2015 Monitoring Report

Middle Fork Crow River Watershed District
189 County Road 8 NE
Spicer, MN 56288
(320) 796-0888
www.mfcrow.org

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Purpose of Water Monitoring

The Middle Fork Crow River Watershed District (MFCRWD) was formed in 2005 to protect and preserve water quality in the Middle Fork Crow River watershed. Monitoring plays a vital role for the District to achieve this goal. Results from the District monitoring program help us assess water quality trends in the watershed and provide information on where to target best management practices. To help track long-term changes, 5 stream sites have been established and the 8 major lakes in the watershed are thoroughly monitored every year. In addition to major lakes the District also monitors the Hubbard, Schultz, Wheeler chain of lakes. District staff and several volunteers conduct monitoring. To determine if the watershed is reaching water quality goals, monitoring data is evaluated on an annual basis.

The monitoring program is funded through two sources. A Clean Water Partnership Continuation grant from the Minnesota Pollution Control Agency provides the majority of funding and the Calhoun Lake Association, Diamond Lake Area Recreation Association, George Lake Association, Green Lake Property Owners Association, Long Lake Association, and Nest Lake Improvement Association provide additional funding for their respective lakes.

This report provides an assessment of the data collected by the MFCRWD volunteers and staff from 2007 to 2015. The report forms part of a long term effort to track water quality trends throughout the watershed.

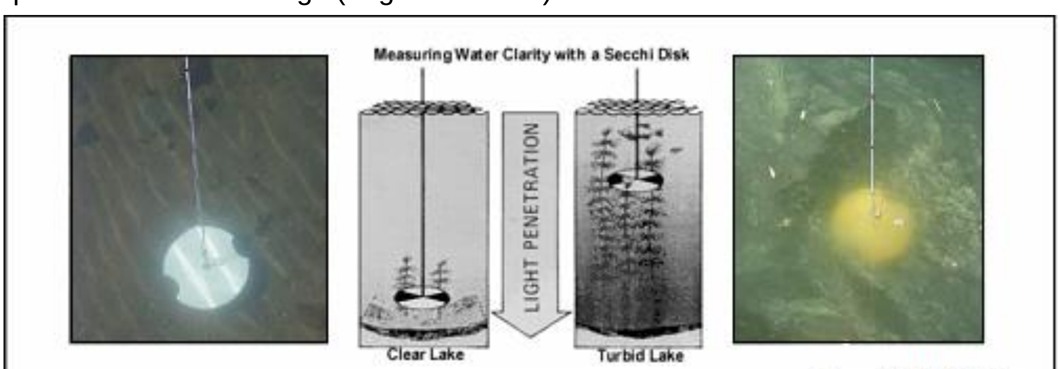
Monitoring Methods and Tools

Volunteers and staff members monitor lake and stream water quality, stream flow, and precipitation throughout the watershed using chemical analysis, secchi disks, secchi tubes, flow gauging equipment, a multiparameter water quality meter, and rain gauges.

Secchi Disk

One of the most common tools used to measure overall lake water quality is the secchi disk. Secchi disk measurements over time can give a general indication of issues in a lake by estimating the water clarity, or turbidity. Turbidity is suspended materials such as algae, silt, and organic matter in the water.

A secchi disk is a weighted circular metal disk, 8 inches in diameter, attached to a rope marked for measurement. The disk is black and white or all white in color. To collect a secchi disk measurement, the disk is lowered into the water column until it disappears. The secchi depth is measured by recording the depth at which the disk reappears. Deeper secchi disk readings (larger numbers) indicate clearer water.

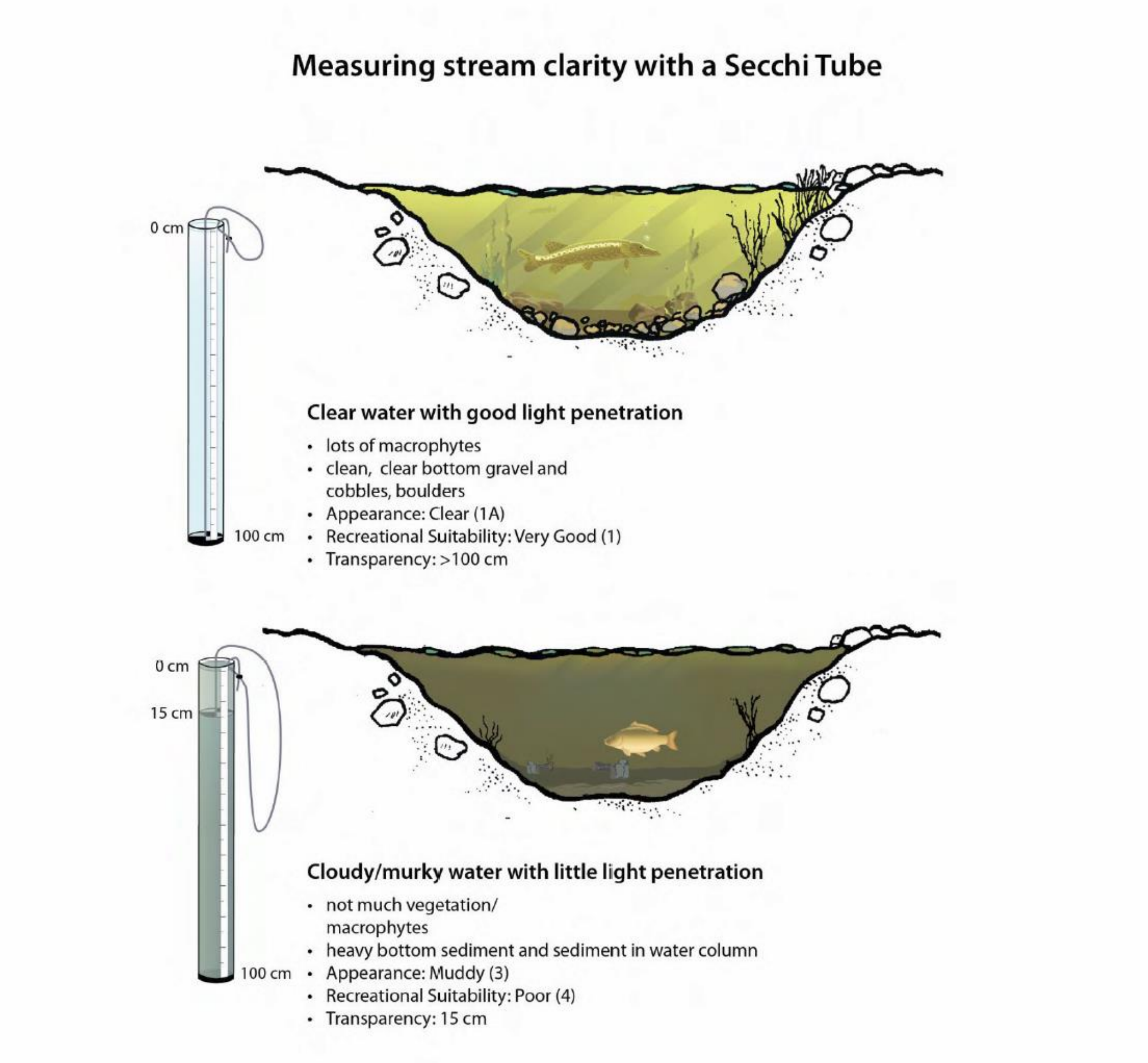


Credit: MPCA

Secchi Tube

In rivers and streams, soil particles such as sand, silt, and clay are carried and deposited with the current. When there is too much material suspended in the water, the water transparency, or clarity decreases. Low transparency readings can be indicative of an erosion problem within the river or the river's watershed. As sand, silt and clay (sediment) levels increase, the river or stream may become unsuitable for fish and other aquatic species.

Transparency is measured using a secchi tube. To collect a secchi tube reading, the tube is filled with water from the flowing stream. Looking down into the tube, a weighted secchi disk is lowered into the tube by a line. To obtain a secchi tube reading, the depth of the water at the midpoint between disappearance and reappearance of the disk is recorded in centimeters, which are marked on the side of the tube. If the disk is fully visible when the tube is filled, the reading reflects >100 cm. In general, low secchi tube readings indicate high levels of sediment suspended in the stream. A greater secchi tube value reflects better water clarity.



Credit: MPCA

Grab Samples

Grab samples provide insight into the chemical condition of the water body and determine its suitability for fisheries, recreational activities, and groundwater recharge. They also become an important indicator of potential land use problems in the watershed. Stream samples were collected monthly or bimonthly from April through September and tested for Total Phosphorus (TP), Total Suspended Solids (TSS), and Total Kjeldahl Nitrogen (TKN). Lake samples were collected monthly or bimonthly also from May through September and tested for TP, TSS, and Chlorophyll-a (Chl-a).

