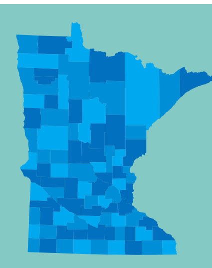
Stressor Identification

February 2024

Chippewa River Watershed Stressor Identification Report Update 2024




MINNESOTA POLLUTION CONTROL AGENCY



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Executive summary

The Minnesota Pollution Control Agency (MPCA) uses 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 this data, an Index of Biological Integrity (IBI) score can be developed, which provides a measure of overall community health. 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 major 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.

This report summarizes SID work in the Chippewa River Watershed. There were 28 stream reaches identified with biological impairments within the watershed. Each stream reach (Assessment Unit Identification [AUID] is described further in Section 2. A summary of the stressors identified in each stream reach is found in Table 14.

After examining many candidate causes for the biological impairments, the following stressors were identified as probable causes of stress to aquatic life:

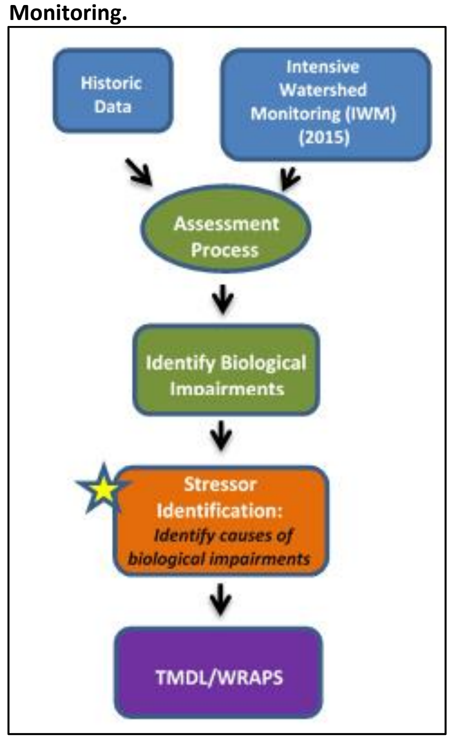
- Hydrologic Alteration
- Connectivity
- Insufficient Physical Habitat
- Dissolved Oxygen (DO)
- Eutrophication
- Suspended Solids
- Nitrate-Nitrogen

1 Introduction

1.1 Monitoring and Assessment

Water quality and biological monitoring in the Chippewa River Watershed have been ongoing. As part of the MPCA's Intensive Watershed Monitoring (IWM) approach, monitoring activities increased in rigor and intensity in the Chippewa River Watershed during the years of 2021-2022 and focused more on biological monitoring (fish and macroinvertebrates) as a means of assessing stream health. The data collected during this period, as well as historic data dating back to 2011, were used to identify stream impairments (Figure 1).

Figure 1. Process map of Intensive Watershed Monitoring.

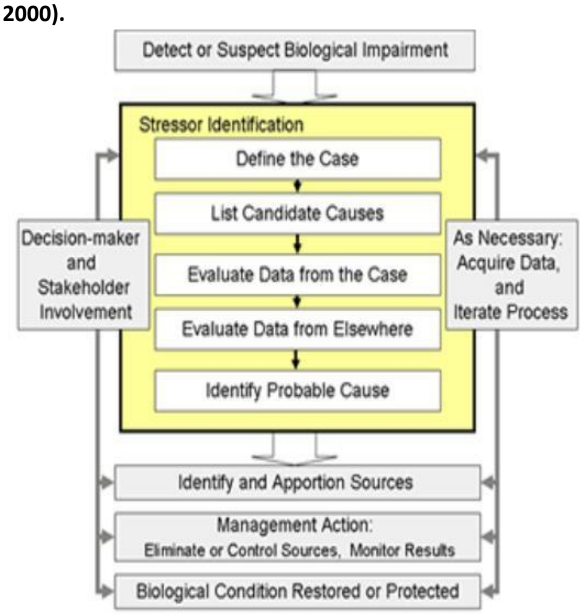


Once a biological impairment is discovered, the next step is to try and identify the source(s) of stress to the biological community. A SID analysis is a step-by-step approach for identifying probable causes of an impairment in a particular system. Completion of the SID process does not result in a finished Total Maximum Daily Load (TMDL) study. The product of the SID process is the identification of the stressor(s) for which the TMDL may be developed. For example, the SID process may help investigators determine excess fine sediment is a stressor to the biological community, but a separate effort is then required to determine the TMDL and implementation goals needed to restore the impaired condition.

1.2 Stressor Identification Process

The MPCA follows the U.S. Environmental Protection Agency's (EPA's) process of identifying stressors that cause a biological impairment, which has been used to develop the MPCA's guidance to SID (Cormier et al. 2000; MPCA 2008). The EPA has also developed an updated, interactive web-based tool, the Causal Analysis/Diagnosis Decision Information System (CADDIS; EPA 2010). This system provides an enormous amount of information designed to guide and assist investigators through the process of SID. Additional information on the SID process using CADDIS can be found here: CADDIS. SID is a key component of the major watershed restoration and protection projects being carried out under Minnesota's Clean Water

Figure 2. Stressor Identification process (Cormier et al. 2000).



Legacy Act. SID draws upon a broad variety of disciplines and applications, such as aquatic ecology, geology, geomorphology, chemistry, land use analysis, and toxicology. A conceptual model showing the steps in the SID process is shown (Figure 2). Through a review of available data, stressor scenarios are developed that aim to characterize the biological impairment, the cause, and the sources/pathways of the various stressors.

Strength of evidence (SOE) analysis is used to evaluate the data for candidate causes of stress to biological communities. The relationship between stressor and biological response are evaluated by considering the degree to which the available evidence supports or weakens the case for a candidate cause. Typically, much of the information used in the SOE analysis is from the study watershed (i.e., data from the case). However, evidence from other case studies and the scientific literature is also used in the SID process (i.e., data from elsewhere).

The existence of multiple lines of evidence that support or weaken the case for a candidate cause generally increases confidence in the decision for a candidate cause. Additionally, confidence in the results depends on the quantity and quality of data available to the SID process. In some cases, additional data collection may be necessary to accurately identify the stressor(s) causing impairment. Additional detail on the various types of evidence and interpretation of findings can be found here: CADDIS.

1.3 Index of Biological Integrity Scores and Biological Classes

Aquatic biota are known to be responsive to a wide variety of anthropogenic impacts and, at the community level, reflect the integrated result of physical, chemical, and biological processes through time (Barbour et al. 1999). In this manner, aquatic communities provide a direct, comprehensive perspective on water quality, and lend themselves well to tools that utilize community-level parameters, such as the IBI.

The IBI was originally developed as a tool for assessing the condition of rivers and streams in the Midwestern United States (Karr 1981, Karr et al. 1986). The concept has since been expanded to a wide variety of geographic regions and ecological systems and has demonstrated its effectiveness in several applications (e.g., condition monitoring, SID). At its core, the IBI provides a framework for translating biological community data into information regarding ecological integrity ("the capability of supporting and maintaining a balanced, integrated, functional organization comparable to that of the natural habitat of the region," Frey 1977). It utilizes a variety of attributes ("metrics") of the biological community, each of which responds in a predictable way to anthropogenic disturbance.

Biological metrics are based on ecological traits of species and represent different aspects of ecological structure and function. The metrics are scored numerically to quantify deviation from least-disturbed conditions, and summed together producing a composite IBI score that characterizes biological integrity (Karr et al. 1986). Narrative language within Minnesota Administrative Rule identifies an IBI calculation as the primary determinant for evaluating impairment of aquatic biota (Minn. R. 7050.0150, subp. 6, Impairment of biological community and aquatic habitat). More information on Fish and Invertebrate IBI development can be found here: (MPCA 2014a; MPCA 2014b).

Recognizing that biological communities vary along natural gradients; an effort was undertaken to develop a stream classification framework for Minnesota's riverine fish and invertebrate communities. A classification framework was developed that divides Minnesota rivers and streams into 11 "fish classes" and 9 "invertebrate classes". These classes are differentiated by region, drainage area, gradient, thermal regime, types of habitat sampled, qualitative and quantitative habitat measurements, and observations of flow at the time of sampling (MPCA 2017ab).

The biological classes have been further broken up into three-Tiered Aquatic Life Uses (TALU). The aquatic life expectations for streams, as expressed as IBI scores, form the basis for TALU. TALU divides streams into Exceptional, General, and Modified Uses. Exceptional use streams will be high quality waters with fish and invertebrate communities at or near undisturbed conditions. General use streams will be waters with good fish and invertebrate communities that meet minimum goals. Modified use streams will be waters with legally altered habitat that prevents fish and invertebrate communities from meeting minimum goals. Each of these classifications have specific biological threshold scores for both fish and invertebrates (Table 1). Stream reaches addressed in this report contain one or more biological sampling bio sites that did not meet the threshold for their respective class.

The biologically impaired reaches addressed in this report within the Chippewa River Watershed consist of three fish classes and two invertebrate classes, as well as both general and modified uses (Table 1). The biological fish and invertebrate classes are as follows:

Fish Class 1 - Southern Rivers

Large warm/cool water rivers in southern Minnesota and the western portion of the Red River Basin.

Sites in southern Minnesota and the Glacial Lake Agassiz Basin (GLAB) ecoregion, where watershed area exceeds 300 square miles.

Fish Class 2 - Southern Streams

Large warm/cool water streams and small rivers in southern Minnesota and the far-western portion of the Red River Basin.

Sites in southern Minnesota and the GLAB ecoregion, where watershed area exceeds 30 square miles but is less than 300 square miles.

Fish Class 3 - Southern Headwaters

Small, moderate to high-gradient warm/cool water streams in southern Minnesota and the far-western portion of the Red River Basin.

Sites in southern Minnesota and the GLAB ecoregion, where watershed area is less than 30 square miles and gradient is greater than 0.5 m/km.

Fish Class 7 – Low Gradient

Small, moderate to high-gradient warm/cool water streams in southern Minnesota and the far-western portion of the Red River Basin.

Sites in southern Minnesota and the GLAB ecoregion, where watershed area is less than 30 square miles and gradient is greater than 0.5 m/km.

Invert Class 5 – Southern Streams Rock Riffle

Rock riffle, high gradient streams in the Eastern Broadleaf Forest, Prairie Parklands, and Tall Parklands ecological provinces.

Sites in southern Minnesota where watershed area is less than 500 square miles.

Invert Class 7 – Prairie Streams Glide Pool

Glide pool, low gradient streams in the Prairie Parklands and Tall Aspen Parklands ecological provinces.

Sites in southern Minnesota where watershed area is less than 500 square miles.

Table 1. Fish and Invertebrate bio classes and their numeric IBI thresholds addressed within the Chippewa River SID Report.

Fish		
Bio Class	**General Use IBI Threshold**	**Modified Use IBI Threshold**
Class 1 – Southern River	49	N/A
Class 2 – Southern Stream	50	35
Class 3 – Southern Headwater	55	33
Class 7 – Low Gradient	42	15

Invertebrates		
Bio Class	**General Use IBI Threshold**	**Modified Use IBI Threshold**
Class 5 – Southern Streams Rock Riffle	37	24
Class 7 – Prairie Streams Glide Pool	41	22

1.4 Data used in Stressor Identification

The SOE analysis in SID uses several different types of data from various sources. A variety of published and nonpublished sources were used to assign trophic, reproductive, habitat, tolerance, and life history traits to different taxa known to inhabit Minnesota's rivers and streams (Balon 1975, Pflieger 1975, Becker 1983, Lyons 1992, Barbour et al. 1999, Etnier and Starnes 1999, Goldstein and Meador 2004, Frimpong, and Angermeier 2009).

The biological metric, tolerance value, habitat, and chemical parameter data used in this report is summarized below.

Biological Metrics

Biological metrics are simply different groupings of certain taxa combined into groups based off commonalities related to their taxonomy, morphometry, behavior, habitat requirements, or life history traits. This type of trait-based approach groups species that experience their environment in a similar fashion and emphasizes the functional structure of biological communities (Karr and Chu 1999).

Tolerance Values- Taxa

Tolerance values were determined for various fish and invertebrate taxa using MPCA biological sampling data to refine existing tolerance attributes derived from literature. Taxa-specific tolerance values were calculated by using a weighted-averaging process (Meador and Carlisle 2007) (Sandberg 2013) using the taxa abundance in a biological sample and the parameter/pollutant (e.g., phosphorus, total suspended solids (TSS), nitrate-nitrite, DO, habitat/channel characteristics) concentration/value at the time of the sample. This assigns a tolerance value that indicates the most common concentration/value that each species was found during biological sampling by the MPCA within Minnesota.

Tolerance Index Values - Biological Site

A Tolerance Index Value for bio sites for certain parameters/pollutants is calculated by using a weighted-averaging process of the taxa specific tolerance values of each taxon that is present at a biological Bio site. Each Bio site gets a tolerance index value based off the tolerance values and number of fish of each species present at the bio site.

MSHA - Habitat Data

Habitat characteristics are recorded using a qualitative, observation-based method modified from Rankin, 1989. The Ohio QHEI is a physical habitat index designed to provide an empirical evaluation of the lotic macro-habitat characteristics that are important to fish communities, which are generally important to other aquatic life. Although similar to the Ohio QHEI, the MSHA has been modified to more adequately assess important characteristics influencing Minnesota streams. The MSHA incorporates measures of watershed land use, riparian quality, bank erosion, substrate type and quality, instream cover, and characteristics of channel morphology, stability, and development.

Monitoring Data

Water samples were collected and analyzed by several different public and private entities throughout Minnesota. This monitoring data is entered into the MPCA's Environmental Quality Information System (EQuiS) database and is used for a variety of purposes, including SID. There are two main types of monitoring data collected in the Chippewa River Watershed:

Grab Samples

Water samples are collected from a river, stream, wetland, ditch, etc. and sent to a laboratory for analysis. Labs can test for a variety of different parameters and pollutants, such as total phosphorus (TP), TSS, nitrate-nitrite, Chlorophyll-*a* (Chl-*a*), and many others. Results are usually given in the form of a concentration of total pollutant per unit of water (e.g., milligrams per Liter (mg/L)).

Field Measurements

Temperature, specific conductance, DO and pH measurements are recorded with a field meter using point measurements. These measurements indicate the concentration/value at the time of the reading and are usually taken while collecting grab samples. Measurements are typically taken using YSI Sonde field meters or some equivalent meter.

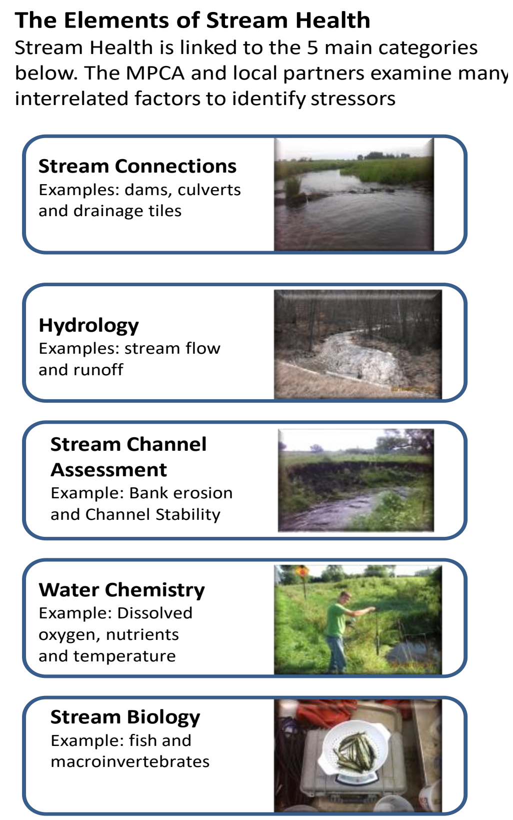
Diurnal Measurements

Under eutrophic conditions, excessive algae growth during the day produces relatively high concentrations of oxygen and can supersaturate the water. Overnight, as photosynthesis stops producing oxygen and bacteria consumes the dead algae, oxygen levels can drop significantly below 5 mg/L. Field meters are deployed for weeks at a time and usually record field measurements every 15 minutes. This allows overnight DO levels to be monitored in order to assess the amount of diurnal DO flux, or the difference between the highest and lowest DO levels in a 24-hour cycle.

1.5 Stressors, Biological Metrics, and Tolerance Values

The elements of a healthy stream consist of five main components: stream connections, hydrology, stream channel assessment, water chemistry, and stream biology (DNR; Figure 3). The following flowchart shows the five components of a healthy stream. If one or more of the components are unbalanced, the stream ecosystem fails to function properly and may be listed as an impaired water body. These dynamics are important to understand when going through SID evaluation.

Figure 3. The five components of stream health and conditions that stress streams (DNR).



Common stressors to biological communities are specific aspects within one of the five stream elements. The stressors and biological metrics that are examined in this report are listed and explained below (MPCA 2017c). Metrics are based on ecological traits of species and represent different aspects of ecological structure and function.

Hydrologic Alteration

Hydrologic alteration describes any type of change to the way water moves within a watershed. Many types of alterations have occurred in the past and continue today, including channel alteration, rerouting and ditching of streams, water withdrawals, land cover alteration, subsurface tile drainage, and impoundments or dams. Hydrologic alteration and its effects on channel instability, bank erosion, excess sediment, and destruction or reduced habitat are all possible stressors.

Changes in landscape vegetation, pavement, and drainage can increase how fast rainfall runoff reaches stream channels. This creates a stronger pulse of flow, followed later by decreased baseflow levels. According to the authors of a review on flow effects (Poff 1997), “Streamflow quantity and timing are critical components of water supply, water quality, and the ecological integrity of river systems. Indeed, streamflow, which is strongly correlated with many critical physicochemical characteristics of rivers, such as water temperature, channel geomorphology, and habitat diversity, can be considered a ‘master variable’...” Increasing surface water runoff and seasonal variability in stream flows have the potential for both indirect and direct effects on fish populations (Schlosser 1990).

The inverse effect to an increase of stream flow with artificial subsurface drainage and trapezoidal ditches is seen in the reduction of base flow conditions during periods of low precipitation. Within this watershed, there are times where base flows within upland tributaries drastically drop and dry up later in the summer. Carlisle et al 2011 found a strong correlation between diminished streamflow and impaired biological communities. Numerous studies have found conventional trapezoidal ditches to be inferior to natural streams in terms of sediment transport capacity and channel stability over time (Urban and Rhoads 2004; Landwehr and Roads 2003). Conventional ditches are designed to handle low frequency, high-magnitude flood events. This design may not support adequate water depth and velocities for transporting sediment and maintaining stream features (e.g., glide, riffle, run, pool) during low to moderate flow periods. The common result is excess sedimentation of the stream bed as particles become immobile and aggrade over time. In general, this design does not provide good habitat for aquatic species or provide stability of its streambed and stream banks.

Habitat availability can be scarce when flows are interrupted, low for a prolonged duration, or extremely low, leading to decreased wetted width, cross sectional area, and water depth. Flows that are reduced beyond normal baseflow decrease living space for aquatic organisms and competition for resources increases.

Pollutant concentrations can increase when flows are lower than normal, increasing the exposure dosage to organisms. Tolerant organisms can out-compete others in such limiting situations and will thrive. Low flows of prolonged duration lead to macroinvertebrate and fish communities comprised of generalist species or that have preference for standing water (EPA 2012). Drainage of wetlands within the Chippewa River Watershed has increased the speed that water moves within the watershed. This has the effect of reducing water storage and the amount of water available during times of low precipitation, lowering groundwater tables, and reducing near channel storage that otherwise sustains lateral drainage during dry periods (Blann et al. 2009). Wetlands tend to slow water down and store it on the landscape, metering out the water over time.

Table 2. Hydrologic alteration related fish metric descriptions.

Fish Metric	Metric Description	Response to Hydrologic Alteration Stress
General %	Generalized fish species are correlated with channelization and are adaptable to different habitats through generalized food preferences. Trophic generalists are able to utilize multiple food resources (e.g., macrophytes, plankton, detritus). They are more tolerant of degradation than trophic specialists because they can survive even if sensitive food resources (e.g., benthic invertebrates) are reduced or eliminated, by switching to other, less sensitive, food resources.	**Increase**
Nesting Non-Lithophilic Spawner %	Relative abundance of nonlithophilic, nest-guarding individuals. The numbers of nest guarder species are positively correlated with low flow conditions. Nonlithophilic nest-builders include species that build and spawn in or over nests constructed from materials other than coarse substrate. Because these species invest time and energy in preparing nests, and frequently also invest time and energy in guarding the nests and/or caring for their eggs and offspring, they experience an advantage in degraded habitats and other stressful environmental conditions.	**Increase**

Table 3. Hydrologic alteration related invertebrate metric descriptions.

Invertebrate Metric	Metric Description	Response to Hydrologic Alteration Stress
Clinger %	Relative abundance (%) of clinger invertebrates. High flows and the associated increased flow velocities can displace macroinvertebrates downstream, and move habitat features like woody debris out of the stream. Woody debris and other habitat features are important as living surfaces for clinging invertebrates.	**Decrease**
Collector – filterer %	Relative abundance (%) of collector-filterers. The number of collector – filterer taxa represent the number of different taxa that collect their food by filtering it out of the water column. The filtering is typically done one of two ways: 1) by using physical adaptation such as a filamentous antennal structure or 2) by constructing a net that filters the water, gathering filtered material from the net. Collector-filterer macroinvertebrates that filter food particles from the water column have shown negative responses to low flows.	**Decrease**
Long – lived %	Macroinvertebrate types may shift from those species having long life cycles to shorter ones, because these species can complete their life cycle within the bounds of the recurrence interval of the elevated flow conditions.	**Decrease**
Percent Ditched Tolerant/Intolerant %	Relative abundance (%) of individuals that are considered tolerant or intolerant to ditching of the stream channel. Tolerant means that the invert has been found in streams with high percentages of ditching, intolerant means those inverts have not been found in streams with high percentages of ditching.	
Low Depth Variability Tolerant/Intolerant%	Relative abundance (%) of individuals that are considered tolerant or intolerant to low depth variability. Tolerant means that the invert has been found in streams with low depth variability, intolerant means those inverts have not been found in streams with low depth variability.	
Low Flow Tolerant/Intolerant %	Relative abundance (%) of individuals that are considered tolerant or intolerant low flows. Tolerant means that the invert has been found in streams with low flows, intolerant means those inverts have not been found in low flows.	

Connectivity

Connectivity in river ecosystems generally refers to how water features are linked to each other on the landscape or how locations within a stream are connected. Connectivity also pertains to locations adjacent to a stream, such as a stream's connectivity to its floodplain. These different types of connectivity affect biology differently, do not often produce the same effects, and often times are linked to other stressors like habitat.

In Minnesota, there are more than 1,150 dams on streams, rivers, and lakes for a variety of purposes (DNR 2024). Dams usually directly block seasonal fish migration for reproduction and overwintering. Stream channel road crossings also have the potential to become physical barriers to fish movement. Crossings can either be culverts (metal corrugated tubes or concrete boxes) or bridges. The crossings can become barriers when they are not installed properly, either due to incorrect sizing for the stream or put at the wrong elevation and/or slope. Bridges generally don't become barriers because they are wider, and the channel can naturally adjust. Culverts are more likely to become a migration barrier if not engineered or installed properly. If culverts are too small, the passing water will increase in velocity. The velocity can become too fast for smaller fish species to move through (Warren and Pardew 1998). Improper slope of the culvert will also lead to high velocity. If culverts are installed at an incorrect elevation, they can be "perched" at the outlet end, meaning the base of the culvert is above the water level of the stream. Minnesota's native fish species are not capable of doing the leaping and surging required for migrating through these situations in the way that salmon, for instance, can navigate ledges in streams. The denser the road network, and the older the crossing constructions, the more opportunity there is for barriers to be found. Disrupted migration not only alters reproduction of fish; it also impacts mussel species that utilize fish movement to disperse their offspring. Structures, such as dams, have been shown to reduce species richness of systems, while also increasing the abundance of tolerant or undesirable species (Winston 1991; Santucci V.A. 2005).

Table 4. Connectivity related fish metric descriptions.

Fish Metric	Metric/Tolerance Metric Description	Response to Connectivity Stress
Mature Age >3 %	Relative abundance (%) of individuals with a female mature age >=3. Late maturity is a trait adaptive to stable, well-connected environments that allow these species to access the habitats and resources necessary for their life history requirements, over many years of growth and development. Stable environmental conditions are typically associated with minimal human disturbance. Therefore, the presence of large numbers of late-maturing species and/or individuals is an indication of a high-quality resource.	**Decrease**
Migrating %	Relative abundance (%) of migratory fish, which tend to not be found in streams with a barrier that prevents fish movement/migration.	**Decrease**

Habitat

Habitat is a broad term encompassing all aspects of the physical, chemical, and biological conditions needed to support a biological community. This section will focus on the physical habitat structure including geomorphic characteristics and vegetative features (Griffith, Rashleigh, and Schofield 2010). Excess fine sediment deposition on benthic habitat has been proven to adversely impact fish and macroinvertebrate species that depend on clean, coarse stream substrates for feeding, refuge, and/or reproduction (Newcombe and MacDonald 1991). Specific habitats needed by a healthy biotic community can be minimized or altered by practices on the landscape by way of resource extraction, agriculture, forestry, urbanization, and industry. These landscape alterations can lead to reduced habitat availability, such as decreased riffle habitat, reduced habitat quality, and embedded gravel substrates. Biotic population changes can result from decreases in availability or quality of habitat by way of altered behavior, increased mortality, or decreased reproductive success (Griffith, Rashleigh, and Schofield 2010).

Schlosser (1982) compared the trophic structure, reproductive success, and growth rate in fishes from a natural and modified (ditched) stream in central Illinois. The study found that the ditched stream experienced a loss of pool habitat, increased organic substrates, and a shift in trophic structure to omnivores and herbivores instead of insectivores and piscivores. In a study conducted in the east-central Indiana corn belt region, Lau et al (2006) found that channelized streams had lower quality fish assemblages when compared to natural streams, and that a reduction in riffle and pool habitats associated with channelization was the most significant factor affecting the fish assemblage. Fish communities are typically influenced through a reduction in spawning habitat or egg survival (Chapman 1988) and a reduction in prey items as a result of decreases in primary production and benthic productivity (Bruton 1985; Gray and Ward 1982).

Table 5. Habitat related fish metric descriptions.

Fish Metric	Metric Description	Response to Habitat Stress
Benthic Insectivore minus Tolerant %	Relative abundance (%) of benthic insectivore individuals (excludes tolerant taxa). Benthic insectivore and invertivore species rely on undisturbed benthic habitats to feed and reproduce. Many benthic invertivores require clean coarse substrates and an ample supply of aquatic macrophytes or woody debris for cover. Benthic insectivore species occupied the same type of niche as darters. This allows a greater degree of sensitivity in evaluating streams that naturally had few darter species. An increase in benthic insectivore species was correlated with increased biotic integrity.	**Decrease**
Benthic Insectivore %	Relative abundance (%) of benthic insectivore individuals (including tolerant taxa). Benthic insectivore and invertivore species rely on undisturbed benthic habitats to feed and reproduce. Many benthic invertivores require clean coarse substrates and an ample supply of aquatic macrophytes or woody debris for cover. Benthic insectivore	**Decrease**

Fish Metric	Metric Description	Response to Habitat Stress
	species occupied the same type of niche as darters. This allows a greater degree of sensitivity in evaluating streams that naturally had few darter species. An increase in benthic insectivore species was correlated with increased biotic integrity.	
Darter Sculpin Sucker %	Relative abundance (%) of darter, sculpin, and round-bodied sucker individuals. Darters and sculpins are commonly found in riffle habitats and are considered sensitive to water quality degradation. Darters and sculpins are generally found in higher quality streams. These species are benthic insectivores; they rely on undisturbed benthic habitats to feed and reproduce. The degradation of benthic habitats will cause the species to decline. Because darters and sculpins require clean coarse substrate materials to thrive, they tend to disappear in streams that have been affected by siltation or channelization.	**Decrease**
Dominant Two %	Relative abundance (%) of individuals of the two most abundant species. Highly altered streams tend to have less diversity often dominated by a few taxa.	**Increase**
Lithophilic Spawner %	Relative abundance (%) of lithophilic individuals. This metric uses species that have both guarding and nonguarding spawning behavior that require clean gravel or cobble for success. This metric detects changes in environmental disturbance, particularly siltation.	**Decrease**
Riffle %	Relative abundance (%) of individuals that predominately utilize riffle habitats. Riffle species are those that require riffle habitat as part of their life history either for feeding, reproduction, or both. Sedimentation can decrease this type of habitat thereby negatively impacting these species.	**Decrease**
Simple Lithophilic Spawner %	Relative abundance (%) of simple lithophilic individuals. This metric uses species that have simple, nonguarding spawning behavior that require clean gravel or cobble for success. This metric detects changes in environmental disturbance, particularly siltation.	**Decrease**
Tolerant %	Relative abundance (%) of tolerant individuals. Tolerant species are those that are known to persist in poor quality streams. They may become the dominant component in streams that have been chemically or physically altered.	**Increase**
MSHA Score Tolerant/ Sensitive %	Relative abundance (%) of individuals that are considered tolerant or intolerant to low MSHA scores. Tolerant means that the fish has been found in streams with low MSHA scores, intolerant means those fish have not been found in streams with low MSHA scores.	
Percent Embedded Tolerant/ Sensitive %	Relative abundance (%) of individuals that are considered tolerant or intolerant to high embedded sediments. Tolerant means that the fish has been found in streams	

Fish Metric	Metric Description	Response to Habitat Stress
	with high percentages pf embedded substrate, intolerant means those fish have not been found in streams with high percentages of embedded substrate.	
Low Substrate Score Tolerant/ Sensitive %	Relative abundance (%) of individuals that are considered tolerant or intolerant to low substrate scores. Tolerant means that the fish has been found in streams with low substrate scores, intolerant means those fish have not been found in streams with low substrate scores.	

Table 6. Habitat related invertebrate metric descriptions.

Invert Metric	Metric Description	Response to Habitat Stress
Burrower %	Relative abundance (%) of burrowers in subsample. Burrowers "Burrow" into fine sediments or tunnel into plant stems, leaves or roots. Many chironomid midges (Diptera: Chironomidae) and segmented worms (Oligochaeta) are burrowers.	**Increase**
Climber %	Relative abundance (%) of climbers in subsample, climbers "Climb" up the stems and leaves of submerged plants, roots, and woody debris.	**Decrease**
Clinger %	Relative abundance (%) of clingers in subsample. "Clinger" macroinvertebrate taxa have adaptations for attachment to surfaces in stream riffles. They typically dwell in swift water and attach themselves to the surfaces of coarse substrates or woody debris. They are particularly dependent on the interstitial spaces created by gaps in overlapping coarse material (large gravels, cobbles, boulders, etc.).	**Decrease**
Ephemeroptera Plecoptera Trichoptera %	Relative abundance (%) of Ephemeroptera, Plecoptera & Trichoptera individuals in subsample. Ephemeroptera, or mayflies, are benthic invertebrates that are sensitive to environmental disturbance. They occupy a variety of habitats including interstitial spaces between rocks, rock surfaces, sediment, and aquatic vegetation.	**Decrease**
Legless %	Relative abundance (%) of legless individuals in subsample. Legless species are tolerant of degraded habitat conditions.	**Increase**
Sprawler %	Relative abundance (%) of sprawler individuals in subsample. Sprawlers inhabit surfaces of floating leaves or on the surface of fine sediments.	**Decrease**
MSHA Score Tolerant/ Intolerant %	Relative abundance (%) of individuals that are considered tolerant or intolerant to low MSHA scores. Tolerant means that the invert has been found in streams	

Invert Metric	Metric Description	Response to Habitat Stress
	with low MSHA scores, intolerant means those inverts have not been found in streams with low MSHA scores.	
Percent Embedded Tolerant/ Intolerant %	Relative abundance (%) of individuals that are considered tolerant or intolerant to high embedded sediments. Tolerant means that the invert has been found in streams with high percentages of embedded substrate, intolerant means those inverts have not been found in streams with high percentages of embedded substrate.	
Low Substrate Score Tolerant/ Intolerant %	Relative abundance (%) of individuals that are considered tolerant or intolerant to low substrate scores. Tolerant means that the invert has been found in streams with low substrate scores, intolerant means those inverts have not been found in streams with low substrate scores.	

Dissolved Oxygen

DO refers to the concentration of oxygen gas within the water column. Adequate DO is important to growth and reproduction of aquatic life. Oxygen diffuses into water from the atmosphere (turbulent flow enhances this diffusion) and from the release of oxygen by aquatic plants during photosynthesis.

If DO concentrations become limited or fluctuate dramatically, aerobic aquatic life can experience reduced growth or fatality (Allan 1995). Low DO, or highly fluctuating concentrations of DO can have detrimental effects on many fish and macroinvertebrate species (Davis 1975; Nebeker 1991). Fish and invertebrates require oxygen for respiration. Many species of fish avoid areas where DO concentrations are below 5 mg/L (Raleigh 1986). Additionally, fish growth rates can be significantly affected by low DO levels (Doudoroff and Warren 1965).

In most streams and rivers, the critical seasonal conditions for stream DO usually occur during late summer when water temperatures are at or near the annual high while stream flow volumes and rates are near base flow. The critical daily period for DO is early morning when the daily DO flux is at its minimum. Human activities can alter many of these driving factors and change the DO concentrations of water resources. Increased nutrient content of surface waters is a common human influence, which can result in excess aquatic plant growth. This situation often leads to a decline in daily minimum oxygen concentrations and an increase in the magnitude of daily DO concentration fluctuations due to the decay of the excess organic material, increased usage of oxygen by plants at night, and their greater oxygen production during the daytime. Humans may directly add organic material by municipal or industrial effluents. These forms of pollution increase the risk of eutrophication, which can also lead to low DO.

Table 7. DO related fish metric descriptions.

Fish Metric	Metric Description	Response to Low DO Stress
Taxa Count #	Total taxa richness of fish. The total number of species declines as environmental degradation increases. Hybrids, subspecies, and exotics are not included in this metric.	**Decrease**
Mature Age >3 %	Relative abundance (%) of species with a female mature age > 3 years excluding tolerant species. Late maturity is a trait adaptive to stable, well-connected environments that allow these species to access the habitats and resources necessary for their life history requirements, over many years of growth and development. Stable environmental conditions are typically associated with minimal human disturbance. Therefore, the presence of large numbers of late-maturing species and/or individuals is an indication of a high quality resource.	**Decrease**
Sensitive %	Relative abundance (%) of generally sensitive individuals. Highly altered streams often have low percentages of sensitive fish and higher percentages of tolerant ones.	**Decrease**
Serial Spawner %	Relative abundance (%) of serial spawning individuals. Serial spawning fish spawn multiple times a year and are more prevalent in streams with low DO conditions.	**Increase**
Tolerant %	Relative abundance (%) of generally tolerant individuals. Highly altered streams often have low percentages of sensitive fish and higher percentages of tolerant ones.	**Increase**
DO Tolerance Index Value	DO Tolerance Index Value.	**Decrease**
Low DO Tolerant/ Sensitive %	Relative abundance (%) of individuals that are tolerant or sensitive to low DO. DO tolerant means that an invert is found in streams with low DO concentrations. Sensitive means that an invert is not found in areas with low DO.	

Table 8. DO related invertebrate metric descriptions.

Invert Metric	Metric Description	Response to Low DO Stress
Ephemeroptera Plecoptera Trichoptera %	Relative abundance (%) of Ephemeroptera, Plecoptera & Trichoptera individuals. These three orders typically diminish as DO levels lower. Relative abundance (%) of Ephemeroptera, Plecoptera and Trichoptera. Ephemeroptera, or mayflies, are benthic invertebrates that are sensitive to environmental disturbance. They occupy a variety of habitats including interstitial spaces between rocks, rock surfaces, sediment, and aquatic vegetation. Plecoptera, or stoneflies, are among the most sensitive indicator organisms. They occupy the interstitial spaces between rocks,	**Decrease**

Invert Metric	Metric Description	Response to Low DO Stress
	woody debris, and vegetation, and require a relatively high amount of DO to survive. Trichoptera, or caddisflies, are a diverse group of benthic insects that are considered good indicators of environmental disturbance. As a group, they are somewhat more tolerant to pollution than mayflies, but in the presence of significant impairment they do not persist as a diverse community. Because of their ability to exploit a variety of habitats, their diversity is a good indicator of habitat quality. Their ability to thrive in lentic conditions makes them excellent indicators for use in slow moving streams as well.	
HBI_MN	A measure of pollution based on tolerance values assigned to each individual taxon developed by Chirhart.	**Increase**
Taxa Count	Total taxa richness of inverts. The total number of species declines as environmental degradation increases.	**Decrease**
DO TIV	DO Tolerance Index Value.	**Decrease**
Low DO Intolerant/ Intolerant %	Relative abundance (%) of DO intolerant individuals. DO tolerant means that an invert is found in streams with low DO concentrations. Intolerant means that an invert is not found in areas with low DO.	

Eutrophication

Phosphorus (P), an important plant nutrient, is typically in short supply in natural systems, but human activity on the landscape often exports phosphorus to waterways, which can impact stream organisms. Phosphorus exists in several forms, with the soluble form, orthophosphorus, readily available for plant and algal uptake. While phosphorus itself is not toxic to aquatic organisms, it can have detrimental effects via other associated chemistry when levels are elevated above natural concentrations. Increased nutrients can cause excessive aquatic plant and algal growth (eutrophication), which alters physical habitat, food resources, and oxygen levels in streams. Excess plant growth increases DO during daylight hours and saps oxygen from the water during the nighttime. As plant material dies, bacterial decomposition lowers DO through absorption. Streams dominated with submerged macrophytes experience the largest swings in DO and pH (Wilcox R. 2001). Suspended algae in the water column (often measured as Chl-*a*) also produce these effects. In some cases, oxygen production leads to extremely high levels of oxygen in the water (supersaturation), which can cause gas bubble disease in fish. The wide daily fluctuations in DO caused by excess plant growth and algae are also correlated to degradation of aquatic communities (Heiskary 2013).

Determining the type of suspended material within a stream (mineral vs. organic) is important for proper conclusions about the stressor and source (erosion vs. nutrient enrichment vs. a wastewater discharge). Elevated total suspended volatile solids (TSVS) concentrations can impact aquatic life in a similar manner as suspended sediment, with the suspended particles reducing water clarity. Unusually high concentrations of TSVS can indicate excess nutrients (causing algal growth) and an unstable DO regime.

Table 9. Eutrophication related fish metric descriptions.

Fish Metric	Metric Description	Response to Eutrophication Stress
Taxa Count #	Total taxa richness of fish. The total number of species declines as environmental degradation increases. Hybrids, subspecies, and exotics are not included in this metric.	**Decrease**
Darter %	Relative abundance (%) of darter individuals. Many darters are considered sensitive to water quality degradation. They require clean coarse substrate material to thrive, and tend to disappear in streams affected by siltation, channelization, and eutrophication.	**Decrease**
Omnivore %	Relative abundance (%) of omnivorous individuals. Omnivores have the ability to utilize multiple food sources, which allows them to switch to another food source when one is depleted.	**Increase**
Simple Lithophilic Spawner %	Relative abundance (%) of simple lithophilic individuals. Relative abundance (%) of simple lithophilic individuals. This metric uses species that have simple spawning behavior that requires clean gravel or cobble for success. This metric detects changes in environmental disturbance, particularly siltation.	**Decrease**
Phosphorus Tolerant/ Sensitive %	Relative abundance (%) of phosphorus tolerant/sensitive individuals. Phosphorus tolerant means that a fish is found in streams with high phosphorus concentrations. Sensitive means that a fish is not found in areas high phosphorus concentrations.	

Table 10. Eutrophication related invertebrate metric descriptions.

Invert Metric	Metric Description	Response to Eutrophication Stress
Crustacean and Mollusca %	Relative abundance (%) of Crustacean and Molluscan individuals in subsample.	**Increase**
Collector – Gatherer Taxa #	Taxa richness of collector-gatherers. The number of collector-gatherer taxa represents the number of different taxa that collect their food by gathering it from the substrate.	**Decrease**
Ephemeroptera Plecoptera Trichoptera %	Relative abundance (%) of Ephemeroptera, Plecoptera and Trichoptera. Ephemeroptera, or mayflies, are benthic invertebrates that are sensitive to environmental disturbance. They occupy a variety of habitats including interstitial spaces between rocks, rock surfaces, sediment, and aquatic vegetation. Plecoptera, or stoneflies, are among the most sensitive indicator organisms. They occupy the interstitial spaces between rocks, woody debris, and vegetation, and require a relatively high amount of DO to survive.	**Decrease**

Invert Metric	Metric Description	Response to Eutrophication Stress
	Trichoptera, or caddisflies, are a diverse group of benthic insects that are considered good indicators of environmental disturbance. As a group, they are somewhat more tolerant to pollution than mayflies, but in the presence of significant impairment they do not persist as a diverse community. Because of their ability to exploit a variety of habitats, their diversity is a good indicator of habitat quality. Their ability to thrive in lentic conditions makes them excellent indicators for use in slow moving streams as well.	
Scraper %	Relative abundance (%) of scraper individuals in subsample. Scrapers scrape algae off rocky surfaces and often thrive in eutrophic streams with high algae growth.	**Increase**
Taxa Count All #	Total taxa richness of macroinvertebrates. Taxa richness is considered a good indicator of environmental quality. In most types of aquatic ecosystems as environmental disturbance increases, taxa richness decreases.	**Decrease**
Phosphorus Tolerant/ Intolerant %	Relative abundance (%) of phosphorus tolerant/intolerant individuals. Phosphorus tolerant means that an invert is found in streams with high phosphorus concentrations. Intolerant means that an invert is not found in areas with high phosphorus concentrations.	

Suspended Solids

Sediment and turbidity are among the leading pollutant issues affecting stream biological impairment in the United States (EPA 2012). Recent studies in Minnesota have demonstrated that human activities on the landscape have dramatically increased the sediment entering streams and rivers since European settlement (Triplet 2009) and (Engstrom 2009). Sediment can come from land surfaces such as exposed soil or from unstable streambanks. The soil may be unprotected for a variety of reasons, such as construction, mining, agriculture, or insufficiently-vegetated pastures. Human actions on the landscape, such as channelization of waterways, riparian land cover alteration, artificial drainage, and increased impervious surface area can cause stream bank instability leading to sediment input from bank sloughing. Fine sediment often gets deposited on the stream bottom and can cover and embed coarser sediment. Although sediment delivery and transport are an important natural process for all stream systems, sediment imbalance (either excess suspended sediment or lack of sediment) can be detrimental to aquatic organisms. Organic particles, including algae, can also contribute to TSS.

Excess deposited/bedded fine sediment (DBS) upon benthic habitat has been proven to negatively impact fish and macroinvertebrate species that depend on clean, coarse stream substrates for feeding, refugia, and/or reproduction. Highly embedded coarse substrates reduce spawning habitat and interstitial spaces for the fish and macroinvertebrate taxa, which depend on these microhabitats.

Benthic insectivores are fish species that prey on insect life that occupy benthic (stream bottom) habitats. The abundance and richness of fish species with this trophic trait has been shown to decrease as the percentage of fine sediment increases (Berkman and Rabeni 1987).

Table 11. TSS related fish metric descriptions.

Fish	Metric Description	Response to Suspended Solids Stress
Benthic Feeder %	Relative abundance (%) of benthic feeding individuals. Relative abundance (%) of benthic insectivore individuals (excludes tolerant species). Benthic insectivore and invertivore species rely on undisturbed benthic habitats to feed and reproduce. Many benthic invertivores require clean coarse substrates and an ample supply of aquatic macrophytes or woody debris for cover. Benthic insectivore species occupied the same type of niche as darters. This allows a greater degree of sensitivity in evaluating streams that naturally had few darter species. An increase in benthic insectivore species was correlated with increased biotic integrity.	**Decrease**
Centrarchid - Tolerant %	Relative abundance (%) of Centrarchid individuals (excludes tolerant species). These species are sight feeders that can be negatively impacted by increased TSS.	**Decrease**
Herbivore %	Relative abundance (%) of herbivorous individuals. Fish species that utilize vegetation. These species are negatively impacted by the loss of vegetation, which can be caused by sedimentation and hydromodification.	**Increase**
Long – lived %	Relative abundance (%) of long – lived individuals. Long lived species typically have long life histories and as a result require more time to recover from disturbance.	**Decrease**
Perciformes - Tolerant %	Relative abundance (%) of Perciformid individuals (excludes tolerant species). Fish species in the family Percidae includes walleye, perch, and darters. Species classified as tolerant are not included in this metric.	**Decrease**
Riffle %	Relative abundance (%) of individuals that predominately utilize riffle habitats. Riffle species are those that require riffle habitat as part of their life history either for feeding, reproduction, or both. Sedimentation can decrease this type of habitat thereby negatively impacting these species.	**Decrease**
Simple Lithophilic Spawner %	Relative abundance (%) of simple lithophilic individuals. Relative abundance (%) of simple lithophilic individuals. This metric uses species that have simple spawning behavior that requires clean gravel or cobble for success. This metric detects changes in environmental disturbance, particularly siltation.	**Decrease**
TSS TIV	TSS Tolerance Index Value.	**Increase**
Phosphorus Tolerant/ Sensitive %	Relative abundance (%) of phosphorus tolerant/intolerant individuals. Phosphorus tolerant means that a fish is found in streams with high TSS concentrations. Sensitive means that a fish is not found in streams with high TSS concentrations.	

Table 12. TSS related invertebrate metric descriptions.

Invert	Metric Description	Response to TSS Stress
Collector – filterer %	Relative abundance (%) of collector – filterer individuals in subsample.	**Decrease**
Plecoptera %	Relative abundance (%) of Plecoptera individuals in subsample. Plecoptera, or stoneflies, are among the most sensitive indicator organisms. They occupy the interstitial spaces between rocks, woody debris, and vegetation, and as such, are sensitive to sedimentation.	**Decrease**
Sprawler %	Relative abundance (%) of sprawler individuals in subsample. Sprawlers tend to "sprawl" on fine sediments and are often found in streams with high percentages of fine sediment and embeddedness.	**Increase**
TSS TIV	TSS Tolerance Index Value.	**Increase**
TSS Intolerant/ Intolerant %	Relative abundance (%) of taxa intolerant to TSS. TSS tolerant means that an invert is found in streams with high TSS concentrations. Intolerant means that an invert is not found in streams with high TSS concentrations.	

Nitrates

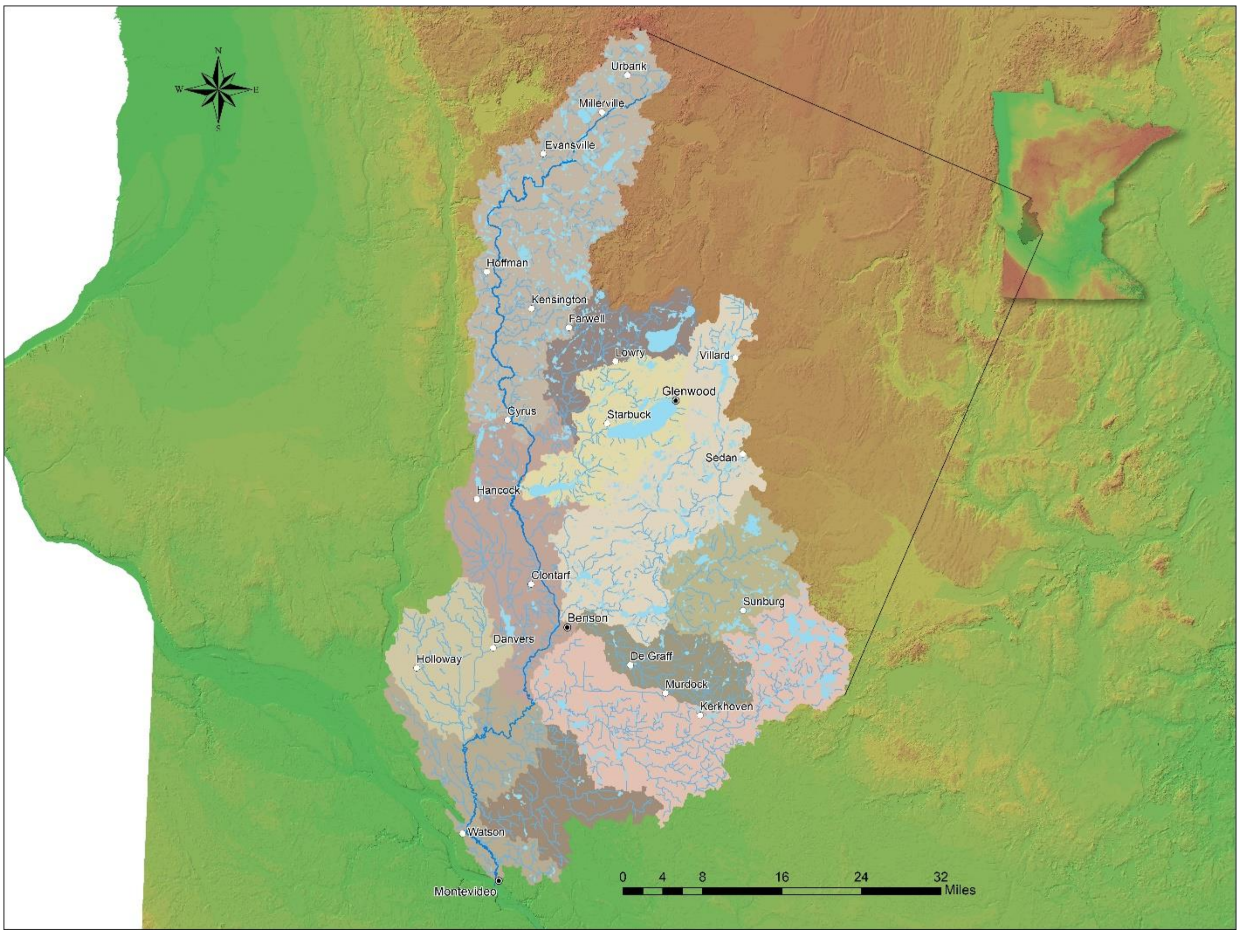
Nitrate (NO_3) and nitrite (NO_2) are components of the natural nitrogen cycle in aquatic ecosystems. NO_2 anions are naturally present in soil and water and are readily converted to NO_3 by microorganisms as part of the nitrification process of the nitrogen cycle. As a result, nitrate is far more abundant than nitrite. Although the water test commonly used measures both nitrate and nitrite, because a large percentage is nitrate, this report will refer to these data as being nitrate. Nitrate is commonly applied as a crop fertilizer. Nitrate transport pathways can be different depending on the geology and hydrology of the watershed. When water moves quickly through the soil profile, as in the case of watersheds with karst geology or in heavily tiled watersheds, nitrate transport can become significant. Apart from its function as a biological nutrient, some levels of nitrate can become toxic to organisms. Nitrate toxicity depends on concentration and exposure time, as well as the sensitivity of the individual organisms. The intake of nitrate by aquatic organisms converts oxygen carrying pigments into forms that are unable to carry oxygen, thus inducing a toxic effect on fish and macroinvertebrates (Grabda et al 1974). Certain species of caddisflies, amphipods, and salmonid fishes seem to be the most sensitive to nitrate toxicity according to Camargo and Alonso (2006), who cited a maximum level of 2.0 mg/L nitrate N as appropriate for protecting the most sensitive freshwater species and nitrate-N concentrations under 10.0 mg/L to protect several other sensitive fish and aquatic invertebrate taxa. Currently the State of Minnesota has a proposed nitrate criteria for protection of aquatic life of 8 mg/L for Class 2B waters of the state, which was developed based on methods in Minnesota rules along with the best available science available at this time.

Table 13. Nitrate related invertebrate metric descriptions.

Invert	Metric Description	Response to Nitrate Stress
Trichoptera Taxa %	Relative percentage of taxa belonging to Trichoptera.	**Decrease**
Nitrogen TIV	Nitrogen Tolerance Index Value.	**Increase**
Nitrate Tolerant/ Intolerant %	Relative abundance (%) of taxa tolerant/ intolerant to high nitrate concentrations. Tolerant means that an invert is found in streams with high nitrate concentrations. Intolerant means that an invert is not found in streams with high nitrate concentrations.	

2 Watershed Description

Figure 4. Map of the Chippewa River Watershed boundaries.



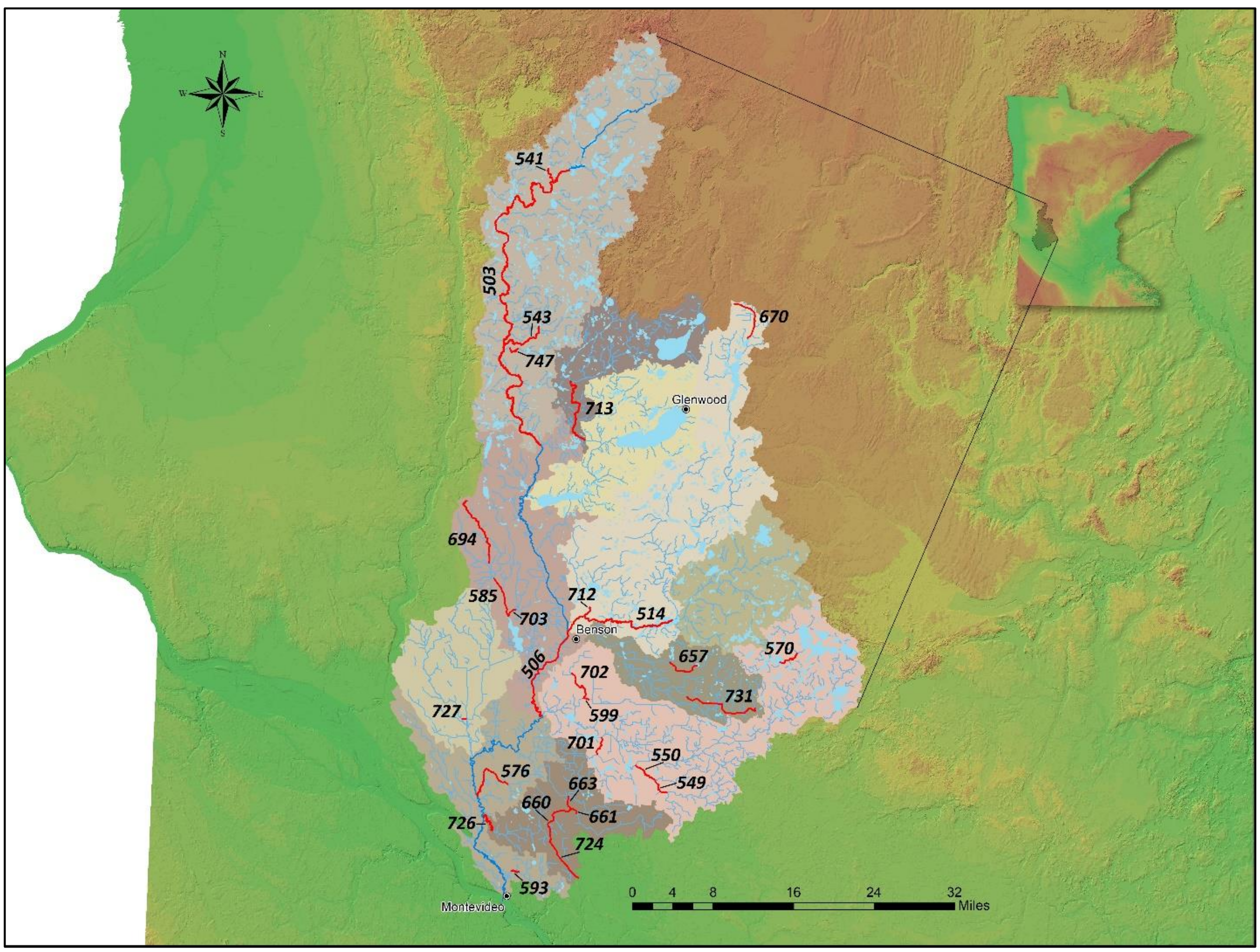
The Chippewa River Watershed (07020005) is located in west-central Minnesota (Figure 4). The watershed falls in three different Ecoregions. The North Central Hardwood Forest Ecoregion covers the eastern two-thirds of the watershed, the Northern Glaciated Plains Ecoregion covers the west-central part of the watershed, and the Western Corn Belt Plains Ecoregion covers the southern part of the watershed. Much of the landscape of this watershed was modified by the early settlers in the area.

Draining wetlands and modifying stream channels were used to gain land for agriculture. Now approximately 79% of the watershed is used for agricultural production.

The Chippewa River Watershed is 1 of 13 major tributaries to the Minnesota River. The headwaters of the Chippewa River are located in Otter Tail County and it flows 130 miles southwest to its mouth in Montevideo, where it joins the Minnesota River. The 1.3-million-acre (2,080 square miles) watershed lies between the Pomme de Terre River to the west and Hawk Creek, North Fork Crow, Sauk and Long Prairie Rivers to the east, with the last three discharging to the upper Mississippi rather than the Minnesota River like the Chippewa. The basin drains portions of eight counties. Several major tributaries including the Little Chippewa River, East Branch Chippewa River, Shakopee Creek, and Dry Weather Creek contribute to the flow of the mainstem. Major lakes include Emily, Minnewaska, Norway, Florida, Chippewa, Lobster, Reno, Aaron, Moses, and Red Rock. These are important fisheries and recreational areas. Roughly 42,300 people live in the Chippewa River Watershed in 32 small towns and rural areas.

3 Biological Impaired Reaches and Stressors

Figure 5. Map of biological impairments identified in the Chippewa River Watershed. Impaired reaches are shown in red.



Twenty-eight biologically impaired stream reaches are addressed in this SID Report (Table 14). The majority of the impairments were in the western and southern part of the watershed area (Figure 5).

Table 14. Summary of biologically impaired reaches and stressors identified in this report.

Stream Reach	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
07020005-541	✓	O	✓	O	O	O	O
07020005-543	✓	O	✓	O	O	✓	O
07020005-747	O	✓	✓	✓	✓	✓	O
07020005-503	✓	O	✓	✓	✓	✓	O
07020005-713	✓	✓	✓	O	O	✓	O
07020005-514	✓	O	✓	✓	O	✓	O
07020005-670	✓	O	✓	O	O	O	O
07020005-712	✓	O	✓	✓	✓	O	O
07020005-585	✓	O	✓	O	O	O	O
07020005-694	✓	O	✓	✓	O	O	✓
07020005-703	✓	O	✓	✓	✓	O	O
07020005-506	O	O	✓	O	O	✓	O
07020005-727	✓	✓	✓	✓	✓	O	O
07020005-657	✓	✓	O	O	O	O	O
07020005-731	✓	✓	✓	✓	✓	O	O
07020005-549 07020005-550	✓	O	✓	✓	✓	✓	✓
07020005-570	✓	✓	✓	✓	✓	O	✓
07020005-599 07020005-702	✓	✓	✓	✓	✓	O	✓
07020005-701	✓	O	✓	O	O	O	O
07020005-576	O	O	O	O	O	O	O
07020005-593	O	✓	✓	O	O	O	O
07020005-660 07020005-724	✓	✓	✓	✓	✓	O	✓
07020005-661 07020005-663	✓	O	✓	✓	✓	O	O
07020005-726	✓	O	O	✓	✓	✓	✓

✓= Stressor, **O** = Inconclusive

In the Cycle 1 assessment, biological data from channelized stations were not evaluated due to the policy of not assessing channelized portions of rivers and streams at that time. Many of the streams were opted-in prior to the Cycle 2 assessment of this watershed to evaluate Cycle 1 data now that TALU have been adopted in rule. See Section 1.3 for more details on TALU.

3.1 Headwaters of the Chippewa River

3.1.1 07020005-541 Unnamed Creek

Figure 6. Satellite image of reach 07020005-541 and its watershed.

3.1.1.1 Biological Community

The MIBI score of 15 was below the Invert Class 7 southern prairie stream glide pool general use threshold of 22 (Table 15). A very simple invert community even for a modified use low gradient stream; only 20 taxa collected, 90% of which are considered tolerant. The bio site was dominated by *hyallella*, a tolerant amphipod. The other dominant taxa present were worms, which are also considered tolerant.

Biological Metric Data

Table 15. Invert IBI score and threshold for stream reach.

07020005-541 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN071 8/18/2009	15.0	22

3.1.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 16. Hydrologic alteration related invert metrics for stream reach.

07020005-541 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth variability Tolerant %	Low Depth variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
09MN071 8/18/2009	1.2	0.3	0.0		13.1	0.0		89.3	0		0	1.2
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.6**	**9.9**	**5.6**		↑	↓		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓									

Hydrologic Alteration Summary

Invert biological metrics for hydrologic alteration are very poor. Clingers, collector-filterers, and long-lived percentages were very low. The most numerous invert present was the amphipod *Hyalella*, which is considered tolerant to low depth variability. The bio site was dominated by inverts tolerant to low stream depth variability (Table 16).

The entire stream channel upstream of the impaired reach, several tributaries, as well as the reach itself has been altered and ditched. The stream channel has been ditched through several wetlands upstream. Based on the very poor scores of the biological metrics and the extensive alteration of the stream channel, hydrologic alteration is a stressor in reach 07020005-541.

3.1.1.3 Connectivity

Connectivity Metric Data

Table 17. Connectivity related fish metrics for reach.

07020005-541 **Fish Class 3** **Modified Use**	Mature Age >3%	Migrating Individual %
09MN071 7/6/2009	0	0
Statewide average for channelized Class 3 southern headwater bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

The fish biological metrics for connectivity are very poor. There were no late-maturing or migrating fish caught (Table 17). The culvert near the bio site could be a fish barrier under high flows but is inconclusive as a stressor at this time (Figure 7).

3.1.1.4 Habitat

Habitat Metric Data

Table 18. Habitat related invert metrics for stream reach.

07020005-541 **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN071 8/18/2009	8.6	3.7	1.2	8.7	11.6	84.1
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 19. Invert tolerance metrics for stream reach.

07020005-541 **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN071 8/18/2009	89.3	0.6		87.5	0.6		80.5	0.6
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 20. Habitat assessment scores for stream reach.

07020005-541	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN071 7/06/2009	0	10.5	9	14	13	46.5
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

Invert metrics related to habitat were mostly poor. Burrower and legless percentage scored well; however, this was influenced by the amphipod *Hyallela* making up over 74% of the total number of inverts caught at the site, which is not legless or a burrower (Table 18).

The invert community was 89.3% tolerant to low Minnesota State Habitat Assessment scores, 87.5% tolerant of high percent embeddedness of substrates, and 80.5% tolerant to low substrate scores (Table 19). The most numerous invert taxa present, *Hyallela*, *Caenis*, *Enallagma*, *Neoplea*, *Physella*, and *Haliplus* are tolerant to low MSHA habitat scores. *Hyalella*, *Caenis*, *Enallagma* are tolerant to high embeddedness of substrates and high percentage of fine sediments.

The MSHA score conducted during the invert bio visit was poor, indicating degradation and lack of habitat for invertebrates (Table 20). Specifically, poor substrate and channel morphology scored poorly and MSHA scores mostly lined up with the tolerances of inverts caught during the bio visit.

Habitat is a stressor to the macroinvertebrate community. The bio site has excessive amounts of fine sediment, low substrate types, and low channel morphology and appears to be having a negative effect on the invert community and causing the high numbers of poor habitat tolerant invertebrates observed at bio site 09MN071.

Figure 7. Photo taken just downstream of bio site 09MN071 on June 10th, 2022.

3.1.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 21. DO related invert metrics for stream reach.

07020005-541 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN071 8/18/2009	8.6	7.4	20	7.2		87.8	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↓	↑
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Summary

Invert low DO metrics were mixed as both the Hilsenhoff Biotic Index (HBI_MN) score was below the statewide class average and the DO tolerance index value scored above the statewide average (Table 21). The invert *Hyalella* comprised over 74% of the taxa that were observed at the bio site and such, the characteristics of *Hyalella* dominate the metrics of the site. *Hyalella*, as well as *Ceanis*, *Enallagma*, and *Neoplea* are all tolerant to low DO and the percentage of low DO is 87.8% of the total inverts caught.

Based on the invertebrate tolerance scores and the dominance of DO tolerant invertebrates caught, DO is likely a stressor in this reach, but at this time it is inconclusive.

3.1.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 22. Eutrophication related invert metrics for stream reach.

07020005-541 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN071 8/18/2009	76.1	7	8.6	1.2	20		89.3	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.6**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 23. Phosphorus monitoring data for stream reach.

<table>
<tr><td rowspan="2">07020005-541
P Sample Data
0.100 mg/L target</td><td rowspan="2">Range of Data (mg/L)</td><td colspan="7">Monthly Average of Samples (mg/L)
[# of Samples]</td><td rowspan="2">June-Aug Average (mg/L)
[# of Samples]</td></tr>
<tr><td>April</td><td>May</td><td>June</td><td>July</td><td>August</td><td>Sept</td><td>Oct</td></tr>
<tr><td rowspan="3">S011-115
(2022)</td><td rowspan="3">0.182 – 0.204</td><td>-</td><td>-</td><td>-</td><td>0.193
[2]</td><td>-</td><td>-</td><td>-</td><td rowspan="3">0.193
[2]</td></tr>
<tr><td colspan="7">Maximum Value</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>0.204</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Eutrophication Summary

Invert eutrophication metrics were mostly poor. The Crustacean *Hyalella* dominated the invert community. Collector-gatherers were below the class average. EPT taxa were low as well as the total taxa count. Phosphorus tolerant species comprised over 89.3% of the total number of inverts caught and there were no phosphorus intolerant species. Scrapers were low, though there were some present (Table 22).

Two samples were collected and analyzed for phosphorus in 2022. The summer average was 0.193, above the standard of 0.15 mg/L (Table 23).

