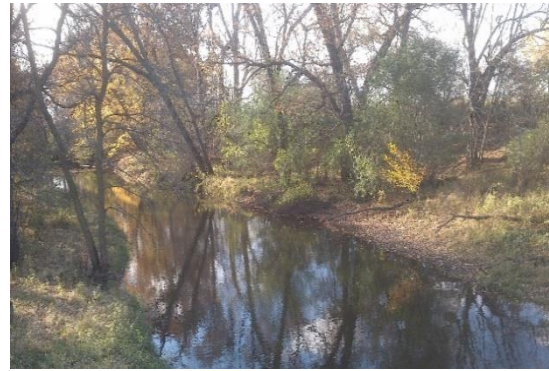


SID Update

Roberts Creek Watershed

March 2023



The purpose of Cycle 2 stressor identification (SID) work is to perform SID in a way that supports Cycle 2 watershed restoration and protection efforts, with an emphasis on meeting local partner needs, protection of biotic integrity, and identifying changes in biotic condition. Cycle 2 SID work is designed and executed to add value to local partner implementation planning efforts. SID staff will seek to strengthen local partnerships and provide scientific analyses and recommendations in a format and timeframe that is most useful to local partners.

Roberts Creek Watershed was identified for Cycle 2 SID work via conversations with local partners and professional judgment from the Minnesota Pollution Control Agency (MPCA) staff. Factors that led to selection included:

- Limited chemistry data in the upper part of the watershed.
- Potential location for future implementation work; could provide opportunity to gather baseline data now and some form of “effectiveness” monitoring in the future.
- Roberts Creek Watershed is upstream of the city of Austin, which has a long history of flooding issues.

Goals for Cycle 2 SID work in Roberts Creek Watershed included:

- Summarize current chemical, biological, and physical conditions and identify changes between Cycle 1 (2009) and Cycle 2 (2019).
- Identify stressors and pollutant sources that are currently impacting biological communities and/or threaten future biological condition.
- Identify any “hot spots” or areas contributing a disproportionate amount of a pollutant.
- Identify and prioritize restoration areas.
- Provide value to local planning efforts.

Cycle 1 SID Summary:

- Cycle 1 SID was conducted on Roberts Creek (AUID -504 and -506) and Unnamed Creek (AUID -534 and -593).
- Habitat, nitrate, and flow alteration were identified as stressors in Cycle 1 on all stream reaches mentioned above and dissolved oxygen (DO) and total suspended solids (TSS) were inconclusive on all reaches. Phosphorus was a stressor on Roberts Creek (AUID -504), inconclusive on Unnamed Creek (AUID -534 and -593), and not a stressor on Roberts Creek (AUID -506).

Cycle 2 SID Summary:

- Cycle 2 SID was conducted on Roberts Creek (AUID -506) and Unnamed Creek (AUID -505 and -534).
- Additional data collected after Cycle 1 confirmed the Cycle 1 habitat, nitrate, and flow alteration stressors; eutrophication, DO, and TSS were inconclusive in Cycle 2 and fish passage was a stressor on both stream segments with fish impairments (AUID -506 and -534).

This SID update document summarizes biological condition and provides monitoring highlights and stressor conclusions for Roberts Creek Watershed. This document is designed to complement existing Cedar River Watershed reports (e.g. the Cedar River Watershed Restoration and Protection Strategy [WRAPS] and Cedar-Wapsipinicon Comprehensive Watershed Management Plan [CWMP]), which should also be used to inform watershed work; these documents contain information such as priority issues, priority areas, and pollutant loading data which are critical in prioritizing implementation work.