The Importance of Chemistry

Phosphorus – Phosphorus is one of the key elements necessary for growth of plants and animals. If too much phosphorus enters the waterway, algae and aquatic plants will grow excessively and choke up the waterway. As the algae and plants die, their decomposition depletes the water body’s oxygen supply, leading to the loss of aquatic life. Some sources of phosphorus include cropland (fertilizer and soil), human and animal waste, and stormwater runoff from urban areas.

Total Suspended Solids – Materials suspended in the water column can decrease the diversity of aquatic organisms and increase the water temperature. Plant populations can decrease as the suspended materials block the ability of sunlight to penetrate the water. Fish populations and other aquatic organisms suffer when eggs are smothered by silt and clay. The material suspended in the water can be both organic (plankton, sewage) and inorganic (silt, clay). By measuring total suspended solids, the effects of runoff on a water body can be determined.

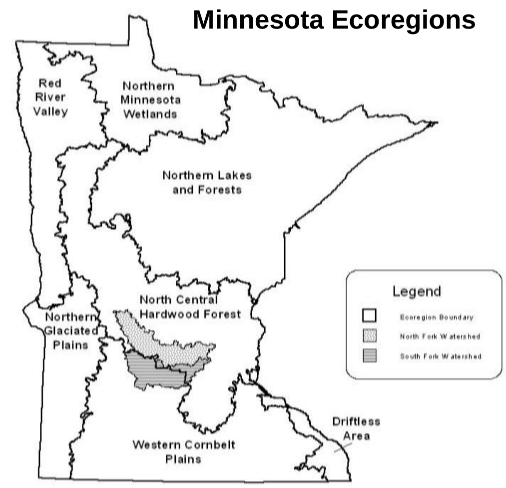
Chlorophyll-a – Chlorophyll-a is the pigment in plants that make them look green. Measuring chlorophyll-a indicates the amount of algae in the water column.

Total Kjeldahl Nitrogen (TKN) – TKN is a form of nitrogen that is used as an indicator for the presence of organically bound nitrogen and ammonia in wastewater; manure or sewage.

Data Results and Discussion

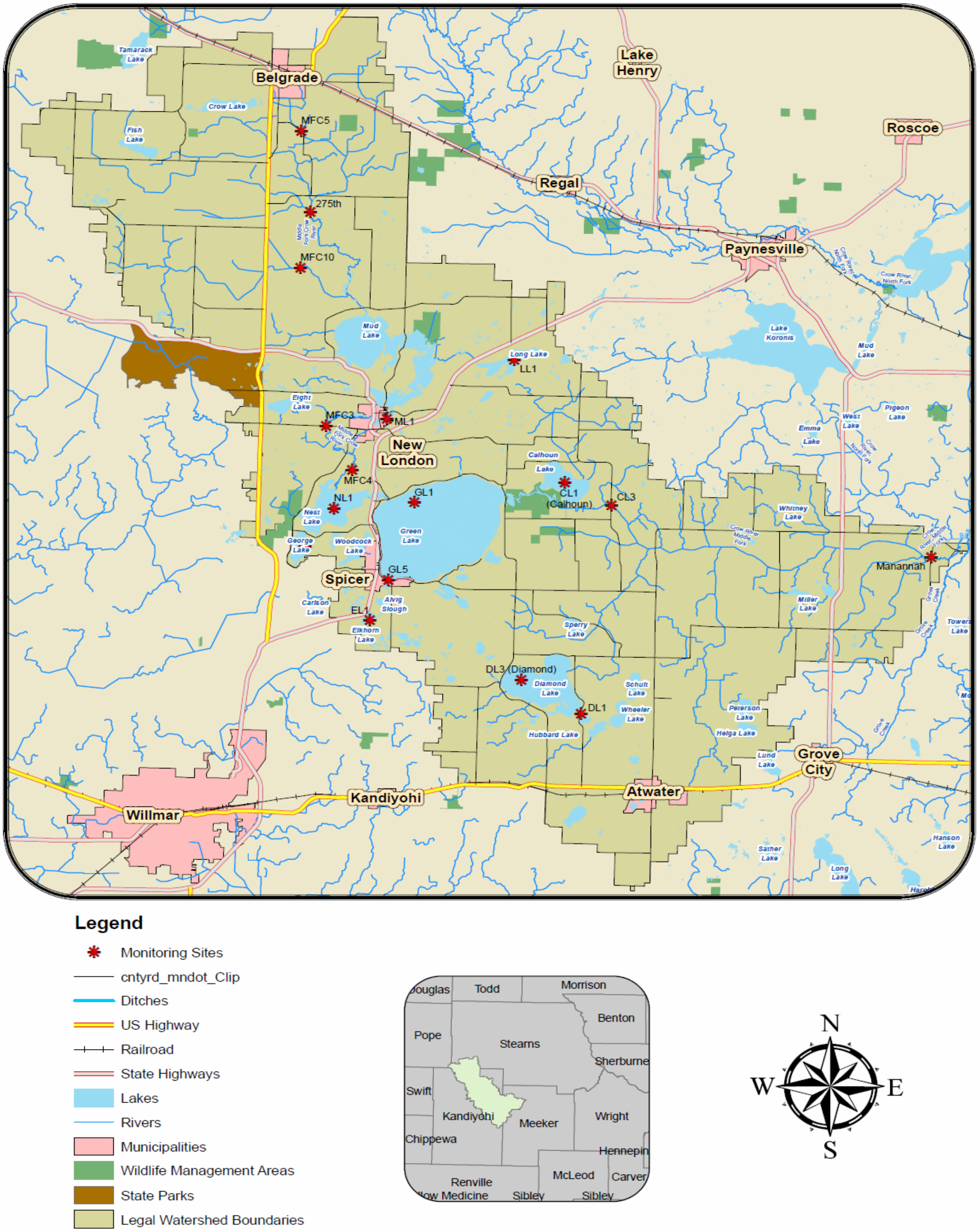
When reviewing stream and lake data, it is useful to have a reference or average value to compare the data. Water quality values found in southern Minnesota are expected to be different than those found in northern Minnesota because of differences in precipitation patterns, land cover, soils, topography, land use practices, etc. Therefore, **Ecoregional Averages** are used rather than a statewide average or reference. These are developed with the use of ecoregional reference lakes and streams that have been minimally impacted by pollution. Data that represents the lower and upper boundaries of the reference water bodies are used as comparison values. Under most circumstances, water quality results in the watershed are expected to fall within the ranges of the reference water bodies. Chemistry samples with lower readings indicate better water quality, while higher secchi disk and secchi tube readings represent water that is clearer. The Middle Fork Crow River watershed is located in the North Central Hardwood Forest ecoregion.

Minnesota Ecoregions



Middle Fork Crow River Watershed District

Monitoring Sites



River Water Quality

The MFCRWD has established five stream sites in the watershed that are monitored for transparency and chemistry; flow monitoring is conducted at 3 of these sites for modeling purposes. Whenever data results are being reviewed, it is important to emphasize that several years of monitoring are required to track significant changes in water quality. However, this “snapshot” can indicate seasonal trends along a watercourse or areas of concern.

Fig. 1.1 shows average annual stream transparency readings from 2009 through 2015. Higher transparency readings indicate better water quality. On average, all five sites had excellent transparency.

Fig. 1.1

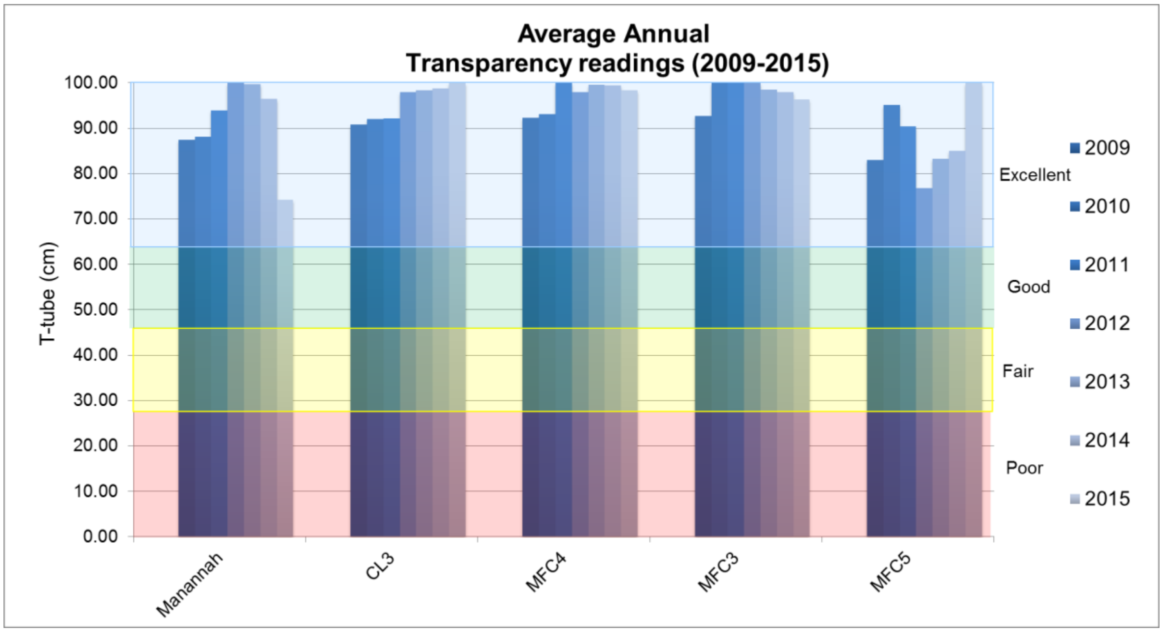


Fig. 1. 2 shows average annual stream Total Phosphorus (TP) concentrations from 2007 through 2015. The shaded area indicates the ecoregional average for TP. In 2015, average concentrations of Total Phosphorus met or exceeded ecoregion averages.