The related invert biological metric scores indicate that eutrophic conditions are stressing the invert community and the collected samples showed elevated phosphorus levels. Eutrophication is likely a stressor in reach 07020005-541, though is inconclusive at this time.

3.1.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 24. TSS related invert metrics for stream reach.

<table>
<tr><td>07020005-541
Invert Class 7
Modified Use</td><td>Collector – filterer %</td><td>Plecoptera %</td><td>Sprawler %</td><td>TSS TIV</td><td></td><td>TSS Tolerant Taxa %</td><td>TSS Intolerant Taxa %</td></tr>
<tr><td>09MN071 8/18/2009</td><td>0.3</td><td>0</td><td>84.1</td><td>14.2</td><td></td><td>5.2</td><td>0</td></tr>
<tr><td>Statewide average for channelized Class 7 prairie stream glide pool bio sites</td><td>9.9</td><td>0.02</td><td>27.0</td><td>16.3</td><td></td><td rowspan="2">↑</td><td rowspan="2">↓</td></tr>
<tr><td>Expected response to TSS stress</td><td>↓</td><td>↓</td><td>↑</td><td>↑</td><td></td></tr>
</table>

Suspended Solids Summary

Invert related metrics were mostly poor. There were no Plecoptera or TSS intolerant taxa caught. Sprawler invertebrates were well above the class average as *Hyalella* dominated the invert community, which would indicate there was excess fine sediment and siltation deposited on the stream bottom. The TSS tolerance index value of the community was below the class average. The number of TSS tolerant to intolerant individuals was not excessively high as only 5.2% of the inverts caught are considered tolerant to TSS.

One transparency measurement was taken in 2022. The transparency measured 29cm, above the standard of 10cm. The TSS sample taken during the bio visit was 1 mg/L, well below the standard of 30 mg/L for the Central Nutrient Region.

TSS are inconclusive as a stressor to the invertebrate community. The dominance of one invertebrate seemed to have caused some of the metrics to score very poorly. However, the TIV score as well as the low numbers of TSS tolerant taxa present do not indicate that TSS is causing the biological impairment.

3.1.1.8 Nitrates

Nitrate Biological Metric Data

Table 25. Nitrate related invert metrics for stream reach.

07020005-541 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrate Tolerant %	Nitrate Intolerant %
09MN071 8/18/2009	5	1.9		11.3	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 26. Nitrate monitoring data for stream reach.

07020005-541 Nitrate/Nitrite Sample Data 8 mg/L target	Range of Data (mg/L) [# of Samples]	Monthly Average (mg/L) [# of Samples]						
		April	May	June	July	August	Sept	Oct
S011-115 (2022)	0.07 – 0.8 [5]	-	-	0.7 [1]	0.4 [4]	-	-	-
		Highest Value (mg/L)						
		-	-	0.7	0.8	-	-	-

Summary

The macroinvertebrate assemblage at site 09MN071 were mixed. Trichoptera taxa percent were just below the class average at 5% and the nitrogen TIV score was below the class average (Table 25). The biological site did not have any nitrate intolerant taxa versus 11.3% nitrate tolerant taxa, which was mostly the mayfly *Caenis*.

Five measurements were conducted in reach 07020005-541 and analyzed for nitrate/nitrite (Table 26). All of the samples had total nitrate concentrations below the proposed nitrate criteria for protection of aquatic life of 8 mg/L.

Due to the mixed biological response and relatively low nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-541.

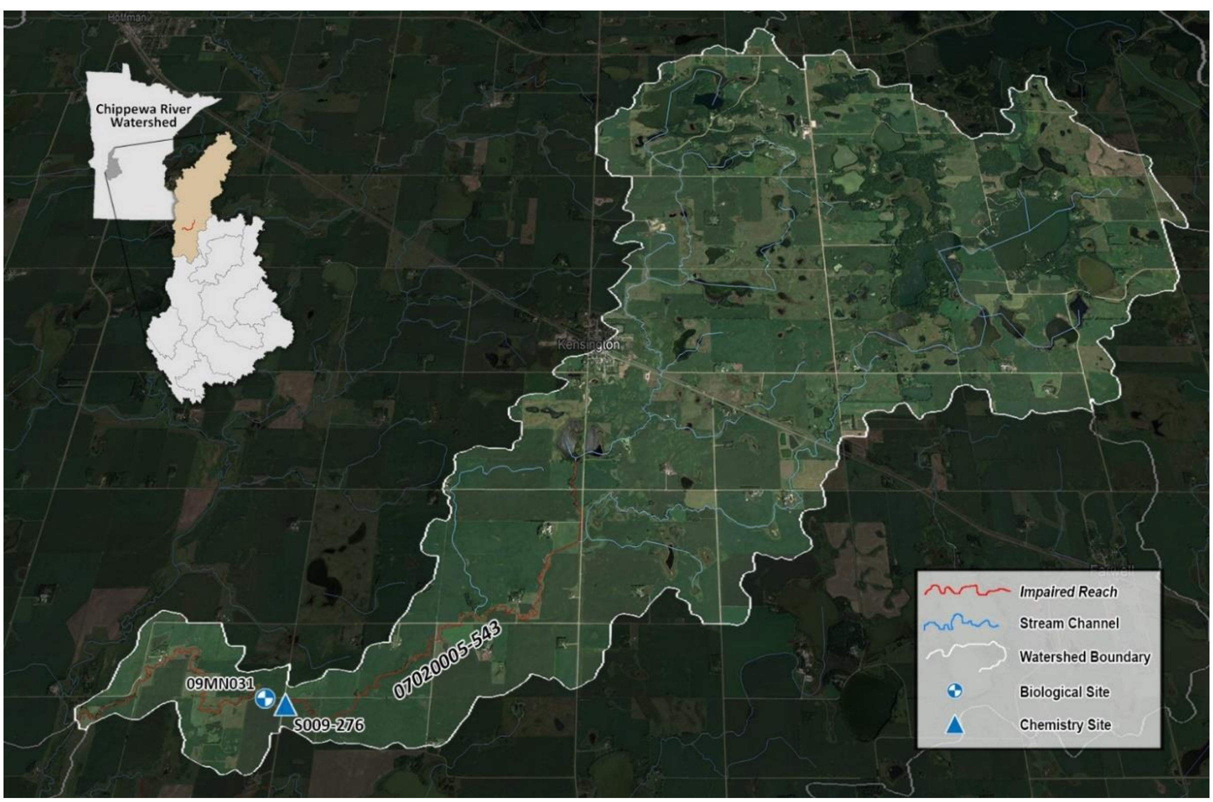
3.1.1.9 Reach Stressors

Table 27. Summary of stressors for stream reach.

07020005-541	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	O	O	O	O

3.1.2 07020005-543 Judicial Ditch 30

Figure 8. Satellite image of reach 07020005-543 and its watershed.



3.1.2.1 Biological Community

Reach 07020005-543 is impaired for fish. Bio site 09MN031 was sampled for fish in 2019, but flows were too low in 2009 for a sample. The FIBI score of 32.9 was just below the Fish Class 3 Southern Headwaters modified use threshold of 33. Fathead minnows and brook sticklebacks dominated the fish community. They are both tolerant, short maturing, and short-lived fish, which resulted in poor metric scores (Table 28). The four most numerous taxa caught are all considered either tolerant or very tolerant.

Biological Metric Data

Table 28. Fish IBI score and threshold for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	Fish IBI Score	Class Threshold Score
09MN031 8/07/2019	32.9	33

3.1.2.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 29. Hydrologic alteration related fish metrics for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
09MN031 8/7/2019	58.1	66.2
Statewide average for channelized Class 3 southern headwater bio sites	**56.3**	**24.0**
Expected response to **Hydrologic** stress	↑	↑

Hydrologic Alteration Summary

The biological metrics related to hydrologic alteration scored very poorly when compared to the average of class 3 headwater streams. Generalized fish species are correlated with channelization and are adaptable to different habitats through generalized food preferences. Bio site 09MN031 had a population of generalist fish of 95.7% and 58.1% of the population as fathead minnows, a generalist fish, dominated the fish community. Nesting fish comprised 71.4% and 66.2% of the total fish population (Table 29). Both fathead minnows and brook stickleback are both nesting fish.

The watershed of reach 07020005-543 had been extensively altered. Almost all the tributaries upstream have been altered as well as the impaired reach itself.

Based on the very poor scores of the biological metrics, hydrologic alteration is a stressor in this reach. The primary impact in this reach from hydrologic alteration is the ditching of the stream itself as well as its tributaries, which can affect biology in several ways. Ditching destroys the natural geomorphology of the stream, which reduces the riffle, run, glide, and pool environments needed to support a diverse invertebrate community. It cuts the stream off from its floodplain, which provides habitat and cover and dissipates some of the stream's power during high flows. Ditching and tiling of the tributaries and surrounding landscape contributes to low base flows during times of low precipitation, contributing to the stagnation of the water within the ditch and eutrophication of the water causing excessive algae growth from the nutrient overloading of phosphorus and nitrogen.

3.1.2.3 Connectivity

Connectivity Metric Data

Table 30. Connectivity related fish metrics for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	Mature Age >3%	Migrating Individual %
09MN031 8/7/2019	0	0
Statewide average for channelized Class 3 southern headwater bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related bio metrics are poor. There were no long-maturing or migrating taxa present (Table 30). The culvert at the road crossing near bio site 09MN031 did not appear to be a fish barrier during site visits. Connectivity is inconclusive as a stressor.

3.1.2.4 Habitat

Habitat Metric Data

Table 31. Habitat related fish metrics for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	Benthic Insectivore minus Tolerant %	Benthic Insectivore %	Darter Sculpin Sucker %	Dominant Two %	Lithophilic Spawner %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN031 8/7/2019	0	0	0	64.9	0	0	0	87.8
Statewide average for channelized Class 3 southern headwater bio sites	**10.9**	**12.0**	**10.6**	**63.5**	**58.0**	**22.6**	**30.1**	**76.7**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 32. Habitat related fish tolerance values for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN031 8/7/2019	77.0	0		50.0	0		97.3	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 33. Habitat assessment scores for stream reach.

07020005-543	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN031 7/07/2009	0	12.5	4	10	11	37.5
09MN031 8/06/2009	1.5	10	17	9	13	50.5
09MN031 8/07/2019	0	11	13.9	12	15	51.9
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The fish community at bio site 09MN031 scored very poorly in all eight habitat related fish metrics when compared to all other Class 3 southern headwater bio sites that meet the FIBI modified use threshold. In the 2019 visit there were no benthic insectivores, darters, lithophilic spawners, or riffle dwelling fish caught (Table 31). Habitat related fish tolerance metrics were also very poor as the MSHA score, high embeddedness, and poor substrate tolerant fish caught were very high and almost no sensitive fish within those categories were caught (Table 32).

The MSHA scores for all visits were poor. Siltation and embeddedness of coarse substrates were observed during biological sampling of the ditch (Table 33). Channel morphology was also poor as the site was observed to have low sinuosity and very poor pool width. The top six fish caught are considered tolerant or very tolerant to poor substrate scores.

Habitat is a stressor to the fish community in reach 07020005-543. There are several factors that are contributing to habitat stress within the reach, including the ditching of the stream channel itself. Ditching the stream has caused a lack of riffle, run, glide, and pool environments needed to support a diverse fish community. Although these geomorphological features begin to form over time, even in a ditch, they are destroyed by regular ditch cleanouts, evidence of which were observed in the reach during site visits. The bio site appears to have excessive amounts of fine sediment deposition and a lack of geomorphic features that are stressing the fish biologic community in this reach.

3.1.2.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 34. DO related fish metrics for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN031 8/7/2019	8	0	0	47.3	87.8	7.8		98.7	0
Statewide average for channelized Class 3 southern headwater bio sites	**10**	**14.4**	**6.0**	**10.6**	**76.7**	**8.2**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Dissolved Oxygen Monitoring Data

Table 35. DO monitoring data for stream reach.

07020005-543 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-276 (2016-2019)	5.5 – 10.5	-	0% [1]	0% [3]	0% [4]	0% [6]	0% [2]	0% [2]	0% [16]
		Minimum Value							
		-	9.3	5.5	7.9	7.5	7.7	8.3	

Dissolved Oxygen Summary

The fish community at bio site 17MN231 scored below average in all four DO related fish metrics when compared to the average of all other Class 3 southern headwater bio sites that meet the FIBI modified use threshold. No fish with females that take more than three years to mature were caught. The percentage of serial spawners was well above the class average. DO tolerant species were 99.7% of the fish population (Table 34).

Although no DO measurements taken during sampling were below the warmwater standard of 5 mg/L, none of those measurements were taken before 8:00 a.m., when values are usually the lowest.

Based on the related fish biological metric scores DO may be a stressor in this reach. Though the poor metrics could be caused by other stressors. Due to supporting data not confirming DO problems, it is inconclusive as a stressor at this time.

3.1.2.6 Eutrophication

Eutrophication Biological Metric Data

Table 36. Eutrophication related fish metrics for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %	Phosphorus Tolerant %	Phosphorus Sensitive %
09MN031 8/7/2019	8	0	48.7	0	89.2	0
Statewide average for channelized Class 3 southern headwater bio sites	**10**	**10.6**	**19.8**	**30.1**	↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓		

Eutrophication Monitoring Data

Table 37. Phosphorus monitoring data for stream reach.

07020005-543 P Sample Data 0.100 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-276 (2019-2022)	0.172 – 0.273	-	-	-	0.179 [2]	0.273 [1]	-	-	0.210 [3]
		Maximum Value							
		-	-	-	0.185	0.273	-	-	

Eutrophication Summary

The fish community at bio site 09MN031 scored below average in all three eutrophication related fish metrics when compared to the average of all other Class 3 southern headwater bio sites that meet the FIBI modified use threshold. There were no darters or simple lithophilic spawning fish. Omnivorous fish comprised 48.7% of the population. Nearly all individuals present were tolerant to phosphorus (Table 36).

Three samples were collected and analyzed for phosphorus from 2019 through 2022. The summer average was 0.210 mg/L (Table 37).

The biological community is showing the effects of the elevated phosphorus. Phosphorus sampling showed high concentrations, well above the central nutrient standard of 0.100 mg/L. Eutrophication appears to be a stressor in this reach though is inconclusive at this point. It is recommended that more TP and DO data be collected.

3.1.2.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 38. TSS related fish metrics for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN031 8/7/2019	0	1.4	0	13.5	1.4	0	0	20.5		10.8	0
Statewide average for channelized Class 3 southern headwater bio sites	**31.4**	**1.0**	**10.8**	**4.9**	**12.4**	**22.6**	**30.1**	**15.5**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

TSS Monitoring Data

Table 39. TSS monitoring data for stream reach.

07020005-543 TSS Sample Data 30 mg/L Target	Range of Data (mg/L)	% of Monthly Samples > 30 mg/L [# of Samples]							% of Total Samples > 30 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-276 (2019)	57 - 64	-	-	-	-	100% [2]	-	-	100% [2]

Table 40. Transparency monitoring data for stream reach.

07020005-543 Secchi Tube Data 15 cm target	Range of Data (mg/L)	% of Monthly Samples < 15 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-276 (2016 - 2022)	8 – 55	-	0% [1]	0% [4]	50% [4]	17% [6]	0% [2]	0% [2]	15.8% [19]

Suspended Solids Summary

The fish community at bio site 09MN031 scored poorly in most of the TSS related fish metrics when compared to the average of all other Class 3 southern headwater bio sites that meet the FIBI modified use threshold (Table 38). The dominance of fathead minnows and brook sticklebacks at the site negatively affected these metrics. The percentage of long-lived fish was higher than average; however, this was mostly due to the presence of eight common carp, which are tolerant to high TSS concentrations.

Two samples were collected and analyzed for TSS in 2019; both samples had a TSS concentration above 30 mg/L (Table 39). Stream Secchi tube measurements had exceedances of the S-tube equivalent of 15 cm (Table 40).

Figure 9. Photo taken from road crossing near bio site 09MN031 on reach 07020005-543.

Mid and late season TSS samples and S-tube measurements showed high levels of suspended sediment. Field visits confirmed that the water appeared to be cloudy due to suspended sediment (Figure 9). The preponderance of evidence indicate TSS is a biological stressor. TSS is likely contributing to the fine sediment and embeddedness within the stream channel.

3.1.2.8 Nitrates

Nitrate Biological Metric Data

Table 41. Nitrate related invert metrics for stream reach.

07020005-543 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrogen Intolerant %
09MN031 8/6/2019	12.9	3.4		48.9	0.3
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↑
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 42. Nitrate monitoring data for stream reach.

07020005-543 Nitrate/Nitrite Sample Data 8 mg/L target	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S009-276 (2019-2022)	0.5 – 2.2 [7]	-	1.2 [1]	1.6 [1]	1.9 [4]	0.5 [1]	-	-
		Highest Value						
		-	-	1.6	2.2	0.5	-	-

Summary

The macroinvertebrate assemblage at site 09MN031 scored just above the nitrate TIV score when compared to all other macroinvertebrate Class 7 prairie stream glide pool bio sites that meet the MIBI modified use threshold (Table 41). The most dominant taxa present was the Trichoptera taxa Hydropsychidae, and the third most numerous taxa present, the black fly *Simulium* are both not considered tolerant to nitrogen. The nitrogen TIV score was only one tenth of a percent above the class average. The nitrogen tolerant to intolerant ratios was high, though this could be due to the effects of other stressors, such as habitat and sedimentation.

Seven samples were collected in reach 07020005-543 and analyzed for nitrate/nitrite (Table 42). All the nitrate samples were very low. Due to the mixed biological response and relatively low nitrate concentrations, nitrates inconclusive as stressor to aquatic life in reach 07020005-543.

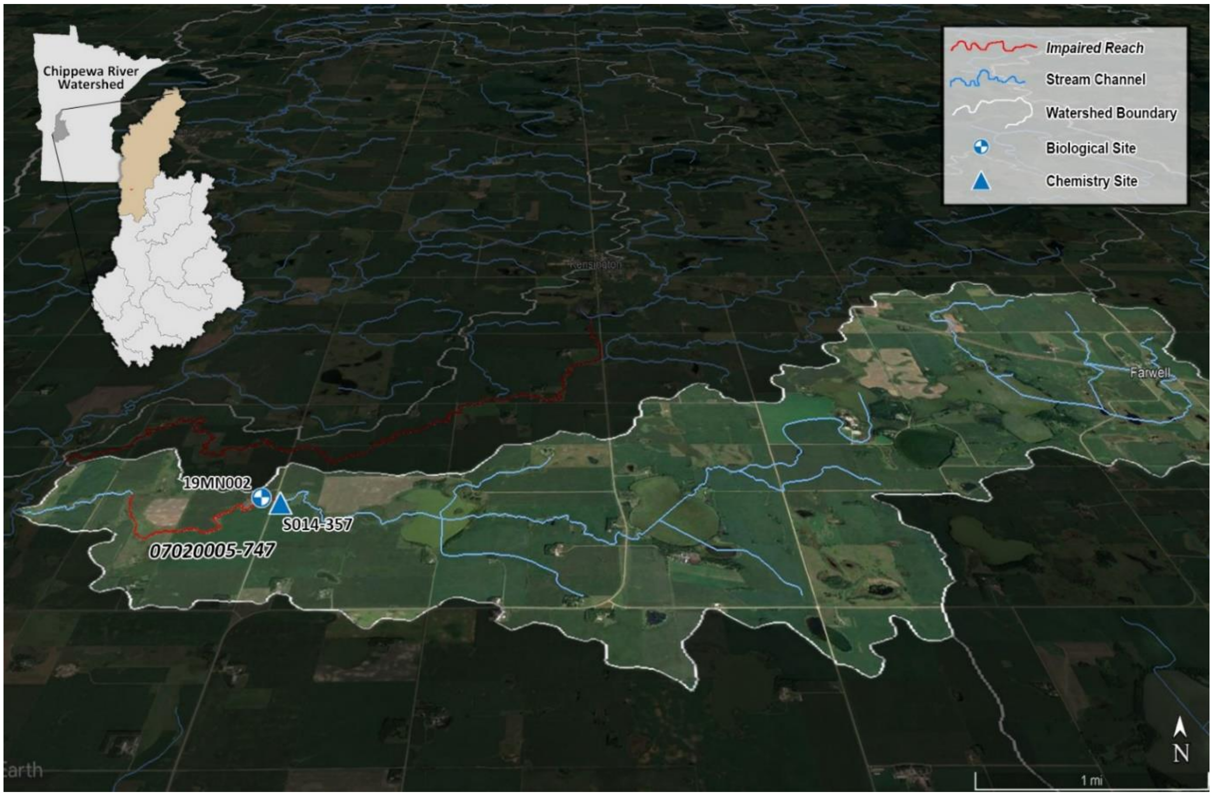
3.1.2.9 Reach Stressors

Table 43. Summary of stressors for stream reach.

07020005-543	**Hydrologic Alteration**	**Connectivity**	**Habitat**	**Dissolved Oxygen**	**Eutrophication**	**Suspended Solids**	**Nitrate**
✓ = Stressor O = Inconclusive	✓	O	✓	O	O	✓	O

3.1.3 07020005-747 Unnamed creek

Figure 10. Satellite image of reach 07020005-747 and its watershed.



3.1.3.1 Biological Community

Bio site 19MN009 was sampled for both fish and inverts in 2019. The FIBI score of 31.4, just below the Fish Class 3 southern headwater modified use threshold of 33 (Table 44). Fathead minnows, central mudminnows, and brook stickleback dominated the fish community as well as other tolerant taxa.

The invertebrate community was also sampled in 2019 and scored a 25.7, actually above the Invert Class 7 modified use threshold of 22 but within the confidence interval (Table 45). The site was dominated by the amphipod *Hyalella* and the black fly *Simulium*. There were decent numbers of two caddisfly taxa, *Cheumatopsyche* and Hydropsychidae, which is likely why the IBI score was above the threshold though there were only 16 total taxa caught, which is far below the class average.

Biological Metric Data

Table 44. Fish IBI score and threshold for stream reach.

07020005-747 **Fish Class 3** **Modified Use**	Fish IBI Score	Class Threshold Score
19MN002 8/07/2019	31.4	33

Table 45. Invert IBI score and threshold for stream reach.

07020006-521 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
19MN002 8/06/2019	25.7	22

3.1.3.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 46. Hydrologic alteration related fish metrics for stream reach.

07020005-747 **Fish Class 3** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
19MN002 8/07/2019	66.2	71.7
Statewide average for channelized Class 3 southern headwater bio sites	**56.3**	**24.0**
Expected response to **Hydrologic** stress	↑	↑

Table 47. Hydrologic alteration related invert metrics and tolerance values for stream reach.

07020005-747 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %	Percent Ditched Tolerant %	Percent Ditched Intolerant %	Low Depth Variability Tolerant %	Low Depth Variability Intolerant %	Low Flow Tolerant %	Low Flow Intolerant %
19MN002 8/6/2019	34.0	31.2	0.9	5.6	0.3	65.7	13.9	14.2	0.3
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**	↑	↓	↑	↓	↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓						

Hydrologic Alteration Summary

The hydrologic alteration related fish metrics were poor (Table 46). Generalized fish species are correlated with channelization and are adaptable to different habitats through generalized food preferences. Bio site 19MN002 had a generalist fish population of 66.2%. Nesting fish were even higher at 71.7%. Ninety-three percent of all the fish caught are considered either a tolerant or very tolerant taxa.

Hydrologic alteration related invert metrics were mixed (Table 47). Clinger percentage was above the class average as 53 *Simulium* and 43 Hydropsychidae caddisflies were caught, which are both considered clingers. The caddisflies are considered tolerant to low flows but are intolerant to low depth variability, indicating that variability of the stream flow could be affecting the biological community in this stream section. The percentage of invertebrates tolerant to ditching was low.

The biological metrics were mixed. Fish metrics were poor, however, the road crossing near the site is a fish barrier and may be contributing to those poor metrics. The reach itself and some of its tributaries has a mix of some altered and natural reaches. The invertebrate metrics were better and although the long-lived percentage was quite low, there is no indication that altered hydrology is the cause. Hydrologic alteration is inconclusive as a stressor at this time.

3.1.3.3 Connectivity

Connectivity Metric Data

Table 48. Connectivity related fish metrics for stream reach.

07020005-747 **Fish Class 3** **Modified Use**	Mature Age >3 %	Migrating Individual %
19MN002 8/07/2019	1.6	5.0
Statewide average for channelized Class 3 southern headwater bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Fish taxa whose females take greater than three years to mature were low as only yellow perch were caught (Table 48). Migrating taxa were well below the class average at only 5% due to 16 Iowa darters that were caught. The culvert just upstream of the bio site was observed to be a fish barrier at both high and low flows. Site visits in May and June (Figure 11) showed a school of bullheads concentrated near the mouth of the culvert. The velocity of the water flowing through the culvert appeared to be too fast to allow the fish to swim upstream and the culvert itself is placed too high relative to the stream channel bottom. Site visits in July, after flows had gone down, still showed the bullhead school concentrated near the mouth. However, instead of high flows, it appeared that low flows and the improper elevation were preventing the fish from traveling upstream as they were observed stuck along the inside of the culvert (Figure 12). There is some aggradation upstream of the culvert and a scour hole and perched condition on the downstream end.

Figure 11. Photo of the downstream side of the culvert near bio site 19MN002 showing a school of bullheads swimming against the current. Left photo was taken on 5-27-22. Right photo was taken on 6-10-22.

Figure 12. Photo of the downstream side of the culvert near bio site 19MN002 showing a school of bullheads swimming in the pool and trying to swim up the side of the culvert (left). Closeup of bullheads within the culvert (right)Both photos were taken on 7-21-22.

Connectivity metrics were very poor and a fish barrier was observed just upstream of the bio site. Connectivity is a stressor to reach 07020005-747. It is recommended that a different size culvert be installed at the road crossing that was observed at the proper elevation. It is also recommended that other road crossings be inspected to ensure that fish can pass through and migrate along this stream.

3.1.3.4 Habitat

Habitat Metric and Tolerance Data

Table 49. Habitat related fish metrics for stream reach.

07020005-747 **Fish Class 3** **Modified Use**	Benthic Insectivore minus Tolerant %	Benthic Insectivore %	Darter Sculpin Sucker %	Dominant Two %	Lithophilic Spawner %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
19MN002 8/07/2019	5.0	5.0	5.0	72.4	0	0	0	93.5
Statewide average for channelized Class 3 southern headwater bio sites	**10.9**	**12.0**	**10.6**	**63.5**	**58.0**	**22.6**	**30.1**	**76.7**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 50. Habitat related fish tolerance values for stream reach.

07020005-747 **Fish Class 3** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %	Percent Embedded Tolerant %	Percent Embedded Sensitive %	Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
19MN002 8/7/2019	73	5	56.2	0	89.1	0
Statewide average for channelized Class 3 southern headwater bio sites						
Expected response to **Habitat** stress	↑	↓	↑	↓	↑	↓

Table 51. Habitat related invert metrics for stream reach.

07020005-747 **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
19MN002 8/6/2019	0	0.6	34.0	16.5	4.4	63.9
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 52. Habitat related invert tolerance values for stream reach.

07020005-747 **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
19MN002 8/6/2019	66.4	0		67.0	0		64.2	5.6
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 53. Habitat assessment scores for stream reach.

07020005-747	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
19MN002 8/06/2019	1	11	10.5	9	13	44.5
19MN002 8/07/2019	0	12	19	11	6	48
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The fish community in reach 07020005-747 scored below average in all eight habitat related fish metrics when compared to all other channelized Class 3 southern headwater bio (Table 49). There were 16 Iowa Darters present, which is a benthic insectivore. The two most dominant fish present, fathead minnows and the central mudminnow, comprised over 72% of the total fish caught. Both are tolerant to fine sediments and poor substrate. There were not lithophilic spawning or riffle dwelling fish caught. Tolerant fish made up over 93% of the total number caught. Habitat related fish tolerance metrics were also very poor as the percents of MSHA score, high embeddedness, and poor substrate tolerant fish caught were very high and almost no sensitive fish within those categories were caught (Table 50).

The habitat related invert metrics were mixed as half scored poorly (Table 51). Metrics that scored poorly were climber percentage, which was very low. EPT percentage was below the class average at 16.5%, though there were some in the sample. The most dominant invert caught, the amphipod *Hyalella*, is a sprawler, which contributed to the very high percentage of spawlers present. Metrics that scored well were burrowers, as there were none present. Clinger percentage was above the class average as the second through fourth most numerous inverts caught were all clingers. There were very few legless inverts caught. Habitat related invert tolerance metrics scored very poorly as all three tolerance metrics were above 60% tolerant individuals (Table 52).

The MSHA scores were on the low end of fair as neither was above 50 (Table 53). The riparian zone was the best score out of all the categories as it had moderate riparian width, heavy shade, and erosion was minimal. Several types and sizes of substrates, including cobble, gravel, and sand were observed at the bio sites during both site visits in 2019. There was also good cover observed at the site including undercut banks, and overhanging vegetation. The channel morphology score scored poorly as there was poor sinuosity, depth variability, and pool width. Evidence of dredging was also noted.

The bio metrics were mixed, though mostly poor as the fish metrics were very poor and invert metrics were mostly poor. Tolerance metrics were poor across the board. Almost all the fish caught were tolerant in some way to poor habitat and the invertebrate sample was dominated by one tolerant amphipod. Both MSHA scores were low. Habitat is a stressor in reach 07020005-747.

3.1.3.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 54. DO related fish metrics and tolerance values for stream reach.

07020005-747 **Fish Class 3** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
19MN002 8/07/2019	8	1.6	5	56.2	93.5	7.8		100	0
Statewide average for channelized Class 3 southern headwater bio sites	**10**	**14.4**	**1.7**	**10.6**	**76.7**	**8.2**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Table 55. DO related invert metrics and tolerance values for stream reach.

07020005-747 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
19MN002 8/06/2019	16.5	7.3	16	6.4		65.4	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 56. DO monitoring data for stream reach.

<table>
<tr><td rowspan="2">07020005-747
DO Data
5 mg/L target</td><td rowspan="2">Range of Data (mg/L)</td><td colspan="7">% of Monthly Samples < 5 mg/L
[# of Samples]</td><td rowspan="2">June - Aug
<5 mg/L %
[# of Samples]</td></tr>
<tr><td>April</td><td>May</td><td>June</td><td>July</td><td>August</td><td>Sept</td><td>Oct</td></tr>
<tr><td rowspan="3">S009-282
(2016-2017)</td><td rowspan="3">3.4 – 10.2</td><td>-</td><td>0
[1]</td><td>33.3
[3]</td><td>25
[4]</td><td>50
[8]</td><td>0
[2]</td><td>0
[2]</td><td rowspan="3">40
[10]</td></tr>
<tr><td colspan="7">Minimum Value</td></tr>
<tr><td>-</td><td>8.5</td><td>3.4</td><td>4.1</td><td>3.5</td><td>6.2</td><td>8.2</td></tr>
</table>

Dissolved Oxygen Summary

The DO fish metrics of bio site 19MN002 scored mostly poor in DO related fish metrics when compared to the average of all other modified Class 3 southern headwaters bio sites that meet the FIBI modified use threshold (Table 54). Overall taxa count and number of fish that take more than three years to mature were just below the class averages. The Iowa darters caught brought the percent of sensitive fish above the class average, though it was the only sensitive taxa caught. Serial spawners were well above the class average and tolerant individuals were over 93% of the total fish caught. The DO TIV score was below the class average and every fish caught is considered tolerant to low DO.

Invertebrate DO related metrics were mixed (Table 55). The DO tolerance index value and the HBI_MN scored well. EPT % scored below the class average, though not too far as there were some numbers of Hydropsychidae caddisflies and a few mayflies caught. Total taxa count was poor as only 16 different taxa were caught, with the top four most numerous making up the majority of those. The DO tolerance index value was just above the class average. However, the most numerous invert caught, *Hyallela*, is considered tolerant to low DO, which made the percentage of DO tolerant individuals quite high. There were no low DO intolerant invertebrates observed in the sample.

Several DO measurements taken during sampling were below the warmwater standard of 5 mg/L (Table 56). 40% of the samples taken from June through August were below 5 mg/L with a low of 3.4 mg/L.

Based on the mostly poor related fish and invertebrate biological metric scores, tolerance values, and the DO values below 5 mg/L, DO appears to be a stressor in this reach.

3.1.3.6 Eutrophication

Eutrophication Biological Metric Data

Table 57. Eutrophication related fish metrics and tolerance values for stream reach.

07020005-747 **Fish Class 3** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
19MN002 8/07/2009	8	5.0	61.8	0		93.5	0
Statewide average for channelized Class 3 southern headwater bio sites	**10**	**10.6**	**19.8**	**30.1**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Table 58. Eutrophication related invert metrics and tolerance values for stream reach.

07020005-747 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
19MN002 8/06/2009	62.0	6	16.5	0.3	16		65.7	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.6**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 59. Phosphorus monitoring data for stream reach.

07020005-747 P Sample Data 0.100 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-282 (2019-2022)	0.182 – 0.450	-	-	-	0.200 [2]	0.450 [1]	-	-	0.283 [3]
		Maximum Value							
		-	-	-	0.218	0.450	-	-	

Eutrophication Summary

Fish metrics and tolerance values at bio site 19MN002 all score very poorly (Table 57). Taxa count was just below the class average. Darter percentage, at 5%, was below the class average of 10.6%. The percentage of omnivorous fish very high and there were no lithophilic spawners caught. The percentage of fish tolerant to high phosphorus was very high at over 93% as 6 of the 8 fish taxa caught are considered tolerant.

Eutrophication related invertebrate metrics were also mostly poor (Table 58). Crustacean and Mollusca percentage was well above the class average as the most dominant invert, *Hyalella*, was 61% of the total number of inverts caught. There were also a couple of snails and crayfish caught as well. Collector-gatherer taxa count was low and below the class average. EPT percentage was below the class average as there were 45 Hydropsychidae caddisflies caught. Hydropsychidae are usually considered a generally tolerant caddisfly. The percentage of inverts tolerant to high phosphorus was high and there were no inverts caught that are intolerant to high phosphorus, indicating that high levels of phosphorus is affecting the biological community in this reach. Out of the metrics that scored well, only one scraper, a snail, was caught.

Eleven samples were collected and analyzed for phosphorus from 2017 through 2020. The summer average was 0.283 mg/L, well over the eutrophication standard of 0.100 mg/L (Table 59).

The fish and invert biological communities are showing the effects of the elevated phosphorus, and the limited phosphorus sampling showed elevated concentrations of phosphorus. There are two highly eutrophic shallow lakes upstream of the bio site, including Lake Wicklund, which is impaired by nutrients, that are likely contributing to eutrophic conditions within the stream channel. The preponderance of evidence suggests that eutrophication is a stressor in this reach.

3.1.3.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 60. TSS related fish metrics and tolerance values for stream reach.

07020005-747 **Fish Class 3** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
19MN002 8/07/2009	0	0	0	4.7	6.5	0	0	19.7		3.1	0
Statewide average for channelized Class 3 southern headwater bio sites	**31.4**	**1.0**	**10.8**	**4.9**	**12.4**	**22.6**	**30.1**	**15.5**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 61. TSS related invert metrics and tolerance values for stream reach.

07020005-747 **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
19MN002 8/06/2009	31.2	0	63.9	15.3		15.1	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Monitoring Data

Table 62. TSS monitoring data for stream reach.

07020005-747 TSS Sample Data	Range of Data (mg/L)	% of Monthly Samples > 30 mg/L [# of Samples]							% of Total Samples > 30 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-282 (2019)	110 - 110	-	-	-	-	100 [2]	-	-	100 [2]

Table 63. Transparency monitoring data for stream reach.

07020005-747 Secchi Tube Data 25 cm target	Range of Data (mg/L)	% of Monthly Samples < 25 cm [# of Samples]							% of Total Samples < 25 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-282 (2016-2022)	8 – 32	-	0 [1]	25 [4]	100 [4]	80 [5]	100 [2]	100 [2]	70.5 [18]

Suspended Solids Summary

The fish community at bio site 19MN002 scored below average in all seven TSS related fish rigor metrics when compared to the average of other Class 3 southern headwater bio sites (Table 60). There were no benthic feeders, Centrachids, herbivores, or riffle dwelling fish present. Two long-lived taxa, the common carp and yellow perch, were present though there were only 10 and 5 individuals caught respectively. Nontolerant Perciformes were present though below the class average as only 16 Iowa darters and the 5 yellow perch were present. TSS tolerant fish percentage was rather low as only the common carp is considered tolerant to TSS.

TSS related invertebrate metrics were mostly poor (Table 61). There were no Plecoptera or invertebrates caught and the sprawler *Hyalella* dominated the invert community. The percent of TSS tolerant individuals caught was 15% compared to zero TSS intolerant. The two metrics that scored well were collector - filterers and the TSS TIV score. There were a fair population of collector – filterers due to the numbers of the black fly *Simulium* and Hydropsychidae caddisflies. The TSS Tolerance Index Value was also just below the class average.

Two samples were collected and analyzed for TSS in August of 2019. Both were well above the central standard of 30 mg/L (Table 62). There were 18 transparency readings done from 2016 to 2022 using a Secchi tube (Table 63). Over 70% of the total measurements were above 25 cm. Water was observed to be colored green on multiple site visits and exceedances of both TSS and S-Tube were measured later in the season, which may indicate that the TSS in the water may be organic in nature, rather than sediment.

Due to the mostly poor biological metrics as well as the TSS and transparency data, TSS appears to be a stressor to the biological community in reach 07020005-747, though evidence shows it is likely related to eutrophication and organics rather than sediment.

3.1.3.8 Nitrates

Nitrate Biological Metric Data

Table 64. Nitrate related invert metrics for stream reach.

07020005-747 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
19MN002 8/06/2009	12.5	2.6		15.1	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 65. Nitrate monitoring data for stream reach.

07020005-747 Nitrate/Nitrite Sample Data 8 mg/L Target	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S009-387 (2019-2022)	0.05 – 1.0 [7]	-	0.6 [1]	0.5 [1]	0.75 [4]	0.05 [1]	-	-
		Highest Value						
		-	0.6	0.5	1.0	0.05	-	-

Summary

The macroinvertebrate assemblage at site 19MN002 scored was mixed (Table 64). The biological bio site showed a fair amount of Trichoptera taxa, and the number of Trichoptera individuals was well above the class average of two. The nitrogen TIV score was below the class average. However, the amount of nitrate tolerant invertebrates was relatively high at 15.1% compared to the fact that no inverts caught are considered intolerant to nitrate.

Seven samples were collected or measured within reach 07020005-747 and analyzed for nitrate/nitrite (Table 65). All the values were very low, well below the proposed nitrate criteria for protection of aquatic life of 8 mg/L. Due to the mixed biological response and relatively low percentage of nitrate tolerant and low nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-747.

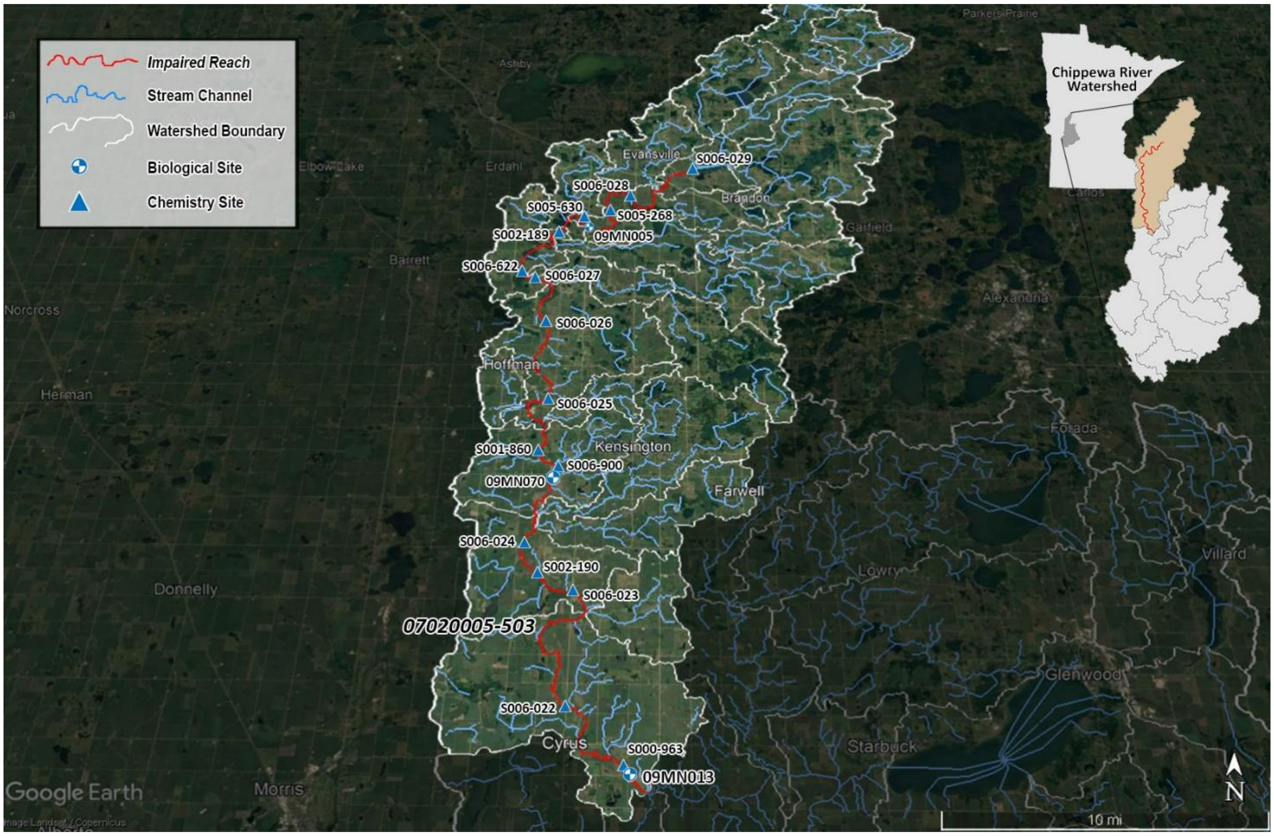
3.1.3.9 Reach Stressors

Table 66. Summary of stressors for stream reach.

07020005-747	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	O	✓	✓	✓	✓	✓	O

3.1.4 07020005-503 Chippewa River

Figure 13. Satellite image of reach 07020005-503 and its watershed.



3.1.4.1 Biological Community

Reach 07020005-503 is a 70.88-mile-long reach that flows from the upper headwaters area down to the confluence with the Little Chippewa River. It flows through two ecoregions, the North Central Hardwood Forests and Northern Glaciated Plains. It has three biological monitoring sites throughout the reach, one in the upper, middle, and lower sections and is impaired for both fish and macroinvertebrates. 09MN005 is the furthest upstream and was only sampled for invertebrates in 2021. The other two bio sites, 09MN070 and 09MN013, were sampled for both fish and inverts in 2019 and 2020.

Both bio sites that were sampled for fish, 09MN070 and 09MN013, are classified as a Fish Class 1 Southern River bio site. 09MN070 is located roughly in the middle of the reach. The site was dominated by fathead minnows and the score of 28.6 was below the Class 1 threshold and lower confidence interval. The bio condition gradient scores indicate a degraded community with sensitive taxa markedly diminished. Bio site 09MN013 scored a 30.7 and was also dominated by fathead minnows, though less so than at site 09MN070 (Table 67).

All three bio stations within the reach are classified as Invert Class 5 southern stream rock riffle stations. 09MN005 scored a 28.2 and was dominated by the midge *Polypedilum*. Bio site 09MN070 scored 31.5 and was also dominated by the midge *Polypedilum* as well as the black fly *Simulium*. Site 09MN013 was better and scored just above the class average with a score of 38.3. The three most numerous inverts caught at this site were the two mayflies *Maccaffertium*, *Fallceon*, and the caddisfly Hydropsyche. All three stations scored poorly for stonefly taxa richness and predator taxa richness in the Southern Streams Riffle-Run Invert IBI (Table 68).

Biological Metric Data

Table 67. Fish IBI score and threshold for stream reach.

07020005-503 **Fish Class 1** **General Use**	Fish IBI Score	Class Threshold Score
09MN070 6/14/2021	28.6	49
09MN013 6/15/2021	30.7	

Table 68. Invert IBI score and threshold for stream reach.

07020005-503 **Invert Class 5** **General Use**	Invert IBI Score	Class Threshold Score
09MN005 8/06/2019	28.2	37
09MN070 8/06/2019	31.5	
09MN013 8/05/2020	38.3	

3.1.4.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

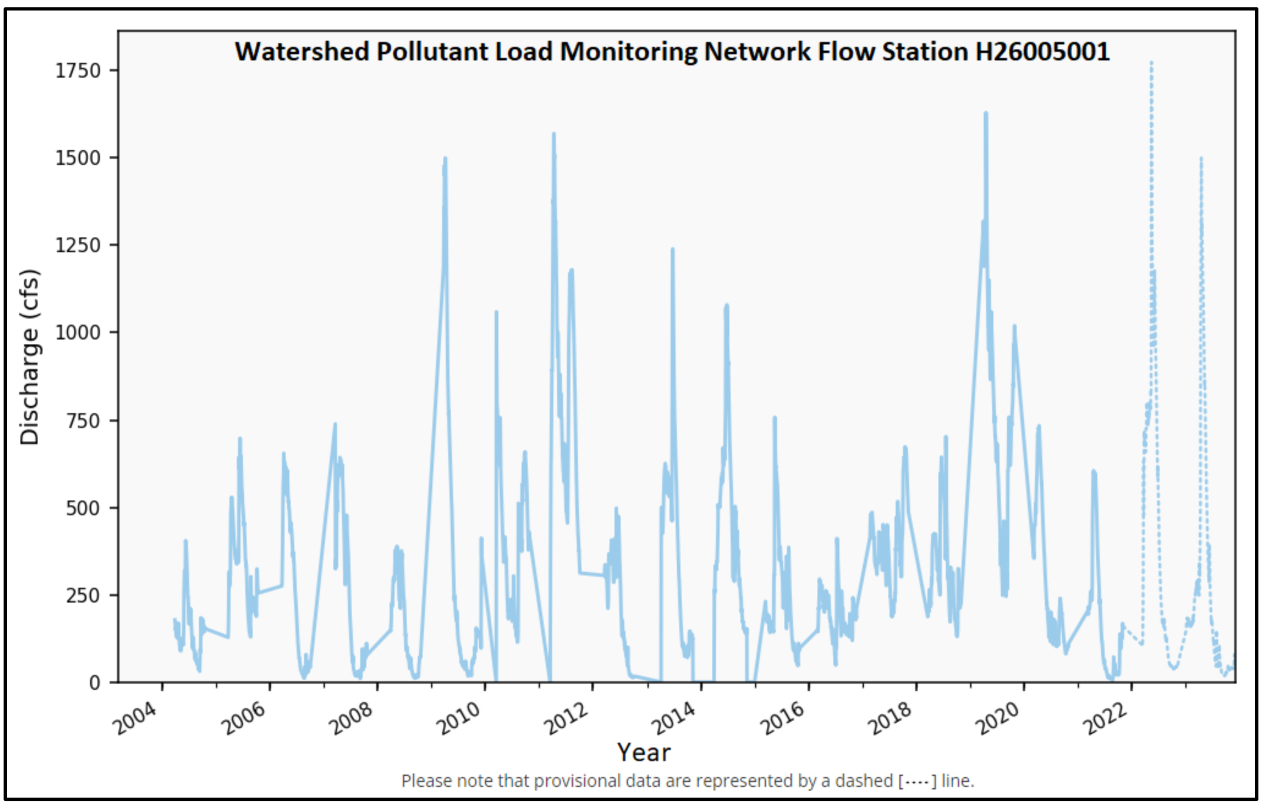
Table 69. Hydrologic alteration related fish metrics for stream reach.

07020005-503 **Fish Class 1** **General Use**	General %	Nesting Non Lithophilic Spawner %
09MN070 6/14/2021	66.5	70.8
09MN013 6/15/2021	48.5	33.2
Statewide average for natural Class 1 southern stream bio sites	**20.7**	**16.0**
Expected response to **Hydrologic** stress	↑	↑

Table 70. Hydrologic alteration related invert metrics and tolerance values for stream reach.

07020005-503 **Invert Class 5** **General Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth variability Tolerant %	Low Depth variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
09MN005 8/06/2019	84.2	74.7	1.9		0.3	3.2		0.6	46.5		45.3	0.3
09MN070 8/06/2019	44.5	41.1	3.5		15.3	8.1		11.2	36.1		34.9	0
09MN013 8/05/2020	52.7	27.0	7.4		14.6	16.5		13.4	42.1		73.5	0.3
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**49.5**	**26.9**	**9.0**									
Expected response to **Hydrologic** stress	↓	↓	↓		↑	↓						

Figure 14. Discharge at WPLMN station H26005001 located just downstream of reach 07020005-503.



Hydrologic Alteration Summary

The hydrologic alteration related fish metrics were poor (Table 69). Site 09MN070 scored worse than site 09MN013. Bio sites 09MN070 and 09MN013 had generalist fish populations of 66.5% and 48.5% respectively. Generalized fish species are correlated with channelization and are adaptable to different habitats through generalized food preferences. Nesting fish were also well above the class average at both sites.

Hydrologic alteration related invert metrics were mixed (Table 70). The percentage of clingers and collector-filterers were decent at all three sites, though they were just below the class average at 09MN070. At the two upper bios sites clingers were high partly due to the high numbers of the black fly *Simulium*, though there were decent numbers the caddisflies *Ceratopsyche* and *Cheumatopsyche* at upper bio site 09MN005 and the caddisfly *Potamyia* at the middle bio site 09MN070. The caddisfly Hydropsyche was present in large numbers at lower bio site 09MN013, indicating that the natural channel geomorphology is sufficient to support these altered hydrology intolerant caddisflies. The percent of inverts that are considered tolerant vs intolerant to ditching was good, especially at the furthest downstream bio site. Bio site 09MN070 did have some inverts tolerant and intolerant to ditching, though the percentage of those tolerant to intolerant was less than 10%. Low flow tolerant invertebrates were very high at all three bio sites and those intolerant were less than a percent at two of the sites.

Hydrologic alteration related fish metrics were poor. Several sections of the reach itself have been ditched or altered in some way. The invert metrics scored mostly well, though long-lived and low flow tolerant metrics were poor. The majority of the direct tributaries to this reach have also been altered in some way, often by straightening and ditching the stream channel with the intention of moving water through the channel more quickly. A flow station located just downstream of the reach show that the flow in the upper Chippewa have reached near zero cfs five out of the last 10 years (Figure 14). It appears that hydrologic alteration is a stressor to the biological community, particularly fish, though the invert tolerance values indicate that low flows may be affecting that biological community as well.

3.1.4.3 Connectivity

Connectivity Metric Data

Table 71. Connectivity related fish metrics for stream reach.

07020005-503 **Fish Class 1** **General Use**	Mature Age >3 %	Migrating Individual %
09MN070 6/14/2021	11.8	13.0
09MN013 6/15/2021	18.8	16.8
Statewide average for natural Class 1 southern river bio sites	**40.4**	**23.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Metrics for fish whose females take greater than three years to mature were low at both bio sites (Table 71). Migrating fish were present, including 13 blackside darters, 12 white suckers, and 7 slenderhead darters, though the percentage was below the class average for southern rivers.

Due to the presence of late-maturing and migratory species as well as the lack of any fish barrier that was observed, connectivity is inconclusive at this time.

3.1.4.4 Habitat

Habitat Metric Data

Table 72. Habitat related fish metrics for stream reach.

07020005-503 **Fish Class 1** **General Use**	Benthic Insectivore minus Tolerant %	Benthic Insectivore %	Darter Sculpin Sucker %	Dominant Two %	Lithophilic Spawner %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN070 6/14/2021	14.9	14.9	14.6	70.8	14.0	9.0	14.0	68.0
09MN013 6/15/2021	12.9	12.9	10.9	44.6	40.1	23.8	24.8	49.5
Statewide average for natural Class 1 southern river bio sites	**20.6**	**20.9**	**18.5**	**48.6**	**29.2**	**13.9**	**25.0**	**22.1**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 73. Habitat related fish tolerance values for stream reach.

07020005-503 **Fish Class 1** **General Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN070 6/14/2021	66.2	2.2		77.6	2.8		62.4	2.5
09MN013 6/15/2021	45.6	11.4		61.9	3.5		43.6	5.5
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

Table 74. Habitat related invert metrics for stream reach.

07020005-503 **Invert Class 5** **General Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN005 8/06/2019	0.3	13.3	84.2	47.8	16.1	1.9
09MN070 8/06/2019	2.2	31.0	44.5	36.1	40.1	10.3
09MN013 8/05/2020	3.2	13.5	52.7	68.2	18.3	7.4
Statewide average for natural Class 5 bio sites	**7.5**	**14.7**	**49.5**	**43.9**	**36.0**	**16.8**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 75. Habitat related tolerance invert metrics for stream reach.

07020005-503 **Invert Class 5** **General Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN005 8/06/2019	2.2	25.3		1.9	25.3		0.6	29.1
09MN070 6/14/2021	13.1	8.4		11.8	8.4		11.2	13.4
09MN013 6/15/2021	25.9	4.5		5.1	4.5		2.9	12.8
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 76. Habitat assessment scores for stream reach.

07020005-503	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN005 8/06/2019	0	9	18.3	13	28	68.3
09MN070 8/06/2019	1	8	16.3	6	17	48.3
09MN070 6/14/2021	0	5	22	7	20	54
09MN013 8/05/2020	2.5	9.5	16.4	8	24	60.4
09MN013 6/15/2021	0	9	25.2	14	29	77.2
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

Habitat related fish metrics scored mostly poor (Table 72). Fish habitat related metrics and tolerance values are a bit better at the downstream site 09MN013 compared to the middle bio site 09MN070. Invert metrics and tolerance values at the far upstream site 09MN005 were mostly good, were worse at the middle site 09MN070, and were mostly good again at the downstream site 09MN013.

09MN005

Only inverts were sampled at this site (Table 74). The metrics scored mostly well as burrowers and legless inverts were low. Clingers and EPT inverts were well above the class average, and sprawlers were very low at only 1.9%. Tolerance values were also very good as there were good numbers of the caddisfly *Ceratopsyche morosa*, which was the second most numerous invert present (Table 75). *Ceratopsyche* is considered intolerant or very intolerant to several habitat related metrics, as indicated by its tolerance values.

Site 09MN013 had the highest MSHA habitat assessment score in the reach (Table 76). The riparian zone scored well as here was adequate riparian width and little bank erosion. There were several types of substrate present, including boulders, cobble, gravel, and sand. This is a natural section of the reach and it has very good geomorphological features. There was excellent sinuosity, depth variability, pool width, and channel development.

09MN070

There were some benthic insectivores, darters, and suckers present, though the percentages were below the class averages (Table 72). The two most dominant fish present at site 09MN070 comprised more than 70% of the total population, indicating a lack of diversity. Lithophilic and simple lithophilic fish were present, though were well below the class average. Riffle dwelling fish were very low as only 12 white suckers, 7 slenderhead darters, and 1 stonecat were caught. 68% of the total number of fish present at bio site 09MN070 are considered tolerant or very tolerant, including the most numerous fish present, the fathead minnow, which is considered tolerant to several habitat tolerance values, which all scored poorly (Table 73). Overall, the metrics and tolerance values at site 09MN070 were poor.

Invert metrics were mixed as three out of the six invert metrics scored poorly (Table 74). Both burrowers and legless were low and there was a decent percentage of climbers present. There were some clingers present, with the percentage being just below the class average. The percent of EPT inverts present was also below the class average by about seven percentage points. Sprawlers were also below the class average. The tolerance values at site 09MN070, while not terrible, were worse than the other two bio sites in the reach (Table 75). While there were habitat intolerant inverts present, there were also tolerant percentages that exceeded 10% of the total population.

The MSHA habitat assessments conducted at site 09MN070 were the two lowest scores in the reach (Table 76). The 2019 assessment scored poorly in its substrate score as there were some embedded sediments and siltation present. Bio site 09MN070 is located on a short, ditched section of the reach and as such, geomorphology also scored low as there was only moderate depth variability, sinuosity, and pool width.

09MN013

Habitat related fish metrics at site 09MN013 were mixed (Table 72). The three metrics that scored well were the dominant two, lithophilic spawning, and riffle dwelling fish percentages. Benthic insectivores, darters, and simple lithophilic spawners were present, though below their class averages. Habitat tolerance values were mostly poor as fathead minnows and spotfin shiners were the two most numerous fish caught, both of which are considered tolerant to several habitat related tolerance values (Table 73). There were some hornyhead chubs and slenderhead darters present, which helped the MSHA score sensitive percentage.

The habitat related invert metrics scored mostly well (Table 74). Burrowers, legless, and sprawlers all scored below the class average. Clingers and EPT scored well as four out of the top five invert taxa caught were either mayflies or caddisflies. Climbers were just below the class average at 13.5%.

The MSHA scores were moderate, the riparian zone had good shade and riparian width, though bank erosion was an issue. Several types and sizes of substrates, including cobble, gravel, and sand were observed at the bio sites during both site visits in 2017. There was also good cover observed at the site, including deep pools, undercut banks, logs and woody debris, and boulders. The channel morphology score was good as depth variability, sinuosity, channel stability and channel development scored well. Invert tolerance values were mixed as the percentage of low MSHA score tolerant inverts was high at 25.9% with only 4.5% considered intolerant. Both the percent of tolerant inverts to embeddedness and low substrate scored well.

The bio metrics were mixed as the fish metrics were mostly poor; however, invert metrics scored mostly well, with the middle bio site 09MN070 scoring worse than the other two sites. The furthest upstream and furthest downstream sites are both in a natural section of the river, while site 09MN070 lies within a straightened and ditched section of reach 07020005-503. Habitat appears to be a stressor to the biological community in the reach. The prevalence of lithophilic spawners, riffle dwelling fish, prevalence of climbers, high percentage of legless inverts at 09MN070, and the low numbers of sprawlers all corroborate substrate not limiting the biology throughout the entire reach. The relatively good substrate scores and the several types and sizes of substrate found as well as the low embeddedness of coarse sediment throughout the reach indicate that the habitat stress is likely coming from the lack of geomorphology within straightened and ditched sections of the reach, especially at bio site 07MN070.

3.1.4.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 77. DO related fish metrics and tolerance values for stream reach.

07020005-503 **Fish Class 1** **General Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN070 6/14/2021	18	11.8	3.7	73.6	68.0	6.7		63.0	0
09MN013 6/15/2021	20	18.8	13.4	62.4	49.5	7.0		44.1	0
Statewide average for natural Class 1 southern river bio sites	**22.4**	**40.4**	**13.5**	**35.6**	**22.1**	**7.6**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Table 78. DO related invert metrics and tolerance values for stream reach.

07020005-503 **Invert Class 5** **General Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN005 8/06/2019	47.8	7.0	20	7.8		0.6	27.9
09MN070 8/06/2019	36.1	7.7	35	7.2		10.6	14.6
09MN013 6/15/2021	68.2	7.7	35	7.3		2.2	22.0
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**43.9**	**7.0**	**41.9**	**7.1**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 79. DO monitoring data for upper stream reach near bio site 09MN005.

07020005-503 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-189 **S005-630** **S006-026** **S006-027** **S006-028** **S006-029** **S006-622** **S006-623** (2009-2019)	2.1 – 13.8	0 [2]	0 [12]	1.8 [55]	4.5 [66]	4.7 [64]	0 [23]	0 [11]	3 [233]
		Minimum Value							
		11.0	7.6	4.2	4.0	2.1	6.3	8.4	

Table 80. DO monitoring data for middle stream reach near bio site 09MN070.

07020005-503 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S001-860 **S002-190** **S006-023** **S006-025** **S006-900** (2009-2021)	0.8 – 14.3	0 [11]	11.8 [17]	8.2 [49]	9.6 [52]	16.3 [49]	0 [20]	0 [6]	11.8 [204]
		Minimum Value							
		9.1	3.8	3.5	1.3	0.8	5.9	9.6	

Table 81. DO monitoring data for lower stream reach near bio site 09MN013.

07020005-503 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S000-963 **S000-964** **S000-979** **S006-022** (2009-2021)	1.1 – 11.3	-	0 [7]	18.8 [32]	13.8 [29]	5.9 [34]	0 [12]	0 [3]	10.3 [117]
		Minimum Value							
		-	5.5	3.2	3.8	1.1	5.5	9.2	

Dissolved Oxygen Summary

09MN005

DO related invert metrics at site 09MN005 scored mostly well. The percentage of EPT inverts was well above the class average as 8 out of the top 13 most numerous inverts present are either mayflies or caddisflies, including the caddisfly *Ceratopsyche*, which is considered very intolerant to low DO. The HBI_MN score was at the class average and taxa count was below the class average. The DO TIV score was above the class average and the percentage of low DO tolerant to intolerant inverts present was very good, with only 0.6% of the total number of inverts caught considered tolerant to low DO and 27.9% considered intolerant to low DO.

DO chemistry data near bio site 09MN005 was good. Only 3% of the total number of measurements taken were below 5mg/L and no one month had a percent exceedance above 5%.

09MN070

DO related fish metrics were poor (Table 77). Taxa count was below the class average. Late maturing fish are well below the class average as only 13 channel catfish, 12 white suckers, and 9 shorthead redhorse were caught. Sensitive fish were very low. Serial spawners were very high as the two most numerous fish taxa present, fathead minnows and spotfin shiners, are both considered serial spawners. Tolerant fish were also very high at 68% and the DO tolerant percentage was 63%.

The invert community at site 09MN070 looked a lot different than upstream at site 09MN005 (Table 78). This site was dominated by the midge *Polypedilum* as well as the black fly *Simulium*. It had far less EPT and had a higher HBI_MN score. Taxa count was higher, however, most of the inverts present were neither tolerant nor intolerant to low DO and the percent of low DO tolerant inverts present was higher at 10.6%, with a low DO intolerant percentage of 14.6%.

DO chemistry data near bio site 09MN070 was poor, with May, June, July, and August all having percent exceedances above 5% of measurements below 5mg/L. A low of 0.8% was measured in August. Overall, the 11.8% exceedance of all samples below 5 mg/L was the worst in the reach.

09MN013

Habitat related fish metrics at this bio site were also poor, though all the metrics scored better than at the previous site (Table 77). Fathead minnows were the most dominant fish at this site as well, though it was less dominant than at bio site 09MN070, which led to 44.1% of the total number of fish caught considered tolerant to low DO.

DO related invert metrics were similar to the other sites within the reach, especially the furthest upstream site 09MN005. EPT was very high here at 68.2% of the total number of inverts caught as 11 out of the top 16 most numerous inverts present are either mayflies or caddisflies, including the most numerous invert present, the mayfly *Maccaffertium*, which is considered intolerant to low DO. Only 2.2% of the total number of inverts caught are considered tolerant to low DO with 22% considered intolerant.

DO chemistry data near bio site 09MN013 was poor, with June, July, and August all having percent exceedances above 5% of measurements below 5mg/L. This section of the reach had some of the highest monthly percent exceedances, with June and July having exceedances of 18.8% and 13.7%. The percent exceedance for all samples was at 10.3%.

Overall, reach 07020005-503 is a relatively long reach that varies considerably through its 70-mile-long length. Splitting up the reach into three sections, an upper, middle, and lower section, which corresponds to the three bio sites, 09MN005, 09MN070, and 09MN013 respectively. The upper section of the reach, near bio site 09MN005, had the best-looking biological metrics and chemistry data with low exceedance percentages. DO does not appear to be stressing the upper section of the reach. Moving downstream, the biological metrics and chemistry data looked worse, especially in the middle section near bio site 09MN070. There were some very low DO values measured in both the middle and lower section of the reach. Due to the poor biological metrics and chemistry data in the middle and lower sections of the reach, DO appears to be a stressor to the biological community in reach 07020005-503.

3.1.4.6 Eutrophication

Eutrophication Biological Metric Data

Table 82. Eutrophication related fish metrics and tolerance values for stream reach.

07020005-503 **Fish Class 1** **General Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophillic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN070 6/14/2021	18	11.8	65.8	14.0		78.6	0
09MN013 6/15/2021	20	4.0	40.1	24.8		61.8	0
Statewide average for natural Class 1 southern river bio sites	**22.4**	**4.4**	**15.5**	**25.0**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Table 83. Eutrophication related invert metrics and tolerance values for stream reach.

07020005-503 **Invert Class 5** **General Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN005 8/06/2019	0.9	6	47.8	3.5	20		3.2	2.5
09MN070 8/06/2019	7.2	13	36.1	3.1	31		23.4	0.6
09MN013 8/06/2019	1.3	11	68.2	22.8	35		20.8	0.6
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**9.3**	**15.0**	**43.9**	**15.8**	**41.9**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 84. Phosphorus monitoring data for upper stream reach near bio site 09MN005.

07020005-503 P Sample Data 0.100 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-630 **S006-622** **S006-623** (2009-2011)	0.054 – 0.232	-	0.194 [2]	0.085 [6]	0.131 [1]	0.106 [3]	0.086 [2]	-	0.118 [8]
		Maximum Value							
		-	0.196	0.114	0.131	0.113	0.086	-	

Table 85. Phosphorus monitoring data for middle stream reach near bio site 09MN070.

07020005-503 P Sample Data 0.100 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-190 **S006-900** (2009-2021)	0.017 – 0.479	0.136 [16]	0.137 [17]	0.193 [17]	0.361 [14]	0.226 [11]	0.158 [12]	0.106 [2]	0.208 [42]
		Maximum Value							
		0.342	0.214	0.321	0.396	0.295	0.257	0.117	

Table 86. Phosphorus monitoring data for lower stream reach near bio site 09MN013.

