Vermillion River Monitoring Network

2020 Monitoring Summary

Prepared for the Vermillion River Watershed Joint Powers Organization
by the Dakota County Soil and Water Conservation District

Monitoring Summary

The Vermillion River Monitoring Network was created to assess water quality and quantity in the Vermillion River Watershed. Monitoring staff with Dakota County Soil and Water Conservation District and Scott Soil and Water Conservation District visit eight locations on a biweekly basis from snowmelt (mid-March) through November 1 (Figure 1). Despite the onset of the COVID-19 pandemic, water monitoring in the watershed took place from March to November without pause. Large rainfall events were few and far between resulting in most samples being collected during baseflow or low water level conditions.

Monitoring activities include sample collection, continuous temperature and water level data downloads, biological monitoring, and equipment maintenance. The data collected though this effort include a combination of chemical, physical, and biological parameters and assessments, enable local agencies such as the Vermillion River Watershed Joint Powers Organization (VRWJPO) to better understand the health of the stream and implement appropriate management strategies throughout the watershed.

Analysis shows that many of the water monitoring parameters are meeting state water quality standards and indicate a generally healthy condition in the Vermillion River and its tributaries.

Chemistry

Nitrate (NO_3; a form of nitrogen) levels were quite low, except at the one station on the South Branch Vermillion River (Figure 2). The South Branch station (SB802) has a significant nitrate load compared to others in the network. High levels of nitrate in drinking water pose a human health risk and are likely related to the soils, artificial drainage, and agricultural land use that is predominant in the South Branch Vermillion River subwatershed. Monitoring locations downstream of the confluence with South Branch have elevated nitrate levels in comparison to sites higher in the watershed.

The other primary nutrient monitored in the watershed is *phosphorus*, an essential life element for plants. Excess phosphorus can lead to eutrophication and increased algae growth in the river. The median level for all sites is below the state standard during baseflow conditions (Figure 3). Elevated concentrations were recorded during runoff and snowmelt events at all monitoring events throughout the season. Highest variability is seen at VR24 (most upstream site), SB802, and VR803 (most downstream site monitored by the VRWJPO.

Low *dissolved oxygen* concentrations following runoff events were common at several sites (Figure 4). The median dissolved oxygen levels met the standard for both 2A and 2B stream sites during baseflow conditions. NC801 and NC808 have the lowest recorded levels during baseflow, but the median level above the standard at similar levels to other sites. Median levels at the two sites on North Creek were below the standard during runoff sampling (SC806 (South Creek) was at the standard); individual event violations occur at several sites during runoff conditions.

High levels of *total suspended solids* (contributing to turbid, cloudy, water) following runoff events were also common at several sites (Figure 5). In conversation with Minnesota Pollution Control Agency (MPCA) staff, it was determined that the 2B warmwater sites in the Vermillion River watershed should be assessed using the Central River Nutrient Region total suspended solids standard (30 mg/L) instead of the South River Nutrient Region standard (65 mg/L) as was previously done. Sample medians were at or below (meeting) the state standard at all stations during baseflow conditions. Standard exceedances occurred during runoff conditions at all monitoring water sites, particularly at VR24 and SB802. None of the eight sites had exceedances during snowmelt events.

Temperature

The Vermillion River watershed includes stream reaches with both coldwater and warmwater use designations meaning that temperature standards are applied to the middle watershed (coldwater), but are not applicable to the reaches in the upper and lower parts of the watershed (warmwater). The coldwater reaches of the Vermillion River and its tributaries are home to a self-sustaining brown trout population, so there is great interest in reducing or maintaining water temperatures suitable for a healthy brown trout fishery.

Continuous temperature data, measured in 15-minute intervals, has been collected annually starting in 2005 for many of the sentinel monitoring stations in the Vermillion River monitoring network. The temperature data for 2020 for NC801 and NC808 (Farmington) shows temperature maximums were measured in the resistance range (orange; > 20°C) during all summer months with the highest median water temperatures observed in July (Figure 6).

