Watershed assessment and trends update

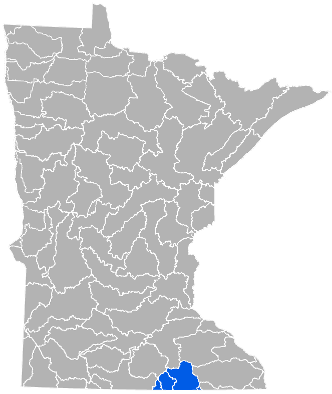
Cedar, Shell Rock, Winnebago, and Upper Wapsipinicon River Watersheds

Cedar River Basin

Why is it important?

The Cedar, Shell Rock, Winnebago, and Wapsipinicon Rivers located along the Minnesota/Iowa border are important water resources for local communities. All four of these watersheds flow out of Minnesota through Iowa and into the Mississippi River. With the headwater portion of these watersheds in Minnesota, activities in these rivers have considerable impact on the water quality and beneficial uses downstream in the neighboring state of Iowa. These rivers provide considerable recreational opportunities such as fishing, canoeing, and kayaking. Gamefish species sought by anglers include northern pike, smallmouth bass, catfish, and walleye. Canoeing and kayaking are popular; portions of the Shell Rock River, Cedar River in Minnesota and Iowa, and the Wapsipinicon in Iowa, are designated water trails. These rivers also provide important habitat and corridors for wildlife and aquatic communities. A portion of the Wapsipinicon near the Mississippi River is one of five designated Protected Water Areas in Iowa. The second largest city in Iowa, Cedar Rapids, depends on this important water resource for drinking water.

Figure 1. From west to east, the Winnebago, Shell Rock, Cedar, and Upper Wapsipinicon River Watersheds locations in Minnesota



This update summarizes the second round of intensive monitoring for these watersheds. This on-going monitoring of these valuable resources helps determine progress toward these waters meeting water quality standards, preserving the beneficial uses for the future, and helps refine management decisions for improving degraded water resources.

Is the water quality improving?

Over the past five to ten years scientists observed little change overall in water quality of the Cedar, Shell Rock, Winnebago, and Wapsipinicon River Watersheds. While the biological condition in individual streams may have improved or declined between initial monitoring and the current monitoring effort, the overall health of fish and macroinvertebrate communities did not significantly change over this period. Continued problems include elevated bacteria, excess sediment (turbidity), nutrients, and low dissolved oxygen levels. Surface water monitoring is essential to determining whether lakes and streams meet water quality standards designed to ensure that waters are fishable and swimmable.

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 survey 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 survey looks at fish and macroinvertebrate communities as well as water chemistry. Data is examined to determine which waters are healthy and need protection, and which are polluted and need restoration.

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

- The overall quality of the fish communities across the four major watersheds increased slightly since the initial sampling in 2009 for the Cedar River and Shell Rock River Watersheds, and 2015 for the Winnebago River and Wapsipinicon River Watersheds. As a result of the 2019 sampling, three reaches had fish community impairments that were delisted/corrected, which reduced the total from 21 to 19 aquatic life impairments based on fish for the four watersheds.
- Stream macroinvertebrate communities exhibited a net increase in biological condition, with five streams that were either delisted or corrected on the 2022 Impaired Waters List, and two new macroinvertebrate impairments, which reduced the total number of macroinvertebrate impairments from 39 to 36.
- The quality of the fish communities in the mainstem Cedar, Shell Rock, and Wapsipinicon Rivers improved from initial sampling to 2019. More specifically, the quality of the fish communities in County Ditch 16 (Shell Rock River Watershed) and the Middle Fork of the Little Cedar River (Cedar River Watershed) have improved considerably.
- The quality of the fish community at the pour-point of the Winnebago River (Lime Creek) Watershed at the Iowa border declined slightly since 2015. The largest declines in fish community quality occurred in the Little Cedar River (mainstem) and Woodbury Creek in the Cedar River Watershed. For now, these streams are still meeting water quality standards for the fish community.
- The quality of both the fish and macroinvertebrate communities improved in the Cedar River near Austin as well as County Ditch 16 in the Shell Rock River Watershed.
- No lakes in this study exhibited declining clarity.

Highlights of monitoring

- Two stations in the Cedar River Watershed have been designated as long-term monitoring locations, and each have been sampled six times between 2009 and 2019. After initially being listed as impaired in 2009, long-term monitoring stations on Woodbury and Roberts Creeks have consistently yielded macroinvertebrate index of biological integrity (IBI) scores indicative of a healthy community, resulting in the removal of the macroinvertebrate impairments from the 2022 Impaired Waters List. Roberts and Woodbury Creeks currently support quality fish communities. Despite healthy aquatic communities, Roberts Creek is potentially susceptible to failing to meet water quality criteria if degradation occurs.
- Although Fountain Lake was assessed as impaired for aquatic recreation in 2008 and aquatic consumption in 2012, fish community data had not been collected to assess aquatic life until 2018. This data confirms that Fountain Lake is also impaired for aquatic life, which aligns with the previous beneficial use assessments.

- A total of 50 fish species were collected during the 2019 watershed survey. Of these, 15 are considered sensitive species — susceptible to pollution and watershed disturbance. One of these species, the Ozark minnow, is a State Species of Concern. Seven of the species are considered tolerant, while nine of the species are considered very tolerant to watershed stressors.

