Bassett Creek Watershed Management Commission

BCWMC Monitoring Program Review

November 25, 2019

Results of October 4, 2019 TAC Brainstorming and Prioritizing Goals and Objectives of BCWMC Monitoring Program

Goal/Objective	Priority Level	Notes
Assess waterbodies against State standards	High	
Track changes and trends	High	
Detect issues early for proactive management	High	
Understanding impacts of climate change	High	• Particularly changes related to flow. • Noted need to track temperature changes. • Noted need to communicate trends.
Gathering chloride data	High	
Understanding effectiveness and function of stormwater ponds (sink vs. source)	High	
Avoid duplication of monitoring efforts	High	
Gather data to help residents understand aquatic ecology and chemistry conditions	High	
Assessing ecological health	High/Med	
Gather data needed to maintain pollutant loading and hydrologic/hydraulic models	High/Med	
Effectively target projects and programs	Med	
Detect new AIS and assess suitability of AIS	Med	
Analyze effects of high chlorides	Med	For instance, at what chloride level does a lake stop mixing? U of M is studying effects of chlorides as well.
Assessing effectiveness of specific BMPs including CIP projects	Med	This is likely more a role for cities rather than Commission
Identifying and tracking emerging contaminants	Med/Low	PFAS, for instance
Understanding fish communities	Med/Low	Bassett Creek Main Stem – fish impairment; data gap
Bacteria source assessment	Low	
Assess wetland health and function	Low	
Assessing for harmful algal blooms	Special case	
Identify biological stressors	Special case	
Understanding impacts of carp	Special case	
Gather data to help with grant applications or grant requirements	Special case	

This memo answers the question "how well does the current monitoring program align with or meet the TAC's goals/objectives" for the goals considered a high or medium priority.

For some goals, the memo also answers the following questions:

- What are the minimum monitoring requirements/standards or guidelines?
- Does the BCWMC monitoring program meet the requirements/standards/guidelines? If not, does it exceed requirements or is there a gap and why does it differ?

Note: Potential gaps are highlighted blue; areas that exceed requirements are highlighted yellow.

High Priority Goal: Assess waterbodies against State standards
(*MPCA standards: MN Administrative Rules 7050.0222 Subp. Class 2B waters*
https://www.revisor.mn.gov/rules/7050.0222/)

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
   - Lake water quality monitoring program meets this goal, including future listings with respect to aquatic plants (lake plant IBI)
   - Stream monitoring:
     - Biological/macroinvertebrate monitoring program meets this goal for biological standards, with the exception of fish monitoring (not included in BCWMC program)
     - Stream flow and water quality monitoring program meets this goal
2. What are the minimum monitoring requirements/standards or guidelines?
3. Does the BCWMC monitoring program meet the requirements/standards/guidelines? If not, does it exceed requirements or is there a gap and why does it differ?

   - **For assessing lake eutrophication** (*MPCA Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List 2020 Assessment and Listing Cycle*):
     - Minimum data requirements for assessing lake eutrophication:
       - Samples collected over a minimum of 2 years (in the 10-year assessment period)
         - BCWMC monitoring program for Priority 1 water bodies exceeds the requirement as they are monitored every 3 years (i.e., 3 years of data every 10 years)
         - BCWMC monitoring program for Priority 2 waterbodies meets this requirement as they are monitored every 5 years (i.e., 2 years of data every 10 years)
       - Samples collected from June to September. Typically, a minimum of 8 individual data points (over the 2 years) required for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), Secchi disc.
         - BCWMC collects data on 5 occasions during June through September of each year.
         - Priority 1 water bodies = 15 data points in 10 years
         - Priority 2 waterbodies = 10 data points in 10-years
         - BCWMC lake monitoring = collection of one sample within two weeks after ice out, which is outside of the required June through September period
       - Samples collected from upper most 3 meters of water column
         - BCWMC lake monitoring = phosphorus data collected at different depths, not just at the water surface