Biological Communities

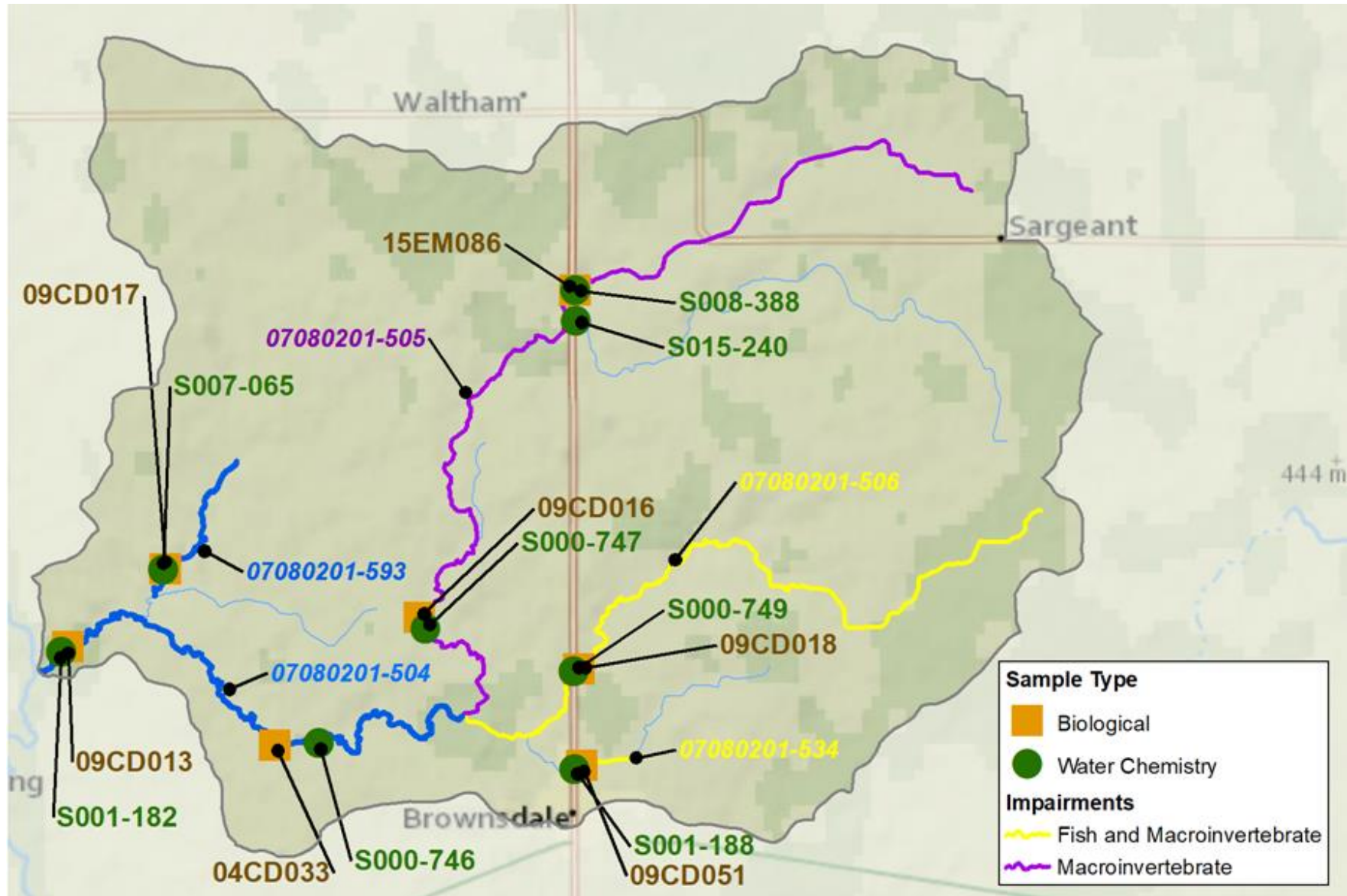
Fish and macroinvertebrate communities in the Roberts Creek Watershed are of varying quality; some are impaired and not meeting standards while others are healthy and meeting standards (Table 1, Figure 1). This variability is typical of many small warmwater streams in the region. The lower portion of Roberts Creek (station 09CD013) was the only stream reach sampled in Cycle 1 and Cycle 2; station 09CD013 is sampled routinely as it is a long-term biological monitoring site and most fish index of biological integrity (FIBI) and macroinvertebrate index of biotic integrity (MIBI) scores were similar between samples. In general, macroinvertebrates belonging to the family Chironomidae (flies/nonbiting midges) dominated most samples and the fish community was primarily comprised of Cyprinidae (shiners, dace, minnows, stonerollers, chubs), Percidae (darters), and Catostomidae (white suckers).

The biological impairments are located in the upper part of the watershed on Roberts Creek (AUID -506) and two Unnamed Creeks (AUIDs -505 and -534); all of these stream reaches have macroinvertebrate impairments and Roberts Creek (AUID -506) and Unnamed Creek (AUID -534) also have fish impairments. The lower portion of Roberts Creek (AUID -504) and Unnamed Creek (AUID -593) are meeting biological standards. The macroinvertebrate listing for Roberts Creek (AUID -504) was removed from the impaired waters list due to the most recent assessment indicating aquatic life use support. This assessment included recent data that show improved water quality in Roberts Creek, even while the cause or causes of improvement were not immediately apparent. The macroinvertebrate listing for Unnamed Creek (AUID -593) was also removed from the impaired waters list; this change in status was due to application of more recent standards and data (as opposed to apparent improvements in water quality). The MPCA biologists noted that the overall condition of Roberts Creek (AUID -504) is “very good relative to other similarly sized reaches in the watershed.”

Table 1: Fish and MIBI scores in Roberts Creek Watershed.

Waterbody	AUID	Biological Stations	Biological Impairment	Class	FIBI	FIBI Threshold	FIBI Year	MIBI	MIBI Threshold	MIBI Year				
Roberts Creek	504	04CD033		2Bg	74.2	55	2004	10.7	37	2004				
					41.5			2020						
		09CD013			49.3	50		2Bg	50		2009	43	65.1	2009
					46.2						2013		60.1	2013
					48.1						2015		68.1	2015
					49.6						2017		44.3	2017
					51.7						2019		48.0	2019
					52.9						2021		67.7	2020
Unnamed Creek	505	09CD016	Macroinvertebrates	2Bg	63.8	55	2009	55.7	43	2009				
		51.7			2015			20.0		2015				
		15EM086			51.7	55	2021	42.7	43	2020				
Roberts Creek	506	09CD018	Fish, Macroinvertebrates	2Bg	39.4	55	2009	29.3	43	2009				
Unnamed Creek	534	09CD051	Fish, Macroinvertebrates	2Bg	45.8	55	2009	17.0	43	2009				
Unnamed Creek	593	09CD017		2Bg	62.4	55	2009	45.9	43	2009				
								51.1		2012				

Figure 1: Roberts Creek Watershed monitoring stations and biological impairments.