Success story

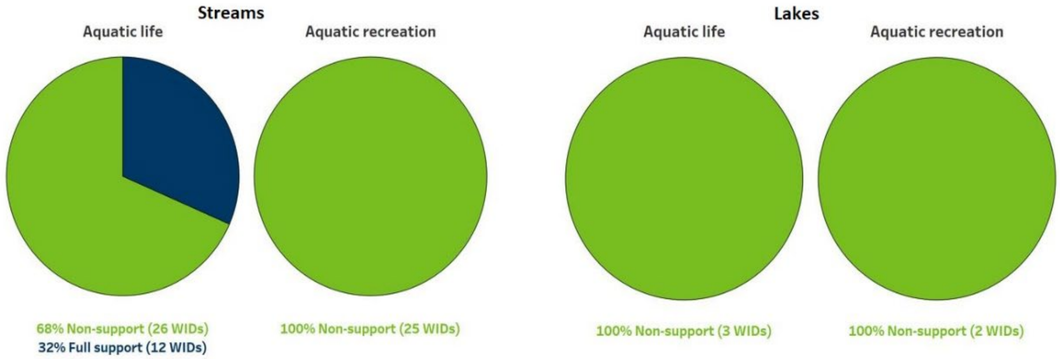
In the Dobbins Creek Subwatershed (Cedar River Watershed) ongoing projects to increase water storage and restore stream channel condition have occurred since 2009. Some of these projects include grassed waterways (**Picture 1**) to reduce erosion in fields and reduce sediment in the stream, along with water storage structures to reduce the impact of high-flow rain events on stream condition. While the upper reaches of Dobbins Creek have been shown to have poor macroinvertebrate and fish communities, the lower reaches below and within the area receiving restoration have shown a consistently healthy macroinvertebrate and fish community. Fish samples in this lower reach of Dobbins Creek consist of 16 to 21 species, only one to two intolerant species, and two to five sensitive species (5-15% of individuals in the samples) representing a balanced and diverse fish community. Efforts to restore riparian areas and instream habitat in reaches that have persistent flow conditions create the opportunity for macroinvertebrate and fish communities to thrive.

Picture 1. Field condition before and after implementation of a grassed waterway within the Dobbins Creek Subwatershed. Photo courtesy of Mower County SWCD.

Watershed assessment results

MPCA and partners initially monitored water quality conditions in 2008-2009 in the Cedar River, in 2009-2010 in the Shell Rock River, and in 2015-2016 in the Winnebago River and the Upper Wapsipinicon River Watersheds. Water quality conditions were monitored again in 2019-2020 across the entire basin (within Minnesota). Chemistry data collected by MPCA and some local partners between 2011 and 2020 were used for assessment. The data used to assess the condition of Minnesota waterbodies focus on whether they are meeting water quality standards for aquatic life, recreation, and consumption. The goal of these assessments is to determine which waters are healthy and in need of protection, and which are polluted and require restoration.

Figure 2. Assessment results for aquatic life and aquatic recreation of lakes and streams in the Cedar Basin Watersheds. Fountain Lake consists of 3 WIDs (North, East, and West bays).



Streams and rivers

Across the Cedar Basin watersheds, 38 stream reaches have been assessed for aquatic life, with 32% of the stream reaches supporting their designated aquatic life uses (**Figure 2**). Of the 36 stream reaches assessed for aquatic life based on biology, 18 existing fish impairments remained after the current sampling effort, along with the addition of one new fish impairment. Thirteen reaches had supporting fish and macroinvertebrate communities. Another 13 reaches had supporting fish communities, with non-supporting macroinvertebrate communities, and two of which were not assessed or sampled for macroinvertebrates.

Four stream reaches in the Cedar Basin that were previously listed as impaired due to poor macroinvertebrate community health have been recommended to be delisted for macroinvertebrate impairment due a consistent increase in community health scores: two reaches in the Cedar River Watershed, one in the Shell Rock River Watershed, and one in the Winnebago River Watershed. There are not clear associations between the increased community scores and changes in the contributing watershed, but a clear upward trend in biological conditions is encouraging to see. The trend of increasing precipitation and associated stable flows, as well as these stations having good instream habitat, intact riparian zones, and/or buffers, could also be a contributing factor to the presence of a more resilient macroinvertebrate community.

Three reaches: Bancroft Creek in the Shell Rock River Watershed, Turtle Creek near the confluence with the Cedar River, and the Wapsipinicon River were removed from the Impaired Waters List as the result of the fish communities currently meeting water quality standards. These improvements to the fish community are not attributed to specific projects in upstream watersheds; several potential factors over time likely contributed to the attainment of standards, including changes to BMP practices, buffer strips, and changes to fish barriers.

None of the assessed stream reaches in the basin were found to be supporting the aquatic recreation designated use due to elevated levels of bacteria. Data from monitoring conducted in 2019-2020, and by local partners between 2011-2020, confirmed 13 of the 21 previous bacteria impairments from past monitoring efforts, resulting in new *E. coli* impairments on 12 stream reaches (eight of the reaches lacked sufficient data for assessment, but existing impairment designations will remain). These new impairments are unlikely to be a signal of any significant negative change in watershed condition since initial monitoring was completed in these watersheds. Rather, the new impairments are more likely a function of enough data to assess in these watersheds. Nine of the 12 new impairments are in the Dobbins Creek Subwatershed of the Cedar River Watershed, which was monitored intensively by Cedar River Watershed District and the University of Minnesota in the summer of 2015. Monitoring data also showed three streams vulnerable to impairment due to excess bacteria, indicating elevated bacteria counts near the standard.

