CRWD 2025 Stormwater Summary

April 22, 2026

CRWD 2025 Stormwater Summary

Saint Paul, Minnesota

Cover image: Highland Bridge Central Water Feature, [CRWD Staff]

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1 Stormwater Monitoring in CRWD

1.1 About CRWD

The Capitol Region Watershed District (CRWD) is a small, urban watershed located entirely within Ramsey County, Minnesota. It is part of the Upper Mississippi River Basin, with all runoff eventually discharging into the Mississippi River through 42 storm tunnel outfall pipes along a 13-mile stretch in St. Paul. Established in 1998, CRWD is a special-purpose unit of government dedicated to managing, protecting, and improving the District's water resources. The watershed encompasses portions of five cities: Falcon Heights, Lauderdale, Maplewood, Roseville, and Saint Paul (Figure 1). Land use is primarily residential and commercial, with areas of industrial development and parkland. All stormwater runoff within the watershed boundaries is collected and conveyed through an extensive network of underground storm sewer pipes that eventually drain to the Mississippi River.

1.2 Stormwater in CRWD

Urban development and human activities have significantly impacted water quality in CRWD lakes, ponds, wetlands, and the Mississippi River. The expansion of impervious surfaces, such as roads and rooftops, has increased stormwater runoff, carrying pollutants into local water bodies. This runoff contributes to higher storm peak flows, local flooding, reduced groundwater recharge, and degraded aquatic habitats.

Stormwater transports nutrients, sediment, heavy metals, bacteria, and chloride, making it the primary source of pollution to CRWD water resources. Water quality data indicate impairments for nutrients, bacteria, and turbidity, preventing many water bodies from meeting standards for fishing, aquatic habitat, and recreation. The Mississippi River and Como Lake are listed on the Minnesota Pollution Control Agency's (MPCA) 303(d) list of impaired waters, requiring Total Maximum Daily Load (TMDL) studies.

The key pollutant of concern in CRWD is phosphorus, which fuels algal blooms, reducing oxygen levels and increasing water turbidity. Common phosphorus sources include fertilizers, leaves, pet waste, and wastewater discharges. Sediment, another major pollutant, reduces water clarity and transports phosphorus. It originates from construction sites, erosion, and winter road sanding.

Heavy metals, such as lead and zinc, can be toxic and bioaccumulate in organisms, entering waterways from vehicle wear, roofing materials, and road de-icing agents. Pathogens from animal waste and illicit sanitary connections pose health risks, while chloride from road salt threatens aquatic life by creating a saline environment. Since chloride does not break down naturally, its accumulation in water bodies is a growing concern.

1.3 CRWD Monitoring Goals

CRWD established its monitoring program in 2004 to assess water quality and quantity of District lakes, wetlands, ponds, and stormwater, identify problem areas, evaluate the effectiveness of Best Management Practices (BMPs), and promote an understanding of District water resources. The objectives of the program are to identify water quality problem areas, quantify subwatershed runoff pollutant loadings, evaluate the effectiveness of BMPs, provide data for calibration of hydrologic, hydraulic, and water quality models, and promote understanding of District water resources and water quality. Additionally, CRWD's monitoring efforts support compliance with Municipal Separate Storm Sewer System (MS4) permit requirements, which mandate the monitoring of stormwater discharges to assess progress toward water quality goals and total maximum daily load (TMDL) reductions.

CRWD is divided into sixteen major subwatersheds (Figure 1), five of which discharge directly into the Mississippi River. The Minnesota Pollution Control Agency has classified the portion of the river adjacent to the District as impaired for specific pollutants, including total suspended solids (TSS) affecting aquatic life and fecal coliform impacting aquatic recreation.

1.4 Purpose of Report

The 2025 Stormwater Summary presents a subset of stormwater monitoring data collected by CRWD in 2025. This report focuses on data from four major subwatersheds: Como, East Kittsondale, McCarrons, and Trout Brook), detailing methods, total volume, and pollutant load results. It compares 2025 findings to previous years to assess trends in stormwater discharge, pollutant transport, and overall water quality. Additionally, the report examines how annual climatic variations—such as precipitation patterns and storm intensity—affect stormwater runoff and pollutant loading.

For further context on these climatic influences, refer to the CRWD 2025 Climatological Summary. Annual monitoring reports, including past stormwater, lakes, and climate reports are available on the CRWD website (www.capitolregionwd.org).

For additional information and to view/download data from stations not mentioned in this report, please visit the CRWD Water Data Reporting Tool: https://waterdata.capitolregionwd.org/applications/public.html?publicuser=Guest#waterdata/stationoverview

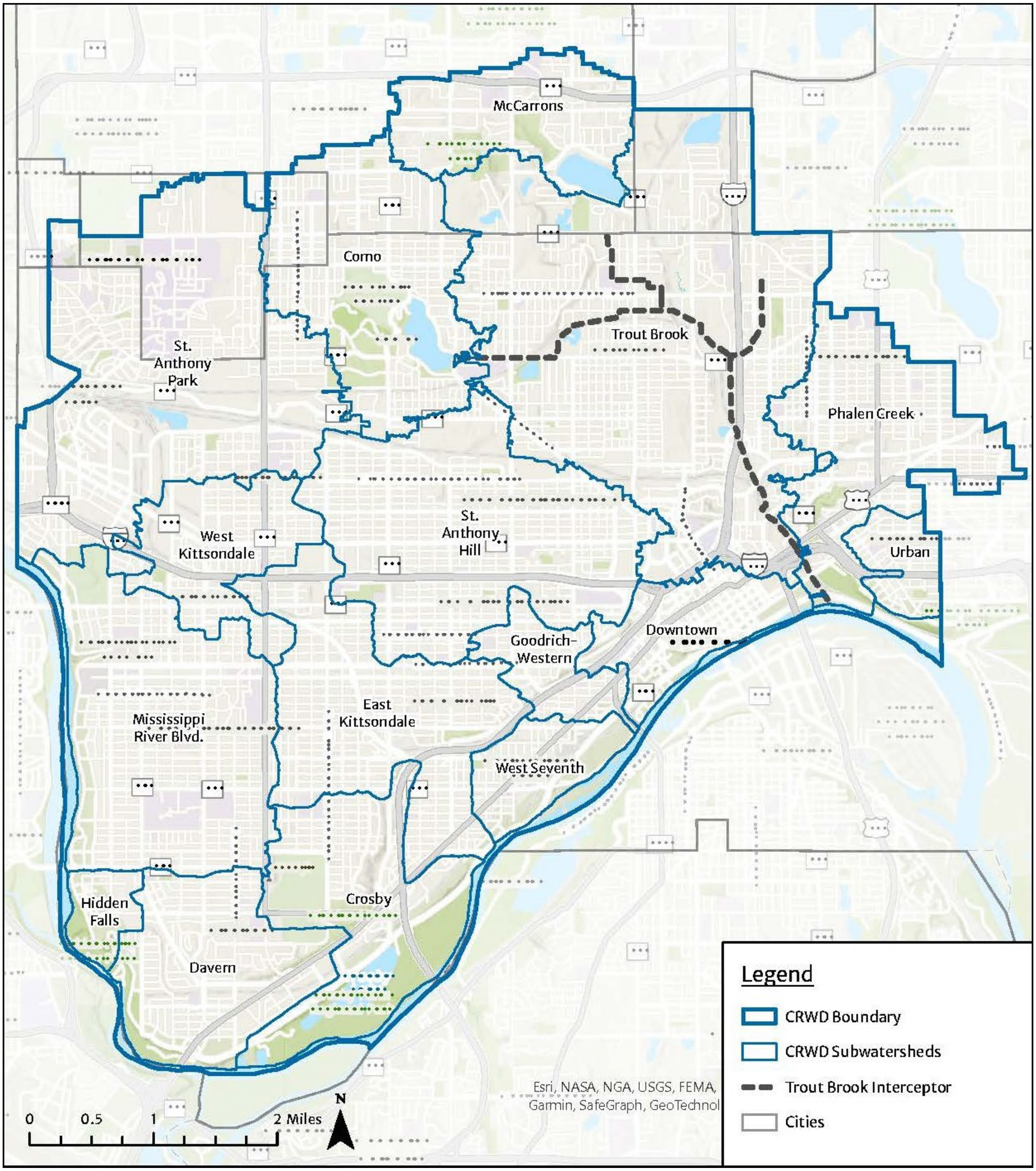

Figure 1: CRWD watershed and subwatershed boundaries

1.5 Monitoring Locations and Descriptions

In 2025, CRWD collected water quality and/or quantity data at four monitoring stations located at the outlets of District subwatersheds (Table 1, Figure 2). East Kittsondale and Trout Brook Outlet are located at or near the outlets of subwatersheds which drain directly to the Mississippi River. Villa Park Outlet and Como 3 are located within minor subwatersheds which do not drain directly to the River, but are still ultimately connected through downstream subwatersheds. The Como 3 station is located near the Como D subwatershed outlet which drains into Como Lake, and the Villa Park Outlet station is located at the outlet of the Villa Park subwatershed which drains into Lake McCarrons.

Table 1: Station name, description, and drainage area of monitoring stations analyzed

Station Name	Description	Drainage Area (acres)
Como 3	Outlet of Como 3 subwatershed (one inlet to Como Lake)	517
East Kittsondale	Outlet of East Kittsondale subwatershed	1,861
Trout Brook Outlet	Outlet of the Trout Brook Storm Sewer Interceptor	5,028
Villa Park Outlet	Outlet of Villa Park subwatershed (the main inlet to Lake McCarrons)	1,080

Table 2 outlines the period of record, total number of monitoring days in 2025, the number of potential monitoring days every year, the percentage of monitoring days captured in 2025, and samples collected in 2025 for all four stations. Como 3 does not have baseflow and is therefore monitored seasonally from ~April – November. The remaining three stations all have continuous baseflow and are operational year-round. All four monitoring stations have been monitored since early in the CRWD monitoring program's establishment and are considered long-term monitoring stations for the District.

Any missing days of monitoring in 2025 were due to equipment/power failures, maintenance needs, or seasonal equipment removal at the station.

Table 2: Stations analyzed and data collection periods

Station	Period of Record	Total Days Monitored in 2025	Total Annual Potential Monitoring Days	Percentage of Monitoring Days Captured in 2025	Samples Collected in 2025
Como 3	2009 - Current	196	214	92%	23
East Kittsondale	2005 - Current	360	365	99%	41
Trout Brook Outlet	2007 - Current	349	365	96%	38
Villa Park Outlet	2006 - Current	355	365	97%	37

1.6 Data Collection and Analysis Methods

CRWD collects, manages, reviews, and analyzes all stormwater quality and quantity data. Both water quality composite and grab samples are collected during different flow regimes at the four stations listed in Table 2. In 2025, samples were submitted to Metropolitan Council Environmental Services and Pace Environmental Laboratories for analysis. Water quantity data for all four stations in Table 2 are collected using area-velocity sensors. All stormwater quality and quantity data are compiled in the KISTERS WISKI software, where it is reviewed for accuracy and completeness.

Because the MPCA has not established numeric stormwater standards for total phosphorus (TP) or TSS CRWD data are compared to regional benchmarks, including Lambert’s Landing and applicable downstream TMDLs. TSS is evaluated against the South Metro Mississippi TSS TMDL, and TP against the Lake Pepin Excess Nutrient TMDL. When making these comparisons, flow-weighted average concentrations (in mg/L) were used. See Appendix A Section 2.3 for more information on standards used.

Discharge volumes, loads, and yields presented in this report are based on available data and are not normalized for differences in monitoring period length. As a result, data gaps (indicated in Table 2 above) may lead to underestimation at some sites.

For detailed monitoring and analysis methods, see Appendix A.

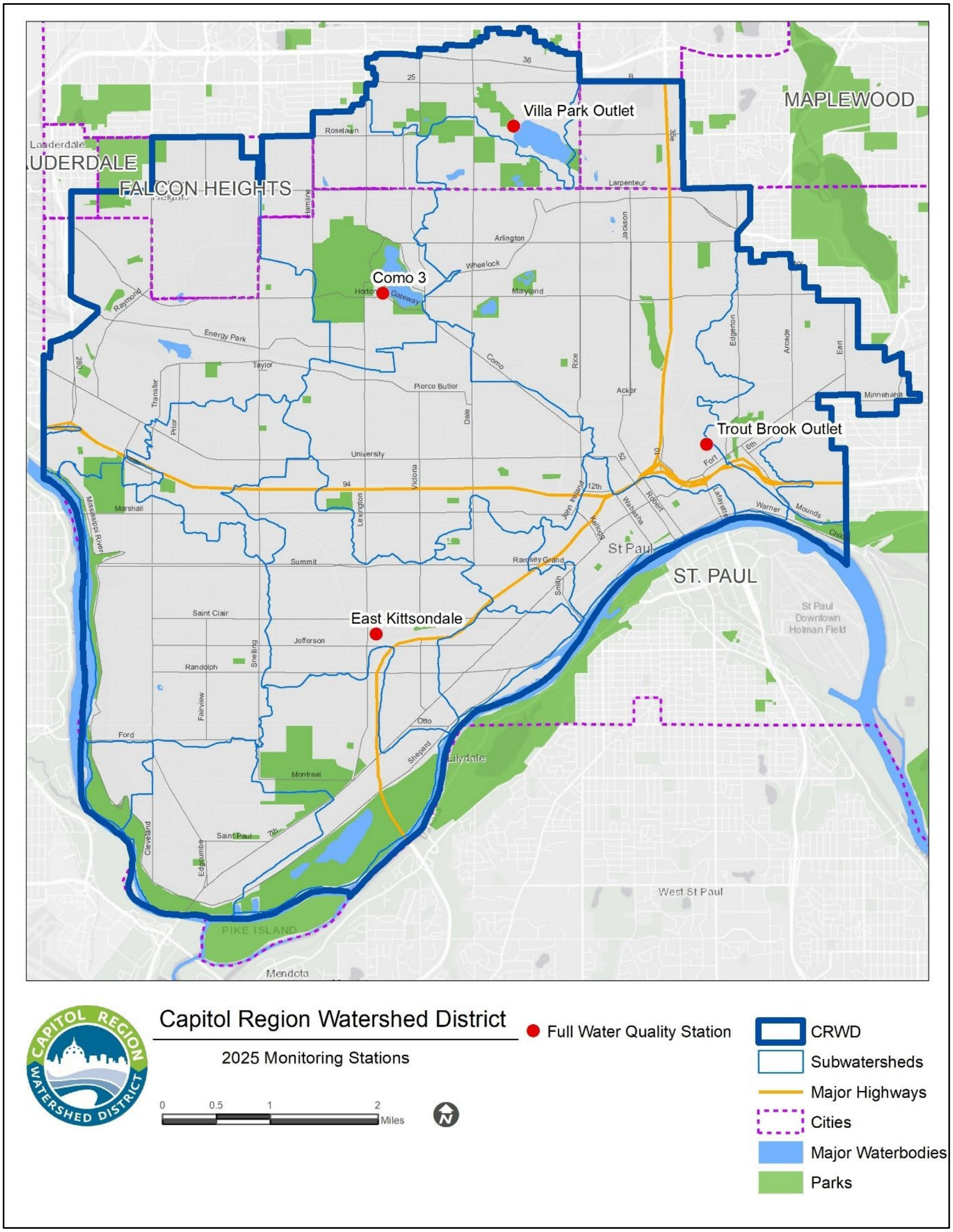

Figure 2: CRWD 2025 stormwater monitoring station locations

2 2025 Stormwater Discharge Results

2.1 Total Annual Discharge

Total annual discharge represents the cumulative volume of water conveyed through a storm tunnel over the course of a year and accounts for all flow types, including baseflow, stormflow, and snowmelt runoff. In 2025, total annual discharges were slightly greater than the historical annual average at all four stations (Figure 3).

