October 2025

Stressor Identification

Long Prairie River Watershed Stressor Identification Report Update 2025

A study of local stressors limiting the biotic communities in the Long Prairie River Watershed.

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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Key terms and abbreviations

AUID	Assessment Unit Identification
DNR	Minnesota Department of Natural Resources
DO	Dissolved Oxygen
EPA	U.S. Environmental Protection Agency
FIBI	Fish Index of Biotic Integrity
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
MIBI	Macroinvertebrate Index of Biotic Integrity
MPCA	Minnesota Pollution Control Agency
MSHA	Minnesota Stream Habitat Assessment
SID	Stressor Identification
TALU	Tiered Aquatic Life Use
TIV	Tolerance Index Value
TP	total phosphorus
TSS	total suspended solids
UAA	Use Attainability Analysis
WID	water body identification

Introduction

Since 2008, the Minnesota Pollution Control Agency (MPCA) has substantially increased the use of biological monitoring and assessment as a means to determine and report the condition of the state's rivers and streams. This basic approach is to examine fish and aquatic macroinvertebrate communities and related habitat conditions at multiple sites throughout a major watershed. From these data, an Index of Biological Integrity (IBI) score can be developed, which provides a measure of overall community health. These scores are then compared to the appropriate IBI thresholds (stream class), which are determined by the type and location of the stream or river that was sampled. If the fish or macroinvertebrate IBI (MIBI) score fails to meet the standards set by the stream class, it is termed a "biological impairment" and is placed on the U.S. Environmental Protection Agency's (EPA's) impaired wasters list. If biological impairments are found, stressors to the aquatic community must be identified.

Stressor identification (SID) is a formal and rigorous process that identifies stressors causing biological impairment of aquatic ecosystems and provides a structure for organizing the scientific evidence supporting the conclusions (Cormier et al. 2000). In simpler terms, it is the process of identifying the probable factors causing harm to aquatic life. SID is a key component of the major watershed restoration and protection projects being carried out under Minnesota's Clean Water Legacy Act. Information on the SID process can be found on the EPA website http://www.epa.gov/caddis/. Specific information on Minnesota's processes for SID in streams can be found on MPCA's webpage "stressor identification" at https://www.pca.state.mn.us/water/your-water-stressed. Minnesota Department of Natural Resources (DNR) has a similar webpage for lakes - "Stressors to Biological Communities in Minnesota's Lakes" https://www.dnr.state.mn.us/waters/surfacewater_section/lake_ibi/index.html.

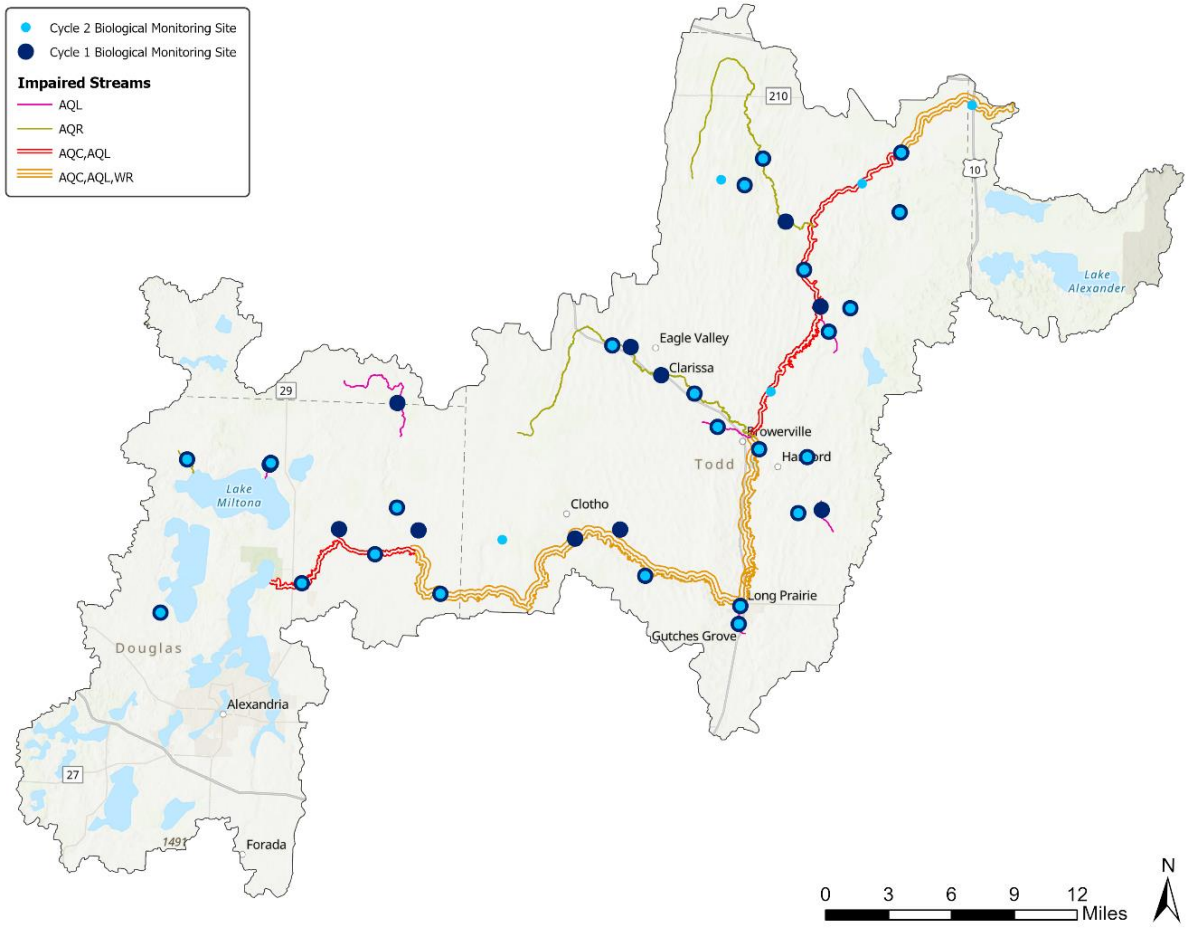
This report assesses the probable factors causing harm to aquatic life for the Long Prairie River Watershed. This update or "Cycle 2" assessment uses updated biological monitoring data collected in 2011 and 2023. This report also contains SID work that was completed after the Cycle 1 watershed monitoring, at stations located on streams that were channelized. The MPCA did not have the tools to assess channelized streams until the Tiered Aquatic Life Use (TALU) assessment process was written into rule in 2014. Stations that were sampled in 2011 on channelized streams, were not assessed until TALU criteria were finalized. As a result, these Assessment Unit Identification (AUIDs) were not included in the Cycle 1 SID Report (MPCA 2014).

Overview of the Long Prairie River Watershed

The Long Prairie River Hydrologic Unit Code (HUC)-8 Watershed (07010108) is divided into HUC-12 subwatersheds and three were studied in this report. The HUC-12 subwatersheds that were previously studied can be found in the Cycle 1 Long Prairie River Watershed SID Report https://www.pca.state.mn.us/sites/default/files/wq-ws5-07010108.pdf.

During Cycle 1 of watershed monitoring, a biological station was placed at the outlet of the HUC-14, 12, 10, and 8 levels in order to monitor each HUC-8 watershed in an unbiased manner. As the MPCA began Cycle 2 monitoring, efforts were scaled back to provide the ability to sample stations that were local priorities, while still monitoring at a sufficient level to detect change. Biological monitoring stations are placed at the outlet of each of the HUC-12 subwatersheds, with a preference for stations that have existing monitoring data from the Cycle 1 (Figure 1).

Figure 1: Biological Monitoring Stations and Biological Impairments within the Long Prairie River Watershed



Biologically impaired streams

Biological sampling from the Cycle 2 monitoring effort resulted in one new stream reach with a fish and/or macroinvertebrate community impairment. In addition to this one new impairment from the Cycle 2 monitoring, three stream reaches are now assessed as impaired that were deferred in Cycle 1 due to being channelized. These reaches were brought into the SID update process and are listed below (Table 1).

Table 1: Summary of aquatic life impairments and stressors in the Long Prairie River Watershed.