- How and why does the BCWMC monitoring program exceed the minimum requirements?
  - Priority 1 waterbodies are monitored more frequently than required in order to better track trends and identify potential issues in a timely manner.
  - BCWMC also analyzes for soluble reactive phosphorus and total nitrogen to more completely assess lake eutrophication, including the quantity of phosphorus readily available to algae (soluble reactive phosphorus) and whether the lake's water quality is driven by phosphorus or nitrogen—total nitrogen to total phosphorus ratio shows whether phosphorus or nitrogen is the nutrient limiting algal growth. The latter informs the Commission as to whether phosphorus loading reduction from the watershed would be expected to improve lake water quality.
  - BCWMC also collects the following additional field data at 1-meter depths: dissolved oxygen, temperature, specific conductance, pH, and oxidation reduction potential. The additional field data provide a comprehensive assessment of lake processes which impact lake eutrophication, such as stratification, mixing, anoxia, oxidation/reduction potential (indicates internal phosphorus loading potential from sediment), and productivity (e.g., increased algal and plant growth cause pH increases). Specific conductance also helps to detect changes in lake chloride concentrations.
  - BCWMC also collects phytoplankton and zooplankton samples. Phytoplankton and zooplankton data provide a more thorough assessment of the lake ecosystem, including changes in eutrophication. Additionally, the phytoplankton data inform of blue-green algal blooms and the risk of public health concerns from the blooms. Zooplankton analyses provide an opportunity for early detection of invasive species such as spiny waterflea and possibly zebra mussel veligers. Changes in zooplankton data also could indicate changes in toxic substances (e.g., increases in a toxic substance would cause zooplankton declines).

- **For assessing stream eutrophication** (*MPCA Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List 2020 Assessment and Listing Cycle*):
  - Minimum data requirements for assessing stream eutrophication:
    For TP, chlorophyll-*a*, and BOD5: Minimum of 12 measurements per parameter within the 10-year assessment period (minimum 2 years required); seasonal average of June to September data
    - For BCWMC monitoring on North Branch, Sweeney Lake Branch, and Plymouth Creek, samples are generally collected April - November with some additional samples collected December - March
    - The BCWMC's monitoring program for North Branch, Sweeney Lake Branch, and Plymouth Creek exceeds this requirement for TP and chlorophyll-a as they are monitored for two consecutive years every six years (4 years of data every 10 years). BOD5 is not monitored; a gap.
    - The MCES Watershed Outlet Monitoring Program (WOMP) for the Main Stem exceeds this requirement for TP and chlorophyll-a because they are monitored annually (10 years of data every 10 years). BOD5 is not monitored; a gap.
    - Although the specific number of measurements June - September could vary depending upon distribution of the 15 sample events during each

year of monitoring, it is anticipated that approximately 8 sample events would occur per year for a total of 32 samples in 10 years. BOD5 is not monitored; a gap.

- WOMP station collects samples about 18 to 22 times June - September for a total of about 180 to 220 samples in 10 years. BOD5 is not monitored; a gap.
- The BCWMC stream monitoring program and MCES WOMP program collect TP and chlorophyll-*a* samples throughout the year, which exceeds the guidelines of June through September monitoring.

- How and why does the BCWMC monitoring program exceed the minimum requirements?
  - BCWMC/MCES WOMP monitoring programs exceed the minimum requirements because the streams are monitored more frequently than required for TP and chlorophyll-a. BCWMC monitoring exceeds this requirement because the program was designed to align with WOMP monitoring for consistency across the watershed, and to understand conditions during a longer portion of the year. MCES WOMP monitoring exceeds the requirement because the program is designed to understand stream conditions year-round. The streams are not monitored for BOD5 as it is not expected to be a problem; this is a gap.

- For DO flux: Minimum of a 4-day deployment is required – June to September; minimum of two deployments over separate years in the assessment window is required.
  - BCWMC and WOMP monitoring programs do not include dissolved oxygen deployment; this is a gap.
- Why is there a gap with the BCWMC/MCES WOMP monitoring program?
  - The BCWMC/MCES WOMP monitoring programs do not include oxygen deployment. The BCWMC's program gap occurs because the BCWMC program was aligned with WOMP monitoring protocols for consistency across the watershed. Although the MCES WOMP program does not currently include oxygen deployment, MCES indicated possible DO deployment in 2020 during July and August, in response to remarkably low instantaneous DO measurements in summer 2019 at the WOMP station.

