Watershed assessment and trends update

Pomme de Terre River Watershed

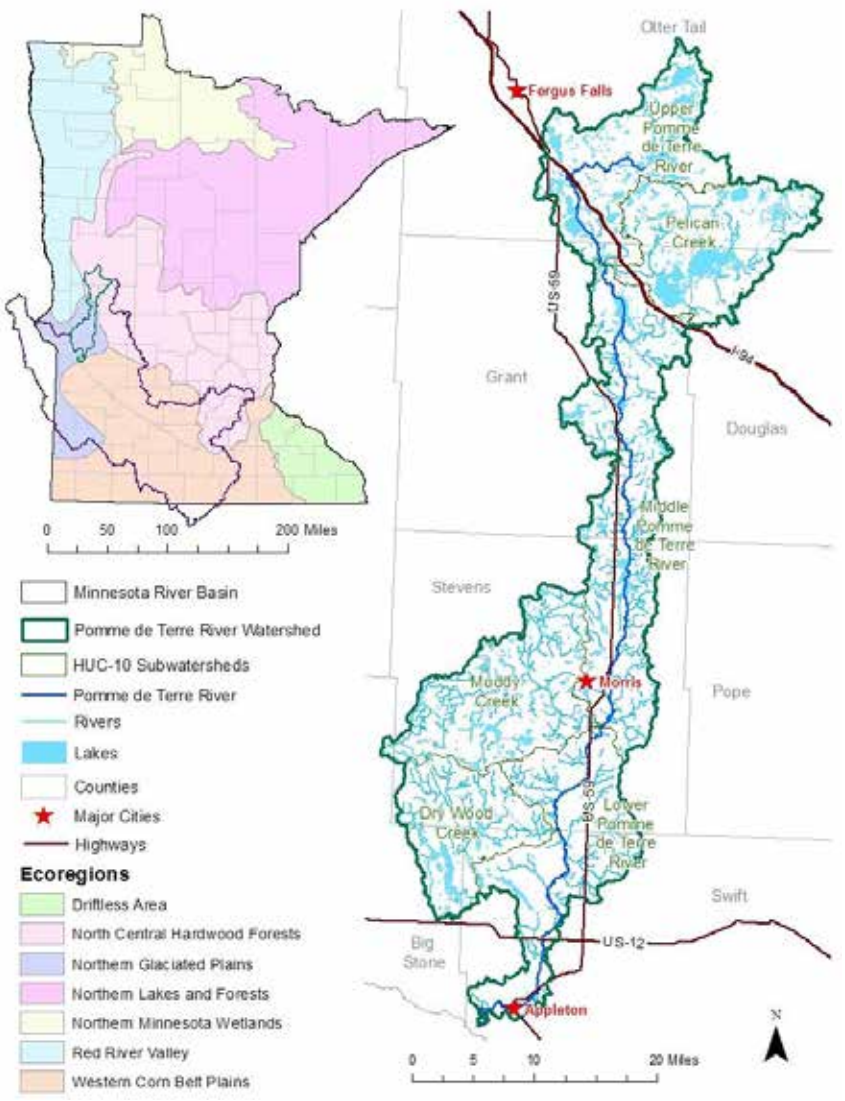
Minnesota River Basin

Why is it important?

Lake Christina, located in the upper portion of the Pomme de Terre Watershed, is a nationally-recognized staging area for migratory waterfowl. Waters in the watershed are also important for recreation like fishing and swimming. There are quality-fishing opportunities for fish species like channel catfish, walleyes, and northern pike in its lakes and the Pomme de Terre River.

Is the water quality improving?

Over the past decade, scientists observed little change in water quality in the Pomme de Terre River Watershed. While the biological condition in individual streams may have improved or declined between 2007 and 2017, the overall health of fish and macroinvertebrate communities did not change over this period. Continued problems include elevated bacteria, excess sediment (turbidity) and low dissolved oxygen levels. Water monitoring is essential to determining whether lakes and streams meet water quality standards designed to ensure that waters are fishable and swimmable.



The Pomme de Terre River Watershed in western Minnesota is a tributary to the Minnesota River.

While local partners and state agencies monitor water quality on an ongoing basis, the Minnesota Pollution Control Agency (MPCA) and local partners conduct an intensive exam of major lakes and streams in each of the state's 80 watersheds every 10 years.