Biological and Habitat Assessments

The MPCA developed biological indices to evaluate the health of the macroinvertebrate community in the Vermillion River. In 2020, nine sites were monitored in various parts of the watershed. The macroinvertebrate index of biological integrity (MIBI) scoring data is not available at this time.

Habitat assessments were completed using the MPCA's Minnesota Stream Habitat Assessment protocol to further evaluate and understand the biological integrity of stream reaches. Of the sites monitored in 2020, eight sites had a 'fair' score and one sites scored 'good' (Figure 7).

Bacteria Sampling

Some parameters have been measured at undesirable levels. *Escherichia coli (E. coli)* bacteria levels are high in many streams of southeast Minnesota, and the Vermillion River and its tributaries are no exception. Monitoring results in 2020 show numerous low-level exceedances during the season at all of the sites in the network, but the geometric mean at each site had less variability than in 2019 (Figure 8).

E. coli levels at VR24 continue to be higher than samples collected at other monitoring sites within the watershed. In 2020, the geometric mean for *E. coli* samples at VR24 was twelve times more than the standard, whereas other sites were between two to nine times higher than the standard (most sites were 2-3x higher).

Agency Monitoring

The Minnesota Department of Natural Resources (DNR) continues its monitoring effort in response to potential impacts to the quantity of water within the Vermillion River from groundwater withdrawals via appropriations. The DNR maintains responsibility for twelve stream gaging stations within the watershed as part of this effort. The VRWJPO contracts annually DNR hydrologists for assistance with maintenance, rating-curve development, and data analysis and compilation at these stations.

The VRWJPO provides cost share for the operation of the U.S. Geological Survey (USGS) Blaine Avenue gaging station, which has the longest continuous record of flow in the watershed. Real-time stage and flow data is available from the USGS station. This information can be accessed at https://waterdata.usgs.gov/mn/nwis/uv?site_no=05345000.

Continuous temperature monitoring was conducted at the eight stream gaging stations the DCSWCD, Scott SWCD, and DNR operate, as well as at the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP) station in Hastings.

Conclusion

The Vermillion River Monitoring Network is valuable in that the watershed can be assessed on its physical, chemical, and biological characteristics, and that information is then used to make informed management decisions. Restoring in stream and riparian habitat, reducing nutrients and suspended materials in the stream, and minimizing temperature peaks, among other possible conservation strategies, will have a cascading positive effect on the overall health of the river. It is important to consider physical parameters such as temperature, which plays an essential role particularly in cold water streams. Water quantity and flow patterns have a significant impact on aquatic communities, with too much or too little causing stress. An effective management strategy would be one which integrates both the quality and quantity aspects of the Vermillion River.

