METROPOLITAN COUNCIL

Environmental Services

2016

River Water Quality Summary for the Twin Cities Metropolitan Area

This report is a brief technical summary of the 2016 conventional river monitoring program. In 2016, Metropolitan Council Environmental Services (MCES) conducted river monitoring at six automated continuous stations and 20 conventional grab sampling sites on five major rivers: Mississippi, Minnesota, St. Croix, Vermillion, and Rum. The 2016 conventional sampling effort resulted in 881 field visits, 3,593 field parameter readings, and over 25,500 laboratory results.

Rivers are an important natural resource for the Twin Cities Metropolitan Area (metro area) and provide many valuable services: they are popular destinations in summer months for boating, swimming, and camping; they are used frequently for year-round fishing; and the upper Mississippi River is a drinking water source. The MCES river monitoring program provides data that is used by federal, state, and local organizations to help make informed decisions to maintain and protect these beneficial services.

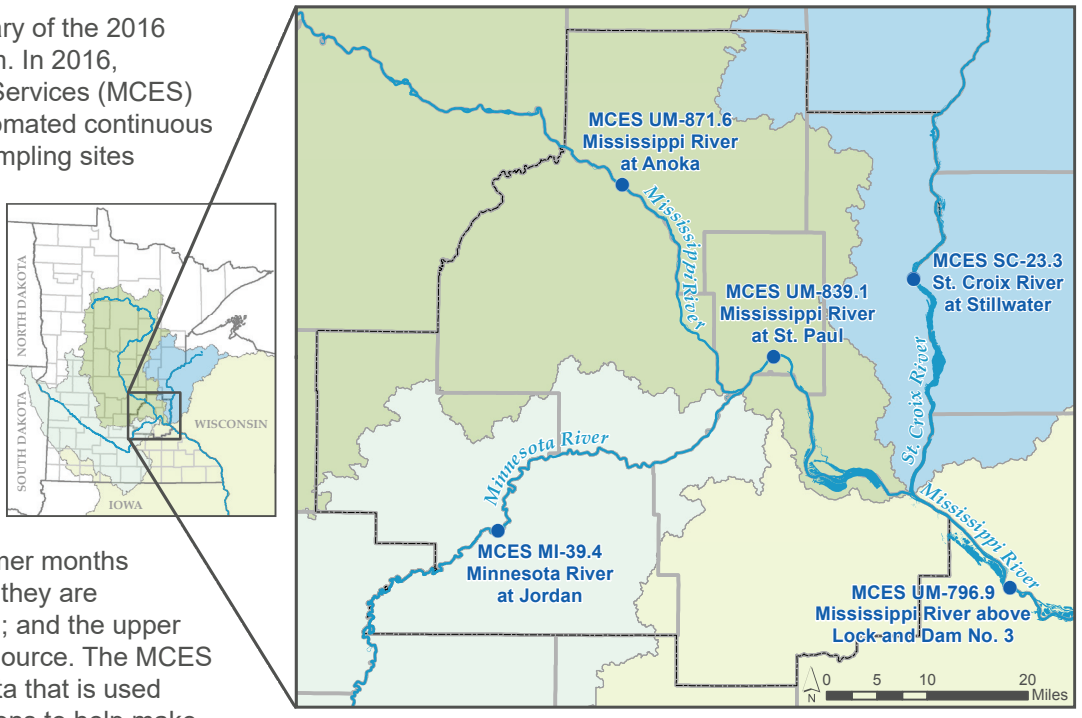


Figure 1: Key metro area monitoring locations and watersheds of the Mississippi, Minnesota, and St. Croix Rivers.

To summarize the water quality of rivers in the metro area in 2016, MCES calculated medians of key water quality parameters from five sites (Figure 1). These five sites were chosen from the 20 conventional river monitoring locations because they represent where the Mississippi, Minnesota, and St. Croix Rivers enter, converge, and exit the metro area. MCES compared the 2016 median of each key water quality parameter to a 10-year reference period from 2007-2016. Concentrations are highly affected by river flow and volume which can vary between years. The comparison between 2016 and the previous decade should not be taken as an indication of increasing or decreasing water quality, but rather as a snapshot comparison to conditions of recent years.

Box-and-whisker plots (boxplots) were used to summarize key water quality parameter measurements from the 10-year reference period. Figure 2 shows an explanatory legend of the boxplots used in this report. Note that 50% of the data points fall within the box (also known as the interquartile range), with the centroid delineated by the median line. The outer extents of the whiskers designate the maximum and minimum values. Median values for 2016 measurements are plotted as a red triangle on top of the 10-year boxplot.