- For pH: Range is 6.5 ≤ concentration ≤ 9.0; minimum of 20 samples needed to indicate standard is met; June to September data
  - BCWMC monitoring for North Branch, Sweeney Lake Branch, and Plymouth Creek does not include pH measurements; this is a gap
  - The MCES WOMP for the Main Stem includes about 8 measurements during June through September; this is a gap.
- Why is there a gap with the BCWMC/MCES WOMP monitoring program?
  - The BCWMC monitoring program was designed to be consistent with WOMP monitoring. When the program began, the WOMP program did not include pH. Although MCES recently added pH to the WOMP monitoring program, BCWMC has not yet added pH to the program. If BCWMC changes its program to be consistent with MCES WOMP, a gap will exist because the number of samples collected by the MCES WOMP program is less than the minimum data requirement.
  - The MCES WOMP for the Main Stem includes pH measurements about 25 to 30 times per year and only about 8 times during June through

September, which is less than the minimum data requirement. MCES monitors pH at the same frequency of other field parameters. Increasing the frequency of pH monitoring would would require additional site visits exclusively for measurement of pH.

- **For assessing stream total suspended solids (TSS)** (*MPCA Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List 2020 Assessment and Listing Cycle*):
    - Data for assessments must be collected from April through September
    - A stream is considered impaired for TSS if the TSS measurement exceeds the standard more than 10% of the days of the assessment season (April through September) or at least three TSS measurements exceed the standard
        - BCWMC monitoring on North Branch, Sweeney Lake Branch, and Plymouth Creek exceeds this requirement. Data are generally collected April - November with some additional samples collected December - March
        - The MCES WOMP monitoring program exceeds this requirement. Grab samples are collected every two weeks year-round (26 samples per year) and storm-activated discrete auto grab samples during storm events are collected 10 to 15 times each year.
    - Why does the BCWMC/MCES WOMP monitoring program exceed the minimum requirements?
        - BCWMC monitoring on North Branch, Sweeney Lake Branch, and Plymouth Creek is designed to be consistent with WOMP monitoring and to understand conditions during a longer portion of the year.
        - MCES WOMP monitoring program is designed to understand stream conditions year-round.

- **For assessing stream E. coli** (*MPCA Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List 2020 Assessment and Listing Cycle*):
    - E. coli results must be analyzed within 24 hours of sample collection to be used for assessment
    - Data aggregated over the full 10-year period by individual month (e.g., all April values for all 10 years, all May values, etc.).
    - At least three months of data must be collected, preferably between June and September, and at least 5 values must be collected per month for those three months (15 samples).
        - BCWMC monitoring on North Branch, Sweeney Lake Branch, and Plymouth Creek does not meet this requirement; this is a gap. Grab samples are analyzed for E. coli so they can be analyzed within 24 hours of collection. Approximately 15 grab samples are collected per 2-year monitoring period. The distribution of the samples over the year will vary, but it is expected that approximately 4 samples will be collected during the June - September period. During each 10-year assessment period, it is anticipated that 16 samples will be collected during the June through September period (4 months); this is 4 samples per month.
        - MCES WOMP monitoring exceeds this requirement. Approximately 26 grab samples per year are collected (every two weeks). Samples are collected during all twelve months of the year. During each 10-year

assessment period, 40 samples will be collected during the June-September period (4 months).

- Why does the BCWMC monitoring program exceed the minimum requirements?
  - BCWMC monitoring program for North Branch, Sweeney Lake Branch, and Plymouth Creek exceeds this requirement in order to be aligned with WOMP monitoring protocols for consistency across the watershed.
  - MCES WOMP monitoring program is designed to annually understand stream conditions year-round.

- **For assessing stream un-ionized ammonia**: (*MPCA Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List 2020 Assessment and Listing Cycle*):
  - Ammonia at elevated levels in the un-ionized form (NH_3) is toxic to aquatic life. The chronic un-ionized ammonia standard for Bassett Creek and Plymouth Creek is < 0.04 mg/L un-ionized ammonia. The fraction of total ammonia in the un-ionized form in water is dependent on ambient pH and temperature. Therefore, pH and temperature as well as total ammonia must be measured at the same time and place to determine the un-ionized ammonia concentration. The quantity of data required for assessing impairment is not specified; this is a gap.
    - The BCWMC stream monitoring program currently does not measure pH. Because pH measurement at the time of total ammonia sample collection is required to compute un-ionized ammonia, un-ionized ammonia concentrations cannot be determined from the BCWMC's current monitoring program. The MCES program meets the requirement because temperature, pH, and total ammonia are measured at the same time and place.
      - Why is there a gap with the current BCWMC monitoring program? The BCWMC monitoring program was designed to be consistent with WOMP monitoring which did not include pH when the program was initiated. Although MCES recently added pH to the WOMP monitoring program, BCWMC has not yet added pH to the program. Without pH, it is not possible to compute un-ionized ammonia.
- **For assessing stream trace metals** (cadmium, chromium, copper, lead, nickel, and zinc): : (*MPCA Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List 2020 Assessment and Listing Cycle*):
  - The MPCA guidance does not specify the amount of data required for assessing trace metals. The chronic standards vary with ambient total hardness. Therefore, hardness and metals must be measured at the same time and place to determine the standards used for assessing trace metals.
    - The BCWMC and WOMP programs include collection of trace metals and hardness at the same time and place. Hence, the programs meet minimum data requirements.