Denotes Todd County

Stream	AUID	Aquatic Life Impairment	Monitoring Data Source Year	Dissolved Oxygen	Phosphorus	TSS	Connectivity	Hydrology/ Geomorphology	Habitat	Flow
Unnamed Creek*	-599	Fish	Warmwater Reach from 2011 and 2022 Sampling				x		x	
Unnamed Creek*	-600	Macroinvertebrates	Channelized Stream from 2011 Sampling		x			x	x	x
CD 11*	-552	Fish, *E. coli*	Warmwater Reach from 2011 and 2022 Sampling				X	x	x	x
Long Prairie River	-505	Fish, DO, SO4	Warmwater Stream from 2011 and 2022.	x						

x = direct stressor (stressor directly contributing to the biological impairment), X = secondary stressor (stressor that is not the direct stressor, but is still contributing to the biological impairment), ◊ = Possible contributing root cause (stressor that is not a direct or secondary stressor, but may be contributing to other stressors, causing stress to the biological communities, ? = Inconclusive

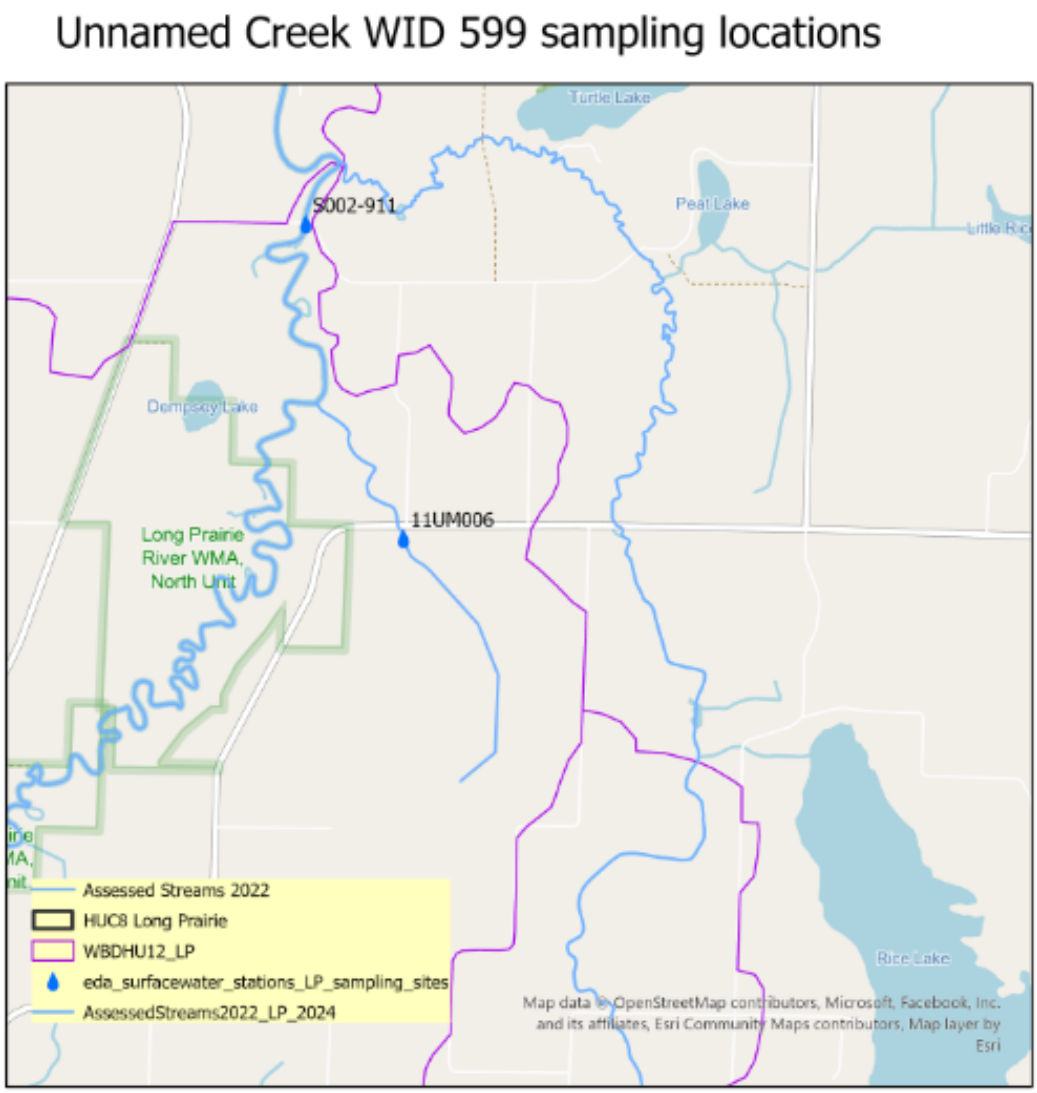
*Denotes channelized streams that may be part of a Judicial or County ditch system.

The SID data collection, analysis, and recommendations for each of these impaired AUIDS will be discussed and sorted into HUC-12 subwatersheds for this report.

Unnamed Creek (07010108-599)

Impairment: Unnamed Creek (WID -599) flows for 1.97 miles. This water body identification (WID) is the farthest downstream section of unnamed Creek and is fed by two drainage ditches, both are unnamed tributary creeks that meet to form Unnamed Creek. WID 599 and the upstream tributaries are all channelized. There is one biological monitoring stations (11UM006) that was sampled on Unnamed Creek (Figure 2). Fish were sampled at 11UM006 in 2011 and 2022 and macroinvertebrates were sampled in 2011 and 2022. The data indicated that the fish in Unnamed Creek were not meeting standards and resulted in a new fish impairment for the 2024 Impaired waters list. The fish class at 11UM006 is fish class 6 (Northern Headwater). The macroinvertebrate class at 11UM006 is Class 6 (Southern Forest Stream GP). The macroinvertebrate sample was assessed and fully supports the Class 6 (Southern Forest Stream GP).

Figure 2: Sampling locations on Unnamed Creek WID 599.



Data and Analyses

Chemistry

Extensive water chemistry data has been collected on Unnamed Creek from 2010-2011 and 2021-2022 at one monitoring locations (S012-006) (Table 2).

Table 2: Water chemistry data collected on Unnamed Creek from 2010-2011 and 2021-2022. Data available at https://webapp.pca.state.mn.us/surface-water/search.

Parameter	Sample Count	Applicable Standard	Average Result	Min Result	Max Result	% exceeding standard
Temperature, water	16		17.90	10.16	24.18	
Specific conductance						
pH	16	6.5-9.0	7.64	7.42	8.07	0
Dissolved Oxygen	16	5.0 mg/L	8.08	4.65	14.98	6.3
Inorganic nitrogen (nitrate and nitrite)	9	10	0.41	0.05	1.40	0
Phosphorus	9	0.10	0.08	0.04	0.19	11
Transparency, tube with disk	16	25 cm	95.75	67	100	0
Total suspended solids	2	30	2.60	2.40	2.80	0

Nutrients – Phosphorus

Phosphorus values from the dataset on Unnamed Creek (Table 2), shows that the average TP is below the Central Region River Nutrient standard (0.100 mg/L) with an average value of 0.08 mg/L. However, although the average phosphorus value is low, there is evidence that TP can become elevated during the summer months, as 11% of the samples were above the standard. Overall, due to 89% of the phosphorus values meeting the standard, phosphorus is not considered to be a stressor in Unnamed Creek, but additional monitoring should be conducted every few years to quantify the amount of phosphorus in the stream.

Dissolved Oxygen

Dissolved oxygen (DO) levels in Unnamed Creek (Table 2), are above the standard in 94% of the data points. Since this AUID is in the Northern Headwater class the applicable standard is 5.0 mg/L. **DO is not considered to be a stressor** in Unnamed Creek.

Total Suspended Solids

The limited TSS dataset for Unnamed Creek indicates that TSS values are low in the creek, with 100% of the values occurring below the standard of 30 mg/L (Table 2). However, **TSS is inconclusive** as a stressor to the aquatic life in Unnamed Creek as the dataset is very limited and additional TSS samples should be collected in the future to verify that TSS is not an issue.

Conductivity

Specific conductivity values were within range on Unnamed Creek (Table 2) and is **not considered to be a stressor** in Unnamed Creek.

Temperature

Temperature values were within range on Unnamed Creek (Table 2) and is **not considered to be a stressor** in Unnamed Creek.

Habitat

Habitat was classified as fair/poor on Unnamed Creek, through the Minnesota Stream Habitat Assessment (MSHA) evaluations during the fish and macroinvertebrate samples (Figure 3). This section of stream has been historically ditched and flows through a large woody wetland, perfect habitat for beaver activity. Stream substrate was dominated by sand, silt and some clay during the 2011 and 2022 site visit.