Monitoring Highlights

Stream Temperature

- Several instantaneous (point) measurements were collected throughout the watershed over the last decade (2011 through 2020), and all were below 30°C (daily average warmwater standard). Also, a sonde was deployed near the mouth of Roberts Creek (S001-182) in 2019 and all stream temperatures were suitable for warmwater biota as no values exceeded 30°C. However, issues during deployment resulted in only four days of usable data.

Nitrate

- Nitrate samples were collected across the watershed at eight stations as part of Cycle 2 SID in 2019 and 2020, with a goal to sample various flow conditions and establish a range of nitrate concentrations (Figure 2). Concentrations ranged from 0.05 to 17 mg/L (average of 8.2 mg/L), and 29 (29%) of the 99 samples were above 10 mg/L. In general, concentrations were elevated across the watershed with each station having at least one sample above 10 mg/L; the highest concentrations were observed in spring/early summer and the lowest concentrations in late summer/early fall. Precipitation has significant influence on concentration dynamics from year to year (magnitude, variability, duration of elevated concentrations, etc.). Nitrate tolerant macroinvertebrates were also abundant across the watershed. Nitrate tolerant macroinvertebrates in the upper end of Roberts Creek Watershed on stream segments with macroinvertebrate impairments (AUIDs -505, -506, and -534) ranged from 46% to 90%.

Nitrate concentrations at station S007-065 are unique compared to the other stations due to the fact they remained fairly elevated throughout the entire year; the minimum concentration at station S007-065 in 2020 was 7.9 mg/L whereas minimum concentrations across the other stations ranged from 0.05 to 4.3 mg/L (the average concentration at station S007-065 in 2020 was 10.4 mg/L compared to a range of 5.1 to 8.5 mg/L across the other stations). One caveat with station S007-065 is that it was only sampled in 2020 and all other stations were sampled in both 2019 and 2020. Stations S001-188, S000-749, S015-240, and S008-388 allow us to compare stream segments in the headwaters area of Roberts Creek Watershed; these stations have similar drainage areas (approximately 1,800 acres, 3,500 acres, 3,800 acres, and 2,700 acres respectively), which provides a more valuable comparison when looking at nitrate concentration and potential load (Figure 3). In general, station S001-188 was consistently lower than the other headwaters stations; the average concentration for S001-188 was 7.0 mg/L whereas averages for the other three stations ranged from 8.7 to 8.9 mg/L.

Nitrate concentrations across the watershed over the last decade (2011 through 2020) ranged from 0.05 to 27 mg/L (average of 9.2 mg/L, 190 samples); 75 samples (40%) were above 10 mg/L.

Habitat

- The MPCA Stream Habitat Assessment (MSHA) scores throughout the watershed range from 42 (“poor”) to 68 (“good”). In general, MSHA scores decreased across the watershed from Cycle 1 to Cycle 2; a habitat example from biological monitoring in 2019 can be seen in Figure 4. Fine substrate is abundant in the upper end of Roberts Creek Watershed (Figure 5), and bank erosion and embeddedness were also documented. Elevated burrowers and legless individuals and reduced clingers were present in the upper part of the watershed (where biological impairments are located, Figure 6); this is often associated with lack of coarse substrate and/or woody debris,

excess fine substrate, embeddedness, etc. The fish community also reflects excess fine substrate/lack of coarse substrate as limited riffle dwelling individuals were present. In addition, “inadequate flow for riffle organisms” was noted in the upper part of the watershed (station 15EM086) in 2020 during macroinvertebrate sampling and minimal flow/dry stream flow conditions were documented in 2021 (stations 09CD018 and 09CD051, Figure 7); low flow conditions can impact habitat quality and availability. Overall, habitat conditions vary across the watershed with most MSHA scores in the “fair” range.

Fish Passage

- As mentioned above in the habitat section, minimal flow/dry streambed conditions were documented in the upper end of the watershed in August 2021 (Figure 7) and “inadequate flow for riffle organisms” was noted during macroinvertebrate sampling in 2020. These conditions are likely periodic based on climate, but fish passage does appear to be negatively impacting the fish community during low flow years. Migratory fish on stream segments with fish impairments comprised 3% (09CD018) and 8% (09CD051) of the community, well below the average (23%) for similar streams; these values are from 2009 as these stations weren’t sampled in Cycle 2.

Flow Alteration

- Most of mainstem Roberts Creek and Roberts Creek tributaries are natural channels; however, much of the headwater areas in the watershed are altered and drained via subsurface tile (Figure 8). In addition, low to no flow conditions have been documented in the headwaters portion of the watershed (Figure 7); these type of flow conditions are common during late summer/fall in altered and drained landscapes. Recent analysis for Dobbins Creek (just south of Roberts Creek) identified upward trends for precipitation and streamflow; precipitation increased during all seasons (during the post-change period, 1990 through 2020), and the largest runoff volumes occurred from April through June with the lowest in August. This analysis was provided by Minnesota Department of Natural Resources (DNR) staff for use in Cycle 2 SID work in the Dobbins Creek Watershed; precipitation and streamflow trends are likely similar in Roberts Creek Watershed. Flow alteration is complex and impacts biology in various ways throughout the year (e.g., both high/increased flows and low/no flow time periods can impact biology throughout the year).