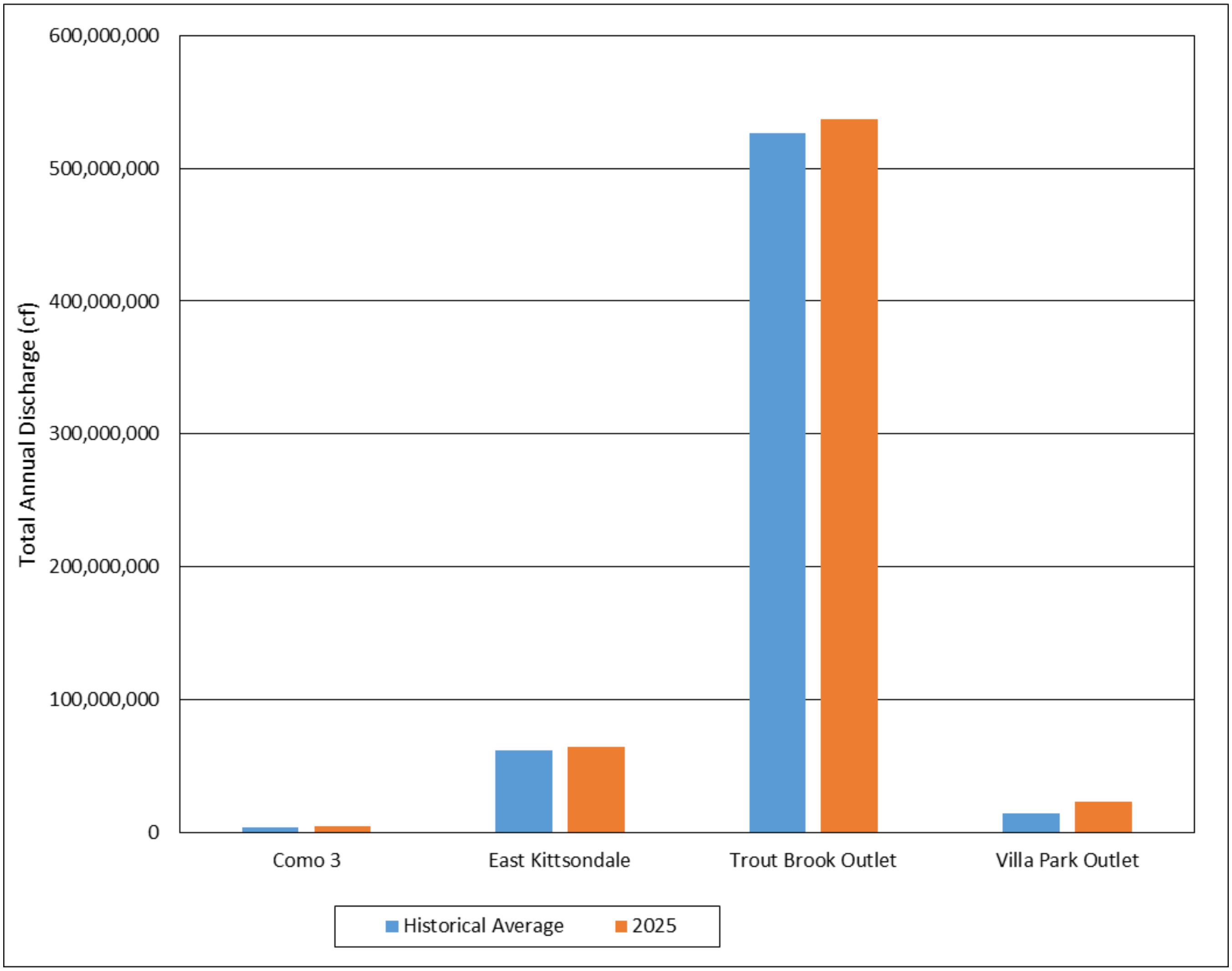

Figure 3: Total annual discharge (cf) for 2025 compared to historical annual averages (not normalized by flow regime or monitoring period)

2.2 Annual Water Yields

Annual water yield represents the total volume of water discharged from a watershed over the course of a year normalized by drainage area, allowing flows from watersheds of different sizes to be compared. The total annual water yields reported below account for all flow types, including baseflow, stormflow, and snowmelt runoff. In 2025, annual water yields followed a similar trend to total annual discharge, with all sites experiencing higher annual water yields compared to historical annual averages (Figure 4).

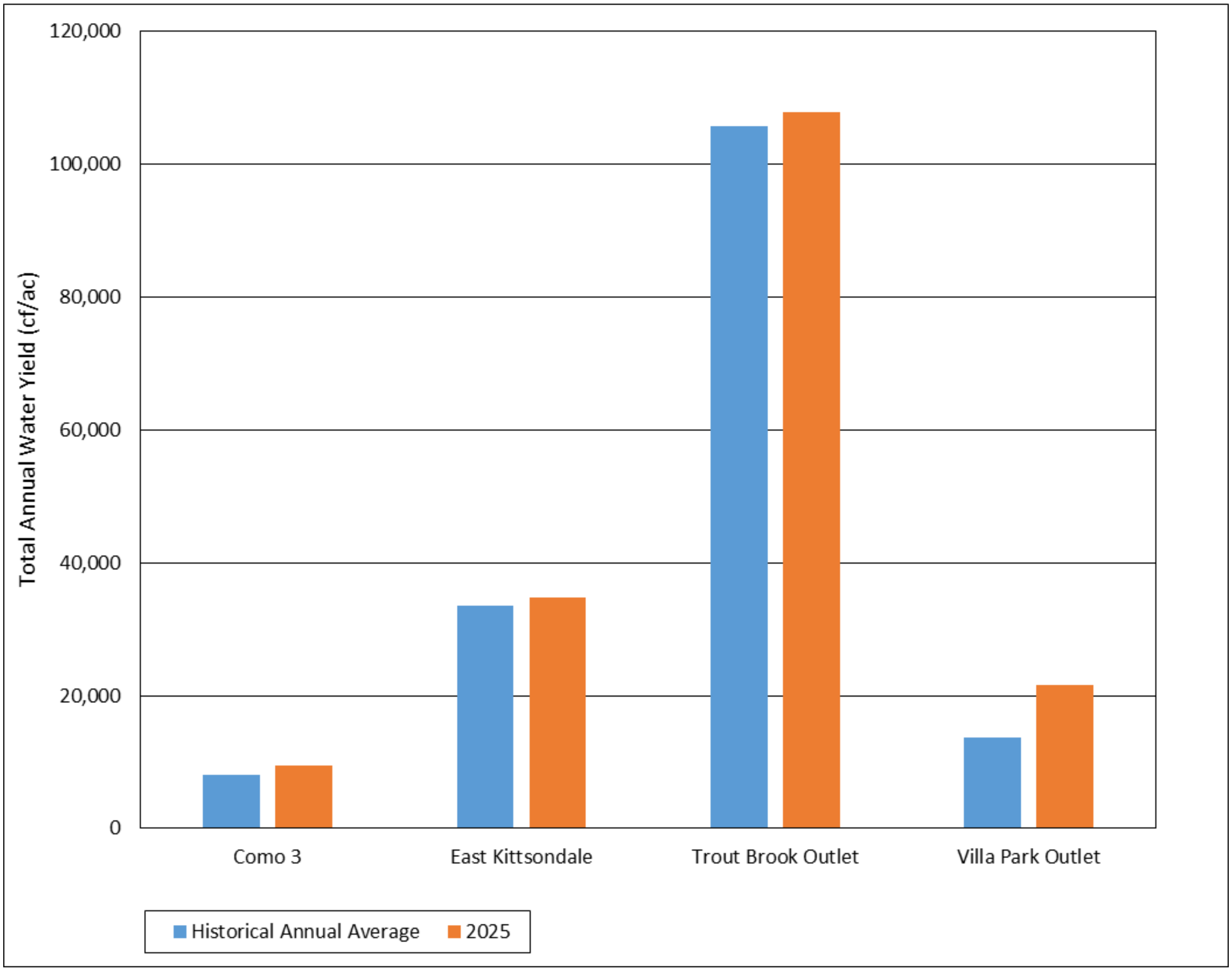

Figure 4: Total annual water yield (cf/ac) for 2025 compared to historical annual averages (not normalized by flow type or monitoring period)

3 2025 Water Quality Results

3.1 Total Phosphorus

3.1.1 Total Phosphorus Overview

TP is a key urban stormwater pollutant because small increases can contribute to poor water quality in lakes and streams. In CRWD, phosphorus enters stormwater from sources such as fertilizers, leaves and grass clippings, soil erosion, and other organic debris on impervious surfaces. TP often increases during storm events, when runoff mobilizes phosphorus and transports it to downstream water resources.

Elevated phosphorus levels can stimulate excessive algae and aquatic plant growth, reduce water clarity, and contribute to low dissolved oxygen conditions. CRWD monitoring tracks TP under different flow conditions to identify where and when phosphorus export is greatest and to inform management strategies across the watershed.

3.1.2 Total Phosphorus Results

In 2025, annual total TP loads (in lbs) – including stormflow, baseflow, and snowmelt – varied across monitoring stations, with three exceeding historical annual averages and one falling below. TP loads were higher than historical annual averages at Como 3, Trout Brook Outlet, and Villa Park Outlet. In contrast, East Kittsondale's TP load was lower than its historical TP average (Figure 5). Trout Brook Outlet had the highest TP load (3,861 lbs), followed by East Kittsondale (969 lbs).

Trout Brook Outlet had the highest TP yield (0.77 lbs/ac), followed by East Kittsondale (0.52 lbs/ac), indicating that these subwatersheds experienced particularly high phosphorus transport relative to their drainage area (Figure 6).

All stations exceeded the Lake Pepin Excess Nutrients TMDL (0.10 mg/L) , whereas only Como 3 and East Kittsondale exceeded the 2025 average TP concentration at Lambert's Landing (0.16 mg/L) (Figure 7 - See Appendix A, Section 2.3 for more information on standards used). This disparity is largely due to the Mississippi River's high volume of water, which provides significant dilution of phosphorus concentrations. In contrast, the monitored outfall stations drain smaller urbanized subwatersheds where stormwater runoff directly influences phosphorus levels. Without the same dilution capacity as the river, these smaller systems experience higher TP concentrations.

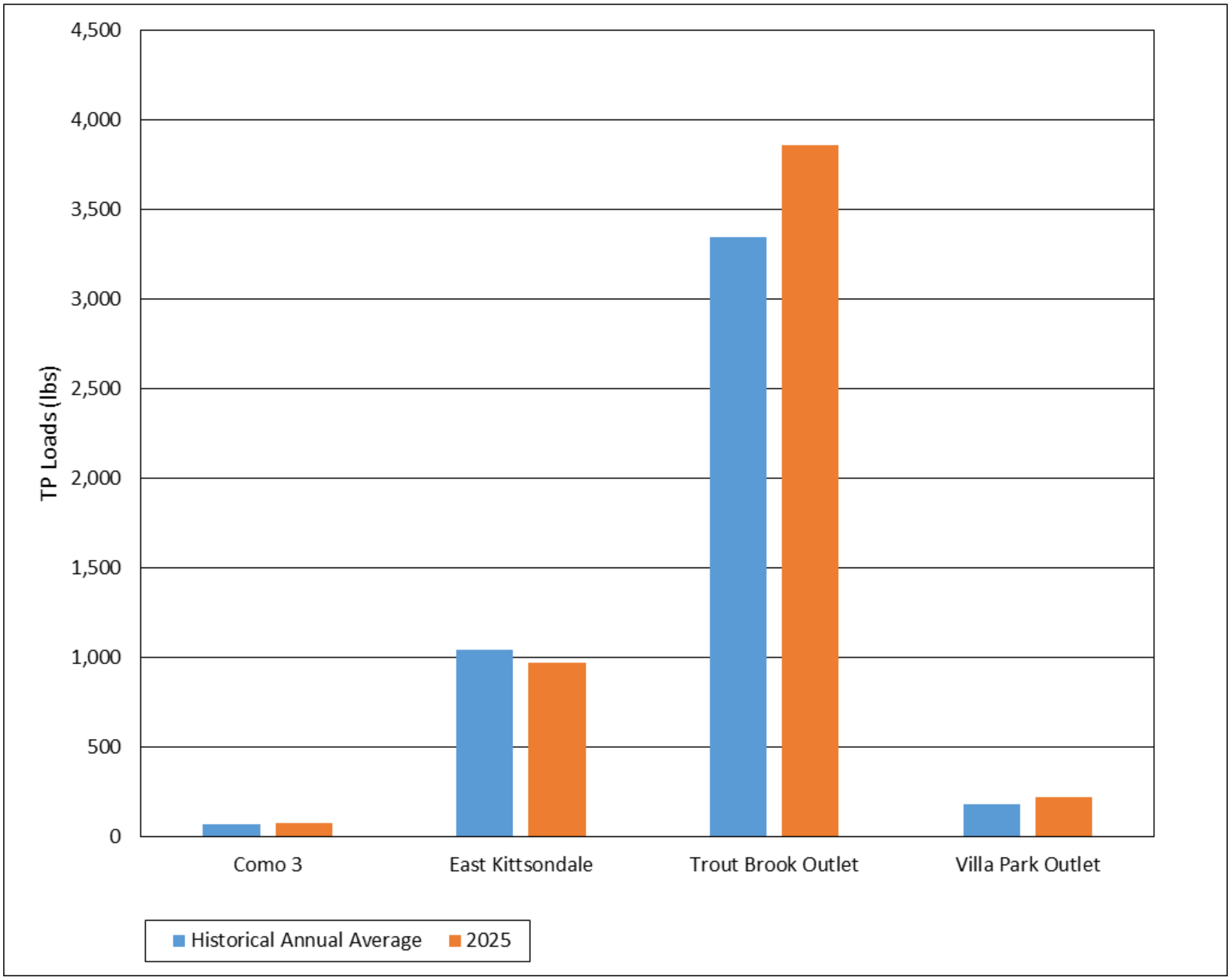

Figure 5: Annual total phosphorus loads (lbs) for 2025—including stormflow, baseflow, and snowmelt – compared to historical annual averages (not normalized by flow regime or monitoring period)

