



## 2020–2021 Stream Monitoring and 2020 Biotic Index Evaluation of the Sweeney Lake Branch of Bassett Creek

The Bassett Creek Watershed Management Commission (BCWMC) monitored the Sweeney Lake Branch of Bassett Creek for water depth, flow, temperature, specific conductance, and stream water quality during 2020 and 2021. BCWMC also continuously monitored the stream for dissolved oxygen for a one-week period in June 2022. The Minnesota Pollution Control Agency (MPCA) monitored the stream for pH, dissolved oxygen, and water quality in 2020 and 2021. In 2020, the MPCA monitored macroinvertebrates, and the BCWMC monitored habitat. The BCWMC used the macroinvertebrate data to complete a biotic index evaluation of the stream. This report presents the results of these monitoring efforts.

### Summary

The Sweeney Lake Branch of Bassett Creek drains approximately 3.8 square miles of northern St. Louis Park and southern Golden Valley. The Sweeney Lake Branch originates in Golden Valley and flows northeast for 3.6 miles, through Schaper Pond and Sweeney Lake, and joins the Main Stem of Bassett Creek in Theodore Wirth Regional Park just downstream of Sweeney Lake. The Sweeney Branch monitoring station drains an area of approximately 2.6 square miles. The following table summarizes information about the monitoring station watershed.

#### Monitoring Station Watershed

Drainage area	1,694.5 acres (2.6 square miles)
Imperviousness	43.2%
Commercial/Industrial	320 acres
Multifamily residential	71 acres
Public/institutional	134 acres
Single-family residential	733 acres
Major highway	246 acres

The purpose of the stream monitoring program is to evaluate flow and water quality, detect changes over time, determine whether the MPCA water quality and biological standards are being met, and identify stressors to the biological community.

Results of the Sweeney Lake Branch of Bassett Creek monitoring program show the stream failed to meet MPCA standards for *E. coli* bacteria, chlorides, and total suspended solids. MPCA standards were met for temperature, pH, dissolved oxygen, metals (total cadmium, chromium, copper, nickel, lead, and zinc) and river eutrophication standards (RES).

Between 1980 and 2020, the BCWMC collected benthic macroinvertebrates (bottom-dwelling organisms) from the Sweeney Lake Branch of Bassett Creek on 11 occasions to evaluate water quality and detect changes over time. The 2020 monitoring program evaluated macroinvertebrates (MPCA) and habitat (BCWMC).

The MPCA developed and added the Macro-invertebrate Index of Biotic Integrity (M-IBI) to Minnesota's water quality standards to help identify biologically impaired rivers and streams. The 2020 M-IBI score for the Sweeney Lake Branch of Bassett

Creek was 42.1, compared with the MPCA impairment threshold of 43. The MPCA concluded the stream was not biologically impaired because the M-IBI score was less than a point below the impairment threshold and the stream has relatively decent habitat for a moderately channelized urban stream. A habitat survey completed in 2020 indicated overall habitat conditions had declined between 2015 and 2020. Habitat declines included increased erosion and sediment deposits (embeddedness).

## Recommendations

Because the Sweeney Lake Branch of Bassett Creek failed to meet the MPCA standards for chlorides, total suspended solids, and E. coli bacteria from 2020 through 2021, and the 2020 M-IBI score was slightly below the M-IBI impairment threshold, the Commission Engineer recommends that BCWMC continue to:

- **Assess the Sweeney Lake Branch of Bassett Creek** to identify the cause of high concentrations of total suspended solids, chlorides, and E. coli bacteria and implement management measures to reduce these concentrations with the goal of meeting the MPCA water quality standards for the stream.
- **Evaluate the stream corridor** for erosion and identify and implement management measures to repair the erosion.
- **Continue education efforts to reduce chloride use** in the watershed (e.g., Smart Salting Level 1 Certification course) with the goal of meeting the MPCA chloride standard for the stream.
- **Support MPCA efforts to complete a stressor ID on the Sweeney Lake Branch of Bassett Creek** by providing requested data and other information.
- **Continue monitoring stream habitat, flow, water quality, and macroinvertebrates** to evaluate if the stream meets MPCA water quality and biological standards, identify changes over time, and identify stressors to the macroinvertebrate community.

## 2020–2021 stream monitoring program

The water quality and flow of the Sweeney Lake Branch of Bassett Creek was monitored from 2020 through 2021 at a station immediately south (upstream) of the frontage road on the south side of Hwy 55 and just downstream of the biological monitoring location (Figure 1). Water depth, flow, specific conductance, and temperature were measured continuously during the monitoring period. The BCWMC collected water quality samples manually on 21 occasions to monitor baseflow conditions and with an automatic sampler on 17 occasions to monitor storm events. The MPCA collected water quality samples manually on 28 occasions. Monitoring was completed from March 6 through March 12, 2020, and from May 23, 2020, through November 11, 2021. Monitoring was not conducted between March 12 and May 23, 2020, due to restrictions during the COVID-19 pandemic. Because ice conditions in the channel during the winter months prevent accurate continuous flow, temperature, and specific conductance measurements, the monitoring period for these parameters was limited to spring through early winter.

Storm and baseflow samples were analyzed for nutrients (total phosphorus, ortho phosphorus, dissolved phosphorus, nitrate/nitrite, ammonia, and total Kjeldahl nitrogen), solids (total suspended solids and volatile suspended solids), chlorides, hardness, calcium, and magnesium. Baseflow samples were also analyzed for chlorophyll *a*, and E. coli bacteria. Quarterly grab samples were analyzed for metals (chromium, cadmium, copper, lead, nickel, and zinc). The MPCA measured dissolved oxygen and pH when collecting baseflow samples. The BCWMC continuously measured dissolved oxygen from June 8 through 15, 2022. The following equipment was used for the monitoring program:

- A radar water-level sensor (Figure 2) measured water levels at 15-minute intervals, and a data logger (Figure 3 and Figure 4) recorded the measurements. A data logger is an electronic device that records data over time. Flow was measured at a range of depths using a flow meter, and a stage-rating curve was developed to estimate flow from the measured water depths. The stage-rating curve equation was added to