- **For assessing lake and stream chloride**: (*Monitoring guidelines from MPCA's Statewide Chloride Management Plan Draft April 2019*)
  - <u>For lakes</u>: collect samples January through May and during the typical summer season sampling. Collect a bottom sample and surface sample in lakes with potential for stratification.
    <u>For streams</u>: collect samples December through April and during the typical summer season sampling. Collect a matching conductivity reading with each sample taken for

chloride analysis.
For waters without data: collect monthly chloride and conductivity data during the critical period. If possible, expand effort to weekly sampling during critical period.
For "high risk" waters: (those not currently impaired but showing a high risk of impairment) recommended expansion of monitoring.

- Lake and streams considered impaired if two or more exceedances of chronic criterion (230 mg/L) within a three-year period or one exceedance of acute criterion (860 mg/L) is considered an impairment.
    - BCWMC stream monitoring program for North Branch, Sweeney Lake Branch, and Plymouth Creek meets the minimum data requirements. Samples are collected during the critical December through April period and during the typical summer season. A conductivity reading occurs with each sample taken for chloride analysis.
    - BCWMC lake monitoring program includes collection of chloride data May through September. Because the program includes sampling from both the surface and bottom during the January through May period and during the typical summer season, the program appears to meet the minimum data requirements. However, the MPCA's monitoring guidelines suggest more frequent sampling for lakes with no data (monthly sampling during January – May), and for lakes not currently impaired but showing a high risk of impairment, even more frequent sampling is recommended (e.g., weekly or twice weekly); potential gap.

- **For assessing the stream index of macroinvertebrate biological integrity (MIBI)** (*MPCA's Macroinvertebrate Data Collection Protocols for Lotic Waters in Minnesota 2017*):
The MIBI score is the sum of the scores from 10 individual metrics. Each metric assesses an attribute of the macroinvertebrate community, and collectively the metrics assess the overall health of the community. Each MIBI metric has a scale of 0 to 10; increasing scores indicate improving conditions. The maximum possible MIBI score is 100.
    - Minimum data requirements:
        - Reach length = 35x mean stream width; minimum reach length = 150 meters; maximum reach length = 500 meters.
        - Conduct sampling during daylight late-July through October.
        - Sample when streams are at or near base-flow, not during flood or drought events.
        - Conduct macroinvertebrate community sampling in conjunction with the water chemistry and physical habitat assessment protocols
        - Stream assessment determinations: MIBI score must meet or exceed standard (at least 37 for Bassett Creek).

      (*MPCA 2014c [Water Chemistry Assessment Protocol for Stream Monitoring Sites] and MPCA 2014d [MPCA Stream Habitat Assessment (MSHA) Protocol for Stream Monitoring Sites]*). Additional protocols that may be used during a site visit include: MPCA 2012 [*Stream Condition and Stressor Identification (SCSI) protocol for Stream Monitoring Sites] and MPCA 2014e [Channel Condition and Stability Index (CCSI): MPCA protocol for assessing the Geomorphic Condition and Stability of Low-Gradient Alluvial Streams*].

        - BCWMC program meets the minimum data requirements. Samples collected in early October using MPCA methodology per the minimum data requirements

described above. A habitat assessment occurs after collection of the macroinvertebrate samples. Water chemistry data are collected from a location very near the macroinvertebrate sample location

