	100	6
NUMBER	6	6	5	5	5	6	5	6	6	5	5	4	3	5	5	5	5
COV	0.464	0.427	0.470	0.551	0.503	2.04	0.700	1.19	0.958	1.74	1.30	1.28	0.815	0.834	1.22	1.20	0.578

Table 6. Camden Inlet SW 2022 stormwater chemistry and statistics. Grab samples are denoted with a * by Date Sampled. Values in red were flagged during monthly blind performance checks with the contracting laboratory. NS = no sample, TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride,

TSS = Total Suspended Solids, VSS = Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, FOG = Fat Oil and Grease, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

Date Sampled	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
2/28/2022*	0.16	0.10	0.082	2.2	0.93	38	252	19	7	362	<20	<5.0	73	8.0	1	<20	9
3/15/2022*	0.72	0.35	0.089	3.3	0.41	44	56	95	45	188	163	6.5	>2420	43.6	3.7	43.6	27
4/5/2022*	0.05	0.05	0.042	1.6	1.15	11	292	2	<2	373	7	<5.0	20	4.0	<0.1	<20	4
5/25/2022*	0.18	0.10	0.071	1.2	0.72	4	140	12	7	223	21	<5.0	1354	7.0	1	<20	6
7/13/2022	0.46	0.17	0.117	1.5	0.64	5	80	213	70	135	60	NS	NS	16	4	20	10
7/23/2022	0.57	0.37	NS	2.3	1.30	80	68	59	22	137	72	NS	NS	30	4	25	14
8/3/2022	1.21	0.27	0.175	3.4	1.03	40	45	297	77	99	267	NS	NS	32	20	74	17
8/6/2022	0.28	0.13	0.089	1.1	0.67	50	34	60	22	75	59	NS	NS	NS	NS	NS	NS
8/7/2022	0.24	0.08	0.047	0.8	0.33	<2	28	52	19	63	56	NS	NS	16	5	38	6
8/12/2022*	0.06	0.05	NS	1.0	0.34	<2	24	5	<2	33	29	<5.0	NS	4.0	<0.5	<20	4
8/12/2022	0.26	0.06	NS	1.8	0.69	2	24	65	19	38	39	NS	NS	15	4	30	5
8/18/2022	0.14	0.06	NS	1.8	1.41	3	24	38	15	55	39	NS	NS	18	3	30	5
8/19/2022	0.14	0.06	NS	1.0	0.57	3	38	39	16	58	40	NS	NS	19	2	<20	5
8/27/2022	0.29	0.13	NS	1.9	1.01	<2	24	73	26	47	62	NS	NS	10	4	32	9
8/29/2022	0.16	0.06	NS	2.7	0.83	<2	26	50	15	50	33	NS	NS	7.8	2.9	24.4	3
GEOMEAN (composite only)	0.296	0.114	0.0869	1.66	0.783	5.40	35.5	72.3	24.7	68.9	58.5	-	-	16.7	4.16	27.7	7.45
ARITHMETIC MEAN (all samples)	0.33	0.14	0.09	1.84	0.80	19	77	72	24	129	64	3	967	17	4	26	9
MAX	1.21	0.37	0.17	3.40	1.41	80	292	297	77	373	267	7	2420	44	20	74	27
MIN	0.05	0.05	0.04	0.83	0.33	1	24	2	1	33	7	3	20	4	0	10	3
MEDIAN	0.24	0.10	0.08	1.76	0.72	4	38	52	19	75	40	3	714	16	3	25	6
STDEV	0.31	0.11	0.04	0.82	0.33	25	85	80	23	112	67	2	1148	12	5	18	7
NUMBER	15	15	9	15	15	15	15	15	15	15	15	5	4	14	14	14	14
COV	0.93	0.79	0.48	0.45	0.42	1.3	1.2	1.1	0.95	0.87	1.1	0.55	1.2	0.70	1.3	0.68	0.73

Table 7. Camden Outlet 2022 stormwater chemistry and statistics. NS = no sample, TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride, TSS = Total Suspended Solids, VSS =

Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

Date Sampled	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
8/19/2022	0.30	0.056	0.004	3.51	0.497	80	62	36	31	172	100	13	1	<20	9
8/20/2022	0.238	0.102	0.005	3.17	1.724	65	58	35	28	185	52	12	1	23	9
8/29/2022	0.231	0.048	NS	3.374	0.228	65	62	29	29	163	64	10	<0.5	24	9
GEOMEAN	0.26	0.07	0.00	3.35	0.58	70	61	33	29	173	69	12	1	18	9
ARITHMETIC MEAN	0.26	0.07	0.00	3.35	0.82	70	61	33	29	173	72	12	1	19	9
MAX	0.30	0.10	0.00	3.51	1.72	80	62	36	31	185	100	13	1	24	9
MIN	0.23	0.05	0.00	3.17	0.23	65	58	29	28	163	52	10	0	10	9
MEDIAN	0.24	0.06	0.00	3.37	0.50	65	62	35	29	172	64	12	1	23	9
STDEV	0.04	0.03	0.00	0.17	0.80	9	2	4	2	11	25	2	0	8	0
NUMBER	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
COV	0.157	0.421	0.160	0.050	0.98	0.12	0.04	0.11	0.06	0.07	0.35	0.132	0.48	0.41	0.05

Stormwater Hydrographs

The hydrographs for level and flow measured from June through October 27 at the Camden Inlets N NW, S NW, SW, and Camden Outlet are presented in **Figures 5** through **Figures 8**.

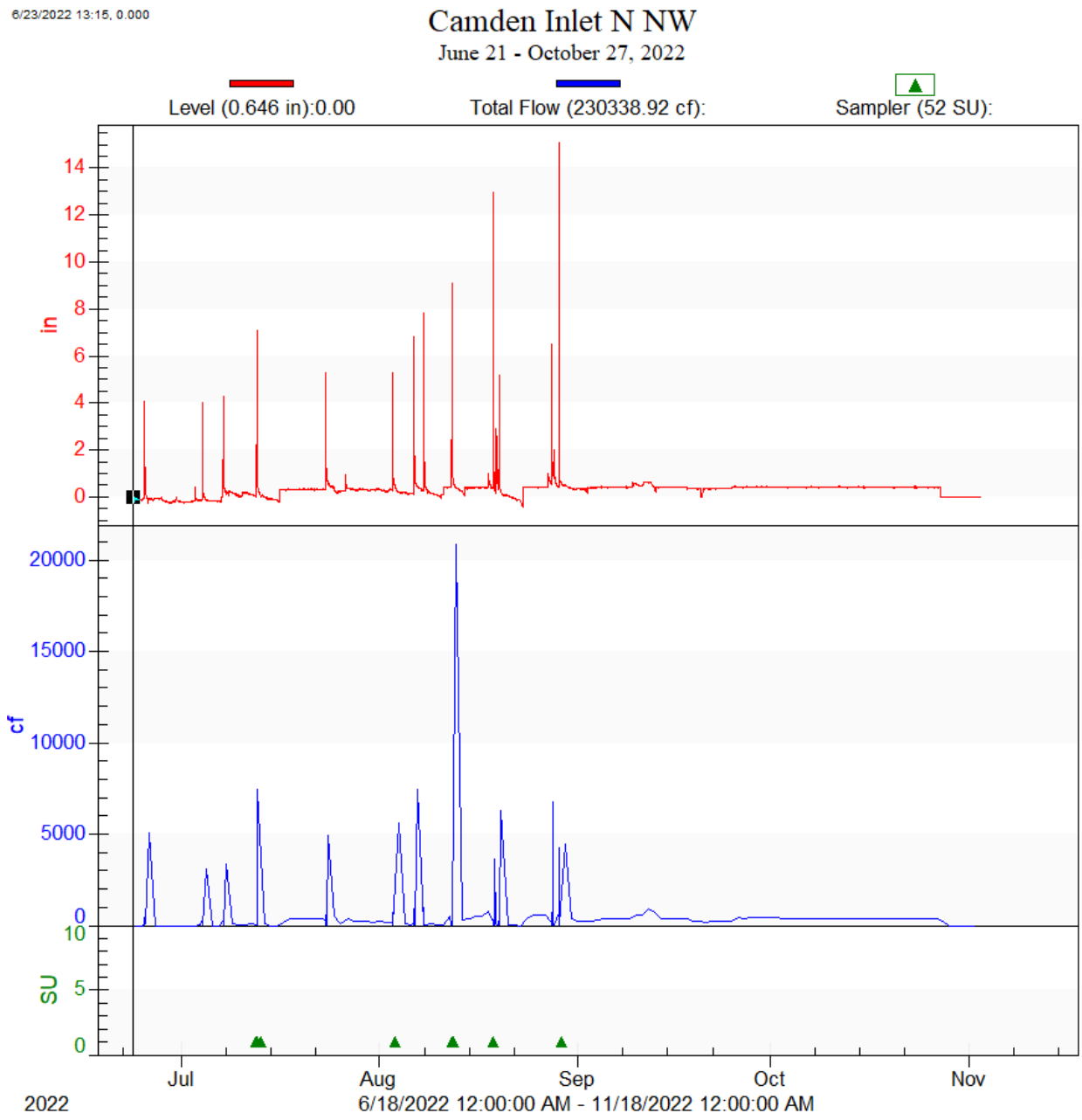


Figure 5. Camden Inlet N NW hydrograph of level and flow. Green triangles represent when the auto-sampler attempted to take a sample. Flow monitoring began on June 21 and ended on October 27, 2022.

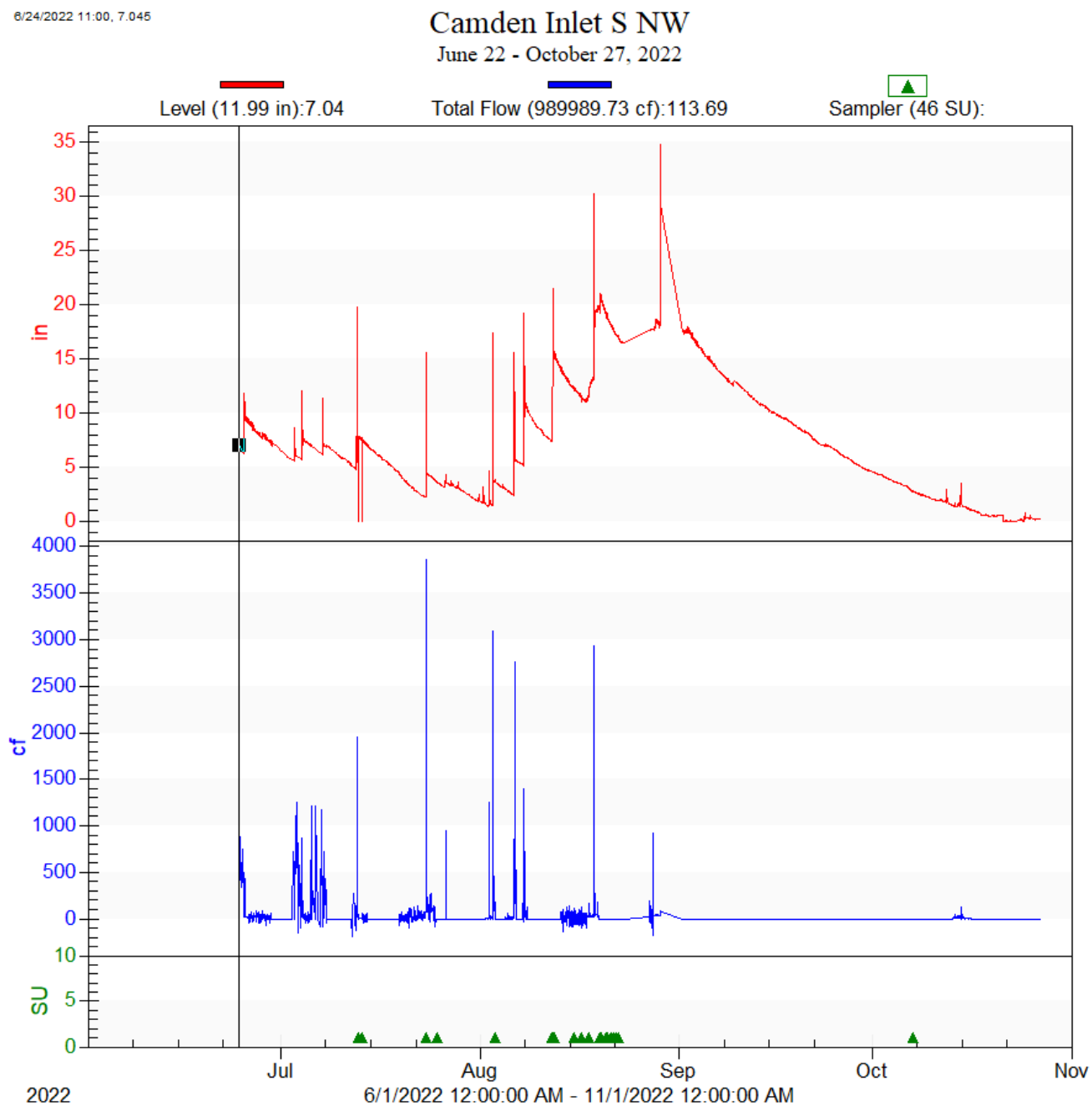


Figure 6. Camden Inlet S NW hydrograph of level and flow. Green triangles represent when the auto-sampler attempted to take a sample. The level and total flow series were edited to mitigate the influence of backflow on the data. Note that Camden S NW has around 7 inches of standing water. Flow monitoring began on June 22 and ended on October 27, 2022.

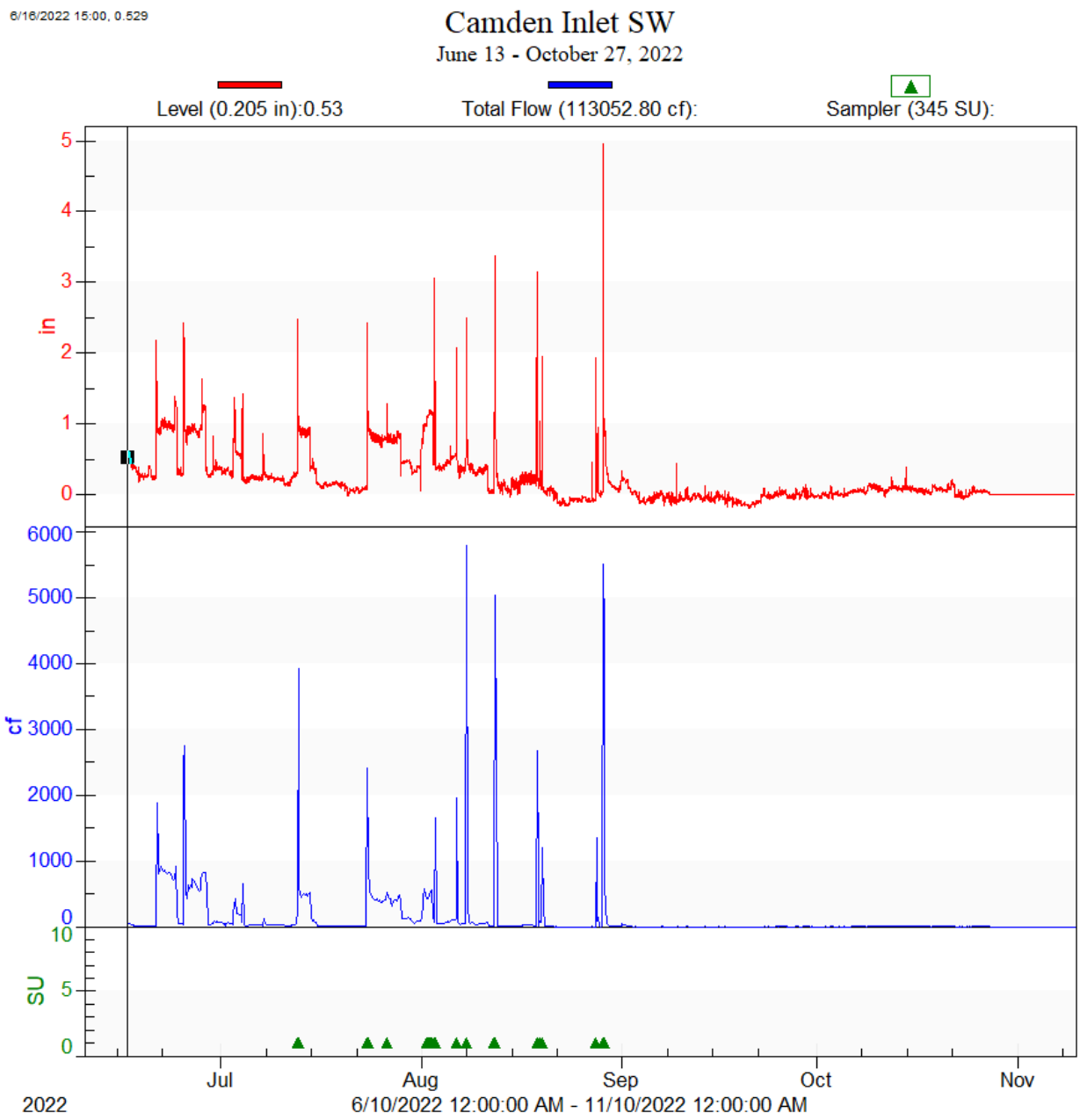


Figure 7. Camden Inlet SW hydrograph of level and flow. Green triangles represent when the auto-sampler attempted to take a sample. Flow monitoring began on June 13 and ended on October 27, 2022.

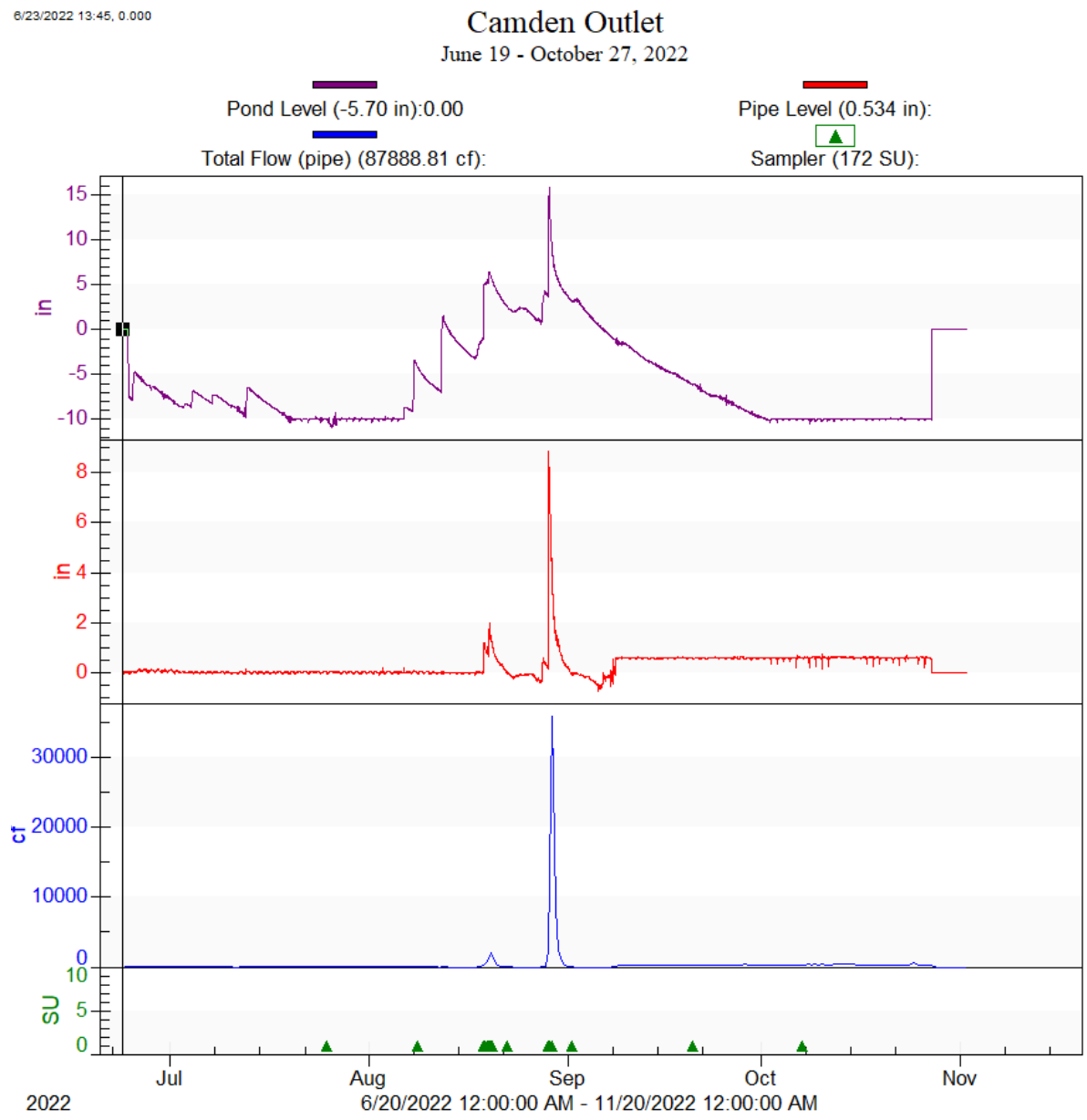
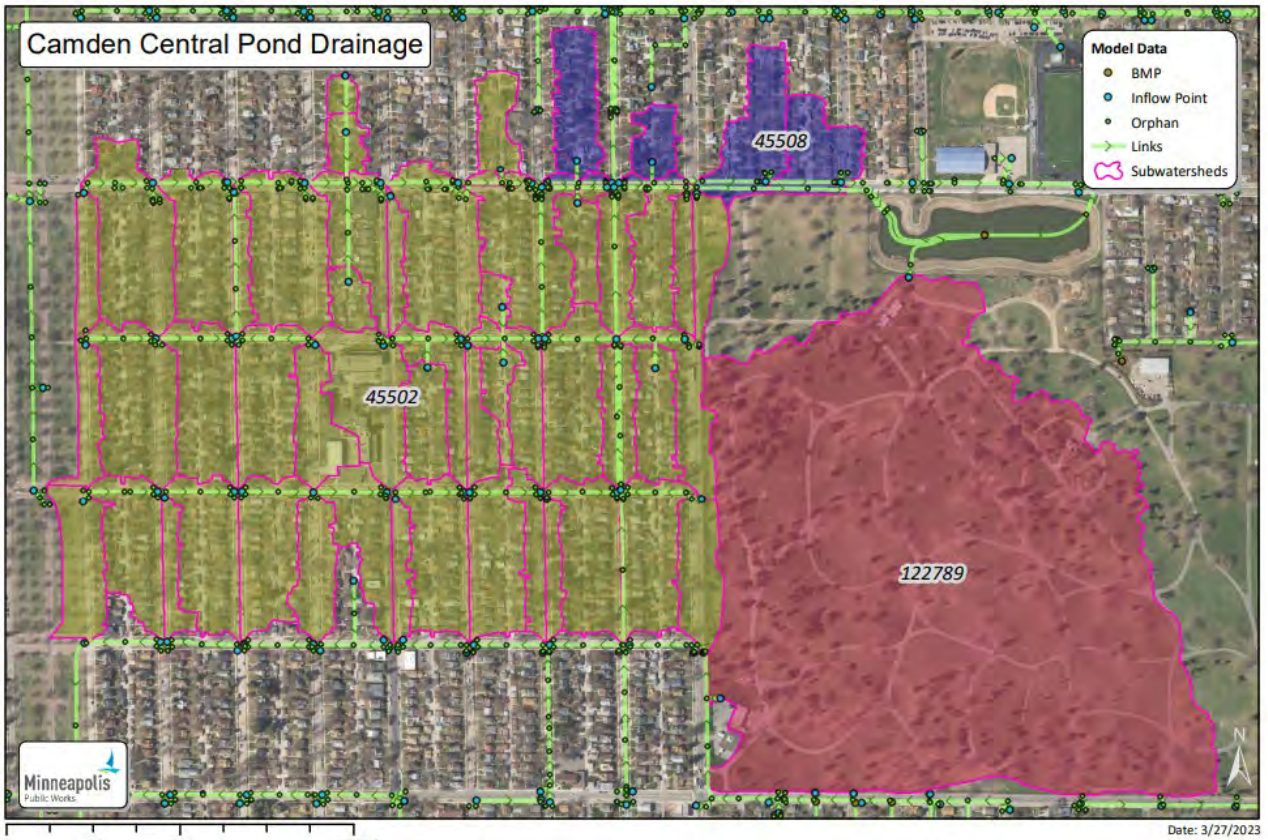


Figure 8. Camden Outlet hydrograph of pond level, pipe level, and pipe flow. Green triangles represent when the auto-sampler attempted to take a sample from flow in the pipe. Flow monitoring began on June 19 and ended on October 27, 2022. Flow registered on the pipe probe once the pond level reached ~5 inches. The pond probe was positioned higher than the actual water level of the pond for the majority of the monitoring season, as evident by flat level readings in August and October when the pond level reduced to -10 inches or lower.

