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<th>Definition</th>
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<tr>
<td>BMP</td>
<td>Best Management Practices</td>
</tr>
<tr>
<td>BOD</td>
<td>Biochemical Oxygen Demand</td>
</tr>
<tr>
<td>BWSR</td>
<td>MN Board of Water &amp; Soil Resources</td>
</tr>
<tr>
<td>cfs</td>
<td>cubic feet per second</td>
</tr>
<tr>
<td>CFU/100 mL</td>
<td>colony forming units per 100 milliliters</td>
</tr>
<tr>
<td>Chlor-(a)</td>
<td>Chlorophyll-(a)</td>
</tr>
<tr>
<td>CREP</td>
<td>Conservation Reserve Enhancement Program</td>
</tr>
<tr>
<td>CRWD</td>
<td>Cleanwater River Watershed District</td>
</tr>
<tr>
<td>CWP</td>
<td>Clean Water Partnership</td>
</tr>
<tr>
<td>District</td>
<td>Cleanwater River Watershed District</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>lbs</td>
<td>Pounds</td>
</tr>
<tr>
<td>MDNR</td>
<td>Minnesota Department of Natural Resources</td>
</tr>
<tr>
<td>MPCA</td>
<td>Minnesota Pollution Control Agency</td>
</tr>
<tr>
<td>µg/L</td>
<td>micrograms per liter</td>
</tr>
<tr>
<td>mg/L</td>
<td>milligrams per liter</td>
</tr>
<tr>
<td>NCHF</td>
<td>North Central Hardwood Forest</td>
</tr>
<tr>
<td>Ortho-P</td>
<td>Ortho-Phosphorus</td>
</tr>
<tr>
<td>RIM</td>
<td>Reinvest in Minnesota</td>
</tr>
<tr>
<td>SOD</td>
<td>Sediment Oxygen Demand</td>
</tr>
<tr>
<td>TMDL</td>
<td>Total Maximum Daily Load</td>
</tr>
<tr>
<td>TP</td>
<td>Total Phosphorus</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solids</td>
</tr>
<tr>
<td>WMP</td>
<td>Watershed Management Plan</td>
</tr>
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</table>
Executive Summary

This report was prepared for the Clearwater River Watershed District (CRWD) to provide a progress report of Watershed Management Plan (WMP) Implementation activities in the District. The report summarizes 2017 hydrologic, hydraulic and water quality monitoring data and provides an analysis of progress towards goals in the context of the District’s watershed management activities.

In 2017, the CRWD made progress towards goals established in the Watershed Management Plan by doing the following:

- Continued to monitor water quality, hydrology, and hydraulics to track water quality trends and the effectiveness of existing management strategies. These actions help to improve efficiencies of implementation of projects.
- Moved implementation of the Nitrogen Mitigation Plan for the Clearwater Harbor, Hidden River Waste Water Treatment System forward.
- Conducted rough fish removal and migration management as necessary.
- Constructed the Watkins Area Stormwater Project.
- Continued enrollment in the alternative tile intake project and recruited project participants to reduce sediment and bacteria load in the upper watershed.
- Completed maintenance on existing projects as noted in annual project inspections.
- Continued education and outreach efforts.
- Conducted the annual strategic planning session in March to evaluate WMP implementation, performed adaptive management and identified additional needs. This includes identifying additional projects and continuing to apply for grant dollars to fund other CRWD projects.
- Continued discussions for update of the 10-year comprehensive plan.

At District’s annual planning session in March, the Board set the direction for 2018. The major tasks upcoming for the District include:

- Update the WMP (last updated in 2009).
- Implementation projects and programs towards achieving water quality goals.
- Continue monitoring, inspection and maintenance, and civic engagement programs.
- Continue to coordinate with lake associations, county and state government on AIS issues.
- Continue with implementation of the Nitrogen Mitigation Plan for the Clearwater Harbor / Hidden River waste water systems.
- Revisit lake and stream restoration and protection goals.

Significant hydrologic, hydraulic and water quality findings in this report include the following:

1. Overall, annual precipitation and runoff was slightly above the 30-year normals at monitored locations for the year in 2017. Precipitation ranged from 34.11 inches in one station at Watkins to 28.90 inches at the other Watkins station. This shows the high variation in precipitation over small areas. Runoff near the watershed outlet was below average at 5.12 inches (compared to 7.8 inches in an average year).
2. Phosphorus loads from the Clearwater River are stable to declining, but certain locations are still above water quality target loads.
3. Lake water quality is stable to improving in all CRWD lakes based on long-term trends. Water quality in both Cedar Lake and Lake Betsy- lakes directly downstream of intensive District water quality improvement activities- is stable to improving. Lake Betsy water quality has improved dramatically since implementation activities began in 2009; water quality in Cedar Lake has stabilized below the water quality goal since work began in 2007.

4. All but two district lakes (Albion and Henshaw) met the state standard for Secchi depth, a response parameter.

5. Lake Augusta, impaired for nutrients, met the water quality TP standard 6 of the past 10 years monitored (2007-2017), and the 10-year average is 42 ug/L, just shy of the 40 ug/L standard.

6. Clear Lake water quality TP continued to improve and saw a record low concentration of 71 ug/L TP, just above it 60ug/L state standard.

7. The 10-year average summer surface TP concentration in Union Lake is below the 40ug/L TP standard.

8. Clearwater Lake East documented the lowest average summer surface TP concentration on record, 15.5 ug/L.

9. IBI scoring by MPCA with District samples shows the Clearwater River downstream of the Kinston Wetland Restoration is meeting state IBI standards and may be delisted.

Information on the status of existing CRWD projects can be found by referring to the CRWD’s Annual Project Inspection Report, located online at [http://www.crwd.org/](http://www.crwd.org/).
1.0 Introduction

1.1 MISSION STATEMENT
The District’s mission is to promote, preserve and protect water resources within the boundaries of the CRWD in order to maintain property values and quality of life.

1.2 DISTRICT HISTORY
The area encompassed by the CRWD is rich in soil and water resources. The presence of those resources has encouraged the growth of two economic mainstays in this Central Minnesota territory – farming and tourism. Around these basics have grown the communities that support their needs. As population and industry grow, those priceless resources, which we often take for granted, may deteriorate.

In the 1960s and early 1970s, those who fished and enjoyed the waters of the Clearwater River Chain of Lakes began to notice a decrease in the clarity of those waters, an increase in the number of rough fish (bullheads and carp), and an increase in the growth of algae on the surface of the water. Property owners sought new tests from scientists interested in water quality. Those tests revealed that the nutrient content of the water had increased substantially since 1946 – phosphorus was coming into the Clearwater Lake at a rate almost double the rate considered damaging.

The lakes through which the Clearwater River flowed were aging much too quickly. That process, which is a natural phenomenon called "eutrophication," was being helped along at an alarming rate via pollution entering the river system from cities, farmland, private property, and industry.

Further reports concluded that the rate of phosphorus input could be reduced by as much as 50% if the cities of Watkins, Kimball, and Annandale, and the Modern Craftsmen's Milk Association of Watkins installed on-land waste treatment systems instead of discharging sewage and industrial effluents into the Clearwater River and Warner Creek. In addition, if the phosphorus input from all non-point sources (such as septic tanks, agricultural wastes, storm water runoff, and soil erosion) could be significantly reduced, water quality in the watershed could be restored to an acceptable level.

After a lengthy series of meetings and legal research, those concerned came to the conclusion that only a watershed district, with its powers of enforcement and its abilities to assess and to obtain federal and state funding, could tackle the pollution problem in the Chain of Lakes. The CRWD was the culmination of years of hard work and the beginning of many more years of work aimed at undoing some of the damage done over a long period of time to one of our most important resources – our lakes and streams.

The CRWD was established as a unit of local government on April 9, 1975, through citizen petition by order of the Minnesota Water Resources Board, acting under authority of Chapter 112, MSA (the Minnesota Watershed Act). Though the original thrust of the CRWD and its five-member Board of Managers was the improvement of water quality in the Clearwater River Chain of Lakes, its scope has grown into a complete program of water management within its boundaries.
1.3 DISTRICT INFORMATION

| Address          | 75 Elm Street East, PO BOX 481  
|                  | Annandale, MN 55302            |
| Website          | www.crwd.org                   |
| Office hours     | By appointment in office,      |
| Board meeting schedule | Regular meetings are held monthly on the 3rd Wednesday at 6:00pm at Annandale City Hall in Annandale, MN. Special meetings are called on an as-needed basis. |

1.4 MONITORING & REPORT OBJECTIVES

The Clearwater River Watershed District's (CRWD's) ongoing monitoring program—started in 1980— is critical to track long term water quality and hydrologic trends. This report summarizes data to evaluate progress towards water quality goals through program/ project implementation. This allows the CRWD to optimize costs and benefits of natural resource protection programs within the District. The 2017 monitoring plan is summarized in Appendix A, monitoring locations and impaired waters are summarized in Figure 1-1.

The objectives of the Water Quality Monitoring and Watershed Management Plan Implementation Status program are:

1. Track progress towards water quality goals for impaired waters by:
   a) Measuring water quality trends in lakes and streams and pollutant loads.
   b) Tracking programs and projects implemented.
   c) Evaluating water quality in the context of programs/ projects implemented.
2. Fill data gaps identified in the TMDLs.
3. Continue to provide baseline water quality data and calibration data sets to refine TMDL load reductions.
4. Track long-term trends in all CRWD waters monitored ensuring early detection of declining trends. Appendix B and C summarize historical loading and water quality data.
5. Provide recommendations for ongoing programs, projects and watershed management strategies based on data.
Figure 1: Impairments and water quality monitoring locations in the Clearwater River Watershed District.
2.0 2017 Financial Condition of the CRWD

<table>
<thead>
<tr>
<th>SUMMARY OF REVENUES</th>
<th>SUMMARY OF EXPENDITURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Property Taxes $250,378</td>
<td>Governance $90,331</td>
</tr>
<tr>
<td>Intergovernmental Revenue $318,491</td>
<td>Administration &amp; General $137,749</td>
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<tr>
<td>Special Assessments $405,455</td>
<td>Technical &amp; Engineering $158,046</td>
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<tr>
<td>Misc. &amp; Interest Income $13,327</td>
<td>Operation &amp; Maintenance $274,189</td>
</tr>
<tr>
<td></td>
<td>Water Quality Monitoring 34277</td>
</tr>
<tr>
<td></td>
<td>Capital Outlay 297218</td>
</tr>
</tbody>
</table>

Total Revenue $987,651  Total Expenditures $991,810

Fund Balances – January 1, 2017 $930,092
Fund Balances – December 31, 2017 $925,941

Note: The District conducts an independent audit annually; audited financial statements are available for public review at the District’s office during normal business hours, at the Annandale Public Library, and online at: http://crwd.org/audit_reports.html. The above information can be found on pages 10-11 of the audit report.

The activities of the CRWD are funded by a combination of an ad valorem tax levy (based on property values within the CRWD), special assessments, and grants. Funds raised by special assessment can only be used for the specific purpose they were levied for. The CRWD budget, corresponding levies and special assessments are approved after public notice and hearing, as dictated by statute. This public hearing is
normally held at the September regular meeting. A detailed budget is available for public review at the CRWD office.
3.0 Progress Towards Water Quality Goals | Status of CRWD Projects and Programs

The CRWD Watershed Management Plan (WMP) identifies the upper watershed (upstream of Lake Betsy) as the highest priority for implementing both capital projects and programmatic BMPs. Because of the flow-through nature of the Clearwater Chain of Lakes, water quality in upper watershed lakes like Clear Lake and Lake Betsy is the primary driver of water quality in downstream lakes like Clearwater Lake. Nutrient loads from upper watershed lakes and their tributary watersheds drive impairments in lakes further downstream. Clear Lake, Lake Betsy, and the tributary watersheds are targeted for intensive BMPs to not only improve water quality in those lakes, but to also reduce the load to downstream water bodies. All lakes will eventually be targeted, but the greatest impact will be achieved for the lowest cost by initially focusing the efforts on improvements in the upstream end of the District and working downstream.