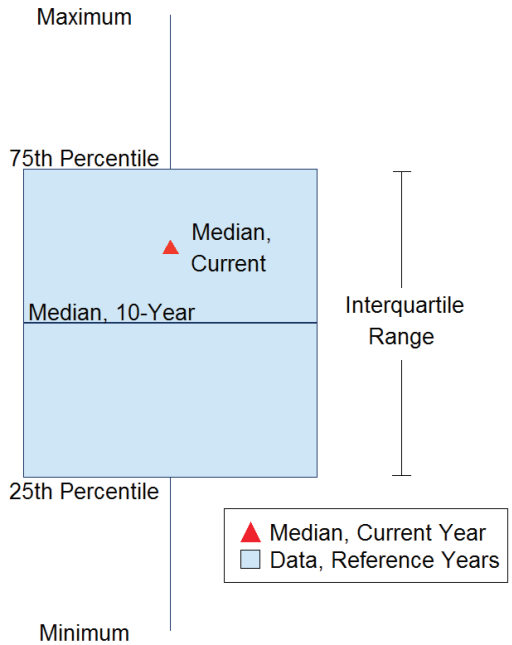


Figure 2: Explanatory legend that demonstrates how information is summarized throughout this report.

2016 median concentrations were also compared to state water quality standard values where applicable. Standards allow the state to objectively evaluate the quality of Minnesota's water resources and ensure the region's waters are protected. The values discussed in this report represent only a part of the standard for each parameter; standards can have additional specifications such as how frequently and by how much samples can exceed the standard, in addition to the time frame in which the standard is in effect. Having samples which exceed the standard value does not mean the water body is impaired. The impairment status is officially determined by the Minnesota Pollution Control Agency (MPCA), and can depend on criteria beyond the standard value. MCES simply presents standards alongside this data as a point for comparison.

Table 1: Water quality standard values at the five sampling sites

Parameter	Mississippi River at Anoka	Mississippi River at St. Paul	Mississippi River above Lock and Dam 3	Minnesota River at Jordan	St. Croix River at Stillwater
Chloride – mg/L	230	230	230	230	230
Dissolved Oxygen – mg/L	5	5	5	5	5
***E. coli* bacteria** – organisms/100mL	1,260	1,260	1,260	1,260	1,260
Total Suspended Solids – mg/L	30	32	32	65	15
Total Phosphorus – mg/L	0.10	0.125	0.10	0.15	0.05
Nitrate–Nitrogen – mg/L	10	NA	NA	NA	10

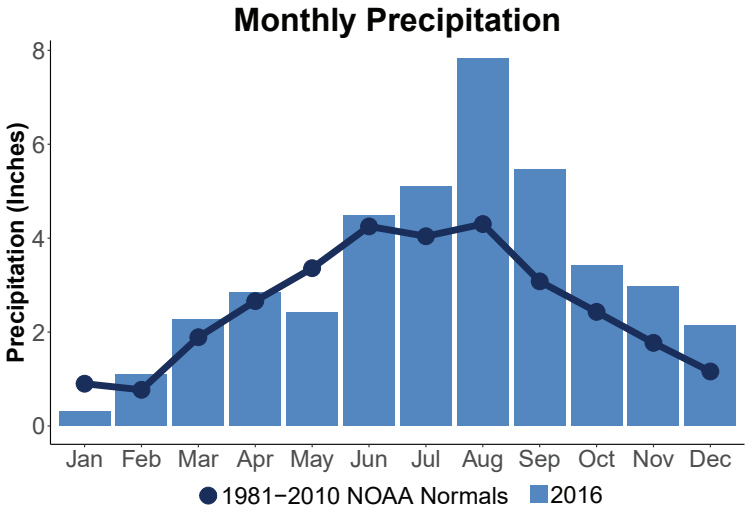
Precipitation

Description

Precipitation is measured at the Minneapolis-St. Paul International Airport, which is a good indicator of significant rainfall events in the metro area because of its central location.

2016 Results

Precipitation in the metro area during 2016 was above the normal precipitation, as defined by NOAA 1981-2010 Climate Normals (a data set updated every 10 years). Total precipitation in 2016 was 40.3 inches, 9.7 inches above normal; it was the wettest year on record for the region since recordings began in 1871. The first half of the year demonstrated fairly typical precipitation, with a deficit of 0.42 inches below normal. The second half of the year was exceptionally wet, with 10.1 inches above normal; it went on record as the wettest second half of the year since 1900.