To detect any changes in water quality, this intensive exam looks at fish and macroinvertebrate communities as well as water chemistry. They use the data to see which waters are healthy and need protection, and which are polluted and need restoration.

- The Pomme de Terre River upstream of Barrett, continues to support high-quality fish and bug communities, including several fish species, such as rainbow darters, weed shiners, and hornyhead chub that are intolerant of pollution. This region should continue to be protected.
- Elevated flows hampered biological sampling efforts in 2017. Ten stations were not sampled for fish and macroinvertebrates. Sampling at these locations was postponed until 2018 due to persistent high flows.
- Macroinvertebrate communities generally are good in the northern half of the watershed.
- Across the watershed, there is no significant change in stream biological condition over the last 10 years for both fish and macroinvertebrates.

MPCA scientists monitored the fish and bugs, along with several water quality parameters, in the Pomme de Terre River Watershed as part of the statewide effort to gauge the health of major lakes and rivers.

Landowners have installed hundreds of best management practices to improve water quality, but many more are needed. It takes time for these practices to show results.

Highlights of monitoring

- For lakes with long-term trends, 29% are seeing improvements in water quality and 62% are showing no change.
- Drywood Creek shows an increase in Index of Biotic Integrity (IBI) scores for both fish and macroinvertebrates over the last 10 years.
- Flows in the Pomme de Terre River and its tributaries are increasing as a result of both artificial drainage and increased precipitation. Increasing streamflow has implications for stream channel conditions and pollutant loading. This leads to more channel erosion and possibly more pollutant loading, even if pollutant concentrations are stable.
- Nitrate-nitrogen showed a statistically significant change, increasing about 11% each year, or about 0.07mg/L.
- The northern two-thirds of the watershed, upstream of Muddy Creek, supports healthy stream macroinvertebrate communities based on 2017 and 2018 monitoring. The northern one-third of the watershed, upstream of Barrett, supports healthy stream fish communities. The one exception to this pattern is Pelican Creek.
- In 2012, Pelican Creek was placed on the impaired waters listed for aquatic life use, based on macroinvertebrates. Monitoring data collected in 2017 suggests that the community may be attaining aquatic life use goals, but there was insufficient data to make a case to delist or correct the macroinvertebrate impairment. The MPCA is planning macroinvertebrate monitoring in Pelican Creek to assess its status by attempting to obtain a sample at or near summer baseflow conditions.

Success story

In 2020, the Minnesota Department of Natural Resources removed an old dam on Drywood Creek, a tributary to the Pomme de Terrre River.

When the dam was built in 1971, the goal was to prevent rough fish from migrating upstream to Drywood Lake southwest of Morris in Stevens County. It didn't work; carp could get over the dam at times, while native species could not. This lack of connectivity harms fish populations upstream.

By 1997, erosion caused the dam to fail, leaving a channel around the concrete structure. The creek below the dam had been straightened from the natural meander. Without its natural curves to slow water flow, the creek suffered from greater streambank erosion, and restricted access for flood flows.

With the dam removed, fish – and bugs – can now move as needed to find food and spawn. The biology of the creek should improve as far as numbers and diversity of species. Removing the dam also helps restore the floodplain to hold back and filter water.

Several partners worked together to remove a failing dam on Drywood Creek and restore its natural meander, helping to improve the creek's water quality along with fish and bug populations.

Several partners cooperated on the dam removal project, which was funded through several state programs, including the Clean Water Fund. See the full story on the MPCA website: www.pca.state.mn.us/featured/going-natural-water-quality.

About this study

The Pomme de Terre River Watershed, covers 875 square miles in west central Minnesota within the Minnesota River Basin. The northern portion is located in the Northern Central Forest Ecoregion, while the central and southern portions are located in the Northern Glaciated Plains Ecoregion.

The watershed's population of about 16,000 contains the larger cities of Morris and Appleton. Portions of six counties in the watershed include Otter Tail, Douglas, Grant, Stevens, Swift, and Big Stone. The watershed contains six HUC-10 subwatersheds, 68 stream reach AUIDs, and 217 lakes. In 1981 the six counties formed the Pomme de Terre River Association to work on monitoring and projects to protect and improve water quality in the watershed. The MPCA and partners monitored water quality conditions in 2007-2008 and again in 2017-2018. Chemistry data collected by local partners between 2009 and 2018 were used for assessment. The data used to assess the condition of Minnesota waterbodies, focus on whether or not they are meeting water quality standards for aquatic life, recreation, and consumption. The overall goal of these assessments is to ultimately determine which waters are healthy and in need of protection, or are polluted and require restoration.