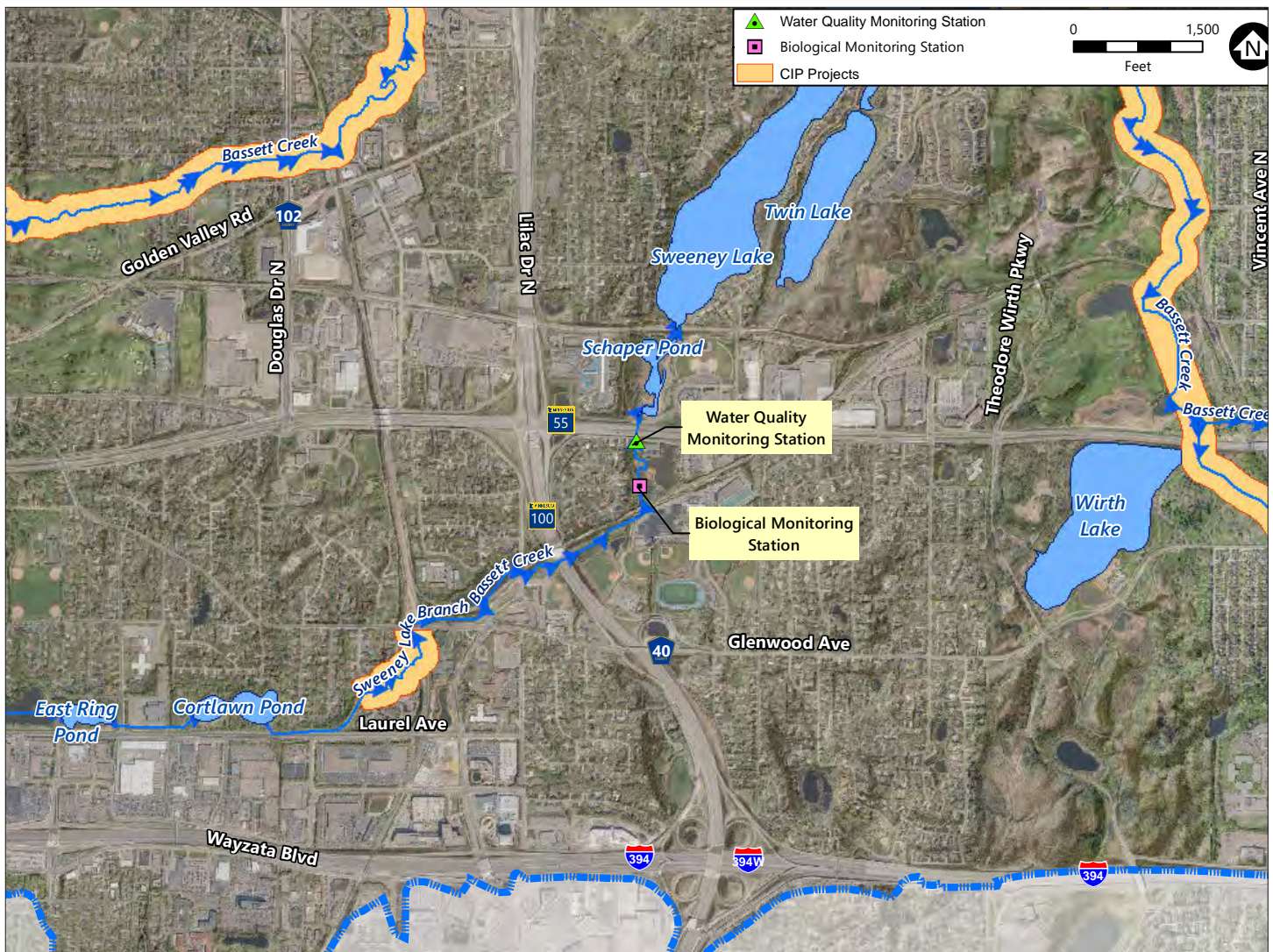


Figure 1: Sweeney Lake Branch of Bassett Creek water quality and biological monitoring locations

the data logger program, which allowed the automatic computation of flow from water depth for the duration of the monitoring period.

- Cellular modem (Figure 3): Enabled staff to control equipment and download data from their office.
- SunSaver regulator (Figure 3): This instrument controls the current flowing from the solar panel to the battery and prevents the current from flowing in reverse (i.e., battery to the solar panel).
- Solar panel (Figure 4): Charged the battery used to operate the equipment.
- Automatic sampler (Figure 5): Collected storm samples.
- Temperature probe and data logger: The probe measured water temperature, and the data logger (Figure 3 and Figure 4) recorded the measurements.



Figure 2: Radar water level sensor

- Specific-conductance probe and data logger: The probe measured specific conductance, and the data logger (Figure 3 and Figure 4) recorded the measurements.



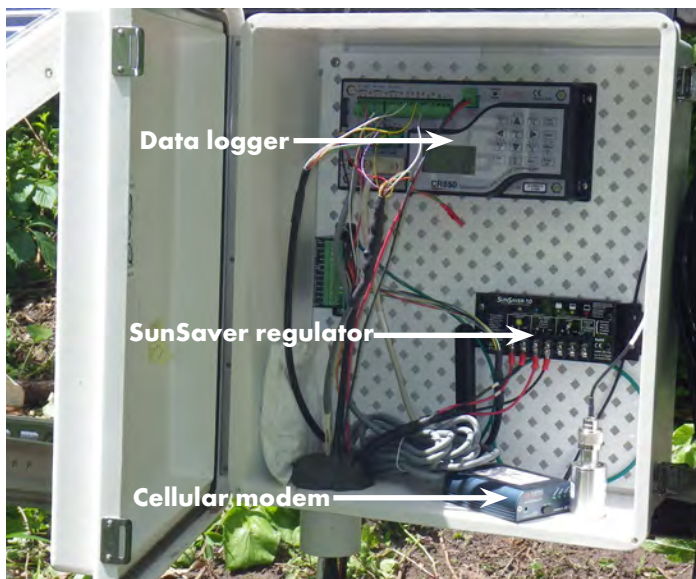


Figure 3: Data logger, SunSaver regulator, and cellular modem

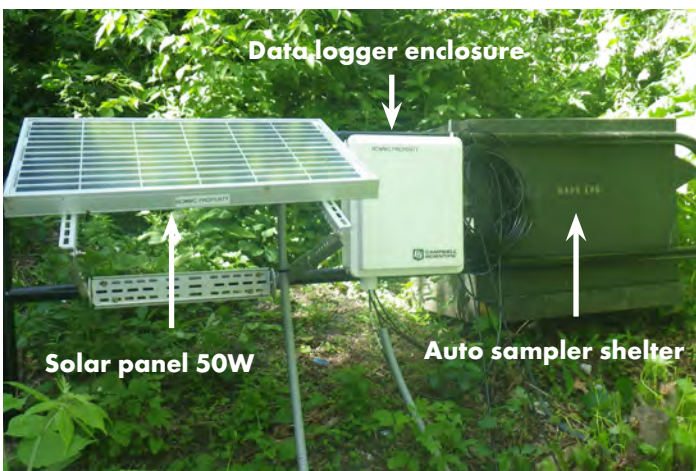


Figure 4: Solar panel, flow logger enclosure, and auto sampler shelter



Figure 5: Automatic sampler and external battery

## Results of 2020–2021 stream monitoring program

### Water depth and flow

Water depth and flow were measured at 15-minute intervals throughout the monitoring period. The results are shown in Table 1 and Figures 6 and 7.

The highest flows during 2020 and 2021 are more uncertain and considered provisional due to limited depth and flow data at the high levels during the development of the stage-rating curve. Due to the flashiness of the stream (rapid increases and decreases in depth and flow after a storm), it is difficult to capture these high measurements.