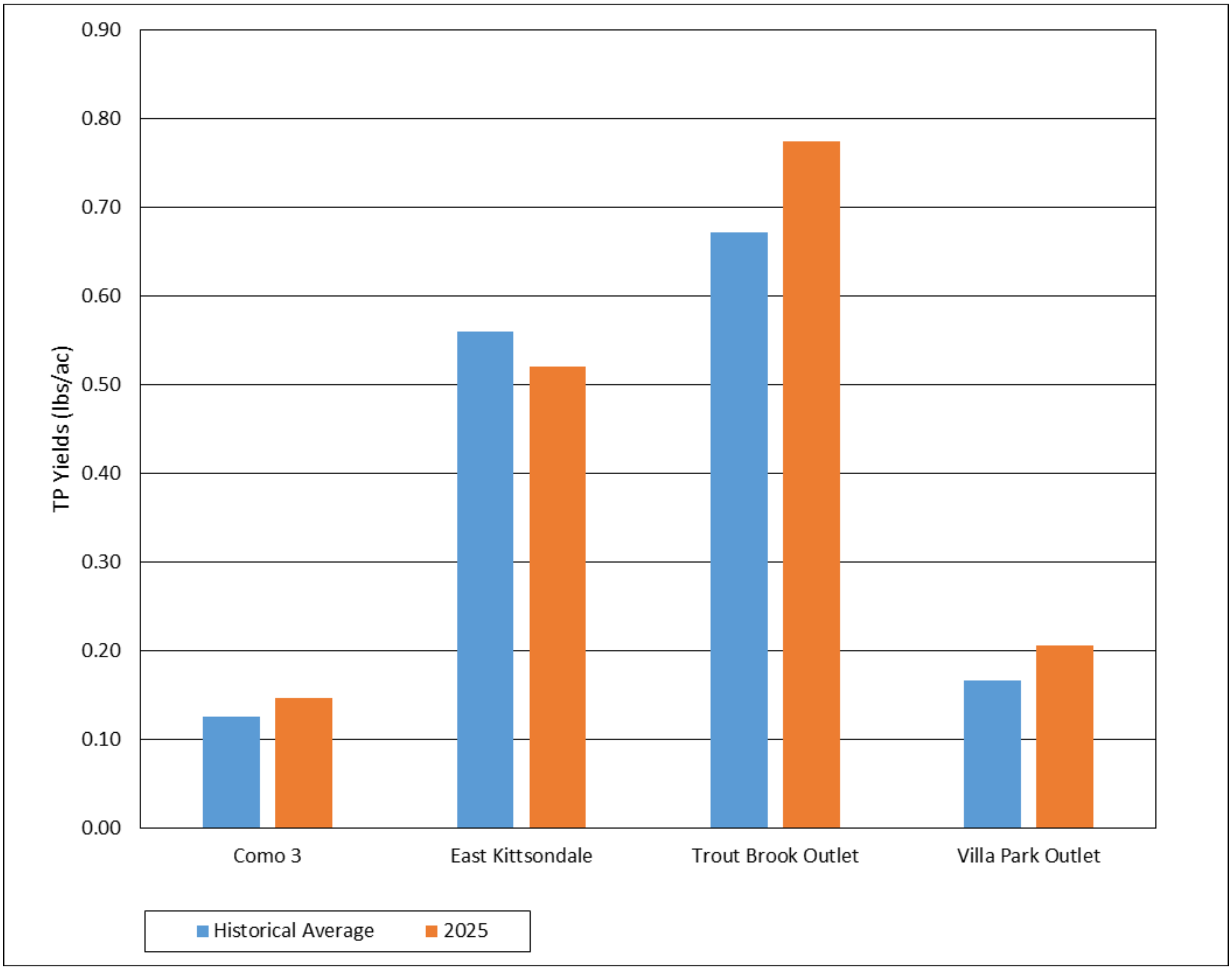

Figure 6: Annual total phosphorus yields (lbs/ac) —including stormflow, baseflow, and snowmelt—for 2025 compared to historical annual averages (not normalized by flow regime or monitoring period)

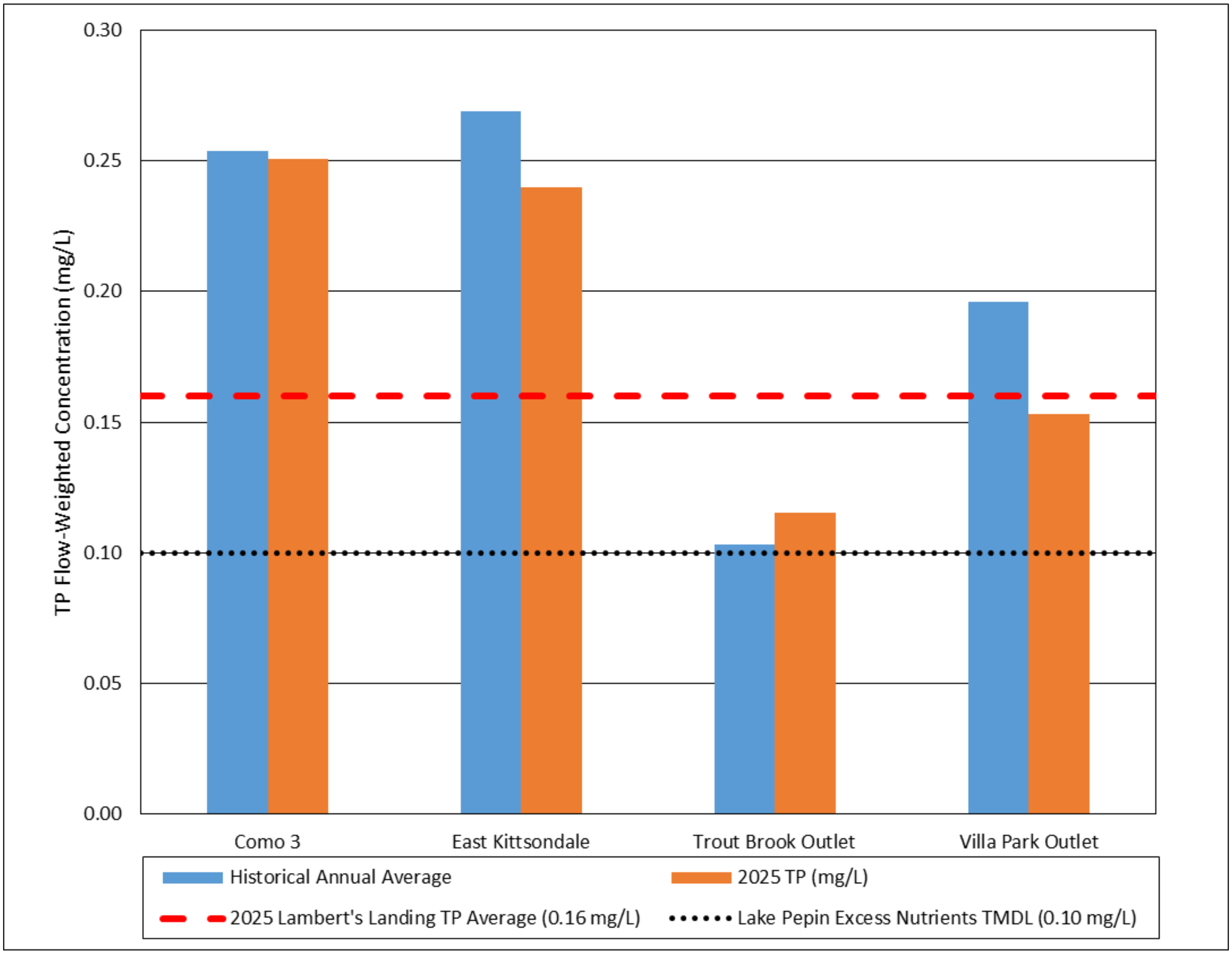

Figure 7: Average annual total phosphorus flow-weighted concentrations (mg/L) — including stormflow, baseflow, and snowmelt—compared to Lambert's Landing and the Lake Pepin Excess Nutrients TMDL

3.2 Total Suspended Solids

3.2.1 Total Suspended Solids Overview

TSS measure the amount of sediment and other particulate matter suspended in the water column. In urban stormwater, TSS can come from eroding soils, construction activity, road dust and grit, streambank erosion, and debris washed from impervious surfaces during rain events. TSS concentrations are typically low during baseflow but can rise quickly during storms as runoff mobilizes and transports sediment.

High TSS levels can reduce water clarity, degrade aquatic habitat, and carry other pollutants, such as phosphorus, through the watershed. CRWD monitoring evaluates TSS under both baseflow and stormflow conditions to better understand sediment transport, identify high-loading areas, and assess the effectiveness of stormwater management practices.

3.2.2 Total Suspended Solids Results

In 2025, annual TSS loads (in lbs) – including stormflow, baseflow, and snowmelt – were lower than historical annual averages at all stations (Figure 8). Trout Brook Outlet had the highest TSS load (910,727 lbs) followed by East Kittsondale (377,233 lbs).

East Kittsondale had the highest TSS yield (202.70 lbs/ac), followed by Trout Brook Outlet (182.73 lbs/ac), indicating that these subwatersheds experienced particularly high sediment transport relative to their drainage area (Figure 9).

Como 3 and East Kittsondale exceeded the 2025 average TSS concentration at Lambert’s Landing (64 mg/L) and the South Metro Mississippi TSS TMDL (32 mg/L) (Figure 10 – see Appendix A, Section 2.3 for more information on standards used). The exceedances are largely due to the Mississippi River’s high volume and flow rate, which dilute sediment concentrations compared to smaller urban tributaries. In contrast, stormwater outfalls and smaller streams receive more localized runoff, often carrying higher sediment loads from impervious surfaces, construction sites, and eroded soils.

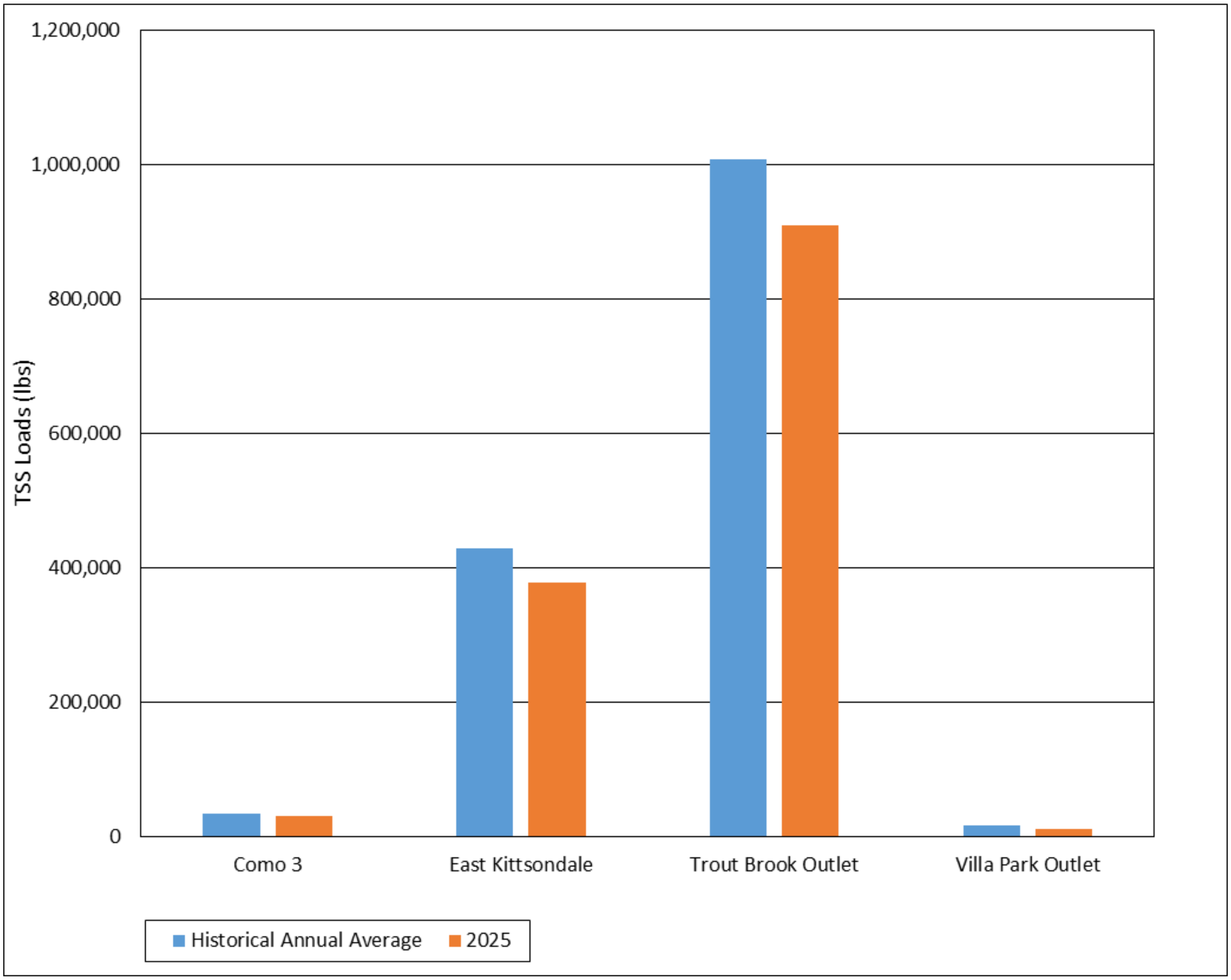

Figure 8: Total annual suspended solids loads (lbs) —including stormflow, baseflow, and snowmelt—for 2025 compared to historical annual averages (not normalized by flow regime or monitoring period)

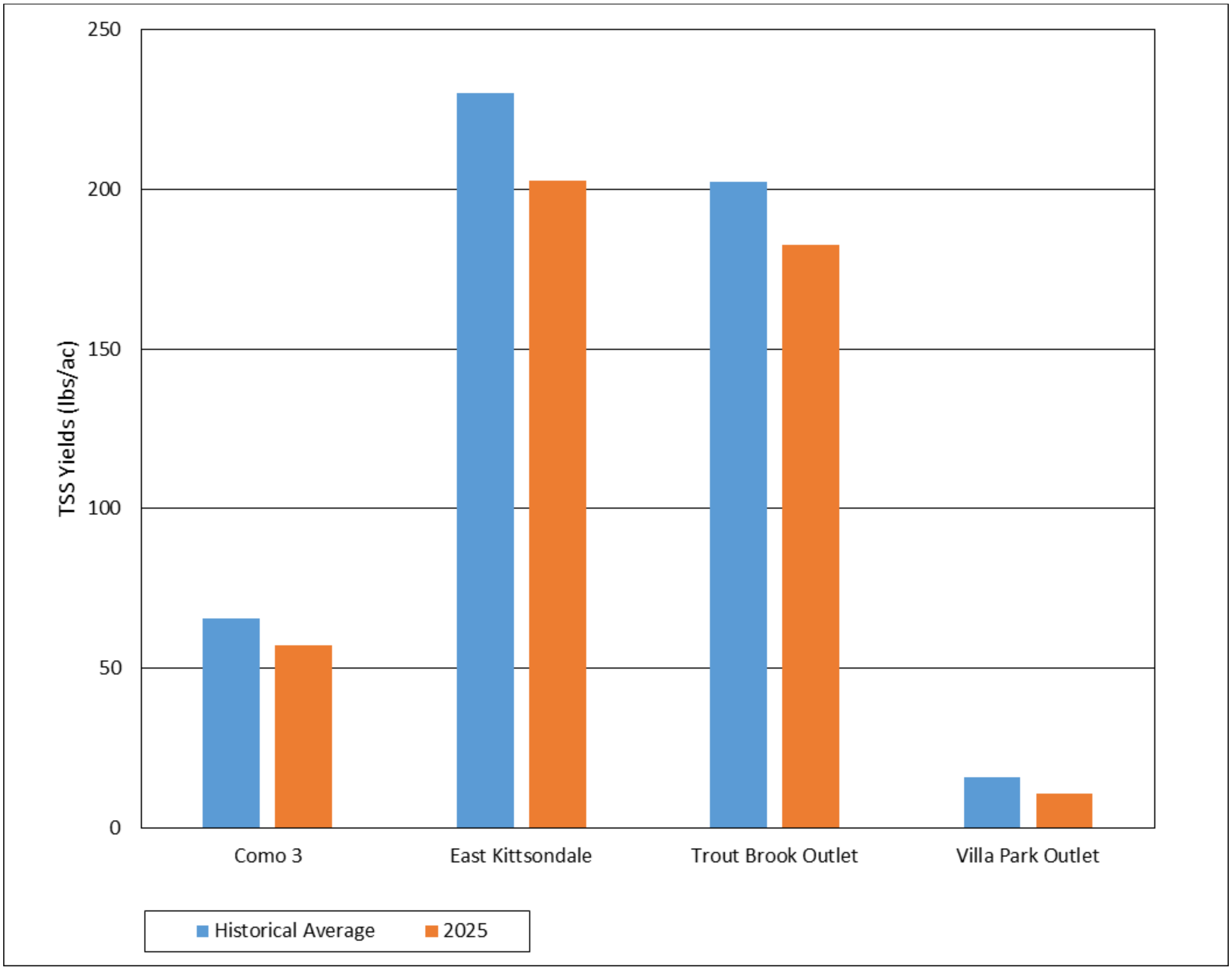

Figure 9: Total annual suspended solids yields (lbs/ac) —including stormflow, baseflow, and snowmelt—for 2025 compared to historical annual averages (not normalized by flow regime or monitoring period)