Streams

Overall, about one-third of the stream reaches pass for aquatic life uses (Figure 1) in the Pomme de Terre River Watershed. While streams like the upper reaches of the Pomme de Terre River have fish and macroinvertebrate communities that are in good condition, the majority of streams, particularly in the lower two-thirds of the watershed, have biological communities that are severely degraded (Figure 2-next page). In general, fish and macroinvertebrate communities in the

watershed exhibit signs of degradation characterized by a dominance of pollution-tolerant species. Aquatic macroinvertebrate communities tended to be in better condition than fish between the city of Barrett and Muddy Creek in the mainstem Pomme de Terre River.

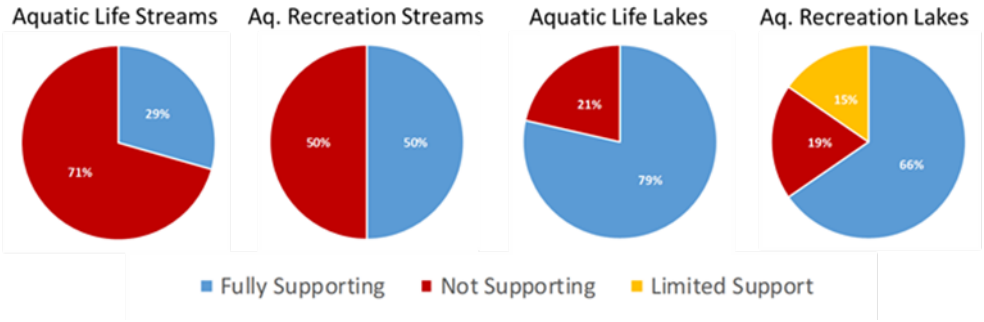


Figure 1. Watershed assessment results for aquatic life in streams and aquatic recreation in streams and lakes.

There are two Watershed Pollutant Load Monitoring Network (WPLMN) stations that operate every year on a long-term basis. The long-term nature of these stations is critical for trend analysis, measuring between-year differences in pollutant loading, and helping determine pollutant sources and their contributions.

In the Pomme de Terre River Watershed, elevated bacteria, excess sediment (turbidity) and low dissolved oxygen were the primary chemical impairments found throughout the watershed. Land use consists of a combination of mixed forest, wetlands, row crops, and pastures in the headwaters. Moving downstream, it transitions to primarily row crops, which could be driving some of the sediment issues seen in the downstream reaches of the Pomme de Terre River.

Lakes

In general, lakes in the headwaters and those with less anthropogenic (human) influence (i.e., more forest and prairie within their watershed) were meeting standards. Many of those lakes were also deep (more than 15 feet). Lakes with intensively developed (i.e., urban or agricultural) watersheds, flow-through lakes, and shallow lakes were more likely to be impaired. Internal loading (the recycling of phosphorus within a lake) will have to be addressed after watershed inputs of nutrients are controlled for shallow lakes in the watershed. Newly impaired lakes include Barrett, North, and South Drywood.

Aquatic life assessments based on the fish community were conducted on 17 lakes. Oliver (East and West basins) and South Turtle were found to have impaired fish communities. Stressors that could be influencing those communities are degraded and/or developed shorelines, and agricultural land use.

Protection priority should be given to lakes particularly sensitive to an increase in phosphorus with a documented decline in water quality (measured by Secchi transparency), a comparatively high percentage of developed land use in the area, or monitored phosphorus concentrations close to the water quality standard (Figure 2). Middle, Eagle, Jolly Ann, and Long (Otter Tail County) were identified as having very good water quality. Chautauqua and Middle Pomme de Terre lakes are not currently impaired but were identified as vulnerable to exceeding water quality standards as nutrient concentrations were elevated. Protection efforts would be beneficial on these systems.

