2016 Water Quality Assessment Report

Red Cliff Band of Lake Superior Chippewa

Clean Water Act Section 106 Assistance Agreement BG 00E01930



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Section 1. Program Background	3
Section 2. Purpose of Monitoring Program	4
Section 3. Monitoring Framework	5
Section 4. Monitoring Locations	8
Section 5. Monitoring Results	9
Chicago Creek	10
Station CC02 – Chicago Creek at State Highway 13	10
Station CC03 – Chicago Creek at Blueberry Road	
Station CCM01 – Mouth of Chicago Creek	14
Frog Creek	16
Station FC01- Frog Creek	16
Station FCM01 – Mouth of Frog Creek	
Lake Superior	
Station LS01 – Lake Superior at Buffalo Bay Marina	
Raspberry River	
Station RR03 – Raspberry River at Rowley Road	
Station RR01 – Raspberry River at Campground Boat Ramp	
Station RRM01 – Mouth of Raspberry River	
Red Cliff Creek	
Station RCC01- Red Cliff Creek at State Highway 13	
Station RCC03 – Red Cliff Creek at Blueberry Road	
Station RCCM01 – Mouth of Red Cliff Creek	
Sand River	
Station SR02 – Sand River at State Highway 13	
Station SRM01- Mouth of Sand River	
Sucker Creek	
Station SC01 – Sucker Creek at County Highway K Road	
Station SCM02- Sucker Creek Mouth	40
Macroinvertebrate Monitoring	
Water Quality Concerns	44
References	46
Appendices	47

Table of Contents

Section 1. Program Background

The Water Resource Program has been active since 1980, reflecting the awareness and concern for water quality and engaging tribal members within the Red Cliff Reservation. In 1989, Red Cliff was granted treatment in the same manner as a state status for the Clean Water Act Section 106 (CWA 106). The CWA 106 refers to the water pollution control program. Likewise, Red Cliff was granted treatment in the same manner as a state in 2008 for the Clean Water Section Act 319 (CWA 319). The CWA 319 refers to nonpoint (NPS) source pollution prevention, funds which will assist in these monitoring and any project efforts.

The Reservation includes approximately 46 stream miles, of which 37 miles are considered to be intermittent. These many small and unnamed intermittent streams play an important seasonal role in conveyance of water and in providing habitat for amphibians, wildlife and many types of plants. There is currently no complete inventory of the Reservation's intermittent streams and these streams are not currently monitored by the Tribe's Water Resources Program.

The following atlas table gives a description of the estimated number of stream miles, wetland acres, and Lake Superior shoreline miles for the Red Cliff Reservation (see Table 1).

Table 1. Atlas of Tribal Waters within the exterior boundaries of the Red Cliff Reservation								
Total number of stream/river miles	46.1 Miles							
Total number of Lake Superior shoreline miles	22.3 Miles							
Total number of wetland acres	805 Acres							

The Reservation's watersheds all discharge to Lake Superior and are found within the HUC 04010301, which is known as the Nemadji to Fish Creek regional unit of the southern shoreline of Lake Superior. Located in the Superior-Ashland Clay Plain, this region of the Lake Superior Basin is often referred to as the "red clay plain" due to its highly erodible red clay soils. All of the Reservation's watersheds are located in Bayfield County, Wisconsin and fall within the Bayfield Peninsula Northwest and Bayfield Peninsula Southeast watersheds (see Map 1). Three HUC-12 sub-watersheds that fall within these larger watersheds cross the Reservation, including; the Sand River watershed, the Raspberry River watershed, and the Red Cliff Creek watershed, each of which contain smaller sub-watersheds.



Map 1 - Watersheds flowing through the Red Cliff Reservation with reservation boundaries. Source: Red Cliff Water Resources Program

The Red Cliff Reservation and its' waters provide diverse habitats for a wide variety of plant and animal life. Local natural resources including the water itself are important to the Tribe for biological, cultural, sustenance, medicinal, spiritual, and economic reasons. The uses of the land and quality of the waters on the Bayfield Peninsula directly affect the resources, health, and welfare of the Tribe presently and for future generations to come.

Section 2. Purpose of Monitoring Program

The purpose of CWA Section 106 monitoring is to protect and improve all Tribal waters to the extent that water quality and associated habitat fully support all aquatic life at levels that allow for continued reproduction and biological functions, safe commercial and subsistence utilization, protection of cultural resources, and membership uses. These monitoring efforts will allow the Tribe to identify problem areas, track trends over time, identify NPS source pollution impacts, and address public health concerns.



Map 2 – Monitoring sites throughout the Red Cliff Reservation. Source: GoogleEarth

Section 3. Monitoring Framework

The monitoring framework of the Tribe's CWA Section 106 surface water monitoring project is to sample for water quality at 16 sites during the open water season (see Map 2 and Table 2) in accordance with EPA approved quality assurance project plans (QAPPs). Measurements of flow are taken once a month at the same sites during the open water season. Visual habitat observations will be taken periodically to document changes. Basic meteorological data are collected for calibration of field equipment and during sampling events.

Consistent collection of chemical, physical, and biological data beginning in 2012 through present by the Water Resources Program has enabled the Tribe to begin a baseline of data to aid the Tribe in creating an inventory of its water quality.

Baseline Water Quality Monitoring

Monitoring includes field measurements, laboratory analysis of water chemistry parameters, and stream habitat assessments. Funding was used to monitor eight fixed stations prior to 2013 (red sites on Map 2) and eight additional fixed stations beginning 2013 (yellow sites on Map 2).

The surface water quality parameters (chemical/physical) that are monitored at all sites include:

Field Measured Parameters

pH, temperature, dissolved oxygen, conductivity, turbidity, flow, and visual habitat assessment

Laboratory Measured Parameters

Total Phosphorus, Total Nitrogen, Nitrates+Nitrites, Total Kjeldahl Nitrogen, Nitrogen as Ammonia, Total Suspended Solids, and E. coli.

During the 2016 sampling season, Northern Lake Service, Inc. and Northland College ARE Lab were the contracted laboratories for water quality testing. Surface water samples were sent for analysis and in return analytical reports were provided to Red Cliff Environmental Department staff. Frequency of data collection capture seasonal hydrologic changes to establish ranges of natural baseline fluctuation within an annual hydraulic period. Sample frequency may decrease in the future to monitor for changes in the quality of local watersheds only. Flow measurements were taken once a month during the open water season, when site conditions allow. Visual habitat observations are taken at least once per season (Spring, Summer, Fall) or when any changes (natural or induced by human activity) in the stream or upstream within the watershed take place.