TP/ Eutrophication

- Total phosphorus (TP) samples were collected across the watershed at eight stations as part of Cycle 2 SID in 2019 and 2020, with a goal to sample various flow conditions and establish a range of TP concentrations (Figure 2). Concentrations ranged from 0.01 to 0.69 mg/L (average of 0.123 mg/L), and 20 (20%) of the 99 samples exceeded the river eutrophication standard for the South Region (0.15 mg/L). Each station had at least one exceedance, with most occurring during elevated flow conditions. In general, TP concentrations were low (below the standard) during low flow conditions. When comparing the headwaters stations (S001-188, S000-749, S015-240, and S008-388), station S008-388 often had the lowest concentrations and station S015-240 often had the highest concentrations (Figure 3). These stations also had the lowest average concentration (0.079 mg/L) and highest average concentration (0.138 mg/L). The Sargeant WWTP discharges upstream of station S015-240, which is a potential reason (in addition to differences in nutrient management/conservation practices, soils, tile drainage, etc.) why this station is often higher than the other headwater stations; effluent samples collected from 2004 through 2022 ranged from 0.2 to 5.3 mg/L (average of 1.6 mg/L, 85 samples). Two chlorophyll-*a* (chl-*a*) and BOD samples were collected in 2019 (one in July and one in August) at station S001-182 (near the mouth of Roberts Creek); all samples were meeting standards. However, there

was a chl-*a* exceedance (72 µg/L) at this station in September 2009. There were no daily DO flux exceedances during the limited (only four days of usable data) 2019 sonde deployment, but occasional low DO has been documented. Although elevated TP has been documented, the recent (although limited) response variable (chl-*a*, BOD, and DO flux) data is meeting standards therefore it's unclear if excess TP is resulting in eutrophication issues.

TP concentrations across the watershed over the last decade (2011 through 2020) ranged from 0.01 to 1.01 mg/L (average of 0.159 mg/L, 176 samples); 49 samples (28%) were greater than 0.15 mg/L.

DO

- Several instantaneous (point) measurements were collected throughout the watershed over the last decade (2011 through 2020), and two (1%) were below the DO standard of 5 mg/L; both exceedances occurred on Roberts Creek in 2012 (S000-749 – 2.9 mg/L in July, S000-746 – 2.3 mg/L in September). In addition, low DO (4.4 mg/L) was documented in the upper end of Roberts Creek during fieldwork in August 2021 (Figure 7). A sonde was deployed near the mouth of Roberts Creek (S001-182) in 2019 and no low DO was identified; however, issues during deployment resulted in only four days of usable data. Overall, DO conditions appear suitable for warmwater biota most of the time, but occasional low DO has been documented. The fish and macroinvertebrates show minimal signs of DO stress, with generally few low DO tolerant individuals. The probability of meeting the DO standard based on the composition of the fish community ranged from 77% to 92% across the watershed (this range includes samples from 2004, 2009, 2013, 2015, 2017, and 2019).

TSS

- TSS samples were collected across the watershed at eight stations as part of Cycle 2 SID in 2019 and 2020, with a goal to sample various flow conditions and establish a range of TSS concentrations (Figure 2). Concentrations ranged from 1.2 to 560 mg/L (average of 38.9 mg/L), and 17 (17%) of the 99 samples exceeded the warmwater TSS standard (65 mg/L). All stations except S007-065 had at least one exceedance, with most occurring during elevated flow conditions. In general, TSS concentrations were low (below the standard) during low flow conditions, but Roberts Creek (AUID -504) does have a TSS impairment. TSS tolerant macroinvertebrates in the upper end of Roberts Creek Watershed on stream segments with macroinvertebrate impairments (AUIDs -505, -506, and -534) comprised 21% to 70% of the community. Station 15EM086 was the only station on a biologically impaired reach that was sampled after Cycle 1; TSS tolerant macroinvertebrates were 43% (2015) and 21% (2020) of the community. The probability of meeting the TSS standard based on the composition of the fish community was 55% (09CD051) and 59% (09CD018) in 2009; these are the only stations located on AUIDs with fish impairments and they were not sampled in Cycle 2. Although elevated TSS concentrations have been documented and some biological indication of TSS stress exists, it's unclear if TSS is a stressor at this time due to concerns that the biological response may be driven by another stressor(s). Regardless, sediment is a concern via habitat loss and degradation from an abundance of fine substrate and embeddedness.

TSS concentrations across the watershed over the last decade (2011 through 2020) ranged from 1.2 to 744 mg/L (average of 51.7 mg/L, 175 samples); 40 samples (23%) were greater than 65 mg/L.

Figure 2: 2019 and 2020 TSS (brown box plots), TP (purple box plots), and nitrate (green box plots) concentrations (mg/L) in Roberts Creek Watershed. The red lines represent the TSS standard (65 mg/L), river eutrophication standard for the South Region (0.15 mg/L), and nitrate drinking water standard (10 mg/L).