- **For assessing the lake plant eutrophication index of biological integrity (IBI):**
  (*MDNR-developed lake plant eutrophication IBI; Radomski, P. and D. Perleberg. 2012. Application of a versatile aquatic macrophyte integrity index for Minnesota lakes. Ecological Indicators 20:252-268*). Used to measure eutrophication stress to lake plant communities and based on measurements of species diversity and composition, including algae; and species abundance and condition. Currently, the MPCA uses this IBI as supporting information only in assessing the lake fish IBI.
    - Monitoring guidelines for assessing lake plant eutrophication.
      - Not specific on number of years of data or how many monitoring events
      - Recommended 100 sample points per survey
      - Four sampling method options for the aquatic plant survey – National Lakes Assessment Project plant survey method (NLAP), transect survey method, point intercept survey method, and Minnesota Biological Survey method (MCBS).
      - IBI score compared to standard to assess impairment. However, MPCA currently uses this IBI only as supporting information in assessing the lake fish IBI.
    - ➢ BCWMC lake monitoring program meets the guidelines. BCWMC uses the point intercept survey method, one of the four recommended methods. Per MDNR recommendations, BCWMC uses up to 125 sample points to ensure sufficient sample points for statistical evaluation of the data; sample points are spaced 20 – 100 meters apart.

- **For assessing the lake fish index of biological integrity (IBI)**
  The fish IBI only applies to Medicine Lake because it is the only lake in the watershed with a surface area greater than 100 acres. The MDNR has conducted fish surveys on Medicine Lake at a frequency of 2 to 8 years during 1981 through 2017. The BCWMC does not regularly monitor fish communities. However, MDNR staff have committed to conduct annual fish IBI surveys as part of the MPCA's every-10-year watershed assessment schedule, which meets the criteria for assessment. The MDNR developed the lake fish IBI that the MPCA incorporated into its every-10-year watershed assessment process. The DNR developed four fish-based IBI tools for lakes 100 – 10,000 acres in size. Each IBI tool/score is generated using between eight and 15 calculated measurements. Examples include: the number of intolerant species sampled, the number of tolerant species sampled, the number of vegetation-dwelling species sampled, the percentage of small benthic individuals captured in seining and electrofishing sampling gears, and the percentage of insect-eating species sampled in trap nets. The MDNR uses gill netting, trap netting, seining and backpack electrofishing to develop a full picture of the fish community living in a lake. Information on the number of species and quantity of individuals collected are used to calculate the IBI score, which ranges from 0 – 100.
    - Minimum data requirements for assessing lake fish IBI:
      MDNR staff perform the fish sampling: gill netting, trap netting, seining and backpack electrofishing
    - Lake assessment determinations:
      The IBI score is compared to the standard to assess if the lake is impaired. The MPCA uses the lake plant eutrophication IBI as supporting information when making the assessment.

High Priority Goal: Track changes and trends

1. How well does current monitoring program align with/meet the TAC's goals/objectives?

   Overall, the BCWMC monitoring programs are designed with the goal to track changes over time. In many cases, our monitoring record goes back to the 1970s. Trends are analyzed and reported during every regular monitoring season.

2. What are the minimum monitoring requirements/standards or guidelines?
3. Does the BCWMC monitoring program meet the requirements/standards/guidelines? If not, does it exceed requirements or is there a gap and why does it differ?
   - To delist a lake with an eutrophication impairment, the MPCA guidance documents notes an improving total phosphorus trend as one basis for delisting, but does not provide requirements for statistical analyses. BCWMC uses the Mann- Kendall/Sen's Slope trend test to determine trends and uses WQ Stat Plus software to perform the trend analysis. A minimum of 10 data points are required for the Mann-Kendall/Sen's Slope trend test.
   - BCWMC water level monitoring program meets track changes goal. Although BCWMC has not previously statistically analyzed lake level data, it would be possible to perform a Mann-Kendall/Sen's Slope trend test on the annual average data; the lack of analysis could be considered a gap. The BCWMC water level monitoring data is not regularly graphed/shared with the BCWMC or the public; this is a gap. The BCWMC does not collect precipitation data in the watershed, but nearby stations could be used to track monthly precipitation data; this is a gap.
   - BCWMC lake water quality monitoring program meets this goal. The Mann-Kendall/Sen's Slope trend test is performed using the most recent 10 average summer total phosphorus, chlorophyll-a, and Secchi disc values during every regular monitoring season. (program follows MPCA guidelines)
   - BCWMC stream monitoring:
     - Biological/macroinvertebrate monitoring program meets this goal
     - Stream flow and water quality monitoring program: MCES tracks changes and trends for the WOMP station; BCWMC monitoring will meet this goal for the other 3 stream segments as monitoring continues