Table 8. Composite sampling storm events and corresponding flow data from each monitoring site. NS = no sample. Precipitation data was measured at the Crystal Airport in Brooklyn Center, MN. Flow data was estimated using the hydrographs generated by the auto-samplers, see Figures 5 to 8. Note that some samples taken at the Outlet did not correspond with a precipitation event and were thus excluded from this table.

Rain Event Date	Duration (hours)	Precip. (inches)	Cam In N NW (cf)	Cam In S NW (cf)	Cam in SW (cf)	Cam Outlet (cf)
7/12/2022	2	0.25	14769	49083	5757	NS
7/23/2022	4	0.37	NS	NS	4842	NS
8/3/2022	1	0.03	NS	NS	1783	NS
8/6/2022	6	0.29	NS	NS	2138	NS
8/7/2022	3	0.95	NS	NS	6272	NS
8/12/2022	4	1.26	41245	149351	7633	NS
8/18/2022	4	0.38	8680	NS	3507	NS
8/19/2022	9	0.76	NS	NS	1564	1156
8/27/2022	5	0.71	NS	NS	1572	NS



ID	Area (acres)	Impervious	Institutional	Multi-Family	Office	Park, Recreational, or Preserve	Retail and Other Commercial	Right of Way	Single Family Attached	Single Family Detached	Undeveloped
45508	10.5	48.0%	5.5%	0.0%	0.0%	0.0%	0.0%	23.4%	0.0%	71.1%	0.0%
45502	127.8	44.9%	5.4%	0.6%	0.1%	2.0%	0.5%	28.1%	1.0%	61.9%	0.2%
122789	84.2	9.9%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Figure 9. Aerial map of Camden Pond showing watershed sizes and land use breakdowns. Map provided by the City of Minneapolis Public Works.

Chemical load calculations using the geometric mean of each chemical parameter for composite samples are shown in **Table 9** The largest calculated load in pounds for each parameter are highlighted in orange. **Table 10** shows relative percentages for each site for the total flow, total drainage area, and total loads for each parameter, calculated using information from **Figure 9**. While the load inputs are calculated from measured data, the flow-weighted samples were only collected between July through October, so the data does not provide a comprehensive view of the entire year. The monitoring period had only 5.93 inches of precipitation, while the yearly total was 22.97 inches. See **Chapter 29** for more information on climate.

Chemical Load Tables

Table 9. The 2022 flow totals, calculated pollutant loads, and removal efficiency for Camden Inlets N NW, S NW, SW, and Camden Outlet. The Total Loading column is summed using data from the three inlets. Removal Efficiency was calculated using Total Loading and Camden Outlet data. Flow was measured from July to October. Orange highlights indicate the largest calculated load for a parameter.

Site Name	Cam Inlet N NW	Cam Inlet S NW	Cam Inlet SW	Total Loading	Cam Outlet	Removal Efficiency
Total Flow (L)	**6,522,472**	**28,033,367**	**3,201,304**	**37,757,143**	**24,887,365**	**-**
TP (lb)	4.15	24.8	2.09	31.0	1.40	95%
TDP (lb)	1.47	14.2	0.803	16.5	0.358	98%
SRP (lb)	1.20	11.4	0.614	13.2	0.0238	100%
TN (lb)	29.4	108	11.7	149	18.4	88%
NOx (lb)	6.19	65.8	5.53	77.5	3.18	96%
Cl (lb)	120	1156	38.1	1,314	382	71%
Hardness (lb)	295	2596	251	3,141	333	89%
TSS (lb)	381	2183	510	3,075	181	94%
VSS (lb)	163	1140	174	1,477	160	89%
TDS (lb)	496	5871	487	6,853	948	86%
COD (lb)	525	1782	413	2,719	380	86%
Cu (lb)	147	544	118	809	0.06417	100%
Pb (lb)	100	161	29.3	290	0.00275	100%
Zn (lb)	799	2052	196	3,046	0.0963	100%
DOC (lb)	56.1	371	52.6	479	49.9	90%

Table 10 The 2022 relative percentages for each site for the total flow, total drainage area, and total loads for each parameter.

Site Name	Cam Inlet N NW	Cam Inlet S NW	Cam Inlet SW
% Of total flow	17.3	74.2	8.48
% Of total drainage area	4.72	57.4	37.8
% Of total TP load	13.4	79.9	6.73
% Of total TDP load	8.89	86.2	4.86
% Of total SRP load	9.10	86.2	4.66
% Of total TN load	19.7	72.4	7.88
% Of total NOx load	7.98	84.9	7.13
% Of total Cl load	9.11	88.0	2.90
% Of total Hardness load	9.39	82.6	7.98
% Of total TSS load	12.4	71.0	16.6
% Of total VSS load	11.0	77.2	11.8
% Of total TDS load	7.23	85.7	7.10
% Of total COD load	19.3	65.5	15.2
% Of total Cu load	18.1	67.2	14.6
% Of total Pb load	34.5	55.4	10.1
% Of total Zn load	26.2	67.4	6.42
% Of total DOC load	11.7	77.3	11.0

Discussion

Chemical Load Calculations

Camden Inlet S NW produced the largest loads across all measured parameters, as seen in **Table 9**. This makes sense, as its drainage area is 74% of the total drainage area for the pond, as shown in **Table 10**. While Camden Inlet SW does have a large drainage area, it is mainly comprised of pervious surfaces and has little to no vehicle traffic, so it did not contribute significant pollutant loads. Camden Inlet N NW, despite having a much smaller drainage area than the SW site, registered higher loads for all parameters except SRP, NOx, and Hardness when compared to the SW site.

Camden Outlet recorded significantly lower loads of all parameters as compared to the three inlets; however, this can be partially attributed to the lack of significant precipitation due to a regional drought during most of the monitoring season. Because of this, the pond only outflowed three times, so the true efficiency of the pond cannot accurately be determined using this year's data. When comparing the total loads flowing into the pond with the loads from the Outlet, it appears as though the pond is performing well at removing pollutants. Removal efficiencies ranged from 71% for Cl to 100% for SRP, Cu, Pb, and Zn. All parameters registered lower levels at the Outlet than at the inlets.

Sampler Programming

2022 was the first year that the MPRB studied Camden Pond using auto-samplers, which presented many challenges in setting up monitoring sites and troubleshooting problems. The groundwork done this season will allow for more effective monitoring at Camden Pond in future years. Determining the appropriate programming for each site proved to be especially difficult. Standard sampler setup for the MPRB is to trigger the sampler when water level in the pipe reaches 1-inch and then take samples at regular intervals measured in cubic feet (cf). The sample pacing depends on the size of the pipe and the size of the watershed. Programming for each monitoring site was adjusted based on observations of hydrographs produced during storms, **Figure 10**.

Figure 10. MPRB staff reprogramming the sampler at Camden S NW.

Camden Outlet, N NW Inlet, and SW Inlet were all initially programmed to trigger off a 1-inch level and take samples every several hundred cubic feet. After viewing data from several storms, it was determined that the samples were being collected too close together and did not accurately capture the entire storm event. To mitigate this, the volumetric pacing between samples was increased, sometimes multiple times, until samples were captured across the whole storm event.

Camden Inlet S NW was a more difficult case, as the pipe regularly has around 7 inches of standing water, shown in **Figure 11**. This introduces the issue of backflow, where water flows from the pond into the pipe rather than the other way around. This back and forth “sloshing” effect can distort the hydrograph, as shown in **Figure 12**, and make it difficult to capture representative samples.

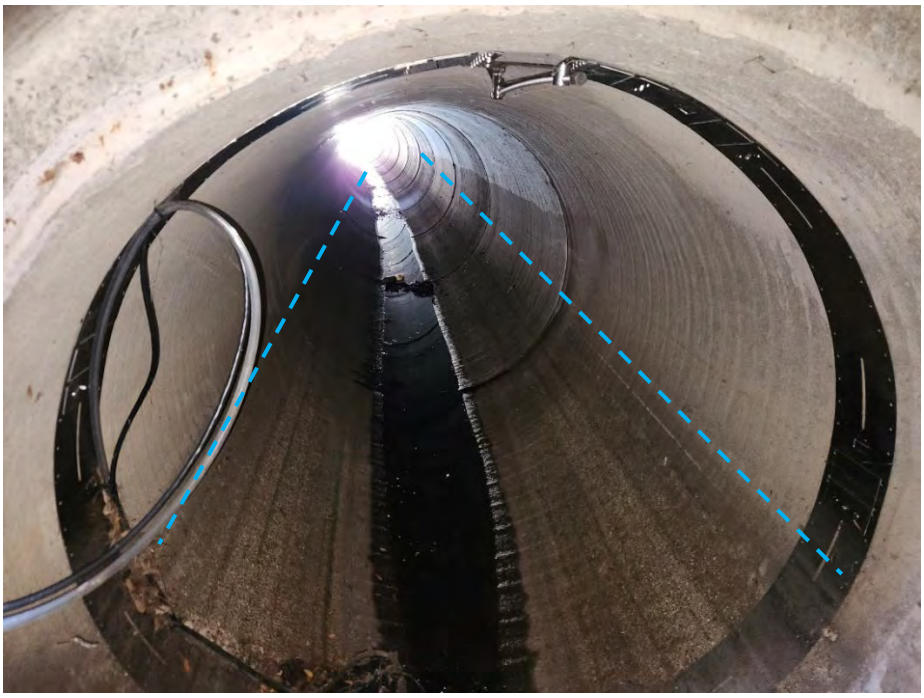


Figure 11. Image of Camden S NW pipe with some standing water. This image was taken at the end of the monitoring season, several months into a severe drought. Note the water line markings on the side of the pipe (blue dashed lines), showing the usual level of standing water.

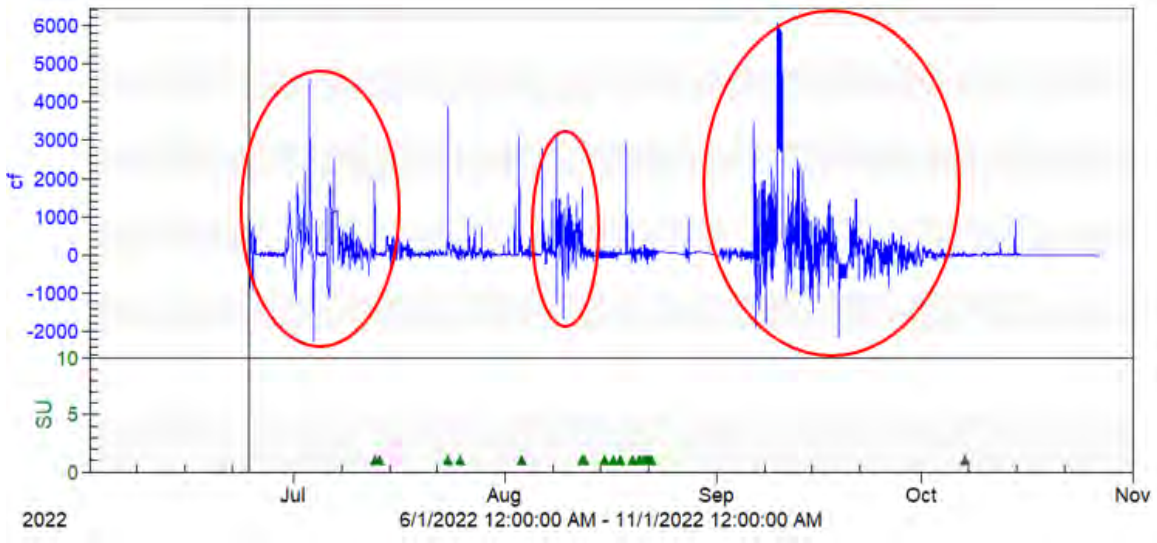


Figure 12. A graph of the original total flow data from Camden Inlet S NW. Areas showing evidence of backflow, represented by rapid, dramatic oscillations between positive and negative flow, are circled in red.

Initially, the Camden S NW sampler was programmed to trigger off a 7.5-inch level and a pacing of 200 cf. The pacing was increased several times but still was not effective in capturing samples from the entire hydrograph. Eventually, staff elected to alter the programming to use the concept of

hysteresis for the trigger along with a set pacing. For the first attempt the trigger was set at greater than 2 cubic feet per second (cfs) for 3 minutes with 500 cf pacing. This means that the sampler triggered once the rate of flow in the pipe remained at or above 2 cfs for at least 3 minutes, and then took samples every 500 cf that flowed by. Since this formula does not rely on water level as the trigger, some impact from backflow can be avoided. The trigger was increased to greater than 2.5 cfs for 3 minutes, and then again to greater than 5 cfs for 2 minutes, with some improvement in sampling success. A lack of precipitation towards the end of the monitoring season ended the window of experimentation earlier than expected, so it is likely that further fine-tuning will be necessary in subsequent years of the study.

One potential solution for the S NW site could be to move the monitoring site farther upstream. By relocating the sampling site one to two blocks away from the pond, standing water and backflow could likely be avoided; however, any stormwater inputs between the monitoring site and the pond inlet would not be accounted for. Another option would be to trigger the S NW sampler off the level measured by the N NW sampler, as the pipes run parallel to one another. When comparing hydrographs from both sites, peak flow and level are roughly comparable. The N NW site does not have standing water or backflow and was more successful in capturing samples during the 2022 season. The consequence of this setup would be if the N NW site malfunctions, the S NW site will not be able to collect samples.

Study Design

The primary intention of this study was to measure the efficiency of Camden Pond at removing nutrients from stormwater and preventing them from flowing downstream. This was done by measuring stormwater inputs (Camden Inlets N NW, S NW, and SW) and comparing results with measurements from the pond outlet (Camden Outlet). The City of Minneapolis has particular interest in this as the pond was not originally intended for nutrient removal and was built for flood control purposes. A secondary goal was to assess how much storage capacity the pond truly contained, as compared to what was originally calculated by the designers/engineers.

In 2022, the scope of the study was severely limited by the lack of significant precipitation events, especially later in the monitoring season. The pond only outflowed three times during the monitoring season, so few comparisons could be made between the quality of inflowing verses outflowing water. Additionally, the actual pond level was often below the pond level probe, making an assessment of the pond storage capacity difficult to accurately measure. Several more years of data during years with higher precipitation will be necessary to draw meaningful conclusions. In the future, the MPRB is interested in making more observations on blue-green algae levels in Camden Pond using a visual monitoring index (VMI) during future monitoring. The connection between algae blooms and nutrient loading is well known, and this relationship is of interest to the MPRB as algae blooms can be harmful to public health (Paerl & Otten, 2013).

Conclusions

Load calculations were completed for each inflowing Camden Pond watershed monitored and removal efficiencies were calculated for the pond outlet.

- The lack of significant precipitation in 2022 made it difficult to accurately assess the pond's performance. More years of data collection will be necessary to make confident assertions and accurately assess load and pond performance.
- The ability to accurately calculated removal efficiency was very limited since only a small number of samples could be collected in 2022 due to the regional drought.
- Removal efficiencies for all parameters were over 70% indicating the pond was effective at treating stormwater inputs.

The true storage capacity of Camden Pond could not accurately be assessed in 2022.

- The pond level probe was often above the actual water level of the pond, making for inaccurate measurements.
- Calculations of storage capacity were not performed due to the lack of quality data.

Sampler programming and site set-up provided many monitoring challenges in 2022.

- This was the first year the MPRB monitored Camden Pond using auto-samplers.
- Much of the monitoring season was spent troubleshooting equipment and experimenting with sampler programming. This prevented the full provisions of the NPDES permit from being met.
- The N NW monitoring site proved especially difficult to monitor due to issues with backflow. The MPRB has developed strategies to potentially mitigate this in the future.

NPDES Permit provisions for stormwater monitoring were met or were attempted in 2022.

- All monitoring for the NPDES permit as it applied to this project was attempted to be completed, see **Table 11**. This included continuous flow monitoring starting between June 13 and June 24 and ending on October 27, 2022. Site installs were delayed due to late receipt of equipment and issues coordinating with the MPRB cement shop for hardware installations.
- At least ten flow-weighted composite samples that were collected and analyzed for NPDES chemistry at the SW site. Due to technical issues with equipment and sampler programming, fewer than ten composite samples were collected at the N NW and S NW sites. Only three samples were collected at the Outlet due to the regional drought causing low water levels in the pond.
- Quarterly grab samples were taken or attempted to be taken and analyzed for NPDES chemistry, FOG, and *E.coli* at the three inlets.

Table 11. Summary of stormwater sampling at Camden Pond in 2022. Camden Outlet was not attempted for grab sampling.

Site Name	Camden Inlet N NW	Camden Inlet S NW	Camden Inlet SW	Camden Outlet
# Of grab samples	2	3	4	-
# Of composite samples	4	3	11	3

The MPRB will continue to update the study design and site setup in future years of monitoring.

- Sampling during a year with normal levels of precipitation will allow more study goals to be met.
- The pond level probe will be placed at a lower elevation to account for the low water level of the pond.
- Site sampler pacing will continue to be updated to best fit the generated hydrographs.
- The MPRB will assess algae blooms via a visual monitoring index at Camden Pond to monitor the presence of blue-green algae blooms during the monitoring season.

Powderhorn Lake Inlet Monitoring

Background

The City of Minneapolis Public Works (MPW) and the Minneapolis Park and Recreation Board (MPRB) developed a major restoration plan for Powderhorn Lake in 1999. In 2001, five continuous deflective separation (CDS) grit chambers were installed to remove solids from stormwater inflow see **Figure 4**. A drawing of a CDS unit is shown in **Figure 2**. The Powderhorn Lake watersheds are shown in **Figure 3**.

Despite this and other restoration work, the lake was listed as impaired and placed on the Environmental Protection Agency (EPA) 303(d) list based on eutrophication and biological indicators in 2001. Powderhorn Lake later trended towards better water quality and met state standards for several years and was subsequently removed from the 303(d) list in 2012. After relapsing to poor water quality, Powderhorn was relisted on the EPA 303(d) list as impaired for nutrients in 2018.

The purpose of monitoring the stormwater inlets into Powderhorn Lake was to:

1. Measure the pollutant load of the main tributaries to Powderhorn Lake. This information can be used to assist in any future external load reduction plans.
2. Trouble shoot the CDS unit functionality, since work done in 2020 discovered that the CDS units were not functioning as designed.
3. Comply with the National Pollutant Discharge Elimination System (NPDES) Permit provision to monitor stormwater BMPs for the purpose of adaptive management.

In 2022, four of the largest Powderhorn Lake watershed inlets were auto-monitored downstream of their CDS units. Current watershed monitoring work at Powderhorn began in 2019. Refer to the Water Resources Report from 2019, 2020, and 2021, found at https://www.minneapolisparks.org/park-care-improvements/water_resources/, for more information on Powderhorn Lake inlet monitoring. The MPRB also studied CDS and sump units at Powderhorn Lake from 2002-2004 and neighborhood rain garden effectiveness in 2009.

Figure 1. Images of the four Powderhorn Lake stormwater monitoring sites.

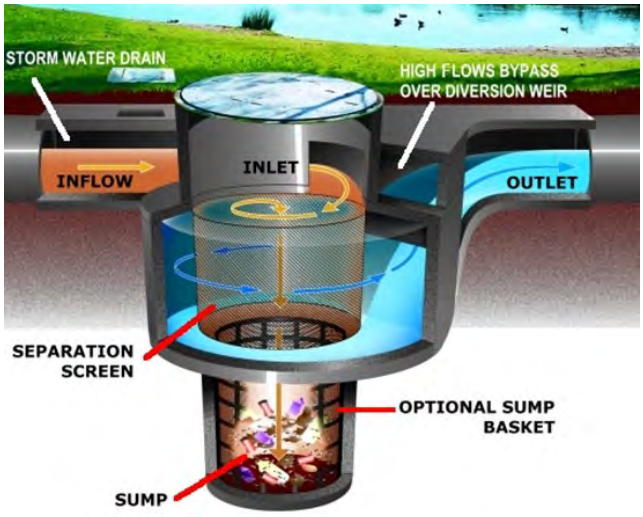


Figure 2. Cross section showing components of a CDS grit chamber unit. Image source: https://prismatech.com.my/products-ecoclean-cds.php archives.

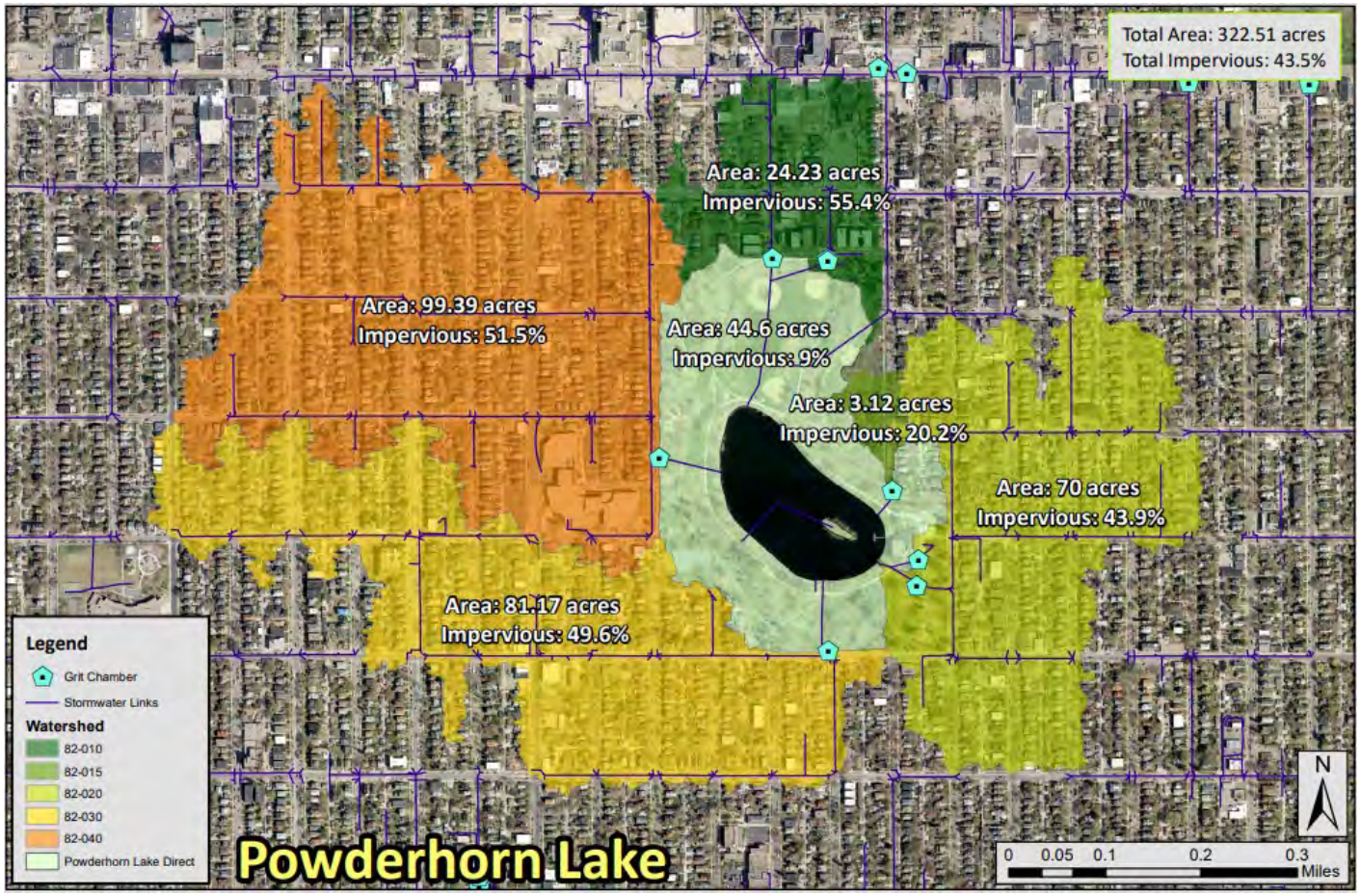


Figure 3. Powderhorn Lake watershed drainage areas shown with subwatershed sizes. All inlets have CDS units except the 3.12-acre area which has a sump catch basin. The dark green area in the north contains two CDS units – the MPRB monitors only the eastern one, which receives runoff from 12.87 acres. Map provided by Minneapolis Public Works.