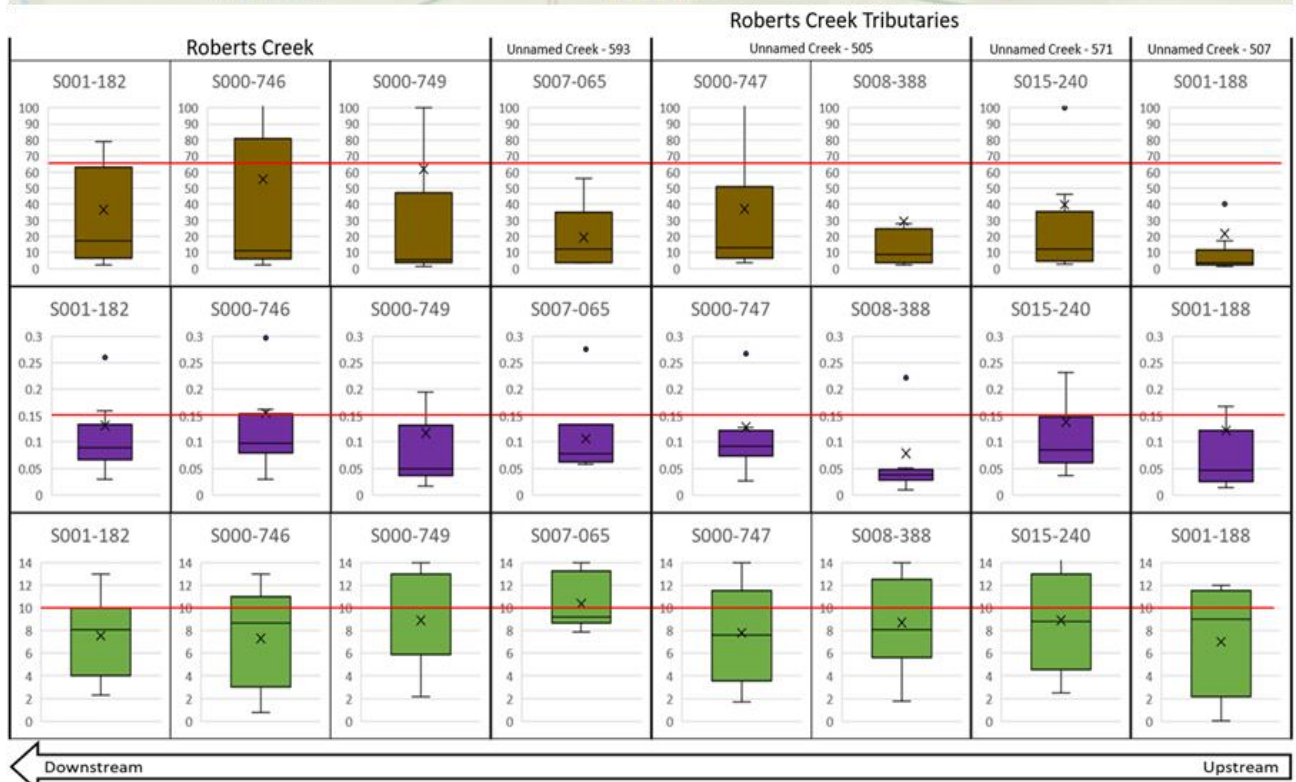
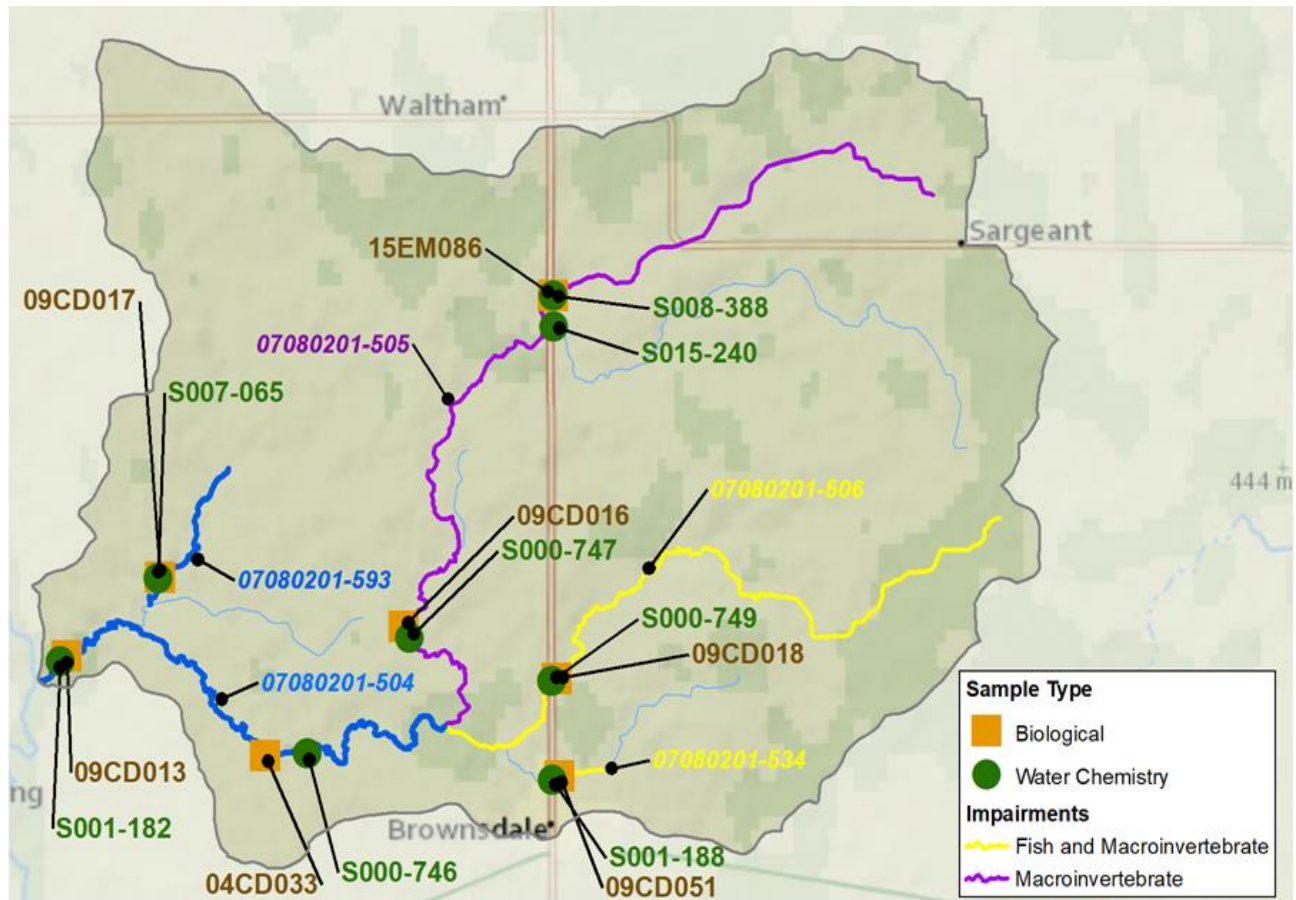