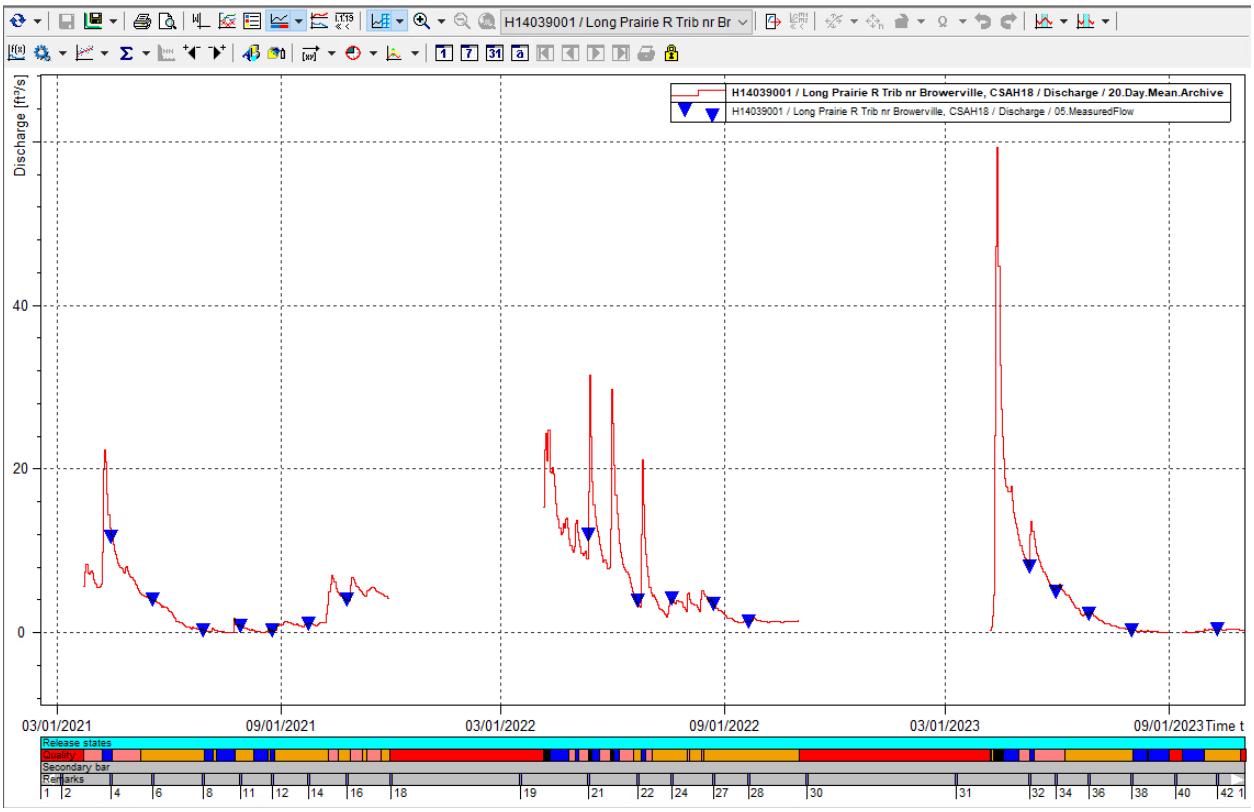
Figure 3: MSHA Habitat scores for Unnamed Creek

In general, the MSHA evaluations score poor on Unnamed Creek; however, there is a stark difference in the habitat availability between the two visits from the biological monitoring station (11UM006) shown in Figure 3. The most significant differences between the two visits can be seen in the cover and channel morphology categories. The substrate at 11UM006 was dominated by sand and silt, with the presence of clay also noted. Healthy fish communities need coarse substrate to build nests and spawn. Excessive fine sediment also affects juvenile fishes, as the sediment is stirred into the water column creating TSS, it can easily tear sensitive juvenile fish gills. Similarly, many sensitive macroinvertebrates also have specialized gills that are used to breathe DO. Excessive fine sediments can damage these gills, similar to juvenile fishes, making the creek inhabitable for sensitive species. In addition to the differences in substrate between the two biological monitoring stations, channel morphology also changed between the two stations. The channel morphology score at 11UM006 indicated that the channel development was poor (no pools, slow velocity runs, and no riffles **Lack of habitat is a stressor** to the aquatic life in 11UM006 due to poor channel morphology and substrate.

Hydrology and geomorphology

Over time, there have been many changes on the landscape that have changed the natural hydrology and geomorphology of Unnamed Creek, and the entire subwatershed. The most significant historical changes to the landscape have been land conversion from mature deciduous forests and woody wetlands to cultivated crops and hay/pasture and the channelization of the natural streams and wetlands. Unnamed Creek has been straightened along the entire length of the AUID. Historically, Unnamed Creek was comprised of multiple wetlands and small stream channels. The channel was altered to drain the landscape, starting from the South, and ending downstream where Unnamed Creek flows into the Long Prairie River. This new channel created a direct connection throughout the subwatershed. This channel alteration accelerates stream flow, resulting in higher flows during precipitation events which achieves the agricultural land use drainage goals, but causes instability. Water leaves the landscape quickly, resulting in periods of higher flow than what would have naturally occurred. Then, as these flows quickly drain, the flow regime quickly transitions to slow moving low gradient flow, reaching very low conditions starting early in the summer (Figure 4). Although 2023 was a dry summer, Unnamed Creek was already mostly very slow and low by the end of June. This reach is very low gradient and has very slow stream velocities for large portions of the summer upstream of CR18.

Figure 4: stream flow from 2021 through 2023.



Due to the channelization of Unnamed Creek, the creek does not have a natural stream pattern that can be assessed for stability. Utilizing the biological monitoring sampling pictures and MSHA evaluations of stream bank condition, the banks appear to be stable and not actively eroding. Therefore, due to the altered hydrology and geomorphology of Unnamed Creek causing the channel to get very low flow, it is an **inconclusive stressor** in Unnamed Creek. Since the invertebrate community has an acceptable MIBI score it is acknowledged that the altered hydrology may not be contributing to the low fish IBI (FIBI) score.

Connectivity

The culvert crossing by 11UM006 off CR18 is a fish barrier. The drop structure associated with this crossing is a barrier at all flow regimes as can be seen in the photos below. Sampling site 11UM006 is on the upstream side of the culvert. This culvert is **considered the main stressor** at the sampling location for fish as it poses a barrier to fish movement within the stream at almost all flow regimes.

Figure 5: May 17, 2023; high flow at CR18 crossing. Velocities prevent fish passage.

Figure 6: August 1, 2023; low flow at CR18 crossing. Drop structure at outlet and minimal water in culvert prevent fish passage.

Stressor signals from biology

Fish

Fish were sampled in 2011 and 2022 as part of the Cycle 1 and 2 monitoring effort. A total of four fish species were collected, with the brook stickleback and central mudminnow being the most dominate. The brook stickleback and central mudminnow is one of the most pollution tolerant fish species in the state of Minnesota. All the other fish species that were collected are also considered tolerant of pollutants.

Tolerance index values (TIV) were calculated for Unnamed Creek using the fish community. The total suspended solids (TSS) TIV found that the fish community has an 57% probability of coming from a stream that is meeting the TSS standard. No fish species that are tolerant or sensitive of elevated TSS were found in any of the fish samples, indicating a weak TSS signal from the biology. Therefore, the **fish community response to TSS is weak, and therefore, is inconclusive.**

DO TIV scores were also calculated for Unnamed Creek using the fish communities. This calculation indicated that the fish community has an average probability of only 9.9 and 16.8% of coming from a stream that was meeting the DO standard. Three of the four fish species collected are either tolerant or

very tolerant of low DO, indicating that **low DO has the potential to be a stressor** to the fish community in Unnamed Creek.

Phosphorus tolerance of the fish community was also investigated in Unnamed Creek using the fish species characteristics. Two of the fish species collected within the 2011 sample were tolerant of elevated phosphorus. As for sensitive species, zero fish species that are sensitive or intolerant of elevated phosphorus were found in the sample. The presence of elevated phosphorus tolerant species and the absence of intolerant species indicates that **phosphorus may be a stressor to the fish community** in Unnamed Creek.