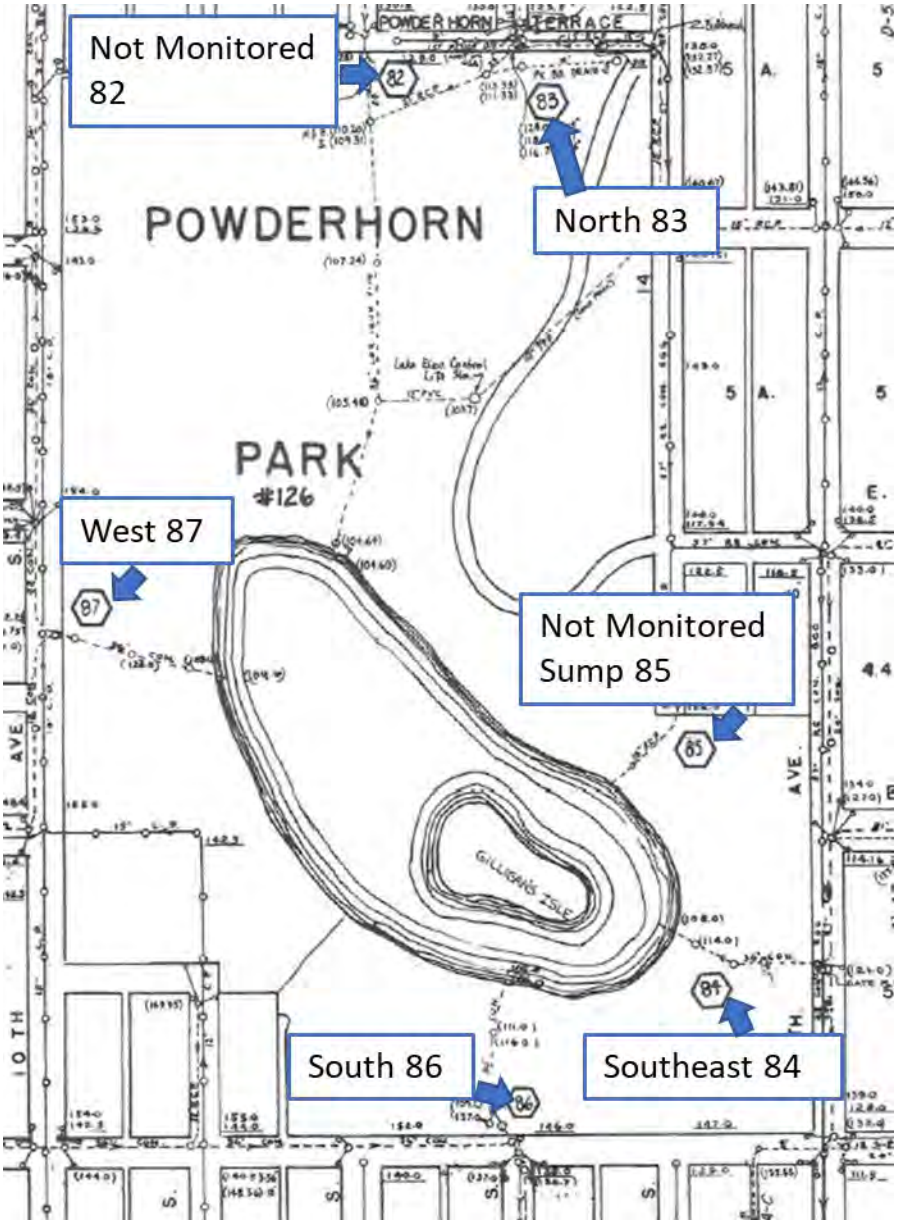


Figure 4. Map of CDS surrounding Powderhorn Park with Minneapolis Public Works ID numbers.

There are five CDS grit chambers and one sump structure installed in-line with stormwater pipes leading to Powderhorn Lake. A sump is a pit, typically in a catch basin, that traps solids. **Table 1** shows the Powderhorn CDS grit chambers with Minneapolis Public Works ID numbers, location, and drainage areas for each unit. CDS unit 82 was not monitored since it is adjacent to and has an almost identically sized watershed to CDS unit 83. Sump 85 was not monitored because it makes up only about 1% of the entire Powderhorn watershed, at 3.12 acres and 20.2% impervious surfaces, and likely does not contribute a significant nutrient loading to the lake.

Table 1. A list of the Best Management Practices (BMP's) surrounding Powderhorn Lake, their MPRB name, Minneapolis ID number, BMP type, drainage area, location, and pipe size.

MPRB Site Name	Minneapolis Grit ID #	BMP Type	Drainage Area (Acres)	Location	Outlet Pipe Size (Inches)
	82	CDS Hydrodynamic Separator	11.4	12th Ave S and Powderhorn Terrace	24
Powderhorn Inlet North	83	CDS Hydrodynamic Separator	12.9	13th Ave S and Powderhorn Terrace	21
Powderhorn Inlet Southeast	84	CDS Hydrodynamic Separator	68.8	3421 15th Ave S	36
	85	Sump Manhole	3.1	3329 14th Ave S	15
Powderhorn Inlet South	86	CDS Hydrodynamic Separator	81.2	13th Ave S and East 35th Street	30
Powderhorn Inlet West	87	CDS Hydrodynamic Separator	99.4	3318 10th Ave S opposite of house #3318	36

Methods

Site Installation

Monitoring equipment at each of the sites included: ISCO 2150 datalogger, 2105ci LTE combined interface module/modem, low-profile AV probe, and a 3700 ISCO sampler complete with tubing and intake strainer. Area velocity (AV) probes and intake strainers were oriented to point upstream, **Figure 5**. The equipment at the North Inlet was hung from eyebolts below grade in the manhole, while all the other sites had above-grade monitoring boxes with access holes for tubing and cables drilled through the manhole collars. Cables and tubing were anchored with zip-ties to the sidewall eyebolts or side-iron manhole ladders. Monitoring boxes were rectangular 4 ft x 3 ft x 3 ft locking wooden boxes which protected and housed both the sampler and datalogger equipment. The boxes were not able to keep out rodents, which occasionally chewed on cables and made nests under the equipment. Future above-ground installations will have all holes plugged with steel wool to deter rodent activity.

The dataloggers used cell phone modems to remotely upload data to the MPRB ISCO database server from Monday through Friday. A cell phone antenna was installed at each site to allow communication with the datalogger. The datalogger could also be remotely accessed to turn the samplers on/off, adjust the level, pacing, and triggers, or download data.

Sites were installed in late April/early May and began taking samples during a storm event on May 12, 2022. Sites were uninstalled in late October.

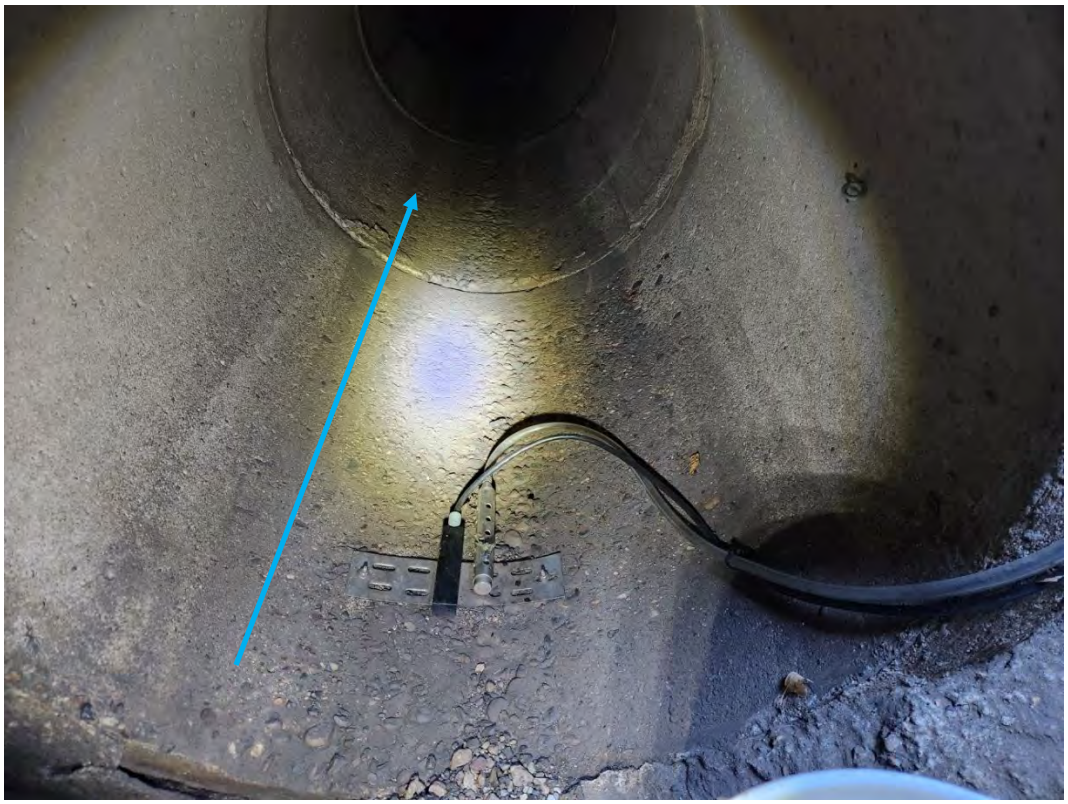


Figure 5. Photo of the AV probe and intake strainer at Powderhorn Inlet SE in October. The equipment is attached to a stainless-steel plate that is bolted into the pipe. The blue arrow indicates direction of water flow.

Sample Collection

All samplers were multiplexed, flow-paced, equipped with 24 one-liter bottles, 3/8-inch inner-diameter vinyl tubing, and an intake strainer. They collected four samples per 1-L bottle, and each sampler contained 24 1-L bottles. This allowed a maximum of 96 samples to be collected over a storm event and create a flow-weighted composite. The dataloggers were programmed to pulse the samplers after a 1-inch trigger and after a set volume or pacing had passed. The pacing depended on the size of the pipe at the site.

In 2022, all Powderhorn monitoring was done downstream of the CDS units to enable sampling of nutrient inputs to the lake. The samplers collected material less than 3/8 inches in size that bypassed over the internal weir or passed through the CDS chamber screen in addition to flow through the CDS unit. Solid material greater than 3/8 inches were not sampled, such as leaf litter, cigarette butts, plastic bags, or various other debris.

In previous years, the South, West, and Southeast Inlets had significant by-pass flows at the internal CDS overflow weirs. It is believed that this situation was caused by the CDS screens becoming plugged. When routine bypass occurs, water backs up the upstream pipes, past the CDS unit, and sand and solids settle in the upstream pipe. Bypass and in-pipe solids settling were not concerns in 2022 mainly due to the lack of significant storm events.

Monitoring Parameters and Methods

A list of the chemical parameters required by the NPDES permit for analysis of auto-monitored composite stormwater samples is shown in **Table 2**. NPDES permit-required chemistry methods, reporting limits and holding times for auto-monitored composite samples used in this project are also shown in this table.

Table 2. Chemistry parameters required for auto-monitored stormwater samples by the NPDES permit. Analysis method, reporting limit, and holding times for parameters analyzed by Instrumental Research, Inc. and Pace Laboratories.

Parameter	Abbreviation	Units	Method	Reporting Limit	Holding Time
Chemical Oxygen Demand	COD	mg/L	SM 5220-D	20 mg/L	28 days
Dissolved Organic Carbon	DOC	mg/L	SM 5310-C-00	1.5 mg/L	28 days
Chloride, Total	Cl	mg/L	SM 4500-Cl^- B	2.0 mg/L	28 days
Hardness	Hard	mg/L	SM 2350 C	5.0 mg/L	6 months
Copper, Total	Cu	µg/L	EPA 200.8	1 µg/L	6 months
Lead, Total	Pb	µg/L	EPA 200.8	0.10 µg/L	6 months
Zinc, Total	Zn	µg/L	EPA 200.7	20 µg/L	6 months
Nitrate/Nitrite, Total as N	NOx	mg/L	SM 4500-NO_3 E	0.030 mg/L	28 days
Total Nitrogen	TN	mg/L	Alkaline Persulfate Oxidation	0.500 mg/L	28 days
Phosphorus, Total Dissolved	TDP	mg/L	SM 4500-PE	0.010 mg/L	48 hours
Phosphorus, Total	TP	mg/L	SM 4500-PE	0.010 mg/L	48 hours
Solids, Total Dissolved	TDS	mg/L	SM 2540 C	5.0 mg/L	7 days
Solids, Total Suspended	TSS	mg/L	SM 2540 D	1.0 mg/L	7 days
Solids, Volatile Suspended	VSS	mg/L	EPA 160.4	2.0 mg/L	7 days

Results

Sample Collection

In 2022, rainfall grab and composite samples were collected during storms ranging from 0.10 to 1.23 inches of precipitation. Due to the regional drought, samples from storms with less than 0.10 inches of precipitation were sometimes included in the data. Snowmelt grab samples were collected from three snowmelt events at the Powderhorn Inlets S, SE, and W sites. Powderhorn Inlet N was inaccessible for grab sampling. **Table 3** shows the snowmelt grab samples collected. See **Chapter 24** for more information on grab sampling. **Table 4** shows the precipitation and flow-weighted composite storm samples collected. **Figure 6** shows what composite samples look like in the field. Precipitation was measured by a rain gauge at MPRB's southside service center located at 3800 Bryant Ave. S. in Minneapolis, MN. A precipitation event was defined as a storm greater than 0.10 inches and separated by eight hours or more from other precipitation.

The 2022 NPDES chemical concentrations and statistics for the composite samples collected at Powderhorn Inlets S, SE, W, and N can be seen in **Table 5** through **Table 8**. If less than values were present, half the value was used for statistical calculations. The statistics calculated for each site were the geometric mean (GEOMEAN), arithmetic mean, maximum (MAX), minimum (MIN), standard deviation (STDEV), number of samples, and coefficient of variance (CV). Note that the geometric means were calculated using only data from composite samples. Arithmetic means were calculated using data from composite and grab samples. If a sample was not analyzed and no data are presented it is marked NS for no sample, usually due to low volume. Storm event data and congruent flow data are found in **Table** 9. The geometric means in **Tables 5** through **Table 8** were used for load calculations, which are found in **Table 10** and **Table 11**.

Figure 6. Photo of ISCO 3700 autosampler with flow-weighted composite samples inside.

Table 3. The 2022 snowmelt grab events staff sampled or attempted to sample at the Powderhorn Inlets. X = quarterly grab sample. NS = No Sample.

Date	Powderhorn In S	Powderhorn In SE	Powderhorn In W
2/28/22	X	X	X
3/8/22	X	X	X
3/15/22	NS	NS	NS

Table 4. The 2022 rainfall grab events sampled or attempted to be sampled at the three Powderhorn Inlets. X = quarterly grab samples, X/C = Quarterly grab samples with a flow-paced composite. NS = No Sample.

Start Date	Start Time	End Date	End Time	Rain (inches)	Duration (hours)	Intensity (in/hour)	Hours since last rain	Powderhorn In S	Powderhorn In SE	Powderhorn In W
4/5/2022	10:15	04/06/22	5:45	0.5	19.5	0.026	34.75	X	X	X
5/25/2022	0:30	05/25/22	12:45	0.58	12.25	0.047	113.25	X/C	X/C	X/C
6/13/2022	6:00	06/13/22	8:00	0.09	2.00	0.045	47.75	NS	NS	NS
8/12/2022	4:00	08/12/22	7:45	0.84	3.75	0.224	101	X/C	X/C	X/C

Stormwater Chemistry

Table 5. Powderhorn Inlet N 2022 composite sample chemistry and statistics. NS = No sample. TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride, TSS = Total Suspended Solids, VSS = Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, FOG = Fat Oil and Grease, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

Date Sampled	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
5/11/2022	1.725	0.476	0.213	8.01	0.044	13.5	48	468	161	90.0	524	55.9	88.8	252	17.9
6/30/2022	1.299	0.704	0.610	NS	NS	NS	NS	5	140	68.0	NS	NS	NS	NS	NS
7/10/2022	1.278	0.379	0.277	7.281	NS	NS	NS	42	34	NS	NS	NS	NS	NS	NS
7/12/2022	1.182	0.257	0.139	2.13	0.354	7.0	36.0	231	89.0	82.5	165	43.0	52.4	182	15.1
7/26/2022	1.274	0.659	0.366	6.42	0.177	45.0	60.0	94.0	46.0	188	200	39.0	17.5	137	46.6
8/3/2022	1.346	0.535	0.088	6.70	<0.03	45.0	60.0	118	61.5	195	270	NS	NS	NS	NS
8/6/2022	0.596	0.302	0.182	2.04	0.332	4.5	30.0	54.5	29.0	85.0	77.3	26.6	7.6	120	15.3
8/8/2022	0.371	0.220	0.148	1.702	0.469	4.0	24.0	31.0	14.3	55.0	55.5	19.4	6.2	53.2	9.0
8/12/2022	0.531	0.196	0.126	NS	NS	7.3	28.0	63.3	29.3	NS	NS	NS	NS	NS	NS
8/17/2022	0.648	0.356	0.101	3.39	2.17	7.5	42.0	61.0	28.0	113	135	27.9	8.5	121	29.2
8/18/2022	0.393	0.150	0.088	1.56	1.50	3.0	22.0	117	39.8	37.5	99.1	25.4	20.8	96.8	5.1
8/19/2022	0.339	0.106	NS	2.20	0.94	3.5	20.0	141	49.0	37.5	113	30.6	25.2	107	4.7
8/28/2022	0.342	0.198	0.124	2.35	1.23	5.5	18.0	64.0	27.2	52.5	91.8	16.5	15.3	79.2	7.2
8/29/2022	NS	NS	0.102	NS	NS	8.0	30.0	28.8	17.2	<5.0	71.6	NS	NS	NS	NS
MEAN (geometric)	0.740	0.301	0.16	3.30	0.35	8.16	32.9	68.1	42.4	59.0	131	29.6	18.6	117	12.7
MEAN (arithmetic)	0.87	0.35	0.20	3.98	0.72	12.8	35.4	108	54.7	83.8	164	31.6	26.9	128	16.7
MAX	1.72	0.70	0.61	8.01	2.17	44.9	60.0	468.	161	195	524	55.9	88.8	252	46.6
MIN	0.34	0.11	0.09	1.56	0.02	3.00	18.0	4.6	14.3	2.5	55.5	16.5	6.20	53.2	4.70
MEDIAN	0.65	0.30	0.14	2.35	0.41	7.16	30.0	63.7	36.9	75.2	113	27.9	17.5	120.0	15.1
STDEV	0.49	0.19	0.15	2.55	0.72	15.3	14.2	118	45.0	58.0	135	12.4	27.1	59.0	13.6
NUMBER	13	13	13	11	10	12	13	14	14	12	11	9	9	9	9
CV	0.559	0.552	0.753	0.640	0.989	1.19	0.401	1.093	0.824	0.692	0.826	0.393	1.007	0.463	0.82

Table 6. Powderhorn Inlet S 2022 chemistry data. Grab samples are denoted with a * by Date Sampled. Values in red were flagged during monthly blind QAQC performance checks with the contracting laboratory. NS = No sample. TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride, TSS = Total Suspended Solids, VSS = Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, FOG = Fat Oil and Grease, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

Date Sampled	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
2/28/2022*	1.02	0.201	0.120	6.42	0.490	3599	110	254	106	5653	449	35.5	583	48	37	320	26
3/8/2022*	0.635	0.191	<0.003	6.38	0.450	1450	76	116	48	2443	236	14.3	190	31	17.3	133	19
4/5/2022*	0.277	0.064	0.060	2.13	0.545	60	26	47	19	172	76	<5.0	1439	22	14	73	15
5/11/2022	0.746	0.224	0.050	4.03	0.119	5	30	217	84	65	202	NS	NS	31	58	98	9
5/25/2022*	0.428	0.164	0.114	1.66	0.172	8	28	39	26	63	75	<5.0	2987	17	9	66	14
5/25/2022	0.580	0.361	0.072	1.94	0.030	9	36	38	30	90	92	NS	NS	27	8	60	18
5/30/2022	0.839	0.197	0.091	3.40	0.550	9	38	228	80	93	211	NS	NS	39	80	167	13
6/30/2022	1.25	0.430	0.400	NS	NS	NS	NS	3	158	74	NS	NS	NS	NS	NS	NS	NS
7/5/2022	0.990	0.310	0.130	2.98	0.070	25	52	84	30	143	96	NS	NS	26	15	84	30
7/7/2022	2.27	0.175	0.088	2.97	NS	NS	NS	100	45	NS	NS	NS	NS	NS	NS	NS	NS
7/10/2022	1.92	0.472	0.344	6.04	NS	NS	NS	109	62	NS	NS	NS	NS	NS	NS	NS	NS
7/12/2022	1.44	0.324	0.151	1.78	0.066	25	92	292	108	120	180	NS	NS	43	63	172	21
7/26/2022	1.31	0.618	0.239	4.50	0.623	35	88	63	41	265	199	NS	NS	NS	NS	NS	NS
8/3/2022	2.49	1.21	0.470	7.61	NS	45	120	61	33	308	320	NS	NS	NS	NS	NS	NS
8/6/2022	0.816	0.294	0.188	2.73	0.311	7	38	115	54	105	199	NS	NS	38	24	126	21
8/8/2022	0.431	0.119	0.068	1.43	0.219	4	20	89	43	55	109	NS	NS	24	17	73	8
8/12/2022*	0.178	0.107	0.092	0.83	0.262	1	14	18	8	40	49	<5.0	NS	8	4	39	5
8/12/2022	0.350	0.117	0.095	1.98	0.523	3	20	58	29	55	58	NS	NS	22	14	79	8
8/18/2022	0.772	0.229	0.050	2.23	2.19	9	48	96	54	134	172	NS	NS	28	23	129	32
8/18/2022	0.439	0.117	0.051	1.07	1.06	5	28	141	58	55	183	NS	NS	31	49	133	7
8/19/2022	0.438	0.098	NS	2.68	0.748	4	26	211	87	53	152	NS	NS	39	74	149	5
8/28/2022	0.424	0.175	0.097	2.71	1.19	7	26	130	59	65	97	NS	NS	22	39	92	8

Table 6 (Continued). Powderhorn Inlet S 2022 statistics.