07020005-503 P Sample Data 0.100 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S000-963 (2009-2020)	0.015 – 0.332	-	0.124 [4]	0.314 [8]	0.249 [6]	0.213 [7]	0.151 [6]	-	0.234 [21]
		Maximum Value							
		-	0.330	0.314	0.332	0.288	0.220	-	

Eutrophication Summary

09MN005

Eutrophication related invert metrics and tolerance values in the upper reach near bio site 09MN005 were mostly good (Table 82). Crustaceans and mollusks were very low and EPT invertebrates were above the class average as four out of the top six inverts caught were either a caddisfly or a mayfly. Scrapers were low as only a few riffle beetles and the mayfly *Heptagenia* were present. Overall taxa count was low, though there were good numbers of the two caddisflies *Ceratopsyche* and *Cheumatopsyche*. Phosphorus intolerant invert numbers were low, though so were phosphorus tolerant inverts.

Phosphorus monitoring in the upper section of the reach was poor as monthly averages, as well as the summer average, were above the standard of 0.1 mg/L. Compared to the rest of the reach, this section had lower phosphorus concentration averages.

09MN070

Eutrophication related fish metrics were mostly poor at this bio site (Table 82). Taxa count was just below the class average and there were very few sensitive fish caught. Omnivores were very high here and simple lithophilic spawning fish were low as only 12 white suckers, 9 shorthead redhorse, and 2 carmine shiners were present. Darter percentage was higher than the class average as the third and fourth most numerous fish taxa present were johnny and blackside darters. The top two fish present, the fathead minnow and spotfin shiner are both tolerant to phosphorus, resulting in 78.6% of the total number of fish caught being tolerant to phosphorus with no phosphorus sensitive fish present.

Eutrophication related invert metrics were mixed (Table 83). Crustaceans and mollusks were low, as 22 *Hyalella* amphipods were present. Scrapers were low as only 10 *Stenelmis* beetles were caught. Taxa count was lower than the class average. The percentage of phosphorus tolerant inverts was high at 23.4% with hardly any phosphorus intolerant inverts present.

Phosphorus chemistry data was very poor in the middle section of the reach (Table 85). Every monthly average was above the class average with some very high averages and concentrations.

09MN013

Eutrophication related fish metrics were poor (Table 82). Taxa count and darter percentages were just below their class averages. Omnivores were well above the class average as fathead minnows were the most numerous fish caught. Simple lithophilic spawners scored just below the class average at 24.8%. Phosphorus tolerant fish made up 61.8% of all the fish caught. The top two fish present, the fathead minnow and spotfin shiner are both tolerant to phosphorus, resulting in 61.8% of the total number of fish caught being tolerant to phosphorus with no phosphorus sensitive fish present.

Eutrophication related invert metrics were mostly poor (Table 83). Crustacean and mollusk percentage and EPT percentage all scored well. Collector-gatherer taxa were low, though there were several mayfly collector-gatherers present, *Labiobaetis dardanus*, *Tricorythodes*, *Labiobaetis propinquus*, and *Baetis intercalaris*. There were some collector-gatherer mayflies present, such as 13 *Baetis*, 5 *Ancentrella*, and 2 *Tricorythodes*. Scrapers were high as the most numerous invert present, the mayfly *Maccaffertium*, is considered one. Total taxa count at this site wasn't too low at 35, though still below the class average. Phosphorus tolerant inverts made up 20.8% of the total number of inverts caught with very few phosphorus intolerant inverts present.

Phosphorus sampling in this section of the reach was poor. Concentration values were very high throughout the year and averages were well above the standard of 0.100 mg/L.

Overall, the biological metrics throughout the reach are showing a community that is showing eutrophication stress and phosphorus sampling was very poor, especially in the middle to lower section of the reach. Eutrophication is a stressor in those sections of the reach.

3.1.4.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 87. TSS related fish metrics and tolerance values for stream reach.

07020005-503 **Fish Class 1** **General Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN070 6/14/2021	12.4	0.6	0	8.4	12.7	9.0	14.0	24.6		17.4	0
09MN013 6/15/2021	14.4	0.5	0	16.3	6.0	23.8	24.8	25.6		33.2	0
Statewide average for natural Class 1 southern river bio sites	**21.4**	**4.1**	**1.0**	**43.6**	**18.0**	**13.9**	**22.2**	**33.9**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 88. TSS related invert metrics and tolerance values for stream reach.

07020005-503 **Invert Class 5** **General Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN005 8/06/2019	74.7	0	1.9	15.9		36.1	2.5
09MN070 8/06/2019	41.1	0	10.3	20.2		55.5	0.3
09MN013 8/05/2020	27.0	0	7.7	21.5		64.5	0.6
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**26.9**	**0.5**	**16.8**	**15.9**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

TSS Monitoring Data

Table 89. Total TSS monitoring data for upper stream reach near bio site 09MN005.

07020005-503 TSS Sample Data	Range of Data (mg/L)	% of Monthly Samples > 30 mg/L [# of Samples]							% of Total Samples > 30 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-630 (2009)	11 – 51	-	0 [2]	25 [4]	0 [1]	0 [3]	0 [2]	-	8.3 [12]

Table 90. Transparency monitoring data for upper stream reach near bio site 09MN005.

07020005-747 Secchi Tube Data	Range of Data (mg/L)	% of Monthly Samples < 25 cm [# of Samples]							% of Total Samples < 25 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-189 **S005-268** **S006-026** **S006-027** **S006-028** **S006-029** **S006-622** (2009-2021)	7 – 100+	9.8 [41]	9.5 [63]	10.7 [112]	21.8 [124]	25.8 [124]	11.4 [79]	13.8 [22]	16.4 [567]

Table 91. TSS monitoring data for middle stream reach near bio site 09MN070.

07020005-503 TSS Sample Data	Range of Data (mg/L)	% of Monthly Samples > 30 mg/L [# of Samples]							% of Total Samples > 30 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-190 **S006-900** (2009-2020)	2 - 148	33.3 [15]	60 [15]	81.3 [16]	85.7 [14]	54.5 [11]	33.3 [12]	0 [2]	55.0 [91]

Table 92. Transparency monitoring data for middle stream reach near bio site 09MN070.

07020005-747 Secchi Tube Data	Range of Data (mg/L)	% of Monthly Samples < 25 cm [# of Samples]							% of Total Samples < 25 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S004-387 **S013-644** **S013-696** (2009-2020)	8 – 100+	26.7 [15]	54.5 [22]	60.4 [53]	71.2 [59]	61.8 [55]	69.6 [23]	75 [8]	62.1 [325]

Table 93. TSS monitoring data for lower stream reach near bio site 09MN013.

07020005-503 TSS Sample Data	Range of Data (mg/L)	% of Monthly Samples > 30 mg/L [# of Samples]							% of Total Samples > 30 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S000-963 (2009-2020)	1.9 – 138	-	25 [4]	83.3 [6]	100 [4]	100 [5]	50 [4]	-	73.9 [23]

Table 94. Transparency monitoring data for lower stream reach near bio site 09MN013.

07020005-747 Secchi Tube Data	Range of Data (mg/L)	% of Monthly Samples < 25 cm [# of Samples]							% of Total Samples < 25 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S000-963 **S006-022** (2009-2021)	6 – 100+	-	54.5 [11]	69.7 [33]	80.7 [31]	71.4 [35]	41.7 [12]	66.6 [3]	70.4 [125]

Suspended Solids Summary

09MN005

TSS related invert metrics at site 09MN005 were mixed. Collector-filterer percentage was well above the class average as the top three invertebrates present, *Simulium*, *Ceratopsyche*, and *Cheumatopsyche*, are all collector- filterers. There were no Plecoptera present. Sprawlers were also low at only 1.9%. The TSS TIV score was good and was just at the class average. The percentage of TSS tolerant inverts caught was 36.1% of the total and only 2.5%, the 7 protoptila, are considered intolerant to TSS.

TSS data was limited in this section of the reach as only 12 samples were taken in 2009, which is the oldest data year that is being used in the report. Only 8.3% of the total number of samples taken were over 30mg/L.

09MN070

TSS related fish metrics in the middle of the reach were mostly poor (Table 87). Benthic feeders were present as there were good numbers of both johnny and blackside darters present, though they were still below the class average. Centrarchids were very low and there were no herbivores present. Long-lived fish were well below the class average. Perciforms percentage wasn’t too much lower than the class average and the 12 white suckers and seven slenderhead darters made up the 9% riffle dwelling percentage. There were some simple lithophilic spawners present as well though the percentage was still below the class average. The TSS TIV scored well and was better than the average. TSS tolerant fish made up 17.4% of the total number caught.

TSS related invert metrics were mostly poor (Table 88), except for the percentage of collector-filterers and sprawlers. The second and third most numerous inverts present, *Simulium* and *Potamyia*, are both considered collector-filterers and there were several other caddisfly collector-filterers present in lesser numbers. No Plecoptera were observed at all. Sprawlers were present, though they were below the class average as the site was dominated by climber and clinger inverts. The TSS TIV score was above the class average and over 55% of the total number of inverts caught are considered tolerant to TSS.

09MN013

TSS related fish metrics were mostly poor in this section of the reach, though some were better than at the site upstream (Table 87). There were some benthic feeders present, though they were below the class average. Centrarchids, herbivores, and perciform percentages were very poor. Long-lived percentage was better than at the upstream site though still well below the class average. The percentage of TSS tolerant fish caught was 33.2%. Riffle dwelling fish score well as there were 16 hornyhead chubs, 10 white suckers, 7 slenderhead darters, and 4 stonecats present. Five of the top seven fish taxa caught are considered lithophilic spawners, which scored above the class average and the TSS TIV score was low.

TSS related invertebrate metrics were mixed and were similar to the upstream site (Table 88). There were no Plecoptera and very few invertebrates considered intolerant to TSS. TSS tolerant invertebrates were 64.5% of the total number caught. Collector-filterers scored well as there were several collector-filterer caddisfly taxa present, including the third most numerous invert present, Hydropsyche.

Twenty-three samples were collected in the lower reach and analyzed for TSS from 2009 through 2020 (Table 93). All months had very high exceedance percentages and 73.9% of the total number of samples collected were above the standard of 30 mg/L of TSS. 125 transparency measurements were done from 2009 to 2021 (Table 94). 70.4% of all the measurements taken were below 25 cm.

Due to the mostly poor biological metrics, TSS, and transparency data, suspended solids appear to be a stressor to the biological community throughout reach 07020005-503.

3.1.4.8 Nitrates

Nitrate Biological Metric Data

Table 95. Nitrate related invert metrics and tolerance values for stream reach.

07020005-503 **Invert Class 5** **General Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN005 8/06/2019	25	2.9		32.0	2.2
09MN070 8/06/2019	17.1	3.0		43.0	0.6
09MN013 8/05/2020	22.9	3.8		48.9	0.3
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**13.6**	**2.9**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 96. Nitrate monitoring data for stream reach.

07020005-503 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S004-387 (2017-2020)	0.01 – 3.4 [100]	0.9 [18]	0.2 [18]	0.2 [19]	0.2 [12]	0.2 [13]	0.2 [12]	0.4 [12]
		Highest Value						
		2.2	0.4	0.9	0.4	0.5	0.6	0.4

Nitrate Summary

The nitrate related invert metrics and tolerance values at site 09MN005 were mixed (Table 92). Trichoptera taxa was 25% of the total number of taxa and the nitrogen TIV score was right at the class average. At 32%, there was a high percentage of nitrogen tolerant and very few nitrogen intolerant inverts caught.

Nitrate related invert metrics and tolerance values at site 09MN070 were mostly poor (Table 92). There was still a good percentage of Trichoptera taxa as well as good numbers of them present. The nitrogen TIV was just above the class average and 43% of the total number of inverts caught are considered tolerant to nitrogen.

Nitrate related invert metrics and tolerance values at site 09MN070 were mostly poor (Table 92). Trichoptera taxa percentage was 22.9. The second most numerous invert present was the mayfly Fallceon, which is considered very tolerant to nitrogen. The percentage of nitrogen tolerant inverts caught was 48.9%.

One hundred samples were collected in reach 07020005-503 and analyzed for nitrate/nitrite (Table 93). All the values were very low, well below the proposed nitrate criteria for protection of aquatic life of 8 mg/L. Due to the mixed biological response and relatively low percentage of nitrate tolerant and low nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-503.

3.1.4.9 Reach Stressors

Table 97. Summary of stressors for stream reach.

07020005-503	**Hydrologic Alteration**	**Connectivity**	**Habitat**	**Dissolved Oxygen**	**Eutrophication**	**Suspended Solids**	**Nitrate**
✓ = Stressor O = Inconclusive	✓	O	✓	✓	✓	✓	O

3.2 Little Chippewa River

3.2.1 07020005-713 Little Chippewa River

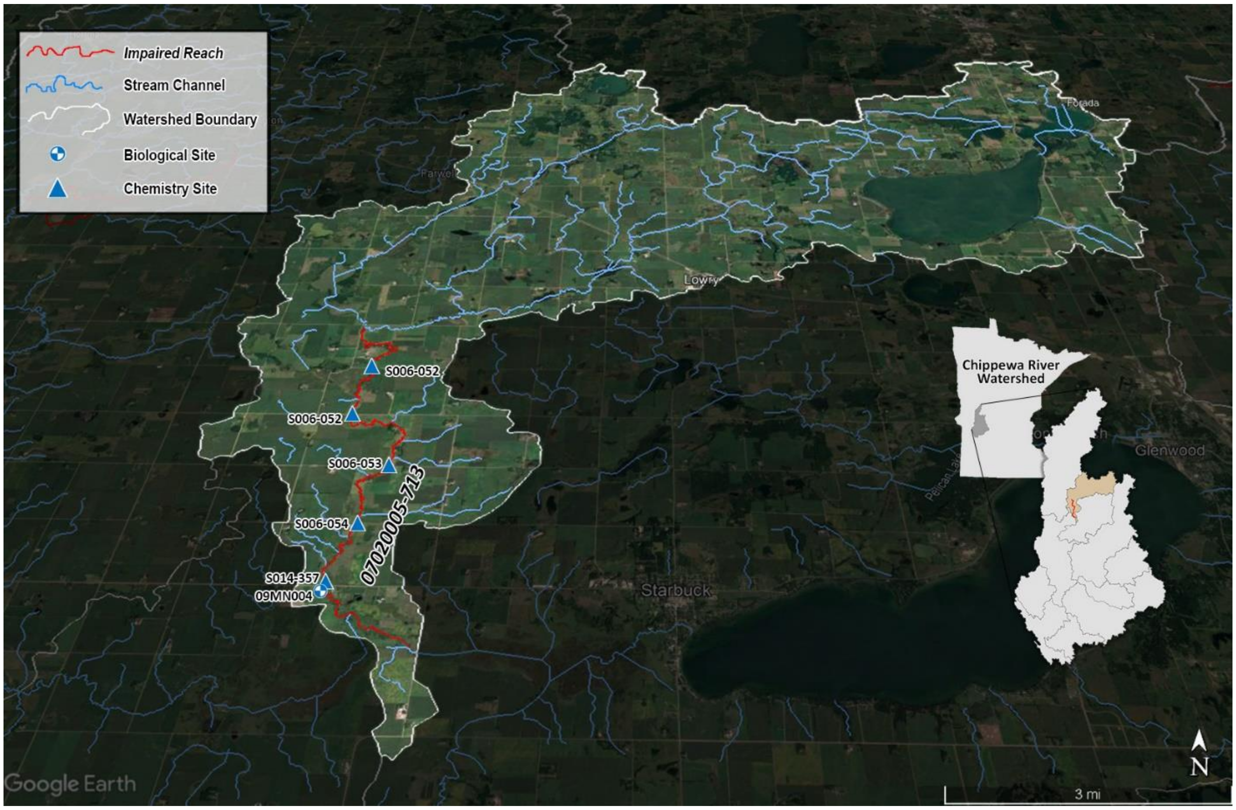


Figure 15. Satellite image of reach 07020005-713 and its watershed.

3.2.1.1 Biological Community

Biological Metric Data

Table 98. Fish IBI score and threshold for stream reach.

07020005-713 **Fish Class 2** **General Use**	Fish IBI Score	Class Threshold Score
09MN004 6/16/2021	3.1	50

Table 99. Invert IBI score and threshold for stream reach.

07020005-713 **Invert Class 7** **General Use**	Invert IBI Score	Class Threshold Score
09MN004 8/6/2019	41.2	41

Bio site 09MN004 was sampled for fish in June of 2021. The FIBI score of 3.1 was very poor and well below the Fish Class 2 southern stream general use threshold of 50 (Table 98). Fathead minnows and white suckers dominated the fish community. 68 fish were caught during the fish sampling and of those, only two hornyhead chubs are considered sensitive. Eighty-five percent of the total number of fish caught are considered either tolerant or very tolerant.

Inverts were sampled in August of 2019. The MIBI score of 41.2 was just above the class average of 41 but was within the confidence interval. The site had several different mayflies at the site, which contributed to the IBI score. The mayflies present in higher numbers, such as *Falceon*, *Labiobaetis*, *Heptagenia*, and *Maccaffertium*, are considered tolerant or very tolerant to nitrogen, TSS, and phosphorus. Considering that the macroinvertebrate community degraded slightly in 2019 (when most other sites improved) and the fact that both years have MIBI scores that were near the threshold, this WID was listed for macroinvertebrates.

3.2.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 100. Hydrologic alteration related fish metrics for stream reach.

07020005-713 **Fish Class 2** **General Use**	General %	Nesting Non Lithophilic Spawner %
09MN004 6/16/2021	85.3	69.1
Statewide average for natural Class 2 southern stream bio sites	**42.2**	**19.1**
Expected response to **Hydrologic** stress	↑	↑

Table 101. Hydrologic alteration related invert metrics and tolerance values for stream reach.

07020005-713 **Invert Class 7** **General Use**	Clinger %	Collector – filterer %	Long – lived %	Percent Ditched Tolerant %	Percent Ditched Intolerant %	Low Depth variability Tolerant %	Low Depth variability Intolerant %	Low Flow Tolerant %	Low Flow Intolerant %
09MN004 8/6/2019	37.9	18.9	3.5	0.6	23.3	7.3	13.0	68.5	0
Statewide average for natural Class 7 prairie stream glide pool bio sites	**38.5**	**19.1**	**8.0**						
Expected response to **Hydrologic** stress	↓	↓	↓	↑	↓	↑	↓	↑	↓

The fish hydrologic alteration related biological metrics were poor (Table 100). Generalized fish species are correlated with channelization and are adaptable to different habitats through generalized food preferences. Bio site 09MN004 had a population of generalist fish of 85.3% of the population. Nesting fish were high and well above the class average. Fathead minnows, which are a generalized and nesting fish, dominated the fish community. Three of the four most numerous taxa present are considered generalist fish.

The invert hydrologic alteration related biological metrics were poor. Clinger percentage was just barely below the class average at 37.9%, though this was mostly due to the large numbers of the black fly *Simulium*, though there were some lessor amounts of the mayflies *Maccaffertium* and *Heptagenia*, which are all clingers as well. Long-lived invertebrates scored poorly as only six riffle beetles and three crayfish were present in the sample. The altered hydrology tolerance values were mixed. Both the percent ditched and the depth variability tolerant to intolerant percentages scored well, which would be expected since reach 07020005-713 is primarily a natural channel and these tolerance values are indicative of stress from channelization. Flow tolerant to intolerant percentage scored very poorly; however, as 9 of the top 11 inverts present are considered either tolerant or very tolerant to low flows. This is consistent with what is known about the watershed of this stream. The stream channel has been ditched through a wetland and connected to Outlet Creek and most of its tributaries are altered in some way. Usually this is due to the tributary being ditched and the surrounding land tiled to drain water. The upper watershed, upstream of reach 07020005-713, still has several shallow lakes and wetlands that the stream itself and some of its tributary's flow through. Further downstream, within the reach itself, most of those wetlands have been ditched through. The tributaries in this section also have far more ditch drained wetlands.

Based on the poor scores of both the fish and invert biological metrics as well as the high percentage of flow tolerant invertebrates, hydrologic alteration is a stressor in this reach. It appears that the alteration of flows within the watershed are the main contributor to the stress on the biological community.

3.2.1.3 Connectivity

Connectivity Metric Data

Table 102. Connectivity related fish metrics for stream reach.

07020005-713 **Fish Class 2** **General Use**	Mature Age >3%	Migrating Individual %
09MN004 6/16/2021	19.1	19.1
Statewide average for natural Class 2 southern stream bio sites	**12.4**	**28.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related metrics were poor (Table 102). The percentage of fish that take more than three years to mature and migrating fish was 19.1% due to the 13 white suckers that were caught. Both values are below the class averages. Instead of flowing south and west the stream channel has been redirected at the end of reach 07020005-713. The stream channel has been ditched through a wetland and connected to Outlet Creek, which then flows into Lake Mary. This lake appears to have a water level control structure at its outlet that would restrict fish migration (Figure 16). This structure is essentially a small, one-foot-tall waterfall that would be a barrier to native fish migration.

Figure 16. Lake water level control structure at the outlet of Lake Mary.

Due to the poor connectivity related fish metrics and evidence of channelization and the redirection of the stream channel, connectivity appears to be a stressor to the biological community in this reach.

3.2.1.4 Habitat

Habitat Metric Data

Table 103. Habitat related fish metrics for stream reach.

07020005-713 **Fish Class 2** **General Use**	Benthic Insectivore minus Tolerant %	Benthic Insectivore %	Darter Sculpin Sucker %	Dominant Two %	Lithophilic Spawner %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN004 6/16/2021	11.8	11.8	11.8	76.5	30.9	22.1	19.1	85.3
Statewide average for natural Class 2 southern stream bio sites	**20.4**	**22.5**	**23.8**	**47.1**	**58.3**	**32.5**	**39.4**	**44.9**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 104. Habitat related fish tolerance values for stream reach.

07020005-713 **Fish Class 2** **General Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
04MN004 6/16/2021	73	5		56.2	0		89.1	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

Table 105. Habitat related invert metrics for stream reach.

07020005-713 **Invert Class 7** **General Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN004 8/06/2019	0.6	6.3	37.9	69.1	4.4	12.9
Statewide average for natural Class 7 prairie stream glide pool bio sites	**7.5**	**21.6**	**38.5**	**38.5**	**39.8**	**20.9**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 106. Habitat related tolerance metrics for stream reach.

07020005-713 **Invert Class 7** **General Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN004 8/6/2019	51.1	0.6		15.8	0.6		6.9	6.0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 107. Habitat assessment scores for stream reach.

07020005-713	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN004 8/06/2019	1	9.5	15.1	8	24	57.6
09MN004 6/16/2021	0	9	9	8	22	48
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The fish community in reach 07020005-713 scored below average in most of the habitat related fish metrics when compared to the natural Class 2 southern stream average. Benthic insectivore and darter percentage was 11.8% of the total number of fish caught due to eight johnny darters captured. There were some lithophilic fish caught, though they were below the class average for natural streams. All the tolerance value percentages were very poor as well.

Invert metrics were mixed. The percent of burrowers, legless, and sprawlers were all low, which indicates poor substrate and high levels of fine sediment and muck are not a problem. The percentage of EPT taxa, specifically mayflies, was well above the Invert Class 7 average for natural channels. Clingers were just below the class average and climbers were well below the class average. The tolerance values were also mixed. The MSHA tolerant to intolerant percentages was very poor. The substrate tolerant (6.9%) to intolerant (6%) percentage was better. Eight out of the 10 most numerous invertebrates present are considered tolerant or very tolerant to low cover.

This site only had five different taxa and 68 total fish caught, with fathead minnows making up over 57 % of them. This could indicate that habitat is affecting the fish community, however, it is also possible that some other stressor is limiting the fish community, especially as connectivity was also identified as a stressor to the fish community. Invert metrics were mixed as climbers were the only metric that scored very poorly. The MSHA tolerant to intolerant percentages were also very poor. Bio site 09MN004 is in a short, straightened, ditched section of the Little Chippewa River, which is mostly natural. The preponderance of evidence suggests that habitat is a stressor to the biological community, particularly lack of cover and embeddedness of coarse substrate.

3.2.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 108. DO related fish metrics and tolerance values for stream reach.

07020005-543 **Fish Class 3** **General Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO Relative Abundance TIV		DO Tolerant %	DO Sensitive %
09MN004 6/16/2021	5	19.1	2.9	60.3	85.3	8.4		57.4	0
Statewide average for natural Class 2 southern stream bio sites	**20.4**	**23.9**	**18.7**	**28.7**	**44.9**	**8.4**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Table 109. DO related invert metrics and tolerance values for stream reach.

07020005-713 **Invert Class 7** **General Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN004 8/6/2019	69.1	7.7	27	7.0		7.3	15.5
Statewide average for natural Class 7 prairie stream glide pool bio sites	**38.5**	**7.6**	**37**	**6.9**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 110. DO monitoring data for stream reach.

07020005-713 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S004-705 **S006-054** **S006-053** **S006-052** **S006-051** (2010-2021)	1.5 – 12.4	-	0 [13]	2.9 [35]	9.1 [55]	16.3 [43]	9.1 [11]	0 [2]	8.9 [157]
		Minimum Value							
		-	5.1	4.1	3.9	1.5	4.4	9.6	

Dissolved Oxygen Summary

Overall, the DO fish metrics and tolerance values scored poorly. Over 57% of the fish caught are tolerant to low DO while there were no fish caught who are sensitive to low DO. Taxa count was very low compared to the class average. Species with females that take more than three years to mature comprised 4.4% and 11.3%, both well below class average. Overall taxa count was well below average as there were only five different taxa, most of which were the very tolerant fathead minnow. Serial spawners were very high, and the DO tolerance index value scored just at the class average.

Invert metrics were mixed (Table 109). The HBI_MN scored poorly but was just above the class average. Total taxa count was also below the class average. Metrics that scored well were the percentage of EPT taxa, specifically mayflies, which was well above the Invert Class 7 average for natural channels. The DO TIV score was just above the class average and the number of inverts tolerant to low DO was relatively low at 7.3%. There were also a fair number of inverts present that are intolerant to low DO.

There were 157 DO measurements taken from 2017 through 2020 (Table 110) and 8.9% of them were below the standard value of 5 mg/L (Table 110). Some very low values were recorded, especially in July and August with 9.1% and 16.3% of samples in those months below the standard of 5 mg/L.

Fish biological metric scores indicate that DO is stressing them. Invert metrics were generally better and even the metrics that were below the class average were not too bad. Due to the conflicting DO related metrics, and the poor measured DO monitoring data, DO is a likely a stressor in this reach, though at this time it is inconclusive.

3.2.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 111. Eutrophication related fish metrics and tolerance values for stream reach.

07020005-713 **Fish Class 2** **General Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %	Phosphorus Tolerant %	Phosphorus Sensitive %
09MN004 6/16/2021	5	11.8	76.5	19.1	57.4	0
Statewide average for natural Class 2 southern stream bio sites	**20.4**	**11.7**	**16.5**	**39.4**	↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓		

Table 112. Eutrophication related invert metrics and tolerance values for stream reach.

07020005-713 **Invert Class 7** **General Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN004 8/6/2019	7.9	11	69.1	17.4	27		37.5	0
Statewide average for natural class 7 prairie stream glide pool bio sites	**11.8**	**13.2**	**38.5**	**16.1**	**37.0**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 113. Phosphorus monitoring data for stream reach.

07020005-713 P Sample Data 0.100 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S004-705 (2019 - 2021)	0.030 – 0.342	-	0.108 [3]	0.185 [3]	0.266 [3]	0.206 [2]	0.190 [2]	-	0.221 [8]
		Maximum Value							
		-	0.186	0.225	0.342	0.240	0.255	-	

The fish community at bio site 09MN004 scored poorly in three out of four eutrophication related fish metrics when compared to the Class 2 average (Table 111). Total taxa count was way below the class average. Omnivores were very high as fathead minnows dominated the fish community. Simple lithophilic spawners were present as 13 white suckers were caught; however, at 19% it was well below the class average. The percentage of phosphorus tolerant fish was very high, again due to the dominance of fathead minnows at the site. No fish considered sensitive to phosphorus were caught.

The invert community scored poorly in three out of five phosphorus related metrics. There were some collector – gatherer taxa present, though they were just below the class average. The percentage of EPT invertebrates was well above the class average at 69.1% of the total number caught. However, of that 69.1%, 48.4% of those are either caddisflies or mayflies that are considered either tolerant or very tolerant to high phosphorus. *Heptagenia* and *Maccaffertium*, are considered scrapers and the percentage of scrapers was just above the class average. Total taxa count was below the class average. Inverts tolerant to phosphorus were high at 37.5% and no phosphorus intolerant inverts were present.

Thirteen samples were collected and analyzed for phosphorus from 2019 through 2021. The summer average was over twice the standard of 0.100 mg/L (Table 113). Phosphorus values were high throughout the year and the monthly class averages for all the months data was taken for, May through September, was also above the standard.

Both the fish and invert biological communities are showing the effects of the elevated phosphorus. The most numerous fish and invertebrates present are both very tolerant to high phosphorus. Eutrophication is very likely a stressor in reach 07020005-713, though due to lack of evidence of excessive primary production during the SID field work, it is inconclusive at this time.

3.2.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 114. TSS related fish metrics and tolerance values for stream reach.

07020005-713 **Fish Class 2** **General Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN004 6/16/2021	30.9	0	0	0	11.8	22.1	0	19.1		0	0
Statewide average for natural Class 2 southern headwater bio sites	**37.4**	**4.9**	**9.6**	**11.7**	**18.7**	**32.5**	**39.4**	**18.2**		↓	↓
Expected response to **Suspended Solids** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 115. TSS related invert metrics and tolerance values for stream reach.

07020005-713 **Invert Class 7** **General Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN004 8/6/2019	18.9	0	12.9	24.0		60.3	0
Statewide average for natural Class 7 prairie stream glide pool bio sites	**19.1**	**0.2**	**20.9**	**17.8**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Monitoring Data

Table 116. TSS monitoring data for stream reach.

07020005-713 TSS Sample Data 30 mg/L target	Range of Data (mg/L)	% of Monthly Samples > 30 mg/L [# of Samples]							% of Total Samples > 30 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S004-705 (2019 - 2020)	36.8 – 142	-	100 [2]	100 [2]	100 [3]	100 [2]	100 [2]	-	100 [11]

Table 117. Transparency monitoring data for stream reach.

07020005-713 TSS Sample Data	Range of Data (mg/L)	% of Monthly Samples < 25 cm [# of Samples]							% of Total Samples < 25 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S004-705 **S006-054** **S006-053** **S006-052** **S006-051** (2010 - 2022)	7 – 100	-	53.9 [13]	25.7 [35]	61.1 [54]	46.5 [43]	45.5 [11]	100 [2]	46.8 [158]

Suspended Solids Summary

The fish community at bio site 09MN004 scored poorly in all the TSS related fish metrics when compared to the average of all Class 2 southern stream bio sites that meet the FIBI general use threshold (Table 114). Some of these metrics scored very poorly; these include Centrarchids, herbivores, long-lived, and simple lithophilic spawning fish were not present. Benthic feeders were below the class average, though there were 13 white suckers and 8 johnny darters caught. White suckers are also considered riffle dwelling fish. The TSS tolerance index value was just above the class average. There were no fish caught that are considered either tolerant or intolerant to TSS.

The invert community at bio site 09MN004 scored poorly three out of four TSS related invert metrics when compared to the average of all Class 7 prairie stream glide pool bio sites that meet the MIBI general use threshold (Table 115). Collector-filterers percentage was just below the class average at 18.9%. There were no Plecoptera present and the TSS TIV score was over six points above the class average. Sprawler percentage was lower than the class average as only two inverts, *Hyallela* and *Tricorythodes*, were present in larger numbers. The percentage of TSS tolerant inverts was very high at 60.3% of the total number of inverts caught while no inverts considered intolerant to TSS were present.

Eleven samples were collected and analyzed for TSS from 2019 through 2020 (Table 116). All of the samples collected over five different months were above the standard of 30mg/L. There were 158 transparency measurements taken from 2010 to 2022. The percentage of measurements below 25cm was high. Of all transparency measurements, 46.8% were below 25cm and both early spring and later summer transparency was low, indicating that both sediment during high early spring flows as well as late summer algae growth due to eutrophication are likely an issue in this reach.

The TSS related fish metrics are poor, though the fish sample itself was relatively small and is being affected by connectivity issues so it is hard to draw a definitive conclusion from the fish data alone. TSS related invert metrics were also poor and the sample itself is more robust and is a better indicator of TSS stress. TSS sampling and transparency measurements were also very poor. Due to the preponderance of evidence, TSS are a stressor to the biological community, especially the inverts, in reach 07020005-713.

3.2.1.8 Nitrates

Nitrate Biological Metric Data

Table 118. Nitrate related invert metrics and tolerance values for stream reach.

07020005-713 **Invert Class 7** **General Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN004 8/6/2019	11.4	4.7		58.7	0
Statewide average for natural Class 7 prairie stream glide pool bio sites	**10.9**	**3.2**		↓	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 119. Nitrate monitoring data for stream reach.

07020005-713 Nitrate/Nitrite Sample Data 8 mg/L target	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S004-705 (2009)	0.03 – 2.3 [23]	1.1 [5]	0.1 [4]	0.5 [7]	0.3 [3]	0.3 [2]	0.3 [2]	-
		Highest Value						
		2.3	0.2	1.0	0.3	0.4	0.4	-

Summary

The macroinvertebrate assemblage at site 09MN004 was mixed (Table 118). Trichoptera taxa percentage, which tend to decrease in streams with excessive nitrate values, was just above the class average. The nitrogen TIV score indicates a macroinvertebrate community that is generally tolerant to high levels of nitrates and the percentage of nitrate tolerant inverts caught was 58.7% of the total number caught, some of which were caddisflies.

23 samples were collected within reach 07020005-713 and analyzed for nitrate/nitrite (Table 119). All the values were very low, well below the proposed nitrate criteria for protection of aquatic life of eight mg/L. Due to the somewhat mixed biological response and low nitrate concentrations, nitrates are inconclusive as a stressor in reach 07020005-713.

3.2.1.9 Reach Stressors

Table 120. Summary of stressors for stream reach.

07020005-713	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	✓	✓	O	O	✓	O

3.3 East Branch Chippewa River

3.3.1 07020005-514 East Branch Chippewa River

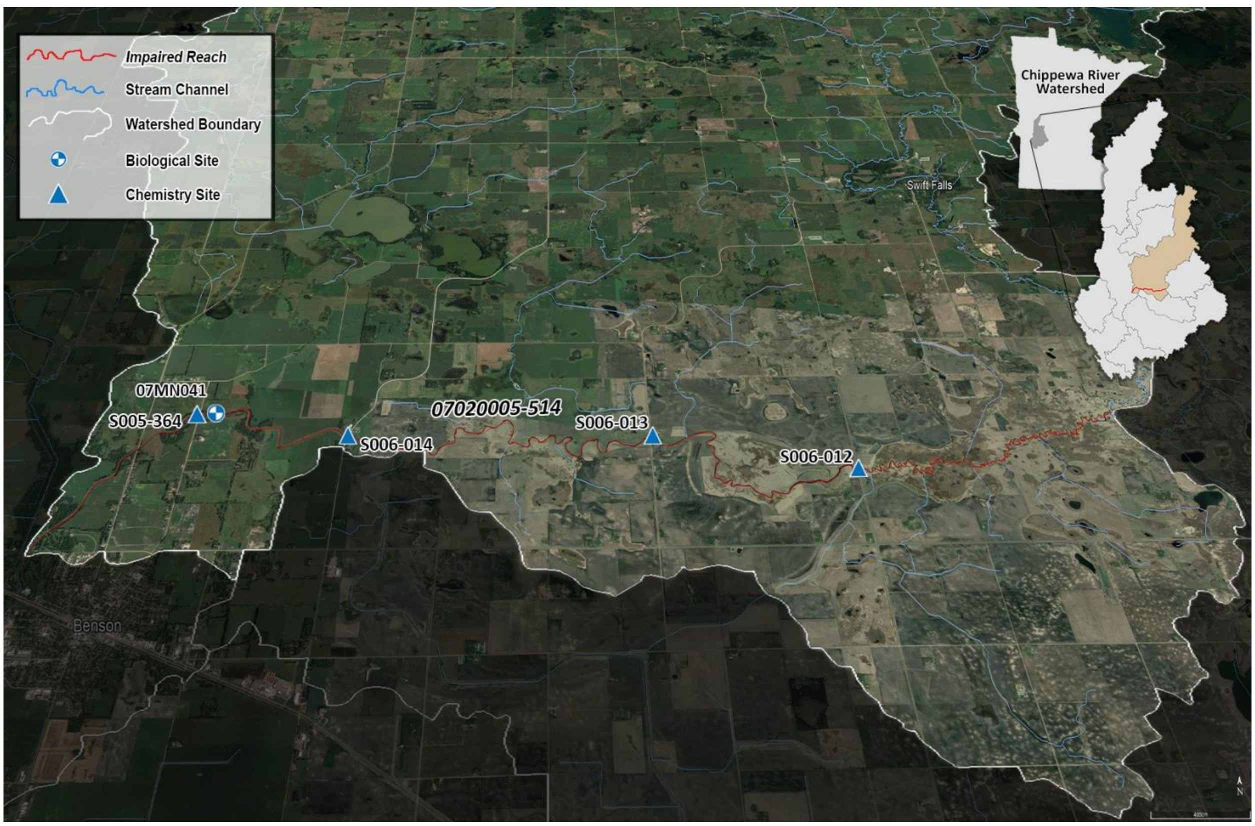


Figure 17. Satellite image of reach 07020005-514 and its watershed.

3.3.1.1 Biological Community

Bio site 07MN041 was sampled twice for inverts, once in 2019 and once in 2009. The MIBI scores of 29.6 and 27.5 were just below the Invert Class 2 general use threshold of 31 (Table 121).

Bio site 07MN041 shows an increasing trend in the number of *Hyalella*, accounting for two-thirds of the entire sample. A similar decreasing “trend” in taxa richness is also evident among the years this station has been sampled. Bio site 09MN026 had less dominance by *Hyalella* or any one invertebrate.

Table 121. Invert IBI score and threshold for bio sites.

07020005-514 **Invert Class 2** **General Use**	Invert IBI Score	Class Threshold Score
07MN041 8/11/2009	27.5	31
07MN041 8/07/2019	29.6	

3.3.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 122. Hydrologic alteration related invert metrics for stream reach.

07020005-514 **Invert Class 2** **General Use**	Clinger %	Collector – filterer %	Long – lived %	Percent Ditched Tolerant %	Percent Ditched Intolerant %	Low Depth Variability Tolerant %	Low Depth Variability Intolerant %	Low Flow Tolerant %	Low Flow Intolerant %
07MN041 8/11/2009	11.4	3.9	1.8	20.7	0.9	54.2	22.2	25.5	0.3
07MN041 8/07/2019	7.0	1.5	3.6	3.6	9.7	61.3	6.9	29.6	0.3
Statewide average for natural Class 2 prairie forest river bio sites	**43.2**	**22.9**	**6.7**	↑	↓	↑	↓	↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓						

Hydrologic Alteration Summary

The invertebrate metrics for altered hydrology were mostly poor at bio site 07MN041 (Table 122). Clingers, collector-filterers, and long-lived inverts were all very low when compared to the class average. The percent ditched tolerant to intolerant percentage wasn’t bad in the 2019 sample, mainly due to the presence of the mayfly Labiobaetis, which is considered intolerant of ditching. However, the depth variability and low flow tolerance values were very poor.

The reach itself has been ditched and dredged in the past and is mostly altered. Recent use attainability analysis has determined that habitat is not limiting and therefore the bio sites are considered general use. Bio site 07MN041 has over a 512 square mile watershed and the East Branch is a substantial tributary to the Chippewa River. Even so, at least half of the reach appears to have been channelized at some point in the past. Around bio site 07MN041 the channel width is very wide, and the bottom is flat with very little depth variability, no riffles or pools, and has poor sinuosity.

Due to the poor invert metrics, the dominance of Hyalella, along with evidence of channel alteration and poor geomorphology, altered hydrology is a stressor to the invert community in reach 07020005-514.

3.3.1.3 Connectivity

Connectivity Metric Data

Table 123. Connectivity related fish metrics for stream reach.

07020005-514 **Fish Class 1** **General Use**	Mature Age >3 minus Tolerant %	Migrating %
07MN041 6/09/2009	17.0	15.8
07MN041 6/17/2021	10.3	27.4
Statewide average for natural Class 1 southern river bio sites	**37.5**	**23.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

The fish biological metrics for connectivity are mixed (Table 123). The most recent data at bio site 07MN041 had a below average percentage of nontolerant fish that take more than three years for the females to reach sexual maturity. The percentage of migrating individuals was above the class average. The first metric, the percentage of fish who take longer than three years to mature can be affected more easily by other stressors. Due to the presence of migrating fish and no known barriers, connectivity is inconclusive as a stressor.

3.3.1.4 Habitat

Habitat Metric Data

Table 124. Habitat related invert metrics for stream reach.

07020005-514 **Invert Class 2** **General Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
07MN041 8/11/2009	1.2	21.3	11.4	29.1	23.7	45.3
07MN041 8/07/2019	0.3	14.2	7	28.5	3.9	66.1
Statewide average for natural Class 2 prairie forest river bio sites	**6.9**	**14.0**	**43.2**	**54.8**	**25.9**	**17.6**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 125. Habitat related tolerance values for stream reach.

07020005-514 **Invert Class 2** **General Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
07MN041 8/11/2009	58.1	0.3		58.1	0.3		49.1	14.7
07MN041 8/07/2019	81.6	0		72.5	0		61.3	0.9
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 126. Habitat assessment score for stream reach.

07020005-514	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
07MN041 6/9/2009	0	9	17.2	3	8	37.2
07MN041 8/7/2019	2.5	8.5	10	10	6	37
07MN041 6/17/2021	0	9	10	6	-1	24
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The habitat related invert metrics in reach 07020005-514 are mixed (Table 124). Burrowers were very low, which corroborates the MSHA evaluation indicating sand was present. Climbers also scored better than the average. Legless inverts were also low. Poor metrics include low numbers of clingers, EPT, and high numbers of sprawlers, which can indicate high levels of silt present. In all, the invert metrics indicate a habitat that is somewhere in the middle. Tolerance values were very poor as the percentage of inverts tolerant to poor MSHA scores was over 80%, with none that were considered intolerant (Table 125). Embeddedness tolerant percent was also very high at 72.5% with no intolerant caught and low substrate tolerant was over 60%. The invert *Hyalella* was part of the reason these metrics were poor as it was over 62% of the total number of inverts caught. *Hyalella* is tolerant to poor MSHA scores and poor substrate as well as very tolerant to embeddedness. There were also some numbers of the mayfly *Labiobaetis proinquus* and the caddisfly *Nectopsyche candida*, which are commonly found in reaches with low MSHA scores, which drove that percentage up.

The MSHA habitat scores indicate poor habitat in the reach around bio site 07MN041 (Table 126). The reach is highly altered and channelized at the location of the bio site due to a bridge crossing and is probably not completely indicative of the habitat of the overall reach. Even so, MSHA scoring does take into account some of the reach upstream and downstream of the site. The reach has had three MSHA assessments done in 2009, 2019, and 2021. All scores were what would be considered poor, and the latest one conducted in 2021 scored lower than the previous two. Reasons for the poor scores throughout the three visits include little to no shade, low depth variability, poor sinuosity, no riffles or pools present, poor channel development, and evidence of dredging and bank shaping.

Due to the somewhat poor invert metrics, very poor tolerance values, and poor habitat assessments, habitat appears to be stressing reach 07020005-514. It appears that embeddedness and poor geomorphology are the main reasons for habitat stress.

3.3.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 127. DO related invert metrics for stream reach.

07020005-514 **Invert Class 2** **General Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
07MN041 8/11/2009	29.1	7.7	33	6.6		49.4	0.6
07MN041 8/07/2019	28.5	7.6	26	6.4		61.3	0.6
Statewide average for natural Class 2 prairie forest rivers	**54.8**	**7.3**	**35.5**	**7.1**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 128. DO monitoring data for stream reach.

07020005-514 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-364 S006-012 S006-013 S006-014 (2009-2021)	1.1 – 13.7	0% [33]	0% [49]	8.1% [86]	7.3% [69]	9.3% [54]	0% [20]	0% [13]	6.1% [278]
		Minimum Value							
		8.2	5.2	2.8	1.1	2.4	6.6	7.3	

Dissolved Oxygen Summary

The low DO related invertebrate metrics in reach 07020005-514 were poor (Table 127). There were some EPT taxa caught that were neither tolerant nor intolerant to DO, though the percentage of EPT individuals was well below the Invert Class 2 average. Taxa count numbers were moderate, though the amphipod *Hyalella*, which is tolerant to low DO, dominated the invert community at 62.3% of the total number of inverts caught. This also caused the percentage of DO tolerant inverts to be very high and there were only two inverts caught out of 313 that are considered intolerant to low DO. The two most numerous mayflies and the most numerous caddisfly present are considered very tolerant to low flows.

There were 324 DO measurements taken throughout the reach between 2009 to 2021. More than 5% of the DO values in the months of June, July, and August fell below 5 mg/L.

Based on the poor DO related invert biological metric scores, tolerance values, and dominance of the amphipod *Hyalella*, as well as the measured DO values, low DO is a stressor in this reach.

3.3.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 129. Eutrophication related invert metrics for stream reach.

07020005-514 **Invert Class 2** **General Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count #		Phosphorus Tolerant %	Phosphorus Intolerant %
07MN041 8/07/2009	41.1	10	29.1	7.8	33		61.8	14.4
07MN041 8/07/2019	59.7	8	38.7	19.2	26		77.6	0.9
Statewide average for natural Class 2 prairie forest rivers	**6.6**	**11.9**	**54.8**	**13.8**	**35.5**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 130. Phosphorus monitoring data for stream reach.

07020005-514 P Data 0.100 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-364 (2009-2022)	0.005 – 0.540	0.119 [41]	0.102 [44]	0.175 [49]	0.144 [34]	0.142 [35]	0.108 [28]	0.092 [21]	0.157 [118]
		Maximum Value							
		0.364	0.458	0.540	0.270	0.282	0.256	0.288	

Eutrophication Summary

Eutrophication related invertebrate metrics in reach 07020005-514 were poor. Collector gatherer taxa were generally low. There were some mayflies and caddisflies, though the percentage of individuals was below the class average. Two of the more numerous inverts present, the mayfly *Tricorythodes* and the caddisfly *Nectopsyche*, are both considered tolerant to high phosphorus. The mayfly *Plauditus*, considered intolerant to high phosphorus, was the second most numerous invert in the 2009 sample. *Plauditus* was not found in the reach in 2019. Scrapers increased from the 2009 to the 2019 visit which may indicate an increase in algae growth. Total taxa count also decreased from the 2009 to the 2019 visit. The site was dominated by the amphipod Hyalella. High numbers of Hyalella can be a signal of impairment. They feed on organic material/detritus, so high numbers can be a sign of eutrophication.

There were 252 samples collected and analyzed for phosphorus from 2009 through 2022 (Table 130). The summer average was well above the standard of 0.100 mg/L and there were extremely high values measured in every month from April through October.

The biological community is showing the effects of the elevated phosphorus and the phosphorus sampling showed very high concentrations. Both eutrophication related biological metrics and the sampling data appear to have gotten worse from 2009 to 2019. Eutrophication is very likely a stressor in reach 07020005-514, though due to lack of evidence of excessive primary production during the SID field work, it is inconclusive at this time.

3.3.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 131. TSS related invert metrics for stream reach.

07020005-514 **Invert Class 2** **General Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
07MN041 8/11/2009	3.9	0	45.4	17.5		35.6	0.9
07MN041 8/7/2019	1.5	0	66.1	18.2		31.1	1.8
Statewide average for natural Class 2 prairie forest rivers	**17.6**	**0.6**	**17.6**	**18.4**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

TSS Monitoring Data

Table 132. TSS monitoring data for stream reach.

07020005-514 TSS Data 30 mg/L target	Range of Data (mg/L)	% of Monthly Samples > 30 mg/L [# of Samples]							% of Total Samples > 30 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-364 (2009-2022)	3.6 - 300	50% [40]	38.1% [42]	61.2% [49]	47.1% [34]	58.8% [34]	28.6% [28]	35% [20]	47.4% [247]

Table 133. Transparency monitoring data for stream reach.

07020005-514 Secchi Tube Data 25 cm target	Range of Data (mg/L)	% of Monthly Samples < 25 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-364 **S006-012** **S006-013** **S006-014** (2009-2022)	2 - 100+	24.3% [37]	23.5% [51]	41.6% [101]	56.5% [85]	49.2% [65]	19.2% [26]	10.5% [19]	39.1% [384]

Suspended Solids Summary

The TSS related invertebrate metrics in reach 07020005-514 were mostly poor (Table 127). Collector – filterers were very low and no Plecoptera were observed. Sprawlers were very high, which can indicate high amounts of fine sediment and siltation. The TSS TIV scores scored decently, though were just below the TIV class average. The percentage of TSS intolerant inverts caught was high at 31.1%.

From April to October from 2009 through 2022, 247 samples were collected and analyzed for TSS (Table 132). All months had a high percentage of samples exceeding 30 mg/L and 47.4% of the total samples taken were above that value. Transparency Secchi tube data also corroborated the TSS data and each month had high a percentage of samples below 25 cm. Over 39% of the 384 samples were below the transparency target of 25 cm.

The invertebrate biological community are showing the effects of the elevated TSS. Both the TSS and transparency sampling were poor and the dataset was very robust with several hundred samples and measurements taken. Due to the preponderance of evidence, TSS is a stressor in reach 07020005-514.

3.3.1.8 Nitrates

Nitrate Biological Metric Data

Table 134. Nitrate related invert metrics for stream reach.

07020005-514 **Invert Class 2** **General Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
07MN041 8/11/2009	12.1	2.9		35.9	0.9
07MN041 8/07/2019	11.5	2.7		31.1	0.6
Statewide average for natural Class 2 prairie forest rivers	**15.8**	**2.9**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 135. Nitrate monitoring data for stream reach.

07020005-514 Nitrate/Nitrite Sample Data 8 mg/L target	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S005-364 (2009-2022)	0.05 – 7.88 [201]	1.5 [41]	1.7 [43]	2.5 [49]	1.2 [34]	0.9 [34]	1.6 [27]	2.1 [21]
		Highest Value						
		4.2	7.9	7.6	5.7	5.3	7.2	5.8

Summary

The nitrate related invertebrate metrics in reach 07020005-514 were mixed (Table 134). There were some Trichoptera taxa present though the percentage was below the class average. The most numerous caddisfly present was *Nectopsyche*, which is considered very tolerant to nitrates. The only intolerant taxa present was the midge *Pentaneura*; only two individuals were present in the sample.

There were 249 samples collected over thirteen years. Overall, nitrate concentrations were generally low, though there were some samples close to 8 mg/L, the proposed nitrate criteria for protection of aquatic life (Table 135).

Due to the mixed biological response and relatively low nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-514.

3.3.1.9 Reach Stressors

Table 136. Summary of stressors for stream reach.

07020005-514	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	✓	O	✓	O

3.3.2 07020005-670 Unnamed creek

Figure 18. Satellite image of reach 07020006-576 and its watershed.

3.3.2.1 Biological Community

Biological Metric Data

Bio site 09MN034 was sampled once for fish in 2009. Only one fish taxa was caught consisting of 26 mudminnows. Mudminnows are considered generally very tolerant. With only one very tolerant type of fish caught the fish IBI score was zero (Table 137). 09MN034 is considered a Fish Class 7 low gradient bio site.

Bio site 09MN034 was sampled twice for inverts on the same day in 2009. The MIBI scores of 6.9 and 14.2 were well below the Invert Class 7 modified use threshold of 22 (Table 138). Both samples were dominated by *Physella* snails and the amphipod *Hyalella*, both very tolerant taxa. Both samples have a low number of taxa even for a low gradient/modified use stream.

Table 137. Fish IBI score and threshold for stream reach.

07020005-670 **Fish Class 7** **Modified Use**	Fish IBI Score	Class Threshold Score
09MN034 7/01/2009	0	33

Table 138. Invert IBI score and threshold for stream reach.

07020005-670 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN034 8/20/2009	6.9	22
09MN034 8/20/2009	14.2	

3.3.2.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 139. Hydrologic alteration related fish metrics for stream reach.

07020005-670 **Fish Class 7** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
09MN034 7/01/2009	0	0
Statewide average for channelized Class 7 low gradient bio sites	**35.0**	**29.6**
Expected response to **Hydrologic** stress	↑	↑

Table 140. Hydrologic alteration related invert metrics for stream reach.

07020005-670 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth Variability Tolerant %	Low Depth Variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
09MN034 8/20/2009	1.6	0.3	3.9		62.7	0.6		38.5	1.0		0.6	3.2
09MN034 8/20/2009	4.2	1.0	2.9		65.7	0.3		39.5	0.7		0.7	3.2
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**		↑	↓		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓									

Hydrologic Alteration Summary

The fish visit was very poor as only 26 central mudminnows were caught, which is neither a generalist or nesting fish. Due to this fact, the fish metrics are likely unreliable to assess hydrologic alteration (Table 139). It is likely that hydrologic alteration is a stressor to the fish community due to the fact that only one fish taxon was caught in the reach.

The invertebrate metrics for altered hydrology were mostly poor. The percentages of clingers, collector – filterers, and long – lived invertebrates were all well below the class averages (Table 140). The site was dominated by snails, amphipods, and the tolerant damselfly *Coenagionidae*. The ratio of inverts tolerant to ditched stream channels as well as low depth variability compared to those that are intolerant was also very high. Low flow tolerant individuals were low, though intolerant individuals were also relatively low, possibly indicating that low flows are a stressor as much as the reduction in habitat and geomorphology related to the ditching of the stream channel.

Hydrologic alteration is a stressor in this reach. Only one type of fish was caught during sampling and altered hydrology related invert biological metrics were very poor. The primary impact in this reach from hydrologic alteration is from ditching of the stream by the straightening and deepening of the channel. Cleaning out the bottom of the ditch destroys any morphological habitat that may have developed in the channel and disrupts the movement of sediment in the stream, contributing to the deposition of fine sediments within the ditch. Artificial drainage into the ditch creates a pathway for nutrient overloading of phosphorus and nitrogen, which contributes to eutrophication and can cause high DO flux.

3.3.2.3 Connectivity

Connectivity Metric Data

Table 141. Connectivity related fish metrics for stream reach.

07020005-670 **Fish Class 7** **Modified Use**	Mature Age >3%	Migrating Individual %
09MN034 7/01/2009	0	0
Statewide average for channelized Class 7 low gradient bio sites	**4.4**	**6.9**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

The fish biological metrics for connectivity are very poor (Table 141), though it is hard to come to any conclusions because only 26 central mudminnows were caught, which is not considered a migrating or late-maturing fish. The culvert near the bio site did not appear to be a fish barrier as it was sufficiently wide. The bio site is on a ditched reach with highly channelized connectivity tributaries. Just downstream the ditch flows into what appears to be a ditched wetland that could be restricting some fish migration. Connectivity could be a stressor to the bio site, though there are likely other stressors contributing to the low biotic response and is inconclusive as a stressor at this time.

3.3.2.4 Habitat

Habitat Metric Data

Table 142. Habitat related fish metrics for stream reach.

07020005-670 **Fish Class 7** **Modified Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN034 7/01/2009	0	0	0	0	0	0	0	100
Statewide average for channelized Class 7 low gradient bio sites	7.1	6.8	25.7	19.2	3.7	7.4	20.5	56.0
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 143. Habitat related fish tolerance values for stream reach.

07020005-670 **Fish Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN034 7/01/2009	0	0		0	0		100	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

Table 144. Habitat related invert metrics for stream reach.

07020005-670 **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN034 8/20/2009	1.3	63.3	1.6	0.3	59.2	32.8
09MN034 8/20/2009	1.6	61.7	4.2	0.7	56.8	31.5
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 145. Habitat related tolerance metrics for stream reach.

07020005-670 **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		High Embeddedness Tolerant %	High Embeddedness Intolerant %		Poor Substrate Tolerant %	Poor Substrate Intolerant %
09MN034 8/20/2009	92.9	0.6		93.6	1.0		41.8	0.6
09MN034 8/20/2009	94.2	0.3		96.4	0.3		43.7	0.3
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 146. Habitat assessment scores for stream reach.

07020005-670	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN034 7/01/2009	0	9	4	6	4	23
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The fish biological metrics for habitat are all poor, apart from pioneer species, as the metrics are based off the characteristics of the only fish caught, the central mudminnow (Table 142). The central mudminnow is considered tolerant to poor substrate (Table 143).

The habitat related invertebrate biological metrics for habitat are mixed (Table 144). Burrowers scored well as there were very few worms and shore flies present, which are considered burrowers. Climbers also scored well. Climbers scored above average, though this was mostly due to the dominance of snails at the bio site. Clingers, EPT, legless, and sprawlers all scored very poorly. Overall, the habitat related invertebrate metrics are considered poor.

Habitat related invertebrate tolerance values are very poor (Table 145). In the first site visit, the top three most numerous inverts present are tolerant to poor MSHA scores and embeddedness. The five most numerous inverts present are tolerant to low substrate scores. At the second site visit the top three most numerous inverts present are tolerant to poor MSHA scores and poor substrate scores. The six most numerous inverts present are tolerant to high embeddedness.

The MSHA score conducted during bio visits was very poor indicating extreme lack of habitat for fish and invertebrates. There was very little substrate that would provide good habitat for either fish or invertebrates. Being artificially straightened, the channel morphology provides very little habitat such as riffles and pools. No coarse substrate was observed, and high amounts of silt were present. There was very little depth variability, sinuosity, and no riffles present in the stream channel. Due to the poor fish and invertebrate metrics and tolerance values, ditching of the stream channel, and poor habitat and stream substate observed at the bio site, habitat is a stressor to the biological community.

3.3.2.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 147. DO related fish metrics for stream reach.

07020005-670 **Fish Class 7** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN034 7/01/2009	1	0	0	0	100	5.6		100	0
Statewide average for channelized Class 7 low gradient bio sites	**11.7**	**9.8**	**17.3**	**28.6**	**56.0**	**6.5**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Table 148. DO related invert metrics for stream reach.

07020005-670 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN034 8/20/2009	0.3	8.9	17	6.3		42.4	0.6
09MN034 8/20/2009	0.7	8.9	21	6.3		43.0	0.3
Statewide average for Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Summary

Most of the low DO related fish metrics at bio site 09MN034 scored poorly (Table 147). The central mudminnow is not considered a serial spawner so that is the only metric that did not score poorly.

Most of the low DO related invert metrics at bio site 17MN210 scored poorly (Table 148). The number of EPT present were very low, the HBI_MN score was above the class average, and taxa count was well below the class average. The percent of low DO tolerant invertebrates was over 40% to less than 15% of intolerant inverts present. The DO TIV score wouldn't be considered poor, but it was just one tenth above the class average.

Only one DO measurement was taken during the fish sampling visit; it was 11.6 mg/L, above the warmwater standard of 5 mg/L.

Due to the biological metrics, it is highly likely that DO is stressing the biological community. Based on the lack of data, DO is inconclusive as a stressor in this reach.

3.3.2.6 Eutrophication

Eutrophication Biological Metric Data

Table 149. Eutrophication related fish metrics for stream reach.

07020005-670 **Fish Class 7** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN034 7/01/2009	1	0	0	0		100	0
Statewide average for channelized Class 7 low gradient bio sites	**11.7**	**6.6**	**16.4**	**20.5**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Table 150. Eutrophication related invert metrics for stream reach.

07020005-670 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN034 8/20/2009	87.5	5	0.3	56.0	17		92.2	0
09MN034 8/20/2009	83.1	6	0.7	52.6	21		93.5	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.6**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Summary

The eutrophication related fish metrics at bio site 09MN034 mostly all scored poorly (Table 149). Since the central mudminnow is not an omnivore, that metric was zero. It is considered very tolerant to high phosphorus concentrations.

The eutrophication related invertebrate metrics at bio site 09MN034 all sored very poorly (Table 150). Mollusks and crustaceans dominated the invertebrate community as the snail *Physella* and the amphipod *Hyallella* were the two most numerous inverts present during both visits. Collector-gatherer taxa were well below the class average and there were only a couple EPT present. The percent of scrapers was very high as *Physella* is considered one, and there were several other snails that are considered scrapers present. Total taxa count was well below the class average. Over 90% of the total number of inverts caught during both site visits are considered tolerant to high phosphorus concentrations.

Only two samples were collected for phosphorus, one in 2009 and one in 2022. Neither were above the standard of 0.100 mg/L.

The biological community is showing the effects of the elevated phosphorus. Phosphorus sampling was very limited and did not show elevated concentrations. Moderate algae growth was observed at the station. Eutrophication is very likely a stressor in this reach but due to lack of elevated phosphorus concentrations it is inconclusive as a stressor in this reach.

3.3.2.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 151. TSS related fish metrics for stream reach.

07020005-670 **Fish Class 7** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN034 7/01/2009	0	0	0	0	0	0	0	11.9		0	0
Statewide average for channelized Class 7 low gradient bio sites	**12.2**	**4.4**	**8.2**	**7.1**	**13.4**	**7.4**	**20.1**	**13.4**		↑	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 152. TSS related invert metrics for stream reach.

07020005-670 **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN034 8/20/2009	0.3	0	32.8	17.4		61.1	0.6
09MN034 8/20/2009	1.0	0	31.5	17.5		60.5	0.3
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Suspended Solids Summary

The TSS related fish metrics at bio site 09MN034 all scored very poorly (Table 151). Due to the central mudminnow being the only fish that was caught, its characteristics are reflected in the fish metrics, tolerance index value, and tolerance values at the bio site. The central mudminnow is neither tolerant or intolerant to TSS and its TIV value is below the channelized Class 7 average.

The TSS related invertebrate metrics at bio site 09MN034 all scored poorly. There was almost no collector – filterers and no Plecoptera present. Large numbers of the amphipod *Hyalella* were present, which is a sprawler. The TSS TIV score was above the class average for both visits and the percentage of tolerant inverts present was very high, especially when compared to the TSS intolerant percentage as only two Corydalidae individuals were present.

Invert TSS related metrics and tolerance values were poor. Habitat assessments indicated that siltation and embeddedness were an issue in the reach. The TSS sample taken during fish sampling was very low at only 3.6 mg/L. TSS is likely a stressor in this reach and the main way it is affecting it is by causing siltation and embeddedness; however, due to lack of supporting data, it is inconclusive at this time.

3.3.2.8 Nitrates

Nitrate Biological Metric Data

Table 153. Nitrate related invert metrics for stream reach.

07020005-670 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN034 8/20/2009	5.8	3.8		56.0	0
09MN034 8/20/2009	9.5	3.9		57.0	0.3
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 154. Nitrate monitoring data for stream reach.

07020005-670 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S011-084 (2022)	3.1 – 3.8 [3]	-	3.8 [1]	-	3.3 [2]	-	-	-
		Highest Value						
		-	3.8	-	3.4	-	-	-

Summary

The nitrate related invertebrate metrics at bio site 09MN034 were mostly poor (Table 153). There were some Trichoptera taxa present, though the actual numbers present were very low. The nitrogen TIV scores were just higher than the class average and the percentage of nitrate tolerant individuals was high during both site visits while almost no nitrate intolerant inverts were present.

Three samples were collected in reach 07020005-670 and analyzed for nitrate (Table 154). None of the nitrate samples had concentrations greater than 8 mg/L, the proposed nitrate criteria for protection of aquatic life. Though the biological response appears to be poor, *Physella*, a snail that is very tolerant to nitrogen, dominated the invertebrate community and skewed the nitrate metrics and tolerance values. While it can’t be ruled out that nitrate may be causing some of the stress to the biological community, due to the fact that snails are generally considered tolerant to a lot of different stressors, along with the relatively low nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-670.

3.3.2.9 Reach Stressors

Table 155. Summary of stressors for stream reach.

07020005-670	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	O	O	O	O

3.3.3 07020005-712 Unnamed creek

Figure 19. Satellite image of reach 07020005-712 and its watershed.

3.3.3.1 Biological Community

Bio site 09MN026 was sampled once for fish in 2009. The IBI score was 38.3, below the general use threshold of 50 (Table 156). Sensitive taxa were markedly diminished (northern redbelly dace and blacknose shiner) and were present in low numbers. The fish community was dominated by very tolerant individuals, mostly fathead minnows.

Biological Metric Data

Table 156. Fish IBI score and threshold for stream reach.

07020005-712 **Fish Class 2** **General Use**	Fish IBI Score	Class Threshold Score
09MN026 6/10/2009	38.3	50

3.3.3.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 157. Hydrologic alteration related fish metrics for stream reach.

07020005-712 **Fish Class 2** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
09MN026 6/10/2009	70.9	67.4
Statewide average for natural Class 2 southern stream bio sites	**42.5**	**19.1**
Expected response to **Hydrologic** stress	↑	↑

Hydrologic Alteration Summary

The fish biological metrics for altered hydrology are poor (Table 157). Generalist and nesting fish were well above the class average as the most numerous taxa present, fathead minnows, are considered both a generalist and nesting fish. The stream reach around and immediately downstream of the bio site has been altered and a wetland appears to have been ditched through and drained directly downstream of bio site 09MN026.

Based on the alteration and ditching of the stream reach and the poor scores of the biological metrics as well as the dominance of fathead minnows, a fish typically seen in highly altered streams, hydrologic alteration is a stressor in this reach.

3.3.3.3 Connectivity

Connectivity Metric Data

Table 158. Connectivity related fish metrics for stream reach.