3.1 PROCESS

The CRWD WMP is specific in its focus: implement the identified projects and programs in high priority geographical areas. The District makes annual adjustments to further focus and refine management activities. The Board and staff review this report, compare findings to the WMP, and then prioritize projects and programs. They typically select one-three projects and programs to focus on in the coming year. The annual planning is based on remaining programs and projects identified in the Plan, water quality monitoring findings as well as other opportunistic projects identified during the year. This ongoing strategic planning keeps the CRWD focused and efficient.

3.2 YEARLY SUMMARY OF PROGRESS | STATUS OF PROJECTS AND PROGRAMS

The following section summarizes year by year strategy as well as programs and projects undertaken since the plan was adopted:

2009

▲ Prioritized six projects from the overall TMDL Implementation Plan
  • City of Kimball Stormwater Retrofit
  • Lake Betsy Internal Load Management
  • Watkins treatment area
  • Targeted Fertilizer Application Project
  • Kingston Wetland Restoration
  • Clear Lake South Sand Filter/ Weir

▲ Applied for grants for each of prioritized projects, received grant for Kimball stormwater (Kimball Stormwater would eventually be broken into two phases, grant for Phase I was received in 2009).

▲ Implemented agricultural BMPs identified in the TMDL Implementation Plan in upper watershed.

▲ Conducted additional monitoring, including collection of lake bottom samples and sediment phosphorus release analysis in Clear and Betsy Lakes.

▲ Implement education program including watershed tours and outreach to lake associations, farmers and local government units.
2010
- Applied for and received Section 319 grant for Kingston Wetland Restoration and Targeted Fertilizer Application Project.
- Applied for Watkins Area Restoration Grant and Lake Betsy Internal Load, grants not funded.
- Applied for and received CCM funding for streambank restoration.
- Implemented BMPs identified in the TMDL Implementation Plan.
- Conducted additional monitoring to fill in data gaps and continue to assess internal loading in District lakes, including collection of lake bottom samples and sediment phosphorus release analysis in Augusta and Scott Lakes.
- Implement education program including watershed tours and outreach to lake associations, farmers and local government units.
- Implemented Fertilizer Field Trial Project.

2011
- Constructed Kimball Stormwater Project (now known as Phase I).
- Applied for and secured a grant for Kimball Stormwater Phase II.
- Implemented BMPs identified in the TMDL Implementation Plan.
- Applied for and received CCM funding for streambank restoration.
- Conducted supplemental water quality and hydrologic monitoring in accordance with recommendations of the implementation plan throughout the District to track progress and focus implementation efforts.
- Implement education program including watershed tours and outreach to lake associations, farmers and local government units.
- Implemented Fertilizer Field Trial Project.

2012
- Applied for and secured one grant for two projects in the Cedar Lake Subwatershed:
  - Highway 55 project
  - Swartout Wetland Project
- Completed Clear Lake South Sand Filter/Weir.
- Implemented BMPs identified in the TMDL Implementation Plan.
- Applied for and received CCM funding for streambank restoration.
- Conducted supplemental water quality and hydrologic monitoring in accordance with recommendations of the implementation plan throughout the District to monitor project performance and better focus implementation efforts.
- Implement education program including watershed tours and outreach to lake associations, farmers and local government units.
- Implemented Targeted Fertilizer Project.

2013
- Advanced implementation for priority projects:
  - Completed design of Kimball Phase II stormwater retrofit; worked to complete permitting.
  - Further developed feasibility for Betsy Lake Internal Load Management.
  - Feasibility study of Lake Augusta Internal Load management options.
  - Lake Augusta AIS Project.
- Applied for and received CCM funding for streambank restoration.
- Secured funding for 20 CCM crew hours for stream bank stabilization for 2014.
- Implemented BMPs identified in the TMDL Implementation Plan.
Conducted supplemental water quality and hydrologic monitoring in accordance with recommendations of the implementation plan throughout the District to monitor project performance and better focus implementation efforts.

Implement education program including watershed tours and outreach to lake associations, farmers and local government units.

Began Kingston Wetland Restoration Project.

Implemented Targeted Fertilizer Project.

2014

Advanced implementation for priority projects:

- Completed 90% of construction for Kimball Phase II stormwater retrofit.
- Conducted Feasibility Study Betsy Lake Internal Load Management.
- Completed design and permitting for two Cedar Lake watershed projects, construction to begin early in 2015
- Continued implementation of Targeted Fertilizer Application Program, early reports from Co-Ops indicate enrollment is approaching goals.

The Targeted Fertilizer Application Program was Awarded:

- Minnesota Association of Watershed District Program of the Year
- Environmental Initiative Natural Resources Award.

Applied for both rounds of MN Board of Water and Soil Resources’ (BWSR) Targeted Watershed Implementation Program to complete the plan implementation; CRWD was not selected for either grant.

Applied for a Clean Water Legacy (CWL) grant for the Watkins Project.

Applied for Section 319 funds for the Alternative Tile Intake Demonstration Program

Measured and recorded positive results of the Kingston Wetland Restoration Project including reduced soluble phosphorus export from the wetland and improved dissolved oxygen concentrations downstream.

Conducted supplemental water quality and hydrologic monitoring in accordance with recommendations of the implementation plan throughout the District to monitor project performance and better focus implementation efforts.

Implemented education program including watershed tours and outreach to lake associations, farmers and local government units.

2015

Received a Clean Water Legacy Grant for the Watkins project and began design and permitting.

Completed final project closeout for Kimball Phase II.

Completed construction for the Highway 55 portion of the grant-funded Cedar Lake Watershed Protection and Improvement Project.

Achieved substantial completion Swartout portion of the grant-funded Cedar Lake Watershed Protection and Improvement Project.

Awarded 319 funds for the Alternative Tile Intake Demonstration Program and began program implementation.

Continued to enroll landowners in the Targeted Fertilizer Application Program.

Reported positive results of the Kingston Wetland Restoration Project in the final report and maintained sediment forebay.

Continued to implement rough fish management (removal and migration barriers).

Implemented agricultural best management practices via existing District cost-share and/or partnering with other entities (ex SWCDs).
Conducted water quality and hydrologic monitoring in accordance with recommendations of the implementation plan throughout the District to monitor project performance and better focus implementation efforts.

Continued Aquatic Invasive Species (AIS) work with lake associations as initiated by lake associations. Actively participated with county-level AIS activities.

Implemented education program including school district outreach via partnership with Sauk River Watershed District, watershed tours and outreach to lake associations, farmers and local government units.

2016

- Continued implemented 319 funded Alternative Tile Intake Demonstration Program.
- Completed and submitted the final project report to the MN Pollution Control Agency.
- Continued to implement rough fish management (removal and migration barriers).
- Implemented agricultural best management practices via existing District cost-share and/or partnering with other entities (ex SWCDs).
- Continued annual project and program inspections and maintenance.
- Conducted water quality and hydrologic monitoring in accordance with recommendations of the implementation plan throughout the District to monitor project performance and better focus implementation efforts.
- Continued Aquatic Invasive Species (AIS) work with lake associations as initiated by lake associations. Actively participated with county-level AIS activities.
- Continued education program including school district outreach via partnership with Sauk River Watershed District, watershed tours and outreach to lake associations, farmers and local government units.

2017

- Completed construction of the Watkins stormwater management project.
- Implemented agricultural best management practices via existing District cost-share and/or partnering with other local entities.
- Conducted water quality and hydrologic monitoring in accordance with recommendations of the implementation plan throughout the District to monitor project performance and better focus implementation efforts.
- Continued Aquatic Invasive Species (AIS) work as initiated by lake associations. Actively participated with county-level AIS activities.
- Continued to implement education program including school district outreach via partnership with Sauk River Watershed District, watershed tours and outreach to lake associations, farmers and local government units.
- Inspected District projects to assess maintenance needs and function
- Conducted active maintenance on District projects including
  - Lake Augusta Erosion Control Project
  - School Section Lake Outlet
- Biological monitoring conducted at Kinston Wetland showing the Clearwater River met state IBI standards.
Table 3—1: 2017 Summary of Progress | Status of Projects and Programs

<table>
<thead>
<tr>
<th>Activity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advisory Committee</td>
<td>Per MN Statute 103D, the CRWD Board of Managers has appointed an advisory committee. More information on the committee, include meeting minutes, can be found at: <a href="http://crwd.org/advisory_committee.html">http://crwd.org/advisory_committee.html</a>.</td>
</tr>
<tr>
<td>Annual Project Inspections</td>
<td>On an annual basis, the CRWD conducts a review of the operational status of all projects the CRWD owns, operates and/or maintains on the landscape. At a minimum visual inspection of individual project’s components are performed, with more in-depth inspections performed as warranted. From this, actions items needed to maintain operational effectiveness are determined. The results of these inspections are summarized annual in a Project Inspection Report, which serves to provide an annual status update to the CRWD Board of Managers. A copy of report can be viewed at: <a href="http://crwd.org/publications_reports.html">http://crwd.org/publications_reports.html</a>. Status of projects and programs that do not physically exist on the landscape are covered below.</td>
</tr>
<tr>
<td>Aquatic Invasive Species (AIS) Treatment Programs</td>
<td>The CRWD has established four programs for the treatment of AIS in certain CRWD waters. These programs are funded by special assessments, and the lake associations on each lake undertake the management of the treatment programs via agreement with the CRWD; the CRWD acts as a fiscal agent on all projects. In addition, the CRWD actively participated with county-level AIS activities, principally by serving in an advisory role.</td>
</tr>
<tr>
<td>Bog Control Projects</td>
<td>In response to high water levels in the mid-1980s that caused severe floating bog problems on Augusta, Clearwater, and Grass Lakes, the CRWD set up two bog control projects with the cooperation of the lake property owners involved. These projects included acquisition and improvement of access areas for bog removal, and the funding (via assessment) and process for removal of floating bogs deemed harmful. The CRWD works in conjunction with the Minnesota Department of Natural Resources as well as other local authorities in removal of problematic bogs from choke points on these three lakes in order to ensure river flow is not restrict such that flooding could result. Bog removal by the CRWD is governed by CRWD Policy. Minimal bog activity was noted in 2017.</td>
</tr>
<tr>
<td>Education and Outreach Program</td>
<td>Program is a collection of activities, events, publications, etc. that fall under various projects and programs of the CRWD. Provides means to: • Inform citizens on CRWD activities • Encourage involvement and ownership of water-resource issues • Discover citizen concerns • Establish and test methods Activities completed in 2017 under this program include: • Multiple press releases, reports, and other publications. • Several CRWD advisory committee meetings. • Booth at both Annandale and Kimball Business Expos • Attendance at multiple meetings and with individuals on a variety of circumstances. • Commented on variance and permit requests from Corinna Township, Meeker County, Stearns County and Wright County.</td>
</tr>
<tr>
<td>Activity</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Partnership</td>
<td>Partnership continued with Sauk River Watershed District to extend their school-age outreach programming to schools in the CRWD.</td>
</tr>
</tbody>
</table>
| Incentive Program            | **Agricultural Incentives**  
• Inventive program focused on variable rate fertilizer application and alternative tile intake programs.  
Visit: [http://crwd.org/incentives.html](http://crwd.org/incentives.html) to learn more about these incentive offerings. |
| Partnerships                 | **Mississippi River (St. Cloud) Watershed WRAPS**  
Collaborated with partners on this project where possible. The CRWD remains committed to working with its partners on the watershed restoration and protection strategies report process. |
| Project-specific             | **Agricultural Cost-Share BMPs**  
Continued targeted implementation of agricultural cost-share best management practices (BMPs) in high priority locations identified in TMDL studies.  
• Included continuing to work on the federal Section 319-funded Alternative Tile Intake Project.  
• Implementation of Clearwater River Restoration and Protection Phase II Project (Clean Water Partnership-funded), as well as continuing recruitment of landowners in the targeted area for BMP implementation. |
|                             | **Watkins Area Stormwater Treatment Project**  
Continued design and permitting work on the Clean Water Legacy Grant project for stormwater management in and around Watkins, MN. |
| Rough Fish Management Program| The CRWD continues to implement rough fish management strategies (principally removal and migration barriers) in areas of the CRWD where management funding has been established. In addition, several test net surveys were conducted to determine if lake seining was warranted in 2016. Open water seining was conducted on Lake Louisa in fall 2016 with low rough fish pull numbers. Under ice seining on Swartout Lake was planned for early winter 2017. |
| Water quality monitoring     | Conducted water quality and hydrologic monitoring in accordance with recommendations of the WMP throughout the District to monitor project performance and better focus implementation efforts. |
### 3.3 SUMMARY OF PRIORITY PROJECTS

The CRWD has implemented several major projects to achieve water quality goals; status is shown below.