	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
GEOMEAN (composite only)	0.892	0.267	0.130	2.95	0.292	10.3	41.3	85.3	55.1	98.5	146	-	-	29.9	28.9	106	13.4
ARITHMETIC MEAN (all samples)	0.911	0.282	0.148	3.21	0.534	280	48.2	114	57.4	502	166	11.5	1300	29.2	32.0	117	15.3
MAX	2.49	1.21	0.470	7.61	2.19	3599	120	292	158	5652	449	35.5	2987	48.7	80.0	320	32.0
MIN	0.178	0.064	0.050	0.828	0.030	1.00	14.0	2.58	8.00	40.0	48.6	2.50	190	7.70	4.30	39.0	4.90
MEDIAN	0.759	0.199	0.096	2.71	0.467	9.00	36.0	98.0	51.0	91.3	172	2.50	1011	27.9	22.8	98.0	13.8
STDEV	0.640	0.249	0.121	1.93	0.528	868	32.5	79.8	35.0	1321	98.6	14.4	1240	10.2	24.4	65.1	8.64
NUMBER	22	22	20	21	18	19	19	22	22	20	19	5	4	17	17	17	17
COV	0.702	0.883	0.821	0.599	0.988	3.11	0.674	0.700	0.610	2.63	0.594	1.26	0.954	0.349	0.763	0.555	0.566

Table 7. Powderhorn Inlet SE 2022 stormwater chemistry and statistics. Grab samples are denoted with a * by Date Sampled. Values in red were flagged during monthly blind QAQC performance checks with the contracting laboratory. NS = No sample. TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride, TSS = Total Suspended Solids, VSS = Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, FOG = Fat Oil and Grease, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

Date Sampled	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
2/28/2022*	1.05	0.15	0.08	7.09	0.39	5098	160	258	106	8132	455	33.7	97	46	38	322	32
3/8/2022*	0.58	0.17	0.05	5.74	0.36	2199	120	78	33	3813	236	15.8	137	25	11	112	22
4/5/2022*	0.25	0.07	0.06	2.43	0.46	20	21	39	17	105	44	<5.0	NS	15	10	59	14
5/11/2022	0.59	0.14	0.07	2.93	0.32	3	16	249	104	45	155	NS	NS	29	36	71	6
5/25/2022*	0.37	0.18	0.14	1.53	0.28	6	30	21	15	78	59	<5.0	4106	25	4	45	15
5/25/2022	0.54	0.38	0.09	2.24	<0.04	9	38	35	26	100	97	NS	NS	26	8	70	16
5/30/2022	0.89	0.23	0.13	3.75	0.26	8	28	324	121	65	228	NS	NS	37	89	209	10
6/30/2022	1.33	0.27	0.16	NS	NS	NS	NS	3	260	127	NS	NS	NS	NS	NS	NS	NS
7/5/2022	0.88	0.36	0.13	3.60	<0.04	17	84	63	26	134	114	NS	NS	26	10	78	31
7/12/2022	1.65	0.32	0.15	5.88	<0.04	6	80	361	147	97	333	NS	NS	41	69	196	19
8/12/2022*	0.19	0.11	0.09	0.96	0.22	<2	16	14	6	40	33	<5.0	NS	7	3	33	5
8/12/2022	0.40	0.11	0.11	1.89	0.39	<2	20	85	38	42	85	NS	NS	23	15	67	7
8/17/2022	0.78	0.32	0.03	3.21	2.65	7	40	110	51	117	174	NS	NS	33	24	144	30
GEOMEAN (composite only)	0.802	0.245	0.0987	3.16	0.117	5.51	36.8	81.2	70.9	83.6	152	-	-	30.0	25.0	106	14.1
ARITHMETIC MEAN (all samples)	0.730	0.216	0.100	3.44	0.448	615	54	126	73	992	168	11	1447	28	26	117	17
MAX	1.65	0.376	0.164	7.091	2.652	5098	160	361	260	8132	455	34	4106	46	89	322	32
MIN	0.190	0.075	0.033	0.963	0.015	1	16	3	6	40	33	3	97	7	3	33	5
MEDIAN	0.590	0.184	0.092	3.07	0.301	7	34	78	38	100	134	3	137	26	13	75	16
STDEV	0.427	0.102	0.041	1.90	0.711	1546	47	126	73	2380	127	14	2303	11	27	86	10
NUMBER	13	13	13	12	12	12	12	13	13	13	12	5	3	12	12	12	12
COV	0.585	0.473	0.41	0.553	1.588	2.52	0.858	1.00	0.997	2.40	0.760	1.205	1.59	0.381	1.038	0.734	0.57

Table 8. Powderhorn Inlet W 2022 stormwater chemistry. Grab samples are denoted with a * by Date Sampled. Values in red were flagged during monthly blind QAQC performance checks with the contracting laboratory. NS = No sample. TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride, TSS = Total Suspended Solids, VSS = Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, FOG = Fat Oil and Grease, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

Date Sampled	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
2/28/2022*	1.17	0.09	0.07	5.23	0.14	3699	160	472	250	5875	521	44	97	66	66	460	26
3/8/2022*	0.55	0.21	0.18	4.42	0.51	1300	84	67	29	2043	171	8	84	21	10	116	16
4/5/2022*	0.33	0.06	0.04	2.34	0.41	80	32	79	29	180	103	<5.0	NS	28	24	95	13
5/11/2022	0.70	0.18	0.07	3.61	0.28	6	25	211	79	47	123	NS	NS	35	64	105	7
5/25/2022*	0.42	0.19	0.13	1.54	0.24	10	26	48	36	67	58	<5.0	1935	20	21	103	13
5/25/2022	0.54	0.38	0.10	2.19	0.08	9	30	28	20	85	77	NS	NS	22	7	51	14
6/30/2022	1.21	0.49	0.48	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
7/5/2022	1.41	0.27	0.13	6.17	0.07	25	80	155	74	195	184	NS	NS	NS	NS	NS	NS
7/13/2022	0.78	0.17	0.06	1.36	0.21	7	96	314	116	70	104	NS	NS	36	43	106	14
7/27/2022	1.05	0.41	0.17	4.01	0.54	40	80	73	38	225	184	NS	NS	41	17	85	52
8/3/2022	1.50	0.64	0.07	7.37	0.09	40	108	131	68	273	338	NS	NS	NS	NS	NS	NS
8/6/2022	0.83	0.22	0.13	3.27	0.54	7	40	135	49	110	221	NS	NS	40	41	155	23
8/7/2022	0.34	0.10	0.05	1.07	0.22	3	16	37	17	52	94	NS	NS	20	12	55	6
8/12/2022*	0.17	0.11	0.09	0.98	0.21	2	12	14	8	25	26	<5.0	NS	8	4	34	4
8/12/2022	0.35	0.11	0.09	1.44	0.57	2	18	76	36	45	52	NS	NS	23	19	64	5
8/18/2022	0.69	0.37	0.08	5.57	2.96	9	60	35	21	137	136	NS	NS	17	12	74	34
8/18/2022	0.36	0.11	0.04	1.01	0.98	4	22	94	40	45	94	NS	NS	31	35	98	6
8/19/2022	0.52	0.09	NS	2.41	0.72	5	27	247	86	47	131	NS	NS	36	89	163	4
8/28/2022	0.41	0.19	0.13	2.00	1.10	5	24	115	55.5	52.5	86	NS	NS	18	35	81	8

Table 8 (Continued). Powderhorn Inlet W 2022 stormwater statistics. TP = Total Phosphorus, TDP = Total Dissolved Phosphorus, SRP = Soluble Reactive Phosphorus, TN = Total Nitrogen, NOx = Nitrate/Nitrite, Cl = Chloride, TSS = Total Suspended Solids, VSS = Volatile Suspended Solids, TDS = Total Dissolved Solids, COD = Chemical Oxygen Demand, FOG = Fat Oil and Grease, Cu = Copper, Pb = Lead, Zn = Zinc, DOC = Dissolved Organic Carbon.

	TP mg/L	TDP mg/L	SRP mg/L	TN mg/L	NOx mg/L	Cl mg/L	Hardness mg/L	TSS mg/L	VSS mg/L	TDS mg/L	COD mg/L	FOG mg/L	E. Coli MPN	Cu µg/L	Pb µg/L	Zn µg/L	DOC mg/L
GEOMEAN (composite only)	0.677	0.221	0.0992	2.62	0.370	8.33	39.0	99.8	46.1	85.7	125	-	-	27.5	26.1	88.1	11.2
ARITHMETIC MEAN (all samples)	0.702	0.231	0.118	3.11	0.548	292	52	130	58	532	150	12	705.3	29	31	115	15
MAX	1.50	0.638	0.481	7.372	2.961	3699	160	472	250	5875	521	44	1935	66	89	460	52
MIN	0.170	0.057	0.042	0.978	0.069	2	12	14	8	25	26	3	83.9	8	4	34	4
MEDIAN	0.550	0.192	0.092	2.375	0.345	8	31	86	39	77	113	3	97	25	23	97	13
STDEV	0.394	0.157	0.100	1.96	0.673	903	41	117	55	1411	118	18	1065	14	24	98	13
NUMBER	19	19	18	18	18	18	18	18	18	18	18	5	3	16	16	16	16
COV	0.561	0.680	0.847	0.631	1.23	3.09	0.78	0.91	0.95	2.65	0.78	1.53	1.51	0.471	0.78	0.85	0.85

Stormwater Hydrographs

The hydrographs for level and flow measured from May through November at the Powderhorn Inlets N, SE, S, and W are presented in **Figures 7** through **Figures 10**.

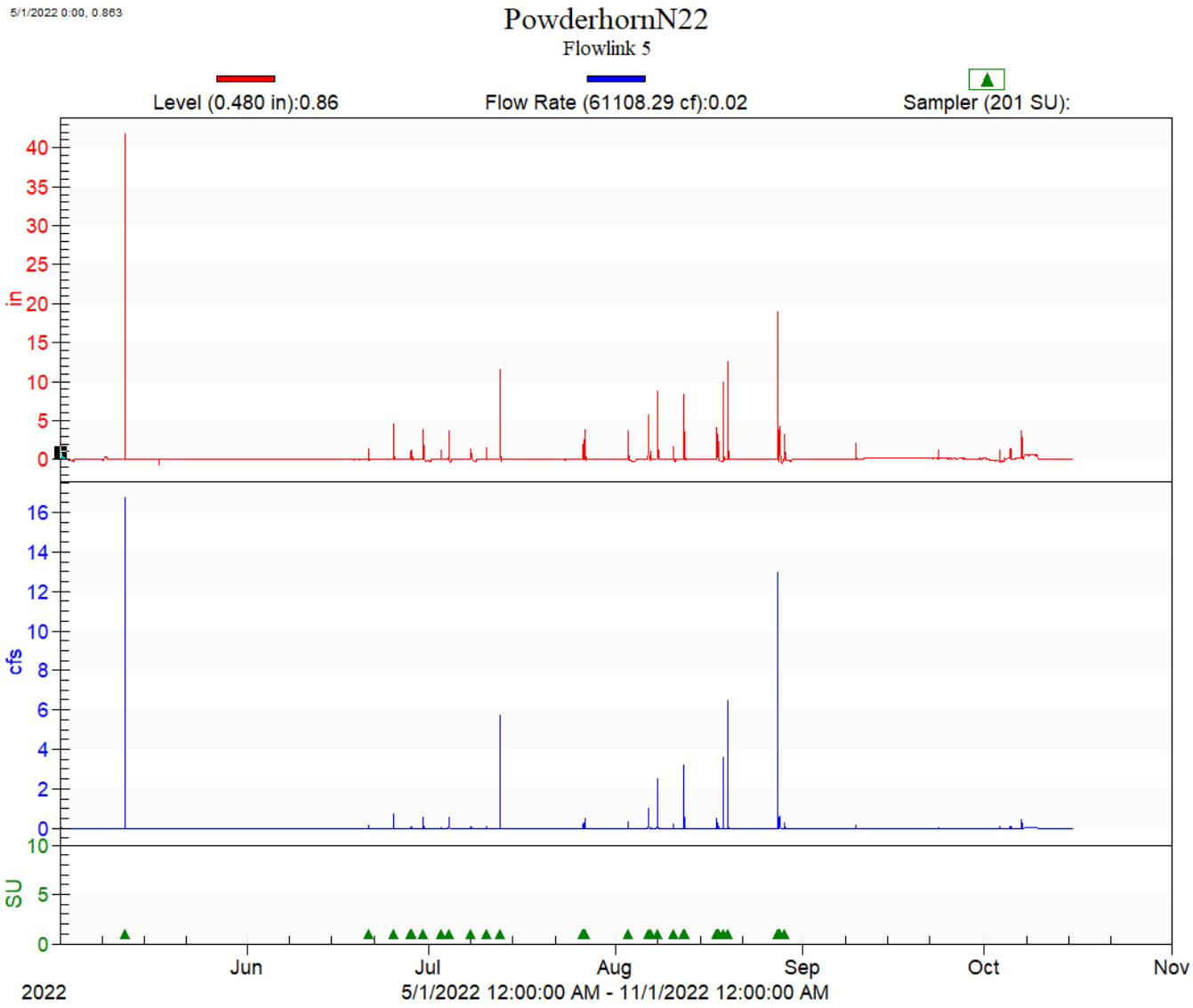


Figure 7. Powderhorn Inlet N hydrograph of level and flow from April 29 to October 27, 2022. Green triangles represent when the auto-sampler attempted to take a sample.

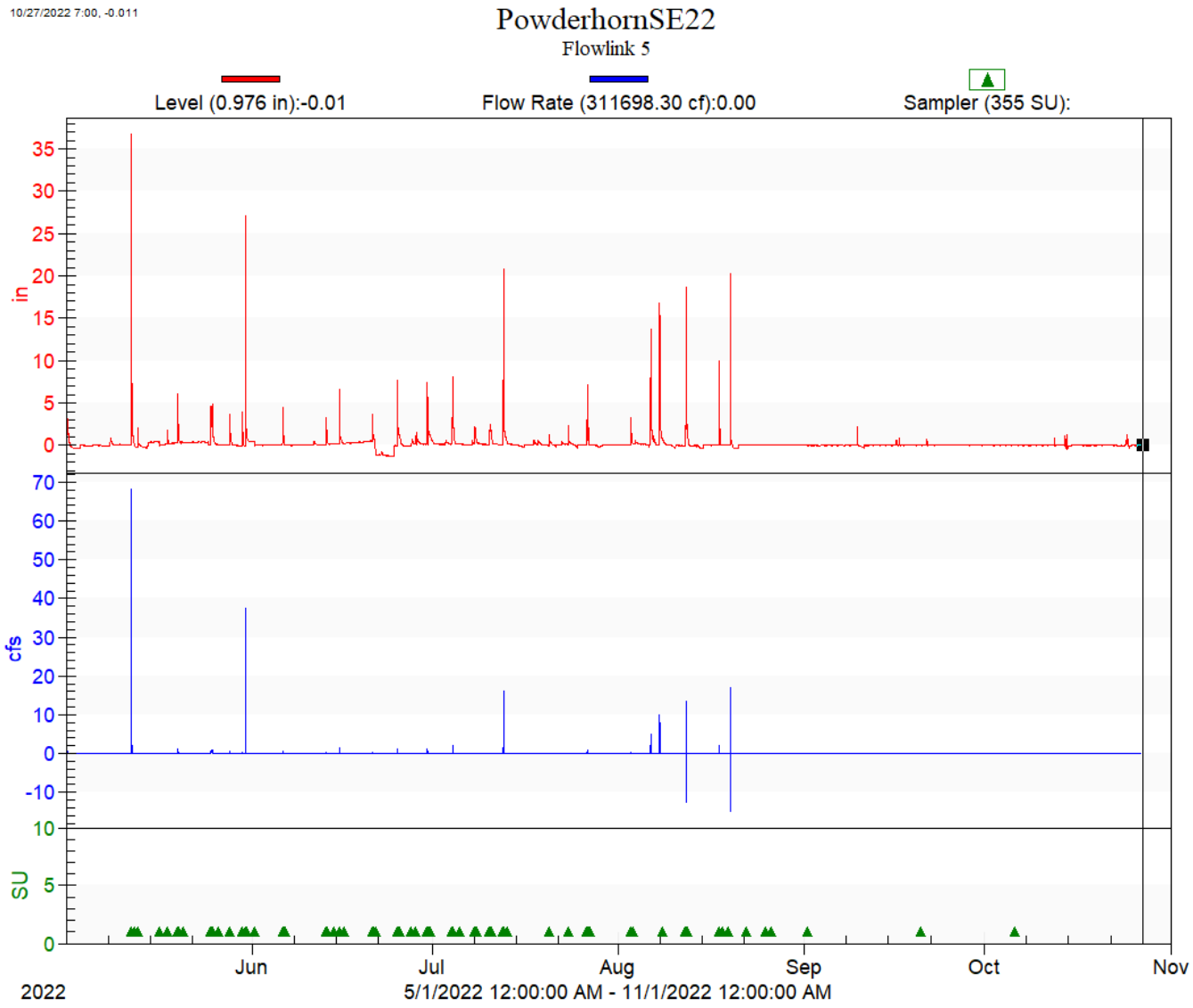


Figure 8. Powderhorn Inlet SE hydrograph of level and flow from April 27 to October 27, 2022. Green triangles represent when the auto-sampler attempted to take a sample.

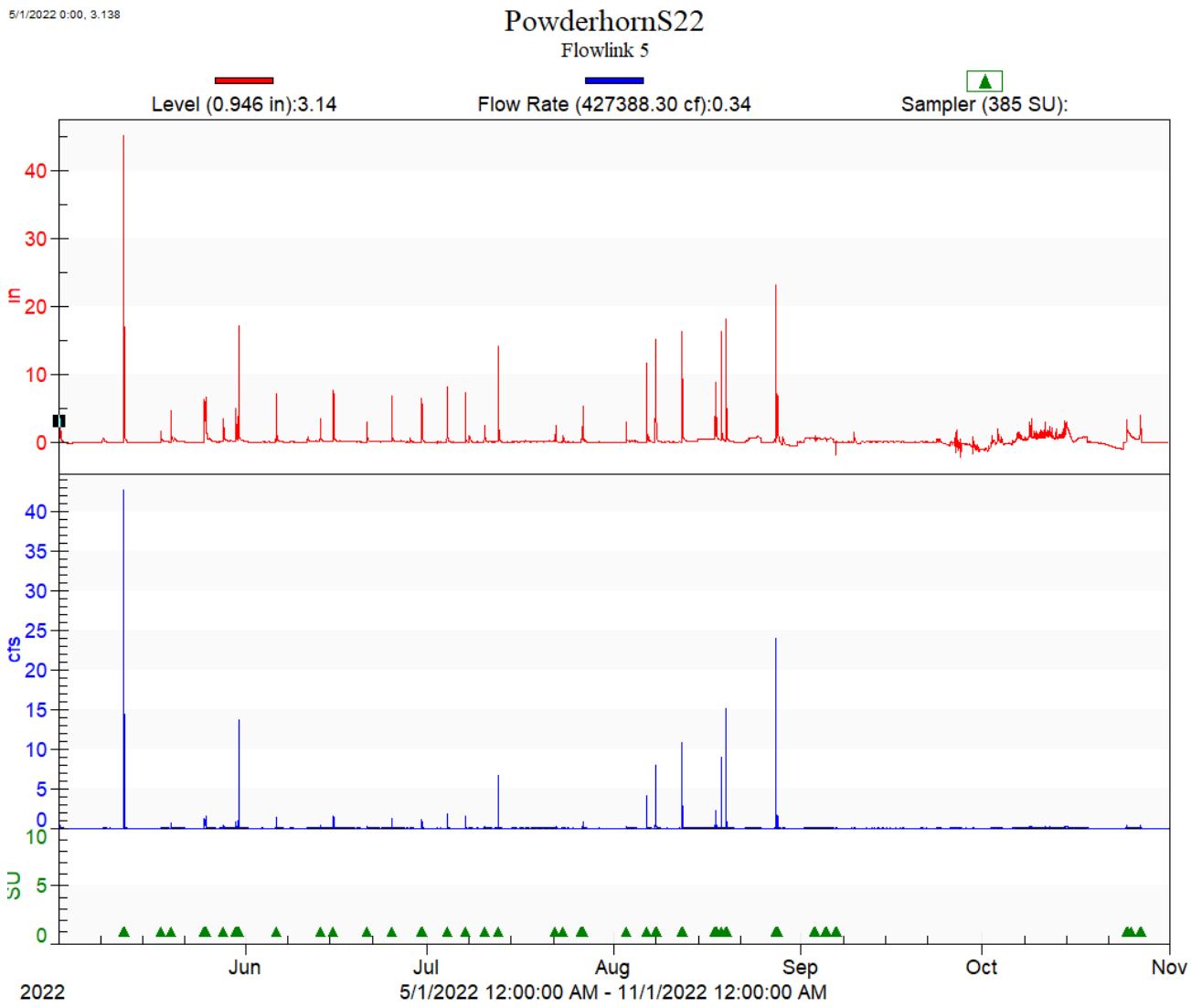


Figure 9. Powderhorn Inlet S hydrograph of level and flow from April 29 to October 27, 2022. Green triangles represent when the auto-sampler attempted to take a sample.

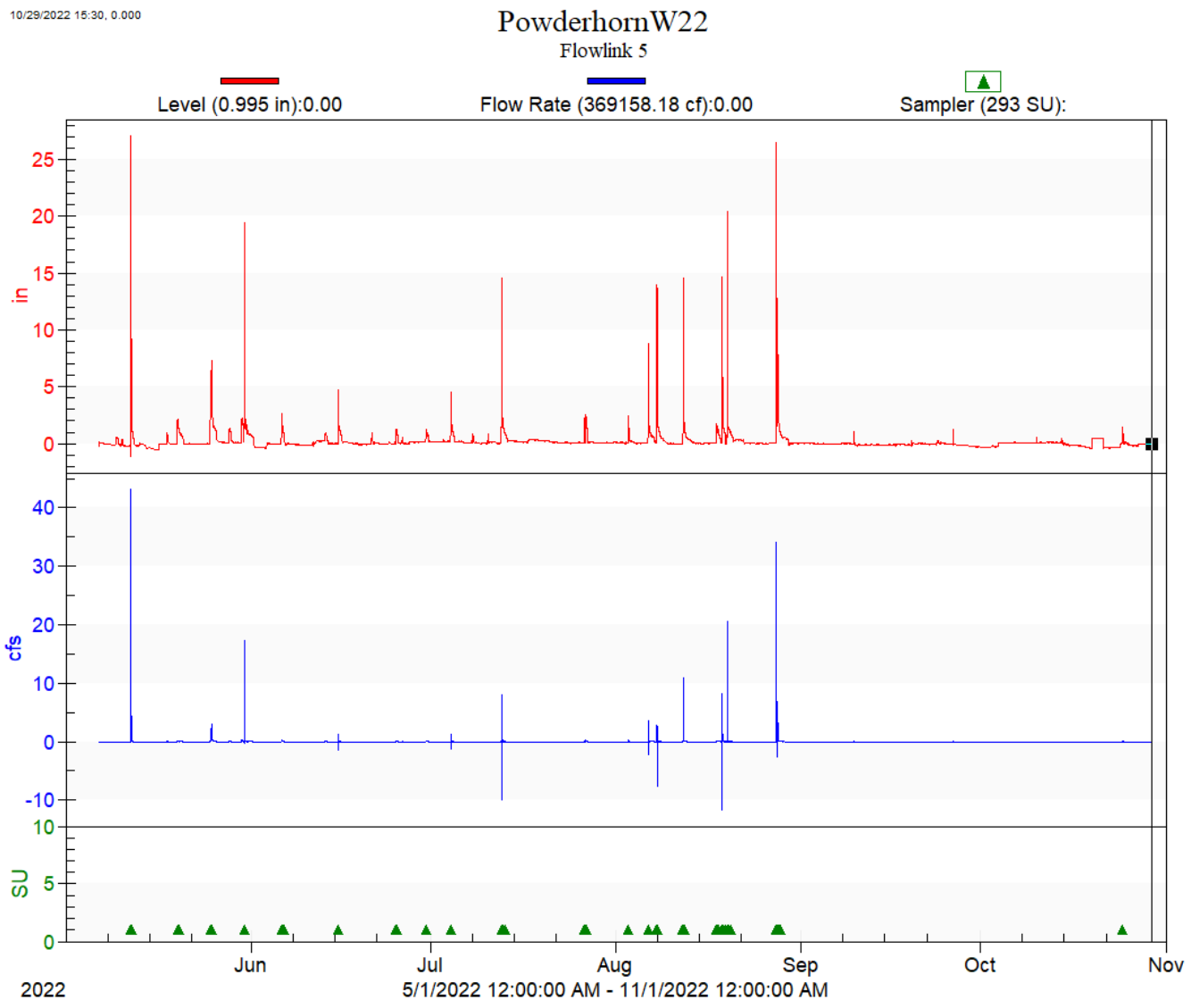


Figure 10. Powderhorn Inlet W hydrograph of level and flow from May 6 to October 27, 2022. Green triangles represent when the auto-sampler attempted to take a sample.

Table 9. Composite sampling storm events and corresponding flow data from each monitoring site. NS = no sample. Precipitation data was measured at the Minneapolis-St. Paul International Airport (MSP). Flow data was estimated using the hydrographs generated by the auto-samplers, see Figures 7 to 10.

Rain Event Date	Duration (hours)	Precip. (inches)	Pow In N (cf)	Pow In SE (cf)	Pow In S (cf)	Pow In W (cf)
5/11/2022	2.75	1.23	4150	100968	90305	99987
5/25/2022	13.8	0.6	NS	14662	28726	44043
5/30/2022	2.75	0.62	NS	35476	29647	NS
6/30/2022	3.50	0.07	714	2968	2665	1479
7/5/2022	4.25	0.24	NS	9171	6090	1578
7/7/2022	7.75	0.09	NS	NS	1020	NS
7/10/2022	4.00	0.11	522	NS	931	NS
7/12/2022	9.25	0.38	7406	18210	12828	14729
7/26/2022	6.25	0.16	2637	NS	3009	5129
8/3/2022	1.50	0.02	1277	NS	908	1979
8/6/2022	12.0	0.58	6136	NS	16451	1339
8/7/2022	3.50	0.78	8558	NS	36469	3559
8/12/2022	3.75	0.84	13333	30261	34725	37935
8/17/2022	7.50	0.14	4376	5192	NS	NS
8/18/2022	2.00	0.25	NS	NS	11976	10781
8/19/2022	6.75	0.34	8697	NS	15143	25637
8/28/2022	0.250	0.02	5404	NS	10770	17298
8/29/2022	1.00	0.01	955	NS	NS	NS

Load calculations using the geometric mean for each chemical parameter at each site are shown in **Table 10** and **Table 11**. Loads were calculated in pounds for each site by multiplying the geometric mean for each parameter by the liters of flow and a conversion factor.

It should be noted that while these load inputs are measured data, the flow-weighted samples were only collected from May through October, and the snowmelt samples were grab samples. The flow-weighted sample measurement period had approximately 10.39 inches of precipitation, while the yearly total was 22.97 inches. In 2022, Minneapolis received significantly less precipitation than the 29-year annual average precipitation of 31.62 inches (NWS/NOAA). See **Chapter 29** for more information on climate.

Table 10. The 2022 flow totals and load calculations for Powderhorn Inlets N, S, SE, and W. Orange highlights indicate the largest load for a parameter.