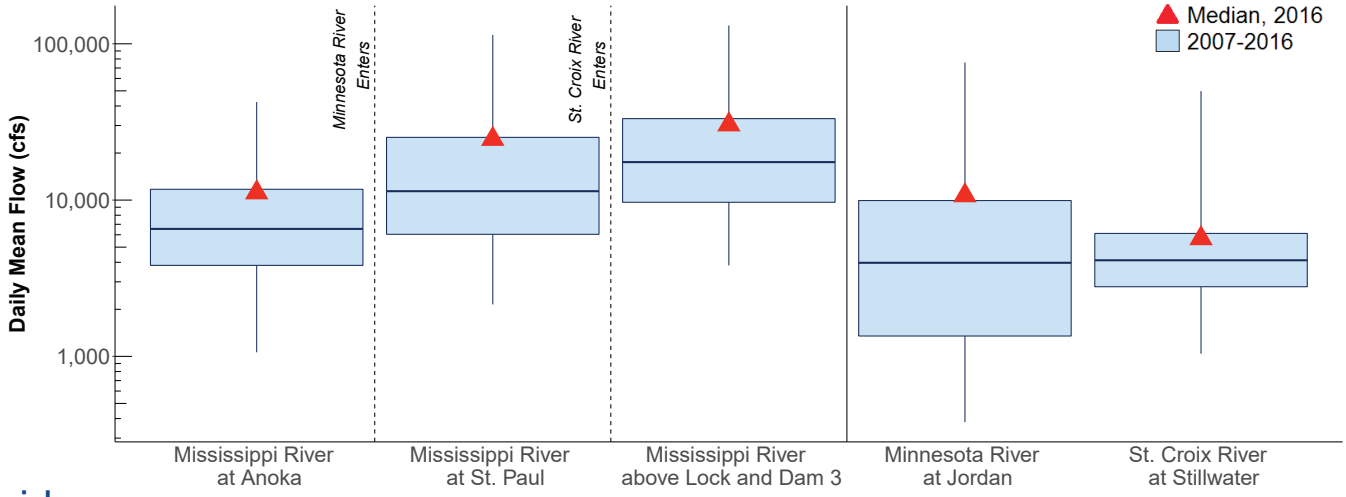
River Flow

Description

The rate of water flowing in a river affects aquatic life, channel geometry, and capacity to carry pollutants. River flow is influenced by precipitation and watershed characteristics. During wet periods, nonpoint source pollutants are often carried through storm sewer systems and natural drainage systems to lakes, smaller streams, and subsequently to the major rivers. High flows can cause stream bank erosion, habitat destruction, and flooding. During dry periods, low flows can result in more concentrated river pollution, increased sediment deposition, and lower habitat quality.

2016 Results

2016 was an exceptionally wet year, and consequently, 2016 median daily flow at all five sites fell above 10-year median daily flow. In the St. Croix River at Stillwater, the top three daily flow measurements from 2007-2016 all occurred in 2016. In the Minnesota River at Jordan, the 2016 median flow exceeded the 75th percentile for daily flows from 2007-2016. It was the largest departure of 2016 medians from the 10-year medians (169% higher). The 2016 median flows of the St. Croix River site and three Mississippi River sites all exceeded the 10-year median flows, but fell below the 75th percentile.