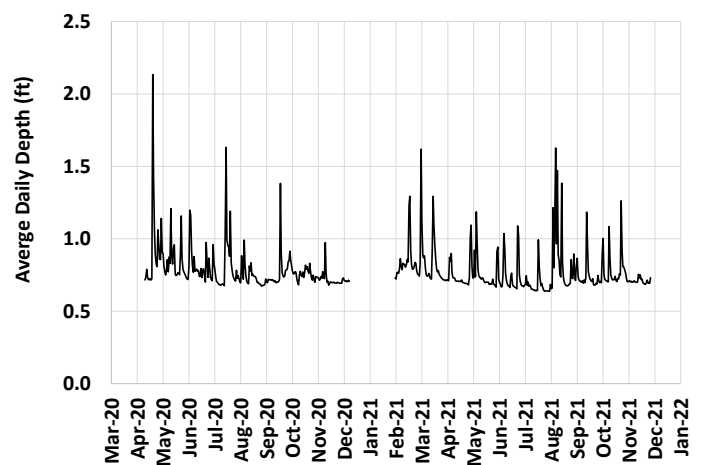


Figure 6: Average daily depth of the Sweeney Lake Branch of Bassett Creek

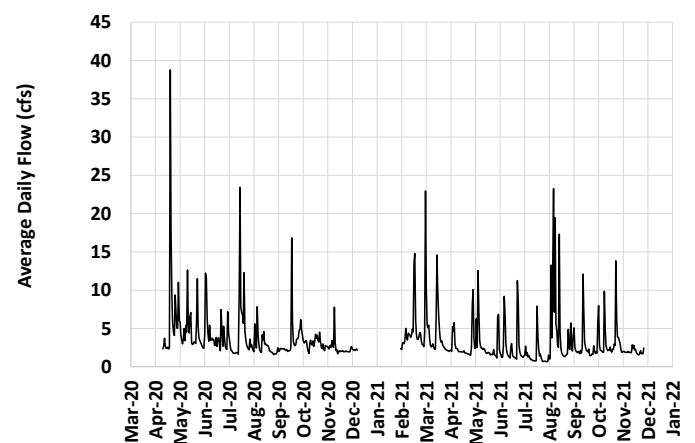


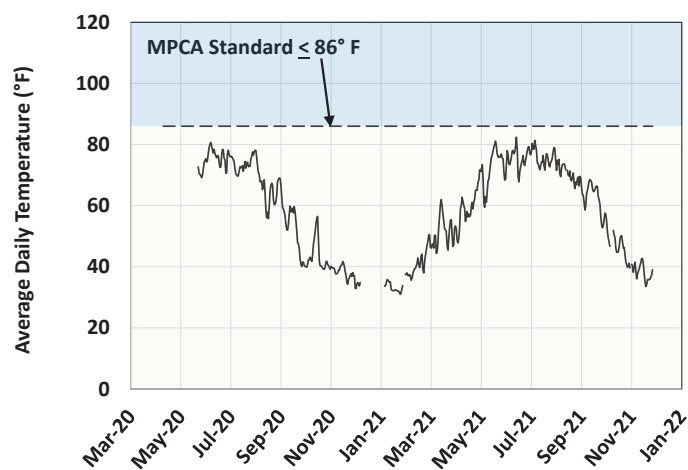
Figure 7: Average daily flow of the Sweeney Lake Branch of Bassett Creek

**Table 1: 2020–2021 water depth and flow in the Sweeney Lake Branch of Bassett Creek**

Parameter	2020			2021		
	Low	High	Average	Low	High	Average
<b>Average daily water depth</b>	0.67 feet 9/20/2020	2.13 feet 5/17/2020	0.79 feet	0.64 feet 8/2/2021, 8/4–6/2021, and 8/14–19/2021	1.63 feet 8/27/2021	0.77 feet
<b>Average daily flow in cubic feet per second (cfs)</b>	1.6 cfs 8/8/2020 and 9/20/2020	38.8 cfs 5/17/2020	3.8 cfs	0.7 cfs 8/14–19 2021	23.3 cfs 8/27/2021	3.3 cfs

## Temperature

Temperature was measured at 15-minute intervals throughout the monitoring period. During the 2020 monitoring period, the average daily temperature ranged from 33° F to 81 °F; the overall average was 58 °F (Figure 8). During the 2021 monitoring period, the average daily temperature ranged from 31 °F to 82 °F; the overall average was 58 °F (Figure 8). All measurements met the MPCA standard of less than or equal to 86 °F. The MPCA is not currently using the standard to assess warm-water streams, such as the Sweeney Lake Branch of Bassett Creek. Instead, it evaluates mostly cold-water fisheries for temperature-caused impairment because of the special sensitivity of cold-water fish to temperature elevations.

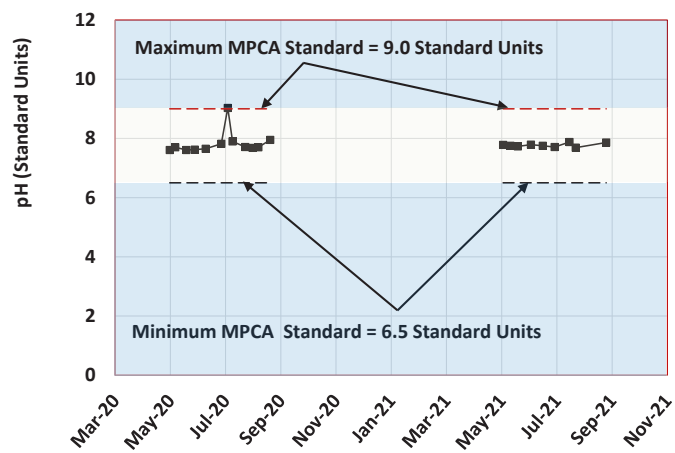


**Figure 8: Average daily temperature of the Sweeney Lake Branch of Bassett Creek**

## pH

The pH of water is a measure of the degree of its acid or alkaline reaction. The applicable pH standard for the Sweeney Lake Branch of Bassett Creek is a minimum of 6.5 and a maximum of 9.0. A stream meets the standard for pH if the standard is met at least 90 percent of the days of the monitoring season. A designation of meeting the standard for pH generally requires at least 20 suitable measurements from a data set that gives an unbiased representation of conditions over at least 2 different years.

During the 2020 monitoring period, pH ranged from 7.6 to 9.0; the overall average was 7.8 (Figure 9). During the 2021 monitoring period, pH ranged from 7.7 to 7.9; the overall average was 7.8 (Figure 9). The 2020–2021 data included 21 pH measurements, and all measurements were within the MPCA standard of 6.5 to 9.0. Hence, the Sweeney Lake Branch of Bassett Creek meets the standard for pH.



**Figure 9: 2020–2021 pH from the Sweeney Lake Branch of Bassett Creek**

## Dissolved oxygen

Dissolved oxygen is required for all aquatic organisms to live. When dissolved oxygen drops below acceptable levels, desirable aquatic organisms, such as fish, can be harmed or killed. The MPCA dissolved oxygen standard for the Sweeney Lake Branch of Bassett Creek is at least 5 mg/L as a daily minimum. The stream meets the dissolved oxygen standard if at least 90 percent of the measurements are at least 5 mg/L and there are at least three such measurements. A designation of meeting the standard generally requires at least 20 measurements over at least 2 different years.