Table 2 - Red Cliff's CWA 106 Water Quality Monitoring Sites, Parameters, and Frequency.									
Monthly	Nutrients *	TSS	E.coli	Field **					
RCC01	X	Х	Х	Х					
RCC03	X	Х	Х	X					
RCCM01	X	Х	Х	X					
RR01	X	Х	Х	Х					
RR03	X	Х	Х	Х					
RRM01	X	Х	Х	X					
SR02	X	Х	Х	X					
SRM01	X	Х	Х	X					
CCM01	X	Х	Х	X					
CC02	X	Х	Х	Х					
CC03	X	Х	Х	Х					
LS01	X	Х	Х	Х					
FC01	X	Х	Х	Х					
FCM01	X	Х	Х	X					
SC01	X	Х	Х	X					
SC02	X	Х	Х	Х					
* Nutrients include: Total Phosp	horus, Total N	itrogen, Nitrate	s+Nitrites, Tota	al Kjeldahl					
	Nitrogen, and A	Ammonia							
** Field Parameters include: pH	H, DO, Conduct	ivity, Turbidity	, Temperature,	and Flow					

The following table lists available criteria for comparisons (see Table 3). Several of these parameters are basic water characteristic parameters based on local geology and stream type. Water quality results are compared to threshold criteria; site specific guidelines will be developed based on past data collected when the Tribe applies for TAS for water quality standards.

Table 3 -	- Applicable water quality crite	eria used for result cor	nparisons.	
Parameter	Criteria	Source	Comment	
Dissolved Oxygen	Values should fall between 5-12 mg/L	EPA Criteria Recommendations	EPA Technical Contact, Katherine Marko	
рН	Values should fall between 6-9	State of WI	-	
Turbidity	Values should not exceed 30.78 NTU	EPA Criteria Recommendations	Ecoregion VIII Subecoregion 50	
Total phosphorus	Should not exceed .012 mg/L	EPA Criteria Recommendations	Ecoregion VIII Subecoregion 50	
E. coli	Should not exceed 235 CFU (STV) 126 CFU (GM)	EPA Criteria Recommendations	Full body contact recreation	
Total Nitrogen	Should not exceed .44 mg/L	EPA Criteria Recommendations	Ecoregion VIII Subecoregion 50	
Nitrite/nitrate	Should not exceed 0.03 mg/L	EPA Criteria Recommendations	Ecoregion VIII Subecoregion 50	
Total Kjeldahl	Should not exceed	EPA Criteria	Ecoregion VIII	
Nitrogen	.33 mg/L	Recommendations	Subecoregion 50	
Ammonia	Should not exceed 1.9 mg/L	EPA Criteria Recommendations	Aquatic Life Ambient Water Quality Criteria for Ammonia- Freshwater 2013	

Macroinvertebrate Monitoring

The Wisconsin Department of Natural Resources (WiDNR) Basin Plan for the Lake Superior Basin notes a lack of information on the watersheds on the Reservation, but acknowledges the known existence of several rare macroinvertebrates in the Red Cliff Reservation. Macroinvertebrate communities are assessed annually on a rotational basis in the various sub watersheds of the Reservation and collected at a minimum of four sites during the Fall season. The collection and identification methods utilized by Red Cliff are outlined in the Surface Water Macroinvertebrate Monitoring QAPP.

The advantages of using this type of biological assessment include:

- 1) Fluctuating environmental conditions can be monitored long-term.
- 2) Macroinvertebrate communities can be utilized as indicators of general ecological integrity as many genera live in-stream for more than one season.
- 3) Macroinvertebrates are usually abundant in streams and sampling will have no detrimental effect on the community.
- 4) Individuals are easily identified and established tolerance values are available.

5) Bioassessment data compliments water chemistry data in that the first gives a more longterm description of water quality while the second gives a "snapshot" of conditions at the time of sampling.

Macroinvertebrate sampling results will be used to calculate several different indices that relate the samples to a determination on water quality. Several different indices will be utilized in order to allow for comparison of water quality conclusions of each index. This comparison will assist in the determination of impacts to each water body sampled. The following table lists available criteria for comparisons (see Table 4). Several of these indices are based on particular impacts, local geology and/or stream type. These indices will not have a "not to exceed" criteria but will rather have a numerical indicator range.

Table	4 – Applicable Criteria fo	or macroinvertebrate mon	itoring.
Parameter	Criteria	Source	Comment
Hilsenhoff Biotic Index	Calculation based on tolerance guilds	Hilsenhoff, 1987	Focuses on organic pollution disturbances to DO concentrations
Biological Community Index	Predicted community tolerance quotient compared to the sampled community quotient	Winget and Magnum, 1979	Some water chemistry required. Higher numerical result indicates better quality.
Total abundance	Sum of individuals in sample	Lille et al 2003	Higher abundance indicates higher quality
Taxonomic Richness	Total number of sampled taxa	Lille et al 2003	Lowest level of identification possible is recommended
EPT Taxa Richness (Ephemeroptera, Plecoptera, Trichoptera)	Total number of EPT taxa known to be sensitive to habitat disturbance	Lille et al 2003	Numerical result goes down as disturbance goes up

Section 4. Monitoring Locations

All sites are found within the HUC 04010301. All sites drain into Lake Superior and are considered part of the Lake Superior Basin. The HUC is referred to as the "Beartrap-Nemadji" area of the Southern Shoreline of Lake Superior. All of the watersheds are located on the Red Cliff Indian Reservation in Bayfield County, Wisconsin.

Baseline Water Quality Monitoring

Sampling sites are located at headwater locations, primary tributary junctions, and final river discharge areas into Lake Superior. Sites are located to provide upstream and downstream assessment capability only to identify future monitoring needs, potential problems, and simple classification of areas. Sampling sites were chosen in each sub watershed, where access was available with the above data objectives in mind (see Table 5). Access is of logistical importance to this primarily forested area. Locations will provide data for comparison at stream/river origins, tributary input locations and final discharge areas into Lake Superior.