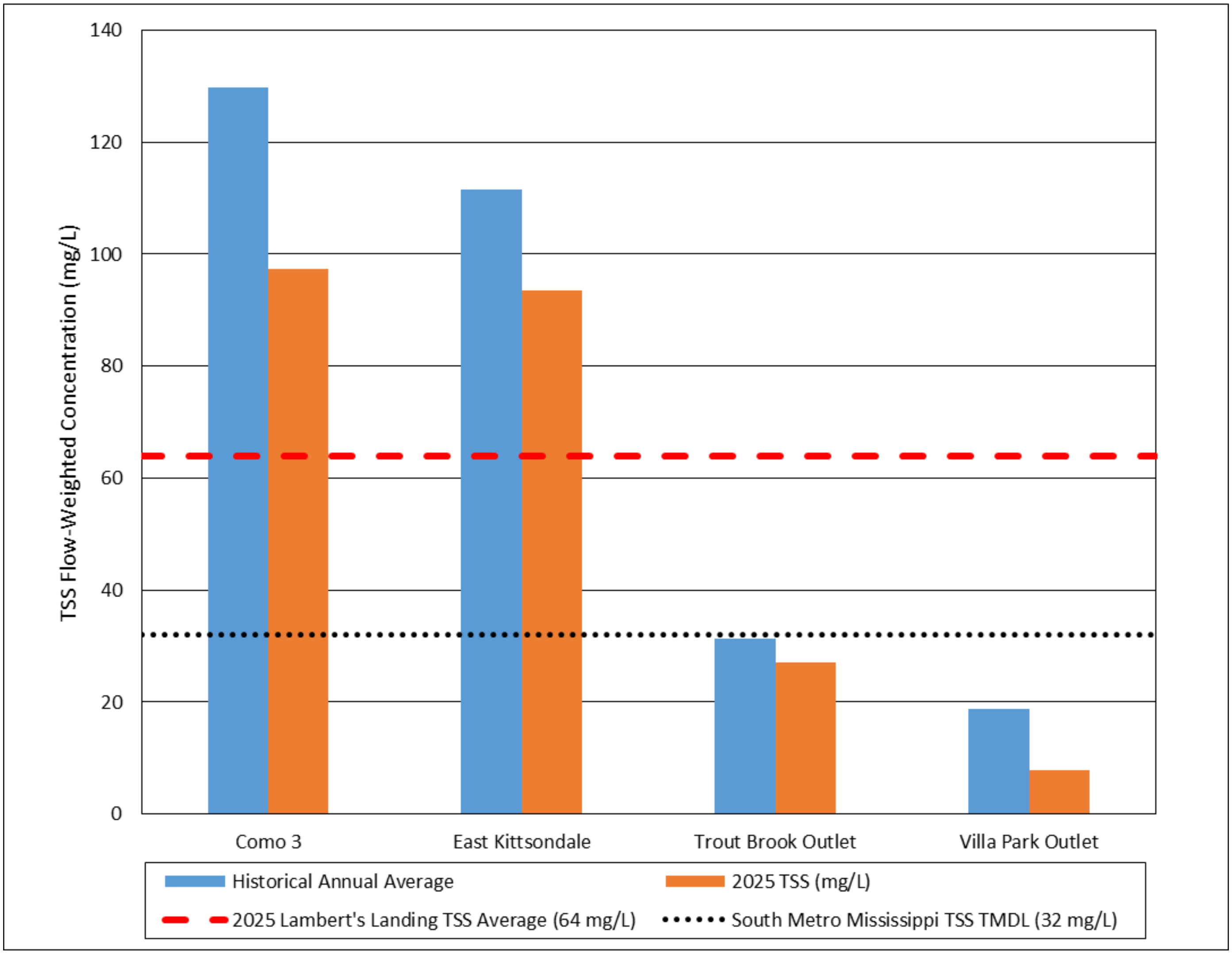

Figure 10: Average annual total suspended solids flow-weighted concentrations (mg/L) —including stormflow, baseflow, and snowmelt—compared to Lambert's Landing and the South Metro Mississippi TSS TMDL

3.3 Chloride

3.3.1 Chloride Overview

Chloride from road salt is a common urban pollutant in CRWD. Road salt is added to our roads, sidewalks, parking lots, etc during cold weather months when we experience ice and snow to increase their safety. When snowmelt or rain occurs, the chloride that has built up on impervious surfaces, as well as the chloride that has built up in the snowpack that has been shoveled from these surfaces, flows into storm sewers, eventually making its way to all types of water resources. Because there is no feasible way to remove chloride once it enters a water resource, chloride accumulates in streams, lakes, and groundwater. Chronic exposure can harm aquatic life and reduce alter community structures within a lake food chain, making chloride a key water quality concern for CRWD lakes.

To address this, CRWD is implementing a Chloride Pollution Prevention Plan (CPPP) aimed at reducing winter road salt use while maintaining public safety. The plan guides management actions such as improved winter practices, education, coordination with partners, and long-term monitoring. Stormwater monitoring helps track when and where chloride is highest, understand its behavior in different flow conditions, and evaluate the effectiveness of prevention efforts.

3.3.2 Chloride Results

The period of record box plots for chloride (Cl-) concentrations at all four stations reveal a consistent pattern that confirms the impacts of road salt during winter months: snowmelt median concentrations are the highest of all three flow types at all four stations (Figure 11). Baseflow median concentrations are the next highest at all four stations, which is evidence of chloride retention in groundwater and slow-release processes of surface waters, while storm event concentrations tend to be lower as storm runoff dilutes chloride levels.

The median snowmelt values for all stations and the median baseflow value for East Kittsondale exceeded the MPCA chronic standard (230 mg/L). The exceedance at East Kittsondale is due to the baseflow in this subwatershed being primarily comprised of groundwater, indicating how high the chloride concentrations are in our groundwater. None of the median storm event values exceeded the standard. While this standard is designed for comparison of surface water (lakes, streams, etc.) data to state standards to determine impairment, comparing our stormwater data to this standard can be informative. Stormwater in the District flows into/through District lakes and eventually to the Mississippi River. This comparison indicates that high concentrations of chloride in different flow regimes of stormwater runoff can have a large impact on area surface waters.

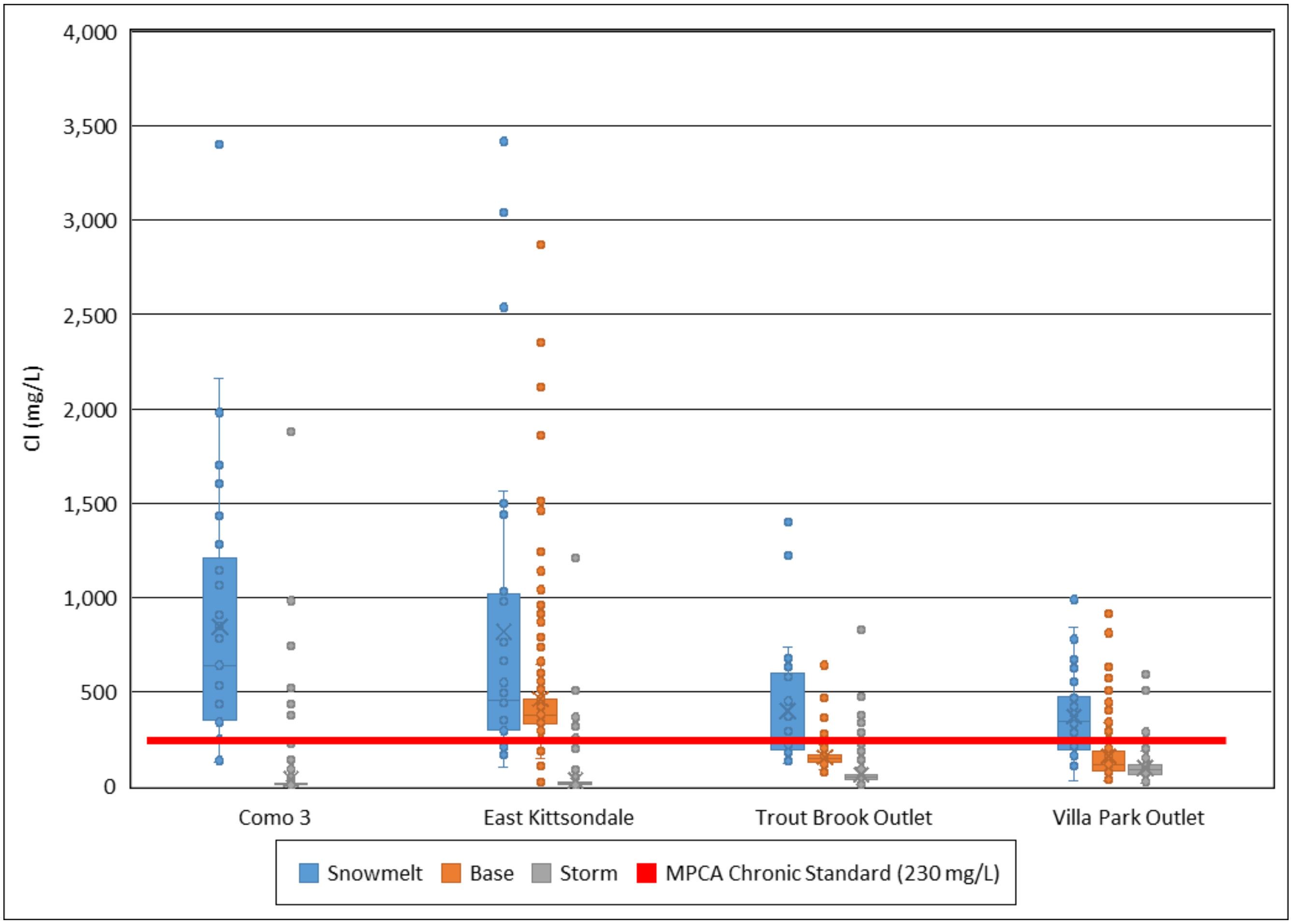

Figure 11: Chloride concentration (mg/L) period of record boxplots for snowmelt, base, and storm (*Four snowmelt values were removed from Como 3 for readability: 18,622 mg/L, 8,060 mg/L, 6,460 mg/L, and 5,140 mg/L. Como 3 also does not have baseflow and therefore no baseflow boxplot is included.)

3.4 Bacteria

3.4.1 Bacteria Overview

Escherichia coli is a type of bacteria commonly used to indicate the presence of fecal contamination in surface waters. While naturally occurring in the intestines of humans and animals, elevated levels in streams and stormwater can signal pollution from urban runoff, pet waste, or failing septic systems.

E. coli levels tend to be low during baseflow conditions, when streams are dominated by groundwater inputs, but can spike during storm events, as rainfall washes bacteria from streets, lawns, and other urban surfaces into stormwater systems. These short-term spikes can pose a risk to recreational users and aquatic life, making monitoring essential to understand when and where contamination occurs.

CRWD monitoring tracks *E. coli* under both baseflow and stormflow conditions to identify high-risk periods and locations, and inform strategies to reduce bacterial contamination across the watershed.

3.4.2 Bacteria Results

The 2025 *E. coli* grab sample results highlight a clear distinction between baseflow and stormflow conditions in terms of bacterial contamination. Of the 34 baseflow grab samples taken in 2025, only two exceeded the MPCA maximum numeric recreational standard for Class 2 waters of 1,260 cfu/100mL, indicating that under normal, non-storm conditions, *E. coli* levels generally remain within acceptable limits across the watershed, when compared to the state surface water standard (Table 3).

In contrast, stormflow conditions resulted in significantly higher exceedances, with 17 out of 19 storm grab samples surpassing the MPCA standard. This suggests that precipitation-driven runoff is a major driver of bacterial contamination, likely due to the mobilization of bacteria from sources such as urban surfaces and animal waste. (Table 4).

Site-Specific Findings:

- Como 3, East Kittsondale & Trout Brook Outlet: All stormflow grab samples exceeded the MPCA recreational standard (1,260 cfu/100mL), indicating a persistent and substantial bacterial load during wet weather conditions.
- Villa Park Outlet: A single stormflow grab sample exceeded >242,000 MPN/100 mL. Waterfowl activity (ducks and geese) in this area is the probable source of fecal contamination contributing to the elevated concentration. This is the highest recorded level of *E. coli* for a stormflow grab sample at Villa Park Outlet within its 20-year dataset.

Table 3: Baseflow grab sample E. coli concentrations at CRWD monitoring stations in 2025

Base Grab Sample Date	East Kittsondale	Trout Brook Outlet	Villa Park Outlet
1/16/2025	17	308	47
2/21/2025	5	261	1
3/26/2025	10	13	2
4/30/2025	--	44	10
5/30/2025	36	147	53
6/24/2025	147	261	98
7/10/2025	22	--	74
8/26/2025	46	163	54
9/16/2025	--	93	1,733
9/17/2025	291	--	--
10/24/2025	50	84	76
11/20/2025	125	71	19
12/15/2025	--	1,300	76
12/22/2025	114	--	--

▨ Value exceeds MPCA maximum numeric standard (1,260 cfu/mL)

Table 4: Stormflow grab sample E. coli concentrations at CRWD monitoring stations in 2025

Storm Grab Sample Date	Como 3	East Kittsondale	Trout Brook Outlet	Villa Park Outlet
5/20/2025	1,860	3,930	2,650	2,420
6/13/2025	6,770	4,950	--	770
6/25/2025	27,550	30,760	21,430	4,960
7/16/2025	6,270	8,330	30,300	>242,000
7/21/2025	3,010	9,850	11,120	436

▨ Value exceeds MPCA maximum numeric standard (1,260 cfu/mL)

3.5 Heavy Metals

3.5.1 Heavy Metals Overview

Metals such as cadmium, chromium, lead, nickel, and zinc can enter stormwater from urban surfaces, building materials, and vehicle-related sources. While small amounts occur naturally, elevated concentrations can be toxic to aquatic life, particularly during sensitive life stages.