During the 2020 monitoring period, dissolved oxygen measurements ranged from 4.7 to 9.4; the overall average was 6.8 (Figure 10). During the 2021 monitoring period, dissolved oxygen measurements ranged from 5.1 to 9.9; the overall average was 7.8 (Figure 10). Because only one of the 21 measurements (5 percent) during 2020–2021 failed to meet the standard of at least 5 mg/L (Figure 10), the Sweeney Lake Branch of Bassett Creek meets the standard for dissolved oxygen.

Stream dissolved oxygen concentrations generally follow a diurnal cycle, with concentrations increasing during the day and decreasing overnight. When eutrophication causes undesirable levels of algae or rooted plants in a stream, the stream may respond with oxygen levels below 5 mg/L overnight due to excess removal of oxygen from the stream by plant respiration. Photosynthesis by plants during the day adds oxygen to the stream. This daily fluctuation in dissolved oxygen (lower levels at night and higher levels during the day) is termed DO flux.

Continuous dissolved oxygen was measured in the Sweeney Lake Branch of Bassett Creek during June 8–15, 2022. During the monitored period, dissolved oxygen measurements ranged from 4.91 mg/L to 14.50 mg/L; the overall average was 9.32 mg/L (Table 2). Because only two of the 687 measurements (0.3 percent) failed to meet the standard of at least 5 mg/L (Figure 11) the Sweeney Lake Branch of Bassett Creek meets the standard for dissolved oxygen. DO flux ranged from 2.25 mg/L to 8.97 mg/L; the overall average was 6.20 mg/L (Table 2).

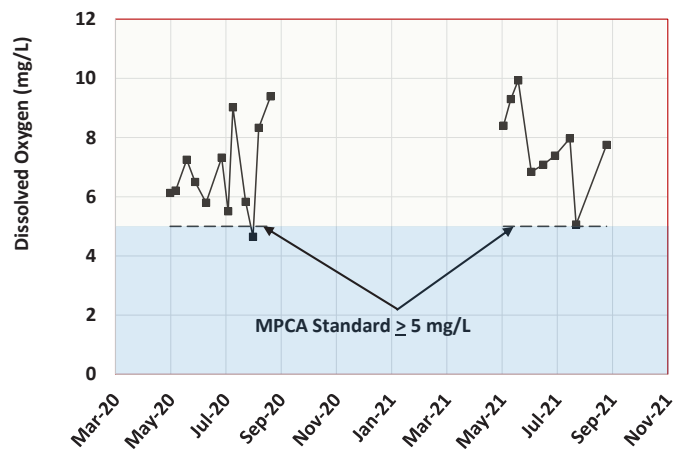


Figure 10: 2020–2021 dissolved oxygen from the Sweeney Lake Branch of Bassett Creek

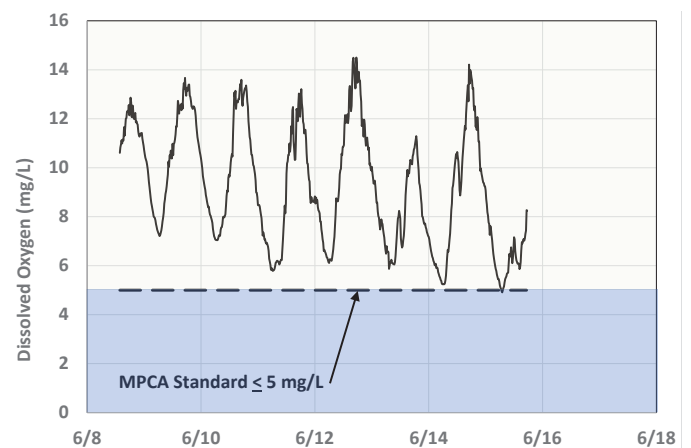


Figure 11: Continuous dissolved oxygen from the Sweeney Lake Branch of Bassett Creek, June 8–15, 2022

## Total phosphorus, chlorophyll $\alpha$ , and dissolved oxygen (DO) flux

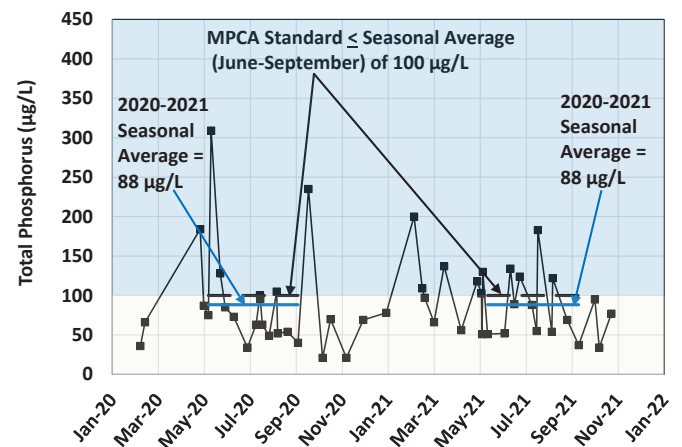
While phosphorus is necessary for plant and algae growth, too much phosphorus leads to excessive algae, decreased water clarity, and water quality impairment. Some common sources of phosphorus are fertilizers, leaves and grass clippings from streets, atmospheric deposition, soil erosion, and material from plant die-off. The quantity of algae in water is measured by chlorophyll  $\alpha$ , a pigment in algae. The MPCA standard for total phosphorus, chlorophyll  $\alpha$ , and DO flux is the river eutrophication standard (RES). RES is a two-part standard, requiring an exceedance of the “causative variable” (total phosphorus) and a “response variable” (chlorophyll  $\alpha$  and DO Flux), which indicates the presence of eutrophication (excessive nutrients). Total phosphorus, chlorophyll  $\alpha$ , and DO flux are considered in combination and not independently.

**Table 2: Continuous dissolved oxygen (DO) measurements on the Sweeney Lake Branch of Bassett Creek (June 8-15, 2022)**

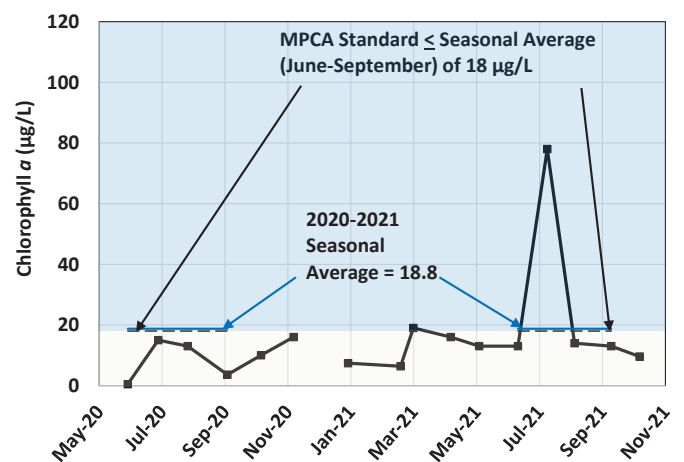
Date	Daily Average DO (mg/L)	Daily Maximum DO (mg/L)	Daily Minimum DO (mg/L)	Daily (Diel) DO Flux (mg/L)
6/8/2022	11.45	12.86	10.61	2.25
6/9/2022	10.54	13.67	7.21	6.46
6/10/2022	9.92	13.59	7.04	6.55
6/11/2022	8.87	13.21	5.79	7.42
6/12/2022	10.02	14.50	6.11	8.39
6/13/2022	8.22	11.29	5.87	5.42
6/14/2022	9.07	14.21	5.24	8.97
6/15/2022	6.45	9.08	4.91	4.17
<b>Average</b>	<b>9.32</b>	<b>12.80</b>	<b>6.60</b>	<b>6.20</b>