Aquatic life

Fish and macroinvertebrate communities are a direct measure of aquatic life in the rivers and streams. Between the first and second rounds of biological monitoring in the Pomme de Terre River Watershed the MPCA, adopted new rules to assess aquatic life in channelized streams and

ditches associated with a Tiered Aquatic Life Use framework (TALU). The new rules provide reasonable aquatic life protections for waterbodies that were legally altered prior to the advent of the Clean Water Act. The most recent assessments include aquatic life use designations and assessment results for six altered streams segments that were not assessed in Cycle 1.

In the Pomme de Terre River Watershed, seven new stream segments were found to have impairments for biology (four reaches for fish and macroinvertebrates, and three additional reaches for fish). The only new impairment on a natural reach of Pelican Creek is upstream of a dam, which could be a barrier to fish colonization. Downstream and near the confluence with the Pomme de Terre River, Pelican Creek had passing biological fish scores in 2007 and 2017. Fish communities downstream of the Barrett and macroinvertebrates downstream of Muddy Creek generally do not meet standards designed to protect aquatic life.

In the Pomme de Terre River Watershed, elevated phosphorus levels were prevalent across the watershed. Relative to other major watersheds in Minnesota, (Figure 3) cumulative water quality conditions as measured in the Pomme de Terre River reflect the transitional nature of the watershed. Ten-year average water runoff and levels of pollutants (suspended solids, phosphorus, and nitrate nitrogen) fall mid-way between those seen in other parts of the state. Figure 3 shows statewide monitoring results for total phosphorus (TP).

In addition to the WPLMN site in Appleton, (that has been operating every year since 2007), there is a subwatershed-scale site upstream that has been operating since 2013. Based on results of this site we now see that nitrate-nitrogen, phosphorus, and suspended solids concentrations increase from the upper watershed to the lower watershed. This is likely due to land use in the watershed. Similar maps for other pollutants and supporting data can be found at: https://www.pca.state.mn.us/water/watershed-pollutant-load-monitoring