Metals behave differently depending on water conditions. During baseflow, metals are often less toxic because groundwater typically has higher hardness, which helps buffer metals. In contrast, storm events and snowmelt can carry higher loads of metals from streets, rooftops, and other impervious surfaces. Higher metals loads, along with lower water hardness during these events, increases the potential for toxicity.

Monitoring metals in both baseflow and stormflow conditions allows CRWD to identify when and where metals pose the greatest risk, guide management actions, and assess the effectiveness of stormwater controls in protecting streams, lakes, and downstream waters including the Mississippi River.

3.5.2 Heavy Metals Results

The MPCA surface water standards for metals chronic toxicity are based on water hardness rather than fixed values; these calculated values for 2025 are in Table 5. Appendix A, Section 2.3.2, provides the equations used to calculate standards for cadmium, chromium, lead, nickel, and zinc.

In 2025, metals concentrations never exceeded MPCA standards during baseflow at any station (Table 6). In contrast, exceedances were more common in snowmelt and storm events due to lower water hardness and higher pollutant loading from direct surface runoff. Lead and zinc were of particular concern:

- **Lead:** Average storm concentrations exceeded standards at all stations except Villa Park Outlet, while snowmelt exceedances occurred at Como 3 and East Kittsondale. Annual average lead concentrations also exceeded the MPCA standard at Como 3 (Table 6).
- **Zinc:** Exceeded at Como 3 for both average storm concentration and average annual concentration, and at East Kittsondale for average snowmelt concentration and average storm concentration.

Annual average concentrations for cadmium and chromium at Como 3, East Kittsondale, and Trout Brook Outlet exceeded those at Lambert’s Landing, while Villa Park Outlet only exceeded Lambert’s Landing for zinc. Lambert's Landing did not exceed any of its metals toxicity standards. This contrasts with several stations in the report that experienced exceedances, particularly during stormflow and snowmelt conditions. The lack of exceedances at Lambert's Landing is likely due to greater dilution capacity in the Mississippi River compared to smaller tributary sites (like our stormsewer pipes).

Table 5: 2025 metals standards (mg/L) based on average 2025 hardness

Parameter	2025 Average	Lambert's Landing	Como 3	East Kittsondale	Trout Brook Outlet	Villa Park Outlet
Hardness	Snowmelt		144	142	240	340
	Base			525	332	307
	Storm		54	68	118	194
	Annual	340	69	243	226	257
Cadmium	Snowmelt	--	0.0015	0.0015	0.0023	0.0030
	Base	--	--	0.0042	0.0029	0.0027
	Storm	--	0.0007	0.0008	0.0013	0.0019
	Annual	0.003	0.0008	0.0023	0.0022	0.0024
Chromium	Snowmelt	--	0.2795	0.2764	0.4244	0.5639
	Base	--	--	0.8052	0.5523	0.5187
	Storm	--	0.1252	0.1507	0.2370	0.3557
	Annual	0.563	0.1530	0.4283	0.4043	0.4487
Lead	Snowmelt	--	0.0051	0.0050	0.0097	0.0151
	Base	--	--	0.0263	0.0146	0.0133
	Storm	--	0.0015	0.0019	0.0039	0.0074
	Annual	0.015	0.0020	0.0099	0.0090	0.0106
Nickel	Snowmelt	--	0.2151	0.2125	0.2970	0.2970
	Base	--	--	0.2970	0.2970	0.2970
	Storm	--	0.0938	0.1136	0.1814	0.2970
	Annual	0.297	0.1154	0.3342	0.3148	0.3506
Zinc	Snowmelt	--	0.1447	0.1430	0.2228	0.2990
	Base	--	--	0.4322	0.2926	0.2742
	Storm	--	0.0630	0.0763	0.1220	0.1856
	Annual	0.299	0.0776	0.2250	0.2119	0.2360

Table 6: Metals data (mg/L) and chronic toxicity standard exceedances at CRWD monitoring stations in 2025

Parameter	Average	Lambert's Landing	Como 3	East Kittsondale	Trout Brook Outlet	Villa Park Outlet
Cadmium	Snowmelt	--	0.00041	0.00045	0.00014	<0.00010*
	Base	--	--	0.00010	0.00010	<0.00010*
	Storm	--	0.00015	0.00019	0.00014	0.00010
	Annual	0.00010	0.00020	0.00018	0.00012	0.00010
Chromium	Snowmelt	--	0.01206	0.01831	0.00410	<0.00250*
	Base	--	--	<0.00250*	<0.00250*	<0.00250*
	Storm	--	0.00618	0.00451	0.00446	<0.00250*
	Annual	0.00300	0.00716	0.00516	0.00355	<0.00250*
Lead	Snowmelt	--	0.00777	0.01613	0.00522	<0.00050*
	Base	--	--	<0.00050*	0.00066	<0.00050*
	Storm	--	0.01666	0.01267	0.01424	0.00057
	Annual	0.00072	0.01518	0.00855	0.00720	0.00053
Nickel	Snowmelt	--	0.00401	0.00861	0.00279	0.00098
	Base	--	--	0.00189	0.00135	0.00124
	Storm	--	0.00569	0.00438	0.00506	0.00161
	Annual	0.00217	0.00541	0.00389	0.00316	0.00139
Zinc	Snowmelt	--	0.09340	0.18617	0.04477	0.00573
	Base	--	--	0.00747	0.01182	0.00802
	Storm	--	0.12130	0.09196	0.06712	0.01275
	Annual	0.00555	0.11665	0.07040	0.04006	0.01003

🟩 CRWD monitoring station exceeded the MPCA chronic standard for surface waters

* A “<” symbol indicates that all sample results for that average concentration were reported below the laboratory reporting limit (RL). As a result, the true average concentration is less than the reported quantification limit.

4 2025 Precipitation and Impact to Stormwater Runoff

4.1 Precipitation and Pollutant Loading

The 2025 growing season (May–September) experienced above-average precipitation in CRWD, with total rainfall 2 inches higher than normal (see 2025 Climatological Summary). This excess precipitation contributed to increased stormwater runoff volumes (Figures 12 and 13 – Como 3 and Villa Park Outlet are shown separately to improve visual clarity) and led to higher TP and TSS pollutant loading during the growing season (Figures 14 through 17 - Como 3 and Villa Park Outlet are shown separately to improve visual clarity). Figures 12 through 17 are cumulative plots, meaning each graph shows the running total of event volume or pollutant load over the course of 2025. These results also show that cumulative TP and TSS loads generally increased in response to large precipitation events.

June was particularly wet, with a total precipitation of 7.28 inches—2.70 inches above the 30-year monthly normal of 4.58 inches. This intense rainfall event contributed to marked increases in stormwater runoff and pollutant loading. Como 3 had its highest TP and TSS event load in June (11.89 lbs and 4,788.76 lbs respectively), and East Kittsondale had its highest TSS event load in June (68,519 lbs). Also, all stations had their greatest increases in stormwater volume during June.

The extreme precipitation in June played a major role in the overall increases in stormwater volumes and pollutant loading observed throughout the growing season. When monthly precipitation totals are high early in the season, stormwater ponds, lakes, and wetlands across the landscape often reach capacity and soils are saturated. As a result, additional rainfall leads to greater stormflow because these surface waters have less ability to absorb and hold more water, contributing to higher stormwater volumes and pollutant loads throughout the growing season.

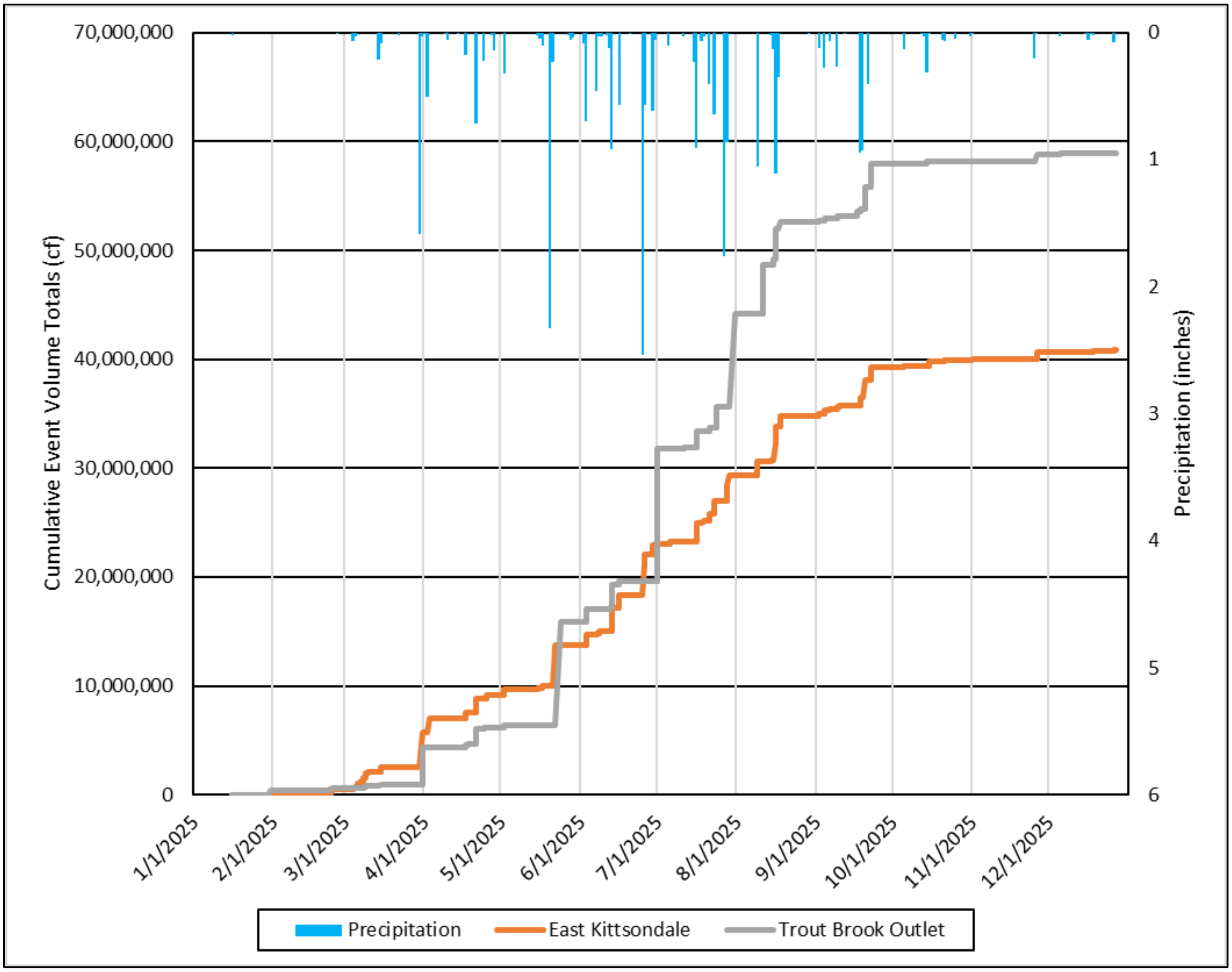

Figure 12: 2025 cumulative stormwater volume (cf) compared to precipitation (inches)

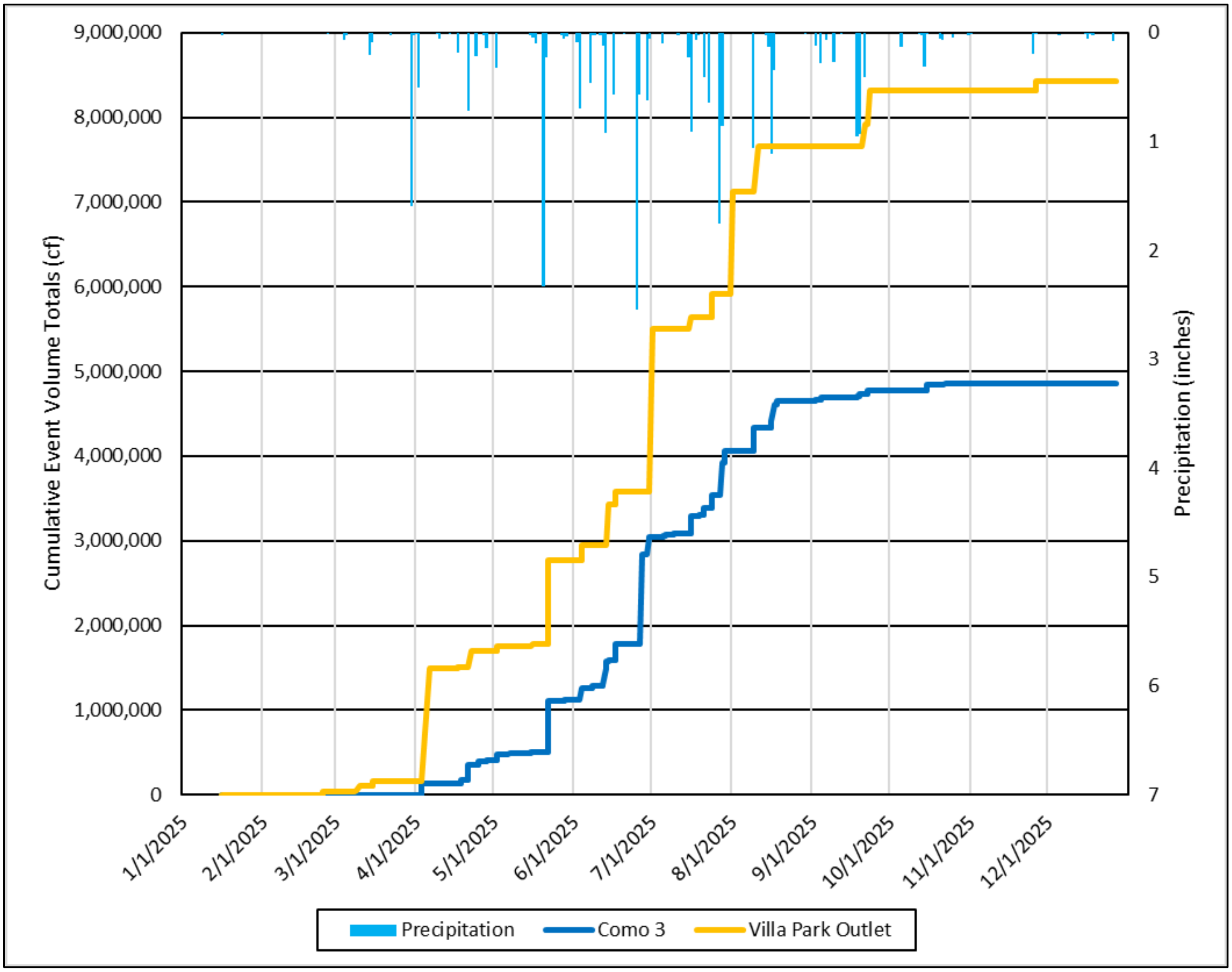

Figure 13: 2025 cumulative stormwater volume (cf) compared to precipitation (inches)