To determine whether a stream is impaired, total phosphorus and chlorophyll a data must be collected during at least two different years during a 10-year period, and a minimum of 12 measurements per parameter (from June to September) must be used to determine the seasonal averages. The seasonal averages are then compared with the MPCA standard for each parameter: a maximum of 100 µg/L for total phosphorus and a maximum of 18 µg/L for chlorophyll a. For DO flux, a minimum 4-day deployment is required from June through September, with a minimum of two deployments over separate years. The MPCA standard for DO flux is a maximum of 3.5. The stream meets the RES if either the causative variable (total phosphorus) or response variables (chlorophyll a and DO flux) meet their respective standards.

The 2020 through 2021 seasonal average (June through September) for the causative variable, total phosphorus (TP), was 88 µg/L, which met the MPCA standard (Figure 12). The 2020 through 2021 seasonal average response variable, chlorophyll a, was 18.8 µg/L, slightly exceeding the MPCA standard of 18 µg/L (Figure 13). The DO flux from June 8–15, 2022, ranged from 2.25 mg/L to 8.97 mg/L, with an average of 6.20 mg/L (Table 2). DO flux exceeded the MPCA standard from June 9 through 15. However, because the causative variable (TP) met the MPCA standard, the stream meets the RES.



**Figure 12: Total phosphorus from the Sweeney Lake Branch of Bassett Creek**



**Figure 13: Chlorophyll a from the Sweeney Lake Branch of Bassett Creek**



## Chlorides

Chloride concentrations in area streams have increased since the early 1990s, when many government agencies switched from sand or sand/salt mixtures to salt for winter road maintenance. When snow and ice melt, the salt goes with it, washing into lakes, streams, wetlands, and groundwater. It only takes 1 teaspoon of road salt to permanently pollute 5 gallons of water. And, once in the water, there is no way to remove chloride.

Because high chloride concentrations can harm fish and plant life, the MPCA has established maximum and chronic chloride standards. The maximum standard is the highest concentration of chloride that aquatic organisms can be exposed to for a brief time with zero-to-slight mortality. The chronic standard is the highest chloride concentration that aquatic life can be exposed to indefinitely without causing chronic toxicity. Chronic toxicity is defined as a stimulus that lingers or continues for a long period, often one-tenth the life span or more. A chronic effect can be mortality, reduced growth, reproduction impairment, harmful changes in behavior, and other nonlethal effects. A lake or stream is considered impaired if two or more measurements exceed the chronic criterion (230 mg/L) within 3 years or if one measurement exceeds the maximum criterion (860 mg/L).

Based on samples collected in 2020 and 2021, chloride concentrations in the Sweeney Lake Branch of Bassett Creek ranged from a low of 103 mg/L, measured in August 2020, to a high of 654 mg/L, measured in February 2021 (Figure 14). All samples collected by BCWMC during 2020 and 2021 met the MPCA maximum chloride standard, but 16 of the 30 samples (53 percent) exceeded the MPCA chronic chloride

standard (Figure 14). The MPCA collected chloride samples in May 2020 (160 mg/L) and May 2021 (223 mg/L), and both samples met the MPCA maximum and chronic chloride standards.

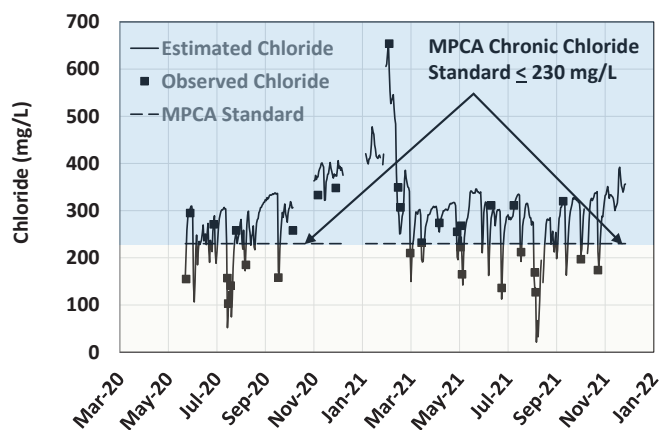
Additional information about chloride concentrations was captured by performing a specific-conductance analysis. Specific conductance measures how well water can conduct electricity. It indicates what is dissolved in the water and increases with larger numbers of ions, including chloride ions. A linear regression analysis of specific conductance and chloride measurements from the Sweeney Lake Branch of Bassett Creek indicated that 89 percent of the specific-conductance value was due to chloride ions in the stream. The outcome of the linear regression analysis was a regression equation, which is a statistical model of the relationship between specific conductance and chloride. The model was used to estimate average daily chloride values from the average daily specific-conductance values measured in the stream.

In 2020, the estimated chloride concentrations in the stream ranged from 52 mg/L to 406 mg/L, with an average of 284 mg/L (Figure 14). The estimated number of days that chloride concentrations exceeded the MPCA standard was 133 of the 171 days of specific-conductance measurements (78 percent, Figure 14). In 2021, the estimated chloride concentrations in the stream ranged from 21 mg/L to 656 mg/L, with an average of 302 mg/L (Figure 14). The estimated number of days that chloride concentrations exceeded the MPCA standard was 262 of the 314 days of specific-conductance measurements (83 percent, Figure 14).

The Sweeney Lake Branch of Bassett Creek is not included on the 303(d) list of Minnesota's impaired waters for chloride. However, because more than two chloride samples exceeded the MPCA chronic chloride standard during 2020 and 2021, the stream would be considered impaired for chlorides.

## E. coli bacteria

The Environmental Protection Agency (EPA) determined that *E. coli* is the preferred indicator of the potential presence of waterborne pathogens. The MPCA standard for *E. coli* protects streams used for two types of recreation: primary body contact (e.g., swimming, where inadvertent ingestion of water is likely) and secondary body contact (e.g., wading, where the likelihood of ingesting water is much



**Figure 14: 2020–2021 Chloride concentrations: Observed and estimated from average daily specific-conductance measurements of the Sweeney Lake Branch of Bassett Creek by BCWMC**



smaller). The MPCA uses average and maximum E. coli values to determine impairment. E. coli standards are applicable only during the warmer months of April through October since swimming or wading in Minnesota streams during the November through March period is not expected.

Average E. coli is assessed by a standard based on a geometric mean EPA criterion of 126 E. coli colony-forming units (cfu) per 100 mL. Data are aggregated by individual month (e.g., all April values, all May values, etc.) for up to 10 years to determine impairment due to high average monthly E. coli values. At least 3 months of data must be collected, preferably between June and September, and at least five values must be collected per month for those 3 months (15 samples) to determine impairment due to high average E. coli.