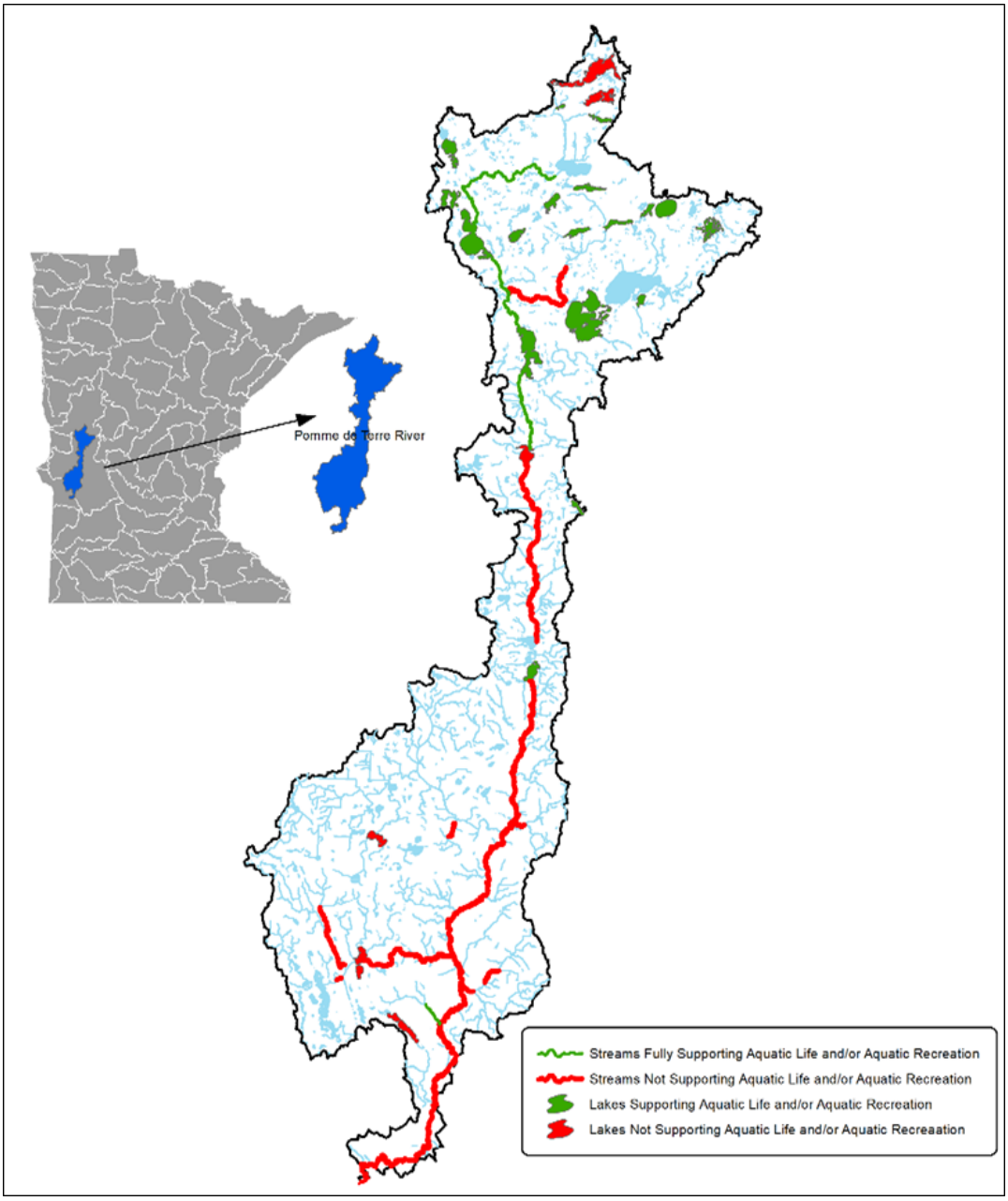


Figure 2. Assessment results for aquatic life and aquatic recreation on rivers, streams, and lakes.

Trends

A key objective of the 2017 monitoring effort was to evaluate if and how water quality has changed since 2007 (Figure 4-next page). If water quality has improved, it is important to understand to what extent strategy development, planning, and implementation, based on the initial work and combined with actions that were already underway, may be responsible. It is equally important to understand if water quality does not appear to be changing, or is declining. Either way, the knowledge will help inform future activities.

Trends in four different aspects of water quality was analyzed to provide as robust a picture as possible of what is happening in the Pomme de Terre River Watershed:

1) Streamflow, sediment (total suspended solids), TP, and nitrogen (nitrate)
2) Biological communities
3) Clarity of lakes
4) Climate

