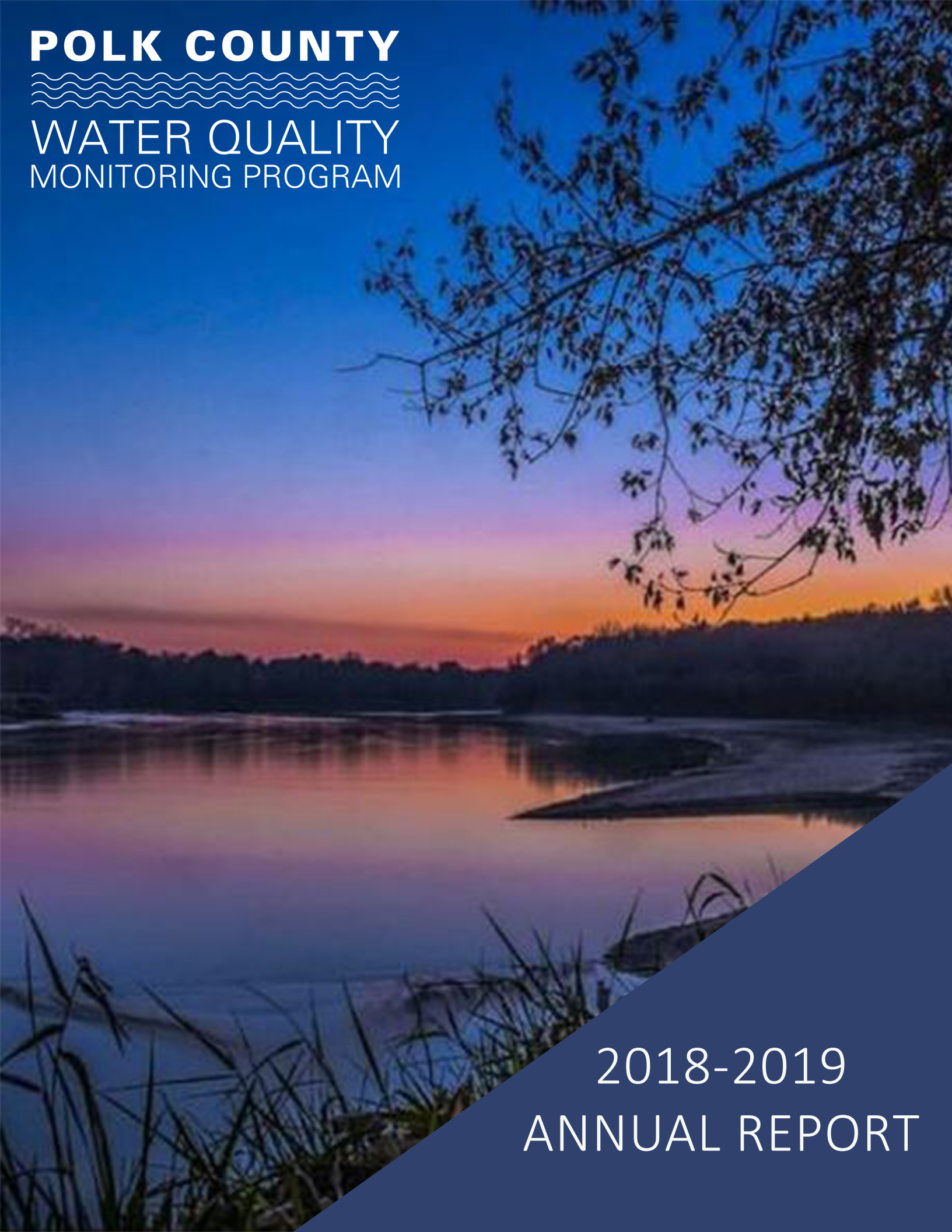

POLK COUNTY
WATER QUALITY MONITORING PROGRAM

2018-2019 ANNUAL REPORT

Polk County Conservation
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Project Summary

In November 2012, voters supported the Polk County Water and Land Legacy Bond (PCWLL) in historic fashion, passing the measure with 72% support. This large margin of victory clearly shows that there is strong support for critical water quality, wildlife, trails, and recreation projects. In part, this bond has allowed Polk County Conservation (PCC) to start a water monitoring program to help assess watershed quality in Polk County, Iowa. The Polk County Conservation Water Quality Monitoring Program (PCCWQMP) began in the spring of 2015. The goal of this monitoring is to design and implement a series of biweekly monitoring events that will assess the water quality of watersheds within Polk County. Specific objectives of these events include establishing a baseline for determining stream health based on chemical, physical, habitat and biological parameters, assessing the health of the local watersheds, targeting areas in need of water quality improvement, creating partnerships in order to grow our water monitoring program and to gain a better understanding of the needs of our watershed system within Polk County. To achieve these objectives PCCWQMP, working with IOWATER (Iowa's statewide citizen monitoring program 1999-2016) and the Iowa Department of Natural Resources (Iowa DNR), selected sites designed to complement existing IOWATER sites. In fall 2016, PCCWQMP staff completed the first full year of assessments on 32 sites at creeks, streams and drainage ditches throughout Polk County. Since then, our program collaborated with surrounding municipalities, trained additional staff, city employees and public volunteers to allow our program to grow to 70 sites. City partnerships include Cities of Altoona, Ankeny, Des Moines, Des Moines Parks and Recreation, Johnston and West Des Moines.

Establishing a program to assess the health of the watersheds and create a better understanding of the needs of our watershed system within Polk County is not without challenges. The Iowa Nutrient Reduction Strategy (INRS) was developed with the goal of reducing nutrient loads, which end up in the Mississippi River and ultimately in the Gulf of Mexico, by 45%. The strategy specifically looks at phosphate and nitrogen levels, nutrients that lead to algae growth. These are the leading cause of hypoxia, low dissolved oxygen which cannot support aquatic life, in the Gulf of Mexico. Several challenges identified in the INRS report are consistent with challenges the PCCWQMP faces. Such challenges include:

1. How much data is necessary to accurately establish a baseline for determining the stream health and assess the health of the watersheds? The Nutrient Water-Quality Monitoring Framework suggests that 10-20 years of regular monitoring in small stream sites, consistently is critical. Operating a monitoring program long term comes with several challenges. However long-term monitoring is necessary to develop a baseline trend as weather and streamflow vary from year to year.
2. What parameters determine if target areas are in need of water quality improvement? Where do the nutrients come from or how to identify the origin of nutrients? What are the relative contributions of nutrients from recent human activity versus nutrients already present in soil and sediment (legacy nutrients)?
3. Which management practices are most effective? How long before the management practices implemented have an impact on water quality?

Despite these challenges, Polk County Conservation continues to monitor streams throughout Polk County. This report summarizes chemical and physical data collected by PCCWQMP staff, partners and volunteers for stream sites from mid-September 2018 through mid-September 2019.

PCCWQMP field monitors, following IOWATER procedures, complete chemical and physical assessments at their sites twice a month, year round, as weather and site condition safety allow. Field monitors complete assessments on the first and third weeks of each month.

Of the 70 sites, 63 were monitored for the entire reporting period, three were monitored for part of the year and four sites were not monitored. A total of 1426 site visits were completed for the 70 sites, a 17% increase over 2017-18. The ability to obtain data was affected by drought, flooding and inaccessible sites. Late summer high temperatures and lack of rain resulted in dry creek beds at five sites in summer 2019 resulting in no assessments seven times. Flooding reduced ability to access stream sites mid-March through May 2019. Ice and icy conditions also affected 124 assessments in 2018-19. Site data is available on the EPA Water Quality Exchange (WQX) website (https://www.epa.gov/waterdata/water-quality-data-wqx) and summarized annually.

The chemical/physical assessment includes recording air temperature, water temperature, nitrite, nitrate, pH, chloride, dissolved oxygen, phosphate, transparency, water color, water odor, stream width and depth. Water odor was recorded 98% of the time as "none." The presence of water odor may be indicative of problems with water quality. Nineteen assessments reported fishy (11), sewage (9), musky or organic smell (4) and sulfur (2) odors. Water color often indicates the presence of sediment or algae in water. As sediment or algae accumulate in water, transparency drops. This is measured with a transparency tube. "Clear" water color correlates with a high transparency reading, generally between 51 and 60 centimeters. More than half of the transparency results were 51 centimeters or greater. Higher transparency results tends to occur during late fall months when cooler temperatures and lower rainfall are typical, leading to less runoff. Unusually wet weather in 2018 and 2019 resulted in greater runoff which affected transparency throughout the year. Rainfall totals for 2018 were nearly 10 inches higher than normal. This heavy rainfall, combined with substantial snowpack and saturated soils, resulted in flooding in February and March 2019. In June 2019 it was reported that the last 12 months had been the wettest on record for Iowa, followed by three months of below normal rainfall which resulted in abnormally dry or moderate drought conditions. Transparencies of less than 10 cm were reported most frequently in August 2019. The yearly average transparency for all sites (46 cm) was lowest mid-June through mid-September 2019. Lowest transparency coincided with increased algal growth in warm summer waters and displaced sediments. This sediment, a result of agriculture or development erosion and exposed stream banks, was captured in high stream flows caused by rain events.

Water temperature increases more rapidly in streams with little vegetation cover, shallow depths, and heavy sediment loads. Increasing water temperatures during the summer causes a drop in dissolved oxygen concentrations. Dissolved oxygen (DO) concentrations of less than 5 milligrams per liter (mg/L), low enough to negatively affect aquatic life, occurred on 4% of assessments. As expected, these occurred most frequently in when stream flow was lowest and water temperatures were highest. Sites on drainage ditches 4 and 38 reported low DO concentrations more frequently throughout the year.

Site yearly averages for chloride concentrations were less than 100 mg/L for all but 8 sites monitored. High concentrations of chloride (greater than 100 mg/L) often corresponded to winter and spring runoff containing road salt, however high chloride levels also occurred in every month of the 2018-2019 monitoring period at various sites. Chloride readings over 100 (102 to over 756 mg/L) were found on 27 of the sites throughout the year. Greenwood, Golf, Jordan, Saylor, Walnut, and Yeader Creeks had the highest occurrence of chloride concentrations over 100 mg/L. Jordan, Golf, Greenwood and Laurel Hill Creeks reported a yearly average chloride concentration over 100 mg/L, which may indicate additional sources of chloride salts..

Phosphate concentrations throughout the year were below the threshold of 0.6 mg/L 88% of the time. Little Beaver Creek site 977121, Camp Creek site 977152, Greenwood Pond creek site 977333 and Yeader Creek sites 977003 and 977273 reported yearly average concentrations greater than 0.6 mg/L. Potential sources of this could include fertilizers, wastewater, or sediment load.

Most nitrite (94% of the samples) and nitrate concentrations (99% of the samples)were within the normal ranges. Nitrite in water is rare as it quickly converts to nitrate; therefore, it is not surprising that concentrations were typically zero. A result of less than 0.3 mg/L is considered normal. Nitrate is more commonly found in Iowa waterways than nitrite. Nitrate concentrations equal to or greater than 20 mg/L, the IOWATER suggested threshold, can result in health issues if water is consumed. The drinking water standard set by the EPA is even lower at 10 mg/L. Less than half of the sites (24 of 70) reported nitrate concentrations of 10 mg/L or greater at least once during the reporting period. However, no sites reported yearly average nitrate concentration greater than the drinking water standard. Of the PCCWQMP sites, concentrations of 20 mg/L were reported during September 2018, June and July 2019 on 7, or 0.6% of the assessments.

In general, streams in Polk County, while at times do not meeting drinking water standards, are safe for recreational purposes. Nitrate levels in rural streams are often well over historic concentrations, which were less than 3 mg/L and continue to exceed drinking standards. High chloride concentrations may indicate the presence of human or animal waste and warrant further testing to determine if there is bacteria present which would lead to a health concern.

Parameters Monitored

Polk County Conservation Water Quality field monitors completed 1426 site assessments for 69 of the 70 water quality monitoring sites. Of the 70 sites, 64 were monitored for the entire reporting period. Two sites, added in May 2019, were monitored as they were assigned on the same schedule. One site has an assigned monitor but no assessments were submitted. Three sites no longer have monitors and were not monitored. These sites remain unmonitored until new volunteer field monitor is available.

Sites were sampled twice a month. Each chemical and physical sampling assessment included: weather, water clarity, color, odor, water and air temperature, precipitation over last 24 hours, stream width and maximum depth, transparency, pH, nitrate, nitrite, dissolved oxygen, chloride and phosphate.

In addition to the chemical/physical assessments, habitat and biological assessments were completed in July or August for each actively monitored site. Habitat assessments document changes in the

streamside landscape over time. Biological assessments involve collecting and identifying benthic macroinvertebrates, aquatic insects and other small invertebrates which can be indicative of the health of the stream.

Physical Parameters

Water Odor

Water odor can indicate potential problems in a stream. Field monitors record one or more of the following: none, chemical, fishy, petroleum, sewage or other. Sewage and manure odors in the air are not uncommon in Iowa, but it is uncommon for Iowa waterways to have an odor. A rotten egg smell indicates the presence of hydrogen sulfide gas. Hydrogen sulfide is a by–product of anaerobic decomposition, a natural process of plant decay and typical in areas with large amounts of organic matter and low dissolved oxygen. In some cases, this smell can indicate sewage leaks as well. Petroleum or chemical smells can indicate industry or storm sewer runoff and may signal a serious pollution problem. Musky odors are generally described as a natural and slight organic odor and may be a product of organic waste or sewage contamination. No odor was reported on 98% of the completed assessments. Sewage odor, when reported, was attributed to natural decay processes in most cases.

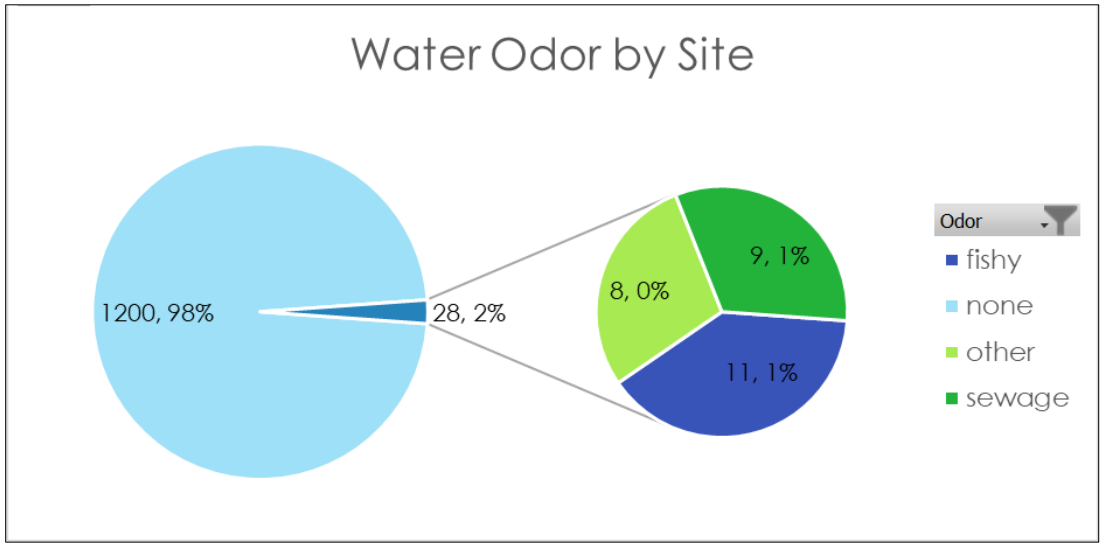

Figure 1. Water Odor Results for All Sites from Mid-September 2018 through Mid-September 2019

Water Color

Similar to water odor, the color of water can indicate potential water quality problems. Field monitors were asked to select one or more of the following water color descriptors: clear, brown, green, oily sheen, reddish, blackish, milky, and/or gray. Clear water does not guarantee clean water but indicates a low level of dissolved and suspended particulates. Brown water is usually due to presence of sediment. Green water usually indicates the presence of algae. An oily sheen may be present as a by-product of decomposition or may be due to chemical pollution. Rust or orange substances, often accompanied with an oil-like sheen, are due to natural occurring bacteria. Reddish or orange colored water indicates the presence of iron oxides. Blackish water occurs with leaf decomposition. These leaf pigments may then also cause the water to become murky. Milky water is caused by salts in the water. Gray water can be caused by both natural and human-made activities.

Polk County Conservation monitoring site samples reported water color as "clear" 42% of the time. It is common for the water clarity to drop after precipitation events as runoff picks up soil from exposed soil along banks and surrounding area. Nearly 20% of results were reported as "brown" or "clear and brown." Less than 1% of assessments reported water color as "green." Occurrences of oily, reddish, or blackish water were rare and primarily attributed to decaying vegetative material. Less than 1% of assessments reported milky or gray water (Fig. 2).

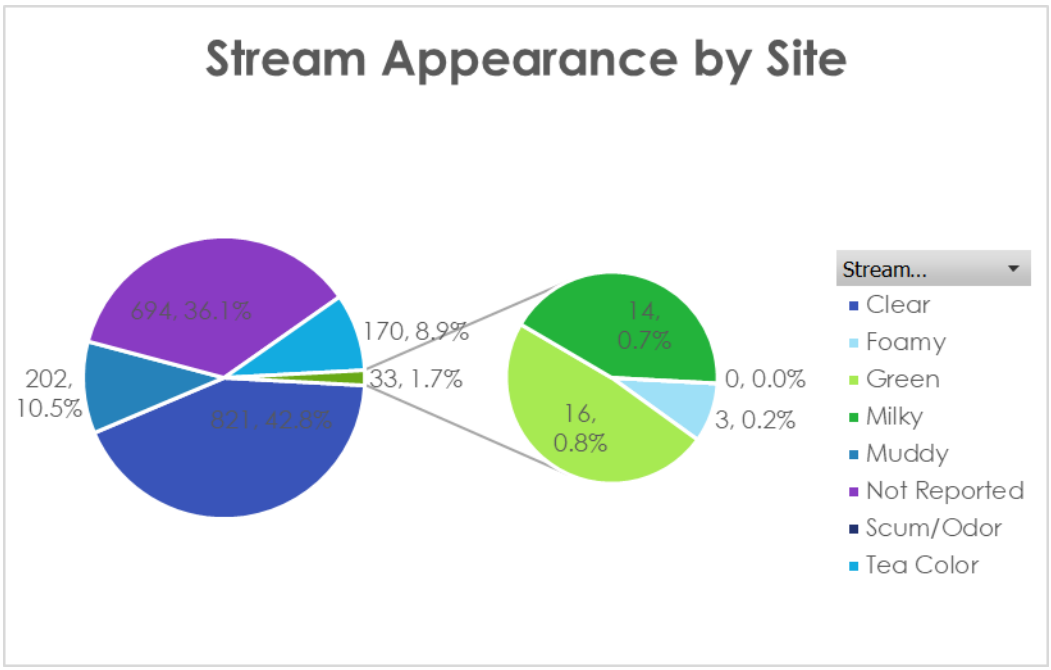

Figure 2. Water Color Results for All Sites during Mid-September 2018 – Mid-September 2019

Transparency

Transparency is a measure of water clarity. The more suspended material such as soil, algae and microbes present in the water, the less transparent the water. Transparency is measured with a transparency tube with a scale that ranges from 0 to 60 centimeters. The higher the transparency, the clearer the water. Transparencies of 30 centimeters or greater were reported 83% of the time and 66% of the time transparency readings were greater than 50 centimeters. Lowest transparency readings occurred May 2018 through September 2019 with long periods of sunlight, high water temperatures and drought affecting creek levels and promoting algal growth. Winter and early spring assessment period median results were consistently 60 and 60+, maximum clarity. The assessment period average transparency dropped to 46 centimeters in late spring through early fall due to the combination of soil runoff and increased algal growth. The yearly average minimum for all sites was 19 cm.

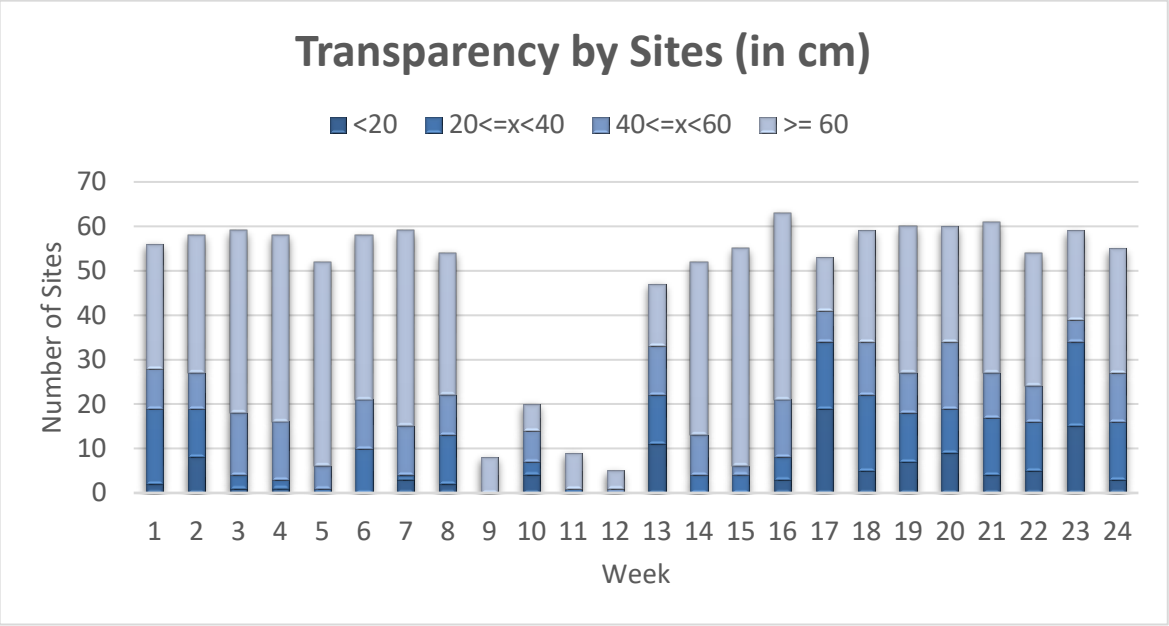

Figure 3. Transparency Readings for All Sites mid-September 2018 – mid-September 2019

Water Temperature

Water temperature directly affects many properties of a stream. Temperatures fluctuate seasonally, daily and hourly. High temperatures reduce the amount of dissolved oxygen water is able to hold. Temperature affects photosynthesis by algae and aquatic plants as well as metabolic rates of aquatic animals and organisms. Groundwater flow, weather, riparian vegetation and other factors affect stream water temperatures. The median water temperature ranged from 34 to 76 degrees Fahrenheit (Fig. 4).

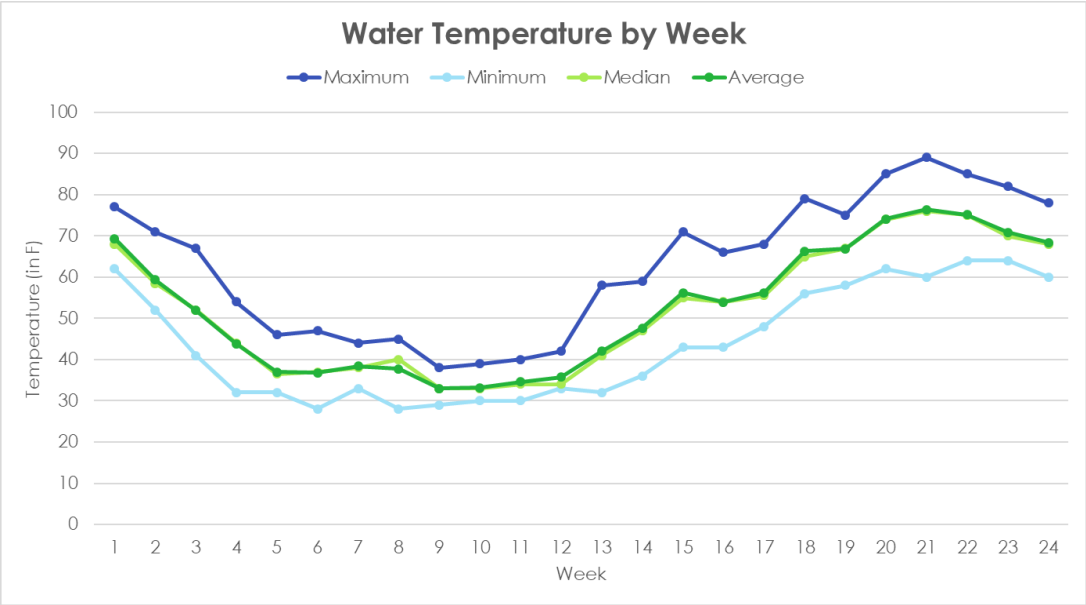

Figure 4. Water Temperatures for All Sites during Mid-September 2018 – Mid-September 2019

Weather Conditions

Rain and snow events affect water color and clarity as sediment travels into the waterway. Weather conditions including rainfall within the last 24 hours were recorded during each assessment. Typically, water clarity drops after rain events, chlorides rise with snowmelt and clarity improves when winter temperatures arrive.

The 2018-2019 water year started with an above normal rainfall and temperature for the previous year. In January, the Iowa DNR EcoWire reported that 2018 was deemed second only to 1993 in precipitation. The trend continued with heavy snow pack and rainfall, combined with saturated soils, bringing widespread flooding to Iowa in March. The March edition of Iowa DNR EcoWire reported “As a result, this is the first spring in the last three years that has started with no drought in Iowa," said Tim Hall, DNR’s coordinator of hydrology resources. “Everyone was ready for spring, but unfortunately the rain and warm weather and snow melt have combined to bring us the flooding that nobody wanted."

May was the sixth wettest on record for Iowa (June 13 edition of Iowa DNR EcoWire). June, although typically is the wettest month of the year, precipitation was an inch below normal. Despite less than

normal rainfall, rainfall combined for May and June were above normal which allowed groundwater levels to remain shallow across the state. These wet conditions allowed continued recharge to the groundwater system. Due to lower than normal precipitation in June and July, streamflow dropped back to normal levels and groundwater remained unaffected by dryness. (July 11 Iowa DNR Water Summary Update)

By September 2019, half of Polk County was abnormally dry but streamflow and groundwater conditions were considered within normal range.

The *Iowa DNR News 2019 Water Ye*ar Update of November 21, 2019 reported above normal rainfall (7.31 inches above normal) with "the past 18 months the wettest on record for the state." The 2018-2019 Water Year was the 45th warmest, 1.8 degrees below normal.

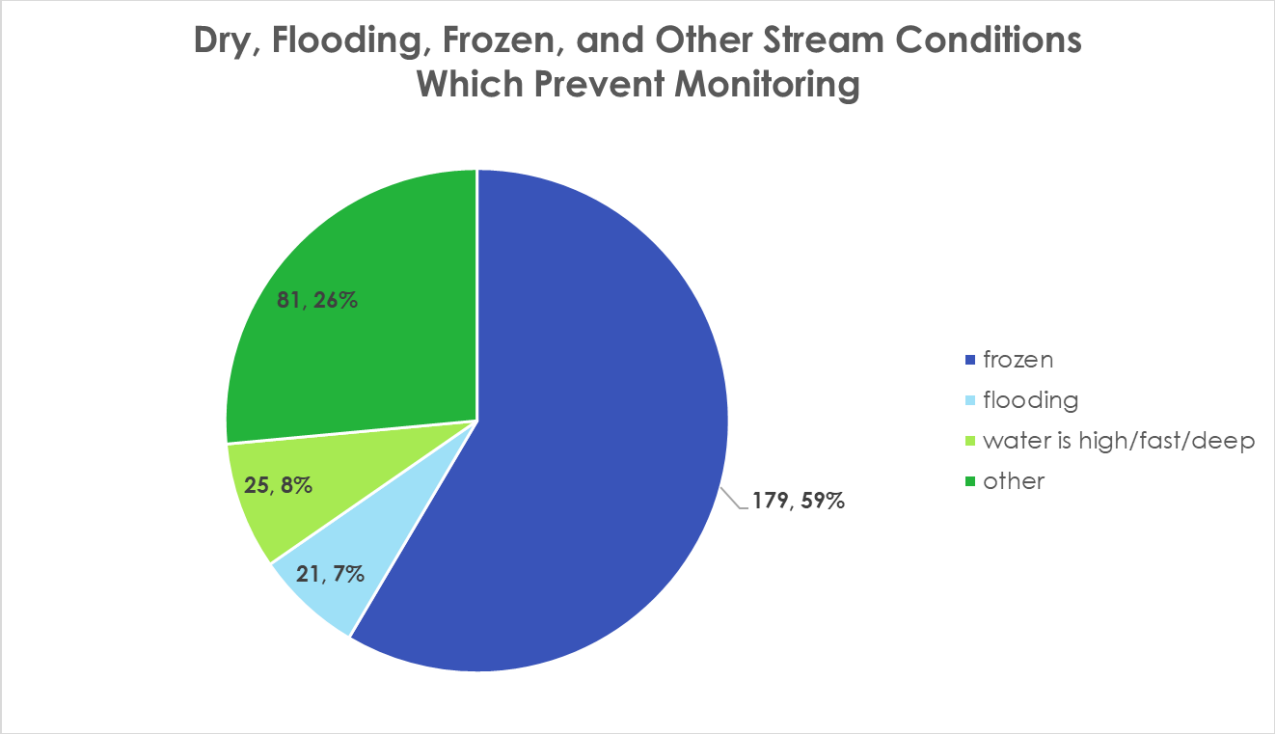

Figure 5. Conditions which Prevent Monitoring Mid-September 2018 –Mid-September 2019

Chemical Parameters

Chloride

Chloride is a salt and can be from many different sources including: fertilizers, human or animal waste, and municipal wastewater discharge. . Elevated levels in winter often are due to road salt runoff. Recent studies indicate that high levels could also be due to residual chloride in groundwater levels. Typical concentrations of chloride in Iowa streams range from 20 to 30 milligrams per liter (mg/L). Prolonged exposure to levels greater than 100 mg/L (ppm) results in detrimental effects on aquatic life. The Minnesota Stormwater Manual states that the "chronic standard for chloride to protect for 2B uses is 230 mg/L. The chronic standard is defined in Minn. R. 7050.0218, subp. 3.l., as "the highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity." The 230 mg/L value is based on a 4-day exposure of aquatic organisms to chloride. The maximum standard to protect for 2B uses is 860 mg/L. The maximum standard is defined in Minn. R. 7050.0218, subp. 3.T., as "the highest concentration of a toxicant in water to which organisms can be exposed for a brief time with zero to slight mortality." The 860 mg/L value is based on a 24-hour exposure of aquatic organisms to chloride." These criteria were adopted from the EPA Aquatic Life Ambient Water Quality Criteria for Chloride (published 1988).

Yearly average chloride readings ranged from 25 to 158 mg/L. Yearly average chloride readings over 100 mg/L were reported for 12% of the sites. Concentrations over 100 mg/L occurred during each monitoring week. Concentrations over 200 mg/L occurred most frequently during the winter months due to road salt runoff but were also reported in mid-July 2019 (Fig. 6).

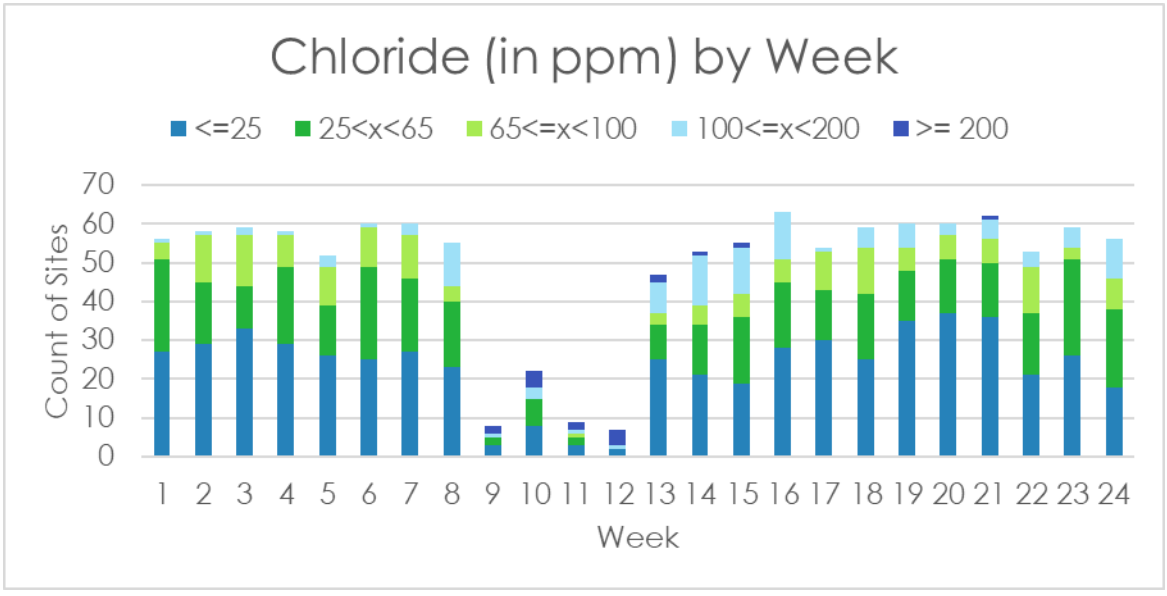

Figure 6. Frequency of Chloride Concentrations over 100 mg/L Mid-September 2018 - Mid-September 2019

In 2018-19, 133 assessments at 27 sites reported results over 100 mg/L. Des Moines Greenwood (1 sites), Des Moines Laurel Hill (1 site), Jordan (4 sites), Golf (1 site) and North Walnut (1 site) Creeks reported yearly average results over 100 mg/L of chloride. Two sites on Jordan and Greenwood Creeks experienced chloride concentrations over 600 mg/L. These above normal readings occurred in late

February and early March. In mid-May through mid-September, (weeks 17-24) forty assessments reported chloride concentrations over 100 mg/L at times when road salt runoff would not be found. (Fig. 7). PCCWQMP staff are working with various organizations to determine a reason for these abnormally high readings.

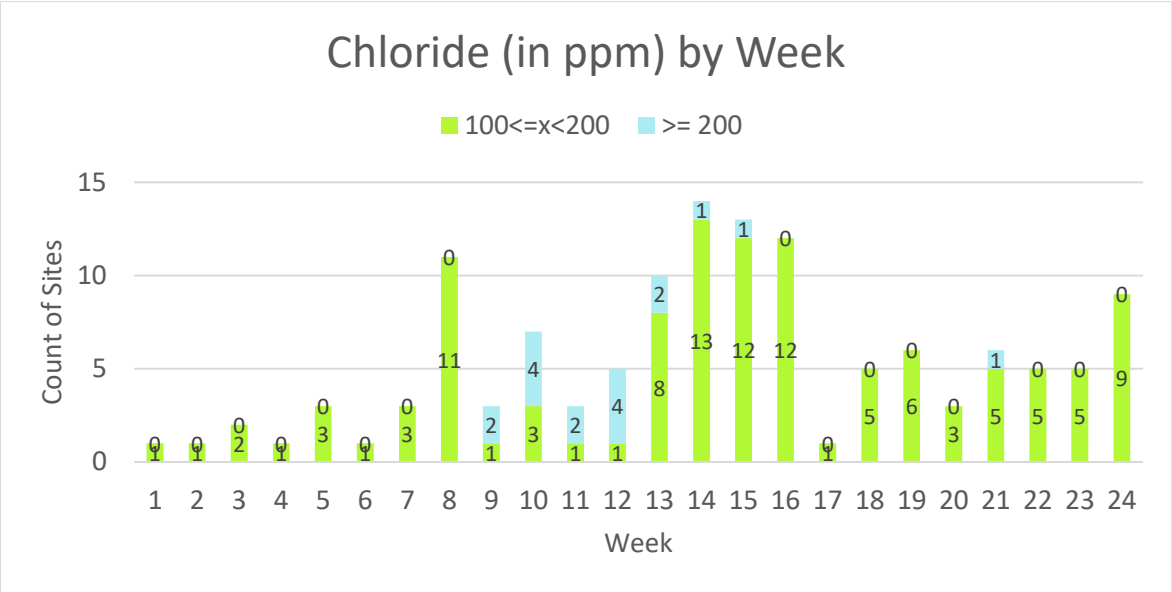

Figure 7. Sites with Yearly Average Chloride Concentrations over 100 mg/L Mid-September 2018 – Mid-September 2019

Dissolved Oxygen

The amount of dissolved oxygen in water fluctuates with water temperature, stream flow and rate of photosynthesis of aquatic plants. Transparency, time of day, time of year and human activities influence these factors. Iowa's water quality standard to support aquatic life is a minimum of 5 mg/L of dissolved oxygen for warm water streams. Dissolved oxygen concentrations are best during the winter months, typically highest December through April (Fig. 8).

Yearly average results ranged from 4-11 mg/L. One site, Drainage Ditch 38 (site number 977311) had yearly average 4.47 mg/L, lower than the minimum water quality standard, which adversely affects aquatic life.

Sites reporting dissolved oxygen concentrations at or below 5 mg/L occurred 101 times throughout the year. Bluff, Crawford, Case Lake Inflow, Drainage Ditches 4 and 38, Easter Lake Outlet, Fourmile, Greenwood (3 sites), Little Beaver, Little Fourmile, Magnolia, Santiago, Saylor and Yeader Creeks also reported periodic low dissolved oxygen readings (2, 3 or 4 mg/L) throughout the 2018-19 monitoring year.

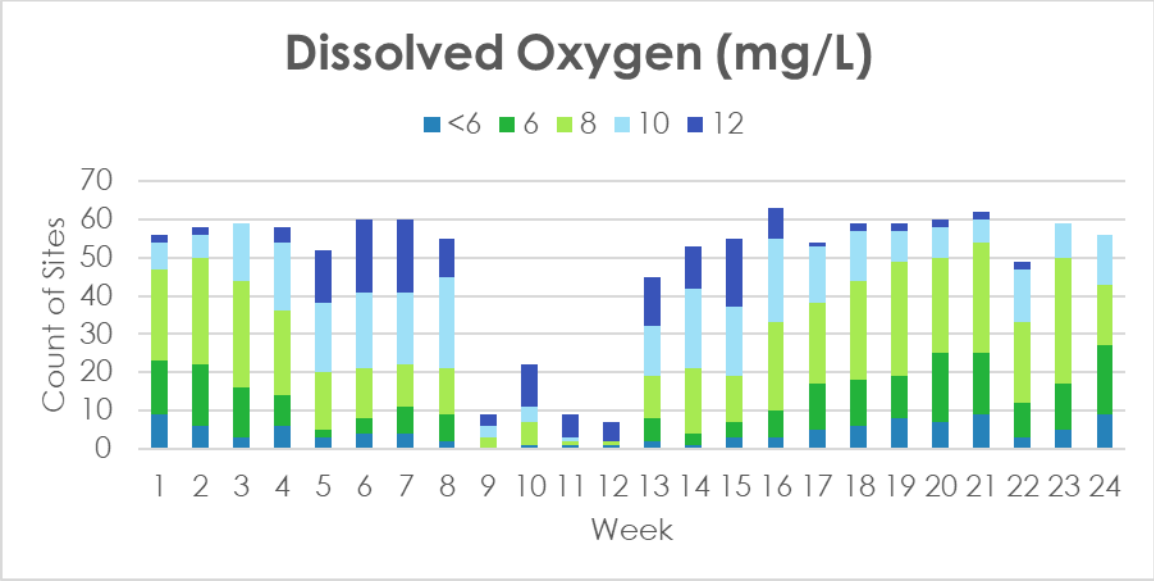

Figure 8. Sites with Yearly Average Dissolved Oxygen Concentrations over 100 mg/L Mid-September 2018 – Mid-September 2019

pH

The pH of water is a measure of its acidity and is quantified on a logarithmic scale of zero to 14. A neutral pH reading is seven. Readings less than seven are acidic and readings higher than seven are basic. Readings below six can have a harmful impact on the health of the aquatic system. The pH level is affected by the types of soils and bedrock in the watershed and acidity of precipitation. Acidic water can allow substances such as ammonia and heavy metals to leach from soils. Basic water can also have a negative effect on aquatic organisms. Iowa rivers average 8.2 due to alkaline soils and limestone bedrock in many areas. The majority of PCCWQMP sites consistently had pH readings of 7, 8 or 9 (Fig. 12). A reading of 6 or less was recorded only 6% of the time. It is not uncommon to have low pH readings during winter when water temperatures are below 40 degrees Fahrenheit.

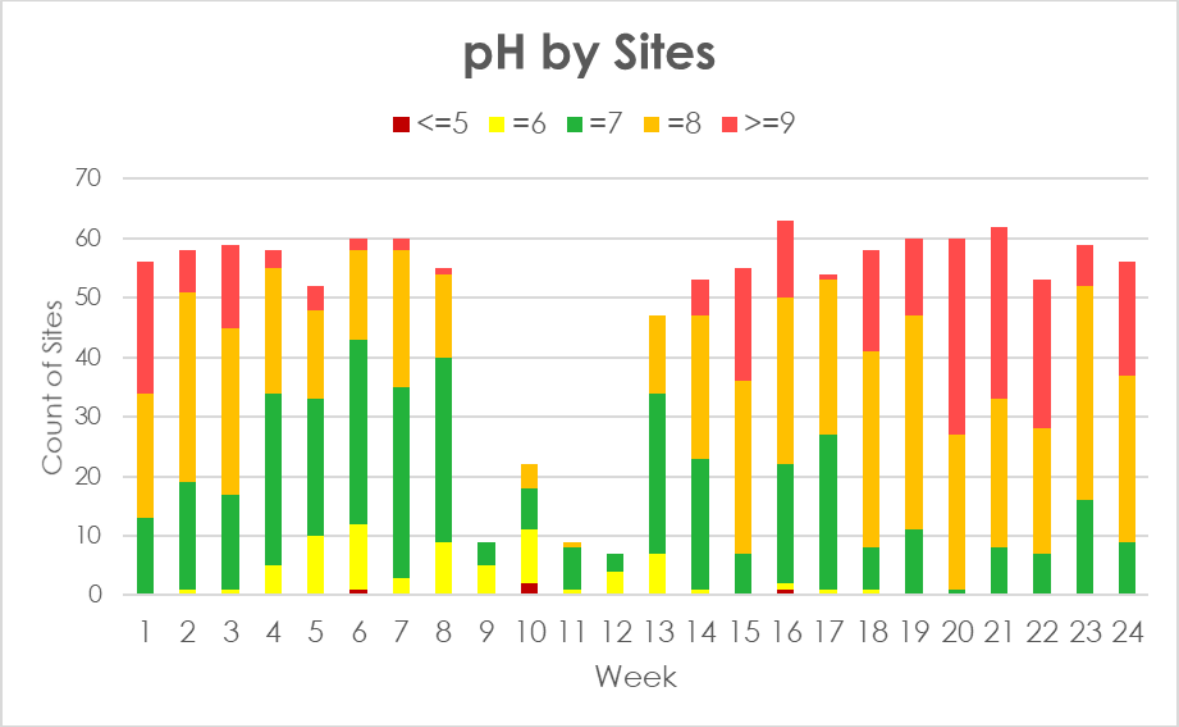

Figure 9. Comparison of pH for All Sites Mid-September 2018 Through Mid-September 2019

Nitrogen

Nitrogen in water was recorded in two forms, nitrate and nitrite. Both nitrate and nitrite are necessary nutrients for plant growth. Too much nitrogen in the water will result in increased plant growth and can change the types of plants and other organisms that live in the stream. Nitrogen in streams can come from human and animal waste, decomposing plants, leaching from soil, and fertilizers from lawns, golf courses and farmland.