Maximum E. coli is assessed by a criterion of a maximum of 1,260 cfu that is not to be exceeded by 10 percent of all samples collected from April through October over the 10-year assessment period (independent of month) (Figure 15).

If the geometric mean of the aggregated monthly values for one or more months exceeds 126 cfu per 100 mL, that reach is considered impaired. Also, a waterbody is considered impaired if more than 10 percent of individual values over the 10-year assessment period (independent of month) exceed 1,260 cfu per 100 mL.

E. coli data collected from 2020 through 2021 were assessed to determine whether average E. coli values met the MPCA impairment standard. The April through October monthly geometric means from the aggregated 2020 through 2021 values ranged from a low of 48 cfu per 100 mL to a high of 305 cfu per 100 mL (Figure 15). Geometric means during May, June, July, September, and October failed to meet the MPCA standard of 126 cfu per 100 mL (Figure 15). Hence, by this standard, the stream would be considered impaired.

A water body is also considered impaired if more than 10 percent of individual samples taken from April 1 through October 31 over a 10-year period (independent of month) exceed 1,260 cfu per 100 mL. In 2020 and 2021, sample values of 2,421 cfu/100 mL, measured on July 24, 2020, and 1,300 cfu/100 mL, measured on August 25, 2021, exceeded the impairment threshold (Figure 16). Two samples out of 34 (6 percent) collected during the April through

October period in 2020 and 2021 exceeded the MPCA standard. Because the number of samples exceeding the MPCA standard was less than 10 percent of individual samples taken from April 1 through October 31 during the two-year monitoring period, the MPCA standard was met.

The Sweeney Lake Branch of Bassett Creek is not currently included on the 303(d) list of Minnesota's impaired waters for E. coli bacteria. However, because the geometric mean of the aggregated monthly E. coli values for one or more months during 2020 and 2021 exceeded 126 cfu per 100 mL, the Sweeney Lake Branch would be considered impaired for E. coli bacteria.

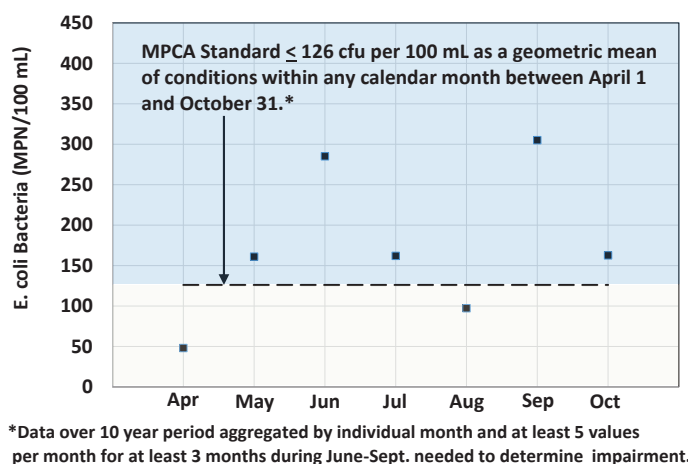


Figure 15: 2020–2021 monthly geometric means of E. coli bacteria from the Sweeney Lake Branch of Bassett Creek

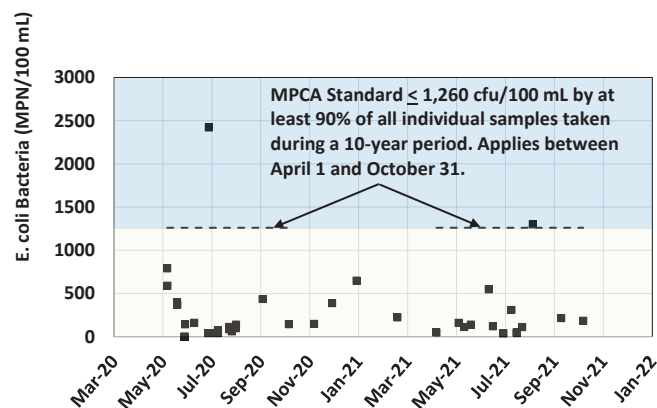


Figure 16: 2020–2021 E. coli bacteria from the Sweeney Lake Branch of Bassett Creek

## Total suspended solids

Total suspended solids consist of soil particles, algae, and other materials that are suspended in water and cause a lack of clarity. Excessive total suspended solids can harm aquatic life and degrade aesthetic and recreational qualities. A stream is considered to exceed the standard for total suspended solids (30 mg/L) if (1) the standard is exceeded more than 10 percent of the days of the assessment season (April through September) and (2) there are at least three such measurements exceeding the standard.

In 2020, total suspended solids concentrations in the Sweeney Lake Branch of Bassett Creek ranged from a low of 4 mg/L to a high of 62 mg/L (Figure 17); the average was 20 mg/L. Four of the 17 samples collected from April through September (24 percent) exceeded the MPCA standard of 30 mg/L (Figure 17).

In 2021, total suspended solids concentrations in the Sweeney Lake Branch of Bassett Creek ranged from a low of 4 mg/L to a high of 59 mg/L (Figure 17); the average was 22 mg/L. Eight of the 18 samples collected from April through September (44 percent) exceeded the MPCA standard of 30 mg/L (Figure 17).

The Sweeney Lake Branch of Bassett Creek is not currently included on the 303(d) list of Minnesota's impaired waters for total suspended solids. However, because the total suspended solids standard was exceeded in more than 10 percent of the samples collected from April through September of 2020 and 2021, and there were at least three measurements, the stream would be considered impaired for total suspended solids.

## Metals

Metals are naturally occurring elements found throughout the earth's crust. Their multiple industrial, domestic, agricultural, medical, and technological applications have led to their widespread distribution in the environment. Because heavy-metal-induced toxicity can harm aquatic life, the MPCA has established three standards for Class 2B waters—chronic, maximum, and final acute values (FAVs)—for each metal type. (The MPCA has classified Bassett Creek as a Class 2B water.) The chronic standard (CS) is the highest toxicant concentration that aquatic organisms can be indefinitely exposed to with no harmful effects. The maximum standard (MS) is a

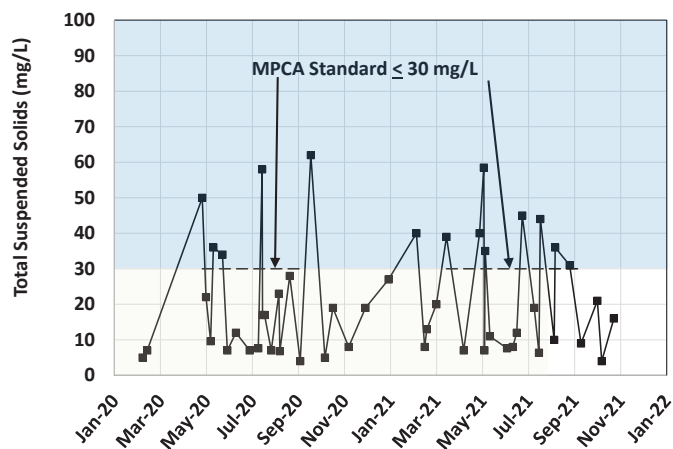


Figure 17: 2020–2021 Total suspended solids from the Sweeney Lake Branch of Bassett Creek

concentration that protects aquatic organisms from the potentially lethal effects of a short-term “spike” in toxicant concentrations. The MS is always equal to one-half of the FAV: the concentration that would kill about one-half of the exposed individuals of a very sensitive species. The FAV is most often used as an “end-of-pipe” effluent limit to prevent an acutely toxic condition in the effluent or the mixing zone. Because increases in water hardness decrease the toxicity of metals, the MPCA metals standards vary with water hardness. To show this variation in Figures 18 through 23, metal concentrations are plotted on the y-axis and hardness on the x-axis.