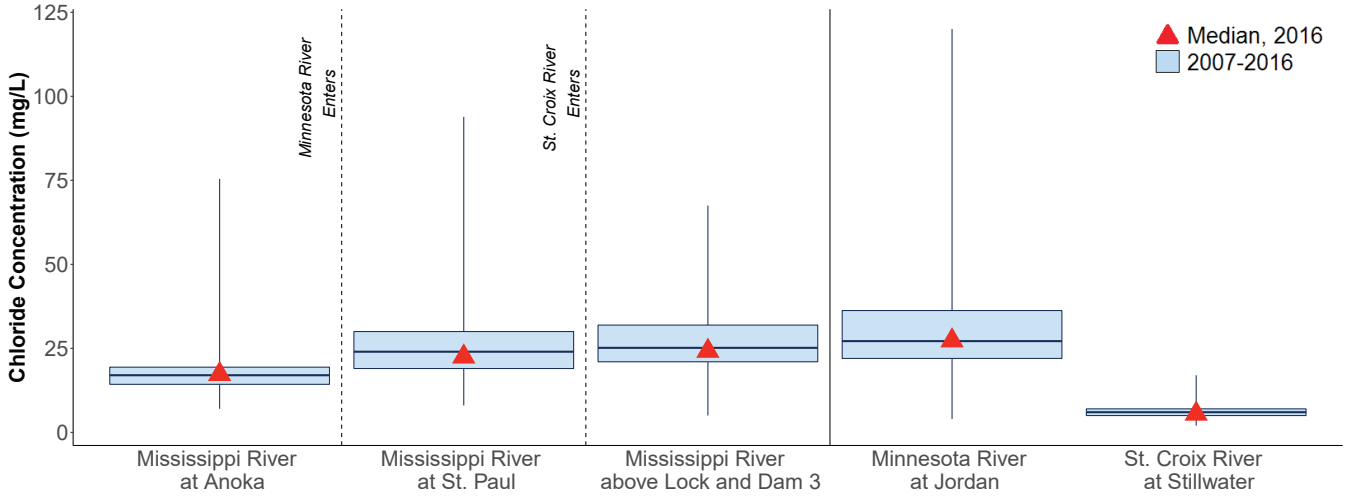
Chloride

Description

Chloride, one component of salt, is typically used for winter maintenance of roads, sidewalks, and parking lots and for home water softening. It can also come from certain types of fertilizers. Excess levels of chloride in the environment can be toxic to aquatic and terrestrial organisms. Chloride is not easily removed after it is introduced to natural waters, and there are no processes that naturally cycle chloride through the environment.

2016 Results

In 2016, median chloride concentrations were similar to 10-year median chloride concentrations. The spread of chloride measurements in the St. Croix River at Stillwater was smaller compared to the Minnesota and Mississippi River sites, suggesting higher consistency in measurements. The St. Croix River basin in the metro area has less urban development and impervious cover than the Minnesota and Mississippi River basins. This may mean smaller amounts of road salt are required for winter snow and ice maintenance, suggesting a higher consistency of low concentrations in the St. Croix basin. All chloride measurements in the 10-year dataset for all five river monitoring sites fell below the state standard of 230 mg/L.



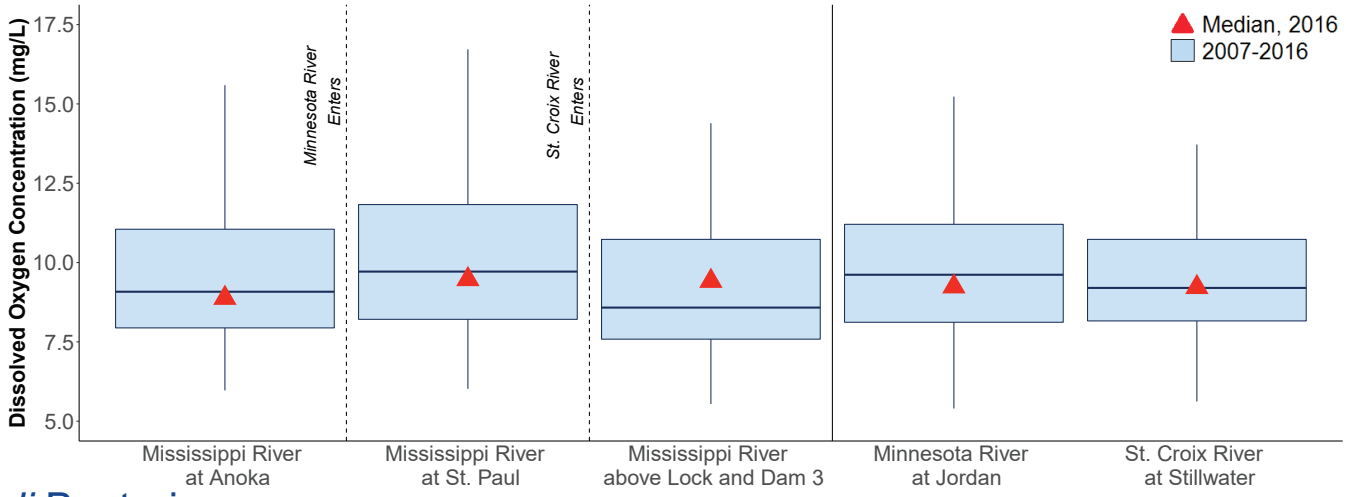
Dissolved Oxygen

Description

Dissolved oxygen is the amount of oxygen dissolved in water. It can enter an aquatic system from the atmosphere and it is also produced by aquatic plants through photosynthesis. Dissolved oxygen concentrations can be reduced by high temperatures, low water flow, high pollution, and decomposition of organic material in the water. Since almost all organisms require oxygen to live, high levels of dissolved oxygen are essential for a healthy river system, and low levels can lead to a loss of fish and other organisms from the area.