07020005-712 **Fish Class 2** **General Use**	Mature Age >3 %	Migrating Individual %
09MN026 6/10/2009	7.7	1.5
Statewide average for natural Class 2 southern stream bio sites	**23.9**	**28.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

The fish biological metrics for connectivity are very poor. There were only two late-maturing taxa caught, yellow perch and white suckers. Of those two, only 14 yellow perch and one white sucker was caught. Only two migrating taxa were caught, blackside darters and white suckers. Only two blackside darters were caught.

Figure 20. Photo of the bridge culvert just upstream of bio site 09MN026.

The culvert at the road crossing just upstream does appear to be very wide and shallow, as the water was only a few inches deep as it was coming through the culvert and may be a fish barrier during moderate to low flows (Figure 20).

Due to the low numbers of migratory and late maturing species, as well as the observations of the culvert during site visits, connectivity could be a stressor to the bio site. At this time, it is inconclusive as a stressor in reach 07020005-712.

3.3.3.4 Habitat

Habitat Metric Data

Table 159. Habitat related fish metrics for stream reach.

07020005-712 **Fish Class 2** **General Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN026 6/10/2009	2.0	1.0	2.6	64.8	0	0.5	2.0	72.5
Statewide average for natural Class 2 southern stream bio sites	**20.4**	**18.2**	**58.3**	**19.0**	**5.2**	**32.5**	**19.4**	**44.9**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 160. Habitat related fish tolerance values for stream reach.

07020005-712 **Fish Class 2** **General Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN026 6/10/2009	66.3	0		84.7	0		71.9	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 161. Habitat assessment scores for stream reach.

07020005-712	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN026 6/10/2009	2.5	10.5	14	12	26	65
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The fish biological metrics for habitat are all very poor (Table 159). Very few nontolerant benthic insectivores, darters, and lithophilic spawners were present. Pioneer species were high as fathead minnows dominated the bio community. No piscivores were present and only one individual riffle dwelling fish, the white sucker, was caught. Simple lithophilic spawners consisted of only two blackside darters, one common shiner, and one white sucker. Seventy-two percent of the total number of fish present are considered tolerant. Tolerance values are also poor as fathead minnows are considered very tolerant to low MSHA scores, high embeddedness, and tolerant to poor substrate. Fathead minnows made up 66.3% of the total number of fish caught.

The reach had one MSHA assessment done in 2009. Overall, the reach scored a 65 out of a possible score of 100, which is a decent score and seems to contradict the habitat biological metrics and tolerance values at site 09MN026. Much of the stream segment (>90%) was found to have modified habitat characteristics consistent with channelization. There is a small section starting just upstream of the bio site down to just below the bio site that has naturally occurring meanders and geomorphology, causing the MSHA scores to be better at the bio site and not indicative of most of the stream reach.

Habitat related fish metrics and habitat tolerance values were very poor. Although the MSHA scores were decent right at the bio site, most of the stream reach is channelized. Habitat is a stressor to the biological community.

3.3.3.5 Dissolved Oxygen

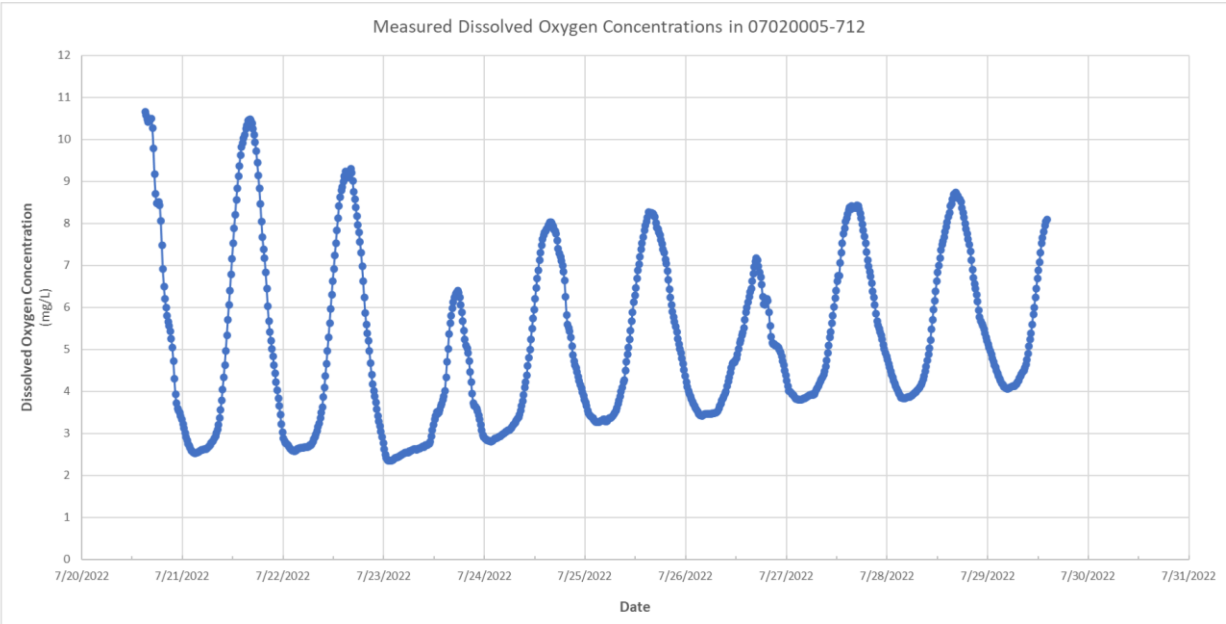
Dissolved Oxygen Biological Metric Data

Table 162. DO related fish metrics for stream reach.

07020005-712 **Fish Class 2** **General Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO Relative Abundance TIV		DO Tolerant %	DO Sensitive %
09MN026 6/10/2009	14	7.7	2.0	80.6	72.5	8.2		83.7	0
Statewide average for natural Class 2 southern stream bio sites	**20.4**	**23.9**	**18.7**	**27.8**	**44.9**	**8.4**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Dissolved Oxygen Monitoring Data

Figure 21. Measured DO values from a YSI sonde deployment.



Dissolved Oxygen Summary

The low DO related fish metrics and tolerance values at bio site 09MN026 all scored poorly (Table 162). Taxa count was low at only 14. The percentage of late-maturing fish was very low as only 13 perch and 1 white sucker were caught. The only sensitive fish were three blacknose shiners and one northern redbelly dace, which are very tolerant to low DO. Serial spawning fish were very high, at 80.6% of the total number of fish caught. Fathead minnows, a serial spawner, dominated the fish community. Tolerant fish were 72.5% of the total number of fish caught, well above the class average. The DO tolerance index value was below the class average. 83.7% of all the fish caught are considered tolerant to low DO.

One DO measurement was taken in July of 2022. The value was measured at 10.9 mg/L, above the standard of 5 mg/L. A YSI Sonde DO meter was deployed from July 20, 2022 to July 29, 2022. Every night the meter was deployed, the DO dropped below the standard of 5mg/L.

Based on the poor DO related fish metrics and low measured DO values, DO is a stressor in this reach.

3.3.3.6 Eutrophication

Eutrophication Biological Metric Data

Table 163. Eutrophication related fish metrics for stream reach.

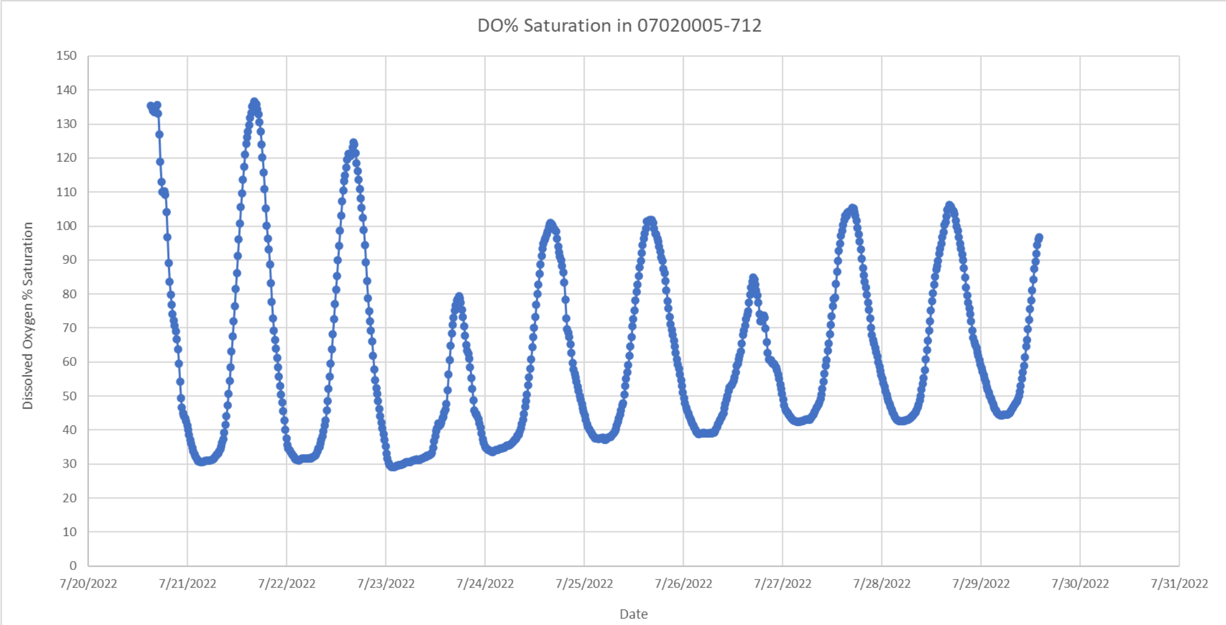
07020005-712 **Fish Class 2** **General Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN026 6/10/2009	14	1.0	68.9	2.0		81.1	1.5
Statewide average for natural Class 2 southern stream bio sites	**20.4**	**11.7**	**16.5**	**19.4**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 164. Phosphorus monitoring data for stream reach.

07020005-712 P Data 0.100 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-080 (2022)	0.106 – 0.157	-	-	-	0.133 [2]	-	-	-	0.133 [2]
		Maximum Value							
		-	-	-	0.157	-	-	-	

Figure 22. Measured DO percent saturation values from a YSI sonde deployment.



Eutrophication Summary

The eutrophication related fish metrics at bio site 09MN026 mostly all scored poorly (Table 163). Taxa count was well below the class average with only 14 unique taxa caught. Darter percentage was vey low as only two blackside darters were caught. Omnivore percentage was very high, especially compared to the class average, as fathead minnows dominated the fish community. There were some other omnivores present in lower numbers as well, such as the very tolerant black bullhead, yellow bullhead, and blacknose shiner. Simple lithophilic spawners were also very low at only 2% of the total number fish caught. Four out of the top five fish taxa caught are considered either tolerant or very tolerant to phosphorus.

Only two samples were collected for phosphorus from 2022. Both were above the central standard of 0.100 mg/L (Table 164). Continuous DO concentrations were measured during a YSI sonde deployed from July 21st to July 29th 2022 (Figure 20). DO flux was measured above 8 mg/L. Continuous DO percent saturation was measured in 2022 using a YSI sonde deployed from July 21st to July 29th (Figure 21). The percent saturation was measured above 100% several times during the sonde deployment.

The biological community is showing the effects of elevated phosphorus. Phosphorus sampling was very limited but did show elevated concentrations. DO flux was measured above 5 mg/L, and DO percent saturation was elevated as well. Eutrophication is a stressor in this reach.

3.3.3.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 165. TSS related fish metrics for stream reach.

07020005-712 **Fish Class 2** **General Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	Relative Abundance TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN026 6/10/2009	1.5	0	0.5	7.1	8.2	0.5	2.0	23.3		13.7	2.0
Statewide average for natural Class 2 southern stream bio sites	**37.4**	**4.9**	**9.6**	**11.7**	**18.7**	**32.5**	**39.4**	**18.1**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Suspended Solids Summary

The TSS related fish metrics at bio site 09MN026 all scored poorly (Table 165). There were very few benthic feeders, herbivores, riffle dwellers, and simple lithophilic spawners. There were no nontolerant Centrarchids present. There were some long-lived fish present, but they were still below the class average as only 14 yellow perch were present. The TSS relative abundance tolerance index value was five percentage points above the class average. TSS tolerant fish were only 13% of the total number of fish caught, as 27 spotfin shiners were caught, the second most numerous fish present. There were a few TSS intolerant fish caught.

There was only one TSS sample taken within the reach during a bio site visit. The TSS concentration was 16mg/L, below the standard of 30 mg/L. Four Secchi tube measurements were done during site visits in 2022. None were below the central river region Secchi tube target of 25cm.

Although the TSS related bio metrics are poor and could indicate that TSS is stressing the bio community, the percentage of TSS tolerant individuals caught was relatively low compared to other bio sites. TSS is inconclusive as a stressor to aquatic life at this time. It is likely that other factors, such as altered hydrology and habitat are contributing to the poor fish metrics. It is recommended to collect more TSS data and conduct a sediment substrate analysis in order to determine whether TSS is a biological stressor.

3.3.3.8 Nitrates

Nitrate Biological Metric Data

Table 166. Nitrate related invert metrics for stream reach.

07020005-712 **Invert Class 7** **General Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN026 8/11/2009	7.1	3.2		57.5	0
Statewide average for natural Class 7 prairie stream glide pool bio sites	**10.9**	**3.2**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 167. Nitrate monitoring data for stream reach.

07020005-712 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S011-080 (2022)	0 – 0.4 [6]	-	-	0.4 [1]	0.1 [5]	-	-	-
		Highest Value						
		-	-	0.4	0.4	-	-	-

Summary

The nitrate related invertebrate metrics at bio site 09MN026 were mixed (Table 167). While there were some Trichoptera taxa present, the percentage fell below the class average. There was a high amount of nitrate tolerant invertebrates as well as complete lack of nitrate intolerant invertebrate species. The nitrogen TIV score did score right at the class average.

Six samples were collected in reach 07020005-712 and analyzed for nitrate (Table 167). All the concentrations were very low, under 1 mg/L, and well below 8 mg/L, the proposed nitrate criteria for protection of aquatic life. The biological response could be interpreted as showing nitrate stress but there are relatively low nitrate concentrations. As such, nitrates are inconclusive as a stressor to aquatic life.

3.3.3.9 Reach Stressors

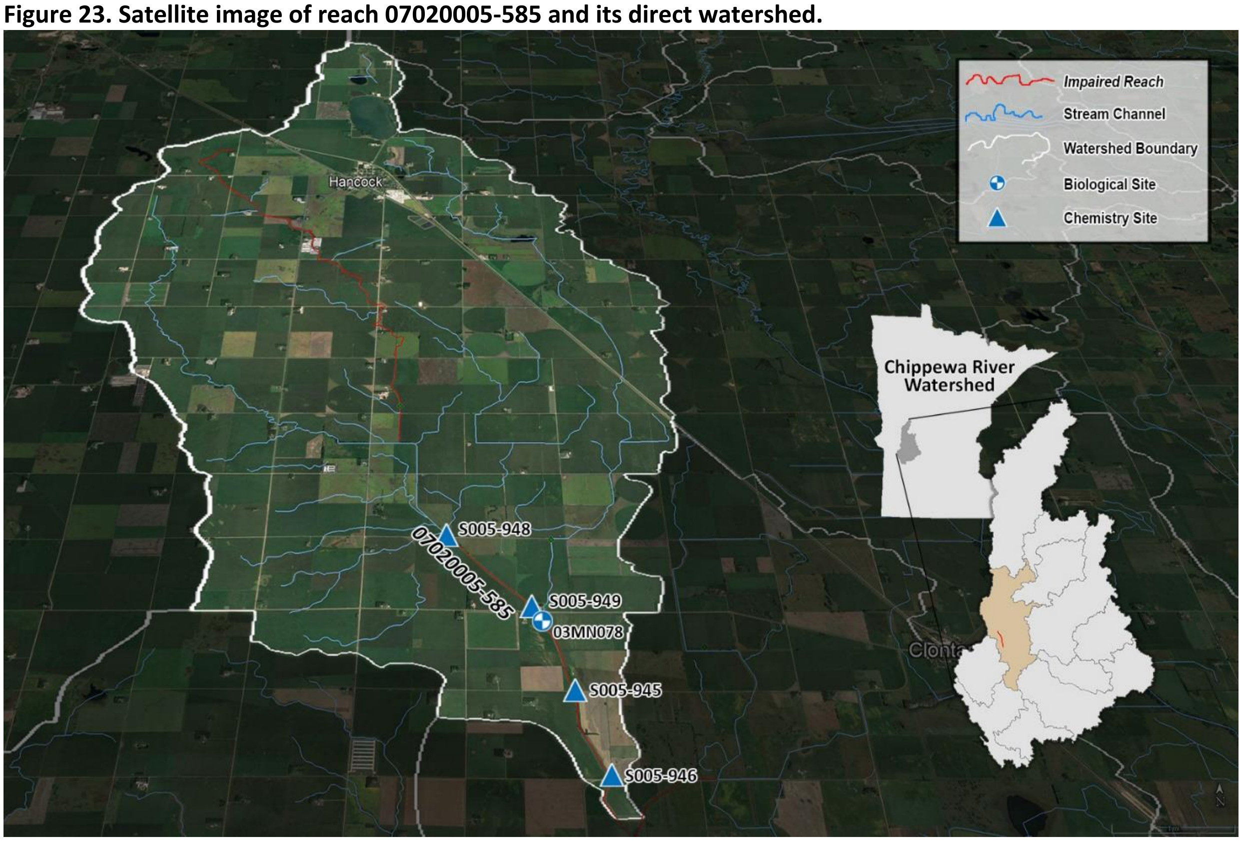
Table 168. Summary of stressors for stream reach.

07020005-712	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	✓	✓	O	O

3.4 County Ditch No. 3

3.4.1 07020005-585 Judicial Ditch 9

Figure 23. Satellite image of reach 07020005-585 and its direct watershed.



3.4.1.1 Biological Community

Reach 07020005-585 was sampled for fish in both 2009 and 2019. The FIBI scores of 0 and 7.4 are well below the Fish Class 2 southern stream modified use threshold of 35 (Table 169). In the latest site visit, johnny darters were the most numerous fish taxa present and although it was the only nontolerant fish present, it is considered a short lived, nesting, pioneer fish. Sensitive taxa were markedly diminished, and the site had a reduced complexity and redundancy of ecosystem function. There were a total of five fish species collected and all were tolerant except one. No sensitive species were present.

Biological Metric Data

Table 169. Fish IBI score and threshold for stream reach.

07020005-585 **Fish Class 2** **Modified Use**	Fish IBI Score	Class Threshold Score
03MN078 6/23/2009	0.0	35
03MN078 8/08/2019	7.4	

3.4.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 170. Hydrologic alteration related fish metrics for stream reach.

07020005-585 **Fish Class 2** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
03MN078 6/23/2009	54.9	20.9
03MN078 8/08/2019	16.9	55.4
Statewide average for channelized Class 2 southern stream bio sites	**43.9**	**30.6**
Expected response to **Hydrologic** stress	↑	↑

Hydrologic Alteration Summary

The hydrologic alteration related fish biological metrics were mixed (Table 170). The metric scores were actually opposite each other for the different years when compared to the class averages. In the 2019 sample, generalists were relatively low and were below the class average as there were only 11 blacknose dace and 3 white suckers caught. Nesting fish were high as the most numerous fish present, the johnny darter, are considered a nesting fish. Out of the five fish taxa caught, four of them are considered either very tolerant or tolerant.

Reach 07020005-585, also called Judicial Ditch 9, is entirely ditched and channelized. The stream channel has been shaped and altered to carry water quickly and efficiently, and as such, there are little to no geomorphic features present and the ditch's elevation has been lowered compared to the surrounding land. This has affected both habitat and connectivity and as such, altered hydrology is a stressor to the biological community in reach 07020005-585.

Figure 24. Photo showing reach 07020005-585 near bio site 03MN078.

3.4.1.3 Connectivity

Connectivity Metric Data

Table 171. Connectivity related fish metrics for stream reach.

07020005-585 **Fish Class 2** **Modified Use**	Mature Age >3 %	Migrating Individual %
03MN078 6/23/2009	0	0
03MN078 8/08/2019	3.6	3.6
Statewide average for channelized Class 2 southern stream bio sites	**28.0**	**21.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Metrics related to connectivity were very poor (Table 171). The only late maturing or migrating fish present were three white suckers. Latitudinal connectivity appears to be an issue as the stream has been ditched and entrenched, essentially cutting it off from its floodplain. The type of culvert just upstream of the bio site has a very wide, flat bottom and could likely be a longitudinal fish barrier, though it is unclear at this time. Connectivity is likely a stressor to the biological community in reach 07020005-585.

3.4.1.4 Habitat

Habitat Metric Data

Table 172. Habitat related fish metrics for stream reach.

07020005-585 **Fish Class 2** **Modified Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
03MN078 6/23/2009	4.3	4.3	54.9	4.3	0	0	54.9	95.8
03MN078 8/8/2019	51.8	51.8	16.9	51.8	0	3.6	16.9	48.2
Statewide average for channelized Class 2 southern stream bio sites	**19.1**	**16.5**	**35.6**	**23.6**	**8.0**	**19.5**	**26.2**	**46.4**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 173. Habitat related fish tolerance values for stream reach.

07020005-585 **Fish Class 2** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
03MN078 6/23/2009	16.6	54.9		23.4	0		17.5	0
03MN078 8/8/2019	3.6	13.3		0	0		31.3	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 174. Habitat assessment scores for stream reach.

07020005-585	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
03MN078 8/7/2019	0	7	7	10	6	30
03MN078 8/8/2019	0	8	15	10	7	40
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The fish community in reach 07020005-585 scored poorly in most of the habitat related fish metrics when compared to all other channelized Class 2 bio sites (Table 172). The characteristics of the johnny darter is influencing the metrics of the 2019 sample as there were more of them than all the other fish combined. Benthic insectivores and darter percentages were the same percentage as the number of johnny darters present, both were above the class average. Lithophilic spawners and simple lithophilic spawners decreased from 2009 to 2019 as only 11 blacknose dace were present in the 2019 sample. However, in 2009, 129 blacknose dace were caught, bringing the percentage of lithophilic spawners above the class average. No piscivores were present either year and riffle dwelling fish were either not present or very low. Tolerant fish percentage actually decreased in 2019 due to the fact that the johnny darter is not considered tolerant.

Fish tolerance values were somewhat mixed (Table 173). The percentage of fish that are tolerant to low MSHA scores compared to ones that are sensitive scored well as there were 11 blacknose dace present in the sample, a fish that is sensitive to low scores. Percent embeddedness didn't show much as there were no fish caught that are sensitive or tolerant to that value. Low substrate scores were poor as 31.3% of the total number of fish present are considered tolerant to that value. The second most numerous fish caught during the 2019 visit is the central mudminnow, which is considered generally very tolerant and is also considered very tolerant to low substrate as well as high amounts of fine sediment.

The MSHA scores were poor (Table 174). In the latest visits the bio site scored a 30 and 40 out of 100. Surrounding land use was very poor as it scored a zero, which is typical of sites in areas with high agriculture. Most of the other habitat scores were somewhere in the middle as the riparian zone, substrate, and cover were somewhere in the middle of their maximum scores. The substrate score was better on the August 8th visit as gravel was observed, bringing the score up. More silt was observed on the August 7th site visit and no coarse substrate was present in the location of that habitat assessment. Channel morphology scores were poor for both visits as there was low depth variability, sinuosity, channel development, and no riffles observed. Evidence of dredging was observed during both assessments as well.

Due to the mostly poor habitat biological metric scores and MSHA scores, habitat is a stressor to the fish biological community. Due to complete lack of riffle dwelling fish, the high percentage of low substrate tolerant fish, and the poor geomorphic MSHA scores, it appears that lack of geomorphic features, such as riffles and pools, along with lack of coarse substrate, are causing biological stress to the fish community.

3.4.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 175. DO related fish metrics for stream reach.

07020005-585 **Fish Class 2** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Intolerant %
03MN078 6/23/2009	5	0	0	23.4	95.8	8.5		17.5	0
03MN078 8/8/2019	5	3.6	0	0	48.2	7.2		31.3	0
Statewide average for channelized Class 2 southern stream bio sites	**14.5**	**28.0**	**8.4**	**25.3**	**46.4**	**8.2**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Dissolved Oxygen Monitoring Data

Table 176. DO monitoring data for stream reach.

07020005-585 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-945 **S005-946** **S005-948** **S005-949** (2009-2017)	5.74 – 12.21	-	0% [6]	0% [47]	0% [32]	0% [36]	0% [10]	0% [1]	0% [131]
		Minimum Value							
		-	8.5	6.5	6.8	5.7	6.4	9.1	

Dissolved Oxygen Summary

The fish community scored mostly poorly in DO related fish metrics when compared to the channelized Class 2 averages (Table 175). Taxa count was low and very few late-maturing fish were present. There were also no sensitive fish caught. Generally, tolerant fish were lower in the 2019 sample and just above the class average, due to the abundance of johnny darters caught, which are not considered tolerant or sensitive. The DO TIV decreased from 2009 to 2019 and the percentage of DO tolerant fish increased in the same time period. The percentage of serial spawning fish was the only metric that scored well when compared to the class average and the bigmouth shiner, which was the second most numerous fish caught in 2009 was absent in 2019.

Although no DO measurements taken during sampling were below the warmwater standard of 5 mg/L, none of those measurements were taken before 8:00a.m., when values are usually the lowest (Table 176).

Based on the mostly poor low DO related biological metric scores and tolerance values the biological community is likely stressed by low DO. Due to the fact that the DO dataset is rather robust with 131 samples taken over 8 years, and none of the samples showed low values, DO is inconclusive as a stressor in this reach.

3.4.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 177. Eutrophication related fish metrics for stream reach.

07020005-585 **Fish Class 2** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
03MN078 6/23/2009	5	4.3	0	54.9		17.5	0
03MN078 8/8/2019	5	51.8	3.6	16.9		31.3	0
Statewide average for natural Class 2 southern stream bio sites	**14.5**	**13.6**	**25.5**	**26.2**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Eutrophication Summary

The eutrophication related fish metrics were somewhat mixed, especially in the 2019 sample (Table 177). The percentage of darters was relatively high as there were 43 johnny darters present, the most numerous fish caught in 2019. Omnivores were very low and though simple lithophilic spawners did decrease from 2009 to 2019, there were some present, such as the central mudminnow and white sucker.

There were only two samples collected and analyzed for phosphorus in July of 2022. The concentrations were 0.022 mg/L and 0.030 mg/L, well below the standard of 0.100 mg/L for TP.

The eutrophication related biological metrics were mixed and sampling, though limited, did not show elevated levels of phosphorus. DO data did not show excessively high or low DO values, as is typical in streams with eutrophication issues. While there was a large percentage of phosphorus tolerant individuals present, due to lack of supporting evidence, eutrophication is inconclusive as a stressor in this reach.

3.4.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 178. TSS related fish metrics for stream reach.

07020005-585 **Fish Class 2** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
03MN078 6/23/2009	4.3	0	0	0	4.3	0	54.9	13.0		0	0
03MN078 8/8/2019	55.4	0	0	0	51.8	3.6	16.9	12.0		0	0
Statewide average for channelized Class 2 southern stream bio sites	**30.1**	**6.2**	**2.9**	**21.3**	**28.7**	**19.5**	**26.2**	**18.8**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

TSS Monitoring Data

Table 179. Transparency monitoring data for stream reach.

07020005-585 Secchi Tube Data 30 cm target	Range of Data (cm)	% of Monthly Samples < 30 cm [# of Samples]							% of Total Samples < 30 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-945 **S005-946** **S005-948** **S005-949** (2009-2022)	12 – 100+	-	0 [6]	2.1 [48]	0 [40]	0 [36]	40 [10]	0 [1]	3.5 [141]

Suspended Solids Summary

The fish community in reach 07020005-585 scored poorly in four out of eight TSS related fish metrics (Table 175). There was a high percentage of benthic feeders and Perciformes, as the johnny darter was the most numerous fish caught. Simple lithophilic spawners were present but were below the class average. There were no Centrarchids, herbivores, or long – lived fish present. Riffle dwelling fish were very low as only three white suckers were caught. The TSS TIV was well below the class average as there were no fish caught that are considered tolerant to TSS.

There was 141 transparency measurements conducted from 2009 through 2022. Only 3.5% of the measurements were below 30mg/L, all of which were in September of 2010.

Due to the mixed TSS fish metrics and tolerance values, as well as the extensive dataset showing high transparency readings, TSS is inconclusive as a stressor to aquatic life in reach 07020005-585.

3.4.1.8 Nitrates

Nitrate Biological Metric Data

Table 180. Nitrate related invert metrics for stream reach.

07020005-585 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
03MN078 8/10/2009	2.9	3.2		71.9	0
03MN078 8/07/2019	8.1	1.9		23.4	0.3
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 181. Nitrate monitoring data for stream reach.

07020005-585 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S005-949 (2022)	0.1 – 0.41 [4]	-	-	-	0.28 [4]	-	-	-
		Maximum Value						
		-	-	-	0.41	-	-	-

Summary

The nitrate related invert metrics and tolerance values were mixed in reach 07020005-585 (Table 180). There were some caddisfly taxa present and the percentage was above the class average, though the most numerous caddisflies were *Cheumatopsyche*, which is considered very tolerant to nitrates. The nitrogen tolerance index value was below the class average as the site was dominated by Oligochaeta, which is neither tolerant nor intolerant to nitrates.

Four nitrate samples were either collected or measured in reach 07020005-585 (Table 181). All four were extremely low, well below the 8 mg/L proposed nitrate criteria for protection of aquatic life. Due to the mixed biological response and low measured nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-585.

3.4.1.9 Reach Stressors

Table 182. Summary of stressors for stream reach.

07020005-585	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	O	O	O	O

3.4.2 07020005-694 Unnamed creek

Figure 25. Satellite image of reach 07020006-503 and its watershed.

3.4.2.1 Biological Community

Invertebrate sampling in reach 07020005-694 was done once in 2009 and scored an 11.6, well below the threshold of 22 (Table 183). Invert sample is largely comprised of tolerant taxa, predominantly *Dicrotendipes* (midge), Oligochaeta (worm), and *Physa* (snail).

Biological Metric Data

Table 183. Invert IBI score and threshold for stream reach.

07020005-694 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN061 8/10/2009	11.6	22

3.4.2.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 184. Hydrologic alteration related invert metrics for stream reach.

07020005-694 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth Variability Tolerant %	Low Depth Variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
09MN061 8/10/2009	9.5	5.8	0.3		74	0		73.7	0		0.3	7.6
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**		↑	↓		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓									

Hydrologic Alteration Summary

Hydrologic alteration related invert metrics and tolerance values were mostly poor (Table 184). The percentage of clingers was low as only a few midges that are considered clingers were caught. Collector-filterers were also low as only 13 individuals of the midge rheotanytarsus were caught. There were almost no long-lived inverts present. Both tolerance percentages for percent ditched and low depth variability were very high as the midge *Dicrotendipes* made up over 60% of the total number of inverts caught. *Dicrotendipes* is considered very tolerant to ditching as well as tolerant to low depth variability. Low flow tolerance values scored well as there were very few low flow tolerant inverts present.

The invert biological community appear to be showing a negative response from hydrologic alteration. with the fish metrics showing a negative response. The entire reach has been ditched and shaped to move water off the landscape and there are very few geomorphic features and coarse sediments observed in the reach. Hydrologic alteration appears to be a stressor to the invert community in this reach.

3.4.2.3 Connectivity

Connectivity Metric Data

Table 185. Connectivity related fish metrics for stream reach.

07020005-694 **Fish Class 3** **Modified Use**	Mature Age >3 %	Migrating Individual %
09MN061 7/01/2009	0	0
Statewide average for Class 3 southern headwater bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Figure 26. Bridge crossing near bio site 09MN061.

There were no fish whose females take greater than three years to mature or any migrating fish present (Table 185). The bridge crossing and culverts right at the bio site are likely a fish barrier during low flows (Figure 26).

Due to the absence of late maturing and migratory species and evidence of a fish barrier at the road crossing, it appears that connectivity is likely a stressor in reach 07020005-694, though is inconclusive at this time.

3.4.2.4 Habitat

Habitat Metric Data

Table 186. Habitat related invert metrics for stream reach.

07020005-694 **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN061 8/10/2009	71.9	14.1	9.5	0.3	95.1	3.1
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 187. Habitat related invert tolerance values for stream reach.

07020005-694 **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN061 8/10/2009	74.0	0		13.8	0		67.9	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 188. Habitat assessment scores for stream reach.

07020005-694	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN061 7/01/2009	0	7	5	14	7	33
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The invert community in reach 07020005-694 scored poorly in almost all the habitat related invert metrics and tolerance values (Table 186 and 187). The percentage of burrowers was very high as the two most numerous inverts present, *Dicrotendipes* and Oligochaeta, are burrowers. Climber, clinger, and EPT percentages were well below the class averages. The most prevalent climbers were the 20 *Physella* snails caught, which are very tolerant to many habitat related metrics. Almost all of the inverts present were legless, which are very common in reaches with poor habitat. The only good metric was the low percentage of sprawlers present. Tolerance value percentages were poor as well, especially the MSHA scores and substrate tolerant percentages. There were no intolerant individuals of those same tolerance values.

One MSHA score was calculated during the 2009 reach and was poor (Table 188). Substrate scored very poorly as only silt was observed during the site visit. Channel morphology was also very poor as there was no sinuosity, no riffles, poor channel development, and embeddedness of coarse sediment.

Invertebrate metrics and tolerance values were very poor as was the MSHA score. *Dicrotendipes*, the most numerous invert present, is considered tolerant and very tolerant to poor substrate and poor MSHA scores. Habitat is a stressor to the invertebrate community in reach 07020005-694.

3.4.2.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 189. DO related invert metrics for stream reach.

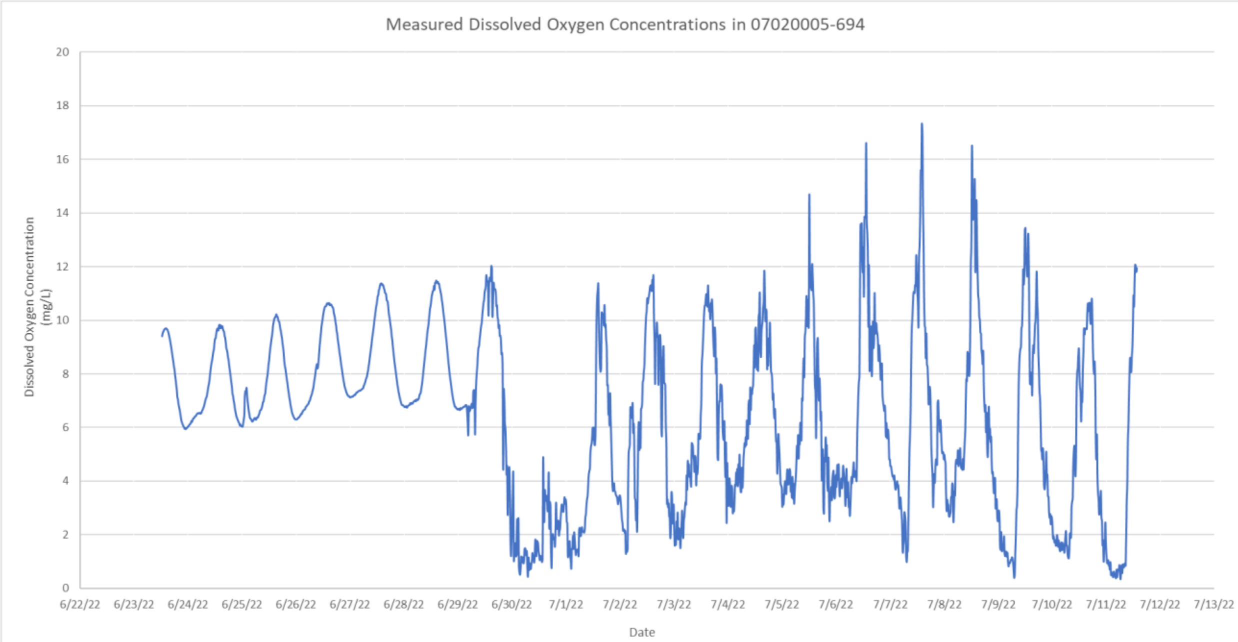
07020005-694 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN061 8/10/2009	0.3	7.9	24	5.5		67.3	0
Statewide average for Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 190. DO monitoring data for stream reach.

07020005-694 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-950 **S005-951** **S005-952** **S005-953** **S005-954** **S005-971** (2012-2022)	4.0 – 16.5	-	-	0% [28]	7.1% [14]	0% [9]	0% [3]	-	1.9% [54]
		Minimum Value							
		-	-	6.6	4.0	5.6	7.9	-	

Figure 27. Continuous DO data at site 09MN061.



Dissolved Oxygen Summary

Invertebrate metrics related to low DO were mostly poor, with only the HBI_MN score that was just below the class average (Table 186). There were very few EPT inverts present and both taxa count and the DO TIV were below the class average. The percentage of low DO tolerant inverts present was 67.3% and there were no inverts caught that are considered intolerant to low DO (Table 187). The most numerous invert present, *Dicrotendipes*, is considered tolerant to DO.

There were 54 DO measurements taken from 2012 to 2022. During this time only one measurement was below 5 mg/L. A YSI sonde was deployed from 6/23/22 to 7/11/22. During this deployment, DO values were measured below the standard of 5 mg/L over half the nights (Figure 27).

Based on the mostly poor biological metric scores and tolerance values and the measured sonde values, DO is a stressor in this reach.

3.4.2.6 Eutrophication

Eutrophication Biological Metric Data

Table 191. Eutrophication related invert metrics for stream reach.

07020005-694 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN061 8/10/2009	6.4	12	4.2	8.3	24		12.9	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.6**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 192. Phosphorus monitoring data for stream reach.

07020005-694 P Sample Data 0.15 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-950 (2022)	0.040 – 0.047	-	-	-	0.044 [2]	-	-	-	0.044 [2]
		Maximum Value							
		-	-	-	0.047	-	-	-	

Table 193. DO% Saturation monitoring data for stream reach.

07020005-694 DO% Sat Data	Range of Data (%)	Monthly Average of Samples (%) [# of Samples]							June-Aug Average (%) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-950 (2022)	83.1 – 130.7	-	-	83.1 [1]	130.7 [1]	-	-	-	106.9 [2]

Eutrophication Summary

Eutrophication related Invert metrics were mixed throughout the reach and the metrics that scored poorly were generally the same from upstream to downstream. Crustaceans and mollusks were low and collector gatherer taxa count was just over the class average. Three out of the top four most numerous taxa are collector gatherers, the midges *Dicrotendipes* and *Microspectra*, and Oligochaeta. Scrapers were also low. The poor metrics include low numbers of EPT individuals and a lower-than-average taxa count. There were also some phosphorus tolerant species compared to no phosphorus intolerant species present.

Only two samples were collected and analyzed for phosphorus in 2022. The average was very low, well below the 0.100 mg/L eutrophication standard (Table 192). There was one high DO percent saturation value that was measured in the reach (Table 193) and diel DO flux was measured to be well above 5 mg/L during the sonde deployment (Figure 27).

The eutrophication biological metrics were mixed. Phosphorus sampling was limited and had low values. DO flux was high during the sonde deployment. Due to the bio metrics being mixed and limited phosphorus data, eutrophication is inconclusive as a stressor in this reach. It is recommended that more phosphorus and other related data is collected in this reach to further evaluate whether eutrophication is a stressor in this reach.

3.4.2.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 194. Eutrophication related invert metrics for stream reach.

07020005-694 **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN061 8/10/2009	5.8	0	3.1	12.3		9.8	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Monitoring Data

Table 195. Transparency monitoring data for stream reach.

07020005-694 Secchi Tube Data 25 cm target	Range of Data (cm)	% of Monthly Samples < 25 cm [# of Samples]							% of Total Samples < 25 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-950 **S005-951** **S005-952** **S005-953** **S005-954** **S005-971** (2009-2015)	10 - 100	-	0 [2]	2.3 [43]	0 [26]	15 [20]	20 [5]	-	5.2 [96]

Suspended Solids Summary

The TSS related invert metrics were mixed. Collector – filterer numbers were low and there were no Plecoptera present. Sprawler percentage was low, well below the average of 27. The TSS TIV score was well below the class average as well. Although there were no inverts present that are considered intolerant to TSS, the percentage of invert tolerant to TSS was just below 10, which is relatively not a low score.

Ninety-six transparency readings were taken within the reach from 2009 to 2015. August had a 15% exceedance of the 25 cm standard equivalent and there was a 5.2% exceedance of all the samples taken. It appears that transparency was worse in the late summer measurements, which may indicate that the TSS in the water column could be from algae growth, rather than sediment issues that typically occur during high flows in the springtime.

TSS metrics are mixed and although there are some exceedances in the S-tube measurements, the data is not too bad and is more of a problem in late summer. Due to the mixed bio metrics, TSS is inconclusive as a stressor to the biology in reach 07020005-694.

3.4.2.8 Nitrates

Nitrate Biological Metric Data

Table 196. Nitrate related invert metrics for stream reach.

07020005-694 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN061 8/10/2009	0	3.6		78.3	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 197. Nitrate monitoring data for stream reach.

07020005-694 Nitrate/Nitrite sampling data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S005-950 (2022)	0 – 20.9 [6]	-	-	12.8 [2]	0.1 [4]	-	-	-
		Highest Value						
		-	-	20.9	0.2	-	-	-

Summary

The macroinvertebrate assemblage in reach 07020005-694 scored poorly in most of the nitrate related metrics (Table 196). The reach had no Trichoptera taxa, which tend to decrease in streams with excessive nitrate values. The nitrate TIV score was above the class average and there were many nitrate tolerant invertebrates as well as almost a complete lack of nitrate intolerant invertebrates. Three out of the top four most numerous inverts present are considered very tolerant to high nitrates, including the midges *Dicrotendipes* and *Microspectra*.

Only six samples were collected in reach 07020005-694 (Table 197). There was one sample from June 9th that was very high (>20 mg/L) and one from June 23rd that was 4.6 mg/L. The rest of the samples, taken in July, were all below 1 mg/L. This is a typical trend seen in southwestern Minnesota where high levels of nitrates are seen in the spring when snow melt and runoff can carry high amounts of fertilizer and manure that were applied to the land into the stream.

Due to the very poor invert metrics and the evidence of very high nitrate values, nitrates appear to be a stressor in reach 07020005-694.

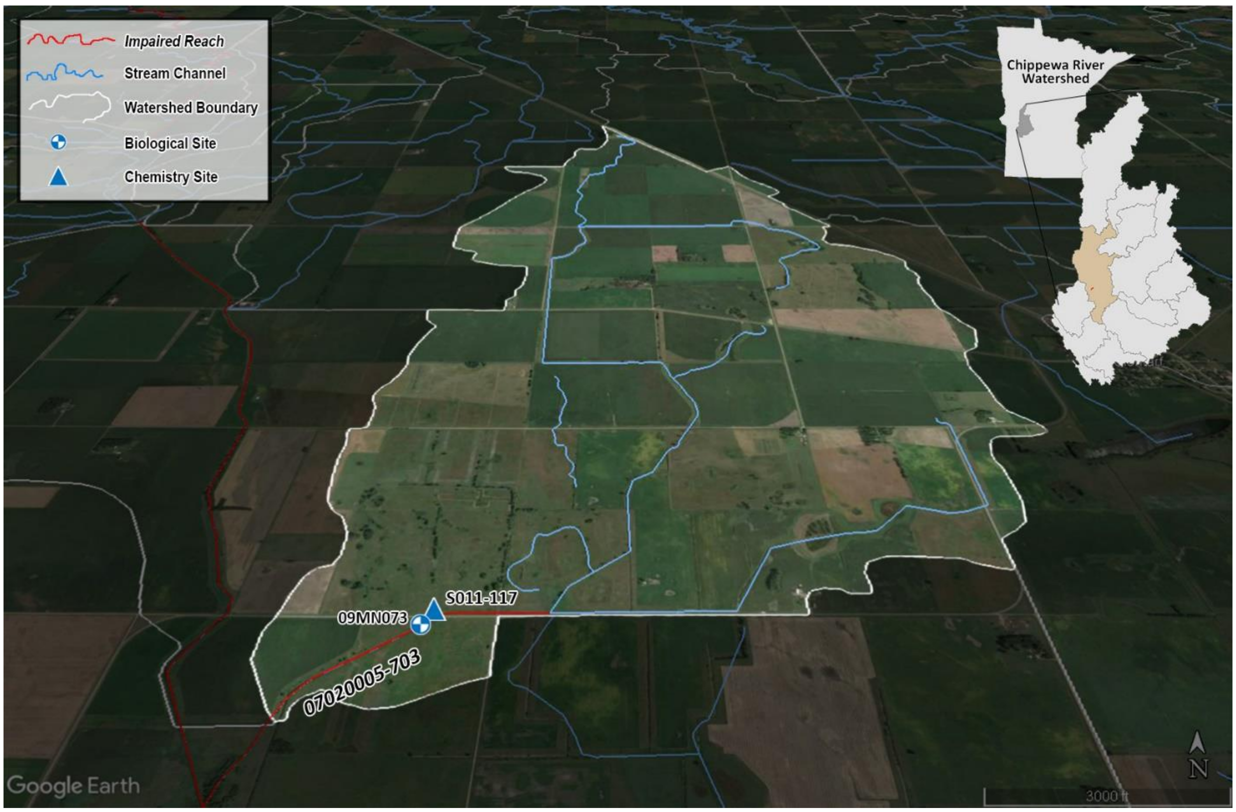
3.4.2.9 Reach Stressors

Table 198. Summary of stressors for stream reach.

07020005-694	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	✓	O	O	✓

3.4.3 07020005-703 Unnamed Creek

Figure 28. Satellite image of reach 07020005-703 and its watershed.



3.4.3.1 Biological Community

Reach 07020005-703 was sampled for invertebrates in August of 2009, the site scored a 16.4 out of a possible 31 (Table 199). The site was dominated by three taxa, *Caenis*, *Physella*, and *Hyalella*, all of which are tolerant. Although *Caenis* is a mayfly, it is one of the most tolerant mayflies, as it is considered tolerant to altered hydrology, habitat, and several nutrient parameters.

Biological Metric Data

Table 199. Invert class score and threshold for stream reach.

07020005-703 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN073 8/10/2009	16.4	31

3.4.3.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 200. Hydrologic alteration related invert metrics for stream reach.

07020005-703 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth Variability Tolerant %	Low Depth Variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
09MN073 8/10/2009	5.3	3.0	1.0		88.2	0		91.8	0.3		1.6	4.3
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**		↑	↓		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓									

Hydrologic Alteration Summary

Hydrologic alteration related invert metrics were mostly poor (Table 200). Clingers, at just 5.3% of the population, were well below the class average. Collector-filterers were also low as only a few tanytarsus midges were present in any numbers. Long-lived inverts were also below the class average at only 1%. The percentage of inverts tolerant to ditching and low depth variability were 88.2% and 91.8% respectively with very few to no intolerant individuals.

The hydrologic alteration related invert metrics were very poor, except for low flow tolerance values. The reach itself has been extensively ditched and straightened, as well as its tributaries upstream. Due to the poor biological metrics and tolerance values, and the alteration of the stream channel, hydrologic alteration is a stressor in reach 07020005-703.

3.4.3.3 Connectivity

Connectivity Metric Data

Table 201. Connectivity related fish metrics for stream reach.

07020005-703 **Fish Class 7** **Modified Use**	Mature Age >3 %	Migrating %
09MN073 6/10/2009	0	0
Statewide average for Fish Class 7 low gradient bio sites	**9.8**	**6.8**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Both connectivity related fish metrics were very poor as there were no late-maturing or migrating fish present (Table 201). There were only 35 fish caught total during the site visit and the two most numerous taxa are considered generally very tolerant and tolerant. The culvert at the road crossing near the bio site appears to be a fish barrier (Figure 29). The culvert is undersized compared to the stream channel width and relatively high velocities were observed going through it during the site visit. Due to the complete absence of late maturing or migratory species, it appears that connectivity is likely a stressor in reach 07020005-703, though it is inconclusive currently.

Figure 29. Culvert at the road crossing near bio site 09MN073.

3.4.3.4 Habitat

Habitat Metric Data

Table 202. Habitat related invert metrics for stream reach.

07020005-703 **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN073 6/10/2009	2.3	13.0	5.3	65.5	17.6	75.8
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**9.1**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 203. Habitat related invert tolerance values for stream reach.

07020005-703 **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN073 6/10/2009	92.8	0		92.8	0.3		20.3	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 204. Habitat assessment scores for stream reach.

07020005-703	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN073 6/10/2009	3	11	9	5	8	36
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

Habitat related invertebrate metrics were mixed, however, a closer look at the invertebrate community shows a poor invertebrate community in relation to habitat (Table 202). The bio community was dominated by one invertebrate, the mayfly *Caenis*, which made up over 64% of the total number of individual inverts present. As such, the characteristics of *Caenis* has influenced the metrics and tolerance values at the bio site. *Caenis* is considered tolerant to low MSHA score, very tolerant to high embeddedness, and tolerant to high percentages of fine sediment. It is also considered tolerant to low depth variability. Burrowers were low at the bio site as only five Pisidiidae pea clams were present. Climbers were present, but were mostly only *Physella* snails, which was the second most numerous taxa present. Clingers were very low and well below the class average and the clingers present consisted of midges and beetles. EPT percentage was high, though this was due to the dominance of *Caenis*. Spawlers made up over 75% of the total number of inverts present as *Caenis* is considered a sprawler, and the amphipod *Hyalella* was present as the third most numerous invert in the sample.

Tolerance values were also very poor (Table 203). Over 92% of the total number of inverts caught are considered tolerant to both poor MSHA scores and high embeddedness, with none to less than a percent of inverts considered intolerant. Low substrate values, while not as bad as the other two, was still poor as over 20% of the inverts caught are considered tolerant to poor substrate.

An MSHA score was calculated during the invert visit in 2009 and scored poorly at a 36 out of 100 (Table 204). While the riparian zone score was decent, due to the width of the riparian zone and no bank erosion. The reach has been altered and the banks have been shaped to move water efficiently and the bank sides are vegetated and have been shaped to an angle where erosion has been minimal around the bio site. Substrate scored poorly as there was no coarse substrate present except sand, and most of the stream bottom was covered in silt. Cover was poor as the ditch sides are comprised of brome, a relatively short grass that is often planted on areas that have been altered and constructed as it grows quickly and stabilizes disturbed soil but offers limited cover to the stream itself. Channel morphology was also observed to be poor, with a score of only 8 out of a possible 35. The ditch had almost no depth variability, no sinuosity, no riffles or pools, and poor channel development. Only slow and moderate stream velocity types were observed as well, as low channel development and poor geomorphology can contribute to slower stream flows.

Due to the mostly poor habitat related invert metrics and poor tolerance values, as well as the poor MSHA score, habitat is a stressor to the invert community in reach 07020005-703.

3.4.3.5 Dissolved Oxygen

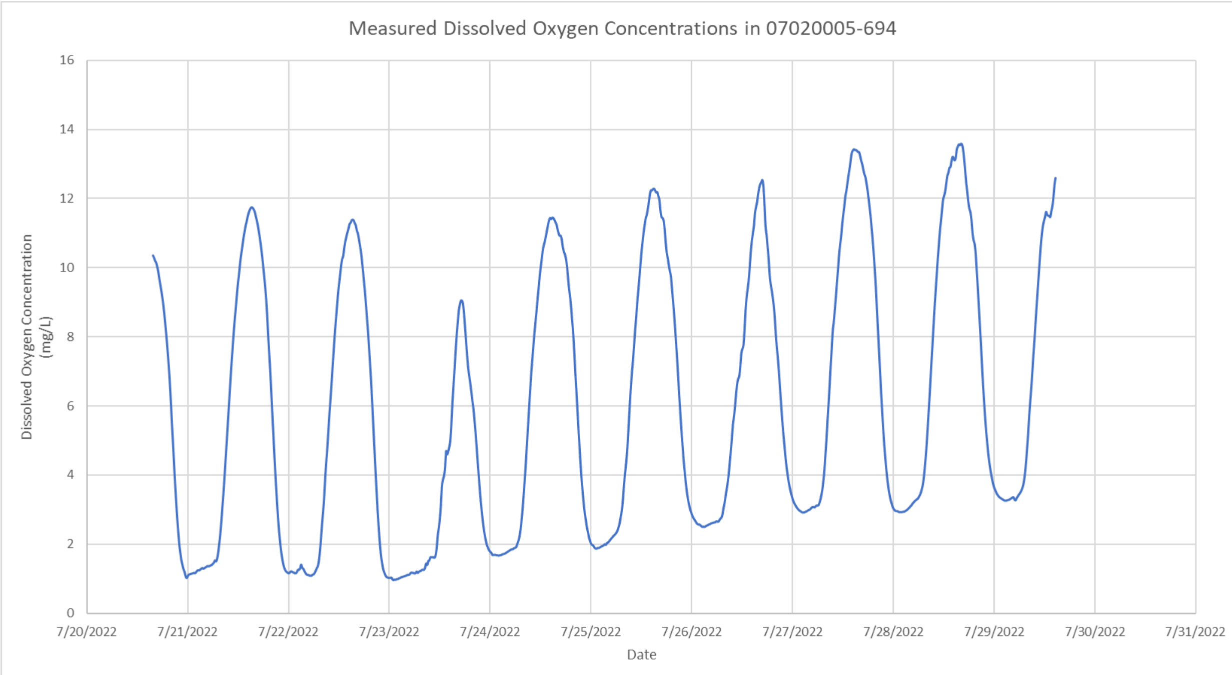
Dissolved Oxygen Biological Metric Data

Table 205. DO related invert metrics for stream reach.

07020005-703 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN073 6/10/2009	65.4	8.7	30	6.2		82.0	0
Statewide average for Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Figure 30. Continuous DO data at site 09MN073.



Dissolved Oxygen Summary

The DO related invert metrics in reach 07020005-703 were mixed (Table 205). Although the percentage of EPT inverts looks high at 65.4%, this was mainly due to the mayfly *Caenis* dominating the invert sample. *Caenis* made up 65% of the total number of EPT present and is considered tolerant to low DO. The HBI_MN score was above the class average and taxa count was just below. The DO TIV number scored right at the class average. 82% of the total number of individual inverts present and five out of the top six invert taxa present are considered either tolerant or very intolerant to low DO.

Only two DO spot measurements were taken during sampling and neither were below the warmwater standard of 5 mg/L. However, those measurements were not taken before 8:00 a.m., when values are usually the lowest. A YSI Sonde water meter measured continuous DO data from 7/20/2022 to 7/29/2022 (Figure 30). During this deployment, DO values were measured below the standard of five mg/L every evening that it was deployed.

Based on the mostly poor biological metric scores, tolerance values, and the measured sonde values, DO is a stressor in this reach.

3.4.3.6 Eutrophication

Eutrophication Biological Metric Data

Table 206. Eutrophication related invert metrics for stream reach.

07020005-703 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN073 6/10/2009	17.9	8	65.5	9.3	30		92.8	0.3
Statewide average for natural Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.1**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 207. Phosphorus monitoring data for stream reach.

07020005-694 P Sample Data 0.15 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S0111-117 (2022)	0.082 – 0.159	-	-	-	0.121 [2]	-	-	-	0.121 [2]
		Maximum Value							
		-	-	-	0.159	-	-	-	

Eutrophication Summary

Invert metrics were mixed throughout the reach. Crustaceans and mollusk percentage was lower than the class average. Collector-gatherer taxa numbers were lower than average. EPT was high, though again, due to the prevalence of the mayfly *Caenis*, which is considered tolerant to phosphorus. Scraper percentages were low and taxa count was just below the class average. In all, over 92% of the total number of individual inverts caught are considered tolerant or very tolerant to phosphorus.

Two samples were collected and analyzed for phosphorus in 2022; one was above, and one was below the standard of 0.100 mg/L (Table 207).

A YSI Sonde water meter measured continuous DO data from 7/20/2022 to 7/29/2022 (Figure 30). During this deployment, diel DO flux was measured at or above 5 mg/L almost every day.

The biological community is showing the effects of the elevated phosphorus, phosphorus sampling showed elevated concentrations, and DO flux was measured at 5 mg/L or greater. Eutrophication is a stressor to the biological community in reach 07020005-703.

3.4.3.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 208. Eutrophication related invert metrics for stream reach.

07020005-703 **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN073 6/10/2009	3.0	0	75.5	16.7		14.8	0.3
Statewide average for natural Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Monitoring Data

Table 209. Transparency monitoring data for stream reach.

07020005-703 Secchi Tube Data 30 cm target	Range of Data (cm)	% of Monthly Samples < 30 cm [# of Samples]							% of Total Samples < 30 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-117 (2009-2022)	>100	-	-	0 [2]	-	-	-	-	0 [2]

Suspended Solids Summary

All of the TSS relater invert metrics scored poorly (Table 210). Collector – filterer numbers were low. There were no Plecoptera present, and sprawlers comprised over 75% of the total number of inverts caught. The TSS TIV value was above the class average. Even though *Caenis* was the most numerous invert present and it is not considered tolerant to TSS, the percentage of TSS tolerant inverts was still high at 14.8%.

Only two transparency measurements were made, one in 2009 and one in 2022 (Table 209). Both were taken in June, and both were greater than 100cm.

TSS appears to be impacting aquatic life and invertebrate metrics are showing signs of TSS stress. Without more TSS data within the reach it is hard to determine whether it is a stressor to the biology in reach 07020005-703 and is inconclusive.

3.4.3.8 Nitrates

Nitrate Biological Metric Data

Table 210. Nitrate related invert metrics and tolerance values for stream reach.

07020005-703 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN073 6/10/2009	0	3.3		79.0	0.3
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 211. Nitrate monitoring data for stream reach.

07020005-703 Nitrate/Nitrite data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S011-117 (2022)	0 – 0.3 [6]	-	-	0.2 [1]	0.08 [5]	-	-	-
		Highest Value						
		-	-	0.2	0.3	-	-	-

Summary

The nitrate related invert metrics and tolerance values were mostly poor (Table 210). There were no Trichoptera taxa present, which tend to decrease in streams with excessive nitrate values. The nitrogen TIV scored right at the class average and there was a large percentage of nitrate tolerant invertebrates. There was almost a complete lack of nitrate intolerant invertebrates throughout the reach.

Only six samples were collected and analyzed for nitrate in reach 07020005-703 (Table 211). None of the total nitrate samples had concentrations greater than 1mg/L, well below the proposed nitrate criteria for protection of aquatic life of 8 mg/L.

Due to the poor biological nitrate related invert metrics, it is possible that nitrates are a stressor to the invert community. However, due to the lack of supporting chemistry data, it is inconclusive at this time.

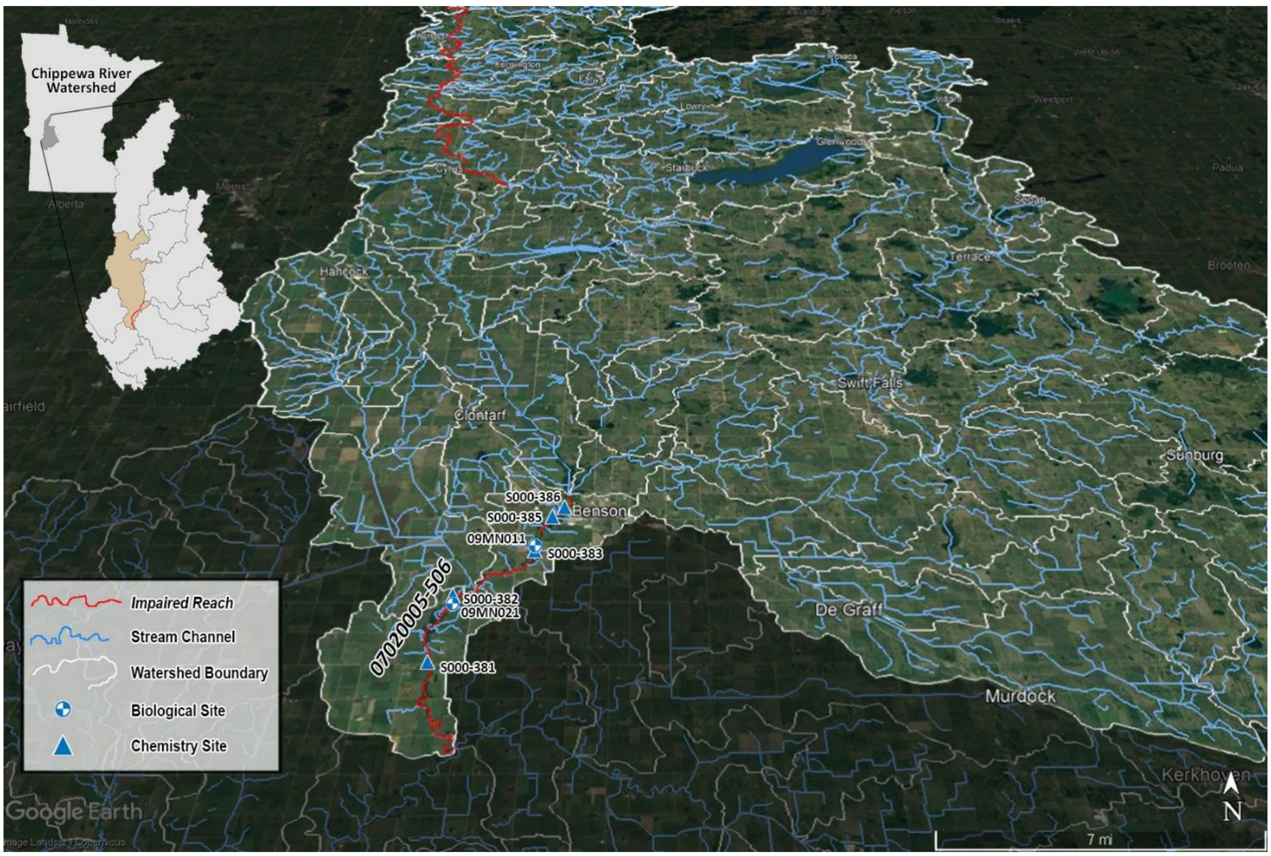
3.4.3.9 Reach Stressors

Table 212. Summary of stressors for stream reach.

07020005-703	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	✓	✓	O	O

3.4.4 07020005-506 Chippewa River

Figure 31. Satellite image of reach 07020005-506 and its watershed.



3.4.4.1 Biological Community

Reach 07020005-506 is a 12-mile-long section of the mainstem Chippewa River. Both bio sites are on an altered section of the river, where the channel has been straightened and shaped as it flows through and below the city of Benson. Further downstream, past bio site 09MN021, the stream channel takes on a more natural, meandering pattern. The bio site IBI scores were mixed (Table 213). Bio site 09MN011 was sampled on 6/22/2021. The fish IBI score was 36.1, below the class average of 49. Bio site 09MN021 scored well above the class average at 72.2. Spotfin shiners were the most numerous fish taxa present at both bio sites. The second most numerous taxa present at bio site 09MN011 was the very tolerant bigmouth buffalo and it had less fish caught, and less darter and sensitive taxa present than site 09MN021. Site 09MN011 was dominated by two fish taxa, making up 55% of the total fish population.

Biological Metric Data

Table 213. Fish IBI score and threshold for stream reach.

07020005-506 **Fish Class 1** **General Use**	Fish IBI Score	Class Threshold Score
09MN011 6/22/2021	36.1	49
09MN021 6/22/2021	72.2	

3.4.4.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 214. Hydrologic alteration related fish metrics for stream reach.

07020005-506 **Fish Class 1** **General Use**	General %	Nesting Non Lithophilic Spawner %
09MN011 6/22/2021	18.2	22.7
09MN021 6/22/2021	11.9	27.9
Statewide average for channelized Fish Class 1 southern river bio sites	**40.7**	**21.4**
Expected response to **Hydrologic** stress	↑	↑

Hydrologic Alteration Summary

The hydrologic alteration related fish metrics are mixed (Table 214). Generalized fish species are correlated with channelization and are adaptable to different habitats through generalized food preferences. Bio sites 09MN011 and 09MN021 had a generalist fish population of 18.2% and 11.9% respectively. Both values are below the class average. Nesting fish, however, scored high at both sites. Largemouth and rock bass, both nesting fish, were present at both sites but were more numerous at site 09MN021, which contributed to those being higher than the class average.

Most of the stream reach has been altered and shaped into straightened ditch with altered banks. Further downstream of 09MN021, the reach takes on a more natural, meandering channel. The biological metrics were mixed, and generalists were well below the class average. As such, hydrologic alteration is inconclusive as a stressor to the biological community in reach 07020005-506.

3.4.4.3 Connectivity

Connectivity Metric Data

Table 215. Connectivity related fish metrics for stream reach.

07020005-506 **Fish Class 1** **General Use**	Mature Age >3 %	Migrating %
09MN011 6/22/2021	45	18
09MN021 6/22/2021	29.2	35.6
Statewide average for channelized Fish Class 1 southern river bio sites	**30.0**	**22.7**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related fish metrics were mixed. Fish taxa whose females take greater than three years to mature were relatively high, with 09MN021 just barely below the class average. The largemouth buffalo is considered a late-maturing taxa and was the second most numerous fish caught at site 09MN011, which contributed to that metric being at 45%. Bio site 09MN021 had a lower percentage of late maturing fish, though there were more late maturing fish taxa present at this bio site, such as the shorthead redhorse, white sucker, golden redhorse, rock bass, and walleye present.

With decent numbers of both late-maturing and migratory species, connectivity is inconclusive as a stressor to the biological community in reach 07020005-506.

3.4.4.4 Habitat

Habitat Metric Data

Table 216. Habitat related fish metrics for stream reach.