Quarterly samples were collected from the Sweeney Lake Branch of Bassett Creek and analyzed for total cadmium, total chromium, total copper, total nickel, total lead, and total zinc during the 2020 and 2021 monitoring period. All samples met the MPCA standards (Figures 18 through 23), indicating metals are not causing heavy metal toxicity to aquatic organisms in the stream.

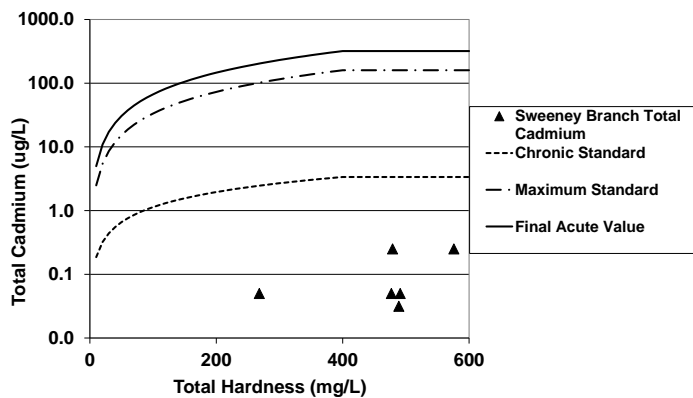


Figure 18: 2020-2021 total cadmium from the Sweeney Lake Branch of Bassett Creek compared to MPCA standards

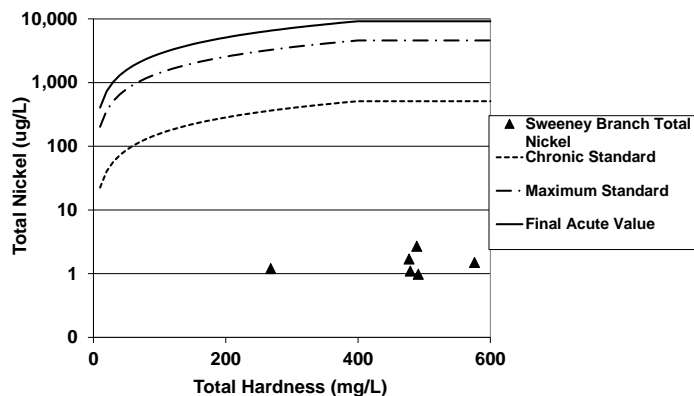


Figure 21: 2020-2021 total nickel from the Sweeney Lake Branch of Bassett Creek compared to MPCA standards

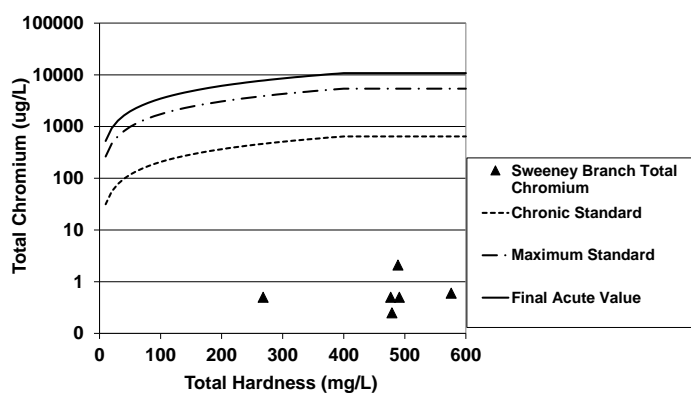


Figure 19: 2020-2021 total chromium from the Sweeney Lake Branch of Bassett Creek compared to MPCA standards

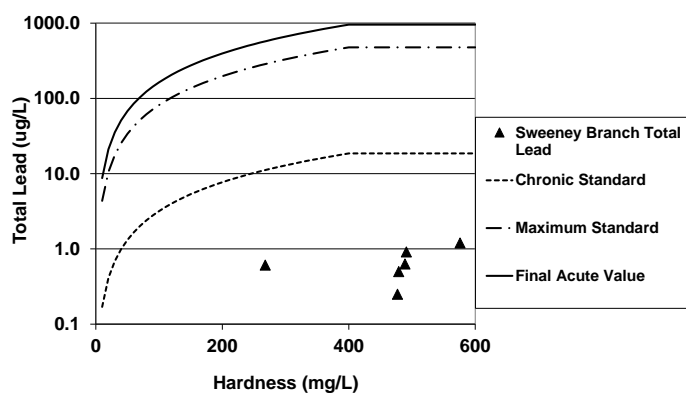


Figure 22: 2020-2021 total lead from the Sweeney Lake Branch of Bassett Creek compared to MPCA standards

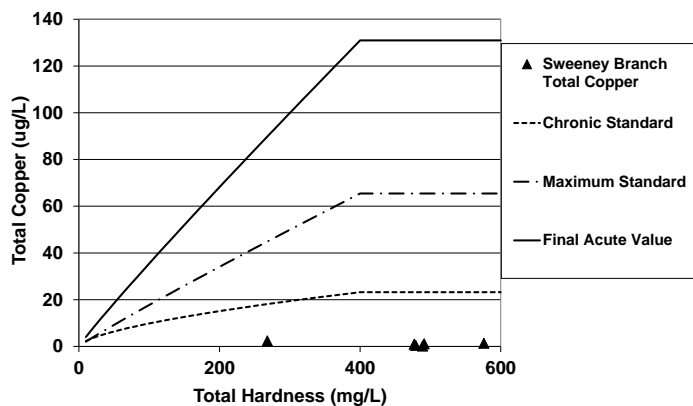


Figure 20: 2020-2021 total copper from the Sweeney Lake Branch of Bassett Creek compared to MPCA standards

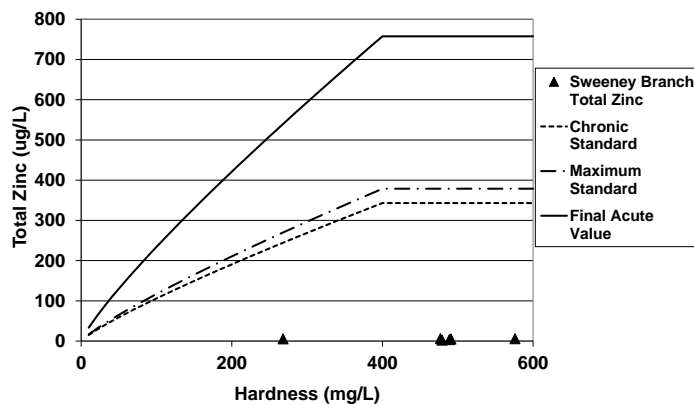


Figure 23: 2020-2021 total zinc from the Sweeney Lake Branch of Bassett Creek compared to MPCA standards



# Biotic index evaluation

Between 1980 and 2021, the BCWMC collected benthic macroinvertebrates (bottom-dwelling organisms) from the Sweeney Lake Branch of Bassett Creek on 11 occasions (see Figure 1 for the sampling location). The purpose of the sampling was to evaluate water quality and detect changes over time.