Table 3—2: Priority Implementation Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>TP Reduction (lbs/yr)</th>
<th>Expense</th>
<th>Learn more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cedar Lake Restoration (06-01 Original)</td>
<td>1,500</td>
<td>$295,000</td>
<td><a href="http://crwd.org/cash_061.html">http://crwd.org/cash_061.html</a></td>
</tr>
<tr>
<td>City of Kimball Stormwater Management (Phase I)</td>
<td>244</td>
<td>$189,550</td>
<td><a href="http://crwd.org/tmdl_willowcreek.html">http://crwd.org/tmdl_willowcreek.html</a></td>
</tr>
<tr>
<td>Clear Lake Notched Weir</td>
<td>588</td>
<td>$80,000</td>
<td><a href="http://crwd.org/clear_southnotch.html">http://crwd.org/clear_southnotch.html</a></td>
</tr>
<tr>
<td>City of Kimball Stormwater Reclamation and Reuse (Phase II)</td>
<td>1,175</td>
<td>$985,000</td>
<td><a href="http://crwd.org/tmdl_kimball-stormwater-PHI.html">http://crwd.org/tmdl_kimball-stormwater-PHI.html</a></td>
</tr>
<tr>
<td>Kingston Wetland Feasibility Study and Wetland Restoration</td>
<td>1,955</td>
<td>$589,000</td>
<td><a href="http://crwd.org/tmdl_kingston_restore.html">http://crwd.org/tmdl_kingston_restore.html</a></td>
</tr>
<tr>
<td>Conservation Corps Streambank Restoration</td>
<td>1,280</td>
<td>$583,000</td>
<td><em>TP load reduction associated with sediment load reduction</em></td>
</tr>
<tr>
<td>Cedar Lake Watershed Protection and Improvement Projects (06-01-Modified)</td>
<td></td>
<td></td>
<td><a href="http://crwd.org/cash_061_protectandimprove.html">http://crwd.org/cash_061_protectandimprove.html</a></td>
</tr>
<tr>
<td>Project</td>
<td>TP Reduction (lbs/yr)</td>
<td>Expense</td>
<td>Learn more</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-----------------------</td>
<td>-------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>GPS Fertilizer Application</td>
<td>3,200</td>
<td>$437,000</td>
<td><a href="http://crwd.org/tmdl_targetedfertilizer.html">http://crwd.org/tmdl_targetedfertilizer.html</a></td>
</tr>
<tr>
<td>Expand Education Program</td>
<td>N/A</td>
<td>N/A</td>
<td>Incorporated in grant funded scopes of work are efforts to expand the CRWD’s Education/Outreach programs. The CRWD had a strong relationship with Lake Associations and hosts educational events that primarily target adults. The education program was expanded to include social media outreach as well as school age children in the community.</td>
</tr>
</tbody>
</table>

### Projects In Progress

<table>
<thead>
<tr>
<th>Project</th>
<th>TP Reduction (lbs/yr)</th>
<th>Expense</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watkins Area Stormwater Treatment</td>
<td>796</td>
<td>$645,882</td>
<td>Land was acquired for this project in mid-2000s. An initial grant application for $351,906 scored highly but was not selected in 2009 due to amount requested. Conducted additional feasibility work and completed another grant application which was not awarded. The District received grant award in 2015 and began design and permitting. Construction is planned for mid-2017. <a href="http://crwd.org/tmdl_watkins-area-stormwater.html">http://crwd.org/tmdl_watkins-area-stormwater.html</a>.</td>
</tr>
</tbody>
</table>

### Potential Future Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Potential TP Reduction (lbs/yr)</th>
<th>Estimated Expense</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Betsy internal load management</td>
<td>1,300 – 6,500 lbs</td>
<td>$250,000-$600,000</td>
<td>A feasibility study was conducted in 2014 to support project development, alum treatment is under consideration. Watershed soluble phosphorus loads to Clear Lake are a priority and needed to meet lake water quality goals. Investigate opportunities to retrofit existing project to incorporate soluble phosphorus removal.</td>
</tr>
<tr>
<td>CD 20 project</td>
<td>TBD</td>
<td>TBD</td>
<td>CD 20 is a major source of bacteria to the Clearwater River. Investigate sources and opportunities to mitigate loads. Identify and develop projects to reduce soluble phosphorus loading in the watershed.</td>
</tr>
<tr>
<td>Watkins soluble phosphorus load reduction</td>
<td>TBD</td>
<td>TBD</td>
<td>Identify and develop projects to reduce soluble phosphorus loading.</td>
</tr>
<tr>
<td>Other soluble phosphorus load reduction</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
</tr>
</tbody>
</table>
4.0 Managers’ Plan of Work for 2018

4.1 PLAN OVERVIEW
The CRWD Board of Managers approved the following plan at their March 21th, 2018 regular meeting. The scope of this plan is limited to a high-level overview, providing a summary of work envision by the CRWD Board of Managers for the year. Throughout the year, new information and opportunities may arise; as such, implementation of the plan may be altered at any time. While focused only on 2018, the plan factors in long-term planning to ensure the District remains on task to accomplish its mission and purposes.

Many work items covered below are too complex to be completely covered in a single, all-encompassing work plan. As such, many of these items have their own stand-alone work plans.

Table 4—1: 2018 Plan Categories Summary

<table>
<thead>
<tr>
<th>Categories</th>
<th>Work Item</th>
<th>Priority Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General administration</strong></td>
<td>Make improvements to file management system</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>Make improvements to special assessment system</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>Re-estimate phosphorus removal calculations</td>
<td>Medium Priority</td>
</tr>
<tr>
<td></td>
<td>Investigate technological opportunities to improve productivity</td>
<td>Low Priority</td>
</tr>
<tr>
<td><strong>Operation &amp; maintenance</strong></td>
<td>Continue monitoring at Annandale Wetland Treatment System</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>Lake Augusta Erosion Control: finish repairs</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>Repair/ replace fish barrier at Henshaw Lake</td>
<td>Medium Priority</td>
</tr>
<tr>
<td></td>
<td>Sanitary Sewer Systems, under professional management</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>Watkins Wetland Treatment System: make decision on implementing repairs and/or restoration efforts to address soluble phosphorus</td>
<td>Medium Priority</td>
</tr>
<tr>
<td><strong>Capital improvement</strong></td>
<td>Clearwater Harbor/ Hidden River Project #18-1: secure grant funding and construct</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>Clearwater Lake AIS Project #17-2: continue proceedings</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>School Section Lake Project #17-1: complete construction, monitor outflows</td>
<td>High Priority</td>
</tr>
<tr>
<td></td>
<td>Watkins Area Stormwater Treatment Project: finish and closeout project</td>
<td>High Priority</td>
</tr>
<tr>
<td>Programming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td></td>
</tr>
<tr>
<td>Agricultural Incentive Programs: finish and closeout ATI &amp; CRR&amp;PII projects, continue District-wide incentive offerings, continue collaborations with local partners</td>
<td>High-Medium Priority</td>
<td></td>
</tr>
<tr>
<td>Aquatic Invasive Species Programs: continue fiscal agent role, continue to serve in advisory roles for county programs, assist lake associations considering District projects</td>
<td>High-Medium Priority</td>
<td></td>
</tr>
<tr>
<td>Civic Engagement Program: attend various meetings, update fact sheet, attend Expos, make press releases, continue social media and school-age educational outreach, consider additional CE programming</td>
<td>High-Medium Priority</td>
<td></td>
</tr>
<tr>
<td>Floating Bog Control Programs: continue to remove problem floating bogs as needed</td>
<td>High Priority</td>
<td></td>
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<tr>
<td>Inspection Program: perform inspections of CRWD infrastructure and issue report</td>
<td>High Priority</td>
<td></td>
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<tr>
<td>Residential/Commercial Incentive Programs: continue District-wide incentive offerings</td>
<td>Medium Priority</td>
<td></td>
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<tr>
<td>Rough Fish Management Programs: consider repairs/ modifications to existing migration barriers (as-needed), operate temporary trap at Segner Pond inlet, operate trap at State Hwy 55, investigate seining from Betsy and Scott Lakes</td>
<td>High-Medium Priority</td>
<td></td>
</tr>
<tr>
<td>Vegetation Management Program: perform management at multiple CRWD sites, control woody and noxious species at sewer and wetland treatment projects</td>
<td>High Priority</td>
<td></td>
</tr>
<tr>
<td>Water Quality Monitoring Program: Refer to 2018 WQM Proposal</td>
<td>High Priority</td>
<td></td>
</tr>
</tbody>
</table>

| Potential Opportunities | 
|---|---|
| Clear Lake North Subwatershed: partner with Clear Lake Property Owners to conduct monitoring study | Medium Priority |
| Lakes Louisa and Marie Internal Load Mgmt: make investments to gather data; develop and implement an internal load mgmt. plan and secure grant funding | Medium Priority |
| Fairhaven Creek: implement a monitoring study to help determine issues in Subwatershed, seeking grant funding to help improve conditions | Medium Priority |
| Theil Creek: implement a monitoring study to help determine issues in Subwatershed, seeking grant funding to help improve conditions | Medium Priority |
| CREP & RIM Opportunities: Work with local SWCDs to implement CREP & RIM in strategic locations within the CRWD | Medium Priority |
| Norton Ave Erosion Control: Partner with Wright SWCD to complete this effort | High Priority |
### 4.2 PLAN DETAILS