2016 Results

In 2016, median dissolved oxygen concentrations were nearly the same as the 10-year median dissolved oxygen concentrations. All dissolved oxygen measurements in this dataset for all five river monitoring sites were above the state standard, a minimum of 5 mg/L.



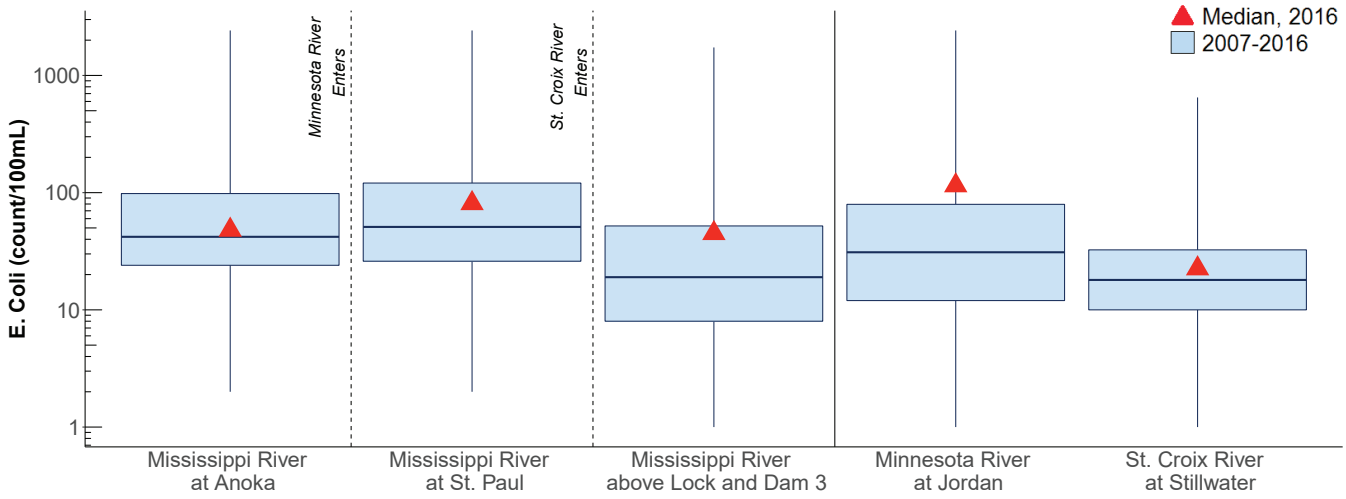
E. coli Bacteria

Description

Escherichia coli (*E. coli*) are bacteria which typically originate from failing septic tanks, untreated wastewater, livestock, pets, and wildlife. High *E. coli* levels can indicate the presence of potentially dangerous pathogens in water bodies such as typhoid fever, hepatitis, and dysentery. Therefore, the concentration of *E. coli* is one of several parameters used to determine a river's suitability for recreational purposes and public health.

2016 Results

In 2016, the median *E. coli* concentration fell above the 10-year median at all five sites. The largest departures of 2016 median *E. coli* concentrations from 10-year medians were in the Minnesota River at Jordan (271% higher) and the Mississippi River above Lock and Dam 3 (137% higher). Large departures between the 10-year and 2016 *E. coli* medians could be related to excessive precipitation in 2016. Heavy rainfall can cause increased runoff, sweeping mismanaged waste and sewage into surface waters. The *E. coli* state standard is dependent on the time of year and how frequently the standard is exceeded. Therefore, the medians are not directly comparable to the standard. However, comparing the median to the standard value provides a good benchmark for comparison. The 2016 median concentrations at all five river monitoring sites fell below the acute standard of 1,260 organisms/mL.