Figure 3: 2019 and 2020 nitrate, TSS, and TP concentrations in the headwaters area of Roberts Creek Watershed (stations S001-188, S000-749, S015-240, and S008-388). In general, station S001-188 often had lower nitrate concentrations than the other headwater stations, and station S008-388 often had the lowest TP concentrations while station S015-240 often had the highest concentrations.

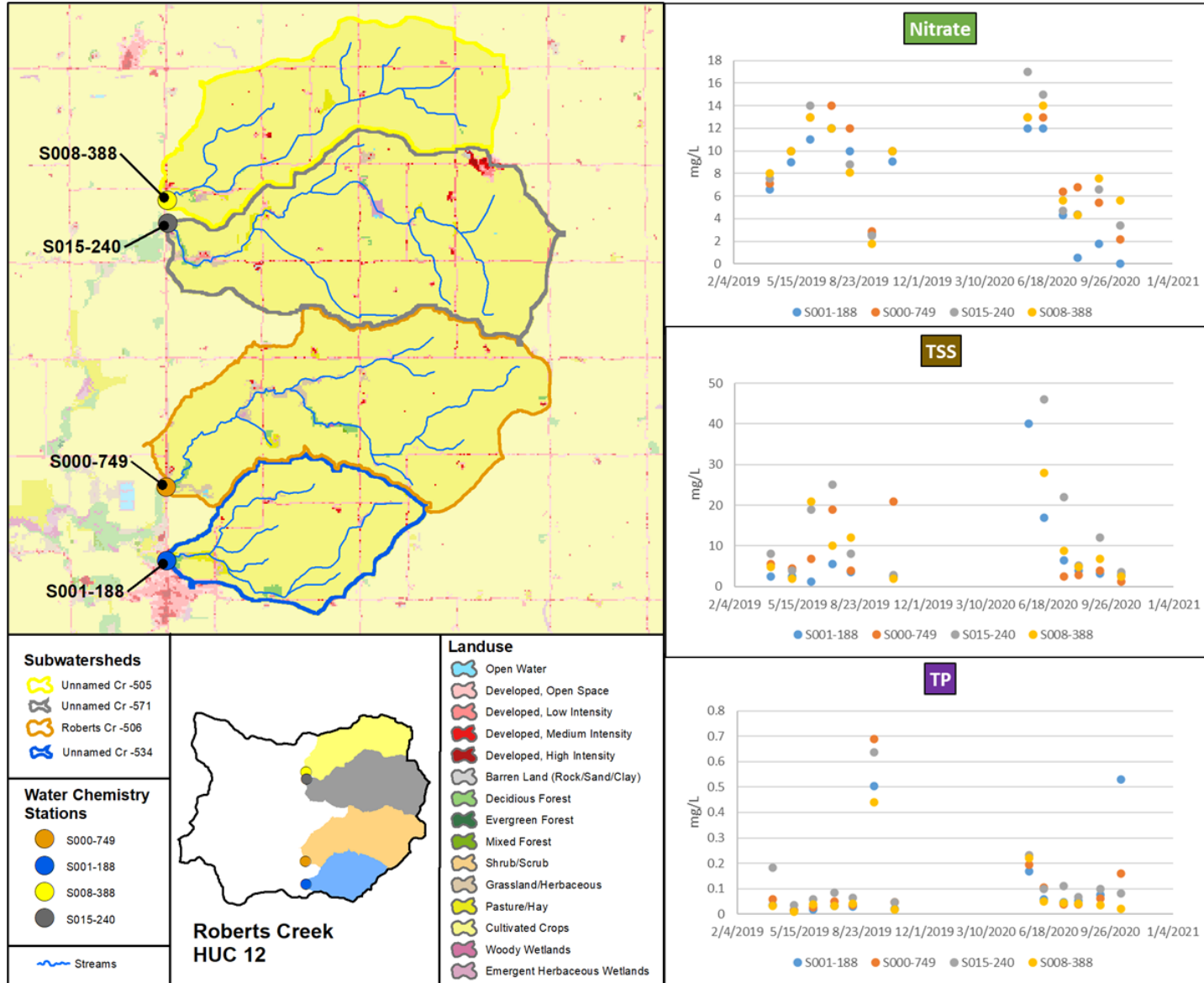