#### Table 4 - 2: 2018 Detailed Plan of Work

<table>
<thead>
<tr>
<th>Work Category</th>
<th>WMP Goal</th>
<th>Title</th>
<th>Summary</th>
<th>Plans</th>
<th>Priority</th>
</tr>
</thead>
</table>
| Other         | General Coordination | Improve file management system | Ongoing improvements are being made to increase productivity | • Make improvements to CRWD’s file management system to implement new record retention schedule and provide secure, off-site storage for disaster recovery  
• Consider investing in a software solution in the future | High |
| Other         | General Coordination | Improve special assessment system | Ongoing improvements are being made to increase productivity | • Working with the counties, develop better procedures to reduce time spent managing special assessment files and increase productivity  
• Working with Banyon, develop procedures to routinely update the assessment tracking program | Medium |
| Capital Improvement | Maintain Biologic Integrity | Clearwater Lake AIS Project #17-2 establishment | A new AIS project was instituted by petition in 2017. | • Complete proceedings. | High |
| Capital Improvement | Other | School Section Lake Project #17-1 | Newly re-established project, currently in construction phase | • Complete construction.  
• Move into operation & maintenance phase. | High |
| Capital Improvement | Reduce Watershed Loads | Clearwater Harbor - Hidden River Project #18-1 | The MN Pollution Control Agency, as part of its operating permit for these two sewer systems, has mandated a nitrogen mitigation and analysis plan (NMAP) be implemented by permit expiration in 2019. | • Order improvement.  
• Secure grant funding.  
• Construct project. | High |
| Monitoring & Research | Reduce Watershed Loads | Annandale Wetland Treatment System - Maintenance/ Restoration | Sampling was conducted in 2017 to quantify nutrient treatment taking place in the wetland and provide direction on maintenance/ restoration needs. | • Continue monitoring program in 2018. See memo from Wenck Associates, Inc. | High |
| Monitoring & Research | Reduce Watershed Loads | Clear Lake North subwatershed - soluble phos abatement | Funding opportunity to better quantify nutrient loading through the Clear Lake North Wetland complex. Previous work by CRWD noted this area high in soluble phosphorus export. | • Perform monitoring study to better quantify nutrient loading sources and rates.  
• Present results of study and begin working on potential abatement actions. | High |
<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Project</th>
<th>Status</th>
<th>Details</th>
<th>Priority</th>
</tr>
</thead>
</table>
| **Operation & Maintenance**      | Reduce Watershed Loads        | Lake Augusta Erosion Control Maintenance | Ordered by CRWD Board in 2017; work is to be completed in 2018.        | • Contractor completes site stabilization.  
• Sedimentation in southern inlet culvert is addressed.  
• Remove trees within basin fencing  
• Thin canopy in certain portions of western gully  
• Engineer updates Project’s annual nutrient removal calculation.                                                                                                                                | High     |
| **Capital Improvement**          | Reduce Watershed Loads        | Watkins Area Stormwater Project      | Major construction completed, finish remaining construction items and begin first full year of operation | • First year operations: address issues as they arise  
• Carry out site’s water quality monitoring plan                                                                                                                                                    | High     |
| **Other**                        | Reduce Watershed Loads        | Watkins Wetland Treatment System - Maintenance/Restoration | Previous project inspections have noted this project needs channel and berm maintenance. In addition, monitoring has indicated this wetland is likely a soluble phosphorus source. | • Decide whether to direct engineer to undertake study on potentially retrofitting the system.  
• Implement recommendations.                                                                                                                                                                  | High     |
| **Operation & Maintenance**      | Reduce Internal Loads         | Replace Henshaw Lake Fish Barrier    | Current barrier is not functioning well. Requires frequent cleaning.  | • Replace with new design. Work with township on replacement.                                                                                                                                      | High     |
| **Programming**                  | Reduce Internal Loads         | Ongoing rough fish management        | Fish seining has been performed on multiple lakes in the CRWD to improve lake ecology and maintain water quality. Multiple fish traps and migration barriers have been installed in the CRWD to improve management. | • Maintain existing fish migration barriers.  
• Trap & sein from lakes/ streams as deemed necessary. State Highway 55 fish trap will not be operated in 2018.  
• Consider add’l investments to improve management efforts.                                                                                                                                       | High     |
| **Programming**                  | Environmental Education       | Events: Business Expos, field days, watershed tours | Part of programming to create & increase public awareness, develop ownership & buy-in among citizens in water quality improvement efforts, provide useful information & encourage decision makers and improve adoption of conservation on the landscape. | • Host booth at Annandale Business Expo.  
• Host booth at Kimball Business Expo.  
• Work with LGU partners to implement field days.  
• Host tour in 2018.                                                                                                                                                                              | Medium   |
| Programming | Environmental Education | Website & social media | Part of programming to create & increase public awareness, develop ownership & buy-in among citizens in water quality improvement efforts, provide useful information & encourage decision makers and improve adoption of conservation on the landscape. | • Continue to maintain website, make social media postings as time allows.  
• Consider website update this year or next. | High |
| Programming | Environmental Education | Traditional: Brochures, press releases, flyers | Part of programming to create & increase public awareness, develop ownership & buy-in among citizens in water quality improvement efforts, provide useful information & encourage decision makers and improve adoption of conservation on the landscape. | • Minimum two-page brochure annually  
• Press release summer and winter 2018. | Medium |
| Programming | Environmental Education | Outreach to public officials and stakeholders | Part of programming to create & increase public awareness, develop ownership & buy-in among citizens in water quality improvement efforts, provide useful information & encourage decision makers and improve adoption of conservation on the landscape. | • As able, attend meetings (ex. lake associations) to discuss watershed issues. | Medium |
| Programming | Environmental Education | School-age education outreach | A few years ago, the CRWD made a significant investment in outreach to school-age children by partnering with the Sauk River Watershed District. | • Continue to provide adequate funding to continue this partnership. | High |
| Programming | Environmental Education | Review LGU land-use decisions | Most LGUs publish notices when they consider undertaking a land use change that is different from their ordinance/ rules structure. This provides an opportunity for the CRWD to provide comments/ suggestions on said changes from a water resource perspective. | • As able, review notices from LGUs on proposed land use changes and provide feedback from a water resource perspective.  
• As able, review changes/ updates to LGU rules, ordinances and plans and provide feedback from a water resource perspective. | Low |
| Programming | Environmental Education | CE 2.0 | Make new investments to help improve CRWD storytelling | • Take high-quality videos of CRWD projects and activities.  
• Develop interactive story maps/ story boards to deploy online. | High |
<table>
<thead>
<tr>
<th>Other</th>
<th>Performance Monitoring</th>
<th>Nutrient removal calculations</th>
<th>Several legacy projects (ex. Annandale Wetland Treatment System, Lake Augusta Erosion Control) were originally calculated to contribute a significant nutrient load reduction. It has been some time since those projects were analyzed to determine whether those calculations remain accurate. These figures are used to help determine ongoing project usefulness.</th>
<th>• As able, re-estimate phosphorus removal calculations for legacy projects (ex. Annandale Wetland Treatment System). Either a schedule should be developed, or this should be done as maintenance/restorations are completed.</th>
<th>Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Improvement</td>
<td>Reduce Internal Loads</td>
<td>Evaluate Louisa and Marie Lakes for internal load reduction effort</td>
<td>Modeling update in 2017 indicated these lakes were a high priority for internal load management due to the seasonal affect on water quality</td>
<td>• Consider performing an alum dosing study • Consider grant application to perform treatment</td>
<td>Medium</td>
</tr>
<tr>
<td>Monitoring &amp; Research</td>
<td>Performance Monitoring</td>
<td>Annual Water Quality Monitoring Program</td>
<td>Program to collect water quality data (primarily chemistry and hydrology) to establish trends, assist with setting goals, determine projects, practices, and programs to implement and evaluate effectiveness of completed projects, practices and programs.</td>
<td>• Refer to individual work plan</td>
<td>High</td>
</tr>
<tr>
<td>Operation &amp; Maintenance</td>
<td>Performance Monitoring</td>
<td>Annual Project Inspection Program</td>
<td>The CRWD has implemented an annual inspection program of its existing infrastructure as part of its commitment to ensuring all projects are operationally effective.</td>
<td>• Perform visual inspections of each CRWD infrastructure during the months of April - June. • Summarize inspections in a report to the CRWD Board by July. Prioritization of necessary repairs/modifications follows.</td>
<td>High</td>
</tr>
<tr>
<td>Monitoring &amp; Research</td>
<td>Performance Monitoring</td>
<td>Field testing data collection application</td>
<td>Software application to assist with water quality monitoring in the field.</td>
<td>• Complete field testing.</td>
<td>Medium</td>
</tr>
<tr>
<td>Monitoring &amp; Research</td>
<td>Other</td>
<td>Fairhaven Creek monitoring study</td>
<td></td>
<td>• Implement a monitoring study to help determine issues in Subwatershed; seek grant funding to help improve conditions.</td>
<td>Medium</td>
</tr>
<tr>
<td>Monitoring &amp; Research</td>
<td>Other</td>
<td>Theil Creek monitoring study</td>
<td></td>
<td>• Implement a monitoring study to help determine issues in Subwatershed; seek grant funding to help improve conditions.</td>
<td>Medium</td>
</tr>
<tr>
<td>Operation &amp; Maintenance</td>
<td>Reduce Watershed Loads</td>
<td>Maintain sanitary sewer systems</td>
<td>The CRWD owns and operates four communal wastewater treatment systems</td>
<td>• Continue to operate and maintain said systems via professional management contract and set maintenance schedules.</td>
<td>High</td>
</tr>
</tbody>
</table>
| Operation & Maintenance | Maintain Biologic Integrity | Vegetation Management Program | Several CRWD projects require various levels of vegetation management to maintaining native plantings and control invasive and noxious species. | • Seek quotes for management services at select CRWD projects.  
• Control woody vegetation and noxious species at three sewer systems treatment areas.  
• Control woody vegetation and noxious species at the three wetland treatment systems and the isolation unit. | High |
|-------------------------|-----------------------------|-------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|---------------------|
| Programming             | Maintain Biologic Integrity | Existing CRWD AIS Projects    | The CRWD is addressing AIS in three ways: 1) acting as a fiscal agent via establishment of projects to control existing and new AIS infestations on lakes where residents have petitioned for projects, 2) serve in advisory roles on county-established AIS committees and task forces and 3) encourage local groups & governments, along with state groups & governments, in their efforts to address; provide support as needed/as able. | • Continue fiscal agent role.  
• Consider amending projects, instituting projects based on resident efforts.  
• Continue to advise county AIS programs | High |
| Programming             | Other                       | Bog Control Projects          | Instituted in the 1980s to control floating bogs that could potentially cause flooding problems by blocking flow at key choke points, namely the Grass Lake Dam, the channel between Grass and Clearwater Lake and the channel between Augusta and Clearwater Lake. Can also remove problem floating bogs below Grass Lake Dam if deemed necessary. | • As needed, remove floating bogs that threaten to block flow at noted points. | High |
| Operation & Maintenance | Other | Pleasant Lake Outlet Control Project | Instituted in the 1980s to provide flood control assistance. | • Complete small repairs.  
• Operate as needed. | High |
|-------------------------|-------|-------------------------------------|-------------------------------------------------|---------------------------------|------|
| Programming             | Reduce Watershed Loads | Ag Incentive Programs | The CRWD has a history of leading, partnering and encouraging installation and adoption of practices on agricultural lands to address nutrient exportation to water resources. Today the CRWD has multiple efforts underway to continue this effort. | • Continue to develop partnerships with locals SWCDs to accelerate practice adoption in priority subwatersheds.  
• Continue district-wide incentive offering, focusing on leveraging existing offerings from outside groups (ex. RIM/ CREP/ CRP, state cost-share, EQUIP) for implementation in prioritized areas. | Medium |
| Programming             | Reduce Watershed Loads | Alternative Tile Intake | These two grant projects were undertaken to better prioritize areas in need of practices to reduce nutrient exportation in the watershed, and to implement practices. The grants expire mid-2018. | • Finish design work at MC Road 17 & Kingston St.  
• Finish installation of practices at remaining sites on docket.  
• Complete final project reporting.  
• Implement civic engagement efforts per grant work plans. | High |
| Programming             | Reduce Watershed Loads | Non-ag incentive | The CRWD has a history of leading, partnering and encouraging installation & adoption of practices in areas where residential/ commercial development results in stormwater runoff or causes impacts to receiving waters. These efforts continue today. | • Continue district-wide incentive offering, focusing on leveraging existing offerings from outside groups for implementation in prioritized areas. | Medium |
| Other                   | Reduce Watershed Loads | Norton Ave Erosion Control | Wright County SWCD is in the process of providing additional practices to slow water flow and protect the downstream gully from further erosion. The CRWD may assist in this effort. | • Provide cost-share assistance to implement project. | High |
Clearwater River Watershed District

2017 Annual Report

Appendix A: 2017 Monitoring Program
OFFICE MEMORANDUM

TO: BOARD OF MANAGERS
FROM: ADMINISTRATOR LOEWEN
DATE: 03/06/2017
SUBJECT: PROPOSED 2017 WATER QUALITY MONITORING PROGRAM APPROVED BY BOM 03-15-2017

Introduction
The Clearwater River Watershed District has conducted an annual water quality monitoring program at select locations throughout the watershed since 1981 in an effort to assess District progress towards water quality goals, track long-term water quality trends, and evaluate effectiveness of existing water quality improvement projects and programs. The proposed 2017 program is intended to continue this effort.