High Priority Goal: Detect issues early for proactive management

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
   - Water level monitoring program somewhat meets this goal, but monitoring is only monthly (BCWMC used to monitor twice/month during open water months); potential gap. Water level monitoring program does not include reporting monthly precipitation to show correlation; potential gap (see "track changes and trends" goal above).
   - Lake water quality monitoring program plus CAMP meets this goal (CAMP provides annual monitoring data in between BCWMC monitoring years)
   - Stream monitoring:
     - Biological/macroinvertebrate monitoring program somewhat meets this goal due to less-frequent monitoring (once every six years, BCWMC used to monitor once every three years) and nature of the data (chemical water quality monitoring better at detecting issues). The six-year gap between monitoring events could prevent early detection of issues for proactive management; this is a gap.
     - Stream flow and water quality monitoring program: MCES data for the WOMP station readily available but you need to go find it/review it; BCWMC monitoring data for the other 3 stream segments will be available as monitoring continues (data more helpful in tracking changes than in being proactive). BCWMC monitoring at each stream segment is

once every six years. The six year gap between monitoring events could prevent early detection of issues for proactive management; this is a gap.

High Priority Goal: Understanding impacts of climate change:

- ***Particularly changes related to flow***
- ***Noted need to track temperature changes***
- ***Noted need to communicate trends***

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
   - Water level monitoring program meets this goal, even though monitoring is only monthly. Do not currently communicate water levels and do not track monthly precipitation along with water levels – potential gap.
   - Lake water quality monitoring program + CAMP meets this goal (temperature is measured); reporting of temperature changes (or lack thereof) are not regularly communicated – potential gap. Trend analyses of temperature data are not performed to determine statistically significant changes in temperature – potential gap.
   - Stream monitoring:
     - Biological/macroinvertebrate monitoring program meets this goal as it is designed to understand and track biological communities which may be altered due to climate change.
     - Stream flow and water quality monitoring program: MCES data for the WOMP station includes continuous temperature and flow data, which are readily available but you need to go find it/review it. Trend analyses of temperature and flow data are not performed to determine statistically significant changes of temperature and flow; this is a potential gap. BCWMC monitoring data includes continuous temperature and flow data for the other 3 stream segments; this data will be available as monitoring continues. In the future, when sufficient BCWMC monitoring data have been collected, trend analyses of the temperature and flow data could be performed to determine statistically significant changes in temperature and flow, which could indicate climate change.

High Priority Goal: Gathering chloride data [see also the "for assessing lake and stream chloride" item under "Assess waterbodies against State standards"]:

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
2. What are the minimum monitoring requirements/standards or guidelines?
3. Does the BCWMC monitoring program meet the requirements/standards/guidelines? If not, does it exceed requirements or is there a gap and why does it differ?
   - Lake water quality monitoring program somewhat meets this goal by collecting chloride data during regular monitoring (once every 3 to 5 years in lakes). CAMP does not collect chloride data. This is a possible gap if more frequent chloride measurements are warranted.
   - Stream monitoring:
     - Stream flow and water quality monitoring program: MCES (Main Stem monitoring) meets this goal by collecting chloride samples every year they monitor; the BCWMC monitoring program somewhat meets the goal by collecting chloride data once every 6 years in other streams. This is a possible gap if more frequent chloride measurements are warranted.

High Priority Goal: Understanding effectiveness and function of stormwater ponds (sink vs. source)

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
   - This is a potential gap. The BCWMC currently does not monitor stormwater ponds and does not model effectiveness/function using the watershed-wide P8 water quality model. As part of the

2017 annual P8 model update, the BCWMC completed a pond prioritization. The pond prioritization identified the ponds that provide the most water quality treatment (most effective), the ponds that are most likely to fill with sediment, and the ponds that are most important to maintain. Through their MS4 permits, cities are required to assess the effectiveness of their stormwater ponds, so there may not be a role for BWMC in monitoring. There could be a role for the BCWMC to further evaluate high-priority ponds.

- Research underway/ongoing by University of Minnesota/St. Anthony Falls Laboratory.