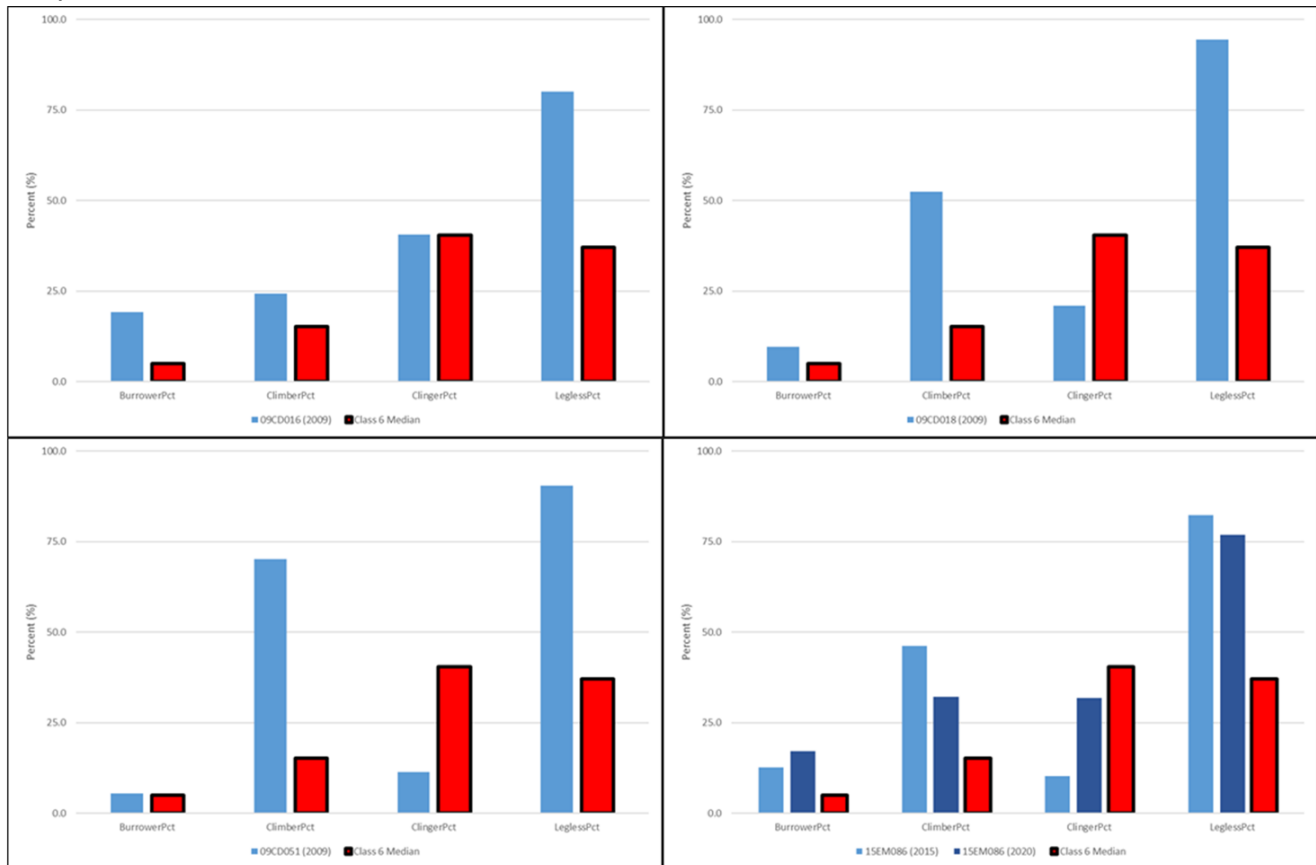
Figure 4: Habitat example from biological monitoring station 09CD013 in Roberts Creek Watershed in 2019.



Figure 5: Examples of habitat conditions in the upper end of Roberts Creek Watershed on biologically impaired stream reaches. Although some of the MSHA scores were ok, fine substrate and streambank instability/erosion are present and negatively impacting habitat conditions.