Fig. 1.2

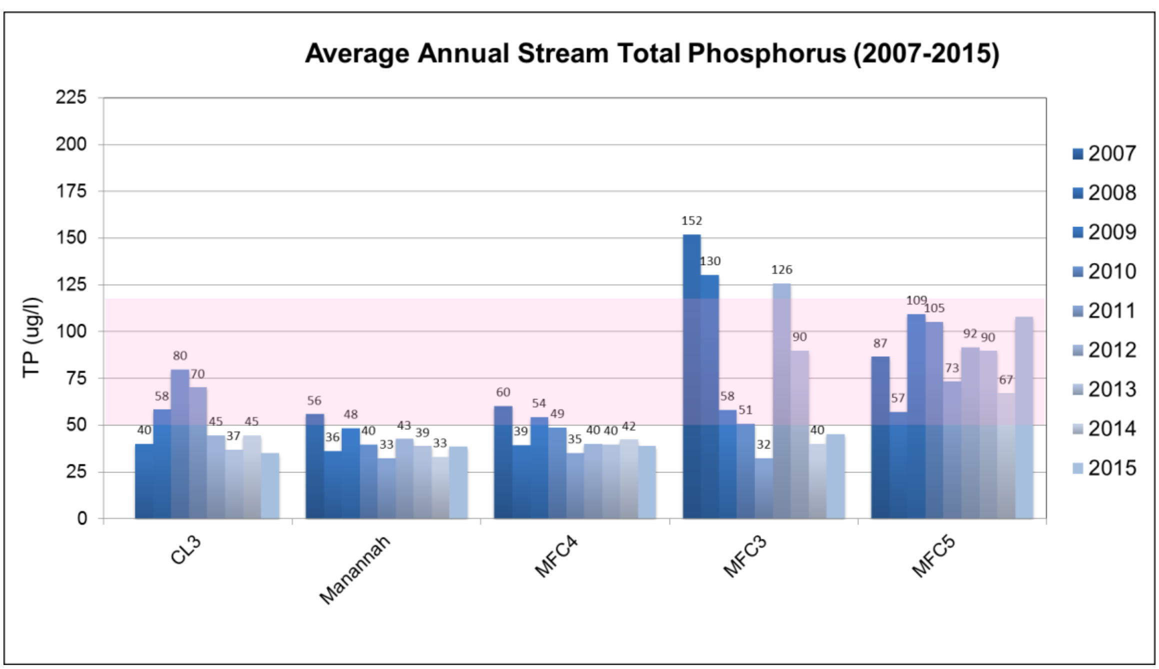


Fig. 1.3

Fig. 1.3 represents average annual total suspended solids (TSS) from 2007 through 2015. The shaded box depicts the ecoregional average for TSS. In 2015, all five sites were within or better than ecoregional averages, indicating good water quality.

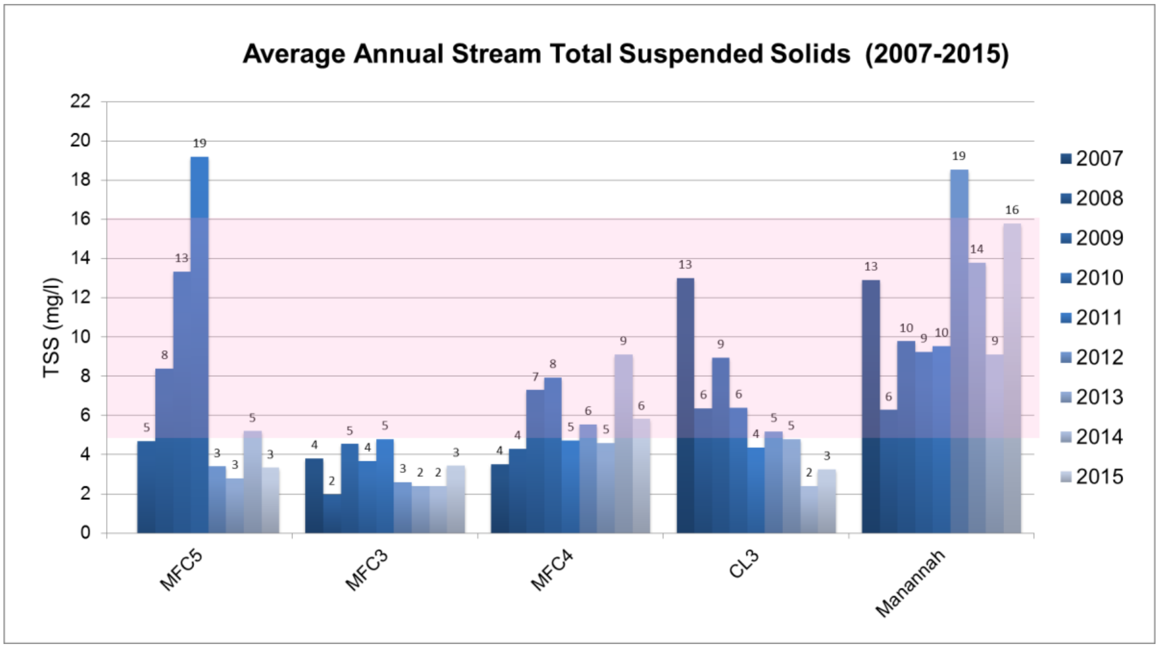
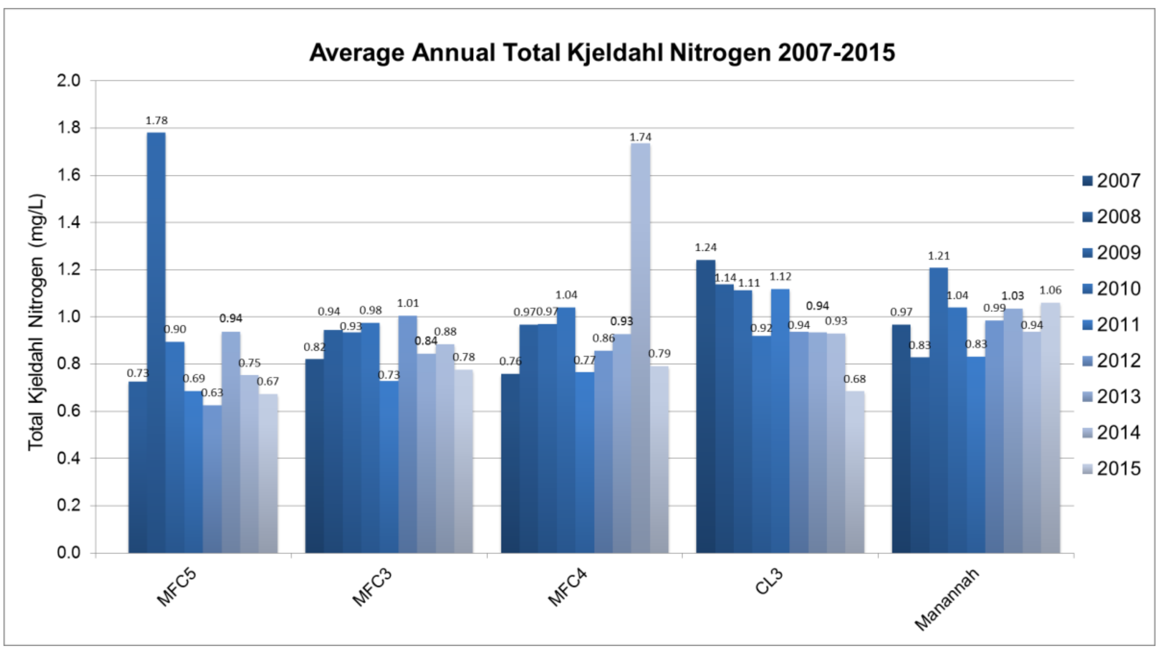