Appendix

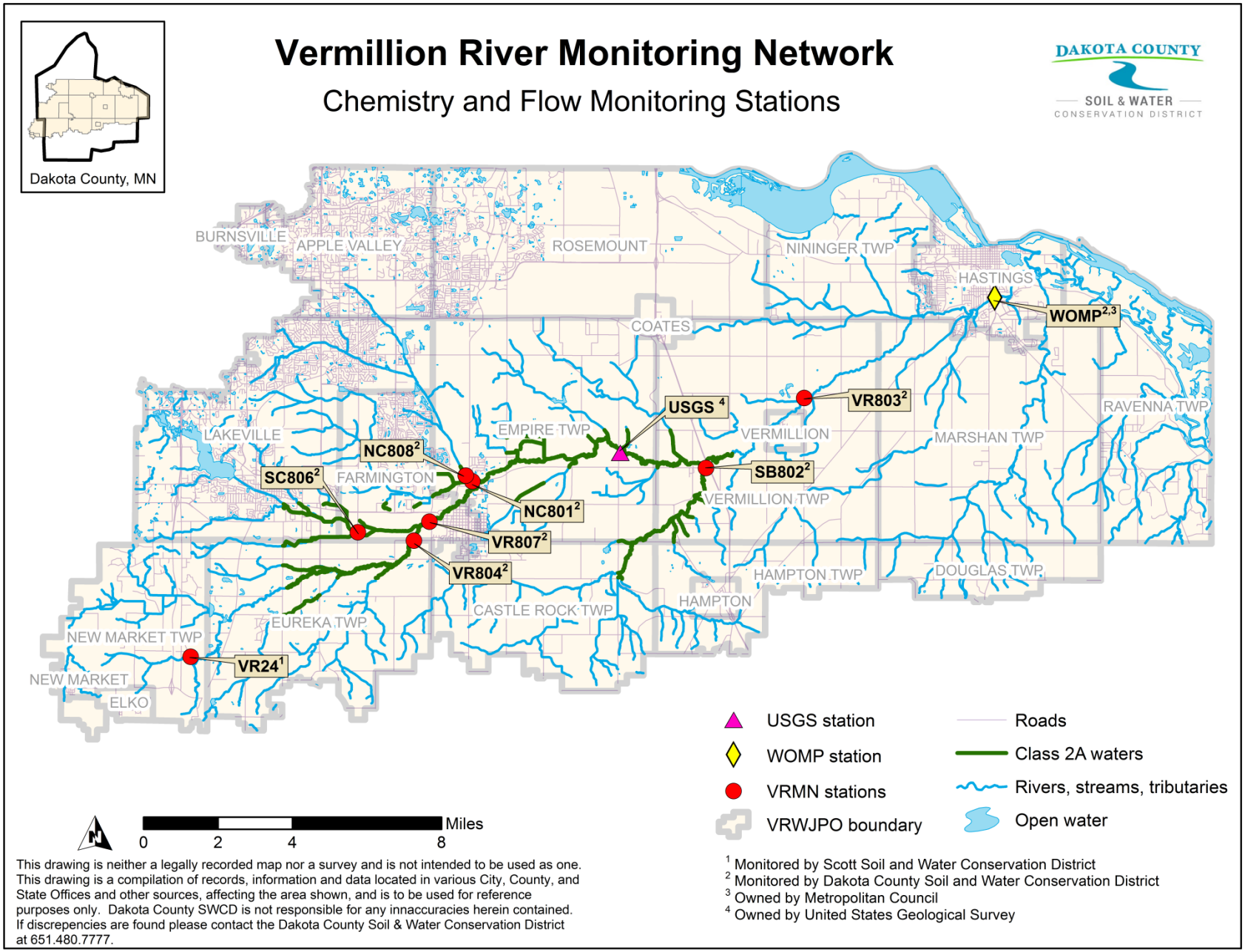

Figure 1. Vermillion River Monitoring Network (VRMN) chemistry and flow monitoring stations.