Excess sediment, also referred to as turbidity and TSS (total suspended solids), impacts many of the Cedar River Basin's streams. There are 10 stream reaches with existing turbidity impairment listings in the basin, along with one stream with an existing TSS impairment. Data from the monitoring conducted in 2019-2020 confirmed four of these previous turbidity impairments from past monitoring efforts and resulted in a new TSS impairment on the Cedar River from its headwaters to Roberts Creek and on Roberts Creek from an unnamed creek near Brownsdale to the Cedar River. Six of the reaches lacked sufficient data to assess for TSS, but existing turbidity impairments will remain. Additionally, two stream reaches in the basin were identified as being vulnerable to TSS impairment based on monitoring data.

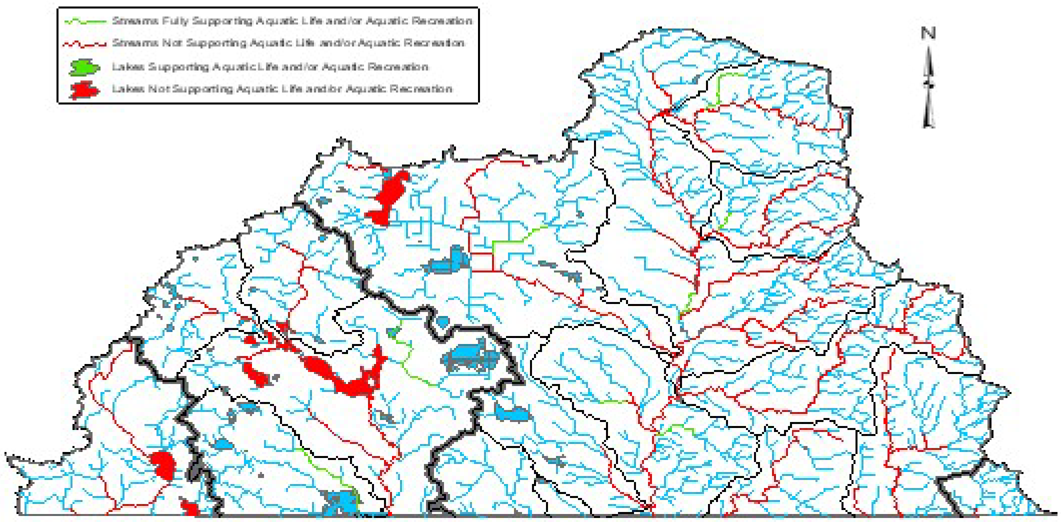
Previous monitoring and assessment along with stressor identification efforts within the Cedar River Basin have identified low dissolved oxygen in streams as an issue, with five existing impairments for dissolved oxygen in the basin. Data collected between 2011 and 2020 confirmed the impairments for four of the five existing impairments, with one stream reach having insufficient information to assess. Additionally, these monitoring efforts resulted in a new dissolved oxygen impairment on an unnamed creek downstream of Judicial Ditch 25 in Freeborn County. All but one of the dissolved oxygen impairments in the basin are found within the Lime Creek Subwatershed of the Winnebago River Watershed. These stream reaches are low-gradient, highly altered, and drain into and out of the nutrient-impaired Bear Lake — all factors that likely contribute to the low dissolved oxygen observed.

Three stream reaches in the basin have impairments for river nutrients based on a multi-part standard that includes total phosphorus (TP) and one or more of the following response variables: pH, chlorophyll-a, dissolved oxygen flux, biological oxygen demand (BOD). The river nutrient impairment in the Shell Rock River from Albert Lea Lake to Goose Creek was confirmed with new data collected through 2019-2020 monitoring efforts. MPCA recently completed a Total Maximum Daily Load (TMDL) study that was approved by the U.S. Environmental Protection Agency in June 2021 to address this river's nutrients impairment and others across the Shell Rock River Watershed. The other two impairments for river nutrients will remain listed due to insufficient or inconclusive (e.g., near the applicable water quality standards) data.

Throughout the Cedar River Basin, elevated bacteria, excess sediment (TSS/turbidity), and low dissolved oxygen were the most common chemical impairments found. Impairments for river nutrients were also found on a smaller number of stream reaches across the basin. Land use throughout the basin is dominated by cultivated crops, and many stream channels have been heavily altered, which may contribute to and exacerbate these water chemistry impairments.

A pH impairment on the Shell Rock River (07080202-501) from Albert Lea Lake to Goose Creek will be removed from the Impaired Waters List due to a strong dataset that shows pH standards being met for most of the assessment data window (2011-2020).

Figure 3. Watershed assessment results for the Cedar River Basin.