Table 5 – Surface water monitoring sites.									
Site Name	L	ocation							
Red Cliff Creek (RCC)#01	90°49' 2.840"W	46°52' 9.462"N							
Red Cliff Creek(RCC) #03	90°47' 22.26"W	46°53'14.42"N							
Red Cliff Creek Mouth (RCCM) #01	90° 46.455"W	46° 52.985"N							
Raspberry River (RR)#01	90°48' 43.420"W	46°55' 51.583"N							
Raspberry River (RR)#03	90°50' 29.597"W	46°55' 3.020"N							
Raspberry River Mouth (RRM) #01	90°49'50.69"W	46°56'7.25"N							
Sand River (SR)#02	90°57' 23.344"W	46°53' 56.820"N							
Sand River Mouth(SRM) #01	90° 56.051"W	46° 56.004" N							
Chicago Creek Mouth (CCM)#01	90°47' 9.53"W	46°51' 29.08"N							
Chicago Creek (CC) #02	90°48' 27.493"W	46°51' 44.477"N							
Chicago Creek (CC)#03	90°47'18.87"W	46°51'33.38"N							
Lake Superior (LS)#01	90°47' 12.683"W	46°51' 14.72"N							
Frog Creek (FC)#01	90° 46.881"W	46° 54.337"N							
Frog Creek Mouth (FCM)#01	90° 46.812"W	46° 54.556"N							
Sucker Creek (SC)#01	90° 53.685"W	46° 54.646"N							
Sucker Creek(SC) #02	90°55'1.50"W	46°55'56.50"N							

Macroinvertebrate Monitoring

The Water Resources Program conducts annual macroinvertebrate sampling at 15 locations throughout the Reservation on a rotational basis with a minimum of four sites sampled per year (see Table 5). All macroinvertebrate monitoring sites are located at the surface water monitoring sites, with the exception of LS01 (lake site), in order to provide a more holistic view of each stream (chemical, physical and biological information together).

Section 5. Monitoring Results

Due to malfunction of the Water Resources Program's YSI model 556, the following field parameters have been excluded from this assessment: pH, conductivity, and dissolved oxygen. It is also noted that several turbidity readings were missed during the sampling season due to a malfunction with the Program's LaMotte turbidity meter.

Chicago Creek

Station CC02 - Chicago Creek at State Highway 13

Station CC02 is located upstream of a culvert at the WI State Highway 13 road crossing and downstream of a residential area with minimal amounts of agriculture. It is the closest to the headwaters of Chicago Creek, while staying within reservation boundaries.



Map 3 – Overview of CC02 Source: USGS Topo



Photo 1. Facing east, downstream, September.



Photo 2. Facing west, upstream, September.

Staff visited CC02 monthly from June through November in 2016, with the exception of e.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 6 provides parameter results and basic statistics, data graphs can be viewed in Appendix A.

	Table 6. 2016 Data Statistics for CC02										
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *		
Max Value	686.7	.14	.62	.11	.25	.07	17	17.83	9.71		
Min Value	16.9	.026	.24	.027	.34	.019	2	1.19	7.6		
Median	260.3	.052	.285	.06	.34	.0275	2.7	11.81	8.99		
Average	296.88	.065	.37	.07	.43	.033	6.04	11.46	8.77		
# Sample	13	6	6	6	6	6	5	6	3		
# Detections	13	6	6	5	6	6	5	6	3		
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78		
	•	•	* Para	ameters meas	ured in the fi	eld	•	•			

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from .24-.62 mg/L
- Nitrite + Nitrate ranging from 0.027-0.11 mg/L
- Total Nitrogen ranging from .25-.34 mg/L
- Phosphorus ranging from .019-.07 mg/L
- E.coli ranging from 16.9-686.7 MPN/100mL

No turbidity values exceeded the established comparitive criteria during the visits in 2016. Based on the EPA criteria recommendations, there were five (5) E.coli values in the month of July and two (2) values in the month of August that exceeded the established threshold criteria during the visits in 2016. The threshold values for E.coli have been established at 235 cfu/100mL single sample maximum and 126 cfu/100mL as a geometric mean of at least 5 samples collected over a 30 day period. The single sample maximum was exceeded for E.coli a total of seven (7) times throughout the sampling period, with both July and August exceeding the geometric mean threshold.

Based on the EPA criteria recommendations, there were two (2) Total Kjelhdal Nitrogen, four (4) Nitrite + Nitrate, two (2) Total Nitrogen, and six (6) Total Phosphorus values above the reference criteria.

Station CC03 - Chicago Creek at Blueberry Road

Station CC03 is located downstream of a culvert on Blueberry Road. There are residential and commercial properties located upstream of this site, as well as the tribe's powwow grounds which consists of an open field and outhouses. During the 2016 season, the Red Cliff Treaty Natural Resources Division installed a fish ladder in the nearby culvert to improve Brook Trout passage. Prior to 2012, the stream was used as an ATV crossing at this location.



Map 4 – Overview of CC03. Source: USGS Topo



Photo 3. Facing south, downstream, June.



Photo 4. Facing west, upstream, June.

Staff visited CC03 monthly from June through November in 2016 to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 7 provides a summary of basic statistics and core field parameters, data graphs can be viewed in Appendix A.

	Table 7. 2016 Data Statistics for CC03										
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *		
Max Value	209.8	.22	.55	.11	.64	.059	3.7	18	15		
Min Value	7.4	.025	.2	.019	.2	.023	1	1.04	9.55		
Median	123.5	.046	.38	.093	.46	.04	2.5	12.06	12		
Average	118.72	.075	.39	.39	.45	.04	2.28	11.23	12.18		
# Sample	6	6	6	6	6	6	5	6	3		
# Detections	6	6	6	5	6	6	5	6	3		
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78		
			* Para	ameters meas	ured in the fi	eld					

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from .2-.55 mg/L
- Nitrite + Nitrate ranging from .019-.11 mg/L
- Total Nitrogen ranging from 0.2-.64 mg/L
- Total Phosphorus ranging from 0.023 0.059 mg/L

No E.coli or turbidity values exceeded the established threshold criteria during the 2016 sampling season. The threshold values for E.coli have been established at 235 cfu/100mL single sample maximum and 126 cfu/100mL as a geometric mean of at least 5 samples collected over a 30 day period. The single sample maximum was not exceeded for E.coli.

Based on the EPA criteria recommendations, there were four (4) Total Kjeldahl Nitrogen, four (4) Nitrite + Nitrate, three (3) Total Nitrogen, and six (6) Total Phosphorus values that were above the reference criteria.

Station CCM01 – Mouth of Chicago Creek

Station CCM01 is located downstream of CC02 and CC03, at the mouth of Chicago Creek. Due to its proximity to Lake Superior, this site occasionally experiences seiching. Also noted, the Red Cliff Wastewater Treatment Facility discharges within 300 feet of shore and there are campsites located south approximately within 25 feet of site.



Map 5 – Overview of CCM01. Source: USGS Topo



Photo 5. Facing east, downstream, September.