Appendix

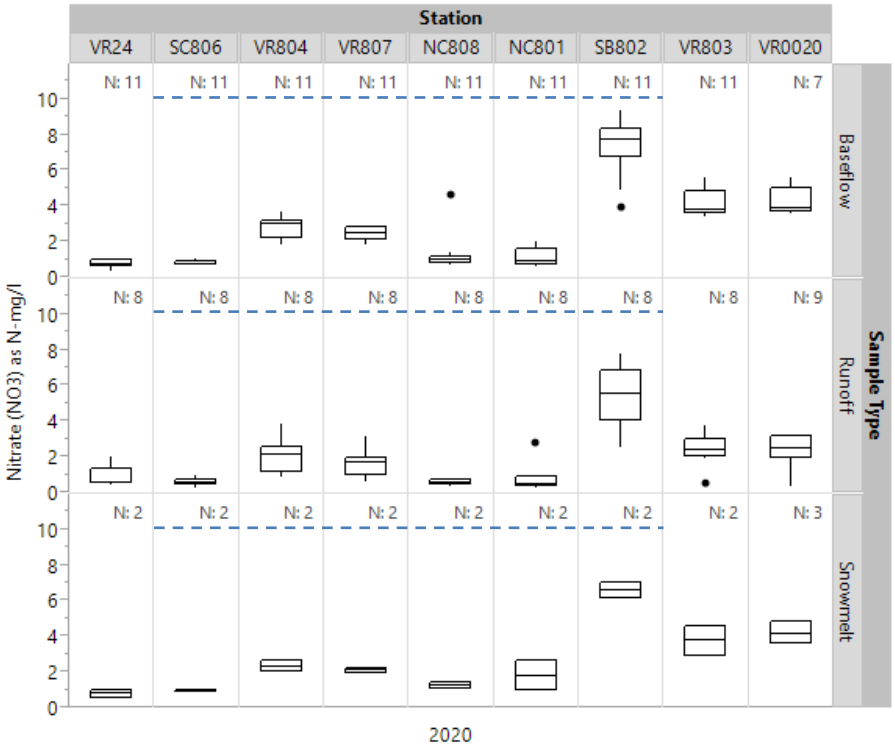

Figure 2. Nitrate nitrogen for each station, categorized by sample type, for 2020. Blue dashed line represents the domestic consumption state standard (≤10 mg/L).

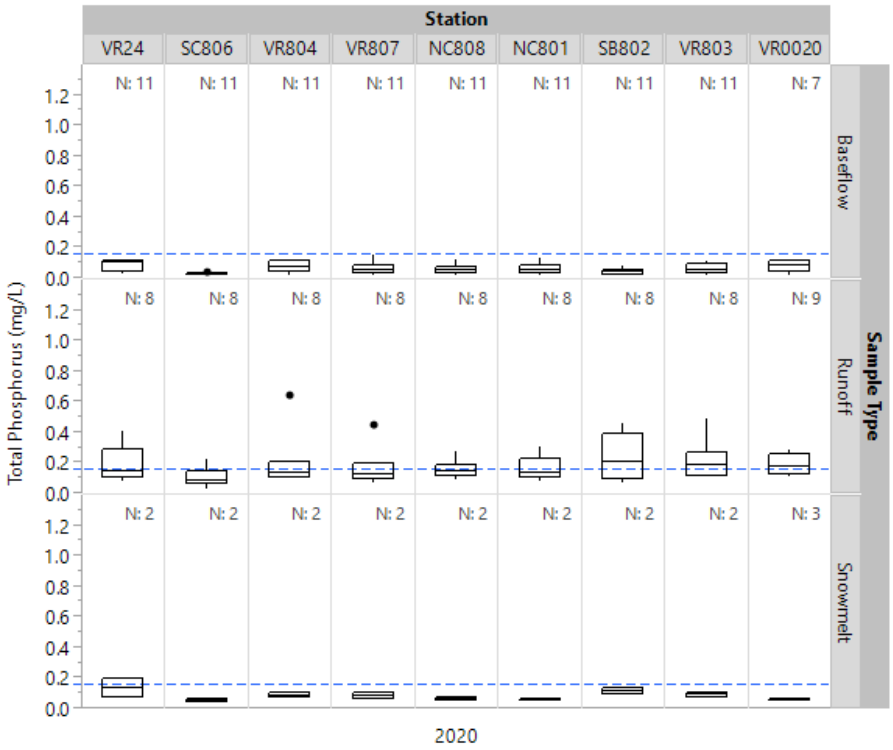

Figure 3. Total phosphorus (TP) for each station, categorized by sample type, for 2020. Blue dashed line represents the state standard for total phosphorus, ≤ 0.15 mg/L.