The water quality monitoring program is divided into three categories: data MAR (management, analysis, reporting), baseline monitoring of lake and stream and supplemental monitoring. The 2017 proposed monitoring stations are shown in Figure 1. Tables 1-4 provide detail on the proposed baseline monitoring. Table 5 is a proposed baseline monitoring schedule. The proposed budget for both baseline and supplemental monitoring is shown in Tables 6-7.

Data Management, Analysis and Report
Data drives decisions, and the 2017 water quality monitoring program is designed to provide high-quality data to assist the CRWD in its work. The objectives of the monitoring program are:

1. Track progress towards water quality goals for impaired waters by:
   b. Evaluating water quality in the context of programs/ projects implemented.
2. Fill data gaps identified in the TMDLs
3. Continue to provide baseline water quality data and calibration data sets to refine TMDL load reductions
4. Track long-term trends in all CRWD waters monitored ensuring early detection of declining trends
5. Provide recommendations for ongoing and new programs and projects.

The hydrologic, hydraulic and water quality monitoring data (field and laboratory) collected under this proposal will be evaluated to determine progress towards water quality goals. Data will also be uploaded in the MPCA’s online database (i.e. EQuIS). The CRWD will publish results annually.

Baseline Monitoring: Lakes
The recommended 2017 lake monitoring includes the 12 lakes shown in Table 1.

- All lakes will be monitored once per month from June – September (i.e. typical growing season). All lakes will have temperature and dissolved oxygen profiles taken, as well as secchi disk readings. All
lakes will have surface samples taken for laboratory analysis for the following parameters: chlorophyll-A, ortho-phosphorus and total phosphorus.
  - Lake Betsy will also have bottom samples taken for laboratory analysis for the following parameters: ortho-phosphorus, total phosphorus and total iron.
- As shown in table 2, Swartout Lake is scheduled to have lake sediment core surveys taken as part of efforts to better ascertain the effect water quality improvement efforts have had on the lake, as well as to better quantify internal loading for the waterbody.
- As shown in table 3, 2 lakes are scheduled to have aquatic vegetation surveys and/or fisheries surveys completed in late summer (likely August) to track the vegetation and fish communities in each lake. The lakes would also be mapped using sonar equipment during the survey to provide vegetation biovolume data. This information is used to track overall lake ecological health, water quality trends, and inform management decisions.
Table 1: Baseline lake monitoring for CRWD lakes

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</thead>
<tbody>
<tr>
<td>Clearwater:</td>
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<td></td>
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<tr>
<td>East Basin</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>West Basin</td>
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<td>Main Stem:</td>
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<tr>
<td>Augusta</td>
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<td>Marie</td>
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<tr>
<td>Louisa</td>
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<td>X</td>
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Notes:  Project #06-1; @ Chain of Lakes (1980) Project, #Monitored from Nordell Bridge, +Every three year rotation
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Notes:  Project #06-1; @ Chain of Lakes (1980) Project, # sediment surveys completed in 2006
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**Notes:** Project #06-1; @ Chain of Lakes (1980) Project, V stands for point-intercept vegetation survey, F stands for standard fisheries survey, * denotes outside entity completed (ex. MNDNR), ** denotes fish IBI assessment and/or targeted survey was performed by MNDNR +Every five year rotation | Vegetation surveys do not include AIS-only surveys
Baseline monitoring: Streams
The recommended 2017 stream monitoring includes the 10 streams shown in Table 4.

- All streams will be monitored once per month from ice-out (~March-April) to October (unless otherwise noted). All streams will have temperature, dissolved oxygen (DO), pH, specific conductance and flow measurements taken. All streams will have samples taken for laboratory analysis for the following parameters: ortho-phosphorus, total phosphorus and total suspended solids.
  - The MPCA is willing to deploy a continuous dissolved oxygen (DO) meter for a three week window at CR28.2. The data collected from this deployment will be useful in determining how DO concentrations are responding to work undertaken at the Kingston Wetland Project. To complement this deployment, supplemental 3 recommends taking an additional monthly DO reading at CR28.2 before 8:00am in conjunction with the planned stream monitoring noted above.
  - E-coli monitoring at CR29.0 will be dropped for this year, to be reactivated in 2018.
- For 2017, a station will be established and active at the to-be-constructed Watkins Area Stormwater Treatment Project once completed to better quantify project effectiveness. This station will have an additional sample taken to try to quantify the effectiveness of the project. As such, station CO 20-2.0 will be dropped from the monitoring program, as it is no longer deemed necessary.
- Additional sampling will continue at the outlet pipe of the East Swartout component (station SSW02) to ascertain project effectiveness.
- Macro-invertebrate sampling will be conducted at CR28.2 to better ascertain the effectiveness of the Kingston Wetland Project, as well as overall stream health. This sampling is planned to be conducted every two years for the foreseeable future.
- Continuous water level monitoring will be recorded using pressure transducers at stations CR29.0, CR28.2, Fairhaven Dam (FHD), CR10.5 and the station at the Watkins Area Stormwater Treatment Project.
  - If supplemental 1 is approved, a pressure transducer would also be deployed at CD 20-1.0.
  - If supplemental 2 is approved, station SSW04 would also have a transducer deployed.
Table 4: Baseline stream monitoring for CRWD streams

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</table>

| No. streams monitored by CRWD | 7 | 9 | 10 | 9 | 13 | 15 | 15 | 15 | 10 | 10 | 12 | 12 | 10 |
| Notes: ^ Project #06-1, @ Chain of Lakes (1980) Project, # general fund supported, * multiple samples taken to test project effectiveness, + three-year rotation |
Supplemental Monitoring

In addition to the categories listed above, several supplemental monitoring efforts are offered for consideration in 2017. These efforts would allow the CRWD to track the success of individual projects or to investigate specific water quality concerns.

**APPROVED** Supplemental Monitoring Task 1: Pressure Transducer Purchase- deployed at CD20-1.0
The placement of a pressure transducer at CD20-1.0 will help the CRWD in determining the effect of said wetland on water quality. Purchase of pressure transducer with installation components is ~$1,500.00. Set up, installation, and operation is estimated at 4 hours of staff time.

**APPROVED** Supplemental Monitoring Task 2: Pressure Transducer Purchase- deployed at SSW04
The placement of a pressure transducer at SSW04 will help the CRWD in tracking water quality in the Cedar Lake Subwatershed, as well as the effectiveness of the recently-completed Cedar Lake Watershed P&I Project. Purchase of pressure transducer with installation components is ~$1,500.00. Set up, installation, and operation is estimated at 4 hours of staff time.

**APPROVED** Supplemental Monitoring Task 3: Additional DO readings at CR28.2
To better quantify DO levels in this impaired section of the Clearwater River, the MPCA is willing to deploy a continuous dissolved oxygen (DO) meter for a three week window at this site. The data collected from this deployment will be useful in determining whether this section of the Clearwater River is now meeting standards for DO. To complement this deployment, this supplemental recommends taking an additional monthly DO reading from this site before 8:00am from ice-out to October. Staff time to complete this additional monitoring is estimated at 2 hours.

**APPROVED** Supplemental Monitoring Task 4: Additional precipitation monitors
It is recommended the CRWD add 1-2 additional precipitation monitors to the existing four sites in order to better quantify the effect precipitation has on runoff in the CRWD. An additional $20 per month per monitor plus ~3 hours of staff time to locate willing monitors and provide training materials are the costs to implement this supplemental.

**APPROVED** Supplemental Monitoring Task 5: High-level flow gauging at CR 28.2 and CR 29.0
It is recommended the CRWD rent equipment to better calibrate the existing flow rating curves at CR28.2 and CR29.0 in order to better quantify pollutant loading. Current curves are not well-calibrated for high flows at these sites, as staff is unable to monitoring high flows due to equipment limitations. Equipment rental and staff time is estimated to be ~$1,000 for 2017.

For CR10.5, the MPCA will be solicited to run their special-purpose remote control boat to measure high flows.
Table 5: Baseline 2017 Monitoring Schedule

<table>
<thead>
<tr>
<th>Category</th>
<th>2017 Schedule</th>
<th>Station</th>
<th>Parameters</th>
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<tr>
<td></td>
<td>Once in August</td>
<td>*Late July- early August surveys on Lakes Betsy and Clear (Chain of Lakes O&amp;M Fund)</td>
<td>*Point-source vegetation surveys</td>
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<tr>
<td></td>
<td>Once Winter 2017-18</td>
<td>*Swartout Lake (Project #06-1 O&amp;M fund)</td>
<td>*Lake sediment survey</td>
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<tr>
<td>Streams:</td>
<td>Monthly March-October Note: additional samples taken at SSW04 and Watkins Stormwater</td>
<td>*CLN, CLS, CR 10.5, WR0.2 (General Fund) *CD 20-1.0, CR 28.2 &amp; CR 29.0 (Chain of Lakes O&amp;M Fund) *Watkins Stormwater Site (Watkins Stormwater Capital Fund) *SSW02 &amp; SSW04 (Project #06-1 O&amp;M)</td>
<td>Field: DO, temperature, conductivity, pH Lab: total phosphorus, ortho phosphorus, TSS</td>
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<tr>
<td></td>
<td>Once in August</td>
<td>CR28.2 (Chain of Lakes O&amp;M Fund)</td>
<td>*Macro-invertebrate sampling conducted by outside vendor w/ CRWD staff assistance as needed</td>
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<td></td>
<td>Continuous: March-October</td>
<td>*CR 10.5 &amp; FHD (General Fund) *CR 28.2 &amp; CR 29.0 (Chain of Lakes O&amp;M Fund) *Watkins Stormwater (Watkins Stormwater Capital Fund)</td>
<td>Place pressure transducers after ice-out, check throughout year, pull in October</td>
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<tr>
<td>Precipitation:</td>
<td>Daily</td>
<td>Corinna, Kimball, Watkins</td>
<td>Rain gauge stations (4)</td>
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Note: any approved supplements are added to the schedule at field staff’s discretion.
Table 6: Proposed 2017 Water Quality Monitoring Cost Sheet, per category and funding source

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<tr>
<th>Funding Source</th>
<th>Estimated Field Staff Costs ($32.50/hr.)</th>
<th>Laboratory Costs</th>
<th>Other Costs</th>
<th>Total Costs</th>
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Notes: Mileage to and from sampling site, or delivering samples to lab and/or shipper are not included.
Table 7: Proposed 2017 Water Quality Monitoring Budget, per funding source

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<th>Funding Source</th>
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<td><strong>TOTAL</strong></td>
<td>$45,925.20</td>
<td>$43,020.00</td>
<td>$(2,905.20)</td>
</tr>
<tr>
<td><strong>Supplemental Monitoring Only</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General [100]</td>
<td>$577.50</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Data Acquisition Fund [205]</td>
<td>$4,260.00</td>
<td>$5,920.00</td>
<td>$1,660.00</td>
</tr>
<tr>
<td>Chain of Lakes [210]</td>
<td>$65.00</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$4,902.50</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Both Baseline and Supplemental Monitoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General [100]</td>
<td>$20,387.90</td>
<td>$24,350.00</td>
<td>$3,962.10</td>
</tr>
<tr>
<td>Data Acquisition Fund [205]</td>
<td>$4,260.00</td>
<td>$5,920.00</td>
<td>$1,660.00</td>
</tr>
<tr>
<td>Chain of Lakes [210]</td>
<td>$14,034.80</td>
<td>$8,670.00</td>
<td>$(5,364.80)</td>
</tr>
<tr>
<td>Project #06-1 [215]</td>
<td>$11,022.80</td>
<td>$6,000.00</td>
<td>$(5,022.80)</td>
</tr>
<tr>
<td>Watkins Stormwater [406]</td>
<td>$1,122.20</td>
<td>$4,000.00</td>
<td>$2,877.80</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$50,827.70</td>
<td>$48,940.00</td>
<td>$(1,887.70)</td>
</tr>
<tr>
<td><strong>5% contingency (baseline only)</strong></td>
<td>$2,296.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
<td>$53,123.96</td>
<td></td>
<td>$(4,743.61)</td>
</tr>
</tbody>
</table>

Note: Previous years instituted Water Quality Monitoring Program proposals are:
2016: $56,329.73
2015: $47,604.15
2014: $47,050.00
2013: $38,626.00
2012: $47,714.00
2011: $53,706.00
METHODS FOR DETERMINING VEGETATION & FISH HEALTH

Overview

Biodiversity is important in maintaining a healthy lake ecosystem. Biodiversity is considered to be a principle driver of ecosystem function and critical to ecosystem resilience and stability. A diverse ecosystem provides a number of services such as nutrient recycling, improved water quality, and increased recreational opportunities. Human disturbances often lead to a decrease in species diversity resulting in a weakening and/or loss of support to the ecosystem services provided by healthy biotic community.