Nitrite is a transitional product and therefore is rare in water as it quickly returns back to the atmosphere as nitrogen gas or converts to nitrate. Not surprisingly, PCCWQMP sites had very few instances of detectable nitrite. Most of the readings (95%) were reported as zero mg/L.

Nitrate, however, is very soluble in water and therefore is now present at high levels in some streams, particularly those found near rural agricultural areas. Historically, nitrate concentrations were low. In the early 20th century, nitrate concentrations in the Iowa, Cedar and Des Moines Rivers increased from less than 0.06 mg/L in 1906-07 to 1.6-2.8 mg/L in 1944-1956, to 6.1- 7.2 mg/L over the last 30 years. (Iowa Geological Survey, 1955; Iowa Department of Natural Resources-Geological Survey Bureau, 2001.)

PCCWQMP sites had nitrate concentrations of 5 or 10 mg/L, 227 times or 19% of the time (Fig. 14). While this concentration is at or below the drinking water quality standard for nitrate (10 mg/L), it is more than two times the concentration found in the mid 1940's and 50's. Five sites located in Beaver, Deer, Mud, Rock and Walnut Creeks reported concentrations of 20 mg/L. Most sites frequently reported readings over 10 mg/L throughout the spring and summer. Sites with high nitrates in the spring are often found in rural Polk County and may be experiencing fertilizer runoff from agricultural lands. Spikes of nitrates in the fall are attributed to fall fertilizer application in suburban and urban areas. Long-term exposure to elevated nitrate can have a detrimental impact on human health and the aquatic system.

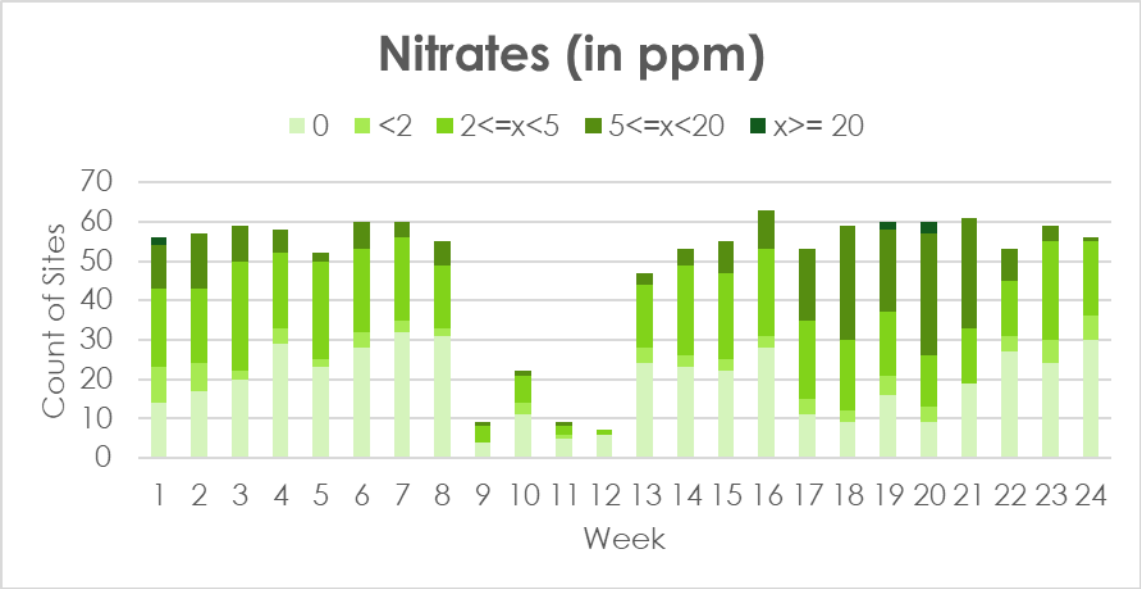

Figure 10. Frequency of Nitrate Concentrations for All Sites Mid-September 2018 – Mid-September 2019

Phosphate

Phosphorus naturally occurs in streams attached to sediment. Dissolved orthophosphate, an essential nutrient, is generally the limiting factor for plant growth in surface water. Natural sources of phosphorus are from soil and rocks; however, when elevated levels occur it is often the result of human, animal or industrial waste reaching waterways and runoff from fertilized lawns and farmland. Excess phosphorus in water results in increased plant growth and algal blooms. When these plants and algae begin to die and decompose, hypoxia (low dissolved oxygen) can result and lead to the death of plant and animal life in the stream. The water quality monitoring kit measures orthophosphate, which will be referred to as simply "phosphate."

According to the Iowa DNR, average phosphate concentrations for Iowa streams is 0.19 mg/L. The majority of PCCWQMP results fall in a similar range of 0-0.2 mg/L. PCCWQMP uses the IOWATER guidelines, which considers phosphate concentrations over 0.6 mg/L abnormal. Yearly averages were above the 0.6 mg/L at 3 sites on Little Beaver, Yeader and Greenwood Pond Creeks. Assessment results ranged from 0 to 6 mg/L with the highest concentrations occurring in late summer and fall 2019 (Fig. 11).

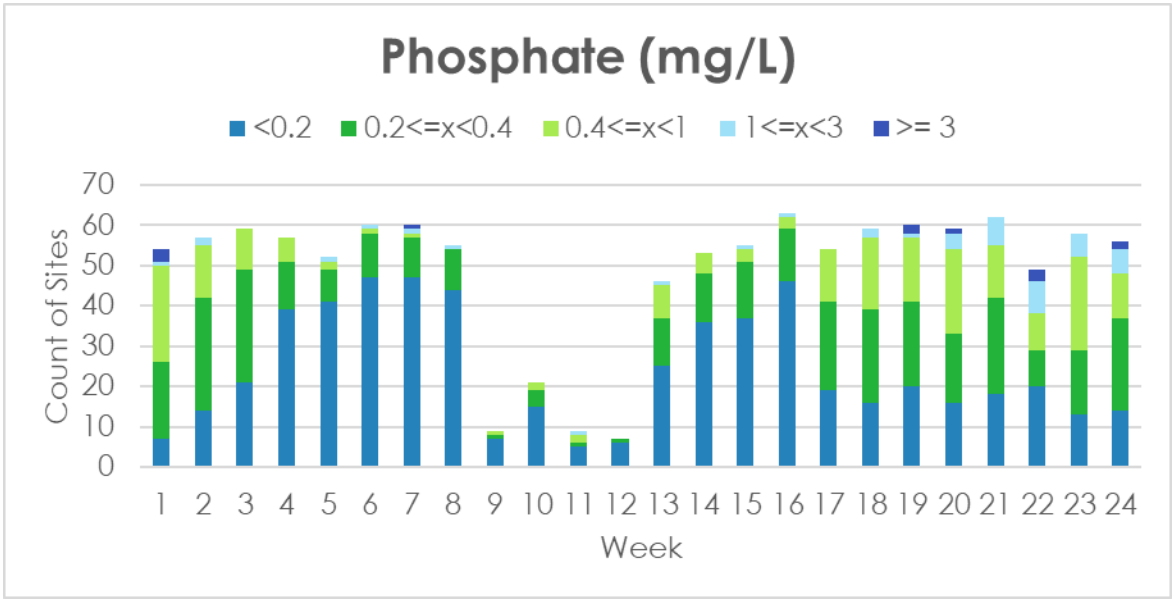

Figure 11. Phosphate Concentrations for All Sites during Mid-September 2018 – Mid-September 2019

Benthic Macroinvertebrates

Benthic macroinvertebrates (BMI) which are sensitive to pollution are a good water quality indicator. Those which are "pollution intolerant" (BMI high-quality group) indicate a healthy stream with good water quality. Those organisms which are "somewhat tolerant" to pollution (BMI middle-quality group) are able to survive some water quality degradation but are unable to tolerate very poor conditions which the BMI low-quality group can, due to special adaptations. Biological assessments were conducted in late July or early August.

Macroinvertebrates of the BMI low-quality group represent only 38% of the total macroinvertebrate species found (Fig. 16). Following the IOWATER Biological Assessment manual procedure, a simplified Index of Biotic Integrity (IBI) was calculated for each water monitoring site. The High-Quality (HQ) benthic macroinvertebrates were given a tolerance score of three, the Middle-Quality (MQ) a score of 2 and the Low-Quality (LQ) a score of 1. To provide a method of comparison, a metric is calculated for each site using the following calculation:

$$IBI = \frac{(\#HQ \times 3) + (\#MQ \times 2) + (\#LQ \times 1)}{\#HQ + \#MQ + \#LQ}$$

Biological Assessment Results for 2018-2019

Sites with an IBI equal or less than 1.75 are considered to have poor benthic macroinvertebrate community. Sites with IBI within the range of 1.76 – 2.25 would indicate fair benthic macroinvertebrate population and sites with scores greater than 2.25 would indicate the site is dominated by benthic macroinvertebrates in the high-quality group.

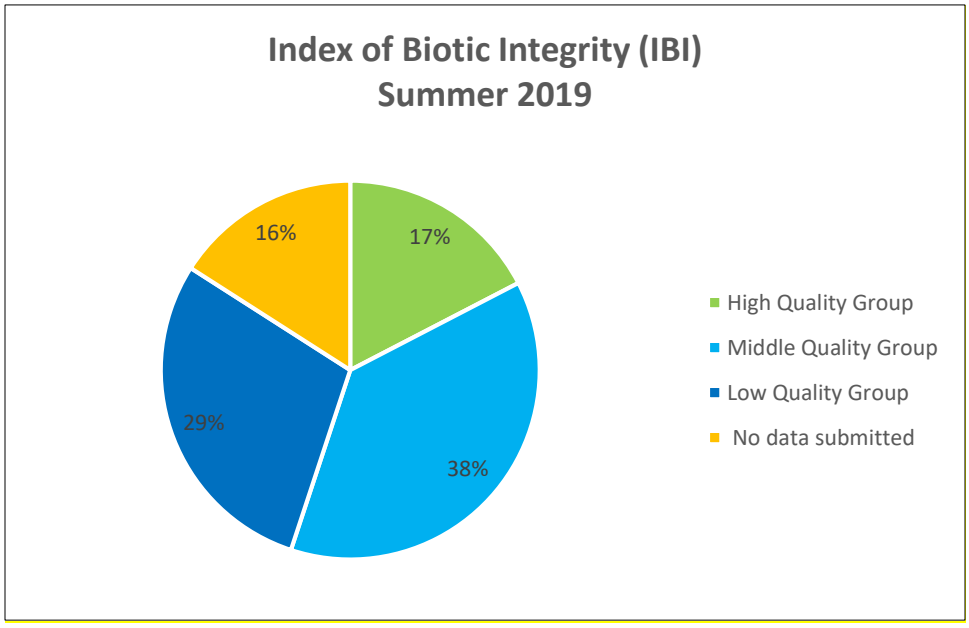

Figure 12. Summer 2019 Biological Assessment Results

Analysis Results

Beaver Creek Watershed

Site Number	Creek Name	Site Name
BBV 925036	Beaver Creek	Beaver Creek Snapshot (Site 18 - Beaver Creek)
BBV 977120	Beaver Creek	Beaver Creek Snapshot (Site 19 - Beaver Creek)
BBV 977160	Beaver Creek	Polk County Snapshot (Site Beaver Creek at Prairie Point)
BLB 977121	Little Beaver Creek	Beaver Creek Snapshot (Site 20 - Little Beaver Creek)
BLB 977125	Beaver Creek	NW 62nd Street in Johnston

Table 1. Beaver Creek Water Quality Monitoring Sites

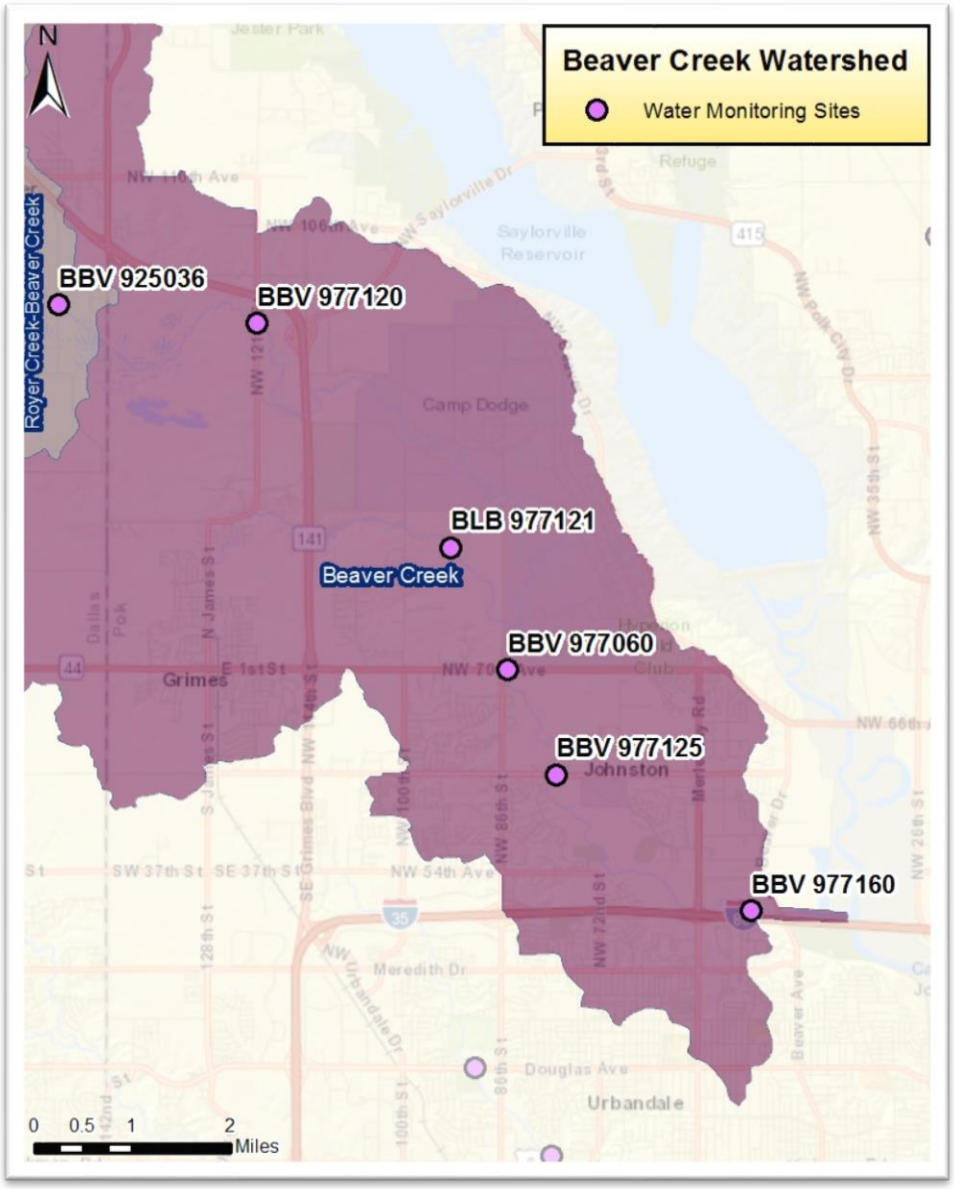

Figure 13. Beaver Creek Water Quality Monitoring Sites

The Beaver Creek watershed encompasses 244,347 acres and is dominated by agriculture with only a small fraction of urban acreage. Four sites in Beaver Creek watershed were identified for monitoring (Fig. 13) and one site on Little Beaver Creek. One site on Beaver Creek (site 977125) was not monitored during this water year.

The site furthest upstream, **Beaver Creek Site 925036** (Fig. 14), is just south of Granger, in Dallas County. Downstream, **Beaver Creek Site 977120** (Fig. 15) is located on NW 121st Street, south of Highway 141. **Beaver Creek Site 977160** (Fig. 16), is located north of I-80, near the Trestle to Trestle Trail. **Little Beaver Creek Site 977121** (Fig. 18) is near Crosshaven Park in Johnston. Site 977125 is not an active water monitoring site.

Figure 14. Beaver Creek Site 925036

Beaver Creek Site 925036 (Fig. 14), is south of the City of Granger, in Dallas County, and adjacent to the water treatment facility. The monitoring site is located along agricultural and forest land. This portion of Beaver Creek has an open canopy with exposed soil and low plants and grass along the left bank. The right bank is more vegetated providing a small amount of shade along the north bank.

This site was frozen from late January through early March 2019. The site was flooded in late March 2019.

Nitrate concentrations ranged from 0 mg/L to 10 mg/L (Fig. 20). Above normal phosphate concentrations of 0.6 mg/L were recorded in fall 2018 and again in August 2019 (Fig. 21). Dissolved oxygen concentrations were 8 mg/L or 10 mg/L all year except in early June when 6 mg/L was recorded (Fig. 22). All recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings (Fig. 23). Due to the unstable banks and early spring flooding

preventing safe access during winter and early spring, any winter road salt runoff would not have been detected during monitoring.

The biological assessment was completed on July 16, 2019. The assessment found two species of benthic macroinvertebrates. The calculated IBI was 2.33 indicating a good benthic macroinvertebrate population present.

Figure 15. Beaver Creek Site 977120

Beaver Creek Site 977120 (Fig. 15) is located on NW 121st Street, south of Highway 141. The monitoring site is surrounded by agricultural and forested land. The left bank is lined with trees providing some shade along the monitoring site.

This site was frozen from late January through early March 2019. The site was flooded in late March 2019.

Recorded nitrate concentrations were all low (0 mg/L - 5 mg/L), below the drinking water standard of 10 mg/L except one concentration of 10 mg/L recorded in mid-July 2019 (Fig. 20). High phosphate concentrations (0.6 mg/L – 0.8 mg/L) were recorded in fall 2018, early July and late August 2019 (Fig. 21). Dissolved oxygen concentrations ranged from 6 mg/L in late September 2018 to 8 mg/L and 10 mg/L found throughout the rest of the year (Fig. 22). All recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings (Fig. 23). Due to ice and early spring flooding which prevented safe access during winter and early spring, any winter road salt runoff was not detected during this time.

Three species of benthic macroinvertebrates were found in the July 16, 2019 biological assessment. The resulting IBI was calculated as 2.500 indicating a good benthic macroinvertebrate population present.

Figure 16. Beaver Creek Site 977160 at Trestle to Trestle Trail Bridge Summer 2019

Beaver Creek Site 977160 (Fig. 16), is located north of I-80, near the Trestle to Trestle Trail. Recreational trail and commercial businesses are the predominant land use in this area. Grass and low plants along the banks leave an open canopy at this site. Because of the Trestle to Trestle Bridge supports, this site often experienced logjams. In spring 2019, a large ice flow on Beaver Creek washed out the pilings supporting the bridge. Construction to replace the bridge will begin in 2020.

Monitoring at this site was hampered by unsafe conditions frequently throughout the 2018-2019 monitoring year. The site was frozen or inaccessible due to ice from January through early March 2019. Flooding or torrential flows effected monitoring in October and November 2018, March, April, May and July 2019. Construction made site inaccessible in September 2019.

Figure 17. Flooding at Site Beaver Creek Site 977160 April 3, 2019

The maximum recorded nitrate level reached 20 mg/L, well over the Iowa stream nitrate average of 5.8 mg/L and above the drinking water standard of 10 mg/L in July 2019 (Fig. 20). These levels, a health risk for drinking water, are not considered a safety concern for in stream recreational activities such as canoeing, kayaking, fishing, etc. Abnormal phosphate concentrations (0.6 mg/L – 0.8 mg/L) were reported in fall 2018 and summer through fall 2019 (Fig. 21). Recorded dissolved oxygen concentrations remained within normal limits throughout the 2018-2019 monitoring period (Fig. 22). Chloride concentrations were low, with the maximum concentration of 43 mg/L recorded (Fig. 23).

A biological assessment for this site was completed on July 19, 2019. Nine species of benthic macroinvertebrate species of all BMI quality groups were found. The calculated IBI of 2.689 for site 977160 indicated a good benthic macroinvertebrate community.

Figure 18. Little Beaver Creek Site 977121

Little Beaver Creek Site 977121 (Fig. 18) is near Crosshaven Park in Johnston. This area is primarily a suburban residential area with agricultural land nearby. The sloping banks are covered primarily with grass and low growing plants leaving the site with an open canopy. The bottom of the streambed was silt but in July 2018 the bottom was reported as sandy likely due to early spring flooding.

A musky odor was reported in October 2018 when streamflow was normal. At that time all parameters were normal except a 0.3 mg/L nitrite concentration and a 1 mg/L phosphate concentration were recorded. A fishy odor was reported in early June and early August 2019. In early June, a phosphate result of 0.6 mg/L was reported as well. All other results were within normal parameters. In August, 2019, high phosphate (5 mg/L) and chloride (123 mg/L) concentrations were reported.

One nitrate concentration of 20 mg/L was recorded in September 2018, a concentration of 10 mg/L was recorded in early August 2019. All other nitrate concentrations (0 mg/L – 5 mg/L) were low during the 2018-2019 monitoring period (Fig. 20). Most recorded phosphate concentrations were above normal, ranging from 0 mg/L to as high as 5 mg/L (Fig. 21). Dissolved oxygen concentrations were all above the abnormal threshold except the September 2019 reading of 4 mg/L (Fig. 22). Above normal chloride concentrations occurred in late February 2018 (153 mg/L) and early August 2019 (123 mg/L). All other recorded chloride concentrations ranged between 25 mg/L and 98 mg/L (Fig. 23).

Nine species of benthic macroinvertebrates were found during the biological assessment completed July 19, 2019. An IBI of 1.733 was calculated which would indicate a poor benthic macroinvertebrate community present.

Figure 19. Erosion after Recent Flooding 3-25-19 Little Beaver Creek Site 977121

Early spring flooding affected many areas causing erosion along streambanks. The flooding caused by rapid snow melt and in some areas, ice jams, caused streambank erosion along Little Beaver Creek Site 977121 (Fig. 19).

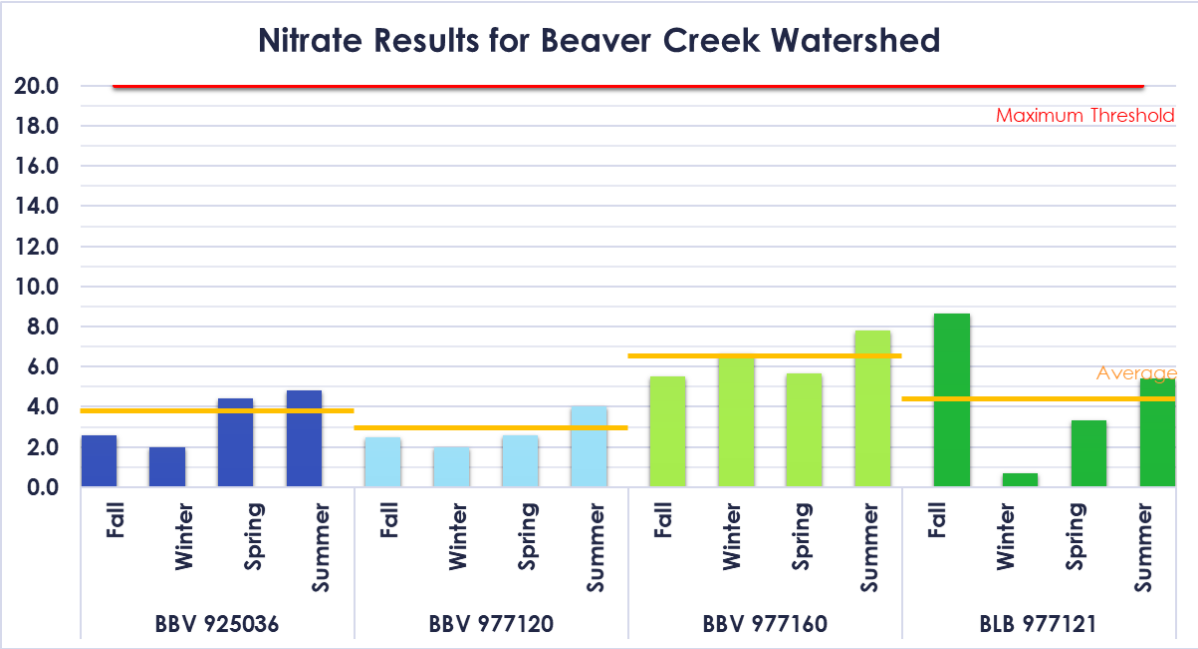

Figure 20. Seasonal Nitrate Concentrations for Beaver Creek mid-September 2018 through mid-September 2019

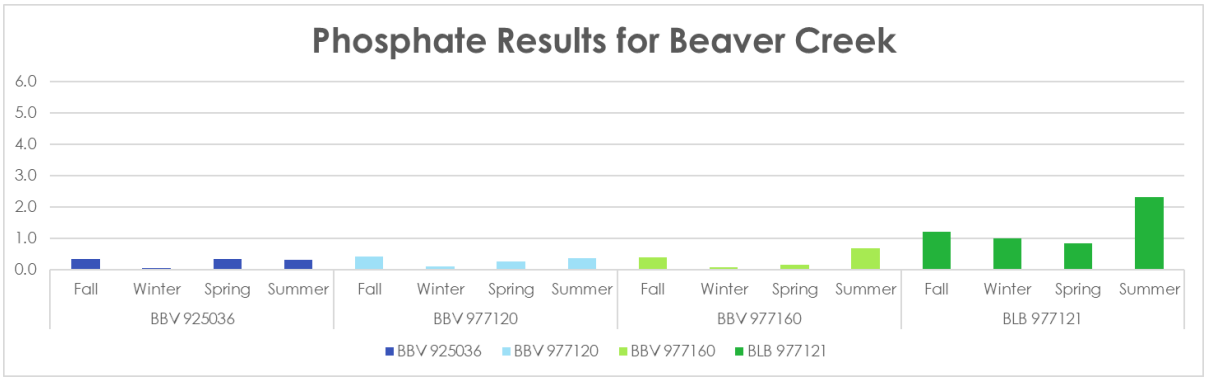

Figure 21. Seasonal Average Phosphate Concentrations for Beaver Creek mid-September 2018 through mid-September 2019

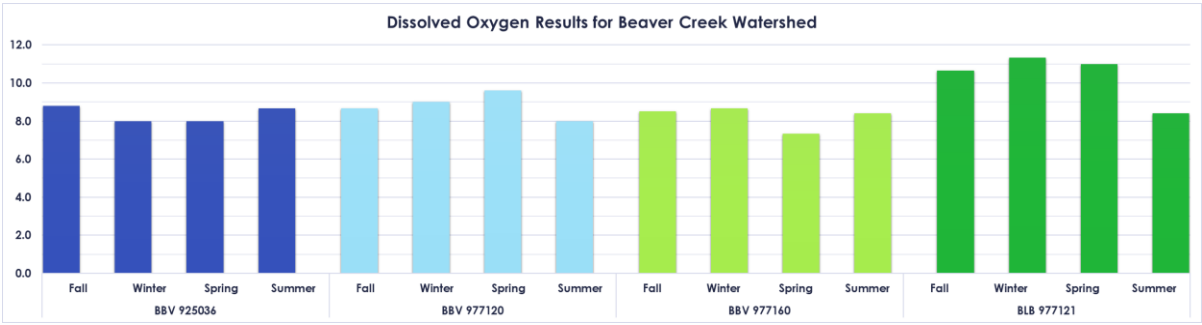

Figure 22. Seasonal Average Dissolved Oxygen Concentrations Beaver Creek mid-September 2018 through mid-September 2019

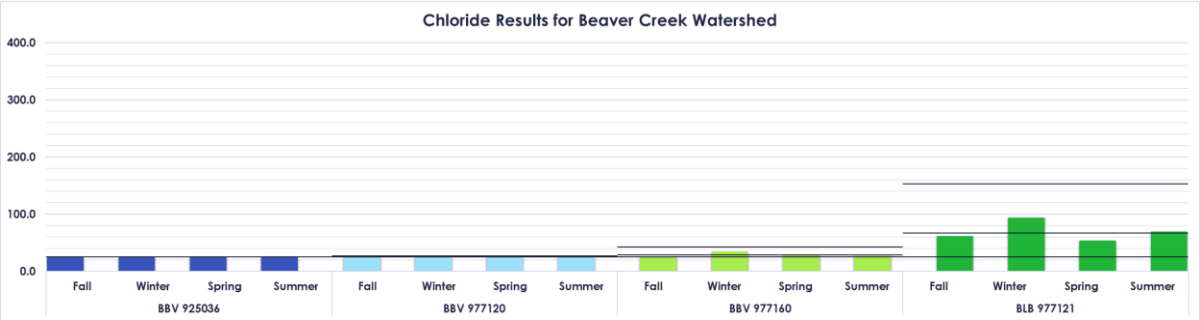

Figure 23. Seasonal Average Chloride Concentrations for Beaver Creek mid-September 2018 through mid-September 2019

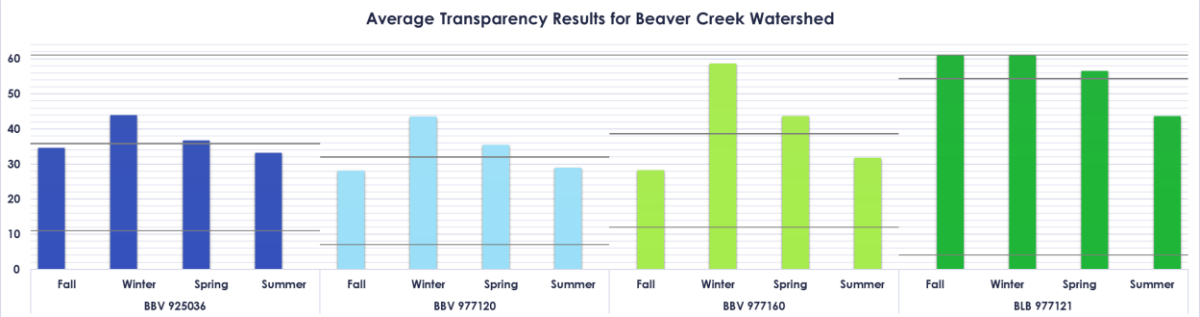

Figure 24. Seasonal Average Transparency Results for Beaver Creek mid-September 2018 through mid-September 2019

Big Creek (Downstream of Big Creek Lake)

Site Number	Creek Name	Site Name
BBG 977192	Big Creek	Big Creek – Through Polk City Park/Refuge

Table 2. Big Creek Water Quality Monitoring Sites

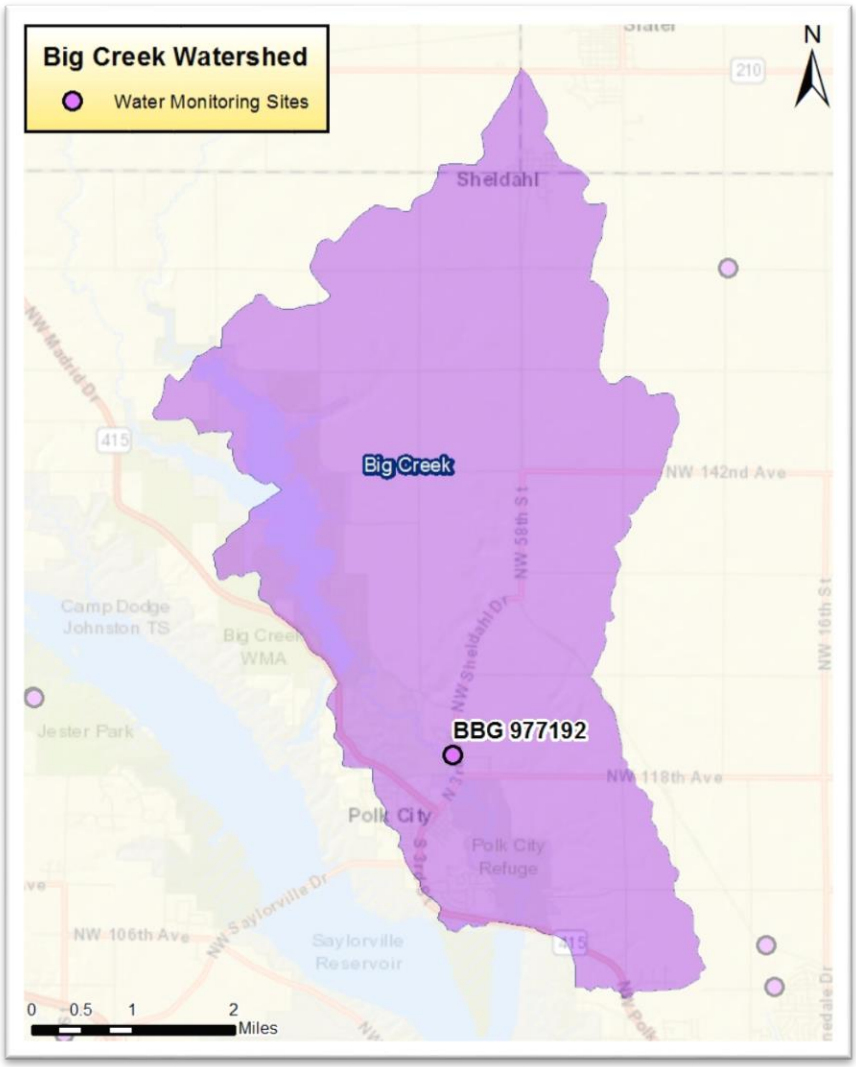

Figure 25. Big Creek Water Quality Monitoring Site 977192

Big Creek Site 977192 (Fig. 27) is located on Big Creek near All Sesaons Park in Polk City, Iowa. This creek, in part, is also referred to as Wolf Creek. The creek leaves Big Creek Lake, flows through and along the Tournamenet Club of Iowa golf course until reaching the water monitoring site. The creek flows along the park terminating at the Saylorville Wildlife Refuge.

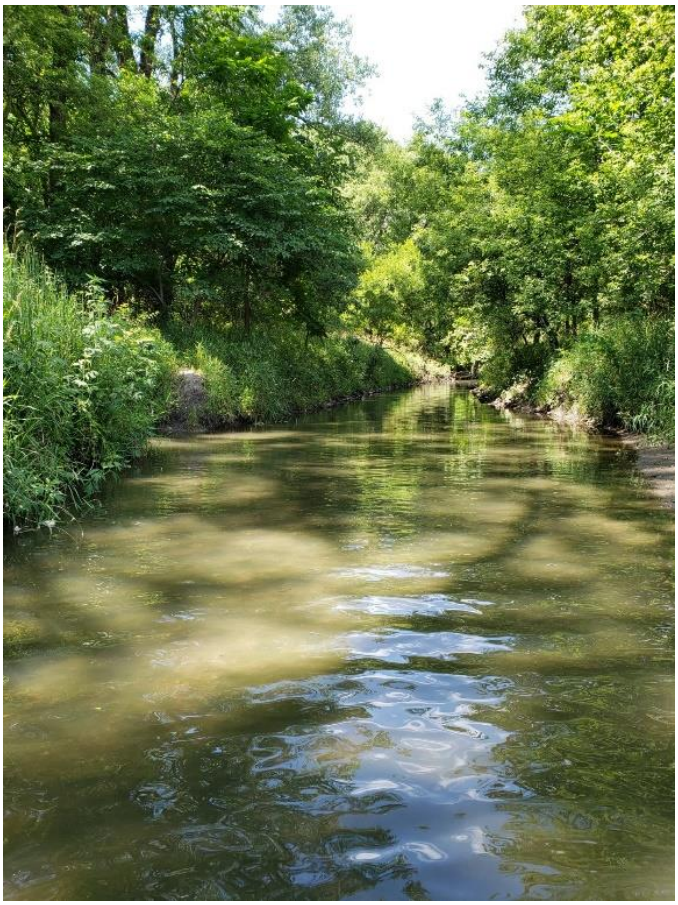

Figure 26. Big Creek Site 977192

Monitoring on **Big Creek Site 977192** (Fig. 26) began on May 5, 2017. During the 2018-2019 monitoring period this site was inaccessible due to ice late January through early March and flooding in late May. The chemical assessment yearly averages reported during 2018-2019 were all within normal range for all recorded dissolved oxygen and chloride conentrations (Figs. 29 and 30).

Nitrate concentration ranged 0 mg/L to 5 mg/L, well below the drinking water standard of 10 mg/L (Fig. 27). Phosphate concentrations were all at or below the abnormal theshold o f0.6 mg/L for the 2018-2019 water monitoring year (Fig. 28).

A biological assessment for this site was completed on July 16, 2019. Benthic macroinvertebrate species of all BMI quality groups were found. The IBI of 2.08 for site 977192 fell in the middle-quality benthic macroinvertebrate population range indicating a good benthic macroinvertebrate community.