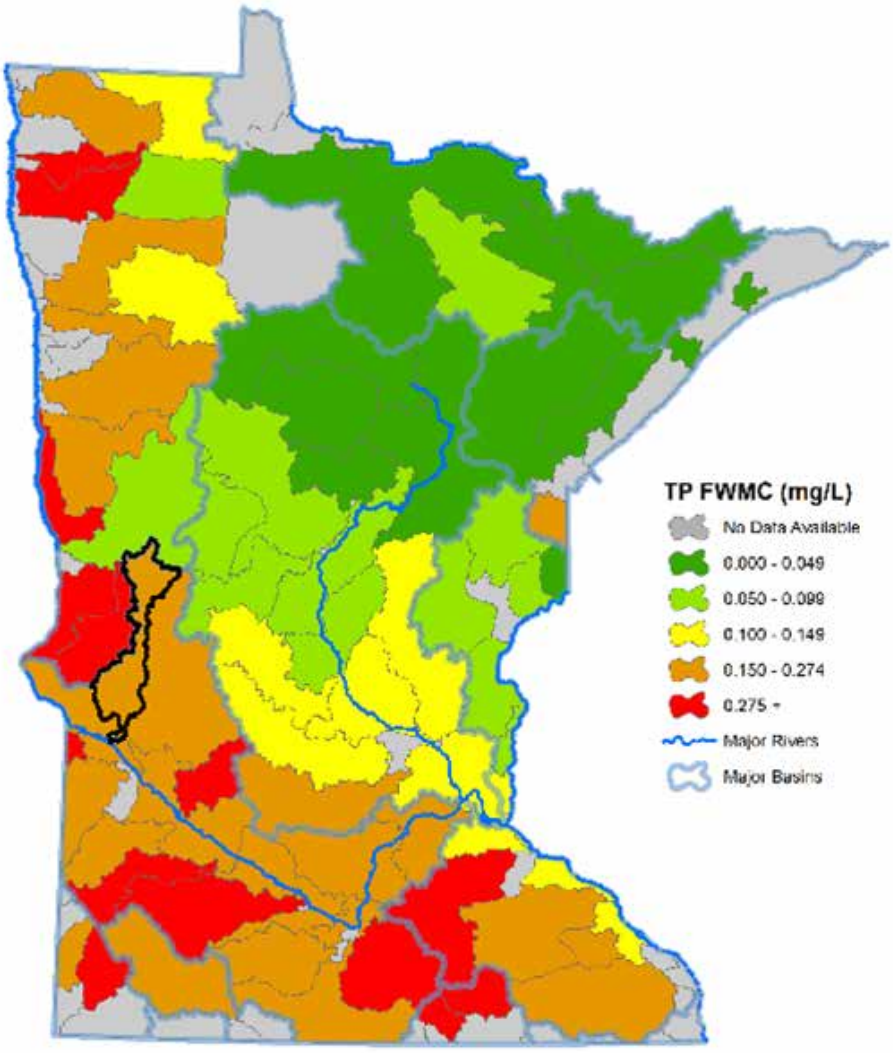


Figure 3. Average TP flow weighted mean concentration by major watershed.

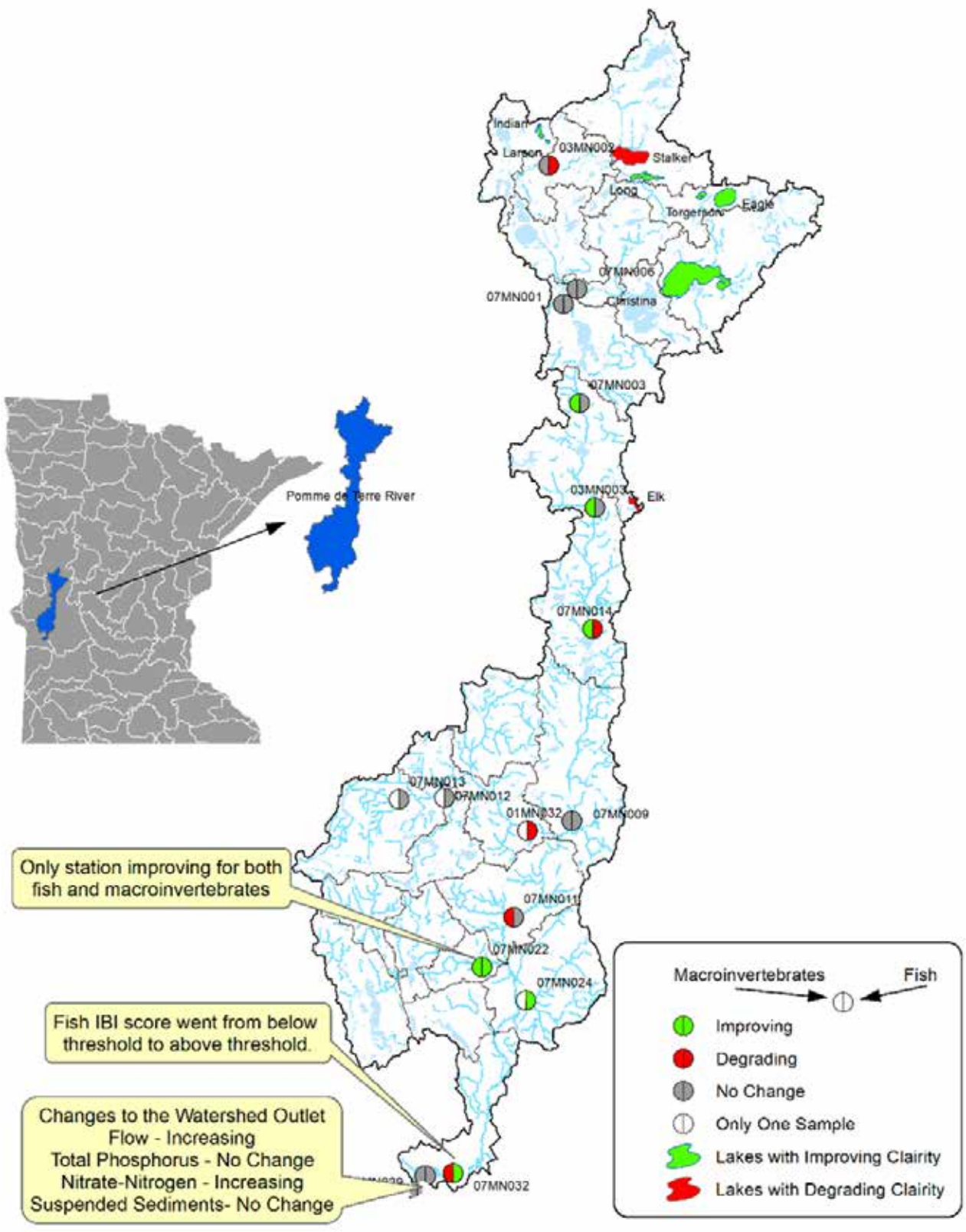


Figure 4. Change in water quality in the Pomme de Terre River Watershed.