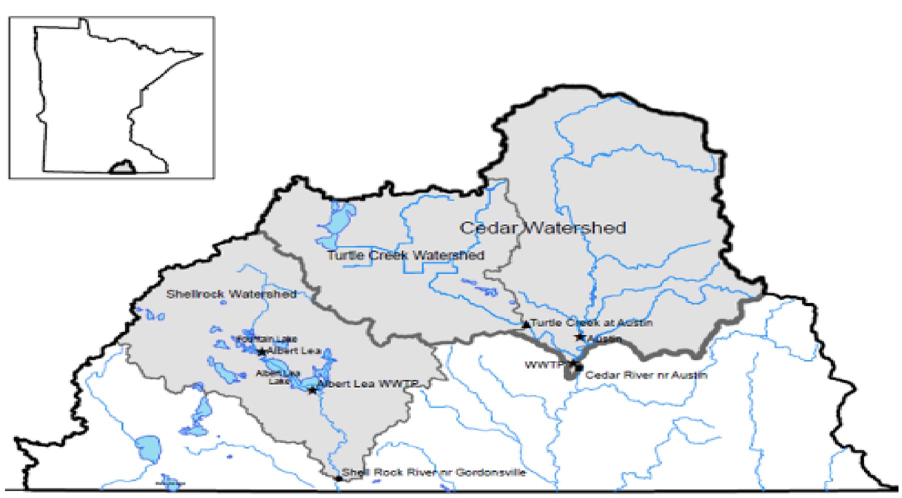


Cedar River Watershed long-term monitoring stations

Due to both state and local concerns and the impacts that the Cedar River has on downstream waters, two Watershed Pollutant Load Monitoring Network (WPLMN) sites were installed to better understand water quality and pollutant loading dynamics within the watershed.

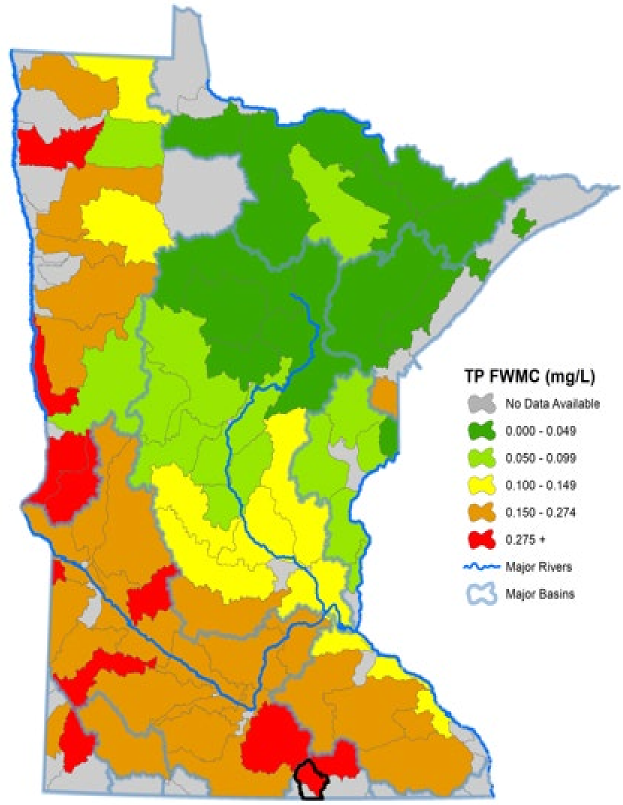
One site is the outlet site, the other is the Turtle Creek Subwatershed site. The Turtle Creek Subwatershed site represents a large ditch system in which the watershed is drained primarily by sub-surface drain tile. On average, the Turtle Creek Subwatershed accounts for 25% of the annual TP load, the City of Austin’s Wastewater Treatment Plant (WWTP) accounts for 34%, and the upper watershed accounts for 42% of the total TP load. The WWTP is in the process of an upgrade, and annual phosphorus loads are estimated to be reduced by 12%, or 20 metric tons annually.

Figure 4. Location of Watershed Pollutant Load Monitoring network stations in the Cedar Basin.



Annual nitrate flow-weighted mean concentrations (FWMC) at the outlet site are 9-9.5 mg/L while the Turtle Creek site averages 8.75 mg/L. Currently Minnesota does not have a river nitrate standard unless the river is used as a source of drinking water. This is not the case for the Cedar River in Minnesota; however, the drinking water standard of 10 mg/L provides a reference when looking at the overall condition of the river. Concentrations near or above this standard are not a good thing. The downstream city of Cedar Rapids, Iowa, must draw water from Ranney wells because the river concentrations are normally above 10 mg/L. These Ranney wells provide some protection but are still strongly influenced by the river. On average, 26% of the annual nitrate load can be attributed to the Turtle Creek Subwatershed. Since the nitrate concentrations tend to run higher at the outlet site, the WPLMN installed a continuous nitrate monitoring probe at the site that currently collects data at 15-minute intervals. In the future, real time nitrate loads will be available based on this continuous probe data.

Figure 5. Average nitrate/nitrite flow weighted mean concentration by major Minnesota watershed, with the Cedar River Watershed outlined in black.



The Austin WWTP upgrade will also help to reduce a portion of the nitrogen load. The upgrade will include a bioreactor to help reduce total nitrogen in the effluent. The WWTP plant measures total nitrogen which is composed of (NO2+NO3+TKN). Currently the WPLMN samples for NO2+NO3 and TKN as separate parameters.

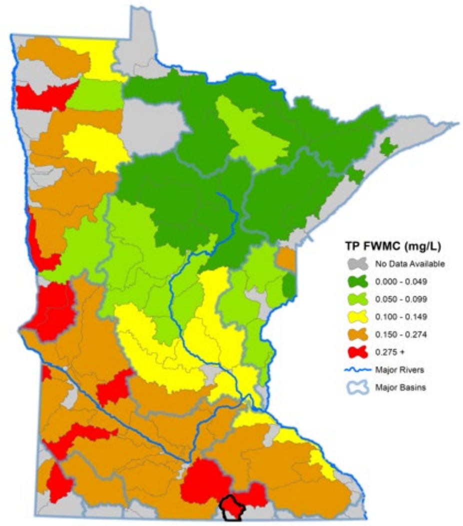
TSS is primarily related to higher flow storm events. On average, the Turtle Creek Watershed contributes approximately 39% of the TSS annual load. The average FWMC of TSS is 38.2 mg/L at the outlet site and 55.6 mg/L at the Turtle Creek site.