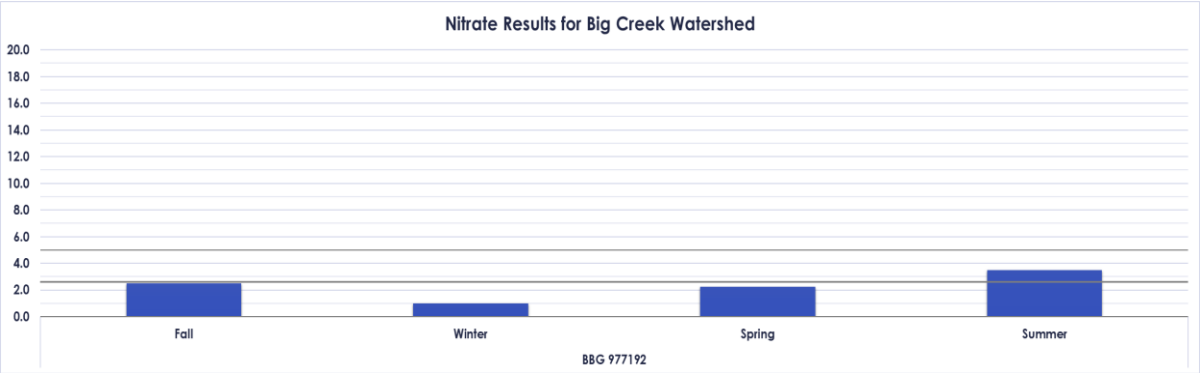

Figure 27. Seasonal Average Nitrate Concentrations for Big Creek Site mid-September 2018 through mid-September 2019

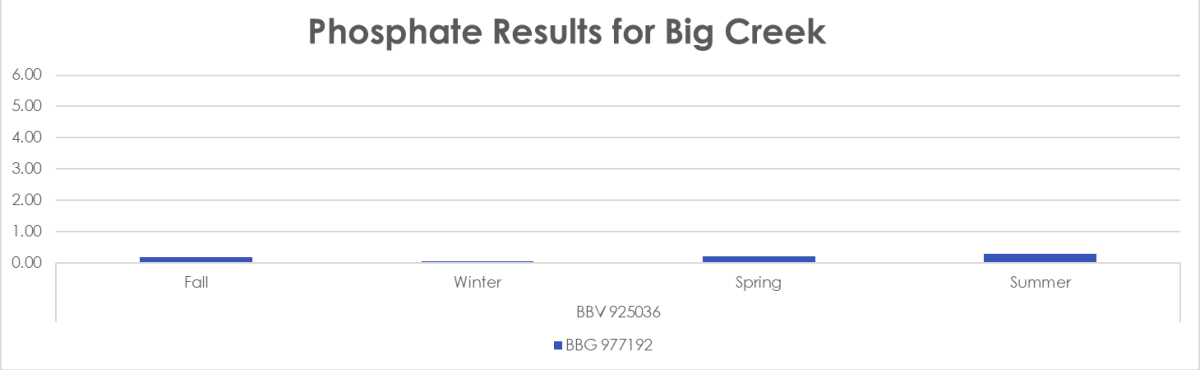

Figure 28. Seasonal Average Phosphate Concentrations for Big Creek Site mid-September 2018 through mid-September 2019

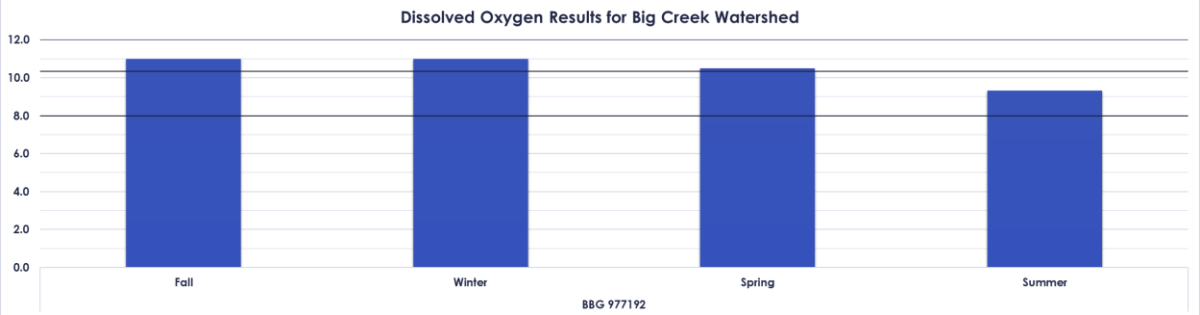

Figure 29. Seasonal Average Dissolved Oxygen Concentrations for Big Creek Site mid-September 2018 through mid-September 2019

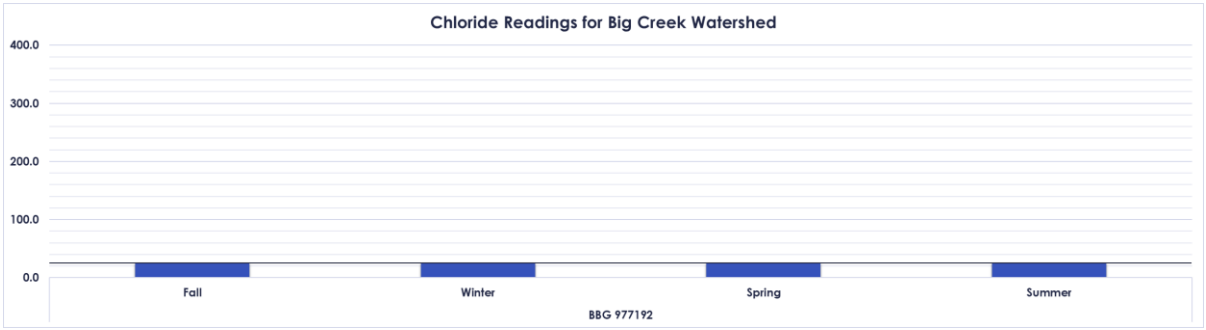

Figure 30. Seasonal Average Chloride Concentrations for Big Creek Site mid-September 2018 through mid-September 2019

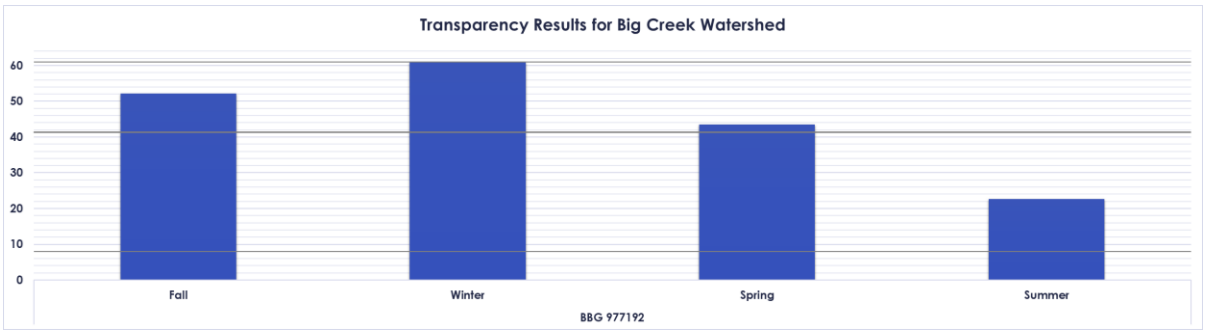

Figure 31. Seasonal Average Transparency for Big Creek Site mid-September 2018 through mid-September 2019

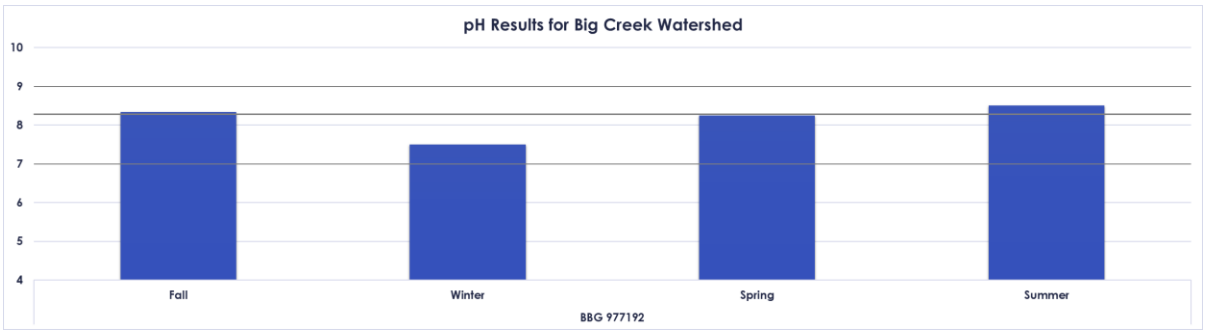

Figure 32. Seasonal Average pH Results for Big Creek mid-September 2018 through mid-September 2019

Mud, Camp and Spring Creeks Watersheds

Site Number	Creek Name	Site Name
CCM 977152	Camp Creek	Camp Creek/Thomas Mitchell Park
CCM 977066	Camp Creek	Polk County Snapshot (Site CC1 - Camp Creek)
CCM 977067	Camp Creek	Polk County Snapshot (Site CC2 - Camp Creek)
MMD 977303	Mud Creek	Mud Creek - NE 62nd
MMD 977304	Mud Creek	Mud Creek - NE 12th Av
MMD 977302	Mud Creek	Mud Creek NW of Runnells
SSP 977242	Spring Creek	Spring Creek (PH Site 6)
SSP 977108	Spring Creek	Polk County Snapshot (Site SC2 - Spring Creek)

Table 3. Mud, Camp and Spring Creeks Water Quality Monitoring Sites

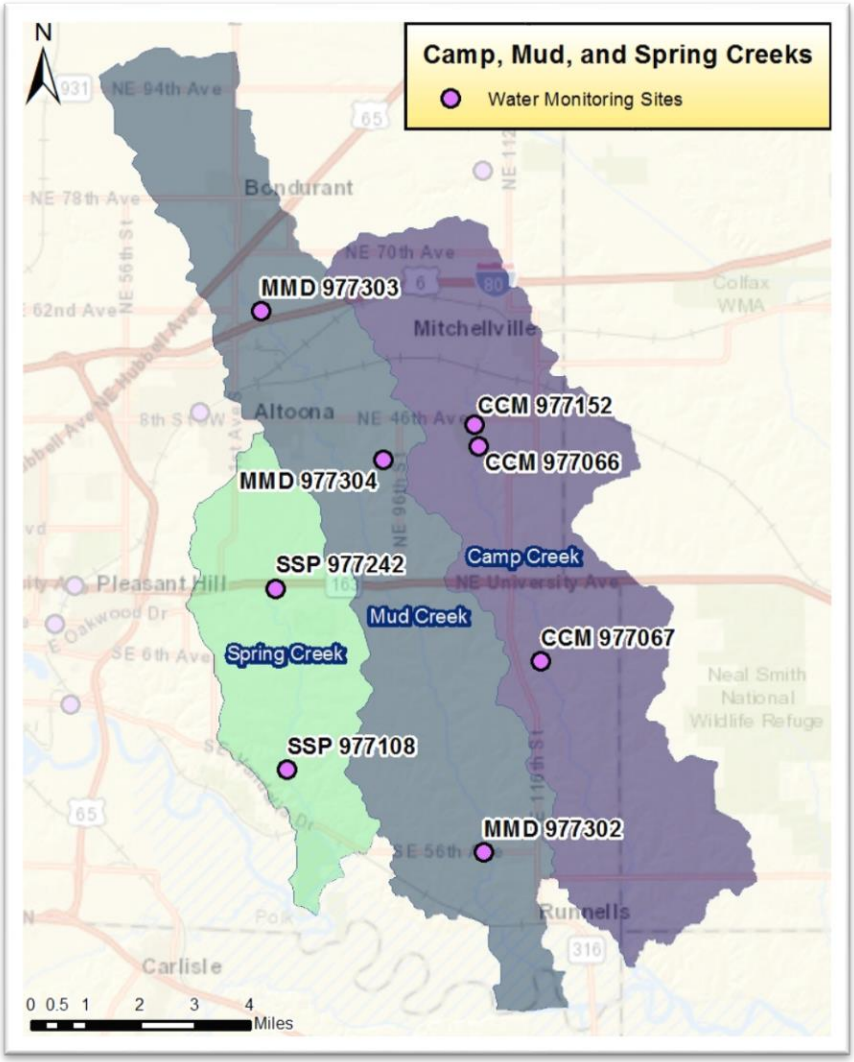

Figure 33. Camp Creek Water Monitoring Sites

The Mud, Camp and Spring Creeks Watersheds cover over 64,511 acres. Although primarily rural land, communities in this area include rapidly urbanizing areas of Pleasant Hill, Altoona and Bondurant.

Mud and Spring Creek sites reported yearly averages for all parameters within the normal range. The yearly average phosphate readings were higher than normal on Camp Creek Site 977152. All other yearly averages were within the normal range.

Camp Creek

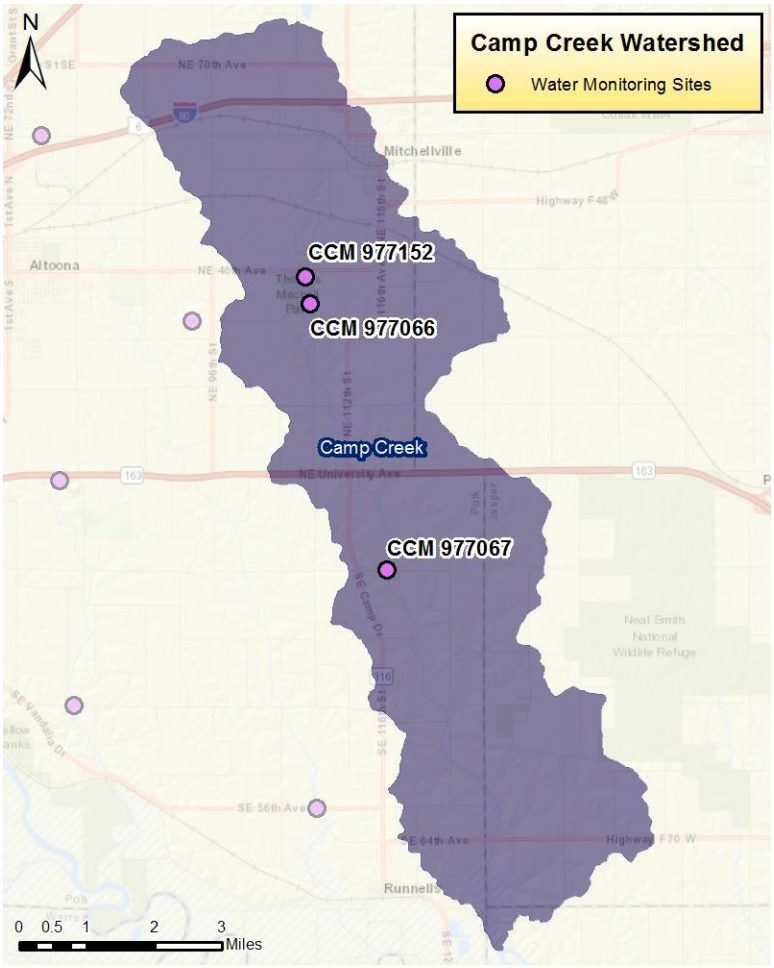

Figure 34. Camp Creek Watershed

Camp Creek Site 977152 (Fig. 35) is located on the north end of Thomas Mitchell Park near the pedestrian creek crossing. Upstream of this site is primarily agricultural land. The banks at the monitoring site are primarily covered with grass and low growing plants and has an open canopy.

During the 2018-2019 monitoring period, this site was effected by road and bridge construction upstream causing increased turbidity and gray water in August 2019. Data was not obtained in late January and early March due to icy conditions.

Figure 35. Camp Creek Site 977152

Nitrate concentrations ranged between 0 mg/L and 10 mg/L (Fig. 38). Phosphate concentrations were above normal in September 2018, mid-February, April, July through September 2019 (Fig. 39). These are likely due to runoff from nearby agricultural land. Dissolved oxygen concentrations (6 mg/L – 12 mg/L) were within normal range throughout the year (Fig. 40). Only one chloride concentration was above the 100 mg/L threshold in September 2019, with a reading of 102 mg/L. Chloride concentrations ranged between 25 mg/L and 80 mg/L (Fig. 41).

A biological assessment was completed on July 15, 2019 with five species identified. An IBI of 2.42 indicates a good benthic macroinvertebrate population present.

Figure 36. Camp Creek Site 977066

Camp Creek Site 977066 (Fig. 36) is located downstream within Thomas Mitchell Park. The banks are lined with grass, low growing plants and trees which provide a partly shaded canopy. In August 2019, this site was effected by road and bridge construction upstream.

January through early March 2019, no assessment data was obtained due to frozen water and icy conditions.

Nitrate concentrations ranged from 0 mg/L to 10 mg/L (Fig. 38). Phosphate concentrations improved slightly from results found upstream. Above normal results occurred September 2018, April, July through September 2019 (Fig. 39). Dissolved oxygen concentrations (6 mg/L – 12 mg/L) were within normal range throughout the year (Fig. 40). No chloride concentrations were above the 100 mg/L threshold and ranged between 25 mg/L and 91 mg/L (Fig. 41).

A biological assessment was completed on July 15, 2019 with six species identified. An IBI of 2.40 indicates a good benthic macroinvertebrate population present.

Figure 37. Camp Creek Site 977067

Camp Creek Site 977067 (Fig. 37) is located in the far southeast corner of the county near the Metro Waste Authority Environmental Learning Center (Fig. 33). This site is located along a steep, grassy bank with open canopy.

No data was obtained due to ice and unsafe winter conditions in late January through early March 2019. In May 2019, foam was noted, probably of organic origin. A manure odor was detected in August of 2019. No other results were abnormal during this assessment.

Nitrate concentrations ranged from 0 mg/L to 10 mg/L (Fig. 38). Phosphate concentrations improved from results found upstream. Above normal results occurred September 2018, July and September 2019 (Fig. 39). Dissolved oxygen concentrations (6 mg/L – 12 mg/L) were within normal range throughout the year (Fig. 40). No chloride concentrations were above the 100 mg/L threshold, ranging between 25 mg/L and 37 mg/L (Fig. 41).

A biological assessment was conducted on July 15, 2019. Two species were identified resulting in an IBI of 1.50 which indicated a poor benthic macroinvertebrate population present.

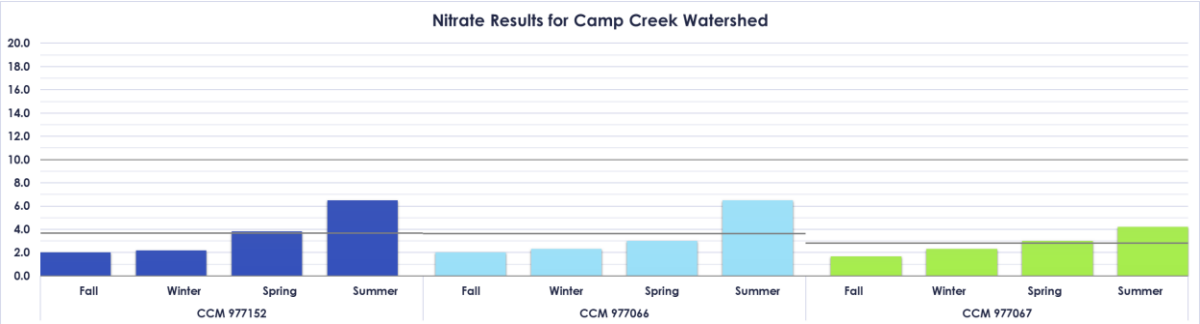

Figure 38. Seasonal Average Nitrate Concentrations for Camp Creek Mid-September 2018 through Mid-September 2019

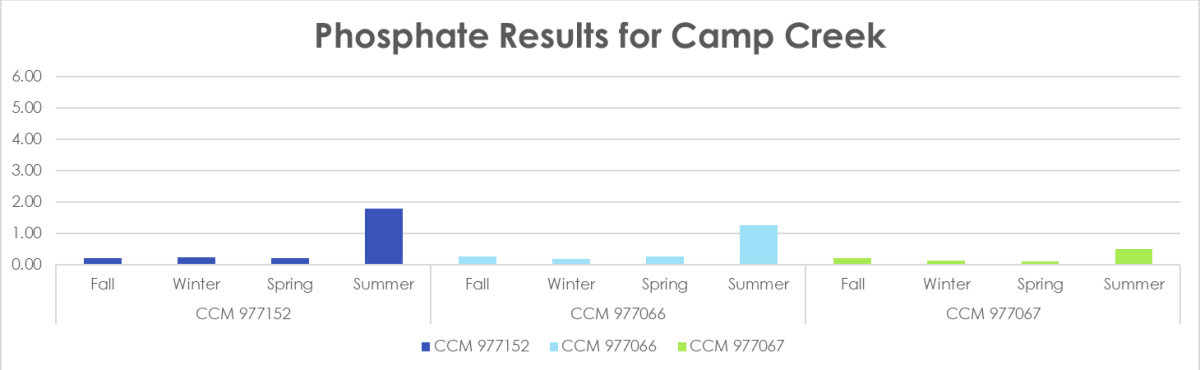

Figure 39. Seasonal Average Phosphate Concentrations for Camp Creek Mid-September 2018 through Mid-September 2019

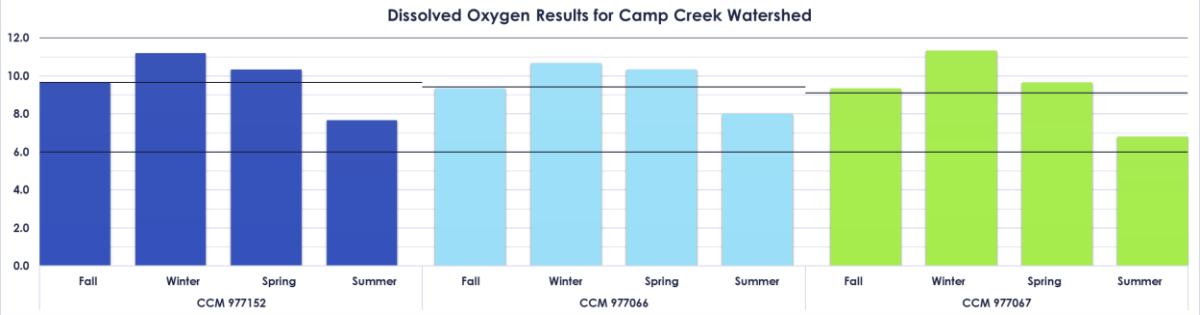

Figure 40. Seasonal Average Dissolved Oxygen Concentrations Camp Creek Mid-September 2018 - Mid-September 2019

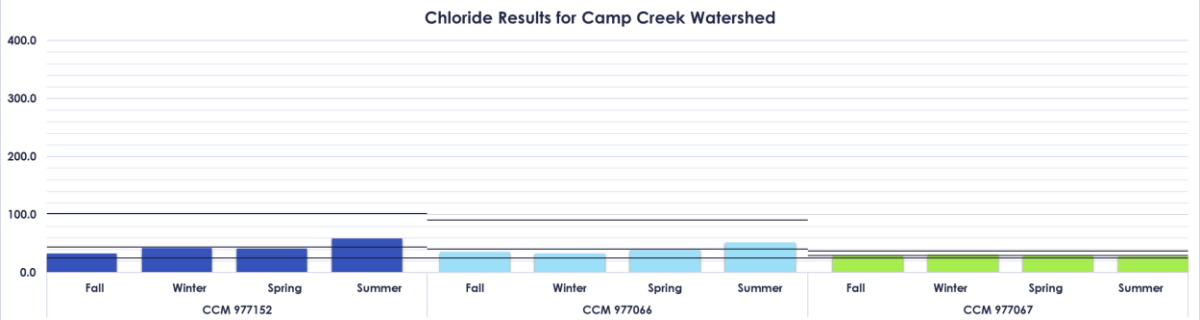

Figure 41. Seasonal Average Chloride Concentrations for Camp Creek Mid-September 20187 through Mid-September 2019

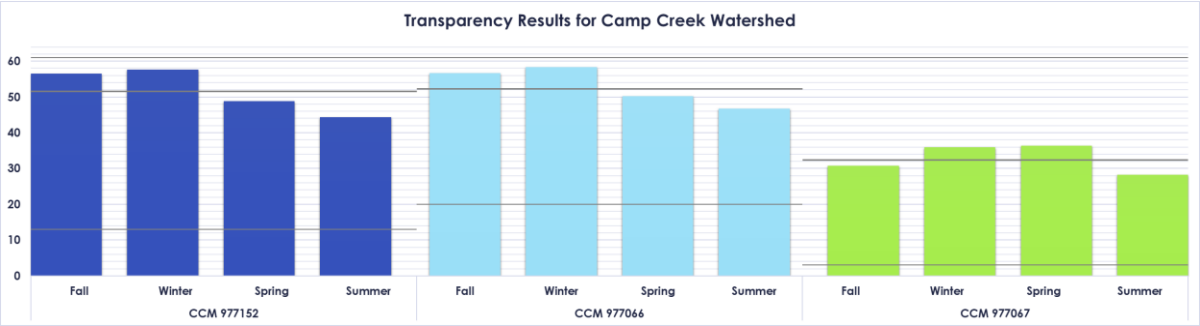

Figure 42. Seasonal Average Transparency for Camp Creek Mid-September 2018 through Mid-September 2019

Mud Creek

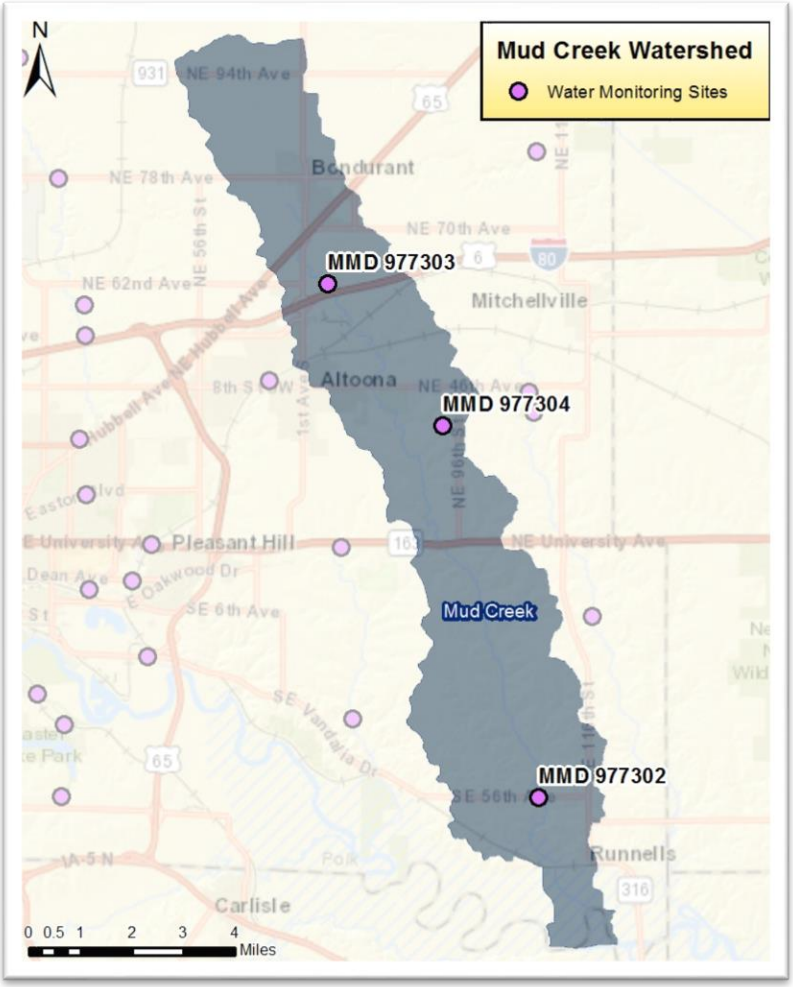

Figure 43. Mud Creek Water Quality Monitoring Sites

Three sites are monitored in Mud Creek. **Mud Creek Site 977303** is south of Bondurant just north of Interstate 80. **Mud Creek Site 977304** is located along Highway 163 and **Mud Creek Site 977302** is near the southeast county boundary (Fig. 43).

Figure 44. Mud Creek Site 977303

Mud Creek Site 977303, south of Bondurant just north of Interstate 80 is a partly shaded site located near agricultural land (Fig. 43).

No data was obtained during late winter through early spring due to ice cover.

Nitrate and dissolved oxygen concentrations at the three Mud Creek locations remained in the normal range throughout the year (Figs. 47 and 49). Phosphate concentrations were low throughout the year, ranging from 0 mg/L to 0.4 mg/L (Fig. 48). Chloride concentrations were at or below 49 mg/L for all recorded assessments during the 2018-2019 water monitoring period (Fig. 50).

A biological assessment was completed on July 15, 2019. Seven species of benthic macroinvertebrates of high- and middle-quality groups were identified resulting in an IBI of 1.9655 indicating a good benthic macroinvertebrate population present.

Figure 45. Mud Creek Site 977304

Mud Creek Site 977304 is located north of Highway 163 on NE 12th Avenue east of Southeast Polk High School (Fig. 43). This area is primarily agricultural and forested land, however, the monitoring site has an open canopy with rip rap, grass, shrubs and low trees lining the banks.

Data was not obtained due to frozen conditions or flooding from late January through early March and June 2019.

Nitrate concentrations ranged from 0 mg/L to 10 mg/L (Fig. 47). One above normal phosphate concentration of 1.0 mg/L was reported in mid-December 2018 (Fig. 48). Dissolved oxygen concentrations were often found at or above the 6 mg/L threshold (Fig. 49). Most recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings with no reading above 37 mg/L (Fig. 50).

A biological assessment was completed on July 15, 2019. Two species of benthic macroinvertebrates were identified, one of the high-quality group and one of the middle-quality group. The IBI results of 2.091 indicate an overall healthy stream with a good population present.

Figure 46. Mud Creek Site 977302

Mud Creek Site 977302 is near the southeast county boundary (Fig. 43). While banks are mostly covered by grass and low growing plants, mature trees partly shade this site.

This site was frozen from late January through early March 2019. No data was obtained during this timeframe. Nitrate concentrations fell within normal range (0 mg/L -10mg/L) for all completed assessments (Fig. 47). Phosphate concentrations of 0 mg/L were recorded for all assessments except September 2018 (0.6 mg/L), October 2018 (0.4 mg/L) and September 2019 (0.2 mg/L) (Fig. 48). Dissolved oxygen concentrations were reported within normal range (Fig. 49). All recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings except one in early May with a 31 mg/L result (Fig. 50). These results fall well below the 100 mg/L threshold.

Seven species of benthic macroinvertebrates of high- and middle-quality groups were identified for the biological assessment completed on July 18, 2019. The IBI results of 2.214 indicate a good population present.

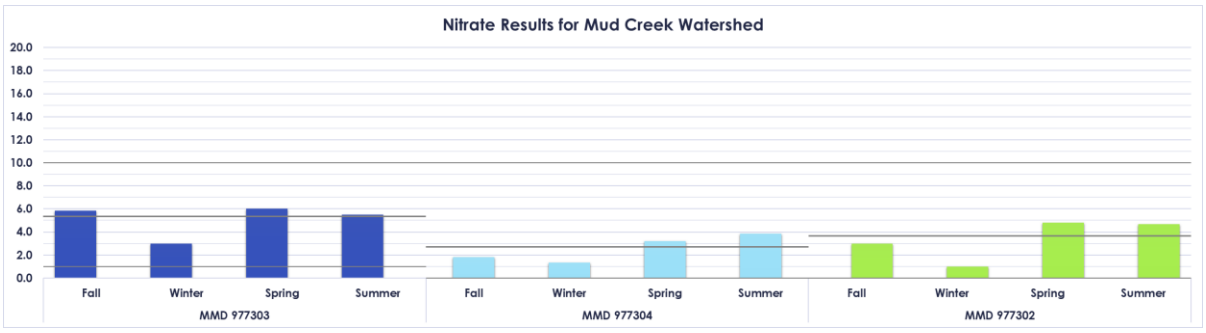

Figure 47. Seasonal Average Nitrate Concentrations for Mud Creek Mid-September 2018 - Mid-September 2019

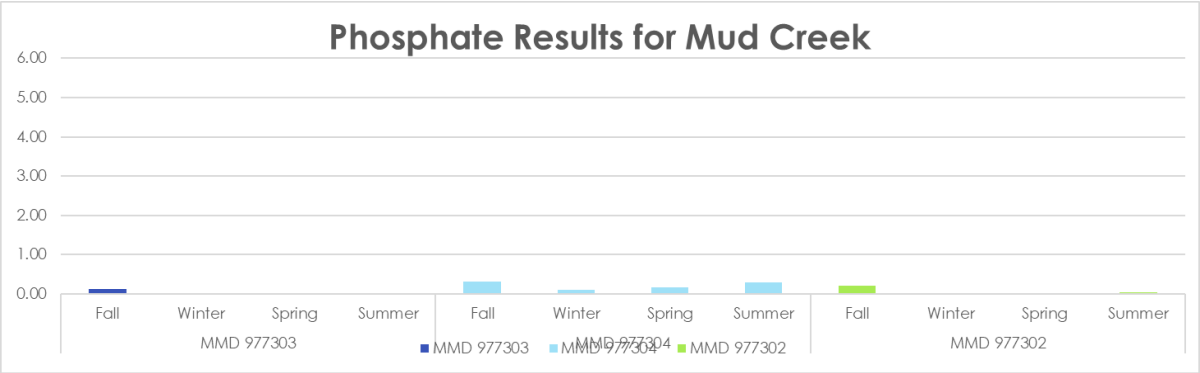

Figure 48. Seasonal Average Phosphate Concentrations for Mud Creek Mid-September 2018 - Mid-September 2019

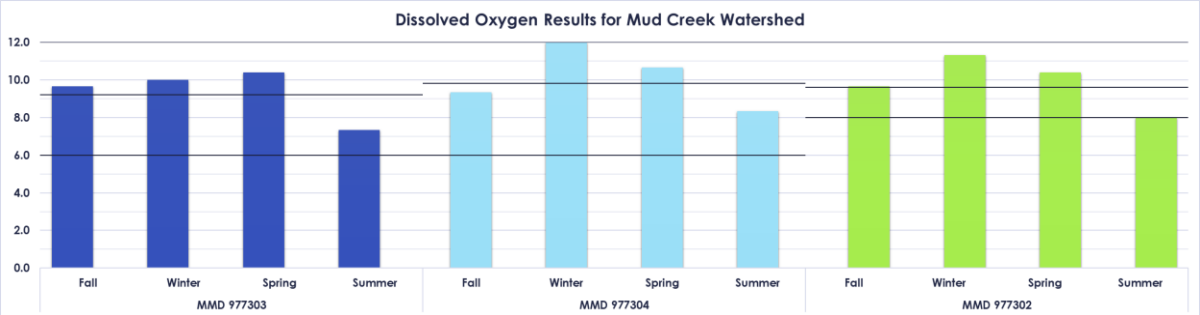

Figure 49. Seasonal Average Dissolved Oxygen Concentrations for Mud Creek Mid-September 2018 - Mid-September 2019

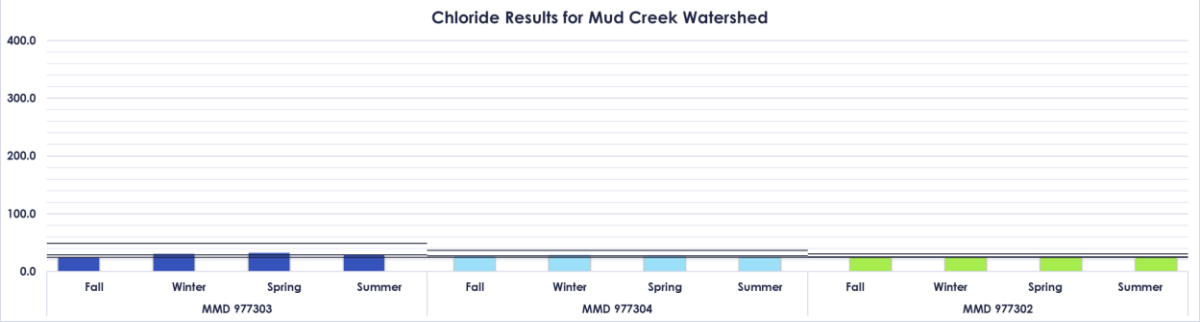

Figure 50. Seasonal Average Chloride Concentrations for Mud Creek Mid-September 2018 - Mid-September 2019

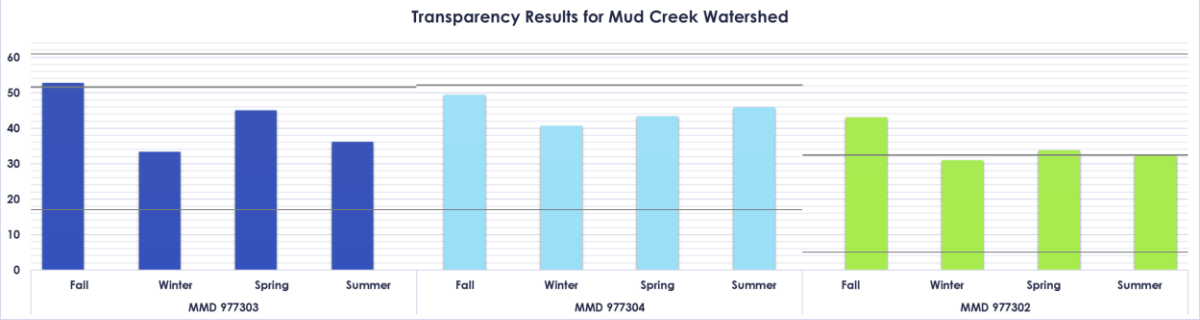

Figure 51. Seasonal Average Transparency for Mud Creek Mid-September 2018 - Mid-September 2019

Spring Creek

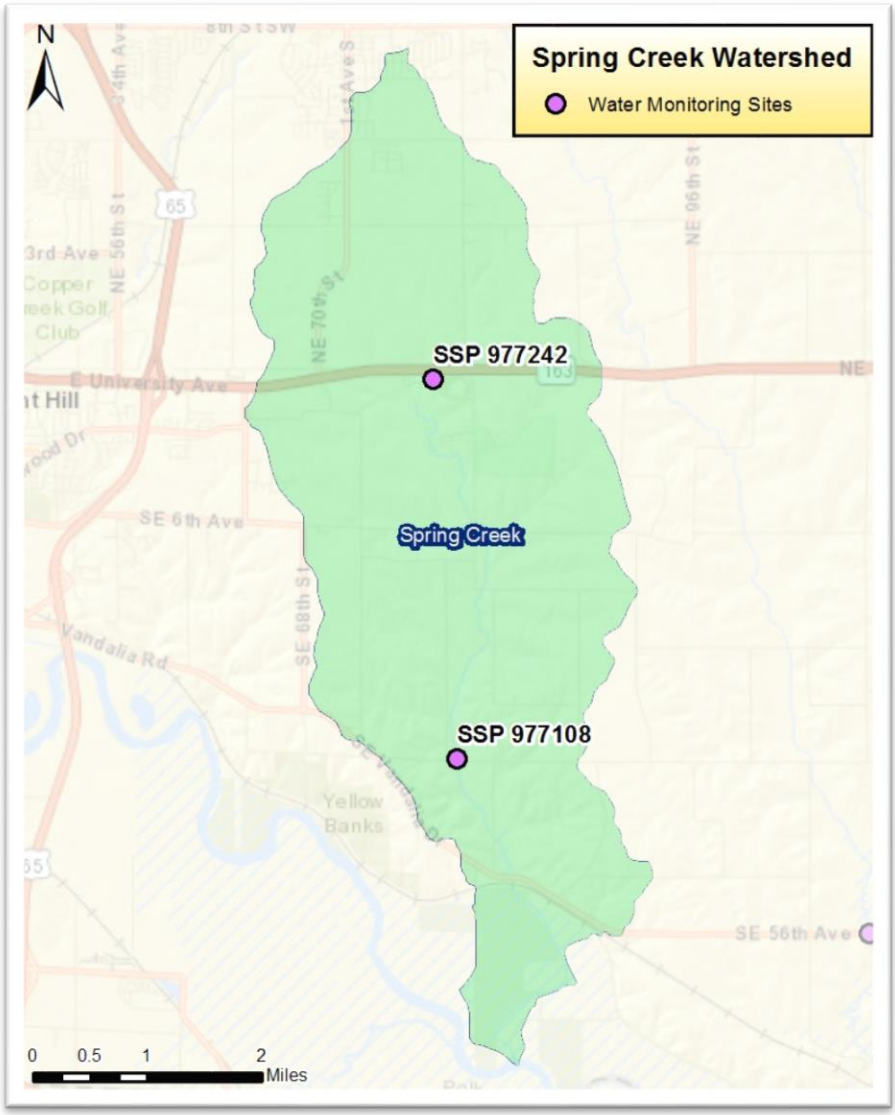

Figure 52. Spring Creek Water Quality Monitoring Sites

Figure 53. Spring Creek Site 977242

Spring Creek Site 977242 is located south of Highway 163 near Southeast Polk High School (Fig. 53). This portion of Spring Creek flows through forested land near commercial businesses but the monitoring site itself has an open canopy with grass and low growing shrubs and plants covering the banks.

This site was frozen from January through early March preventing data to be obtained. Stagnant water was reported in July 2019 but assessment was completed.

One recorded nitrate concentration of 10 mg/L was recorded in late May 2019, all others ranged between 0 mg/L to 5 mg/L (Fig. 55). Phosphate concentrations were low (0 mg/L – 0.2 mg/L) for the 2018-2019 water monitoring period (Fig. 56). No abnormal dissolved oxygen concentrations were recorded (Fig. 57). All recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings except two, a 31 mg/L reading in April 2019 and 37 mg/L in September 2019 (Fig. 58). These results fall well below the 100 mg/L threshold.

A biological assessment was completed on July 18, 2019. Six species of benthic macroinvertebrates were identified. The IBI results of 1.821 indicate a fair population present.

Figure 54. Spring Creek Site 977108

Downstream ten miles from site 977242 on Vandalia Drive is **Spring Creek Site 977108** (Fig. 52). Both sites are located in a mostly rural area. This site has an open canopy as both banks are covered with low growing plants and grasses. Spring Creek is shaded some trees and downstream by the Vandalia Drive Bridge.

Data could not be obtained from late January through early March 2019 due to ice. Nitrate concentrations ranged between 0 mg/L and 5 mg/L, all well below the drinking water standard of 10 mg/L and the recreational threshold of 20 mg/L (Fig. 55). Recorded phosphate concentrations were all normal (0 mg/L – 0.4 mg/L) throughout the water monitoring period (Fig. 56). Dissolved oxygen concentrations ranged from 6 mg/L to 12 mg/L (Fig. 57). All recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings (Fig. 58). These results fall well below the 100 mg/L threshold.

The biological assessment was completed on July 18, 2019. Six species of benthic macroinvertebrates were identified. The IBI of 2.00 was calculated and indicated a fair benthic macroinvertebrate population present.