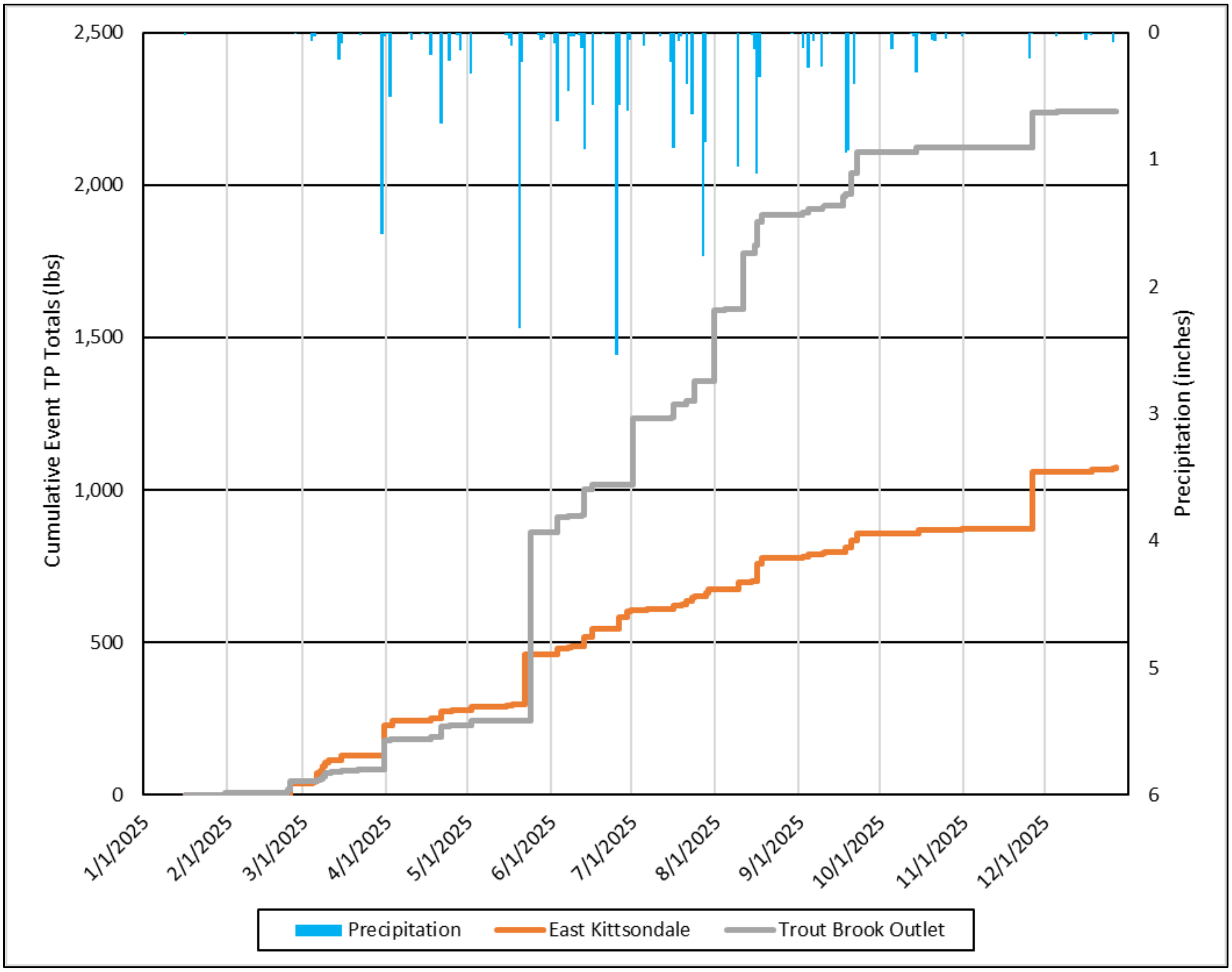

Figure 14: 2025 cumulative total phosphorus storm loads (lbs) compared to precipitation (inches) (not normalized by flow regime or monitoring period)

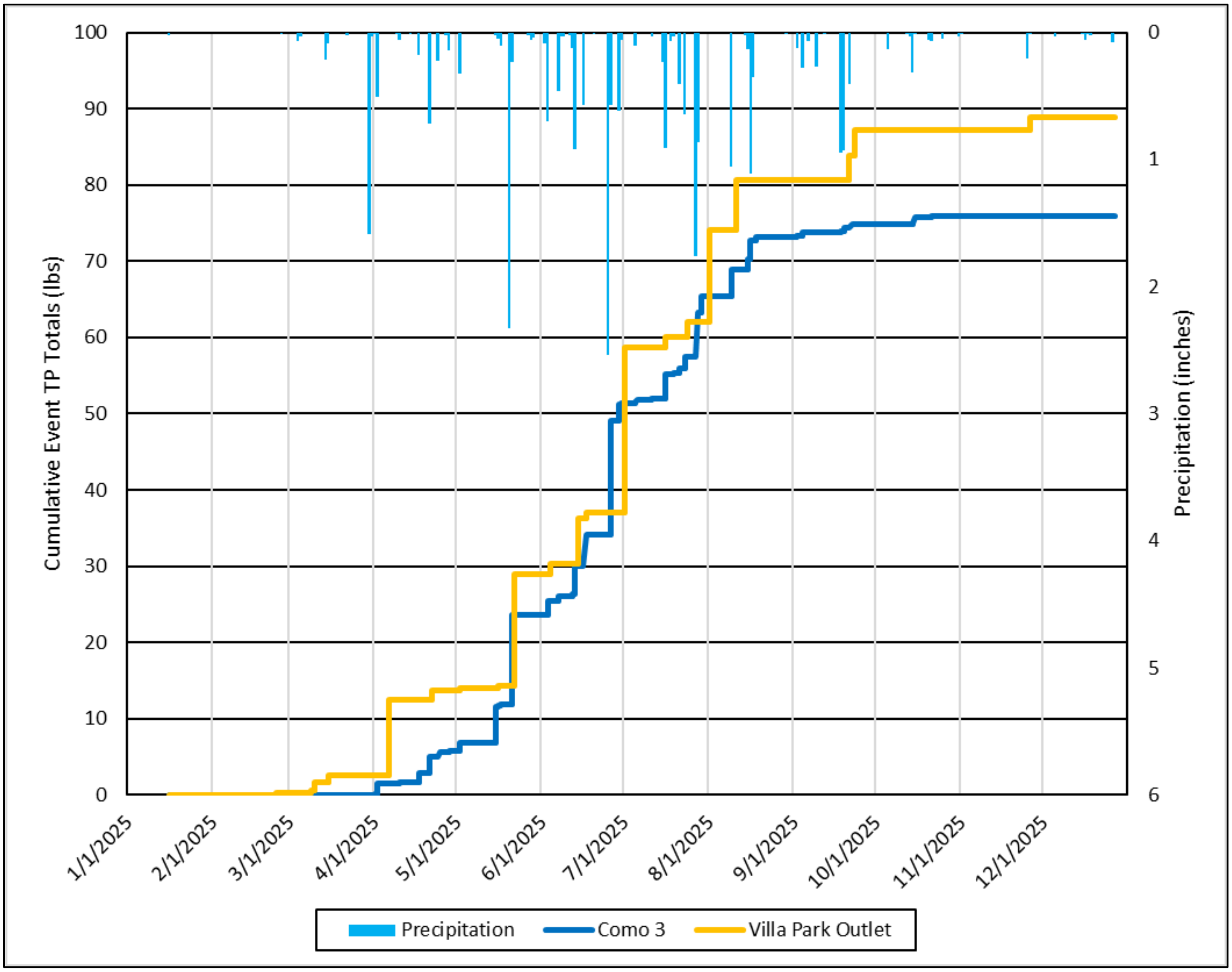

Figure 15: 2025 cumulative total phosphorus storm loads (lbs) compared to precipitation (inches) (not normalized by flow regime or monitoring period)

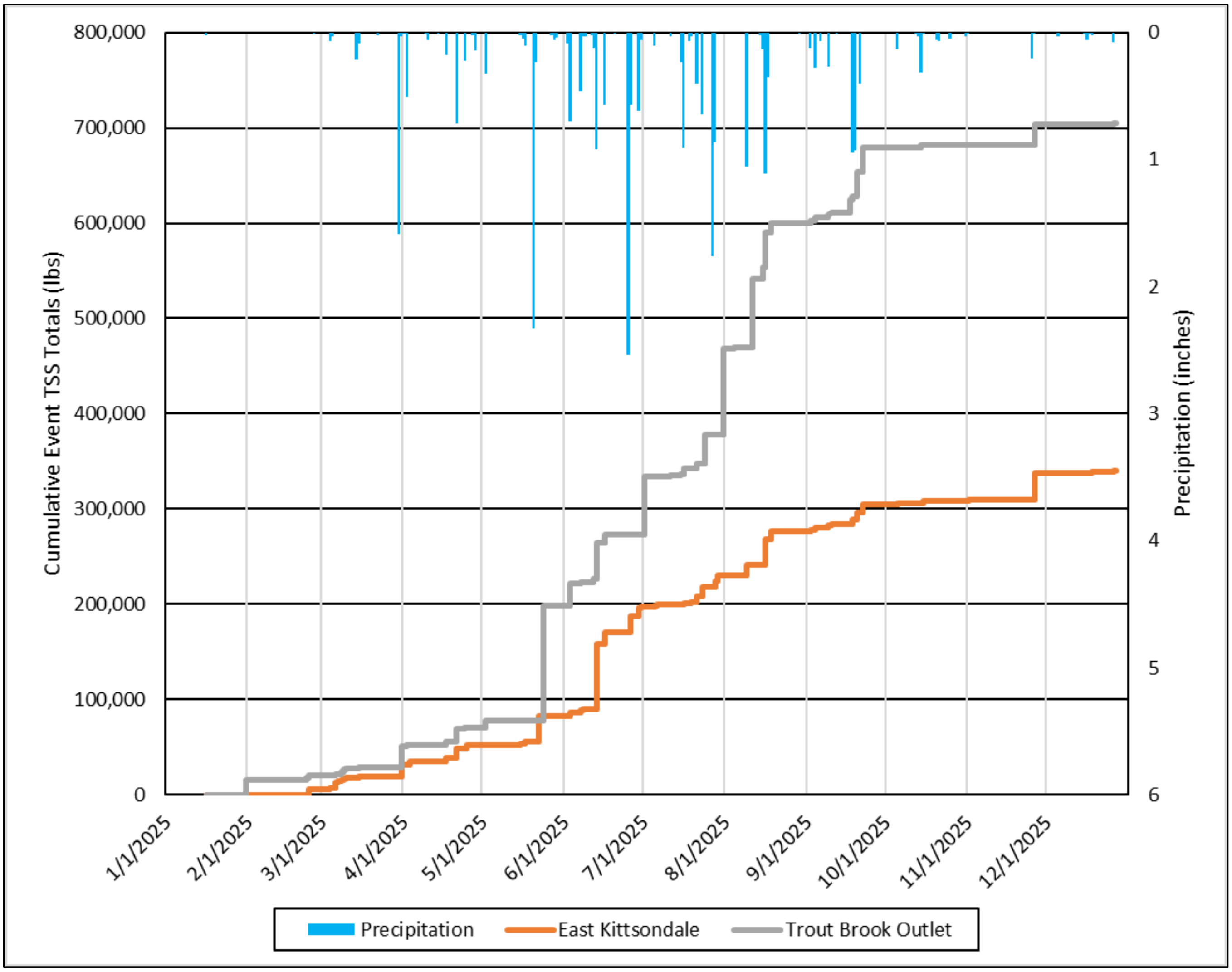

Figure 16: 2025 cumulative total suspended solids storm loads (lbs) compared to precipitation (inches) (not normalized by flow regime or monitoring period)

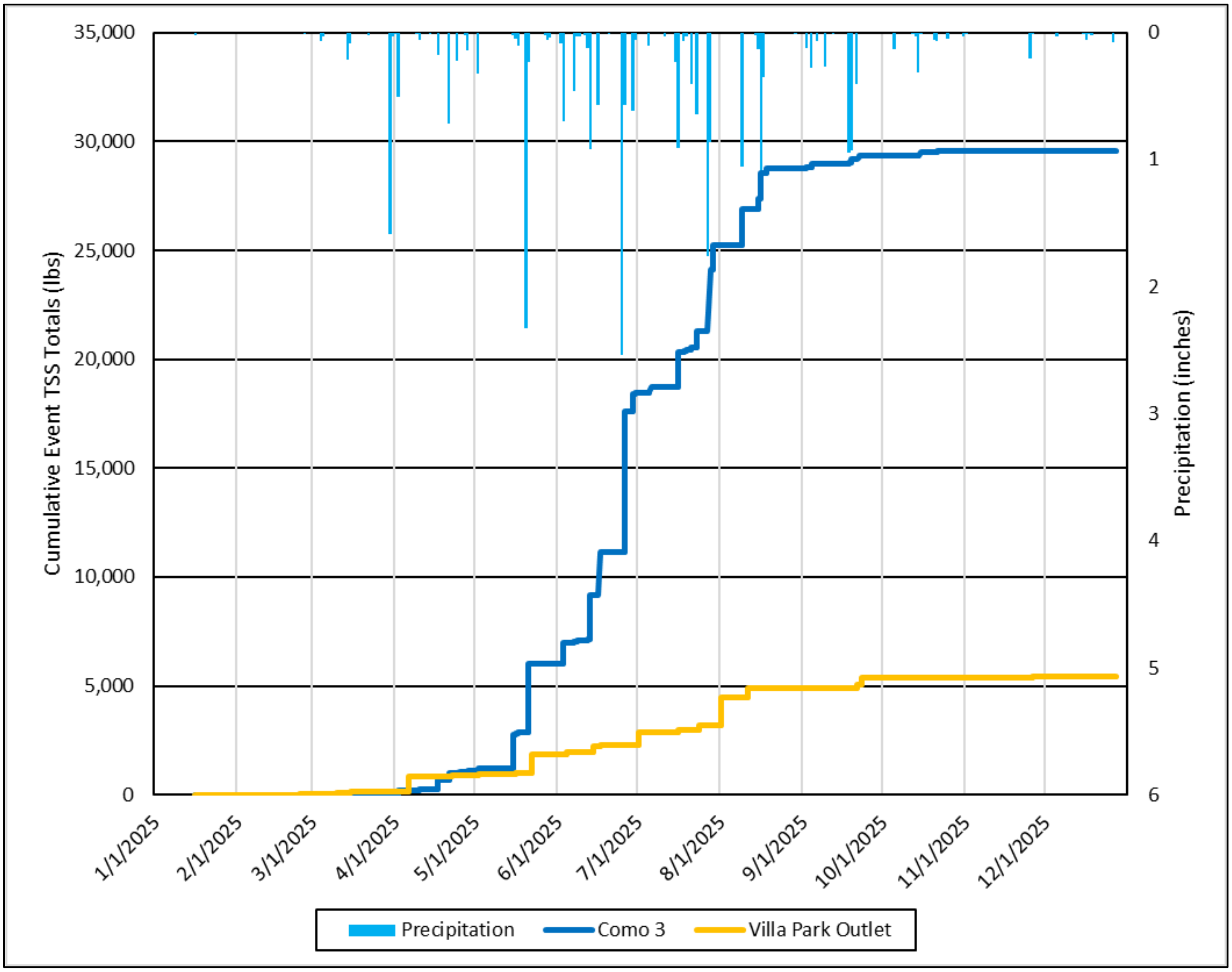

Figure 17: 2025 cumulative total suspended solids storm loads (lbs) compared to precipitation (inches) (not normalized by flow regime or monitoring period)

4.2 2025 Stormwater Highlight: November 25 Storm

A storm on November 25, 2025 produced some of the most significant water quality impacts observed during the year, demonstrating that amount of precipitation alone does not determine stormwater impact. Although the event delivered only 0.2 inches of rain, it followed nearly a month of little to no precipitation, allowing pollutants to accumulate on the landscape and all impervious surfaces. Late-season conditions, including extensive leaf litter and organic debris, further increased the availability of nutrients and oxygen-demanding materials for mobilization during runoff.