Total Suspended Solids

Description

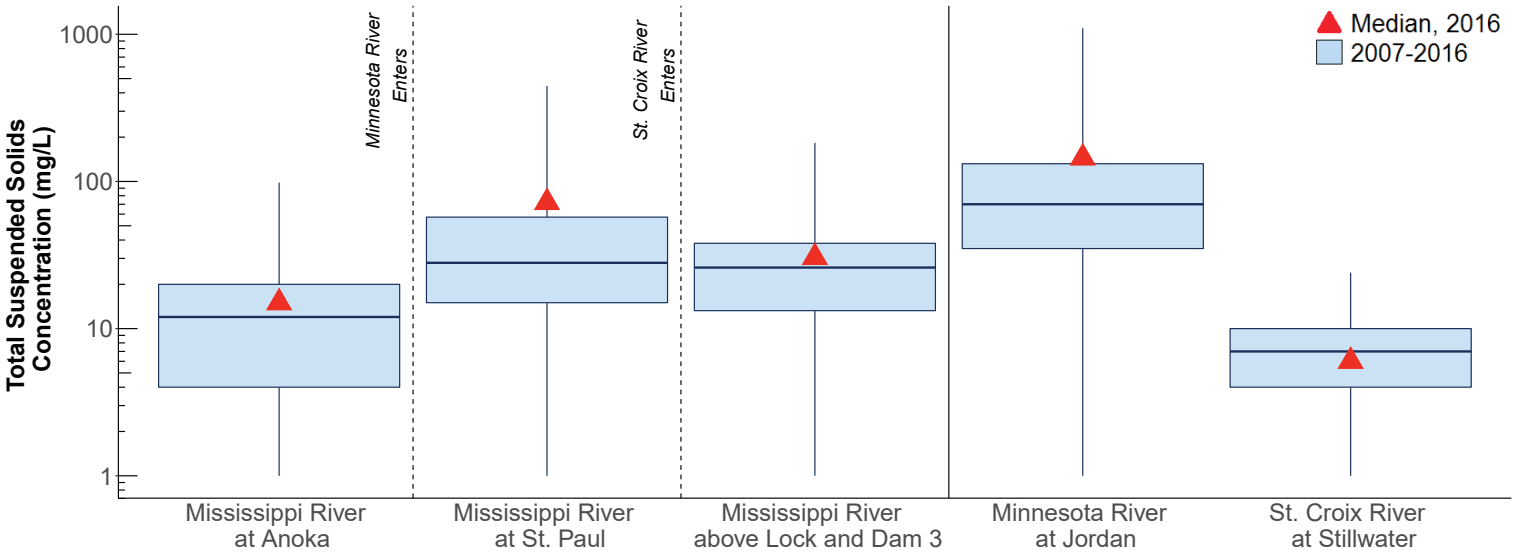
Total suspended solids are any material suspended in water which can be removed with a filter. There are a variety of sources including eroded sediment from stream banks, lawns, construction sites, and agricultural fields as well as organic particulate such as decaying matter and algae. High levels of total suspended solids in rivers may harm aquatic life by decreasing the light available for plant growth, increasing water temperature, clogging gills of aquatic inhabitants, and covering habitat. High levels can also affect recreational use by decreasing water clarity and creating unfavorable swimming conditions.

2016 Results

In 2016, the median total suspended solids concentration fell below the 10-year median in the St. Croix River at Stillwater; the remaining sites fell above the 10-year median. The largest departures of 2016 medians from 10-year medians were in the Minnesota River at Jordan (106% higher) and the Mississippi River at St. Paul (157% higher). The Minnesota River basin has younger geology and sandy glacial deposits that make it more susceptible to erosion than the St. Croix and Mississippi River basins. Given that 2016 was an exceptionally wet year, this basin could have experienced higher erosion than in years past. The Mississippi River at St. Paul showed a 2016 median above the 75th percentile; this large departure could be in part due to the TSS-rich water of the Minnesota River entering the Mississippi.

The spread of total suspended solids measurements in the St. Croix River at Stillwater was smaller when compared to the Minnesota and Mississippi River sites, suggesting higher consistency in measurements. This could be attributed to the nature of land use in the basin. The St. Croix basin is less urban and agriculturally dominated than the Mississippi and Minnesota basins, both land use types could experience higher amounts of runoff and erosion. Additionally, and as discussed above, the geology of the St. Croix basin is less susceptible to erosion.

The total suspended solids state standard is dependent on the time of year and how frequently the standard is exceeded. Therefore, the medians are not directly comparable to the standard. However, comparing the median to the standard value provides a good benchmark for comparison. The 2016 median concentrations in the Mississippi River at Anoka and above Lock and Dam 3, and the St. Croix River at Stillwater fell below their respective standards. The 2016 median concentrations in the Mississippi River at St. Paul and the Minnesota River at Jordan fell above their respective standards.