Site Name	Pow Inlet N	Pow Inlet S	Pow Inlet SE	Pow Inlet W
Total Flow (L)	3,343,213	13,185,230	11,936,967	10,450,247
TP (lb)	5.46	25.9	21.1	15.6
TDP (lb)	2.22	7.77	6.46	5.10
SRP (lb)	1.21	3.77	2.60	2.28
TN (lb)	24.3	85.6	83.2	60.3
NOx (lb)	2.55	8.49	3.07	8.52
Cl (lb)	60.1	299	145	192
Hardness (lb)	237	1201	969	900
TSS (lb)	502	2478	2137	2299
VSS (lb)	312	1602	1865	1063
TDS (lb)	435	2863	2201	1976
COD (lb)	967	4243	4013	2874
Cu (lb)	0.218	0.869	0.790	0.633
Pb (lb)	0.137	0.841	0.658	0.602
Zn (lb)	0.859	3.07	2.80	2.03
DOC (lb)	93.8	389	372	257

Table 11. The 2022 load per area calculations for Powderhorn Inlets N, S, SE, and W. Green highlights indicate the largest load/acre for a parameter.

Site	Pow Inlet N	Pow Inlet S	Pow Inlet SE	Pow Inlet W
Acreage	12.91	81.17	70.0	99.39
TP (lb/acre)	0.423	0.319	0.301	0.157
TDP (lb/acre)	0.172	0.096	0.092	0.051
SRP (lb/acre)	0.093	0.046	0.037	0.023
TN (lb/acre)	1.88	1.05	1.19	0.606
NOx (lb/acre)	0.197	0.105	0.044	0.086
Cl (lb/acre)	4.66	3.69	2.07	1.93
Hardness (lb/acre)	18.4	14.8	13.8	9.05
TSS (lb/acre)	38.9	30.5	30.5	23.1
VSS (lb/acre)	24.2	19.7	26.6	10.7
TDS (lb/acre)	33.7	35.3	31.4	19.9
COD (lb/acre)	74.9	52.3	57.3	28.9
Cu (lb/acre)	0.0169	0.0107	0.0113	0.0064
Pb (lb/acre)	0.0106	0.0104	0.00940	0.00606
Zn (lb/acre)	0.0666	0.0378	0.0400	0.0204
DOC (lb/acre)	7.26	4.79	5.32	2.59

Discussion

Pollutant Load Calculations

The largest overall external load to Powderhorn Lake appears to be coming from Powderhorn Inlet S, which drains an area of 81.17 acres. This watershed produced the largest overall load for the following chemical parameters:

- TP
- TDP
- SRP
- TN
- Cl
- Hardness
- TSS
- TDS
- COD
- Cu
- Pb
- Zn
- DOC

When breaking down the load calculations into load per acre, the Powderhorn Inlet N site (12.91 acres) had the highest load per acre for all chemical parameters except VSS and TDS. This may be in part due to equipment issues that prevented flow from being recorded at the end of the monitoring season, which inflated these numbers. The largest watershed is Powderhorn Inlet W (99.4 acres), which registered some of the lowest numbers out of all sites for both loads and load/acre in most parameters. Powderhorn Inlet W did record the highest load for NOx, but when taking its size into account this was not notable. Powderhorn Inlet SE (68.75 acres) had similar loads as Powderhorn Inlet S, though slightly lower, and had the highest load and load/acre for VSS.

Powderhorn Inlets S and SE should be a high priority in reducing external loading to Powderhorn Lake. It is unclear why these mostly residential watersheds would be producing such a large external load, but the effects of this nutrient loading on Powderhorn Lake are apparent. The lake was frequently covered by HABs during 2022 to the point of disrupting recreation activities due to high levels of cyanotoxins in the water, **Figure 11**.

Figure 11. A blue green algae bloom at Powderhorn Lake during the summer of 2022. The inlet pictured on the left connects directly to the SE Inlet stormwater monitoring site.

Monitoring Challenges

The 2022 stormwater monitoring season posed several challenges. Primarily, the lack of significant precipitation events prevented staff from collecting as many storm samples as intended. Minneapolis received 8.65 fewer inches of precipitation this year compared to the 29-year normal, according to NOAA, and 3 inches fewer than in 2021. Much of the rainfall during the monitoring season came in the form of small, short-lived spurts of precipitation, and did not amount to enough flow to trigger the auto samplers. This was especially true during the final months of the monitoring season when, according to the United States Drought Monitor (USDM), the Twin Cities area was in a severe drought. The timing of the storms also posed some difficulties, as many significant precipitation events occurred outside of the workday or over the weekend, hindering staff's ability to collect samples in a timely manner. Several important chemical parameters have limited holding times and were not able to be analyzed after more than 48 hours had passed.

In addition to climatological challenges, equipment failures and environmental factors also affected the stormwater monitoring practices. Two of the Powderhorn sites needed an area velocity probe replaced, twice at Powderhorn N and three times at Powderhorn SE, due to damage done by storms or animals. The N and SE Inlets had problems with animals chewing on cables and knocking over antennas. The N and W Inlets had equipment washed away during large early-season storm events. In the future, more steps will be taken to protect equipment from these influences, such as plugging holes in sampling boxes with steel wool to deter rodents.

CDS Unit Functionality

The CDS units around Powderhorn Lake have been malfunctioning due to significant clogging and sediment deposition in the upstream pipes and within the units themselves. When the units clog, they become anoxic and solids break down into smaller-sized or dissolved material which then exits through the CDS screens during the next storm event. A clogged CDS unit provides minimal treatment since water will bypass the unit entirely when it cannot exit through the screen. The City of Minneapolis has observed that the external side of the CDS screens can become clogged, but there are no access ports to easily clean them. City of Minneapolis staff are exploring options that will allow for access and cleaning of the external screens to ensure CDS functionality.

In 2022, individual CDS unit inlet/outlet efficacy was not evaluated. In the short-term, to reduce the external load to Powderhorn Lake, the CDS units should be retrofit to allow for thorough cleaning and more frequent maintenance. Future monitoring of individual CDS unit inlet/outlet and any bypass may be needed to determine if the units are working effectively and to determine an appropriate maintenance schedule. Due to higher amounts of overall loading coming from the S and SE drainage areas, these could be designated priority watersheds for enhanced street sweeping and public educational activities or other best management practice installations.

Conclusions

Pollutant loads to Powderhorn Lake were calculated using data collected during the monitoring season.

- Load calculations were completed for each Powderhorn Lake watershed monitored and key contributors were identified as the S and SE watersheds. This information can be used to assist in any future external load reduction plans.
- Powderhorn Inlets S and SE were the watershed that had the highest loading per acre and the highest loading based on total flow. Both watersheds registered higher levels of TP compared to the others.

CDS unit functionality was assessed and findings were consistent with previous years of the study.

- CDS units at Powderhorn Lake are often clogged with debris and unable to function as designed.
- Units are effective at filtering stormwater until their external screens clog, allowing stormwater to bypass the units and proceed downstream with minimal treatment.
- Units should be retrofitted to have maintenance access ports for cleaning of the external screens or replaced with a different design that does not have issues with clogging.
- CDS units 84 and 86 should be the priority to decrease loading to Powderhorn Lake.

Monitoring challenges mainly included equipment failures from natural causes and a limiting amount of precipitation.

- The Twin Cities area was in a drought for most of the monitoring season, limiting the number of stormwater samples collected.
- Multiple sites had equipment failures and needed replacement during the monitoring season. The damage to the sites was mainly from rodents chewing cables and large storms ripping equipment off of their anchors.

Most NPDES Permit provisions for stormwater monitoring were met in 2022.

- All monitoring for the NPDES permit as it applied to this project was attempted to be completed, see **Table 12**. Flow monitoring was completed starting between April 27 and May 6 and ending on October 27.
- At least ten flow-weighted composite storms were collected and analyzed for NPDES chemistry for Inlets N, S, and W. Only eight samples were collected at Inlet SE due to multiple equipment failures throughout the monitoring season.
- Quarterly grab samples were taken and analyzed for NPDES chemistry, FOG, and *E. coli* at all sites except Powderhorn Inlet N, which was deemed inaccessible for grab sampling in 2021.

Table 12. Summary of stormwater sampling at Powderhorn Lake in 2022.

Site Name	Powderhorn Inlet N	Powderhorn Inlet S	Powderhorn Inlet SE	Powderhorn Inlet W
# Of grab samples	-	5	5	5
# Of composite samples	14	17	8	14

Hoyer and Windom Green Stormwater Infrastructure Monitoring

Background

The purpose of the Hoyer and Windom Green Stormwater Infrastructure (GSI) monitoring is to better understand how effective these structures are at flood control and reducing the impacts of stormwater runoff. A secondary goal is to assess the performance of different GSI site designs in natural conditions and use that information to enhance future designs. Due to an ordinance change, the City of Minneapolis is building numerous small-footprint infiltration/filtration basins throughout the city. Many of these GSI Best Management Practices (BMPs) treat less than 1 acre of impervious surface. The City of Minneapolis chose two GSI sites to be monitored 2022, Hoyer and Windom. This was the second year this project was conducted.

This project is a partnership between the City of Minneapolis, Saint Anthony Falls Hydrology Laboratory (SAFL) at the University of Minnesota, the Mississippi Watershed Management Organization (MWMO), and the Minneapolis Park and Recreation Board (MPRB). The funding, survey, and GIS data used in the project were supplied by the City of Minneapolis. Monitoring of rainfall, flow, infiltration tests, and flood functionality tests were the responsibility of both the City and SAFL. Public outreach and education were the responsibility of MWMO. Confined space entry, soil sampling/testing, and monthly observational field inspection data were the responsibility of the MPRB.

The Hoyer GSI site is in Northeast Minneapolis and includes three different basins located in the same neighborhood, shown in **Figure 1**. They drain approximately 0.072 acres of a residential watershed, of which 0.0407 acres are impervious, and were designed primarily for flood control. Hoyer A is at the southeast corner of 36 ½ Avenue NE and Fillmore Street NE and has been monitored since 2021. Two additional sites were added to the project in 2022: Hoyer B at the

northwest corner of that same intersection, and Hoyer C on the southeast corner of 36 ½ Avenue NE and Buchanan Street SE. All sites had underdrain caps and boots installed on July 19th, 2022. Each site has a brick-filtered splash pad pretreatment basin and an overflow inlet.

Figure 1. The Hoyer A (1), B (2), and C (3) GSI basins in the summer of 2022 , and site locations shown in map view (4).

The Windom GSI site, shown in **Figure 2,** is in Southwest Minneapolis on the block of West 62nd Street and Dupont Avenue South. It drains approximately 3.67 acres of a residential watershed, of which 0.506 acres are impervious. The Windom site has a capped underdrain and was designed for stormwater infiltration. The site includes five Rain Guardian Bunker pretreatment basins along a main bioretention channel.

Figure 2. The Windom GSI basin in fall of 2022 in southwest Minneapolis. A Rain Guardian Bunker pretreatment basin filled with leaves can be seen in the lower left corner.

Methods

Equipment Setup

Nova Lynx tipping bucket rain gauges were installed at Hoyer A and Windom with HOBO Pendant dataloggers, shown in **Figure 3**. HOBO MX2001-01-SS water level loggers were installed at the surface grade of both sites to determine ponding drawdown time as seen in **Figure 4**. One HOBO MX2001-04-SS water level logger was installed in the underdrain behind a spring ring V-notch weir at Hoyer A, shown in **Figure 5**. A HOBO water level logger was not installed in the Windom underdrain in 2022, but it may be installed in 2023. Hoyer and Windom each had HOBO surface level and rain gauge equipment installed on September 30th, 2021.

Figure 3. A rain gauge being installed at the Hoyer GSI site.

Figure 4. A surface HOBO water level logger being installed at the Windom GSI site.

Infiltration Testing

The sites were flooded using a truck full of non-potable water to discharge a known volume into the GSI curb-cut inlet. The purpose of the infiltration test was to flood the GSI basin and measure: 1) the time it took for saturation and ponding to occur, and 2) the time it took for any ponding to draw down to the surface. The intention was to first simulate a 1-inch design storm and see if there was ponding or infiltration in the GSI. Then, additional water was added to test the limits of the BMP by inundating it beyond its design capacity and observe the effects. A flood/hydrant test was conducted at Hoyer A and C on October 4th, 2022, shown in **Figure 5**.

Figure 5. A flood test on 10/4/2022 at Hoyer A. Sandbags were used to direct flow into the grate.

During the Hoyer flood test, it was noticed that the underdrain discharge water was brown and darker compared to the clear inlet water. It was assumed the coloration was due to the compost added to the Hoyer GSI. During flood testing in 2021, similar results were observed. Because of this observation, grab samples were collected from both the inlet and the underdrain outlet, shown in **Figure 6.** National Pollutant Discharge Elimination System (NPDES) water chemistry parameters were analyzed for both the inlet and outlet samples to determine how the GSI was contributing nutrients/pollutants to runoff.

Figure 6. Samples of the clear inlet water, right, and colored underdrain outlet water, left, during the Hoyer GSI flood/hydrant test on October 4th, 2022.

Soil Sampling

Soil samples were collected on July 12th, 2022, at both Hoyer and Windom. The soil samples were collected from three predetermined sub-sample locations at the bottom of each basin and composited, shown in **Figure 7**. The sampling protocol was: 1) surface debris was cleared, 2) a 4-inch diameter hole was dug 6 inches of depth, and 3) soil samples were collected with a trowel. Three sub-samples were combined into one Ziplock bag constituting one composite sample. The Ziplock bags were labeled with the site name and the date collected. Soil samples were analyzed by the University of Minnesota Soil Lab.

The GSI soil chemistry tests performed at the University of Minnesota Soils Laboratory were:

- Phosphorus (Bray P)
- Loss on ignition – organic matter % (LOI OM)
- Total nitrogen %
- Chloride
- Total solids moisture %
- Total solids %
- Elemental metals, shown in **Table 4**

Figure 7. A soil sub-sample being collected by MPRB staff at the Hoyer A GSI site.

Field Observations

Monthly field observations and measurements were taken at each GSI site as shown in **Table 1**. Photos of each pretreatment basin and infiltration basin were also taken monthly.

Table 1. Field observational data collected monthly at each GSI site.

Parameter	**Metric**				
Weather Conditions	Wind Direction	Wind Speed	Air Temperature	% Cloud Cover	
Plant Health	% Alive	% Stressed	% Dead		
Inlet Conditions	Photograph	% Pretreatment Basin Filled	Sediment Material Inches	Sediment Material Makeup	Evidence of Erosion After Pretreatment
General GSI Conditions	Signs of Inlet Bypass	Signs of Ponding	Soil Sample Collected		

Results

Pretreatment Basin Design

MPRB collected observations and photographs monthly, as detailed in **Table 1**. This data allowed the functionality of the pretreatment basins to be determined. The purpose of a pretreatment basin is to filter out particulates and lower the energy level of incoming stormwater before it enters the infiltration basin. Windom and Hoyer GSI each employed a different pretreatment basin design, shown in **Figure 8**.

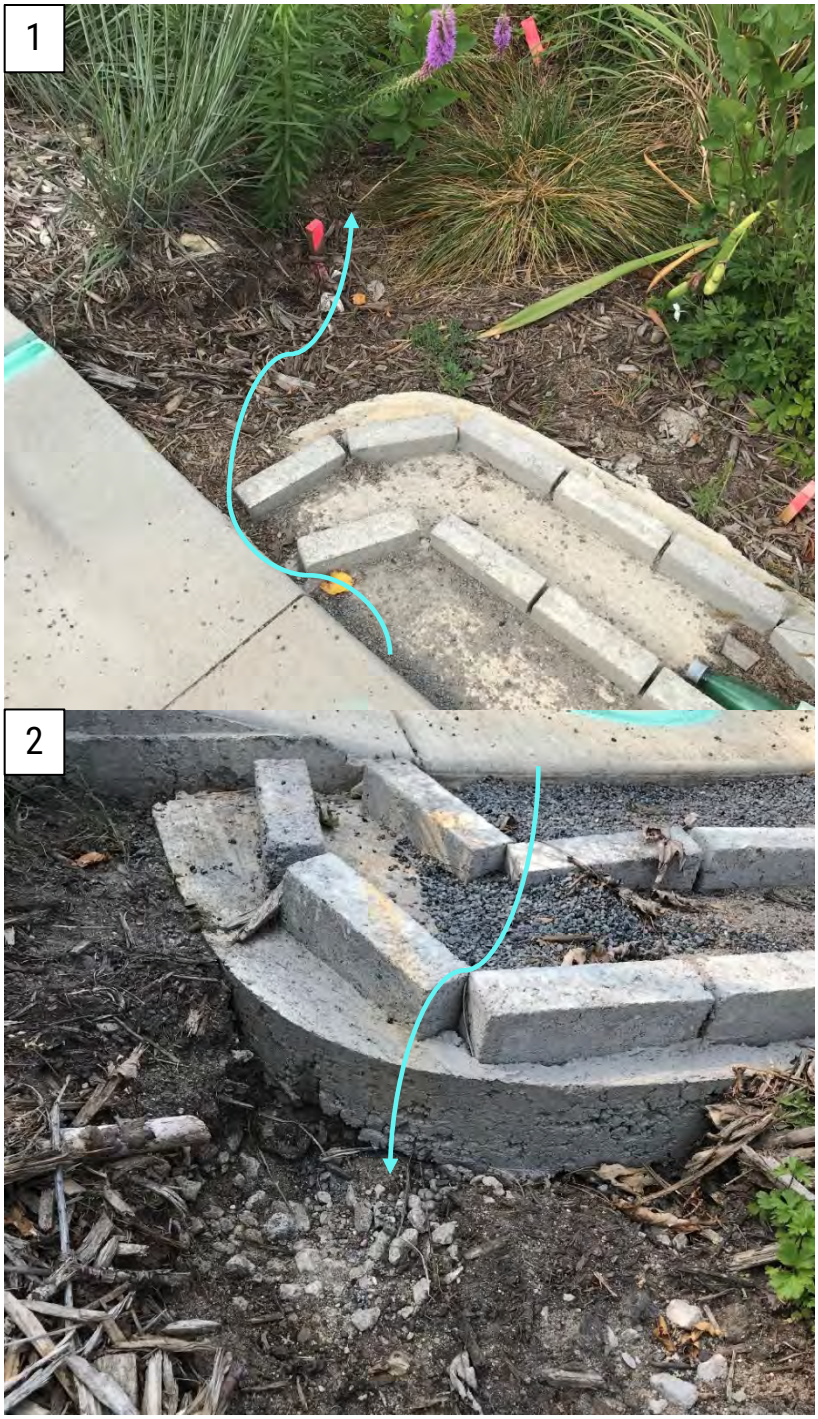
Figure 9. (1) A Windom pretreatment basin clogged with leaves in October 2022. (2) A Windom pretreatment basin clogged with sediment, soil, and leaves in June 2022.

Hoyer employs a type of pretreatment basin design that utilizes two rows of bricks with small gaps between them to filter out debris/sediment and decrease water energy, see **Figure 10**. The bricks are organized in arcs and attached to a concrete splash pad, which empties into an infiltration basin lined with plants and trees. This design proved to be moderately effective at filtering out sediment and debris but struggled more with erosion than the Windom design. The sites were not built exactly to specifications due to communication errors between the contractors and engineers, so

spacing between bricks was variable. This resulted in either sediment clogging the gaps and allowing water to bypass the pretreatment basin or water flowing around the inlet and not being filtered at all, depending on if the gaps were too small or too large.

Hoyer B had a large gap between both rows of bricks on the left side of the pretreatment basin. This allowed water to slip straight through without dropping much of its sediment load or losing energy, resulting in a deep channel eroding into the infiltration basin. Hoyer C had the opposite problem. There, the bricks have little to no space between them, causing sediment to build up to the point of water flowing over the bricks. This caused significant erosion in the area immediately beyond the pretreatment basin, including erosion underneath the splash pad itself. If this level of erosion continues, structural issues may result. One positive note about these designs is the ease of cleaning. There is no grate to remove, and debris can be vacuumed or swept away easily without specialized equipment. These basins are located adjacent to private property and will primarily be maintained by homeowners, which likely influenced the selection of this design.

Figure 10. (1) The pretreatment basin at Hoyer B showing how large gaps allowed water to travel straight into the infiltration basin. (2) The pretreatment basin at Hoyer C showing how sediment build up allowed water to bypass filtration. Blue arrows show the path of water flow, which was determined by the distribution of sediment and erosion in the basins.



Hoyer Water Chemistry

The water chemistry results from the 2022 Hoyer flood test are shown in **Table 2a** and **2b**. The inlet samples were taken directly from the discharge end of the water truck that contained non-potable water. The outlet samples were taken from a boot in the stormsewer where the capped underdrain outlets to the stormsewer. Outlet sample concentrations were higher than inlet sample concentrations for all parameters except ammonia. *Escherichia coli* (*E. coli*) levels increased significantly at Hoyer A but did not change at Hoyer C. Concentrations of critical nutrients like nitrogen and phosphorus increased after passing through the GSI filters, indicating that material from the overlaying media may be leaching into the stormsewer. GSI sites are no longer constructed with this kind of bioretention media due to this issue.

Table 2a. Water chemistry data from the Hoyer A flood/hydrant test on 10/4/22.

Parameter	Units	Hoyer A In	Hoyer A Out	Percent Increase/Decrease
Chemical Oxygen Demand	mg/L	<15	127	1593%
E. Coli	MPN/100mL	<1	387	77300%
Hardness	mg/L CaCO3	83	129	55%
Ammonia	mg/L	0.48	<0.06	-94%
Nitrate/Nitrite	mg/L	0.70	3.15	350%
Total Kjeldahl Nitrogen	mg/L	0.60	3.60	500%
Total Phosphorus	mg/L	0.25	1.66	564%
Soluble Reactive Phosphorus	mg/L	0.16	1.27	689%
Sulfate	mg/L	23.4	31.7	35%
Total Dissolved Solids	mg/L	156	388	149%
Total Suspended Solids	mg/L	<3	172	11367%
Volatile Suspended Solids	mg/L	<3	22	1367%

Table 2b. Water chemistry data from the Hoyer C flood/hydrant test on 10/4/22.

Parameter	Units	Hoyer C In	Hoyer C Out	Percent Increase/Decrease
Chemical Oxygen Demand	mg/L	<15	120	1500%
E. Coli	MPN/100mL	<1	<1	0%
Hardness	mg/L CaCO3	92	167	82%
Ammonia	mg/L	0.51	0.16	-69%
Nitrate/Nitrite	mg/L	0.75	4.18	457%
Total Kjeldahl Nitrogen	mg/L	0.66	1.80	173%
Total Phosphorus	mg/L	0.24	1.31	455%
Soluble Reactive Phosphorus	mg/L	0.15	0.78	404%
Sulfate	mg/L	23.4	27.3	17%
Total Dissolved Solids	mg/L	159	284	79%
Total Suspended Solids	mg/L	<3	429	28500%
Volatile Suspended Solids	mg/L	<3	23	1433%

GSI Soil Sample Chemistry

Soil elemental chemistry data were collected monthly in 2021 to create a baseline dataset for each site and have been averaged in the following data tables. In 2022 soil samples were collected only once at each site on 7/12/2022. As more stormwater infiltrates, it would be expected that soil chemistry may change. **Table 3** shows the GSI baseline soil sample results for phosphorus, nitrogen, chloride, percent solids, and organic matter compared with data from 2022. **Table 4** shows a list of the elemental chemistry components analyzed at the University of Minnesota Soils lab. **Table 5a and b** shows the elemental chemistry of the GSI soil samples.

The baseline soil tests in 2021 showed the Hoyer A and Windom site's soils were similar, but had differences in nitrogen, organic matter, total solids moisture, total solids moisture %, and total solids content. In 2022, Hoyer A decreased in moisture percent, but increased in Bray P, LOI OM, chloride, total nitrogen, and percent solids. Windom decreased in Bray P, chloride, and percent solids, but increased in LOI OM, total nitrogen, and percent moisture. Hoyer B and C were not part of the study in 2021 so there is no data to compare them to. This year, Hoyer sites had higher Bray P, LOI OM, chloride, and soil moisture than Windom, which had higher total nitrogen and percent solids.

Elemental chemistry results for Windom show increasing concentrations in all elements except Ca, Cr, Mg, Mn, and P, while all concentrations increased for Hoyer A, compared to 2021. Windom had higher Al, As, Co, Pb, and V than the Hoyer sites in 2022. Hoyer sites had higher B, Ba, Ca, Cd, Cu, K, Li, Mg, Mn, Mo, Na, P, S, Si, Sr, and Zn than Windom. Both sites had similar levels of Be, Cr, Fe, Ni, Rb, and Ti.

Table 3. The soil test data from each of the GSI sites in 2021 and 2022. LOI OM = Loss on ignition - organic matter. Data from 2021 are averages from data collected over 3 months.