Shell Rock River Watershed long-term monitoring stations

Since the Shell Rock River drains to Iowa, the WPLMN placed a long-term monitoring site just above the Minnesota/Iowa border. This site helps to provide a better understanding of water quality and pollutant load dynamics within the watershed, as well as the Shell Rock River's load contribution to Iowa. 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. Over the past decade, the Shell Rock WPLMN site still has much higher than desired levels of phosphorus and nitrate (**Figure 6**).

The high phosphorus concentrations and loads can be partially attributed to the City of Albert Lea's WWTP; about 45% of the phosphorus load. Plans to upgrade the city's WWPT are underway, and TP loads contributions are expected to be reduced by 32%. There is also currently a project to dredge portions of Fountain Lake, which will also help to further reduce TP concentrations in the river.

Figure 6. Average total phosphorus flow-weighted mean concentration by major Minnesota watershed, with the Shell Rock Watershed outlined in black.



Suspended sediment concentrations tend to be on the low end for this portion of the state. An average FWMC of 27.3 mg/L is likely the result of a series of lakes (including Albert Lea Lake) upstream that allow sediment to settle out. The solids often noticed at the monitoring site tend to be in the form of algae and are likely the product of high phosphorous concentrations (**Picture 2**).

Lakes

Shallow lakes with highly disturbed watersheds due to agricultural and urban (shoreline) development dominate the landscape in the Cedar River Basin. All the lakes for which sufficient data was available for assessment were found to not support the aquatic recreation designation use due to excess nutrients. Overall, no new lake recreation impairments resulted from this assessment process based on data collected from 2011-2020. All nine of the existing nutrient impairments will remain on the basin's lakes. Several lakes in the basin had recently undergone or were undergoing water level drawdowns for wildlife management in coordination with the Minnesota Department of Natural Resources. Data from these lakes were not assessed as they are not representative of typical hydrologic states for these lakes.

Although the Cedar River Basin contains numerous shallow lakes, only Fountain Lake was eligible to be assessed for aquatic life use based on fish IBI data. Other lakes in the basin were either subject to recent winterkill events that adversely impacted fish or were too small for the fish IBI to be appropriate. Fountain Lake, which consists of three WIDs (East, North, and West bays), was found to have an impaired fish community. During the fish IBI surveys, 17 fish species were captured. All six species classified as tolerant in the fish IBI (Bigmouth Buffalo, Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish, and Orangespotted Sunfish) were sampled whereas no small benthic-dwelling species were sampled. These metrics, in addition to the other metrics used in the fish IBI, were below expectations when compared to similar healthy lakes. Stressors that are likely influencing this community include excess nutrient inputs from agricultural and urban land uses, degraded and/or developed shorelines, and internal loading.

Picture 2. Water collected from the Shell Rock River.

Local partners are active across the basin's watersheds in implementing BMPs to improve water quality in the valued lakes found in the basin, but ultimately the condition of lakes in the Cedar River Basin is changing slowly (if at all). BMPs implemented on the landscape targeting improvements in lake water quality will require time to be reflected in monitoring results. Internal loading (the recycling of phosphorus within a lake) will also have to be addressed after watershed inputs of nutrients are controlled for lakes in the watershed.