Total Phosphorus

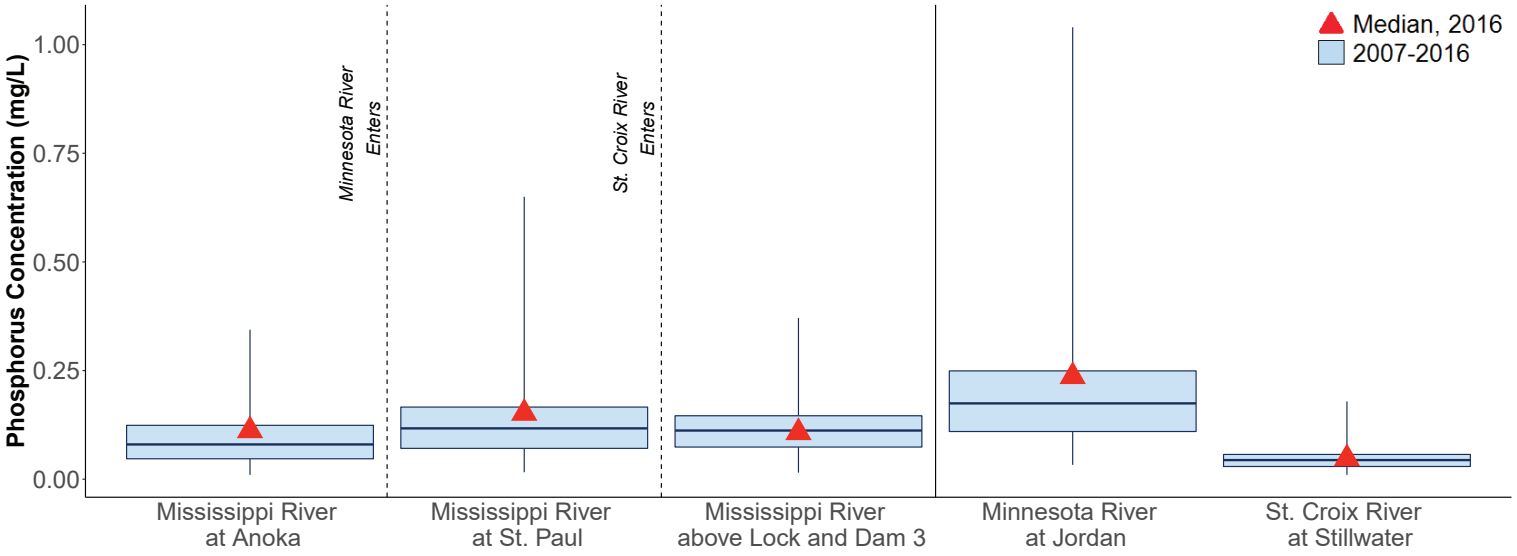
Description

Phosphorus is an essential nutrient necessary for the growth of aquatic organisms. Nutrients cycle naturally in the environment, but elevated levels of phosphorus in rivers can be caused by lawn or agricultural fertilizers, malfunctioning septic systems, manure, and pet wastes. High levels of phosphorus can stimulate excess growth of aquatic plants, causing algae blooms which reduce oxygen levels in the water. This creates unlivable conditions for most aquatic life and makes the water unusable for most recreational activities.

2016 Results

In 2016, the median phosphorus concentration in the Mississippi River above Lock and Dam 3 did not exceed the 10-year median concentration. The remaining sites experienced 2016 medians above 10-year medians, however departures were small and did not exceed 10-year 75th percentiles. The spread of phosphorus measurements in the St. Croix River at Stillwater was smaller when compared to the Minnesota and Mississippi River sites, suggesting higher consistency in measurements. This could be due to the land use and geologic age of the St. Croix basin versus the Mississippi and Minnesota basins, as discussed in the total suspended solids results section.

The total phosphorus state standard is dependent on the time of year and is considered alongside other parameters not included in this report. Therefore, the medians are not directly comparable to the standard. However, comparing the median to the standard value provides a good benchmark for comparison. The 2016 median concentrations in the Minnesota River at Jordan and in the three sites along the Mississippi River fell above the respective state standards. The 2016 median concentration in the St. Croix River at Stillwater fell below the state standard.