High Priority Goal: Avoid duplication of monitoring efforts

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
   - BCWMC has been doing a better job of coordinating with agencies and member cities regarding monitoring efforts. BCWMC ensures no duplication of specific monitoring, collaborates with other monitoring efforts to reduce costs (TPRD collects samples on our behalf in Medicine Lake), and uses others' data, when available. There may be gaps with some citizen monitoring programs as more data may be collected than we are using or know about, such as MPCA's Citizen Stream Monitoring Program, and Hennepin County's River Watch & Wetland Health Evaluation Program monitoring)

High Priority Goal: Gather data to help residents understand aquatic ecology and chemistry conditions

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
   - For the priority waterbodies, BCWMC monitoring is comprehensive and monitoring reports are user-friendly, informative, and available online. A gap may exist for non-priority waterbodies where monitoring/reporting is lacking but residents are still interested in their conditions (such as South and North Rice Ponds).

High/Medium Priority Goal: Assessing ecological health

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
   - Due to the significant amount of biological and habitat data collected on both streams and lakes, the BCWMC monitoring program meets this goal. We can always collect more data or perform more studies but it's likely we already have the data needed to make management decisions. The one gap regarding understanding ecological health is the lack of fish data. However, the MDNR collects fish data for some water bodies.

High/Medium Priority Goal: Gather data needed to maintain pollutant loading and hydrologic/hydraulic models

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
   - The BCWMC monitoring program generally meets this goal.
   - The BCWMC P8 water quality model is updated annually with data provided by the cities regarding new BMPs or new information about existing BMPs. Stream/inflow monitoring data is used to occasionally update and calibrate the P8 model.
   - The BCWMC XP SWMM model is updated annually with data provided by the cities—new/updated information regarding watershed divides, stormwater ponds, storm sewer pipes, etc.—and with data obtained through the BCWMC plat review process. The model was calibrated at the downstream end using WOMP station data, and at the downstream end of Plymouth Creek using TRPD monitoring data; elsewhere, the model could only be verified using the lake level monitoring data. The BCWMC stream monitoring data will provide flow data that could be used in future calibration efforts.

Medium Priority Goal: Effectively target projects and programs

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
    - The BCWMC monitoring program generally meets this goal, particularly through its P8 and XP-SWWM models which can help identify pollutant hot spots and significant flooding concerns.
    - The BCWMC lake and stream water quality monitoring programs meet this goal, as the data collected helps the Commission prioritize where projects/programs are needed (e.g., water bodies with poor or deteriorating water quality or AIS).

Medium Priority Goal: Detect new AIS and assess suitability of AIS

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
    - The BCWMC monitoring program generally meets this goal.
    - The BCWMC lake water quality monitoring program meets this goal – aquatic plant monitoring program identifies AIS plants and AIS animals that are attached to the plants. The BCWMC calculates the suitability of some AIS for each lake monitored. The BCWMC zooplankton monitoring program identifies invasive zooplankters (spiny waterflea) and zebra mussel veligers (if present in the zooplankton sample). The BCWMC does not monitor specifically for most AIS animals (e.g., Chinese mystery snail, rusty crayfish, etc.), a potential gap.
    - Stream monitoring:
        - Biological/macroinvertebrate monitoring program meets this goal, as AIS plants and animals are identified, if found.
        - Stream flow and water quality monitoring program: Not applicable, as the program is limited to monitoring flow, physical, and chemical parameters. The stream monitoring locations are very close to the biological/macroinvertebrate monitoring locations. The biological/macroinvertebrate monitoring program identifies AIS plants and animals and meets this goal.

Medium Priority Goal: Analyze effects of high chlorides:

- ***For instance, at what chloride level does a lake stop mixing? U of M is studying effects of chlorides as well.***

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
    - The BCWMC lake monitoring program collects monitoring information that helps to understand if a lake is in danger of not mixing or mixing less frequently – in addition to chloride data, this information includes temperature, dissolved oxygen, and specific conductance.
    - Stream monitoring:
        - Biological/macroinvertebrate monitoring program meets this goal, as it tracks species that could be negatively affected by high chloride concentrations.
        - Stream flow and water quality monitoring program: Not applicable because monitoring is limited to flow, physical, and water chemistry (not biological) parameters.

Medium Priority Goal: Assessing effectiveness of specific BMPs including CIP projects

1. How well does current monitoring program align with/meet the TAC's goals/objectives?
    - The Commission has assessed the effectiveness of only one CIP project: the Schaper Pond Diversion Project. CIP effectiveness monitoring, like BMP monitoring is not a role the Commission has taken. Monitoring the effectiveness of specific BMPs in specific locations is more appropriate for cities than the BCWMC. However, future effectiveness monitoring of some CIP projects may be warranted and should be discussed at the time of CIP project inception. This is currently a gap.