Photo 6. Facing west, upstream, September.

Staff visited CCM01 monthly from June through November in 2016 to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 8 provides parameter results and basic statistics, data graphs can be viewed in Appendix A.

	Table 8. 2016 Data Statistics for CCM01										
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *		
Max Value	770.1	.14	.5	.53	.71	.048	15	20.43	11		
Min Value	28.1	.025	.18	.18	.49	.009	2.7	7.4	3.18		
Median	101.2	.05	.26	.25	.56	.02	6.5	13.04	5.9		
Average	195.88	.06	.29	.29	.58	.02	7.04	13.68	6.69		
# Sample	10	6	6	6	6	6	5	6	3		
# Detections	10	6	6	6	6	6	5	6	3		
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78		
	•		* Para	ameters meas	ured in the fi	eld	•	•	•		

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from .18-.5 mg/L
- Nitrite + Nitrate ranging from .18-.53 mg/L
- Total Nitrogen ranging from 0.49-.71 mg/L
- Total Phosphorus ranging from 0.009 0.048 mg/L

Turbidity values did not exceed the established threshold criteria during the 2016 sampling season. Based on the EPA criteria recommendations, there were three (3) E.coli values in the month of October that exceeded the established threshold criteria during the visits in 2016. The threshold values for E.coli have been established at 235 cfu/100mL single sample maximum and 126 cfu/100mL as a geometric mean of at least 5 samples collected over a 30 day period. The single sample maximum was exceeded for E.coli a total of three (3) times in the month of October, leading to one (1) exceedance in the geometric mean threshold.

Based on the EPA criteria recommendations, there were two (2) Total Kjeldahl Nitrogen, six (6) Nitrite + Nitrate, six (6) Total Nitrogen, and (4) Total Phosphorus values above the threshold criteria.

Frog Creek

Station FC01- Frog Creek

Station FC01 is near the headwaters of Frog Creek and upstream of Station FCM01. The area is known for historic logging but is primarily forested, and currently has a tribal member owned cabin located to the west.



Map 6 – Overview of FC01. Source: USGS Topo



Photo 7. Facing north, downstream, September.



Photo 8. Facing southeast, upstream, September.

Staff visited FC01monthly from June through November in 2016, with the exception of E.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 9 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

	Table 9. 2016 Data Statistics for FC01									
Statistic	E.coli (MPN/ 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *	
Max Value	78	.067	.27	2.4	2.6	.097	6	12.85	1	
Min Value	7.5	.038	.11	.03	.14	.017	1.7	5.52	.4	
Median	18.9	.059	.14	.05	.19	.02	3	10.98	.97	
Average	29.88	.056	.166	.44	.67	.033	3.43	9.69	.79	
# Sample	5	6	6	6	6	6	5	6	3	
# Detections	5	6	5	6	5	6	4	6	3	
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78	
			* Para	ameters meas	ured in the fie	eld				

Parameters of notable concern include:

- Nitrite + Nitrate ranging from .03-2.4 mg/L
- Total Nitrogen ranging from 0.14-2.6 mg/L
- Total Phosphorus ranging from 0.017 0.097 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were four (4) Nitrite + Nitrate, one (1) Total Nitrogen, and six (6) Total Phosphorus values above the reference criteria.

Station FCM01 - Mouth of Frog Creek

Station FCM01 is located at the mouth of Frog Creek, southeast of the Frog Bay Tribal National Park. A private cabin is located to the west of the mouth. During the summer months, the mouth is often cut off from Lake Superior due to a shoal. The site can also experience occasional seiching. Wild rice can be found in the last ³/₄ mile of the stream before Frog Creek meets Lake Superior.



Map 7 – Overview of FCM01. Source: USGS Topo



Photo 9. Facing south, upstream, August.



Photo 10. Facing north, downstream, August.

Staff visited FCM01 monthly from June through November in 2016, with the exception of E.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 10 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

	Table 10. 2016 Data Statistics for FCM01										
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *		
Max Value	98.7	.084	.63	.4	.73	.032	3	19.83	15		
Min Value	8.4	.053	.14	.1	.21	.011	1	5.85	.85		
Median	16.1	.077	.24	.32	.35	.014	2.2	14.27	1.3		
Average	34.86	.073	.31	.27	.39	.018	2.1	13.6	5.72		
# Sample	5	6	6	6	6	6	5	6	3		
# Detections	5	4	5	3	6	4	5	6	3		
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78		
			* Para	ameters meas	ured in the fi	eld					

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.14-.63 mg/L
- Nitrite + Nitrate ranging from .1-.4 mg/L
- Total Nitrogen ranging from 0.21-.73 mg/L
- Total Phosphorus ranging from 0.011 0.032 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were three (3) Nitrite + Nitrate, one (1) Total Kjeldahl Nitrogen, three (3) Total Nitrogen, and three (3) Total Phosphorus values above the reference criteria.

Lake Superior

Station LS01 - Lake Superior at Buffalo Bay Marina

Station LS01 is located on the Lake Superior shoreline in front of the Legendary Waters Resort and Casino. The site is located at a boat launch within a small marina capable of holding approximately 30 boats. Adjacent to the boat launch is a swimming beach. Previously, the land near the current casino property was mostly forested, with an art center, church and cemetery, and campground; the church, cemetery, and campground still remain. Currently, the land surrounding the casino is mostly open cut lawn with fragmented areas of trees, large parking lot, and open campground area.



Map 8 – Overview of LS01. Source: USGS Topo



Photo 11. Facing south, September.



Photo 12. Facing north, September.

Staff visited LS01 monthly from June through November 2016, with the exception of temperature readings in the months of July and August, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 11 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

	Table 11. 2016 Data Statistics for LS01										
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *		
Max Value	5.2	.076	.42	.4	.77	.007	4	17.03	.42		
Min Value	1	.025	.11	.31	.4	.007	1	8.72	.35		
Median	2	.037	.19	.32	.5	.007	2.1	9.93	.38		
Average	2.66	.038	.22	.34	.52	.007	2.3	11.4	.38		
# Sample	6	6	6	6	6	6	5	4	2		
# Detections		5	5	6	6	1	4	4	2		
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78		
	•		* Para	ameters meas	ured in the fi	eld	•	•	•		

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.11-.42 mg/L
- Nitrite + Nitrate ranging from .31-.4 mg/L
- Total Nitrogen ranging from 0.4-.77 mg/L

No turbidity, phosphorus, or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were six (6) Nitrite + Nitrate, one (1) Total Kjeldahl Nitrogen, and four (four) Total Nitrogen values above the reference criteria.