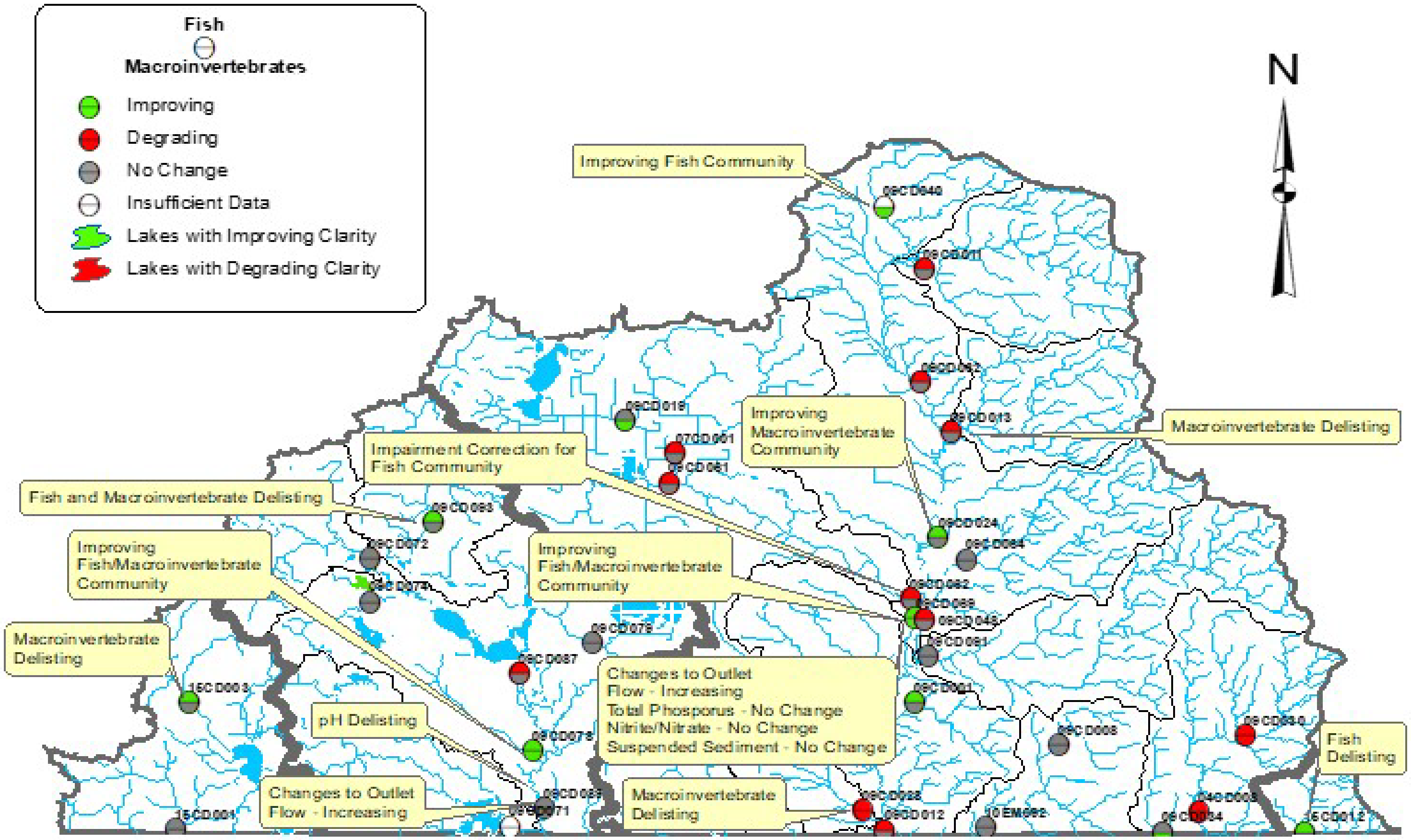
Trends

A key objective of the 2019 monitoring effort was to evaluate if and how water quality has changed since the initial monitoring (**Figure 7**). Where water quality has improved, it's important to understand what may have caused this improvement. This helps affirm actions taking place on the landscape and can further promote additional action. To help inform future monitoring activities, it is equally important to understand if water quality does not appear to be changing or is declining.

Trends in four categories of water quality data were analyzed to provide a robust picture of what is happening in the Cedar Basin watersheds:

1) Streamflow and pollutant concentrations (sediment (TSS), TP, and nitrate)
2) Biological communities
3) Clarity of lakes and streams
4) Climate

Figure 7. Change in water quality in the Cedar Basin watersheds.



Streamflow and pollutant concentrations

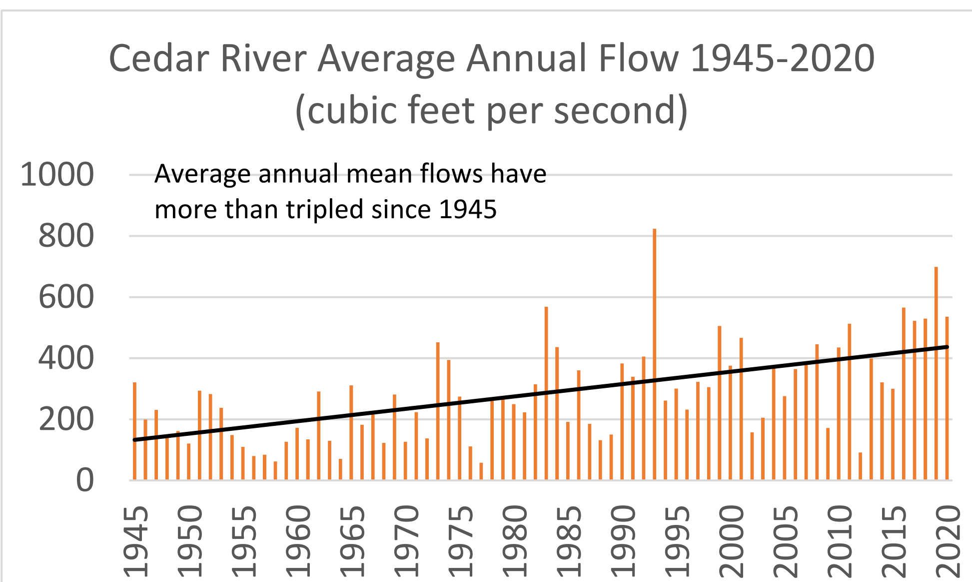
Trend analysis for nitrate, phosphorus, and suspended sediment concentrations was done for the period of 2008-2019 at the monitoring station near the outlet of the Cedar River Watershed. All three parameters (NO2+NO3, TP, and TSS) showed no significant change. Trend analysis was not possible at the Turtle Creek Subwatershed station as it has not been operating for a long enough period; this analysis will be possible in the future. Similar to the Cedar River, the Shell Rock River trend analysis of three key water pollutants (phosphorus, nitrate-nitrogen, and suspended sediment) shows no significant change as well.

While no nitrate trend was detected, the average nitrate concentrations in the Cedar Watershed are among the highest in the state. This may be due to changing cropping practices, expanded agricultural drainage, and climate change. See **Figure 5**.

Given climate change and potential land use changes, the lack of a trend for nitrates, phosphorus, and sediment might be viewed as a positive and the result of coordinated state and local watershed management efforts, including changes to some agricultural practices.