In 2020, the MPCA monitored the Sweeney Branch of Bassett Creek for macroinvertebrates, and the BCWMC assessed the stream's habitat. The MPCA used the Macroinvertebrate Index of Biotic Integrity (M-IBI) to assess the health of the stream's macroinvertebrate community. The MPCA developed the M-IBI and added it to Minnesota's water quality standards to help identify biologically impaired rivers and streams.

## Sweeney Lake Branch of Bassett Creek habitat

Habitat is a key factor in determining the presence and distribution of macroinvertebrates in streams. Stream macroinvertebrates are influenced by such habitat factors as substrate size and composition, the quantity of fine sediment deposited on the substrate, and the presence of vegetation. The substrate provides places for food and refuge for

macroinvertebrates. Aquatic vegetation provides shelter against predation by small fish. Adverse changes in habitat can result in adverse changes to the macroinvertebrate community.

The BCWMC completed habitat surveys of the Sweeney Lake Branch of Bassett Creek at Woodstock Avenue in 2015 and 2020 using the MPCA quantitative habitat survey method. The survey results are summarized in Table 3. Overall, habitat conditions declined between 2015 and 2021. Habitat changes documented by the 2020 survey include the following.

### *Evidence of habitat improvement:*

- Increased flows and water depths
- Increase in percent length of transect with overhanging vegetation
- Decrease in percent of transects with left-bank erosion

### *Evidence of habitat degradation:*

- Increase in average embeddedness of coarse sediment
- Increase in percent of transects with right-bank erosion
- Increase in average length of bank erosion per transect for both left and right banks
- Decrease in average amount of algae observed on the quadrat

**Table 3: 2015 and 2020 habitat comparison: Sweeney Lake Branch of Bassett Creek at Woodstock Avenue**

Parameter	2015	2020
Discharge (flow [cfs] when macroinvertebrate samples were collected)	1.9	2.1
Average depth of water (cm)	14	17
Average depth of fine sediment (cm)	15	15
Average embeddedness of coarse sediment (%)	67	69
Percent of transects with left-bank erosion	69	54
Percent of transects with right-bank erosion	85	92
Average length of bank erosion per transect: left bank (m)	0.4	1.2
Average length of bank erosion per transect: right bank (m)	0.9	>3.0
Average amount of algae (filamentous or attached) observed on quadrat (%)	2	0
Average number of macrophytes observed on quadrat (%)	0	0
Percent length of transect over at least 10 cm of water depth with overhanging vegetation	5	7
Percent length of transect over at least 10 cm of water depth with submergent vegetation	0	0
Percent length of transect over at least 10 cm of water depth with emergent vegetation	0	0
Percent length of transect over at least 10 cm of water depth with woody debris	12	9
Percent length of transect over at least 10 cm of water depth with boulders	0	0.8
Percent length of transect over at least 10 cm water depth with undercut banks	1	0

- Decrease in percent length of transect with woody debris
- Decrease in percent length of transect with undercut banks

## M-IBI biological metrics

The MPCA has established biological water quality standards for all Minnesota streams and rivers, including Bassett Creek. A macroinvertebrate index of biotic integrity (M-IBI) and a fish index of biotic integrity (F-IBI) were added to Minnesota standards and approved by the United States Environmental Protection Agency on June 26, 2018.

The M-IBI helps identify biologically impaired rivers and streams by assessing the health of their macroinvertebrate communities. The M-IBI score is the sum of the scores from 10 individual metrics. Each metric assesses an attribute of the macroinvertebrate community; collectively, the metrics assess the community's overall health. Each M-IBI metric has a scale of 0 to 10, the lowest possible score is 0, and the highest is 10. Increasing scores indicate improving conditions. Because 10 metrics are summed to attain the M-IBI score, and each metric has a maximum score of 10, the maximum possible score is 100. To meet the MPCA macroinvertebrate standard, the sum of the scores from the 10 individual metrics must equal or exceed

the impairment threshold—a score of at least 43 for the Sweeney Lake Branch of Bassett Creek.

The MPCA collected macroinvertebrate samples from the Sweeney Lake Branch of Bassett Creek on September 1, 2020, and computed the M-IBI to determine whether the stream met the M-IBI biological standard. The 2020 M-IBI score for the Sweeney Lake Branch of Bassett Creek was 42.1 (Figure 24). The MPCA concluded the stream was not biologically impaired because the M-IBI score was less than a point below the impairment threshold and the stream has relatively decent habitat for a moderately channelized urban stream.

The MPCA monitored a slightly different station location in 2020 than the BCWMC monitored in 2015, when the M-IBI score was 48.9—well above the impairment threshold. The MPCA station location began about 5 meters downstream from the BCWMC station and did not include a riffle area monitored by the BCWMC (Figure 25). The MPCA indicated the riffle was not monitored because it is very close to the culvert; due to the influence of the culvert structure on flow, the MPCA considered the riffle artificial rather than natural. It is not known whether the differences in 2015 (48.9) and 2020 (42.1) M-IBI scores were due to the differences in sample location or degradation of the macroinvertebrate community caused by stressors in the stream such as high chloride concentrations or high total suspended solids concentrations.

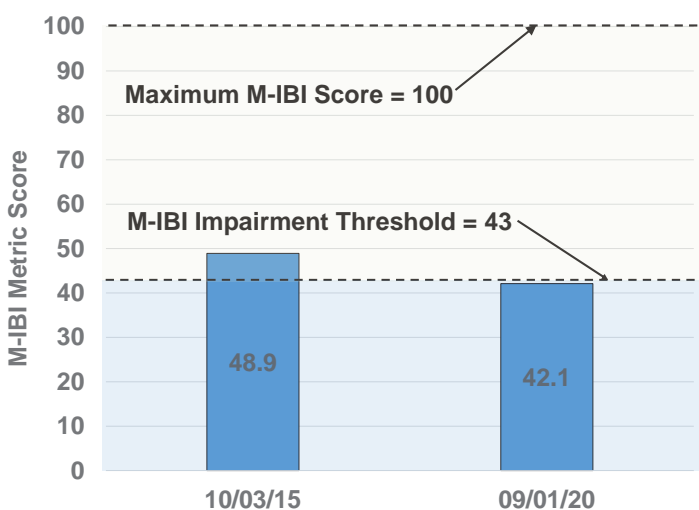


Figure 24: 2015 and 2020 M-IBI metric scores from the Sweeney Lake Branch of Bassett Creek



Figure 25: The 5-meter reach of stream pictured above was sampled by BCWMC in 2015 but not included in the 2020 MPCA survey. A riffle near the culvert was included in the 2015 BCWMC sample reach but not in the 2020 MPCA sample reach.