Despite being far from the largest precipitation event of the year, the storm generated record-high concentrations at multiple monitoring locations. East Kittsondale and Como 3 recorded their highest TP storm grab concentrations (4.82 mg/L and 2.29 mg/L respectively) observed for the period of record (Figure 18). The storm also produced the highest recorded carbonaceous biological oxygen demand (CBOD) storm grab levels at Como 3, East Kittsondale, and Trout Brook Outlet (94 mg/L, 210 mg/L and 84 mg/L respectively), indicating substantial mobilization of nutrients and organic matter (Figure 19).

Proactive leaf management, including timely street sweeping, raking and bagging leaves, and public education on keeping leaves out of streets and storm drains, can substantially reduce nutrient and CBOD loads during these events. Additional strategies such as enhanced fall maintenance of stormwater BMPs and prioritizing treatment in highly responsive subwatersheds may further limit pollutant mobilization during late-season storms.

It is important to note that the concentration data for the November 25 event, as well as the comparison storms, came from storm grab samples rather than storm composite samples. As such, these values represent a single point in time rather than conditions across the full storm event. While grab samples do not capture the full variability of a storm event, the elevated concentrations observed on November 25 nevertheless underscore the intensity of pollutant mobilization during this event.

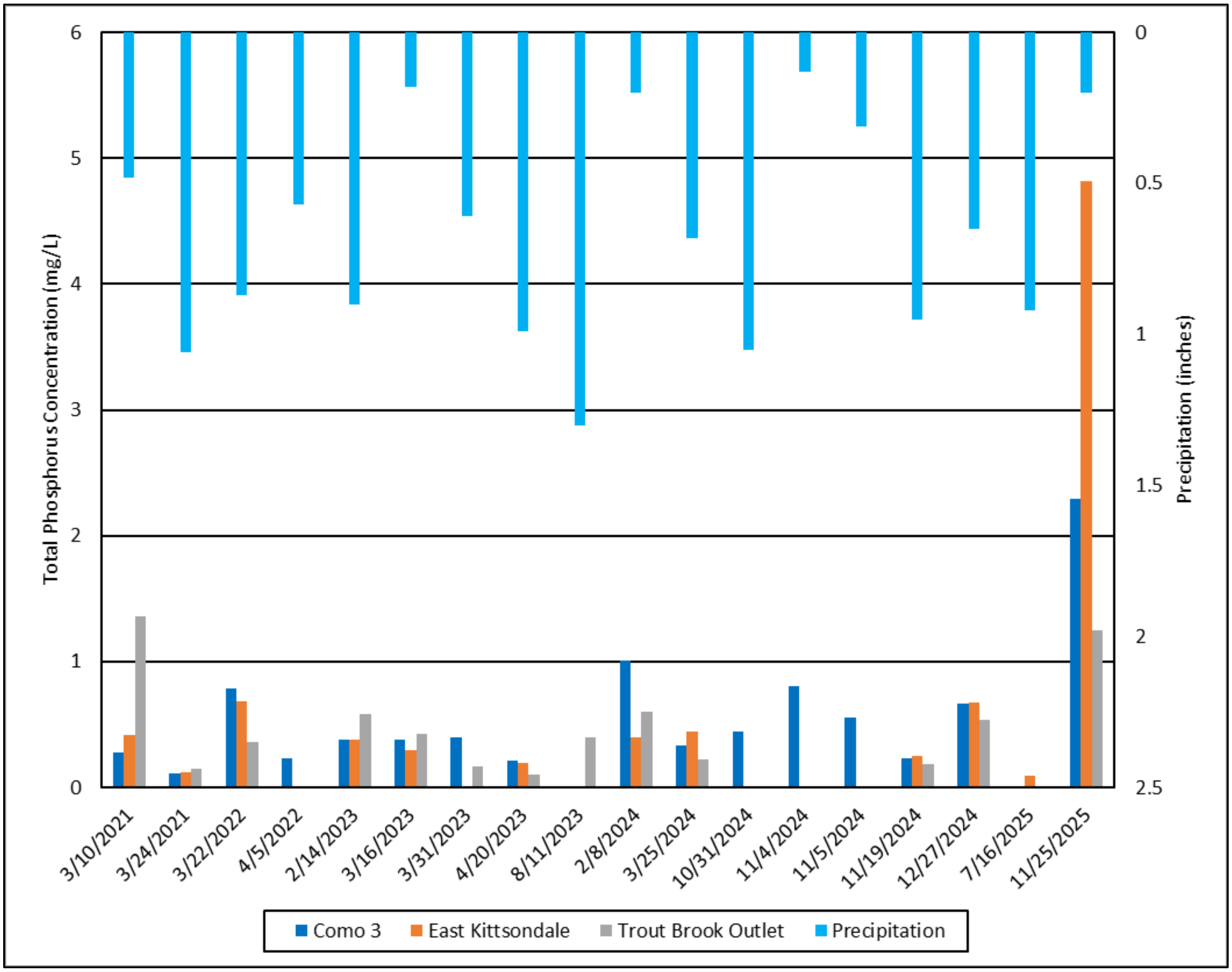

Figure 18: Comparison of TP storm grab concentrations (mg/L) and precipitation (inches) for storm grab samples from 2021 through 2025

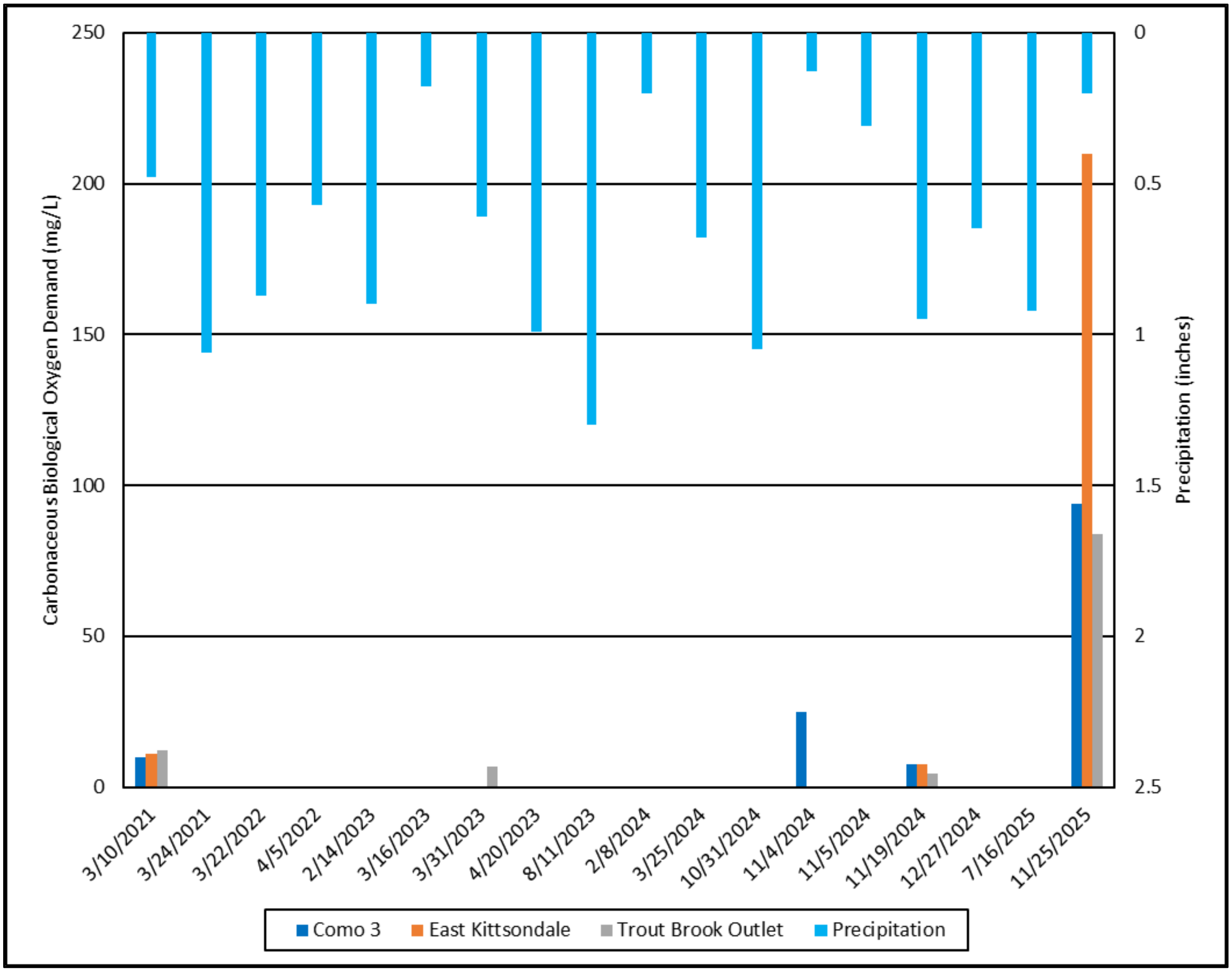

Figure 19: Comparison of CBOD storm grab concentrations (mg/L) and precipitation (inches) for storm grab samples from 2021 through 2025

5 Summary

In 2025, precipitation timing and seasonal variability played a defining role in shaping stormwater dynamics across the watershed. Above-average growing season rainfall increased stormwater volumes and pollutant loads, while prolonged dry periods followed by storms amplified concentration-driven impacts. Together, these conditions highlighted how both cumulative rainfall and event timing influence pollutant transport.

Key takeaways from this 2025 analysis include:

- **Annual stormwater discharge was above-average at all stations**. Total annual discharge and water yield were higher than historical averages at all four stations, driven largely by above-normal precipitation during the growing season.
- **June was a defining month for stormwater runoff**. Exceptional rainfall in June (7.28 inches) produced peak stormwater volumes and elevated TP and TSS loads at most stations, significantly influencing annual totals.
- **Stormwater pollutant responses varied by subwatershed**. TP loads exceeded historical averages at three of the four stations, particularly at Trout Brook Outlet and East Kittsondale, and yields indicate disproportionately high phosphorus export from Trout Brook Outlet. By contrast, TSS loads were below historical averages at all stations, although yields suggest relatively higher sediment export from certain subwatersheds.
- **Subwatersheds show higher concentrations of pollutants than the Mississippi River**. Exceedances of TP, TSS, and metals standards were more common at CRWD monitoring stations due to limited dilution capacity compared to Lambert's Landing on the Mississippi River.
- **Chloride remains a significant concern**. Snowmelt concentrations were consistently highest, with median snowmelt values and one baseflow value exceeding the chronic standard. Storm concentrations were generally lower due to dilution.
- **Storms drive bacterial mobilization**. Only 2 of 34 baseflow *E. coli* samples exceeded standards, compared to 17 of 19 stormflow samples, confirming precipitation-driven runoff as the primary driver of bacterial spikes.
- **Metals toxicity exceedances only occurred during storm and snowmelt events**. No baseflow exceedances occurred in 2025, but storm and snowmelt events—when hardness is lower and runoff is direct—produced more frequent lead and zinc exceedances.
- **Precipitation timing matters as much as rainfall depth**. The November 25 storm (0.2 inches) produced record-high storm grab concentrations at multiple stations following a prolonged dry period and heavy leaf accumulation.
- **A small number of events can drive major impacts**. Both the June rainfall and the late-fall 11/25 storm demonstrate how specific seasonal and antecedent conditions can disproportionately influence annual water quality outcomes.

We will continue to monitor the District's stormwater in 2026 to accomplish the overall objectives of the CRWD monitoring program, further assess the impact of changing precipitation patterns, and inform management strategies to protect water quality.

Appendix A: CRWD Stormwater Monitoring & Analysis Methods

1 Monitoring Methods

1.1 Water Quantity Monitoring

The District monitors water quantity by measuring flow in select stormsewer pipes using area-velocity (AV) sensors. These AV sensors measure both the water depth and velocity every 5 or 15 minutes and allow for the measurement of flow under all flow conditions. The area-velocity sensors are secured to the base and center of the pipe or channel and are connected to a logger either above ground or hanging in the pipe that stores all recorded data.

These data are used to calculate discharge or volumetric flow of water at the station by relating water depth in the pipe or channel to area (each pipe or channel has a unique relationship) and multiplying by the velocity reading.

1.2 Water Quality Monitoring

The District collects water quality samples at select stations during four types of flow regimes: baseflow, stormflow, and snowmelt. Baseflow samples are collected year-round at a frequency of once/month. Stormflow samples are collected during precipitation events greater than or equal to a 0.5 inch event. Snowmelt samples are collected during winter and spring months where conditions align to produce active snowmelt that is observed flowing in the street gutters. Illicit discharge samples are collected during any part of a flow regime where staff observes an unpermitted direct or indirect non-stormwater discharge to the storm drain system.

From ~November – March, all samples are collected as grab samples (due to the inability to operate any specialized equipment during winter months), and include a separate *Escherichia coli* (*E.coli*) sample in a sterilized collection bag. From ~April – October, baseflow and stormflow samples are primarily collected as composite samples, with a separate *E.coli* grab sample. Snowmelt and illicit discharge samples are only collected as grab samples. All grab and composite sampling methods are described in Sections 1.2.1 and 1.2.2.

1.2.1 Composite Sample Collection

To monitor water quality of both baseflow and stormflow using composite sampling, an automated water sampler with individual collection bottles is installed in conjunction with flow monitoring equipment. To collect a baseflow sample, the sampler is programmed to collect samples into each individual bottle over the course of a 24 hr period.

To collect stormflow samples, the samplers are programmed to collect a water sample when the flow of water reaches a specified depth or velocity. Generally, samplers are programmed to capture storm events greater than or equal to the 0.5 inch precipitation event. A sample into an individual bottle is collected after a specified volume of water passes through the station in order to collect samples throughout the entire duration of a storm.

The baseflow or stormflow samples collected in the individual collection bottles within the sampler are combined and mixed to produce a single composite sample. This approach provides a better representation of water quality throughout the entirety of a stormflow or baseflow event as opposed to taking a single grab sample.

1.2.2 Grab Sample Collection

To monitor water quality of baseflow, stormflow, and snowmelt using grab sampling, a sample is collected using a sample bottle on a rope that is lowered into the middle of the flow in the pipe.

Bacteria grab samples for *E. coli* are collected using a separate grab sampler that collects the sample into a separate sterilized bag for analysis. These samples are collected at water quality monitoring stations during storm events when runoff is generated, and staff are able to visit the stations. At stations with baseflow, bacteria base grab samples are collected once a month.

2 Analysis Methods

2.1 Lab Sample Analysis Methods

Water quality samples are delivered to the Metropolitan Council Environmental Services (MCES) Laboratory for analysis. The chemical parameters, methods of analysis, and holding times for MCES are listed in Table 1. If the lab analysis occurs after the holding time of a given chemical parameter has expired, that chemical parameter is not analyzed.

If the sample requires a select analyte that MCES is unable to analyze, the sample is submitted to Pace Analytical Laboratory (Pace) for analysis. The chemical parameters, methods of analysis, and holding times for Pace are listed in Table 2.

Table 1: 2025 Analysis methods, reporting limits, and holding times for MCES.