The development of health assessment indices have provided a means in which natural resources managers can evaluate and monitor the health of a lake's biological community to help focus restoration and preservation efforts. The species that make up a community vary in their tolerance to human disturbances, therefore, as the episodic and cumulative disturbances occur to a system a decrease in species richness and a shift to species that are very tolerant to disturbance. Assessment tools developed by the MnDNR use these tolerance differences to relate the relative health of a given lake. Specifically, different sets of tools have been developed to relate the health of the fish community (Fish IBI) and another set of tools for the vegetation community (FQI).

Floristic Quality Index

The Floristic Quality Index (FQI) is a vegetation health assessment tool that is based on a metric of species richness and a Coefficient of Conservatism (C), which is a score (0-10) that relates a species site fidelity and tolerance to disturbance. Thus, species that have narrow habitat ranges and/or low tolerance to stress have high C-values. Therefore, the more species observed in a lake and the greater the C-values the greater the system health.

FQI assessment was designed to allow for health assessment from various community sampling techniques. Three different survey methods can be used: Minnesota Biological Survey methods, MnDNR transects or point intercept surveys (most common). All three methods have limitations yet all are relatively good at capturing and evaluating the health of the vegetation community.

Due to natural differences in species composition between deep and shallow lakes and ecoregions, two unique sets of thresholds were developed for FQI scoring for the North Central Hardwoods ecoregion (Table 1). The MnDNR has performed at least one survey and FQI assessment on all of the CRWD lakes presented in this appendix. Each lake report card shows the most recent FQI score for each lake and how it relates to the impairment thresholds presented in Table 1. It should be pointed out that the report cards only show FQI assessments conducted by the MnDNR, and therefore do not include any FQI assessments based on surveys performed by CRWD or other parties.

Table 1: Minnesota Department of Natural Resources North Central Hardwoods ecoregion point intercept and transect sampling FQI impairment thresholds for deep and shallow lakes.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Deep</th>
<th>Shallow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceptional</td>
<td>32.4</td>
<td>26.0</td>
</tr>
<tr>
<td>Impaired</td>
<td>18.6</td>
<td>17.7</td>
</tr>
</tbody>
</table>

Fish Index of Biotic Integrity

The Fish IBI is comprised of multiple metrics that integrate aspects of species richness, community assemblage, and trophic composition. The combining of all individual metrics results in a single score that relates the relative health of the fish community with healthier systems having greater overall scores. Low scores are typically associated to imbalanced communities filled with tolerant species and high scores are typically received when communities are balanced and filled with intolerant species.

Fish IBI sampling includes trap and gill net surveys along with nearshore backpack electrofishing and beach seining. Together these various sampling gears are able to capture information from various habitats throughout a lake and also target all fish species.

Minnesota lakes that fall within lake classes 20 - 43 (Schupp lake classification) have been partitioned into four distinct Fish IBIs. Lake class groups are clustered together using eight lake attributes that account for the expected variability of a fish community due natural phenomenon (Table 2).

Table 2: Minnesota Department of Natural Resources fish IBI tool classification.

<table>
<thead>
<tr>
<th>IBI Tool</th>
<th>Schupp's Lake Class</th>
<th>Lake Classification Group Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>22, 23, 24, 25, 27</td>
<td>Generally, deep lakes with high shoreline complexity (SDI) that are typically less than 80% littoral.</td>
</tr>
<tr>
<td>4</td>
<td>28, 29, 30, 31, 32</td>
<td>Compared to LCG 2 these lakes on average are smaller, have intermediate littoral area, have less shoreline complexity (typically rounder basins). They also typically have a low trophic status, low phosphorus levels, and clearer water compared to LCG2.</td>
</tr>
<tr>
<td>5</td>
<td>33, 34, 35, 36, 37, 39</td>
<td>Central and Northern MN lakes of shallow to moderate depths (mostly littoral). Generally, naturally eutrophic lakes with lots of vegetation and soft sediment.</td>
</tr>
<tr>
<td>7</td>
<td>38, 41, 42, 43</td>
<td>Shallowest lakes typically consisting of &gt; 80% littoral area. Primarily in the southern half of the state. Excludes winterkill lakes (w/in 10 years) and riverine lakes.</td>
</tr>
</tbody>
</table>

Due to these expected differences and unique IBIs each tool has its own set of thresholds to generalize the relative health of a lake’s fish community (Table 3).

Table 3: Minnesota Department of Natural Resources impairment thresholds for fish IBI tools.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Tool 2</th>
<th>Tool 4</th>
<th>Tool 5</th>
<th>Tool 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceptional</td>
<td>64</td>
<td>59</td>
<td>61</td>
<td>NA</td>
</tr>
<tr>
<td>Impaired</td>
<td>44</td>
<td>38</td>
<td>24</td>
<td>36</td>
</tr>
</tbody>
</table>

The MnDNR has performed Fish IBI assessments on six lakes throughout the CRWD: Cedar, Betsy, Louisa, Clearwater, School Section, and Bass. The lake report cards for each of these lakes present the Fish IBI score and how it relates to the impairment thresholds presented in Table 3.

More information on Fish IBI methodology can be found on the MnDNR’s website:
http://www.dnr.state.mn.us/waters/surfacewater_section/lake_ibi/index.html
ALBION LAKE

QUICK FACTS
- **Littoral Area**: 251 acres
- **Residence Time**: 1477 days
- **Surface Area**: 251 acres
- **Subwatershed Area**: 1,094 acres
- **Maximum Depth**: 9 feet
- **Upstream Waters**: None

- **Common Fish**: Common carp, black bullhead
- **Dominant Vegetation**: Sago pondweed
- **Invasive Species**: Curly-leaf pondweed
- **Status**: Impaired; TMDL Completed 2010

**TO DO LIST**
- Rough fish management
- AIS management
- Manage upstream loads

**Fish Health (IBI)**
- Impaired
- Supporting

*Fish IBI has not been assessed

**Vegetation Health (FQI)**
- Impaired
- Supporting
- Exceptional

*Sample date: 8/14/2015

**Sediment P Release (mg/m²/day)**
- Low
- Moderate
- High

*Sediment release rate has not been assessed
ALBION LAKE

2017 Water Quality

Phosphorus

TP (ug/L)

4/1 5/1 6/1 7/1 8/1 9/1 10/1

Historic Water Quality

TP

Growing Season Average

Shallow Lake Standard


Chlorophyll-a

Chlorophyll-a (ug/L)

Growing Season Average

Shallow Lake Standard


Secchi Depth

Secchi Depth (m)

Growing Season Average

Shallow Lake Standard

**QUICK FACTS**

- **Littoral Area**: 96 acres
- **Surface Area**: 222 acres
- **Subwatershed Area**: 796 acres
- **Maximum Depth**: 34 feet
- **Upstream Waters**: None

**Common Fish**

- Bluegill, Northern Pike, Yellow Bullhead, Largemouth Bass

**Dominant Vegetation**

- Currently obtaining vegetation info from DNR

**Invasive Species**

- Currently obtaining vegetation info from DNR

**Status**

- Not impaired

---

**TO DO LIST**

▲ Protect water quality
▲ Manage upstream loads
▲ AIS management and prevention

---

**Fish Health (IBI)**

<table>
<thead>
<tr>
<th>Score</th>
<th>Impaired</th>
<th>Supporting</th>
<th>Exceptional</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>45</td>
<td>64</td>
</tr>
</tbody>
</table>

*Sample date: 8/09/2017

**Vegetation Health (FQI)**

<table>
<thead>
<tr>
<th>Score</th>
<th>Impaired</th>
<th>Supporting</th>
<th>Exceptional</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>18.6</td>
<td>32.4</td>
</tr>
</tbody>
</table>

*Sample date: 8/10/2015

**Sediment P Release (mg/m²/day)**

<table>
<thead>
<tr>
<th>Score</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.3</td>
<td>7.5</td>
<td></td>
</tr>
</tbody>
</table>

*Sediment release rate has not been assessed
**CEedar Lake**

**Quick Facts**
- **Littoral Area**: 315 acres
- **Surface Area**: 790 acres
- **Subwatershed Area**: 9,715 acres
- **Maximum Depth**: 108 feet
- **Upstream Waters**: Swartout, Albion, Henshaw
  - **Common Fish**: Bluegill, Northern Pike, Walleye, Largemouth Bass
  - **Dominant Vegetation**: Coontail, northern water milfoil, chara
  - **Invasive Species**: Eurasian water milfoil, curly-leaf pondweed
  - **Status**: Not Impaired

**To Do List**
- AIS management
- Rough fish management in upstream lakes
- Manage upstream soluble P loads

**Fish Health (IBI)**
- Impaired
- Supporting
- Exceptional
  - 23.1
  - *Sample date: 6/14/2006*

**Vegetation Health (FQI)**
- Impaired
- Supporting
- Exceptional
  - 22.1
  - *Sample date: 8/17/2015*

**Sediment P Release (mg/m²/day)**
- Low
- Moderate
- High
  - 0
  - 3.3
  - 7.5
  - *Sediment release rate has not been assessed*
CEDAR LAKE

2017 Water Quality

![Graph of Phosphorus levels from 4/1 to 10/1 in 2017. The graph shows TP (Total Phosphorus) and ortho-P (Orthophosphate) with historical standards for comparison.]

Historic Water Quality

![Graph of TP (Total Phosphorus) from 1993 to 2017, showing growing season average and deep lake standard.]

![Graph of Chlorophyll-a levels from 4/1 to 10/1 in 2017. The graph shows chlorophyll-a with historical standards for comparison.]

![Graph of Chlorophyll-a levels from 1993 to 2017, showing growing season average and deep lake standard.]

![Graph of Secchi Depth from 4/1 to 10/1 in 2017. The graph shows Secchi depth with historical standards for comparison.]

![Graph of Secchi Depth from 1993 to 2017, showing growing season average and deep lake standard.]