07020005-506 **Fish Class 1** **General Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN011 6/22/2021	12.0	12.0	24.0	3.0	16.0	11.0	18.0	40.0
09MN021 6/22/2021	37.4	36.1	39.3	6.9	24.2	26.0	34.2	19.2
Statewide average for channelized Fish Class 1 southern river bio sites	**15.8**	**15.0**	**25.0**	**9.3**	**15.6**	**8.5**	**21.2**	**26.4**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 217. Habitat related fish tolerance values for stream reach.

07020005-506 **Fish Class 1** **General Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN011 6/22/2021	31.0	0		46.0	4.0		32.0	0
09MN021 6/22/2021	9.4	10.8		41.7	8.1		6.7	10.8
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 218. Habitat assessment scores for stream reach.

07020005-506	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN011 8/06/2019	0	7	12	5	4	28
09MN011 6/22/2021	1	8	13	6	7	35
09MN021 6/06/2020	0	5.5	12	2	8	27.5
09MN021 6/22/2021	0	6	19	3	2	30
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The habitat related fish metrics in reach 07020005-506 were mixed (Table 216). Bio site 09MN011 scored worse than site 09MN021. Benthic insectivores, darters, and lithophilic spawners were all low at 09MN011 and tolerant fish were 40% of the total number caught. Pioneer, piscivore, and riffle percentages scored well at both sites. Tolerance values were very poor at site 09MN011 and were mixed at bio site 09MN021 (Table 217). Embeddedness tolerance values were poor at both sites, which correspond to embeddedness observed at the bio site during MSHA assessments.

The MSHA scores were poor as the riparian zone had poor shade and riparian width (Table 218). Besides a lot of silt present, only sand and gravel were observed in low amounts and embeddedness was observed during all the habitat assessments. Cover was poor at the site as the bank is very straight and shaped to move water. Channel morphology score was very poor throughout the reach. There were no riffles or pools, and very little depth variability was observed at both bio sites.

The fish bio metrics were mixed as the fish metrics are mixed, though mostly poor at the upstream bio site, 09MN011. MSHA scores were poor. Habitat is a stressor in reach 07020005-506 at the upstream bio site, 09MN011.

3.4.4.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 219. DO related fish metrics for stream reach.

07020005-506 **Fish Class 1** **General Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV	DO Tolerant %	DO Sensitive %
09MN011 6/22/2021	17	45.0	4.0	39	39.8	6.8	17.0	0
09MN021 6/22/2021	28	29.2	0	35.2	19.2	7.3	23.8	5.4
Statewide average for channelized Fish Class 1 southern river bio sites	**22.1**	**30.0**	**10.9**	**38.5**	**26.4**	**7.3**	↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓		

Dissolved Oxygen Monitoring Data

Table 220. DO monitoring data for stream reach.

07020005-506 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S000-381 **S000-382** **S000-383** **S000-385** **S000-386** (2012-2021)	4.8 – 13.0	0 [12]	0 [20]	3.5 [29]	0 [31]	0 [19]	0 [15]	0 [5]	0.9 [114]
		Minimum Value							
		9.0	6.7	4.8	5.5	7.2	7.4	9.0	

Dissolved Oxygen Summary

The DO related fish metrics were mixed (Table 219). Metrics at bio site 09MN011 scored worse than 09MN021, with late maturing fish the only metric that scored well in the upstream bio site, compared to the downstream site. Sensitive fish were very low at both sites and serial spawners were relatively high. Tolerant fish were high, especially at 09MN011. The DO TIV at 09MN011 was below the class average. DO tolerant fish comprised 17% to 23.8% of the fish population and DO sensitive percentages were very low.

Only one DO measurement taken during sampling was below the warmwater standard of 5 mg/L, but none of those measurements were taken before 8:00 a.m., when values are usually the lowest (Table 220).

Based on the mixed DO related fish biological metric scores and lack of low DO concentrations, DO is inconclusive as a stressor in this reach.

3.4.4.6 Eutrophication

Eutrophication Biological Metric Data

Table 221. Eutrophication related fish metrics and tolerance values for stream reach.

07020005-506 **Fish Class 1** **General Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN011 6/22/2021	17	5.0	30.0	18.0		63.0	0
09MN021 6/22/2021	28	23.7	9.6	34.3		27.8	0
Statewide average for channelized Fish Class 1 southern river bio sites	**22.1**	**4.5**	**13.3**	**21.2**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 222. Phosphorus monitoring data for stream reach.

07020005-506 P Sample Data 0.150 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S000-382 **S000-383** **S000-385** (2012-2021)	0.026 – 0.459	0.142 [12]	0.146 [18]	0.162 [17]	0.184 [11]	0.178 [12]	0.095 [8]	-	0.173 [40]
		Maximum Value							
		0.380	0.459	0.316	0.208	0.233	0.159	-	

Table 223. DO% Saturation monitoring data for stream reach.

07020005-747 DO% Sat Data	Range of Data (%)	Monthly Average of Samples (%) [# of Samples]							June-Aug Average (%) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S000-382 **S000-383** (2019-2021)	79.6 – 87.1	-	-	86.7 [2]	-	81 [2]	-	-	83.9 [4]

Eutrophication Summary

The eutrophication related fish metrics and tolerance values were mixed. The upstream bio site 09MN011 scored mostly poor, compared to the downstream site 09MN021, which scored mostly well. At bio site 09MN011 the taxa count was low, and the omnivore percentage was very high with bigmouth buffalo the second most numerous fish caught. Simple lithophilic spawners were also lower at this site. Downstream there were a lot more taxa present, including a large darter percentage. Omnivores were markedly less represented at this site as well.

Seventy-eight samples were collected and analyzed for phosphorus from 2012 through 2021. The summer average was 0.173 mg/L, above the standard of 0.15 mg/L (Table 222). The monthly averages of June, July, and August were all above the standard, as was the summer average. DO percent saturation data was limited, with only four measurements. Saturations were not measured above 100%.

The biological community may be showing the effects of the elevated phosphorus, especially at the upper bio site 09MN011. Phosphorus sampling showed elevated concentrations though percent saturation was not high. Eutrophication is inconclusive as a stressor in this reach.

3.4.4.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 224. TSS related fish metrics for stream reach.

07020005-506 **Fish Class 1** **General Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %		Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN011 6/22/2021	12	12	0	45		21	11	18	25.1		66	0
09MN021 6/22/2021	28.8	19.2	0	32.0		46.6	26.0	34.3	27.1		31.8	0
Statewide average for channelized Fish Class 1 southern river bio sites	**17.2**	**7.9**	**0.5**	**35.7**		**29.0**	**8.5**	**21.2**	**34.9**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓		↓	↓	↓	↑			

TSS Monitoring Data

Table 225. TSS monitoring data for stream reach.

07020005-506 TSS Sample Data 65 mg/L target	Range of Data (mg/L)	% of Monthly Samples > 65 mg/L [# of Samples]							% of Total Samples > 65 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S000-382 **S000-383** **S000-385** (2012-2021)	6 - 320	25 [12]	57.9 [19]	39.9 [18]	9.7 [31]	60 [10]	0 [6]	-	43.2 [74]

Table 226. Transparency monitoring data for stream reach.

07020005-506 Secchi Tube Data 10 cm target	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S004-387 **S013-644** **S013-696** (2009-2020)	5 – 100+	8.3 [12]	5 [20]	20 [30]	9.7 [31]	5 [20]	0 [16]	0 [5]	9.0 [134]

Suspended Solids Summary

The TSS related biological fish metrics and tolerance values were mixed throughout the reach (Table 224). The upstream site, 09MN011, scored worse than the downstream site, 09MN021. At site 09MN011, benthic feeders were low, there were no herbivores, and Perciformes were lower than the class average. Simple lithophilic spawners were also below the average. The percentage of TSS tolerant fish was very high at 66% due to the two most numerous fish present, the spotfin shiner and bigmouth buffalo. Metrics that scored well were the percentage of Centrarchids, as both largemouth and rock bass were present. The percentage of long-lived fish was above the class average as three out of the top four fish taxa present are considered long-lived. Riffle dwelling fish and the TSS TIV were also above the class average. Metrics that scored poorly at bio site 09MN021 were the herbivores present (zero) and the long-lived percentage that was just below the class average. The percentage of TSS tolerant fish was also high, though it was half the percentage of site 09MN011. Overall, site 09MN021 had a lot more lithophilic spawners and riffle dwelling fish present as well as Perciformes, such as largemouth bass, several darters, and walleyes.

Seventy-four samples were collected and analyzed for TSS from 2012 through 2021 (Table 225). All of the months from April to August had a high percentage of samples above 65mg/L and the percentage of samples above 65mg/L out of all the samples taken was 43.2%. Secchi tube measurements showed the same pattern as the TSS data.

Due to the mostly poor biological metrics and tolerance values, as well as the TSS and transparency data, TSS appears to be a stressor to the biological community in reach 07020005-506. This appears to be affecting the bio community of the upstream site 09MN011 more so than the downstream site 09MN021.

3.4.4.8 Nitrates

Nitrate Biological Metric Data

Table 227. Nitrate related invert metrics for stream reach.

07020005-506 **Invert Class 2** **General Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrogen Intolerant %
09MN011 8/06/2019	12.8	3.2		55.9	5.4
09MN021 8/06/2020	17.1	3.3		49.8	0
Statewide average for natural Invert Class 2 prairie forest river bio sites	**15.8**	**2.9**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 228. Nitrate monitoring data for stream reach.

07020005-506 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	Aug	Sept	Oct
S000-385 (2012-2016)	0.2 – 3.1 [58]	0.7 [12]	1.0 [17]	1.0 [12]	0.3 [6]	0.5 [7]	0.5 [4]	-
		Highest Value						
		1.8	3.1	2.7	0.5	1.3	0.8	-

Summary

The nitrate related invert metrics and tolerance values were mostly poor (Table 227). There were Trichoptera taxa at both sites, though at 09MN011 the percentage was below the class average. Nitrate TIV scores were above the class average at both sites and the percentage of nitrogen tolerant inverts was high at both bio sites while nitrogen intolerant inverts were very low to none present.

Fifty-eight samples were collected and analyzed for nitrate in reach 07020005-506 (Table 228). All of the concentration values were low, well below the proposed nitrate criteria for protection of aquatic life of 8 mg/L. Due to the mixed data sets between the biological and chemistry data, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-506.

3.4.4.9 Reach Stressors

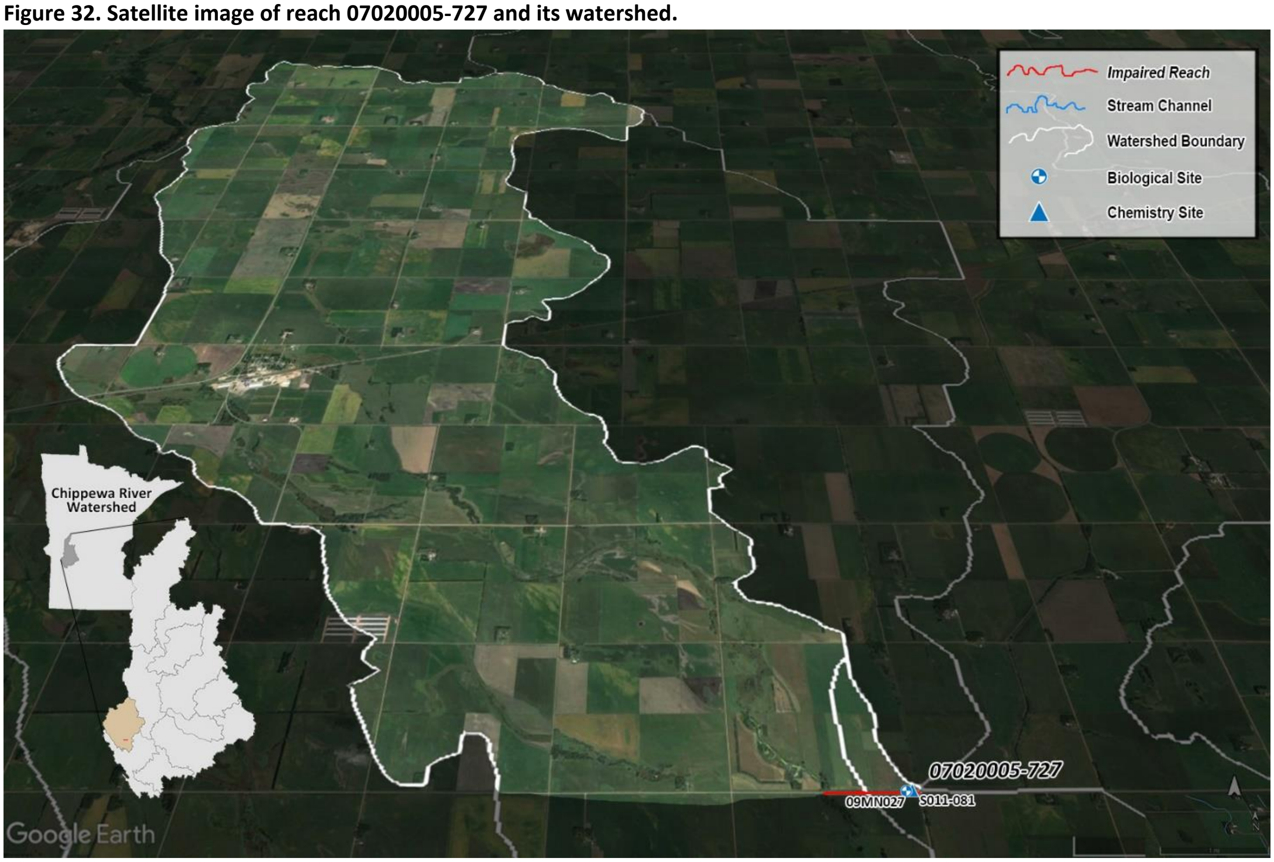
Table 229. Summary of stressors for stream reach.

07020005-506	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	O	O	✓	O	O	✓	O

3.5 Cottonwood Creek

3.5.1 07020005-727 Unnamed ditch

Figure 32. Satellite image of reach 07020005-727 and its watershed.



3.5.1.1 Biological Community

Bio site 09MN027 was sampled for fish in 2009 and in 2019. The FIBI scores were well below the Fish Class 2 southern stream general use threshold of 50 (Table 230). The 2019 score did improve compared to the 2009 sample, mostly due to less short-lived, tolerant, and detritivores present in the 2019 sample. The site was dominated by the very tolerant central mudminnow.

The invertebrate community was also sampled in both 2009 and 2019, which also improved in that time period (Table 231). The site was dominated by the amphipod *Hyalella*, which comprised over 84% of the total number of inverts caught.

Biological Metric Data

Table 230. Fish IBI score and threshold for stream reach.

07020005-727 **Fish Class 2** **General Use**	Fish IBI Score	Class Threshold Score
09MN027 6/17/2009	8.7	50
09MN027 8/08/2019	26.7	

Table 231. Invert IBI score and threshold for stream reach.

07020005-727 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN027 8/06/2009	12.0	41
09MN027 8/08/2019	25.0	

3.5.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 232. Hydrologic alteration related fish metrics for stream reach.

07020005-727 **Fish Class 2** **General Use**	General %	Nesting Non Lithophilic Spawner %
09MN027 6/17/2009	12.0	25.0
09MN027 8/08/2019	27.1	1.4
Statewide average for channelized Class 2 southern stream bio sites	**43.9**	**30.6**
Expected response to **Hydrologic** stress	↑	↑

Table 233. Hydrologic alteration related invert metrics for stream reach.

07020005-727 **Invert Class 7** **General Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth Variability Tolerant %	Low Depth Variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
09MN027 8/06/2009	6.4	2.4	0		77.6	0		74.2	0		0	25.5
09MN027 8/08/2019	8.5	5.0	0		5.7	2.5		89.9	3.5		2.2	0.3
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**		↑	↓		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓									

Hydrologic Alteration Summary

The hydrologic alteration related fish metrics were good (Table 233). Generalized fish species are correlated with channelization and are adaptable to different habitats through generalized food preferences. Bio site 09MN027 had a generalist fish population of 12% and 27.1%, which are below the class average. Nesting fish were very low at only 1.4% as the majority of fish present were lithophilic spawners. Almost all the species caught were either tolerant or very tolerant.

Hydrologic alteration related invert metrics scored mostly poor (Table 233). The most dominant invert, *Hyalella*, made up over 84% of the total number of inverts caught. It is neither a clinger nor a collector-filterer. The next most numerous inverts caught were 13 Coenagrionidae damselflies. Since *Hyalella* made up such a large percentage of the total number of inverts caught, its characteristics dominated the biological metrics and tolerance values. Both *Hyalella* and Coenagrionidae are considered tolerant to low depth variability.

The site was also dominated by invertebrates tolerant of depth variability, as well as tolerant and very tolerant fish. The invert biological metrics were poor and the reach itself is a relatively short diversion channel connecting reaches 07020005-510 and 07020005-547. Hydrologic alteration is stressing the biological community in reach 07020006-521, which is likely from the alteration and ditching of the stream itself.

3.5.1.3 Connectivity

Connectivity Metric Data

Table 234. Connectivity related fish metrics for stream reach.

07020005-727 **Fish Class 2** **General Use**	Mature Age >3 %	Migrating Individual %
09MN027 6/17/2009	0	0
09MN027 8/08/2019	7.1	5.7
Statewide average for channelized Fish Class 2 Southern Stream bio sites	**27.8**	**21.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Although there were late-maturing and migratory fish present, it was due to only four white suckers caught, which is a tolerant species (Table 234). The culvert right at the outlet of 07020005-727 appears to be narrow and is likely constricting migration during high flows (Figure 33). At low flows, during a site visit, a jam of sticks and algae was observed that is likely preventing fish migration as well. Due to the low numbers of fish present, as well as low numbers of late maturing and migrating fish, connectivity appears to be a stressor to the biological community in reach 07020005-727.

Figure 33. Culvert just downstream of bio site 09MN027 showing a likely fish barrier.

3.5.1.4 Habitat

Habitat Metric Data

Table 235. Habitat related fish metrics for stream reach.

07020005-727 **Fish Class 2** **General Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN027 6/17/2009	0	0	3.7	10.2	0	0	0.9	85.2
09MN027 8/08/2019	0	0	27.1	7.1	8.6	5.7	20	90
Statewide average for channelized Fish Class 2 Southern Stream bio sites	**19.1**	**16.5**	**35.6**	**23.6**	**8.0**	**19.5**	**26.2**	**46.4**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 236. Habitat related fish tolerance values for stream reach.

07020005-670 **Fish Class 2** **General Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN027 6/17/2009	33.3	9.3		8.3	0		81.5	0
09MN027 8/08/2019	1.4	14.3		8.6	0		62.9	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

Table 237. Habitat related invert metrics for stream reach.

07020005-727 **Invert Class 7** **General Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN027 8/06/2009	33.1	47.4	6.4	0	97.3	10.9
09MN027 8/08/2019	0.6	5.1	8.5	4.7	3.2	85.2
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 238. Habitat related tolerance values for stream reach.

07020005-727 **Invert Class 7** **General Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN027 8/06/2009	77.3	0		46.7	0		68.8	0
09MN027 8/08/2019	90.2	1.0		89.9	1.0		90.0	1.0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 239. Habitat assessment scores for stream reach.

07020005-727	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN027 6/17/2009	0	11	10.7	10	20	51.7
09MN027 8/08/2019	0	9	18	14	13	54
09MN027 8/08/2019	0	8	15	13	10	46
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The habitat related fish metrics and tolerance values in reach 07020006-521 scored mostly poor (Table 235). There were no nontolerant benthic insectivores or darters, sculpins, or round-bodied suckers present. The most dominant fish present, the central mudminnow, is a lithophilic spawning fish, which caused that percentage to be higher, though still below the class average. Pioneer fish percentage was low and there were some piscivores present. Riffle dwelling and simple lithophilic spawners were both below the class average. Tolerant fish made up 90% of the total number caught. The MSHA score and embedded tolerance values were both decent (Table 236), as the blacknose dace is considered sensitive to low MSHA scores and was the second most numerous fish caught. The central mudminnow was the most numerous fish caught and is considered tolerant to low substrate scores, which has caused that tolerance value to be relatively high.

The habitat related invert metrics scored mostly poor (Table 237). Only burrowers and legless inverts scored well. Climbers, clingers, and EPT percentages were all below the class average and sprawler percentage was very high. Invert tolerance values all scored poorly (Table 238). The top two most numerous inverts caught, the amphipod *Hyalella* and the damselfly Coenagrionidae, are both considered either tolerant or very tolerant to low MSHA scores, high embeddedness, and low substrate scores.

The MSHA scores were mostly poor and ranged from 46 to 54 out of a possible 100. The site scored well in the riparian zone due to a moderate width, low bank erosion, and a decent amount of shade. Substrate scores were decent as gravel and sand were present. Cover scored well with submergent vegetation, undercut banks, and deep pools were observed in the reach. Channel morphology scores were fair as there was decent depth variability and high channel stability, though the ditch itself is very straight and lacks any sinuosity.

The fish and invert bio metrics and tolerance values were mostly poor. Habitat is a stressor to the biological community in reach 07020005-727. Due to the presence of lithophilic spawning fish as well as the low percentage of burrowers and legless invertebrates, it would appear that the habitat stress is likely coming from the lack of geomorphic features such as riffles and sinuosity rather than poor substrate or embeddedness of coarse sediment.

3.5.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 240. DO related fish metrics for stream reach.

07020005-727 **Fish Class 2** **General Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN027 6/17/2009	8	0	0	22.2	85.2	5.8		88.9	0
09MN027 8/08/2019	7	7.1	0	0	90	6.2		72.8	0
Statewide average for channelized Fish Class 2 Southern Stream bio sites	**14.5**	**28.0**	**8.4**	**25.3**	**46.4**	**7.0**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Table 241. DO related invert metrics for stream reach.

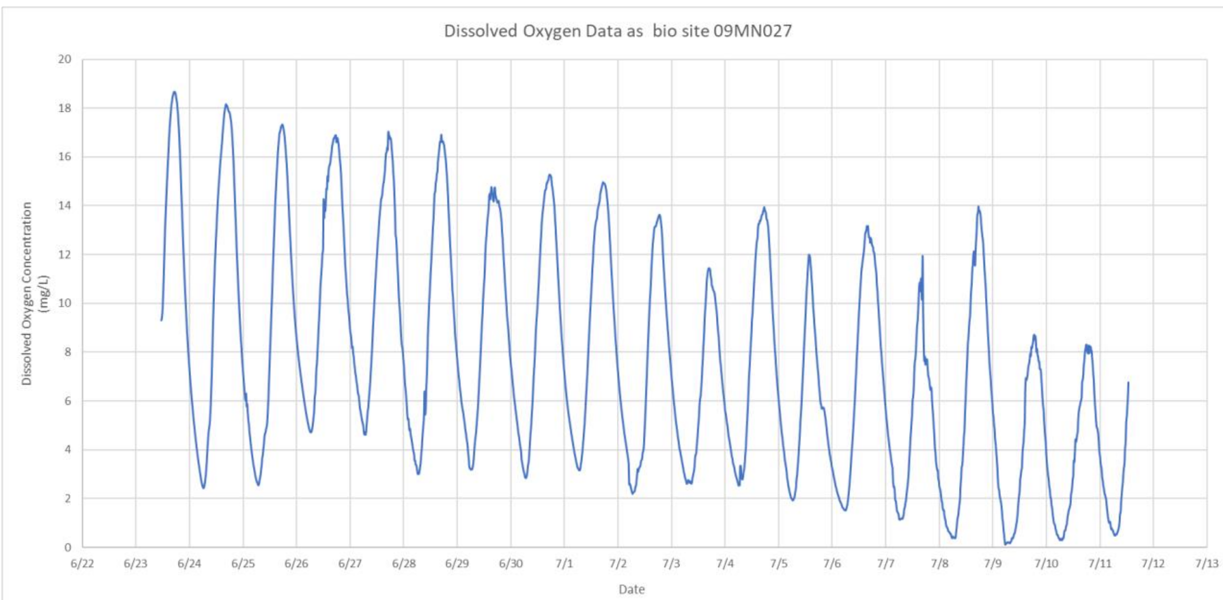
07020005-727 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN027 8/06/2009	0	8.5	25	5.4		69.1	0
09MN027 8/08/2019	4.7	7.4	18	6.0		89.9	3.2
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 242. DO monitoring data for stream reach.

07020005-727 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-081 (2019-2022)	4.2 – 8.7	-	-	0.0 [1]	0.0 [1]	50 [2]	-	-	25 [4]
		Minimum Value							
		-	-	8.7	7.6	4.2	-	-	

Figure 34. Continuous DO data at site 09MN027.



Dissolved Oxygen Summary

The DO related fish metrics at bio site 09MN027 scored mostly poor, with only the serial spawner percentage scoring well (Table 240). Taxa count, late maturing, and sensitive fish percentages were all very low. The fish community had a tolerant fish percentage of 90% as the most numerous fish present, the central mudminnow, is considered a very tolerant fish. DO tolerant species comprised 72.8% of the fish population with no DO sensitive fish caught.

Invertebrate DO related metrics were also mostly poor (Table 241). EPT percentage was very low and total taxa count was also well below the class average. The DO tolerance index value was also just below the class average and 89.9% of the total number of inverts caught are considered tolerant to low DO, with only 3.2% considered intolerant to low DO. The two most numerous inverts present, the amphipod *Hyalella* and the damselfly Coenagrionidae are both considered tolerant to low DO.

One out of the four DO measurements taken was below the warmwater standard of 5 mg/L (Table 242). A YSI Sonde water meter measured continuous DO data from 6/24/2022 to 7/11/2022 (Figure 34). During this deployment DO values were measured below 5mg/L every night of the deployment, with the last four nights dropping below 1 mg/L DO.

Based on the mostly poor related fish and invertebrate biological metric scores and the measured sonde values, DO is a stressor in this reach.

3.5.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 243. Eutrophication related fish metrics for stream reach.

07020005-727 **Fish Class 2** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN027 6/17/2009	8	0	8.3	0.9		33.3	0
09MN027 8/08/2019	7	0	5.7	20		1.4	0
Statewide average for channelized Fish Class 2 Southern Stream bio sites	**14.5**	**13.6**	**25.5**	**26.2**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Table 244. Eutrophication related invert metrics for stream reach.

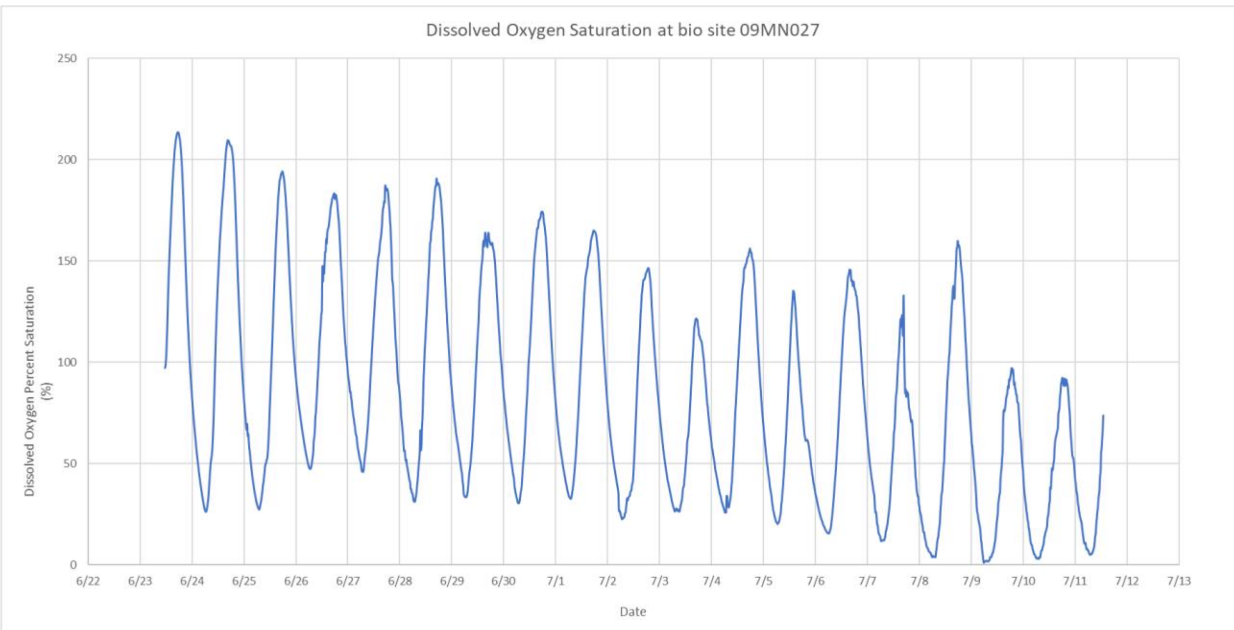
07020005-727 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN027 8/06/2009	38.0	10	0	38.0	25		68.5	0
09MN027 8/08/2019	84.5	7	4.7	0	18		89.6	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.1**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 245. Phosphorus monitoring data for stream reach.

07020005-727 P Sample Data 0.150 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-081 (2019-2022)	0.037 – 0.265	-	-	-	0.049 [2]	0.265 [1]	-	-	0.121 [3]
		Maximum Value							
		-	-	-	0.060	0.265	-	-	

Figure 35. Continuous DO saturation data at site 09MN027.



Eutrophication Summary

The eutrophication related fish metrics at bio site 92MN027 were mostly poor (Table 243). Taxa count was well below the class average. There were no darter individuals and simple lithophilic spawners were below the class average. The percentage of phosphorus tolerant fish was low as only one brook stickleback was caught.

Eutrophication related invertebrate metrics were also mostly poor (Table 244). Crustacean and Mollusca percentage was very high as the Crustacean *Hyallela* dominated the invert community. Collector-gatherer taxa count was low as was the percentage of EPT inverts. Overall taxa count was low. Phosphorus tolerant invert percentage was 89.6%, mostly due to the abundance of phosphorus tolerant and absence of any phosphorus intolerant inverts. Scraper percentage did score well as there were none.

Three samples were collected and analyzed for phosphorus from 2019 through 2022, one value was well above the standard of 0.150 mg/L (Table 245). The summer average was just below the standard (Table 245).

A YSI Sonde water meter measured continuous DO data from 6/23/2022 to 7/11/2022 (Figure 34). During this deployment, diel DO flux was measured at or above 5 mg/L most of the deployment. DO saturation was also collected during the sonde deployment (Figure 35). The percent saturation was very high, well over 100% during most of the deployment.

The biological community may be showing the effects of the elevated phosphorus as phosphorus sampling showed elevated concentrations, and DO flux was 5 mg/L or greater with very high concentrations during the day and very low concentrations at night. The percent saturation was well above 100% for most of the deployment of the sonde. Eutrophication is a stressor in reach 07020005-727.

3.5.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 246. TSS related fish metrics for stream reach.

07020005-727 **Fish Class 2** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN027 6/17/2009	0	0	22.2	0	0	0	0.9	15.9		0	14.8
09MN027 8/08/2019	5.7	0	0	10	1.4	5.7	20	14.2		0	0
Statewide average for channelized Fish Class 2 Southern Stream bio sites	**30.1**	**6.2**	**2.9**	**21.3**	**28.7**	**19.5**	**26.2**	**18.8**		↑	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 247. Suspended solids related invert metrics for stream reach.

07020005-727 **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN027 8/06/2009	2.4	0	11.0	14.6		18.5	0
09MN027 8/08/2019	5.1	0	85.2	15.0		5.4	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Suspended Solids Summary

The fish community at bio site 07MN027 scored below average in seven of the eight TSS related fish metrics when compared to the Class 2 average (Table 246). Benthic feeders, Centrarchids, herbivores, long-lived, Perciformes, and riffle dwelling fish all scored very poorly. There were some simple lithophilic spawners present as there were 10 blacknose dace and four white suckers caught. Tolerance values scored well as the TSS TIV value was below the class average and there were no TSS tolerant or intolerant fish present.

TSS related invertebrate metrics were mostly poor (Table 247). Collector-filterers were below the class average and there were no Plecoptera present. The amphipod *Hyalella*, which is a sprawler, dominated the invert sample, causing the percentage of sprawlers to be over 85%. The TSS TIV and the percent of TSS tolerant inverts was low as *Hyalella* is not considered tolerant to TSS.

Only three transparency measurements were taken in this reach in both 2019 and 2022. All three of them were greater than 100cm.

Due to the mostly poor biological metrics, but decent tolerance values as well as the limited transparency data that was greater than 100cm, TSS is inconclusive as a stressor to the biological community in reach 07020005-727.

3.5.1.8 Nitrates

Nitrate Biological Metric Data

Table 248. Nitrate related invert metrics for stream reach.

07020005-727 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN027 8/06/2009	0	3.6		63	2.7
09MN027 8/08/2019	16.7	2.0		5.7	0
Statewide average for channelized Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 249. Nitrate monitoring data for stream reach.

07020005-727 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S011-081 (2019-2022)	0 – 1.1 [7]	-	-	0.6 [2]	0.08 [4]	0.05 [1]	-	-
		Highest Value						
		-	-	1.1	0.2	0.05	-	-

Summary

The nitrate related invert metrics all scored well (Table 248). The bio site did show a healthy amount of Trichoptera taxa, though the actual numbers of Trichoptera individuals was low. The nitrogen TIV score was below the class average and the percentage of nitrogen tolerant inverts was low at only 5.7%.

Seven samples were collected in reach 07020005-727 and analyzed for nitrate (Table 249). All seven samples had very low concentrations.

Due to the good nitrate related metrics and tolerance values, as well as the low nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-727.

3.5.1.9 Reach Stressors

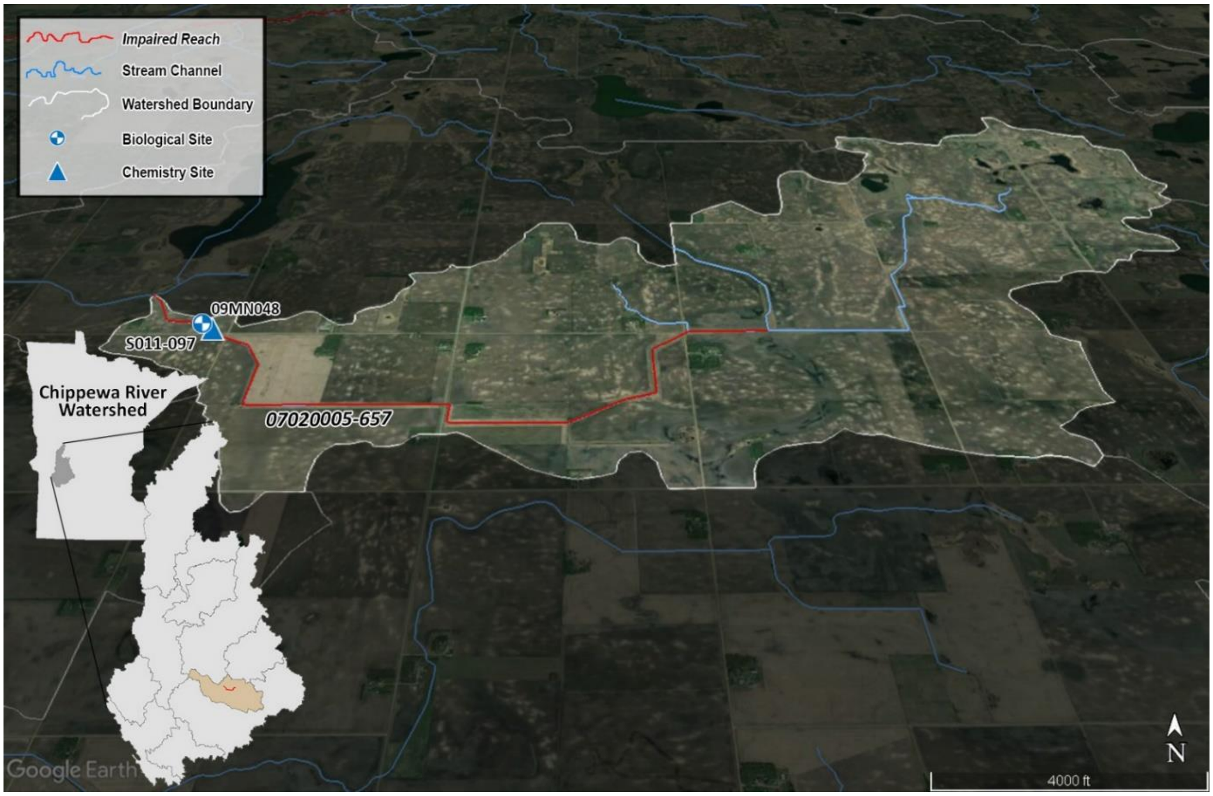
Table 250. Summary of stressors for stream reach.

07020005-727	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	✓	✓	✓	✓	O	O

3.6 Judicial Ditch No. 19

3.6.1 07020005-657 County Ditch 63

Figure 36. Satellite image of reach 07020005-657 and its watershed.



3.6.1.1 Biological Community

Bio site 09MN048 was sampled in 2009 and 2019 (Table 254). The fish IBI scores of 45.7 and 37.2 were not too low but were below the threshold of 55. The top five fish taxa caught are either tolerant or very tolerant and the site was dominated by fathead minnows.

Inverts were sampled twice in 2009 and again in 2019 (Table 252). Like the fish visits, the invert scores were not too far below the class average. The site was dominated by the snail *Physella* and the amphipod *Hyalella*.

Biological Metric Data

Table 251. Fish IBI score and threshold for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN048 6/29/2009	45.7	55
09MN048 6/24/2019	37.2	

Table 252. Invert IBI score and threshold for stream reach.

07020005-657 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN048 8/12/2009	36.8	41
09MN048 8/12/2009	27.1	
09MN048 8/05/2019	35.8	

3.6.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 253. Hydrologic alteration related fish metrics for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
09MN048 6/29/2009	77.8	75.6
09MN048 6/24/2019	88.6	78.9
Statewide average for ditched Class 3 southern headwaters bio sites	**56.3**	**24.0**
Expected response to **Hydrologic** stress	↑	↑

Table 254. Hydrologic alteration related invert metrics for stream reach.

07020005-657 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %	Percent Ditched Tolerant %	Percent Ditched Intolerant %	Low Depth Variability Tolerant %	Low Depth Variability Intolerant %	Low Flow Tolerant %	Low Flow Intolerant %
09MN048 8/12/2009	25.0	15.5	5.1	29.4	13.0	24.1	14.6	0.6	19.6
09MN048 8/12/2009	23.8	16.8	1.2	35.3	19.1	34.0	20.9	1.8	10.3
09MN048 8/05/2019	29.2	10.2	0.3	5.2	10.8	53.2	19.1	9.2	12
Statewide average for ditched Invert Class 7 prairie stream glide pool bio sites	**38.5**	**19.1**	**8.0**	↑	↓	↑	↓	↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓						

Hydrologic Alteration Summary

The hydrologic alteration related fish metrics were poor (Table 253). Generalist fish made up 88.6% of the total percentage of fish caught. The two most numerous fish present, fathead minnow and blacknose dace, are both generalists. Nesting fish were very high as well as both the most numerous fish, the fathead minnow, and the third most numerous fish, the brook stickleback, are both nest builders.

The hydrologic alteration related invert metrics were poor (Table 254), with all the biological metrics scoring poorly when compared to the averages. Clingers were below the class average, though there were some clingers present as the 4th through the 8th most numerous inverts present. Collector-filterers were similar as there were some caddisflies present, though the percentage was still below the class average. Long-lived percentage was less than a percent. Tolerance values were mixed with some altered hydrologic intolerant values above 10% as several mayflies and caddisflies were present, such as *Baetis*, *Ceratopsyche*, and *Cheumatopsyche*. The midge *Micropsectra* was the third most numerous invert present and is very intolerant to low flows.

The channel itself has been extensively altered and shaped into a ditch. The ditch is very steep and deep, making for a very artificial stream channel shape. The stream is small enough however, that it has created its own meandering channel within the larger stream ditch which is oversized for the stream channel. This has created some habitat and depth variability that is not often seen in ditched streams. Low flows also don't seem to be an issue as there was a low percentage of low flow tolerant inverts; 12% of the total number of inverts caught were low flow intolerant.

The fact that it is a headwaters stream and relatively small for the ditch and has created its own meandering channel is likely why the tolerance values are mixed. Overall, the invert community is showing some hydrologic alteration stress. The stream channel itself has been extensively altered and ditched.

3.6.1.3 Connectivity

Connectivity Metric Data

Table 255. Connectivity related fish metrics for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	Mature Age >3%	Migrating %
09MN048 6/29/2009	6.1	1.5
09MN048 6/24/2019	1.8	0
Statewide average for channelized Fish Class 3 prairie headwater bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related fish metrics were very poor. Fish whose females take greater than three years to mature were very low as only six yellow perch were caught. There were no migrating fish present.

The culvert at the road crossing near bio site 09MN048 appears to be a fish barrier (Figure 36). The culvert has created a barrier that fish cannot swim through as the elevation is too high. The culvert is also relatively long and narrow, likely creating velocities that are barriers to fish migration upstream during high flows. Due to the very poor metrics and the culvert, connectivity is a stressor to the biological community in reach 07020005-657.

Figure 36. Photo of culvert underneath the road crossing near bio site 09MN048.

3.6.1.4 Habitat

Habitat Metric Data

Table 256. Habitat related fish metrics for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN048 6/29/2009	0.7	0.7	9.4	70.5	0	0.9	7.1	91.3
09MN048 6/24/2019	0.3	0.3	13.0	78.6	0	0	9.0	95.5
Statewide average for channelized Fish Class 3 prairie headwater bio sites	**10.9**	**10.6**	**58.0**	**32.5**	**2.0**	**22.6**	**30.1**	**76.7**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 257. Habitat related fish tolerance values for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN048 6/29/2009	81.2	6.1		70.4	0		83.5	0
09MN048 6/24/2019	79.5	9.0		75.3	0		82.8	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

Table 258. Habitat related invert metrics for stream reach.

07020005-657 **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN048 8/12/2009	10.4	30.1	25.0	12.3	67.7	23.1
09MN048 8/12/2009	30.8	13.1	23.8	20.4	61.0	13.1
09MN048 8/05/2019	5.5	39.1	29.2	17.8	54.2	25.2
Statewide average for ditched Invert Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 259. Habitat related invert tolerance values for stream reach.

07020005-657 **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN048 8/12/2009	25.9	1.9		29.1	2.5		6.6	1.6
09MN048 8/12/2009	34.7	1.8		7.3	1.5		29.8	3.6
09MN048 8/05/2019	53.2	7.1		52.0	6.8		52.6	7.4
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 260. Habitat assessment scores for stream reach.

07020005-657	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN048 6/1/2009	0	13	18.1	14	24	69.1
09MN048 8/5/2019	0	10.5	18.3	14	13	55.8
09MN048 6/24/2019	0	9	16.6	15	16	56.6
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The habitat related fish metrics were very poor (Table 256). There were very few benthic insectivores or darters present as only one johnny darter was caught. Thirty blacknose dace were caught, which caused the lithophilic spawner percentage to be 13%, far below the class average of 58%. Pioneer percentage was very high as the fathead minnow dominated the fish community. Zero piscivores or riffle dwelling fish were present and tolerant fish comprised 95.5% of the total number of fish caught. Habitat related fish tolerance values were also very poor (Table 257). The percentages of habitat tolerant fish for all three habitat tolerance values were in the 70% to 80% range with very few habitat sensitive fish present at all.

The habitat related invert metrics were mostly good (Table 258). Burrowers were low and climbers were above the class average, though the first and third most numerous inverts present were *Physella* snails and the midge *Micropsectra*. Clingers also scored well as there were decent numbers of the mayfly *Baetis*, though EPT percentage was still below the class average. Legless inverts were high, just below the class average and sprawlers were close to the class average as well. Overall, the metrics look better than they actually are due to the dominance by *Physella* snails and the amphipod *Hyalella*, which skewed the metrics to their characteristics. Invert tolerance values were mostly poor (Table 259). All the tolerance values had roughly 50% tolerant percentages, which were also influenced by the two most dominant inverts. The intolerant percentages were between 5% and 10% due to decent numbers of the caddisfly *Ceratopsyche*.

The MSHA scores were mostly poor (Table 260). The latest assessments done in 2019 scored 55.8 and 56.6 out of 100. The riparian zone scored well as there was decent riparian width and little bank erosion. Substrate scored decent as several sized sediment types, boulders, cobble, gravel, and sand, were observed. Cover was very good as the stream channel is covered in grasses. Channel morphology, while not great, was better than most ditches. There was some depth variability, sinuosity, moderate to high channel stability, and moderate stream velocities. Evidence of dredging and bank shaping caused the score to be lower.

Overall, the fish metrics and tolerance values were poor and were much worse than the invert metrics. The invert metrics scored mostly well, though invert tolerance values were mostly poor. MSHA scores were in the middle. Habitat is likely a stressor in this reach, though it is likely that connectivity is contributing to the poor fish metrics. As such, habitat is inconclusive as a stressor.

3.6.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 261. DO related fish metrics for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	Mature Age >3 %	Serial Spawner %	DO TIV		DO Tolerant %	DO Sensitive %
09MN048 6/29/2009	6.1	68.8	6.4		84.6	0
09MN048 6/24/2019	1.8	76.8	6.3		86.7	0
Statewide average for channelized Fish Class 3 prairie headwater bio sites	**14.4**	**10.6**	**7.0**		↑	↓
Expected response to **DO** stress	↓	↑	↓			

Table 262. DO related invert metrics for stream reach.

07020005-657 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN048 8/12/2009	12.3	7.7	37	6.9		7.6	19.3
09MN048 8/12/2009	20.4	7.4	32	6.6		29.5	23.1
09MN048 8/05/2019	17.8	7.5	35	6.6		24.3	16.6
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 263. DO monitoring data for stream reach.

07020005-657 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-097 (2009-2019)	7.6 – 9.7	-	-	0% [2]	-	0% [1]	-	-	0% [3]
		Minimum Value							
		-	-	7.6	-	8.8	-	-	

Dissolved Oxygen Summary

The DO related fish metrics and tolerance values at bio site 09MN048 were poor (Table 261). Late maturing fish were very low and serial spawners were very high, both metrics being influenced by the fact that fathead minnows dominated the fish community, comprising 74% of the total number of fish caught. DO TIV was lower than the average. In total, the percentage of DO tolerant fish caught were over 86% of the total. There were no DO sensitive fish caught.

The DO related invert metrics and tolerance values were mostly poor (Table 262). EPT percentage was well below the class average. Taxa count was not too far below the average at 35. The DO TIV was also below the average, though by just 0.3 mg/L. The tolerance values are really mixed Although there were high percentages of DO tolerant inverts, there was also a relatively high percentage of DO intolerant inverts present, including good numbers of the mayfly *Baetis* and the caddisfly *Ceratopsyche*.

None of the three DO measurements taken during sampling (Table 263)were taken before 8:00a.m., when values are usually the lowest.

The biological metrics and tolerance values were mixed, however, due to lack of supporting DO data, DO is inconclusive as a stressor at this time.

3.6.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 264. Eutrophication related fish metrics for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN048 6/29/2009	16	0.7	68.7	7.1		81.5	1.6
09MN048 6/24/2019	10	0.3	75.3	9.1		79.5	0
Statewide average for channelized Fish Class 3 prairie headwater bio sites	**10.0**	**10.6**	**19.8**	**26.2**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Table 265. Eutrophication related invert metrics for stream reach.

07020005-657 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN048 8/12/2009	4.9	13	20.4	5.2	32		7.3	0
09MN048 8/12/2009	18.7	15	12.3	17.7	37		23.4	1.6
09MN048 8/05/2019	50.5	10	17.8	30.2	35		24.9	2.5
Statewide average for ditched Invert Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.6**	**17.7**	**33.6**			
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 266. Phosphorus monitoring data for stream reach.

07020005-657 P Sample Data 0.150 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-097 (2009 – 2022)	0.051 – 0.114	-	-	0.094 [2]	0.058 [2]	-	-	-	0.076 [4]
		Maximum Value							
		-	-	0.114	0.065	-	-	-	

Eutrophication Summary

Most of the eutrophication related fish metrics community at bio site 09MN048 were poor (Table 264). Total taxa counts were decent, with the latest visit just at the class average. Darter numbers were very low, and omnivores were over 75% of the total number of fish caught. Simple lithophilic spawners were also well below the class average and the percentage of phosphorus tolerant fish were almost 80% of the total.

Eutrophication related invert metrics were somewhat mixed; however, the latest site visit in 2019 were mostly poor (Table 265). Crustacean and Mollusca percentage and scraper percentage were well above the class average as the two most dominant inverts present were *Physella* snails and the amphipod *Hyalella*. Collector – gatherer taxa count was just below the class average, though three out of the top four most numerous inverts caught are collector-gatherers. EPT percentage was low, though there were good numbers of the mayfly *Baetis* as well as the caddisfly *Ceratopsyche*. Total taxa count was the only metric that scored well and was right at the class average. Inverts considered tolerant to phosphorus were 24.9% with only 2.5% that are intolerant.

Four samples were collected and analyzed for phosphorus from 2009 to 2022 (Table 266). All four samples were low and the average of all the summer samples was only 0.076 mg/L, well below the standard of 0.150 mg/L.

The biological community metrics and tolerance values were mostly poor and appear to be showing the effects of the elevated phosphorus, though the limited phosphorus sampling was low. Although the biological community appears to be stressed by eutrophication there is not enough data to call it a stressor. Eutrophication is inconclusive as a stressor in this reach.

3.6.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 267. TSS related fish metrics and tolerance values for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN048 6/29/2009	1.0	0	6.8	5.2	5.6	0.9	7.1	21.1		0	2.4
09MN048 6/24/2019	0.3	0	2.1	1.8	2.1	0	9.0	21.0		0	2.1
Statewide average for channelized Fish Class 3 prairie headwater bio sites	**31.4**	**1.0**	**10.8**	**4.9**	**12.4**	**22.6**	**30.1**	**15.5**		↑	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 268. TSS related invert metrics and tolerance values for stream reach.

07020005-657 **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN048 8/12/2009	15.5	0	23.1	14.1		19.3	0
09MN048 8/12/2009	16.8	0	13.1	12.9		6.7	0
09MN048 8/05/2019	10.2	0	25.2	16.5		33.3	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Suspended Solids Summary

The TSS related fish metrics were mostly poor, though the tolerance values were mixed (Table 267). Since the TSS metrics are so poor and the tolerance values are not, it would appear that the metrics are likely being influenced by other stressors, likely connectivity.

TSS related invert metrics and tolerance values were mixed (Table 268). Collector-filterers were just above the class average as *Ceratopsyche* and *Cheumatopsyche*, two collector-filterer caddisflies were present. There were no Plecoptera caught. High numbers of sprawlers were present and just below the class average. The TSS TIV score was just above the class average and the TSS tolerant invert percentage was 33.3% with no TSS intolerant inverts present.

Two TSS samples were collected and analyzed for TSS during biological sampling. No sample had a TSS concentration above 65 mg/L. There were a couple Secchi tube readings that were greater than 100cm.

TSS are inconclusive as a stressor to aquatic life at this time. It is likely that other factors, such as altered hydrology, or connectivity are causing poor scores in the fish biological metrics. It is recommended that more TSS data be collected during different flows in order to determine whether it is a biological stressor.

3.6.1.8 Nitrates

Nitrate Biological Metric Data

Table 269. Nitrate related invert metrics for stream reach.

07020005-657 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN048 8/12/2009	3.1	3.8		73.1	0
09MN048 8/12/2009	5.4	3.6		74.5	0
09MN048 8/05/2019	8.6	4.8		62.8	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**10.9**	**3.2**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 270. Nitrate monitoring data for stream reach.

07020005-657 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S011-097 (2017)	0 – 5.4 [6]	-	-	5.2 [2]	1.2 [4]	-	-	-
		Highest Value						
		-	-	5.4	2.1	-	-	-

Summary

The nitrate related invert metrics and tolerance were all very poor (Table 269). There were some Trichoptera taxa present, though below the class average. The nitrogen TIV score was well above the class average at 4.8. The percentage of nitrate tolerant inverts was 62.8% of the total number of inverts present with none considered nitrate intolerant. 13 of the top 17 taxa caught are either tolerant or very tolerant to nitrate.

Six samples were measured for nitrate (Table 270). All the concentration values were below the proposed nitrate criteria for protection of aquatic life of 8 mg/L, though there were some moderate concentrations around 5 mg/L. Although sampling did not show elevated nitrate concentrations, the data set was limited. Due to the extremely poor biological metrics, nitrates are likely a stressor to aquatic life in reach 0702005-657 but currently are inconclusive.

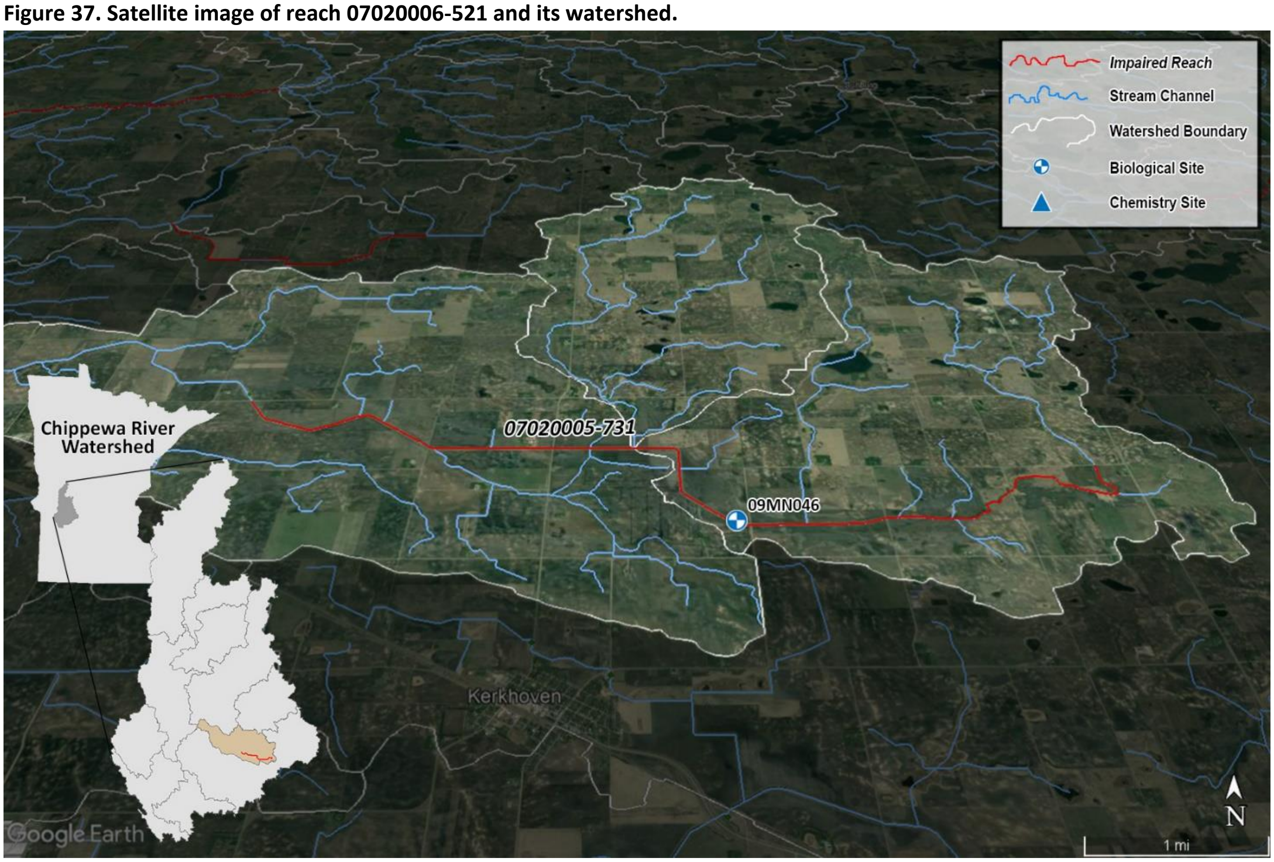
3.6.1.9 Reach Stressors

Table 271. Summary of stressors for stream reach.

07020005-657	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	✓	O	O	O	O	O

3.6.2 07020005-731 Mud Creek

Figure 37. Satellite image of reach 07020006-521 and its watershed.



3.6.2.1 Biological Community

Bio site 09MN046 was sampled once for inverts in 2009 and scored very poorly with an 8.8, well below the modified use threshold of 22 (Table 272). The site was dominated by the amphipod *Hyalella*, which made up over 77% of the total number of inverts caught. Other inverts present include damselflies, snails, and worms. The invert sample had very low total taxa richness and was almost entirely comprised of tolerant taxa.

Biological Metric Data

Table 272. Invert IBI score and threshold for stream reach.

07020005-731 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN046 8/13/2009	8.8	22

3.6.2.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 273. Hydrologic alteration related invert metrics for stream reach.

07020005-731 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %	Percent Ditched Tolerant %	Percent Ditched Intolerant %	Low Depth Variability Tolerant %	Low Depth Variability Intolerant %	Low Flow Tolerant %	Low Flow Intolerant %
09MN046 8/13/2009	2.7	0.9	1.2	17.0	0	91.8	0	0	2.7
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**	↑	↓	↑	↓	↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓						

Hydrologic Alteration Summary

Hydrologic alteration related invert metrics and tolerance values scored mostly poor (Table 273). Clingers and collector-filterers were all very low. Inverts tolerant to ditching and low depth variability was 17% and 91.8% with no intolerant inverts present. The top four inverts present are considered tolerant or very tolerant to low depth variability and three out of the top five inverts present are considered tolerant or very tolerant to ditching.

The site was also dominated by invertebrates who are tolerant to hydrologic alteration metrics. Hydrologic alteration appears to be influencing the biological community. The reach itself has been extensively straightened and altered and is a stressor to the biological community in reach 07020005-731.

3.6.2.3 Connectivity

Connectivity Metric Data

Table 274. Connectivity related fish metrics for stream reach.

07020005-731 **Fish Class 3** **Modified Use**	Mature Age >3%	Migrating %
09MN046 8/13/2009	0	0
Statewide average for channelized Class 3 southern headwater bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Figure 38. Culvert underneath road crossing near bio site 09MN046.

Connectivity Summary

Connectivity related fish metrics were very poor. There were no late maturing or migrating fish present at all. There appears to be a culvert near the bio site that is a fish barrier (Figure 38). It is likely that other road crossings throughout the reach are also fish barriers. Connectivity is a stressor to the biological community in reach 07020005-731.

3.6.2.4 Habitat

Habitat Metric Data

Table 275. Habitat related invert metrics for stream reach.

07020005-731 **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN046 8/13/2009	4.0	12.2	2.7	0.6	10.7	80.5
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 276. Habitat related tolerance values for stream reach.

07020005-731 **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN046 8/13/2009	91.8	0		93.0	0		88.4	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 277. Habitat assessment scores for stream reach.

07020005-731	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN046 6/29/2009	0	8.5	4	5	4	21.5
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The habitat related invert metrics and tolerant values scored mostly poor (Table 275). The site was dominated by the amphipod *Hyalella*, which is a sprawler, causing the percentage of sprawlers to be 80.5%, also causing the other metrics to score low. The tolerance values were also very poor as *Hyalella* is tolerant to several habitat tolerance metrics (Table 276).

The MSHA score was poor (Table 277). There was no coarse substrate as only silt was observed at the site. Channel morphology was very poor as there was no depth variability, sinuosity, or riffles present.

The bio metrics and the MSHA assessment were poor. Habitat is a stressor in reach 07020005-731.

3.6.2.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 278. DO related invert metrics for stream reach.

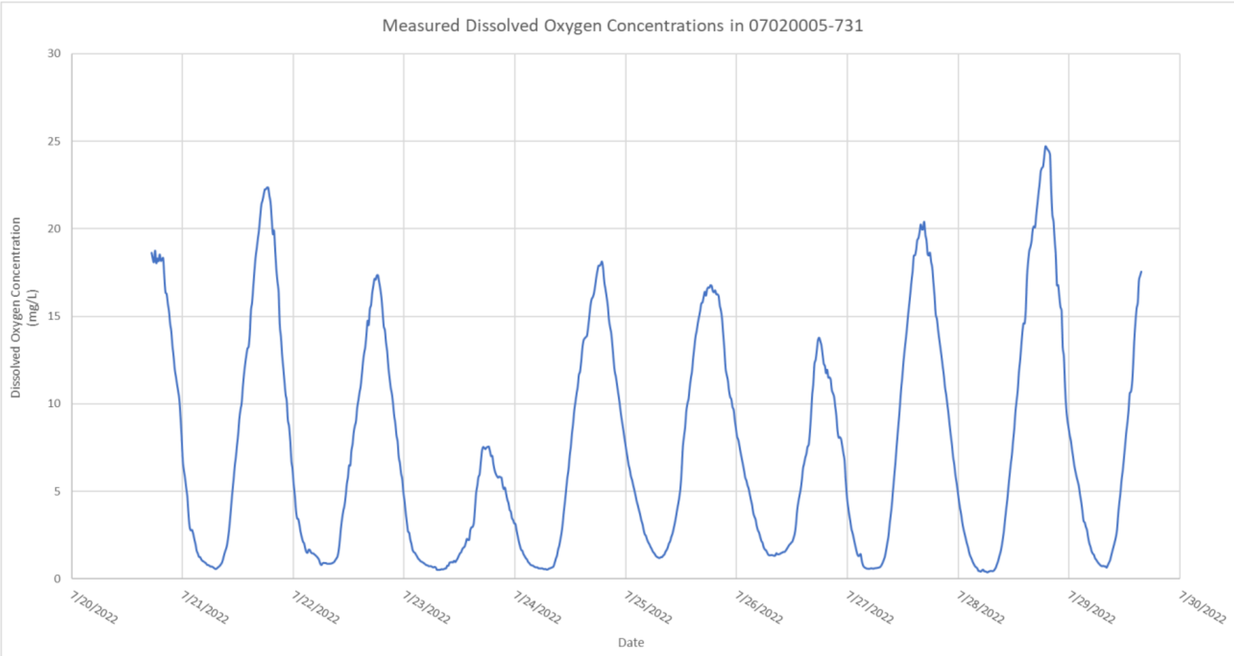
07020005-731 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN046 8/13/2009	0.6	7.6	20	5.7		88.4	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 279. DO monitoring data for stream reach.

07020005-731 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-961 **S005-962** **S005-963** **S005-964** (2011-2022)	2.8 – 16.7	-	0 [4]	6.9 [29]	11.1 [9]	15.4 [13]	12.5 [8]	-	9.5 [63]
		Minimum Value							
		-	6.5	4.0	3.8	2.8	4.9	-	

Figure 39. Continuous DO data at site 09MN046.



Dissolved Oxygen Summary

Invertebrate DO related metrics were poor (Table 278). EPT percentage was very low, less than a percent of the total number of inverts present. Total taxa count was below the class average, as was the DO TIV score. The percentage of DO tolerant inverts was 88% with no DO intolerant inverts caught as the top two inverts caught, *Hyalella* and Coenagrionidae, are considered tolerant and very tolerant to low DO.

Several DO measurements taken during sampling were below the warmwater standard of 5 mg/L (Table 279). A YSI Sonde water meter measured continuous DO data from 7/20/2022 to 7/29/2022 (Figure 40). During this deployment, DO values were measured below 5mg/L every single night of the deployment and were close to zero.

Based on the DO related invertebrate biological metric scores, DO measurements, and the measured sonde values, DO is a stressor in reach 07020005-731.

3.6.2.6 Eutrophication

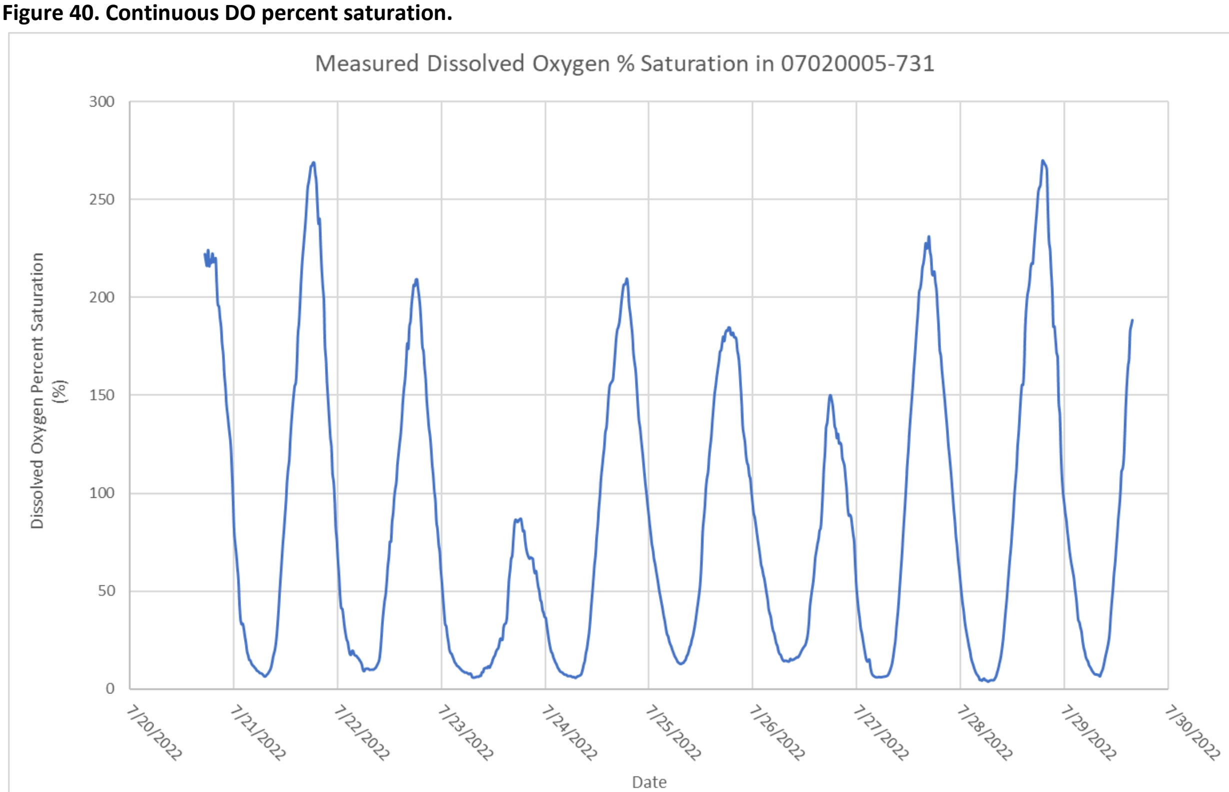
Eutrophication Biological Metric Data

Table 280. Eutrophication related invert metrics for stream reach.