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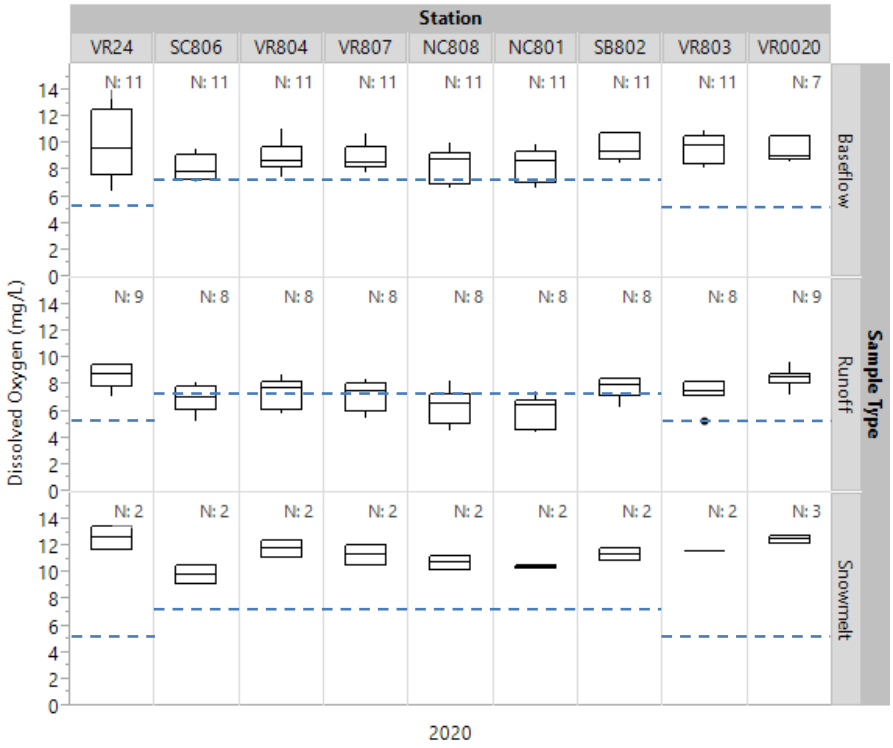

Figure 4. Dissolved oxygen for each station, categorized by sample type, for 2020. Dashed blue lines indicate standards with 7.0 mg/L (2A streams) and 5.0 mg/L (2B streams) as acceptable daily minimums.