Growing Season Average

Deep Lake Standard
QUICK FACTS
- Littoral Area: 441 acres
- Residence Time: 686 days
- Surface Area: 529 acres
- Subwatershed Area: 6,801 acres
- Maximum Depth: 18 feet
- Upstream Waters: None

Common Fish: Northern Pike, Black Crappie, Walleye, Bluegill

Dominant Vegetation: Coontail

Invasive Species: Eurasian water milfoil, Curly-leaf pondweed

Status: Impaired, TMDL completed in 2009

TO DO LIST
- AIS Management
- Manage rough fish
- Manage upstream soluble P loads

Fish Health (IBI)
- Impaired
- Supporting
*Fish IBI has not been assessed

Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High

*Sample date: 8/22/2017
*Sample date: 2009
CLEARWATER LAKE

QUICK FACTS
- Littoral Area: 1,596 acres
- Surface Area: 3,158 acres
- Subwatershed Area: 100,232 acres
- Maximum Depth: 73 feet
- Upstream Waters: Clearwater River, Augusta, Cedar, Otter, and Pleasant Lake
- Common Fish: Bluegill, Northern Pike, Walleye, Largemouth Bass, Yellow Bullhead
- Dominant Vegetation: Obtaining Recent Survey from DNR
- Invasive Species: Eurasian water milfoil, curly-leaf pondweed, zebra mussels
- Status: Not Impaired

TO DO LIST
▲ Protect water quality
▲ Manage upstream loads
▲ AIS management

Fish Health (IBI)
- Impaired
- Supporting
- Exceptional

Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High

*Sample date: 7/15/2008
*Sample date: 8/10/2015
*Sediment release rate has not been assessed
**QUICK FACTS**

- **Littoral Area:** 62 acres
- **Surface Area:** 71 acres
- **Subwatershed Area:** 101,508 acres
- **Maximum Depth:** 35 feet
- **Upstream Waters:** Clearwater Lake, Clearwater River, Bass Lake

**Common Fish:** Bluegill, Northern Pike, Yellow Bullhead

**Dominant Vegetation:** No Recent Survey

**Invasive Species:** Zebra Mussels

**Status:** Not Impaired

**TO DO LIST**

- Protect water quality
- Manage upstream loads
- AIS Management

**Fish Health (IBI)**

- **Impaired**
- **Supporting**
- **Exceptional**

*Fish IBI has not been assessed*

**Vegetation Health (FQI)**

- **Impaired**
- **Supporting**
- **Exceptional**

*Sample date: 8/01/2005*

**Sediment P Release (mg/m²/day)**

- **Low**
- **Moderate**
- **High**

*Sediment release rate has not been assessed*
2017 Water Quality

Phosphorus

Lake not sampled

Historic Water Quality

TP

Growing Season Average
Deep Lake Standard

Lake not sampled

Chlorophyll-a

Growing Season Average
Deep Lake Standard

Lake not sampled

Secchi Depth

Growing Season Average
Deep Lake Standard

Lake not sampled
**QUICK FACTS**

- **Littoral Area**: 271 acres
- **Residence Time**: 1,697 days
- **Surface Area**: 272 acres
- **Subwatershed Area**: 903 acres
- **Maximum Depth**: 8 feet
- **Upstream Waters**: None

**Common Fish**
- Black Bullhead, Common Carp

**Dominant Vegetation**
- Sago pondweed, Coontail, Bushy pondweed

**Invasive Species**
- Curly-leaf pondweed

**Status**
- Impaired, TMDL Completed 2010

**TO DO LIST**
- Rough fish management
- AIS management
- Internal load management study
- Manage upstream load

**Fish Health (IBI)**
- Impaired
- Supporting

*Fish IBI has not been assessed*

**Vegetation Health (FQI)**
- Impaired
- Supporting
- Exceptional

22.1

*Sample date: 8/26/2014*

**Sediment P Release (mg/m²/day)**
- Low
- Moderate
- High

*Sediment release rate has not been assessed*
HENSHPAW LAKE

2017 Water Quality

Phosphorus

TP

ortho-P

Shallow Lake Standard

Chlorophyll-a

Chlorophyll-a

Growing Season Average

Shallow Lake Standard

Secchi Depth

Secchi Depth

Growing Season Average

Shallow Lake Standard

Historic Water Quality

TP

Growing Season Average

Shallow Lake Standard

Chlorophyll-a

Growing Season Average

Shallow Lake Standard

Secchi Depth

Growing Season Average

Shallow Lake Standard
LITTLE MUD LAKE

QUICK FACTS
- **Littoral Area**: 25.1 acres
- **Residence Time**: 1299 days
- **Surface Area**: 37.4 acres
- **Subwatershed Area**: 294 acres
- **Maximum Depth**: 42 feet
- **Upstream Waters**: None

TO DO LIST
- Rough fish management
- AIS management
- Internal load management study
- Manage upstream load

**Common Fish**: No Recent Survey
**Dominant Vegetation**: Coontail
**Invasive Species**: Eurasian watermilfoil
**Status**: Not Impaired

**Fish Health (IBI)**
- Impaired
- Supporting
*Fish IBI has not been assessed*

**Vegetation Health (FQI)**
- Impaired
- Supporting
- Exceptional
*Vegetation FQI has not been assessed*

**Sediment P Release (mg/m²/day)**
- Low
- Moderate
- High
*Sediment release rate has not been assessed*
LITTLE MUD LAKE

2017 Water Quality

Phosphorus

TP (ug/L)

Lake not sampled

Historic Water Quality

TP

Growing Season Average

Deep Lake Standard

Chlorophyll-a

Chlorophyll-a (ug/L)

Lake not sampled

Secchi Depth

Secchi Depth (m)

Lake not sampled

Growing Season Average

Deep Lake Standard
LAKE AUGUSTA

QUICK FACTS
- Littoral Area: 65 acres
- Residence Time: 55 days
- Surface Area: 187 acres
- Subwatershed Area: 62,936 acres
- Maximum Depth: 82 feet
- Upstream Waters: Caroline, Louisa, Marie
- Common Fish: Bluegill, Northern Pike, Crappie, Yellow Bullhead, Common Carp
- Dominant Vegetation: No species was dominant (>50% occurrence)
- Invasive Species: Eurasian water milfoil, curly-leaf pondweed, zebra mussels
- Status: Impaired, TMDL completed in 2010

TO DO LIST
▲ Manage upstream loads
▲ AIS management

Legend
- Monitoring Locations
- Perennial Stream
- Intermittent Stream
- Subwatersheds

Fish Health (IBI)
- Impaired
- Supporting
- Exceptional
  *Sample date: 7/28/2017
  
Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional
  *Sample date: 9/06/2016

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High
  *Sample date: 2010
LAKE AUGUSTA

2017 Water Quality

Historic Water Quality

Phosphorus

TP
- ortho-P
- Deep Lake Standard

Chlorophyll-a

Chlorophyll-a
- Growing Season Average
- Deep Lake Standard

Secchi Depth

Secchi Depth
- Growing Season Average
- Deep Lake Standard

TP

Chlorophyll-a

Secchi Depth
LAKE BETSY

QUICK FACTS

- Littoral Area: 90 acres
- Residence Time: 33 days
- Surface Area: 154 acres
- Subwatershed Area: 43,789 acres
- Maximum Depth: 29 feet
- Upstream Waters: Clearwater River

Common Fish: Channel Catfish, Northern Pike, Black Crappie, Bluegill, Common Carp

Dominant Vegetation: Coontail, Curly-leaf pondweed

Invasive Species: Curly-leaf pondweed

Status: Impaired, TMDL completed in 2009

TO DO LIST

- Rough fish management
- Internal load reduction study and implementation
- Manage upstream loads
- AIS management

Legend

- Monitoring Locations
- Perennial Stream
- Intermittent Stream
- Subwatersheds

Fish Health (IBI)

- Impaired
- Supporting
- Exceptional

Vegetation Health (FQI)

- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)

- Low
- Moderate
- High

*Sample date: 7/27/2012
*Sample date: 8/22/2017
*Sample date: 2009

TO DO LIST

- Rough fish management
- Internal load reduction study and implementation
- Manage upstream loads
- AIS management

Legend

- Monitoring Locations
- Perennial Stream
- Intermittent Stream
- Subwatersheds
QUICK FACTS

- **Littoral Area**: 46 acres
- **Residence Time**: 26 days
- **Surface Area**: 135 acres
- **Subwatershed Area**: 60,132 acres
- **Maximum Depth**: 45 feet
- **Upstream Waters**: Louisa, Marie

**Common Fish**
- Black Crappie, Bluegill, Northern Pike, Largemouth Bass, Common Carp, Walleye, White Sucker

**Dominant Vegetation**
- No Recent Survey

**Invasive Species**
- Curly-leaf pondweed, Eurasian watermilfoil

**Status**
- Impaired, TMDL completed in 2010

TO DO LIST

▲ Manage upstream loads
▲ AIS management
▲ Internal load management study

**Fish Health (IBI)**

- Impaired
- Supporting
- Exceptional

*Fish IBI has not been assessed*

**Vegetation Health (FQI)**

- Impaired
- Supporting
- Exceptional

- Sample date: 6/28/2005

**Sediment P Release (mg/m²/day)**

- Low
- Moderate
- High

*Sediment release rate has not been assessed*
LAKE CAROLINE

2017 Water Quality

Historic Water Quality

**Phosphorus**
- TP
- ortho-P
- Deep Lake Standard

Lake not sampled

**Chlorophyll-a**
- Chlorophyll-a
- Deep Lake Standard

Lake not sampled

**Secchi Depth**
- Secchi Depth
- Deep Lake Standard

Lake not sampled

**TP**
- Growing Season Average
- Deep Lake Standard

**Chlorophyll-a**
- Growing Season Average
- Deep Lake Standard

**Secchi Depth**
- Growing Season Average
- Deep Lake Standard
LAKE LOUISA

QUICK FACTS

- Littoral Area: 122 acres
- Residence Time: 17 days
- Surface Area: 189 acres
- Subwatershed Area: 58,881 acres
- Maximum Depth: 44 feet
- Upstream Waters: Clearwater River, Lake Betsy

Common Fish: Bluegill, Northern Pike, Largemouth Bass, White Sucker

Dominant Vegetation: Coontail

Invasive Species: Curly-leaf pondweed

Status: Impaired, TMDL Completed 2009

TO DO LIST

- Manage upstream loads
- AIS management
- Internal load management study

Fish Health (IBI)

- Impaired
- Supporting
- Exceptional

Vegetation Health (FQI)

- Impaired
- Supporting
- Exceptional

Sediment P Release

- Low
- Moderate
- High

*Sample date: 8/17/2006

*Sample date: 6/20/2005

*Sample date: 2003

*Sediment release rate has not been assessed
LAKE LOUISA

2017 Water Quality

Phosphorus

TP (ug/L)

4/1 5/1 6/1 7/1 8/1 9/1 10/1

Historic Water Quality

TP

Growing Season Average

Deep Lake Standard

0 50 100 150 200 250 300 350 400 450

Chlorophyll-a

Chlorophyll-a (ug/L)

Growing Season Average

Deep Lake Standard

Secchi Depth

Secchi Depth (m)

Growing Season Average

Deep Lake Standard
QUICK FACTS

- **Littoral Area**: 107 acres
- **Residence Time**: 24 days
- **Surface Area**: 146 acres
- **Subwatershed Area**: 59,837 acres
- **Maximum Depth**: 36 feet
- **Upstream Waters**: Clearwater River, Louisa

**Common Fish**: Black Crappie, Bluegill, Northern Pike, White Sucker, Yellow Perch

**Dominant Vegetation**: Coontail, Canadian waterweed

**Invasive Species**: Curly-leaf pondweed

**Status**: Impaired, TMDL Completed 2009

TO DO LIST

- Manage upstream loads
- AIS management
- Internal load management study

**Fish Health (IBI)**

<table>
<thead>
<tr>
<th>Impaired</th>
<th>Supporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>36</td>
</tr>
</tbody>
</table>

*Fish IBI has not been assessed*

**Vegetation Health (FQI)**

<table>
<thead>
<tr>
<th>Impaired</th>
<th>Supporting</th>
<th>Exceptional</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>18.6</td>
<td>32.4</td>
</tr>
</tbody>
</table>