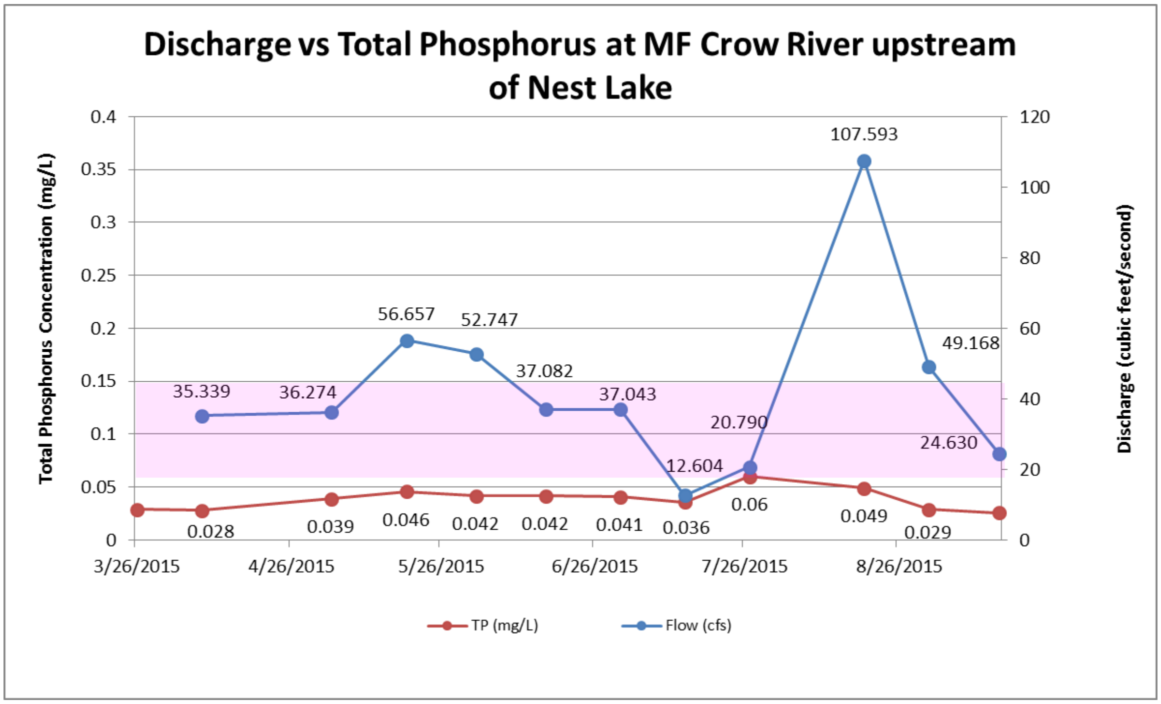
Fig. 1.4 represents average annual total kjeldahl nitrogen (TKN) from 2007 through 2015.

Fig. 1.4



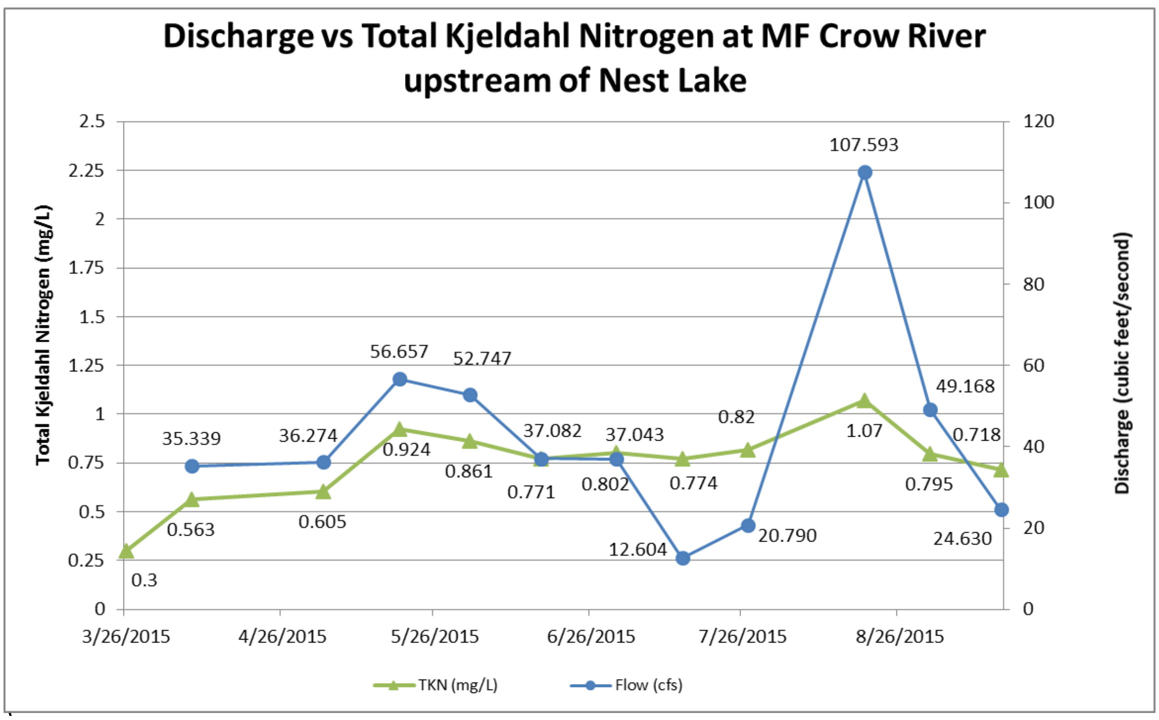
Below is a summary of discharge (flow) data vs total phosphorus at MFC4. The areas shaded in pink shows normal range for the North Central Hardwood Forest ecoregion.

Fig. 1.5



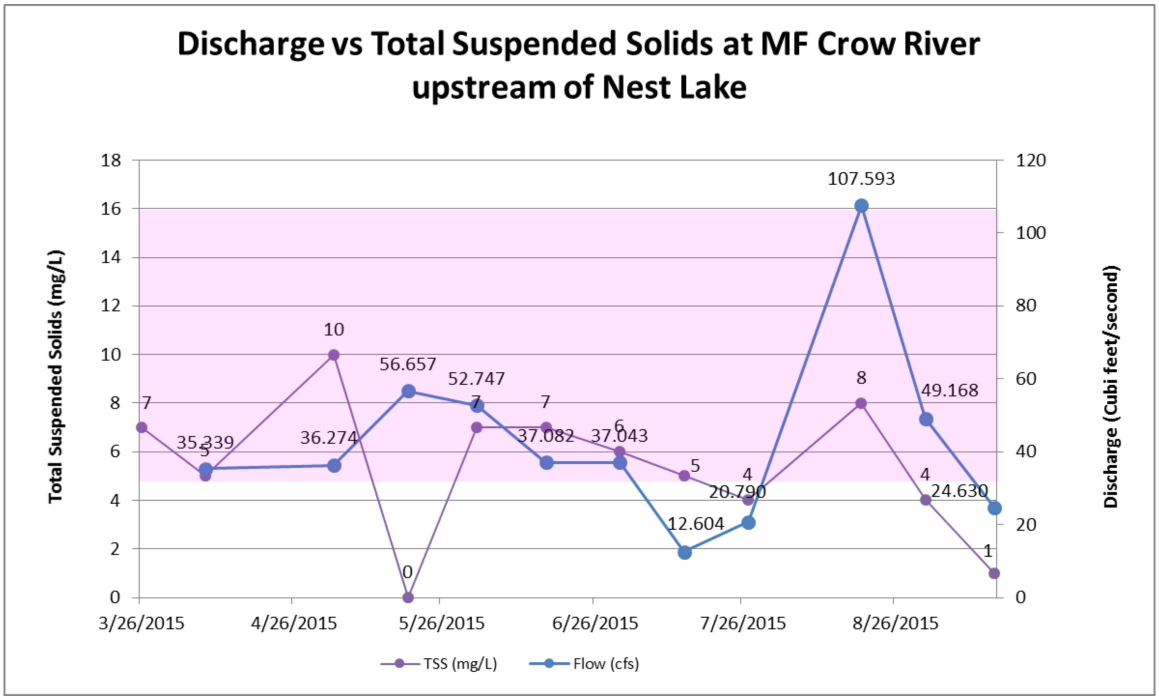
Below is a summary of discharge (flow) data vs total kjeldahl nitrogen at MFC4.