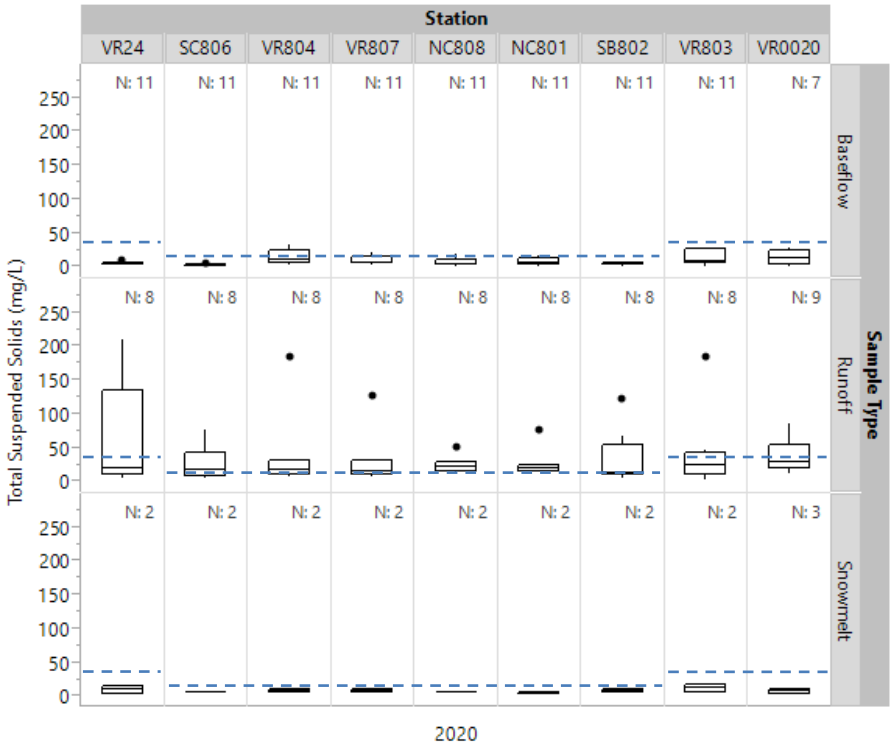

Figure 5. Total suspended solids categorized by sample type for 2020. Blue dashed line represents the state standard for cold 2A (≤10 mg/L) and warm 2B (≤30 mg/L) waters.

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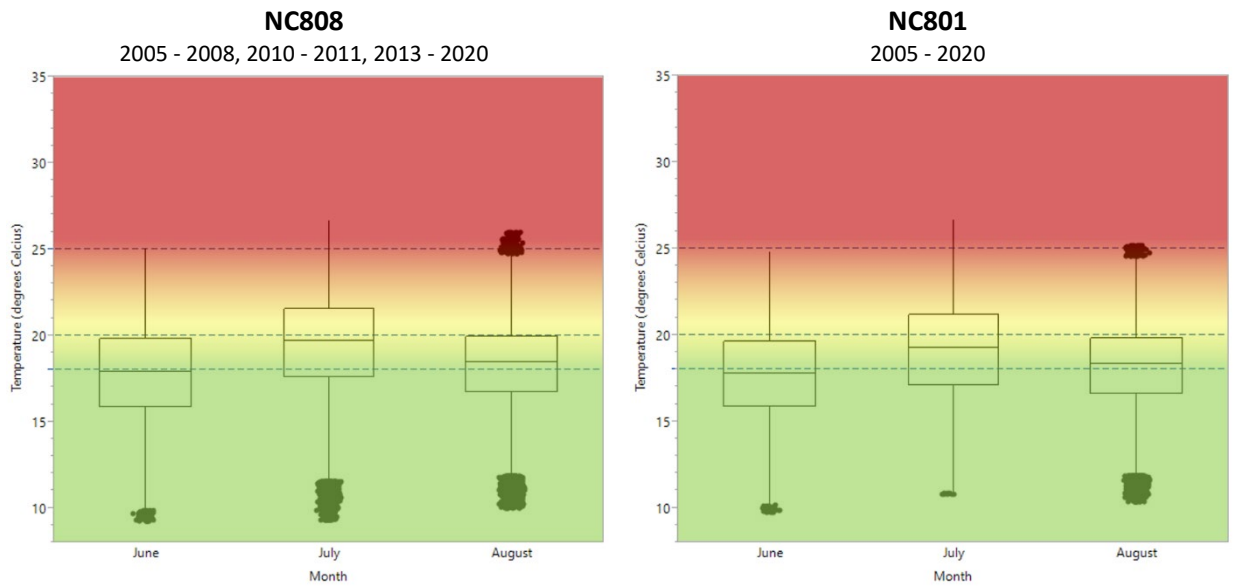

Figure 6. Continuous temperature data for NC808 and NC808 (coldwater stream sites) during the summer months from 2005-2020 (when available). Temperature ranges apply to adult Brown Trout. Optimal <18°C, tolerance 18-20°C, resistance 20-22°C, and complete mortality at 25°C (Coutant (1975), Gardner & Leetham (1914), Bell (2006))