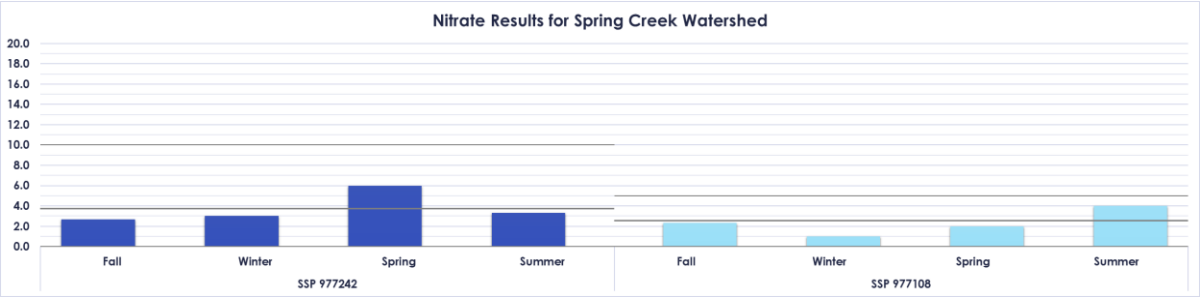

Figure 55. Seasonal Average Nitrate Concentrations for Spring Creek Mid-September 2018 - Mid-September 2019

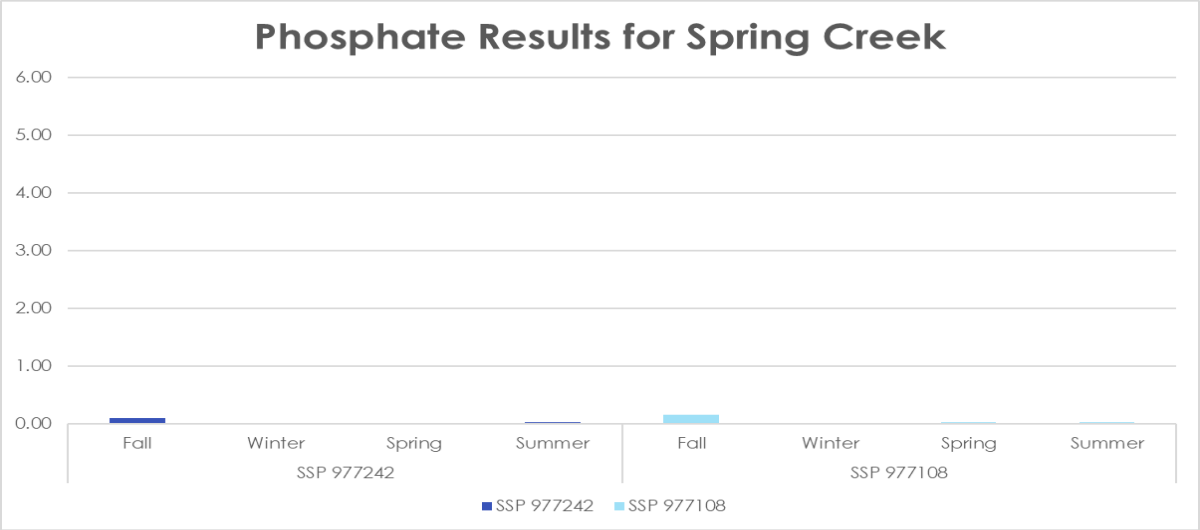

Figure 56. Seasonal Average Phosphate Concentrations for Spring Creek Mid-September 2018 - Mid-September 2019

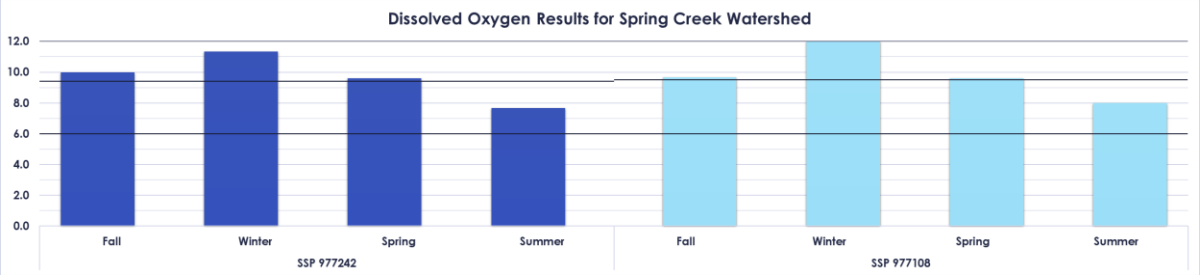

Figure 57. Seasonal Average Dissolved Oxygen Concentrations for Spring Creek Mid-September 2018 - Mid-September 2019

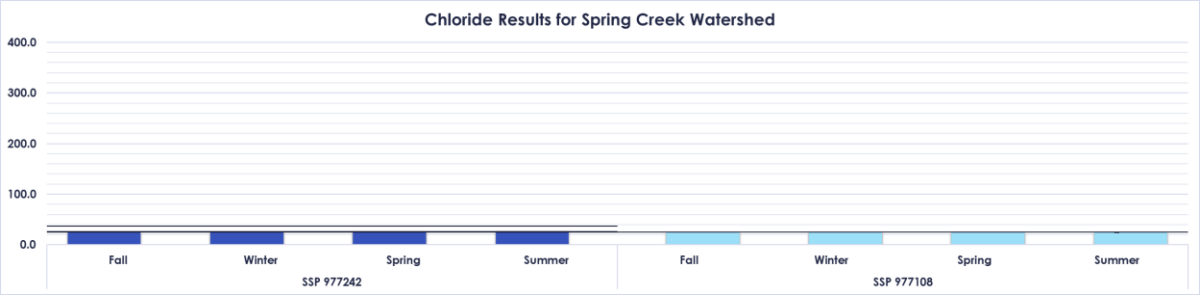

Figure 58. Seasonal Average Chloride Concentrations for Spring Creek Mid-September 2018 - Mid-September 2019

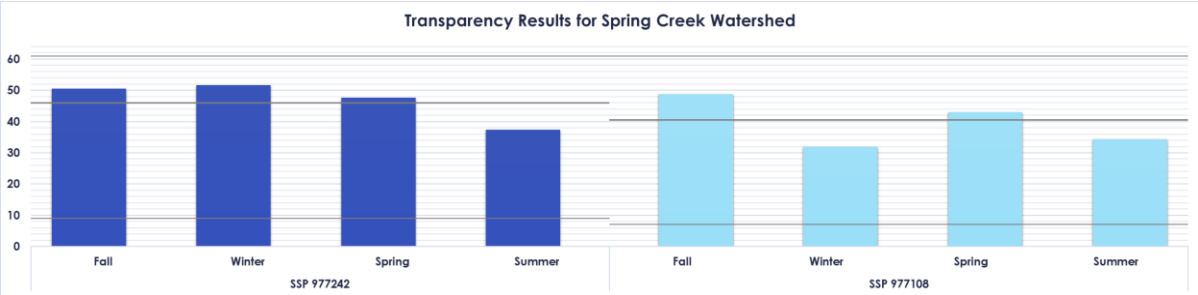

Figure 59. Seasonal Average Transparency for Spring Creek Mid-September 2018 - Mid-September 2019

Northeast Polk County- Drainage Ditches 4 and 38, Bluff, Carney, Indian and Santiago Creeks

Site Number	Creek Name	Site Name
IIN 977327	Indian Creek	Indian Creek at NE 162nd Av
CCR 977307	Carney Creek	Carney Creek at Buttonbush
C04 977310	Drainage Ditch	DD4 - Control Marsh
CBL 977306	Bluff Creek	Bluff Creek - 118th
C38 977311	Drainage Ditch	Drainage Ditch 38
SSN 977322	Santiago Creek	Santiago Creek at Bridge Near NE 82nd Ave

Table 4. Northeast Polk County Water Quality Monitoring Sites

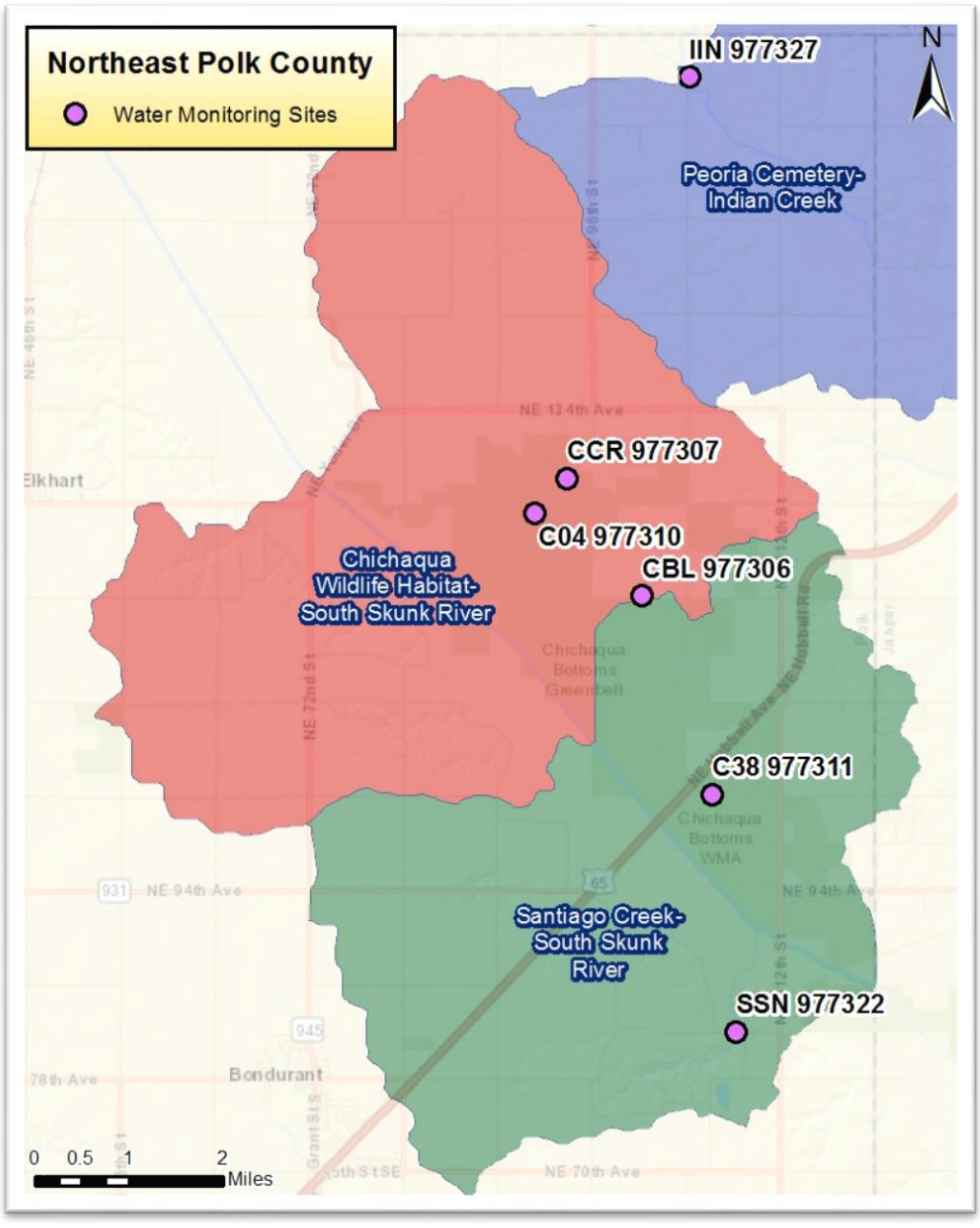

Figure 60. Water Quality Monitoring Sites in Northeast Polk County

Six sites are monitored in far northeast Polk County, one each on Bluff Creek, Carney Creek, Indian Creek and Santiago Creek and Drainage Ditches 4 and 38 (Fig. 60). Monitoring began in Indian Creek and in Santiago Creek, in June 2017. This area is primarily rural agricultural land and has very flat topography. These leads to frequent times of stagnant, shallow water which may indicate the reason for low dissolved oxygen reading at a few of the sites.

Nitrate concentrations for all sites were among the lowest readings of all PCCWQMP sites throughout the year despite being a largely rural area (Fig. 68). Phosphate concentrations at all monitored sites were often found above the 0.6 mg/L threshold (Fig. 69). Dissolved oxygen concentrations were at or below the dissolved oxygen threshold, 2-5 mg/L, throughout much of the year at all sites except the Carney Creek site 977307 (Fig. 70). Chloride concentrations at all sites remained low throughout the year (Fig. 71).

Figure 61. Indian Creek Site 977327

Indian Creek site 977327, is located in rural northeast Polk County (Fig. 61). Monitoring began on Indian Creek site 977327 in mid-June 2017. The banks along the monitoring site are eroded and primarily treed which provides a mostly shaded site.

Flooding and unsafe conditions preventing monitoring at this site in late winter, spring and early summer 2019. Nitrate concentrations were low (0 mg/L – 5 mg/L) throughout the monitoring period when data was obtained (Fig. 68). This site experienced high phosphate levels of 1 mg/L spring and summer 2019 (Fig. 69). The site experienced low dissolved oxygen concentrations of 5 mg/L in November and December 2018 and again in June and July 2019 (Fig. 70). Chloride concentrations were below 35 mg/L for all results, well below the 100 mg/L designated as the abnormal threshold (Fig. 71).

No biological assessment was completed for site 977327 as water was too high to safely access the creek.

Figure 62. Carney Creek Site 977307

Carney Creek Site 977307 Dry August 5, 2019

Carney Creek Site 977307 (Fig. 62) is a heavily vegetated site that flows through well-managed pastureland before entering Chichaqua Bottoms Greenbelt. This decreases sediment load in runoff resulting in clearer water when other more eroded and less vegetated creeks will carry sediment after rainfall.

This site was dry from August through early September 2019. Nitrate (0 mg/L – 5 mg/L), phosphate (0mg/L – 0.4 mg/L), and dissolved oxygen (6 mg/L – 10 mg/L) concentrations were reported within normal range throughout the 2018-19 year (Fig. 67, 68 & 70). All recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings (Fig. 71). These results fall well below the 100 mg/L threshold.

The biological assessment was completed on July 18, 2019. Two species of benthic macroinvertebrates were found resulting in an IBI of 1.4375. This indicates a poor benthic macroinvertebrate population present. The low water levels and drought conditions most likely contributed to so few species being found.

Figure 63. Drainage Ditch 4 Site 977310

Figure 64. Drainage Ditch 4 Site 977310 July 18, 2019

Drainage Ditch 4 Site 977310 (Fig. 63) is a highly vegetated area located in an original Skunk River oxbow. The water originates in Drainage Ditch 4 then flows through the old oxbow to Drainage Ditch 52.

No data was obtained January through early March 2019 due to ice and snow. The creek was dry during monitoring in early September 2019.

Nitrate concentrations ranged from 0 to 2 mg/L, well below the drinking standard of 10 mg/L (Fig. 67). Phosphate concentrations were low through most of the year with slightly elevated levels (0.6 and 0.8 mg/L) in summer 2019 (Fig. 68). This site consistently reported low dissolved oxygen concentrations throughout the year, reaching as low as 3 mg/L (Fig. 70). Chloride readings, when obtained, were the minimum possible reading of less than 31 mg/L (Fig. 71).

Despite low dissolved oxygen results, the IBI of 1.973684 indicated the presence of a fair benthic macroinvertebrate population present. Most benthic macroinvertebrates found were of the medium-quality macroinvertebrate group.

Figure 65. Bluff Creek Site 977306

Bluff Creek Site 977306 (Fig. 65) is a largely shaded, shallow, sandy-bottomed stream near agricultural land. This site is heavily vegetated which decreases the sediment load in runoff from adjacent agricultural land.

Monitoring was not possible in January through February when the creek froze. Nitrate (0-2 mg/L), phosphate (0-0.6 mg/L) and chloride (all less than 31 mg/L) concentrations were well within normal range throughout the year (Figs. 68, 69 & 71). Dissolved oxygen concentrations were reported abnormally low (4-6 mg/L), which is characteristic of shallow and warm streams during the warm summer months (Fig. 70).

The biological assessment was completed on July 18, 2019. Seven species of benthic macroinvertebrates were identified which resulted in an IBI of 1.95 indicating a fair benthic macroinvertebrate population for Bluff Creek site 977306.

Figure 66. Drainage Ditch 38 Site 977311 downstream

Drainage Ditch 38 Site 977311 (Fig. 66), downstream from Chichaqua Bottoms Greenbelt, is surrounded by open field, shrubs and low trees in a primarily agricultural portion of the county.

An oily sheen due to organic decomposition was present in November 2018. Low, stagnant water occurred in March and July of 2019 and dry conditions in August and September 2019.

All reported nitrate concentrations were 0 mg/L (Fig. 68). Phosphate concentrations were recorded within the normal range for all but two assessments (Fig. 69). The dissolved oxygen concentrations throughout the year were low (2-6 mg/L), only reaching acceptable levels in late January 2019 (Fig. 70). Chloride concentrations were less than 31 mg/L, well within normal concentrations throughout for all assessments (Fig. 71).

The biological assessment, completed on July 18, 2019, found eleven species of benthic macroinvertebrates from medium and low quality groups resulting an IBI of 1.62857 indicating a poor benthic macroinvertebrate population at site 977311.

Figure 67. Santiago Creek Site 977322 upstream

Santiago Creek Site 977322 monitoring began in June 2017 (Fig. 67). This monitoring site is located on a shaded portion of the creek. The vegetation along the banks is primarily trees and shrubs and low growing plants and grasses.

This creek was stagnant in November 2018, freezing January through early March when snowmelt and rain replenished creek flow. By mid-June 2019 flow became stagnant and remained slow or stagnant through August 2019.

Nitrate concentrations remained within the normal range (0-5 mg/L) (Fig. 68). High phosphate concentrations (0.6-1 mg/L) occurred once in June, once in July and again in September 2019 (Fig. 69). Dissolved oxygen fell below 6 mg/L three times in summer 2019 (Fig. 70). Chloride concentrations remained at or below 31 mg/L for all reported assessments (Fig. 71).

Only one species (water strider) was found during the biological assessment, completed on July 19, 2019. Because only one species was found, the IBI was not calculated.

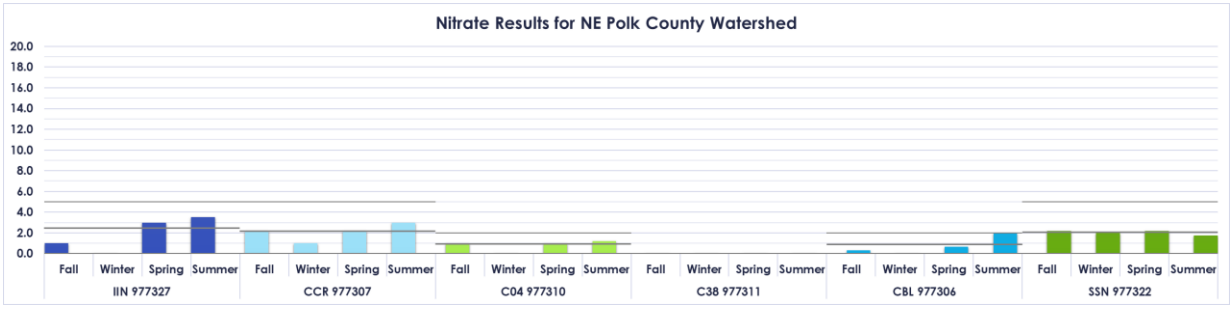

Figure 68. Seasonal Average Nitrate Concentrations NE Polk County Creek Sites Mid-September 2018 - Mid-September 2019

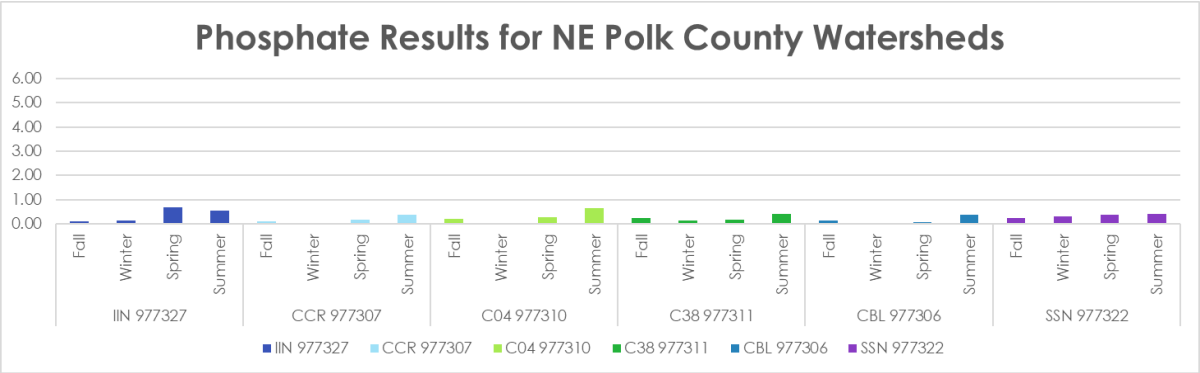

Figure 69. Seasonal Average Phosphate Concentrations NE Polk County Sites Mid-September 2018 - Mid-September 2019

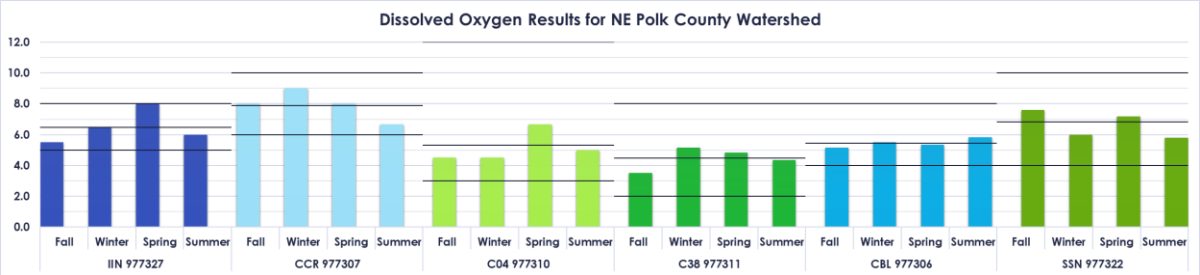

Figure 70. Seasonal Average Dissolved Oxygen Concentrations NE Polk County Mid-September 2018-Mid-September 2019

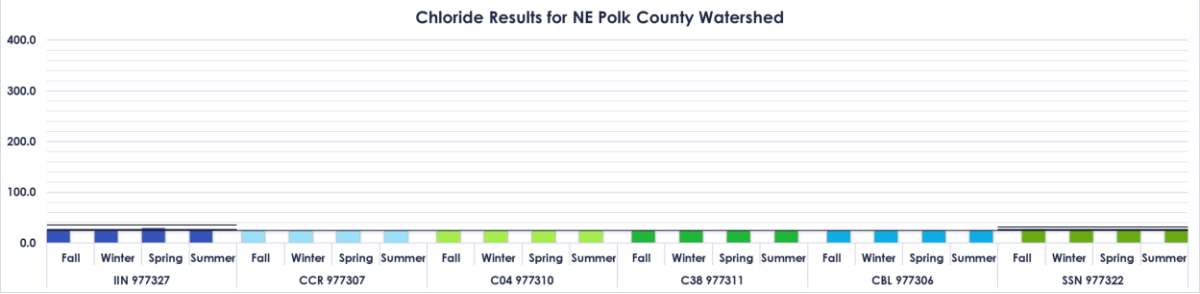

Figure 71. Seasonal Average Chloride Concentrations NE Polk County Creek Sites Mid-September 2018 - Mid-September 2019

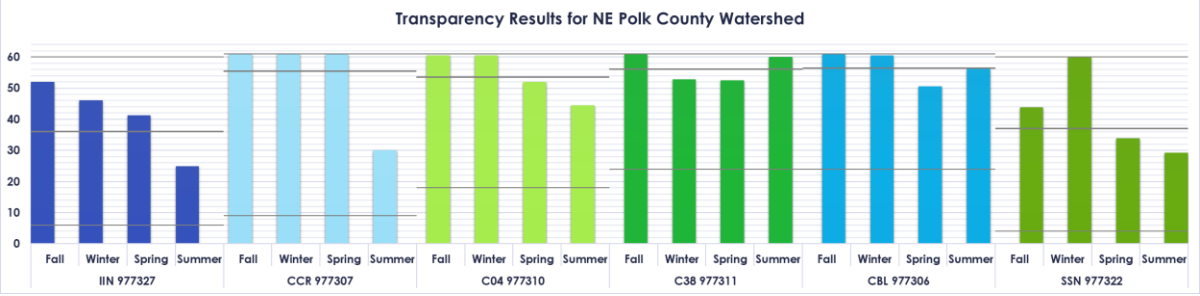

Figure 72. Seasonal Average Transparency NE Polk County Creek Sites Mid-September 2018 - Mid-September 2019

Des Moines Area Creeks

Site Number	Watershed/Area	Creek Name	Site Name
CLI 977326	Case Lake	Case Lake Inflow	Case Lake Inflow
CCW 977325	Crawford Creek	Crawford Creek	Crawford Creek at SE 9th
ELM 977323	Easter Lake	Magnolia Creek	"Unnamed Creek" at Three Lakes Estates
ELO 977275	Easter Lake	Unnamed Creek	Easter Lake Outlet
FFR 977082	Frink Creek	Frink Creek	Near Gay Lea Wilson Trail and SW 42nd
GLU 977012	Gray's Lake	* Monitoring at this site began this year	Unnamed Creek - Trib. to Grays Lake
DGE 977334	Raccoon River	Drainage creek going into northeast side Greenwood Pond near Art Center	Greenwood pond inflow on east side
DGS 977335	Raccoon River	Drainage creek leaving Greenwood Pond near Art Center	Greenwood pond outflow
DGW 977333	Raccoon River	Unnamed creek Greenwood Pond inflow on west side	Greenwood pond inflow on west side
DSM 977328	Des Moines Area	Unnamed tributary of Des Moines River	Prospect Park
DSM 977329	Des Moines Area	Unnamed Creek	Unnamed Creek at Hartford Avenue and Des Moines River Trail

Table 5. Des Moines Area Water Quality Monitoring Sites

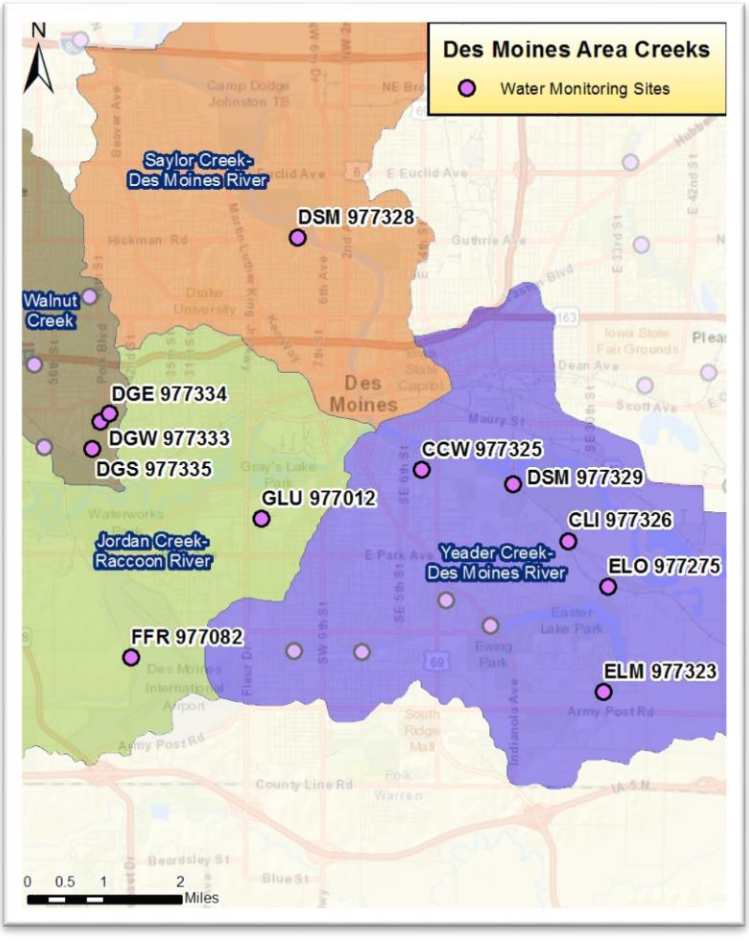

Figure 73. Des Moines Area Water Quality Monitoring Sites

Eleven sites in the Des Moines area encompass various watersheds. One of these sites was added in May 2019 (Fig. 72). Two of the sites, Prospect Park Site 977328 and Hartford Avenue Site 977329, are in the Des Moines River watershed. Three new sites flow into or out of Greenwood Pond are in the Raccoon River watershed.

Frink Creek Site 977082 and the unnamed creek near Gray's Lake Site 977012 are in the Raccoon River watershed. Magnolia Creek Site 977323 (Easter Lake Area), Crawford Creek Site 977325, Case Lake Inflow Site 977326 and Easter Lake Outflow Site 977275 flow into the Des Moines River watershed.

Biological assessments were completed for all but one of these sites, Prospect Park Site 977328. Two biological assessments were completed for sites (977326 and 977333) but found no benthic macroinvertebrates. Most site assessments reported IBI results which indicate fair benthic macroinvertebrates present.

Figure 74. Case Lake Outlet Site 977326 no photograph available

Case Lake Inflow Site 977326 (Fig. 74) is located south of James W. Cownie Soccer Park on Hartford Avenue in Des Moines. The monitoring site is located in an area with little tree cover and steeply sloped grassy banks.

This site was frozen and unable to be monitored from December 2018 through early March 2019. Flooding followed the frozen conditions preventing monitoring in mid-March 2019. In May, mid-July through August 2019, stagnant water conditions were recorded. Unusual water colors of milky and gray were reported at this site in fall 2018 and again in spring 2019. Green water was reported in summer, likely due to a rise in algae from warming waters.

Nitrate concentrations ranged from 0 mg/L to 2 mg/L (Fig. 90). Phosphate were normal except during spring 2019 and again in mid-August 2019 when concentrations reached 0.6 mg/L and 0.8 mg/L (Fig. 91). Low dissolved oxygen concentrations of 4 mg/L, 5mg/L and 6 mg/L were recorded throughout the 2018-

2019 water quality monitoring period (Fig. 92). Chloride concentrations ranged from 37 mg/L to 72 mg/L (Fig. 93).

The biological assessment was completed on July 15, 2019, for Case Lake Site 977326 but no benthic macroinvertebrates were found therefore no IBI was calculated.

Figure 75. Crawford Creek Site 977325 July 5, 2017

Crawford Creek Site 977325 (Fig. 75) is located on the west side of Southeast Ninth Street between East Edison Avenue and East Hillside Avenue. This creek flows northeast into the flood control structure prior to going into the Des Moines River.

Nitrate concentrations of 0-2 mg/L were recorded for all assessments (Fig. 90). Phosphate concentrations ranged between 0 mg/L to 0.6mg/L throughout the monitoring period (Fig. 91). Low dissolved oxygen concentrations (3 – 6 mg/L) were common throughout the year, when monitored, except December 2018 through May 2019 and once in June and August 2019 (Fig. 92. One assessment in mid-March 2019 reported high chloride concentrations (118 mg/L) (Fig. 93).

The biological assessment, completed on July 15, 2019, reported two species of benthic macroinvertebrates of the middle-quality group found in large numbers. The resulting IBI of 2.000 indicated a fair benthic macroinvertebrate population at Crawford Creek site 977325.

Figure 76. Magnolia Creek Site 977323 July 5, 2017

Magnolia Creek Site 977323 (Fig. 76), located in a residential area (Three Lakes Estates) along Southeast 60th Avenue, began monitoring in early July 2018. The monitoring site is located in an open area with no trees, bordered by rip rap, grass, and low growing plants.

No monitoring data was obtained while frozen in mid-December 2018 through mid-March 2019. Sediment entered the creek due to upstream construction in May 2019. Water quality was again effected by sediment flow into the water due to water main break upstream in late June 2019. Stagnant water was reported in mid-July and early August 2019.

Nitrate concentrations ranged from 0 mg/L to 2 mg/L (Fig. 90). Phosphate concentrations were 0 mg/L to 0.4 mg/L (Fig. 91). Low dissolved oxygen results (3 mg/L to 5 mg/L) occurred June through September 2019 (Fig. 92). One chloride concentration of 118 mg/L was reported in mid-March (Fig. 93).

The biological assessment was completed on July 15, 2019. Four species of benthic macroinvertebrates were identified and resulted in an IBI of 1.596 indicating a poor benthic macroinvertebrate population for Magnolia Creek site 977323.

Figure 77. Easter Lake Outlet Site 977275

Easter Lake Outlet Site 977275 (no site photograph available) is north of Easter Lake at Hartford Avenue surrounded by fields and forest. The location of the monitoring site is located in a portion of the outlet with an open canopy with banks covered primarily by grass and low growing plants. Monitoring at the site began in August 2018.

Flooding occurred in October 2018 and again in March through April 2019, and was frozen mid-December 2018 through mid-March 2019, preventing data collection. Few abnormal readings were recorded on the completed assessments. Nitrate concentrations were all normal (Fig. 90). High phosphate concentrations were reported twice in July 2019 (Fig. 91). Dissolved oxygen concentrations were abnormal (3-5 mg/L) in in September and December 2018 and July 2019 (Fig. 92). Chloride remained normal throughout the year except in May 2019 when a chloride concentration of 129mg/L was recorded (Fig. 93).

Despite chemical assessment readings being within the normal range throughout much of the year, our field monitor noticed physical conditions and abnormal chemical concentrations that that warranted further investigation. In July, Justin D'Souza with the City of Des Moines noticed cloudy, green/gray water with an odor at the sampling location. He also has high phosphate and low dissolved oxygen readings. The polluted water was traced to the Easter Lake outflow structure where they found foamy, foggy discharge that smelled of sewage. Water samples were collected within the outflow structure as well as from the water directly below the structure and were analyzed for fecal coliform bacteria. The results of this analysis showed very low levels of E.coli, decreasing the odds of a sewage leak. A chemical analysis of the water was also completed showing high levels of chloride and phosphate. After further investigation by the City of Des Moines and Polk County Conservation staff, it was determined that the source of the polluted water was the hypolimnion (deepest part) of Easter Lake itself because the control structure gate was not properly sealed. The Iowa DNR was consulted and stated that water coming from the hypolimnion was expected to have low dissolved oxygen and high phosphate levels,

indicating that the polluted water was caused from natural processes. Polk County Conservation worked with local engineers to fix the control structure gate to prevent further discharge of water from the deeper levels of the lake.

Figure 78. Easter Lake Outlet Site 977275 July 2019

Figure 79. Easter Lake Outlet Site 977275 August 2019

The biological assessment was completed July 15, 2019. Four species of benthic macroinvertebrates were found most of the middle-quality group which resulted in an IBI of 1.9688 indicating a fair benthic macroinvertebrate population.

Figure 80. Gray's Lake Creek Site 977012

Gray's Lake Creek Site 977012 (Fig. 80) is on the unnamed creek at the First Unitarian Church which flows from a residential neighborhood to Gray's Lake. This site is primarily shaded by trees. Banks are lined with mature trees and low growing plants. Monitoring began on this site in May 2019.

Foam was discovered on this site on June 19, 2019 (Fig. 81). The foam is likely from naturally occurring decomposition as there was no odor or abnormal results associated with it. Nitrate concentrations were all normal (0 mg/L – 2 mg/L) at this site (Fig. 90). Phosphate concentrations were above normal (0.6 mg/L) from mid-June through September 2019 (Fig. 91). A low dissolved oxygen result of 5 mg/L was reported in early May 2019 (Fig. 92). Chloride concentrations ranged from 25 mg/L to 62 mg/L (Fig. 93).

Figure 81. Gray's Lake Creek Site 977012 Foam

The biological assessment was completed on July 16, 2019. Three species of benthic macroinvertebrates were found most of the middle-quality group which resulted in an IBI of 1.8125 indicating a fair benthic macroinvertebrate population.

Figure 82. Frink Creek Site 977082

Frink Creek Site 977082 (Fig. 82) is located off Park Avenue near the Great Western Trail in a forested area. Shrubs and trees line the right bank providing a partly shaded canopy. Monitoring on this site began in early July 2018.

This site was reported frozen in February through early March 2019. Flooding was reported in mid-March 2019. A fishy odor was recorded in August 2019.

Nitrate concentrations ranged from 0 mg/L to 2 mg/L (Fig. 90). Phosphate concentrations of 0 mg/l to 0.2 mg/L were recorded (Fig. 91). Dissolved oxygen concentrations were low (0.6mg/L) in October 2018, January, July through September 2019 (Fig.92). The maximum chloride concentration of 49 mg/L was recorded in November 2018 (Fig. 93).

The biological assessment was completed on July 15, 2019. Five species of benthic macroinvertebrates were identified which resulted in an IBI of 2.0 indicating a fair benthic macroinvertebrate population for Frink Creek Site 977082.

Figure 83. Greenwood Pond West Site 977333

Greenwood Pond West Site 977333 (Fig. 83) found on the west side of Greenwood Park, south of the Art Center, flows into Greenwood Pond from the residential neighborhood northwest of the pond. Monitoring on this site resumed October 2018. This site has grassy banks and is partially shaded by the nearby mature trees of the park.

Many abnormal results were reported at the Greenwood sites. Nitrate concentrations were however, all within the normal range (Fig. 90). Phosphate concentrations (0.6 – 3 mg/L) were recorded in October 2018 and May through September 2019 (Fig. 91). Low dissolved oxygen concentrations (4 – 5 mg/L) were reported in October 2018 and in August 2019 (Fig. 92). Recorded chloride concentrations (110-284 mg/L) were above normal range in spring and summer 2019 (Figs. 93).

The biological assessment was completed on July 20, 2019 but no benthic macroinvertebrates were found.

Figure 84. Greenwood Pond East Site 977334 downstream

Figure 85. Greenwood Pond East Site 977334 upstream

Greenwood Pond East Site 977334 (Figs. 84 and 85) flows into Greenwood Pond from the residential neighborhood northeast of the pond. Monitoring on this site began in July 2018. Monitoring at the site resumed October 2018.

No assessments were completed in mid-January through early March 2019. Nitrate concentrations ranged from 0 mg/L to 2 mg/L (Fig. 90). Phosphate concentrations were above normal (0.6 – 2 mg/L) in November 2018, June through early August and again in early September 2019 (Fig. 91). Low dissolved

oxygen concentrations (3 - 6 mg/L) were reported October 2018, November 2018 and June through September 2019 (Fig. 92). High chloride concentrations (129 to greater than 600 mg/L) were reported throughout the year. The spring results may have been close to meeting the chloride chronic standard (230 mg/L within a 4-day) in March 2019 with reported results of greater than 600 mg/L and 211 mg/L. (Fig. 93). Sewage and fishy odor with scum and oily residue was reported often at this site. These results appear to be due to naturally occurring organic decomposition, high precipitation and a fluctuating water table.

Figure 86. Greenwood Pond East Site 977334 oily sheen organic decay

The biological assessment was completed on July 16, 2019 and resulted in only three species of benthic macroinvertebrate found which resulted in an IBI of 2.3809 indicating a good benthic macroinvertebrate population.

Figure 87. Greenwood Pond South Site 977335

Greenwood Pond South Outlet Site 977335 (Fig. 87) flows out of Greenwood Pond from toward the Raccoon River along the Bill Riley Recreation Trail. Monitoring on this site resumed in October 2018.

Recorded nitrate concentrations were 0 mg/L for all but 3 recorded assessments (Fig. 90) One above normal phosphate concentrations of 0.8 mg/L was reported in early September but all other recorded readings (0-0.4 mg/L) were within normal range (Fig. 91). Dissolved oxygen concentrations ranged between 4 mg/L to 12 mg/L. Dissolved oxygen levels below normal (4-5 mg/L) occurred in November 2018, June through September 2019 (Fig. 92). Road salt runoff was likely the cause of the elevated chloride concentrations (129-439 mg/L) which occurred in March through early April 2019 (Fig. 93).

The biological assessment was completed on July 19, 2019, and resulted in only one species of benthic macroinvertebrate found. The calculated IBI of 2.0 would indicate a fair benthic macroinvertebrate population but due to the low numbers found, it is deemed inconclusive.

Figure 88. Des Moines Prospect Park Site 977328

Des Moines Prospect Park Site 977328 (no photograph available) was added to the Polk County Conservation Water Quality Monitoring Program in July 2018. To date, no assessments have been completed.

Figure 89. Des Moines Hartford Avenue Site 977329

Des Moines Hartford Avenue Site 977329 (Fig. 89) is on an unnamed creek at Hartford Avenue and the Des Moines River Trail, which flows directly into the Des Moines River. Monitoring on this site began in July 2018.

A rotten, organic odor was reported in early December 2018 through January 2019. Green water color was reported from May through early July 2019. An oily residue, of organic origins, was also recorded in June 2019. No other physical parameters were abnormal at that time. Nitrate concentrations (0-10 mg/L) were reported to be within the normal range throughout the year (Fig. 90). High phosphate concentrations (0.6-0.8 mg/L) were reported four times (Fig. 91). Reported dissolved oxygen concentrations (8-12 mg/L) remained within the normal range (Fig. 92). Chloride concentrations remained low (<27-72 mg/L) except during the winter when road salt runoff was likely the cause. January through early March, chloride concentrations ranged from 141 to 227 mg/L, above the 100 mg/L threshold (Fig. 93).

The biological assessment was completed on July 19, 2019. The IBI was calculated as 2.0 which would indicate a fair benthic macroinvertebrate population present but because only one species was found, the result is deemed inconclusive.

