Tribal Nonpoint Source Assessment Report

Red Cliff Band of Lake Superior Chippewa
Environmental Department
Water Resources Program

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This Nonpoint Source (NPS) Assessment Report has been developed to fulfill the United States Environmental Protection Agency's (US EPA) requirements for a Clean Water Act (CWA) section 319 program. This report will assess nonpoint source water quality on lands within the boundaries of the Red Cliff Band of Lake Superior Chippewa Reservation, which consists of approximately 14,541 acres. It shall serve as guidance for the development of a NPS Management Plan and assist in determining the long term assessment needs for the Red Cliff Reservation. The Red Cliff NPS Assessment Report utilizes the Tribe's Water Resources Program's CWA 106 data and other available information about the Bayfield Peninsula to determine priorities for nonpoint source pollution prevention. Future nonpoint source assessment of Reservation waters will be included in the Tribe's annual Water Quality Assessment Report under its CWA 106 Program.

NPS pollution is defined by the EPA as follows:
"Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters."

Though the water resources appear to be mostly healthy, several waterbodies are shown to be threatened by NPS pollution. Historical land cover and stream habitat changes have also negatively impacted the water resources. Available information and data show that the soils on the Reservation (and the Lake Superior Basin in general) are highly erodible and historic land cover and land uses have been greatly altered, therefore nonpoint source pollution is one of the greatest impacts to water resources in the region. The goal of this assessment is to bring attention to water quality parameters and issues that indicate significant nonpoint sources of pollution and provide guidance on how to effectively monitor and reduce such sources.

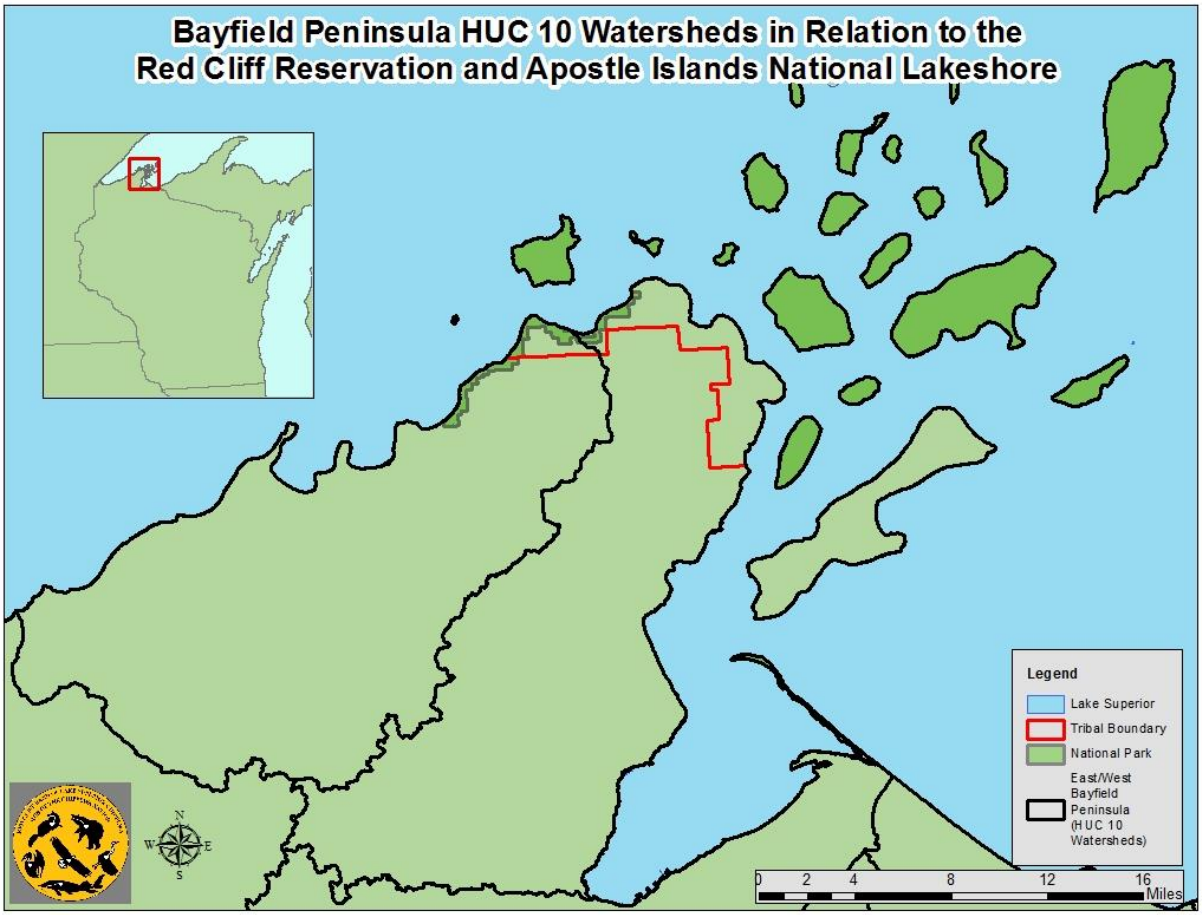
Introduction and Background

The Red Cliff Band of Lake Superior Chippewa is one of many bands of Ojibwe that reside around the Lake Superior region of the United States and Canada. The Red Cliff Reservation (*Gaa-miskwaabikaang)* is located along 22 miles of Lake Superior's southern shore (*Gichigami*) on Wisconsin's Bayfield Peninsula (*Gegaawekamigaang*). This area is commonly known as the "Hub of the Ojibwe."

The Red Cliff Reservation was established for the Red Cliff Band under the terms of the 1854 La Point Treaty and an amendment to the Treaty in 1863. Final allotments were published in 1896, listing the members of the Red Cliff Band. The Red Cliff Band adopted a constitution and by-laws in 1936, meeting the United States Government's requirements for becoming a federally recognized Tribe under the Indian Reorganization Act of 1934 (IRMP, 2006).

The exterior boundary of the Red Cliff Reservation (see Map 1) spans approximately 14,541 acres and contains approximately 804 acres of wetlands (WI Wetlands Inventory), 12 acres of inland lakes/reservoirs/ponds, and 47 miles of streams that are connected to many additional stream miles outside the boundaries. The Reservation is adjacent to the Apostle Islands archipelago, which consists of 22 islands that extend from the Bayfield Peninsula, and 10% of

the Apostle Islands National Lakeshore lies within Red Cliff's borders- held by the U.S. Department of the Interior National Park Service. Table 1 details the watershed HUCs associated with the Reservation.



Map 1 - Red Cliff Band of Lake Superior Chippewa Reservation (red) and the Apostle Islands National Lakeshore (dark green)

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.

Social and Economic Conditions

The Tribe currently has an enrollment of 6,998 Tribal members, of which 1,346 are living within the exterior boundaries of the Reservation (Red Cliff Tribal Enrollment Office, 2016). This region is highly dependent on the tourism industry and many of the local jobs are limited to summer/seasonal work. Employment rates, based on the 2013 Bureau of Indian Affairs Labor Force Report, indicate that of tribal members living on or near the Reservation 34.9% are employed with civilian jobs, and 52% are unemployed (of which 43.5% are available to work).

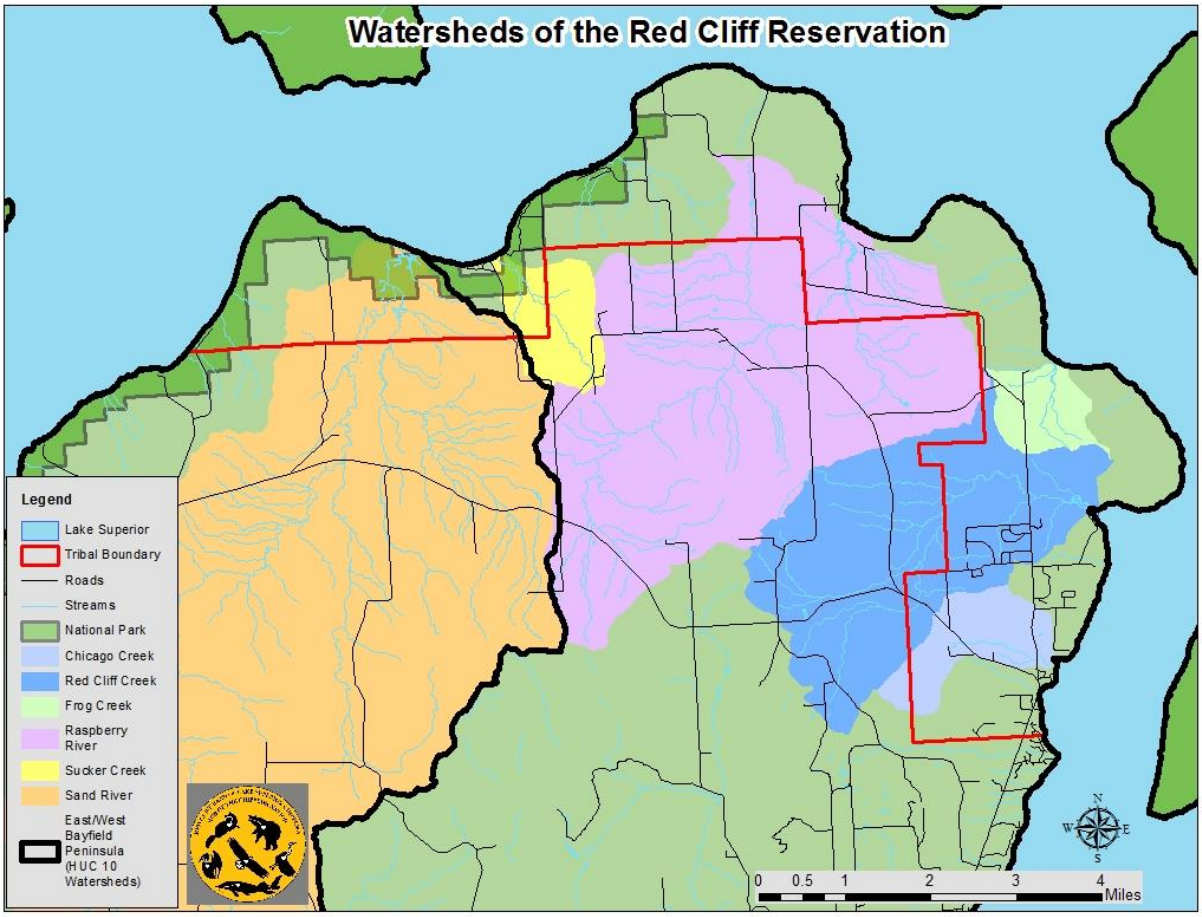
Water Resources Summary

The Reservation's watersheds all discharge to Lake Superior and are found within the HUC-8 04010301 watershed, which is known as the "Beartrap-Nemadji" area of the southern shoreline of Lake Superior (see Map 2 in Appendix A). 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 (see map 3 in Appendix A). 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 4 in Appendix A). 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 (see Table 1 for a complete list of named reservation watersheds and their corresponding sub-watersheds, which can be seen in Map 5).

Table 1 - Watersheds that cross the Red Cliff Reservation Boundaries

HUC- 10 Watersheds	Bayfield Peninsula Northwest 0401030109	Bayfield Peninsula Southeast 0401030110	Big ↓ Small
HUC- 12 Watersheds	Sand River Watershed 040103010901	Raspberry River Watershed 040103011002 Red Cliff Creek Watershed 040103011003	
Named Sub-watersheds within the Reservation	Sand River	<u>Raspberry River Sub-watersheds:</u> Raspberry River and Sucker Creek <u>Red Cliff Creek Sub-watersheds:</u> Red Cliff Creek, Frog Creek, and Chicago Creek	

Wisconsin's Natural Heritage Inventory Database indicates the presence of many water dependent endangered, threatened or special concern species and/or communities in the Reservation's watersheds. These include vascular plants, birds, butterflies and moths, reptiles and amphibians, fish, mussels, macroinvertebrates and coastal bogs and fens as well as northern sedge meadows.



Map 5 - Watersheds flowing through the Red Cliff Reservation with reservation boundaries

The Reservation includes approximately 47 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. Although these streams are not currently monitored, it is important to recognize that they share the same landscape features and subsequent nonpoint source impacts as those streams that are currently monitored by Red Cliff.

The stream habitat is largely sand and silt beds with vegetation and woody debris and most reservation streams lie in deeply cut ravines. The streams that the Water Resources Program currently monitor for water quality are relatively small- 4th order and smaller. Flow measurement data shows that these streams all have low average flow volumes and several have flow volumes below 1cfs at certain times of the year. Some locations also experience water level changes at their mouths due to Lake Superior's seiche. Many of the streams experience flash flooding and increase substantially in volume during spring snowmelt and in fall rains.

The Reservation includes approximately 12 acres of inland lakes, reservoirs and ponds which primarily consist of wastewater treatment ponds and hatchery fish ponds. According to the WI

Wetlands Inventory, there are 804 acres of wetlands, which are composed of upland wetland areas, beaver meadows and coastal estuaries. These wetlands provide habitat to many reptiles, amphibians, fish, birds and mammals.

Groundwater is the source of drinking water for the Reservation either through Tribal utilities, private wells or artesian wells. The United States Geological Survey (USGS) was contracted in 2011 to develop a groundwater flow model to improve understanding of the Tribe's groundwater resource. A draft report of their findings indicates that 80% of the peninsula's groundwater is supplied by recharge, precipitation infiltrating into the ground, and 20% flows underground from the Wisconsin mainland. As the peninsula's groundwater flows toward Lake Superior, 89% discharges into streams, 9% reaches the lake and only about 1% is pumped out by municipal, private, and aquaculture/hatchery wells. Based on groundwater flow directions, the USGS draft study report estimates that the water pumped by the Red Cliff Water and Sewer Department encompasses a capture zone that extends approximately six miles west of Red Cliff's four community wells. This study did not provide any information regarding the quality of groundwater; however the Water and Sewer Department ensures Safe Drinking Water Act (SDWA) compliance through routine monitoring. A Wellhead Protection Plan was completed for the Reservation in 1995, but was updated as a Source Water Protection Plan in 2005 through Wisconsin Community Action Program (WISCAP), and again in 2009. The Source Water Protection Plan will be updated again in winter of 2017.

Water Quality Assessment

Purpose

The purpose of this assessment is to identify waterbodies for which uses have been or are likely to be impaired (threatened) by nonpoint sources (NPS) of pollution unless alternate management practices are implemented. Currently, nonpoint source pollution is the leading source of the nation's water quality problems (US EPA).

NPS pollution occurs when rainfall, snowmelt, or irrigation runs over land or through the ground, transports pollutants, and deposits them into rivers, lakes and coastal waters or introduces them into ground water through infiltration. NPS pollution also causes adverse changes to the vegetation, shape, and flow of streams and other aquatic systems. This type of pollution is referred to as "nonpoint source" because it cannot be traced back to a specific location or source, such as a pipe discharging effluent directly into a waterbody.

NPS pollution is widespread because it can occur any time activities disturb the land or water. Forestry, agriculture, grazing, septic systems, recreational boating, urban runoff, construction, natural or anthropogenic physical changes to stream channels, and habitat degradation are potential sources of NPS pollution. Careless or uninformed household management also contributes to NPS pollution problems.

Method for Conducting Nonpoint Source Assessment

Data utilized in the assessment of nonpoint sources of pollution on the Red Cliff Reservation include: land use data, soil data, and original vegetation data from the Red Cliff Integrated Resource Management Plan and Bayfield County Website; results from the septic system inventory carried out under WISCAP; water quality data collected by the Tribe's Water Resources Program under CWA 106 and other programs; the USGS Bayfield Peninsula Groundwater study draft report; the Lake Superior Basin Regional Assessment & Report Compendium by the WDNR; the Biodiversity Conservation Strategy for Lake Superior and its Nemadji to Fish Creek Regional Unit Plan; and information from the State of the Basin Plan by the Wisconsin Department of Natural Resources (WDNR) for the Lake Superior Basin.

The Red Cliff Water Resources Program has been collecting data on the basic water quality on the Reservation since the early 1990's. Previous sampling efforts focused on chemicals. Macroinvertebrate monitoring (biological monitoring) was initiated in 2009 to augment basic water quality monitoring. Additionally, best professional judgment and knowledge of the history of the Reservation plays an important role in assessing the possible impacts to water quality as well as planning for the management of nonpoint pollution sources. Input from Red Cliff tribal members or other community members is welcomed and specifically sought out annually at Red Cliff's Annual Watershed Symposium, which is hosted by the Water Resources Program or on a case by case basis.