Average annual streamflow has increased dramatically in the Cedar River Watershed (**Figure 8**). Increased streamflow has implications for stream channel conditions, property and safety, and pollutant loading. Increased streamflow results in increased channel erosion and sediment deposition, which can degrade habitat for fish and other aquatic life. Flooding threatens the property and safety of watershed residents. More water means larger pollutant loads and increased chances of downstream flooding. While increasing precipitation is certainly an important factor in the streamflow increase, expanding agricultural drainage and land use changes are also important. In recent years, there has been a significant effort to reduce flows coming from the Dobbins Creek Subwatershed. BMPs strategically placed throughout the Dobbin's Creek Subwatershed are expected to reduce peak flows by 10% during a 100-year, 24-hour event at the outlet site.

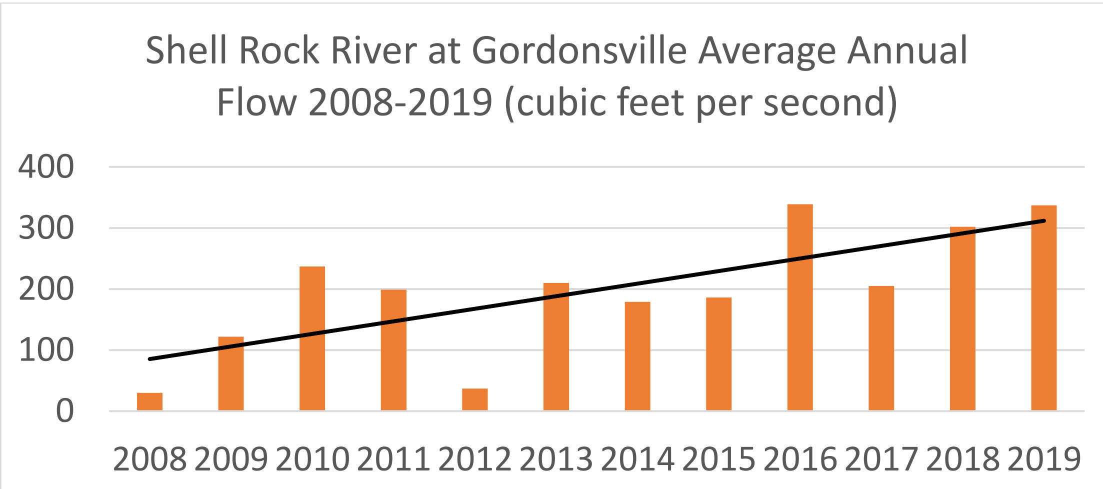
Figure 8. Cedar River annual flow (CFS).



Similar to the Cedar River, average annual flow volume at the Shell Rock River outlet site (**Figure 9**) has shown increases since 2008. These increases are also tied to increasing rainfall amounts, increased agriculture drainage, and land use changes. The apparent increase over the relatively short period (12 years) depicted on this graph is largely driven by the very wet years of 2016, 2018, and

2019. The years 2020 and 2021 were much drier and flows (when data is finalized) will likely be lower. It is worth noting that for rivers in southern Minnesota with long-term records, flows have increased substantially. This includes the Cedar River, where average annual flows have tripled over the past 75 years.

Figure 9. Shell Rock River annual flow (CFS).



Biological 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 31 sites evaluated for both macroinvertebrates and fish (i.e., sites that were sampled in both time periods). The average macroinvertebrate IBI score for the Cedar Basin decreased by 0.9 points between 2009/2015 and 2019, which does not represent a statistically significant change. Similarly, the average fish IBI scores across the four watersheds increased by 3.6 points, which was also not statistically significant. Fish IBI scores increased at 16 of the stations and decreased at 14 of the stations, with the remainder of the stations showing no change in fish IBI scores. A similar change analysis was not completed for lakes because comparable fish community data had not been collected during initial monitoring efforts.

Context for the change analysis results is provided by a characterization of the conditions under which biological monitoring occurred in Cycle 1 and Cycle 2. For the five years prior to sampling in 2009, the Cedar Basin watersheds had experienced a decreasing precipitation trend, which continued for three more years. Conversely, sampling conditions in 2019 took place after five years of average to above-average flow conditions. Long- and short-term precipitation cycles are directly related to flow conditions and can have a significant impact on biological communities. Long-term dry conditions, like those that occurred in 2009, can result in low flow conditions that are stressful to biological communities. Despite the low flow conditions in 2009, a nearly complete set of watershed samples was collected, allowing for a robust comparison between sampling periods. The persistent average to above-average flow conditions preceding the 2019 sampling collection resulted in optimal sampling conditions. The stable flows associated with persistent average to above-average precipitation often result in healthier biological communities, but if flows become too high, sampling conditions can be impacted, and community health scores can be negatively impacted. Given the difference in flow conditions between our two sampling periods, we would expect to see a slight increase in biological health, and this was the case with the fish community.

The health of the invertebrate community between Cycle 1 and Cycle 2 was nearly identical, with a very slight downward trend, which suggests that overall, the low flows experienced in 2009 had a negligible impact on invertebrate health.

Clarity

The Cedar River Basin has 16 lakes with some level of transparency data. Trend analysis was conducted on seven lakes that met data requirements (50 Secchi measurements, eight years of data). Like statewide results, most lakes do not exhibit a significant change, and more lakes have improving clarity than declining. White Lake (Shell Rock River Watershed) had increasing clarity, while the rest of the lakes analyzed showed no trend. None of the lakes analyzed had declining clarity. Much of the data needed to determine these trends comes from scientist volunteers through the Volunteer Water Monitoring Program.