		Bray P	LOI OM	Chloride	Total Nitrogen	Total Solids	
		(mg/kg soil)	(%)	(mg/kg soil)	(% N)	Moisture (%)	Solids (%)
2021	Hoyer A	49.0	2.05	11.6	0.118	16.95	85.1
	Windom	48.3	1.40	9.80	0.087	6.800	93.2
2022	Hoyer A	71.4	4.48	14.2	0.154	10.75	89.1
	Hoyer B	60.6	3.24	13.4	0.122	12.22	87.8
	Hoyer C	65.4	3.62	12.9	0.194	11.38	88.6
	Windom	36.8	2.44	7.27	0.646	7.927	92.1

Table 4. List of the GSI soil chemistry element symbols and element names analyzed at the University of Minnesota Soils Laboratory.

SYMBOL	ELEMENT
Al	Aluminum
As	Arsenic
B	Boron
Ba	Barium
Be	Beryllium
Ca	Calcium
Cd	Cadmium
Co	Cobalt
Cr	Chromium
Cu	Copper
Fe	Iron
K	Potassium
Li	Lithium
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
Na	Sodium
Ni	Nickel
P	Phosphorus
Pb	Lead
Rb	Rubidium
S	Sulfur
Si	Silicon
Sr	Strontium
Ti	Titanium
V	Vanadium
Zn	Zinc

Table 5a. GSI soil elemental chemistry data from 2021 and 2022. MDL = minimum detection limit. The Limit of Detection (LOD), a batchwise instrument detection limit, is expressed in units of mg/L solution independent of dilution factors used to calculate sample concentrations.

Date	Site	Al mg/kg	As mg/kg	B mg/kg	Ba mg/kg	Be mg/kg	Ca mg/kg	Cd mg/kg	Co mg/kg	Cr mg/kg	Cu mg/kg	Fe mg/kg	K mg/kg	Li mg/kg
MDL		0.061	0.011	0.033	0.001	0.000	0.226	0.001	0.001	0.001	0.005	0.032	0.353	0.001
LOD		0.007	0.005	0.002	0.001	0.001	0.156	0.001	0.001	0.001	0.008	0.006	0.021	0.001
2021	Windom	2484	<0.013	<0.001	25.6	<0.001	10075	<0.001	3.50	7.98	7.92	7945	352.3	3.62
	Hoyer A	2024	<0.013	<0.001	22.7	<0.001	29022	<0.001	2.35	5.85	5.53	6823	344.5	3.06
2022	Windom	2839	3.95	4.37	36.6	0.130	7979	0.095	3.60	7.46	8.04	8372	379.6	3.69
	Hoyer A	2393	1.74	7.84	36.2	0.140	30309	0.110	2.95	8.03	9.03	8101	565.7	4.04
	Hoyer B	2269	1.93	5.96	30.9	0.100	31573	0.078	2.86	6.83	11.7	7511	462.9	4.00
	Hoyer C	2619	3.30	6.15	40.5	0.120	28141	0.140	3.22	7.54	9.04	9705	499.0	4.06

Table 5b. GSI soil elemental chemistry data from 2021 and 2022. MDL = minimum detection limit. The Limit of Detection (LOD), a batchwise instrument detection limit, is expressed in units of mg/L solution independent of dilution factors used to calculate sample concentrations.

Date	Site	Mg mg/kg	Mn mg/kg	Mo mg/kg	Na mg/kg	Ni mg/kg	P mg/kg	Pb mg/kg	Rb mg/kg	S mg/kg	Si mg/kg	Sr mg/kg	Ti mg/kg	V mg/kg	Zn mg/kg
MDL		0.068	0.009	0.001	0.054	0.008	0.023	0.009	0.073	0.020	0.137	0.001	0.005	0.011	0.028
LOD		0.004	0.016	0.001	0.008	0.006	0.018	0.005	0.062	0.012	0.024	0.001	0.004	0.021	0.004
2021	Windom	4018	252.3	<0.001	61.7	8.46	338.3	5.27	1.39	277.0	585.7	9.21	128.3	11.5	15.6
	Hoyer	8069	198.5	<0.001	82.9	5.35	397.0	3.98	1.18	600.0	742.5	18.8	104.5	9.28	13.5
2022	Windom	2858	242.3	0.160	66.4	8.75	326.5	10.2	15.6	301.6	877.2	9.59	129.2	13.9	24.4
	Hoyer A	9299	254.0	0.210	154.1	8.42	435.6	4.95	3.75	684.6	1336	22.1	141.4	9.75	35.1
	Hoyer B	10202	250.7	0.330	78.8	6.98	439.8	5.18	13.2	651.6	1240	18.9	134.2	9.60	25.4
	Hoyer C	8567	321.0	0.170	69.3	8.27	442.7	9.46	15.7	673.0	1313	18.9	128.2	11.8	29.1

Maintenance Activity

Site maintenance, including basin watering and grate cleaning, was performed by a contractor at each GSI site in 2022. **Figure 11** shows a water truck at Hoyer A watering the infiltration basin. These activities were done only a few times in 2022 to help ensure vegetation health and keep the site aesthetically pleasing. This level of maintenance mostly preserved natural conditions, whereas in 2021 sites were maintained much more frequently. Starting in the fall of 2022, these sites were no longer under the warranty of the contractors and upkeep is now the responsibility of homeowners with adjacent property. MWMO will help conduct education and outreach to help residents learn how to monitor and care for the basins. The City of Minneapolis will continue to inspect the basins once or twice per year and perform cleaning and repairs as needed.

Figure 11. The Hoyer A GSI site being watered by a subcontractor during the summer of 2021.

Conclusion

In 2022, the MPRB monitored pretreatment basin functionality, analyzed infiltration testing data, performed soil sampling, and assessed future maintenance needs. Information was gathered regarding the efficacy of two types of pretreatment basins and how they may need improvements in design or maintenance. These design practices have already been implemented with newly constructed GSI. Further monitoring at the GSI will be important to better determine the effects of GSI sites on stormwater quality over time.

The Hoyer GSI sites were built for flood control and originally had open underdrains connecting them to the stormsewer. Results from grab sampling during the flood test show that the basins were exporting nutrients rather than retaining them. The underdrains were capped in 2022 which allowed water to infiltrate into the native soil below the bioretention media rather than entering the stormsewer and carry nutrients downstream. Data from this study helped determine that low-nutrient materials should be used in the infiltration basin to reduce water quality impacts downstream, when dealing with uncapped underdrains.

Baseline soils data was collected in 2021 and comparisons were made with data from 2022. This data is important to assess how the sites are infiltrating stormwater, identify which contaminants are washing in from the street, and determine if pollutants are accumulating in the infiltration media. Contaminants/nutrients like chloride, phosphorus, nitrogen, and lead are of particular interest due to their association with negative environmental and human impacts. Additional years of data will provide more information about nutrient transference and if there are pollutants building up at the soil surface.

The functionality of the inlets and vegetation could be better ascertained due to the preservation of more natural conditions in 2022. In 2021, the sites were frequently watered and cleaned, so natural conditions were not preserved. Notably, the late summer and fall of 2022 had few significant precipitation events, which hindered this study. More information about the site's functionality will be determined during average and high precipitation years and when maintenance practices are more normal. In the case of Hoyer, the MPRB recommends the development of a survey that homeowners can fill out to report their maintenance activities. This information will be important to keep track of to determine the true conditions of the study. Homeowners could report on aspects such as frequency of watering and sweeping/vacuuming, take photos of the inlets, and include any other observations they deem important. This would also be a great way to get the public engaged and curious about green stormwater infrastructure.

Detailed analysis of flood test data, infiltration tests, and monitoring data will be provided by SAFL in a future report.

Lake Monitoring

In 2022, Minneapolis Park and Recreation Board (MPRB) scientists monitored 12 of the city's most heavily used lakes, and documented all data in the MPRB Water Resources Report. The data collected were used to calculate a Trophic State Index (TSI) score for each of the lakes . Lower TSI scores indicate high water clarity, low levels of algae in the water column, and/or low phosphorus concentrations. Changes in lake water quality can be tracked by looking for trends in TSI scores over time. In **Table 1** and

Figure 1 TSI trends for Minneapolis lakes from 1991 to 2022 are shown, and in **Table 2** the trend in TSI is shown for Minneapolis lakes for the most recent ten years. A negative slope indicates improving water quality, while a positive slope indicates declining water quality.

These values are especially important for monitoring long-term trends (10+ years). Historical trends in TSI scores are used by lake managers to assess improvement or degradation in water quality. Trends are also used by the Minnesota Pollution Control Agency to assess non-degradation goals.

Most of the lakes in Minneapolis fall into either the mesotrophic or eutrophic category. Bde Maka Ska, Cedar, and Wirth Lake are mesotrophic having moderately clear water and potential for hypolimnetic anoxia during the summer. Brownie Lake, Lake of the Isles, Harriet, and Hiawatha are eutrophic having an anoxic hypolimnion and potential for nuisance growth of aquatic plants. Nokomis and Loring are also eutrophic with high algal productivity. Powderhorn Lake is hypereutrophic having dense algae. Blue-green algae dominates the phytoplankton community on Lake Nokomis and Powderhorn Lake, resulting in periodic appearance of algal scum on these lakes. Spring Lake is also hypereutrophic, with very high nutrient concentrations, but was not sampled in 2022. Scores for Diamond and Grass Lake are not included since these lakes are too shallow to calculate the Secchi portion of the TSI index.

Table 1. Water quality trends in Minneapolis lakes from 1991-2022.

Lakes with Improving Water Quality Indicators	Lakes with Stable Trends	Lakes with Declining Water Quality Indicators
Bde Maka Ska Wirth Lake	Brownie Lake Cedar Lake Lake Harriet Lake Hiawatha Lake of the Isles Loring Pond Lake Nokomis Powderhorn Lake Spring Lake	No lakes with declining trend

Table 2. Water quality trends in Minneapolis lakes from 2013-2022.

Lakes with Improving Water Quality Indicators	Lakes with Stable Trends	Lakes with Declining Water Quality Indicators
No lakes with improving trend	Bde Maka Ska Brownie Lake Cedar Lake Lake Harriet Lake of the Isles Loring Pond Powderhorn Lake Spring Lake	Lake Hiawatha Lake Nokomis

Wirth Lake

Most of the Minneapolis lakes have no directional trend in water quality indicators when all years of data are taken into consideration, as shown in **Table 1**. Most of the major water quality improvement projects done in the lake's watersheds were completed by the early 2000's as a result of the Clean Water Partnership (CWP) Minneapolis Chain of Lakes Project, which developed long-term TSI goals for the Chain of Lakes in 2001. Chemical treatments, like alum, have a life span after which water quality and TSI reflects the new internal and external loading regime of the watershed.

There was significant improvement in water quality indicators in Bde Maka Ska after watershed projects were implemented and the lake was treated with alum (linear regression, $p < 0.05$). TSI scores after 2006 have stabilized. TSI scores at Bde Maka Ska between 2017 and 2022 were higher than the previous few years due to higher chlorophyll-*a* and total phosphorus concentrations but were still below the early 1990s scores. In 2022, the TSI score slightly increased due to shallower water clarity and higher chlorophyll-*a* concentrations.

The water quality in Brownie Lake has been relatively stable, with no significant trend since 1993. Brownie Lake is monitored every other year and was monitored in 2022. Though there were no CWP projects in the Brownie Lake watershed, significant amounts of redevelopment projects have reduced the external load to this lake. The lake is meromictic and highly enriched bottom waters may control water quality at this lake.

Cedar Lake showed improvement following restoration efforts through the late 1990s, particularly after chemical treatment with alum. Since the end of alum effectiveness, estimated as 7-10 years post-treatment, TSI scores gradually increased. When looking at the last ten years of TSI scores for Cedar Lake there is an increasing trend in TSI. Cedar Lake TSI scores between 2017 and 2021 were the highest they have been since the early 1990s due to higher chlorophyll-*a* concentrations and shallower Secchi depths. Increased frequency in algae blooms potentially connected to increased external loading due to high rainfall may partially explain this change. In 2022, the Cedar TSI score decreased due to much deeper water clarity and lower chlorophyll-*a* concentrations.

Diamond Lake and Grass Lake are not included in this TSI analysis, since scores are only appropriate for deeper lake systems and these lakes are too shallow to measure Secchi depth. Except right after storms, the Secchi disk is clearly visible when sitting on the bottom of these two wetlands.

Lake Harriet experienced a few years with very clear water and low TSI scores following a littoral alum treatment in the mid-2000s. TSI scores remained relatively stable for several years since that time. Low TSI scores and very clear water occurred again in 2016 and 2020. The TSI score in Lake Harriet was higher in 2022 compared to previous years due to shallower water clarity and higher chlorophyll-*a* and total phosphorus concentrations but the trend was not significant (linear regression, $p > 0.05$).

Water quality at Lake Hiawatha is heavily influenced by the inflow from Minnehaha Creek. The lake has poorer water quality during drought years, and better water quality in years with high flow from Minnehaha Creek. In 2021 and 2022, there was less precipitation compared to previous years and the

TSI score in Lake Hiawatha was high due to shallower water clarity and increased chlorophyll-*a* and total phosphorus concentrations.

The water quality in Lake of the Isles fluctuates with no time dependent trend. In 2022, the lake had a lower TSI compared to previous years due to deeper water clarity and lower chlorophyll-*a* concentrations, but there was no significant trend (linear regression, $p > 0.05$). Even after an alum treatment and watershed intervention, there was no significant water quality trend in any direction since 1991. External loading in this waterbody likely exceeded any benefit of internal load reduction.

Loring Pond had worsening water quality immediately following a dredging project in 1997; however, between 2000 and 2015 TSI scores decreased indicating improving water quality. Since 2015, the TSI scores in Loring Pond have been slowly increasing due to shallower water clarity and higher chlorophyll-*a* concentrations, particularly in 2019, 2020, and 2022. Extensive duckweed growth, and augmentation with groundwater effect clarity and nutrient concentrations at this shallow lake.

Previously, water quality in Lake Nokomis improved following a biomanipulation project that was completed in 2013. In recent years Lake Nokomis has had higher algal concentrations and increasing TSI scores indicating worsening water quality over the past 10 years (linear regression, $p < 0.05$); however, there is no significant trend since 1992.

Powderhorn Lake has experienced a wide variation in water quality. The lake was placed on the 303d list for exceeding nutrient standards, was removed, and then re-listed after water quality declined. The worst measured TSI scores at this lake occurred in the late 1990s and the best scores in the late 2000s when the lake met standards for several years. Powderhorn had poor water quality most years since 2013 with blue-green algae blooms leading to shallow water clarity. The TSI scores were higher in 2017, 2020, and 2022 due to shallower water clarity and higher chlorophyll-*a* and total phosphorus concentrations.

Water quality in Spring Lake is variable, but there is no significant trend in any direction since 1994. Spring Lake is monitored every other year and was not monitored in 2022. The TSI score increased in 2019 and 2021 due to higher chlorophyll-*a* and total phosphorus concentrations. Spring Lake is a highly nutrient-enriched and chemically stratified lake that is unlikely to respond to nutrient load reduction.

Water quality improvement at Wirth Lake has been occurring since 1992, going from a eutrophic system dominated by algal growth to a moderately clear mesotrophic system (linear regression, $p < 0.05$). The lake was delisted from the 303d list in 2014 based on meeting standards for Secchi, chlorophyll-*a*, and total phosphorus. TSI scores at Wirth Lake between 2017 and 2019 were slightly higher than the previous few years due to increased chlorophyll-*a* and total phosphorus concentrations but improved again between 2020 and 2022.

There are no lakes in Minneapolis with water quality indicators worse than conditions in the early 1990s. Several lakes have seen poor water quality and higher TSI scores between 2017 and 2021. Extraordinary high rainfall amounts received in our region in recent years is a likely contributor to the change in trend from improvement towards stability in most lakes. Data from these years are the reason for the trend changes that have been detected; however, with 2022 being a dry year, better water quality and lower TSI scores were observed in several lakes this year. Lake Hiawatha and Lake Nokomis are trending towards poorer water quality because the TSI scores have been increasing since 2014.

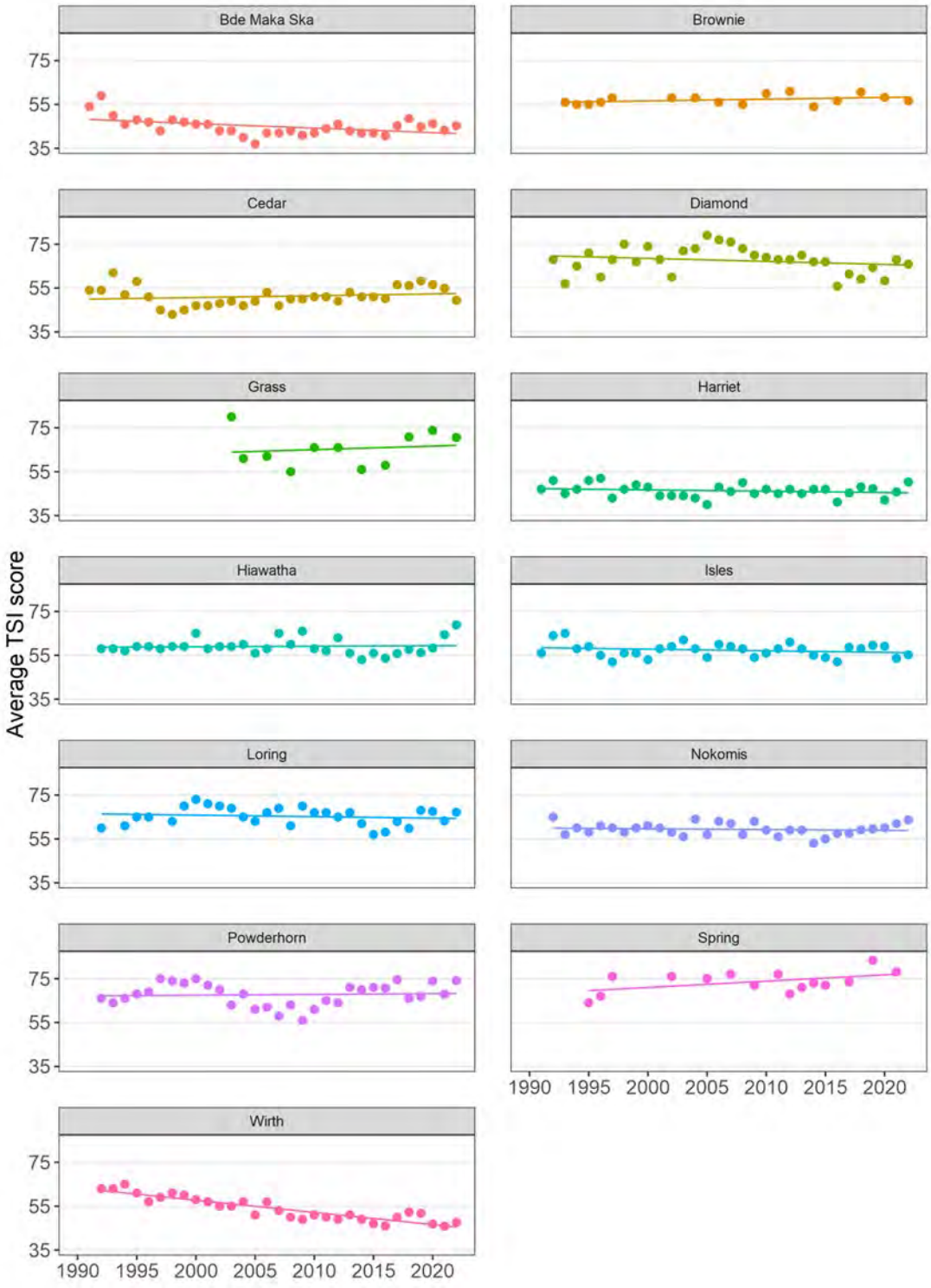


Figure 1. TSI scores and regression analysis for selected Minneapolis lakes 1991–2022. Lower TSI scores indicate high water clarity, low levels of algae in the water column, and/or low phosphorus concentrations. A negative slope indicates improving water quality, while a positive slope indicates declining water quality. Only Bde Maka Ska and Wirth have statistically significant trends ($p < 0.05$).

Frog & Toad Calling Surveys: Minneapolis Stormwater Ponds, 2022

American toad (*Anaxyrus americanus*). *Photograph by J. Winkelman*

Prepared for MaryLynn Pulscher, Minneapolis Park & Recreation Board

By Jenny Winkelman

March 2023

Funding for this survey was provided by the City of Minneapolis Department of Public Works.

BACKGROUND AND OBJECTIVES

The presence and abundance of frogs and toads are a useful indicator of water and habitat quality, as well as short and long-term environmental changes. Standard protocols using calling surveys during peak breeding activity have been used to determine distribution and population trends of frogs and toads by natural resource agencies nation-wide.

The question has been raised whether or not stormwater ponds, constructed to intercept and treat runoff, can also function as a refuge for amphibians. Additionally , the public has voiced concerns about the absence of formerly abundant frogs and toads calling from Hiawatha Golf Course and the surrounding area. To evaluate these concerns, the Minneapolis Park and Recreation Board (MPB) coordinates frog and toad listening surveys at Lake Hiawatha golf course and select stormwater ponds in Minneapolis.

The purpose of these surveys is to:

1. Determine if any frog and toad species (anurans) are found in or near stormwater ponds.
2. Use the Minnesota Frog and Toad Calling Survey protocols adapted for Theodore Wirth Park to Identify species and abundance in stormwater ponds.
3. Generate ideas about why or why not species may use stormwater ponds.

Funding for this project was provided by the City of Minneapolis Department of Public Works.

FINDINGS

- Seven species of frogs and toads—of the 14 species known in MN—have been reported from stormwater sites in Minneapolis since 2016 (Table 2). Not more than three species were found at any single location. American toads are the most commonly heard and widely distributed among stormwater ponds (Figures 1,2; Table 3).

Table 2. Toad and frog species heard in Minneapolis stormwater ponds, 2016–22.

	Total No. species	Species						
		American Toad *Anaxyrus americanus*[1]	Gray Treefrog *Hyla versicolor*	Cope's Gray Treefrog *Hyla chrysoscelis*	Green Frog *Lithobates clamitans*[2]	Northern Leopard Frog *Lithobates pipiens*[2]	Boreal Chorus Frog *Pseudacris maculata*	Spring Peeper *Pseudacris crucifers*
Species heard all years 2016–22	**7**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
South Minneapolis								
37th & Chicago[3]	**1**	X						
East Twin Pond (43rd St S and Park Ave)	**2**	X	X					
West Twin Pond (44th St S and Park Ave)	**0**							
60th S and 1st —north of 62, west of 35W	**1**	X						
Bde Maka Ska SW ponds	**3**	X	X				X[4]	
Roberts Bird Sanctuary	**3**		X	X		X		
Hiawatha Golf Course, ponds 1-4	**1**	X						
Hiawatha Golf Course, corresponds to pond 5	**2**	X	X					
Nokomis SE pond	**1**	X						
Nokomis SW pond	**2**	X		X				
North Minneapolis								
52nd N and Upton, two ponds	**3**	X	X		X[5]			
Camden Central Pond—42nd N & Morgan	**1**	X						
Columbia Golf Course	**3**	X		X				X[6]
Heritage Park N— north of 55, outlet to Mississippi River	**2**	X				X		
Heritage Park S— south of 55	**1**	X						

* Includes all species seen or heard at each site, including outside of the 5-minute sampling.
[1]The genus *Anaxyrus* was formerly called *Bufo.*
[2] The genus *Lithobates* was formerly called *Rana.*
[3] Heard in pond across the road at the Bakken Museum.
[4] Sampling stopped in 2020 due to lack of findings, presence of a fountain, and proximity to where George Floyd was killed.
[5] This is the only location where green frogs are found in Minneapolis during surveys conducted since 2015.
[6] Heard once in 2021. This is the only location where spring peepers have been recorded in Minneapolis during surveys conducted since 2015.

- The phenology of calling by breeding frogs and toads is depicted in Figure 1. The most obvious mid-season breeder are toads (heard in 58% of the sites during the second run, when all sites and years are combined). The sparse presence of other species (heard in <10% of the time at peak breeding activity) is less pronounced but still consistent with what is known for this region[1]. Chorus frogs and northern leopard frogs breed earliest in spring. Mid to late spring breeders are toads, and both species of gray treefrogs. The only exclusively summer breeder heard during these surveys was the green frog. Peak breeding activity is influenced by abiotic factors such as when ice melts, temperatures warm, and the amount and timing of rain. Some species such as treefrogs call intermittently even when not breeding.