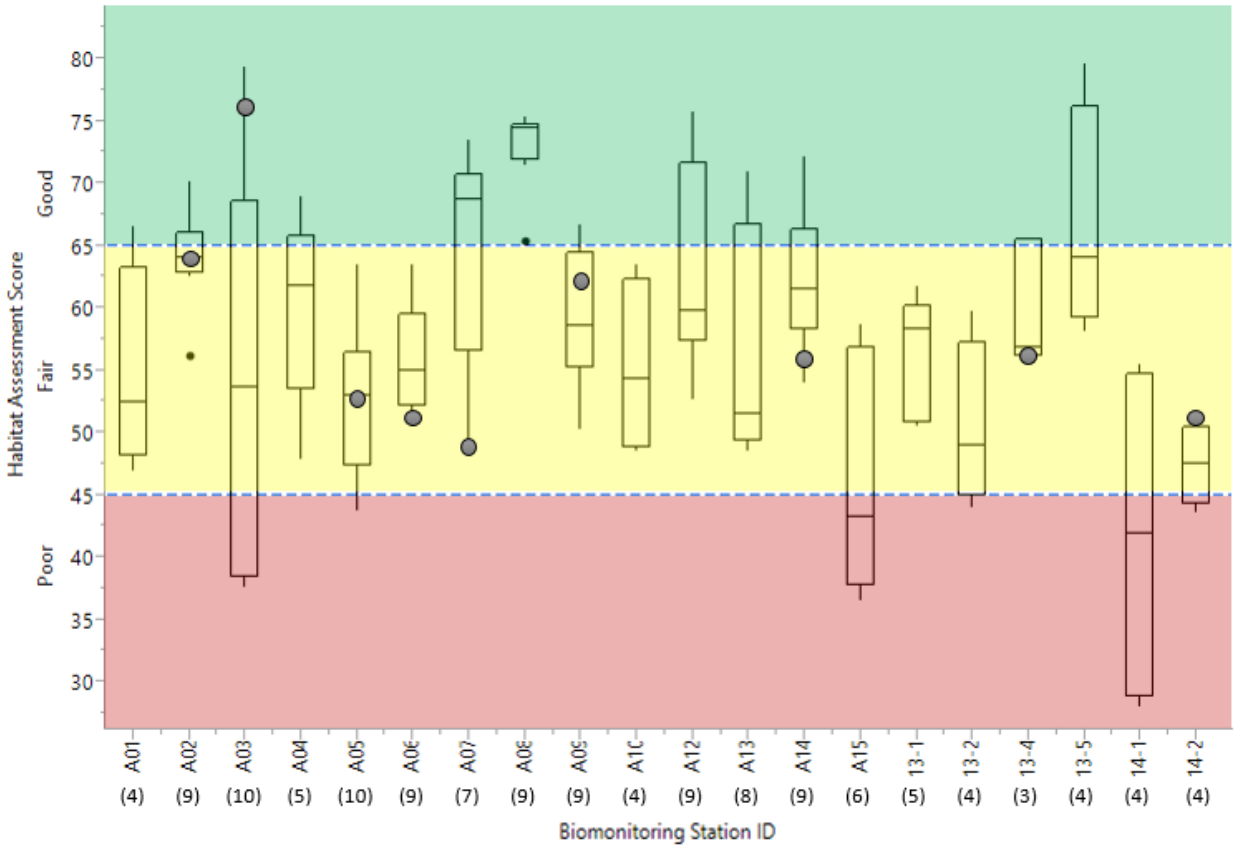

Figure 7. Habitat assessment scores for biomonitoring stations. Habitat scores for 2020 are indicated by grey circle. Dashed blue lines indicate limits for Good (≥66), Fair (45-65), and Poor (≤44) categories. Number of samples collected from 2009-2020 is shown in parenthesis.