*Sample date: 6/23/2005*

**Sediment P Release (mg/m²/day)**

| 0 | 3.3 | 7.5 |

*Sample date: 2003*

*Sediment release rate has not been assessed*
QUICK FACTS

- **Littoral Area**: 33 acres
- **Surface Area**: 60 acres
- **Subwatershed Area**: 690 acres
- **Maximum Depth**: 67 feet
- **Upstream Waters**: None

**Common Fish**
- Bluegill, Northern Pike, Yellow Bullhead, Largemouth Bass

**Dominant Vegetation**
- Currently obtaining vegetation info from DNR

**Invasive Species**
- Currently obtaining vegetation info from DNR

**Status**
- Not impaired

NIXON LAKE

TO DO LIST

▲ Protect water quality
▲ Manage upstream loads
▲ AIS management and prevention

**Fish Health (IBI)**

<table>
<thead>
<tr>
<th></th>
<th>Impaired</th>
<th>Supporting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Fish IBI has not been assessed*

**Vegetation Health (FQI)**

<table>
<thead>
<tr>
<th></th>
<th>Impaired</th>
<th>Supporting</th>
<th>Exceptional</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Vegetation FQI has not been assessed*

**Sediment P Release (mg/m²/day)**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

*Sediment release rate has not been assessed*
OTTER LAKE

QUICK FACTS

- **Littoral Area**: 32 acres
- **Surface Area**: 92 acres
- **Subwatershed Area**: 10,574 acres
- **Maximum Depth**: 51 feet
- **Upstream Waters**: Lake Laura

**Common Fish**: Black Crappie, Bluegill, Northern Pike, Largemouth Bass, Walleye

**Dominant Vegetation**: Diverse community

**Invasive Species**: Curly-leaf pondweed, Eurasian water milfoil

**Status**: Not impaired

TO DO LIST

- Protect water quality
- Manage upstream loads

**Fish Health (IBI)**

- Impaired
- Supporting
- Exceptional

*Fish IBI has not been assessed

**Vegetation Health (FQI)**

- Impaired
- Supporting
- Exceptional

*Sample date: 8/15/2011

**Sediment P Release (mg/m²/day)**

- Low
- Moderate
- High

*Sediment release rate has not been assessed
OTTER LAKE

2017 Water Quality

Phosphorus

Historic Water Quality

TP

Chlorophyll-a

Secchi Depth

Growing Season Average

Deep Lake Standard

Lake not sampled
QUICK FACTS

- **Littoral Area**: 260 acres
- **Surface Area**: 597 acres
- **Subwatershed Area**: 4,325 acres
- **Maximum Depth**: 74 feet
- **Upstream Waters**: None

**Common Fish**
- Bluegill, Yellow Bullhead, Northern Pike, Pumpkinseed Sunfish

**Dominant Vegetation**
- Curlyleaf, Coontail, chara species, Eurasian watermilfoil

**Invasive Species**
- Currently obtaining vegetation info from DNR

**Status**
- Not impaired

**TO DO LIST**
- Manage watershed loads
- Protect water quality
- Operate outlet to minimize flooding

---

**Fish Health (IBI)**

<table>
<thead>
<tr>
<th>Severe</th>
<th>Medium</th>
<th>Great</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>24</td>
<td>61</td>
</tr>
</tbody>
</table>

*Fish IBI has not been assessed

**Vegetation Health (FQI)**

<table>
<thead>
<tr>
<th>Severe</th>
<th>Medium</th>
<th>Great</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>18.6</td>
<td>32.4</td>
</tr>
</tbody>
</table>

*Sample date: 8/21/2017

**Sediment P Release (mg/m²/day)**

<table>
<thead>
<tr>
<th>Severe</th>
<th>Medium</th>
<th>Great</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.3</td>
<td>7.5</td>
</tr>
</tbody>
</table>

*Sediment release rate has not been assessed

---

**Pleasant Lake**

**Fish**
- Bluegill, Yellow Bullhead, Northern Pike, Pumpkinseed Sunfish

**Dominant Vegetation**
- Curlyleaf, Coontail, chara species, Eurasian watermilfoil

**Status**
- Not impaired

**Common Fish**
- Bluegill, Yellow Bullhead, Northern Pike, Pumpkinseed Sunfish

**Invasive Species**
- Currently obtaining vegetation info from DNR

**Legend**
- Monitoring Locations
- Subwatersheds
- Perennial Stream
- Intermittent Stream
- Inflow
- Outflow
PLEASANT LAKE

2017 Water Quality

Phosphorus

TP (ug/L)

[Graph showing TP levels]

Chlorophyll-a

Chl-a (ug/L)

[Graph showing Chl-a levels]

Secchi Depth

Secchi Depth (m)

[Graph showing Secchi depth levels]

Historic Water Quality

TP

Growing Season Average

Deep Lake Standard

[Graph showing TP levels over years]

Chlorophyll-a

Growing Season Average

Deep Lake Standard

[Graph showing Chl-a levels over years]

Secchi Depth

Secchi Depth (m)

Growing Season Average

Deep Lake Standard

[Graph showing Secchi depth levels over years]
QUICK FACTS
- Littoral Area: 188 acres
- Surface Area: 193 acres
- Subwatershed Area: 1,843 acres
- Maximum Depth: 12 feet
- Upstream Waters: None

Common Fish: Black bullhead, Bluegill, Northern Pike
Dominant Vegetation: Northern water milfoil, Illinois pondweed, muskgrass
Invasive Species: Curly-leaf pondweed

Status: Not impaired

TO DO LIST
- Operate outlet to minimize flooding
- Protect water quality

Fish Health (IBI): 26.7
  - Impaired
  - Supporting
  - Exceptional
  *Sample date: 8/18/2008

Vegetation Health (FQI): 19.4
  - Impaired
  - Supporting
  - Exceptional
  *Sample date: 8/11/2011

Sediment P Release (mg/m²/day): 3.3
  - Low
  - Moderate
  - High
  *Sediment release rate has not been assessed
2017 Water Quality

Phosphorus

- TP
- ortho-P
- Shallow Lake Standard

Lake not sampled

Chlorophyll-a

- Chlorophyll-a
- Shallow Lake Standard

Lake not sampled

Secchi Depth

- Secchi Depth
- Shallow Lake Standard

Lake not sampled

Historic Water Quality

TP

- Growing Season Average
- Shallow Lake Standard

Chlorophyll-a

- Growing Season Average
- Shallow Lake Standard

Secchi Depth

- Growing Season Average
- Shallow Lake Standard
SCOTT LAKE

QUICK FACTS

- Littoral Area: 52 acres
- Residence Time: 12 days
- Surface Area: 80 acres
- Subwatershed Area: 51,000 acres
- Maximum Depth: 23 feet
- Upstream Waters: Clearwater River, Lake Betsy, Union Lake
- Common Fish: Black Crappie, Bluegill, Channel Catfish, White Sucker
- Dominant Vegetation: Curly-leaf pondweed
- Invasive Species: Curly-leaf pondweed
- Status: Impaired, TMDL Completed 2009

TO DO LIST

- Rough fish management
- Manage upstream loads
- Internal load management study

Legend
- Monitoring Locations
- Perennial Stream
- Intermittent Stream
- Subwatersheds

Fish Health (IBI)

- Impaired
- Supporting
- Exceptional

*Fish IBI has not been assessed

Vegetation Health (FQI)

0 18.6 32.4

*Sample date: 7/28/1997

Sediment P Release (mg/m²/day)

0 3.3 7.5

*Sample date: 2010

Scott Lake Creek

Clearwater River

Legend
- Monitoring Locations
- Perennial Stream
- Intermittent Stream
- Subwatersheds

Scott Lake

Surface Area: 80 acres
Subwatershed Area: 51,000 acres
Maximum Depth: 23 feet
Upstream Waters: Clearwater River, Lake Betsy, Union Lake
Common Fish: Black Crappie, Bluegill, Channel Catfish, White Sucker
Dominant Vegetation: Curly-leaf pondweed
Invasive Species: Curly-leaf pondweed
Status: Impaired, TMDL Completed 2009

Legend
- Monitoring Locations
- Perennial Stream
- Intermittent Stream
- Subwatersheds

Fish Health (IBI)

- Impaired
- Supporting
- Exceptional

*Fish IBI has not been assessed

Vegetation Health (FQI)

0 18.6 32.4

*Sample date: 7/28/1997

Sediment P Release (mg/m²/day)

0 3.3 7.5

*Sample date: 2010

Scott Lake Creek

Clearwater River

Legend
- Monitoring Locations
- Perennial Stream
- Intermittent Stream
- Subwatersheds
**SWARTOUT LAKE**

**QUICK FACTS**
- **Littoral Area**: 171 acres
- **Residence Time**: 460 days
- **Surface Area**: 171 acres
- **Subwatershed Area**: 5,551 acres
- **Maximum Depth**: 12 feet
- **Upstream Waters**: Henshaw, Albion

**Common Fish**
- Black Bullhead, Black Crappie, Common Carp

**Dominant Vegetation**
- Coontail, sago pondweed, bushy pondweed

**Invasive Species**
- Curly-leaf pondweed

**Status**
- Impaired, TMDL Completed 2010

**TO DO LIST**
- AIS management
- Rough fish management
- Manage upstream loads

**Fish Health (IBI)**
- Impaired
- Supporting

*Fish IBI has not been assessed

**Vegetation Health (FQI)**
- Impaired
- Supporting
- Exceptional

*Sample date: 8/14/2015

**Sediment P Release (mg/m²/day)**
- Low
- Moderate
- High

*Sample date: 2/22/2018
UNION LAKE

QUICK FACTS
- Littoral Area: 27 acres
- Residence Time: 291 days
- Surface Area: 93 acres
- Subwatershed Area: 4,741 acres
- Maximum Depth: 35 feet
- Upstream Waters: None
- Common Fish: Black Crappie, Bluegill, Northern Pike, Largemouth Bass
- Dominant Vegetation: Coontail, curly-leaf pondweed, sago pondweed
- Invasive Species: Curly-leaf pondweed
- Status: Impaired, TMDL Completed 2009

TO DO LIST
- Manage upstream loads

Fish Health (IBI)
- Impaired
- Supporting
- Exceptional

Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High

*Fish IBI has not been assessed
*Sample date: 6/17/2016
*Sediment release rate has not been assessed
UNION LAKE

2017 Water Quality

Historic Water Quality

Phosphorus

TP (ug/L)

Growing Season Average

Deep Lake Standard

Chlorophyll-a

Chlorophyll-a (ug/L)

Growing Season Average

Deep Lake Standard

Secchi Depth

Secchi Depth (m)

Growing Season Average

Deep Lake Standard
Quick Facts:
- Drainage area: 101,569 ac
- Upstream monitored lakes: All lakes
- Upstream monitoring location: All locations
- Impairments: DO, FishesBio

**DO**: All dissolved oxygen measurements were above impairment standard.

**E.coli**: Not measured.
**CR28.2 (Kingston)**

**QUICK FACTS:**
- Drainage area: 33,977 ac
- Upstream monitored lakes: Clear Lake, Little Mud Lake
- Upstream monitoring location: CR29.0
- Impairments: DO, E. coli

**DO:** Dissolved oxygen fell below the impairment standard (5 mg/L) during the 2017 summer season. Only two sample in the spring were above the impairment standard.

**E.coli:** Not measured.
Warner Creek WR0.2

QUICK FACTS:
- Drainage area: 16,992 ac
- Upstream monitored lakes: Henshaw Lake, Albion Lake, Swartout Lake, Cedar Lake
- Upstream monitoring location: SSW04, SSW02
- Impairments: None

DO: All dissolved oxygen measurements were above impairment standard.

E.coli: Not measured.