Land Base and Land Uses Summary

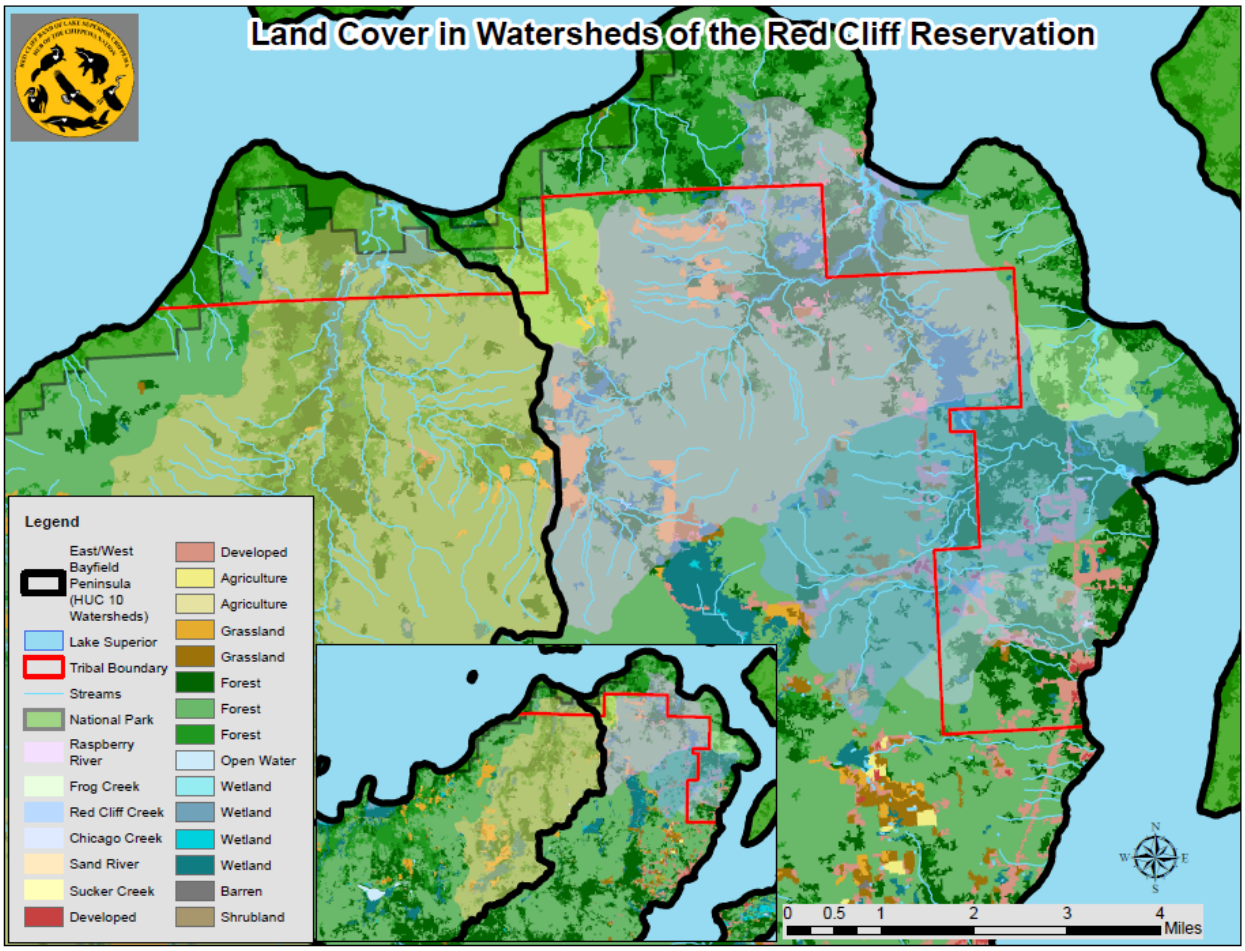
The topography in the area is mostly rolling hills, with steep slopes along drainage areas. Predominant soils in the area consist of the Odanah silt loam complex and Sanborg-Bad River complex. They are formed in clayey till and heavy red clay from depositional beds of ancient lakes and till deposited by glacial action, this region is commonly referred to as the Lake Superior clay plain. The combination of clay and sand at the soil zones interface leads to high susceptibility to erosion as rain and snowmelt run off the clay quickly due to its impermeability. The Lake Superior Biodiversity Conservation Strategy Nemadji to Fish Creek Regional Plan states that this region of Lake Superior "is prone to erosion and sedimentation issues and is one of the largest sources of sediment to Lake Superior (NRCS no date). Accelerated runoff and non-point source pollution affecting both in-channel and nearshore habitats are major threats to biodiversity."

Before European settlement occurred in the region, the land cover consisted of old growth northern and boreal forests (hemlock, maple, birch, white and red pines) and wetlands. The vegetation cover of the entire region was drastically changed by the early 1900's as timber harvesting removed most of the old growth conifer forest. The resulting clear cut areas were very susceptible to fire and erosion. The forest cover has returned, however, its components have drastically changed. Most of the Reservation today is forested, predominantly consisting of aspen and also including balsam fir, maple, birch, basswood, oak, some red and white pines, and hemlocks.

Tribally owned forest covers about 8,000 acres of the Reservation, of which 6,200 forested acres are under Tribal Trust ownership and the rest is allotted to individuals through trust allotments. The rest of the Reservation is non-forest and is a mixture of developed lands with commercial buildings and residential homes, and non-forested wetlands (IRMP, 2006). Current land cover

types within the Reservation and its watersheds are displayed in Map 6. Although agricultural land use is relatively minimal in the area, a few agricultural areas are known within several of the Reservation's watersheds (shown as grasslands on Map 6) and are suspected contributors of NPS pollution to those waterbodies. The Lake Superior Biodiversity Conservation Strategy states that the Nemadji to Fish Creek regional unit of the Lake Superior Basin, in which the watersheds of the Reservation fall, "contains more agricultural land than most other regions [in the basin]." The greatest amount of developed land on the Reservation is in the southeastern portion, where the Tribe's administrative buildings, residential developments, and casino are located. These developed areas primarily fall within the Red Cliff Creek and Chicago Creek watersheds.

Tribal members have consistently held the forests in high regard, which are vital and necessary to the livelihood, and life of many Tribal members. The forests have provided everything necessary to sustain life including, but not limited to food, medicines, shelter, clothing, trade materials, breathable air, and drinkable water. Over-cutting of forests on and around the Reservation can have detrimental effects on the Tribe's culture, as well as water quality through increased runoff, erosion, and sedimentation.



Map 6 – Land cover in watersheds of the Red Cliff Reservation

Jurisdiction and Land Use Authority

The exterior boundary of the Red Cliff Reservation spans approximately 14,541 acres. The Red Cliff Band retains property rights in approximately 56% of these acres. The remaining acres are alienated lands in fee simple or taxable status. Therefore, within the exterior boundary is a mixture of tribal and non-tribal ownership, including lands held by the National Park Service for the Apostle Islands National Lakeshore. Adjacent to the Reservation, the US Forest Service manages a significant central core of the Bayfield Peninsula as part of the Chequamegon National Forest. Other significant land holders in the watersheds include Bayfield County forest lands.

Nonpoint Source Pollution Categories

The Red Cliff Reservation is a rural area in Northern Wisconsin. Based on local land uses and soil types, general nonpoint source pollution categories that apply to this area are forestry, roads, development, agriculture, hydromodification, and marinas.

Forestry

Sources of NPS pollution associated with forestry activities include removal of riparian (streamside) vegetation, logging road construction and use, timber harvesting, soil compaction, and mechanical preparation for the planting of trees. Logging road construction and use are the primary sources of NPS pollution on forested lands because the soil is left entirely exposed. Harvesting trees in the area beside a stream can affect water quality in several ways. Streambank shading is reduced, causing greater water temperatures. Removal of riparian vegetation also increases runoff rates and de-stabilizes stream banks, leading to increased erosion. These changes can harm aquatic life by limiting habitat, sources of food, temperature-limiting shade and shelter, and cause greater sedimentation in streams.

Roads

Roads, highways, and bridges contribute pollutants to water resources. Contaminants from vehicles and activities associated with road and highway construction and maintenance are washed from roads and roadsides when it rains or snow melts. A large amount of this runoff pollution is carried directly to waterbodies. When land is cleared to build a road or bridge, soil erosion is increased. The natural flow of the stream may be altered by a culvert- or culvert failure or bridge, which can alter instream habitat and create barriers to fish and wildlife if proper best management practices (BMPs) are not utilized.

Development

Impervious (nonporous) surfaces like roads, parking lots, and rooftops prevent rain and snowmelt from infiltrating, or soaking into the ground. Most of the rainfall and snowmelt remains above the ground surface, where it runs off rapidly in large amounts. The runoff carries pollutants and sediment from roads, parking lots, roofs, construction sites and other denuded surfaces. Storm sewers and ditches concentrate runoff into smooth, straight conduits. The increased speed of the water flow can erode streambanks, carry pollutants more directly into waterways and damage streamside vegetation and alter habitat.

Agriculture

Agricultural lands, including active croplands, pasture, hay fields, etc. are lands that have limited canopy cover and root structures, thus increasing runoff volumes and rates. Greater amounts of runoff may then lead to heightened erosion and sedimentation and may carry agricultural related contaminants into streams (nutrients, pathogens, etc.). Groundwater contamination may also occur through infiltration.

Hydromodification

Historic hydromodification includes channelization, channel modification, dams, and stream bank and shoreline erosion. Many land uses can contribute to the negative impacts to streams known as hydromodification. Channel modification activities can alter instream water temperatures and sediment characteristics, as well as the rates and paths of sediment erosion, transport, and deposition. A frequent result of hydromodification is a diminished suitability of instream and riparian habitat for fish and wildlife.

Marinas

Although there is no direct influence on the Reservation's streams, marinas on the Reservation can affect the water quality of Lake Superior. Water pollution from boating and marinas is linked to several sources. These sources include poorly flushed waterways, boat maintenance, discharge of sewage from boats, fuel/oil leaks, stormwater runoff from marina parking lots, and the physical alteration of shoreline, wetlands, and aquatic habitat during the construction and operation of marinas, boat ramps and docks.

Effects of Nonpoint Source Pollution

The most common NPS pollutants on the Reservation are sediments and nutrients. Other common NPS pollutants include pathogens (bacteria and viruses), salts, oil, grease, pesticides, toxic chemicals and heavy metals. NPS pollution can result in unsafe swimming and wading areas, disturbed habitat, unsafe drinking water, fish kills, and many other environmental and human health problems. These pollutants can also disturb the functioning of healthy, clean water habitats.

Sediments

Human land use activities, including tilling, maintaining grazing lands for livestock, building stream crossings for roads and building roads, construction, urbanization, and forestry practices, accelerates natural sediment erosion. In addition, the Reservation has noted sediment impacts from beaver activity as beaver dam degradation causes sediment loading. Excess sediment can smother aquatic habitat, reduce water clarity, deplete oxygen, and deposit nutrients and toxins. Nutrients and metals may adhere onto sediment particles and be transported along with sediments into and through aquatic systems.

Nutrients

Nutrients originate from fertilizers, animal waste, failing septic systems (human waste), natural background levels, soil erosion, urban runoff, and atmospheric emissions. Nutrient overloading may stimulate excessive growth of algae and nuisance aquatic plants in streams, lakes and reservoirs- eutrophication. Eutrophication renders water aesthetically unattractive or unsuitable for recreation by reducing water clarity, and impacts aquatic life by lowering dissolved oxygen when larger amounts of plants die and decompose. Excess nitrate (>10 ppm) in drinking water may cause methemoglobinemia- "blue baby syndrome" in infants (World Health Organization).

Pathogens

Pathogens are disease-causing organisms often associated with fecal matter. Fecal coliform bacteria are found in the intestines of warm-blooded animals. Their presence in waters indicates that pathogenic organisms may also be present. They are most commonly associated with failing septic tanks and drain fields from individual sewage treatment systems, pet wastes, high numbers of waterfowl (particularly geese), and grazing animals. Pathogens can make humans sick with both short term side effects as well as more life threatening illnesses.

Toxicants

Toxic substances include heavy metals, petroleum byproducts, and pesticides. They can be harmful to both aquatic and human life. These toxicants are generally resistant to degradation and bioaccumulate in food webs. Sources of toxic contaminants include industrial, commercial, household, and auto emissions. Mercury pollution is extensive in the Lake Superior basin, causing strict "recommended" fish consumption advisories; however mercury originates almost exclusively from outside sources-atmospheric deposition (IRMP, 2006).

Thermal Stress

Thermal stress results from elevated water temperatures that can harm native species while helping non-native species to spread. Thermal stress is caused by runoff from heat-absorbing impervious surfaces, removal of riparian vegetation, shallow water impoundments, and decreased base flow.

Trash

Trash includes plastics, metal, tires, paper, etc. It threatens aquatic life by entangling, cutting, or even killing animals such as birds and fish that mistake trash for food. Litter also detracts from recreational and aesthetic values. Improperly disposed trash- littering, is a result of illegal dumping, street litter, beach litter, and boating waste.

Water Quality Goals

Tribal Water Quality Standards under CWA Sections 518 and 303 have not been established for the Red Cliff Band. The Water Resources Program is anticipated to establish water quality standards within the next two years. The Red Cliff IRMP states that the long-term goal of the Tribe 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, and protection of aquatic cultural resources and public health."*

Until Red Cliff's establishes water quality standards, analytical results for the basic water chemistry parameters analyzed are compared to available criteria from the Bad River Band of Lake Superior Chippewa and the USEPA. This comparison will assist in the determination of impacts to each water body sampled. The following table lists available criteria for comparisons (see Table 2). Several of these parameters are basic water characteristic parameters based on local geology and stream type. Abrupt changes in the value of these parameters will be noted and the cause will be investigated through upstream observations at a minimum.

Table 2 – Applicable water quality criteria used for water quality comparison

Parameter	Criteria	Source	Comment
Dissolved Oxygen	Values should fall between 5-12 mg/L	EPA Criteria Recommendations	EPA Technical Contact, Katherine Marko
pH	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 Nitrogen	Should not exceed .33 mg/L	EPA Criteria Recommendations	Ecoregion VIII Subecoregion 50
Ammonia	Should not exceed 1.9 mg/L	EPA Criteria Recommendations	Aquatic Life Ambient Water Quality Criteria for Ammonia-Freshwater 2013

The Red Cliff Band of Lake Superior Chippewa, retains cultural and historical connections to the waters of the region. The Tribe has retained Treaty Rights to natural resources within ceded lands of Wisconsin, Michigan, Minnesota, and Lake Superior. Commercial and subsistence fishing, cultural migration routes, wild rice beds, fishery restoration, tribal ceremonies, habitat for critical wildlife and tribal medicines, and clean water for consumption are some of the significant uses of tribal waters. Water quality protection is, therefore, a paramount concern for Tribal members and the Tribal Council. The Red Cliff Treaty Natural Resource (TNR) Division is responsible for this protection, and as the responsible agency, the TNR Division's Water Resource Program has undertaken collection and analysis of the Reservation's water quality data. The overall objective of the program is protection and restoration of water resources within the Reservation. Data is collected to provide a base of knowledge from which management decisions may be made.

Existing Water Quality Monitoring Program

The Red Cliff Water Resources Program operates according to approved Quality Assurance Project Plans (QAPPs) under the CWA 106 program. The Water Resources Program conducts monthly surface water testing at 16 locations throughout the Reservation for basic water quality parameters during the open water season (GPS coordinates listed in Table 3 in Appendix B). 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, and specific attention will be paid to occurrences of rain events and flooding. Biological (aquatic macroinvertebrate) monitoring is also conducted on a rotational, annual basis (see Table 6) at each site and biotic index values are given to rate the quality of the waterbody. Site locations are shown in Map 7 in Appendix A and the corresponding measured parameters taken are listed in Table 4. The Legendary Waters Casino Retention Pond Project sites (4 additional sites) listed in Table 3 were only monitored during 2014 and 2015 sampling seasons to assess the success of the Water Resource Program's 2014 casino pond remediation efforts. Wetlands are not currently being monitored; however, 13 wetland sites were inventoried and assessed and a report was completed in February 2016 by Wetlands & Waterways LLC.

Surface water quality parameters (chemical/physical) 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, Ammonia, Total Suspended Solids, and E. coli.

Data collection of hydrological and 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 nonpoint sources may negatively impact water resources. No indications of toxic pollution were found in water sampling conducted initially under the CWA 106 program. Continued baseline monitoring is needed to assist the Tribe in future management decisions and to assess water quality trends as NPS BMPs are implemented.

Other Water Resource Monitoring Projects

Stream Crossing Inventory

Most culverts on tribal roads are not adequately sized or engineered to withstand the increasing intensities of flood events due to climate change. Culvert "blowouts" are common and replacements are often of similar specifications to their pre-damaged state as a result of insufficient BIA transportation funding. The result of these frequent blowouts is mass erosion events of the roadway and ditches that flush downstream. This project was conducted during the field season of 2016 to evaluate the physical and ecological status of perennial stream road crossings occurring within Reservation to develop a Red Cliff road stream crossing inventory necessary for effective remediation planning and prioritization. Results of this effort are displayed in Figure 1. Funding for this project was made available by the EPA Great Lakes National Program Office (GLNPO).

Water Data Loggers

The Water Resources Program deployed water data loggers in Reservation streams during the 2016 and 2017 field season. Sixteen temperature loggers were placed at the current water quality sampling sites as part of ongoing data collection. An additional six data loggers, which read water level as well as temperature, were strategically placed throughout the Reservation for a two year study to assess water quantity issues. This effort will assist the Tribe's resource managers in short term and long term reservation stream trends. Funding for this project will be provided by both US EPA and Bureau of Indian Affairs (BIA) grants.

Wetland Inventory and Assessment Report

Wetland assessments were conducted at several sites throughout the Reservation by Wetlands and Waterways, LLC in the fall of 2015 and summer of 2016. Assessments consisted of random meanders throughout each selected wetland and assessing the area utilizing the WDNR Wetland Rapid Assessment Methodology (WisRAM). The following categories were considered for the functional value assessment for each wetland area; human use values, wildlife habitat, fish and aquatic life habitat, shoreline protection, storm and floodwater storage, water quality protection, groundwater processes, and floristic integrity. Summary tables from the report are included in Appendix B.

Source Water Protection Plan

The Source Water Protection Plan replaced the Tribe's previous Wellhead Protection Plan. The aquifer that supplies drinking water to the Red Cliff Housing Wells 1 and 2, and Red Cliff Wells 3 and 4 are part of the Precambrian Lake Superior Sandstone and has a depth to water of 143 feet below the ground surface. The Red Cliff Water and Sewer Department monitors these wells to ensure SDWA compliance. The Water Resources Program, in conjunction with the Environmental Health Specialist, is currently updating the Source Water Protection Plan, which will be implemented in winter 2017.

Legendary Waters Casino Retention Pond Project

Construction for the Legendary Waters Casino began on the Lake Superior shoreline in 2011 and two stormwater retention/settling ponds were installed. These ponds were meant to retain parking lot/roadway stormwater, reducing runoff and nutrient loading into the lake. Without adequate buffer zones however, excessive amounts of nutrients were reaching the lake through the pond outfalls. In 2014, the Tribe's Water Resources Program utilized CWA 319 competitive funds to plant a 10 foot buffer zone of native wetland plants around each of the retention ponds. These plants are anticipated to uptake water and nutrients, decreasing the rate of water flow and reducing the nutrient levels in the ponds' discharge water. To assess the success of this remediation project, the Water Resource's Program monitored the water quality in both ponds and at their Lake Superior outfalls during the 2014 and 2015 sampling seasons.