07020005-731 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN046 8/13/2009	82.0	8.0	0.6	4.0	20		92.4	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**15.6**	**13.0**	**20.6**	**13.5**	**36.8**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Figure 40. Continuous DO percent saturation.



Eutrophication Summary

Eutrophication related invertebrate metrics were mostly poor (Table 280). Crustacean and mollusk percentage was very high as the amphipod *Hyalella* dominated the invert community and the snail *Physella* was the third most numerous invert present. EPT percentage was very low as was total taxa count. The percentage of phosphorus tolerant inverts was very high at 92.4% of the total caught.

Only one sample was collected and analyzed for phosphorus in 2022. The concentration was 0.132 mg/L, below the standard of 0.150 mg/L.

A YSI Sonde water meter measured continuous DO data from 7/20/2022 to 7/29/2022 (Figure 40). During this deployment, diel DO flux was measured as high as 25 mg/L and near zero every day of the deployment. DO percent saturation was also measured during the sonde deployment, during which it was measured well above 100%, in some cases above 250%, which is very high and indicative of eutrophication (Figure 41).

The biological community is showing the effects of the elevated phosphorus, DO flux was well above 5 mg/L and the percent saturation was very high. Eutrophication is a stressor in reach 07020005-731.

3.6.2.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 281. TSS related invert metrics for stream reach.

07020005-731 **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN046 8/13/2009	0.9	0	80.5	15.0		12.2	0.0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

TSS Monitoring Data

Table 282. Transparency monitoring data for stream reach.

07020005-731 Secchi Tube Data 10 cm target	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-961 **S005-962** **S005-963** **S005-964** (2011-2022)	12 – 100+	-	0 [5]	0 [29]	0 [8]	0 [12]	0 [8]	-	3.1 [61]

Suspended Solids Summary

TSS related invertebrate metrics were mostly poor (Table 281). Collector-filterers were very low, less than 1%. No Plecoptera were present. Sprawlers were over 80% of the total number of inverts caught, which was influenced by the dominance of the amphipod *Hyalella*, which is considered a sprawler. The TSS TIV score was below the class average and the percentage of TSS tolerant inverts was 12.2% with no TSS intolerant inverts caught.

Sixty-one transparency measurements were conducted from 2011 through 2022 (Table 282). None were below 10cm.

Due to the biological metrics being influenced by one invert being so dominant and transparency data having no readings below 10cm, TSS is inconclusive as a stressor to the biological community in reach 07020005-731.

3.6.2.8 Nitrates

Nitrate Biological Metric Data

Table 283. Nitrate related invert metrics for stream reach.

07020005-731 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN046 8/13/2009	0	2.1		8.5	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**11.1**	**3.2**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 284. Nitrate monitoring data for stream reach.

07020005-731 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S004-387 (2022)	2.7 – 6.8 [6]	-	-	6.8 [1]	4.2 [5]	-	-	-
		Highest Value						
		-	-	6.8	6.2	-	-	-

Summary

The nitrate related invert metrics and tolerance values were mixed (Table 283). There were no Trichoptera taxa present at all as the site was dominated by the amphipod *Hyalella* as well as the damselfly Coenagrionidae, both of which are not considered tolerant to nitrogen.

Six nitrate/nitrogen samples were collected in reach 07020005-731 and analyzed for nitrate (Table 284). All the concentration values were below the proposed nitrate criteria for protection of aquatic life of 8 mg/L, though there were some moderate concentrations around 6 and 7 mg/L. Due to the mixed biological response and relatively low nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-731.

3.6.2.9 Reach Stressors

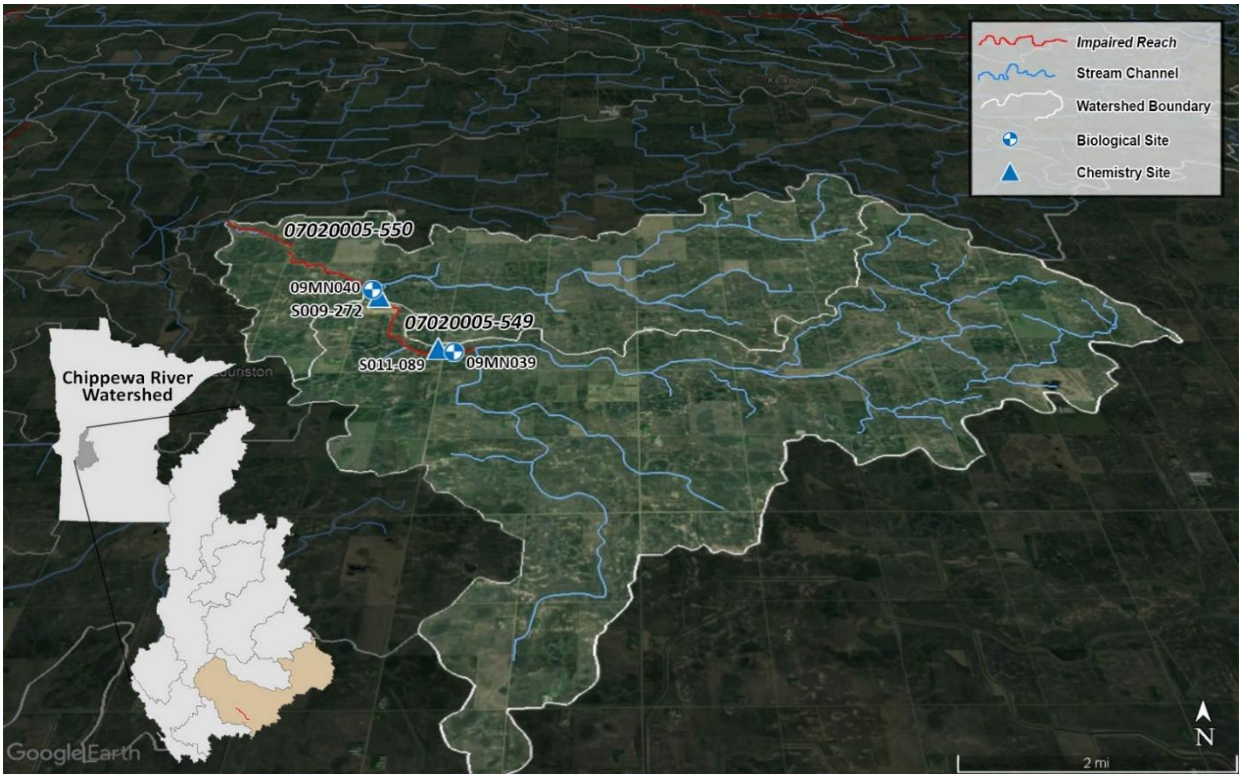
Table 285. Summary of stressors for stream reach.

07020005-731	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	✓	✓	✓	✓	O	O

3.7 Shakopee Creek Watershed

3.7.1 07020005-549, 07020005-550 Unnamed Creeks

Figure 41. Satellite image of reaches 07020005-549 and 07020005-550 and their watershed.



3.7.1.1 Biological CommunityTable 286. Invert IBI score and threshold for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN039 8/13/2009	17.6	22

Table 287. Fish IBI score and threshold for stream reach.

07020005-550 **Fish Class 2** **Modified Use**	Fish IBI Score	Class Threshold Score
09MN040 7/16/2019	21.8	35

The invert IBI score at bio site 09MN039 was 17.6, below the modified class average of 22 (Table 286). The invert sample was almost entirely comprised of tolerant taxa. The sample was largely comprised of various snail genera as four out of the top five inverts present were snails.

The fish IBI score at bio site 09MN040 was 21.8, below the Class 2 threshold of 35 (Table 287). The sample was dominated by tolerant taxa (85%) with no sensitive species present and the taxa diversity is relatively low for southern streams. Only 31 total fish were caught and all but 1 is considered either tolerant or very tolerant.

The fish IBI score at bio site 09MN041 was 0.1, below the Class 7 threshold of 15 (Table 344). Only 24 individuals from 3 separate taxa were collected, which resulted in low end scoring for all metrics.

Biological Metric Data

Table 286. Invert IBI score and threshold for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN039 8/13/2009	17.6	22

Table 287. Fish IBI score and threshold for stream reach.

07020005-550 **Fish Class 2** **Modified Use**	Fish IBI Score	Class Threshold Score
09MN040 7/16/2019	21.8	35

3.7.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 288. Hydrologic alteration related invert metrics for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %	Percent Ditched Tolerant %	Percent Ditched Intolerant %	Low Depth Variability Tolerant %	Low Depth Variability Intolerant %	Low Flow Tolerant %	Low Flow Intolerant %
09MN039 8/13/2009	1.9	0.0	0.9	94.7	0.3	93.2	0	0.9	16.1
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**	↑	↓	↑	↓	↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓						

Table 289. Hydrologic alteration related fish metrics for stream reach.

07020005-550 **Fish Class 2** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
09MN040 7/16/2019	41.9	67.7
Statewide average for channelized Class 2 southern stream bio sites	**43.9**	**30.6**
Expected response to **Hydrologic** stress	↑	↑

Hydrologic Alteration Summary

Hydrologic alteration related fish metrics at bio site 09MN040 were mixed (Table 289). Generalist fish were just below the class average as the most numerous fish taxa present, the johnny darter, is not considered a generalist. It is, however, a nesting fish, as is the fathead minnow, the second most numerous fish present.

Hydrologic alteration related invert metrics and tolerance values were mostly poor (Table 288). Clingers, collector-filterers, and long-lived inverts were all very low. Inverts that are tolerant to ditching and low depth variability were 94.7% and 93.2% of the total caught. Of the top inverts captured, 13 of 14 are considered tolerant or very tolerant to ditching and the top 14 inverts caught are considered tolerant to low depth variability. Low flow tolerant inverts were low as none of the snails present are considered tolerant to low flows.

Hydrologic alteration related fish metrics at bio site 09MN041 were also mixed (Table 345). Only three fish were caught and none of them are considered generalists. The most numerous fish taxa present, brook stickleback, is a nesting fish.

Most of the stream channel itself, as well as the watershed has been extensively altered and ditched. This watershed has a lot of clay in the soil naturally as well as evidence of wetlands that appear to have been ditched and drained. Most of the ditches in the watershed are very large and deep with very steep sides, confining the stream channel (Figure 42 and Figure 43).

Figure 42. Photo taken from the bridge crossing near bio site 09MN040.

Figure 43. Photo taken near bio site 09MN039 showing channelized channel and drainage culverts.

Due to the mostly poor biological metrics and the extensive alteration of the hydrology in the watershed, hydrologic alteration is a stressor in reaches 07020005-549 and 07020005-550.

3.7.1.3 Connectivity

Connectivity Metric Data

Table 290. Connectivity related fish metrics for stream reach.

07020005-549 **Fish Class 3** **Modified Use**	Mature Age >3%	Migrating %
09MN039 6/30/2009	57.4	57.4
Statewide average for channelized Class 3 southern headwaters bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Table 291. Connectivity related fish metrics for stream reach.

07020005-550 **Fish Class 2** **Modified Use**	Mature Age >3%	Migrating %
09MN040 7/16/2019	9.7	9.7
Statewide average for channelized Class 2 southern stream bio sites	**28.0**	**21.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related invert metrics were mixed. At the further upstream bio site, 09MN039, both late maturing and migrating fish scored well and made up 57.4% of the total number of fish caught. This was due to the 78 white suckers that dominated the fish community. Further downstream at bio site 09MN040, both metrics scored poorly with only 9.7% of the total number fish caught being white suckers. The white sucker is both a migrating and late-maturing fish, though it is also considered generally tolerant. Both reaches flow into Shakopee Lake, a shallow reservoir that effectively acts as a fish barrier and cuts the streams upstream off from the Chippewa River. Upstream bio site 09MN039 also had a substantially larger number of fish caught during the sampling visit. Connectivity is inconclusive in reaches 07020005-549 and 07020005-550.

3.7.1.4 Habitat

Habitat Metric Data

Table 292. Habitat related invert metrics for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN039 8/13/2009	4.0	80.2	1.9	1.9	76.8	7.4
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 293. Habitat related invert tolerance values for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN039 8/13/2009	94.7	0		91.0	0		65.6	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

Table 294. Habitat related fish metrics for stream reach.

07020005-550 **Fish Class 2** **Modified Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN040 7/16/2019	41.9	41.9	16.1	71.0	0.0	9.7	9.7	58.1
Statewide average for channelized Class 2 southern stream bio sites	**19.1**	**16.5**	**35.6**	**23.6**	**8.0**	**19.5**	**26.2**	**46.4**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 295. Habitat related fish tolerance values for stream reach.

07020005-550 **Fish Class 2** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN040 7/16/2019	29.0	0		25.8	0		29.0	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 296. Habitat assessment scores for stream reach.

07020005-549	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN039 6/30/2009	0	8	10	12	4	34
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Table 297. Habitat assessment scores for stream reach.

07020005-550	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN040 7/16/2019	0	6.5	3.5	1	5	16
09MN040 8/7/2019	0	5.5	8.3	7	4	24.8
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The habitat related fish metrics and community in reach 07020005-550 were mostly poor (Table 294). Benthic insectivores and darter percentages scored high as the 13 johnny darters were the most numerous fish caught. Although it is a darter, and a benthic insectivore, the johnny darter is also a nesting and pioneer fish. The only riffle dwelling and simple lithophilic fish caught were three white suckers. All the fish that were caught besides the johnny darter are considered either very tolerant or tolerant. Habitat related tolerance values were all poor (Table 295). All three values had tolerant percentages between 25% to 30%.

The habitat related invert metrics were mixed at first glance (Table 292). The dominance of snails in the sample, which are climbers, caused several of the other metrics to score well. The top five inverts caught, four of which are snails with the other being a beetle, are all considered climbers. Snails are typically tolerant to poor habitat, which is the case in this reach. The dominance of climbers caused the percentages of burrowers and sprawlers to score low. Clingers, EPT, and legless inverts all scored poorly. The tolerance values were very poor (Table 293). The percentage of inverts tolerant or very tolerant to poor MSHA scores was 94.7% and the percent of inverts tolerant to high embeddedness was 91%. The top 14 invert taxa caught are at least tolerant and the top 8 inverts are very tolerant to poor MSHA scores. The top 10 inverts caught are either tolerant or very tolerant to high embeddedness of substrate and the top 8 inverts caught are considered very tolerant to low substrate scores.

MSHA scores were poor in both reaches. The habitat at bio site 09MN039 scored a total of 34 out of 100 possible (Table 296). The riparian zone was narrow with moderate shade. Substrate scored poorly with a 10 out of 28. There was some sand present but was embedded by silt. Both overhanging vegetation and submergent vegetation were present as extensive cover was observed with a score of 12 out of 18. Channel morphology scored very poorly as there was low depth variability, poor sinuosity, poor channel development, no riffles, and only slow water velocities. Reach 07020005-550 had two MSHA assessments done in 2019, and both scored very poorly with a 16 and 24.8 out of 100 respectively (Table 297). Riparian width was narrow and heavy erosion was noted. Shade was also lower in this reach, causing the cover score to be poor. Channel morphology also scored very poorly with a 5 and 4 out of a possible 35. While there was some depth variability in this reach, it was low. Sinuosity, channel development, and channel stability were all poor.

Habitat related metrics and tolerance values are poor in both reaches. The streams have been channelized and shaped into straight, very deep incised ditches. Habitat assessments were also very poor. Habitat is a stressor in reaches 07020005-549 and 07020005-550.

3.7.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 298. DO related invert metrics for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN039 8/13/2009	1.9	9.4	35	5.8		64.4	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Table 299. DO related fish metrics for stream reach.

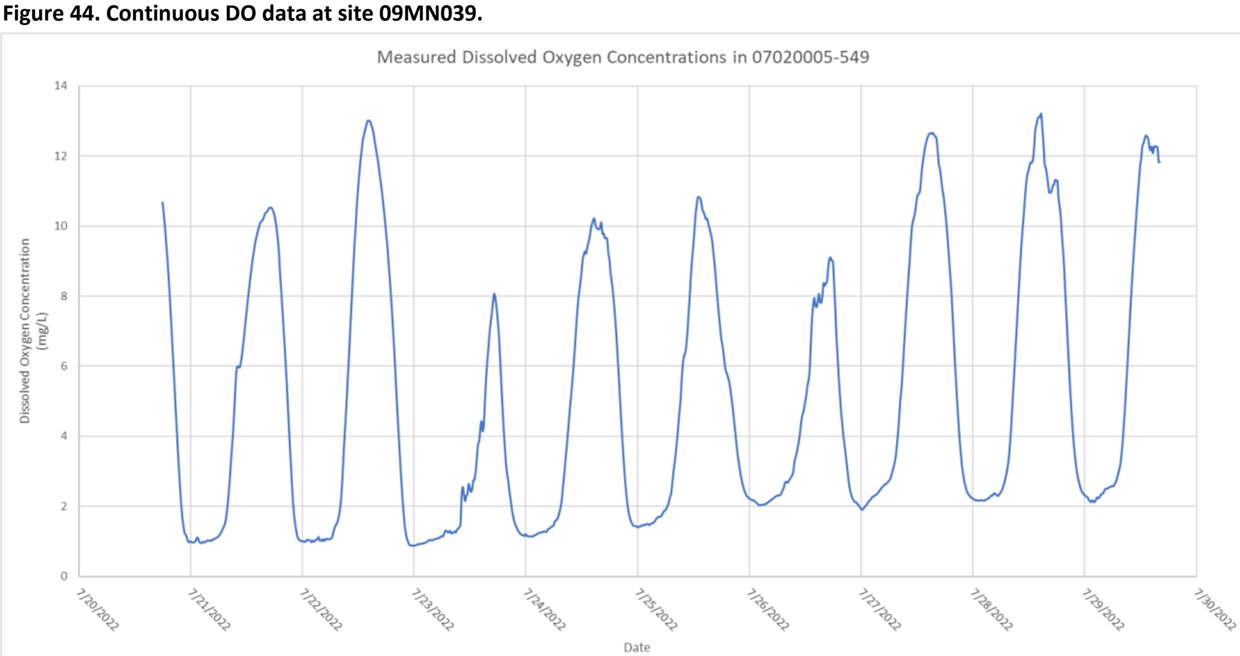
07020005-550 **Fish Class 2** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN040 7/16/2019	7	9.7	0	35.5	58.1	6.9		29.0	0.0
Statewide average for channelized Class 2 southern stream bio sites	**14.5**	**28.0**	**8.4**	**25.3**	**46.4**	**7.0**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Dissolved Oxygen Monitoring Data

Table 300. DO monitoring data for stream reach.

07020005-549, 550 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-272 **S011-089** (2016-2022)	6.1 – 12.8	-	0% [1]	0% [4]	0% [5]	0% [4]	0% [2]	0% [1]	0% [17]
		Minimum Value							
		-	9.7	8.2	6.1	8.2	9.2	12.8	

Figure 44. Continuous DO data at site 09MN039.



Dissolved Oxygen Summary

The DO related fish metrics and tolerance values at site 09MN040 were poor (Table 299). Total taxa count was low, and late-maturing fish were well below the class average. No sensitive fish were caught. Serial spawner and tolerant percentages were above the class average. The DO TIV score was just below the class average and 29% of the total fish caught are considered very tolerant to low DO.

The DO related invert metrics and tolerance values at site 09MN0389 were mostly poor (Table 298). EPT percentage was very low and the HBI_MN value was well above the class average. The DO TIV score was poor as well and 64.4% of all the inverts caught are considered tolerant or very tolerant to low DO. 12 out of the top 13 most numerous inverts caught are considered tolerant to low DO as most snails and beetles are tolerant to low DO conditions.

There were no DO measurements taken during sampling that were below the warmwater standard of 5 mg/L (Table 301). However, none of those measurements were taken before 8:00a.m., when values are usually the lowest. An YSI Sonde water meter measured continuous DO data from 7/20/2022 to 7/29/2022 (Figure 45). During this deployment, DO values were measured below the standard every night of the deployment.

Based on the mostly poor fish and invertebrate biological metric scores and the measured DO values during the sonde deployment, some of which fell below 1 mg/L. DO is a stressor in reaches 07020005-549 and 07020005-550.

3.7.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 301. Eutrophication related invert metrics for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN039 8/13/2009	66.9	10.0	1.9	66.6	35		90.7	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.1**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Table 302. Eutrophication related fish metrics for stream reach.

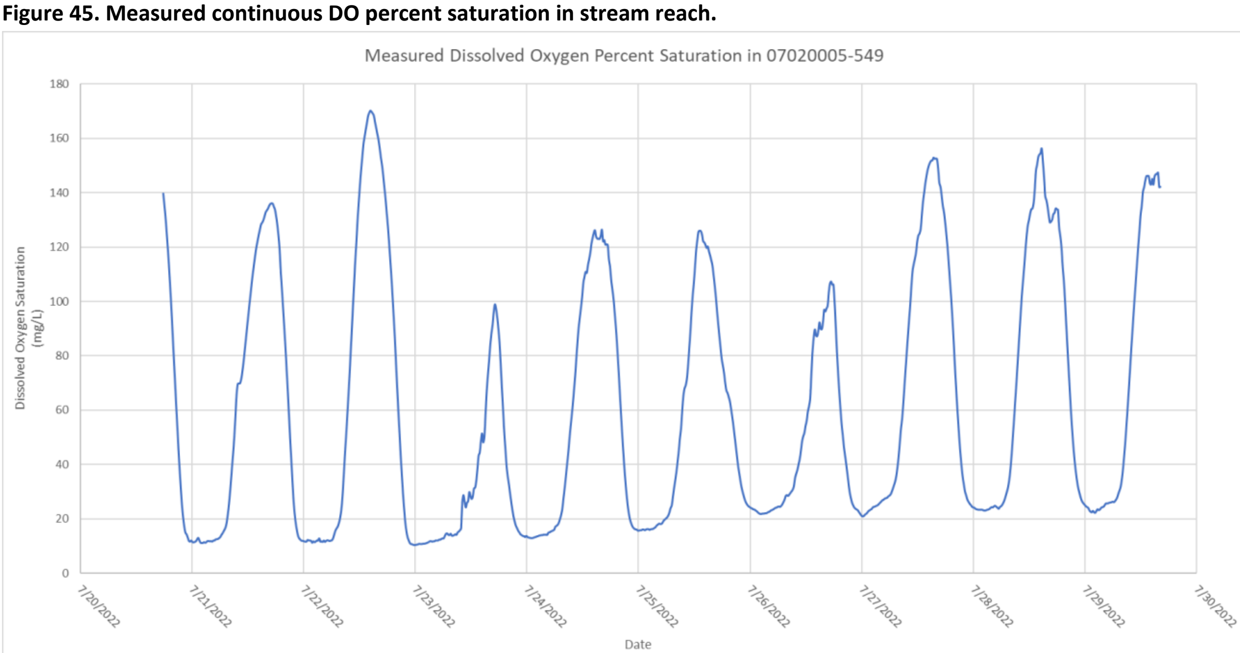
07020005-550 **Fish Class 2** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN040 7/16/2019	7	41.9	35.5	9.7		29.0	0
Statewide average for channelized Class 2 southern stream bio sites	**14.5**	**13.6**	**25.5**	**26.2**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 303. Phosphorus monitoring data for stream reach.

07020005-549 P Sample Data 0.150 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-089 **S009-272** (2022)	0.382 – 0.530	-	-	-	0.445 [4]	-	-	-	0.445 [4]
		Maximum Value							
		-	-	-	0.530	-	-	-	

Figure 45. Measured continuous DO percent saturation in stream reach.



Eutrophication Summary

Eutrophication related fish metrics at bio site 09MN040 were mostly poor (Table 303). Darter percentage was higher than the class average as the most numerous fish caught were 13 johnny darters. Total taxa count was low and fathead minnows, an omnivore, caused that percentage to be higher than the class average. Simple lithophilic spawning fish percentage was very low as the two most numerous fish present, the johnny darter and fathead minnow, are nesting fish. Phosphorus tolerant fish made up 29% of the total number of fish caught with no phosphorus intolerant fish present.

The eutrophication related invert metrics and tolerance values at bio site 09MN039 were mostly poor (Table 301). Mollusk percentage was very high as four out of the top five most numerous inverts present were snails. Collector-gatherer taxa were just below the class average at 10% and EPT percentage was very low, just under 2% of the total. Most snails are scrapers, the percentage of which were well above the class average. Nine of the top 10 most numerous invert taxa caught are either tolerant or very tolerant to high phosphorus and the percentage of the total number of inverts caught that are tolerant to high phosphorus was over 90%.

Phosphorus sampling was limited in the two reaches but was poor overall (Table 303). Four samples, two from each reach, were collected in July of 2022. All of the samples collected were over double the standard of 0.150 mg/L, with an average of 0.445 mg/L. DO diel flux was greater than 5 mg/L every night of the sonde deployment (Figure 45).

DO percent saturation was measured during the sonde deployment from 7/20/2022 to 7/29/2022 (Figure 46). During the deployment the percent saturation went above 100% every day except one, with values exceeding 150% several of the days.

The biological community in both reaches are showing the effects of elevated phosphorus. Phosphorus sampling showed elevated concentrations and DO measurements had both high flux and saturations. Eutrophication is a stressor in both 07020005-549 and 07020005-550.

3.7.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 304. TSS related invert metrics for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN039 8/13/2009	0	0	7.4	17.8		40.9	0.0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Table 305. TSS related fish metrics for stream reach.

07020005-550 **Fish Class 2** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN040 7/16/2019	51.6	0.0	0.0	3.2	41.9	9.7	9.7	18.9		16.1	0.0
Statewide average for channelized Class 2 southern stream bio sites	**30.1**	**6.2**	**2.9**	**21.3**	**28.7**	**19.5**	**26.2**	**18.8**		↑	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

TSS Monitoring Data

Table 306. TSS monitoring data for stream reach.

07020005-549 Secchi Tube Data 10 cm target	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]								% of Total Samples < 10 cm [# of Samples]
		March	April	May	June	July	Aug	Sept	Oct	
S009-272 **S011-089** (2016-2022)	7 – >100	-	-	0% [1]	0% [6]	0% [4]	25% [4]	0% [2]	0% [1]	5.9% [17]

Suspended Solids Summary

The TSS related fish metrics and tolerance values at site 09MN040 were mostly poor (Table 305). Benthic feeders scored high as the johnny darter, the most numerous fish caught, is a benthic insectivore. There were no Centrarchids or herbivores present at all, and the percentage of long-lived fish was very low. Riffle dwelling fishes were well below the class average as were simple lithophilic spawning fish. The TSS TIV score was just one tenth above the class average and the percentage of TSS tolerant fish was 16.1% with no TSS sensitive fish present.

The TSS related invert metrics and tolerance values at site 09MN039 were mostly poor (Table 304). The dominance of snails, which are scrapers, caused other feeding group metrics to score low, including collector-filterers and sprawlers. The most numerous invert present, the *Physella* snail, is considered very tolerant to high TSS. The TSS TIV was just above the class average and over 40% of the total number of inverts caught are considered tolerant to TSS.

Seventeen transparency measurements were conducted from 2016 to 2022 (Table 306). Only one measurement in August was below 10 cm.

Both the fish and invertebrate metrics indicate that TSS is a stressor to aquatic life in both reach 07020005-549 and 07020005-550. Even though the transparency measurements did not show elevated levels it is likely that the limited dataset is not representative of conditions. Extensive deposits of fine sediments were observed during a site visit, which indicates that there are excessive fine sediments within the stream channel. The stream channel itself appears to be incised as well and is likely receiving sediment from streambank erosion due to the stream power eroding the bank during high flows.

3.7.1.8 Nitrates

Nitrate Biological Metric Data

Table 307. Nitrate related invert metrics for stream reach.

07020005-549 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN039 8/13/2009	0	4.1		72.8	0.0
09MN040 8/07/2019	10.5	3.5		64.2	0.3
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**11.1**	**3.2**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 308. Nitrate monitoring data for stream reach.

07020005-549 **07020005-550** Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S009-272 **S011-089** (2022)	0.06 – 14.1 [11]	-	-	12.7 [2]	0.3 [9]	-	-	-
		Highest Value						
		-	-	14.1	1.0	-	-	-

Summary

The nitrate related invert metrics and tolerance values at bio sites 09MN039 and 09MN040 both scored poorly (Table 307). The nitrogen TIV score also indicates a macroinvertebrate community that is generally tolerant to high levels of nitrates.

Eleven samples were collected in both reaches and analyzed for nitrate (Table 308). Two samples taken in June, one from each reach, were above the proposed nitrate criteria for protection of aquatic life of 8 mg/L.

Due to the poor metrics and tolerance values, as well as evidence of high nitrate values, nitrate is a stressor to the biological community in reaches 07020005-549 and 07020005-550.

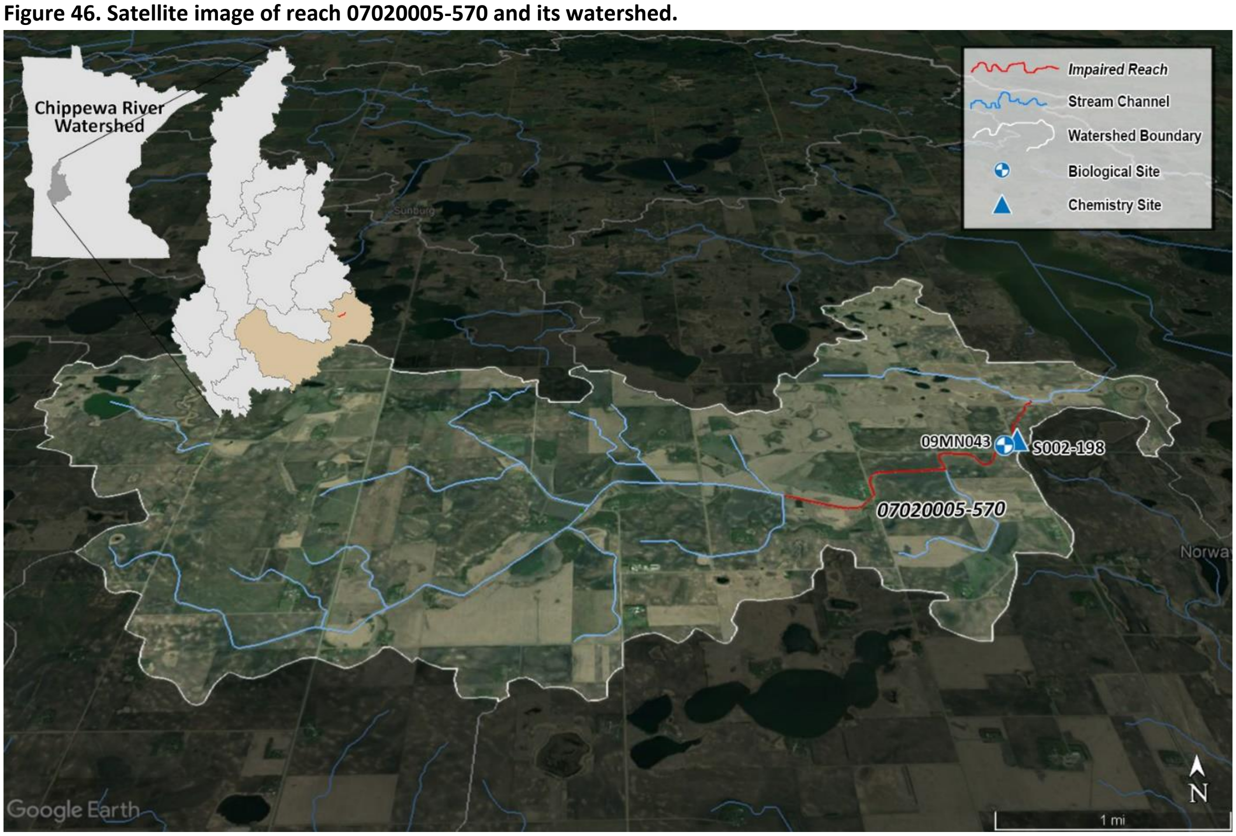
3.7.1.9 Reach Stressors

Table 309. Summary of stressors for stream reach.

07020005-549 07020005-550	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	✓	✓	✓	✓

3.7.2 07020005-570 County Ditch 27

Figure 46. Satellite image of reach 07020005-570 and its watershed.



3.7.2.1 Biological Community

Bio site 09MN043 was sampled twice for fish, once in 2009 and also in 2021 (Table 310). The FIBI scores were very different between the years as only three fish total were caught in 2009, resulting in a score of zero. The latest fish visit was very different, with 110 total fish caught, 81 of which were yellow perch, which was 73% of the total number of fish caught.

Bio site 09MN043 was sampled twice for invertebrates, once in 2009 and in 2019. The MIBI score of 19.3 and 20.4 was below the Invert Class 5 southern stream rock riffle modified use threshold of 24 (Table 311). The amphipod *Hyalella* was the most numerous invert present in the 2019 sample and the second most numerous invert present in 2009. There were also large numbers of amphipods and midges present, both of which are considered tolerant.

Biological Metric Data

Table 310. Fish IBI score and threshold for stream reach.

07020005-570 **Fish Class 3** **Modified Use**	Fish IBI Score	Class Threshold Score
09MN043 6/29/2009	0	33
09MN043 6/16/2021	78.7	

Table 311. Invert IBI score and threshold for stream reach.

07020005-570 **Invert Class 5** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN043 8/13/2009	19.3	24
09MN043 8/5/2019	20.4	

3.7.2.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 312. Hydrologic alteration related fish metrics for stream reach.

07020005-570 **Fish Class 3** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
09MN043 6/29/2009	33.3	0
09MN043 6/16/2021	5.5	4.6
Statewide average for channelized Class 3 southern headwater bio sites	**56.3**	**24.0**
Expected response to **Hydrologic** stress	↑	↑

Table 313. Hydrologic alteration related invert metrics for stream reach.

07020005-570 **Invert Class 5** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth Variability Tolerant %	Low Depth Variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
09MN043 8/13/2009	3.1	4.7	0.0		73.6	0		69.6	0		5.6	11.2
09MN043 8/5/2019	21.8	13.1	1.6		23.7	3.5		69.9	11.5		10.9	0.3
Statewide average for channelized Invert Class 5 prairie stream rock riffle bio sites	**39.2**	**22.1**	**6.5**		↑	↓		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓									

Hydrologic Alteration Summary

The hydrologic related fish metrics scored well when compared to the average of Fish Class 3 bio sites (Table 312). Bio site 09MN043 had a general population of only 5.5% while nesting fish comprised only 4.6% of the total number of fish caught. The yellow perch made up over 73% of the total number of fish caught, which has influenced the metrics. Even so, there were very few generalist or nesting fish present.

The hydrologic related biological invertebrate metrics and tolerance values were poor (Table 313). Bio site 09MN043 had a population of clingers of 21.8%, which is below the class average of 39.2%. Collector – filterers comprised 13.1% of the population. Both metrics were influenced by the high numbers of net spinning caddisflies present. Long – lived inverts were only 1.6% of the population. Tolerance values were also mostly poor (Table 313). The ratio of inverts who are considered tolerant vs intolerant to ditching was relatively high. The percentage of inverts tolerant to low depth variability was over 69%, with 11.5% of the total being intolerant to low depth variability. Low flow tolerant to intolerant was also poor, though only 10.9% of the total are considered tolerant. The two most numerous inverts present, *Hyalella* and the mayfly *Caenis*, are tolerant to low depth variability, with *Caenis* also being very tolerant to ditching.

Based on the mixed scores of the biological metrics, hydrologic alteration is a stressor to the invert community in this reach; it is inconclusive to the fish community.

3.7.2.3 Connectivity

Connectivity Metric Data

Table 314. Connectivity related fish metrics for stream reach.

07020005-570 **Fish Class 3** **Modified Use**	Mature Age >3 %	Migrating %
09MN043 6/29/2009	33.3	33.3
09MN043 6/16/2021	76.4	3.6
Statewide average for channelized Class 3 southern headwater bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Figure 47. Photos of a culvert near bio site 09MN043. The culvert is not set at the proper elevation, creating a fish barrier.

Connectivity related fish metrics were mostly good; however, the one metric that scored poorly in the latest fish sample was migrating fish percentage, which is arguably the most important when evaluating connectivity. The migrating fish present were only three white suckers and one Iowa darter. There is a known barrier on this reach as the culvert near the bio site is a fish barrier at low flows and very likely at high flows (Connectivity Summary). Due to the lack of migrating fish and known fish barrier, connectivity is a stressor in reach 07020005-570.

3.7.2.4 Habitat

Habitat Metric Data

Table 315. Habitat related fish metrics for stream reach.

07020005-570 **Fish Class 3** **Modified Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN043 6/29/2009	0	0	33.3	0	33.3	33.3	33.3	66.7
09MN043 6/16/2021	0.9	0.9	2.7	0.9	7.3	2.7	2.7	13.6
Statewide average for channelized Class 3 southern headwater bio sites	**10.9**	**10.6**	**58.0**	**32.5**	**2.0**	**22.6**	**30.1**	**76.7**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 316. Habitat related fish tolerance values for stream reach.

07020005-657 **Fish Class 3** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN043 6/29/2009	0	0		33.3	0		0	0
09MN043 6/16/2021	0	0		8.2	0		10	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

Table 317. Habitat related invert metrics for stream reach.

07020005-570 **Invert Class 5** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN043 8/13/2009	14.4	47.2	3.1	7.2	63.4	26.9
09MN043 8/5/2019	1.6	5.4	21.8	34.3	10.3	67.9
Statewide average for channelized Invert Class 5 prairie stream rock riffle bio sites	**9.0**	**21.5**	**39.2**	**33.6**	**45.5**	**21.3**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 318. Habitat related invert tolerance values for stream reach.

07020005-570 **Invert Class 5** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN043 8/13/2009	82.3	0		78.0	0		37.0	0
09MN043 8/5/2019	70.2	0		69.9	0		51.9	0.6
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 319. Habitat assessment scores for stream reach.

07020005-570	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN043 6/29/2009	0	14	17.8	13	23	67.8
09MN043 8/5/2019	0	8.5	18.9	14	9	50.4
09MN043 6/16/2021	0	9	8	2	20	39
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The habitat related fish metrics and tolerance values at bio site 09MN043 were mixed (Table 315 and Table 316). Benthic insectivores, darters, lithophilic spawners, and riffle dwelling fish all scored poorly; these metrics indicate that the stream may be lacking in coarse substrate. Tolerance values are mixed as well but the two values that are showing poor scores, embeddedness and low substrate, both scored somewhat poorly.

The habitat related invert metrics were also mixed (Table 317). Burrowers and legless inverts were low and the EPT percentage was just above the class average. The amphipod *Hyalella*, a sprawler, dominated the invert sample. This caused the sprawler percentage to be very high as well as other metrics, such as burrower and legless percentages to be low. The tolerance values were very poor as the percentages of habitat related tolerant percentages ranged from 51.9% to 70.2% of the total number of inverts caught (Table 318). The high percentage of sprawlers and the high percentages of inverts tolerant to embeddedness and poor substrate indicate poor substrate within the reach.

The MSHA scores were mostly poor, with one from 2009 being a moderate 67.8 and two from 2019, scoring 50.4 and 39 (Table 319). Looking at the assessments from 2019 and 2021, embeddedness, silt, and muck were all noted as being present in the stream channel. Cover scored better in the 2019 visit as it was noted as extensive compared to choking vegetation only in the 2021 assessment. This may be due to the fact the two assessments were done by different crews, one focused on fish and one focused on inverts, with an emphasis on different habitat requirements of both. Overall, the assessments from 2019 and 2021 were poor with low substrate and channel morphology scores.

Due to the mostly poor biological metrics, tolerance values, and poor habitat assessments, habitat is a stressor to the biological community at bio site 09MN043.

3.7.2.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 320. DO related fish metrics for stream reach.

07020005-570 **Fish Class 3** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN043 6/29/2009	3	33.3	0	0	66.7	6.6		66.7	0
09MN043 6/16/2021	11	76.4	0.9	2.7	13.6	-		96.4	0
Statewide average for channelized Class 3 southern headwater bio sites	**10**	**14.4**	**1.7**	**10.6**	**76.7**	**7.0**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Table 321. DO related invert metrics for stream reach.

07020005-570 **Invert Class 5** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN043 8/13/2009	7.2	8.8	33	5.7		38.2	0
09MN043 8/5/2019	34.3	7.7	28	6.2		69.9	3.5
Statewide average for channelized Invert Class 5 prairie stream rock riffle bio sites	**33.6**	**7.6**	**36.8**	**6.8**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 322. DO monitoring data for stream reach.

07020005-570 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-198 (2016 – 2017)	4.2 – 12.4	-	0% [1]	0% [4]	25% [4]	25% [4]	0% [2]	0% [1]	12.5% [16]
		Minimum Value							
		-	9.0	8.9	4.2	4.2	6.8	11.5	

Dissolved Oxygen Summary

The habitat related fish metrics were mostly good (Table 320). Taxa count was just above the class average at 11, though the reach was dominated by the yellow perch, which made up 73.6% of the total number of fish caught. With that single fish taxon being so dominant, several of the biological metrics were heavily influenced by its attributes. As such, the late-maturing fish percentage was very high and serial spawning and tolerant fish were both low. The DO related tolerance values were very poor, with 96.4% of all the fish caught considered either tolerant or very tolerant of low DO.

DO related invert metrics and tolerance values were mostly poor, with only EPT percentage scoring well. The second most numerous invert present was the mayfly *Caenis*, which is considered tolerant to low DO. The most numerous invert present, the amphipod *Hyalella*, is also tolerant to low DO, causing the percentage of DO tolerant inverts to be 69.9% of the total number caught.

Out of the 16 total number of DO concentration measurements, 12.5% of them were below 5 mg/L. Low DO was measured in both July and August, two months when DO values are typically at their lowest in Minnesota.

Based on the mixed biological fish metric scores, the poor invert metrics, and the poor fish and invert tolerance values, DO is a stressor in this reach.

3.7.2.6 Eutrophication

Eutrophication Biological Metric Data

Table 323. Eutrophication related fish metrics for stream reach.

07020005-570 **Fish Class 3** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN043 8/13/2009	3	0	33.3	33.3		33.3	0
09MN043 6/16/2021	11	0.9	2.7	2.7		0.9	0
Statewide average for channelized Class 3 southern headwater bio sites	**10.0**	**10.6**	**19.8**	**30.1**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Table 324. Eutrophication related invert metrics for stream reach.

07020005-570 **Invert Class 5** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN043 8/13/2009	42.8	10	7.2	33.1	33		74.5	0
09MN043 8/5/2019	51.3	11	34.3	2.2	28		71.5	0
Statewide average for channelized Invert Class 5 prairie stream rock riffle bio sites	**15.6**	**13.0**	**33.6**	**13.5**	**36.8**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Phosphorus sampling was limited in reach 07020005-570. Only two samples were collected, one in June of 2021 and one in July of 2022. The July sample was 0.298 mg/L of TP, almost twice the standard concentration of 0.150 mg/L. The other sample in June was just below the standard with a concentration of 0.116 mg/L.

Eutrophication Summary

The eutrophication related fish metrics and tolerance values at bio site 09MN043 were mixed (Table 323). In the latest fish visit in 2021, taxa count was just above the class average, omnivores were low, and the percentage of phosphorus tolerant fish present was less than a percent. Darter percentage was very low as only one Iowa darter was caught. Simple lithophilic spawners were well below the class average. The fish metrics were heavily influenced by the dominance of yellow perch at the bio site, which made up 73.6% of the total number of fish caught. The yellow perch is considered neither tolerant nor intolerant generally regarding phosphorus.

Th eutrophication related invert metrics scored mostly poor (Table 324). Crustacean and Mollusca percentage was very high, as the amphipod *Hyalella* dominated the invert sample. Collector – filterer taxa were just below the class average; there were two caddisfly taxa present that are collector-filterers. EPT percentage was just over the class average, though mostly from the 57 *Caenis* mayflies, which are considered tolerant to phosphorus. There were very few scrapers present, with only seven pond snails in the sample. Total taxa count was a little low at 28. There were no intolerant taxa and scrapers were higher than the class average. Overall taxa count was low and the two most numerous taxa are both considered tolerant to high phosphorus, which contributed to the 71.5% phosphorus tolerant invert population.

Only two samples were collected and analyzed for phosphorus in 2021 and 2022. The average of the two was 0.207 mg/L, with the highest concentration of 0.298 mg/L of TP.

The invert biological community is showing the effects of the elevated phosphorus and phosphorus sampling showed elevated concentrations. Although the fish metrics and tolerance values were mixed and inconclusive, eutrophication is a stressor to the invertebrate community within reach 07020005-570.

3.7.2.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 325. TSS related fish metrics for stream reach.

07020005-570 **Fish Class 3** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN043 6/29/2009	33.3	0	0	33.3	0	33.3	33.3	14.5		0	0
09MN043 6/16/2021	2.7	3.6	0	80.9	79.1	2.7	2.7	-		0	0
Statewide average for channelized Class 3 southern headwater bio sites	**30.1**	**6.2**	**2.9**	**21.3**	**28.7**	**19.5**	**26.2**	**15.5**		↑	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 326. TSS related invert metrics for stream reach.

07020005-570 **Invert Class 5** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN043 8/13/2009	4.7	0	26.9	16.3		45.0	0
09MN043 8/5/2019	13.1	0	67.9	15.4		12.8	0
Statewide average for channelized Invert Class 5 prairie stream rock riffle bio sites	**22.1**	**0.1**	**21.3**	**16.1**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

TSS Monitoring Data

Table 327. Transparency monitoring data for stream reach.

07020005-570 Secchi Tube Data 10 cm target	Range of Data (cm)	% of Monthly Samples < 10 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-198 (2016-2022)	11 – 100+	-	0% [1]	0% [6]	0% [4]	0% [4]	0% [2]	0% [1]	0% [18]

Suspended Solids Summary

The TSS related fish metrics were mostly good (Table 325). Benthic feeders and riffle dwelling fish were both low, as were Centrarchids and herbivores. The yellow perch, the most numerous fish by a large margin, is a long-lived Perciform, causing those metrics to score very well. Tolerance values were mixed as there were no TSS tolerant or intolerant fish present.

The TSS related invertebrate community at bio site 09MN043 scored mostly poor (Table 326). There was some collector – filterers present, though at 13.1% they were below the class average. There were no Plecoptera present or any TSS intolerant taxa and TSS tolerant taxa were 12.8%. The TSS TIV was below the class average. The percentage of sprawlers was very high however, as the two most numerous inverts present are both considered sprawlers.

Eighteen transparency measurements were conducted from 2016 through 2022 (Table 327). No sample had a transparency reading below 10 cm.

The fish metrics were mixed and the invert metrics, while scoring poorly, were not as bad as other sites with TSS stress. TSS is inconclusive as a stressor to aquatic life at this time. It is likely that other factors, such as altered hydrology or habitat are causing poor scores in the fish and invert biological metrics. It is recommended to collect more TSS data and conduct a sediment substrate analysis to determine whether TSS is a biological stressor.

3.7.2.8 Nitrates

Nitrate Biological Metric Data

Table 328. Nitrate related invert metrics for stream reach.

07020005-570 **Invert Class 5** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN043 8/13/2009	0	3.5		54.4	0.3
09MN043 8/5/2019	10.7	2.6		36.9	0
Statewide average for channelized Invert Class 5 prairie stream rock riffle bio sites	**11.1**	**3.2**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 329. Nitrate monitoring data for stream reach.

07020005-570 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S002-198 (2021-2022)	0.1 – 18.2 [4]	-	-	9.5 [2]	0.2 [2]	-	0.5 [1]	-
		Highest Value						
		-	-	18.2	0.2	-	0.5	-

Summary

The nitrate related invert metrics and tolerance values were mostly poor (Table 328). The percentage of Trichoptera taxa was just below the class average. The second and third most numerous inverts present, the mayfly *Caenis* and the caddisfly *Cheumatopsyche*, are tolerant and very tolerant to nitrates. Six of the top nine invert taxa present are considered either tolerant or very tolerant to nitrates. The nitrogen TIV score was below the class average, which was highly influenced by the fact that the amphipod *Hyalella*, which is not considered tolerant to nitrates, made up almost half of all the inverts caught. Even so, there were still 36.9% of the total number of inverts caught that are considered tolerant to high nitrates and none that are considered intolerant.

Five samples were collected and analyzed for nitrate (Table 329). One of the June samples had a total nitrate concentration of 18.2 mg/L, well above the proposed nitrate criteria for protection of aquatic life of 8 mg/L. Due to the biological response and evidence of high nitrate concentrations, nitrates are a stressor to aquatic life in reach 07020005-570.

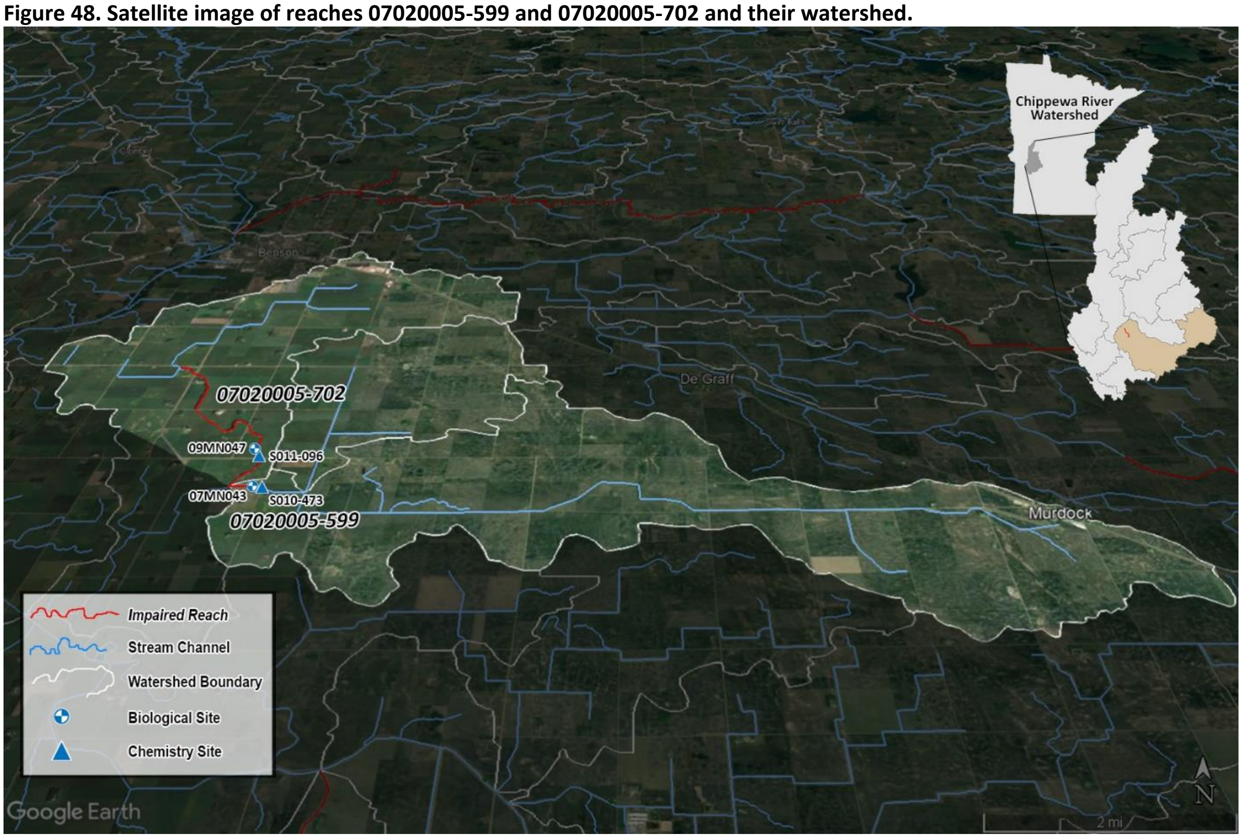
3.7.2.9 Reach Stressors

Table 330. Summary of stressors for stream reach.

07020005-570	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	✓	✓	✓	✓	O	✓

3.7.3 07020005-599, 07020005-702 Judicial Ditch 5

Figure 48. Satellite image of reaches 07020005-599 and 07020005-702 and their watershed.



3.7.3.1 Biological Community

Bio site 07MN043 was sampled on August 13th of 2009. The site scored a 17.7, below the modified Invert Class 7 threshold of 22 (Table 331). The sample had large numbers of tolerant leaches, pea clams, and worms; the invert community was dominated by *Physa* (snails).

Bio site 09MN047 was sampled on August 13th of 2009 (Table 331). The site scored a 17, also below the threshold. The invert sample included one EPT taxa, the very tolerant mayfly genus *Caenis*, which dominated the invert community. The next most numerous inverts present were the midge *Paratanytarsus*, the amphipod *Hyalella*, and Oligochaeta worms All three are considered generally tolerant.

Biological Metric Data

Table 331. Invert IBI score and threshold for stream reach.

07020005-599 **07020005-702** **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
07MN043 8/13/2009	17.7	22
09MN047 8/13/2009	17.0	

3.7.3.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 332. Hydrologic alteration related invert metrics for stream reach.

07020005-599 **07020005-702** **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth Variability Tolerant %	Low Depth Variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
07MN043 8/13/2009	8.8	9.4	4.8		71.2	0		52.1	0		0	11.2
09MN047 8/13/2009	17.0	7.0	3.0		75.2	0.3		76.4	0		0	7.9
Statewide average for channelized Class 7 southern stream rock riffle bio sites	**23.1**	**9.9**	**5.6**		↑	↓		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓									

Hydrologic Alteration Summary

Hydrologic related invertebrate metrics and tolerance values were mostly poor at both bio sites (Table 332). Clingers were low, especially at bio site 07MN043. Bio site 09MN047 had more clingers present as the midge *Paratanytarsus* was the second most numerous invert present. Collector-filterers were low at both bio sites, with the pea clam Pisidiidae being the only collector-filterer present at site 07MN043. 09MN047 also had Pisidiidae present along with the midge tanytarsus. Long-lived inverts were also very low at both sites with the riffle beetle *Dubiraphia* being the only long-lived taxa present in higher numbers. Inverts considered either tolerant or very tolerant to both high percentages of ditching and low depth variability were very high, over 75% of the total number of inverts caught. Low flow tolerance values were good however as there were no inverts considered tolerant to low flows present with some low flow intolerant midges at both sites.

Based on the mostly poor scores of the biological metrics and tolerance values, hydrologic alteration is a stressor in this reach. The primary impact in these reaches from hydrologic alteration is seen in alteration of the stream into a ditch. The Shakopee Creek Watershed is very flat and has a high percentage of clay in the soils, which had caused the formation of wetlands as the soils drained very slowly. Because of this the watersheds for reaches 07020005-599 and 07020005-702 have been almost completely altered and the stream channels themselves have been completely ditched upstream and down to carry water off the landscape quickly from the land and agricultural fields. Drainage within the watershed has changed the timing and delivery of water and nutrients to the streams.

3.7.3.3 Connectivity

Connectivity Metric Data

Table 333. Connectivity related fish metrics for stream reach.

07020005-599 **07020005-702** **Fish Class 7** **Modified Use**	Mature Age >3 %	Migrating %
07MN043 6/17/2009	9.5	9.5
09MN047 6/17/2009	3.4	4.6
Statewide average for channelized Class 7 low gradient bio sites	**9.8**	**6.9**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related fish metrics were mostly poor (Table 333). Bio site 07MN043 score better than site 09MN047. 09MN047 was dominated by two fish, the brook stickleback and central mudminnow while 07MN048 had more fish caught in general and had more taxa with more individuals caught. However, the only late-maturing or migrating fish at either site was the white sucker, a generally tolerant fish. Connectivity appears to be a stressor in both reaches. According to the Minnesota DNR's channel survey, the crossing at 20th Ave SE, upstream of biological monitoring site 07MN043, is undersized, causing a scour hole to form on the downstream end. With a bankfull width of approximately 21 feet, the 10.5' wide x 6.5' tall concrete pipe arch culvert is 50% narrower than what would be recommended for this location. Connectivity is a stressor in reach 07020005-599 and is likely a stressor in reach 07020005-702.

3.7.3.4 Habitat

Habitat Metric Data

Table 334. Habitat related invert metrics for stream reaches.

07020005-599 **07020005-702** **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
07MN043 8/13/2009	22.1	42.7	8.8	0.9	90.9	26.4
09MN047 8/13/2009	12.2	4.3	17.0	55.3	32.8	66.0
Statewide average for channelized Class 7 southern stream rock riffle bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 335. Habitat related tolerance values for stream reaches.

07020005-599 **07020005-702** **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
07MN043 8/13/2009	59.1	0		59.4	0		13.9	0
09MN047 8/13/2009	77.0	0.3		76.1	0.3		21.5	0.3
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 336. Habitat assessment scores for stream reaches.

07020005-599 **07020005-702**	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
07MN043 6/17/2009	0	9.5	13.2	7	19	48.7
09MN047 8/13/2009	0	10	16	10	13	49
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

At first glance invert habitat metrics appear to be mixed (Table 334). At bio site 07MN043 the percentage of burrowers was high as the third and fourth most numerous inverts present were the burrowers Pisidiidae and Oligochaeta. Climbers only scored well due to the dominance of the snail *Physella*, which made up about 38% of the total number of inverts caught. Clingers were low with only 13 riffle beetles along with a couple of midges that are considered clingers. Legless inverts dominated the invert community as 20 out of the top 23 inverts present are legless, including the top 5 most numerous inverts present. Sprawlers were less than a percent below the class average, with the midge *Paramerina* being the fifth most numerous invert present.

Bio site 09MN047 also appears mixed at first glance (Table 334). Burrower percentage at this site was low, though the worm Oligochaeta was the fourth most numerous invert present. Both climbers and clingers were low, with clingers scoring better due to the midge *Paratanytarsus* being the second most numerous invert present. The mayfly *Caenis* was the only EPT taxa present, though it completely dominated the invert community, making up over 55% of all the inverts caught. This has caused the bio metrics to be highly influenced by the characteristics of the tolerant mayfly, causing the EPT and legless percentage to score well. *Caenis* is a sprawler and as such, caused the percentage of sprawlers to be very high, though there were some other taxa present that are considered sprawlers.

The habitat related tolerance values scored very poorly (Table 335). The percentages were influenced by the dominance of the snail *Physella* at site 07MN043 and the mayfly *Caenis* at site 09MN047. Both *Physella* and *Caenis* are considered tolerant to low MSHA scores, very tolerant to high embeddedness, and tolerant to high amounts of fine sediment. At site 09MN047 the top four most numerous inverts are considered either tolerant or very tolerant to low MSHA scores, high embeddedness, and a high percentage of fine sediment. Overall, there were high percentages of poor habitat related tolerant inverts present at both bio sites.

The MSHA scores were both poor as the sites scored very closely to each other (Table 336), with scores of 48.7 and 49 out of a possible 100. Both sites were mostly good in the riparian score, with a moderate riparian width, low bank erosion, and some shade present. Substrate scores were moderate, with some cobble, gravel, and sand present at site 07MN043 and sand and gravel at site 09MN047. Cover scored in the middle as there were some submerged macrophytes and overhanging vegetation present at both sites. Channel morphology was somewhere in the middle as well. At site 07MN043 channel morphology scored a little better than site 09MN047. The depth variability and channel stability scored well, as did the ratio of pool width to riffle width. Site 09MN047 scored lower in-depth variability and no riffles were observed. Sinuosity was poor at both sites. A geomorphic assessment was conducted in July of 2023 in reach 07020005-599. From a habitat standpoint in the reach, a high level of embeddedness, combined with a generally featureless bottom with poorly defined riffles and pools, does not provide optimal habitat for aquatic organisms.

The channelization of the stream reach and lack of well-defined riffles and pools are stressing the biological community. During SID field work, both sites had excessive siltation on the stream bottom. Due to the mostly poor invertebrate metrics and tolerance values, as well as the poor MSHA scores, habitat is a stressor to the invertebrate community.

3.7.3.5 Dissolved Oxygen

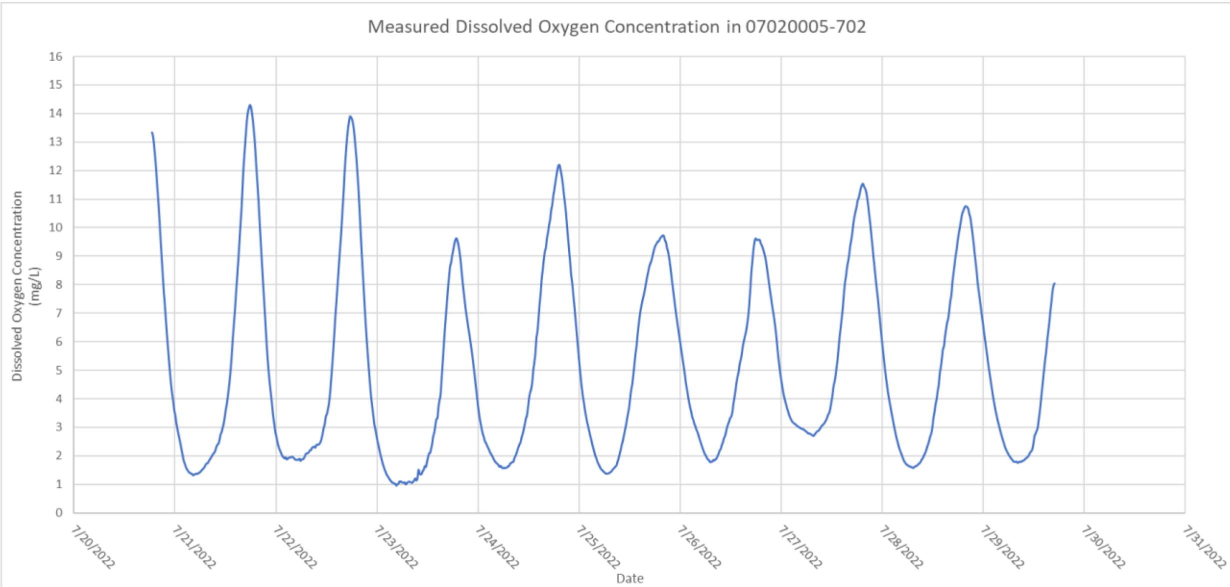
Dissolved Oxygen Biological Metric Data

Table 337. DO related invert metrics for stream reaches.

07020005-599 **07020005-702** **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
07MN043 8/13/2009	0.9	8.9	28	5.3		13.9	0
09MN047 8/13/2009	55.3	8.3	30	5.9		73.9	0.3
Statewide average for channelized Class 7 southern stream rock riffle bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Figure 49. Measured DO concentrations from a YSI sonde deployment.



Dissolved Oxygen Summary

The DO related biological invert metrics were mostly poor (Table 337). All metrics at bio site 07MN043 scored poorly as there were very few EPT present. The HBI_MN score was well above the class average and taxa count was low. The DO TIV score was also below the class average. The percentage of inverts considered tolerant to low DO was 13.9%, which is better than most impaired bio sites, including site 09MN047, which had a low DO tolerant population of 73.9%. Almost no low DO intolerant inverts were caught at either bio site. Bio site 09MN047 scored poorly in everything except EPT percentage, which was due to the prevalence of *Caenis*, a mayfly considered tolerant to low DO. The top four inverts present at the site are considered tolerant to low DO.

DO data was limited in both reaches. There was one measurement taken in reach 07020005-702, which was 12.9 mg/L, well above the standard of 5 mg/L. A YSI sonde was deployed in July of 2022 (Figure 50). During the deployment the DO levels got below 5 mg/L every night, rising between 9 and 14 mg/L during the day, indicating eutrophication issues, which in turn is causing low DO.

Based on the poor biological metrics and tolerance values, as well as the measured DO values, DO is a stressor to the invertebrate communities in reaches 07020005-599 and 07020005-702.

3.7.3.6 Eutrophication

Eutrophication Biological Metric Data

Table 338. Eutrophication related invert metrics for stream reach.