Raspberry River

Station RR03 - Raspberry River at Rowley Road

Station RR03 is located upstream of RRM01 and RR01 at the Rowley Road crossing. During the 2016 season, a bridge was built at this crossing to replace an undersized culvert. There is an overflow channel upstream of the bridge that carries flood water to the north, under the road, and back into the river. The area is mainly forested with some residential and logging operations. Historical logging is prevalent in this watershed. Wild rice is known to grow on this river way.



Map 9– Overview of RR03. Source: USGS Topo



Photo 13. Facing east, downstream, August.



Photo 14. Facing west, upstream, August.

Station RR03 was visited monthly from June through November in 2016, with the exception of E.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 12 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

			Table 12	2. 2016 Data	Statistics for	RR03				
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *	
Max Value	86	.16	.73	.11	.8	.12	20	19.48	28.6	
Min Value	1	.028	.34	.025	.37	.021	2.5	5	5.5	
Median	33.6	.085	.49	.07	.56	.035	3.5	13.17	10.65	
Average	35.2	.086	.49	.07	.55	.047	7.76	12.84	13.85	
# Sample	5	6	6	6	6	6	5	6	4	
# Detections	5	6	6	5	6	6	5	6	4	
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78	
* Parameters measured in the field										

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.34-.73 mg/L
- Nitrite + Nitrate ranging from .025-.11 mg/L
- Total Nitrogen ranging from 0.37-.8 mg/L
- Total Phosphorus ranging from 0.021 0.12 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were four (4) Nitrite + Nitrate, six (6) Total Kjeldahl Nitrogen, four (4) Total Nitrogen, and six (6) Total Phosphorus values above the reference criteria.

Station RR01 – Raspberry River at Campground Boat Ramp

Station RR01 is located upstream of RRM01 and downstream of RR03 at the Raspberry River Tribal Campground boat ramp. The area is used as a launch site for boats, fishing, recreational swimming, camping, and cultural harvest of significant wetland plants; wild rice is known to grow on this river way. Historical logging is prevalent in this watershed.



Map 10 – Overview of RR01. Source: USGS Topo



Photo 15. Facing west, August.



Photo 16. Facing east, August.

Station RR01 was visited monthly May through November in 2016, with the sole exception of September, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 13 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

			Table 1.	3. 2016 Data	Statistics for	RR01				
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *	
Max Value	91	.1	1.1	.22	1.1	.06	7	23	17	
Min Value	12.1	.03	.31	.04	.34	.031	1	6.6	8.44	
Median	37.9	.06	.48	.04	.48	.051	3.9	17.85	11.12	
Average	50.22	.06	.55	.1	.59	.047	3.95	16.32	11.92	
# Sample	5	6	6	6	6	6	5	6	4	
# Detections	5	6	6	3	6	6	4	6	4	
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78	
* Parameters measured in the field										

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.31-1.1 mg/L
- Nitrite + Nitrate ranging from .04-.22 mg/L
- Total Nitrogen ranging from 0.34-1.1 mg/L
- Total Phosphorus ranging from 0.031 0.06 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were three (3) Nitrite + Nitrate, five (5) Total Kjeldahl Nitrogen, three (3) Total Nitrogen, and six (6) Total Phosphorus values above the reference criteria.

Station RRM01 - Mouth of Raspberry River

Station RRM01 is located downstream of RR03 and RR01 at the mouth of the Raspberry River where it meets Lake Superior. This site occasionally experiences seiching. The area primarily consists of a large coastal wetland surrounded by forest with a few residential spots and tribal campground. Fishing, recreational swimming, and cultural harvest of significant wetland plants are uses of this watershed; wild rice is known to grow on this river way.



Map 11 – Overview of RRM01. Source: USGS Topo



Photo 17. Facing northeast, downstream, September.



Photo 18. Facing southwest, upstream, September.

Station RR03 was visited monthly from May through November in 2016, with the exception of E.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 14 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

			Table 14	. 2016 Data S	tatistics for R	RRM01				
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *	
Max Value	25.9	.053	.46	.33	.79	.038	2.7	20.76	13	
Min Value	4.1	.034	.21	.074	.43	.009	2.5	6.95	.73	
Median	23.25	.043	.31	.25	.53	.0285	2.5	17.56	4.81	
Average	19.13	.043	.33	.22	.55	.026	2.57	15.16	5.84	
# Sample	5	6	6	6	6	6	5	6	4	
# Detections	4	5	6	6	6	4	3	6	4	
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78	
* Parameters measured in the field										

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.21-.46 mg/L
- Nitrite + Nitrate ranging from .074-.33 mg/L
- Total Nitrogen ranging from 0.43-.79 mg/L
- Total Phosphorus ranging from 0.009 0.038 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were six (6) Nitrite + Nitrate, three (3) Total Kjeldahl Nitrogen, five (5) Total Nitrogen, and three (3) Total Phosphorus values above the reference criteria.

Red Cliff Creek

Station RCC01- Red Cliff Creek at State Highway 13

Station RCC01 is located upstream of a culvert at the Wisconsin State Highway 13 crossing. It is located downstream of the Tribal Fish Hatchery discharge and UW-Steven's Point Northern Aquaculture Demonstration Facility discharge. This site is located near the headwaters of Red Cliff Creek and is known for having frequent beaver activity.



Map 12 – Overview of RCC01. Source: USGS Topo



Photo 19. Facing south, upstream, September.



Photo 20. Facing northeast, downstream, July.

Staff visited monthly May through November in 2016, with the exception of E.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 15 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

			Table 15	. 2016 Data S	Statistics for F	RCC01				
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *	
Max Value	50.4	.2	.43	.28	.7	.09	8.5	17.9	31.7	
Min Value	1	.06	.21	.11	.32	.053	2	5.22	2.68	
Median	31.3	.08	.29	.19	.5	.06	5.5	12.88	4.4	
Average	25.62	.1	.3	.2	.5	.06	5.72	11.91	12.93	
# Sample	5	6	6	6	6	6	5	6	3	
# Detections	5	6	6	6	6	6	5	6	3	
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78	
* Parameters measured in the field										

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.21-.43 mg/L
- Nitrite + Nitrate ranging from .11-.28 mg/L
- Total Nitrogen ranging from 0.32-.7 mg/L
- Total Phosphorus ranging from 0.053 0.09 mg/L
- Turbidity ranging from 2.68-31.7 NTU

No E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were six (6) Nitrite + Nitrate, three (3) Total Kjeldahl Nitrogen, four (4) Total Nitrogen, six (6) Total Phosphorus, and one (1) Turbidity values above the reference criteria.