Septic System Inventory

The Red Cliff Tribe performed an inventory of septic systems on the Reservation in 2008 and 2009. The systems on the Reservation are of mixed age categories, many of which were in need of repair or replacement. Several septic systems were replaced by the expansion of the water main and sewer service, and the inventory led to the replacement and/or major repair of 18 residential septic systems on the Reservation. A contained outhouse system at the Raspberry Campground was also installed. A major component of this project was outreach and education efforts with homeowners to encourage routine maintenance on systems. The inventory project was funded by an EPA Great Lakes Restoration Initiative grant and coordinated through WISCAP, with the Bad River Tribe assisting.

Discussion of Results

Review of field and laboratory data indicates that every monitored stream flowing through the Reservation is impacted by NPS pollution. The primary pollutants in reservation streams are sediment, nitrogen and phosphorus. Many streams are also affected by E.coli as well. In this rural setting, comprised of highly erodible clay and sandy soils, sources of nutrients are most likely linked to runoff and erosion from cleared lands that are used for agricultural and logging purposes. Nitrogen sources are also potentially linked to failing septic systems and/or outhouses, which are also the most likely source of E.coli.

Review of the Water Resource Program's water quality data from 2014-2015 for the Legendary Waters Resort and Casino ponds and Lake Superior outfalls indicates that the program's 2014 retention pond remediation efforts were relatively successful. While nitrogen and phosphorus levels are lower at the outfall sites, these parameters continue to exceed criteria in both ponds and at both outfalls. Nitrogen and phosphorus are likely contributed from runoff flowing over the casino's large mown grass lawn. High chloride levels were noted at the LS02 outfall site, which can be attributed to additional culverts originating from State Highway 13.

Red Cliff's water quality impairments and potential sources are summarized in Table 5.

Chicago Creek (CC02, CC03, CCM01)

Chicago Creek is a small to mid-size stream that originates from springs and seeps near State Highway 13. This stream's watershed is comprised of privately owned lands, as well as trust and tribal allotments. While the watershed does contain forested areas, the creek is at risk of higher runoff rates due to road crossings at Highway 13 and Blueberry Road, and an ATV/snowmobile trail crossing which was closed to traffic in 2013. The 2016 stream crossing inventory found that the culvert located at Blueberry Road has some erosion around it that needs to be addressed. Also located in the watershed are the Buffalo Bay Gas Station, powwow grounds, a private storage facility, and the Tribe's wastewater treatment facility. This stream has also been influenced by timber harvest within its riparian zone, which causes greater amounts of runoff, erosion, streambank instability, and habitat loss for both terrestrial wildlife and fish within the stream. In the past, effluent from Red Cliff's old community sewage treatment facility was discharged directly into Chicago Creek (IRMP 2006).

Two wetlands within the Chicago Creek watershed were assessed as part of the Wetlands and Waterways inventory and assessment in 2014 and 2015. Sites were located at the CCM01 water quality monitoring site at the mouth and near the Red Cliff Powwow Grounds. The wetland near the CCM01 monitoring site was found to have high human use and wildlife habitat values, exceptional fish and aquatic life habitat value, and medium value for floristic integrity, shoreline protection, flood protection, and water quality protection. The report noted a small population of reed canary grass that should be removed. The site assessed upstream, near the Red Cliff Powwow Grounds, was found to have high value for wildlife and fish and aquatic life habitat. The site was ranked medium for floristic integrity, human use, and water quality protection, and was found to have low flood and shoreline protection.

Review of the Water Resource Program's water quality data from 2013-2016 (see Appendix D) indicates that Chicago Creek is impacted by NPS pollution, and the creek's water quality has slightly declined over the past three years. The stream's temperature appears to be generally increasing, and as expected the dissolved oxygen levels are slowly declining. Phosphorus and turbidity levels appear to be improving, while nitrogen levels have experienced a slight increase at the Highway 13 (CC02) and stream mouth (CCM01) sample sites. 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 (235 CFU) at the mouth (CCM01) sample site. Land uses in the area indicate that the source of E.coli may also be linked to older septic systems and outhouses.

Biotic index scores, shown in Appendix B and Appendix E, indicate that the stream's ecological status has slightly worsened. The Highway 13 (CC02) sample site went from "good" in 2009 to "very poor" in 2012, to "poor" in 2015, and 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 (FC01, FCM01)

Frog Creek is a small spring fed stream, is mostly unaltered and is considered to be remote. The stream has no road crossings and there are only a few nearby homes. The majority of the watershed consists of Bayfield County forest and tribal trust land. The lands surrounding the mouth of Frog Creek are tribally owned, preserved by the Frog Creek Conservation Management

Area (CMA). The Frog Creek CMA was designated in 2017 and includes; the 89 acre Frog Bay Tribal National Park, which became the first ever Tribal National Park in the United States in 2012, an additional 82 acre private parcel acquired in 2017, 80 acres of Bayfield County land also acquired in 2017, and 40 acres of land already in tribal ownership. The old growth boreal forest in the Tribal National Park was never fully cleared by the logging era and was identified by the WDNR to be of global significance. The stream's mouth forms a coastal wetland estuary complex where it enters Frog Bay, which has been identified by the Lake Superior Binational Forum as important to the integrity of the Lake Superior ecosystem for coastal wetlands. This estuary area contains wild rice.

One wetland site within the Frog Creek watershed was assessed as part of the Wetlands and Waterways inventory and assessment in 2014 and 2015. The assessment was conducted near the FC01 water quality monitoring site. The site was ranked exceptional for floristic integrity, human use, wildlife habitat, fish and aquatic life habitat, shoreline protection, flood protection, and water quality protection. A small amount of non-native dill was noted during the assessment and should be removed.

Review of the Water Resource Program's water quality data from 2013-2016 (see Appendix D) indicates that Frog Creek is impacted by NPS pollution, and the creek's water quality has slightly declined over the past three years. 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) by trapping nutrients such as nitrogen and phosphorus. This elevated level of nutrients has in turn led to increased plant growth, which can cause eutrophication. This increased plant growth also causes anaerobic decay when the plants die, which has led to decreases in the stream's dissolved oxygen. Higher temperatures and lower flow rates due to the stream blockage have also likely influenced the stream's dissolved oxygen. Although no exceedances have been detected, E.coli levels also appear to be slightly increasing at both sample sites. Land uses in the area indicate that the source of E.coli and nitrogen may be older septic systems and outhouses, as well as trapped animal fecal matter. Phosphorus as well as nitrogen inputs are likely due to logging activity in the extreme headwaters area.

Biotic index scores can be found in Appendix B and Appendix E. 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 first sampled in 2014 and was designated "fairly poor" and when sampled again in 2016 was given a score of "fair."

Lake Superior at the Legendary Waters Casino Marina & Beach (LS01)

Located on the Lake Superior shoreline in front of the Legendary Waters Resort and Casino is a boat launch and 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 forested campground. Currently, the land surrounding the casino is mostly open cut lawn with fragmented areas of trees, large parking lot, and open campground area. Runoff can also affect the marina and beach area from the nearby outfalls from Casino Pond #1 and Highway 13.

Review of the Water Resource Program's water quality data from 2013-2016 (see Appendix D) 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 persistent at the site, likely due to the manicured lawn just uphill. Dissolved oxygen remains consistently low, which can be attributed to the marina break wall that reduces water flow and aeration through the marina. 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.

Aquatic macroinvertebrates are not sampled at this site because the Water Resources Program conducts biological sampling under a stream sampling QAPP and sampling procedures are different for lakes.

Legendary Waters Casino Pond & Outfall #1 (CPU01, LS02)

This retention pond and its outfall are located west of the Legendary Waters Casino. Major land cover changes occurred in 2010 when this area was cleared for the development of the casino and resort. Large amounts of stormwater runoff from the parking lot and roof are channeled into the retention pond for settling before entering Lake Superior. Remediation efforts to reduce nutrient loadings to Lake Superior from the west-end casino pond (CPU01) occurred in 2014. To assess the success of the casino pond remediation project, the Water Resource's Program monitored the water quality in both the pond and at the Lake Superior outfall during the 2014 and 2015 sampling seasons. The Lake Superior outfall site (LS02) also receives inputs from two additional culverts originating from State Highway 13. In the fall of 2015, a large amount of riprap was installed below the three culverts to reduce erosion and sedimentation into the lake.

Review of the Water Resource Program's water quality data from 2014-2015 (see Appendix D) indicates that the program's remediation efforts have been relatively successful in reducing pollutant loading from the west-end casino pond (CPU01) to Lake Superior (LS02). These sites are however, are still impacted by NPS pollution. Data shows that nitrogen and phosphorus levels are generally lower at the LS02 site than those in the retention pond, however both sites continually exceed criteria. Chloride levels at both sites are also persistent and appear to have been greatly elevated in the fall of 2015 at the LS02 site. This elevation in chloride at the LS02 site is likely due to the riprap installation that occurred in October 2015 which left the casino pond and Highway 13 outfall drainage area void of plants. Total suspended solids appear to be declining at both sites.

Aquatic macroinvertebrates are not sampled at this site because the Water Resources Program conducts biological sampling under a stream sampling QAPP and sampling procedures are different for lakes/ponds. In addition, sampling is not conducted in man-made waterbodies.

Legendary Waters Casino Pond & Outfall #2 (CPU02, LS03)

This retention pond and its outfall are located east of the Legendary Waters Casino. Major land cover changes occurred in 2010 when this area was cleared for the development of the casino and resort. Large amounts of stormwater runoff from the parking lot and roof are channeled into the retention pond for settling before entering Lake Superior. The water quality in this pond may also be influenced by the nearby campground. Remediation efforts to reduce nutrient loadings to Lake Superior from the east-end casino pond (CPU02) occurred in 2014. To assess the success of

the casino pond remediation project, the Water Resource's Program monitored the water quality in both the pond and at the Lake Superior outfall during the 2014 and 2015 sampling seasons.

Review of the Water Resource Program's water quality data from 2014-2015 (see Appendix D) indicates that the program's remediation efforts have been relatively successful in reducing pollutant loading from the east-end casino pond (CPU02) to Lake Superior (LS03). Data show that total nitrogen, phosphorus, suspended solids, and chloride levels are continually lower at the LS03 sample site than the upland CPU02 casino pond site. However, total nitrogen and phosphorus levels continue to exceed or remain just below criteria at both sample sites, which is likely due to the casino's turf management practices.

Aquatic macroinvertebrates are not sampled at this site because the Water Resources Program conducts biological sampling under a stream sampling QAPP and sampling procedures are different for lakes/ponds. In addition, sampling is not conducted in man-made waterbodies.

Raspberry River (RR01, RR03, RRM01)

The Raspberry River is the second largest river system that passes through the Reservation. Over a hundred small seasonal drainages channel water into the seven mile main stem of the Raspberry; this wide drainage area on the heavy clay plain soils, along with forestry practices, contributes to regular occurrences of flash flooding which results in much of the upper stream channel filling in and becoming cluttered with debris.

The majority of the off-Reservation land ownership within the watershed consists of Bayfield County forest lands, privately managed forest cropland, and private ownership. The watershed land ownership within the Reservation boundaries consists mostly of trust land and tribal allotments, with a small amount of privately managed forest lands. Land cover within the watershed is primarily forested, although much of the forest is subject to logging activity. Wetlands are also a prominent land cover type within the watershed, and there are areas of agriculture and residential development in the headwaters region. The mouth of the Raspberry River is surrounded by trust lands and tribal allotments, while the area west of the mouth consists of private lands. There are many road crossings throughout the watershed, including; Blueberry Road, Little Sand Bay Road, several crossings on Old County K, and Highway 13. Raspberry River has been treated periodically with lampricides to kill juvenile lampreys by the United States Fish and Wildlife Service (USFWS).

The last mile of the Raspberry River is considered Class II trout waters by the WDNR and the mouth of the river forms an extensive coastal wetland complex that the Lake Superior Binational Program has identified as important to the integrity of the Lake Superior Ecosystem for coastal wetlands and fish and wildlife spawning and nursery grounds. The Wisconsin Wetlands Association (WWA) also designated this area as a "wetland gem." These communities support diverse populations of flora and fauna, including wild rice, and the area is of great cultural significance to Red Cliff's Tribal members. IRMP survey results identified the area as one of the most culturally significant areas on the Reservation.

Four wetlands within the Raspberry River watershed were assessed as part of the Wetlands and Waterways inventory and assessment in 2014 and 2015. Sites were located; downstream of the Blueberry Road bridge, downstream of the Rowley Road bridge, at the river mouth and near Emil Road. All four sites ranked exceptional for wildlife habitat, and the sites assessed near the

Blueberry Road bridge and Emil Road were also ranked exceptional for fish and aquatic life habitat, shoreline protection, and flood protection. The mouth assessment site ranked exceptional for all metrics. The site near Blueberry Road also ranked exceptional for human use, and water quality protection. The site assessed near the Rowley Road bridge (RR03 water quality monitoring site) received high ratings for floristic integrity, human use, fish and aquatic life habitat, shoreline protection, flood protection, and water quality protection. A small population of reed canary grass was noted at the Blueberry Road site, and a small population of purple loosestrife was noted at the Emil Road site, both populations should be removed.

Review of the Water Resource Program's water quality data from 2013-2016 (see Appendix D) indicates that Raspberry River's water quality has slightly worsened over the past three years. While it appears that nitrogen and phosphorus levels are improving, this is probably due to outliers in the 2013 sampling season, which likely resulted from a storm event. Without considering these outliers, nitrogen and phosphorus levels have remained relatively the same. E.coli levels have also remained seemingly constant, with two exceedances of criteria in the 2015 sampling season occurring at the Raspberry Campground boat ramp site (RR01). Temperatures are on the incline, while corresponding dissolved oxygen levels are declining. This is most likely due to beaver dam impoundments that have decreased stream velocity. Turbidity results are decreasing, which may also be due to beaver dam impoundments that are trapping sediment upstream.

Biotic index scores, shown in Appendix B and Appendix E, 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 back 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 (RCC01, RRC03, RCCM01)

The upper portions of Red Cliff Creek have very little flow due to beaver dam impoundments. The Red Cliff Tribal Fish Hatchery and the Northern Aquaculture Demonstration Facility pour outflow into the creek upstream of Highway 13, potentially increasing the creek's nutrient levels, temperature and volume downstream. The upper portion of the Red Cliff Creek watershed consists primarily of private lands, with some privately managed forests and Bayfield County forest areas. Within the Reservation boundaries, the watershed is comprised primarily of trust lands. Land cover in the watershed is mostly forested, although logging is an active concern. There are several residential developments and home sites throughout the watershed, and agricultural/grassland areas near the headwaters.

There are road crossings at Highway 13, Old County K, and Blueberry Road that can lead to higher rates off runoff and pollution. The 2016 stream crossing inventory identified the culvert at Blueberry Road as a major erosion site in need of repair. This culvert is scheduled for replacement by the Roads Department during the field season 2017. There is also an auto salvage yard, an old closed dump, and historic wastewater pond near the creek, of which the effects are currently unknown. Schooner Bay Marina is located at the stream's mouth at Red Cliff Bay, which could be a nonpoint source of pollutants in the stream's estuary. Another threat to the stream's integrity is invasive species. Red Cliff Creek has been treated periodically with

lampricides to kill juvenile lampreys by the USFWS, and the Tribe occasionally uses nets to catch and behead adult lampreys during their spawning runs. In the coastal estuary, there is an established population of Eurasian ruffe that appears to be limited to this estuary area (IRMP, 2006).

Two wetlands within the Red Cliff Creek watershed were assessed as part of the Wetlands and Waterways inventory and assessment in 2014 and 2015. Sites were located near the Red Cliff Fish Hatchery and downstream of the RCC03 water quality monitoring site near Blueberry Road. The only exceptional rating in this assessment was for wildlife habitat near the Red Cliff Fish Hatchery, the Blueberry Road site ranked high for this parameter. Both the Hatchery site and the Blueberry Road sites ranked high for fish and aquatic life habitat. The Hatchery site also ranked high for flood protection. Both sites were given a medium value for floristic integrity, human use, shoreline protection, and water quality protection. Substantial amounts of hybrid cattail and reed canary grass were identified at the Hatchery site and should be addressed.

Review of the Water Resource Program's water quality data from 2013-2016 (see Appendix D for graphs) indicates that Red Cliff Creek's water quality has remained relatively the same over the last three years. E.coli, temperature, turbidity, and phosphorus levels all appear to be constant in the stream. Dissolved oxygen remains stable at the mouth site (RCCM01) and is increasing at the Highway 13 site (RCC01), while it is slightly declining at the Blueberry Road site (RCC03). The apparent decline in dissolved oxygen at the Blueberry Road site is likely due to upstream beaver dams and stream blockage that slows the stream's velocity and causes a slight increase in temperature. Nitrogen levels appear to show a slight downward trend at the Blueberry Road and Highway 13 sites, however nitrogen appears to be increasing at the mouth, which is potentially related to septic systems and possibly the Tribe's old wastewater retention pond.

Biotic index scores, shown in Appendix B and Appendix E, indicate that the stream's ecological status has slightly improved. The Highway 13 (RCC01) sample site went from "fair" in 2012 to "good" in 2014 and the Blueberry Road (RCC03) sample site went from "good" in 2012 to "very good" in 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 (SR02, SRM01)

The Sand River watershed is the largest watershed associated with the Reservation, although only a small portion of the watershed is located on Tribal lands. As with the neighboring Raspberry River, Sand River is prone to extensive and extreme flash floods. Much of the in-stream cover, woody debris, and habitat has been severely altered because of fluctuating water levels during large precipitation events. Beavers are also common in the stream and also influence hydrologic alterations by removing trees and creating dams. The lower portions of the river are surrounded by northern sedge meadow and alder thicket, and the mouth of the Sand River creates a complex of wetlands, which have been identified by the Lake Superior Binational Program as important habitat area for coastal wetlands and rare communities. Sand Bay is also listed as a WDNR priority wetland site of Wisconsin's Lake Superior Basin.