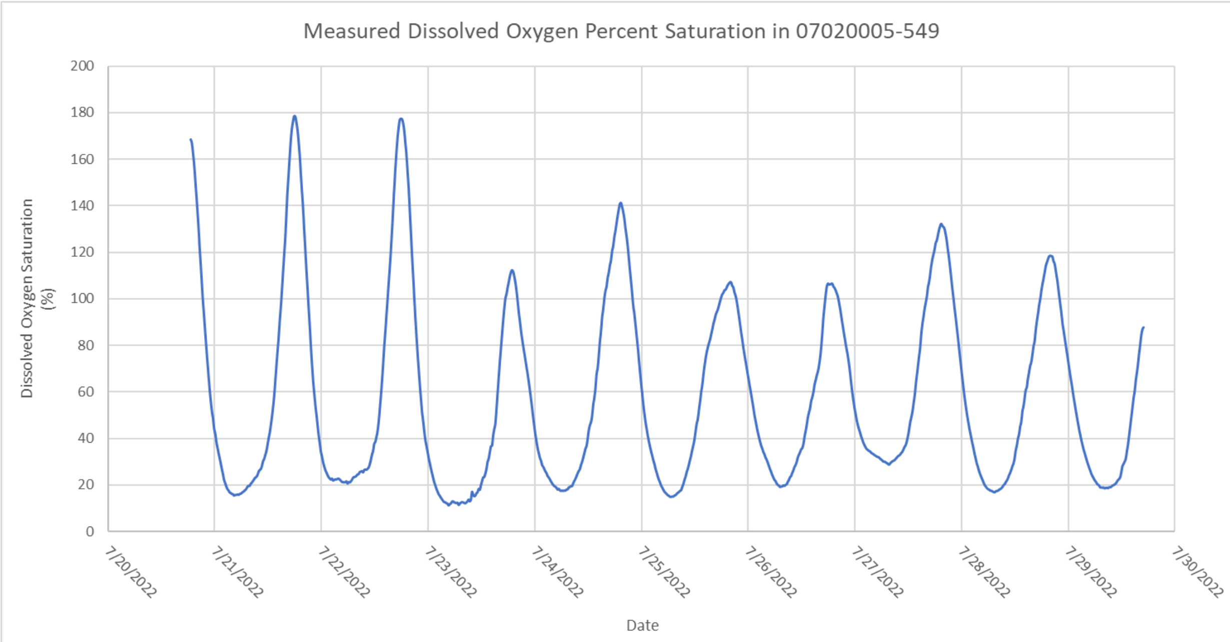
07020005-599 **07020005-702** **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera Taxa %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
07MN043 8/13/2009	48.2	9	0.9	40.3	28.0		59.4	0
09MN047 8/13/2009	8.8	15	55.3	0.6	30		78.8	0
Statewide average for channelized Class 7 southern stream rock riffle bio sites	**23.2**	**11.6**	**20.6**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 339. Phosphorus monitoring data for stream reach.

07020005-599 **07020005-702** P Sample Data 0.15 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S010-473 **S011-096** (2022)	0.067 – 0.472	-	-	-	0.222 [4]	-	-	-	0.222 [4]
		Maximum Value							
		-	-	-	0.472	-	-	-	

Figure 50. Measured continuous DO percent saturation in stream reach.



Eutrophication Summary

Eutrophication related invert metrics appear to be mixed, with bio site 07MN043 scoring poorly and site 09MN047 scoring mostly well (Table 338). The biology at site 07MN043 indicated eutrophication stress, with a typical eutrophic invert community dominated by snails, leeches, pea clams, and worms, all of which are commonly found in eutrophic water. Biological metrics at site 09MN047 appear to score better as the presence of the mayfly *Caenis* has affected the metrics, especially the EPT and collector-gatherer percentages. Total taxa count was a bit low at both sites. Tolerance values at both sites tell a more complete story. The tolerance values for phosphorus tolerant inverts were poor at both sites. Even though the metrics at 09MN047 scored mostly well, the invert community had an invert population of 78.8% phosphorus tolerant individuals. The top four most numerous inverts present at 09MN047 are considered either tolerant or very tolerant to high phosphorus concentrations, including the mayfly *Caenis*, which made up over half of the inverts caught at the site.

Only four samples were collected and analyzed for TP in both reaches. All TP samples were taken in July, with an average concentration of 0.222 mg/L, well above the standard of 0.150 mg/L.

An YSI Sonde water meter measured continuous DO data from 7/20/2022 to 7/29/2022 (Figure 50). During this deployment, diel DO flux was measured at or above 5 mg/L every night that it was deployed. DO percent saturation was also measured during this deployment (Figure 51). Saturation values were above 100% every day of the sonde deployment, with values reaching almost 180%.

The biological community is showing the effects of the elevated phosphorus in both reaches, though in different ways. Phosphorus sampling showed elevated concentrations, and both DO flux and DO saturation were high. Eutrophication is a stressor in reaches 07020005-599 and 07020005-702.

3.7.3.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 340. TSS related invert metrics for stream reach.

07020005-599 **07020005-702** **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
07MN043 8/13/2009	9.4	0	26.4	13.9		45.5	0
09MN047 8/13/2009	7.0	0	66.0	14.5		2.4	0.3
Statewide average for channelized Class 7 southern stream rock riffle bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

Suspended Solids Summary

The TSS related invert metrics and tolerance values were mostly poor at both bio sites (Table 340). Collector-filterers were low and there were no Plecoptera present at both sites. Sprawlers scored just below the class average at bio site 07MN043, with several midges present that are considered sprawlers. At bio site 09MN047 the dominance of the mayfly *Caenis* and the amphipod *Hyalella*, which are both sprawlers, caused that percentage to be very high at 66%. The TSS TIV scores were below the class average and bio site 09MN047 only had a percentage of TSS tolerant inverts of 2.4%. Bio site 07MN043 had a TSS tolerant percentage of 45.5%, mainly due to the dominance of *Physella* snails, which are considered very tolerant to TSS.

There were only a few Secchi tube transparency measurements in both reaches, all of which were >100cm. During SID field work, while deploying the YSI sonde at bio site 09MN047, heavy sedimentation, silt, and embeddedness was observed in the stream channel.

TSS are inconclusive as a stressor to aquatic life at this time. It is likely that other factors, such as altered hydrology or habitat are contributing to the poor metrics, though it is also likely that TSS is contributing as well. The invert metrics show a biological community that is likely affected by TSS but due to lack of data, it is inconclusive. It is recommended that more TSS data be collected during different flows to determine whether it is a biological stressor.

3.7.3.8 Nitrates

Nitrate Biological Metric Data

Table 341. Nitrate related invert metrics for stream reach.

07020005-599 **07020005-702** **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
07MN043 8/13/2009	0	3.7		67.0	0
09MN047 8/13/2009	0	3.1		76.7	0
Statewide average for channelized Class 7 southern stream rock riffle bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 342. Nitrate monitoring data for stream reach.

07020005-599 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S014-363 (2022)	0 – 14.9 [10]	-	-	14.9 [1]	2.5 [9]	-	-	-
		Highest Value						
		-	-	14.9	5.9	-	-	-

Summary

The nitrate related invert biological metrics and tolerance values were mostly poor (Table 341). There were no Trichoptera present at either bio site. The nitrogen TIV scores were mixed, with bio site 07MN043 being just above and site 09MN047 just below the TIV average. Both sites had high percentages of nitrate tolerant inverts present. Site 07MN043 was dominated by the snail *Physella*, which is considered very tolerant to high nitrates. Seven out of the top nine invert taxa caught are considered either tolerant or very tolerant to high nitrates. Bio site 09MN047 had an even greater percentage of nitrate tolerant inverts as the dominant two invert taxa, the mayfly *Caenis* and the midge *Paratanytarsus*, are considered tolerant and very intolerant to high nitrates. Six of the top eight inverts present are considered tolerant to nitrates.

Nitrate sampling was limited in both reaches; however, one of the values in June was 14.9 mg/L, well above the proposed nitrate criteria for protection of aquatic life of 8 mg/L (Table 342). Later in July nitrate concentrations were lower, though some were still moderately elevated at 5.9 mg/L.

Due to the mostly poor nitrate related metrics and very poor tolerance values, as well as evidence of elevated nitrate concentrations, nitrates are a stressor to reaches 07020005-599 and 07020005-702.

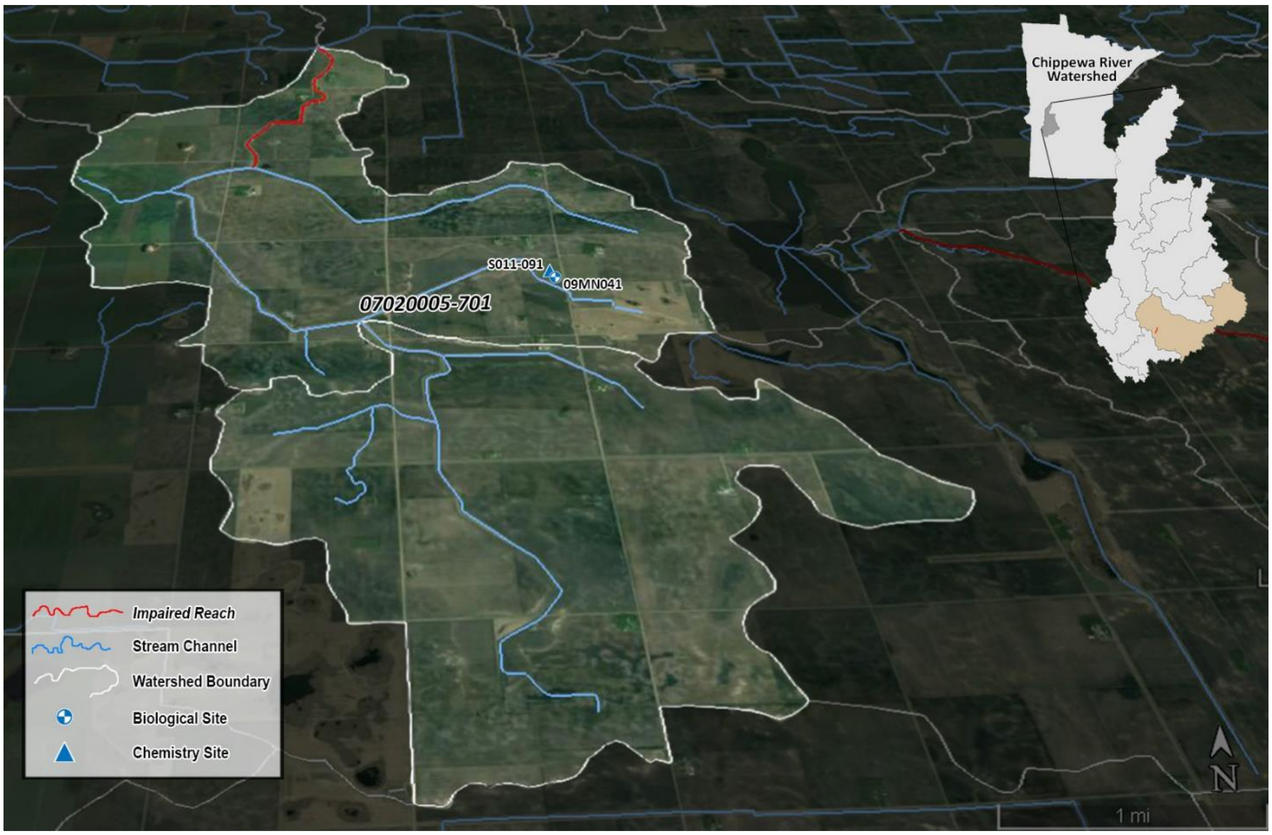
3.7.3.9 Reach Stressors

Table 343. Summary of stressors in stream reach.

07020005-599 07020005-702	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	✓	✓	✓	✓	O	✓

3.7.4 07020005-701 Unnamed Creek

Figure 51. Satellite image of reach 07020005-701 and its watershed.



3.7.5.1 Biological Community

Bio site 09MN041 was sampled fish June of 2009. The FIBI score was very poor, only a 0.1, well below the Fish Class 7 low gradient streams modified use threshold of 15 (Table 344). Eleven blacknose dace, 10 central mudminnows, and 3 northern pike were the only fish caught at the site. The brook stickleback is considered generally tolerant while the central mudminnow is generally very tolerant.

Biological Metric Data

Table 344. Fish IBI score and threshold for stream reach.

07020005-701 **Fish Class 7** **General Use**	Fish IBI Score	Class Threshold Score
09MN041 6/18/2009	0.1	15

3.7.5.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 345. Hydrologic alteration related fish metrics for stream reach.

07020005-701 **Fish Class 7** **Modified Use**	General %	Nesting Non-Lithophilic Spawner %
09MN041 6/18/2009	0	45.8
Statewide average for channelized Class 7 low gradient bio sites	**35.0**	**29.6**
Expected response to **Hydrologic** stress	↑	↑

Hydrologic Alteration Summary

Figure 52. Photo of reach 07020005-701 taken near bio site 09MN041.

The fish biological metrics for altered hydrology are mixed (Table 345). There were no generalist feeders present, though the fish taxa diversity was low as only three different types of fish were caught. The most numerous fish present, the brook stickleback, is a nesting fish, causing that metric to score above the class average.

The reach itself has been straightened and ditched, with an overly large and deep V channel, which is typical of the ditches in this area. The channel type moves a lot of water quickly and efficiently when flows are high, and the channel shape has effectively removed the stream's ability to access a flood plain. During normal base flows the stream itself is very small within the steep sides of the larger ditch, causing the stream channel to have a straight profile with reduced geomorphic features.

Based on the biological metrics and very few fish taxa or total number caught, hydrologic alteration is a stressor within reach 07020005-701. The primary impact in this reach from hydrologic alteration is the shaping of the stream channel itself into a ditch, which has reduced the available fish habitat.

3.7.5.3 Connectivity

Connectivity Metric Data

Table 346. Connectivity related fish metrics for stream reach.

07020005-701 **Fish Class 7** **Modified Use**	Mature Age >3%	Migrating %
09MN041 6/18/2009	0	0
Statewide average for channelized Class 7 low gradient bio sites	**9.8**	**6.9**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

The fish biological metrics for connectivity are poor. There were no late maturing or migrating fish caught. The road crossing near the bio site is likely a fish barrier. Connectivity is likely a stressor in reach 07020005-701 though is inconclusive at this time.

3.7.5.4 Habitat

Habitat Metric Data

Table 347. Habitat related fish metrics for stream reach.

07020005-701 **Fish Class 7** **Modified Use**	Benthic Insectivore minus Tolerant %	Benthic Insectivore %	Darter Sculpin Sucker %	Dominant Two %	Lithophilic Spawner %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN041 6/18/2009	0	0	0	87.5	0	0	0	87.5
Statewide average for channelized Class 7 low gradient bio sites	**7.1**	**8.5**	**6.8**	**65.8**	**25.7**	**7.3**	**9.1**	**56.0**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 348. Habitat related fish tolerance values for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN041 6/18/2009	45.8	0		12.5	0		87.5	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 349. Habitat assessment scores for stream reach.

07020005-701	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN041 6/18/2009	0	8.5	5	7	8	28.5
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The fish biological metrics for habitat and the scores themselves are mostly poor (Table 347). There were no benthic insectivores, darters, lithophilic spawners, or riffle dwelling fish present. Both the brook stickleback and central mudminnow, which made up 87.5% of the total number of fish caught, are both considered generally tolerant. Tolerance values were also poor (Table 348). The most numerous fish present, the brook stickleback, is considered tolerant to low MSHA scores, high fines, and low substrate scores. The central mudminnow, the second most numerous fish present, is considered very tolerant to both high fines and low substrate scores.

The MSHA assessment conducted during the fish bio visit was poor, scoring a 28.5 out of 100 (Table 349). The riparian score was probably the best out of the different categories as it scored an 8.5 out of 14, due mostly to low bank erosion and a wide riparian width. Substrate scored very poorly as only silt was noted as the only substrate type present. Cover was sparse as the reach is a very steep ditch with mostly grass on the banks. Geomorphology was very poor as well. There was no depth variability, no sinuosity, no riffles, and poor channel development. Altered hydrology is indicated as a stressor within the reach, mainly due to the shaping and ditching of the stream itself. This stream has very little habitat for fish and as such, habitat is a stressor in reach 07020005-701.

3.7.5.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 350. DO related fish metrics and tolerance values for stream reach.

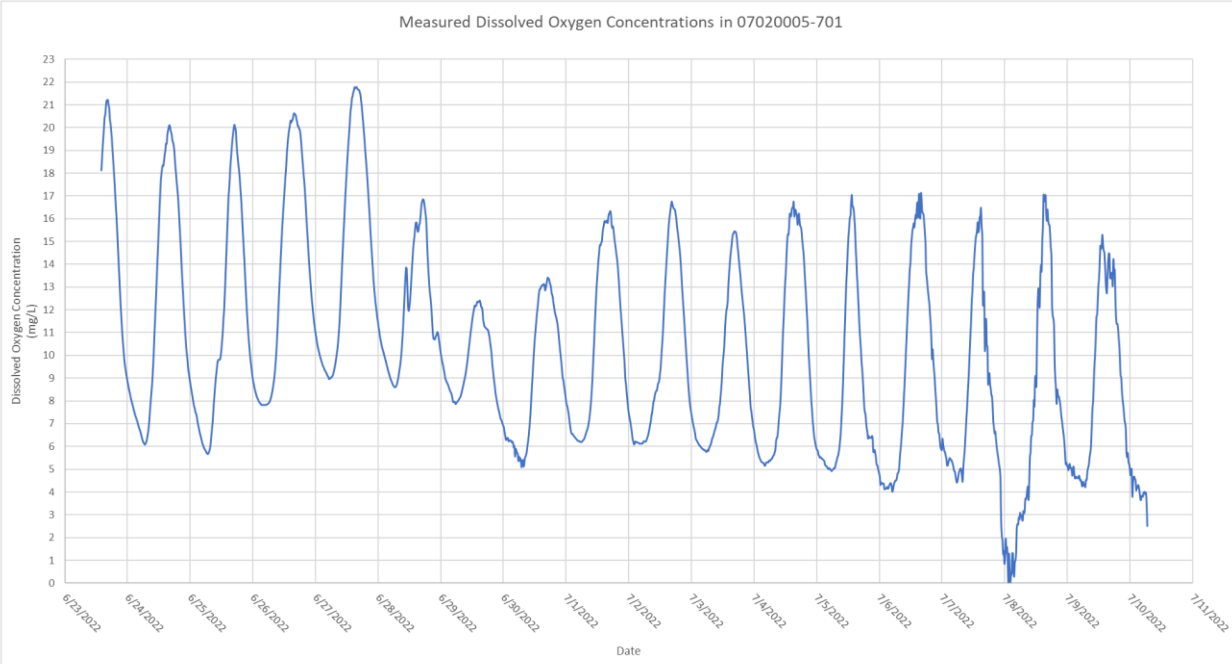
07020005-701 **Fish Class 7** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN041 6/18/2009	3	0	0	0	87.5	5.6		100	0
Statewide average for channelized Class 7 low gradient bio sites	**11.7**	**9.8**	**17.3**	**28.6**	**56**	**6.3**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Dissolved Oxygen Monitoring Data

Table 351. DO monitoring data for stream reach.

07020005-701 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S010-091 (2022)	13.7 – 16.4	-	-	0% [1]	0% [1]	-	-	-	0% [2]
		Minimum Value							
		-	-	16.4	13.7	-	-	-	

Figure 53. Continuous DO data at site 09MN041.



Dissolved Oxygen Summary

The DO related fish metrics at bio site 09MN041 were poor (Table 350). Taxa count was very low as only three fish were caught, none of which are considered late maturing or sensitive fish. The percentage of tolerant fish present was 87.5%, well over the average and the DO TIV score was below the average. All fish caught are considered either tolerant or very tolerant to low DO.

Only two DO measurements were taken during sampling; both were well above the standard of 5 mg/L (Table 351). A YSI Sonde water meter measured continuous DO data from 6/23/2022 to 7/10/2023 (Figure 53). During this deployment, DO values were not measured below the standard of 5 mg/L very often, with only one evening where the value fell below 5 mg/L. Overall the DO data was elevated, with values above 20 mg/L on some days. Diurnal DO flux, or the difference between the highest and lowest DO value in a 24-hour time period, was extremely high, indicating eutrophic conditions.

The DO related fish metrics were poor, there were only three different fish taxa caught. DO measurements in the reach showed very high concentrations, with high flux, though concentrations stayed above 5 mg/L during the sonde deployment. The sonde was deployed relatively early in the sampling season due to the river levels being low. Looking at the sonde data, with the high DO flux and extremely high values during the day, it is highly likely that DO concentrations would fall below 5 mg/L during diurnal lows. Due to the lack of data during late summer, DO is inconclusive as a stressor in the reach.

3.7.5.6 Eutrophication

Eutrophication Biological Metric Data

Table 352. Eutrophication related fish metrics for stream reach.

07020005-701 **Fish Class 7** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN041 6/18/2009	3	0	0	0		100	0
Statewide average for channelized Class 7 low gradient bio sites	**11.7**	**6.6**	**16.4**	**20.5**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Eutrophication Monitoring Data

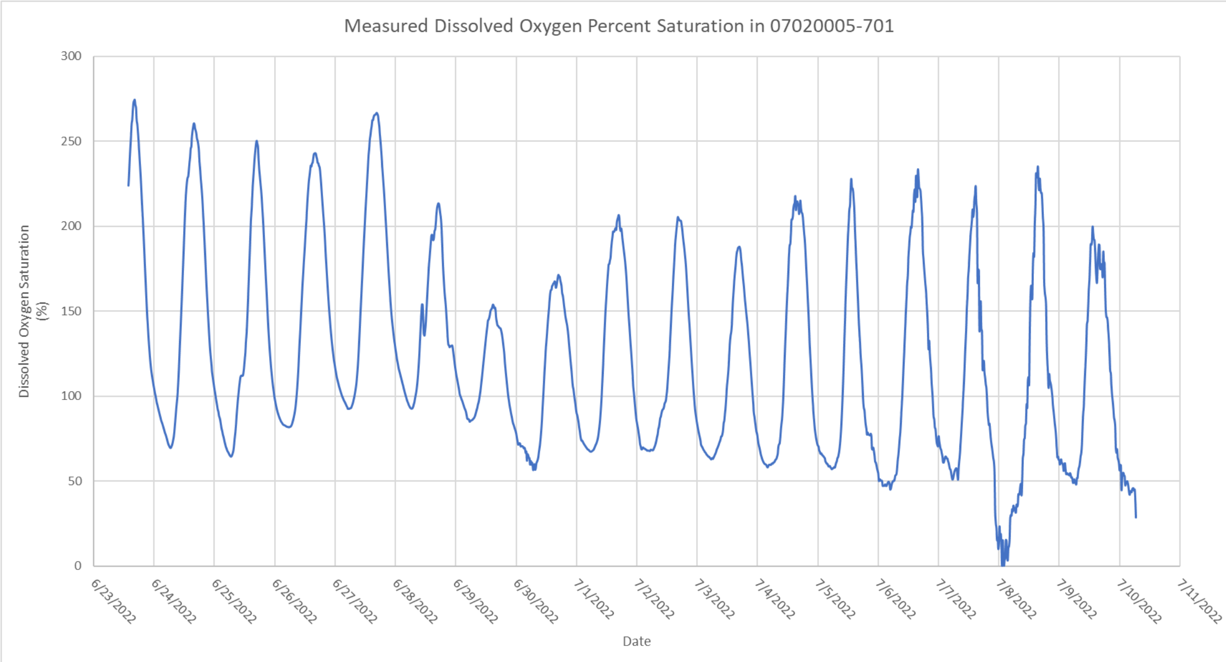
Table 353. Phosphorus monitoring data for stream reach.

07020005-701 P Sample Data 0.150 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S014-354 (2017-2019)	0.052 – 0.054	-	-	-	0.053 [2]	-	-	-	0.053 [2]
		Maximum Value							
		-	-	-	0.054	-	-	-	

Table 354. DO% Saturation monitoring data for stream reach.

07020005-701 DO% Sat Data	Range of Data (%)	Monthly Average of Samples (%) [# of Samples]							June-Aug Average (%) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-091 (2022)	185 – 202	-	-	202.2 [1]	185.0 [1]	-	-	-	193.6 [2]

Figure 54. Measured continuous DO percent saturation in stream reach.



Eutrophication Summary

The eutrophication related fish metrics at bio site 09MN041 mostly scored poor (Table 352). There were only three fish taxa caught, no darters, and no lithophilic spawners caught. Brook stickleback, central mudminnow, and northern pike are all considered tolerant to high phosphorus levels. None of them are omnivores; however, which caused that metric to score well.

Figure 55. Photo taken during sonde deployment on June 23rd 2022, showing floating algae mats, filamentous algae, and algae suspended in the water column.

Two samples were collected and analyzed for phosphorus in 2022 (Table 353). Both samples were low, well below the standard of 0.150 mg/L.

The percent saturation measurement was very high during two site visits in 2022 (Table 354).

An YSI Sonde water meter measured continuous DO data from 6/23/2022 to 7/10/2022 (Figure 53). During this deployment, diel DO flux was measured above 5 mg/L every day except one. During the same sonde deployment DO percent saturation was measured as well (Figure 54). The percent saturation was above 100% every day of the deployment and with many of the values above 250%.

The related fish biological metric scores indicate that eutrophic conditions may be stressing the fish community; however, the collected samples were below the eutrophication standard of 0.150 mg/L. The sonde deployment did show high DO flux, high saturation, and there was excessive algae observed during site visits (Figure 55). Because of the conflicting data sets, eutrophication is likely a stressor in this reach, though at this time it is inconclusive.

3.7.5.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 355. TSS related fish metrics for stream reach.

07020005-701 **Fish Class 7** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN041 6/18/2009	0	0	0	12.5	0	0	0	13.3		0	0
Statewide average for channelized Class 7 low gradient bio sites	**12.2**	**4.4**	**8.2**	**7.1**	**13.4**	**7.3**	**20.5**	**13.9**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

TSS Monitoring Data

Table 356. Transparency monitoring data for stream reach.

07020005-701 Secchi Tube Data 10 cm target	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S011-091 (2022)	23 – 69	-	-	0% [2]	-	-	-	-	0% [2]

Suspended Solids Summary

The TSS related fish metrics at bio site 09MN041 were mostly poor (Table 355). As there were only three fish taxa caught, the fish metrics were highly influenced by the brook stickleback and central mudminnow, both of which are not benthic feeders, Centrarchids, herbivores, Perciformes, riffle dwelling, or simple lithophilic spawners. None of the fish caught are considered tolerant or intolerant to TSS.

Only two transparency measurements were done during SID work in 2022. Neither were below the 10 cm standard (Table 356).

Due to the somewhat mixed biological fish metrics and the low TSS values, TSS and the deposition of fine sediments are likely a stressor to the biological community but with the lack of supporting data. It is recommended to collect more TSS data and conduct a sediment substrate analysis to determine whether TSS is a biological stressor.

3.7.5.8 Nitrates

Nitrate Biological Metric Data

Table 357. Nitrate related invert metrics for stream reach.

07020005-701 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN041	-	-		-	-
Statewide average for Class 7 sites that are meeting the MIBI general use threshold	**10.9**	**3.2**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 358. Nitrate monitoring data for stream reach.

07020005-701 Nitrate/Nitrite Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S011-091 (2022)	1.5 – 17.1 [6]	-	-	11.9 [2]	2.0 [4]	-	-	-
		Highest Value						
		-	-	17.7	2.4	-	-	-

Summary

Inverts were not collected in reach 07020005-701 (Table 357). As such, it is not possible to assess their response to nitrates. Since there were only three fish taxa caught it is difficult to use the fish visit to try to understand the effects nitrates might be having on the biological community in the reach. The most numerous fish present, the brook stickleback, is considered tolerant to nitrogen.

Six samples were collected in reach 07020005-701 and analyzed for nitrate (Table 358). One of the samples in June had a nitrate concentration of 17.7 mg/L, well above the proposed nitrate criteria for protection of aquatic life of 8 mg/L.

Due to inverts not being sampled, and limited nitrate samples, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-701.

3.7.5.9 Reach Stressors

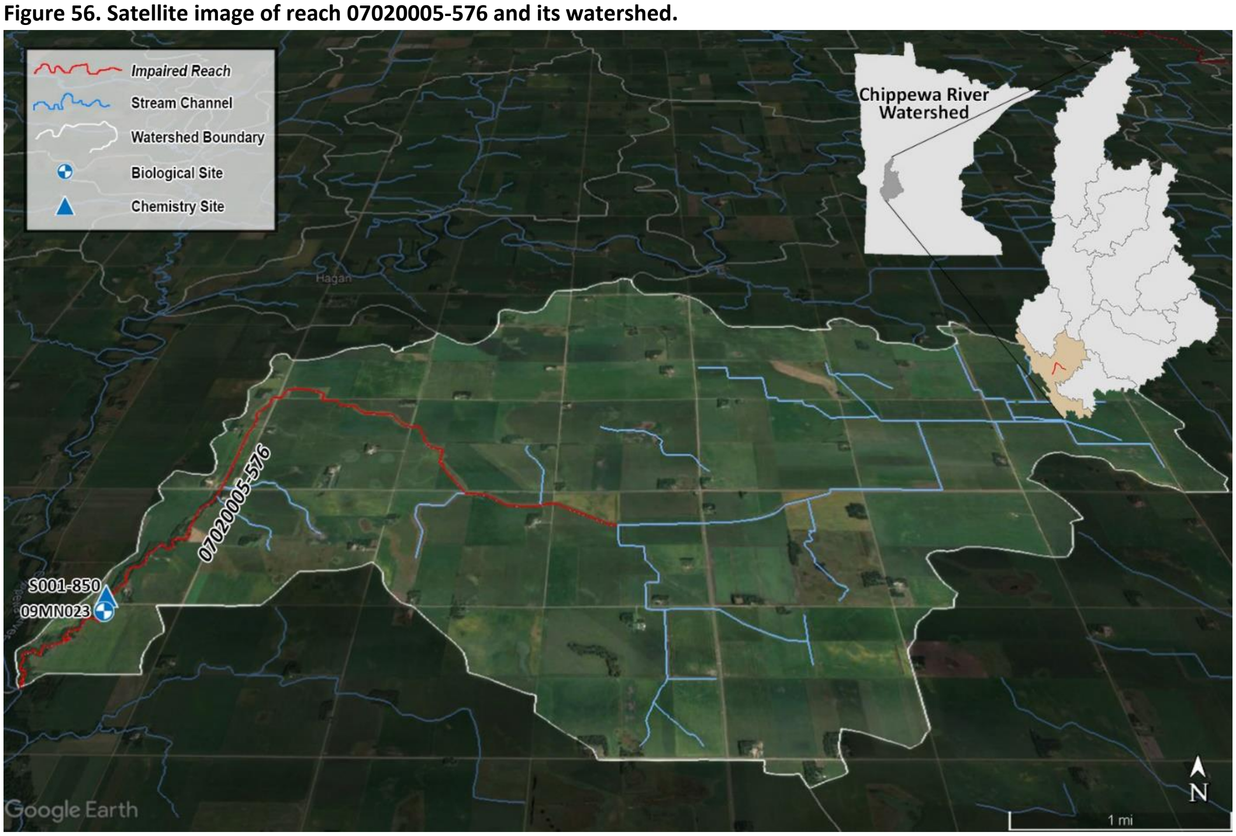
Table 359. Summary of stressors for stream reach.

07020005-701	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	O	O	O	O

3.8 Direct Tributaries

3.8.1 07020005-576 Unnamed creek

Figure 56. Satellite image of reach 07020005-576 and its watershed.



3.8.1.1 Biological Community

Reach 07020005-576 was sampled for fish in June of 2009 where it scored a 45 out of a possible 50 (Table 360). No sensitive taxa were collected and tolerant individuals comprised 94% of the sample. Creek chubs and blacknose dace dominated the fish community, both of which are considered tolerant.

Biological Metric Data

Table 360. Fish IBI score and threshold for stream reach.

07020005-576 **Fish Class 3** **General Use**	Fish IBI Score	Class Threshold Score
09MN023 6/17/2009	45.0	55

3.8.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 361. Hydrologic alteration related fish metrics for stream reach.

07020005-576 **Fish Class 3** **General Use**	General %	Nesting Non Lithophilic Spawner %
09MN023 6/17/2009	95.2	12.7
Statewide average for natural Class 3 southern headwater bio sites	**59.1**	**19.2**
Expected response to **Hydrologic** stress	↑	↑

Hydrologic Alteration Summary

The hydrologic alteration fish metrics were mixed (Table 361). The percentage of generalist feeders was extremely high at 95.2%. The top six fish taxa present are considered generalist feeders. Nesting fish were relatively low.

Based on the mixed data set, mostly natural stream channel, and lack of recent biological or geomorphic data, hydrologic alteration is inconclusive as a stressor in this reach.

3.8.1.3 Connectivity

Connectivity Metric Data

Table 362. Connectivity related fish metrics for stream reach.

07020005-576 **Fish Class 3** **General Use**	Mature Age >3%	Migrating Individual %
09MN023 6/17/2009	0	12.7
Statewide average for natural Class 3 southern headwater bio sites	**13.3**	**22.9**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related fish metrics were poor (Table 362). There were no late-maturing fish present out of the 11 different fish taxa that were caught. One of the fish taxa caught, the white sucker, is a migrating fish and the 11 that were caught made up 12.7% of the fish community, well below the class average.

The biological metrics scored poorly, though there were some migrating fish present. No obvious fish barriers were observed and the culvert near the bio site appeared to be wide enough and placed at the appropriate elevation. Connectivity is inconclusive as a stressor in reach 07020005-576.

3.8.1.4 Habitat

Habitat Metric Data

Table 363. Habitat related fish metrics for stream reach.

07020005-576 **Fish Class 3** **General Use**	Benthic Insectivore minus Tolerant %	Benthic Insectivore %	Darter Sculpin Sucker %	Dominant Two %	Lithophilic Spawner %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN023 6/17/2009	1.2	1.8	1.2	67.9	85.5	12.7	48.5	93.9
Statewide average for natural Class 3 southern headwater bio sites	**14.2**	**16.7**	**12.6**	**58.2**	**69.2**	**28.3**	**33.7**	**70.6**
Expected response to Habitat stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 364. Habitat related fish tolerance values for stream reach.

07020005-576 **Fish Class 3** **General Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN023 6/17/2009	8.5	32.1		11.5	0		8.5	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 365. Habitat assessment scores for stream reach.

07020005-576	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
92MN023 6/17/2009	2.5	11	14	12	22	61.5
Maximum Attainable Habitat Score	**5**	**15**	**27**	**17**	**36**	**100**

Habitat Summary

The habitat related fish biological metrics were mostly poor (Table 363). There were very few benthic insectivores and darters present. The two most numerous fish present, the creek chub and blacknose dace, comprised over 67% of the total fish present. Lithophilic spawning fish percentage was high as the top three fish present are considered lithophilic spawners. Riffle dwelling fish were low and tolerant fish percentage was very high at over 93% as all but 2 of the 11 fish taxa caught are considered either generally tolerant or very tolerant. Tolerance values were mixed (Table 364). The second most numerous fish present, the blacknose dace, is considered sensitive to low MSHA scores, which caused the percentage of fish considered sensitive to low MSHA scores to be 32.1% with 8.5% considered tolerant. The other tolerance values all scored somewhat poorly with no other habitat sensitive fish present.

The MSHA score was 61.5, which is somewhat in the middle as far as whether it is considered good or poor (Table 365). The stream scored some points in the land use category as there is both woodland and prairie adjacent to the stream channel. The riparian score was good as there was a wide riparian width observed with heavy shade covering the stream channel, which also caused cover to score well. Substrate in the stream was decent, with several different substrate types present and moderate embeddedness. Channel morphology also scored decent as there was good depth variability, excellent sinuosity and channel development, and wide pools along with riffles present in the reach.

Although the habitat related metrics were mostly poor, the percentage of lithophilic spawners was very good and the blacknose dace, which is considered sensitive to poor habitat, was the second most numerous fish present. The habitat score was moderate and there is adequate habitat for fish at the bio site. It is likely other stressors are influencing the bio community. Habitat is inconclusive as a stressor at this time.

3.8.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 366. DO related fish metrics for stream reach.

07020005-576 **Fish Class 3** **General Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN023 6/17/2009	11.5	11.5	0	11.5	93.9	7.4		7.3	0
Statewide average for natural Class 3 southern headwater bio sites	**12.2**	**13.3**	**8.6**	**17.1**	**70.6**	**7.3**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Dissolved Oxygen Monitoring Data

Table 367. DO monitoring data for stream reach.

07020005-576 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S001-850 (2016-2017)	7.5 – 10.6	-	0% [1]	0% [3]	0% [4]	0% [4]	0% [2]	0% [2]	0% [16]
		Minimum Value							
		-	8.7	8.3	8.2	7.5	8.5	7.8	

Dissolved Oxygen Summary

The DO related fish community at bio site 09MN023 were mixed (Table 366). Taxa count and late-maturing fish percentage were just below the class averages. There were no sensitive fish caught. Serial spawner percentage was low as there were only 11 fathead minnows caught. All but two of the fish taxa caught are either generally tolerant or very tolerant, causing the percentage to be very high at 93.9%. The DO TIV score was just above the class average and there was a relatively small percentage of DO tolerant fish (7.3% out of the total number caught). No DO sensitive fish were caught.

There were 16 DO measurements taken during between 2016 and 2017, none of which fell below 5 mg/L (Table 367). DO values within the reach were not excessively high either, with most values between 7 and 9 mg/L, indicating that DO within the reach is maintained at an optimal range, neither too low nor too high.

Due to the mixed related fish biological metric scores and good measured values, DO is inconclusive as a stressor in this reach.

3.8.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 368. Eutrophication related fish metrics and tolerance values for stream reach.

07020005-576 **Fish Class 3** **General Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN023 6/17/2009	11.5	1.2	18.2	48.5		8.5	0
Statewide average for natural Class 3 southern headwater bio sites	**12.2**	**12.1**	**14.6**	**33.7**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 369. Phosphorus monitoring data for stream reach.

07020005-576 P Sample Data 0.150 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S001-850 (2022)	0.186 – 0.307	-	-	-	0.247 [2]	-	-	-	0.247 [2]
		Maximum Value							
		-	-	-	0.307	-	-	-	

Eutrophication Summary

The eutrophication related biological fish metrics and tolerance values were mostly poor (Table 368). Taxa count was just below the class average, there were only two johnny darters caught, and omnivore percentage was above the class average. Simple lithophilic spawners scored well as the second and third most numerous fish taxa caught are considered simple lithophilic spawners. The percentage of phosphorus tolerant fish was 8.5% with no phosphorus sensitive fish present.

Only two phosphorus samples were collected in 2022, both of which were above 0.150 mg/L (Table 369). One of the samples was over twice the standard of 0.150 mg/L.

The biological metrics scored mostly poorly and the limited phosphorus sampling showed elevated concentrations, however, phosphorus tolerant fish percentage was only 8.5%, which is relatively low.

DO concentrations were also not excessively high, which is typical of streams with eutrophication issues. Due to conflicting biological and chemical data eutrophication is inconclusive at this time.

3.8.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 370. TSS related fish metrics for stream reach.

07020005-576 **Fish Class 3** **General Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN023 6/17/2009	13.9	0	2.4	0	1.2	12.7	48.5	13.7		0	0
Statewide average for natural Class 3 southern headwater bio sites	**37.8**	**0.9**	**13.3**	**3.6**	**13.6**	**33.7**	**33.7**	**14.9**		↑	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

TSS Monitoring Data

Table 371. Transparency monitoring data for stream reach.

07020005-576 Secchi Tube Data 10 cm target	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]								% of Total Samples < 10 cm [# of Samples]
		March	April	May	June	July	August	Sept	Oct	
S001-850 (2009-2022)	5 – >100	100 [2]	0 [4]	0 [3]	0 [5]	0 [7]	0 [6]	0 [4]	50 [2]	6.1 [33]

Suspended Solids Summary

The TSS related fish metrics were mostly poor (Table 370). Benthic feeder percentage was low, there were no Centrarchids or long-lived fish present. Herbivores, Perciformes, and riffle dwelling fish were all low. There was a healthy percentage of simple lithophilic spawners and the TSS TIV score was below the class average. There were no TSS tolerant or intolerant fish present.

There were no TSS data collected within the reach; however, there were 33 Secchi tube measurements conducted from 2009 to 2022. Overall, there were only two measurements below 10 cm.

The bio metrics were mostly poor, however, lithophilic spawners were high and the TSS TIV score was low. It is likely that other factors are contributing to the poor scores in the biological metrics that scored poorly. Habitat assessment does not indicate fine sediment or embeddedness to be an issue in the reach. It is recommended that more TSS data be collected throughout the year to better assess whether TSS is a problem in this reach.

3.8.1.8 Nitrates

Nitrate Biological Metric Data

Table 372. Nitrate related invert metrics for stream reach.

07020005-576 **Invert Class 5** **General Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN023 8/7/2009	3.4	3.8		68.8	0
Statewide average for natural Invert Class 5 southern stream rock riffle bio sites	**13.6**	**3.0**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 373. Nitrate monitoring data for stream reach.

07020005-576 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S001-850 (2022)	0.3 – 5.3 [5]	-	-	5.3 [1]	0.5 [4]	-	-	-
		Highest Value						
		-	-	5.3	0.7	-	-	-

Summary

The nitrate related invert metrics and tolerance values were poor (Table 372). There were very few Trichoptera taxa present and the nitrogen TIV score was above the class average. Nitrogen tolerant inverts made up 68.8% of the total number of inverts caught, with no nitrate intolerant inverts present. The top 4 invert taxa present are considered very tolerant to nitrates and 13 out of the top 16 taxa are either very tolerant or tolerant to high nitrates.

Only five samples were collected in reach 07020005-576 and analyzed for nitrate (Table 373). One concentration in June was moderately high, though below the proposed nitrate criteria for protection of aquatic life of 8 mg/L. All the other samples, which were taken in July, were very low, below 1 mg/L.

Although the biological response appears to be showing some effects from nitrates, chemistry sampling did not show high nitrate concentrations, though there was only one sample taken in June and none earlier in the year, when nitrate concentrations are usually high. Due to the lack of supporting data, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-576.

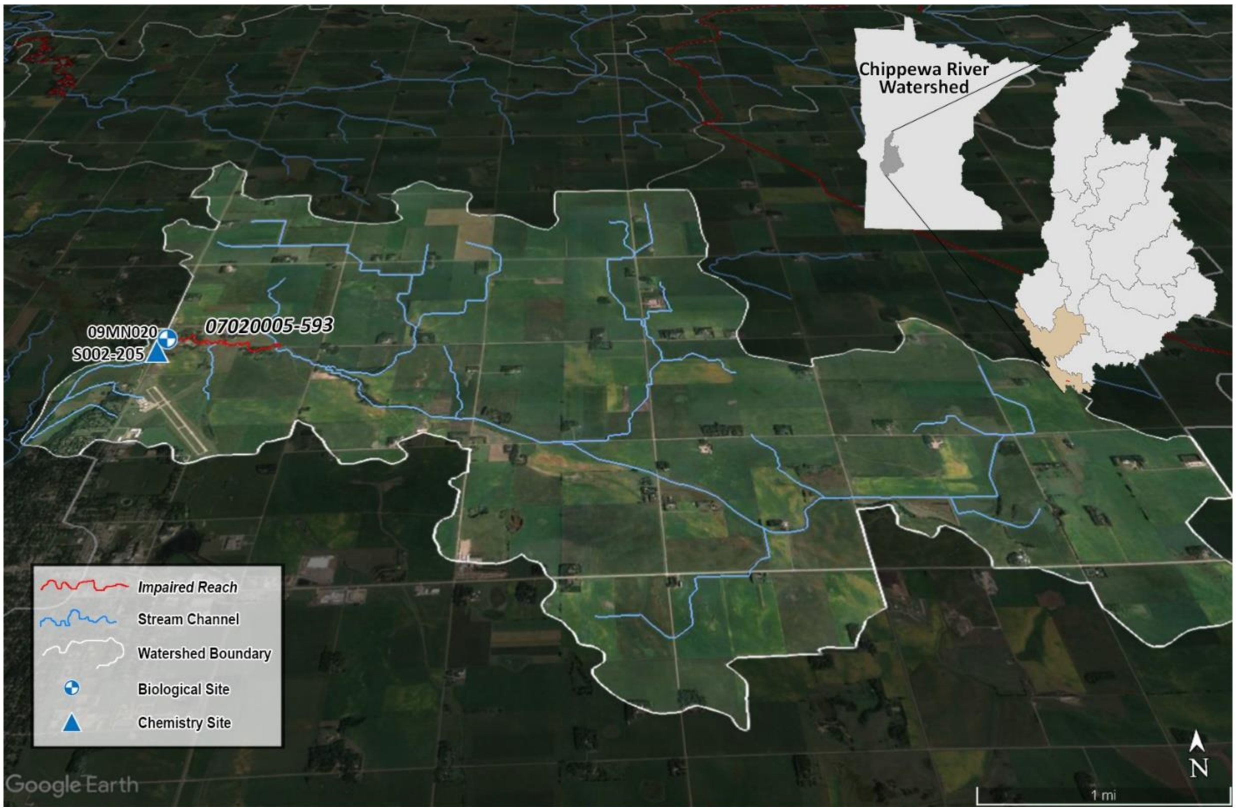
3.8.1.9 Reach Stressors

Table 374. Summary of stressors for stream reach.

07020005-576	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	O	O	O	O	O	O	O

3.8.2 07020005-593 Spring Creek (County Ditch 10A)

Figure 57. Satellite image of reach 07020005-593 and its watershed.



3.8.2.1 Biological Community

Reach 07020005-593 was sampled for fish in June of 2009, scoring a 41.7 (Table 375). Only four fish taxa were caught which are all considered either tolerant or very tolerant. The reach was dominated by two fish, the blacknose dace and creek chub, both of which are considered generalist feeders.

Biological Metric Data

Table 375. Fish IBI score and threshold for stream reach.

07020005-593 Fish Class 3 General Use	Fish IBI Score	Class Threshold Score
09MN020 6/30/2009	41.7	55

3.8.2.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 376. Hydrologic alteration related fish metrics for stream reach.

07020005-593 **Fish Class 3** **General Use**	General %	Nesting Non Lithophilic Spawner %
09MN020 6/30/2009	95.6	5.5
Statewide average for natural Class 3 southern headwater bio sites	**59.1**	**19.2**
Expected response to **Hydrologic** stress	↑	↑

Hydrologic Alteration Summary

Hydrologic alteration related fish metrics were mixed (Table 376). Generalist feeder percentage was very high as three out of the four fish taxa present are considered generalists. Although two of the four fish taxa caught are nesting fish, the numbers of actual fish caught were low, causing the percentage to be well below the class average.

Based on the mixed data sets and lack of recent biological or geomorphic data, hydrologic alteration is inconclusive as a stressor in this reach.

3.8.2.3 Connectivity

Connectivity Metric Data

Table 377. Connectivity related fish metrics for stream.

07020005-593 **Fish Class 3** **General Use**	Mature Age >3%	Migrating Individual %
09MN020 6/30/2009	0	0
Statewide average for natural Class 3 southern headwater bio sites	**13.3**	**22.9**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related fish metrics were poor (Table 377). There were no late maturing or migrating fish present in the reach. During field work a culvert at the bridge crossing appears to be a barrier to fish passage (Figure 58).

The biological metrics scored poorly and a fish barrier near the bio site is likely preventing fish passage. Connectivity is a stressor to the fish biological community in reach 07020005-593.

Figure 58. Photo of the culvert underneath the road crossing near bio site 09MN020 (left) and the artificial rock rapids just downstream of the culvert (right).

3.8.2.4 Habitat

Habitat Metric Data

Table 378. Habitat related fish metrics for stream reach.

07020005-593 **Fish Class 3** **General Use**	Benthic Insectivore minus	Benthic Insectivore %	Darter Sculpin Sucker %	Dominant Two %	Lithophilic Spawner %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN020 6/30/2009	0	0	0	94.5	94.5	0	53.6	100
Statewide average for natural Class 3 southern headwater bio sites	**14.2**	**16.7**	**12.6**	**58.2**	**69.2**	**28.3**	**33.7**	**70.6**
Expected response to Habitat stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 379. Habitat related fish tolerance values for stream reach.

07020005-543 **Fish Class 3** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %	Percent Embedded Tolerant %	Percent Embedded Sensitive %	Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN020 6/30/2009	5.5	53.6	1.1	0	5.5	0
Expected response to **Habitat** stress	↑	↓	↑	↓	↑	↓

MPCA Stream Habitat Assessment Score

Table 380. Habitat assessment scores for stream reach.

07020005-593	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN020 6/30/2009	0	9.5	17.1	7	23	56.6
09MN020 8/7/2019	2.5	5.5	17	13	11	49
Maximum Attainable Habitat Score	**5**	**15**	**27**	**17**	**36**	**100**

Habitat Summary

The habitat related fish metrics were mixed (Table 378). Since only four different fish taxa present, with two of those dominating the community, the attributes of the blacknose dace and creek chub are reflected in the metric percentages. None of the fish caught are considered benthic insectivores or riffle dwelling fish and no darters were caught. The blacknose dace and creek chub made up 94.5% of the total number of fish caught. All the fish caught are considered either generally tolerant or very tolerant. Tolerance values were also mixed (Table 379). The blacknose dace is considered sensitive to low MSHA scores, causing that percentage to be high at 53.6%. The other habitat tolerance values were neither good nor bad as there were no sensitive fish to those values and low percentages of tolerant fish.

The MSHA scores were mixed, with the 2009 assessment scoring better than the one done in 2019 (Table 380). The difference in scores is mostly due to the difference in the channel morphology score, with both depth variability and sinuosity scoring worse in the 2019 assessment with no riffles that were observed. There was some coarse substrate with sand, gravel, and cobbles observed during both visits.

Most of the fish metrics scored poorly, with no riffle dwelling fish present and no riffles were observed during the habitat assessment. There was coarse sediment observed in the reach however, which appears to be supporting lithophilic spawning fish, with large numbers of blacknose dace and creek chubs present. Habitat is stressing the fish population, though it is the lack of geomorphic features that appears to be affecting the biology.

3.8.2.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 381. DO related fish metrics for stream reach.

07020005-593 **Fish Class 3** **General Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV	DO Tolerant %	DO Sensitive %
09MN020 6/30/2009	4	0	0	1.1	100	7.5	5.5	0
Statewide average for natural Class 3 southern headwater bio sites	**12.2**	**13.3**	**8.6**	**17.1**	**70.6**	**7.3**	↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓		

Dissolved Oxygen Monitoring Data

Table 382. DO monitoring data for stream reach.

07020005-593 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-205 (2016-2017)	7.4 – 9.6	-	0% [2]	0% [3]	0% [3]	0% [4]	0% [1]	0% [1]	0% [14]
		Minimum Value							
		-	9.3	8.4	7.7	7.4	9.2	9.4	

Dissolved Oxygen Summary

The DO related fish metrics and tolerance values were mixed (Table 381). Total taxa count was very low at only four. There were no late-maturing, generally sensitive, or DO sensitive fish present and all the fish present are considered generally tolerant. There were very few serial spawners as only two fathead minnows were caught. The DO TIV also scored well and the percentage of low DO tolerant fish was only 5.5%.

Fourteen DO measurements were taken in 2016 and 2017. No measurements fell below the warmwater standard of 5 mg/L (Table 382). Measured values were all between 7.4 to 9.6 mg/L, which is a good range for DO values regarding DO stress.

Due to the mixed related fish biological metric scores and relatively good, measured values, DO is inconclusive as a stressor in this reach.

3.8.2.6 Eutrophication

Eutrophication Biological Metric Data

Table 383. Eutrophication related fish metrics for stream reach.

07020005-593 **Fish Class 3** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN020 6/30/2009	4	0	1.1	53.6		5.5	0
Statewide average for natural Class 3 southern headwater bio sites	**12.2**	**12.1**	**14.6**	**33.7**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Eutrophication Summary

The eutrophication related fish metrics and tolerance values were mixed (Table 380). Total taxa count was low and there were no darters or phosphorus sensitive fish present. Omnivores were low however as only the two fathead minnows caught are considers omnivores. The percentage of lithophilic spawners was above the class average and the percentage of phosphorus tolerant fish was only 5.5%, with only the two fathead minnows and eight brook sticklebacks present.

Only one phosphorus sample was taken in 2022 with a value of 0.140 mg/L, below the southern eutrophication standard of 0.150 mg/L.

The biological metrics and tolerance values were mixed and the chemistry data was limited. Eutrophication is possible as a stressor in this reach, though it is inconclusive. It is just as likely that other stressors, such as connectivity and habitat are affecting the fish community.

3.8.2.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 384. TSS related fish metrics for stream reach.

07020005-593 **Fish Class 3** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN020 6/30/2009	0	0	0	0	0	0	53.6	13.3		0	0
Statewide average for natural Class 3 southern headwater bio sites	**31.4**	**1.0**	**10.8**	**4.9**	**12.4**	**22.6**	**30.1**	**14.9**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

TSS Monitoring Data

Table 385. Transparency monitoring data for stream reach.

07020001-509 Secchi Tube Data 10 cm target	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-205 (2016-2022)	17 – >100	-	0 [2]	0 [4]	0 [3]	0 [4]	0 [1]	0 [1]	0 [14]

Suspended Solids Summary

The TSS related fish metrics and tolerance values were mixed (Table 384). The first seven biological metrics all scored a zero. The simple lithophilic spawner percentage was better than and the TSS TIV score was just below the class average. There were no TSS tolerant or intolerant fish present.

Fourteen transparency measurements were taken from 2016 to 2022, and none were below 10 cm (Table 385).

The bio metrics were mixed and the transparency data had no measurements below 10 cm. TSS is possible as a stressor in this reach, though it is inconclusive. It is just as likely that other stressors, such as connectivity and habitat are affecting the fish community.

3.8.2.8 Nitrates

Nitrate Biological Metric Data

Table 386. Nitrate related invert metrics for stream reach.

07020005-593 **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN020 8/5/2009	7.5	3.3		55	0.3
09MN020 8/7/2019	10.5	3.1		45.3	0
Statewide average for natural Invert Class 7 prairie stream glide pool bio sites	**10.9**	**3.2**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 387. Nitrate monitoring data for stream reach.

07020005-593 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S002-205 (2022)	0.2 – 6.5 [3]	-	-	6.5 [1]	0.4 [2]	-	-	-
		Highest Value						
		-	-	6.5	0.5	-	-	-

Summary

The nitrate related invert metrics and tolerance values were mostly poor (Table 386). Trichoptera taxa percentage was a little low, scoring only 0.4% below the class average. Inverts considered tolerant to high nitrates were high at 45.3% of the total caught, with little to no nitrogen intolerant inverts present. The nitrogen TIV scored well and was just below the class average.

Only three nitrate measurements were taken in reach 07020005-593 (Table 387). One sample taken in June was relatively high at 6.5 mg/L, though it is below the proposed nitrate criteria for protection of aquatic life of 8 mg/L. The other two measurements taken in July were both below 1 mg/L.

Due to the mixed biological response and relatively low nitrate concentrations, nitrates are inconclusive as a stressor to aquatic life in reach 07020005-593.

3.8.2.9 Reach Stressors

Table 388. Summary of stressors for stream reach.

07020005-593	**Hydrologic Alteration**	**Connectivity**	**Habitat**	**Dissolved Oxygen**	**Eutrophication**	**Suspended Solids**	**Nitrate**
✓ = Stressor **O** = Inconclusive	**O**	✓	✓	**O**	**O**	**O**	**O**

3.9 Dry Weather Creek

3.9.1 07020005-660, 07020005-724 Unnamed creeks

Figure 59. Satellite image of reaches 07020005-660 and 07020005-727 and their watershed.

3.9.1.1 Biological Community

Bio site 09MN038 in reach 07020005-724 was sampled in June of 2009, scoring a zero, well below the Fish Class 3 modified use threshold of 33 (Table 389). Only 17 total fish between three taxa were caught, with fathead minnows being the dominant fish present.

Bio site 09MN037 in reach 07020005-660 was sampled in June of 2009, scoring a 14.8, well below the Fish Class 2 modified use threshold of 35 (Table 390). The site was dominated by fathead minnows, a very tolerant, generalist feeder. There was low diversity for southern streams fish class and no sensitive taxa present. Five out of the six fish taxa caught are considered either tolerant or very tolerant.

Bio site 09MN038 was sampled for invertebrates in August of 2009 and scored a 3.7, well below the invert modified Class 7 threshold of 22 (Table 391). The site had very low invert taxa richness and 100% tolerant taxa. Four out of the top six inverts caught were snails. Dry Weather Creek is also impaired by pesticide exceedances, which may explain the extremely poor aquatic community condition.

Bio site 09MN037 was also sampled for invertebrates in August of 2009 and scored a 12.1, below the invert modified Class 7 threshold of 22 (Table 391). This bio site had relatively large numbers of the mayfly *Caenis* and the damselfly Coenagrionidae, both relatively tolerant inverts. The next four most numerous inverts present after those were snails. The sample was comprised of 100% tolerant taxa suggesting that the stream is likely eutrophic.

Biological Metric Data

Table 389. Fish IBI score and threshold for stream reach.

07020005-724 **Fish Class 3** **Modified Use**	Fish IBI Score	Class Threshold Score
09MN038 6/17/2009	0.0	33

Table 390. Fish IBI score and threshold for stream reach.

07020005-660 **Fish Class 2** **Modified Use**	Fish IBI Score	Class Threshold Score
09MN037 6/17/2009	14.8	35

Table 391. Invert IBI score and threshold for stream reaches.

07020005-660 **07020005-724** **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
09MN038 8/14/2009	3.7	22
09MN037 8/14/2009	12.1	

3.9.1.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 392. Hydrologic alteration related fish metrics for stream reach.

07020005-724 **Fish Class 3** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
09MN038 6/17/2009	41.2	100
Statewide average for channelized Fish Class 3 southern headwaters bio sites	**56.3**	**24.0**
Expected response to **Hydrologic** stress	↑	↑

Table 393. Hydrologic alteration related fish metrics for stream reach.

07020005-660 **Fish Class 2** **Modified Use**	General %	Nesting Non Lithophilic Spawner %
09MN037 6/30/2009	64.2	61.2
Statewide average for channelized Fish Class 2 Southern Stream bio sites	**43.9**	**30.6**
Expected response to **Hydrologic** stress	↑	↑

Table 394. Hydrologic alteration related invert metrics and tolerance values for stream reaches.

07020005-660 **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth Variability Tolerant %	Low Depth Variability Intolerant %
09MN038 8/14/2009	0	2.6	0		90.8	0		85.4	0
09MN037 8/14/2009	4	0.9	0.6		92.1	0.6		90.9	1.5
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓						

Hydrologic Alteration Summary

The fish metrics at bio site 09MN037 were mixed (Table 392). Generalized fish species are correlated with channelization and are adaptable to different habitats through generalized food preferences. Bio site 09MN038 had a generalist fish population of 41.2%, below the class average. Nesting fish; however, made up 100% of the total number of fish caught. The fish metrics at bio site 09MN037 were both poor (Table 393). Generalist fish were high at 64.2% as the 38 fathead minnows were the most numerous fish taxa present. Fatheads are also a nesting fish and the percentage of nesting nonlithophilic fish was 61.2%, well above the class average.

Hydrologic alteration related invert metrics scored mostly poor at both bio sites (Table 394). Clingers were low at both sites as the most dominant inverts at site 09MN038 were three different snail taxa, all considered climbers. Site 09MN037 was dominated by the mayfly *Caenis*, a sprawler, and the majority of inverts present were climbers. Collector-filterers and long-lived inverts were low at both sites as well. Tolerance values were mostly poor at both sites. Inverts tolerant to ditching and low depth variability were very high with hardly any inverts considered intolerant to them.

Both the fish and invert hydrologic alteration related metrics and tolerance values were mostly poor. Both the fish and invert communities indicate that hydrologic alteration is a stressor to the biological community. It appears that the ditching and alteration of the reach itself is likely causing the stress, due to the change in the hydrology as well as the lack of habitat within the ditch.

3.9.1.3 Connectivity

Connectivity Metric Data

Table 395. Connectivity related fish metrics for stream reach.

07020005-724 **Fish Class 3** **Modified Use**	Mature Age >3%	Migrating Individual %
09MN038 6/17/2009	0	0
Statewide average for channelized Fish Class 3 southern headwaters bio sites	**14.4**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Table 396. Connectivity related fish metrics for stream reach.

07020005-660 **Fish Class 2** **Modified Use**	Mature Age >3%	Migrating Individual %
09MN037 6/30/2009	0	0
Statewide average for channelized Fish Class 2 Southern Stream bio sites	**28.0**	**21.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related fish metrics were very poor at both bio site 09MN037 and 09MN038 as there were no late maturing or migrating fish present at either site, as such, it is likely a stressor in these reaches. At this time it is inconclusive.

3.9.1.4 Habitat

Habitat Metric Data

Table 397. Habitat related fish metrics for stream reach.

07020005-724 **Fish Class 3** **Modified Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN038 6/17/2009	35.3	35.3	0	76.5	0	0	0	64.7
Statewide average for channelized Fish Class 3 southern headwaters bio sites	**10.9**	**10.6**	**58.0**	**32.5**	**2.0**	**22.6**	**30.1**	**76.7**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 398. Habitat related fish metrics for stream reach.

07020005-660 **Fish Class 2** **Modified Use**	Benthic Insect minus Tolerant %	Darter Sculpin Sucker %	Lithophilic Spawner %	Pioneer %	Piscivore %	Riffle %	Simple Lithophilic Spawner %	Tolerant %
09MN037 6/30/2009	3.0	3.0	7.5	59.7	0	0	7.5	97
Statewide average for channelized Fish Class 2 Southern Stream bio sites	**19.1**	**16.5**	**35.6**	**23.6**	**8.0**	**19.5**	**26.2**	**46.4**
Expected response to **Habitat** stress	↓	↓	↓	↑	↓	↓	↓	↑

Table 399. Habitat related fish tolerance values for stream reaches.

07020005-724 **07020005-660** **Modified Use**	MSHA Score Tolerant %	MSHA Score Sensitive %		Percent Embedded Tolerant %	Percent Embedded Sensitive %		Low Substrate Score Tolerant %	Low Substrate Score Sensitive %
09MN038 6/17/2009	64.7	0		41.2	0		64.7	0
09MN037 6/30/2009	88.1	7.5		58.2	0		88.1	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

Table 400. Habitat related invert metrics for stream reaches.

07020005-724 **07020005-660** **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN038 8/14/2009	13.1	80.9	0	3.2	85.0	4.8
09MN037 8/14/2009	0.6	57.8	4	33.2	35.1	35.7
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 401. Habitat related invert tolerance values for stream reaches.

07020005-724 **07020005-660** **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN038 8/14/2009	85.1	0		81.3	0.6		62.2	0
09MN037 8/14/2009	91.5	0.9		88.1	0.9		46.5	0.9
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 402. Habitat assessment scores for stream reaches.

07020005-660	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN038 6/17/2009	0	8.5	5	5	10	28.5
09MN037 6/17/2009	0	9	11	13	16	49
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

The habitat related fish metrics and tolerance values at both bio site 09MN038 and 09MN037 are both poor (Table 397 and Table 398). Except for six johnny darters at bio site 09MN038 and two at bio site 09MN037 there were no other benthic insectivores or darters present in either reach. Five blacknose dace were caught at bio site 09MN037, causing that metric to score well below the class average. Pioneer taxa were high at both sites and there were no piscivores or riffle dwelling fish present. Generally tolerant fish made up 97% of all the fish caught at bio site 09MN037. Bio site 09MN038 had a generally tolerant percentage of 64.7%, which was below the class average.

Fish tolerance values at both sites were poor as well. All of the habitat related tolerant percentages were high, with very few habitat sensitive fish caught at either site. There were five blacknose dace caught at bio site 09MN037, a 7.5% MSHA sensitive percentage of the total number of fish caught.

Habitat related invert metrics were mixed (Table 400). The main difference between the two bio sites is the 103 *Caenis* mayflies and 83 Coenagrionidae damselflies caught at 09MN037. This caused the EPT and legless metrics to score well when compared to the class average. Climber percentage was well above the class average, though this was due to the prevalence of snails at both sites, though bio site 09MN037 did have 83 Coenagrionidae present, a damselfly climber that is considered very tolerant to several habitat related tolerance values. The EPT percentage was also high at 07MN037 due to large numbers of the mayfly *Caenis*, which is also considered tolerant and very tolerant to habitat related tolerance values and is also considered a sprawler, a type of invert that tends to sprawl on fine sediments. Habitat related tolerance values were all very poor at both bio sites, with high percentages of habitat related tolerant inverts and very few habitat intolerant inverts present (Table 401).

The MSHA assessments were poor (Table 402). Bio site 09MN038 scored very poorly, with a 28.5 out of a possible 100. The substrate score was very poor at bio site 09MN038 with only silt observed at the site. Site 09MN037 scored a little better due to the presence of gravel as well as silt. Cover was also limited at both sites as the shapes of the ditches themselves are very geometric, with steep sides that are not conducive to providing cover over the stream channel. Channel morphology was very poor at both sites as well. Due to the channelization and alteration of the channel there was very little channel development, sinuosity, and geomorphic features present at either site. No riffles were observed at either site and depth variability was poor.

Both the fish and invert bio metrics and tolerance values were mostly poor, with biological communities that are indicative of poor habitat. Habitat is a stressor to the biology of reaches 07020005-660 and 07020005-724.

3.9.1.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 403. DO related fish metrics for stream reach.

07020005-724 **Fish Class 3** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN038 6/17/2009	3	0	0	41.2	64.7	6.4		64.7	0
Statewide average for channelized Class 3 southern headwater bio sites	**10**	**14.4**	**6.0**	**10.6**	**76.7**	**7.2**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Table 404. DO related fish metrics for stream reach.

07020005-660 **Fish Class 2** **Modified Use**	Taxa Count #	Mature Age >3 %	Sensitive %	Serial Spawner %	Tolerant %	DO TIV		DO Tolerant %	DO Sensitive %
09MN037 6/30/2009	6	0	0	58.2	97	6.5		58.2	0
Statewide average for channelized Class 2 southern stream bio sites	**14.5**	**28.0**	**8.4**	**25.3**	**46.8**	**7.2**		↑	↓
Expected response to **DO** stress	↓	↓	↓	↑	↑	↓			

Table 405. DO related invert metrics for stream reaches.