Station RCC03 - Red Cliff Creek at Blueberry Road

Station RCC03 is located upstream of a culvert at the Blueberry Road crossing and is located between sites RCC01 and RCCM01. This waterbody experiences flash flooding with lots of woody debris that frequently blocks the culvert inlet. The culvert is undersized and is being replaced with a larger one during the 2017 season. The area is primarily forested with residential areas and some pastureland upstream.



Map 13 – Overview of RCC03. Source: USGS Topo

Photo 21. Facing east, downstream, September.

Photo 22. Facing west, upstream, September.

Staff visited monthly May through November in 2016 to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 16 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

			Table 16	. 2016 Data S	statistics for F	RCC03				
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *	
Max Value	150	.15	.47	.13	.6	.092	17	17.65	13	
Min Value	25	.03	.2	.04	.26	.021	3.5	4.33	5.2	
Median	58.5	.06	.29	.06	.34	.042	9.3	9.71	9.1	
Average	65.92	.07	.32	.07	.4	.05	10.96	10.54	9.1	
# Sample	6	6	6	6	6	6	5	5	2	
# Detections	6	6	6	6	6	6	5	5	2	
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78	
* Parameters measured in the field										

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.2-.47 mg/L
- Nitrite + Nitrate ranging from .04-.13 mg/L
- Total Nitrogen ranging from 0.26-.6 mg/L
- Total Phosphorus ranging from 0.021–0.092 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were six (6) Nitrite + Nitrate, two (2) Total Kjeldahl Nitrogen, two (2) Total Nitrogen, and six (6) Total Phosphorus values above the reference criteria.

Station RCCM01 - Mouth of Red Cliff Creek

Station RCCM01 is located at the mouth of Red Cliff Creek where it meets Lake Superior. This site also experiences occasional seiching. The area is primarily forested with residential areas, it is noted that a private marina is located on the southern side of the mouth.

Map 14 – Overview of RCCM01. Source: USGS Topo

Photo 23. Facing west, upstream, September.

Staff visited monthly May through November in 2016 to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 17 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

	Table 17. 2016 Data Statistics for RCCM01												
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	us TSS Temp (°C) ?		Turbidity (NTU) *				
Max Value	290.9	.027	.4	.31	.53	.04	9.5	20.98	45				
Min Value	13.5	.027	.2	.13	.43	.017	1.8	7.55	6.22				
Median	60.75	.038	.24	.21	.45	.0295	5.7	16.29	8.4				
Average	89.2	.042	.26	.21	.47	.029	5.4	15.02	19.87				
# Sample	6	6	6	6	6	6	5	6	3				
# Detections	6	5	6	6	6	6	5	6	3				
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78				
* Parameters measured in the field													

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.2-.4 mg/L
- Nitrite + Nitrate ranging from .13-.31 mg/L
- Total Nitrogen ranging from 0.43-.53 mg/L
- Total Phosphorus ranging from 0.017–0.04 mg/L
- Turbidity ranging from 6.22-45 NTU

Based on the EPA criteria recommendations, there was one (1) E.coli value in the month of June that exceeded the established threshold criteria during the visits in 2016. The threshold values for E.coli have been established at 235 cfu/100mL single sample maximum and 126 cfu/100mL as a geometric mean of at least 5 samples collected over a 30 day period. The single sample maximum was exceeded for E.coli one (1) time, but no follow up visits were made to determine the geometric mean due to rain events that left no remaining sampling days during the month.

Based on the EPA criteria recommendations, there were six (6) Nitrite + Nitrate, one (1) Total Kjeldahl Nitrogen, five (5) Total Nitrogen, and six (6) Total Phosphorus values above the reference criteria.

Sand River

Station SR02 – Sand River at State Highway 13

This area is primarily forested with minimal residential impacts. Historical logging is prevalent in this watershed and there are frequent ongoing logging operations. Beaver activity has been occasionally observed upstream of Highway 13.

Map 15 – Overview of SR02. Source: USGS Topo

Photo 24. Facing south, upstream, June.

Photo 25. Facing north, downstream, June.

Staff visited monthly May through November in 2016, with the exception of E.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 18 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

	Table 18. 2016 Data Statistics for SR02												
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *				
Max Value	37.3	.071	.55	.058	.61	.066	6.8	17.66	25				
Min Value	7.3	.035	.14	.021	.14	.011	1.5	4.36	3.88				
Median	21.8	.054	.2	.034	.22	.02	3.75	11.87	8.07				
Average	21.98	.055	.25	.037	.27	.03	3.95	11.05	12.32				
# Sample	5	6	6	6	6	6	5	6	3				
# Detections	5	5	6	4	6	6	4	6	3				
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78				
* Parameters measured in the field													

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.14-.55 mg/L
- Nitrite + Nitrate ranging from .021-.058 mg/L
- Total Nitrogen ranging from 0.14-.61 mg/L
- Total Phosphorus ranging from 0.011–0.066 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were two (2) Nitrite + Nitrate, one (1) Total Kjeldahl Nitrogen, one (1) Total Nitrogen, and five (5) Total Phosphorus values above the reference criteria.

Station SRM01- Mouth of Sand River

This site is located at the mouth of Sand River where it meets Lake Superior. The site occasionally experiences seiching. This area is primarily forested with minimal residential impacts. Historical logging is prevalent in this watershed and there are frequent ongoing logging operations. Beaver dam activity is common in the estuary. The lands near the mouth are also managed by the Apostle Islands National Park Service, within reservation boundaries. Wild rice is also present in the area.

Map 16 – Overview of SM01. Source: USGS Topo

Photo 26. Facing southwest, upstream, June.

Photo 27. Facing north, downstream, June.

Staff visited monthly May through November in 2016, with the exception of E.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 19 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

			Table 19	. 2016 Data S	tatistics for S	SRM01				
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *	
Max Value	42	.081	.55	.36	.84	.075	5	20.33	10	
Min Value	15.8	.036	.16	.18	.39	.01	1.3	7.53	2.1	
Median	18.5	.046	.19	.23	.44	.018	2.5	16.17	2.92	
Average	23.08	.052	.25	.25	.51	.034	2.66	14.61	4.49	
# Sample	5	6	6	6	6	6	5	6	4	
# Detections	5	5	6	6	6	3	5	6	4	
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78	
* Parameters measured in the field										

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.16-.55 mg/L
- Nitrite + Nitrate ranging from .18-.36 mg/L
- Total Nitrogen ranging from 0.39-.84 mg/L
- Total Phosphorus ranging from 0.01–0.075 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were six (6) Nitrite + Nitrate, one (1) Total Kjeldahl Nitrogen, three (3) Total Nitrogen, and two (2) Total Phosphorus values above the reference criteria.