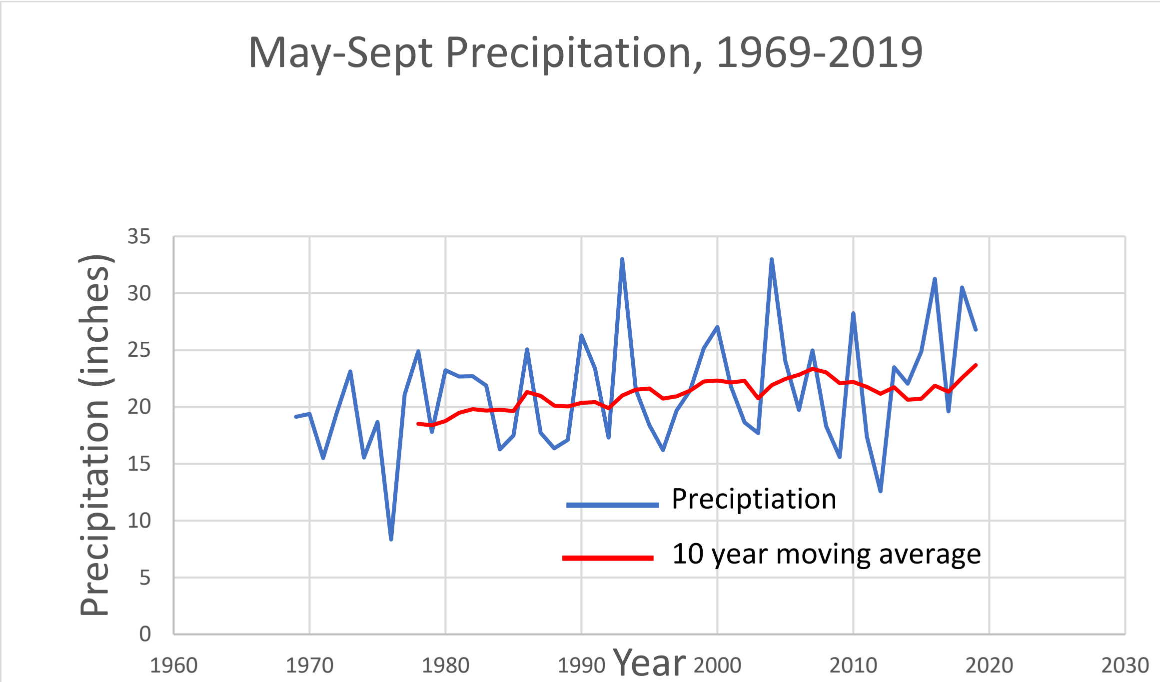
The Cedar River Basin has 75 stream stations that have some level of transparency data, measured with a Secchi tube. Trend analysis was conducted on 15 stream stations that met data requirements. A Tobit regression model, which detects changes in water clarity over time by comparing months across years (Mays are compared to Mays, Junes to Junes, etc.) was used for the analysis. This test also accounts for the limit of the Secchi tube to detect water clarity of 100 centimeters or less. Stream water clarity must change at least 2 cm per decade to be considered a detectable change, or trend.

Degrading clarity was observed at seven of the stations. Improving clarity was observed at three stations. The remaining five stations showed no trend. Multiple stations may exist on an individual stream reach, and different results at monitoring stations along an individual reach are possible and reflect the variability present in stream systems.

Climate

The Cedar Basin Watersheds now receives on average 3.3 to 3.6 additional inches of rain per year when compared to the historical average (1895-2018). Furthermore, climate scientists suggest that precipitation events are becoming more intense. In addition, the average annual temperatures in the watersheds have increased by 0.7 to 0.9 degrees Fahrenheit (F) per year, while average annual winter temperatures have increased by 1.8 to 2.1^{o} F. Increased rainfall and temperature can worsen existing water quality problems. More precipitation and reduced snow cover can increase soil erosion, pollutant runoff, and streamflow. Increased streamflow 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 watersheds. For more information on Climate and watersheds, navigate to [MN DNR Climate Summaries].

Figure 10. Characterization of rainfall conditions for May-September period (1969-2019) for the Cedar River Watershed.



For more information

This study of the Cedar River, Shell Rock River, Winnebago River, and Wapsipinicon River Watersheds was conducted as part of Minnesota's Watershed Approach to restoring and protecting water quality. Efforts to monitor, assess, study, and restore impaired waters, and to protect healthy waters are funded by Minnesota's Clean Water, Land, and Legacy Amendment. Stressor identification for new impairments and updates to the Watershed Restoration and Protection Strategy follow the completion of monitoring and assessment. This approach allows for efficient and effective use of public resources in addressing water quality challenges across the state. The data and assessments produced by this study can inform local efforts to restore and protect waters in these watersheds, such as the One Watershed, One Plan document, a comprehensive watershed management plan that targets projects to protect and restore the watershed's most valuable resources. For more information, go to the Winnebago River, Shell Rock River, Cedar River, or Upper Wapsipinicon River webpages on the MPCA website. And for more specific assessment data, go to the Tableau workbook: https://public.tableau.com/app/profile/mpca.data.services/viz/WaterQualityAssessmentResultsDataViewer/HomePage.

Contact

Dan Fettig
Minnesota Pollution Control Agency
daniel.fettig@state.mn.us
651-757-2542