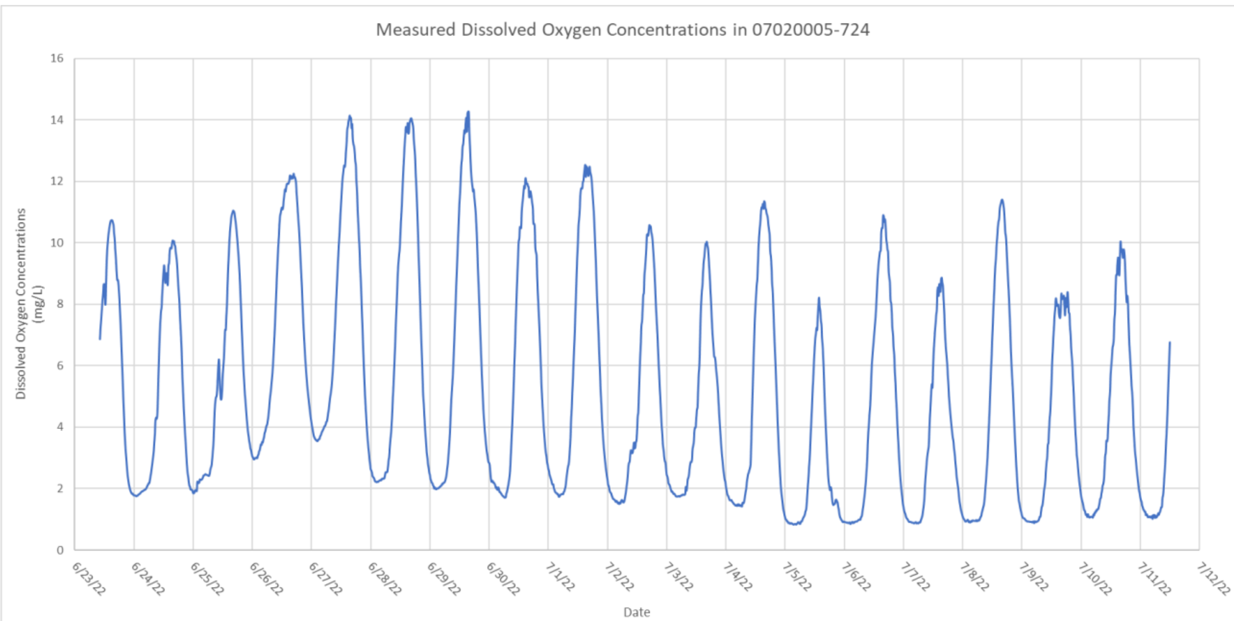
07020005-724 **07020005-660** **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN038 8/14/2009	3.2	8.7	15	6.4		65.4	0
09MN037 8/14/2009	33.2	9.1	25	6.4		76.6	1.5
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 406. DO monitoring data for stream reaches.

07020005-660 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-273 **S005-884** (2011-2022)	0.2 – 20.3	-	0 [16]	0.0 [22]	13.3 [15]	5 [20]	0.0 [7]	-	3.8 [80]
		Minimum Value							
		-	6.7	6.0	4.0	0.2	6.9	-	

Figure 60. Continuous DO data at site 09MN038.



Dissolved Oxygen Summary

The DO related fish metrics scored mostly poor at bio site 09MN038 (Table 404). With only 3 fish taxa and 17 total fish caught, the only metric that scored well was the general tolerant percent, which scored below the class average. Metrics and tolerance values at bio site 09MN037 were all poor, with similar values as bio site 09MN038 except for the general tolerant percentage that was 97% of the total number of fish caught. The DO TIVs were both lower than the class average and 58.2% to 64.7% of the total number of fish caught are considered tolerant to low DO.

DO related invert metrics were mostly poor (Table 405). Bio site 09MN037 had a high percentage of EPT individuals, though mainly due to the dominance of *Caenis*, a mayfly that is considered tolerant to low DO. Besides that metric, both sites were similar in that they had a high HBI_MN score, a low taxa count, and high percentages of inverts considered tolerant to low DO.

Table 407. Eutrophication related fish metrics for stream reach.

07020005-724 **Fish Class 3** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN038 6/17/2009	3	35.3	41.2	0		64.7	0
Statewide average for channelized Class 3 southern headwater bio sites	**10**	**10.6**	**19.8**	**30.1**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Eighty DO measurements were taken between 2011 and 2022 (Table 406). Of all the samples, 3.8% were below 5 mg/L, with most of the low values occurring in July, with a couple in August as well. A YSI Sonde water meter measured continuous DO data from 6/23/2022 to 7/11/2022 (Figure 61). DO values were measured below 5 mg/L every night of the deployment, falling below 1 mg/L several times. A photo was taken during a field visit in November that showed excessive algae growth along the bottom of the stream channel, which is typically not the time of year where algae growth is at its worst (Figure 61).

Figure 61. Culvert downstream of both bio sites showing excessive algae growth along the entire bottom.

Based on the related fish and invertebrate biological metrics and tolerance values, the measured sonde values, and evidence of excessive algae growth, DO is a stressor in these reaches.

3.9.1.6 Eutrophication

Eutrophication Biological Metric Data

Table 407. Eutrophication related fish metrics for stream reach.

07020005-724 **Fish Class 3** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN038 6/17/2009	3	35.3	41.2	0		64.7	0
Statewide average for channelized Class 3 southern headwater bio sites	**10**	**10.6**	**19.8**	**30.1**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Table 408. Eutrophication related fish metrics for stream reach.

07020005-660 **Fish Class 2** **Modified Use**	Taxa Count #	Darter %	Omnivore %	Simple Lithophilic Spawner %		Phosphorus Tolerant %	Phosphorus Sensitive %
09MN037 6/17/2009	6	2.9	56.7	7.5		88.1	0
Statewide average for channelized Class 2 southern stream bio sites	**14.5**	**13.6**	**25.5**	**26.2**		↑	↓
Expected response to **Eutrophication** stress	↓	↓	↑	↓			

Table 409. Eutrophication related invert metrics for stream reaches.

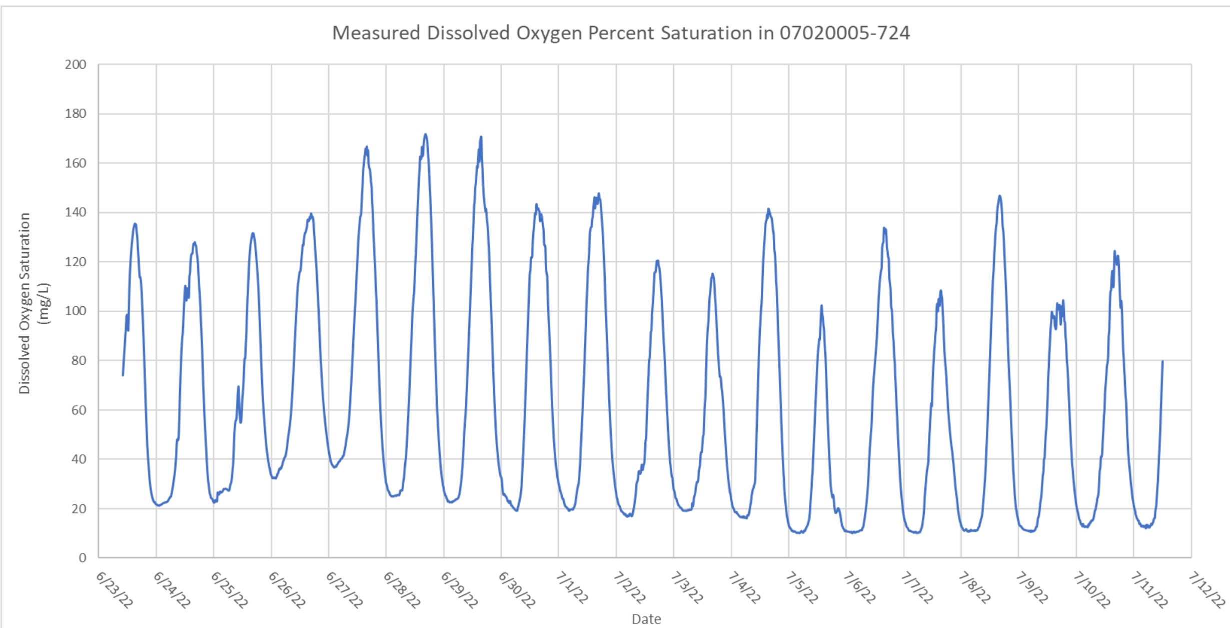
07020005-724 **07020005-660** **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN038 8/14/2009	73.6	5	3.2	70.7	15		89.4	0
09MN037 8/14/2009	32.0	7.0	33.2	30.2	25		91.5	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.1**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 410. Phosphorus monitoring data for stream reach.

07020005-724 **07020005-660** P Sample Data 0.150 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-273 **S005-882** (2022)	0.164 – 0.640	-	-	-	0.428 [4]	-	-	-	0.428 [4]
		Maximum Value							
		-	-	-	0.640	-	-	-	

Figure 62. Measured continuous DO percent saturation in stream reach.



Eutrophication Summary

Eutrophication related fish metrics were mostly poor at bio site 09MN038, with only the darter percentage scoring well due to the six johnny darters caught (Table 407). There were only 3 different taxa caught, with only 17 individuals caught in total. Omnivore percentage was well above the class average and there were no lithophilic spawners present at all. The phosphorus tolerant fish percentage was 64.7% with no phosphorus intolerant fish present at all. Bio site 09MN037 was like 09MN038 with the exception that there were only two johnny darters caught and a few more fish taxa present (Table 408). Omnivore percentage was higher as the percentage of fathead minnows was 56.7% of the total number of fish caught. There were also five blacknose dace present, causing the lithophilic spawner percentage to be 7.5%, still well below the class average. Of the total number of fish caught, 88.1% are considered tolerant to high phosphorus.

Eutrophication related invertebrate metrics were mostly poor (Table 409). There were large numbers of snails at both bio sites, though the difference in the Crustacean and Mollusca percentages was due to the prevalence of the mayfly *Caenis* and the damselfly Coenagrionidae, both of which are considered tolerant to high phosphorus. Collector-gatherers were low at both sites. Most snails are considered scrapers, which caused that metric to score well above the class average. Total taxa count, though a bit better at 09MN037, was low at both sites. The percentage of phosphorus tolerant inverts at both sites was around 90% of the total number of inverts present with no phosphorus intolerant inverts at either site.

Phosphorus sampling was limited as only two samples were taken in each reach (Table 410). However, all the samples taken were above the eutrophication phosphorus standard of 0.150 mg/L, three of which were more than double that value. Overall, the chemistry data indicates that both reaches likely have very high phosphorus throughout the summer months.

An YSI Sonde water meter measured continuous DO data from 6/23/2022 to 7/11/2022 (Figure 61). During this deployment, diel DO flux was measured above 5 mg/L every day of the deployment. DO percent saturation was also measured during the same sonde deployment (Figure 63). The DO percent saturation got above 100% every day of the deployment, with some values at or above 170%, indicating eutrophic oxygen conditions that spike well above 100% during the day.

Both the fish and biological communities in both reaches are showing the effects of the elevated phosphorus, phosphorus sampling showed elevated concentrations, DO flux was above 5 mg/L or greater, and the percent saturation was well above 100% for most of the sonde deployment. Eutrophication is a stressor in both reaches 07020005-724 and 07020005-660.

3.9.1.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 411. TSS related fish metrics for stream reach.

07020005-724 **Fish Class 3** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN038 6/17/2009	35.3	0	0	0	35.3	0	0	17.4		0	0
Statewide average for channelized Class 3 southern headwater bio sites	**31.4**	**1.0**	**10.8**	**4.9**	**12.4**	**22.6**	**30.1**	**15.1**		↓	↓
Expected response to **Suspended Solids** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 412. TSS related fish metrics for stream reach.

07020005-660 **Fish Class 2** **Modified Use**	Benthic Feeder %	Centrarchid - Tolerant %	Herbivore %	Long – lived %	Perciformes - Tolerant %	Riffle %	Simple Lithophilic Spawner %	TSS TIV		TSS Tolerant %	TSS Sensitive %
09MN037 6/30/2009	3.0	0	29.9	0	3.0	0	7.5	23.2		0	0
Statewide average for channelized Class 2 southern stream bio sites	**30.1**	**6.2**	**2.9**	**21.3**	**28.7**	**19.5**	**26.2**	**18.2**		↓	↓
Expected response to **TSS** stress	↓	↓	↓	↓	↓	↓	↓	↑			

Table 413. TSS related invert metrics for stream reaches.

07020005-724 **07020005-660** **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN038 8/14/2009	2.5	0	4.8	14.5		24.1	0
09MN037 8/14/2009	0.9	0	35.7	17.3		41.6	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**16.3**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

TSS Monitoring Data

Table 414. Transparency monitoring data for stream reach.

07020005-724 **07020005-660** Secchi Tube Data	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S009-273 **S005-884** 10 cm target	12 – 100+	-	0 [16]	0 [24]	0 [14]	0 [20]	0 [7]	-	0 [79]

Suspended Solids Summary

The TSS related fish metrics were mostly poor at both bio site 09MN038 (Table 411) and bio site 09MN037 (Table 412). The six johnny darters caused the benthic feeder percentage to be just above the class average. There were no Centrarchids, long-lived, or riffle dwelling fish present at either site. Simple lithophilic spawners were low and both site's TSS TIV scores were higher than their class averages. There were no fish present at either site that are considered either tolerant or sensitive to TSS. Bio site 09MN037 did have 20 Brassy minnows present, which is considered an herbivore.

TSS related invertebrate metrics at both bio sites were mostly poor (Table 413). There were very few collector-filterers and no Plecoptera present. Sprawlers were low at bio site 09MN038 due to the dominance by several snail taxa. The most numerous snail taxa present, *Gyraulus*, is considered neither tolerant nor intolerant to TSS. This caused the TSS TIV score to score below the class average and the percentage of TSS tolerant inverts to be lower than at site 09MN037. The second and third most numerous taxa at 09MN037 are considered tolerant or very intolerant to TSS and the number of individuals present were relatively high. The most numerous invert at the site was the mayfly *Caenis*, which is considered a sprawler.

Between the two bio sites, 79 transparency measurements were taken between 2011 to 2022 (Table 414). None of the measurements were below 10 cm.

Due to the mixed biological metrics, tolerance values, and the robust transparency data showing high transparency values, TSS is inconclusive. It is likely that other stressors, such as connectivity and habitat are affecting the biological communities.

3.9.1.8 Nitrates

Nitrate Biological Metric Data

Table 415. Nitrate related invert metrics for stream reach.

07020005-724 **07020005-660** **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN038 8/14/2009	0	3.2		90.7	0
09MN037 8/14/2009	4	3.3		58.4	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 416. Nitrate monitoring data for stream reaches.

07020005-724 **07020005-660** Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S009-273 **S005-884** (2022)	0.5 – 14.5 [11]	-	-	9.9 [3]	0.5 [8]	-	-	-
		Highest Value						
		-	-	14.5	1.4	-	-	-

Summary

The nitrate related invertebrate metrics at sites 09MN038 and 09MN037 were mostly poor (Table 415). There were a few different Trichoptera taxa present at 09MN037, though the actual numbers of them were very low. The nitrogen TIV scores were pretty much right at the class average. The percentage of nitrogen tolerant invertebrates were very high, over 90% at 09MN038 and 58.4% at 09MN037 with no nitrate intolerant inverts present.

Eleven nitrate samples were measured in reach 07020005-724 and 07020005-660 (Table 416). Two of the values in June were excessively high with an average concentration of 9.9 mg/L, above the proposed nitrate criteria for protection of aquatic life of 8 mg/L. The values in July were low, though this is typical of the ditches in the area, with high nitrate concentrations occurring in springtime, and lower concentrations as the summer goes on. Due to the biological response and relatively high nitrate concentrations in June, nitrates are a stressor to aquatic life in reaches 07020005-724 and 07020005-660.

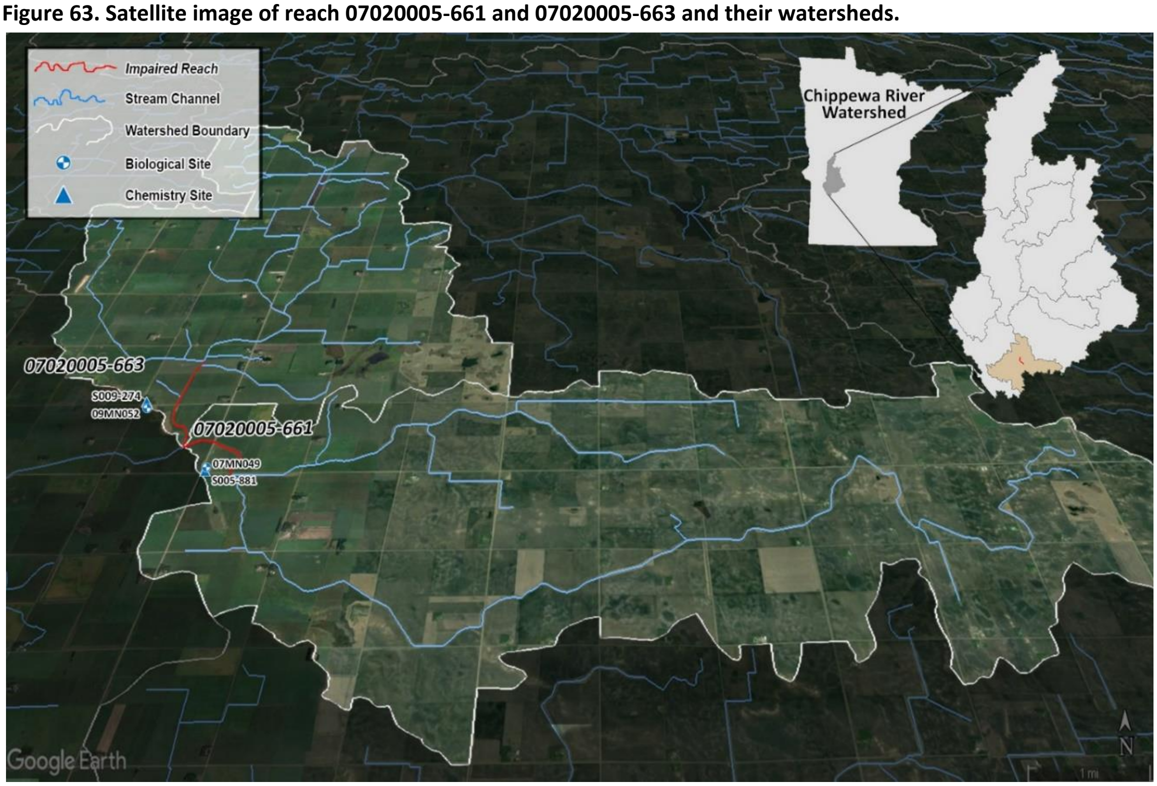
3.9.1.9 Reach Stressors

Table 417. Summary of stressors for stream reaches.

07020005-660 07020005-724	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	✓	✓	✓	✓	O	✓

3.9.2 07020005-661, 07020005-663 Unnamed creeks

Figure 63. Satellite image of reach 07020005-661 and 07020005-663 and their watersheds.



3.9.3.1 Biological Community

Both reaches are altered ditches, shaped into wide, straight channels with very high, steep banks made to move water quickly off the landscape. The two ditches are very similar, with 07020005-661 being slightly narrower with steeper sides than 07020005-663.

The 2019 MIBI score at bio site 07MN049 in reach 07020005-661 is above the modified use threshold and within the confidence interval (Table 418). The site scored better than 09MN052, with several Trichoptera taxa present. Because 2019 was a very wet year another bio visit was scheduled for 2020, though it was not done due to low water levels. This part of the watershed was not in any stage of drought in early August of 2020 (though portions to the north and west were in a moderate drought) according to the US Drought Monitor Map Archive. The lack of flow observed in 2020 was likely due to extensive hydrologic alteration of the watershed as opposed to climatic conditions at that time. Without a clear understanding of what 'normal' conditions look like for this watershed, although 2020 may in fact represent those conditions, the recommendation is to retain the macroinvertebrate impairment despite the passing MIBI score on the basis that 2019 doesn't appear to be representative of the prevailing macroinvertebrate community condition for this channelized stream.

Bio site 09MN052 scored a 10.4, well below the threshold of 22 (Table 418). Despite being one of the wettest years on record, this hydrologically altered watershed had little to no flow during the invert visit (August 7, 2019) which explained the accumulation of silt and muck in the channel and the strong scent of hydrogen sulfide as the substrate was disturbed. Macroinvertebrate community had low taxa richness and had a tolerant taxa percentage of 96%, with the amphipod *Hyalella* dominating the invert community.

Biological Metric Data

Table 418. Invert IBI score and threshold for stream reaches.

07020005-661 **07020005-663** **Invert Class 7** **Modified Use**	Invert IBI Score	Class Threshold Score
07MN049 8/19/2009	8.5	22
07MN049 8/7/2019	28.8	
09MN052 8/7/2019	10.4	

3.9.3.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 419. Hydrologic alteration related invert metrics for stream reaches.

07020005-661 **07020005-663** **Invert Class 7** **Modified Use**	Clinger %	Collector – filterer %	Long – lived %	Percent Ditched Tolerant %	Percent Ditched Intolerant %	Low Depth Variability Tolerant %	Low Depth Variability Intolerant %
07MN049 8/19/2009	4.7	9.8	0	66.5	0	56.4	0
07MN049 8/7/2019	8.8	10.4	3.4	30.5	2.6	72.4	5.5
09MN052 8/7/2019	10.8	1.8	1.2	40.1	0	92.1	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**23.1**	**9.9**	**5.6**				
Expected response to **Hydrologic** stress	↓	↓	↓	↑	↓	↑	↓

Hydrologic Alteration Summary

The hydrologic alteration related invert metrics and tolerance values were poor at both sites, with only collector-filterers at site 07MN049 scoring just above the class average (Table 419). This was primarily due to *Ceratopsyche* being present, a somewhat sensitive caddisfly, which is considered very intolerant to depth variability. Clingers and long-lived inverts were low. Inverts that are considered tolerant to high percentage of ditching and low depth variability were both high with none too little intolerant inverts.

Based on the very poor scores of the biological metrics and tolerance values and the highly modified alteration of the channels, hydrologic alteration is a stressor in this reach. The primary impact in this reach from hydrologic alteration is the ditching of the stream itself, which affects biology in several ways. Ditching destroys the natural geomorphology of the stream, which reduces the riffle, run, glide, and pool environments needed to support a diverse invertebrate community. It cuts the stream off from its floodplain, which provides habitat and cover and dissipates some of the stream's power during high flows. Ditching and tiling of the tributaries and surrounding landscape can contribute to low base flows during times of low precipitation, contributing to the stagnation of the water within the ditch and eutrophication of the water, which causes excessive algae growth from the nutrient overloading of phosphorus and nitrogen.

3.9.3.3 Connectivity

Connectivity Metric Data

Table 420. Connectivity related fish metrics for stream reaches.

07020005-661 **07020005-663** **Fish Class 3** **Modified Use**	Mature Age >3%	Migrating Individual %
07MN049 6/16/2009	0	0
07MN049 7/8/2009	3.1	3.1
07MN049 7/16/2019	1.6	1.6
07MN049 6/15/2021	27.3	27.3
09MN052 6/16/2009	0	0
Statewide average for channelized Fish Class 3 southern headwaters bio sites	**16.3**	**23.8**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Figure 64. Photo of rocks placed under the bridge at road crossing near bio site 07MN049.

The fish biological metrics for connectivity were mixed at first glance (Table 420). The first three site visits at bio site 07MN049 were all very poor, with low numbers of late maturing and migrating fish. The site visit in 2021 had better connectivity metrics as there were 108 white suckers present, both a late-maturing and migrating fish.

The rock riffle created underneath one of the bridge crossings near site 07MN049 is likely preventing fish passage, especially at low flows. Road crossings near bio site 09MN052 were wider with a large culvert underneath the road.

Connectivity is a possible stressor in both reaches, however, it is inconclusive due to the large numbers of white suckers, a migrating fish.

3.9.3.4 Habitat

Habitat Metric Data

Table 421. Habitat related invert metrics for stream reaches.

07020005-661 **07020005-663** **Invert Class 7** **Modified Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
07MN049 8/19/2009	43.6	50.0	3.0	0.3	96.0	3.4
07MN049 8/7/2019	27.9	9.1	8.8	30.2	20.5	49.4
09MN052 8/7/2019	8.5	10.6	10.9	20.1	21.9	69.0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**14.1**	**27.5**	**23.1**	**20.6**	**55.8**	**27.0**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 422. Tolerance values for stream reaches.

07020005-661 **07020005-663** **Invert Class 7** **Modified Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
07MN049 8/19/2009	57.0	0		48.2	0		25.9	0
07MN049 8/7/2019	76.9	4.2		72.1	3.2		54.9	5.2
09MN052 8/7/2019	93.0	0		90.9	0		72.9	0
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 423. Habitat assessment scores for stream reaches.

07020005-661 07020005-663	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
07MN049 6/16/2009	0	8	5	10	11	34
07MN049 7/8/2009	0	10.5	9	1	4	24.5
07MN049 8/7/2019	0	7.5	6	7	3	23.5
07MN049 7/16/2019	0	8	13	5	-1	25
07MN049 6/15/2021	0	7	10.6	11	17	45.6
09MN052 6/16/2009	0	7	5	12	7	31
09MN052 8/7/2019	0	6	1	7	3	17
Maximum Attainable Habitat Score	**5**	**14**	**28**	**18**	**35**	**100**

Habitat Summary

Habitat related invert metrics were mostly poor at both bio sites (Table 421). Site 07MN049 had a high percentage of sprawlers as the most numerous invert present was the amphipod *Hyalella*, a sprawler that is tolerant to several habitat related tolerance values (Table 422). The second and third most numerous inverts at 07MN049 were burrowers, causing that metric to score well above the class average. Both climbers and clingers were low. EPT percentage was above the class average, though this was due to the mayfly *Caenis*, a burrower that is tolerant to several habitat related tolerance values. Bio site 09MN052 had fewer burrowers as the two most numerous inverts at the site are both sprawlers, causing that metric to score very high, well above the class average. Climber and clingers were low at this site as well and although the second most numerous invert was a mayfly, the percentage of EPT was still below the class average (Table 421).

Habitat related tolerance values were very poor (Table 422). There were almost no habitat intolerant inverts present at either site and the percentages of habitat related tolerant inverts were as high as 93%, with several more tolerant percentages in the 70% range.

The MSHA scores conducted during bio visits were poor, with several scores in the 20s and even a 17 at bio site 09MN052 (Table 423). Both reaches have been shaped into ditches. The riparian scores were somewhere in the middle, with little bank erosion observed at either site. Shade was poor as the banks were mostly grass. All the substrate scores were very poor as most of the visits observed no coarse substrate or embedded coarse substrate and moderate to heavy siltation. Channel morphology was also very poor as the reaches themselves were straightened, with very few geomorphic features, low depth variability, and poor riffle development.

Due to the mostly poor habitat metrics, very poor tolerance values, and the poor habitat scores, habitat is a stressor to the biological community.

3.9.3.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 424. DO related invert metrics and tolerance values for stream reaches.

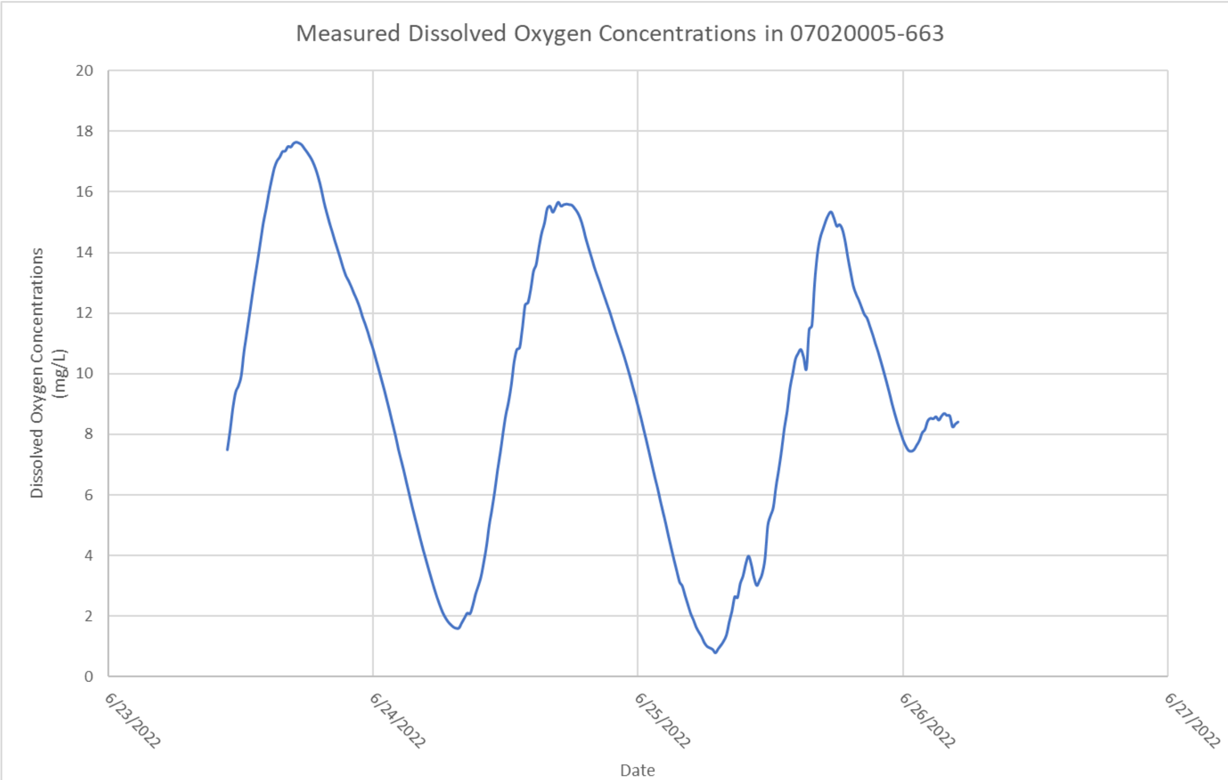
07020005-661 **07020005-663** **Invert Class 7** **Modified Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
07MN049 8/19/2009	0.3	8.3	19	4.3		26.2	0
07MN049 8/7/2019	30.2	7.8	24	6.0		70.0	3.2
09MN052 8/7/2019	20.1	8.0	23	5.9		88.2	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**20.6**	**8.0**	**33.6**	**6.2**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 425. DO monitoring data for stream reaches.

07020005-661 **07020005-663** DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-881 **S009-274** (2011-2022)	4.5 – 20.4	-	0% [8]	0% [12]	10% [10]	0% [12]	0% [5]	-	2.1% [47]
		Minimum Value							
		-	9.1	7.1	4.5	5.2	7.8	-	

Figure 65. Continuous DO data at site 09MN052.



Dissolved Oxygen Summary

The DO related invert metrics were mostly poor at both bio sites (Table 424). The percentage of EPT inverts was relatively high at 07MN049 due to the prevalence of the mayfly *Caenis*, which is considered tolerant to low DO. The most numerous invert present was the amphipod *Hyalella*, also a low DO tolerant invertebrate. Both 2019 visits in both reaches were relatively high at 70% and 88.2% of the total inverts present, with very little to no low DO intolerant inverts. Taxa count was low at both sites and the DO TIV scores were below the TIV average for Class 7 bio sites. Bio site 09MN052 was also dominated by the amphipod *Hyalella* and the mayfly *Caenis*, both DO tolerant taxa. The biology at bio site 09MN052 indicates even more DO stress than 07MN049 as six out of the top seven most numerous invert taxa caught are considered tolerant or very intolerant to low DO.

Only one DO measurement taken during sampling was below the warmwater standard of 5 mg/L (Table 425). However, none of those measurements were taken before 8:00a.m., when values are usually the lowest.

A YSI Sonde water meter measured continuous DO data at 09MN052 from 6/23/2022 to 6/26/2022. During this deployment, DO values were measured below the standard of 5 mg/L both nights of the deployment (Figure 66). This sonde was deployed for only three days due to low water levels. In the three days the DO values ranged from below 1 mg/L to close to 18 mg/L.

The related invert biological metric scores were mostly poor, low DO tolerant inverts dominated both sites, and the sonde deployment showed very low DO values. Because of the poor metrics and tolerance values along with the measured DO values, DO is a stressor in this reach. DO issues are likely exacerbated by eutrophic conditions and low flows.

3.9.3.6 Eutrophication

Eutrophication Biological Metric Data

Table 426. Eutrophication related invert metrics for stream reaches.

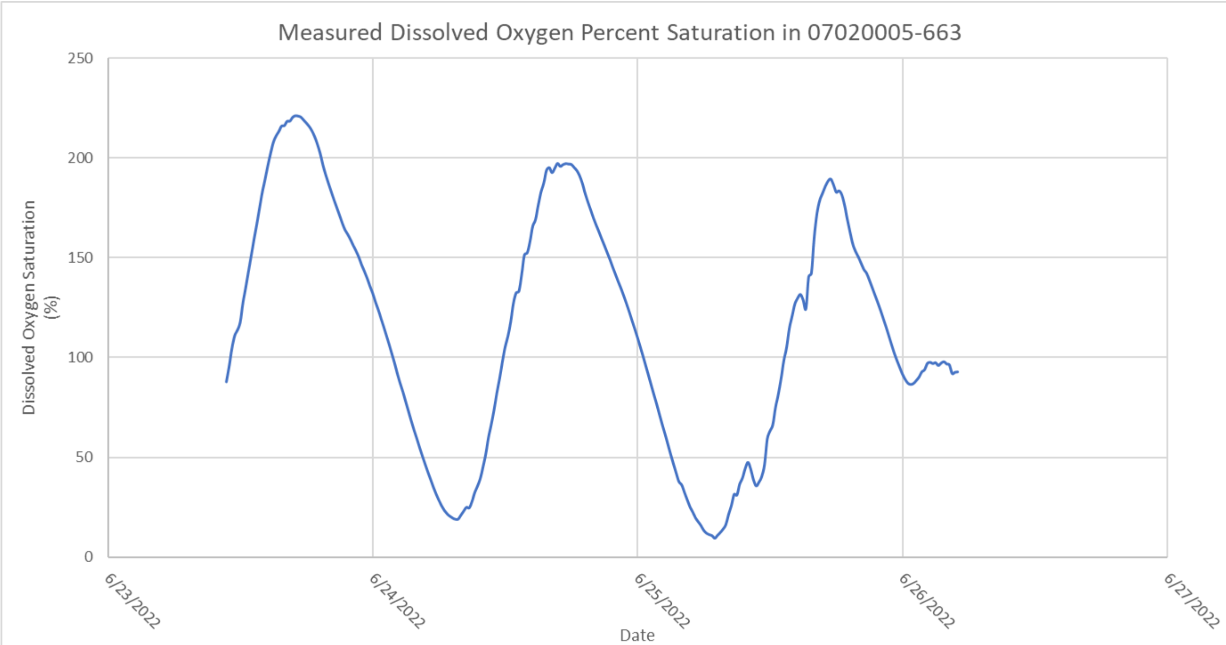
07020005-661 **07020005-663** **Invert Class 7** **Modified Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
07MN049 8/19/2009	56.1	4	0.3	46.6	19		66.2	0
07MN049 8/7/2019	56.2	8	30.2	3.6	24		74.0	0.1
09MN052 8/7/2019	56.5	9	20.1	3.3	23		89.9	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**23.2**	**11.6**	**20.6**	**17.7**	**33.6**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 427. Phosphorus monitoring data for stream reach.

07020005-661 **07020005-663** P Sample Data 0.15 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-881 **S009-274** (2022)	0.118 – 0.482	-	-	-	0.365 [4]	-	-	-	0.365 [4]
		Maximum Value							
		-	-	-	0.482	-	-	-	

Figure 66. Measured continuous DO percent saturation in stream reaches.



Eutrophication Summary

The eutrophication related invert metrics were mostly poor and eutrophic related tolerance values were very poor (Table 426). Crustacean percentage was high at both sites as the amphipod *Hyalella* dominated the invert communities at both sites. Collector-gatherer taxa numbers were just below the class average and EPT percentages were above or close to the class average. However, this was mostly due to the prevalence of the mayfly *Caenis*, which was the second most numerous invert at both sites. Scrapers were low as there were low numbers of snails at both sites. Total taxa counts were well below the class average and many of the invert taxa present had very few individuals present as both sites were dominated by only a few invert taxa. Tolerance values were very poor, with phosphorus tolerant inverts making up 74 and 89.9% of the total number caught, with little to no phosphorus intolerant inverts. The top three most numerous invert taxa at site 07MN049 and the top five most numerous invert taxa at site 09MN052 are considered either tolerant or very tolerant to high concentrations of phosphorus.

Four samples were collected and analyzed for phosphorus in 2022. The summer average was 0.365 mg/L, well above the standard of 0.15 mg/L (Table 427).

A YSI Sonde water meter measured continuous DO data from 6/23/2022 to 6/26/2022. During this deployment, diel DO flux was measured well above 5 mg/L, with flux values close to 16 mg/L (Figure 66). DO percent saturation was also measured during the sonde deployment, during which saturation values exceeded 200% one of the nights and 150% all three nights (Figure 67).

The biological community appears to be showing the effects eutrophication. Phosphorus sampling showed elevated concentrations, though the number of samples was very limited. Diurnal DO flux and percent saturation were very high. Eutrophication is a stressor in both reaches.

3.9.3.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 428. TSS related invert metrics for stream reaches.

07020005-661 **07020005-663** **Invert Class 7** **Modified Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
07MN049 8/19/2009	9.8	0	3.4	11.8		31.4	0
07MN049 8/7/2019	10.4	0	49.4	15.3		11	1.0
09MN052 8/7/2019	1.8	0	69.0	15.5		9.4	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**9.9**	**0.02**	**27.0**	**16.3**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

TSS Monitoring Data

Table 429. Transparency monitoring data for stream reaches.

07020005-661 **07020005-663** Secchi Tube Data 10 cm target	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S005-881 **S009-274** (2011 - 2022)	17 – 100+	-	0% [8]	0% [14]	0% [10]	0% [12]	0% [5]	-	0% [49]

Suspended Solids Summary

The TSS related invert metrics and tolerance values were mostly poor (Table 428). Collector-filterers at site 07MN049 scored just above the class average due to two caddisflies, *Ceratopsyche* and *Cheumatopsyche*, both collector–filterers. Sprawlers were high at both sites due to the sprawler *Hyalella* being the most numerous invert present in both reaches. Site 09MN052 also had large numbers of the mayfly *Caenis*, which is also a sprawler. The TSS TIV scores were all below the class average as TSS tolerant taxa were few as were the total number of individuals and the percentage of TSS intolerant inverts present was also relatively low.

Between the two reaches there were 49 transparency measurements conducted from 2011 through 2022 (Table 429). There were no measurements below 10cm, with the lowest at 17cm.

TSS are inconclusive as a stressor to aquatic life at this time. There is significant sediment deposition within the stream channel, so it is likely that elevated levels of TSS does occur. It is likely that other factors, such as altered hydrology or habitat are also contributing to the poor scores in the invertebrate biological metrics. It is recommended that more TSS data be collected during high flows and during low late summer flows in order to help determine whether it is stressing the biological community.

3.9.3.8 Nitrates

Nitrate Biological Metric Data

Table 430. Nitrate related invert metrics for stream reaches.

07020005-661 **07020005-663** **Invert Class 7** **Modified Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
07MN049 8/19/2009	0	2.3		48.2	0
07MN049 8/7/2019	12.5	2.7		39.0	0
09MN052 8/7/2019	0	2.7		38.3	0
Statewide average for channelized Invert Class 7 prairie stream glide pool bio sites	**5.9**	**3.3**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 431. Nitrate monitoring data for stream reaches.

07020005-661 **07020005-663** Nitrate/Nitrite Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	August	Sept	Oct
S005-881 **S009-274** (2022)	0.05 – 16.9 [11]	-	-	11.2 [3]	0.3 [8]	-	-	-
		Highest Value						
		-	-	16.9	0.8	-	-	-

Summary

The nitrate related invert metrics and tolerance values were mixed at site 07MN049 (Table 431). There were four different caddisfly taxa present; however, the number of caddisfly individuals were low, comprising only 6.2% of the total number of inverts caught. There were no caddisflies present at site 09MN052. The nitrogen TIV score was below the class average at both sites. The percentages of nitrogen tolerant inverts ranged from 38% to 48%, with no nitrogen intolerant inverts at either site. The most numerous invert present at both sites is the amphipod *Hyalella*, which is not considered tolerant nor intolerant to nitrogen. The majority of the other taxa present at both sites are considered either tolerant or very tolerant to nitrogen.

Eleven samples were measured for nitrate in reaches 07020005-661 and 07020005-663 (Table 431). Samples collected in June were high, with the highest value at 16.9 mg/L, well above the proposed nitrate criteria for protection of aquatic life of 8 mg/L. Only the two measurements taken on June 10th were high and by June 23rd the nitrate concentration was only 4.2. All the measurements in July were below 1 mg/L. It is likely that high nitrates may be stressing the invert community, though both these reaches have very poor habitat and eutrophication issues as well. Due to the mixed biological response and most nitrate measurements below 1 mg/L, nitrates are inconclusive as a stressor to aquatic life in reaches 07020005-661 and 07020005-663.

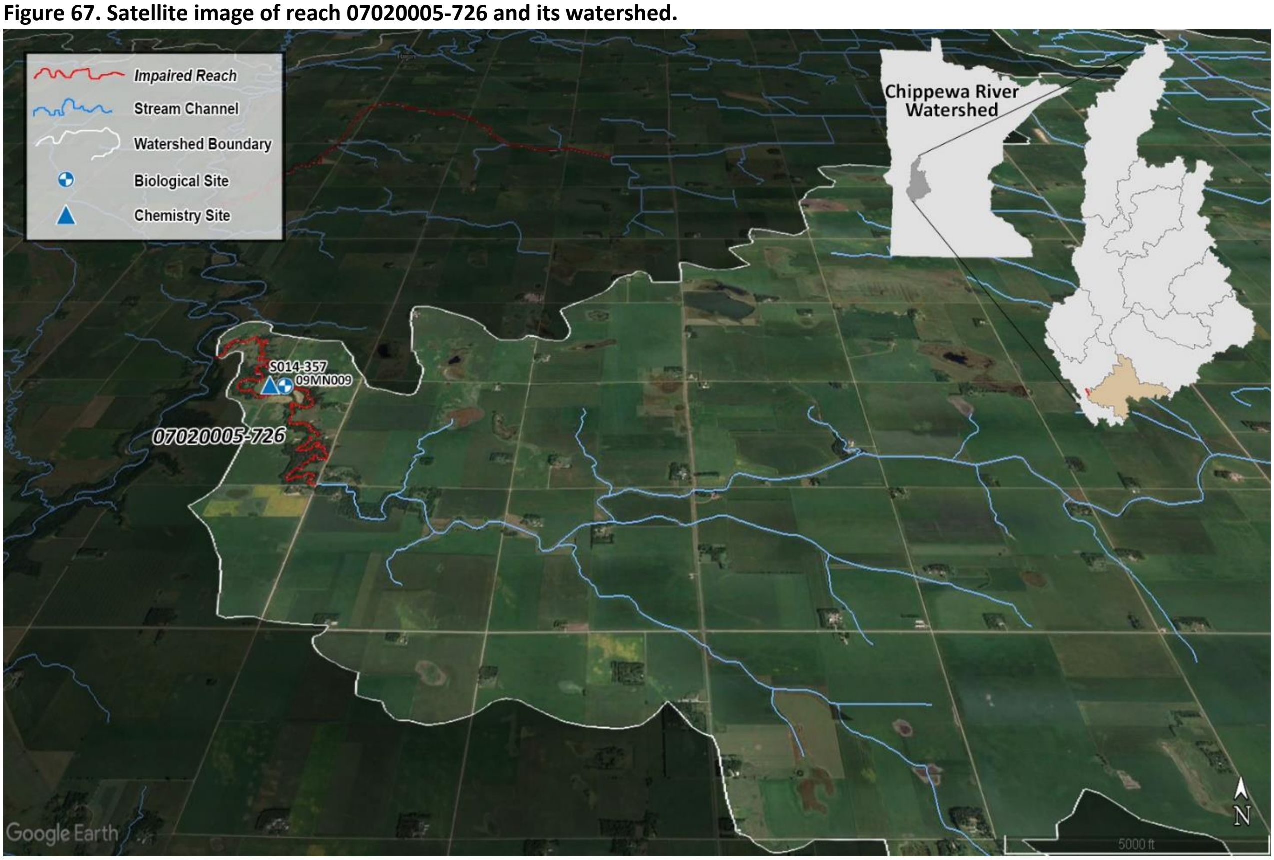
3.9.3.9 Reach Stressors

Table 432. Summary of stressors for stream reaches.

07020005-661 07020005-663	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	✓	✓	✓	O	O

3.9.3 07020005-726 Dry Weather Creek

Figure 67. Satellite image of reach 07020005-726 and its watershed.



3.9.3.1 Biological Community

Bio site 09MN009 was sampled once for inverts in 2009 scoring a 37.5, just above the Class 5 threshold (Table 433). The site was dominated by the snail *Physella*, with the two mayflies *Baetis* and *Caenis* being the second and third most numerous invert taxa present. There were also several midges with decent numbers present. Even though the MIBI score was just above the threshold used at that time, inverts were determined to be impaired after considering all the lines of evidence, which indicates a major change in community structure and a moderate change in ecosystem function, which would also indicate impairment. There was low total and EPT taxa richness for a high gradient stream class and the sample was largely comprised of tolerant taxa.

Biological Metric Data

Table 433. Invert IBI score and threshold for stream reach.

07020005-726 **Invert Class 5** **General Use**	Invert IBI Score	Class Threshold Score
09MN009 8/5/2009	37.6	37

3.9.3.2 Hydrologic Alteration

Hydrologic Alteration Biological Metric Data

Table 434. Hydrologic alteration related invert metrics for stream reach.

07020005-726 **Invert Class 5** **General Use**	Clinger %	Collector – filterer %	Long – lived %		Percent Ditched Tolerant %	Percent Ditched Intolerant %		Low Depth variability Tolerant %	Low Depth variability Intolerant %		Low Flow Tolerant %	Low Flow Intolerant %
09MN009 8/5/2009	21.7	10.4	5.3		46.1	12.9		41.4	21.0		11.6	0.6
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**49.5**	**26.9**	**9.0**		↑	↓		↑	↓		↑	↓
Expected response to **Hydrologic** stress	↓	↓	↓									

Hydrologic Alteration Summary

Hydrologic alteration related invert metrics were mostly poor (Table 434). Clingers were low at 21.7%, though the second most dominant invert present, the mayfly *Baetis*, is a clinger. There were also several other clinger taxa present in lesser numbers as well, including some mayflies, riffle beetles, and caddisflies. Collector-filterers were also relatively low at only 10.4% of the total number of inverts caught. The long-lived percentage of 5.3% was due mostly to eleven *Stenelmis* riffle beetles present. Tolerance values were somewhat mixed with both percent ditched and low depth variability intolerant percentages of 12.9% and 21% with tolerant percentages of 46.1% and 41.4% respectively. The low flow tolerant invert percentage was 11.6% with almost no low flow intolerant inverts present. The most numerous invert present, the snail *Physella*, is considered tolerant to depth variability. The third most numerous invert present, the mayfly *Caenis*, is considered very tolerant to ditching and tolerant to depth variability. The second most numerous invert present, the mayfly *Baetis*, is considered intolerant to both ditching and low depth variability. There were also several invert taxa present in smaller numbers that are considered intolerant to low depth variability. Overall, the reach appears to have some stress from altered hydrology, however, the reach itself is mostly natural with decent habitat features and depth variability. It is likely that hydrologic alteration upstream is affecting the reach, changing the delivery and timing of water delivered to the stream. This has caused the reach to be very flashy during precipitation events, with very low flows during long stretches of low precipitation and drought. Hydrologic alteration is a stressor to the biologic community in reach 07020005-726.

3.9.3.3 Connectivity

Connectivity Metric Data

Table 435. Connectivity related fish metrics for stream reach.

07020005-726 **Fish Class 2** **General Use**	Mature Age >3%	Migrating Individual %
09MN009 6/23/2009	3.8	29.9
Statewide average for natural Class 2 Southern Stream bio sites	**23.9**	**28.0**
Expected response to **Connectivity** stress	↓	↓

Connectivity Summary

Connectivity related fish metrics were mixed as fish whose females take greater than three years to mature were low but migrating fish were just above the class average (Table 435). There were 140 central stonerollers, 20 white suckers, and five blackside darters, all of which are considered migrating fish. With the presence of migrating fish, connectivity is inconclusive as a stressor to the biological community in reach 07020005-726.

3.9.3.4 Habitat

Habitat Metric Data

Table 436. Habitat related invert metrics for stream reach.

07020005-726 **Invert Class 5** **General Use**	Burrower %	Climber %	Clinger %	Ephemeroptera Plecoptera Trichoptera %	Legless %	Sprawler %
09MN009 8/5/2009	7.9	33.3	21.7	33.0	56.6	23.6
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**7.5**	**14.7**	**49.5**	**43.9**	**36.0**	**16.8**
Expected response to **Habitat** stress	↑	↓	↓	↓	↑	↑

Table 437. Habitat related invert tolerance values for stream reach.

07020005-726 **Invert Class 5** **General Use**	MSHA Score Tolerant %	MSHA Score Intolerant %		Percent Embedded Tolerant %	Percent Embedded Intolerant %		Low Substrate Score Tolerant %	Low Substrate Score Intolerant %
09MN009 8/5/2009	43.0	4.1		39.8	4.1		9.4	12.9
Expected response to **Habitat** stress	↑	↓		↑	↓		↑	↓

MPCA Stream Habitat Assessment Score

Table 438. Habitat assessment scores for stream reach.

07020005-726	Land Use	Riparian	Substrate	Cover	Channel Morphology	Total Score
09MN009 6/23/2009	0	14.5	20.8	17	36	88.3
Maximum Attainable Habitat Score	**5**	**15**	**27**	**17**	**36**	**100**

Habitat Summary

The habitat related invert metrics scored mostly poor as the only metric to score well was the percentage of climbers, which was mostly due to the prevalence of the snail *Physella* and the midge *Polypedilum* (Table 436). Burrowers were just above the class average and clingers were low. EPT percentage was 33% as the second and third most numerous inverts present were mayflies with several other mayfly and caddisfly taxa present in lower numbers. The percentage still fell below the class average. Legless inverts and sprawlers were both above the class average. Tolerance values were mostly poor as both the MSHA score and percent embeddedness tolerant percentages were high with a low intolerant percentage (Table 437). The substrate percentages were good as the tolerant percentage was below 10% and the intolerant percentage was 12.9%.

The MSHA score done in 2009 was good with an 88.3 out of 100 (Table 438). The bio site is in an area of low bank erosion and heavy shade around the bio site, causing the riparian zone value to score 14.5 out of 15. Substrate was also decent with a score of 20.8 out of 27 as cobble, gravel, and sand were all present at the bio site and embeddedness of these coarse sediments was light. The reach had a lot of different habitat types that different inverts use including undercut banks, overhanging vegetation, deep pools, woody debris, boulders, root wads, and submerged macrophytes. The riparian zone had good shade and riparian width, though bank erosion was an issue. Several types and sizes of substrates, including cobble, gravel, and sand were observed at the bio sites during both site visits in 2017. There was also good cover observed at the site, including deep pools, undercut banks, logs and woody debris, and boulders. The channel morphology score was good as depth variability, sinuosity, channel stability and channel development scored well. Channel morphology was excellent as it scored 36, the highest possible score. The reach had high depth variability, excellent sinuosity, wide pools, multiple water velocities, and excellent channel development.

Overall, the habitat in the reach near the bio site is very good and diverse for invertebrates. The bio metric values, while mostly poor when compared to the class averages, did not score too badly as several were close to their class average. It is likely that hydrologic alteration upstream, and the flashiness of the river system is influencing the biological metrics. Habitat is inconclusive as a stressor in reach 07020005-726.

3.9.3.5 Dissolved Oxygen

Dissolved Oxygen Biological Metric Data

Table 439. DO related invert metrics for stream reach.

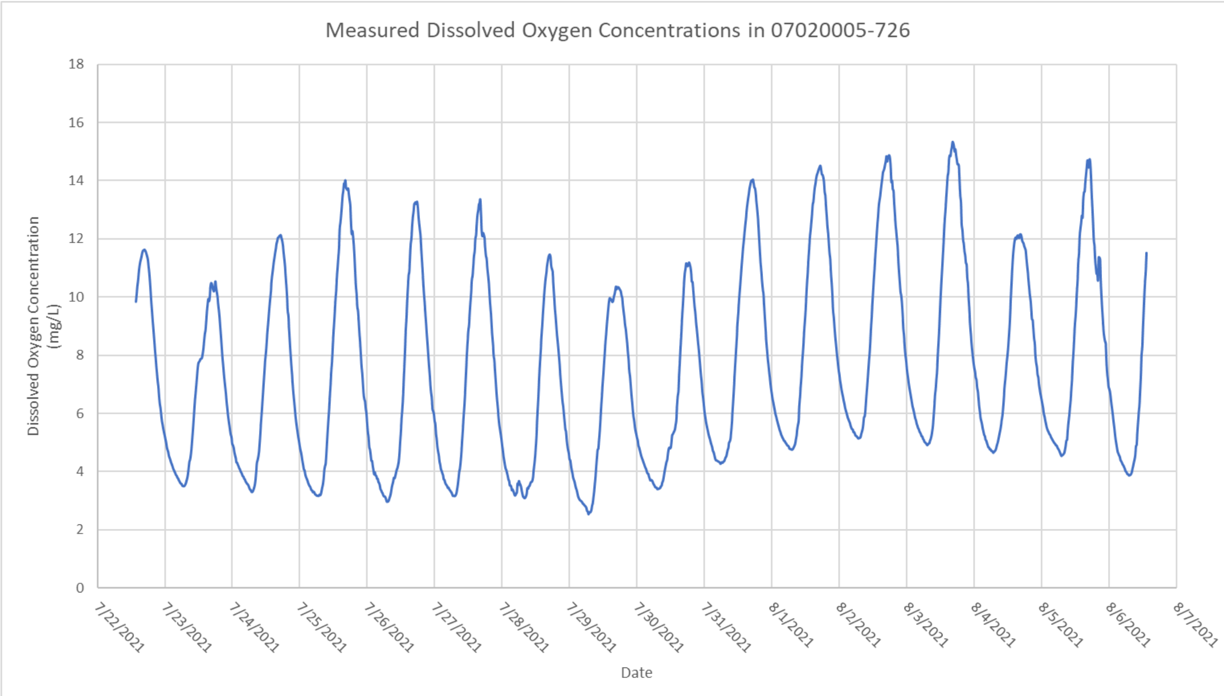
07020005-726 **Invert Class 5** **General Use**	Ephemeroptera Plecoptera Trichoptera %	HBI_MN	Taxa Count #	DO TIV		Low DO Tolerant %	Low DO Intolerant %
09MN009 8/5/2009	33.0	8.2	39	7.0		19.7	20.7
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**43.9**	**7.0**	**41.9**	**7.1**		↑	↓
Expected response to **DO** stress	↓	↑	↓	↓			

Dissolved Oxygen Monitoring Data

Table 440. DO monitoring data for stream reach.

07020005-726 DO Data 5 mg/L target	Range of Data (mg/L)	% of Monthly Samples < 5 mg/L [# of Samples]							May - Sep <5 mg/L % [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-204 (2011-2020)	5.1 – 14.5	0 [9]	0 [30]	0 [25]	0 [21]	0 [26]	0 [12]	0 [2]	0 [25]
		Minimum Value							
		7.2	6.8	5.7	6.3	5.1	6.6	8.3	

Figure 68. Continuous DO data at site 09MN009.



Dissolved Oxygen Summary

DO related invert metrics were mostly poor, though most of the metrics were very close to the class averages (Table 439). EPT invertebrates made up 33% of the total number caught as the second and third most numerous inverts caught were mayflies, including the second most numerous the mayfly *Baetis*. *Baetis* is considered very intolerant to low DO, causing the low DO intolerant percentage to be just higher than the tolerant percentage. The HBI_MN value was above the class average, total taxa count was just below, and the TIV score was right at the class average.

Although no DO measurements taken during sampling were below the warmwater standard of 5 mg/L, none of those measurements were taken before 8:00 a.m., when values are usually the lowest (Table 440). A YSI Sonde water meter measured continuous DO data from 7/22/2021 to 6/6/2021 (Figure 69). During this deployment, DO values were measured below 5mg/L every night of the deployment, with some values close to 2 mg/L.

Based on the related fish and invertebrate biological metric scores and the measured sonde values, DO is a stressor in this reach. It appears that this reach is eutrophic, especially during low flows, which appears to happen often due to the flashiness of the stream.

3.9.3.6 Eutrophication

Eutrophication Biological Metric Data

Table 441. Eutrophication related invert metrics for stream reach.

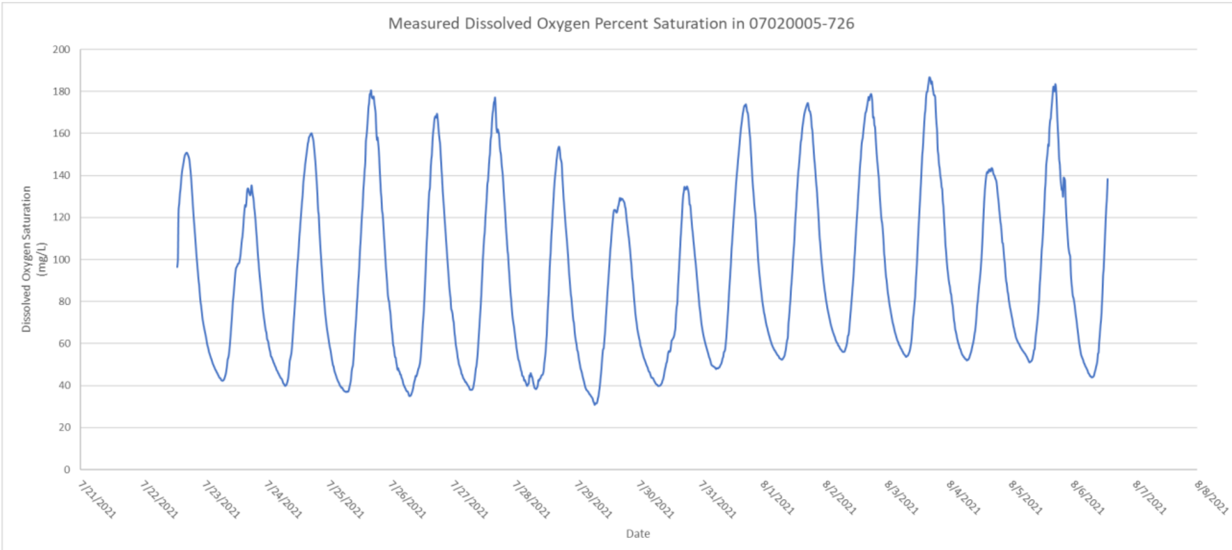
07020005-726 **Invert Class 5** **General Use**	Crustacean and Mollusca %	Collector – Gatherer Taxa #	Ephemeroptera Plecoptera Trichoptera %	Scraper %	Taxa Count All #		Phosphorus Tolerant %	Phosphorus Intolerant %
09MN009 8/5/2009	23.9	11	33.0	25.2	39		39.8	1.3
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**9.3**	**15.0**	**43.9**	**15.8**	**41.9**		↑	↓
Expected response to **Eutrophic** stress	↑	↓	↓	↑	↓			

Eutrophication Monitoring Data

Table 442. Phosphorus monitoring data for stream reach.

07020005-726 P Sample Data 0.150 mg/L target	Range of Data (mg/L)	Monthly Average of Samples (mg/L) [# of Samples]							June-Aug Average (mg/L) [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-204 (2011-2020)	0.012 – 1.05	0.140 [9]	0.193 [23]	0.176 [16]	0.156 [17]	0.212 [20]	0.102 [11]	0.047 [3]	0.183 [53]
		Maximum Value							
		0.541	1.05	0.644	0.413	0.700	0.256	0.057	

Figure 69. Measured continuous DO percent saturation in stream reach.



Eutrophication Summary

Eutrophication related invert metrics were poor (Table 443). Crustacean and Mollusca percentage was well above the class average as the most numerous invert present was the *Physella* snail. There were good numbers of mayflies present however there were few caddisflies, and no stoneflies present, which caused the overall percentage to fall below the class average. Scrapers were above the class average as *Physella* snails are considered a scraper. Taxa count was just below the class average and the percentage of phosphorus tolerant inverts was 39.8% with only 1.3% phosphorus intolerant inverts present.

Ninety-nine samples were collected and analyzed for TP in reach 07020005-726 (Table 442). Monthly averages were above the standard of 0.150 mg/L in the months May through August and the summer average was 0.183 mg/L. Overall the phosphorus concentrations were very high, with one value over 1 mg/L.

A YSI Sonde water meter measured continuous DO data from 7/22/2021 to 8/6/2021 (Figure 69). During this deployment, diel DO flux was measured above 5 mg/L every evening of the deployment with a high value of 11 mg/L. DO saturation was also measured during the deployment (Figure 69). Saturation values were very high during the day, close to 180% several days and dropping into the 30 and low 40 percentages at night.

The biological community is showing the effects of the elevated phosphorus, phosphorus sampling showed elevated concentrations, DO flux was greater than 5 mg/L and the DO saturation was very high. Eutrophication is a stressor in this reach.

3.9.3.7 Suspended Solids

Suspended Solids Biological Metric Data

Table 443. TSS related invert metrics for stream reach.

07020005-726 **Invert Class 5** **General Use**	Collector – filterer %	Plecoptera %	Sprawler %	TSS TIV		TSS Tolerant %	TSS Intolerant %
09MN009 8/5/2009	10.4	0	23.6	16.9		41.4	0
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**26.9**	**0.5**	**16.8**	**15.9**		↑	↓
Expected response to **TSS** stress	↓	↓	↑	↑			

TSS Monitoring Data

Table 444. TSS monitoring data for stream reach.

07020005-726 TSS Sample Data	Range of Data (mg/L)	% of Monthly Samples > 65 mg/L [# of Samples]							% of Total Samples > 65 mg/L [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-204 (2011-2020)	2 - 105	11.1 [9]	34.8 [23]	18.8 [16]	12.5 [16]	20 [20]	0 [12]	0 [3]	19.0 [105]

Table 445. Transparency monitoring data for stream reach.

07020005-726 Secchi Tube Data 10 cm target	Range of Data (mg/L)	% of Monthly Samples < 10 cm [# of Samples]							% of Total Samples < 10 cm [# of Samples]
		April	May	June	July	August	Sept	Oct	
S002-204 (2011-2020)	7 – 100+	0 [9]	16.7 [30]	10.3 [29]	4.3 [23]	11.1 [27]	0 [13]	0 [3]	8.7 [138]

Suspended Solids Summary

The TSS related invert metrics all scored poorly (Table 443). Collector-filterers were low and there were no Plecoptera present. Sprawlers were above the class average; both the mayfly *Caenis* and some sprawler midges were present. *Caenis* was the third most numerous invert present at the bio site. The TSS TIV score was just above the class average and the percentage of TSS tolerant inverts was 41.4% with no TSS intolerant inverts present. The most numerous invert present, the snail *Physella*, is considered very tolerant to TSS and the fourth most numerous invert present, the midge *Polypedilum*, is tolerant to TSS.

One hundred-five samples were collected and analyzed for TSS from 2011 through 2020 (Table 444). Broken down by month, the percentage of samples above 65 mg/L was above 10% in the five months from April to August, with 19% out of the total number of samples taken above 65 mg/L. Transparency measurements, while not quite as poor, were still low in the months of May, June, and August.

Due to the poor biological metrics as well as the TSS and transparency data, TSS appears to be a stressor to the biological community in reach 07020005-726.

3.9.3.8 Nitrates

Nitrate Biological Metric Data

Table 446. Nitrate related invert metrics for stream reach.

07020005-726 **Invert Class 5** **General Use**	Trichoptera Taxa %	Nitrogen TIV		Nitrogen Tolerant %	Nitrate Intolerant %
09MN009 8/5/2009	15.4	3.8		71.2	0
Statewide average for natural Class 5 prairie stream rock riffle bio sites	**13.6**	**3.0**		↑	↓
Expected response to **nitrogen** stress	↓	↑			

Nitrate Monitoring Data

Table 447. Nitrate monitoring data for stream reach.

07020005-726 Nitrate/Nitrite Sample Data	Range of Data (mg/L) [# of Samples]	Monthly Average [# of Samples]						
		April	May	June	July	Aug	Sept	Oct
S004-387 (2011-2022)	0.6 – 15.3 [96]	4.9 [9]	9.1 [20]	10.2 [14]	5.2 [16]	2.7 [18]	6.4 [10]	6.9 [3]
		Highest Value						
		9.1	15.3	12.8	14.2	10.6	12.8	10.7

Summary

Nitrogen related invert metrics were mostly poor (Table 446). Trichoptera taxa percentage was above the class average, however, the actual numbers of caddisflies were low, making up only 7.2% of the total number of inverts present. The nitrogen TIV score was above the class average and 71.2% of all the inverts caught are considered either tolerant or very tolerant to nitrogen with no nitrogen intolerant inverts present at all. Six out of the top seven invert taxa caught are considered either tolerant or very tolerant to nitrogen.

Ninety-six samples were analyzed for nitrate in reach 07020005-726 (Table 447). There were high values every month from April through October, with high monthly averages in May and June that were above the proposed nitrate criteria for protection of aquatic life of 8 mg/L. Due to the biological response and relatively high nitrate concentrations, nitrates are a stressor to aquatic life in reach 07020005-726.

3.9.3.9 Reach Stressors

Table 448. Summary of stressors for stream reach.

07020005-726	Hydrologic Alteration	Connectivity	Habitat	Dissolved Oxygen	Eutrophication	Suspended Solids	Nitrate
✓ = Stressor O = Inconclusive	✓	O	O	✓	✓	✓	✓

4 References

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