Sucker Creek

Station SC01 – Sucker Creek at County Highway K Road

The site is located along County Highway K, in a drainage ditch, which serves as the headwater source; a marsh area can be found on the south side of County Highway K. There is hobby farm with some animals downstream from the site. This area is primarily forested with historical logging and some logging operations still occurring in the watershed, as well as areas of pastureland.

Map 17 – Overview of SC01. Source: USGS Topo

Photo 28. Facing northwest, downstream, June.

Photo 29. Facing north, upstream, June.

Staff visited monthly August through November in 2016 to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 20 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

	Table 20. 2016 Data Statistics for SC01												
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *				
Max Value	1203.3	.14	1.7	.11	1.8	.045	33	16.37	96.9				
Min Value	1	.077	1.1	.025	1.1	.011	9	5.44	13.8				
Median	36.4	.11	1.2	.029	1.2	.0235	19	10.98	55.35				
Average	208.83	.11	1.28	.05	1.34	.026	19.4	10.94	55.35				
# Sample	9	5	5	5	5	5	5	4	2				
# Detections	9	5	5	3	5	4	5	4	2				
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78				
* Parameters measured in the field													

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 1.1-1.7 mg/L
- Nitrite + Nitrate ranging from .025-.11 mg/L
- Total Nitrogen ranging from 1.1-1.8 mg/L
- Total Phosphorus ranging from 0.011–0.045 mg/L
- Turbidity ranging from 13.8-96.9 NTU

Based on the EPA criteria recommendations, there was one (1) E.coli value in the month of August that exceeded the established threshold criteria during the visits in 2016. The threshold values for E.coli have been established at 235 cfu/100mL single sample maximum and 126 cfu/100mL as a geometric mean of at least 5 samples collected over a 30 day period. The single sample maximum was exceeded for E.coli one (1) time. There were no exceedances in the geometric mean threshold.

Based on the EPA criteria recommendations, there were one (1) Nitrite + Nitrate, five (5) Total Kjeldahl Nitrogen, five (5) Total Nitrogen, and two (2) Total Phosphorus values above the reference criteria.

Station SCM02- Sucker Creek Mouth

This area is primarily forested with minimal residential impacts. There is a cultural gathering area west of the mouth of Sucker Creek. Beaver dam activity has been occasionally noted. It is common for the mouth to develop shoals during the summer and fall.

Map 18 – Overview of SCM02. Source: USGS Topo

Photo 30. Facing southeast, upstream, June.

Photo 31. Facing northwest, downstream, June.

Staff visited monthly June through November in 2016, with the exception of E.coli sampling in June, to conduct baseline water quality monitoring. Core measurements were completed and water samples were collected and analyzed for chemical parameters. Table 21 provides basic statistics and core field parameters, data graphs can be viewed in Appendix A.

			Table 21	. 2016 Data S	tatistics for S	SCM02				
Statistic	E.coli (MPN / 100 mL)	Ammonia (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS	Temp (°C) *	Turbidity (NTU) *	
Max Value	46.4	.069	.38	.28	.56	.021	5	18.93	5.1	
Min Value	2	.032	.18	.022	.23	.008	3.5	4.95	1.19	
Median	29.2	.058	.28	.16	.37	.011	4.4	12.53	3.67	
Average	22.74	.052	.27	.16	.38	.013	4.33	12.15	3.32	
# Sample	5	6	6	6	6	6	5	6	3	
# Detections	5	5	6	4	6	5	4	6	3	
Threshold Value	235 (STU) or 126 (GM)	1.9	.33	.03	0.44	0.012	NA	NA	30.78	
* Parameters measured in the field										

Parameters of notable concern include:

- Total Kjeldahl Nitrogen ranging from 0.18-.38 mg/L
- Nitrite + Nitrate ranging from .022-.28 mg/L
- Total Nitrogen ranging from 0.23-.56 mg/L
- Total Phosphorus ranging from 0.008–0.021 mg/L

No turbidity or E.coli values exceeded the established threshold criteria during the 2016 sampling season.

Based on the EPA criteria recommendations, there were three (3) Nitrite + Nitrate, one (1) Total Kjeldahl Nitrogen, two (2) Total Nitrogen, and two (2) Total Phosphorus values above the reference criteria.

	Table 22. Macroinvertebrate HBI values from 2009 – 2016												
Site	2009	2010	2011	2012	2013	2014	2015	2016					
CC02	Good 4.96			Very poor 9.48			Poor 8.23						
CC03							Very good 4						
CCM01				Fair 6.28		Fairly poor 6.86		Fair 6.22					
FC01							Fairly poor 6.56 (only 106 vs. required 125 samples)						
FCM01						Fairly poor 7.21		Fair 5.80					
RR01	Good 5.15				Fair 6.30	Very good 4.21		Very good 4.50					
RR03					Very good 4.02	Poor 7.96		Good 4.55					
RRM01							Fair 6.34						
RCC01				Fair 5.79		Very good 4.45							
RCC03	Very good 4.00			Good 5.15		Good 4.90							
RCCM01							Fair 6.41						
SR02	Excellent 3.34				Fair 5.77	Good 4.62		Very good 3.71					
SRM01							Fair 5.92						
SC01													
SCM01						NA		Poor 7.71					

HBI	Water Quality	Degree of organic pollution
0.00-3.50	Excellent	None
3.51-4.50	Very Good	Slight
4.51-5.50	Good	Some
5.51-6.50	Fair	Fairly significant
6.51-7.50	Fairly Poor	Significant
7.51-8.50	Poor	Very significant
8.51-10.00	Very Poor	Severe

Chicago Creek

Biotic index scores, shown in Table 22 and Appendix B, indicate that the stream's ecological status had slightly worsened but may be improving downstream. The Highway 13 (CC02) sample site went from "good" in 2009 to "very poor" in 2012, to "poor" in 2015. The mouth (CCM01) sample site went from "fair" in 2012 to "fairly poor" in 2014 and back to "fair" in 2016. Samples were taken at the Blueberry Road (CC03) site for the first time in 2015 and it received a biotic index score of "very good."