Fig. 1.6



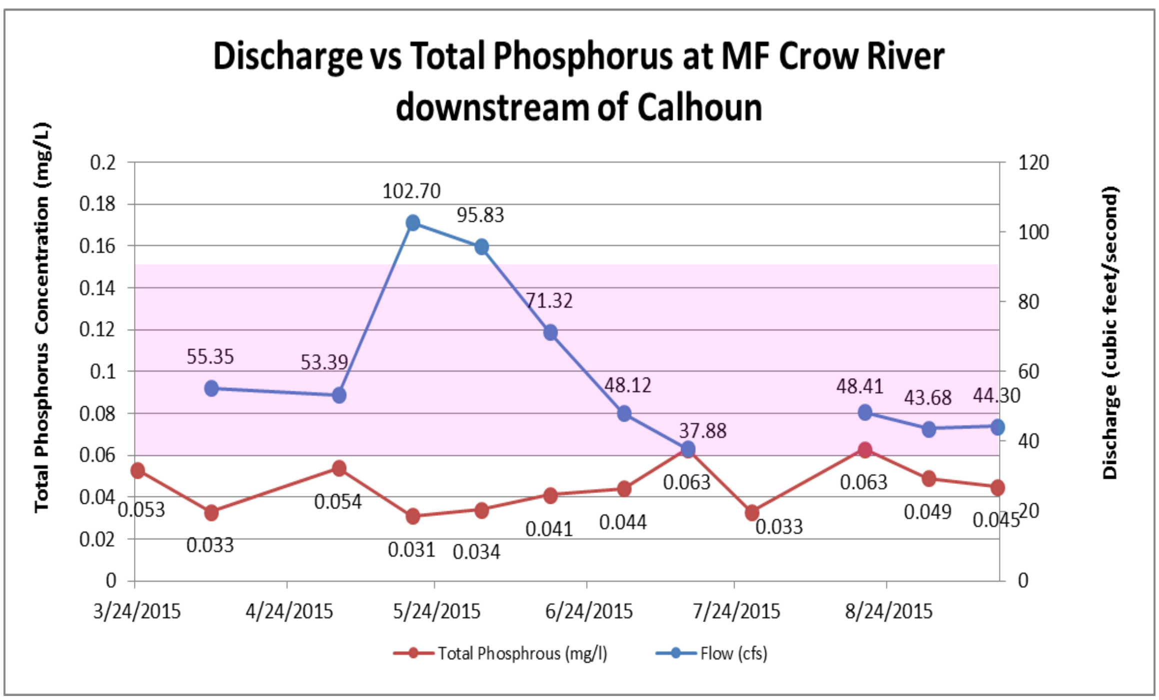
Below is a summary of discharge (flow) data vs total suspended solids at MFC4. The areas shaded in pink shows normal range for the North Central Hardwood Forest ecoregion.

Fig. 1.7



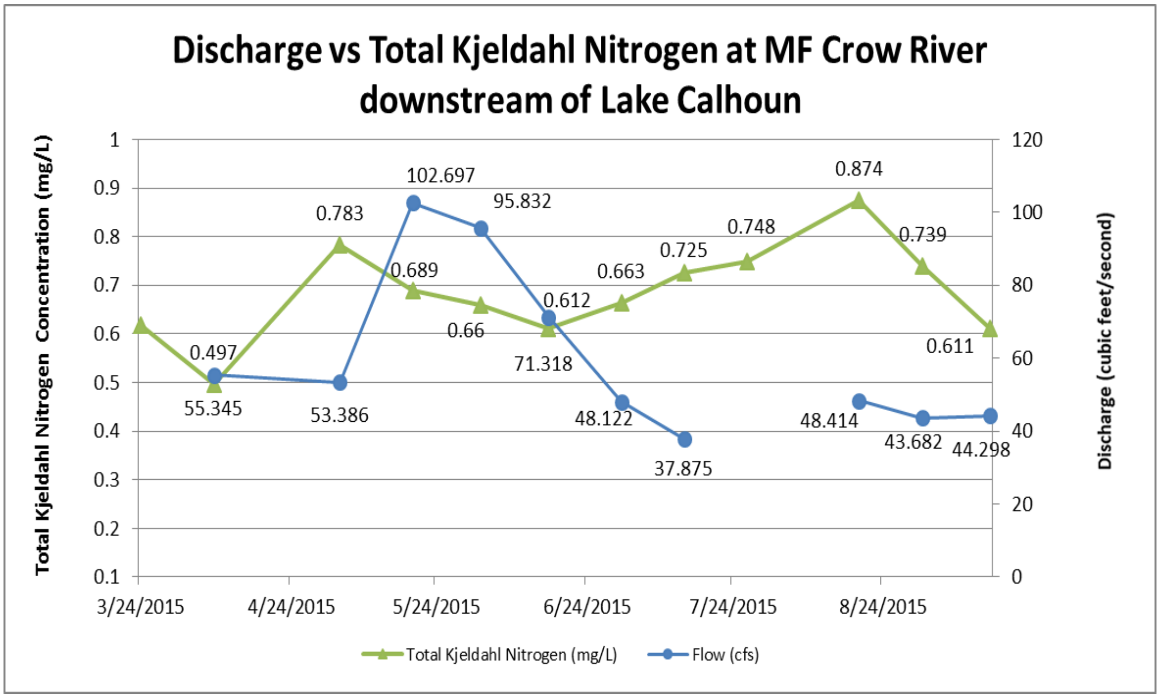
Below is a summary of discharge (flow) data vs total phosphorus at MFC4. The areas shaded in pink shows normal range for the North Central Hardwood Forest ecoregion. The gap in the flow data was due to an equipment malfunction.

Fig. 1.8



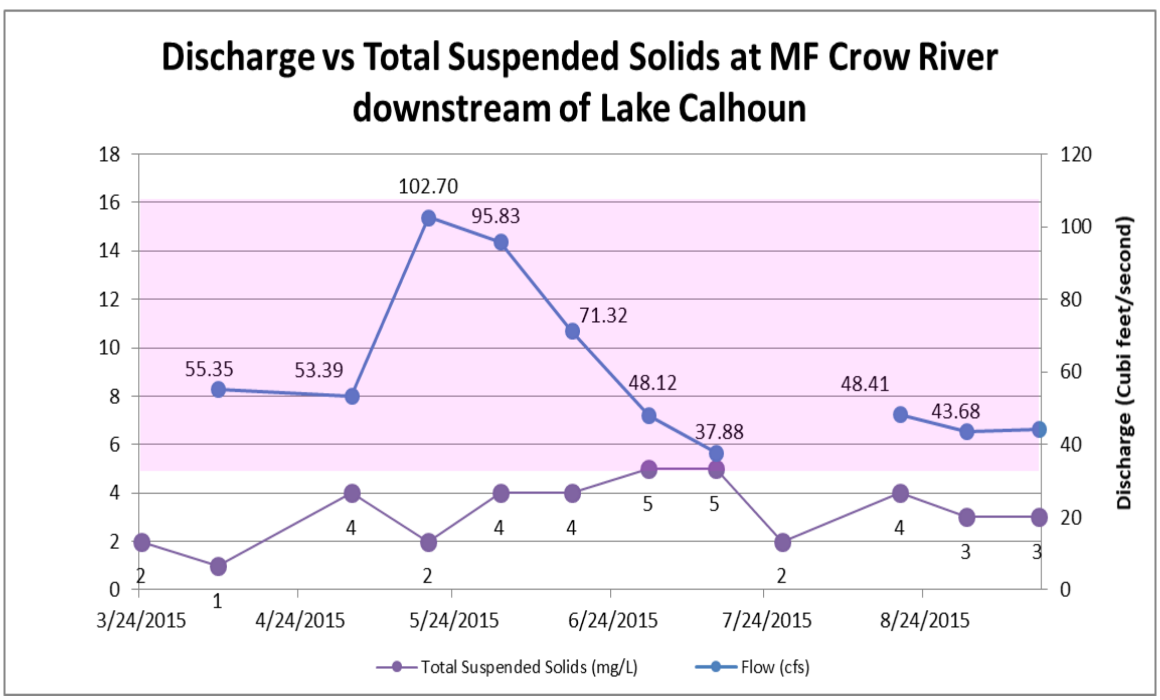
Below is a summary of discharge (flow) data vs total kjeldahl nitrogen at CL3. The gap in flow data was due to equipment malfunction.