Figure 6: Macroinvertebrate habitat metrics in the upper end of Roberts Creek Watershed on biologically impaired stream reaches; the statewide median (red columns) of similar streams meeting the MIBI threshold was used for comparison/context.



Expected Response to Habitat Stress

Burrowers = ↑

Climbers = ↓

Clingers = ↓

Legless = ↑

- **Burrowers:** Burrower species “burrow” in fine sediment indicating potential siltation in riffles.
- **Climbers:** Climber species use habitat such as overhanging vegetation or woody debris.
- **Clingers:** Clinger species attach to rock or woody debris. Clingers may decrease in stream reaches with homogeneous substrate composition, velocity, and depth.
- **Legless:** Legless macroinvertebrates are tolerant species like midges, worms, and snails.

Figure 7: Flow conditions in August 2021 in the upper end of Roberts Creek (09CD018, left) and Unnamed Creek (09CD051, right). The upper end of Roberts Creek had minimal flow and Unnamed Creek was dry, indicating that fish passage can be a stressor during years with limited precipitation. Low DO (4.4 mg/L) was also documented at station 09CD018 during this field visit.



Summary

- Nitrate, habitat, fish passage, and flow alteration are stressing the biology in the upper end of Roberts Creek Watershed, while stream temperature is not currently a stressor and eutrophication, DO, and TSS are inconclusive (Table 2).
- Nitrate concentrations were elevated across the watershed. Cultivated crops dominate the watershed and are the primary source of nitrogen to surface waters; tile drainage is abundant and a primary transport path to surface waters.
- Overall, habitat conditions vary across the watershed with most MSHA scores in the “fair” range. Excess fine substrate and inadequate stream flow (at times) are impacting habitat quality and availability in the upper part of Roberts Creek Watershed. These no flow/minimal flow time periods can also impact variables such as fish passage and DO concentrations (Figure 7).
- Flow alteration is negatively impacting biology in Roberts Creek Watershed; headwater areas are altered and drained via subsurface tile (Figure 8). Altered watercourses are often associated with poor habitat, an abundance of fine substrate, excess nutrients and productivity, altered DO regimes (low DO and high DO flux), and minimal flow time periods. Increasing trends for precipitation and streamflow are also a concern and highlight the need for water storage on the landscape; increases in precipitation and streamflow have the potential to alter multiple variables such as nutrient/sediment loading, bank erosion, and habitat.
- Elevated TP concentrations and low DO have been documented, but it’s uncertain if they are stressing the fish and/or macroinvertebrate communities. Currently there is no clear link indicating that elevated TP concentrations are creating eutrophic conditions resulting in low DO environments. Most TP exceedances occurred during elevated flow conditions (when phosphorus is attached to sediment particles), and very low flows during certain years/times of year may result in periodic low DO in the headwater areas of Roberts Creek and its tributaries.
- TSS concentrations were low (below the standard) during low flow conditions, but Roberts Creek (AUID -504) does have a TSS impairment. Although elevated TSS concentrations have been documented and some biological indication of TSS stress exists, it’s unclear if TSS is a stressor at this time due to concerns that the biological response may be driven by another stressor(s). Regardless, sediment is a concern via habitat loss and degradation from an abundance of fine substrate and embeddedness. Since cultivated crops are the dominant land use in the watershed, likely sediment sources include runoff from agricultural fields and stream bank erosion.
- Stream temperatures are adequate to support warmwater biota.
- When comparing similarly sized headwater stations (S001-188, S000-749, S015-240, and S008-388), a few consistencies were noted. In general, station S001-188 often had lower nitrate concentrations than the other headwater stations, and station S008-388 often had the lowest TP concentrations while station S015-240 often had the highest concentrations (Figure 3).
- Overall, reducing nutrient and sediment loading, improving in-stream habitat, and addressing flow alteration related issues (e.g., poor habitat, fine substrate, nitrogen rich tile water, water storage, etc.) are critical to improve fish and macroinvertebrate health in the headwaters area of Roberts Creek Watershed.

Table 2: Summary of stressors in the Roberts Creek Watershed (● = stressor, ○ = inconclusive stressor, blank = not a stressor, NE = not evaluated).

Waterbody	AUID	Biological Stations	Biological Impairment	Class	Stressors							
					Temperature	Nitrate	Eutrophication	DO	TSS	Habitat	Fish Passage	Flow Alteration
Roberts Creek	504	04CD033, 09CD013		2Bg	NE	NE	NE	NE	NE	NE	NE	NE
Unnamed Creek	505	09CD016, 15EM086	Macroinvertebrates	2Bg		●	○	○	○	●	NE	●
Roberts Creek	506	09CD018	Fish, Macroinvertebrates	2Bg		●	○	○	○	●	●	●
Unnamed Creek	534	09CD051	Fish, Macroinvertebrates	2Bg		●	○	○	○	●	●	●
Unnamed Creek	593	09CD017		2Bg	NE	NE	NE	NE	NE	NE	NE	NE

For more information

For more information, go to <https://www.pca.state.mn.us/watershed-information/cedar-river>.

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