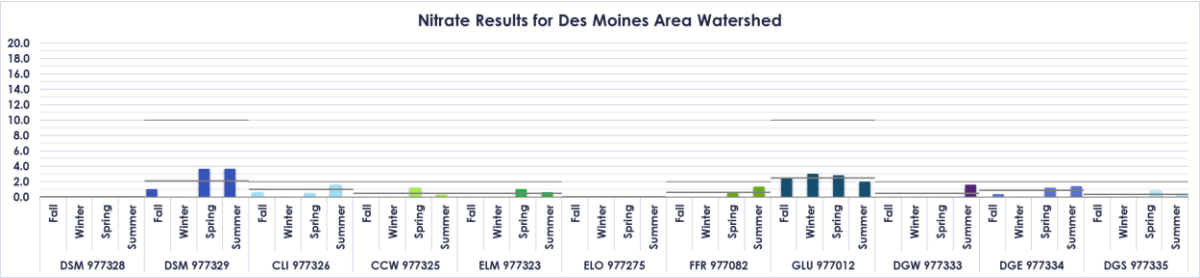

Figure 90. Seasonal Average Nitrate Concentrations for Des Moines Area Creek Sites Mid-September 2019 - Mid-September 2019

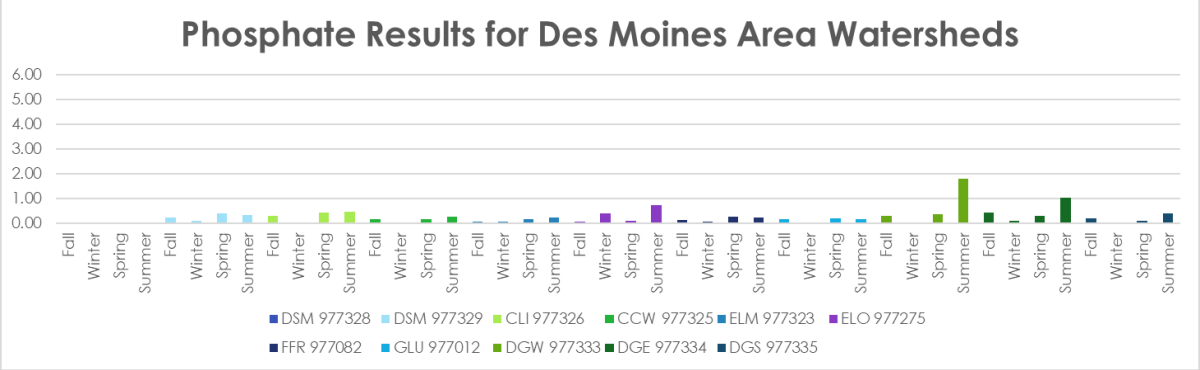

Figure 91. Seasonal Average Phosphate Concentrations for Des Moines Area Creek Sites Mid-September 2019 - Mid-September 2019

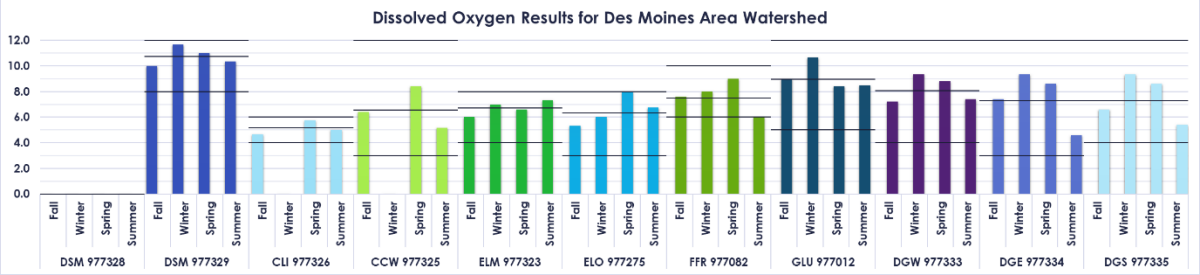

Figure 92. Seasonal Average Dissolved Oxygen Concentrations for Des Moines Sites Mid-September 2019 - Mid-September 2019

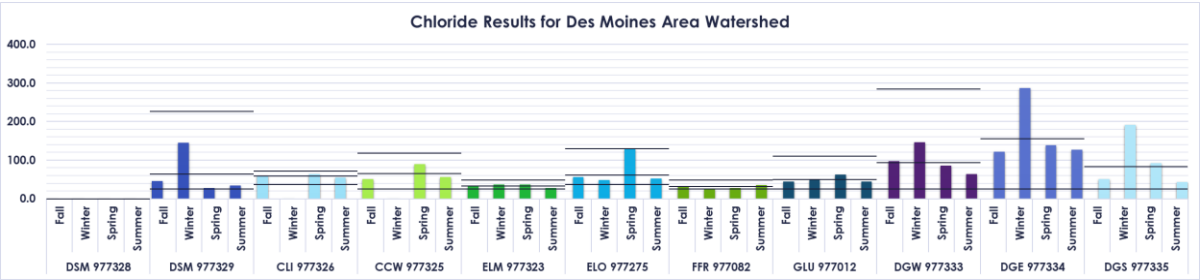

Figure 93. Seasonal Average Chloride Concentrations for Des Moines Sites mid-September 2019 - Mid-September 2019

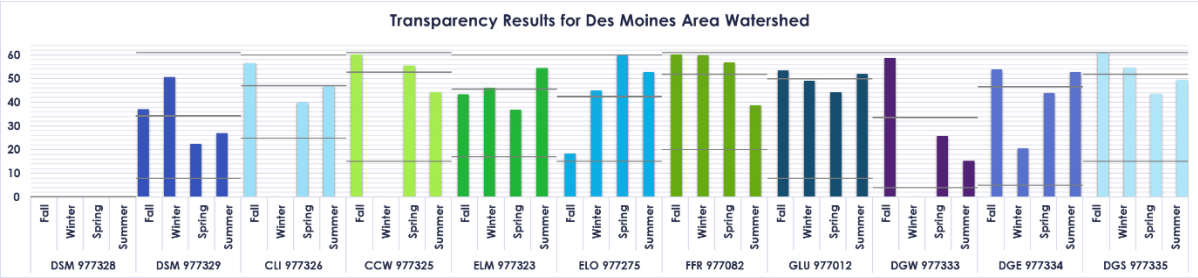

Figure 94. Seasonal Average Transparency for Des Moines Area Creek Sites Mid-September 2019 - Mid-September 2019

Fourmile Creek Watershed

Site Number	Creek Name	Site Name
FFM 977331	Unnamed Creek-into Fourmile Creek	Unnamed Creek in Alleman Country Estates
FFM 977332	Fourmile Creek	Fourmile Creek west of Alleman Country Estates
FDR 977309	Fourmile Creek Tributary - Deer Creek	Deer Creek
FFM 977072	Fourmile Creek	Polk County Snapshot (Site FMC1 - Fourmile Creek)
FFM 977075	Fourmile Creek	Polk County Snapshot (Site FMC3 - Fourmile Creek)
FFM 977301	Fourmile Creek	Fourmile Creek
FFM 977078	Fourmile Creek	Polk County Snapshot (Site FMC6 - Fourmile Creek)
FFM 977079	Fourmile Creek	Polk County Snapshot (Site FMC7 - Fourmile Creek)
FFM 977043	Fourmile Creek	Fourmile Creek at Sargent Park
FFM 977081	Fourmile Creek	Fourmile Creek at Easton Avenue
FFM 977073	Fourmile Creek	Polk County Snapshot (Site FMC10 - Fourmile Creek)
FFM 977308	Fourmile Creek	Fourmile Creek - Vandalia Avenue
FLH 977087	Fourmile Creek - Des Moines Area	Laurel Hill Cemetery Stream
FFM 977312	Fourmile Creek	Muchiknock Creek at Fourmile Creek
FLF 977321	Little Fourmile Creek	Little Fourmile Creek at E. University in Pleasant Hill
FLF 977324	Little Fourmile Creek	Little Fourmile Creek Altoona

Table 6. Fourmile Creek Water Quality Monitoring Sites

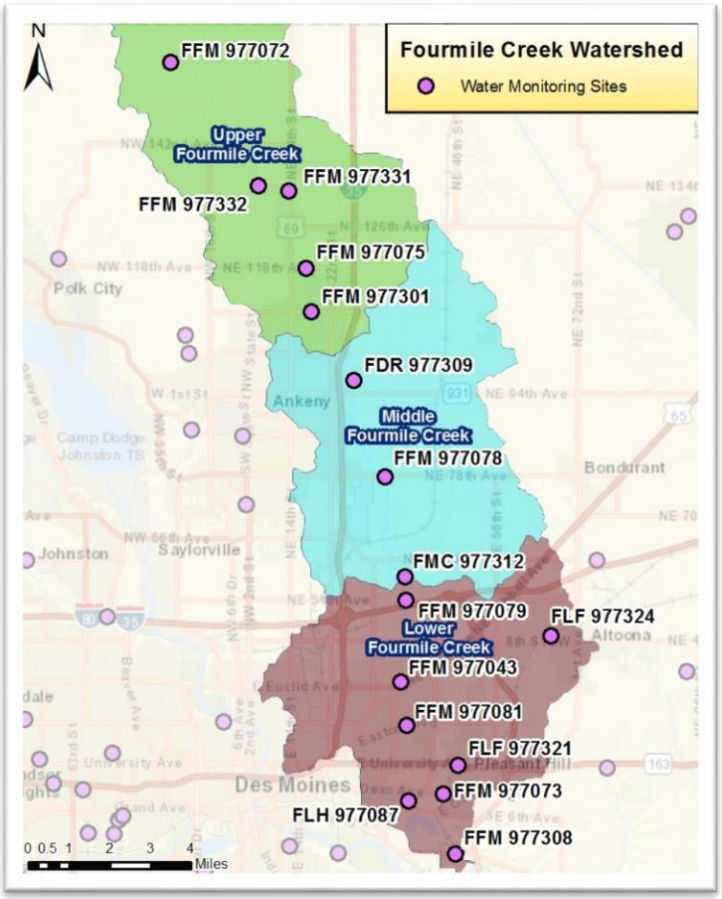

Figure 95. Fourmile Creek Watershed Water Quality

Fourmile Creek watershed is comprised of 76,600 acres of urban and agricultural land (Fig. 95). Sixteen sites are located in the Fourmile Creek watershed from far north central Polk County continuing through the county to its intersection with the Des Moines River in the southern portion of the county.

Fifteen sites were regularly monitored twice a month from mid-September 2018 through mid-September 2019. Four sites were added in the Fourmile Creek watershed in summer of 2018, one of these no longer has a field monitor assigned and is available for adoption.

The spring seasonal average nitrate concentration was at or slighter higher than the drinking water threshold on seven of the fifteen sites that were monitored (Fig. 117). Dissolved oxygen concentrations were normal for all but three sites throughout the year. One site reported low dissolved oxygen concentrations (1-5 mg/L) in December and January 2019 (Fig. 118). Phosphate concentrations were elevated once or twice during the year on many Fourmile Creek watershed sites but seasonal averages remained below the 0.6 mg/L threshold (Fig. 119). Chloride concentrations above the 100 mg/L threshold occurred from late summer 2018 through and continued through summer 2019 at one site with readings ranging 108 to 126 mg/L. Another site only had two recorded abnormal results in July (664 mg/L) and September 2019 (137 mg/L) (Fig. 120).

Biological assessments were completed for fifteen sites. The IBI calculated for each site ranged from 1.333 (poor) to 2.1 (fair).

Figure 96. Alleman Country Estates Site 977331

Alleman Country Estates Unnamed Creek Site 977331 (no photograph available) was added to the Polk County Conservation Water Quality Monitoring Program in July 2018. No assessments have been completed. This site is available for adoption.

Figure 97. Fourmile Creek West Alleman Country Estates Site 977332

Fourmile Creek West Alleman Country Estates Site 977332 (Fig. 97) was added to the Polk County Conservation Water Quality Monitoring Program in July 2018. Nine assessments were completed due to a disruption in monitoring from late October 2018 when the field monitor resigned from the program and the new field monitor began in May 2019. This site is located in an open field area in the rural northern portion of the county near the Alleman Country Estates residential area.

Nitrate concentrations remained at or below the drinking water quality threshold of 10 mg/L throughout the year (Fig. 117). Abnormal phosphate concentrations (0.6 mg/L, 1 mg/L) occurred in May and July 2019 (Fig. 118). Dissolved oxygen concentrations were 5-6 mg/L in October 2018, May, July and September 2019 (Fig. 119). Chloride concentrations remained low throughout the monitoring season (Fig. 120).

The biological assessment was completed on August 5, 2019, and resulted in nine species of benthic macroinvertebrates identified. The calculated IBI of 1.9846 would indicate a fair benthic macroinvertebrate population.

Figure 98. Fourmile Creek Site 977072 July 16, 2019

Fourmile Creek Site 977072 (Fig. 98) is the most rural sampling site in the Fourmile Creek watershed. This site is located in an open area surrounded by agricultural land.

This site was frozen in early March 2019. Nitrate concentrations were at or below the drinking water threshold of 10 mg/L throughout the year (Fig. 117). High phosphate concentrations occurred in March (0.6 mg/L) and July through September 2019 (0.6-2 mg/L) (Fig. 118). This could be due to the occasional presence of cattle upstream. Dissolved oxygen concentrations remained within normal range throughout the year (Fig. 119). All recorded chloride concentrations (<27-57 mg/L) were within the normal range throughout the year (Fig. 120). Algal mats were present in early August 2019.

Figure 99. Fourmile Creek Site 977072 Aug. 7, 2019

A biological assessment was completed for site 977072 on July 15, 2019 with four species of benthic macroinvertebrates found. The number of benthic macroinvertebrates from the low- and middle-quality group resulted in an IBI of 1.4217 which would indicate a poor population present.

Figure 100. Fourmile Creek Site 977301

Fourmile Creek Site 977301 (Fig. 100) is located north of Briarwood Golf Course in northern Ankeny. Grass dominates the stream banks providing an open canopy along this stretch of Fourmile Creek.

Like many creeks, in January through early March 2019, this site was frozen. It experienced low water flow in August and early September causing water to become stagnant. Recorded nitrate concentrations were normal throughout the year (Fig. 117). High phosphate concentrations (0.8, 2 mg/L) were detected once in September 2018 (0.8 mg/L), once in March 2019 (2 mg/L) and again in August 2019 (0.8 mg/L) (Fig. 118). Recorded dissolved oxygen concentrations (8-12 mg/L) fell within the normal range throughout the year (Fig. 119). All recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings except one in early August with a 34 mg/L result (Fig. 120). These results fall well below the 100 mg/L threshold.

The biological assessment was completed on July 15, 2019. Four species of benthic macroinvertebrates were found. Due to the number of mayflies found, a high-quality group, the IBI calculated was 2.267 indicating a good benthic macroinvertebrate population present Fourmile Creek Site 977301.

Figure 101. Deer Creek Site 977309

Deer Creek Site 977309 (Fig. 101 is located upstream from its confluence with Fourmile Creek in Ankeny. Upstream from the site are housing developments and agricultural land. This site has a partly open canopy and is lined with trees, shrubs and grass.

This site was frozen January through mid-March 2019. Nitrate concentrations of 20 mg/L were above drinking water standard in September 2018 and July 2019 (Fig. 117). Two phosphate concentrations above normal (0.6, 1 mg/L) occurred in November 2018 and August 2019 (Fig. 118). All recorded chloride concentrations and dissolved oxygen concentrations were normal (Figs. 119 and 120). Low rainfall in September 2019 resulted in stagnant water and low streamflow.

A biological assessment was completed in July 2019. Only two species of the high- and middle-quality group was found. The IBI of 2.75 was calculated which would indicate a good benthic macroinvertebrate population in this area, however with so few benthic macroinvertebrates found, the result is deemed inconclusive.

Figure 102. Fourmile Creek Site 977079

Fourmile Creek Site 977079 (Fig. 102) is located south of Mally's Weh Weh Neh Kee Park. Flooding in summer of 2018 resulted in highly eroded and unstable banks resulting in monitoring location being moved to a more accessible location nearby.

Ten times this last monitoring period this site was inaccessible due to frozen and unsafe conditions such as flooding, fast flow and deep water. Nitrate concentrations, when recorded were at or below the drinking water standard of 10 mg/L (Fig. 117). Higher than normal phosphate concentrations of 0.6 mg/L were recorded in October and November 2018 (Fig. 118). Dissolved oxygen concentrations ranged between 8 mg/L and 12 mg/L throughout the year (Figs. 119). Low chloride concentrations were recorded throughout the monitoring period with the 41 mg/L the highest recorded result, well below the 100 mg/L threshold (Fig. 120).

Figure 103. Macroinvertebrate Site 977079

A biological assessment completed August 10, 2019. Several species of benthic macroinvertebrates from the middle-quality group were found which resulted a calculated IBI of 1.900 indicating a fair benthic macroinvertebrate population may be present.

Figure 104. Muchiknock Creek Site 977312

Muchinknock Creek Site 977312 (Fig. 104) is located northeast of Mally's Weh Weh Neh Kee Park. This portion of the creek has streambanks dominated by low vegetation leaving a partly open canopy.

Cold temperatures resulted in frozen water in January, February and March 2019. Flooding or water too deep to safely access in late May and early June 2019 and stagnant water in August 2019 resulted in

limited assessment data to be gathered. All recorded nitrate, dissolved oxygen and chloride concentrations were within normal range except four phosphate concentrations (Figs. 117, 119 and 120). Higher than normal phosphate concentrations (0.6 mg/L) occurred in October, November 2018 and August 2019 (Fig. 118).

A biological assessment completed on August 10, 2019. Two species of benthic macroinvertebrates (bloodworm and rat-tailed maggot), both from the low-quality group, were found. This resulted in a calculated IBI of 1.000, indicating a poor benthic macroinvertebrate population present.

Figure 105. Fourmile Creek Site 977043

Fourmile Creek Site 977043 (Fig. 105) is located in Sargent Park. Monitoring began in June of 2018. The streambanks were recently regraded and replanted and are now covered with grass, low vegetation and rip rap leaving a partly open canopy along this area of Fourmile Creek.

Frozen water and unsafe conditions caused by flooding prevented complete assessments to be completed from January through March 2019. All recorded nitrate concentrations were found to be between 0 mg/L and 5 mg/L, within the normal range (Fig. 117). Only one recorded reading, a 0.6 mg/L phosphate concentration in September 2018, was abnormal during the monitoring period (Fig. 118). Dissolved oxygen and chloride concentrations remained normal at this site throughout the monitoring period (Figs. 119and 120).

The biological assessment was completed on September 5, 2019. Eight species of benthic macroinvertebrates were found which resulted in a calculated IBI of 2.056, indicating a fair benthic macroinvertebrate population present.

Figure 106. Fourmile Creek Site 977081

Fourmile Creek Site 977081 (Fig. 106) is located at Easton Avenue west of the Fourmile Creek Community Center. Testing here began in June of 2018. An upstream streambank stabilization project was underway in July 2019.

Assessments were unable to be completed six times due to frozen or unsafe conditions. Higher than normal phosphate concentrations (0.8-1 mg/L) occurred twice, once in September 2018 and again in September 2019 (Fig. 118). All other assessment results were within the normal range. (Figs. 117, 119 and 120).

The biological assessment completed on September 5, 2019 found eight species of benthic macroinvertebrates and resulted in a calculated IBI of 2.4857, indicating a good benthic macroinvertebrate population present.

Figure 107. Fourmile Creek Site 977073

Fourmile Creek Site 977073 (Fig. 107), is located near Sleepy Hollow. Streambanks along this section of Fourmile Creek are primarily lined with tree and shrubs.

This site was frozen from late January through early March 2019. All nitrate concentration were within the normal range (0-10 mg/L) for this monitoring year (Fig. 117). High phosphate concentrations (0.6 mg/L) occurred twice, once in September 2018 and once in June 2019 (Fig. 118). Dissolved oxygen and chloride results were within the normal range. (Figs. 119 and 120).

Figure 108. School of Fish at Fourmile Creek Site 977073

The biological assessment was completed on August 6, 2019. Three species of the high- and middle-quality groups were found and resulted in a calculated IBI of 2.9091, would indicate a good benthic macroinvertebrate population present.

Figure 109. Fourmile Creek Site 977308

Fourmile Creek Site 977308 (Fig. 109) is located at Vandalia Road near Highway 65 and is the last site before Fourmile Creek enters the Des Moines River. Streambanks along this stretch of Fourmile Creek is low growing plants and grass resulting in an open canopy.

Only four complete assessments were submitted for this site. Reported nitrate concentrations remained low (0-2 mg/L) at this site (Fig. 117). All phosphate concentrations were within normal range for the four completed assessments (Fig. 118). Very low dissolved oxygen concentrations (1-5 mg/L) occurred in December 2018 and January 2019 (Fig. 119). Recorded chloride concentrations were all below 31 mg/L (Fig. 120).

No biological assessment was completed for this site.

Figure 110. Laurel Hill Cemetery Site 977087

Laurel Hill Cemetery Site 977087 (Fig. 110) is located along Southeast 36th Street west of Laurel Hill Cemetery. Monitoring began on this site in June 2018.

Nitrate concentrations were normal (0-2 mg/L), below the abnormal threshold (Fig. 117). Recorded phosphate results (0.1 – 0.3 mg/L) were higher than many other sites reported but remained below the abnormal threshold (Fig. 118). Dissolved oxygen concentrations tended to be lower than most sites with 6 mg/L, the most common result, even in winter when dissolved oxygen concentrations rise. No results below this threshold were recorded (Fig. 119). This site reported high chloride concentrations throughout the year. Chloride results ranged from 89 mg/L to 126 mg/L (Fig. 120). A slight fishy odor was reported in early September 2019 although all other parameters were normal.

The biological assessment was completed for this site on August 9, 2019. Four species were found in low numbers which resulted in a calculated IBI of 1.333 indicating a poor benthic macroinvertebrate population present.

Figure 111. Fourmile Creek Site 977075

Fourmile Creek Site 977075 (Fig. 111) is located in northern Ankeny along the edge of a residential area. Upstream from the site is agricultural land.

Nitrate concentrations ranged from 0 to 5 mg/L, well below the Iowa drinking water standard of 10 mg/L (Fig. 117). This site reported high phosphate concentrations (0.6 - 1 mg/L) in March and August 2019 (Fig. 118). No abnormal dissolved oxygen concentrations were reported (Fig. 119). Chloride concentrations were below the minimum concentration on the chloride titrator Quantab scale for all completed assessments (Fig. 120).

The biological assessment was completed on July 19, 2019. Eight species of benthic macroinvertebrates were found for this site. The resulting IBI of 1.8444 for this site indicated a fair benthic macroinvertebrate population.

Figure 112. Fourmile Creek 977078 Downstream

Fourmile Creek Site 977078 (Fig. 112), located near Southeast Oralabor Road northeast of the airport in Ankeny, began monitoring in mid-July 2018. This site has an open canopy with vegetated banks surrounded by forest and residential area.

All parameters were within the normal range for this site. Recorded nitrate (0 – 5 mg/L) and phosphate concentrations (0 – 0.4 mg/L) remained were low throughout the year (Figs. 117 and 118). Dissolved oxygen concentrations ranged from 8-12 mg/L throughout the year, higher than the threshold of 6 mg/L (Fig. 119). Chloride concentrations were within the normal range throughout the year. They did not exceed 57 mg/L, and therefore did not seem to be affected by road salt runoff (Fig. 120).

The biological assessment for site 977078 was completed on July 19, 2019. Six species of benthic macroinvertebrates were found resulting in the calculated IBI of 2.1111 indicated this site has a fair benthic macroinvertebrate population present.

Figure 113. Little Fourmile Creek Site 977321

Little Fourmile Creek Site 977321 (Fig. 113) is located near East University in Pleasant Hill. This portion of Fourmile Creek flows is mostly shaded and bordered primarily with grass and low plants.

Nitrate concentrations were below the Iowa drinking water standard and ranged between 0 mg/L to 5 mg/L (Fig. 117). Only one reported phosphate concentration (0.8 mg/L) was over the threshold of 0.6 mg/L (Fig. 118). Dissolved oxygen concentrations were at or above 8 mg/L for all but one assessment (Fig. 119). Two high chloride concentrations (664, 137 mg/L) were recorded in July and September 2019. All other recorded results fell between 25 mg/L and 64 mg/L (Fig. 120).

Figure 114. Benthic Macroinvertebrates Site 977321

The biological assessment was completed on August 6, 2019. Four species of benthic macroinvertebrates were found and resulted in a calculated IBI of 2.389 indicates this site has a good benthic macroinvertebrate population present.

Figure 115. Little Fourmile Creek Site 977324

Little Fourmile Creek Site 977324 (Fig. 115) is located along the railroad culvert in Altoona Lion's Park. The creek, with vegetated bank lined largely with grass, low plants and trees is mostly shaded along this transect. Monitoring began in July 2018.

The recorded nitrate concentrations ranged from 0 mg/L to 5 mg/L (Fig. 117). All phosphate concentrations (0 mg/L - 0.4 mg/L) fell within normal range (Fig. 118). Two low dissolved oxygen concentrations (5, 4 mg/L) were recorded in mid-July and again in early August 2019 (Fig. 119). One chloride concentration over the 100 threshold was recorded in February 2019. Other chloride concentrations ranged between 25 mg/L to 89 mg/L (Fig. 120).

Figure 116. Mussel Found at Little Fourmile Creek Site 977324

A ten species of benthic macroinvertebrates were found during the July 16, 2019, biological assessment. The IBI of 2.1515 was calculated, which indicates a fair benthic macroinvertebrate population present at Fourmile Creek Site 977324.

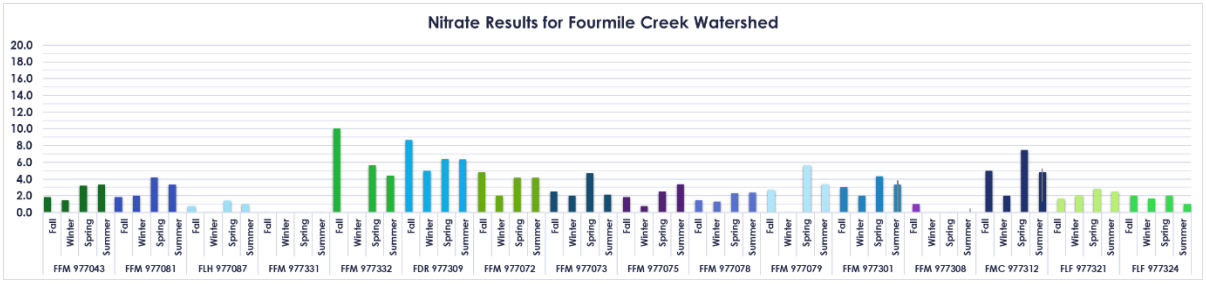

Figure 117. Seasonal Average Nitrate Concentrations for Fourmile Creek Sites Mid-September 2018 - Mid-September 2019

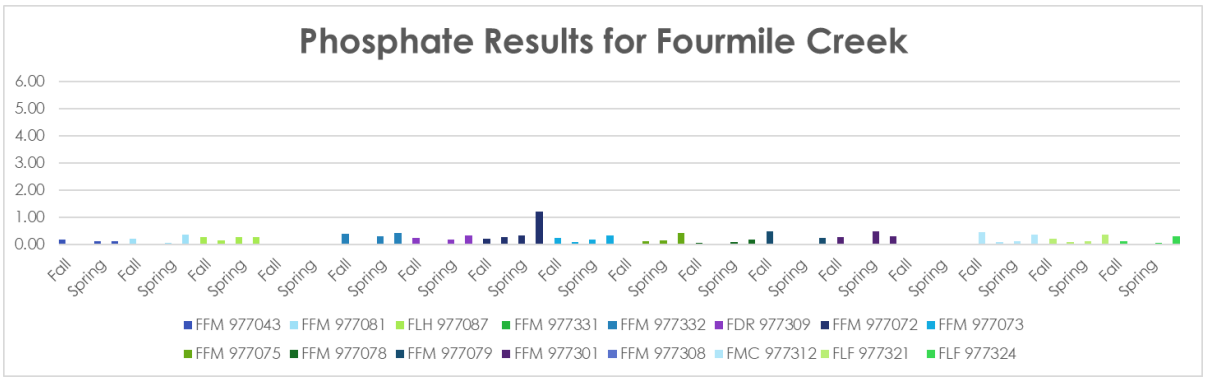

Figure 118. Seasonal Average Phosphate Concentrations Fourmile Creek Sites Mid-September 2018 - Mid-September 2019

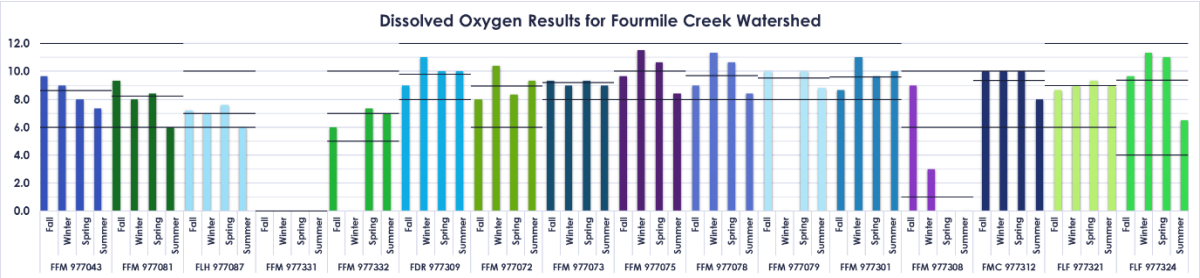

Figure 119. Seasonal Ave. Dissolved Oxygen Concentrations Fourmile Creek Sites Mid-September 2018 - Mid-September 2019

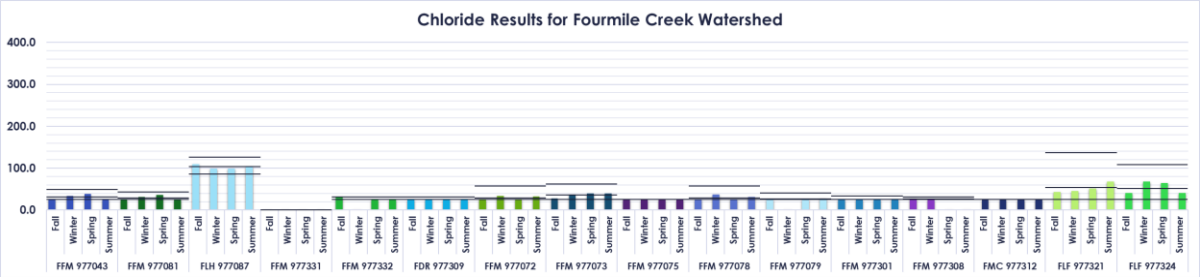

Figure 120. Seasonal Average Chloride Concentrations for Fourmile Creek Sites Mid-September 2018 - Mid-September 2019

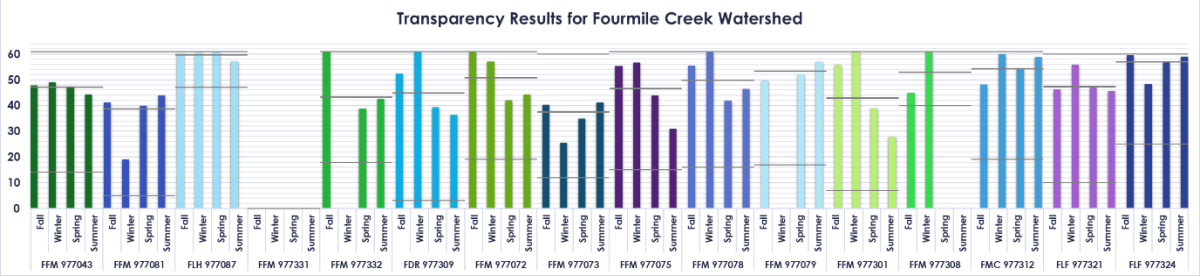

Figure 121. Seasonal Average Transparency for Fourmile Creek Sites Mid-September 2018 - Mid-September 2019

Jordan Creek

Site Number	Creek Name	Site Name
JJR 977085	Jordan Creek	Polk County Snapshot (Site JC1 - Jordan Creek)
JJR 977270	Jordan Creek	Jordan Creek at Walking Trail Bridge
JJR 977029	Jordan Creek	Jordan Creek
JJR 977150	Jordan Creek	Jordan Creek 2 - Barker Lemar

Table 7. Jordan Creek Water Quality Monitoring Sites

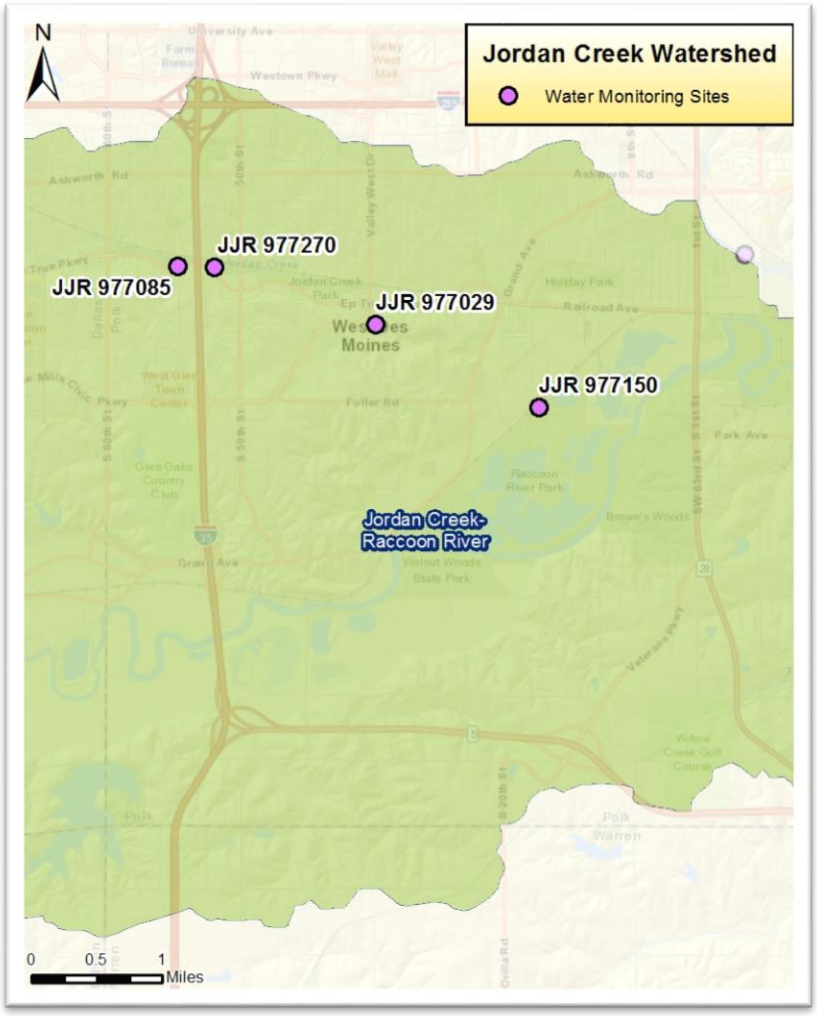

Figure 122. Jordan Creek Water Quality Monitoring Sites

Monitoring began on four sites along Jordan Creek in July 2018 (Fig. 122). Jordan Creek travels west to east through West Des Moines, primarily a suburban area. The upstream western reaches of the creek flow through an area of recent development near Jordan Creek mall.

All four sites experienced above 100 mg/L concentrations of chloride throughout most of the year(Fig. 130). Nitrate, phosphate and dissolved oxygen concentrations were all recorded within normal range on all four sites throughout the water monitoring year (Figs. 127, 128 and 129).

Biological assessments completed on the four sites resulted in IBI of 1.800 – 2.286, all indicating a fair benthic macroinvertebrate population present.

Figure 123. Jordan Creek Site 977085

Jordan Creek Site 977085 (Fig. 123) is located along the Jordan Creek Trail east of Interstate 35. This portion of the creek has an open canopy with vegetated cut banks. The left bank is covered primarily with shrubs and grass while trees dominate the other. Monitoring began in mid-July 2018.

Nitrate concentrations remained low throughout the monitoring year ranging between 0 – 2 mg/L (Fig. 127). Phosphate concentrations (0 – 0.2 mg/L) remained below the 0.6 mg/L threshold throughout the year (Fig. 128). The dissolved oxygen concentrations recorded for the 2018-2019 water monitoring year were at or above 6 mg/L (Fig. 129). High chloride concentrations over 100 mg/L were recorded January through May 2019. Results ranged from 43 – 439 mg/L (Fig. 130).

No biological assessment was completed for this site.

Figure 124. Jordan Creek Site 977270

Jordan Creek Site 977270 (Fig. 124) is located at Walking Trail Bridge north of E. P. True Parkway in West Des Moines east of Interstate 35. Trees dominate the riparian zone along this site, shading much of the creek. Monitoring began in mid-July 2018.

Nitrate concentrations remained low (0 – 2 mg/L) throughout the year (Fig. 127). Phosphate concentrations (0 – 0.2 mg/L) remained within the normal range for all recorded assessments (Fig. 128). All recorded dissolved oxygen concentrations were at or above 6 mg/L (Fig. 129). High chloride concentrations were recorded often and ranged from 49 mg/L to as high as 227 mg/L (Fig. 130).

No biological assessment was completed for this site.

Figure 125. Jordan Creek Site 977029

Jordan Creek Site 977029 (Fig. 125) is located near Mills Civic Parkway by the West Des Moines Police Department in West Des Moines. At the transect of the creek there is an open canopy bordered primarily with grass and low plants on cut, eroded banks. Monitoring began in mid-July 2018.

Nitrate (0 – 2 mg/L) and phosphate (0 – 0.2 mg/L) concentrations were recorded as normal throughout the year (Figs. 127 and 128). The recorded dissolved oxygen concentrations ranged from 6 mg/L to 10 mg/L throughout the water monitoring year (Fig. 129). High chloride concentrations (over 100 mg/L) were recorded December 2018 through September 2019 except in late May and August 2019 (Fig. 130).

No biological assessment was completed for this site.

Figure 126. Jordan Creek Site 977150

Jordan Creek Site 977150 (Fig. 126) is located in Raccoon River Park along the Jordan Creek Trail in West Des Moines. This is an industrial and recreational park area. The monitoring site is shaded by trees and shrubs which border this section of the creek. Monitoring began in mid-July 2018.

All nitrate, phosphate and dissolved oxygen concentrations were within normal range while many chloride concentrations were over the 100 mg/L threshold during the water monitoring year. Recorded nitrate concentrations were low, either 0 or 1 mg/L for each assessment (Fig. 127). Phosphate concentrations ranged from 0 mg/L to 0.3 mg/L (Fig. 128). All recorded dissolved oxygen concentration (6-10 mg/L) were within normal range (Fig. 129). Chloride concentrations ranged from 41 mg/L to 264 mg/L were recorded. Chloride results over 100 mg/L were recorded often from November 2018 through September 2019 (Fig. 130).

No biological assessment was completed for this site.

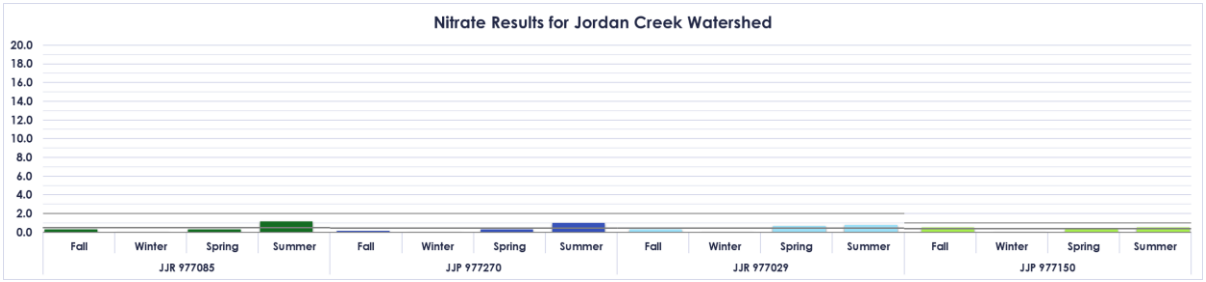

Figure 127. Seasonal Average Nitrate Concentrations for Jordan Creek Sites Mid-September 2018 - Mid-September 2019

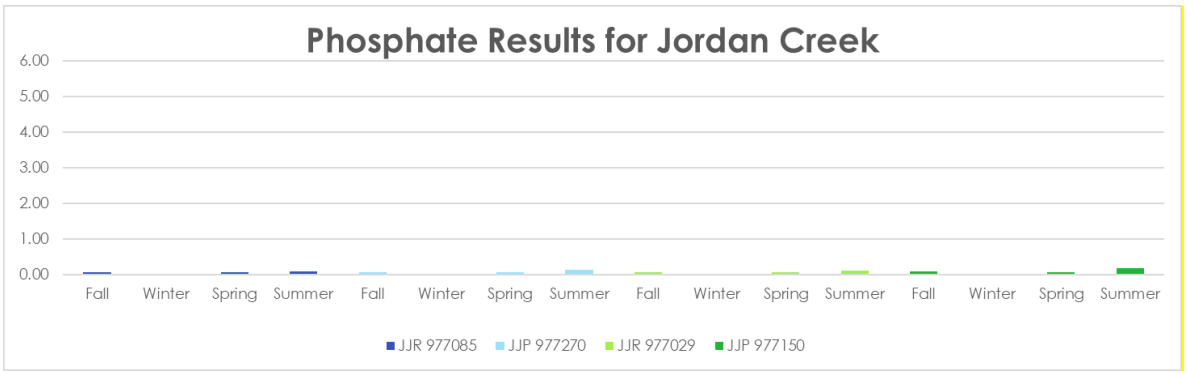

Figure 128. Seasonal Average Phosphate Concentrations for Jordan Creek Sites Mid-September 2018 - Mid-September 2019

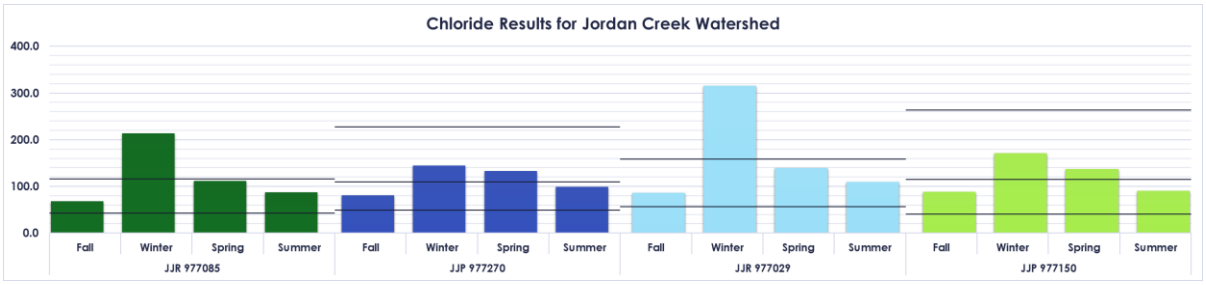

Figure 129. Seasonal Average Chloride Concentrations for Jordan Creek Sites Mid-September 2018 - Mid-September 2019

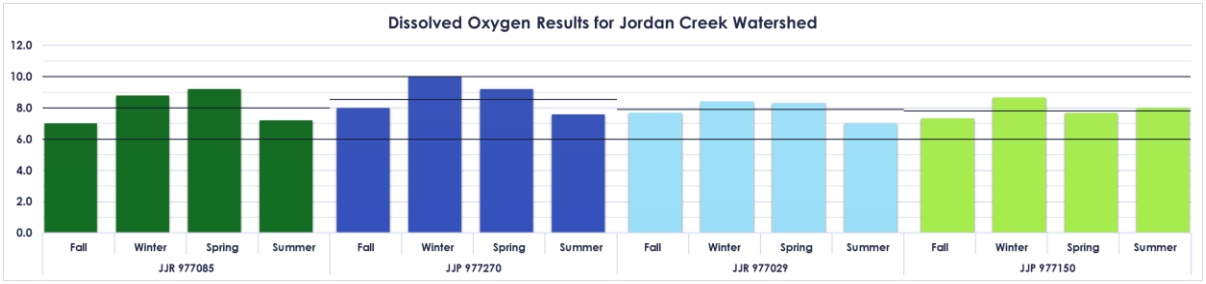

Figure 130. Seasonal Ave. Dissolved Oxygen Concentrations Jordan Creek Sites Mid-September 2018 - Mid-September 2019

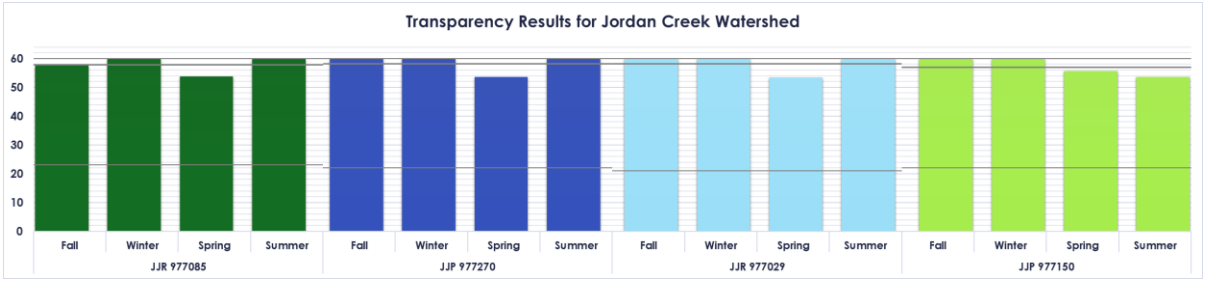

Figure 131. Seasonal Average Transparency for Jordan Creek Sites Mid-September 2018 - Mid-September 2019

Paw Creek

Site Number	Creek Name	Site Name
JPW 977300	Jester Park - Paw Creek	Paw Creek
JPW 977313	Jester Park - Paw Creek	Paw Creek-Golf Course Fork

Table 8. Paw Creek Water Quality Monitoring Sites

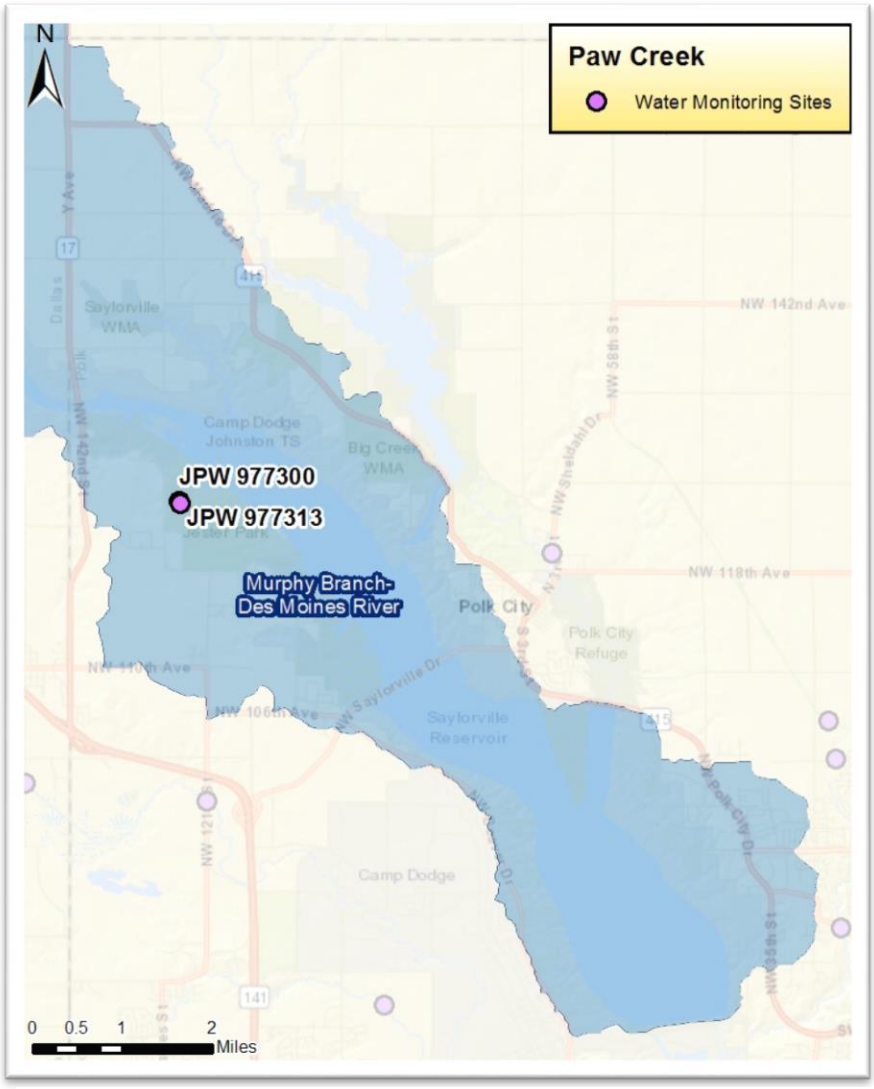

Figure 132. Water Quality Monitoring at Paw Creek

Paw Creek (Fig. 132) is located in Lewis A. Jester Park. The watershed is small and made up largely of parkland and rural area with a small housing development adjacent to the park. Two sites along Paw Creek in Jester Park were monitored. The sites are completely shaded with eroded, cut banks on both sides of creek.