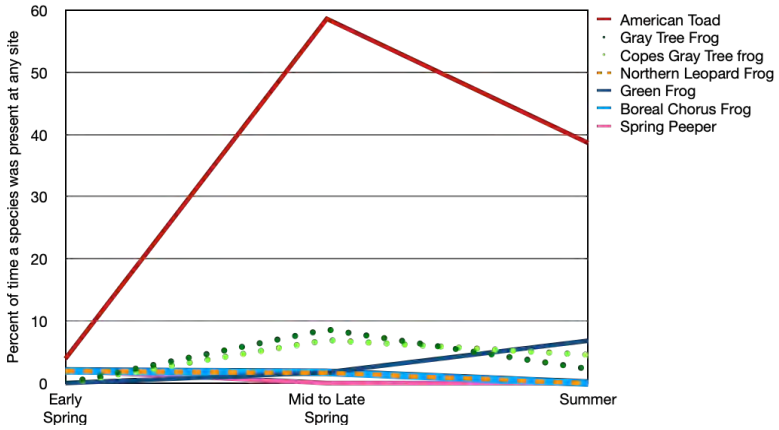


Figure 1. Calling phenology of species during each run (2018-2022).

- American toads (*Anaxyrus americanus*) are clearly the most widespread and abundant species in stormwater ponds occurring in nearly half the years sampled; other species were detected in less than 10% of the years (Figure 2, Table 3). Toads have been heard at least once in all stormwater ponds except West Twin Pond Robert's Bird Sanctuary (Tables 2,3). Toads have also been heard in full chorus (index of 3) multiple times. Drought conditions in 2021 and 2022 dampened even toad calling activity. Breeding may have been shortened and took place between the first two runs.

  Adult toads are largely terrestrial and breed mid-season breeders, and therefore less likely to encounter poor water quality during "first flush" stormwater runoff events in early spring. Adults live mostly on land including winter, which they spend buried below the frost line. By breeding mid-

[1] Mossman, et al. 1998

season, the aquatic development stages (eggs and tadpoles) also avoid the worst water quality in ponds. Consequently, they are more resilient to urbanization as long as other habitat needs are met.

- In 2021, the first and only, solitary spring peeper (*Pseudacris crucifera*) was heard at the Columbia Golf Course ponds. This is highly significant as spring peepers have not been heard elsewhere in Minneapolis since these surveys began in 2015 (suspected but not confirmed in Theodore Wirth Park).

- In 2022, two new records and at new locations were documented for Cope's gray treefrogs (*Hyla chrysoscelis):* at Robert's Bird Sanctuary and southwest of Nokomis in Amelia Pond. Until 2022, they

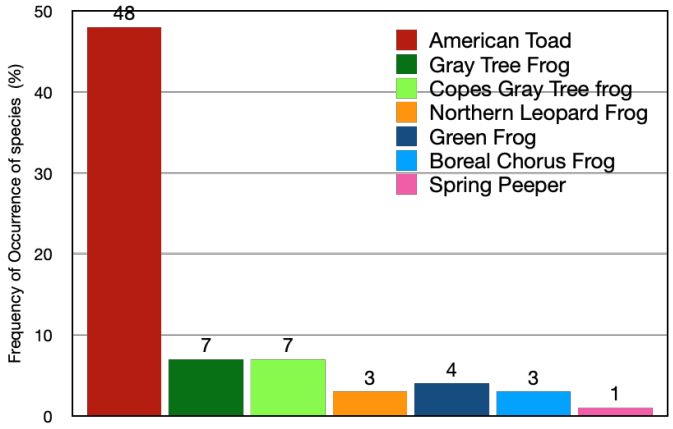


Figure 2. Frequency of occurrence of frog and toad species across all sites and years in Minneapolis stormwater ponds sampled.

were only found at Columbia Golf Course near the pond with the widest riparian zone and vegetated with shrubs and small trees (probably because mowing is not possible on the steep bank). It is important to note that quite a few were heard at Roberts Bird Sanctuary, while only one or two were heard at the other two locations.

Cope's gray treefrogs inhabit the edges of woodlands and fields; whereas, gray treefrogs live in predominantly wooded areas. Cope's gray treefrogs are also found, abundantly, in Theodore Wirth Park at a golf course pond, with a diverse, vegetated shoreline near Regency Hospital. The range and numbers of individuals could probably be expanded to Hiawatha Golf Course, and perhaps other sites, if riparian areas were widened and diversified to include native shrub species. The current practice at golf courses is to mow them as close as possible to the pond edge. Similarly, the number Cope's gray treefrogs at Columbia Golf Course would likely increase by widening and connecting riparian areas among the ponds.

- One or two gray treefrogs (*Hyla versicolor*) have been heard intermittently at different stormwater sites since 2016, except for Roberts Bird sanctuary (Table 3). This is not surprising given the lack of woodlands around stormwater ponds. They prefer breeding ponds well connected with an wooded upland area, where they live most of the year.

Still a full chorus of gray treefrogs was heard at Roberts Bird Sanctuary in 2022, the only site with adjacent upland woodland habitat. Significantly, this site provides a measure of the amount of woodland needed to support their populations in Minneapolis. At Roberts Bird Sanctuary, the woods range from about 450—1,000 ft ft wide, and covers about 35 acres. Given the importance and value of wooded habitat (to birds, carbon sequestration, gray treefrogs and more) there may be opportunities to prioritize, the establishment and natural management of woodland areas that are 450 ft deep along or near water elsewhere in Minneapolis parks (for example along the frequently flooded parkway southwest of Lake Nokomis).

- Many green frogs (*Lithobates clamitans*, are found in the stormwater pond at Upton Ave N and 52nd Ave N (full choruses have been heard). Green frogs have been heard exclusively in the north pond and not anywhere else in the city, including in seven years of similar surveys at Theodore Wirth Park (2015-22).

Table 3. Occurrence of frog and toad species found in years sampled and the number of times a full chorus was heard, 2018–22 (based on presence; full chorus indicated by calling index of 3).

	Percent Occurrence (times in full chorus)						
	American Toad *Anaxyrus americanus*[1]	Gray Treefrog *Hyla versicolor*	Cope's Gray Treefrog *Hyla chrysoscelis*	Green Frog *Lithobates clamitans*[2]	Northern Leopard Frog *Lithobates pipiens*[2]	Boreal Chorus Frog *Pseudacris maculata*	Spring Peeper *Pseudacris crucifers*
South Minneapolis							
East Twin Pond (43rd St S and Park Ave)	**40**	**20**	—	—	—	—	—
West Twin Pond (44th St S and Park Ave)	—	—	—	—	—	—	—
50th S and 1st —north of 62, west of 35W	**25 (1)**	—	—	—	—	—	—
Bde Maka Ska SW ponds	**75 (2)**	**25**	—	—	—	**50**	—
Roberts Bird Sanctuary	—	**50**	**50 (1)**	—	**50**	**—**	—
Hiawatha Golf Course, ponds 1-4 combined	**50 (2)**[3]	—	—	—	—	—	—
Hiawatha Golf Course, corresponds to pond 5	**40 (2)**	**20**	—	—	—	—	—
Nokomis SE pond (Gateway Pond)	**50 (1)**	—	—	—	—	—	—
Nokomis SW pond (Amelia Pond)	**50 (1)**	—	25	—	—	—	—
North Minneapolis							
52nd N and Upton, two ponds[3]	**80 (1)**	**20**	—	**60 (1)**	—	—	—
Camden Central Pond—42nd N & Morgan	**100 (2)**	—	—	—	—	—	—

Columbia Golf Course, combined[4]	**100**	—	**75**	—	—	—	**25**
Heritage Park N— north of 55, outlet to Mississippi River	**100 (3)**	—	—	—	**25**	—	—
Heritage Park S— south of 55	**75 (3)**	—	—	—	—	—	—

[1]The genus *Anaxyrus* was formerly called *Bufo.*
[2] The genus *Lithobates* was formerly called *Rana.*
[3] Full chorus heard in two years, but not from same pond.
[4] This is the only location where green frogs have been found in Minneapolis during surveys conducted since 2015.
[5] Heard once in 2021. This is the only location where spring peepers have been found in Minneapolis during surveys conducted since 2015.

The National Wetland Inventory[2] indicates this particular pond has a hydrology dominated by surface water inputs and from streams and wetlands during flooding (called a "lotic pond throughflow").Nearby Shingle Creek and Lion's Park Pond may be the source of surface water and the green frogs. The amount of stormwater it receives needs to be explored further; however, in the meantime, it constitutes a unique habitat in the city.

Green frogs (and also Northern leopard frogs)are considered aquatic frogs, and overwinter in water that does not freeze solid, and require an ongoing supply of oxygen, making them dependent on high quality water resources. As a result, they are also more vulnerable to urbanization because unlike anurans that overwinter onland, they can't avoid the toxic concentrated first flush of stormwater in spring.

- Boreal chorus frogs were heard near Bde Maka Ska but were actually heard only from a small pond at the Bakken Museum about 200 feet away. It is not known at this time whether this pond functions as a stormwater treatment. Nonetheless it may be an important breeding location for chorus frogs.

- Drought conditions in 2021 and 2022 reduced the period and intensity of breeding choruses throughout the city. Impacts of drought on amphibians in stormwater ponds are not known and likely vary on a pond by pond basis. As climate becomes hotter and drier, this is an important consideration. Depending on their hydrology, some ponds may dry up and pollutants already in ponds may become more concentrated. The flush of pollutants may become more concentrated or occur at different times earlier, during or after breeding. If the latter, the developing stages may be jeopardized.

[2] NWI Wetland Finder MN DNR. Last accessed on March 9, 2023

CONSIDERATIONS FOR MANAGEMENT

The intent of stormwater ponds is to treat runoff prior to discharge, so water quality is intended to be "bad" going in and "better" coming out; stormwater ponds also manage water volume. Amphibians have highly permeable skin and are extremely sensitive to water quality. Deicers (predominantly salts or chlorides) are an inherent part of stormwater runoff especially in the spring, when breeding occurs. Chlorides remain dissolved in water and can only be diluted, not filtered out. Depending on concentration and exposure chlorides harm amphibians, and concentrations may change during a season and overtime. Tolerance to chloride levels varies among species and the developmental state (adults compared to eggs and developing tadpoles)[3].

Habitat management guidelines (HMG) consider the underlying function of stormwater ponds as incompatible with amphibian conservation and discourage their use as a habitat creation strategy[4]. And yet, amphibians are tolerating and using some stormwater ponds as habitat. Much remains to be known about the long term use of stormwater ponds by amphibians, and while conditions are not optimal, wherever possible, opportunities should be sought to manage the ponds in ways that preserve and protect the amphibians found there.

- Some stormwater ponds are more important than others. This study helps identify certain ponds as having higher value as amphibian habitat than others. Characteristics of excavated ponds, and their upland areas, that support anurans should be replicated wherever possible. Ponds that are used by breeding treefrogs, chorus frogs, spring peepers, green frogs and northern leopard frogs should be prioritized. Toads will inherently benefit from other efforts.

- Water quality. Nonpoint source pollution (NPS) such as salt, heavy metals, oils, and other chemicals that wash off roads and the surrounding landscape can be deadly to all life stages of amphibians and likely limit their use of stormwater ponds for breeding. Also salt and other pollutants accumulate in ponds intensifying their effects. Preventing NPS at its source through education;intercepting runoff with wide shoreline buffer strips/riparian areas vegetated with deeply rooted native species; maintaining land and water connections to other habitats; and maintaining water levels in ponds are ways to mitigate water quality impacts on amphibians found in stormwater ponds. Impacts of a changing climate are unknown but are not insignificant- heavy storms could benefit amphibians and dilute pollutant concentration, while dry years could have the opposite effect. Learning more about water quality in priority ponds is needed.

- Irrigation. At golf course ponds, sprinkler irrigation at night creates a humid microhabitat at golf course pond locations, creating unique habitat conditions, with potential for benefitting amphibians. At the least, moist environment facilitates amphibian movement between ponds.

  Stormwater ponds located in golf courses pose unique opportunities substantially different than for a pond surrounded by residential or commercial development. Golf courses have dedicated staff, surrounding green space, and allow for management choices that improve water quality and enable connecting fragmented habitat. As climate changes, they may become increasingly important for

[3] Snodgrass and Ownby 2015

[4] Kingsbury, B.A. and J. Gibson (editors). 2011. Habitat Management Guidelines for Amphibians and Reptiles of the Midwestern United States. Partners in Amphibian and Reptile Conservation Technical Publication HMG-1, 2nd Edition. 161 pp.

frog and toad habitat. The high visibility, aesthetic standards of manicured green spaces and what is required to maintain it also poses a unique set of challenges.

- Riparian areas. Wherever possible, an effort should be made to preserve and expand shoreline areas, and create vegetated connections between nearby ponds. Pond designs include creation of upland habitat but maintenance practices are incrementally reducing them by mowing, evident in plants cut to the tops of the steep slopes (for example at Heritage Park, Central Camden and at the golf courses). This disturbance reduces important habitat and corresponds with invasive species growing at the newly mowed edges. The Columbia Golf Course uses red stakes pounded into the ground surrounding the ponds to delineate mowing edges; however, stake placement appears to mostly prevent mowers from collapsing the shoreline than for defining an adequate riparian buffer for habitat.

  Most of the frogs and toads found in Minneapolis spend most of their lives in upland areas and therefore, require different kinds of riparian and upland habitat with trees and shrubs, not just the formulaic traditional native prairie established next to ponds. For example, gray treefrogs require wooded uplands as seen at Roberts Bird Sanctuary. This site also prescribes the size of a woodland (minimum width of 450 ft) needed to support gray treefrogs and can act as a template for other places in the parks.

- Flooded areas. Areas that seasonally flood can be managed to naturally function as vernal, or temporary ponds. which are amphibian breeding hotspots. These areas can be delineated as lawn-free areas without mowing or leaf removal. Low-lying areas on golf courses, near the Lake Nokomis and Bde Maka Ska stormwater ponds and along parkways are flooded during spring rains and expand amphibian breeding habitat. These wet meadow areas/ vernal ponds (usually managed as turf) are generally warmer (at least three degrees) than the nearby stormwater ponds and when sampled side by side were preferred by calling/breeding toads[5].

- Pond Maintenance activities. The timing and how maintenance is conducted matters in and around a stormwater pond designated to support amphibians. For example, ponds without aquatic frogs, can be dewatered and cleaned out after juveniles disperse from the breeding ponds. For aquatic frogs, leopard and green frogs, winter hibernation sites that don't freeze to the bottom, and remain oxygenated are necessary. Also, stormwater pond maintenance that involves dredging, should not take place in winter, when aquatic frogs cannot escape and ponds will not refill. Likewise, dewatering should not occur during the hottest driest days of the year unless there is a nearby waterbody for them to take refuge in. Adapting construction schedules may be necessary and the inconvenience should be tolerated in locations such as the northern pond at Upton and 52nd, which is the only place in the city where green frogs have been heard in recent years.

RECOMMENDATIONS MOVING FORWARD

- Continue to conduct surveys. Sampling variability emphasizes the importance of multiyear, ongoing surveys. Some sites were recently added and have a shorter sampling history. As stormwater ponds age, negative effects of water quality may intensify and reduce or preclude amphibian use. Likewise,

[5] Pers. comm., J. Winkelman, 2019

after dredging and maintenance, amphibian use may improve. Long Term surveys will help describe these effects.

- Collect additional habitat information. Data collected during the worst times for water quality—soon after the first flush in winter—will help establish minimal standards for water quality. Measuring and identifying vegetation structure can guide protection and prioritizing improvements.
- Fine-tune and educate managers regarding amphibian habitat considerations when planning and implementing maintenance activities in and around the pond. Share and coordinate information so that changes in survey data can be associated, or not, with maintenance activities.
- Integrate what is know about anuran distribution into parkwide planning to create opportunities for creating and protecting habitat for frogs and toads.

LIST OF ABBREVIATIONS

DNR	Refers to Minnesota Department of Natural Resources
HMG	Habitat management guidelines
MFTCS	Minnesota Frog and Toad Calling Surveys
MN PWI	Minnesota Public Waters Inventory
MPRB	Minneapolis Park & Recreation Board
NAAMP	North American Amphibian Monitoring Program
NPS	Nonpoint source pollution
NWI	National Wetlands Inventory
USGS	United States Geological Survey

GLOSSARY

Anuran	Amphibian without a tail (frogs and toads)
Chorus strength	Also called “calling index”
Calling index	Also called “chorus strength”. Rating on a scale of 1–3 where 1=one or two, 2=a few, and 3=many
Explosive breeding	Concentration of intense breeding activity into short periods of times
First flush	Initial surface runoff in a rainstorm in which pollutants are more concentrated compared to the remainder of the storm. In Minnesota, the first flush in spring from a combination of rain and snowmelt is particularly concentrated because it includes a higher concentration of pollutants accumulated over winter.
Run	Sampling window

APPENDIX 1 - Comparison of Differences between MFTCS and the Protocol Used in this Survey

	MFTCS	This Survey (adapted from MFTCS)
Sampling Locations	Randomly assigned and cover a large region. Minimum of 0.5 miles apart.	Not randomly assigned. Limited to Theodore Wirth Regional Park. Locations chosen to align with survey goals Most sites are less 0.5 miles apart.
Data Collection	Measuring water temperature optional; one reading per run used for all sites regardless of location or water source.	Water temperature recorded at all sites, when present and safely accessible.
	Comments limited to one field for all sites and dedicated to how sampling was done (eg., tried to silence frogs at site X).	Additional observations recorded at each location. A field was added to each site for notes about habitat, phenology, weather, etc.
	Records only species heard during the 5-minute listening period. It is optional to note in comments species heard outside of the listening period.	Records frogs and toads **heard** outside of the 5-minute listening period. "P", for present, was used instead of the numeric calling index to distinguish this type of observation from MFTCS protocol in raw data.
	Records only species heard during the 5-minute listening period. Optional to note in comments species seen and not heard.	Records frogs and toads **seen** at a site outside of the 5-minute listening period. P, for present, was used instead of the numeric calling index to distinguish this type of observation from MFTCS protocol.
	Records all species heard during the 5-minute listening period—regardless of distance. Sites are located at least 0.5 miles apart, which prevents hearing calls from another site..	Distinguishes between species heard at the waterbody being sampling site and those heard in the distance (which could be from a nearby sampling site since some are less than a 0.5 mile apart). Calling index for species heard in the distance is denoted by parentheses around the rating, for example (3). Note this is not foolproof as it can be hard to discern whether calls are from an adjacent site or on the far side of the location being sampled.

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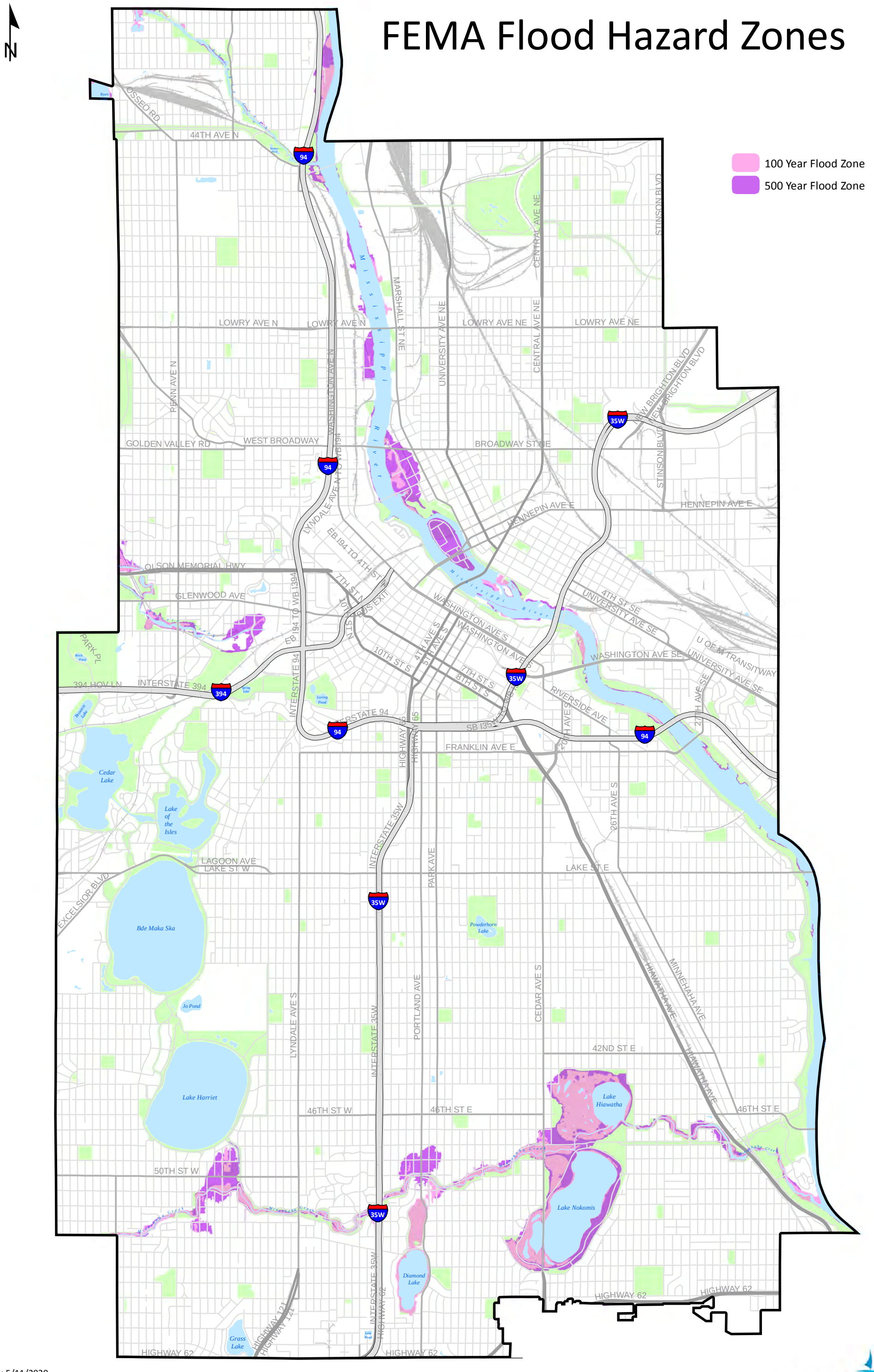
Appendix B

FEMA Flood Hazard Zones



Date: 5/11/2020

Source: National Flood Hazard Layer - Federal Emergency Management Agency
Effective Date : 11-04-2016; Accessed : 06-19-2019

Appendix B1

Minneapolis
Public Works

Watershed Management Boundaries

N

BASSETT CREEK
MINNEHAHA CREEK
MISSISSIPPI
SHINGLE CREEK

SHINGLE CREEK WMO

BASSETT CREEK WMO

MISSISSIPPI WMO

MINNEHAHA CREEK WD

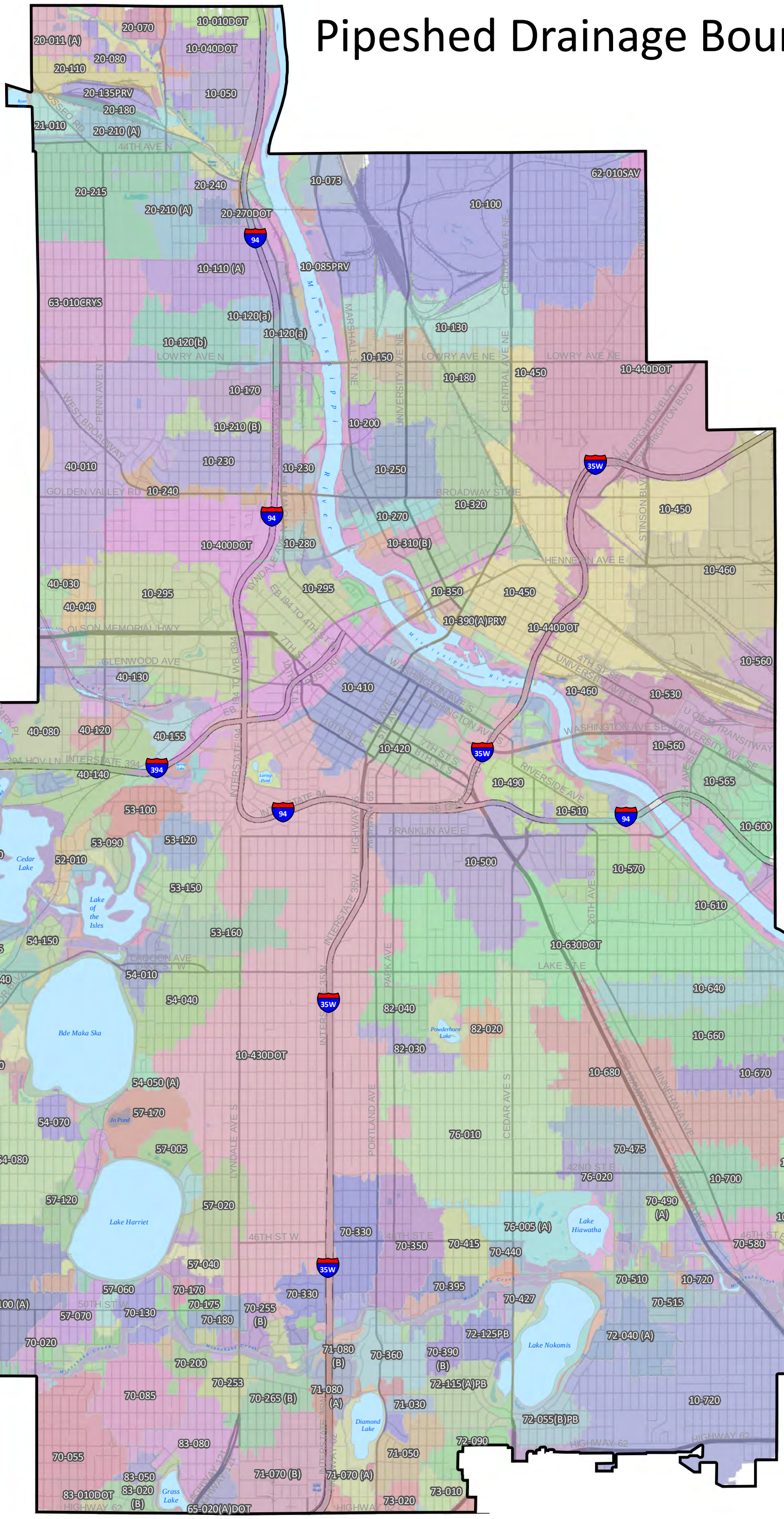
Date: 5/11/2020

Source: Board of Water and Soil Resources
Effective Date : 02-12-2020
Accessed : 05-06-2020