Fig. 1.9



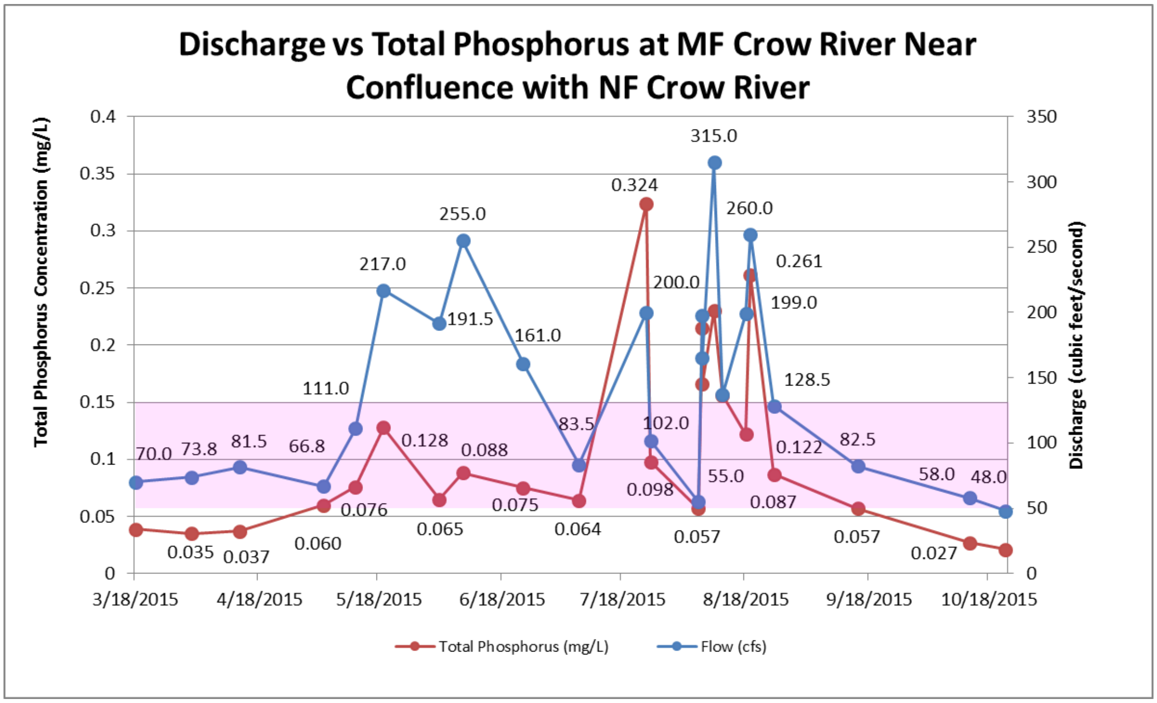
Below is a summary of discharge (flow) data vs total suspended solids at CL3. The areas shaded in pink shows normal range for the North Central Hardwood Forest ecoregion. The gap in flow data was due to equipment malfunction.

Fig. 1.10



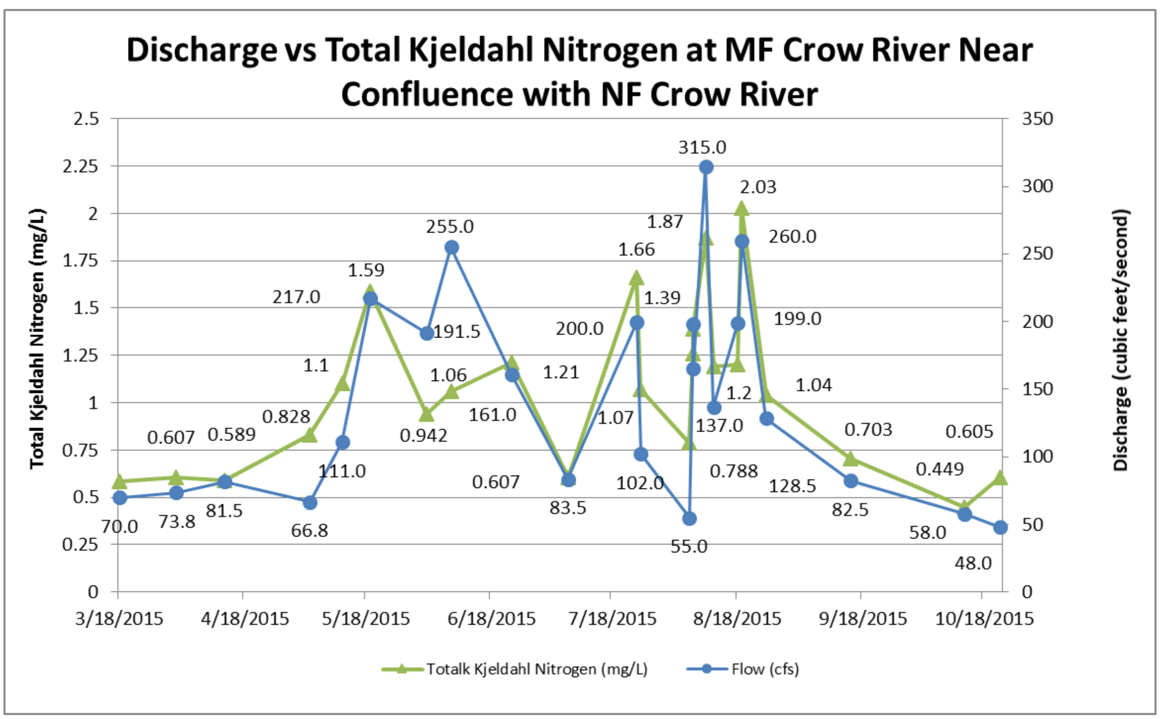
Below is a summary of discharge (flow) vs total phosphorus at Manannah. The areas shaded in pink shows normal range for the North Central Hardwood Forest ecoregion.

Fig. 1.11



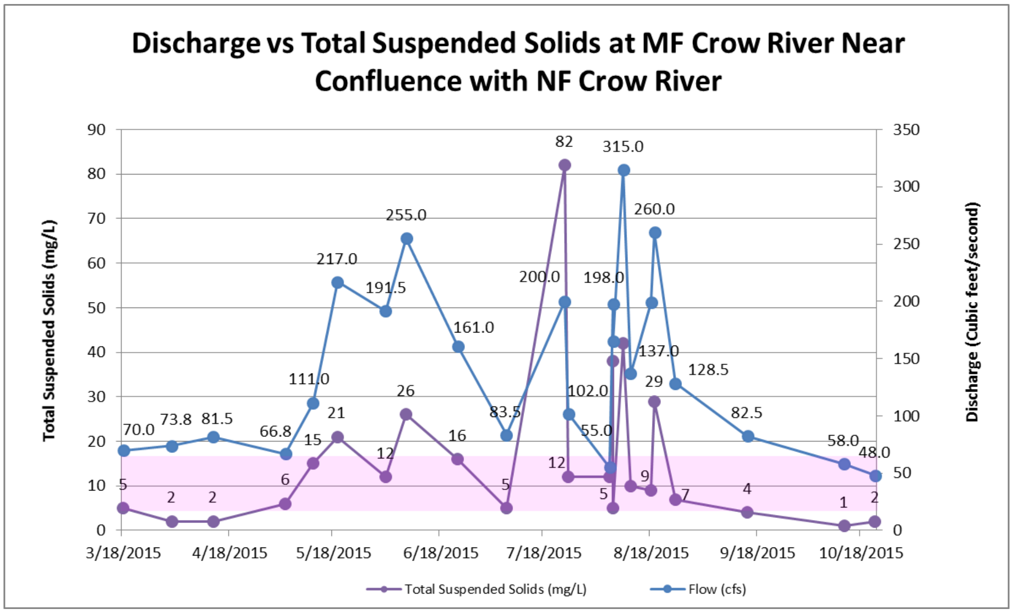
Below is a summary of discharge (flow) vs total kjeldahl nitrogen at Manannah.

Fig. 1.12



Below is a summary of discharge (flow) vs total suspended solids at Manannah. The areas shaded in pink shows normal range for the North Central Hardwood Forest ecoregion.

Fig. 1.13



Lake Water Quality

The eight major lakes in the watershed are monitored annually. When interpreting data results from any water body, it is important to note that readings from at least ten years are necessary to determine trends in water quality. However, a few years of data can provide a “snapshot” of the lake’s health.

Fig. 2.1 represents average annual secchi disk readings. The shaded box indicates the ecoregional average for deep lakes (average depth greater than 15 feet). Calhoun and Monongalia lakes are considered shallow lakes (average depth 15 feet or less) and therefore have a different standard. Since secchi disks are used to measure lake water clarity, a higher number indicates better water quality. All 8 major lakes within the District met or exceeded ecoregion averages for secchi disk transparency in 2015.