Streamflow and pollutant concentrations

Annual streamflow (discharge) data is available for the Pomme de Terre River Watershed since 1936. There is an increasing trend in flow on the Pomme de Terre River (Figure 5).

Seasonal Kendall trend test on suspended sediment, phosphorus, and nitrate-nitrogen concentrations at the Pomme de Terre River outlet were used to determine if changes over time were statistically significant. Only nitrate-nitrogen showed a statistically significant change, increasing about 11% each year, or about 0.07mg/L. It is important to note that most of the change has occurred over the last 3-4 years and because the Pomme de Terre River is starting from a fairly low concentration, the percent of change is larger than some other sites that are increasing at a high rate in terms of mg/L. Suspended solids and TP are neither increasing nor decreasing according to the test.

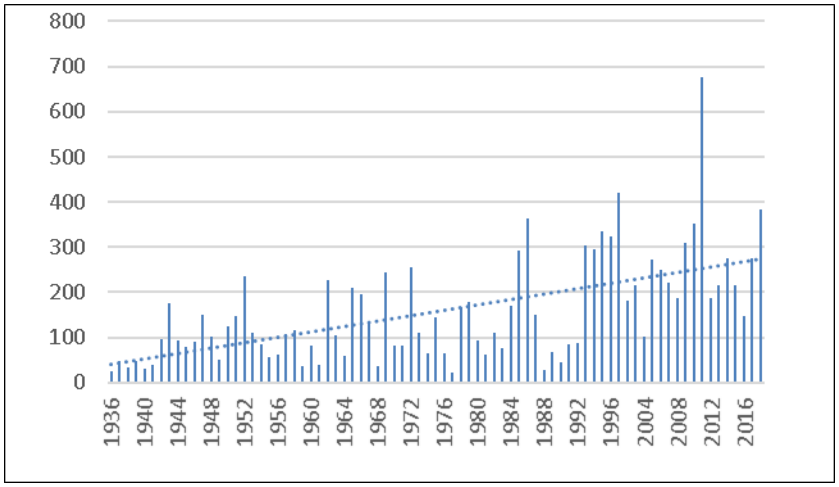


Figure 5. Pomme de Terre River average annual flow (CFS).

Streamflow in the Pomme de Terre River is increasing, which has implications for stream channel conditions and pollutant loading. This could mean more channel erosion and possibly more pollutant loading, even if pollutant concentrations are stable. Because loads represent the total amount of a pollutant moving through a system, this way of measuring water quality is important for downstream resources such as the Minnesota River, where these pollutants may accumulate.

Fish and macroinvertebrate communities

Paired t-tests of fish and macroinvertebrate IBI scores were used to evaluate if biological condition of the watershed's rivers and streams has changed between time periods. Independent tests were performed on each community with 11 sites evaluated for macroinvertebrates and 15 sites evaluated for fish (i.e., sites that were sampled in both time periods). The average macroinvertebrate IBI score for the watershed increased by 5.1 points between 2007 and 2017, this however does not represent a statistically significant change. Similarly, fish IBI scores across the Pomme de Terre River Watershed increased by 0.3 points, which was also not statistically significant.

Context for the change analysis results is provided by a characterization of the conditions under which biological monitoring occurred in time 1 and time 2. In 2007, the Pomme de Terre River Watershed experienced a moderate-severe rainfall deficit (-2.5 in) and was abnormally hot (+2.0 ^{o}F) during the May to September time period (Figure 6). The watershed had above normal rainfall (+5.6 in) and near normal temperature (-0.5 ^{o}F) in 2017 over the May to September time period. Heavy precipitation in August of 2017 (~ 8 inches) effectively ended fish and macroinvertebrate monitoring in the watershed, so the above normal rainfall over the May to September period is not entirely reflective of conditions during biological monitoring. In fact, fish monitoring that did occur in 2017 happened under relatively normal flow conditions in early August.