One wetland within the Sand River watershed was assessed as part of the Wetlands and Waterways inventory and assessment in 2014 and 2015. The Sand River mouth ranked

exceptional for; floristic integrity, human use, wildlife habitat, fish and aquatic life habitat, shoreline protection, flood protection, and water quality protection.

The majority of the land ownership within the watershed, lying outside reservation boundaries, consists of Bayfield County forest lands, with some privately managed forest lands and private ownership. The watershed land ownership within the Reservation boundaries consists mostly of trust land and tribal allotments, with some privately managed forest lands, Bayfield County forest lands, and National Park Service lands. The forests in this watershed are highly subjected to logging activities, and there are several large agricultural/grassland areas near the headwaters. Development in this watershed is limited to a handful of residential homes. Sand River has several road crossings that contribute to increased run off at Highway 13, Happy Hollow Road, Star Route Road, and Sand Pit Road. These road crossings were not assessed during the 2016 stream crossing inventory since they are located outside of reservation boundaries.
The invasive fish Eurasian ruffe is present in the estuary area of the river but does not occur upstream. Sand River has been treated periodically with lampricides to kill juvenile lampreys by the USFWS.

Review of data from 2013-2016 indicates that Sand River is somewhat impacted by NPS pollution, but the stream's water quality remains relatively stable. While E.coli is continually present in the stream, only one exceedance of criteria occurred in the past three years. Turbidity levels remain approximately the same at the mouth site (SRM01) and appear to be declining at the Highway 13 site (SR02), which is potentially due to upstream blockages in the channel. Phosphorus and nitrogen levels are also declining at the Highway 13 site, which is also likely due to upstream blockages. Nitrogen and phosphorus levels appear to be remaining relatively constant at the mouth site; these inputs are likely due to logging activities occurring in the watershed. Temperatures at both sites have remained stable and dissolved oxygen appears to be improving at the Highway 13 site. Dissolved oxygen is continuously low at the mouth site, which can be correlated to the estuary complex that holds a high amount of aquatic plants that are cycling through growth and anaerobic decay.

Biotic index scores, shown in Appendix B and Appendix E, indicate that the stream's ecological status has varied over the past three years, 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 (SC01, SCM02)

Sucker Creek is a small spring fed stream that originates near Old County K and flows for just over a mile before emptying into Sand Bay, east of the Sand River estuary. Sucker Creek has a road crossing at Old County Highway K, and there are several crossings at the end of Ridge Road that are washed out- this section of Ridge Road is inactive. Fish spawning in the stream is limited and at risk due to heavy sedimentation at the mouth and very low amounts of flow. The extreme headwaters of the stream (off reservation) are surrounded by clear-cut agricultural areas that are primarily used for animal grazing. A man-made pond has also been constructed in the stream at this location and is surrounded by mown lawn, disturbing the stream's natural flow patterns and allowing greater amounts of runoff into the waterbody. The only development within this watershed includes a few homes near the agricultural areas of the headwaters.

One wetland within the Sucker Creek watershed was assessed as part of the Wetlands and Waterways inventory and assessment in 2014 and 2015. The site received a medium value for; floristic integrity, human use, wildlife habitat, fish and aquatic life habitat, shoreline protection, flood protection, and water quality protection. A small population of reed canary grass was noted and should be removed.

Review of data from 2013-2016 indicates that Sucker Creek is impacted by NPS pollution and the stream's water quality is continuing to degrade. This is an intermittent stream and the channel is often dry at the Old County K sample site (SC01), thus samples are not able to be taken as regularly as they are on other streams. Although turbidity appears to be stable or declining at both sample sites, nitrogen and phosphorus levels are persistent at the mouth site (SCM01) and are increasing at the Old County K sample site. E. coli levels did not breach criteria in the 2015 sample season, but also appear to be persistent in the stream. Temperatures are increasing at both sites, with dissolved oxygen remaining consistently low at both sites and often breaching criteria- although dissolved oxygen was not measured at the Old County K site during the 2015 sampling season.

Biotic index scores, shown in Appendix B and Appendix E, 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 ever 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 score of "poor" in 2016.

Table 5 – NPS Assessment Summary						
Waterbody Name & Stream Length* (On-reservation - main stem)	**NPS Pollutant(s)**	**Use(s) Impaired**	**Use(s) Threatened**	**Potential Source**	**Future Potential Source Threats**	**Severity (% Exceedances in Total N)**
Chicago Creek 1.75 miles	- Sediment - Nitrogen - Phosphorus - E.coli	- Contact; fishing, swimming, cultural uses -Aquatic life	-	- Possible outdated septic systems - Development - Roads - Historic hydromodification	- Forestry	Impacted (51%)
Frog Creek ~ 1.25 miles	- Sediment - Nitrogen - Phosphorus	-Aquatic life	- Contact; fishing, swimming, cultural uses	- Possible outdated septic systems - Forestry - Sandbar causing trapping of nutrients - Roads	- Development	Slightly Impacted (42%)
Lake Superior (Casino Marina & Beach)	-Nitrogen	-	- Contact; fishing, swimming, cultural uses -Aquatic life	- Casino turf management practices - Development - Roads/parking lot runoff - Historic hydromodification	-	Impacted (79%)
Casino Pond & Outfall #1	-Nitrogen -Phosphorus -Chloride	-	- Contact; fishing, swimming, cultural uses -Aquatic life	- Casino turf management practices - Development - Roads/parking lot runoff - Historic hydromodification	-	Impacted (69%)
Casino Pond & Outfall #2	-Nitrogen -Phosphorus	-	- Contact; fishing, swimming, cultural uses -Aquatic life	- Casino turf management practices - Development - Roads/parking lot runoff - Historic hydromodification	-	Impacted (88%)
Raspberry River ~ 2.25 miles	- Sediment - Nitrogen - Phosphorus - E.coli	- Contact; fishing, swimming, cultural uses -Aquatic life	-	- Forestry - Agriculture - Historic outhouses at the Raspberry Campground - Development - Roads - Beaver activity - Historic hydromodification	-	Impacted (81%)
Red Cliff Creek ~ 3 miles	- Sediment - Nitrogen - Phosphorus -E.coli	- Contact; fishing, swimming, cultural uses -Aquatic life	-	- Forestry - Agriculture - Possible outdated septic systems - Historic wastewater treatment pond - Development - Roads - Beaver activity - Historic hydromodification	-	Impacted (67%)
Sand River ~ 2.1 miles	- Sediment - Nitrogen	-Aquatic life	- Contact; fishing, swimming, cultural uses	- Upstream forestry and agricultural practices - Development	-	Impacted (53%)

	- Phosphorus			- Roads - Beaver activity - Historic hydromodification		
Sucker Creek ~ 1.45 miles	- Sediment - Nitrogen - Phosphorus -E.coli	- Contact; fishing, swimming, cultural uses -Aquatic life	-	- Agriculture - Roads - Historic hydromodification	- Development - Forestry	Impacted (58%)
*On-reservation main stem stream lengths are estimated using Google Earth Pro Not Impacted: Waterbodies with less than 25% Total Nitrogen threshold exceedances from 2013-2016 Slightly Impacted: Waterbodies with less than 50% Total Nitrogen threshold exceedances from 2013-2016 Impacted: Waterbodies with greater than 50% Total Nitrogen threshold exceedances from 2013-2016						

It is important to note that while the many additional unnamed and intermittent streams of the Reservation have not been sampled, they are prone to similar nonpoint source impacts such as those identified in Table 5.

Selection of Best Management Practices (BMPs)

Best management practices will be selected for identified areas of the Reservation and watershed based on the determined cause and nonpoint source pollutants, land owners involved, and known recommendations for the Lake Superior clay plain region. These BMPs can be found in the Red Cliff Tribal Nonpoint Source Pollution Management Plan. Implementation of BMPs will be accomplished through a variety of NPS programs, funding sources, and education and outreach efforts by the Tribe. To implement BMPs, the Tribe may work in collaboration with a variety of agencies, which may include but is not limited to;

- Bureau of Indian Affairs
- US Environmental Protection Agency
- Indian Health Services
- Natural Resources Conservation Service
- Bayfield Regional Conservancy
- Wisconsin Department of Natural Resources
- ABDI-LCD (Ashland, Bayfield, Douglas and Iron County Land and Water Conservation Department)
- Apostle Islands National Park Service
- US Fish and Wildlife Service

The Tribe's Water Resources Program will also collaborate with all of Red Cliff's intergovernmental divisions when appropriate to ensure that BMPs are being utilized where possible within the Tribal government's projects. Collaboration will be most important amongst the Treaty Natural Resources Division, Roads Department, Water and Sewer Department, and the Red Cliff Housing Authority.

Summary of Water Quality Assessment

Overall the water quality of the Red Cliff Reservation is high. Some areas of the Reservation are negatively impacted by excess sediment and nutrients and human or animal waste as indicated by *E.coli* concentrations. The sources of these impacts are considered to be land uses such as outdated septic systems, outhouses, small amounts of agriculture, 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. Some NPS inputs are likely the result of upstream land use management in forestry and roads.

Process for Selecting BMPs

The process for BMP selection will include cooperation with other stakeholders in the watershed, as well as coordination with the Tribe's Treaty Natural Resources Division. Landowners will be contacted as necessary to implement BMPs. Selection of BMPs will depend on the nonpoint source issue being targeted at any particular site, and those that correlate with existing programs by other stakeholders will be considered.

Existing Nonpoint Source Control Programs (BMPs)

The Water Resources Program aims to coordinate BMPs within the Reservation and Tribal Divisions/Departments, and continually collaborate with other agencies within the Bayfield Peninsula. The NPS Assessment Report and Management Plan shall serve as the guide to implementing BMPs and remediation projects.

Water Resources Program

In addition to implementing the septic system inventory in 2009 and the Legendary Waters Casino retention pond remediation project in 2014, the Water Resources Program also installed native buffer strip plantings, a rain garden, and a dune at the Legendary Waters Casino in 2016. The Water Resources Program also installed and regularly monitors dog waste stations at several recreational areas within the Reservation in 2014. Currently, there are dog waste disposal stations (informational stands with trash bags and a closed top trash can) at the Casino's Buffalo Bay and Point Detour Campgrounds, as well as the Raspberry Bay Campground. Additional recreational areas such as the Frog Bay National Park will be considered for dog waste stations as needed. The Water Resources Program also conducts regular outreach and education efforts within the community to encourage local stakeholders to take care of their watersheds.

Reservation Forestry

The Red Cliff Tribe has a Forestry Department that is housed within the Treaty Natural Resources Division. A Forestry Management Plan was previously drafted by the BIA and Environmental Department, but was never approved by the Tribal Council. Therefore, the Tribe's IRMP section on Forest Resources currently serves as the Tribe's Forestry Management Plan. The Bureau of Indian Affairs handles sales of timber while working closely with the Tribe's Forestry Department to select areas for timber harvest or other potential management activities such as prescribed burning and/or forest inventories. When issuing a logging permit, the Forestry & Wildlife Program sets permit conditions that include forestry BMPs.

Tribal Roads

The Roads Department does not currently have an adopted list of nonpoint source BMPs but is currently working to incorporate them into a long term transportation plan. The Tribe currently relies on engineers to include stormwater management in road designs. As the Roads Department proceeds with the drafting of a transportation plan, the Water Resources Program will assist in ensuring that appropriate BMPs are included.

Septic Inventory

The Tribe's septic system inventory was completed in 2009. Many septic systems were found to be in poor condition and several were replaced by the expansion of the water main and sewer service, with another 18 residential septic systems being repaired or replaced. A contained outhouse system at the Raspberry Campground was also installed.
This project assisted in the Tribe in protecting its groundwater and surface water resources.

Red Cliff Housing Authority

The Housing Authority currently does not have best management practices in place for construction. The director has been approached and is interested in learning more about nonpoint source pollution and BMPs.

Bayfield County Land and Water Conservation Department

The Bayfield Land and Water Conservation Department provides technical and financial assistance to landowners for installation of conservation practices that reduce sediments and nutrients in waterways while improving habitat.

Bayfield Regional Conservancy

The Bayfield Regional Conservancy is a non-profit land trust operating in Bayfield, Ashland, Douglas and Sawyer Counties in Wisconsin. The Conservancy works with private landowners, agencies and local governments to protect natural areas and landscapes in northwestern Wisconsin. The Bayfield Regional conservancy was a significant partner in securing and protecting the lands of Frog Bay Tribal National Park.

National Park Service

The Apostle Islands National Park Service does not currently have specific nonpoint source management plans in place.

Wisconsin Department of Natural Resources

The WDNR developed Water Quality Management Plans (Basin Plans) for each of the major watersheds in the state in 2000 -2001, including the Lake Superior watershed. The Basin Plans identify and prioritize issues and identify goals and objectives for ecosystem management in each Basin. In 2003, the WNDR, in conjunction with the LCD, also developed "Best Management Practice Guidelines for the Wisconsin Portion of the Lake Superior Basin." This document includes guidelines and BMPs for project planning, roads, forestry, agriculture, critical areas, habitat, and development.

Nonpoint Source Control Core Participants

Before submittal to the EPA, there will be an internal tribal governmental review of the NPS Assessment Report and Management Plan amongst the Treaty Natural Resources Division (Fish Hatchery Department, Fishery Department, Environmental Department, Natural Resources Department, and Conservation Wardens). Before implementation, the Red Cliff Legal Department will also be asked to review these documents.

During the initial development of Red Cliff's NPS program, the Tribal Planner, Tribal Zoning Administrator, Roads Department and the Housing Authority were key participants in building Red Cliff's capacity for nonpoint source pollution prevention. These Tribal Departments remain involved in protecting Tribal waters from nonpoint sources of pollution on an as needed basis through an open path of communication, through the PAC (project and compliance) process, and collaborative community planning efforts.

Public Participation

The Nonpoint Source Assessment Report and Management Plan ("the documents") were made available to the community for review and comments during a 30-day public comment period from September 25th through October 25th 2017. Paper copies were available at the Tribal

Administrative Offices, Library, and Environmental Department. Electronic copies were also made available on the Tribal website, with information being provided through flyers, and an outreach article posted through the tribal weekly e-newsletter and Facebook page. Information regarding the documents was also shared during the Water Resources Program's 4th annual Watershed Symposium, followed by an evening Community Listening Session (September 26th, 2017) where they were presented and discussed with attendees.

The only comment received during the public comment period came from the Tribe's Chief Warden, noting that the documents did not identify wild rice within Frog Creek and Raspberry River. This important reference to wild rice has been added to the appropriate sections. During the Community Listening Session, the only comment received noted that the previous version of the documents did not contain a formal definition of NPS pollution. This definition has been added to the beginning of both documents.

Conclusions

Data show that streams on the Reservation are negatively impacted by land use activities that increase erosion in the highly erodible sand/clay soils. These activities may include forestry, agriculture, beaver activity, roads, development, and use of old septic systems and campground outhouses. The Tribe is continually working to prevent and correct nonpoint source problems on the Reservation. The Water Resource Program's long-term goal for its NPS Pollution (CWA 319) Program is to develop and implement a watershed management plan. Improved interagency cooperation and outreach to other entities, as well as additional funding and technical assistance will be necessary to significantly address these issues.

This assessment shows that nonpoint source pollution categories are responsible for a significant portion of the impacted and threatened waters of the Reservation; failing septic systems and outhouses, hydromodification (historic cut-over, stream crossings, beaver dams, and stream blockages) and logging all add to the problem. Best management practices (BMPs) will be elaborated in the Nonpoint Source Management Plan. Some possible BMPs to be implemented through tribal management plans and/or tribal codes include:

1. BMPs for proper installation and maintenance of roads and stream crossings (culverts and bridges).
2. BMPs for forestry practices, especially pertaining to logging roads and stream buffers.
3. Stormwater plans for future development that include both construction and long term BMPs.

There are many available resources that outline BMPs for nonpoint source pollution prevention and remediation, some may include but are not limited to:

1. Controlling Nonpoint Source Runoff Pollution from Roads, Highways, and Bridges, EPA-841-F-95-008a
2. EPA Tribal Green Building Toolkit, EPA-909-R-15-003
3. Managing Nonpoint Source Pollution from Agriculture, EPA-841-F-96-004F
4. Managing Nonpoint Source Pollution from Forestry EPA841-F-96-004H
5. Management Measure for Physical and Chemical Characteristics of Surface Waters – II. Channelization and Channel Modification Management Measures, EPA

6. NRCS CAP 106- Forest Management Plans, and technical service providers
7. NRCS Conservation Practice Standard Codes
8. Protecting Water Quality from Urban Runoff, EPA-841-F-03-003
9. Protecting Natural Wetlands, EPA-843-B-96-001
10. Red Cliff Code of Law Chapters 11, 12, and 37.
11. Streambank and Shoreline Protection Management for Hydromodification EPA 840-B-92-002
12. Temporary Stream and Wetland Crossing Options for Forest Management, USDA Forest Service General Technical Report NC-202 1998
13. Wisconsin's Forestry Best Management Practices for Water Quality Field Manual, WDNR

Acronym List

ABDI-LCD – Ashland, Bayfield, Douglas and Iron County Land and Water Conservation Department
APIS NPS- Apostle Islands National Park Service
BIA- Bureau of Indian Affairs
BMPs – Best Management Practices
BRC- Bayfield Regional Conservancy
CBAP- Chequamegon Bay Area Partnership
CC02 – Chicago Creek sample site #2
CC03 – Chicago Creek sample site #3
CCM01 – Chicago Creek Mouth sample site #1
CFS – Cubic Foot per Second
CFU – Colony Forming Units
CPU01 – LW Casino Pond sample site #1
CPU02 – LW Casino Pond sample site #2
CREP – Conservation Reserve Enhancement Program
CWA – Clean Water Act
EPA – United States Environmental Protection Agency
FC01 – Frog Creek sample site #1
FCM01 – Frog Creek Mouth sample site #1
FWS- Fish and Wildlife Service
GLIFWC – Great Lakes Indian Fish and Wildlife Commission
GLNPO – Great Lakes National Program Office
HUC- Hydrologic Unit Code
IHS- Indian Health Services
IRMP – Integrated Resource Management Plan
LCD – Land Conservation Department
LS01 – Lake Superior sample site #1 (LW Casino Marina & Boat Ramp)
LS02 – Lake Superior sample site #2 (LW Casino Pond Outfall)
LS03 – Lake Superior sample site #3 (LW Casino Pond Outfall)
LW- Legendary Waters
NPS – Nonpoint Source
NRCS- Natural Resources Conservation Service
QAPP- Quality Assurance Project Plan
RCC01 - Red Cliff Creek sample site #1
RCC03 - Red Cliff Creek sample site #3
RCCM01 - Red Cliff Creek Mouth sample site #1
RR01 – Raspberry River sample site #1
RR03 - Raspberry River sample site #3
RRM01 - Raspberry River Mouth sample site #1
SC01 – Sucker Creek sample site #1
SC02 – Sucker Creek sample site #2
SR01 – Sand River sample site #1
SRM01 – Sand River Mouth sample site #1
TSS- Total Suspended Solids
USDA- United States Department of Agriculture
USGS- United States Geological Survey
WDNR – Wisconsin Department of Natural Resources
WISCAP – Wisconsin Community Action Program
WQ – Water Quality

References

Ashland, Bayfield, Douglas & Iron County Land Conservation Committees and Wisconsin Department of Natural Resources. Best Management Practice Guidelines for the Wisconsin Portion of the Lake Superior Basin. 2003.