Macroinvertebrates

Macroinvertebrates were not used as signals because the 2011 and 2022 monitoring effort were above the modified use threshold for macroinvertebrates.

Composite conclusion from biology

The fish TIVs are indicating that low DO is a potential stressor to the aquatic life in unnamed Creek; however, the DO dataset indicates that DO is at healthy levels. TSS does not appear to be stressor to the aquatic life in Unnamed Creek. Elevated phosphorus levels may be a stressor to the aquatic life in unnamed Creek. The habitat and geomorphology are heavily altered in Unnamed Creek and are the primary stressors to the aquatic life in Unnamed Creek. The perched culvert is the main stressor to the fish as fish cannot pass upstream under most conditions.

Conclusions about stressors

Stressors

- **Perched culvert on CR18 is the primary stressor.** This culvert impedes fish passage at all flow regimes.
- **Habitat.** The channel morphology score at 11UM006 indicated that the channel development was poor (no pools, slow velocity runs, and no riffles Lack of habitat is a stressor to the aquatic life within 11UM006 due to poor channel morphology and substrate.

Potential/Inconclusive stressors

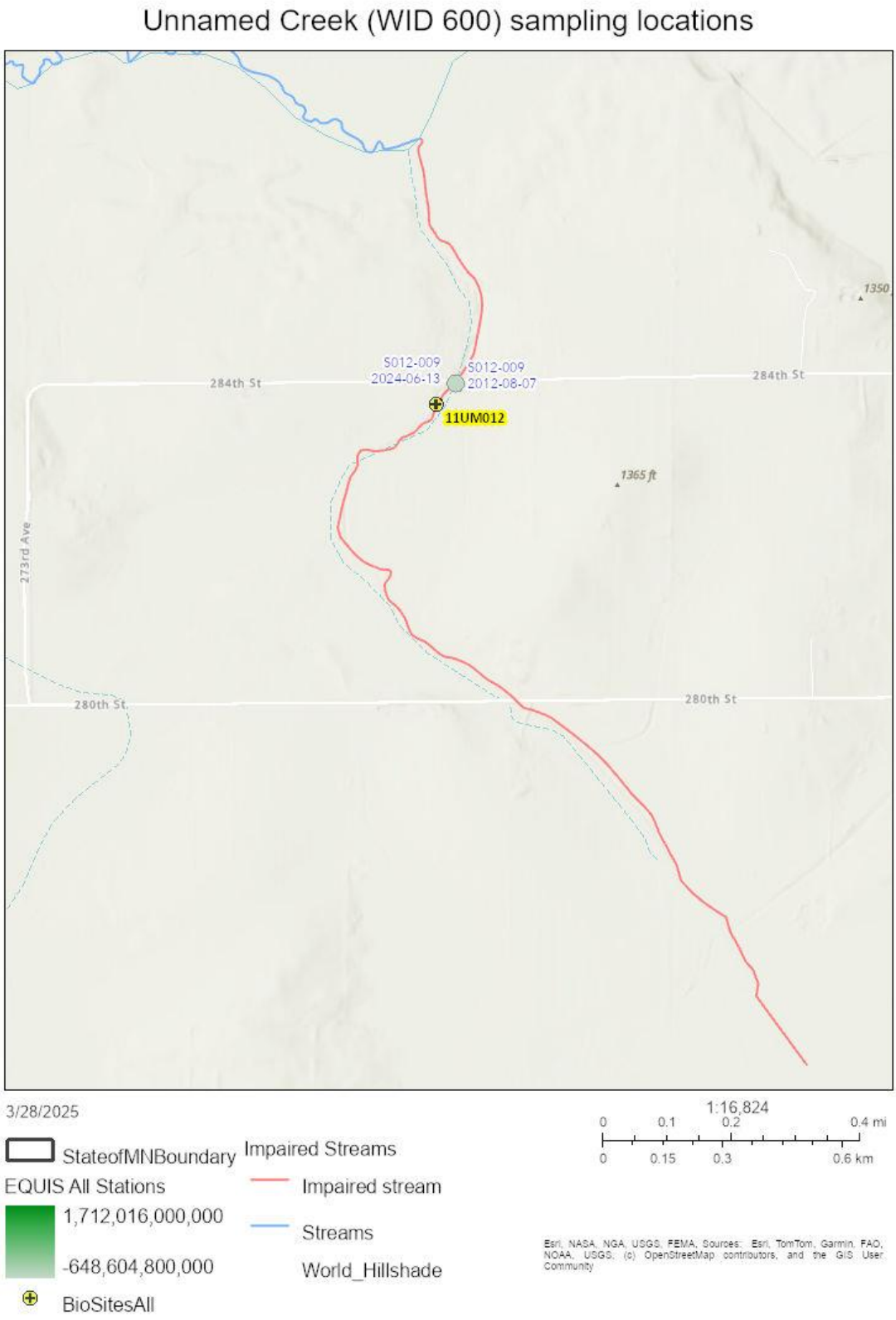
- **DO.** The fish TIVs indicate that DO is a potential stressor to the fish community within Unnamed Creek; however, this may be the result of the low DO tolerant fish species also having the ability to survive in streams with poor habitat and altered hydrology.
- **Altered hydrology/geomorphology.** altered hydrology is an inconclusive stressor to the biology in Unnamed Creek. Poor sinuosity, poor channel development, and fine sediment were noted within the MSHA assessment. These are the result of channel over widening and the creation of a new channel through historical wetlands. Sensitive fish and macroinvertebrates require coarse substrate and good channel morphology to survive and reproduce. However, good sinuosity and the pools and riffles that naturally occur within streams and rivers, do not exist in Unnamed Creek by design. As for the substrate in Unnamed Creek, due to creating a channel through several wetlands, sand has covered all of the coarse substrates that would exist naturally. The

geomorphology, habitat and lack of connectivity of Unnamed Creek have impeded intolerant species from surviving in the creek, due to the channelization and culvert placement on CR18.

Unnamed Creek (07010108-600)

The Unnamed Creek Subwatershed covers 3,844 acres. The WID 600 was initially listed as impaired by aquatic life use based on benthic macroinvertebrate bioassessments in 2011. The macroinvertebrate IBI score was 29 during the Augst 23, 2011, sampling event, which is 7 points below the general use threshold. Site 11UM012 was only sampled during the Cycle 1 event in 2011. Macroinvertebrate samplers noted no riffles, animal access to stream, animal trampling of banks on downstream section of WID, and low DO (3.98 mg/L). The macroinvertebrate sample was dominated by a tolerant scud and blackfly larvae with few caddisflies and Odonates present. The fish were sampled at site 11UM012 on June 14, 2011, and scored an IBI of 57.8 which was well above the general use threshold. The fish sample included 2 sensitive dace species, along with Iowa darter and creek chub, which are also sensitive species. This score listed AUID 600 as a general use stream. As a general use stream the expectation is that the biological life in the stream will meet the associated IBI score to be removed from the impaired waters list. Figure 7 shows the sampling location for WID 600.

Figure 7: Sampling locations on Unnamed Creek WID 600.



Data and Analysis

Chemistry

Water chemistry data has been collected on Unnamed Creek in 2011 and 2023 at monitoring station S012-009 (Table 3).

Table 3: Water chemistry data collected on Unnamed Creek from 2011;2023. Data available at https://webapp.pca.state.mn.us/surface-water/search.

Parameter	Sample Count	Applicable Standard	Avg. Result	Min. Result	Max. Result	% Exceeding standard
Temperature, water	11		17.19	7.89	23.23	
Specific conductance	11		364	251	570	
pH	11	6.5-9.0	7.63	8.02	7.13	0
Dissolved Oxygen	11	5.0	7.41	1.42	12.12	27.3
Inorganic nitrogen (nitrate and nitrite)	6	10	0.05	0.00	0.14	
Total Phosphorus	6	0.100	0.12	0.05	0.20	66.7
Transparency tube with disk	12	25 cm	90.92	36.0	100	0
Total suspended solids	1	30	3.2	3.2	3.2	0

Nutrients – Phosphorus

Phosphorus concentrations from the dataset on Unnamed Creek (Table 3) shows that the average TP concentration is above the Central region River Nutrient standard (0.100 mg/L) with an average concentration of 0.12 mg/L. This reach has row crop agriculture as the dominant land use on the WID upstream of 284th Street crossing where the biological sampling location is located. (Figure 8). Elevated **phosphorus is a stressor** to the macroinvertebrates. Elevated phosphorus occurred in 75% of the eight phosphorus samples collected.