Fig. 2.1

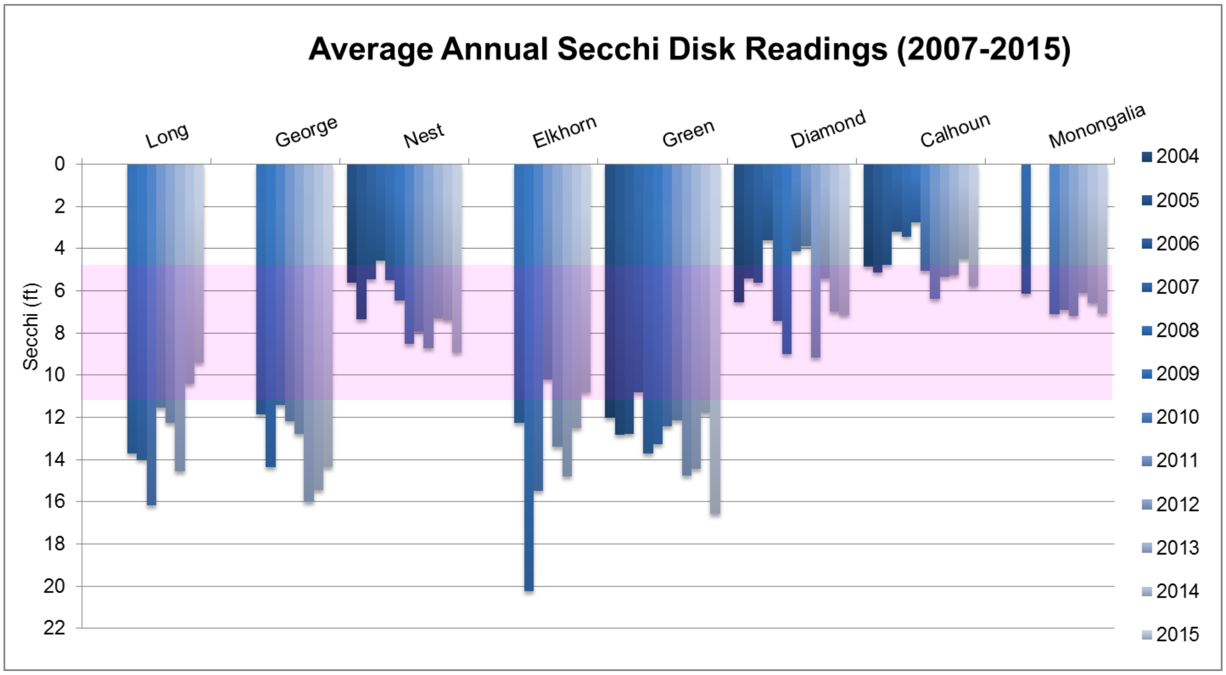


Fig. 2.2 displays the results for average annual chlorophyll-a (Chl-a) from 2004 through 2015. The shaded area depicts the ecoregional average for Chl-a. In 2015, Long, George, Nest, Elkhorn, Green, Calhoun, and Monongalia lakes were within or better than ecoregional averages, representing good to excellent water quality. Diamond Lake exceeded the ecoregional average.

Fig. 2.2

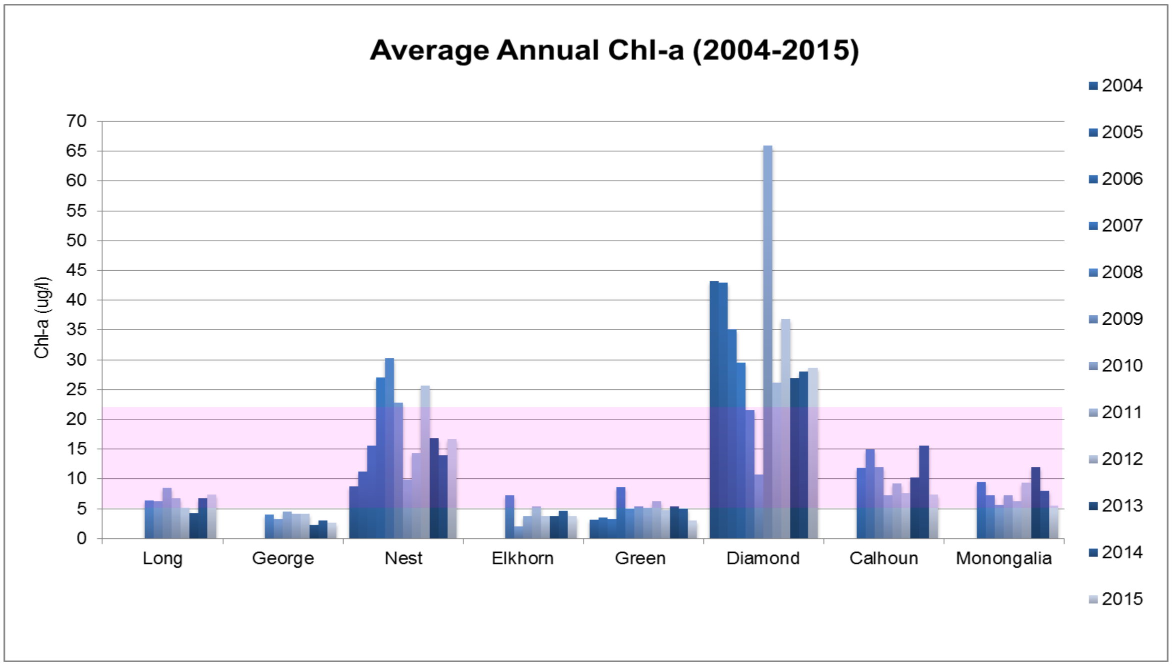


Fig. 2.3 displays the results for average annual total suspended solids (TSS) from 2007 through 2015. The shaded area indicates the ecoregional average for TSS. In 2015, Long, George, Nest, Elkhorn, Green, Calhoun and Monongalia lakes were within or better than ecoregional averages, indicating good to excellent water quality. Diamond Lake exceeded the ecoregional average.

Fig. 2.3

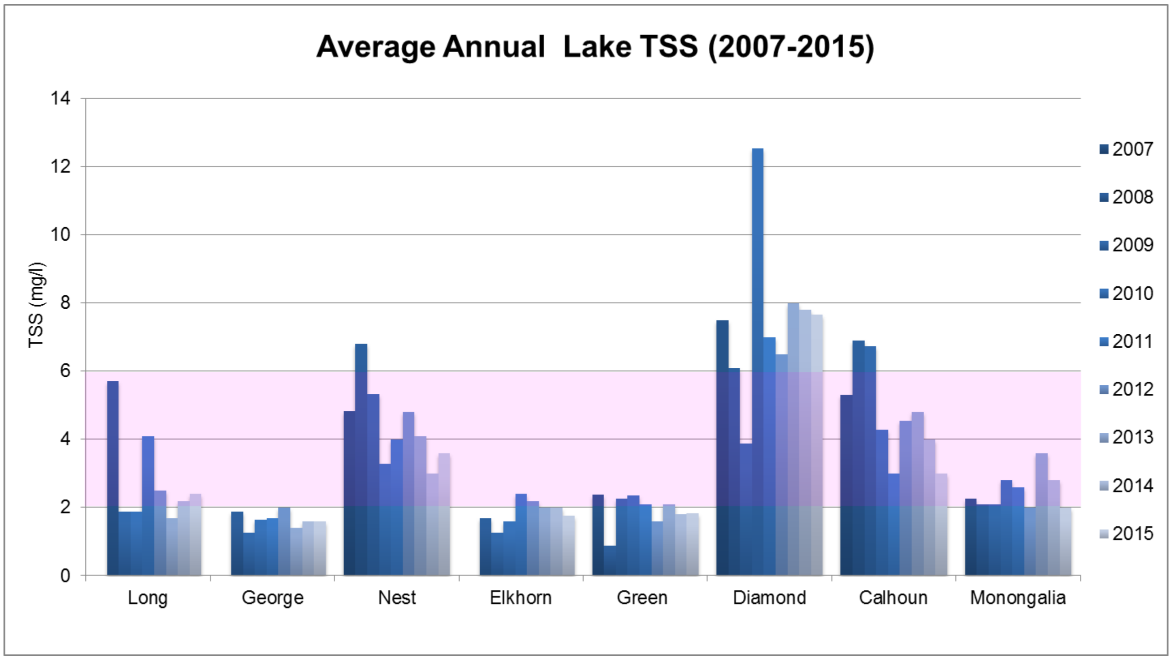
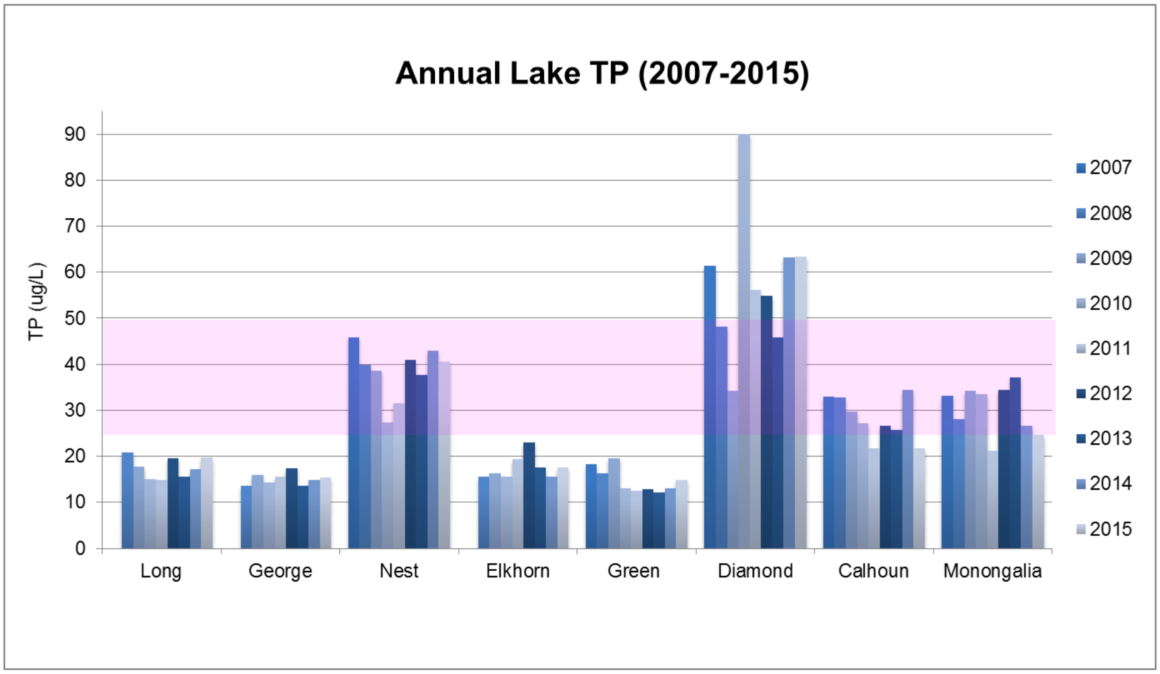