Bayfield County MapViewer, http://www.bayfieldcounty.org

Bayfield Regional Conservancy, Strategic Conservation Plan for Lake Superior's Bayfield Peninsula. 2009.

Epstein E., W. Smith, and E. Judziewicz. Wisconsin Lake Superior Coastal Wetlands Evaluation. Wisconsin Department of Natural Resources – Bureau of Endangered Resources, Madison, WI. 1997.

Great Lakes Commission, Keeping it on the Land! Improving Great Lakes Water Quality by Controlling Soil Erosion and Sedimentation.

Great Lakes Indian Fish and Wildlife Commission, Map to Help You Find Safe Walleye in Lakes Harvested by Red Cliff. http://www.glifwc.org/Biology/inlandfish/mercury/mercury.htm.

Hudson, Matt, Great Lakes Indian Fish and Wildlife Commission. Tribal Assessment of PBT Contaminant Concentrations Across Size Ranges of Four Commonly Harvested Lake Superior Fish, as presented at the Making a Great Lake Superior Conference, Duluth, Minnesota. November 2007.

Institute of Water Research. High Impact Targeting (HIT), A tool for optimizing sedimentation reduction efforts in the Great Lakes Basin. http://www.iwr.msu.edu/hit2/huc_search.asp

Lake Superior Binational Program, A Biodiversity Conservation Strategy for Lake Superior - A Guide to Conserving and Restoring the Health of the World's Largest Freshwater Lake and the Nemadji to Fish Creek Regional Unit Plan. 2015. http://www.natureconservancy.ca/assets/documents/on/lake-superior/A-Biodiversity-Conservation-Strategy-for-Lake-Superior.pdf

Liu, Jia et al. Water. Review and Research Needs of Bioretention Used for the Treatment of Urban Stormwater. January 2014.

Natural Resource Conservation Service website for Technical Guidances, http://efotg.nrcs.usda.gov.

Nonpoint Source Management and the Watershed Approach Participants Manual, Grand Portage, Minnesota. 2007.

Red Cliff Band of Lake Superior Chippewa, Codes and Ordinances.

Red Cliff Band of Lake Superior Chippewa, Integrated Resource Management Plan 2006-2016, 2006.

Red Cliff Band of Lake Superior Chippewa, Storm Water Protection Plan. 2008.

Red Cliff Band of Lake Superior Chippewa, Source Water Protection Plan. 2009.

Red Cliff Band of Lake Superior Chippewa, Tribal Nonpoint Source Assessment Report. 2008.

Red Cliff Band of Lake Superior Chippewa, 2013-2015 Water Quality Assessment Report, 2017.

Red Cliff Band of Lake Superior Chippewa, 2016 Water Quality Assessment Report, 2017.

Superior Watershed Partnership, UW Extension, Lake Superior Watershed Rural Property Guide, Ashland, Bayfield, Douglas, Iron Counties, Wisconsin.

United States Environmental Protection Agency, Controlling Nonpoint Source Runoff Pollution from Roads, Highways and Bridges. EPA841-F-95-008a

United States Environmental Protection Agency, EPA Tribal Green Building Toolkit. EPA-909-R-15-003. 2015. http://www3.epa.gov/region9/tribal/pdf/tribal-green-building-toolkit-mobile-2015.pdf

United States Environmental Protection Agency, Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA840-B-92-002

United States Environmental Protection Agency, Handbook for Developing and Managing Tribal Nonpoint Source Pollution Programs Under Section 319 of the Clean Water Act. http://www.epa.gov/owow/nps/tribes/index.htm

United States Environmental Protection Agency, Management Measure for Physical and Chemical Characteristics of Surface Waters- II. Channelization and Channel Modification Management Measures. http://www.epa.gov/owow/nps/MMGI/Chapter6/ch6-2a.html

United States Environmental Protection Agency, Managing Nonpoint Source Pollution from Boating and Marinas. EPA841-F-96-004I

United States Environmental Protection Agency, Managing Nonpoint Source Pollution from Agriculture. EPA841-F-96-004F

United States Environmental Protection Agency, Managing Nonpoint Source Pollution from Forestry. EPA841-F-96-004H

United States Environmental Protection Agency, Protecting Water Quality from Urban Runoff. EPA841-F-03-003

United States Environmental Protection Agency, Soil Constraints and Low Impact Development, Careful Planning Helps LID Work in Clay Soils. EPA841-R-14-004A

United States Forest Service, Temporary Stream and Wetland Crossing Options for Forest Management. General Technical Report NC-202. 1998.

United States Geological Survey, National Hydrography Dataset (NHD). https://viewer.nationalmap.gov/basic/

United States Geological Survey, Simulation of the groundwater-flow system of the Bayfield Peninsula focusing on the Red Cliff Reservation, Bayfield County, Wisconsin – DRAFT, 2015. ftp://ftpext.usgs.gov/pub/er/wi/middleton/dunning/Red_Cliff_SIR_Draft4.pdf

Wetlands and Waterways, LLC, Wetland Inventory and Assessment Report, Red Cliff Band of Lake Superior Chippewa. February 8, 2016.

Wisconsin Department of Natural Resources, 24K Hydro Geodatabase. July 2015. ftp://dnrftp01.wi.gov/geodata/hydro_24k/

Wisconsin Department of Natural Resources, Ecological Landscapes of Wisconsin, Chapter 21 - Superior Coastal Plain Ecological Landscape. Last updated 2012. http://dnr.wi.gov/topic/landscapes/index.asp?mode=detail&Landscape=15

Wisconsin Department of Natural Resources, Lake Superior Basin Plan, Bayfield Peninsula Southeast Watershed (LS07). http://www.dnr.state.wi.us/org/gmu/superior/BasinPlan/ws07.html.

Wisconsin Department of Natural Resources, Lake Superior Basin Regional Assessment and Report Compendium. 2010. http://blogs.ces.uwex.edu/oppedahl/files/2012/07/Lake_Superior_Regional_Assessment_and_Report_Compendium.pdf

Wisconsin Department of Natural Resources, Managing Woodlands on Lake Superior's Red Clay Plain, Slowing the Flow of Runoff. PUB-FR-385 2007.

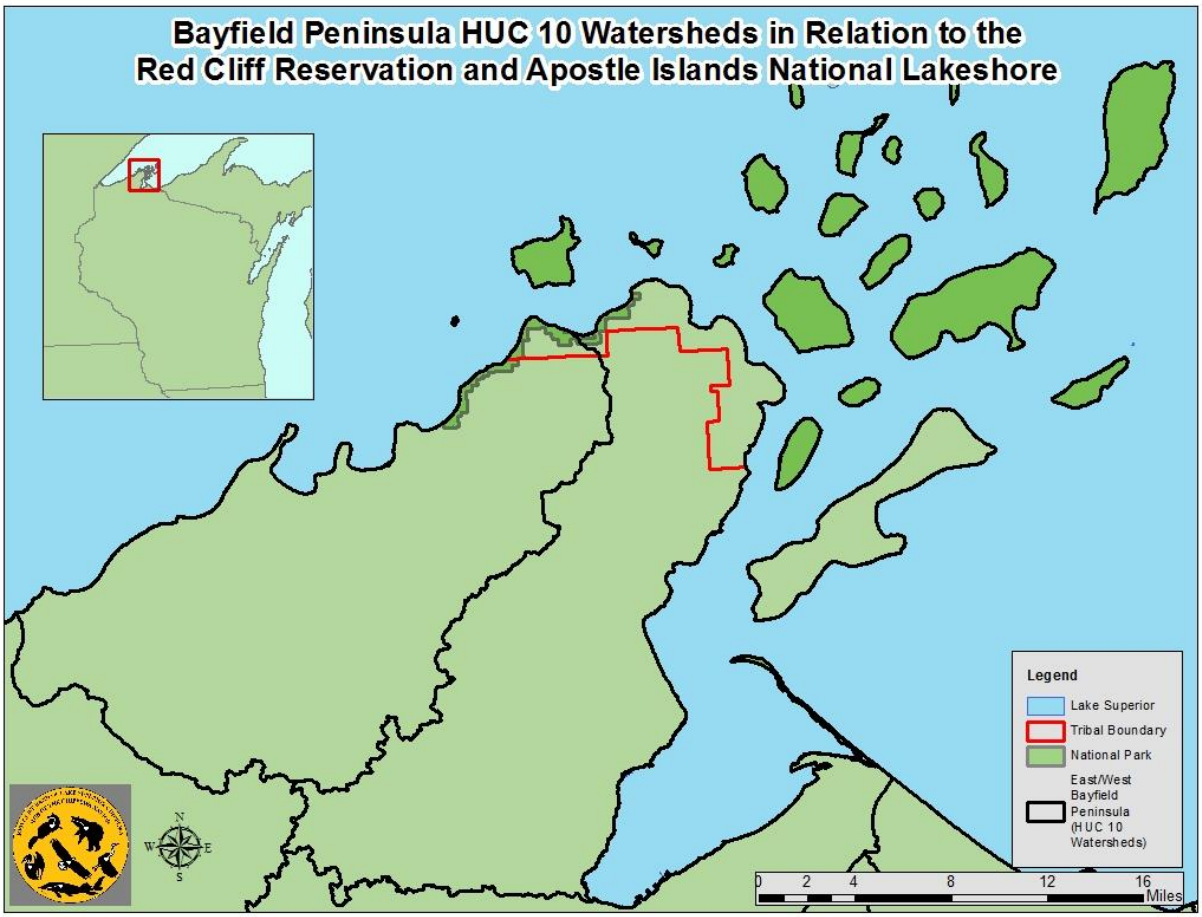
Wisconsin Department of Natural Resources, Surface Water Data Viewer.

http://dnrmaps.wi.gov/SL/Viewer.html?Viewer=SWDV&runWorkflow=Wetland

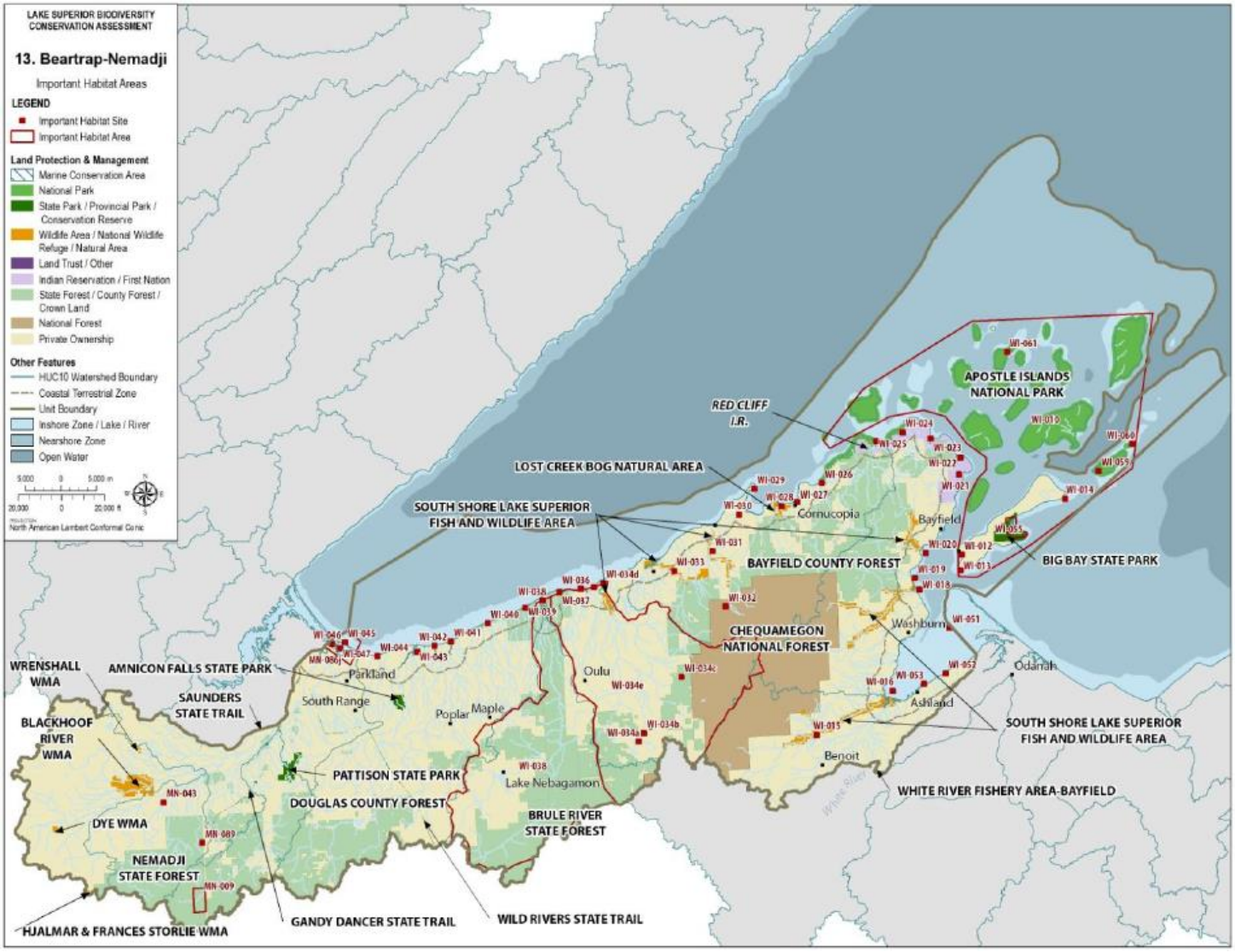
Wisconsin Department of Natural Resources, Wiscland 2.0. August 2016. http://dnr.wi.gov/maps/gis/datalandcover.html

Wisconsin Department of Natural Resources. Wisconsin's Forestry Best Management Practices for Water Quality. Publication number FR-093. 2010.

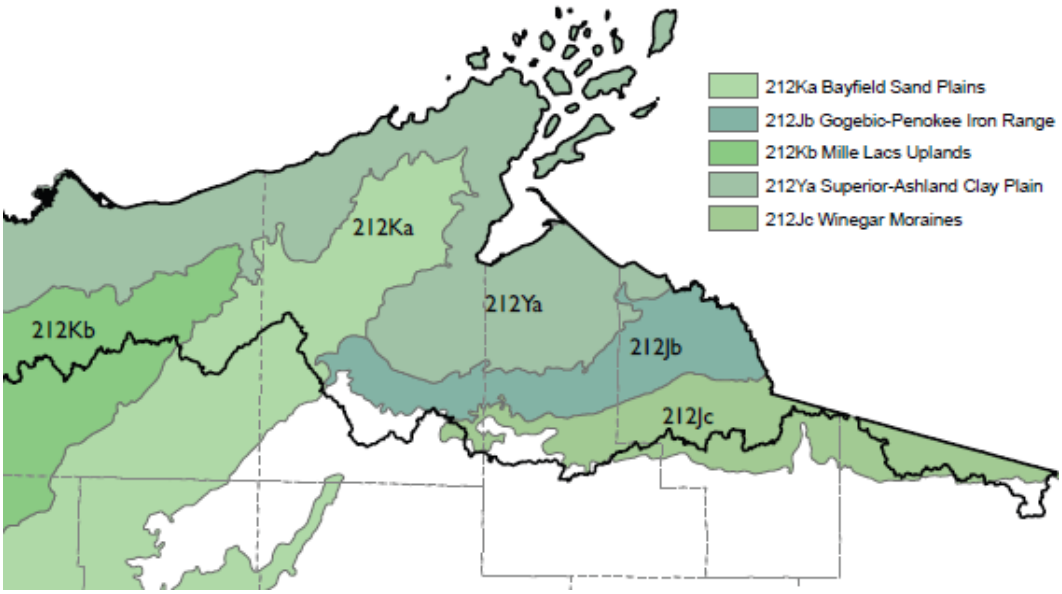
Appendix A
Maps and Figures



Map 1 - Red Cliff Band of Lake Superior Chippewa Reservation (red) and the Apostle Islands National Lakeshore (dark green)

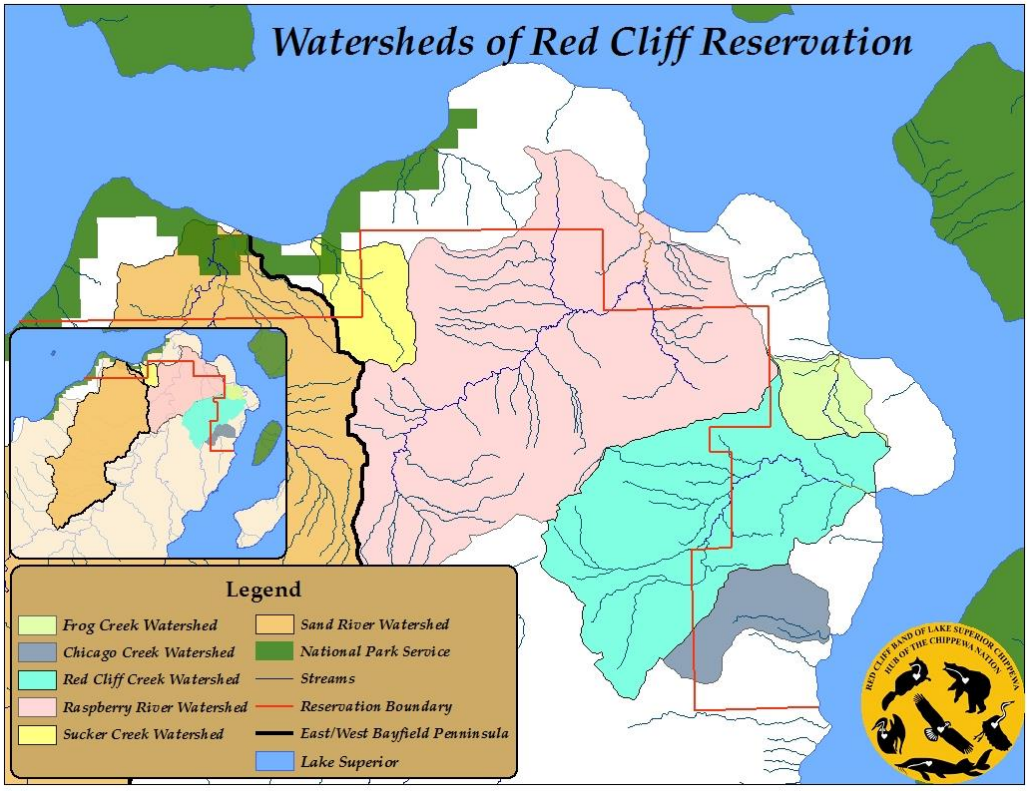


Map 2 - The Beartrap-Nemadji Lake Superior regional unit
Source: A Biodiversity Conservation Strategy for Lake Superior- A Guide to Conserving and Restoring the Health of the World's Largest Freshwater Lake and the Nemadji to Fish Creek Regional Unit Plan. Lake Superior Binational Program. 2015.