Figure 8: Unnamed Creek biological monitoring site 11UM012 and Equis site S012-009. Photo taken 5/03/2023 when stream was flowing. Stream is channelized and has row crop agriculture adjacent to both sides of the channel.

Nutrients – Inorganic Nitrogen

Inorganic nitrogen measured as nitrate-nitrite is well below the 10 mg/L drinking water standard. The average concentration from 6 samples collected was 0.05 mg/L (4). Inorganic **nitrogen is inconclusive as a stressor** to the biology within Unnamed Creek. Additional nitrogen samples should be collected to better understand the nitrogen concentrations within Unnamed Creek.

Dissolved Oxygen

If DO is below 5 mg/L for extended periods of time, biological communities can be severely impacted. DO was collected 11 times in 2023 and 2024. The average DO concentration was 7.41 mg/L. Of the collected DO concentrations, 27% were below the 5 mg/L standard for 2B waters (4). **Low DO is a possible stressor** to the stream biology during periods of low flow.

Conductivity

Specific conductivity values were within range on Unnamed Creek (Table 3) and **is not considered to be a stressor** in Unnamed Creek.

Temperature

Temperature values were within range on Unnamed Creek (Table 3) and **is not considered to be a stressor** in Unnamed Creek.

Total Suspended Solids

TSS data is limited to one sample (Table 3). The concentration was 3.2 mg/L for TSS and is well below the state standard of 30 mg/L in the central TSS zone. Elevated **TSS is not considered to be a stressor** to the macroinvertebrate community. Twelve transparency tube were also collected, and all 12 samples were above the applicable standard. Indicating full support.

Habitat

Habitat was classified as fair on Unnamed Creek, through the MSHA evaluations during the fish and macroinvertebrate samples (Figure 9).

Figure 9: MSHA habitat scores for Unnamed Creek.

There was one habitat assessment conducted at 11UM012 on June 14, 2011, during the fish visit. This site scores good in riparian cover, substrate, cover and channel morphology. There are active cattle pastures downstream of 284th St near water quality station S012-009. The downstream portion of the reach shows signs of active bank erosion from cattle. Figure 10 shows the active pasture on the downstream side of road.

CSAH 12. Photo on the left was taken on 4/28/2021 and the photo on the right was taken on 6/08/2022.

Figure 10: Active cattle pasture just downstream of 284th St at S012-009.

Lack of habitat is a secondary stressor to the aquatic life within WID 600. Fish communities indicate a sensitivity to fines and embedded substrate. However, the old channelization could be impacting the available macroinvertebrate habitat. Only 1 sample was collected at this site, so it is hard to determine any changes from 12 years earlier.

Hydrology and geomorphology

Over time, there have been many changes on the landscape that have changed the natural hydrology and geomorphology of Unnamed Creek, and the entire subwatershed. The most significant historical changes to the landscape have been land conversion from mature forests to pasture and the channelization of the natural streams and wetlands. Unnamed Creek has been partially straightened along the entire length of the WID. Historically, Unnamed Creek was comprised of multiple wetlands

and small stream channels. It appears that the upper reaches of the ditch were cut through wetlands to drain wetlands and convert the land for agricultural purposes with minimal success. This channel alteration accelerates stream flow, resulting in higher flows during precipitation events, which achieves the agricultural land drainage goals, but causes channel instability. Water leaves the landscape quickly, resulting in periods of higher flow than what would have naturally occurred. As the landscape drains, water that was once held in the upstream wetlands is flushed downstream. Then, as these flows quickly drain, the flow regime quickly transitions to intermittent, reaching stagnant conditions starting during periods of low precipitation (Figure 11). **Channelization and the corresponding flow alteration are stressors** to the biological community.

Figure 11: Unnamed Creek at S012-009 on 8/1/2023. Most of the July through September of 2023 streamflow was less than 0.5 cfs or dry by September of 2023.

Connectivity

The culvert crossing by 11UM012 off 284th St **does not appear to be a fish barrier**.

Stressor signals from biology

Fish

Fish were sampled in 2011 as part of the Cycle 1 monitoring effort. A total of nine fish species were collected, with Northern redbelly dace and fathead minnow being the most dominate. Northern redbelly dace are tolerant of low DO, sensitive to nitrogen and TSS. Fathead minnow was the second most dominant fish species sampled. Fathead minnow are tolerant of many pollutants. Pictures from the 2011 fish visit indicate that water levels were higher than anything seen in 2023 during sampling events for water chemistry.

TIV were calculated for Unnamed Creek using the fish community. The Fines and substrate TIV's found that the fish community has an average of 64% fish that are tolerant to increased fines and poor substrate conditions. There are no sensitive taxa to either fines or substrate at the time of sampling. Therefore, the fish community response to fines and substrate is strong, and therefore, **is a stressor** to the fish community.

DO TIV scores were also calculated for Unnamed Creek using the fish communities. This calculation indicated that the fish community has an average probability of 20.7% of coming from a stream that was meeting the DO standard. Four of the fish species collected is tolerant of low DO, while the other five species do not have a documented sensitivity to low DO. Therefore, the fish community response to DO is weak, and therefore, **is inconclusive** currently.

Macroinvertebrates

Macroinvertebrates were also sampled in 2011 and 2012 as part of the Cycle 1 watershed monitoring effort. *Caenis (mayfly)* dominated the sample and are both considered to be tolerant taxa.

Percent Embedded taxa tolerance was investigated using the macroinvertebrate communities. In the 2011 sample, 1 intolerant taxa, 12 tolerant taxa, and 8 very tolerant taxa were collected, the 2012 sample had 0 intolerant taxa, 15 tolerant taxa, and 10 very tolerant taxa were collected (Table 4). Overall, the macroinvertebrate community within Unnamed Creek indicates that **Embeddedness is a stressor** to the macroinvertebrate community.

DO tolerance was also investigated using the macroinvertebrate communities. In 2011, 1 very tolerant taxa and 5 tolerant taxa were collected and in 2012, 13 tolerant taxa and seven very tolerant taxa were collected (Table 4). Although there are 2 and 0 intolerant taxa present, tolerant and very tolerant taxa dominated the sample, and indicate **that low DO has the potential to be a stressor** to the macroinvertebrate community within Unnamed Creek.

Nitrogen tolerance was also investigated using the macroinvertebrate communities. In 2011, 2 intolerant taxa, 20 tolerant taxa and 13 very tolerant taxa were collected, in 2012 three intolerant taxa, 17 tolerant taxa, and 11 very tolerant taxa were collected (Table 4). This indicates that nitrogen is limiting the macroinvertebrate community and nitrogen should be considered a potential stressor. Limited water sample concentrations that were collected did not show elevated nitrogen. Additional sampling should be conducted to better understand the concentrations of nitrogen in the stream.

Phosphorus tolerance was the final tolerance indicator that was investigated in the macroinvertebrate community. In the 2011 sample, 2 intolerant taxa, 7 tolerant taxa and 3 very tolerant taxa were collected and in 2012, 1 intolerant taxa, 17 tolerant taxa and 10 very tolerant taxa were collected (Table 4). These tolerance indicators within the macroinvertebrate community indicate that **phosphorus is a stressor** to the macroinvertebrate community in Unnamed Creek.

Table 4: Macroinvertebrate tolerance index values for Unnamed Creek.

Parameter	Taxa Tolerance	2011 Sample	2012 Sample
DO	# Intolerant	2	0
	# Tolerant	5	13
	# Very Intolerant	2	0
	# Very Tolerant	1	7
Phosphorus	# Intolerant	2	1
	# Tolerant	7	17
	# Very Intolerant	0	0
	# Very Tolerant	3	10
Embedded	# Intolerant	1	0
	# Tolerant	12	15
	# Very Intolerant	1	1
	# Very Tolerant	8	10
Nitrogen	#Intolerant	2	3
	#Tolerant	20	17
	# Very Tolerant	0	1
	# Very Intolerant	13	11

Conclusions about stressors

Stressors

- **Phosphorus.** Elevated phosphorus occurred in 75% of the eight phosphorus samples collected. Water samples collected in 2022 indicated that phosphorus concentrations are routinely above the 0.100 mg/L standard in late May through August.
- **Altered hydrology/geomorphology.** The macroinvertebrates scored poorly and the main issue appears to be substrate related and a lack of quality habitat, along with a lack of baseflow in periods of low precipitation. This was evident in 2023 and 2024 as the channel dried out in August and September of 2023. The year 2023 was a dry year so limited water samples were collected.
- Overall, the macroinvertebrate community within Unnamed Creek indicates that **Embeddedness is a stressor** to the macroinvertebrate community.