Chemical/physical assessments were completed throughout the year except when frozen December 2018 through early March 2019. No data was gathered at either sites in early September 2019 when

sites were dry. A slight oily residue was discovered on both sites April 5 but there was no accompanying odor.

Figure 133. Paw Creek Site 977300

Paw Creek Site 977300 (Fig. 133) is located near the footbridge along Timber Ridge Trail. The streambed of this creek is primarily silt and mud with some cobble. Banks are cut and eroded at transect and canopy is shaded by mature trees along both banks.

Recorded nitrate concentrations were 0 to 5 mg/L throughout the monitoring year (Fig. 135). Phosphate concentrations ranged from 0 – 0.2 mg/L, all well below the threshold of 0.6 mg/L (Fig. 136). Dissolved oxygen concentrations of 8 mg/L were reported frequently throughout the year with two higher concentrations reported, a 10 mg/L in September 2018 and 12 mg/L reported in early December 2018 (Fig. 137). All recorded chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings (Fig. 138).

A biological assessment was completed on July 19, 2019. Seven species of benthic macroinvertebrates, mostly of the middle- and low-quality groups were found which resulted in a calculated IBI of 1.476 which indicated a poor population of benthic macroinvertebrates present.

Figure 134. Paw Creek Site 977313

Paw Creek Site 977313 (Fig. 134) includes the golf course tributary, which enters Paw Creek just downstream from site 977300. The canopy at this site is shaded with mature trees lining both banks.

Results were similar at both sites. Recorded nitrate concentrations were 0 to 2 mg/L throughout the monitoring year (Fig. 135). Phosphate concentrations ranged from 0 – 0.2 mg/L, all well below the threshold of 0.6 mg/L (Fig. 136). Dissolved oxygen concentrations of 8 mg/L were reported throughout the year (Fig. 137). All recorded chloride concentrations were at or below the lowest concentration on the Hach© titrator Quantab scale for all readings (Fig. 138).

A biological assessment was completed on July 19, 2019. Nine species of benthic macroinvertebrates, mostly of the middle- and low-quality groups were found which resulted in a calculated IBI of 1.520 which indicated a poor population of benthic macroinvertebrates present.

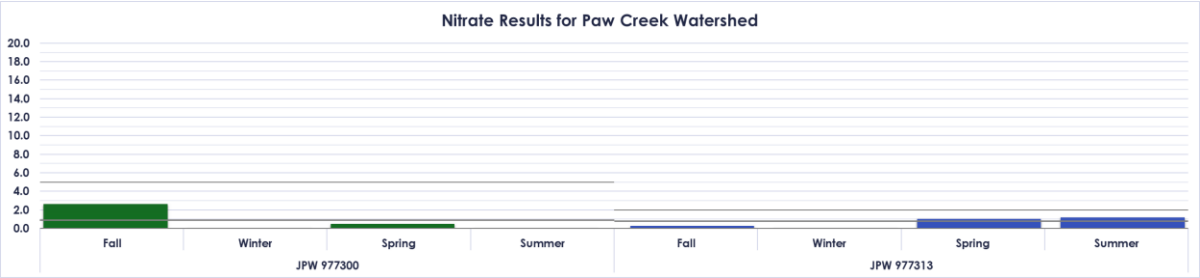

Figure 135. Seasonal Average Nitrate Concentrations for Paw Creek Sites Mid-September 2018 - Mid-September 2019

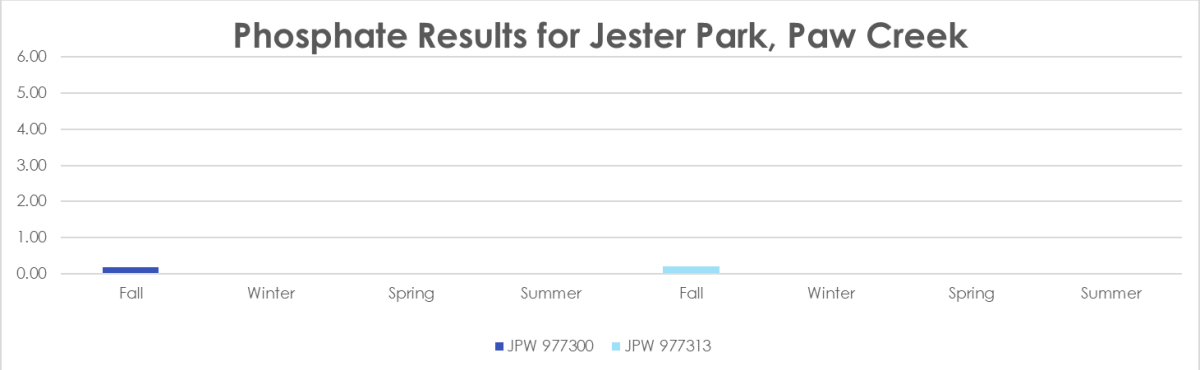

Figure 136. Seasonal Average Phosphate Concentrations for Paw Creek Sites Mid-September 2018 - Mid-September 2019

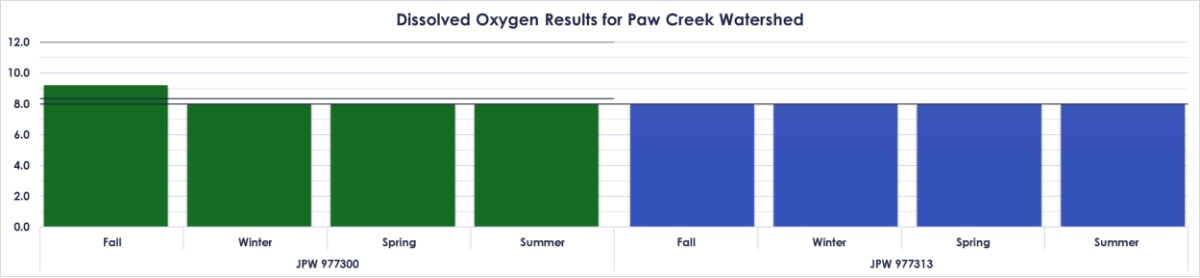

Figure 137. Seasonal Average Dissolved Oxygen Concentrations Paw Creek Sites Mid-September 2018 - Mid-September 2019

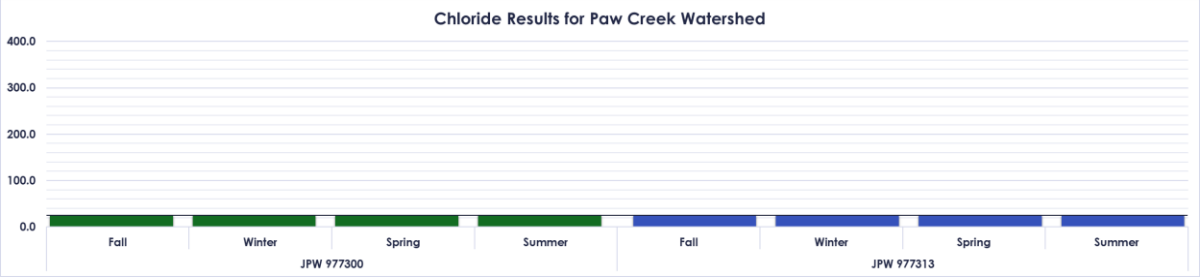

Figure 138. Seasonal Average Chloride Concentrations for Paw Creek Sites Mid-September 2018 - Mid-September 2019

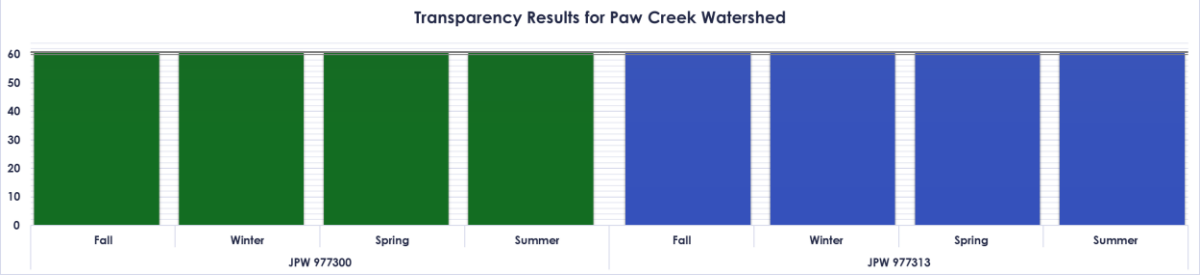

Figure 139. Seasonal Average Transparency for Paw Creek Sites Mid-September 2018 - Mid-September 2019

Rock Creek Watershed

Site Number	Creek Name	Site Name
RRO 977196	Rock Creek	Ankeny-Woodward Bike Trail & Rock Creek
RRC 977104	Rock Creek	Polk County Snapshot (Site RC1 - Rock Creek)
RRC 977105	Rock Creek	Polk County Snapshot (Site RC2 - Rock Creek)

Table 9. Rock Creek Water Quality Monitoring Sites

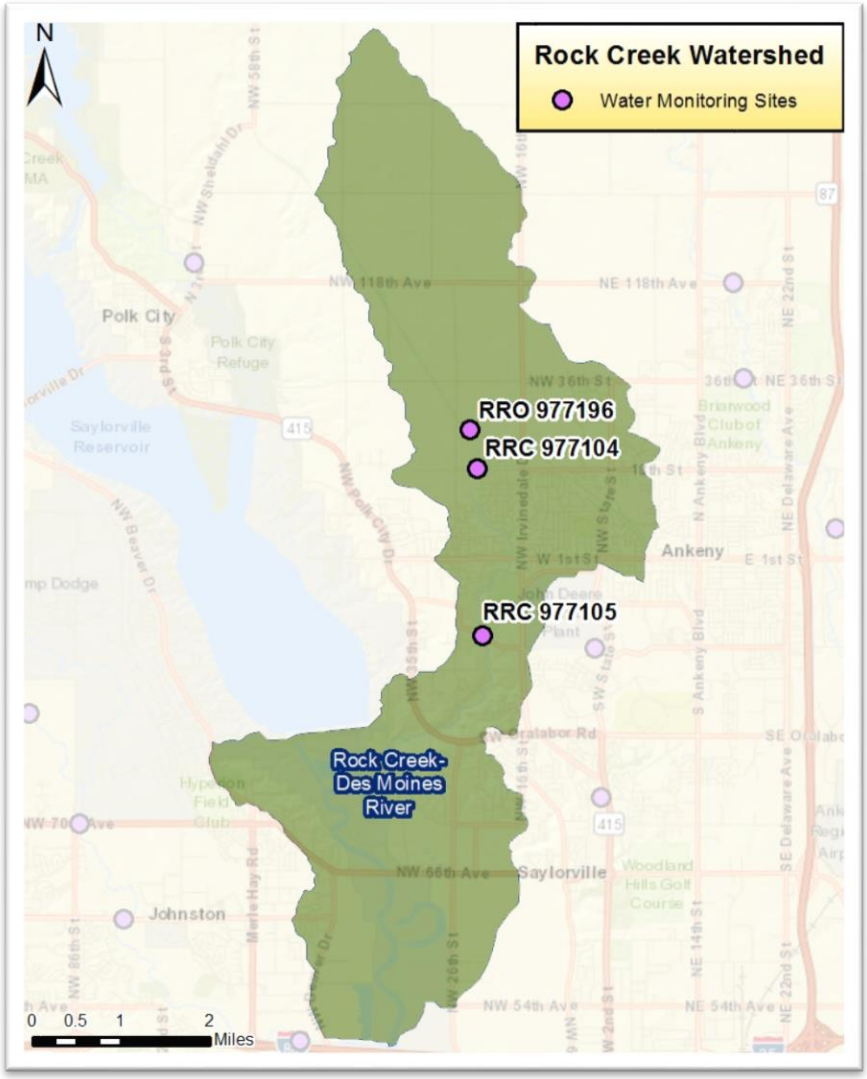

Figure 140. Rock Creek Water Quality Monitoring Sites

Rock Creek is located in Ankeny east of Saylorville Lake (Fig. 140). The watershed begins near the High Trestle (Ankeny – Woodward) Trail located in northern Ankeny along agricultural land. The creek travels south through a suburban residential area along Ankeny Golf and Country Club until it reaches the Saylorville Lake outlet channel of the Des Moines River. Monitoring began on three sites along Rock Creek in July 2018. **Rock Creek Site 977196** (Fig. 141), located on the High Trestle Trail, and **Rock Creek Site 977104** (Fig. 144), approximately 0.5 miles downstream along NW 18th Street, are surrounded by agricultural land. **Rock Creek Site 977105** (Fig. 145), located two miles south on Northwest Polk City Drive, is south of Ankeny Golf and Country Club.

Figure 141. Rock Creek Site 977196

Rock Creek Site 977196 (Fig. 141), is shaded with cut, eroded banks surrounded by trees creating a shaded canopy. The creek flows through agricultural and pastureland and along the High Trestle Trail.

Over the 2018-2019 water monitoring year, this creek site was stagnant 15 times. Monitoring was completed for all but 3 assessment periods in January and February. Recorded nitrate concentrations were within normal range for all assessments but one. Mid-June 2019, a nitrate concentration was reported as 20 mg/L (Fig. 146). Phosphate concentrations ranged from 0.2 mg/L to 0.8 mg/L with above normal concentrations reported four times (Fig. 147). One low dissolved oxygen concentration (5 mg/L) was recorded in March 2019 (Fig. 148). All recorded chloride concentrations were at or below the lowest concentration on the Hach© titrator Quantab scale for all readings (Fig. 149).

On June 5, 2019, prior to the biological assessment, Heidi Anderson, the site field monitor discovered an unusual benthic macroinvertebrate. Tadpole shrimp, (order Notostraca) is a Triops, a small crustacean, and a unique find in this area (Fig. 142).

Figure 142. Tadpole Shrimp Order Notostraca Site 977196 June 5, 2019

A biological assessment was completed on July 15, 2019. One species of benthic macroinvertebrates was found therefore the calculated IBI of 2.000 is inconclusive.

Figure 143. Benthic Macroinvertebrates Site 977196

Figure 144. Rock Creek Site 977104

Rock Creek Site 977104 (Fig. 144) is located downstream from site 977196 and flows along an agricultural field and residential area. The canopy is open with grass and low plants along the cut banks.

This site was stagnant once in September 2019. The nitrate concentrations ranged from 1 mg/L to 5 mg/L throughout the year with one exception of July 2019 when a concentration of 10 mg/L was recorded (Fig. 146). Phosphate concentrations were all but one within normal range. In August 2019, a phosphate concentration of 1 mg/L was recorded (Fig. 147). Dissolved oxygen concentration (6 - 12 mg/L) were within normal range throughout the year (Fig. 148). Chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings (Fig. 149).

A biological assessment was completed on July 19, 2019. Three species of benthic macroinvertebrates, one from each quality group, were found which resulted in a calculated IBI of 2.485 which indicated a good population of benthic macroinvertebrates present at Rock Creek Site 977104.

Figure 145. Rock Creek Site 977105

Rock Creek Site 977105 (Fig. 145) flows along fields and residential area with a mostly open canopy with trees on one bank and grass and low plants on the other.

In late winter, January through early March 2019, this portion of the creek was frozen so no assessments were completed. Nitrate concentrations were well below the abnormal threshold and ranged from 0 to 5 mg/L throughout the year (Fig. 146). Phosphate concentration of 1 mg/L occurred in August 2019, but all other recorded concentrations were within the normal range (Fig. 147). Dissolved oxygen concentrations were 10 mg/L or 12 mg/L for all but three results in June and once in August 2019 (Fig. 148). Most chloride concentrations were below the lowest concentration on the Hach© titrator Quantab scale for all readings except those in January through early March, once in April and again once in September 2019. The highest chloride concentration of 114 mg/L was recorded in early September 2019 (Fig. 149).

A biological assessment was completed on July 19, 2019. Six species of benthic macroinvertebrates were found which resulted in a calculated IBI of 2.485 which indicated a poor population of benthic macroinvertebrates present.

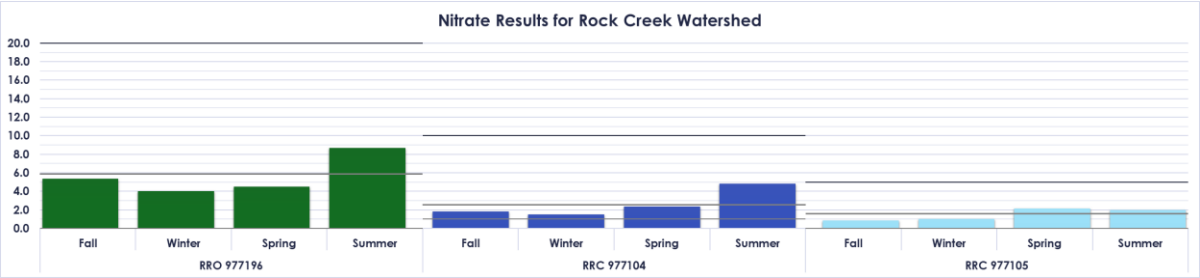

Figure 146. Seasonal Average Nitrate Concentrations for Rock Creek Sites Mid-September 2018 - Mid-September 2019

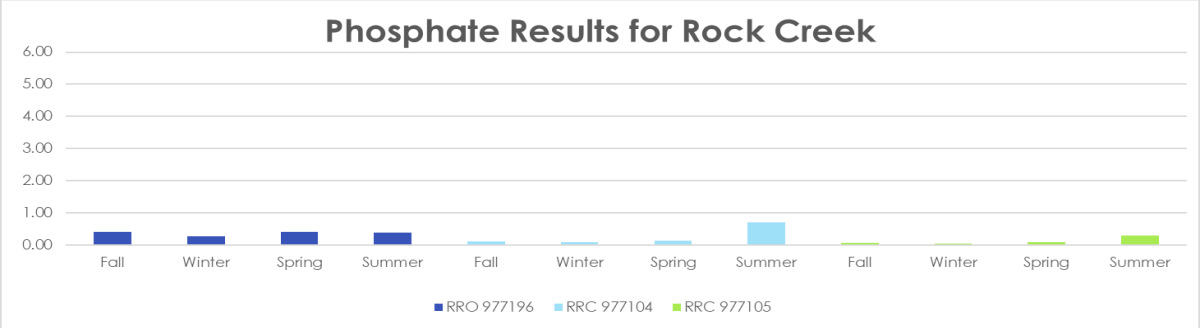

Figure 147. Seasonal Average Phosphate Concentrations for Rock Creek Sites Mid-September 2018 - Mid-September 2019

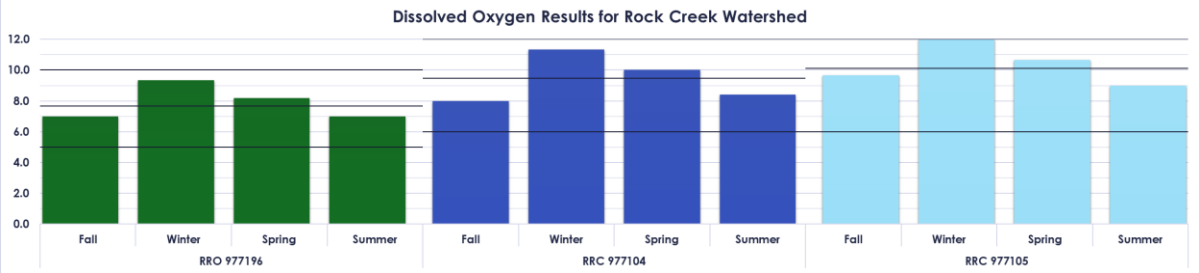

Figure 148. Seasonal Average Dissolved Oxygen for Rock Creek Sites Mid-September 2018 - Mid-September 2019

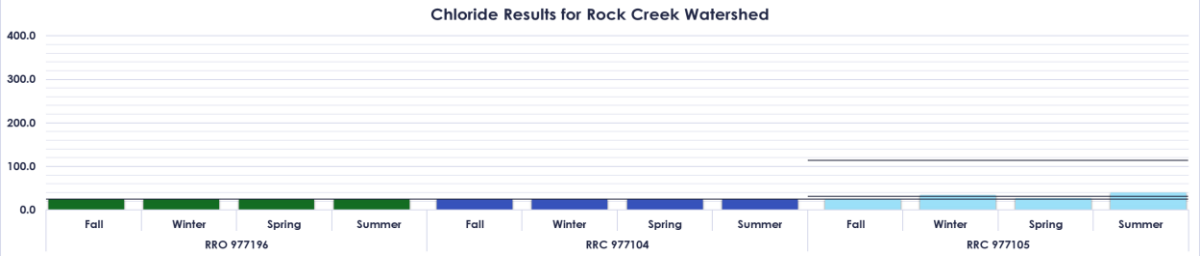

Figure 149. Seasonal Average Chloride Concentrations for Rock Creek Sites Mid-September 2018 - Mid-September 2018

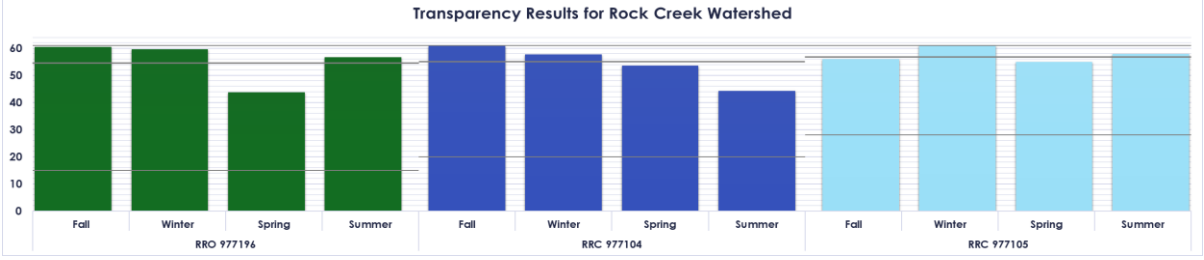

Figure 150. Seasonal Average Transparency for Rock Creek Sites Mid-September 2018 - Mid-September 2019

Saylor Creek Watershed

Site Number	Creek Name	Site Description
SSY 977189	Saylor Creek	N of Prairie Trail At Magazine
SSY 977106	Saylor Creek	Polk County Snapshot (Site Saylor Creek)

Table 10. Saylor Creek Water Quality Monitoring Sites

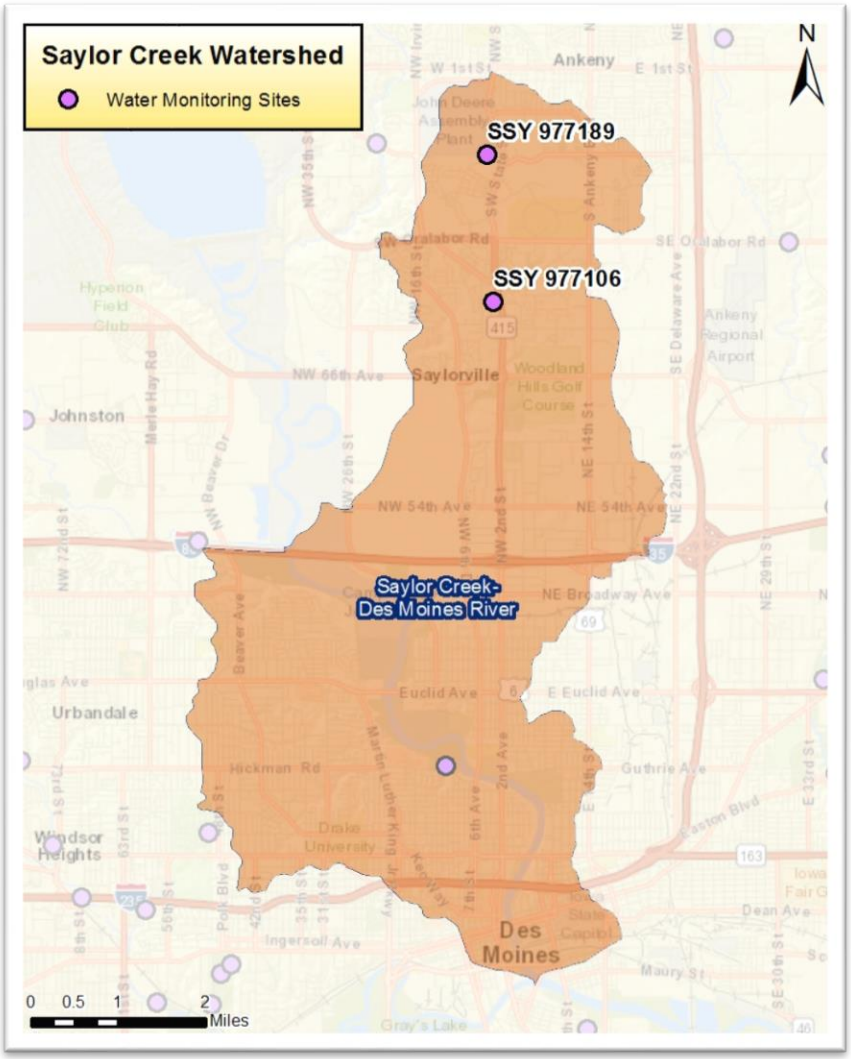

Figure 151. Saylor Creek Water Quality Monitoring Sites

Saylor Creek flows from central Ankeny, near John Deere and the DMACC campus south, to the Des Moines River (Fig. 151). Two sites along Saylor Creek were added to the PCCWQMP in July 2018. **Saylor Creek Site 977189** is located north of Prairie Trail west of Southwest State Street. **Saylor Creek Site 977106** is located approximately 1.75 miles downstream west of Southwest State Street along Northwest 72nd Place in Ankeny.

Figure 152. Saylor Creek Site 977189

Saylor Creek Site 977189 (Fig. 152) is located along a field and residential area. The left bank is primarily lined with trees with the right bank covered with grass and low plants providing an open canopy.

During the 2018-2019 water monitoring year, this site was frozen six times from January through March 2019 and was stagnant in early August 2019. All recorded nitrate concentrations were 0 mg/L for the entire year (Fig. 154). Phosphate concentrations were low (0 – 0.2 mg/L) for all completed assessments but one. In August 2019, a phosphate concentration of 1 mg/L was recorded (Fig. 155). Low dissolved oxygen concentrations (2 – 5 mg/L) were recorded in September through October 2018 and again in July 2019 (Fig. 156). Dissolved oxygen levels tend to drop in the summer. Aquatic life is most affected when levels drop below 6 mg/L. Chloride concentrations above 100 mg/L were recorded in November, December 2018, March, April and September 2019 (Fig. 157).

The biological assessment was completed on July 19, 2019. Nine species of benthic macroinvertebrates were found at Saylor Creek site 977189. The calculated IBI for site 977189 was 2.074 indicating a fair benthic macroinvertebrate community.

Figure 153. Saylor Creek Site 977106

Saylor Creek Site 977106 (Fig. 153) flows through a residential area west of Highway 415. The creek banks are covered with grass and low plants providing an open canopy.

During the 2018-2019 water monitoring period, this site was frozen five times and stagnant twice. Nitrate concentrations were 0 mg/L throughout the year except for one reading in late May that was reported as 1 mg/L (Fig. 154). Two above normal phosphate concentrations were recorded, one in late December 2018 and again in August 2019. Other phosphate concentrations ranged from 0 mg/L to 0.2 mg/L (Fig. 155). Recorded dissolved oxygen concentrations remained at or above normal ranging from 8 mg/L to 12 mg/L (Fig. 156). Chloride concentrations ranged from 25 mg/L to as high as 227 mg/L. Above normal concentrations were reported from late March through early May 2019 (Fig. 157).

A biological assessment was completed on July 19, 2019 at Saylor Creek site 977106 with several species of benthic macroinvertebrates found. IBI of 1.826 indicates a fair benthic macroinvertebrate community present.

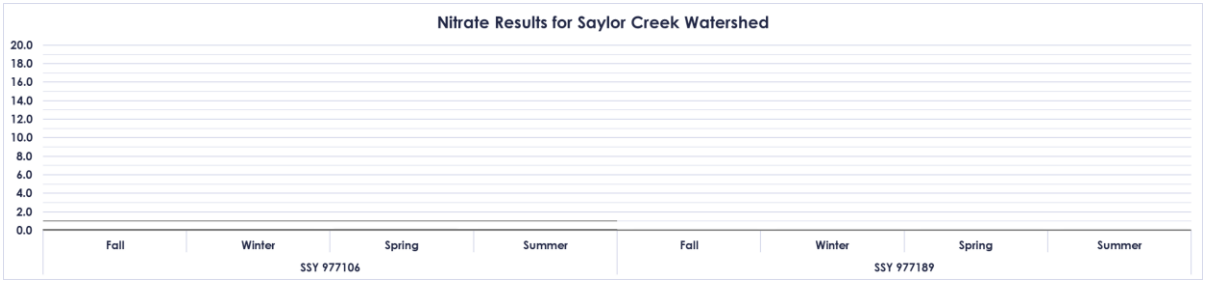

Figure 154. Seasonal Average Nitrate Concentrations for Saylor Creek Sites Mid-September 2018 - Mid-September 2019

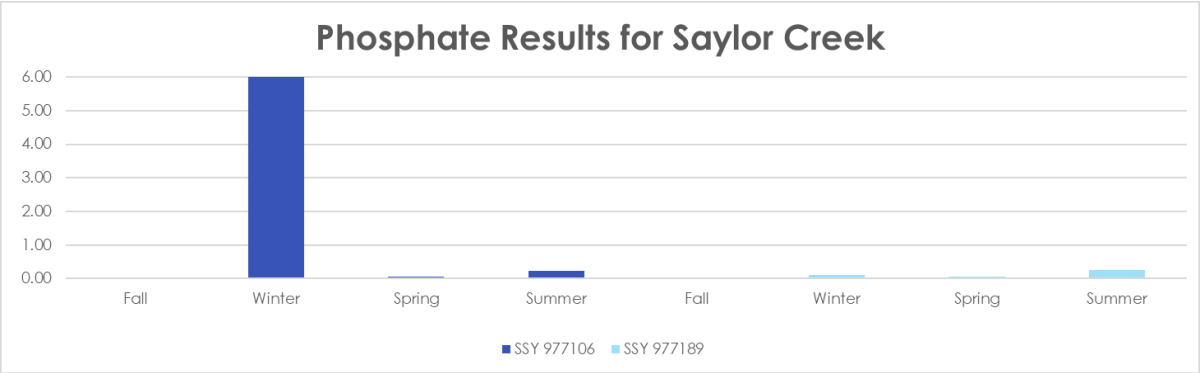

Figure 155. Seasonal Average Phosphate Concentrations for Saylor Creek Sites Mid-September 2018 - Mid-September 2019

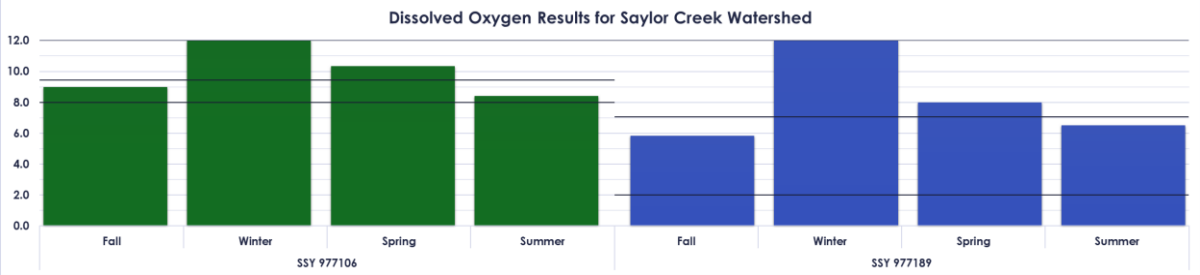

Figure 156. Seasonal Average Dissolved Oxygen Concentrations Saylor Creek Mid-September 2018 - Mid-September 2019

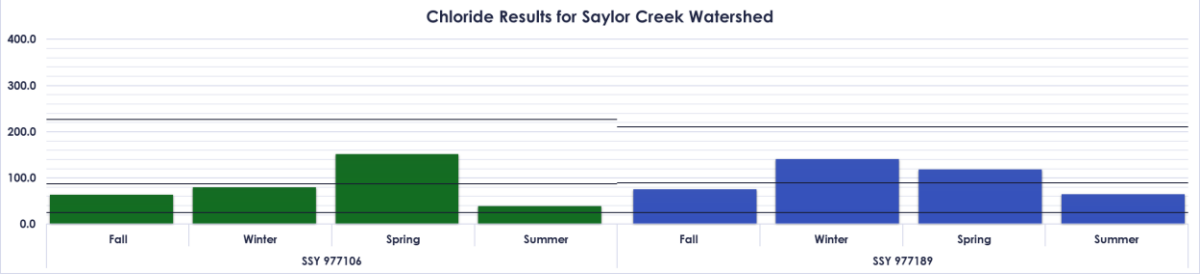

Figure 157. Seasonal Average Chloride Concentrations for Saylor Creek Sites Mid-September 2018 - Mid-September 2019

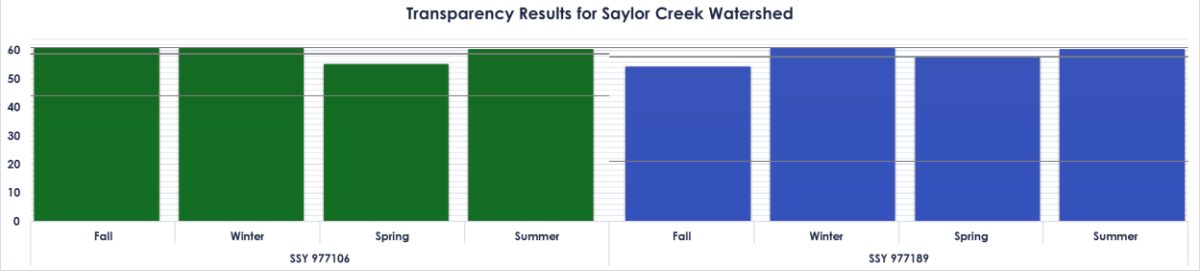

Figure 158. Seasonal Average Transparency for Saylor Creek Sites Mid-September 2018 - Mid-September 2019

Walnut Creek Watershed

Site Number	Creek Name	Site Description
WNW 977252	N Walnut Creek	North Walnut Creek Downstream of Tributary, North of Hickman Road
WNW 977257	N Walnut Creek	North Walnut Creek DS of Tributary (Storm Sewer), N of University Blvd.
WWL 977099	N Walnut Creek	Polk County Snapshot (Site NWC3 - North Walnut Creek)
WWL 977112	Walnut Creek	Polk County Snapshot (Site WC3 - Walnut Creek)
WWL 977147	Walnut Creek	Walnut Creek at Colby Park
WWL 977197	Walnut Creek	Walnut Creek at North Valley Drive
WGC 977330	Unnamed creek-tributary of Walnut Creek	Glendale Cemetery
WGL 977109	Golf Creek – tributary, Walnut Creek	Golf Creek- Exiting Waveland Golf Course

Table 11. Walnut Creek Water Quality Monitoring Sites

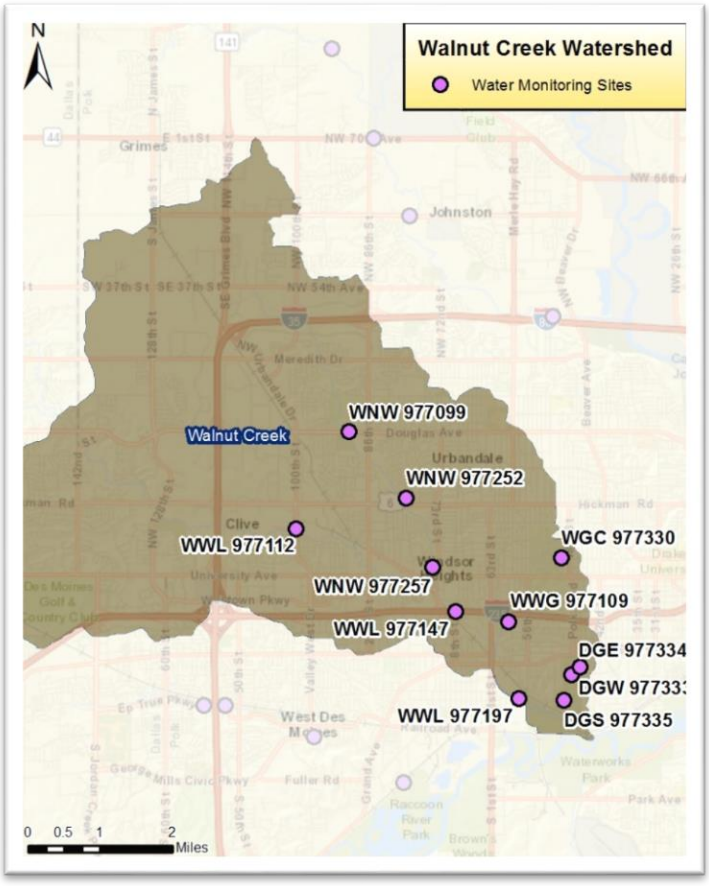

Figure 159. Walnut Creek Water Quality Monitoring Sites

The Walnut Creek watershed (Fig. 159) consists of over 83 square miles or more than 53,000 acres. Roughly, one-half of this area is developed and includes portions of the communities of Des Moines, Clive, Dallas Center, Grimes, Johnston, Urbandale, Waukee, West Des Moines and Windsor Heights. This area continues to change rapidly. As an example, over six square miles, or more than 8% of the watershed land, was developed from 2001-2011. This watershed is a source for metro drinking water.

Three water monitoring sites are located along Walnut Creek with three additional sites located along North Walnut Creek. Two sites were added in June 2018. Site 977330 is located along an unnamed creek in Glendale Cemetery. Site 977109 is located along Golf Creek downstream from Waveland Golf Course.

In May 2019, Johnston High School student, Mariel Castillo, began participating in the Polk County Conservation Water Quality Monitoring Program as part of her senior capstone project. Mariel completed the PCCWQMP training, monitors twice a month at two sites, North Walnut Creek Site 977099 and Walnut Creek site 977112 with the Polk County Conservation site field monitor and will analyze her data to complete her project.

Figure 160. Johnston High School Capstone Student Mariel Monitoring at Site 977099 Fall 2019

Figure 161. North Walnut Creek Site 977099

North Walnut Creek Site 977099, (Fig. 161) is located along the trail at Walker Johnson Park in Urbandale just south of the Douglas Avenue Bridge. A box culvert upstream and a small drainage pipe on the left bank can be found north of the site. The banks are mostly rip rap and grass covered providing an open canopy at the site location then becomes treed as it flows south through the park.