Since monitoring ceased in August of 2017 due to high flows, about half of the anchor sites in the Pomme de Terre River Watershed needed to be sampled in 2018. During the summer months of 2018 the watershed had near normal rainfall (+1.5 in) and was abnormally hot (+1.7 ^{o}F). Overall, given the hot and dry conditions affecting the watershed in 2007 and the wetter than average or near normal conditions, depending on the year, present in time 2, there is a high likelihood that any

observed changes in biological condition at either the watershed or individual site scale are at least partially due to differences in climatic conditions between the two periods.

Clarity of lakes

The Pomme de Terre River Watershed has 44 lakes with some level of transparency data. Trend analysis was conducted on 20 lakes that met data requirements (50 Secchi measurements, eight years of data). Similar to statewide results, most lakes do not exhibit a significant trend and more lakes have improving clarity than declining. Six lakes had increasing clarity; these include Christina, Torgerson, Eagle, Long (in Otter Tail County), Indian, and Larson. Two lakes had declining clarity, Elk and Stalker. Lake Christina is managed to maintain a clear state with abundant vegetation for migrating waterfowl. The lake is known to periodically flip between a clear and turbid state; the current improving trend will be dependent on the lake remaining in a clear state.

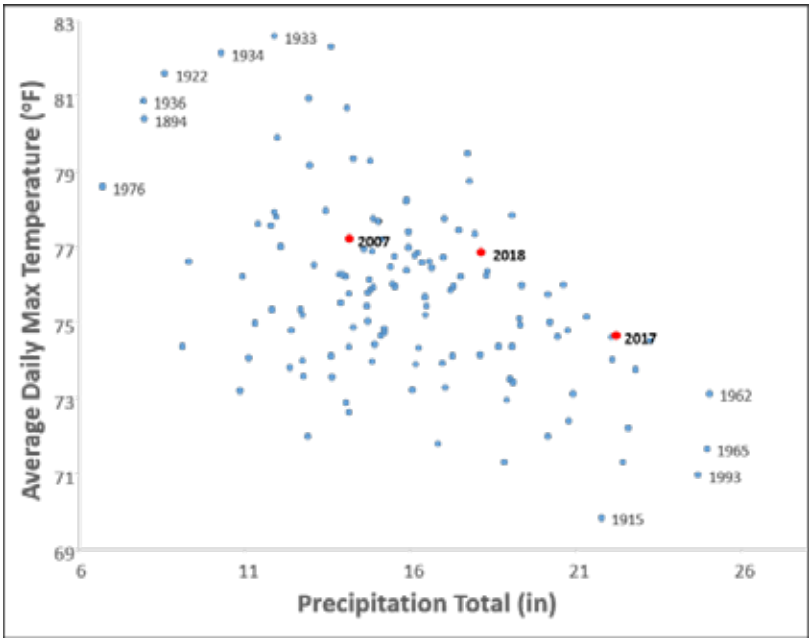


Figure 6. Characterization of air temperature and rainfall conditions for May-September period across historical record for the Pomme de Terre River Watershed. Biological monitoring years for the watershed highlighted in red.

Climate

The Pomme de Terre River Watershed now receives on average 1.8 additional inches of rain from the historical average (1895-2018). Furthermore, climate scientists suggest that precipitation events are becoming more intense. In addition, temperatures in the watershed have increased by about one degree in spring and fall over this time period. Increased rainfall and temperature can worsen existing water quality problems. More precipitation and reduced snow cover can increase soil erosion, pollutant runoff, and streamflow's. Increased streamflow's in turn can lead to stream channel erosion and degraded habitat for fish and other aquatic life. Longer growing seasons with higher temperatures can lead to more algal blooms. These changes will complicate efforts to protect and restore the watershed. DNR climate summary for the Pomme de Terre Watershed.

For more information

Stressor identification for new impairments and updates to the Watershed Restoration and Protection Strategy follow the completion of monitoring and assessment. For more information, go to the MPCA Pomme de Terre River webpage, or search for "Pomme de Terre River" on the MPCA website.

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CLEAN WATER LAND & LEGACY AMENDMENT

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