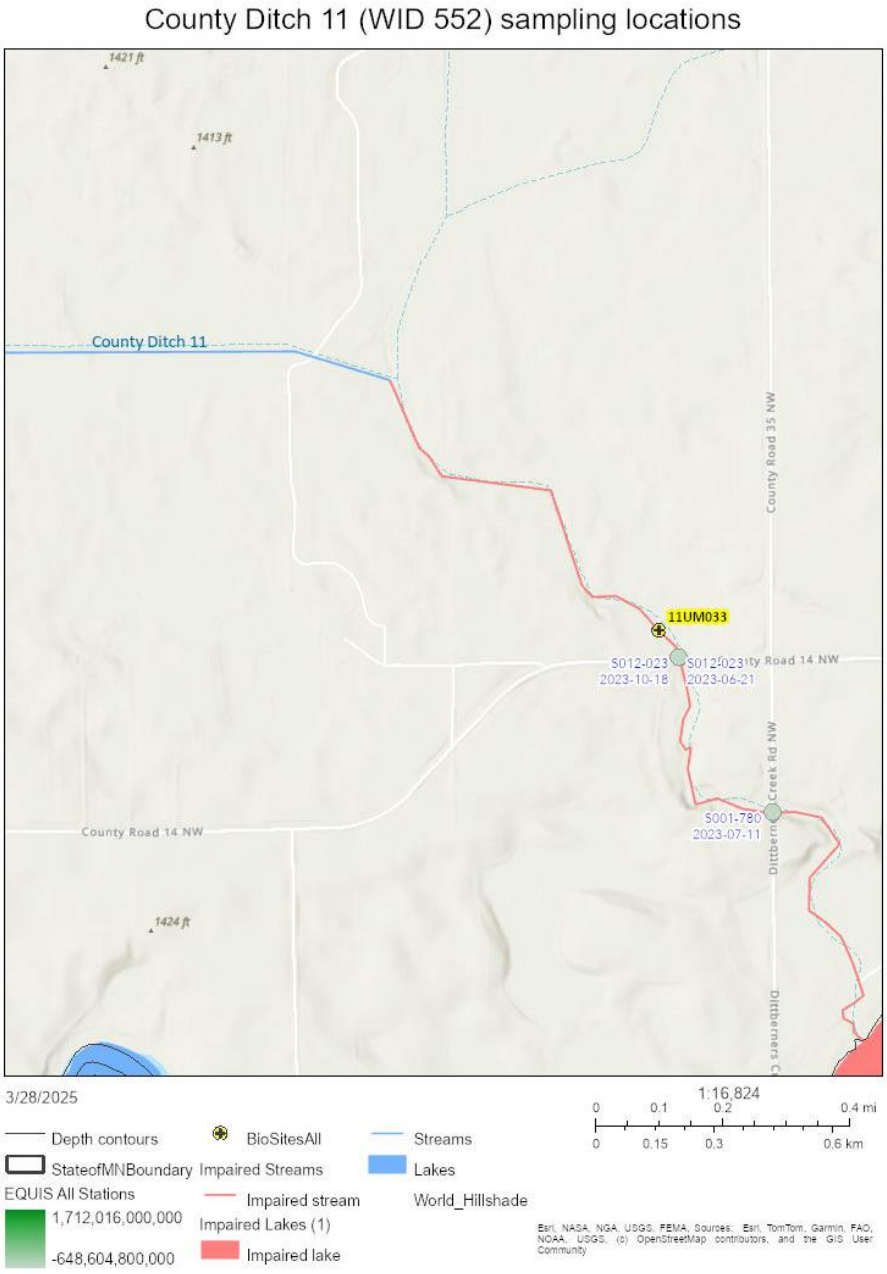
Inconclusive

- Inorganic **nitrogen is inconclusive as a stressor** to the biology within Unnamed Creek. Additional nitrogen samples should be collected to better understand the nitrogen concentrations within Unnamed Creek.

County Ditch 11 (Unnamed Creek) (07010107-552)

Impairment: County Ditch 11 (WID-552) flows for 1.61 miles and is entirely channelized. The drainage area is 21357 acres and comprises of multiple ditches enetering to form Unnamed Creek. There is one biological monitoring station (11UM033) that was sampled for fish and macroinvertebrates in 2011 and 2022 and 2023 (Figure 12). CD11 was assessed in 2023 as part of the second IWM process. Fish IBI scored a 57.9 in 2011 and a 24.5 in 2022 and 29.3 in 2023. Based on the two recent IBI scores fish were assess as **Nonsupport for WID 552**. The fish stream class is class 6 (northern headwaters), and the fish failed with an average IBI score of 26.9. Figure 12 below displays the sampling locations on WID 552.

Figure 12: County Ditch 11 (WID 552) sampling locations



Data and Analyses

Chemistry

Water chemistry data is limited to the samples that were collected during 2010 and 2022-2024 (Table 5).

Table 5: Water chemistry data collected on CD11.

Parameter	Sample Count	Applicable Standard	Avg. Results	Min. Results	Max. Results
Temperature, water	84		18.56	1.11	28.89
Specific conductance	40		527.58	259.5	648
pH	40	6.5-9.0	7.94	7.25	8.24
Dissolved oxygen	40	5.0	8.21	2.46	11.67
Inorganic nitrogen (nitate and nitrite)	36	10	0.41	0.00	1.50
Total phosphorus	36	0.10	0.06	0.03	0.13
Total suspended solids	26	30.0	7.99	3.0	23.0

Nutrients – Phosphorus

Phosphorus values from the dataset show that the average phosphorus concentration is 0.06 mg/L which is well below the Central Region River Nutrient standard of 0.100 mg/L (Table 5). This reach is channelized through an area of hydric soil on the upstream end of the reach. The area immediately near site 11UM033 is an active cattle pasture and there are areas of bank failure in this reach. Elevated **phosphorus is not a stressor** to the fish community.

Dissolved Oxygen

If DO is below 5mg/L for extended periods of time, biological communities can be severely impacted. DO was collected 40 times in 2010 through 2024 (Table 5). The average DO concentration was 8.21 mg/L. Of the collected DO concentrations, 95% were above the 5 mg/L standard for 2B waters. **DO is not a stressor** to the stream biology.

Total Suspended Solids

TSS data is has 26 samples from 2010 through 2024 (Table 5). The values were well below the standard. **TSS is not a stressor** to the stream biology.

Conductivity

Specific conductivity values are within range on CD11 (Table 5) and is **not a stressor** within CD11.

Temperature

Temperature values were within range on CD11 (Table 5) and is **not a stressor** within CD11.

Habitat

Habitat was classified as fair on CD11, through the MSHA evaluation at the fish sample (Figure 13).

Figure 13: MSHA habitat scores for CD11.

Due to the historic channelization of CD11, and fair MSHA score, the assessment of CD11 was brought into the Use Attainability Analysis (UAA) process. It was determined that the habitat of CD11 can support good quality habitat for aquatic life, as a result of the MSHA score. Therefore, CD11 was assessed using the General Use TALU criteria.

Although the MSHA score was fair overall, land use, riparian and channel morphology scored particularily low as noted in Figure 13. Land use scored low because the sampling location is located within a cattle pasture bordered by extensive row crop agriculture.

Figure 14: Sampling station 11UM033 is located within an active cattle pasture.

Channel morphology was another low scoring component of the MSHA evaluation. The MSHA indicated that there was minimal channel depth variability, fair sinuosity, and no channel development (no riffles or pools). Fish and macroinvertebrates need channel depth variability to use as cover from predation and refuge during high precipitation events. No change in the channel depth combined with fair sinuosity and poor channel development impedes the fish and macroinvertebrate's ability to inhabit the creek throughout the summer, especially during high flow events, which can flush these communities downstream. The lack of good channel morphology is caused by the channelization of the creek, as the

manipulation of the channel has been designed to move water quickly, by mechanically removing channel sinuosity, pools, and riffles. **Lack of habitat is a stressor** to the aquatic life in CD11.