This site had one recorded sewage smell in early October 2018 and was frozen twice during the 2018-2019 reporting period. Nitrate concentrations ranged from 0 mg/L to 2 mg/L, well below the abnormal threshold (Fig. 172). One high phosphate concentration of 0.6 mg/L in August 2019 (Fig. 173). Recorded dissolved oxygen concentrations ranged from 6 mg/L to 12 mg/L (Fig. 174). High chloride concentrations (102 - 196 mg/L) occurred in February, April, May, June and September 2019 (Fig. 175). This location has direct runoff from a road, a paved trail and Walker Johnson Park parking lot, so the salt-laden runoff could explain the high winter and spring chloride levels.

A biological assessment was completed in July 15, 2019. Ten species of benthic macroinvertebrates were found, from the middle and poor quality groups. The resulting IBI of 1.3462 indicates a poor benthic macroinvertebrate community present.

Figure 162. North Walnut Creek Site 977252

North Walnut Creek Site 977252 (Fig. 162) is located north of Hickman Road west of Colby Woods Drive in a residential area. The site is partly shaded by some trees and shrubs along the banks. Monitoring began on this site in May 2017. On June 30, 2018, flooding caused substantial bank erosion so the site was closed until May 2019 when a new access location was found upstream.

All but two results were within the normal range. Nitrate concentrations ranged from 0 mg/L to 2 mg/L (Fig. 172). Phosphate concentrations ranged from 0 to 0.2 mg/L (Fig. 173). Dissolved oxygen concentrations ranged from 5 mg/L to 8 mg/L (Fig. 174). A high chloride concentration of 137 mg/L was recorded in May 2019, all other concentrations fell between 50 mg/L and 74 mg/L (Fig. 175).

A biological assessment was completed on July 18, 2019. Only four species of the high- and middle-quality group was found. The IBI of 2.045 was calculated which would indicate a fair benthic macroinvertebrate population in this area, however with so few benthic macroinvertebrates found, the result is deemed inconclusive.

North Walnut Creek Site 977257 (no site photo available) is just over one mile downstream from site 977252. No biological assessment was completed due to the extreme flooding event in early July 2018. There is no longer safe access to this site. This site is no longer being monitored.

In the September 6, 2019, issue of *News from Des Moines Water Works,* citizens were warned to be watchful of the presence of blue-green algal blooms also known as cyanobacteria. The cyanotoxins, produced by certain types of cyanobacteria, may results in illness if humans and animals come in direct contact, ingest, or inhale the toxins. In the summer, the Iowa Department of Natural Resources monitors weekly for such toxins at state park beaches but streams, rivers and ponds are not monitored and are also susceptible. In fall of 2019, harmful blue-green algae blooms were being discovered in Polk County. The source of this bloom was traced to County Club Lake in Clive. Because the water runs from Country Club Lake into Walnut Creek, two water quality monitoring sites along experienced this algal bloom, one in Clive, and later a small amount of algae was discovered downstream at site 977147 near Colby Park in Windsor Heights (Fig. 165).

Figure 163. Algal Bloom Walnut Creek Site 977112

Figure 164. Algal Bloom in Clive 2019

Figure 165. Algae at Walnut Creek Site 977147

Figure 166. Johnston High School Capstone Student Mariel at Walnut Creek Site 977112

Walnut Creek Site 977112 (Fig. 166) is located along the Clive Greenbelt Trail west near the 100th Street bridge. This site is partly shaded by shrubs and low trees lining each sloping bank.

When frozen in late winter, no data was obtained at this site. Nitrate levels were below the drinking water standard (10 mg/L) most the year, reaching 20 mg/L in June and July 2019 (Fig. 172). There were elevated phosphate levels (0.6 mg/L and 0.8 mg/L) early February and mid-August 2019 (Fig. 173). Dissolved oxygen concentrations (6 – 12 mg/L) were within the normal range throughout the year (Fig. 174). Chloride concentrations were recorded well within normal range of below 100 mg/L throughout the year (Fig. 175).

A biological assessment was completed on July 15, 2019. Six species of benthic macroinvertebrates were found. The IBI result of 1.3571 indicated a poor benthic macroinvertebrate community.

Figure 167. Walnut Creek Site 977147

Walnut Creek Site 977147 (Fig. 167) is located along the trail at Colby Park in Windsor Heights and receives runoff from the Interstate 235 Bridge overhead. This site is mostly open with deeply incised banks which are covered with rip rap, grasses and low plants. Many culverts from neighboring business parking lots and park. A dog park is located immediately downstream.

This site was inaccessible three times during the winter due to frozen and unsafe conditions. A fishy smell was present in early August. A small amount of algae was found in early September (Fig. 165).

Nitrate concentrations remained at or below the drinking water standard of 10 mg/L (Fig. 172). Only one phosphate concentration was 0.6 mg/L, the abnormal threshold (Fig. 173). Reported dissolved oxygen concentrations ranged between 5 mg/L and 12 mg/L, only dropping below 6 once in mid-July when water temperatures were at their highest (Fig. 174). A high chloride concentrations of 110 was recorded in April 2019, but the rest ranged between 25 mg/L and 74 mg/L (Fig. 175).

The biological assessment was completed on July 15, 2019, with four species of benthic macroinvertebrates found. The calculated IBI of 2.000 indicated a fair benthic macroinvertebrate community present and possible habitat degradation, although with only four species found the IBI may not be a reliable indicator.

Walnut Creek Site 977197 (Fig. 168) is located east of 63rd Street and south of Grand Avenue in Des Moines. This site is in an open residential area down a steep bank of grass, rip rap and low growing plants. Upstream is a commercial area, residential and public athletic field.

Monitoring was interrupted often in the 2018-2019 monitoring period. Ice and unsafe winter conditions prevented monitoring in mid-January through February 2019. In early spring 2019, streambank construction closed access to this area and the adjacent Walnut Creek Trail for several weeks. Flooding and subsequent mud created from excessive rain prevented monitoring for one week.

All recorded nitrate concentrations fell between 0 mg/L and 5 mg/L (Fig. 172). All phosphate concentrations (0 mg/L – 0.3 mg/L) were within normal levels (Fig. 173). Dissolved oxygen ranged between 6 mg/L and 12 mg/L (Fig. 174). One high chloride concentration of 123 mg/L was recorded in April 2019. The rest ranged between 25 mg/L to 70 mg/L (Fig. 175).

The soil along Walnut Creek is often disturbed lending itself to the pioneering species which often include invasive species. Japanese hops, an aggressive, nonnative, invasive species is found at this location and is thriving (Fig. 168). It was reported to the City of Des Moines. The plants were removed along the Walnut Creek trail.

Figure 168. Invasive Species (Japanese Hops) at Walnut Creek Site 977197

Unfortunately litter and graffiti under bridge and on educational kiosk has been a problem at this site and many other urban sites (Fig. 169). Field monitors document and report these incidences to the appropriate organization for clean-up.

Figure 169. Graffiti at Site 977197

A biological assessment was completed on July 15, 2019. Three species of benthic macroinvertebrates were found. A calculated IBI of 1.083 indicates a poor benthic macroinvertebrate community present.

Figure 170. Walnut Creek Site 977330

Walnut Creek Site 977330 (Fig. 170) is located along an unnamed creek in Glendale Cemetery in Des Moines. This site was added in June 2018. This small creek flows through a grassy field which provides an open canopy.

Monitoring was completed for most of the 2018-2019 water monitoring year, however data was not obtained when this site was frozen in late January and again in early March 2019. The drainage pipe was plugged in May causing site to be inaccessible.

Nitrate concentrations were all well below the drinking water standard of 10 mg/L with recorded concentrations of 0 mg/L and 2 mg/L (Fig. 172). Phosphate concentrations ranged between 0 mg/L and 0.4 mg/L, all well within the normal range (Fig. 173). Dissolved oxygen were consistently low throughout the year (5 mg/L to 8 mg/L) but were most often reported as 6 mg/L (Fig. 174). Chloride concentrations ranged from 31 mg/L to 89 mg/L with no results over the 100 mg/L threshold (Fig. 175).

The biological assessment was completed on August 9, 2019 when five species of benthic macroinvertebrates were found. The calculated IBI of 1.667 indicates a poor benthic macroinvertebrate community.

Figure 171. Walnut Creek/Golf Creek Site 977109

Walnut Creek Golf Creek Site 977109 (Fig. 171), on a tributary of Walnut Creek located southwest of Waveland Golf Course in a residential neighborhood, was added in June 2018. This site has an open canopy with sloping banks covered with grass and some rip rap.

This site was frozen twice during the 2018-2019 water monitoring year. Nitrate concentrations where low, ranging from 0 mg/L to 2 mg/L (Fig. 172). One above normal phosphate concentration of 0.8 mg/L was recorded in late June 2019(Fig. 173). Dissolved oxygen concentrations ranged from 5 mg/L to 8 mg/L (Fig. 174). High chloride concentrations would be expected during times of snowmelt such as those recorded in January and March 2019, but they were reported for all assessments from late March through September 2019 except late June (Fig. 175). Prolonged exposure to concentrations above 100 mg/L has a detrimental effect on aquatic wildlife. This site will be further investigated as to source of the salinity.

The biological assessment was completed on August 8, 2019 when three species of benthic macroinvertebrates were found. The calculated IBI of 1.750 indicates a poor benthic macroinvertebrate community.

The chloride yearly average for North Walnut Creek and Walnut Creek were above normal and the dissolved oxygen yearly average was at the abnormal threshold, however, North Walnut Creek and Walnut Creek sites readings while may be detrimental to aquatic life, is safe for recreation.

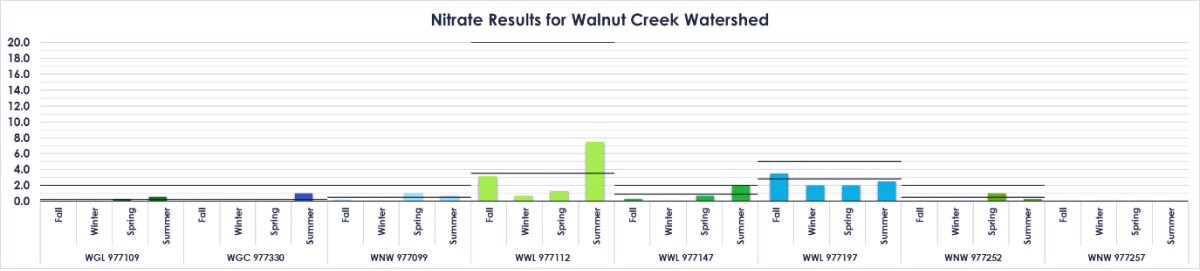

Figure 172. Seasonal Average Nitrate Concentrations Walnut & North Walnut Creek Sites Mid-Sept. 2018 - Mid-Sept. 2019

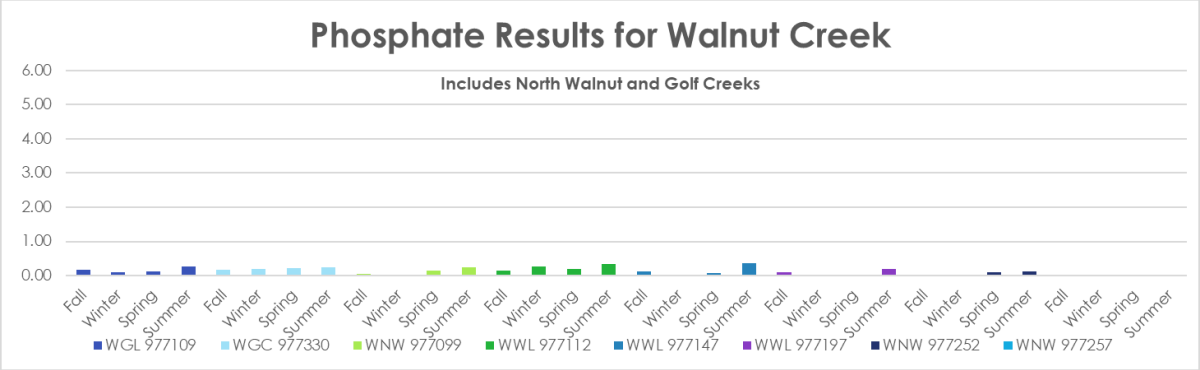

Figure 173. Seasonal Average Phosphate Concentrations Walnut & North Walnut Creek Sites Mid-Sept. 2018 - Mid-Sept. 2019

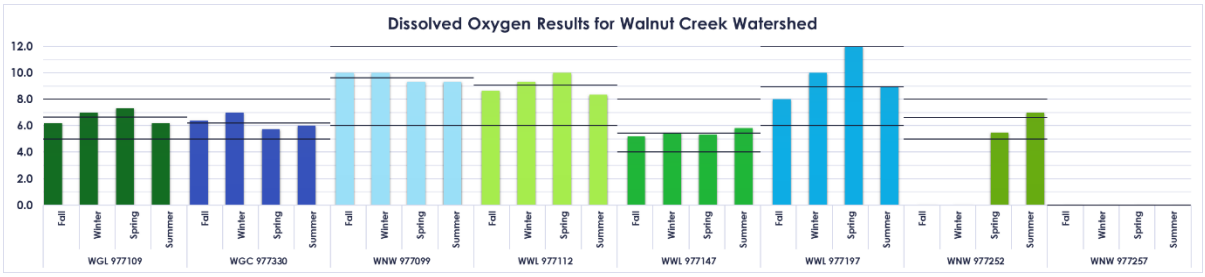

Figure 174. Seasonal Ave. Dissolved Oxygen Concentrations Walnut & North Walnut Creek Sites Mid-Sept. 2018 - Mid-Sept. 2019

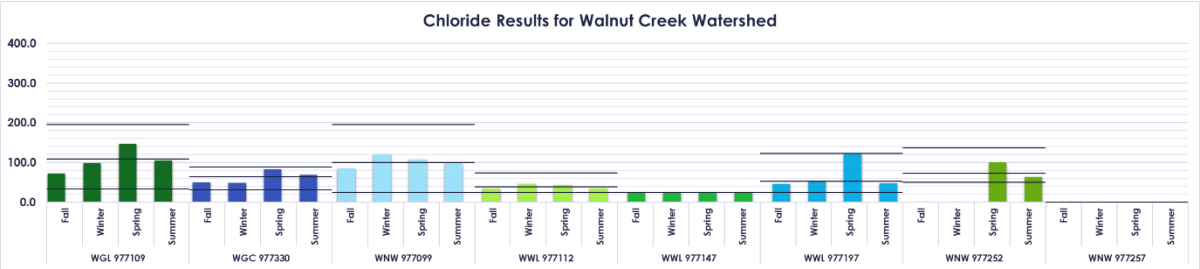

Figure 175. Seasonal Average Chloride Concentrations Walnut & North Walnut Creek Sites Mid-Sept. 2018 - Mid-Sept. 2019

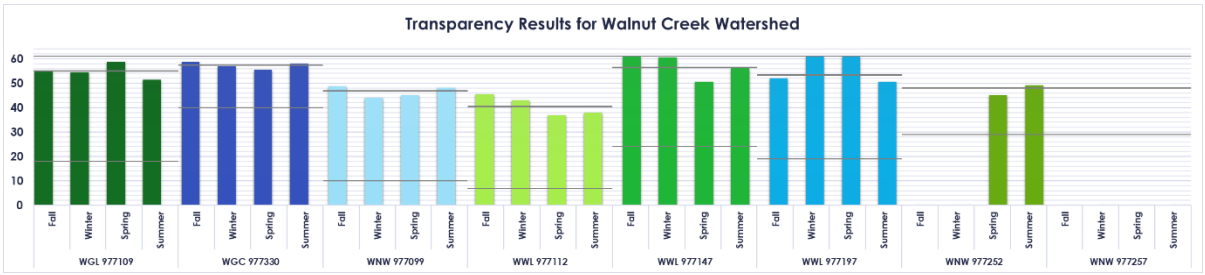

Figure 176. Seasonal Average Transparency Walnut & North Walnut Creek Sites Mid-Sept. 2018 - Mid-Sept. 2019

Yeader Creek Watershed

Site Number	Creek Name	Site Name
YYD 977273	Yeader Creek	Yeader Creek OP
YYD 977305	Yeader Creek	Yeader Creek - S Union
YYD 977003	Yeader Creek	Yeader Creek
YYD 977117	Yeader Creek	Polk County Snapshot (Site YC2 - Yeader Creek)

Table 12. Yeader Creek Water Quality Monitoring Sites

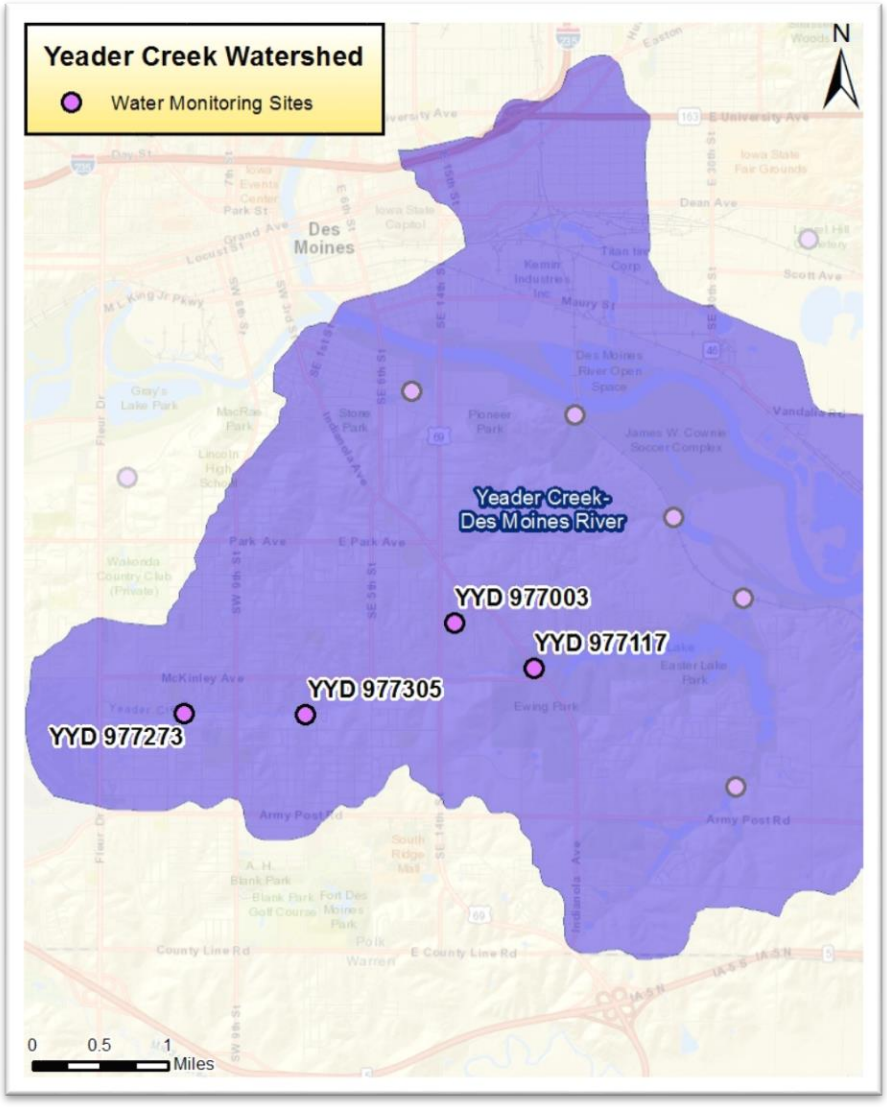

Figure 177. Yeader Creek Water Monitoring Sites

Yeader Creek watershed is a 3,630-acre area of primarily urban, residential and commercial land. Four sites along the 3.5-mile stream were sampled (Fig. 177). Yeader Creek Site 977273 is approximately one-half mile east of the Des Moines International Airport. This site is shallow, narrow and shaded. As you

travel east along the creek, depth and width typically increase and vegetation along the creek decreases. The creek eventually discharges into Easter Lake.

Planned restoration at Easter Lake was completed in the spring of 2019. Due to heavy snowpack and rain, the lake filled before its projection, reaching normal pool on March 13, 2018.

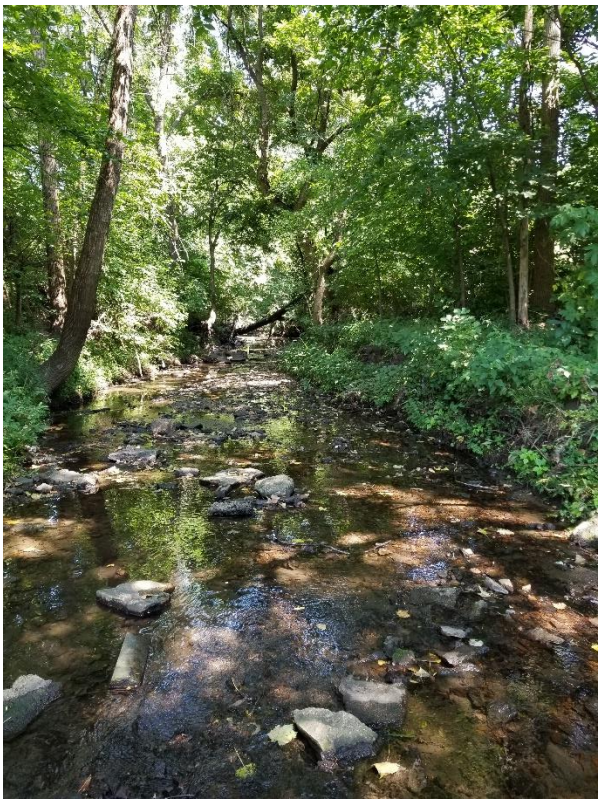

Figure 178. Yeader Creek Site 977273

Yeader Creek Site 977273 (Fig. 178) is located in Des Moines at the Southwest 13th Street Bridge, in a residential area. Of the four Yeader Creek sites, this is the closest to the Des Moines International Airport. This site on Yeader Creek is mostly shaded by high banks and the mature trees on the left bank. The right bank is some trees and shrubs.

Nitrate concentrations were well below the normal range throughout the year (Fig. 182). Phosphate concentrations, in late September 2018 and again in mid-June 2019 were well above the 0.6 mg/L threshold, the rest were below normal throughout the year (Fig. 183). Dissolved oxygen concentrations dropped to 6 mg/L in fall 2019, June and July 2019 (Fig. 184). High chloride concentrations (108 - 180 mg/L) were recorded in January through June 2019 with one exception of 89 mg/L recorded in late May 2019 (Fig. 185).

No biological assessment was completed in 2019. Yeader Creek is listed as an impaired waterway and recreation in the creek is not advised.

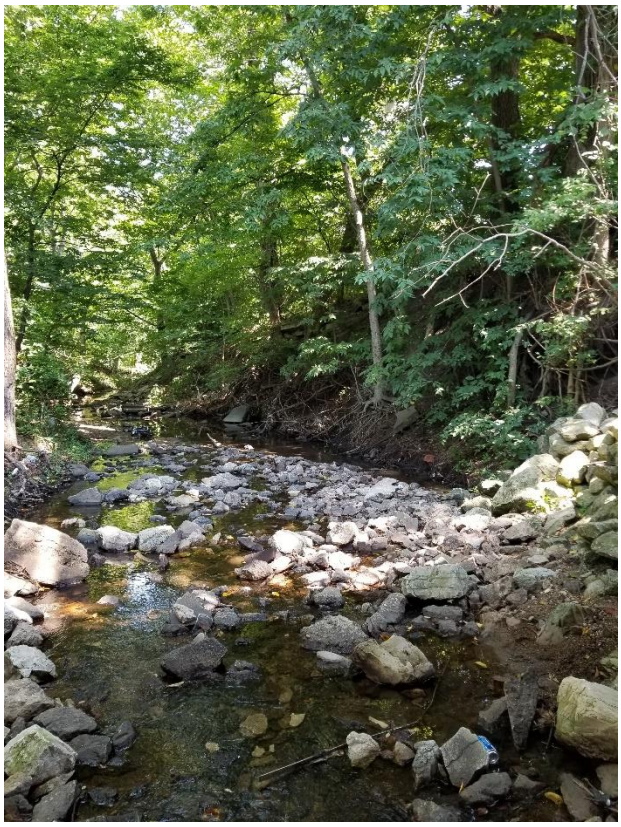

Figure 179. Yeader Creek Site 977305

Yeader Creek Site 977305 (Fig. 179) is located in Des Moines, near the South Union Bridge. This site is fully shaded with tree-lined banks and rocky bed in an urban residential neighborhood.

This site was frozen in late February and early March 2019. Nitrate concentrations were well below the drinking water standard of 10 mg/L (Fig. 182). Phosphate concentrations (0.1 mg/L to 3 mg/L) were below the abnormal threshold of 0.6 mg/L for all but the late September 2018 reading (Fig. 183). Dissolved oxygen concentrations ranged from 6 mg/L to 12 mg/L, all within normal range for the 2018-2019 monitoring period (Fig. 184). Chloride concentrations were below the 100 mg/L threshold for all recorded assessments (25 mg/L to 98 mg/L) except those during the January through early May 2019 when concentrations ranged between 108 mg/L and 141 mg/L, much lower than the previous year's high of over 600 mg/L (Fig. 185).

No biological assessment was completed in 2019.

Figure 180. Yeader Creek Site 977003

Yeader Creek Site 977003 (Fig. 180) is located in Des Moines on Southeast 14th Street in a commercial area. The banks along the site are vegetated with grasses and low plants which provides an open canopy. The low water level and open canopy allows water temperatures to rise rapidly in this area. The creek depth in this area averages 17 centimeters deep.

This site was frozen twice during late winter and experienced gray, milky and oily water in early August 2019. Nitrate concentrations were low throughout the monitoring period, ranging between 0 mg/L and 2 mg/L (Fig. 182). Phosphate concentrations were above the abnormal threshold of 0.6 mg/L in September 2018 and again from early June through September 2019 (Fig. 183). Dissolved oxygen concentrations reached a low of 2 mg/L in August 2019, 4 mg/L in June 2019 and 5 mg/L in September 2019, well below the abnormal threshold of 6 mg/L (Fig. 184). These dangerously low dissolved oxygen concentrations often occur as a result of low water flow, high water temperatures or pollution. Chloride concentrations were high during the snowmelt in January 2019 (129 mg/L). The creek was frozen in February and early March so no measurements were completed. Chloride concentrations were high throughout April (118 mg/L, 129 mg/L) and again in July 2019 when concentration reached 141 mg/L (Fig. 185). Although these levels are above the 100 mg/L threshold, there were no recorded concentrations of over 600 mg/L as were recorded during the 2017-2018 monitoring period.

No biological assessment was completed in 2019.

Figure 181. Yeader Creek Site 977117 at Ewing Park

Yeader Creek Site 977117 (Fig. 181) is located in Des Moines Ewing Dog Park on Indianola Avenue. The site has banks lined with grass and low plants providing an open canopy. The creek depth, when measurable, averages 37 centimeters deep.

Assessment data was not gathered three times in February and March 2019 due to frozen conditions. Water was muddy with an oily sheen in May 2019. The origin of the oily sheen is unknown as there was no accompanying odor. Stagnant water flow was reported in mid-April through early May and again in mid-June and mid-July 2019.

Nitrate concentrations were 0 mg/L throughout the monitoring period except in late August 2019 when 2 mg/L was recorded (Fig. 182). Phosphate concentrations ranged from 0 mg/L to 0.8 mg/L with high results occurring in late September and early October 2018, May, June and September 2019 (Fig. 183). Low dissolved oxygen concentrations (2 mg/L to 6 mg/L) often coincided with stagnant water reports reaching as low as 2 mg/L in July 2019 (Fig. 184). This site had similar low dissolved oxygen concentrations in the 2017-2018 monitoring period. Recorded chloride concentrations were within the normal range throughout the year except in January when road salt runoff elevated levels to 153 mg/L followed by frozen conditions (Fig. 185). These chloride concentrations were significantly lower than the previous year when concentrations over 600 mg/L were recorded.

No biological assessment was completed in 2019.

Yeader Creek Watershed Summary

Nitrate concentrations at all sites were well below the IOWATER threshold of 20 mg/L and the drinking water standard of 10 mg/L (Fig. 182). This urban area would likely not experience spikes in nitrate associated with agricultural land and lawn fertilizer runoff. Larger lawns in affluent, suburban areas generally have a higher use of lawn fertilizers.

Phosphate readings, normally below 0.6 mg/L at each site throughout the monitoring period, were elevated (0 mg/L – 4 mg/L) during the 2018-2019 monitoring period (Fig. 183). This is higher than what was seen in the prior year when all recorded phosphate concentrations were below the abnormal threshold.

Dissolved oxygen concentrations dropped to extremely low levels in fall 2018 and again in summer 2019 at site 977117 and 977003 (Fig. 184).

The primary water quality concern on Yeader Creek is chloride concentration. Seasonal average chloride concentrations, although lower than the previous 2017-2018 water monitoring period, were above the IOWATER threshold of 100 mg/L (109 – 180 mg/L) in winter 2018-2019 and spring 2019 seasons (Fig. 185). Because elevated levels continue through June 2019 when the winter road and deicing runoff would not be present, the elevated chloride concentrations may be the result of human or animal waste or residual salts in surrounding soils.

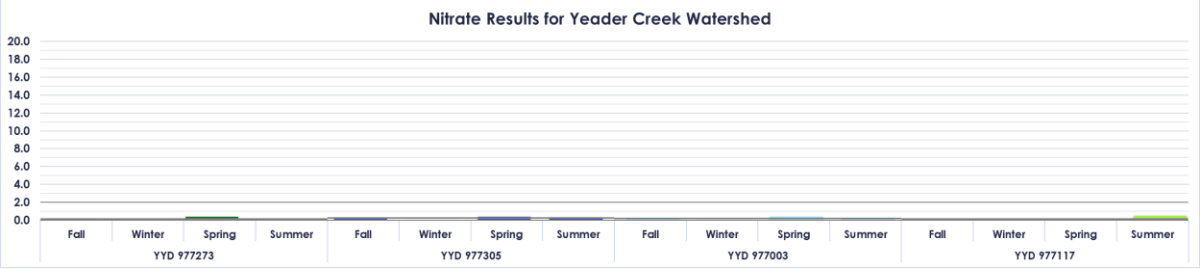

Figure 182. Seasonal Average Nitrate Concentrations for Yeader Creek Sites Mid-September 2018 - Mid-September 2019

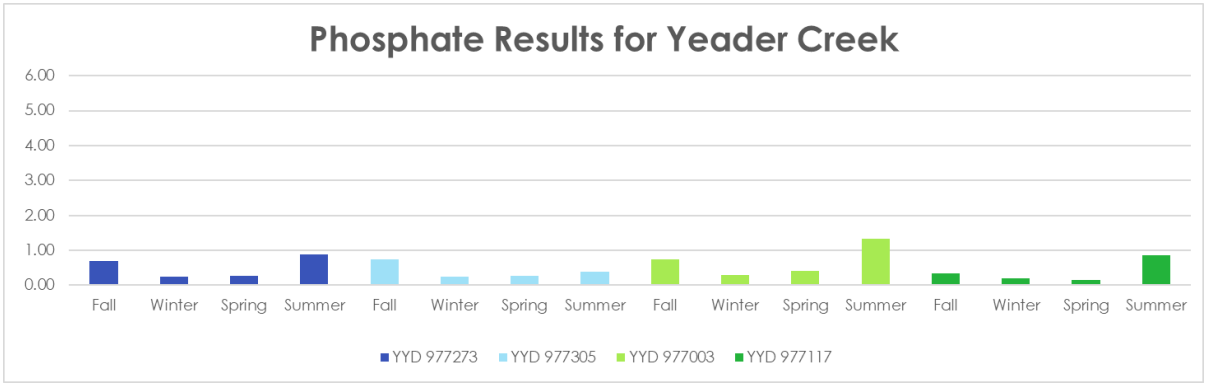

Figure 183. Seasonal Average Phosphate Concentrations for Yeader Creek Sites Mid-September 2018 - Mid-September 2019

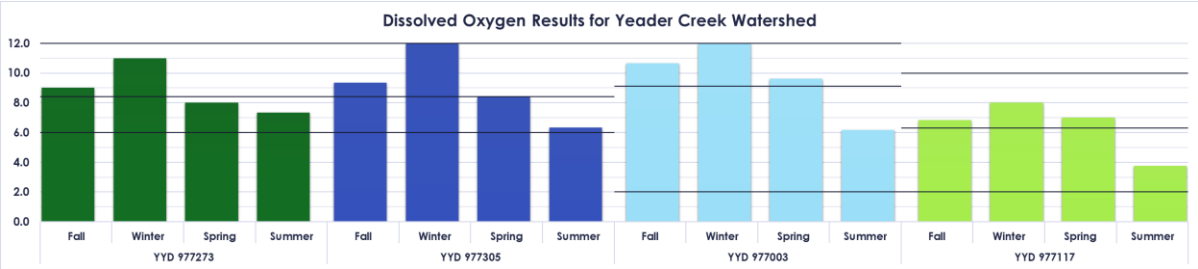

Figure 184. Seasonal Average Dissolved Oxygen Concentrations for Yeader Creek Mid-September 2018 - Mid-September 2019

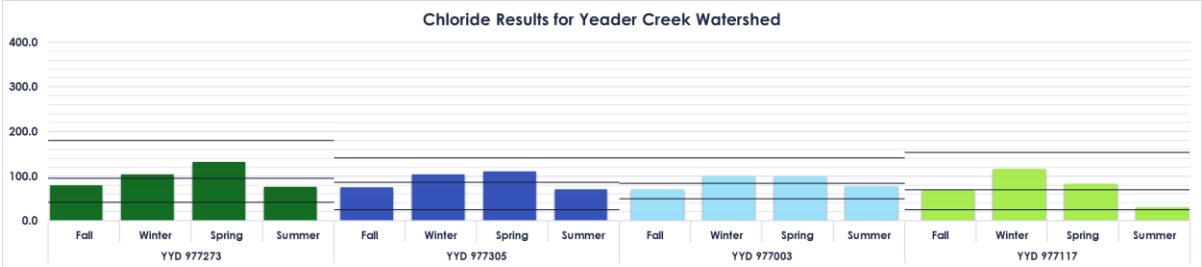

Figure 185. Seasonal Average Chloride Concentrations for Yeader Creek Sites Mid-September 2018 - Mid-September 2019

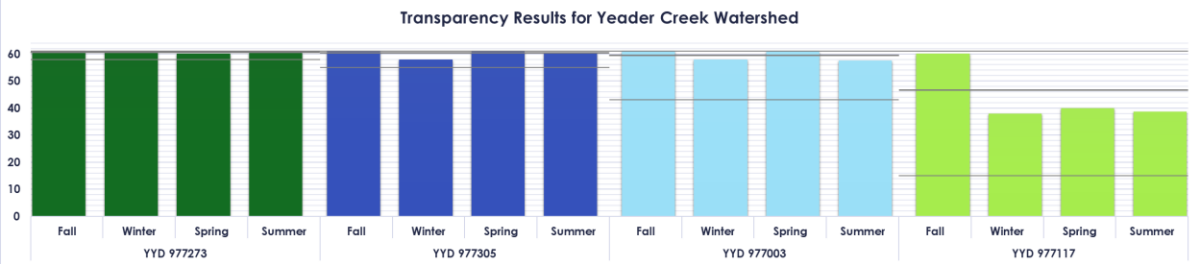

Figure 186. Seasonal Average Transparency for Yeader Creek Sites Mid-September 2018 - Mid-September 2019

Summary

In 2018-2019, the Polk County Conservation Water Quality Monitoring Program (PCCWQMP) sites were monitored by 34 staff and volunteers. PCCWQMP held training two training sessions and partnered with the Des Moines Chapter of Izaak Walton League's Save Our Streams training with 30 staff and volunteers from the Polk County Conservation, City of Des Moines and Des Moines Parks and Recreation in attendance. Participants were trained in IOWATER and PCCWQMP protocols.

PCCWQP field monitors, assigned up to six sites, complete assessments twice a month throughout the year. Due to safety concerns, not all data was obtained during high water events, icy or unsafe conditions. Field monitors completed 1426 site visits for the 70 sites, a 17% increase over 2017-18, 60 biological assessments and 61 habitat assessments for the 70 sites from mid-September 2018 through mid-September 2019. All chemical/physical assessment data obtained were uploaded to the Environmental Protection Agency's Central Data Exchange, available to the public at https://www.epa.gov/waterdata/water-quality-data-wqx.

The majority of chemical/physical assessments completed (over 98%) reported a water odor of "none." Water color is correlated with transparency. Sites which reported "clear" water color generally had a transparency of 51-60 centimeters. Transparency results between 51 and 60 centimeters occurred 66% of the time. Higher transparency tended to occur during normal flow when less rainfall runoff occurred. Transparency was the most variable and had the lowest median level during June through September 2019. Most of the 2018-2019 monitoring year was wet, one of the wettest on record. By late summer, streamflow returned to normal levels and by September 2019 half of Polk County was abnormally dry. The Iowa DNR News 2019 Water Year Update reported above normal rainfall and was 1.8 degrees below normal.

The majority of chloride concentrations were less than 100 mg/L (88% of the completed assessments). Elevated chloride concentrations (greater than 100 mg/L) occurred throughout the year. Most frequently this occurred during snowmelt in January through May. Maximum chloride concentrations were higher 9 sites 200 - 300 mg/L, one site 300 -400 mg/L, two sites 400-500 mg/L, one site 500-600 mg/L and two sites with concentrations greater than 627 mg/L.

Elevated chloride concentrations were frequently reported throughout the monitoring period on several sites. Those sites with readings over 100 mg/L more than twice during the season occurred on Fourmile (Little Fourmile), Little Beaver, Saylor, Jordan, Walnut (and North Walnut) and Yeader Creeks.

Most monitoring site assessments (91.3%) reported dissolved oxygen concentrations greater than 5 mg/L (normal level). For sites with low dissolved oxygen, 5 mg/L or less, (8.7% of assessments) these depressed levels tended to occur most frequently when stream flow was low and water temperatures were at their highest. Dry sites were reported 11 times throughout the monitoring period.

Phosphate concentrations greater than 0.6 mg/L were recorded less frequently in 2018-2019 than the previous monitoring period with 12.8% of assessment readings. Readings above 0.6 mg/L occurred most frequently in June through September 2019. Maximum readings ranged from 0.2 to 5 mg/L.

Nitrate and nitrite nitrogen concentrations were variable. Nitrate-N was 0 mg/L for 39% of the assessments and 1 to 5 mg/L for 55% of the results. Less than six percent of the nitrate results were at or over the drinking water standard of 10 mg/L, a decrease from the previous year.

With four years of data, it is not possible to definitively rate water quality of Polk County or the effectiveness of conservation measures and habitat improvement for any watershed, but trends are emerging. In 2018-19, two areas of concern were high chloride levels even during times of the year when road salts would not be actively entering the system and low dissolved oxygen levels (as low as 2 mg/L). With the growing hypoxic zone in the Gulf of Mexico, nitrate concentrations remain of interest. To further analyze salinity and nitrate results, PCCWQMP has partnered with Drake University.

All sites will continue to be monitored and assessment data uploaded onto the EPA Central Data Exchange. Abnormal results for many new sites occurred during low creek flows and drought. Most streams tested have sufficient water quality to allow recreational use of these creeks, based on the results of the parameters tested.

Resources

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Iowa Department of Natural Resources, IOWATER Program, *10 Years of IOWATER Chemical/Physical Monitoring; What the Data Tell Us report.* 2010.

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Iowa Department of Natural Resources with Iowa Department of Agriculture and Land Stewardship, Iowa State University and the IIHR Hydroscience and Engineering Center, *Stream Water-Quality Monitoring Conducted in Support of the Iowa Nutrient Reduction Strategy.* August 2016.

TCMA Chloride TMDL - Applicable Water Quality Standards and Numeric Water Quality Targets. Minnesota Stormwater Manual. Retrieved from https://stormwater.pca.state.mn.us/index.php/TCMA_Chloride_TMDL_-_Applicable_Water_Quality_Standards_and_Numeric_Water_Quality_Targets

Schilling, K. E., and Drobney, P. M., *Hydrologic Recovery with Prairie Reconstruction at Neal Smith National Wildlife Refuge, Jasper County, Iowa.* April 2014.

Walnut Creek Water Management Authority*, Walnut Creek Watershed Master Plan,* Retrieved from https://walnutcreekwatershed.files.wordpress.com/2016/07/wma_masterplan_june-2016_final.pdf June 2016.

West Virginia Department of Environmental Protection "West Virginia Save Our Streams, Stream Stories, Physical Evaluation" *West Virginia State Agency Directory Online Services*, 2016. Retrieved from http://www.dep.wv.gov/WWE/getinvolved/sos/Pages/SOPphysical.aspx. November, 2016.

Appendix 1. PCCWQMP Materials and Methods

PCCWQMP follows the IOWATER processes and procedures. IOWATER was an Iowa Department of Natural Resources volunteer water quality monitoring program whose goals are to provide a balanced approach for citizens to become involved in protecting and improving water resources. To develop opportunities for citizens to experience and discover the influence of watershed on water quality and to develop a user-friendly process for data collection and interpretation to increase accurate information on the state's water resources. PCCWQMP trains citizen volunteers to conduct basic water chemical, physical and biological measurements using the IOWATER curriculum. Upon completion of the Workshop, the PCCWQMP Field Monitors receive the IOWATER instruction binder, PCCWQMP information folder and water monitoring kit. The PCCWQMP will then be responsible for re-supplying the consumable supplies in the kits for all PCCWQMP sites. Field Monitors are assigned to sites within Polk County area.

Polk County Conservation provides water monitoring kits for staff use in the PCCWQP. These include:

- Hach® test strips- pH (50 tests)
- Hach® test strips- nitrate- N /nitrite N (25 tests)
- Hach® titrators- chloride (40 tests)
- Chemetrics® orthophosphate test kit (30 tests)
- Chemetrics® dissolved oxygen test kit (30 tests)
- armored thermometer
- open-reel fiberglass tape measure (100'/30m.)
- transparency tube (with secchi disk)
- meter stick
- a plastic tub
- waste containers
- set of PCCWQMP At-A-Glance quick reference guide cards
- binder with blank forms, IOWATER Benthic Macroinvertebrate Key, personal safety information

All of the chemical/physical test kits have an expiration date located on the bottom of the test strip container and on the color comparators. The chemical/physical assessment sheet includes a reminder to check the expiration date before using the equipment.