Analyte	Units	Reference Method	Holding Time	Method Detection Limit	Reporting Limit
Ammonia Nitrogen	mg/L	EPA 350.1, Rev.2.0	28 Days 0 hours	0.02	0.06
Cadmium	ug/L	EPA 200.8, Rev. 5.4	180 Days hours	0.021	0.1
Calcium	mg/L	Hardness: SM 2340 B-2011; Ca/Mg: EPA 200.8, Rev 5.4	180 Days hours	0.098	0.5
CBOD_I-5-day	mg/L	SM 5210 B-2016	2 Days 0 hours	Analyte reported to RL	0.2
Chloride ion	mg/L	SM 4500-Cl- E-2011	28 Days 0 hours	1.4	5
Chromium	ug/L	EPA 200.8, Rev. 5.4	180 Days hours	0.58	2.5
Copper	ug/L	EPA 200.8, Rev. 5.4	180 Days hours	0.26	1
E. coli	mpn/100 ml	SM 9223 B (Colilert-18 w/Quanti-Tray)-2016	0 Days 8 hours	Analyte reported to RL	1
Fluoride ion	mg/l		28 Days 0 hours	0.02	0.05
Hardness	mg/L_CaCO3	Hardness: SM 2340 B-2011; Ca/Mg: EPA 200.8, Rev 5.4	180 Days hours	Analyte reported to RL	5.1
Iron	mg/L	EPA 200.8, Rev. 5.4	180 Days hours	0.0041	0.5
Lead	ug/L	EPA 200.8, Rev. 5.4	180 Days hours	0.07	0.5
Magnesium	mg/L	Hardness: SM 2340 B-2011; Ca/Mg: EPA 200.8, Rev 5.4	180 Days hours	0.024	0.5
Nickel	ug/L	EPA 200.8, Rev. 5.4	180 Days hours	0.059	0.5
Nitrate N	mg/L	EPA 353.2, Rev. 2.0	2 Days 0 hours	Analyte reported to RL	0.2
Nitrite N	mg/L	EPA 353.2, Rev. 2.0	2 Days 0 hours	0.02	0.06
Nitrite Plus Nitrate	mg/L	EPA 353.2, Rev. 2.0	2 Days 0 hours	0.05	0.2
Ortho Phosphate as P	mg/L	SM 4500-P F-2011	62 Days 0 hours	0.0049	0.01
pH	pH	SM 4500-H+ B-2011	1 Days 0 hours	Analyte reported to RL	0.01
Potassium	mg/L	Hardness: SM 2340 B-2011; Ca/Mg: EPA 200.8, Rev 5.4	180 Days hours	0.043	0.5
Sodium	mg/L	Hardness: SM 2340 B-2011; Ca/Mg: EPA 200.8, Rev 5.4	180 Days hours	0.009	0.5
Sulfate (SO4)	mg/L	EPA 300.0, Rev. 2.1	28 Days 0 hours	0.078	0.5
Total Dissolved Solids	mg/L	SM 2540 C-2015	7 Days 0 hours	12	24
Total Kjeldahl Nitrogen	mg/L	EPA 351.2, Rev. 2.0 and EPA 365.4	28 Days 0 hours	0.08	0.2
Total Phosphorus	mg/L	EPA 351.2, Rev. 2.0 and EPA 365.4	28 Days 0 hours	0.012	0.05
Total Phosphorus	mg/L	EPA 365.4	28 Days 0 hours	0.012	0.05
Total Suspended solids	mg/L	USGS I-3765-85 (TSS) & I-3767-85 (VSS)	7 Days 0 hours	1	3
Volatile suspended solids	mg/L	USGS I-3765-85 (TSS) & I-3767-85 (VSS)	7 Days 0 hours	1	3
Zinc	ug/L	EPA 200.8, Rev. 5.4	180 Days hours	1.4	5

Table 2: 2025 Analysis methods, reporting limits, and holding times for Pace.

Analyte	Units	Reference Method	Holding Time	Method Detection Limit	Reporting Limit
E. coli	mpn/100 ml	SM 9223 B	0 Days 8 hours	0.5	1
Surfactants	mg/L	EPA method 5540C	2 Days 0 hours	0.0368	0.1
Turbidity	NTU	EPA 180.1	2 Days 0 hours	0.182	0.5

2.2 Data Analysis Methods

All analysis methods described below are performed in KISTERS WISKI software. WISKI is a data management software specifically designed for continuous and discrete water quality data. WISKI was implemented in 2014 by CRWD and is used for all stormwater data storage and analysis.

2.2.1 Flow calculation

Volumetric flow rate for all water quantity monitoring stations is calculated using the equation:

$$Q\ (cfs) = V\ (fps) * A(sq\ ft)$$

Where,

- Q is the volumetric flow rate calculated
- V is the velocity measured by the area-velocity sensor
- A is the area of the water in the pipe, calculated using the level measured by the area-velocity sensor and the pipe shape

2.2.2 Flow partitioning and volume calculation

For stations where both water quantity and quality are monitored and reported on, flow partitioning occurs to separate the flow into different regimes: baseflow, and eventflow (either storm, snowmelt, or illicit discharge). For stations without sustained baseflow, all events corresponding to a precipitation event are considered event intervals. For stations with year-round baseflow, separation of baseflow and eventflow is necessary.

Events are identified using an automated script in WISKI, which takes into account the rate of change in the flow and a threshold above baseflow in the preceding period. Baseflow is considered continuous (but not constant) during storm events. Baseflow is estimated during an event by interpolating between the discharge at the beginning and end of the event interval.

The total volume for each base and event interval is calculated using WISKI , and discharge volumes are summed to calculate a total discharge for the year. Discharge subtotals are also calculated by flow type (base and event). The baseflow total volume amount calculated during an event is subtracted from the total interval discharge to determine the event discharge volume.

2.2.3 Event load calculation

Annual total phosphorus (TP) and total suspended solids (TSS) concentrations (reported by the MCES lab) are used to calculate TP and TSS loads for each sampled event. A median historical monthly concentration is applied to events for which samples were not collected. The median concentration is calculated using the median of all event samples collected for a given monitoring station by month for the entire monitoring record.

All TP and TSS load calculations for each event are completed in WISKI using an automated script that follows the equation:

$$Event\ load\ (lbs) = Event\ Discharge\ (cf) * EMC_s(mg/L) * \left(\frac{28.316\ L}{1\ cf}\right) * \left(\frac{1lb}{453{,}592mg}\right)$$

The event mean concentration (EMC_s) is calculated using the following equation:

$$EMC_s = \frac{[EMC_{tot} - (C_b * f_b)]}{f_s}$$

Where,

- EMC_{tot} is the lab reported composite sample concentration if the event was sampled or the historical monthly median storm concentration if the event was not sampled
- C_b is the historical monthly median base concentration
- f_b is the base fraction of interval volume
- f_s is the storm fraction of interval volume

2.2.4 Base load calculation

Base TP and TSS loads are calculated per month using historical monthly median baseflow concentrations. Baseflow samples collected in each new year of monitoring are included in the historical median calculations.

All baseflow TP and TSS load calculations are completed in WISKI using an automated script that follows the equation:

$$Load\ (lbs) = Monthly\ Baseflow\ Discharge\ (cf) * C_b(mg/L) * \left(\frac{28.316\ L}{1\ cf}\right) * \left(\frac{1lb}{453{,}592mg}\right)$$

Where,

- C_b is the historical monthly median base concentration

2.2.5 Flow weighted average (FWA) concentration calculations

A total flow weighted average (FWA) concentration, as well as a FWA concentration for each flow type, was calculated for TP and TSS for the entire monitoring period in 2014. The total FWA concentration takes into account the differences generally observed between flow types. Flow weighted concentrations take the discrete sample concentrations and weight them based on the flow volumes associated with that event. This presents a more accurate representation than an average of all interval concentrations. At sites with baseflow for example, pollutant concentrations tend to be higher during storm events, but generally account for less of the total annual discharge. An overall average would be skewed toward the higher storm concentrations. In the same manner, FWA concentrations by flow type (e.g. storm, base, snowmelt, illicit discharge) account for differences in the relative effect of individual intervals (flow events) on the average.

Total FWAs for TP and TSS for the entire monitoring season were calculated using the following equation:

$$Total\ FWA\ (mg/L) = \frac{total\ load\ (lbs) * \left(\frac{453{,}592mg}{lb}\right)}{total\ discharge\ (cf) * \left(\frac{28.32L}{cf}\right)}$$

2.2.6 Volume and pollutant yield calculation

Annual yields for total discharge and TP/TSS loads in pounds per acre (lb/ac) are calculated for each monitored subwatershed. This normalizes total discharge and pollutant load by subwatershed drainage area size so that comparisons between different subwatersheds can be made. Annual yields are calculated using the following equation:

$$Yield\ (\mathrm{lbs/ac}) = \frac{total\ discharge\ (cf) or\ total\ load\ (lbs)}{drainage\ area\ (ac)}$$

2.3 Federal and state surface water quality standard, TMDL, and Mississippi River water quality comparisons

Currently, there are no federal or state water quality standards for stormwater. The Minnesota Pollution Control Agency (MPCA) and the U.S. Environmental Protection Agency (EPA) have established surface water quality standards for only certain water quality parameters. Because CRWD's stormwater flows into the Mississippi River, it can be useful to compare CRWD's stormwater data to Minnesota surface water quality standards, (Table 3). These standards are outlined in Minnesota Statute 7050.0222 for Class 2B waters (ORS, 2012). Class 2B waters are waters used for the purpose of aquatic life and recreation that are not protected for drinking water. These standards are set at the lowest concentration of a chemical for which chronic exposure will cause harm to aquatic organisms.

It is also useful to compare CRWD stormwater data to active TMDLs (Table 3) in water resources downstream of CRWD boundaries, as all of our stormwater eventually discharges to the Mississippi River and impacts these downstream water resources.

Finally, CRWD water quality data can also be compared to water quality data collected at Lambert's Landing, a Metropolitan Council Environmental Services water quality monitoring station located on the Mississippi River downstream of the Wabasha Bridge in St. Paul at river mile 839.1.

Table 3: Surface water quality standards and TMDLs for Class 2B waters.

Parameter	MPCA Surface Water Comparison Value
TP[a]	0.10 mg/L
TSS[b]	32 mg/L
E. coli[c]	126 cfu/100mL
E. coli[d]	1,260 cfu/100mL
Chloride[e]	230 mg/L
Chloride[f]	860 mg/L
Cadmium	*
Chromium	*
Lead	*
Nickel	*
Zinc	*

* The MPCA state standard is dependent upon water hardness; See Appendix A section 2.3.2

[a] Lake Pepin Excess Nutrient TMDL

[b] South Metro Mississippi Total Suspended Solid TMDL

[c] MPCA geometric mean state standard

[d] MPCA exceedance state standard

[e] MPCA chronic state standard

[f] MPCA acute state standard

2.3.1 TP and TSS Comparisons

Because the MPCA has not established stormwater standards for TP and TSS, CRWD data is compared to the TP and TSS values of Lambert's Landing, in addition to two TMDLs downstream of District boundaries. TSS values are compared against the South Metro Mississippi Total Suspended Solids TMDL (MPCA 2015), and the TP values are compared against the Lake Pepin Excess Nutrient TMDL (MPCA 2025). When comparing CRWD TP and TSS concentrations to Lambert's Landing and TMDL values, flow-weighted average concentrations were used.

2.3.2 Chronic Metals Standards

State water quality standards for chronic exposure to metals are based on a function of hardness (as outlined in Minnesota Statute 7050.0222 for Class 2B waters (ORS, 2012)). In order to make comparisons between CRWD metals data to state standards and other reference locations, calculation of the state standards for any given year based on measured average hardness by station needs to be completed. Listed below are the equations used to calculate the event type and yearly metals standards for each metal evaluated:

$$Cadmium\ Standard\ \left({}^{\mu g}/_{L}\right) = e^{0.7852*\ln\left[Average\ Hardness\left({}^{mg}/_{L}\right)\right]-3.49}$$

$$Chromium\ Standard\left({}^{\mu g}/_{L}\right) = e^{0.819*\ln\left[Average\ Hardness\left({}^{mg}/_{L}\right)\right]+1.561}$$

$$Lead\ Standard\left({}^{\mu g}/_{L}\right) = e^{1.273*\ln\left[Average\ Hardness\left({}^{mg}/_{L}\right)\right]-4.705}$$

$$Zinc\ Standard\left({}^{\mu g}/_{L}\right) = e^{0.8473*\ln\left[Average\ Hardness\left({}^{mg}/_{L}\right)\right]+0.7615}$$

The Minnesota Rules also state that for waters with hardness values greater than 212 mg/L, the chronic standard for nickel shall not exceed 0.297 mg/L. For those event types or yearly averages which have average hardness values which exceed 212 mg/L, the nickel standard for those event types or year was set equal to the state standard of 0.297 mg/L. If the average hardness value was less than 212 mg/L, the following equation was used to calculate the nickel standard:

$$Nickel\ Standard\left({}^{\mu g}/_{L}\right) = e^{0.846*\ln\left[Average\ Hardness\left({}^{mg}/_{L}\right)\right]+1.1645}$$

Copper is not included in recent analyses due to an equipment contamination issue identified several years ago through CRWD's QA/QC protocols.

2.3.3 Bacteria standard

For *E. coli* bacteria, the MPCA has set the following two provisions as a standard (outlined in Minnesota Statute 7050.0222 for Class 2B waters (ORS, 2012):

1) With greater than five samples taken in a calendar month (April to November), the *E. coli* concentration geometric mean shall be less than 126 cfu/100mL.
2) No more than ten percent of all samples taken during a calendar month (April to November) shall exceed 1,260 cfu/100mL

CRWD collects *E. coli* samples each month from April to November (one base sample and storm samples when feasible), so the MPCA monitoring requirements of the *E. coli* geometric mean standard of 126 cfu/100mL cannot typically be met. Instead, CRWD compares individual *E. coli* monitoring results to the maximum value of the standard, 1,260 cfu/100mL. Because stormwater data cannot be directly compared to the standard for Class 2B waters (streams, lakes, and wetlands), this comparison provides a benchmark only for comparing CRWD stormwater bacteria data. The MCES lab measures *E. coli* as the most probable number per 100 milliliters of water (MPN/100mL). Research shows that MPN/100mL is comparable to cfu/100mL (Massa et al., 2001).

2.3.4 Chloride standard

For chloride, the MPCA has set the following provisions as a standard (outlined in Minnesota Statute 7050.0222 for Class 2B waters (ORS, 2012):

1) No more than one exceedance of the chronic standard (230 mg/L) in three years within the most recent 10-yr period, and
2) No exceedances of the maximum standard (860 mg/L) in the most recent 10-yr period.

CRWD collects chloride data for all samples collected from all flow regimes (snowmelt, base, and storm). Because stormwater data cannot be directly compared to Class 2B waters (streams, lakes, and wetlands), this comparison provides a benchmark only for comparing CRWD stormwater chloride data.

3 QAQC for Monitoring and Analysis Methods

CRWD updates an annual Quality Assurance Program Plan (QAPP) that defines the data quality assurance goals and quality assurance procedures that are applicable to the CRWD monitoring program. The plan includes best practices that can be applied to both routine and non-routine monitoring circumstances. For more detailed information on all protocols for monitoring methods as well as methods for water quantity and quality data review, refer to the current annual version of the CRWD QAPP on the District server.

4 References

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