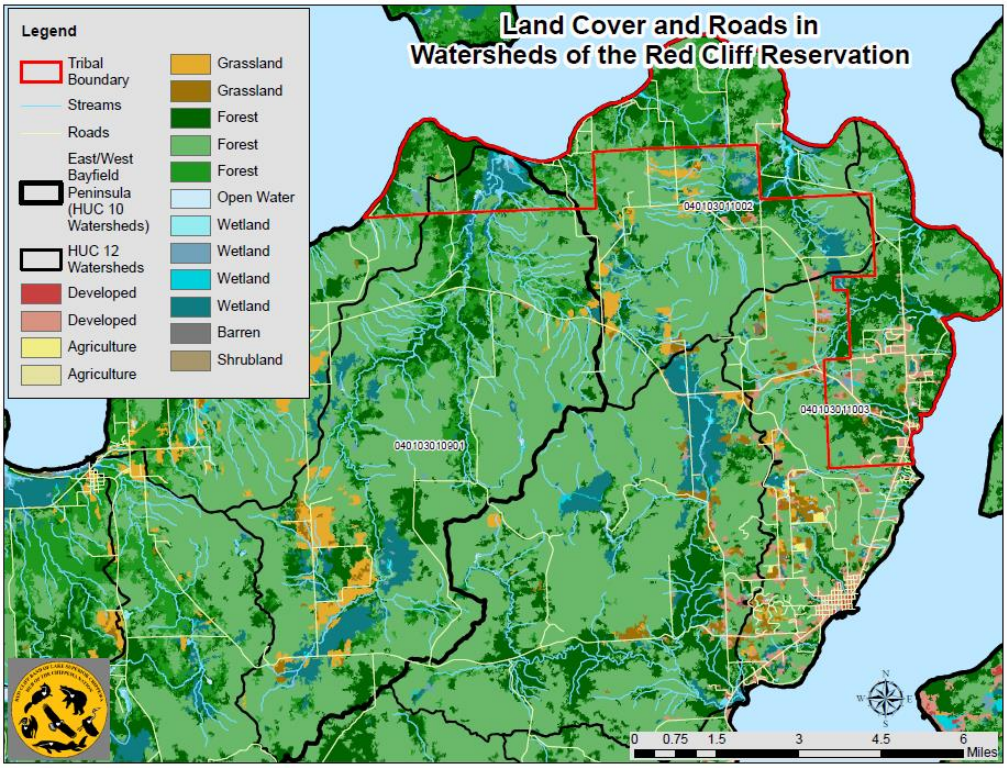


Map 3 - Soil types of the Wisconsin region of the Lake Superior Basin
Source: Lake Superior Basin Regional Assessment and Report Compendium. WDNR 2010

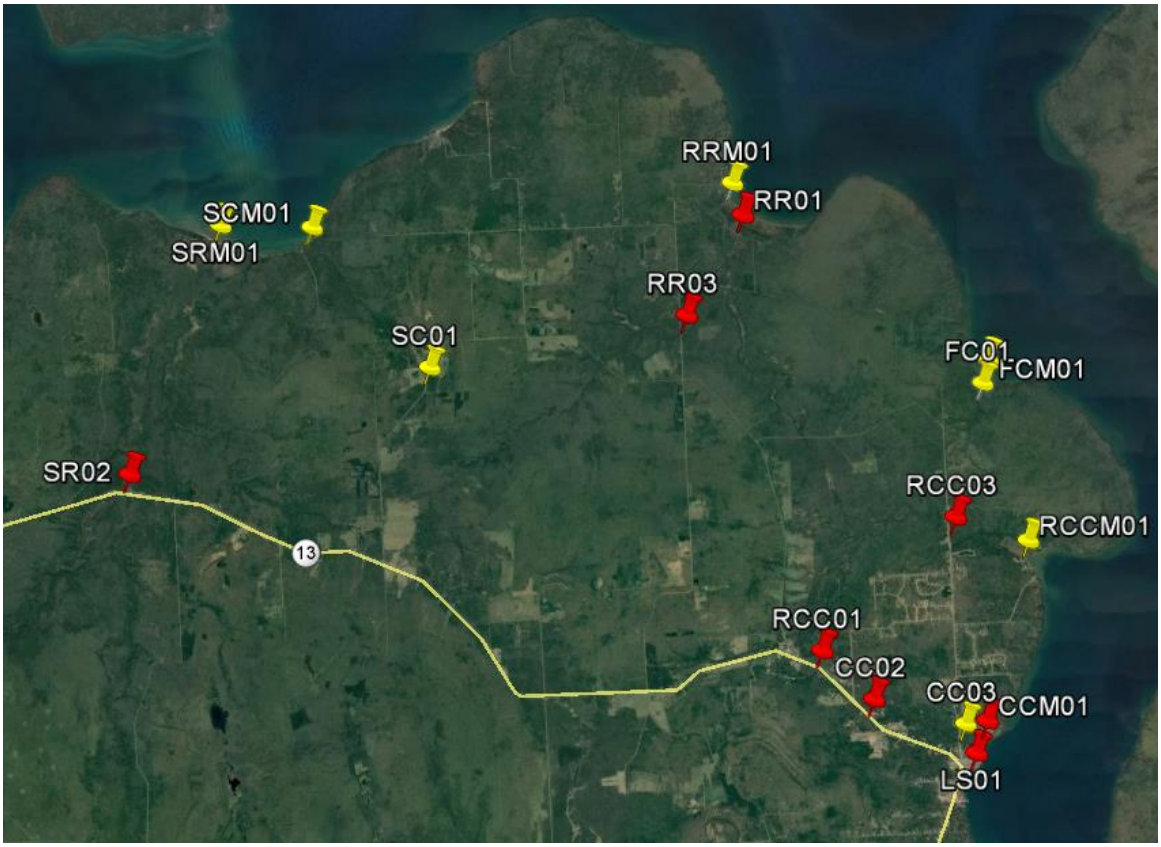
Map 4 - The Red Cliff Reservation falls into two main watersheds; Bayfield Peninsula Northwest (0401030109) and Bayfield Peninsula Southeast (0401030110)
Source: Institute of Water Research, High Impact Targeting



Map 5 - Watersheds flowing through the Red Cliff Reservation with reservation boundaries



Map 6 – Land cover in watersheds of the Red Cliff Reservation



Map 7 - Locations of Red Cliff's CWA 106 Water Quality Monitoring Sites

(red sites have been sampled for at least 10 years and yellow sites have been sampled since 2012)

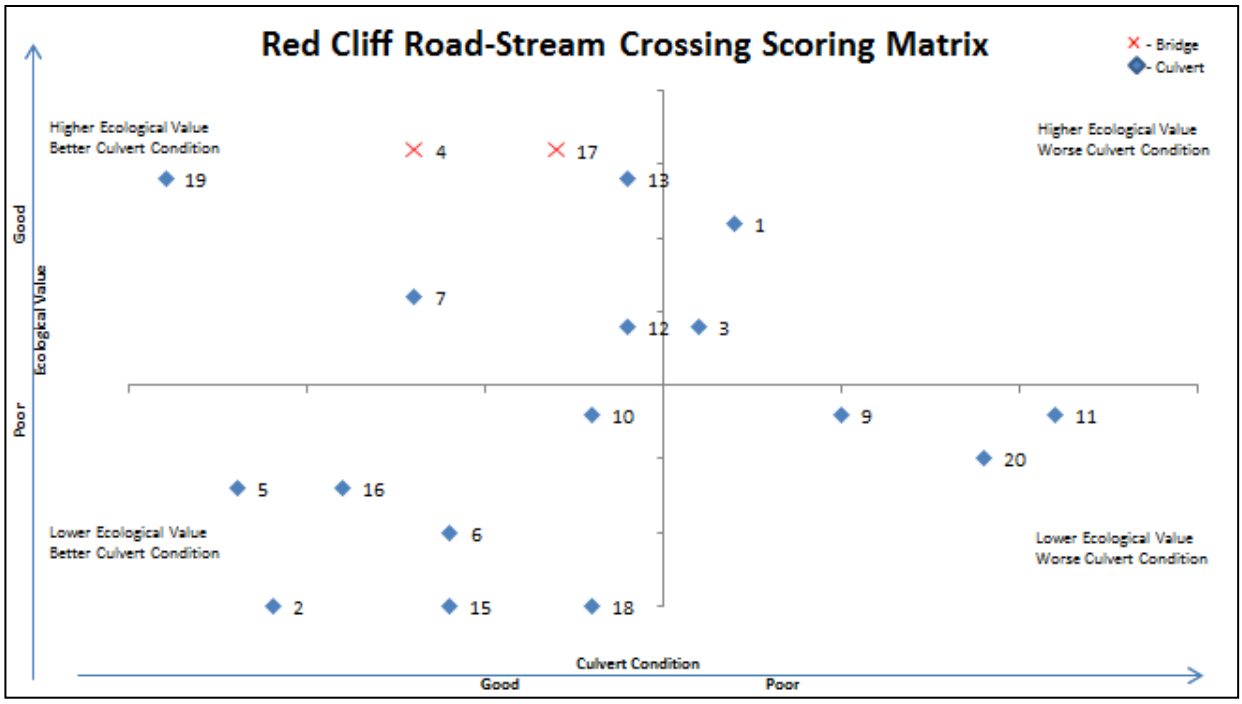


Figure 1 – Red Cliff Reservation Road-Stream Crossing Scoring Matrix

Site Number	Stream/Road	Priority Ranking
01	Red Cliff Creek / Blueberry Road	1
02	Red Cliff Creek Tributary / Blueberry Road	3
03	Red Cliff Creek / Highway 13	1
04 (bridge)	Raspberry River / Blueberry Road	4
05	Unnamed Raspberry River Tributary / Blueberry Road	3
06	Unnamed Stream / Blueberry Road	3
07	Chicago Creek / Highway 13	4
09	Grandma Pete's Creek / Highway 13	2
10	Unnamed Stream / Highway 13	3
11	Unnamed Stream / Highway 13	2
12	Clayton Creek / Highway 13	4
13	Chicago Creek / Blueberry Road	4
15	Unnamed Raspberry River Tributary / Blueberry Road	3
16	Unnamed Raspberry River Tributary / Blueberry Road	3
17 (bridge)	Raspberry River / Rowley Road	4
18	Unnamed Stream / Little Sand Bay Road	3
19	Unnamed Stream / Allen Road	4
20	Unnamed Stream / Little Sand Bay Road	2

Appendix B
Tables

Table 1 - Watersheds that cross the Red Cliff Reservation Boundaries			
HUC- 10 Watersheds	Bayfield Peninsula Northwest 0401030109	Bayfield Peninsula Southeast 0401030110	Big ↓ Small
HUC- 12 Watersheds	Sand River Watershed 040103010901	Raspberry River Watershed 040103011002 Red Cliff Creek Watershed 040103011003	
Named Sub-watersheds within the Reservation	Sand River	<u>Raspberry River Sub-watersheds:</u> Raspberry River and Sucker Creek <u>Red Cliff Creek Sub-watersheds:</u> Red Cliff Creek, Frog Creek, and Chicago Creek	

Table 2 – Applicable water quality criteria used for water quality comparison			
Parameter	**Criteria**	**Source**	**Comment**
Dissolved Oxygen	Values should fall between 5-12 mg/L	EPA Criteria Recommendations	EPA Technical Contact, Katherine Marko
pH	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 Nitrogen	Should not exceed .33 mg/L	EPA Criteria Recommendations	Ecoregion VIII Subecoregion 50
Ammonia	Should not exceed 1.9 mg/L	EPA Criteria Recommendations	Aquatic Life Ambient Water Quality Criteria for Ammonia-Freshwater 2013

Table 3 - Water Quality Sampling Locations	
Site Name	**Location**
Chicago Creek (CC02)	90°48' 27.493"W - 46°51' 44.477"N
Chicago Creek (CC03)	90°47'18.87"W - 46°51'33.38"N
Chicago Creek Mouth (CCM01)	90°47' 9.53"W - 46°51' 29.08"N
Frog Creek (FC01)	90° 46.881"W 46° 54.337"N
Frog Creek Mouth (FCM01)	90° 46.812"W 46° 54.556"N
LW Casino Marina- Lake Superior (LS01)	90°47' 12.683"W - 46°51' 14.72"N
LW Casino Pond Upland (CPU01)	90°47'18.47"W - 46°51'16.69"N
LW Casino Pond Upland (CPU02)	90°47'8.49"W - 46°51'17.83"N
LW Casino Pond Outfall- Lake Superior (LS02)	90°47'17.99"W - 46°51'13.67"N
LW Casino Pond Outfall- Lake Superior (LS03)	90°47'7.62"W - 46°51'17.03"N
Raspberry River (RR01)	90°48' 43.420"W - 46°55' 51.583"N
Raspberry River (RR03)	90°50' 29.597"W - 46°55' 3.020"N
Raspberry River Mouth (RRM01)	90°49'50.69"W - 46°56'7.25"N
Red Cliff Creek (RCC01)	90°49' 2.840"W - 46°52' 9.462"N
Red Cliff Creek(RCC03)	90°47' 22.26"W - 46°53'14.42"N
Red Cliff Creek Mouth (RCCM01)	90° 46.455"W - 46° 52.985"N
Sand River (SR02)	90°57' 23.344"W - 46°53' 56.820"N
Sand River Mouth(SRM01)	90° 56.051"W - 46° 56.004" N
Sucker Creek (SC01)	90° 53.685"W - 46° 54.646"N
Sucker Creek Mouth (SCM02)	90°55'1.50"W - 46°55'56.50"N

Table 4 - Red Cliff's CWA 106 Water Quality Monitoring Sites and Parameters						
Monthly	**Nutrients ***	**TSS**	**Chloride**	**E.coli**	**PAH**	**Lead**
Baseline Monitoring						
RCC01	X	X		X		
RCC03	X	X		X		
RCCM01	X	X		X		
RR01	X	X		X		
RR03	X	X		X		
RRM01	X	X		X		
SR02	X	X		X		
SRM01	X	X		X		
CCM01	X	X		X		
CC02	X	X		X		
CC03	X	X		X		
LS01	X	X		X		
FC01	X	X		X		
FCM01	X	X		X		
SC01	X	X		X		
SC02	X	X		X		
Legendary Waters Casino Retention Pond Project (WQ monitoring 2014-15 only)						
CPU01	X	X	X	X	X	X
CPU02	X	X	X	X	X	X
LS02	X	X	X	X	X	X
LS03	X	X	X	X	X	X
* Nutrients include: Total Phosphorus, Total Nitrogen, Nitrates+Nitrites, Total Kjeldahl Nitrogen, and Ammonia						