The Chemical/Physical Assessment data (pH, dissolved oxygen, water temperature, transparency, nitrate-N, nitrite-N, phosphate) were collected and reported twice per month to Environmental Protection Agency's Central Data Exchange for each site. The collection windows are the first and third week of each month. Polk County Conservation will maintain a database with the monitoring data of the creek site data internally in order to self-monitor the streams.

All parameters use the IOWATER requirements for testing. Details for the IOWATER sampling methods are available in the IOWATER Program Quality Assurance Project Plan (Iowa DNR, 2010) and the PCCWQMP Quality Assurance Project Plan.

The PCCWQMP selects testing sites with consideration of the need factors around them, including accessibility of the site, proximity to activities that may alter water quality and for measuring an overall ambient baseline conditions. PCCWQMP, with local organizations and agencies, chooses sites that will provide the most benefit for the betterment of the Polk County watersheds.

Appendix 2. Assessment Forms

Polk County Water & Land Legacy Bond

POLK COUNTY WATER QUALITY MONITORING PROGRAM

Water Quality Monitoring
Chemical & Physical Assessment

Date: _____ **Time:** _____ **Site #:** _____

PCCWQMP Monitor: _____ **# of participants:** _____

Others Involved: _____

Was the stream dry when it was monitored? Yes No

Weather (Circle ALL that apply):

Sunny Partly Sunny Cloudy Rain Snow Windy Calm

Water color (Circle ALL that apply):

Clear Brown Green Foamy Milky Scum

Oily Reddish Blackish Gray

Water odor (Circle ALL that apply):

None Chemical Fishy Petroleum Sewage Other: _____

Stream flow (along your transect): (Circle ONE)

Dry Stagnant Slow Normal Fast Torrent

Air temperature: _____ °F

Precipitation over the last 24 hours: _____ inches

Transparency (whole numbers only): _____ cm

Stream width (along your transect): _____._____ meters

Maximum stream depth (along your transect): _____._____ meters

pH: _____ Expiration date pH: _____

Nitrite-N: _____ mg/L **Nitrate-N:** _____ mg/L Expiration date N: _____

Dissolved Oxygen: _____ mg/L Expiration date of DO color comparator: _____

Phosphate: _____ mg/L Expiration date of P activator solution: _____

Expiration date on P color comparator: _____

Expiration date on P round comparator: _____

Chloride: _____ Quantab units Converts to _____ mg/L Expiration date Cl: _____

Water Temperature: _____ °F

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IOWATER Volunteer Water Quality Monitoring

Polk County Water & Land Legacy Bond

POLK COUNTY CONSERVATION

Water Quality Monitoring
Biological Assessment

Date: _____ **Time:** _____ **Site #:** _____

PCCWQMP Monitor: _____ **# of participants:** _____

Others Involved: _____

Was the stream dry when it was monitored? Yes No

If stream was not dry but no benthic macroinvertebrates were found, please record any relevant comments in the Notes/Comments section below.

Biological assessment area: Stream width: _____m Stream length: _____m

Benthic Macroinvertebrates (BMI)

High Quality Group *Pollution intolerant*			Middle Quality Group *Somewhat pollution tolerant*			Low Quality Group *Pollution tolerant*		
Tally	# Found	Species	Tally	# Found	Species	Tally	# Found	Species
		Caddisfly			Alderfly			Aquatic Worm
		Dobson Fly			Backswimmer			Black Fly
		Mayfly			Crane Fly			Bloodworm
		Riffle Beetle			Crawdad/Crayfish			Flatworm
		Snail (not pouch)			Crawling Water Beetle			Leech
		Stone Fly			Damselfly			Midge Fly
		Water Penny Beetle			Dragonfly			Mosquito
Total:					Giant Water Bug			Pouch Snail
					Limpet			Rat-tailed Maggot
Notes/Comments:					Mussels/clams			Water Scavenger Beetle
					Orb Snail	**Total:**		
					Predaceous Diving Beetle			
					Scud			
					Sowbug			
					Water Boatman			
					Water Mite			
					Water Scorpion			
					Water Strider			
					Whirligig Beetle			
			Total:					

Collection time (Circle ONE): **0-15 minutes** **15-30 minutes** **30-45 minutes** **45+ minutes**

Identification confidence level (How confident are you that your identification is correct?):

____I am not sure

____Some are correct; I am not sure of others *(Please clarify this in the notes section)*

____I think they are correct

____I'm fairly confident they are correct

____I guarantee they are correct

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IOWATER Volunteer Water Quality Monitoring

Polk County Water & Land Legacy Bond

Water Quality Monitoring
Habitat Assessment

POLK COUNTY WATER QUALITY MONITORING PROGRAM

Date: _____ **Time:** _____ **Site #:** _____

PCCWQMP Monitor: _____ **# of participants:** _____

Others Involved: _____

Was the stream dry when it was monitored? Yes No

Canopy cover over transect (circle ONE):

0-25% (Open) 25-50% (Partly Open) 50-75% (Partly Shaded) 75-100% (Shaded)

Predominant surrounding land use (rank top 2):
(state the top two uses using a 1 for the largest land use and 2 for the second largest land use)

_____ Agriculture (Farming, Row Crops)
_____ Commercial (Businesses)
_____ Field (Conservation Lands, Pasture, Prairie, Wetlands)
_____ Forest (Timber)
_____ Industrial (Factories)
_____ Residential (Playground, Stairs, Suburban, Urban, Walkway
_____ Other (Boating, Campground, Nature Trails, Parks, Steep Slopes)

Evidence of human use (circle either Yes or No):

Yes	No	Boating (boating, canoeing, dock, kayaking, rafting, tubing, water skiing)
Yes	No	Fishing (fishing, tackle)
Yes	No	Other (ATV tracks, camping sites, fire pit/ring, footprints, graffiti, hunting, evidence of kids playing, litter, rope swings, trapping)
Yes	No	Swimming (swimming, wading)

Riparian zone width at transect (circle ONE for EACH bank):

Left Bank (facing upstream)				Right Bank (facing upstream)			
0-6m	6-12m	12-18m	18+ m	0-6m	6-12m	12-18m	18+ m

Riparian zone plant cover at transect (estimate percentage of each):

Left bank (facing upstream)	**Right bank** (facing upstream)
_____% Trees	_____% Trees
_____% Shrubs/low trees	_____% Shrubs/low trees
_____% Grass/low plants	_____% Grass/low plants
_____% Exposed soil	_____% Exposed soil
_____% Other (rip rap, concrete, etc.)	_____% Other (rip rap, concrete, etc.)
100% Total	**100% Total**

Stream habitat type at transect (circle ONE): Riffle Run Pool

Stream Banks at transect (circle ALL that apply):

Left Bank (facing upstream)		**Right Bank** (facing upstream)	
Cut bank-eroding	Sloping bank	Cut bank-eroding	Sloping bank
Cut bank-vegetated	Sand/gravel bar	Cut bank-vegetated	Sand/gravel bar
Constructed bank (drainage ditch)	Rip rap	Constructed bank (drainage ditch)	Rip rap
Other: _____		Other: _____	

Streambed Substrate (along transect, estimate percentages):

_____%	Bedrock – large sheets of stone.
_____%	Boulder – stones larger than 10 inches in diameter.
_____%	Cobble – stones, diameter between 2.5 and 10 inches.
_____%	Gravel – 0.1 to 2 inches in diameter
_____%	Sand – smaller than 0.1 inches in diameter
_____%	Silt/mud – dirt or soil deposited on bottom of the stream
_____%	Detritus – organic material like leaf litter, tree limbs, etc.
100%	**Total**

Microhabitat (circle ALL present in stream reach):

Algae mats	Sand	Undercut banks	Junk (tires, garbage, etc.)
Logjams	Root wads	Leaf packs	Overhanging vegetation
Rip rap	Fallen trees	Rocks	Silt/muck
Weed beds	Other (describe): _____		

Aquatic Plant Cover of Streambed at transect (circle ONE):

0% 1-20% 21-40% 41-60% 61-80% 81-99% 100%

Algae Cover of Streambed at transect (circle ONE):

0% 1-20% 21-40% 41-60% 61-80% 81-99% 100%

Is sewage algae present in the stream (circle ONE)? Yes No Unsure

If yes, please submit a photographic record with this form.

Invasive species (circle ALL found): Yes No

Eurasian water milfoil	brittle naiad	bighead carp	curly-leaf pondweed
purple loosestrife	silver carp	zebra mussels	Chinese mystery snails
rusty crawfish			

Notes/Comments: _____

☐ **Upstream and downstream photos submitted**

Polk County Conservation Water Quality Program
Ginny Malcomson, Program Coordinator
12130 NW 128th Street
Granger, IA 50109
515-323-5300, F: 515-323-5354
Ginny.Malcomson@polkcountyiowa.gov

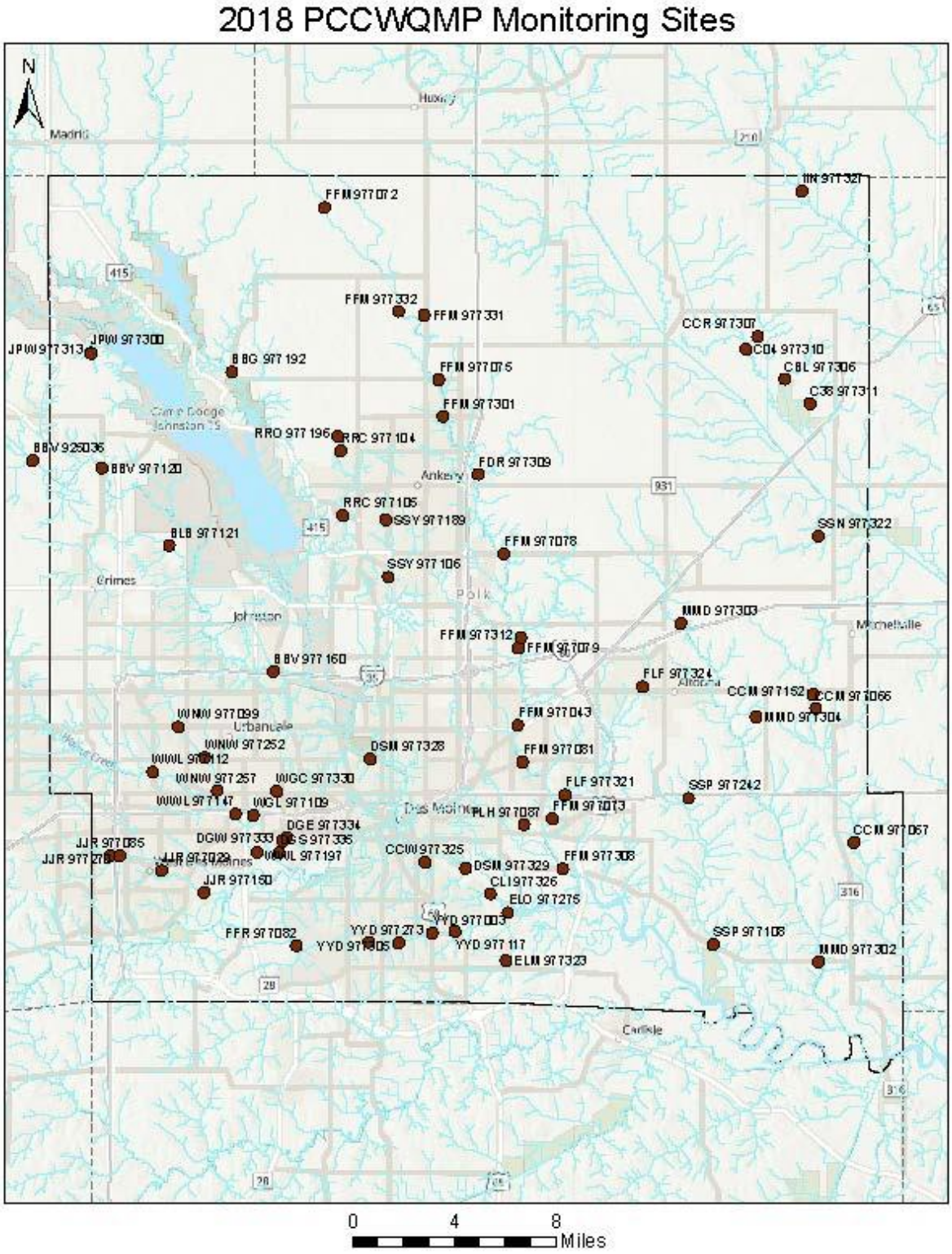
IOWATER
Volunteer Water Quality Monitoring

Appendix 3. PCCWQMP Site Locations

SITE ID	CREEK	SITE NAME
BBG 977192	BIG CREEK	BIG CREEK – THROUGH POLK CITY PARK/REFUGE
BBV 925036	BEAVER CREEK	BEAVER CREEK SNAPSHOT (SITE 18 - BEAVER CREEK)
BBV 977120	BEAVER CREEK	BEAVER CREEK SNAPSHOT (SITE 19 - BEAVER CREEK)
BBV 977125	BEAVER CREEK	7100004 - DES MOINES RIVER - LIZARD CREEK
BBV 977160	BEAVER CREEK	POLK COUNTY SNAPSHOT (SITE BEAVER CREEK AT PRAIRIE POINT)
BLB 977121	LITTLE BEAVER CREEK	BEAVER CREEK SNAPSHOT (SITE 20 - LITTLE BEAVER CREEK)
C04 977310	DRAINAGE DITCH	DD4 - CONTROL MARSH
C38 977311	DRAINAGE DITCH	DRAINAGE DITCH 38
CBL 977306	BLUFF CREEK	BLUFF CREEK - 118TH
CCM 977066	CAMP CREEK	POLK COUNTY SNAPSHOT (SITE CC1 - CAMP CREEK)
CCM 977067	CAMP CREEK	POLK COUNTY SNAPSHOT (SITE CC2 - CAMP CREEK)
CCM 977152	CAMP CREEK	CAMP CREEK/THOMAS MITCHELL PARK
CCR 977307	CARNEY CREEK	CARNEY CREEK AT BUTTONBUSH
CCW 977325	CRAWFORD CREEK	CRAWFORD CREEK AT SE 9TH
CLI 977326	CASE LAKE INFLOW	CASE LAKE INFLOW
DGE 977334	UNNAMED CREEK	GREENWOOD POND INFLOW ON EAST SIDE
DGS 977335	UNNAMED CREEK	GREENWOOD POND OUTFLOW
DGW 977333	UNNAMED CREEK	GREENWOOD POND INFLOW ON WEST SIDE
DSM 977328	DES MOINES AREA	PROSPECT PARK- TRIBUTARY OF DSM RIVER
DSM 977329	DES MOINES AREA	UNNAMED CREEK AT HARTFORD AVENUE AND DSM RIVER TRAIL
ELM 977323	MAGNOLIA CREEK	"UNNAMED CREEK AT THREE LAKES ESTATES"
ELO 977275	UNNAMED CREEK	EASTER LAKE OUTLET
FDR 977309	DEER CREEK	FOURMILE CREEK TRIB-DEER CREEK
FFM 977043	FOURMILE CREEK	FOURMILE CREEK
FFM 977072	FOURMILE CREEK	POLK COUNTY SNAPSHOT (SITE FMC1 - FOURMILE CREEK)
FFM 977073	FOURMILE CREEK	POLK COUNTY SNAPSHOT (SITE FMC10 - FOURMILE CREEK)
FFM 977075	FOURMILE CREEK	POLK COUNTY SNAPSHOT (SITE FMC3 - FOURMILE CREEK)
FFM 977078	FOURMILE CREEK	POLK COUNTY SNAPSHOT (SITE FMC6 - FOURMILE CREEK)
FFM 977079	FOURMILE CREEK	POLK COUNTY SNAPSHOT (SITE FMC7 - FOURMILE CREEK)
FFM 977081	FOURMILE CREEK	FOURMILE CREEK AT EASTON AVENUE
FFM 977301	FOURMILE CREEK	4 MILE CREEK
FFM 977308	FOURMILE CREEK	4 MI CREEK - VANDALIA AV
FFM 977312	FOURMILE CREEK	MUCHIKNOCK CREEK AT 4MI CREEK
FFM 977331	UNNAMED CREEK	UNNAMED CREEK IN ALLEMAN COUNTRY ESTATES-INTO FOURMILE
FFM 977332	FOURMILE CREEK	FOURMILE CREEK WEST OF ALLEMAN COUNTRY ESTATES
FFR 977082	FRINK CREEK	FRINK CREEK NEAR GWT ANDSW 42ND
FLF 977321	LITTLE FOURMILE CREEK	LITTLE FOURMILE CREEK AT E UNIVERSITY IN PLEASANT HILL
FLF 977324	LITTLE FOURMILE CREEK	LITTLE FOURMILE CREEK ALTOONA
FLH 977087	FOURMILE CREEK	LAUREL HILL CEMETERY STREAM
GLU 977012	UNNAMED CREEK	UNNAMED CREEK-INTO GRAY'S LAKE
IIN 977327	INDIAN CREEK	INDIAN CREEK AT NE 162ND AV
JJR 977029	JORDAN CREEK	JORDAN CREEK
JJR 977085	JORDAN CREEK	POLK COUNTY SNAPSHOT (SITE JC1 - JORDAN CREEK)
JJR 977150	JORDAN CREEK	JORDAN CREEK 2 - BARKER LEMAR
JJR 977270	JORDAN CREEK	JORDAN CREEK AT WALKING TRAIL BRIDGE
JPW 977300	PAW CREEK	PAW CREEK
JPW 977313	PAW CREEK	PAW CREEK-GOLF COURSE FORK
MMD 977302	MUD CREEK	MUD CREEK NW OF RUNNELLS
MMD 977303	MUD CREEK	MUD CREEK - NE 62ND
MMD 977304	MUD CREEK	MUD CREEK - NE 12TH AV
RRC 977104	ROCK CREEK	POLK COUNTY SNAPSHOT (SITE RC1 - ROCK CREEK)
RRC 977105	ROCK CREEK	POLK COUNTY SNAPSHOT (SITE RC2 - ROCK CREEK)
RRO 977196	ROCK CREEK	ANKENY-WOODWARD BIKE TRAIL & ROCK CREEK
SSN 977322	SANTIAGO CREEK	SANTIAGO CREEK AT BRIDGE NEAR NE 82ND AVE
SSP 977108	SPRING CREEK	POLK COUNTY SNAPSHOT (SITE SC2 - SPRING CREEK)
SSP 977242	SPRING CREEK	SPRING CREEK (PH SITE 6)
SSY 977106	SAYLOR CREEK	POLK COUNTY SNAPSHOT (SITE SAYLOR CREEK)
SSY 977189	SAYLOR CREEK	N OF PRAIRIE TRAIL AT MAGAZINE
WGC 977330	WALNUT CREEK TRIBUTARY	GLENDALE CEMETERY

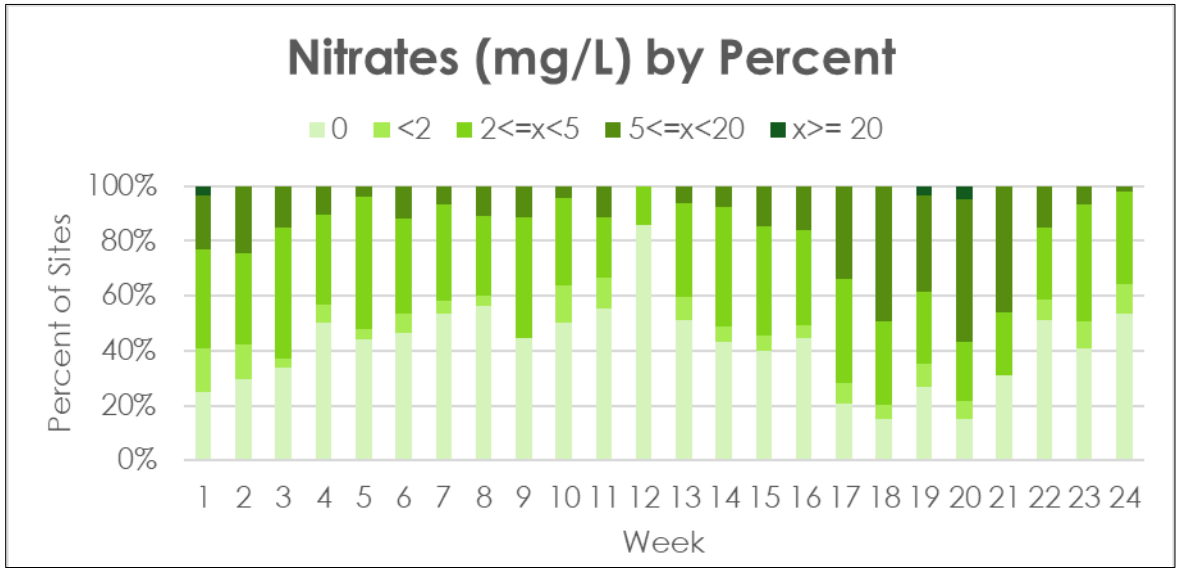
WGL 977109	GOLF CREEK	GOLF CREEK -INTO WALNUT CREEK; EXITING WAVELAND GOLF COURSE
WNW 977252	N WALNUT CREEK	NORTH WALNUT CREEK, NORTH OF HICKMAN RD
WNW 977257	N WALNUT CREEK	NORTH WALNUT CREEK DS OF TRIB (STORM SEWER), N OF UNIV. BLVD.
WNW 977099	WALNUT CREEK	POLK COUNTY SNAPSHOT (SITE NWC3 - NORTH WALNUT CREEK)
WWL 977112	WALNUT CREEK	POLK COUNTY SNAPSHOT (SITE WC3 - WALNUT CREEK)
WWL 977147	WALNUT CREEK	WALNUT CREEK AT COLBY PARK
WWL 977197	WALNUT CREEK	WALNUT CREEK AT NORTH VALLEY DRIVE
YYD 977003	YEADER CREEK	YEADER CREEK
YYD 977117	YEADER CREEK	POLK COUNTY SNAPSHOT (SITE YC2 - YEADER CREEK)
YYD 977273	YEADER CREEK	YEADER CREEK OP
YYD 977305	YEADER CREEK	YEADER CREEK - S UNION

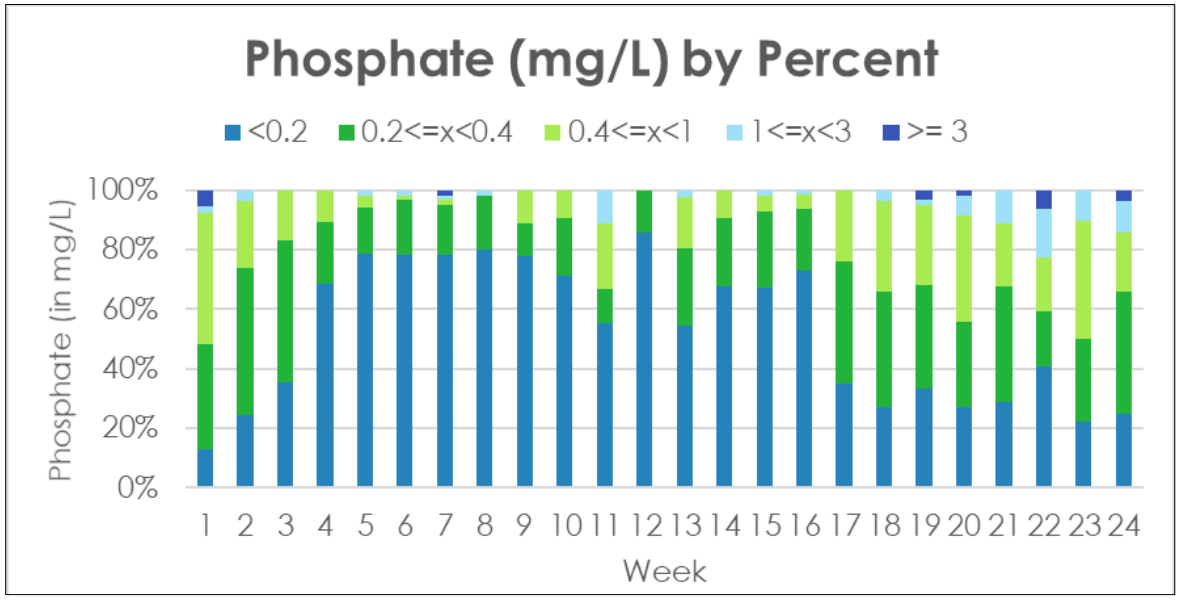
Appendix 4. 2018 Map of PCCWQMP Sites

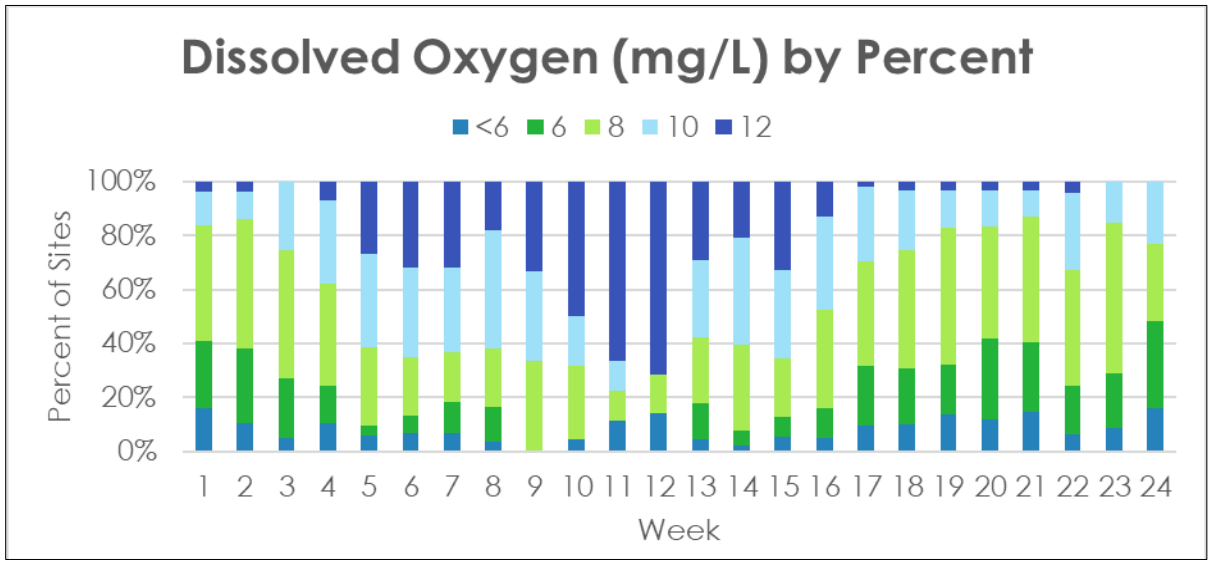


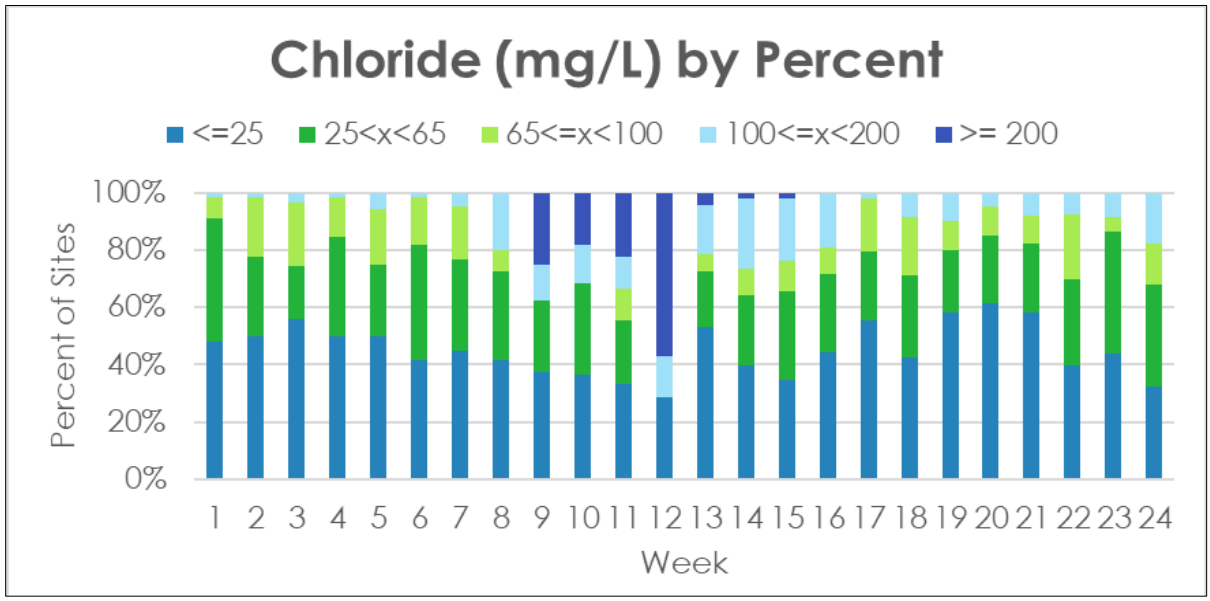
In order to record accurate results, **REMOVE SUNGLASSES** during monitoring. **Safety First** **Use caution when entering a stream, making sure the current is not too strong and bottom will support you.** POLK COUNTY CONSERVATION 515-323-5300	**Dissolved Oxygen** Typical range: 8.7-12.9 mg/L; IA ave. 10.5 mg/L Retest <5mg/L (warm streams)	**Nitrate/Nitrite** Typical range: 3 to 8.5 mg/L (rivers); 0.05 to 0.94 mg/L (lakes) IA ave. = 5.8 mg/L (rivers); 0.07 mg/L (lakes)	**Phosphate** Typical range: 0.11-0.34 mg/L (rivers); 0.05 -0.13 mg/L (lakes) IA ave. = 0.2 mg/L (streams); 0.08 mg/L (lakes)	**Chloride** Typical range: 16 - 29 mg/L IA ave.= 22 mg/L (rivers)
Stream Water Temperature (Biweekly) Record temperature after 2 minutes. **pH (Biweekly)** Facing upstream, along transect with greatest flow. Dip test strip and remove immediately, do not shake. Read in 15 seconds. Record data. Dispose in trash. Typical range: 8.0-8.4 Retest if <6.5 or >9.0	**Dissolved Oxygen (Biweekly)** Facing upstream, along transect with greatest flow, rinse 25 ml sample cup 3 times. Lower cup to wrist depth while holding it upside down. Turn the opening downstream so cup backfills with water. Turn upstream and carefully remove cup and water sample from stream. Gently tip to pour off excess water. Place ampoule in cup and snap off tip. Allow ampoule to fill with water and slowly mix ampoule water. Compare color **after 2 minutes.** Record data in mg/L. Dispose in trash.	**Nitrate/Nitrite (Biweekly)** Facing upstream, along transect with greatest flow. Dip test strip and remove immediately, do not shake. Hold strip level, pad side up for **30 seconds**. Record **NITRITE** (pad on right) Hold level for an **additional 30 seconds** and record **NITRATE** reading (pad on tip of strip). Dispose in trash.	**Phosphate (Biweekly)** Facing upstream, along transect with greatest flow rinse 25 ml sample cup **3 times**. Lower cup to wrist depth while holding it upside down. Turn the opening downstream so cup backfills. Turn upstream, carefully remove water sample from stream. Gently pour off excess water. **Add 2 drops** of Activator Solution, **cap and shake**. **Place ampoule** in cup and snap off tip. Allow ampoule to fill with water. **Slowly mix** ampoule water. Compare color **after 2 minutes.** Record data in mg/L. Dispose water in household drain and ampoule in trash. NOTE: KEEP SUPPLIES OUT OF SUN	**Chloride (Biweekly)** Facing upstream, along transect with greatest flow rinse 25 ml sample cup **3 times**. Fill cup to 25 ml mark. Remove a titrator strip from bottle. *Replace cap immediately*. Insert bottom of titrator into CL sample cup. Do not allow the yellow string at top to become submerged. Allow titrator wick to become completely saturated. There is no time limit– the reaction is complete when yellow string turns dark-**about 5-10 min.**

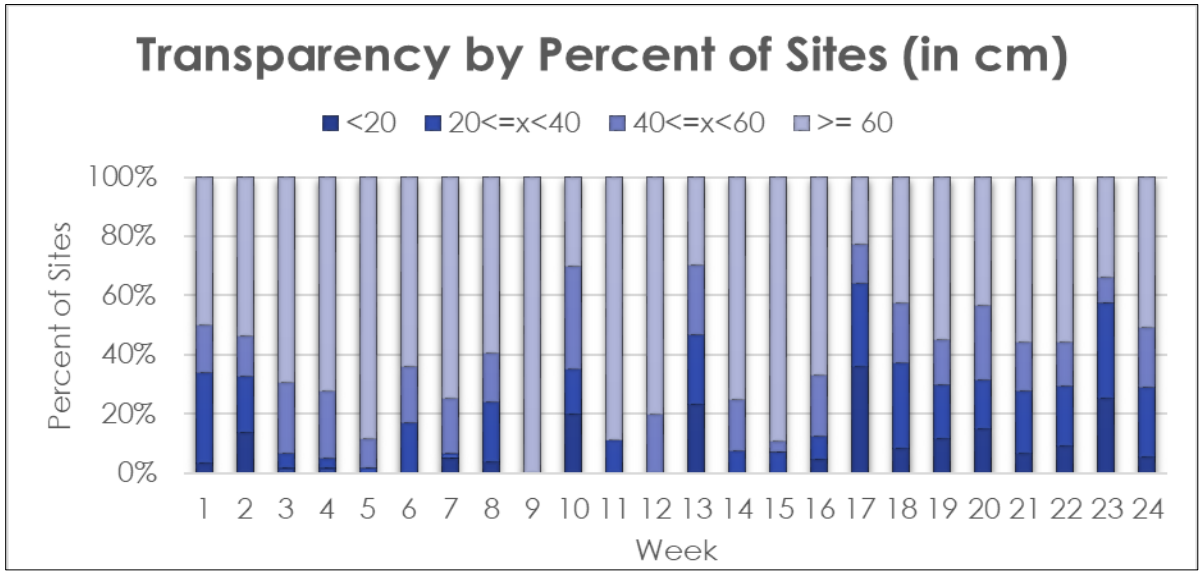
Appendix 6. Results by Parameter for All Sites






Dissolved Oxygen (mg/L) by Percent
<6
6
8
10
12
Percent of Sites
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Week


Chloride (mg/L) by Percent
<=25
25<x<65
65<=x<100
100<=x<200
>= 200
Percent of Sites
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Week


Transparency by Percent of Sites (in cm)
<20
20<=x<40
40<=x<60
>= 60
Percent of Sites
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Week

Appendix 7. End of Year Seasonal Report

FCCWQMP	Transparency TA	Trans. Min	Trans. Max	Mid Sep - Mid Dec Ave	Mid Dec - Mid Mar Ave	Mid March - Mid Jun Ave	Mid June - Mid Sept Ave	pH Threshold	pH Yearly Ave	pH Min	pH Max
WML 977147	55	34	61	61	61	51	55	≤6	8	6	9
WML 977197	53	25	61	52	61	61	47	≤6	8	7	9
WWW 977202	41	18	61	NR	NR	45	39	≤6	8	7	9
WWW 977207	35	1	61	NR	NR	NR	35	≤6	8	8	9
YYD 977373	59	30	61	61	61	60	53	≤6	8	7	9
YYD 977385	59	35	61	61	58	61	54	≤6	8	7	9
YYD 977083	59	43	61	61	58	61	57	≤6	8	7	9
YYD 977117	50	15	61	60	38	40	54	≤6	7	6	8

FCCWQMP	Mid Sep - Mid Dec Ave	Mid Dec - Mid Mar Ave	Mid March - Mid Jun Ave	Mid June - Mid Sept Ave	Nitrate Threshold	Nitrate Yearly Ave	Nitrate Min	Nitrate Max	Mid Sep - Mid Dec Ave	Mid Dec - Mid Mar Ave	Mid March - Mid Jun Ave	Mid June - Mid Sept Ave
WML 977147	8	7	8	9	≥10	0.8	0.0	2.0	0.5	0.0	0.7	1.7
WML 977197	8	8	7	9	≥10	3.5	2.0	5.0	3.5	2.0	2.0	2.8
WWW 977202	NR	NR	7	8	≥10	0.7	0.0	2.0	NR	NR	1.0	0.5
WWW 977207	NR	NR	NR	8	≥10	2.7	1.0	5.0	NR	NR	NR	2.7
YYD 977373	8	7	8	9	≥10	0.2	0.0	2.0	0.2	0.0	0.4	0.3
YYD 977385	8	7	8	9	≥10	0.4	0.0	2.0	0.2	0.0	0.4	0.7
YYD 977083	8	7	8	8	≥10	0.2	0.0	2.0	0.2	0.0	0.4	0.5
YYD 977117	7	7	7	7	≥10	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FCCWQMP	DO Threshold	DO Yearly Average	DO Min	DO Max	Mid Sep - Mid Dec Ave	Mid Dec - Mid Mar Ave	Mid March - Mid Jun Ave	Mid June - Mid Sept Ave	P Threshold	P Yearly Average	P Yearly Min	P Yearly Max
WML 977147	≤5	5	4	8	5	6	5	6	≥0.4	0.7	0.0	0.8
WML 977197	≤5	9	3	12	8	10	12	8	≥0.4	0.7	0.0	0.4
WWW 977202	≤5	7	3	12	NR	NR	6	8	≥0.4	0.1	0.0	0.2
WWW 977207	≤5	7	5	10	NR	NR	NR	7	≥0.4	0.4	0.0	1.5
YYD 977373	≤5	9	6	12	9	11	8	8	≥0.4	0.6	0.1	4.0
YYD 977385	≤5	8	4	12	9	12	8	6	≥0.4	0.5	0.1	3.0
YYD 977083	≤5	9	3	12	11	12	10	6	≥0.4	0.7	0.1	3.0
YYD 977117	≤5	7	3	10	7	8	7	6	≥0.4	0.3	0.0	3.0

FCCWQMP	Mid Sep - Mid Dec Ave	Mid Dec - Mid Mar Ave	Mid March - Mid Jun Ave	Mid June - Mid Sept Ave	Cl Threshold	Cl Yearly Average	Cl Yearly Min	Cl Yearly Max	Mid Sep - Mid Dec Ave	Mid Dec - Mid Mar Ave	Mid March - Mid Jun Ave	Mid June - Mid Sept Ave
WML 977147	0.1	0.0	0.1	0.4	>100	28	25	44	25	25	23	24
WML 977197	0.1	0.0	0.0	0.3	>100	44	25	123	46	53	125	29
WWW 977202	NR	NR	0.1	0.1	>100	70	34	137	NR	NR	100	35
WWW 977207	NR	NR	NR	0.4	>100	22	21	25	NR	NR	NR	22
YYD 977373	0.7	0.3	0.3	1.2	>100	96	25	180	79	104	122	71
YYD 977385	0.7	0.3	0.3	0.4	>100	81	25	141	75	101	111	54
YYD 977083	0.7	0.3	0.4	0.7	>100	87	47	141	70	101	100	69
YYD 977117	0.5	0.2	0.3	0.7	>100	74	25	119	48	117	83	60

Appendix 8. List of 2018-2019 Field Monitors

Adam Fendrick	Polk County Conservation
Abby Chungath	Volunteer
Alan Pasker	Polk County Conservation
Amy Bryant	City Of Ankeny
Amanda Brown	Polk County Conservation
Andrew Phelps	Polk County Conservation
Brody Buskohl	City Of Johnston
Callie Leu Courtright	Des Moines Parks And Recreation
Carla Moore	City Of Ankeny
Charlie Finch	Polk County Conservation
Clayton Ender	City Of Johnston
Curt Smejkal	City Of Des Moines-Sewer Enterprise Div.
Dan Hrubes	Polk County Conservation
Dave Croll	City Of Johnston
David Wilwerding	City Of Johnston
David Weidt	Polk County Conservation
Dean Bruscher	Polk County Conservation
Doug Sheeley	Chichaqua Bottoms Greenbelt
Doug Romig	Polk County Conservation
Erich Braun	Polk County Conservation
Ginny Malcomson	Polk County Conservation
Heidi Anderson	Polk County Conservation

Isaac Svoboda	City Of Des Moines
Jake Slings	City Of Altoona
James Dotzler	Polk County Conservation
Janna Coulter	Polk County Conservation
Jeff Behan	City Of West Des Moines
Jim Tredway	Volunteer
Jody Anderson	Volunteer
Joe Boyles	Polk County Conservation
Joel Van Roekel	Des Moines Parks And Recreation
John Harri	Volunteer
John Roan	Volunteer
John Mackey	Polk County Conservation
Johnathan Gano	City Of Des Moines-Public Works
Jordan Hildreth	Des Moines Parks And Recreation
Josh Dewes	Des Moines Parks And Recreation
Justin D'Souza	City Of Des Moines-Sewer Enterprise Div.
Karen Oppelt	City Of Altoona
Karrah Rau	Volunteer
Katharine Carman	Urbandale High School
Kay Tweedy	Volunteer
Kelly Sand	City Of West Des Moines
Ken Trytek	Des Moines Parks And Recreation
Kendall Fogle	Des Moines Parks And Recreation
Lael Neal	Polk County Conservation
Lewis Major	Polk County Conservation
Lori Foresman-Kirpes	Polk County Conservation
Lowell De Vries	Volunteer
Lucas Tenborg	City Of Des Moines Public Works
Lydia Roush	Des Moines Parks And Recreation
Mariel Castillo	Volunteer
Matt Brown	Des Moines Parks And Recreation
Melissa Schmeling	Polk County Conservation
Nikki Dunbar	Polk County Conservation
Pat Spain	Polk County Conservation
Patti Petersen-Keys	Polk County Conservation
Penny Thomsen	Volunteer
Rich Anderson	Volunteer
Richard Brown	Des Moines Parks And Recreation
Richard Leopold	Polk County Conservation
Ron Dunek	Volunteer
Sam Brown	Volunteer
Sandy Roan	Volunteer
Sophia Campbell	Polk County Conservation
Tad Thomas	Des Moines Parks And Recreation
Vance Weltha	City Of Altoona
Zach Deutmeyer	Polk County Conservation