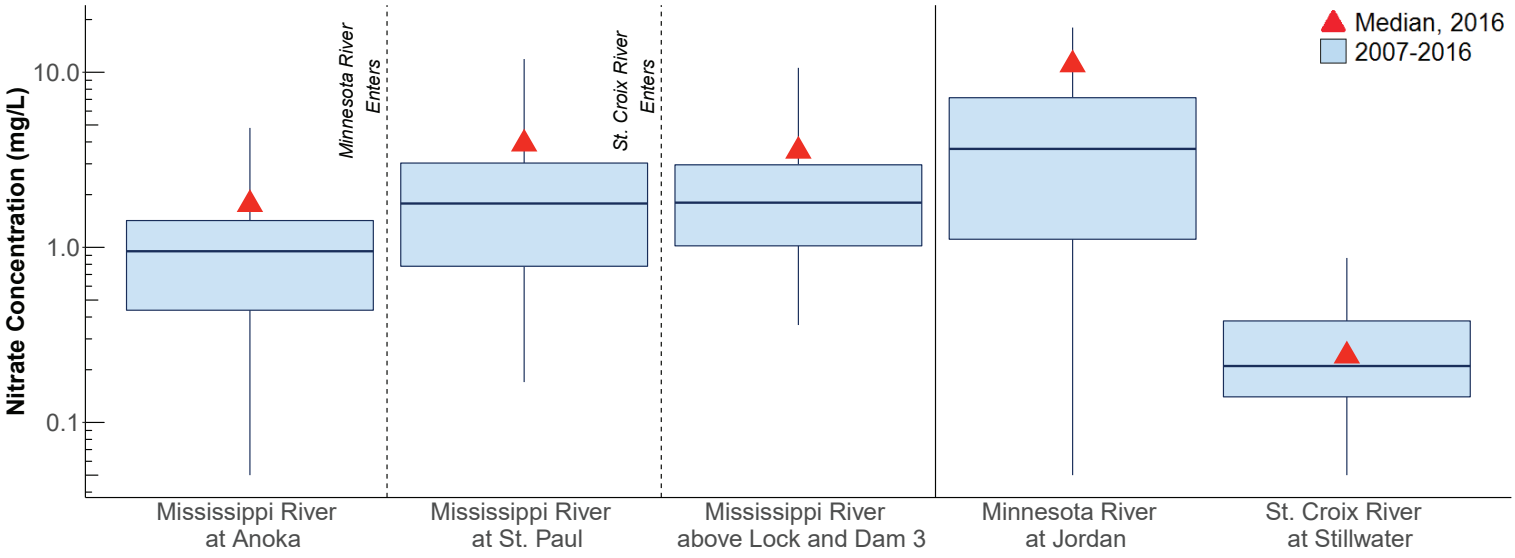
Nitrate-Nitrogen

Description

Nitrate-nitrogen is an essential nutrient necessary for the growth of aquatic organisms. Aside from natural processes, common sources of nitrate include fertilizers, plant debris, and septic and municipal wastewater treatment systems. High nitrate levels can cause the same ecosystem problems associated with high phosphorus concentrations and if consumed can lead to methemoglobinemia, a blood condition typically affecting infants which impairs the ability of red blood cells to efficiently transport oxygen throughout the body.

2016 Results

The spread of nitrate measurements in the St. Croix River at Stillwater was smaller when compared to the Minnesota and Mississippi River sites, suggesting higher consistency in measurements. In 2016, all 5 monitoring locations experienced higher median nitrate concentrations than the 10-year median concentrations. Only the 2016 median in the St. Croix River at Stillwater fell below the 10-year 75th percentile, the remaining sites exceeded 10-year 75th percentiles. The Minnesota River at Jordan had the 2016 median with the largest departure from the 10-year median (203% higher). There currently is not a standard for nitrate in Minnesota beyond the drinking water standard of 10 mg/L. This standard applies only in the Minnesota River at Anoka and the St. Croix River at Stillwater, where both reaches are classified for drinking water usage. The 2016 median concentrations for these sites fell below the drinking water standard.



For More Information

MCES will continue to monitor the Mississippi, Minnesota, and St. Croix Rivers, and will release reports that summarize data.

Past monitoring reports and monitoring data can be found in the Metropolitan Council's Environmental Information Management System (EIMS) at https://eims.metc.state.mn.us/.

For questions or comments about this summary, please contact Erik Herberg at erik.herberg@metc.state.mn.us or at 651-602-1473.

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