Hydrology and geomorphology

Over time, there have been many changes on the landscape that have changed the natural hydrology and geomorphology of CD11, and the entire subwatershed. The most significant historical changes to the landscape have been land conversion from mature forests and woody wetlands to cultivated fields and pastures along with the channelization of the natural streams and wetlands. CD11 has been straightened along the entire length of the WID.

As the channel was altered to drain the landscape, a new channel was cut through mixed forest and woody wetlands, creating a direct connection to CD11. This channel alteration accelerates stream flow, resulting in higher flows during precipitation events, which achieves the agricultural land use drainage goals, but causes channel instability. Water leaves the landscape quickly, resulting in periods of higher flow than what would have naturally occurred. As the landscape drains, water that was once held in the upstream wetlands is flushed downstream, carrying low DO water throughout the reach. Then, as these flows quickly drain, the flow regime quickly transitions to intermittent, reaching stagnant conditions starting early in the summer (Figure 15). Although 2023 was a dry summer, CD11 was already very low by mid-July. The water that was present in the channel was very shallow and the culvert would have been impassable due to low water levels.

Figure 15: CD11 on July 11, 2023. Water levels are very low and fish could not move through the reach at these water levels. Drone flight showing sandbar and sediment accumulation from 6/27/2023.

Drone imagery captured in 2023 (Figure 15) showed sandbars located upstream of the road crossing. It is possible that this excess sediment would have historically settled out within the wetlands that made up most of the riparian pre-settlement, but due to the channelization, the sediment is flushed downstream during precipitation events. Therefore, due to the altered hydrology and geomorphology of CD11 causing the channel to get very low, it is **a secondary stressor**.

Connectivity

The culvert crossing downstream of 11UM033 off Dittberners Creek Road NW does appear to be a fish barrier at certain stream stages. During high flows the velocity coming out of this culvert is very fast, preventing fish passage for most fish species. During low flow events there is not enough water in the culvert to allow for fish passage. Fish passage is only feasible during the right flow regimes as seen in Figure 16. This culvert **appears to be a barrier** to fish movement.

Figure 16: high spring flow velocity barrier in culvert. Water goes through corrugated metal culvert like a fire hose. Photo from 4/25/2023.

Stressor signals from biology

Fish

Fish IBI scores passed during the 2011 sampling event. Flows from the June 15, 2011, event were elevated based on photos from the sampling event. Water levels were lower during the 2022 and 2023 sampling event and the fish IBI scores were below the passing threshold. With limited site visits it is impossible to know the spring runoff conditions and the ability for fish to overwinter in the channel. Migratory numbers of fish are very low in the samples further indicating that connectivity is an issue in the stream.

All three of the fish samples show a negative response to fish metrics that respond to habitat degradation. Fish metrics such as BenInsectPct, DarterSculpSucPct, RifflePct and SLithoPct are all well below the class average values for all Class 6 stream samples. Habitat and water levels can have impacts on these metrics and **are a stressor** to the fish community.

Composite conclusion from biology

The TSS and DO TIVs were inconclusive for fish, but did indicate that habitat is a potential stressor to the fish community. Migratory fish species were low in all samples indicating that connectivity is a stressor to the fish community.

The **habitat and geomorphology are heavily altered within CD11 and are the primary stressors** to the aquatic life within the ditch.

Conclusions about stressors

Stressors

- The **habitat and geomorphology are heavily altered within CD11 and are the primary stressors** to the aquatic life within the ditch. Altered hydrology and geomorphology have also impacted the aquatic life within CD11, by removing habitat, increasing the amount of nutrients drained from the landscape, and altering the historic flow conditions.
- The culvert of Dittberner Road appears to be a barrier to fish during certain flow regimes. Mainly high and lower flows can impede fish from passing through the culvert.

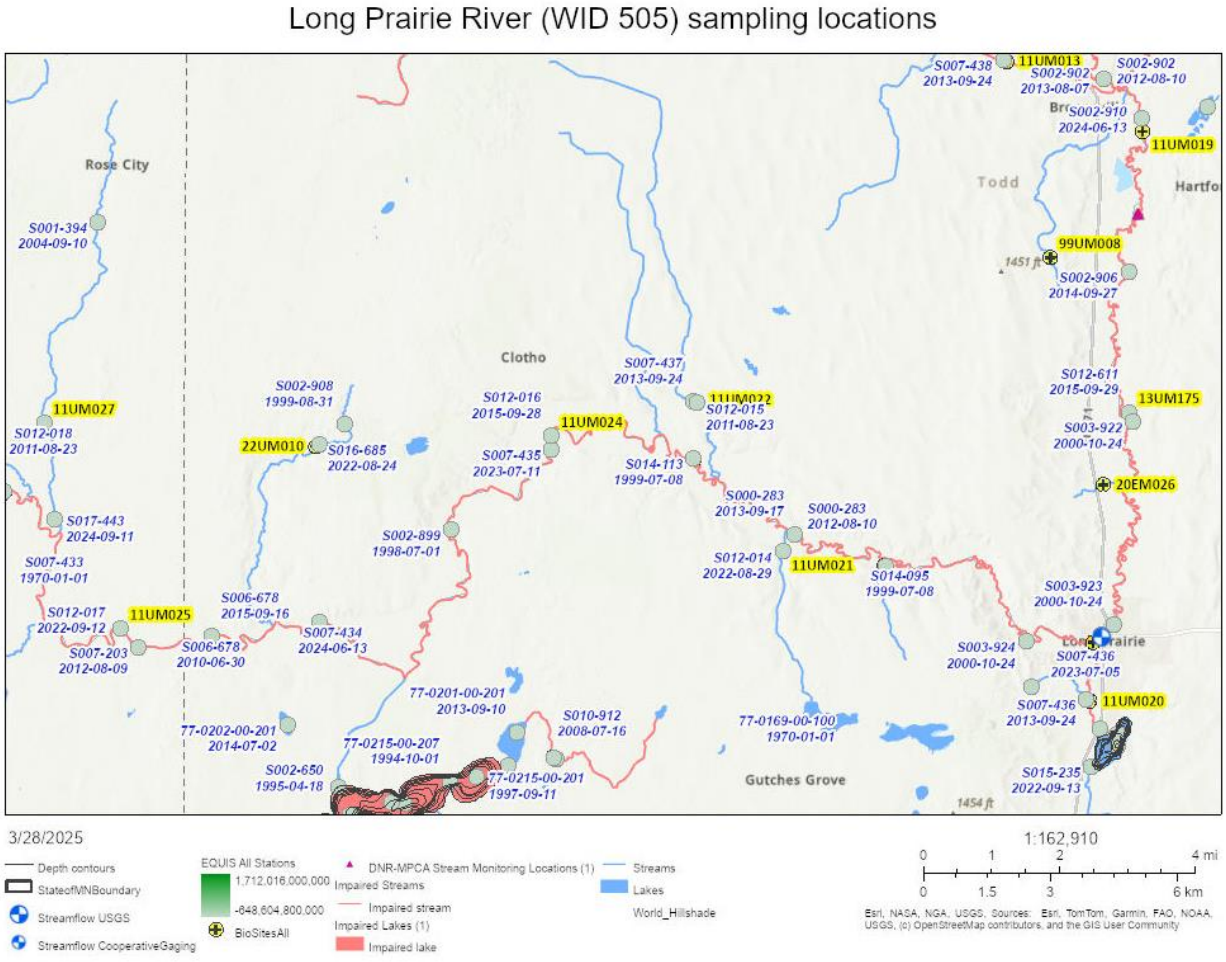
Not stressors

- Phosphorus
- TSS
- Low Dissolved Oxygen
- Temperature
- Specific Conductance

Long Prairie River WID 505

The Long Prairie River WID 505 runs from Browerville, Minnesota upstream to the confluence with Spruce Creek. This WID is 50 miles in length. Existing parameters needing a TMDL are fish bioassessments and sulfate. There is also an existing DO impairment on this WID. A TMDL has been created for DO impairment, however more recent DO data collection shows that DO is still impaired in this WID. The map below shows the extent of WID 505 along with all of the existing sampling locations (Figure 17).

Figure 17: Long Prairie River (WID 505) with monitoring site names and locations.



Impairment: Long Prairie River (WID-505) flows for 50 miles and is partially channelized. There are numerous biological monitoring stations (11UM025,10EM042, 11UM024, 99UM039, 13UM175, 11UM019) that were sampled for fish and macroinvertebrates multiple times since 1999 (Figure 17). Long Prairie River (WID 505) was assessed in 2024 as part of the second watershed assessment process and determined to be impaired by DO, fish bioassessments and Sulfate. During the 2011 assessment process found this WID to be impaired by DO and fish bioassessments.