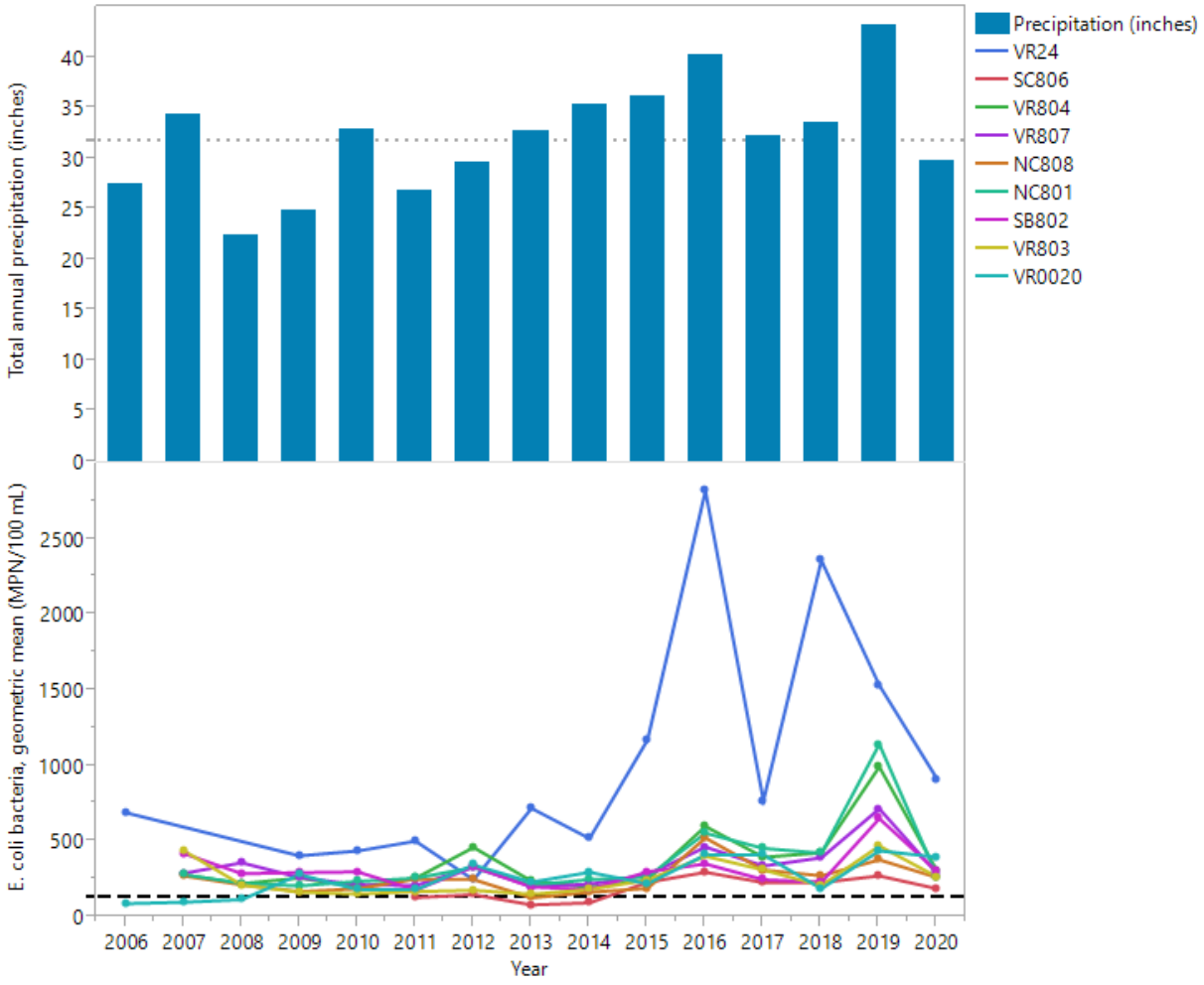

Figure 8. Annual geometric mean of *Escherichia coli* (*E. coli*) bacteria for all stations by year. MPN stands for most probable number of organisms. Black dashed line indicates the 30-day geometric mean standard (for data collected April through October) of ≤126 MPN/100 mL. Bars represent total annual precipitation for each year. Gray dotted line indicates the 30 year (1990-2019) total annual average precipitation at the Minneapolis – St. Paul airport weather station of 31.7 inches.