Table 5 – NPS Assessment Summary						
Waterbody Name & Stream Length* (On-reservation - main stem)	**NPS Pollutant(s)**	**Use(s) Impaired**	**Use(s) Threatened**	**Potential Source**	**Future Potential Source Threats**	**Severity**
Chicago Creek 1.75 miles	- Sediment - Nitrogen - Phosphorus - E.coli	- Contact; fishing, swimming, cultural uses -Aquatic life	-	- Possible outdated septic systems - Development - Roads - Historic hydromodification	- Forestry	Impacted (51%)
Frog Creek ~ 1.25 miles	- Sediment - Nitrogen - Phosphorus	-Aquatic life	- Contact; fishing, swimming, cultural uses	- Possible outdated septic systems - Forestry - Sandbar causing trapping of nutrients - Roads	- Development	Slightly Impacted (42%)
Lake Superior (Casino Marina & Beach)	-Nitrogen	-	- Contact; fishing, swimming, cultural uses -Aquatic life	- Casino turf management practices - Development - Roads/parking lot runoff - Historic hydromodification	-	Impacted (79%)
Casino Pond & Outfall #1	-Nitrogen -Phosphorus -Chloride	-	- Contact; fishing, swimming, cultural uses -Aquatic life	- Casino turf management practices - Development - Roads/parking lot runoff - Historic hydromodification	-	Impacted (69%)
Casino Pond & Outfall #2	-Nitrogen -Phosphorus	-	- Contact; fishing, swimming, cultural uses -Aquatic life	- Casino turf management practices - Development - Roads/parking lot runoff - Historic hydromodification	-	Impacted (88%)
Raspberry River ~ 2.25 miles	- Sediment - Nitrogen - Phosphorus - E.coli	- Contact; fishing, swimming, cultural uses -Aquatic life	-	- Forestry - Agriculture - Historic outhouses at the Raspberry Campground - Development - Roads - Beaver activity - Historic hydromodification	-	Impacted (81%)
Red Cliff Creek ~ 3 miles	- Sediment - Nitrogen - Phosphorus -E.coli	- Contact; fishing, swimming, cultural uses -Aquatic life	-	- Forestry - Agriculture - Possible outdated septic systems - Historic wastewater treatment pond - Development - Roads - Beaver activity	-	Impacted (67%)

				- Historic hydromodification		
Sand River ~ 2.1 miles	- Sediment - Nitrogen - Phosphorus	-Aquatic life	- Contact; fishing, swimming, cultural uses	- Upstream forestry and agricultural practices - Development - Roads - Beaver activity - Historic hydromodification	-	Impacted (53%)
Sucker Creek ~ 1.45 miles	- Sediment - Nitrogen - Phosphorus -E.coli	- Contact; fishing, swimming, cultural uses -Aquatic life	-	- Agriculture - Roads - Historic hydromodification	- Development - Forestry	Impacted (58%)
*On-reservation main stem stream lengths are estimated using Google Earth Pro Not Impacted: Waterbodies with less than 25% Total Nitrogen threshold exceedances from 2013-2016 Slightly Impacted: Waterbodies with less than 50% Total Nitrogen threshold exceedances from 2013-2016 Impacted: Waterbodies with greater than 50% Total Nitrogen threshold exceedances from 2013-2016						

Table 6 - Macroinvertebrate biotic index scores for reservation streams									
Site	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
CC02	Good 4.96			Very poor 9.48			Poor 8.23		x
CC03							Very good 4		x
CCM01				Fair 6.28		Fairly poor 6.86		Fair 6.22	
FC01							Fairly poor *only 106 vs. required 125 samples 6.56		x
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		x
RCC01				Fair 5.79		Very good 4.45			
RCC03	Very good 4.00			Good 5.15		Good 4.90			
RCCM01							Fair 6.41		x
SC01									
SCM01						NA		Poor 7.71	
SR02	Excellent 3.34				Fair 5.77	Good 4.62		Very good 3.71	
SRM01							Fair 5.92		x
x – denotes future sites that have not yet been assigned a biotic index score									

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

Wetland Assessment Area Summary Table

Wetland Inventory and Assessment Report, Red Cliff Band of Lake Superior Chippewa.
February 8, 2016

Table 17: Red Cliff Indian Reservation 2015 Wetland Assessment Area Summary

Site ID	Floristic Integrity	Human Use Values	Wildlife Habitat	Fish and Aquatic Life Habitat	Shoreline Protection	Flood and Stormwater Protection	Water Quality Protection	Groundwater Process	Mean C Value	FQI Value
CCW01	Medium	High	High	Exceptional	Medium	Medium	Medium	Low	Med to High	Low
CCW02	Medium	Medium	High	High	Low	Low	Medium	Low	High	Medium
EBW	Medium	Medium	Exceptional	Low	Low	Medium	Medium	Low	Medium	Low to Med
FCW	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Low	Exceptional	High
LSBW	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Low	Exceptional	Med to High
RCCW01	Medium	Medium	High	High	Medium	Medium	Medium	Low	Exceptional	Medium
RCCW02	Medium	Medium	Exceptional	High	Medium	High	Medium	Low	Med to High	Low to Med
RRW01	High	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Low	High	Medium
RRW02	High	High	Exceptional	High	High	High	High	Low	Exceptional	High
RRW03	Medium	Medium	Exceptional	Exceptional	Exceptional	Exceptional	High	Low	Medium	Medium
RRW04	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Low	Exceptional	Exceptional
SCW	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	High
SRW	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional	Low	Exceptional	Med to High

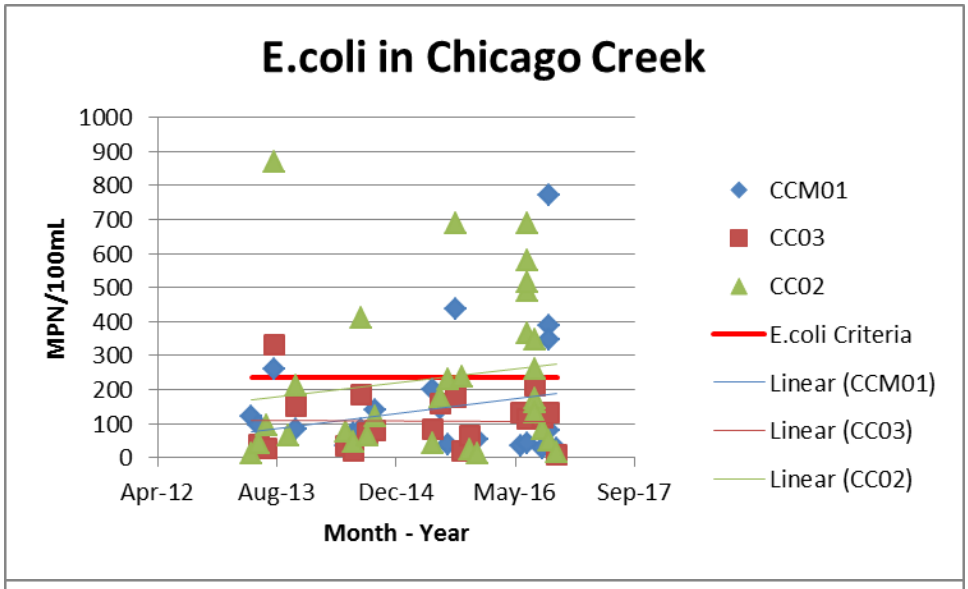
Appendix C
Red Cliff Water Resource Program's CWA 106 Water Quality Monitoring Data

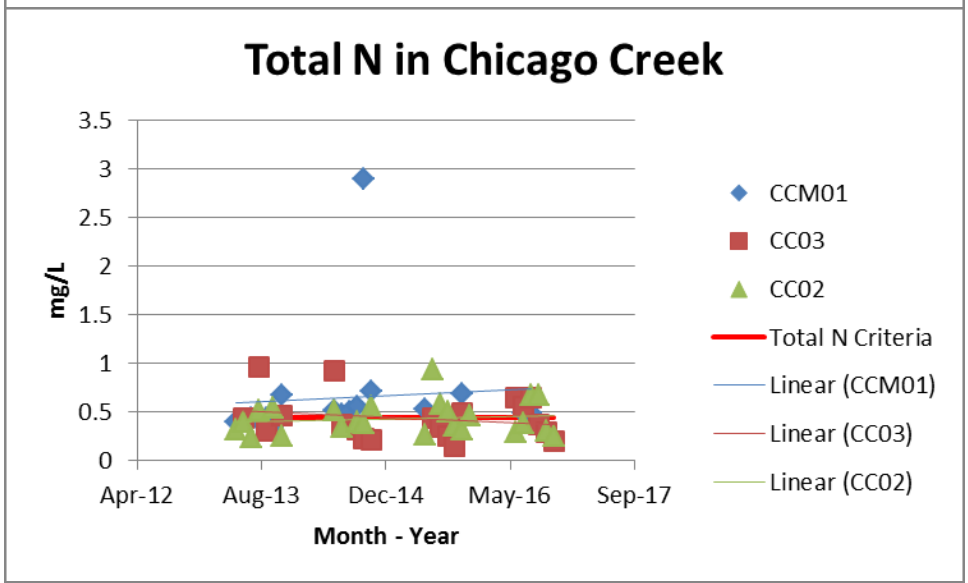
The Red Cliff Water Resource Program's CWA 106 Water Quality Monitoring data can be found at: http://www3.epa.gov/storet/dw_home.html

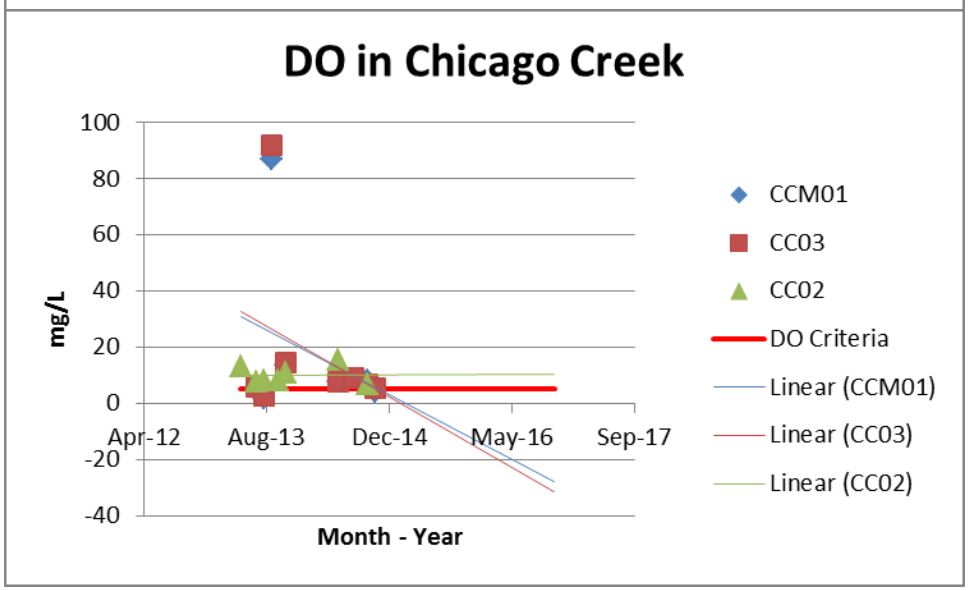
Also see Red Cliff Water Resource Program's CWA 106 Water Quality Assessment Reports (reports include 2012-2015 WQAR and 2016 WQAR): http://redcliff-nsn.gov/divisions/TNRD/WR.htm

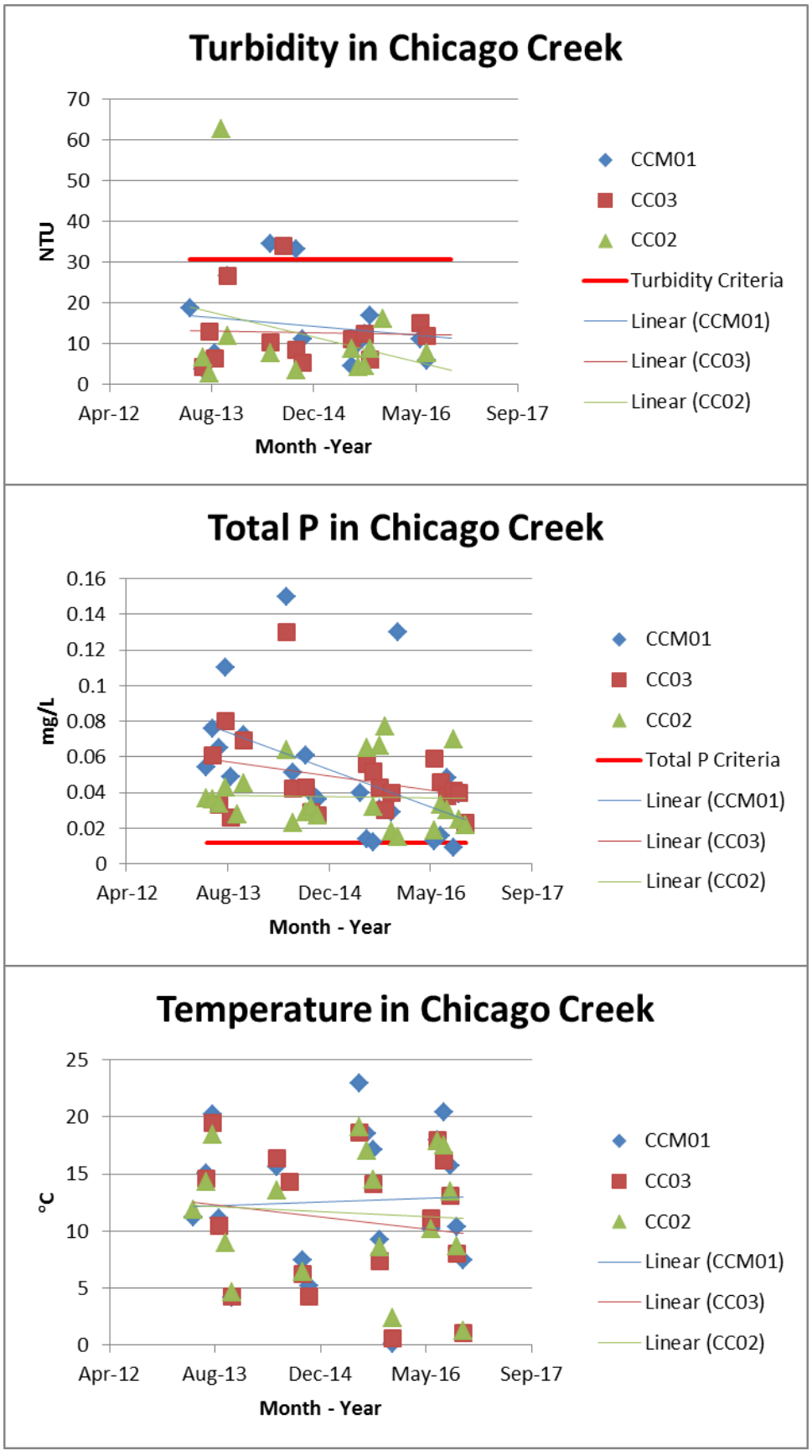
Appendix D
Red Cliff Water Resource Program's CWA 106 Water Quality Monitoring Data Graphs