Data and Analyses

Chemistry

Water chemistry data is limited to the samples that were collected during 2010 through 2024 (Table 6).

Table 6: Water chemistry data collected on the Long Prairie River.

Paramter	Sample Count	Applicable Standard	Avg. Results	Min. Results	Max. Results
Temperature, water	367		18	0.14	30.3
Specific conductance	269		473	226.7	727
pH	310	6.5-9.0	7.81	5.44	8.67
Dissolved oxygen	259	5.0	7.663	0.440	14.97
Inorganic nitrogen (nitrate and nitrite)	318	10.0	0.178	0.00	0.760
Total phosphorus	328	0.100	0.068	0.018	0.352
Total suspended solids	311	30	5.3	0.0	97.0

Nutrients – Phosphorus

Phosphorus values from the dataset show that the average phosphorus concentration is 0.068 mg/L, which is below the Central Region River Nutrient standard of 0.100 mg/L (Table 6). This reach is partially channelized and is flowing out of a series of wetlands located upstream. Review of the data suggests that **phosphorus is not a stressor** to the biology.

Dissolved Oxygen

If DO is below 5mg/L for extended periods of time, biological communities can be severely impacted. DO was collected 259 times between 2010 and 2024 (Table 6). The average DO concentration was 7.66 mg/L but was below the 5 mg/L standard 14.2% of the readings. Currently this WID is impaired by DO concentrations and currently has an active TMDL that was written prior to this assessment cycle. Low **DO is a stressor** to the fish communities at times in this WID.

Total Suspended Solids

TSS data was sampled 311 times between 2010 and 2024 (Table 6) and 2.9% of the samples were above the 30 mg/L standard. The values were well below the standard of 30 mg/L. **TSS is not a stressor** to the fish.

Conductivity

Specific conductivity values are within range on Long Prairie River (Table 6) and is **not a stressor** within Long Prairie River.

Temperature

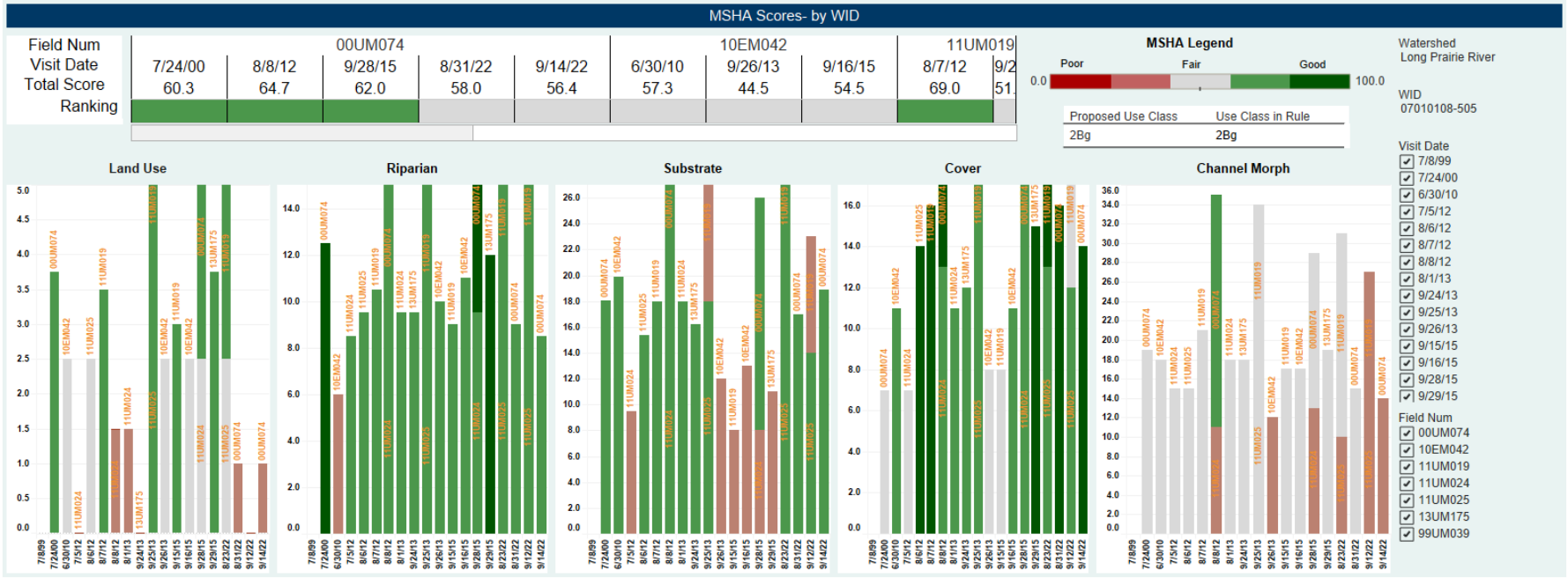
Temperature values were within range on Long Prairie River (Table 6) and is **not a stressor** within Long Prairie River.

Habitat

Habitat was classified as fair on Long Prairie River, through the MSHA evaluation at the biological sample dates (Figure 18). Habitat scores range from fair to good.

Although the MSHA score was fair to good overall, land use and channel morphology scored particularily low as noted in Figure 18. Cover was a low scoring component of the MSHA score, as indicated by the lack of deep pools, boulders, and overhanging vegetation. Healthy fish communities need cover to escape predation. Excessive fine sediment also affects juvenile fishes, as the sediment is stirred into the water column creating TSS, it can easily tear sensitive juvenile fish gills. Similarly, many sensitive macroinvertebrates also have specialized gills that are used to breathe DO. Excessive fine sediments can damage these gills, similar to juvenile fishes, making the creek inhabitable for sensitive species.

Figure 18: MSHA habitat scores for Long Prairie River (WID 505).



Channel morphology was another low scoring component of the MSHA evaluation. The MSHA indicated that there was minimal channel depth variability, poor sinuosity, and no channel development (no riffles or pools). Fish and macroinvertebrates need channel depth variability to use as cover from predation and refuge during high precipitation events. No change in the channel depth combined with fair sinuosity and poor channel development impedes the fish and macroinvertebrate's ability to inhabit the creek throughout the summer, especially during high flow events, which can flush these communities downstream. The lack of good channel morphology is caused by the amount of sand substrate located in the long Prairie River. Excess sand is found at nearly all locations along WID 505. The sand is mobile and can affect pool depths depending on flow regimes. **Lack of habitat is a contributing stressor** to the aquatic life in long Prairie River.

Conclusions about stressors

WID 505 on the Long Prairie River has had historically low DO concentrations. There is an existing TMDL written for low DO concentrations. The fish communities can be impacted by the low DO found throughout WID 505. Recent monitoring has verified that DO concentrations are often below the 5 mg/L standard and is a stressor to the aquatic life in this WID. Low DO is driven by higher flow conditions within this WID. This is seen in Figure 19. This table shows the sampling frequency and number of DO exceedances from data collected from 2016 through 2024.

Figure 19: DO samples for Long Prairie River (WID 505), along with number of samples exceeding the DO standard.

Watershed	WID	Sample Date	Parameters	Ind Sample Year
Long Prairie River	07010108-505	1/1/2016 12:00:00 A..	Dissolved oxygen (DO)	All

Flow Percentile Ranking:
High: <=10% |Moist: >10% and <=40% |Mid-Range : >40% and <=60% |Dry: >60% and <=90% |Low: >90%

Click on a Parameter below to view individual samples:

WID	EQuIS Station	Parameters	Crit Val	Flow Rank	# Samples by Rank	# Meeting Standard	# Exceeding Standard
07010108-505	S002-904	Dissolved oxygen (DO)	5	Dry	8	42	6
				High	30	144	36
				Mid-Range	13	90	0
				Moist	44	234	30
	S002-910	Dissolved oxygen (DO)	5	High	2	8	0
				Mid-Range	1	8	0
				Moist	2	12	0
	S007-434	Dissolved oxygen (DO)	5	High	2	4	0
	S007-435	Dissolved oxygen (DO)	5	High	2	4	0
	S012-017	Dissolved oxygen (DO)	5	Mid-Range	1	4	0
				Moist	2	8	0