Frog Creek

Biotic index scores can be found in Table 22 and Appendix B. The FC01 site was sampled for aquatic macroinvertebrates in 2015 and was assigned a biotic index score of "fairly poor" due to their only being 106 versus the required 125 samples. The mouth sample site (FCM01) was sampled in 2014 and was designated "fairly poor" and was given a value of "fair" in 2016.

Raspberry River

Biotic index scores, shown in Table 22 and Appendix B, indicate that the stream's ecological status has varied. The Raspberry Campground boat ramp (RR01) sample site went from "good" in 2009 to "fair" in 2013 and up to "very good" in 2014 as well as 2016. The Rowley Road (RR03) sample site went from "very good" in 2013 to "poor" in 2014 and up to "good" in 2016. Aquatic macroinvertebrate samples were taken for the first time at the mouth (RRM01) site in 2015 and it was assigned a biotic index score of "fair."

Red Cliff Creek

Biotic index scores, shown in Table 22 and Appendix B, indicate that the stream's ecological status has varied depending on the site. The Highway 13 (RCC01) sample site went from "fair" in 2012 to "very good" in 2014. The Blueberry Road (RCC03) sample site went from "very good" in 2009 to "good" in 2012 and 2014. Aquatic macroinvertebrate samples were taken at the mouth (RCCM01) site for the first time in 2015 and it received a biotic index rating of "fair."

Sand River

Biotic index scores, shown in Table 22 and Appendix B, indicate that the stream's ecological status has varied, but remains relatively good. Scores at the Highway 13 site (SR02) have ranged from "excellent" in 2009, to "fair" in 2013, back to "good" in 2014, and up to "very good" in 2016. The mouth sample site (SRM01) was sampled for macroinvertebrates for the first time in 2015 and it received a biotic index score of "fair."

Sucker Creek

Biotic index scores, shown in Table 22 and Appendix B, indicate that the stream's ecological status is very poor. The Old County K site (SC01) has never been sampled for aquatic macroinvertebrates due to its intermittency. The first sample taken at the mouth site (SCM01) occurred in 2014 and there weren't enough macroinvertebrates present to assign a score, thus yielding a score of "NA", and the site received a ranking of "poor" in 2016.

Water Quality Concerns

Overall, the water quality of the Red Cliff Reservation is high. Some areas of the Reservation are negatively impacted by excess sediment, nutrients, and human or animal waste as indicated by E.coli concentrations. All streams are considered to be impacted by NPS pollution. The sources of these impacts are considered to be land uses such as outdated septic systems, outhouses, small amounts of agriculture/pastureland, logging practices, and possibly aquaculture discharges. This rural area is largely forested and the soils are highly susceptible to erosion. Due to the highly erodible soils, sedimentation is a major concern across the region. Elevated nutrient levels are likely tied to elevated background levels in the local soils. Some NPS source inputs are likely the result of upstream land use management in forestry and roads.

Chicago Creek

Review of the Water Resource Program's water quality data from 2016 (see Appendix A and B) indicates that the stream's water quality has slightly declined. The stream's temperature appears to be generally increasing. Turbidity levels appear to be improving, while phosphorus remains consistently elevated, and nitrogen levels have experienced a slight increase. Nitrogen sources may be linked to historic land use in the headwaters area and septic systems located near the stream south of Highway 13. E.coli levels in the stream are persistent and regularly exceed the threshold at the Highway 13 (CC02) sample site. Land uses in the area indicate that the source of E.coli may also be linked to older septic systems and outhouses, and elevated E.coli levels may also relate to low flows combined with elevated summer temperatures.

Frog Creek

Review of the Water Resource Program's water quality data from 2016 (see Appendix A and B) indicates that the stream's water quality has remained relatively the same. Turbidity and nitrogen levels have slightly improved, while phosphorus levels continue to breach the threshold. The mouth of Frog Creek is regularly closed off by a sand bar. This common blockage of flow appears to be influencing the stream's water quality near the mouth (FCM01) on a year-to-year basis by trapping nutrients such as nitrogen and phosphorus. During the 2016 season, the mouth of Frog Creek was mostly free flowing, which is the most likely reason that nutrient levels appear to have improved.

Lake Superior at the Buffalo Bay Marina

Review of the Water Resource Program's water quality data from 2016 (see Appendix A and B) indicates that boat ramp/beach site is impacted by NPS pollution. Turbidity and phosphorus levels continue to decline at the site, with temperatures remaining consistent. Nitrogen levels are persistently elevated at the site, likely due to the manicured lawn just uphill. Although Canada Geese can generally be found on the casino grounds and beach area, E.coli levels have not exceeded criteria at this site since 2013.

Raspberry River

Review of the Water Resource Program's water quality data from 2016 (see Appendix A and B) indicates that Raspberry River's water quality has remained relatively the same. Nitrogen and phosphorus levels have remained consistent. E.coli levels were improved during the 2016 season, with no threshold exceedances. Turbidity results are decreasing, which may be related to beaver dam impoundments that are trapping sediment upstream, and/or a lack of post-storm data representation.

Red Cliff Creek

Review of the Water Resource Program's water quality data from 2016 (see Appendix A and B) indicates that Red Cliff Creek's water quality has remained relatively the same. E.coli, turbidity, and phosphorus levels all appear to be constant in the stream. Nitrogen levels have slightly improved in the stream.

Sand River

Review of the Water Resource Program's water quality data from 2016 (see Appendix A and B) indicates that the stream's water quality remains relatively stable. Turbidity, nitrogen, and phosphorus levels remain approximately the same. E.coli levels were improved in 2016, with no threshold exceedances.

Sucker Creek

Review of the Water Resource Program's water quality data from 2016 (see Appendix A and B) indicates that the stream's water quality has continued to remain relatively poor. Although phosphorus appears to be stable, E.coli, turbidity and nitrogen levels are persistent.

Data collection of hydrological, biological, chemical parameters through the Water Resources Program has enabled the Tribe to create a baseline of data to aid in creating an assessment of its water quality. Data collection has indicated NPS sources may negatively impact water resources. Continued baseline monitoring is needed to assist the Tribe in future management decisions and to assess water quality trends as NPS source best management practices as well as restoration efforts are implemented. More in depth discussion of NPS source issues and comprehensive review of data can be found in the tribe's NPS Assessment Report.

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Appendices

Appendix A-

Red Cliff Water Resource Program's CWA 106 Water Quality Monitoring Data Graphs

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Chicago Creek

Frog Creek

Lake Superior

54

Raspberry River

Red Cliff Creek

Sand River

Sucker Creek

Appendix B -

Red Cliff Water Resource Program's Macroinvertebrate Monitoring Data Graphs