Fig. 2.4 shows the results for average annual total phosphorus (TP) from 2007 through 2015. The shaded area indicates the ecoregional average for TP. In 2015, Long, George, Nest, Elkhorn, Green, Calhoun and Monongalia lakes were within or better than ecoregion averages for average annual Total Phosphorus concentration. Diamond Lake exceeded the ecoregion average.

Fig. 2.4

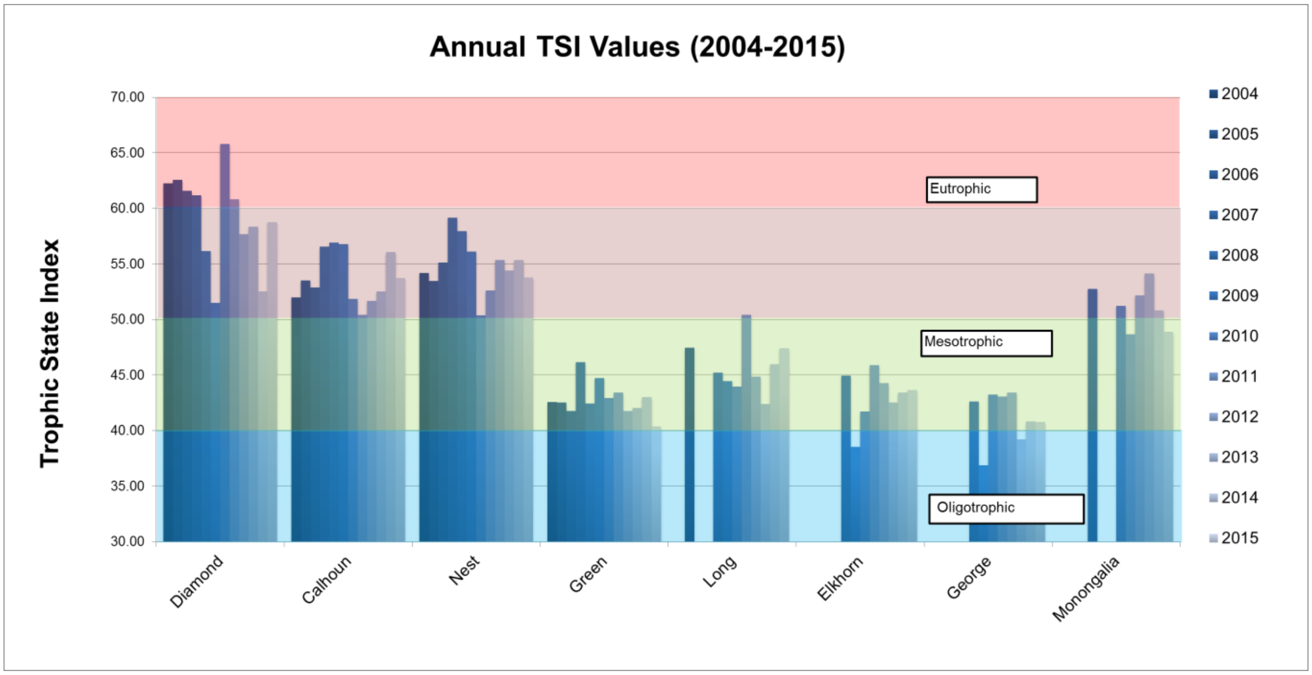


Trophic State Index

Another method that can be used to determine the overall health of a lake is Carlson's Trophic State Index (TSI). Trophic state indicates the overall productivity, or plant and algae growth, occurring in a lake. The TSI uses algal biomass as its basis and is determined by using three productivity parameters: total phosphorus, chlorophyll-a, and secchi disk.

Fig. 2.5 shows the average annual trophic state index from 2004 through 2015. In 2015, Diamond, Calhoun, and Nest lakes were categorized in the lower boundary for classical eutrophy. Green, Long, Elkhorn, George and Monongalia lakes were classified as mesotrophic in 2015.

Fig. 2.5



TSI 30-40 Oligotrophic – clear water, hypolimnion oxygenated throughout the year (except in shallow lakes)
TSI 40-50 Mesotrophic – Water moderately clear, but anoxia becoming more likely in hypolimnion during the summer
TSI 50-60 Lower Boundary of **classical eutrophy**: Decreased transparency, anoxic hypolimnia during the summer, aquatic plant problems evident, warm water fisheries only.
TSI 60-70 Eutrophic: Dominance of blue-green algae, algal scums probable, extensive aquatic plant problems
TSI 70-80 Hypereutrophic: Heavy algal blooms possible throughout the summer, dense aquatic plant beds, but extent limited by light penetration.

Hypolimnion – *the dense, bottom layer of water in a stratified lake. Typically the coldest layer in the summer and the warmest in the winter*

After Moore, 1. And K. Thornton [Ed.] 1988. *Lake and Reservoir Restoration Guidance Manual.* (Doc. No. EPA 440/5-88-002) Source: MINNESOTA POLLUTION CONTROL AGENCY/ *Volunteer Surface Water Monitoring Guide,* 2003
http://www.pca.state.mn.us/water/lakeacro.html

Improving Water Quality

In addition to monitoring water quality throughout the watershed, the MFCRWD assists landowners with the implementation of best management practices (BMPs). BMPs are practices that help protect and improve water quality by reducing the amount of nutrients and sediment that reach local water bodies. To encourage property owners to implement BMPs, the Watershed District provides educational opportunities along with technical and financial assistance. Examples of eligible projects include shoreland and stream restorations, raingardens, wetland restorations, buffer strips, animal exclusions and many more. So what does this mean for lake water quality?

One way to understand the cumulative impact of all these BMPs is to review the projects that have been implemented in each lake's watershed - the area of land that drains into a lake, including the lake itself. The table below shows the number of BMPs that have been implemented throughout the watershed of each major lake by the MFCRWD through 2015. Across the entire Middle Fork Crow River watershed, 65 BMPs have been installed, preventing sediment and nutrients loading to surface waters by nearly 340 pounds per year and the sediment by over 290 tons per year. Those 65 BMPs include 7 agricultural BMPs, 7 raingardens, 34 shoreland restorations, 8 stream restorations, and 9 stormwater BMPs. In addition, the MFCRWD sold 100 rain barrels that will help to reduce run off from impervious surfaces along the lakes and in the communities within the District.

Location	**Total # of BMPs**	**Total Phosphorus Reduced (lbs/yr)**	**Total Sediment Reduced (tons/yr)**
Elkhorn Lake	2	0.49	4.96
Long Lake	1	2.53	2.98
Monongalia Lake	5	45.44	66.81
George Lake	3	2.46	2.00
Nest Lake	12	48.84	25.25
Green Lake	17	56.44	56.95
Calhoun Lake	1	0.78	0.92
Diamond Lake	14	< 54.31	< 16.02
Middle Fork Crow River	10	127.89	120.57
Total Middle Fork Crow River watershed	**65**	**339.18 lbs/yr**	**296.46 tons/yr**

*Data may show different results from years prior due to completion of BMP contracts. Once a contract is fulfilled, MFCRWD has no authority to control the longevity of projects past the contract final dates, thus omitting the data and affecting the totals.