Appendix B2

Minneapolis Public Works

Pipeshed Drainage Boundaries



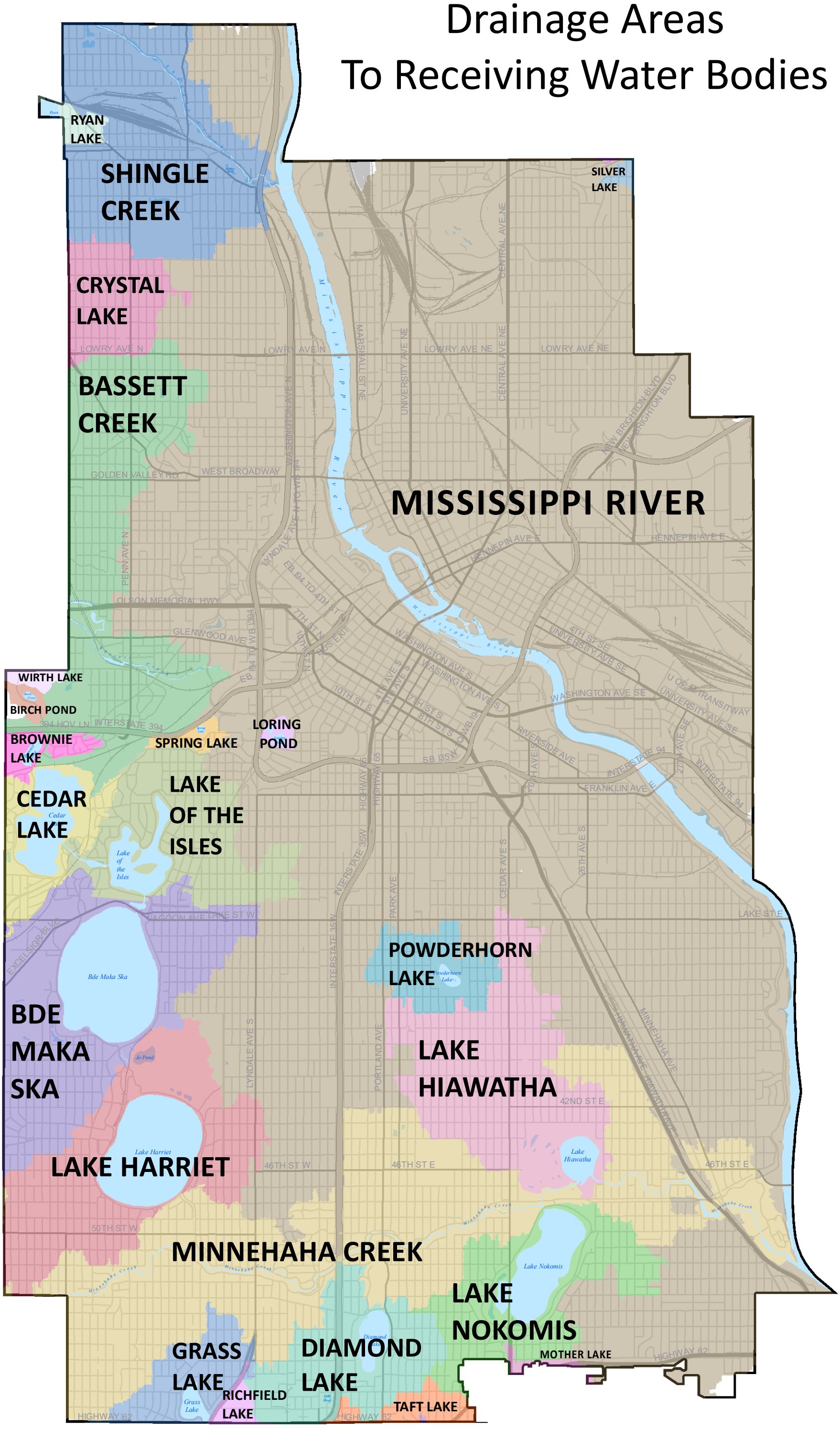
Prefix	Receiving Water
10-XXX	Mississippi River (Mpls)
15-XXX	Mississippi River (UofM)
20-XXX	Shingle Creek
21-XXX	Ryan Lake
40-XXX	Bassett Creek
42-XXX	Wirth Lake
43-XXX	Spring Lake
45-XXX	Loring Pond
51-XXX	Brownie Lake
52-XXX	Cedar Lake
53-XXX	Lake of the Isles
54-XXX	Bde Maka Ska
57-XXX	Lake Harriet
61-XXX	Hart Lake
62-XXX	Silver Lake
63-XXX	Crystal Lake
64-XXX	Legion Lake
65-XXX	Richfield Lake
70-XXX	Minnehaha Creek
71-XXX	Diamond Lake
72-XXX	Lake Nokomis
73-XXX	Taft Lake
74-XXX	Mother Lake
76-XXX	Lake Hiawatha
81-XXX	Birch Pond
82-XXX	Powderhorn Lake
83-XXX	Grass Lake

Date: 4/10/2023
Source: Minneapolis Public Works - Surface Water & Sewers
Effective Date : 04-06-2023; Accessed : 04-10-2023

Appendix B3

Minneapolis
Public Works

Drainage Areas
To Receiving Water Bodies

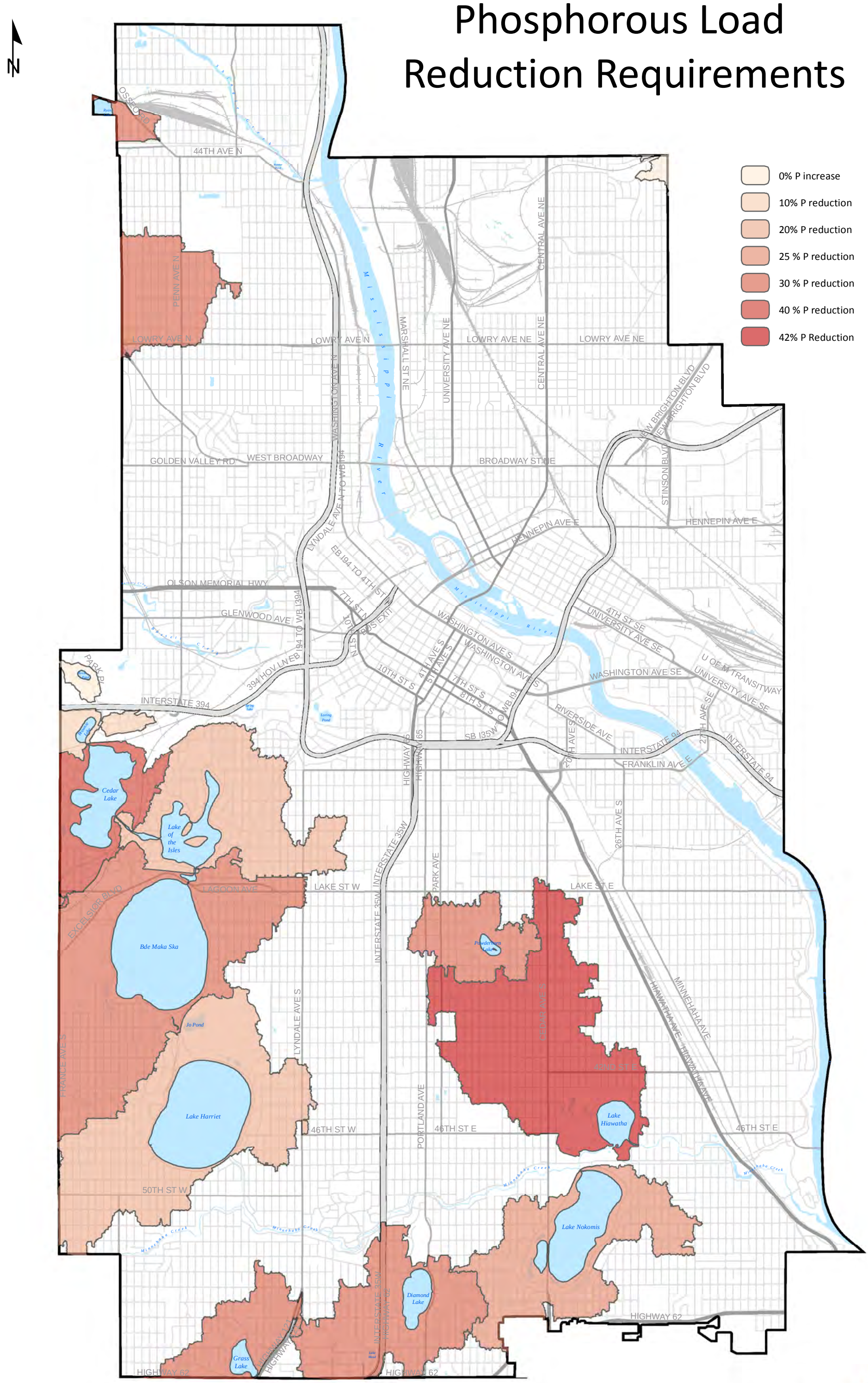


Date: 4/15/2022
Source: Minneapolis Public Works - Surface Water & Sewers
Effective Date : 04-15-2022; Accessed : 04-15-2022

Appendix B4

Minneapolis
Public Works

Phosphorous Load Reduction Requirements

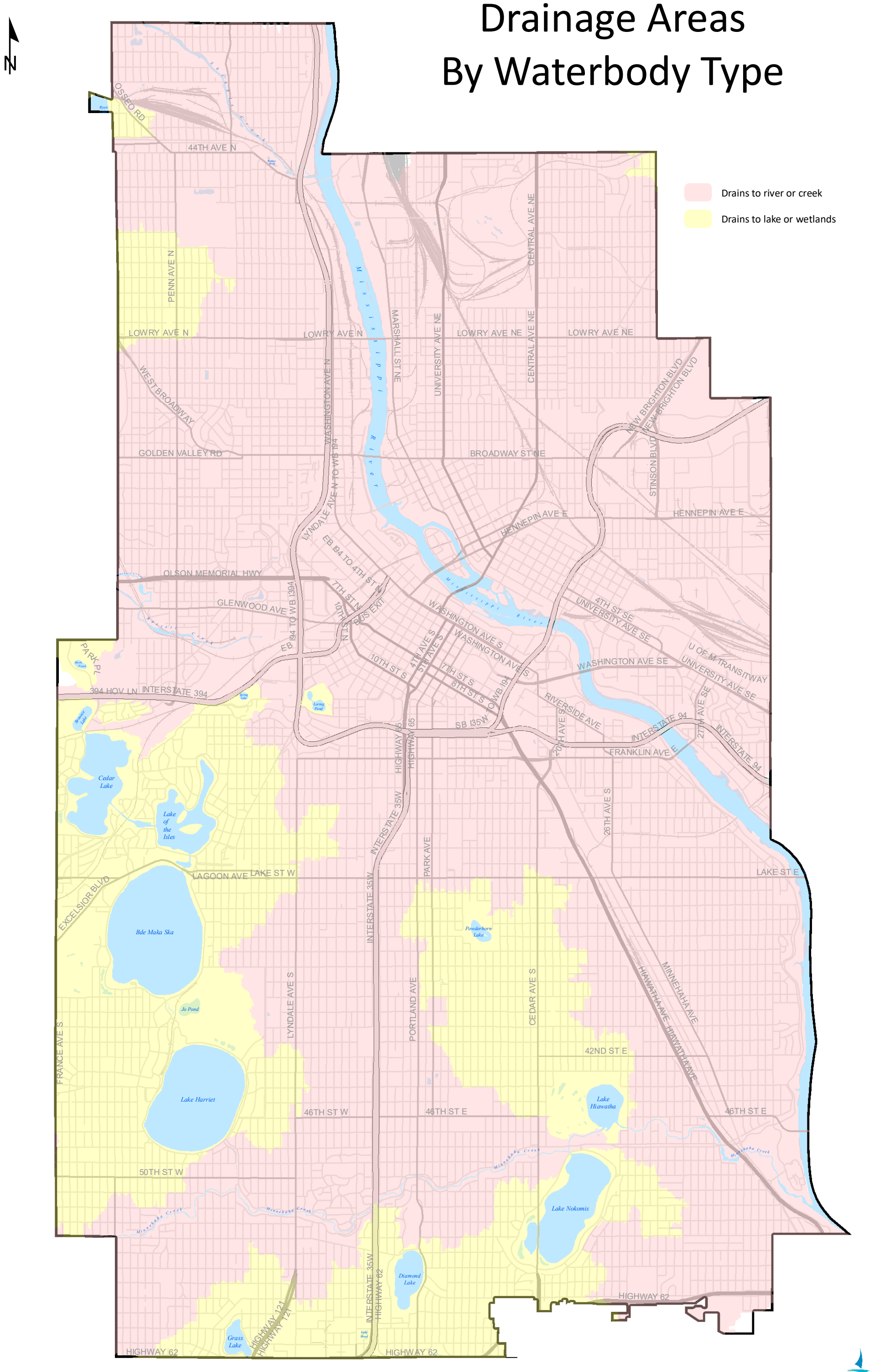


Date: 5/11/2020
Source: Minneapolis Public Works - Surface Water & Sewers

Appendix B5

Minneapolis Public Works

Drainage Areas By Waterbody Type



Date: 4/15/2022
Source: Minneapolis Public Works - Surface Water & Sewers
Effective Date : 04-15-2022; Accessed : 04-15-2022

Appendix B6

Minneapolis Public Works

Hydrologic / Hydraulic Storm Modeling Status

N

H/H Model Status

- Complete
- In Progress

Document Path: M:\PWSWS\ES_Directory\Grp2PatWrase\Grp2Shared\SewerReports\NPDES Reports\2023 report\GIS_Files\2023_Model_Status.mxd

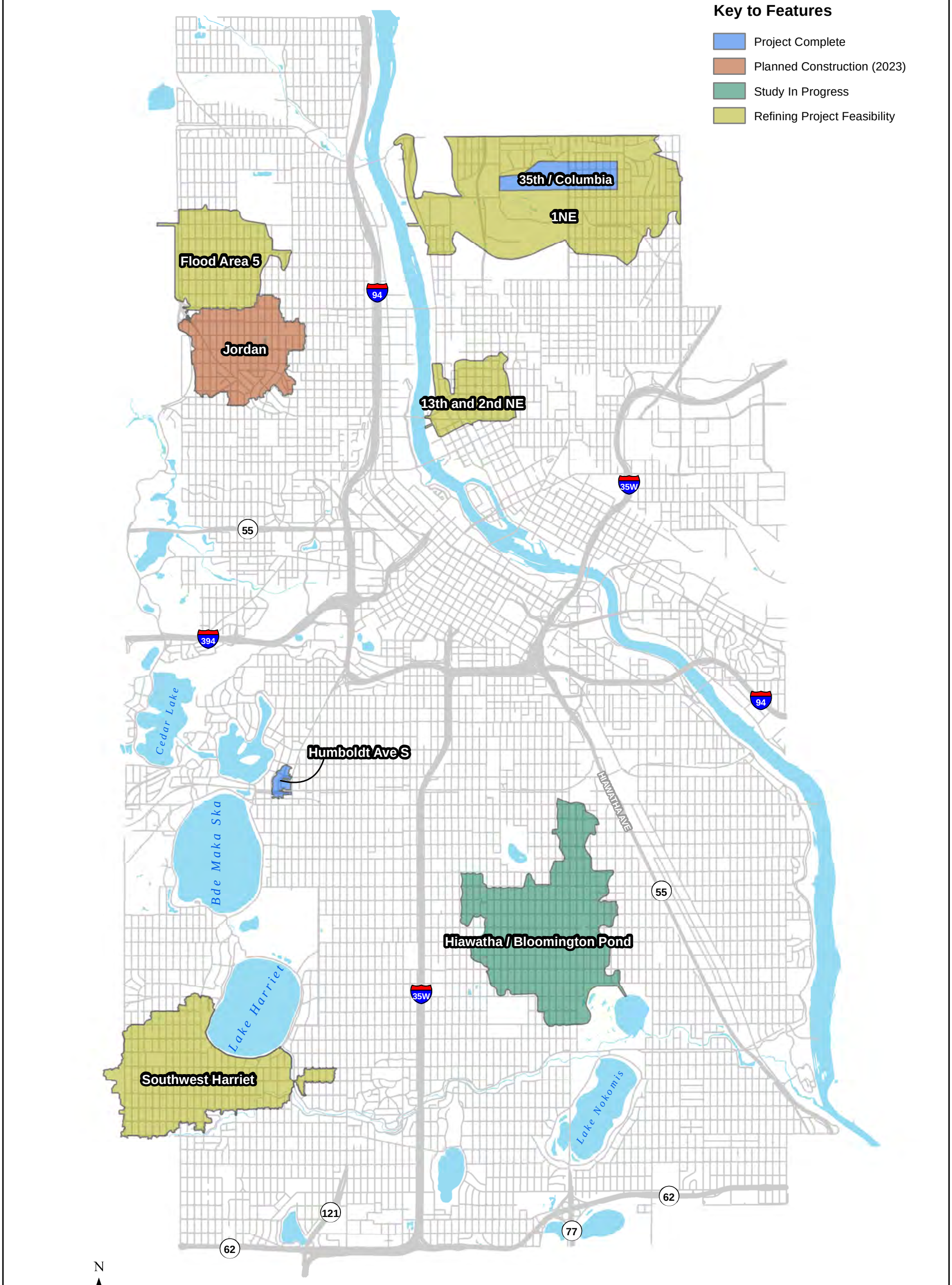
Storm Modeling Status - Appendix B7

Minneapolis
City of Lakes

Surface Water & Sewers Division
Regional Hydrologic / Hydraulic Model
2023 Project Status

4,200 2,100 0 4,200
Feet

Current Flood Mitigation Study Areas



Appendix B8

Minneapolis
City of Lakes

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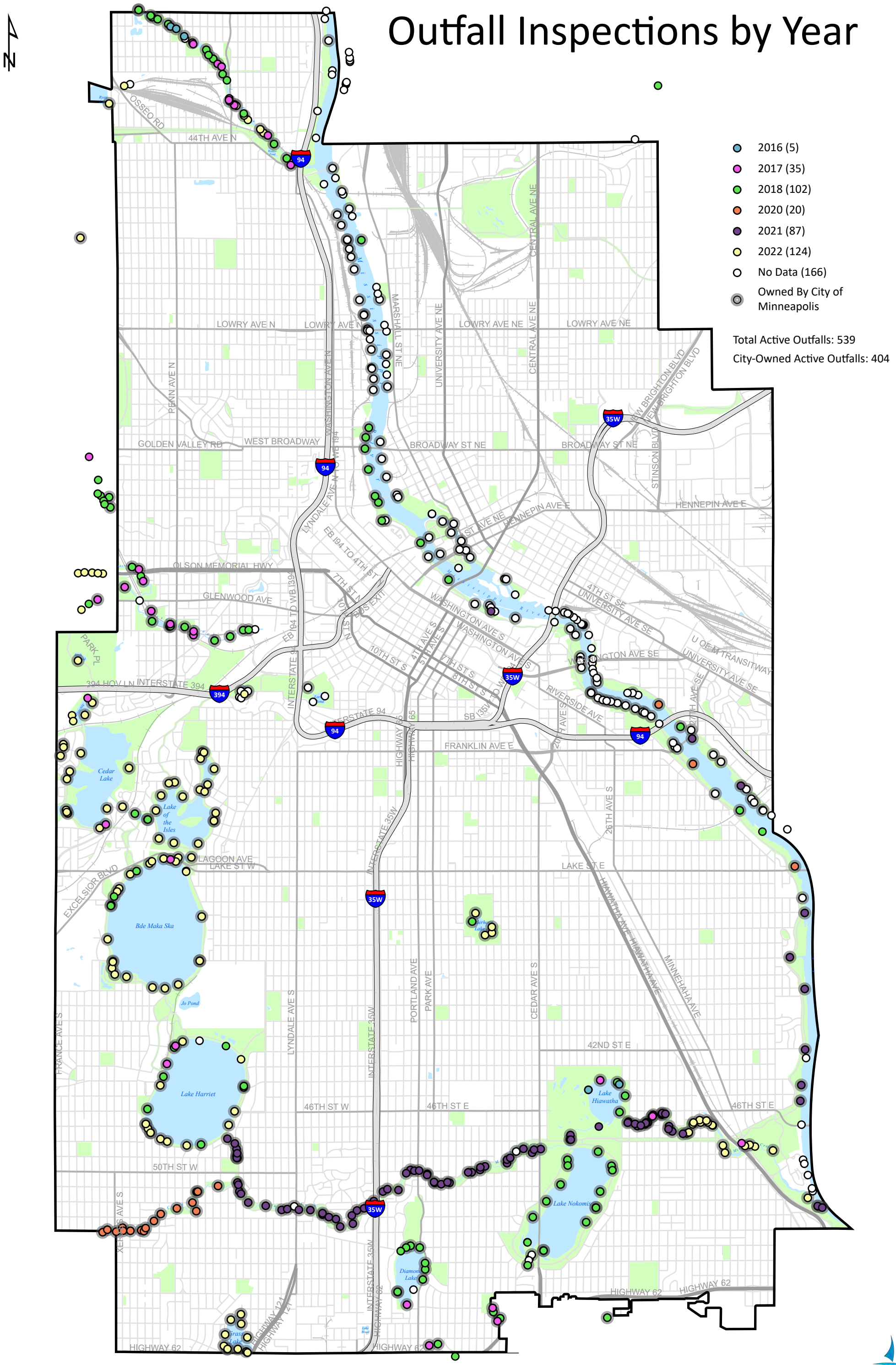
Outfall Inspections by Year



Date Exported: 6/7/2023 10:59 AM

Source: Public Works - Surface Water & Sewers
Effective Date : 1/1/2023

Appendix B9

Minneapolis
Public Works

Appendix C

Minneapolis

City of Lakes

Appendix C: Public Comment

As part of the NPDES permit process the permittees are required to opportunities for public input on the adequacy of the Stormwater Management Program. This input is gathered annually through written comments and through a public hearing before the Minneapolis City Council. All comments and the response to comments are submitted to the MPCA with the Annual Report.

Notice of the public hearing was sent to environmental groups, related governmental entities, all Minneapolis neighborhood groups, and other interested parties on April 17, 2023, and was also published in Finance and Commerce. This year's public hearing was held on May 18, 2023.

The City received no written comments and had one person testify at the public hearing. The response to comments is below.

Henry LaBounta

Mr. LaBounta spoke at the public hearing on trash and litter in Lake of the Isles and in the East Isles Neighborhood. A complete record of his comments can be found on the City's YouTube page at minute 42:40.

Response: *The City of Minneapolis updated the SWMP in 2022 to include trash and litter as pollutants of concern under the following sections of the SWMP: Public Education and Outreach, Public Participation and Involvement, Illicit Discharge Detection and Elimination, Construction Site Stormwater Runoff Controls, and Pollution Prevention and Good Housekeeping for Municipal Operations. No additional modifications to the SWMP to address this issue are proposed.*