Chicago Creek Results

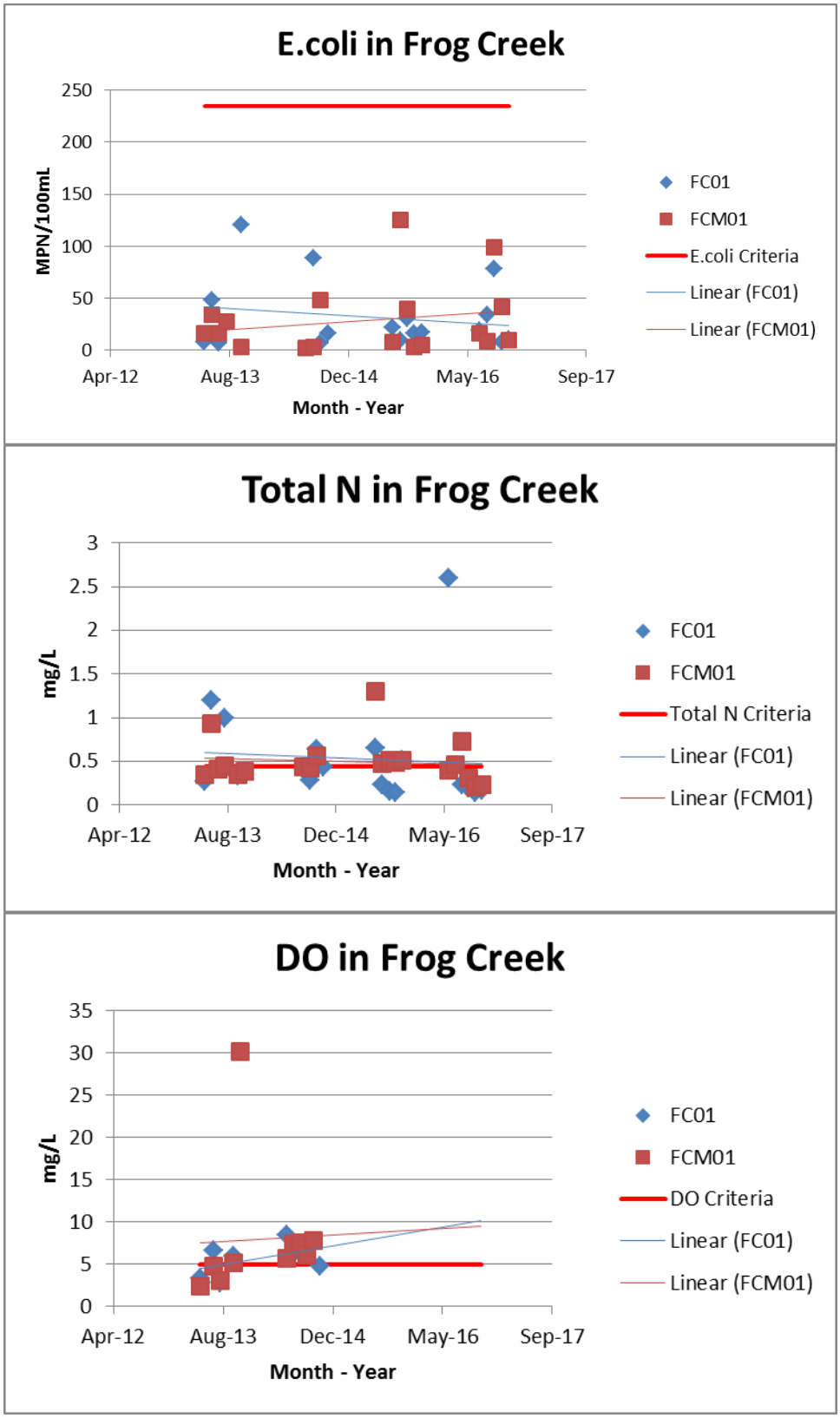


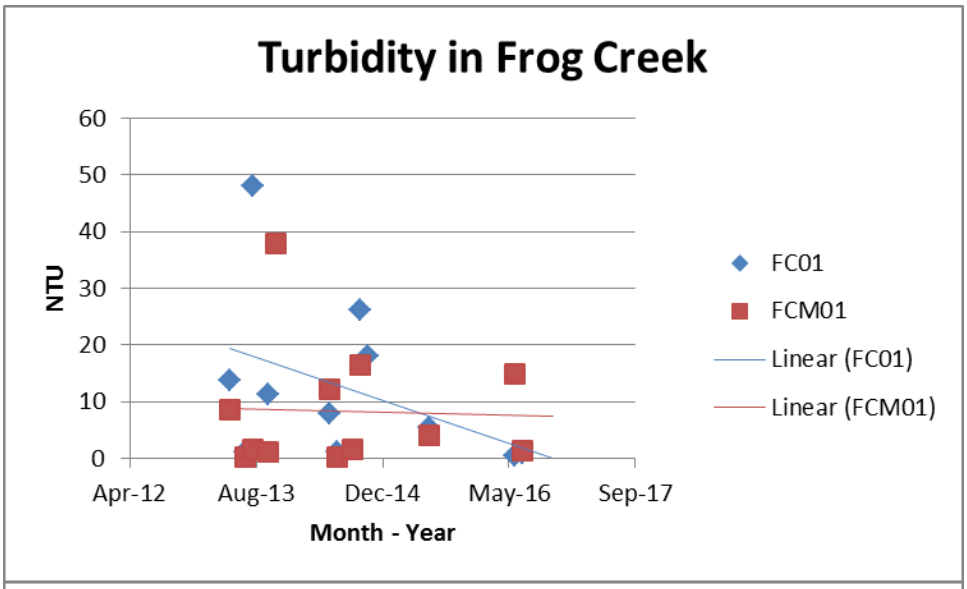


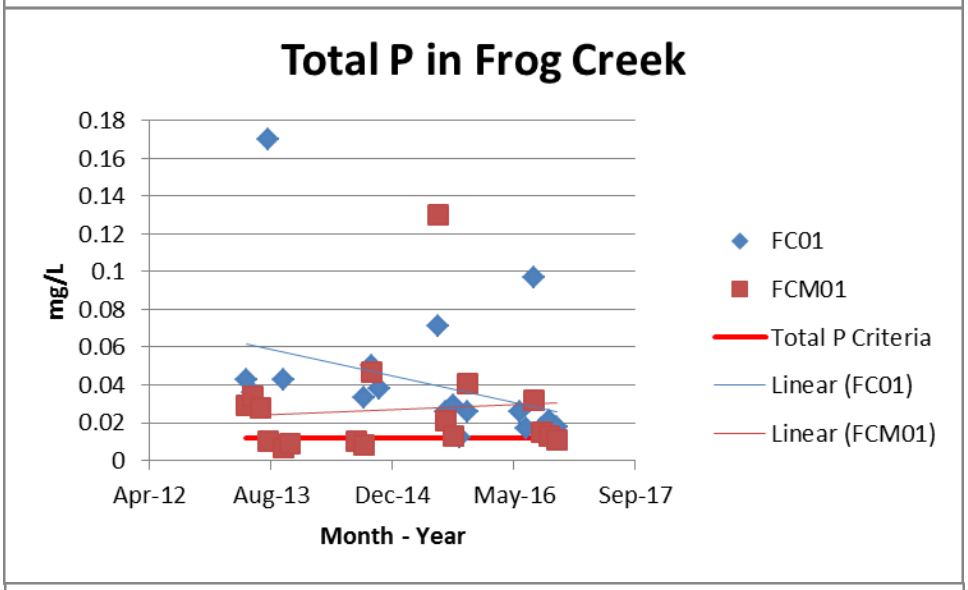


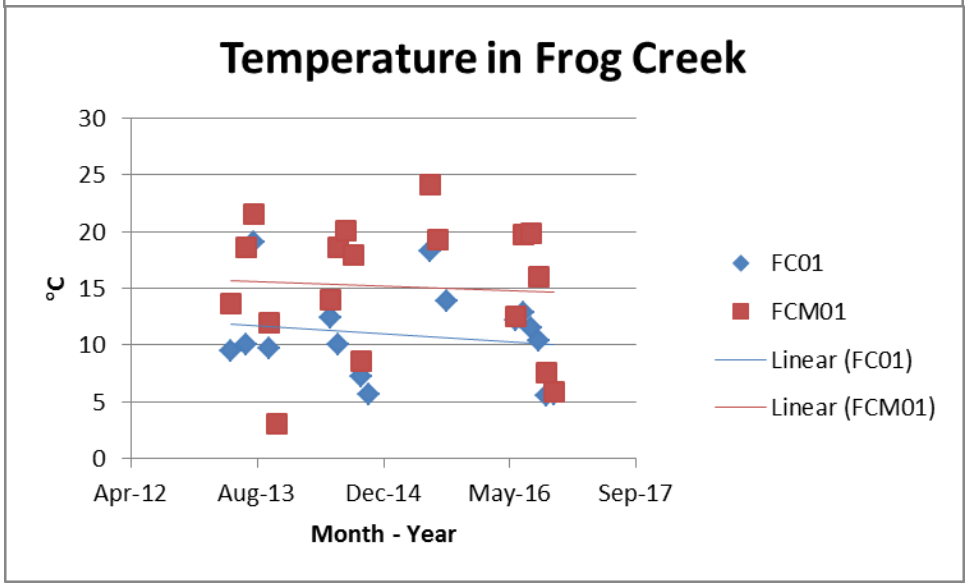

Turbidity in Chicago Creek
NTU
70
60
50
40
30
20
10
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month -Year
CCM01
CC03
CC02
Turbidity Criteria
Linear (CCM01)
Linear (CC03)
Linear (CC02)
Total P in Chicago Creek
mg/L
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
CCM01
CC03
CC02
Total P Criteria
Linear (CCM01)
Linear (CC03)
Linear (CC02)
Temperature in Chicago Creek
°C
25
20
15
10
5
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
CCM01
CC03
CC02
Linear (CCM01)
Linear (CC03)
Linear (CC02)

Frog Creek Results

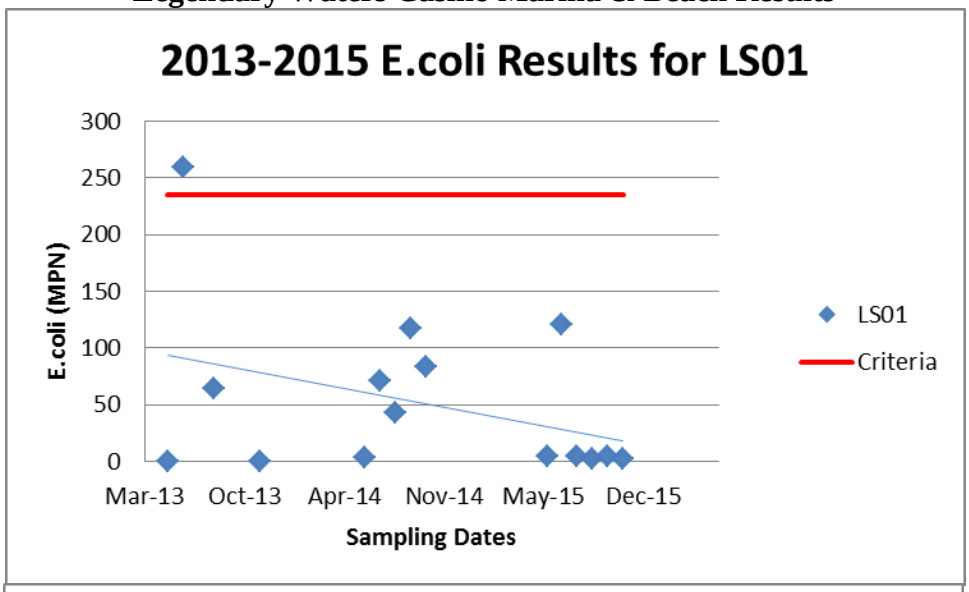


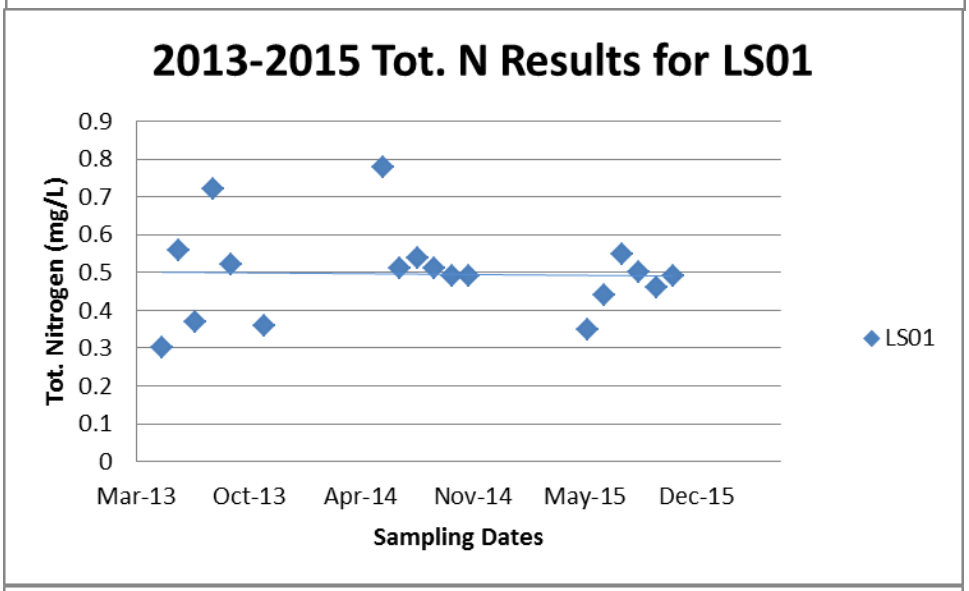

Turbidity in Frog Creek
NTU
60
50
40
30
20
10
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
FC01
FCM01
Linear (FC01)
Linear (FCM01)

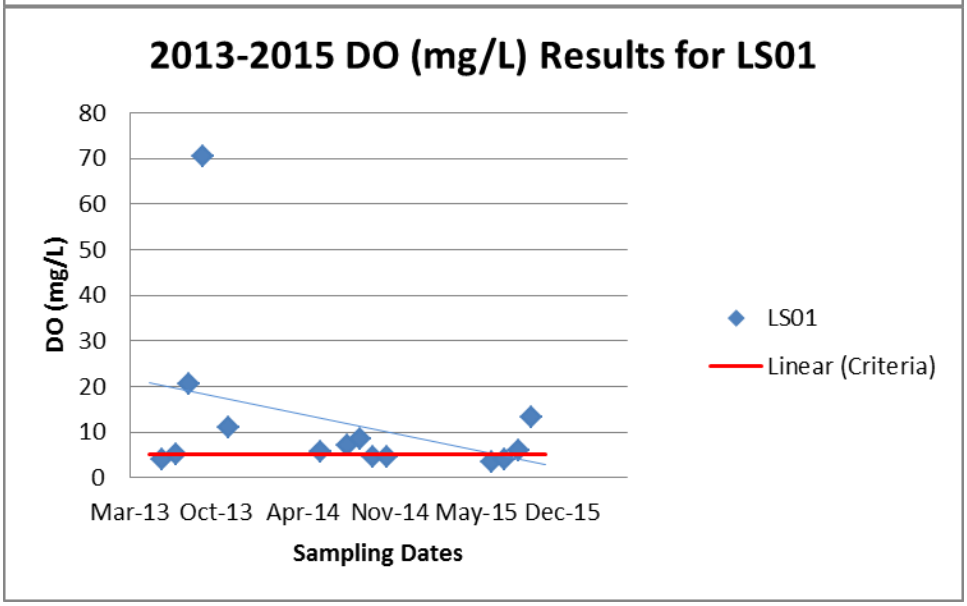

Total P in Frog Creek
mg/L
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
FC01
FCM01
Total P Criteria
Linear (FC01)
Linear (FCM01)

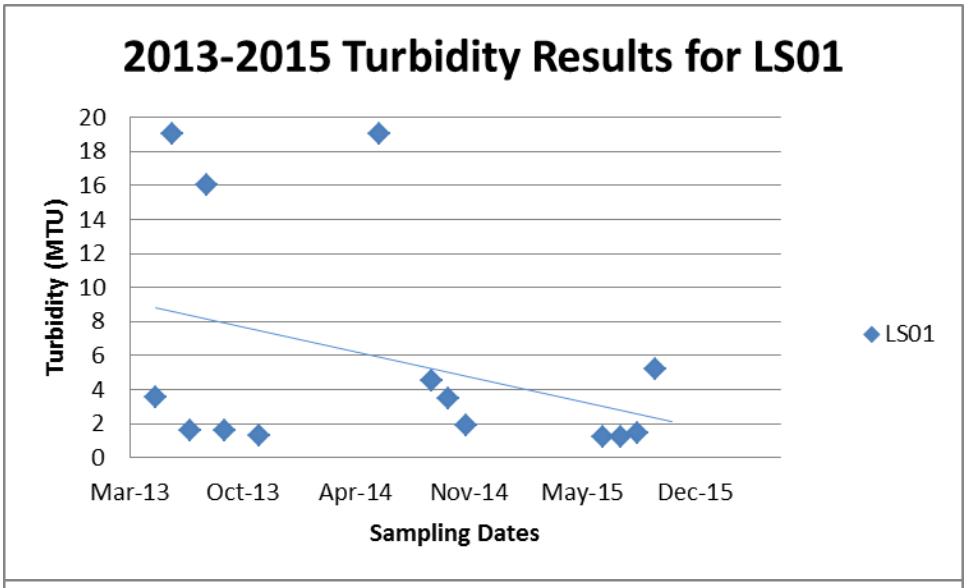

Temperature in Frog Creek
°C
30
25
20
15
10
5
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
FC01
FCM01
Linear (FC01)
Linear (FCM01)

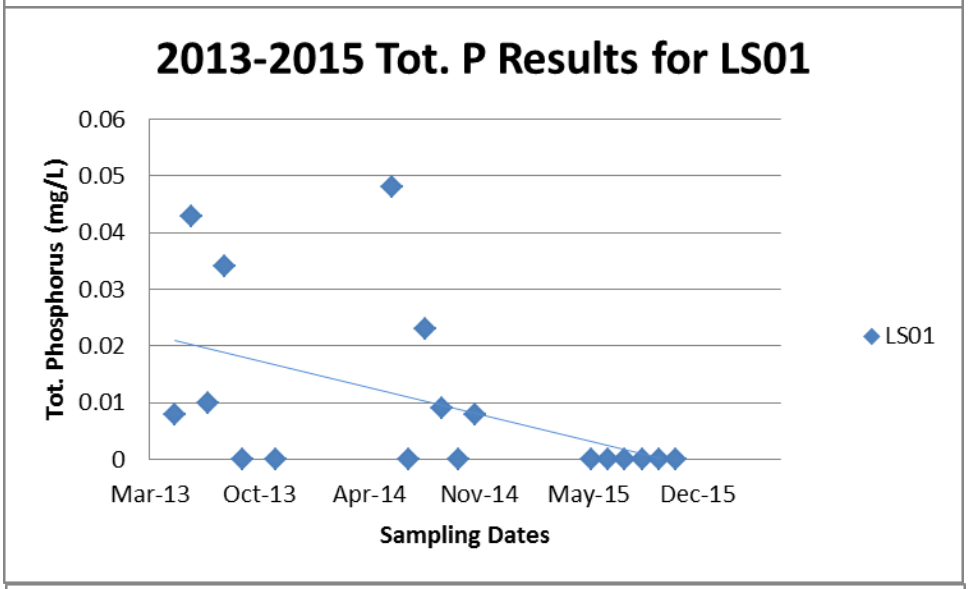
Legendary Waters Casino Marina & Beach Results

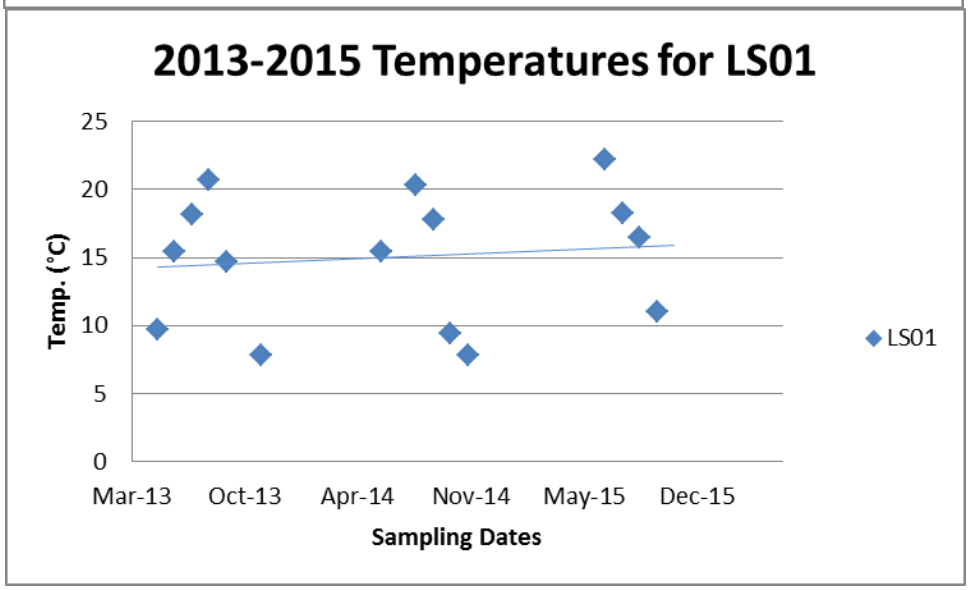




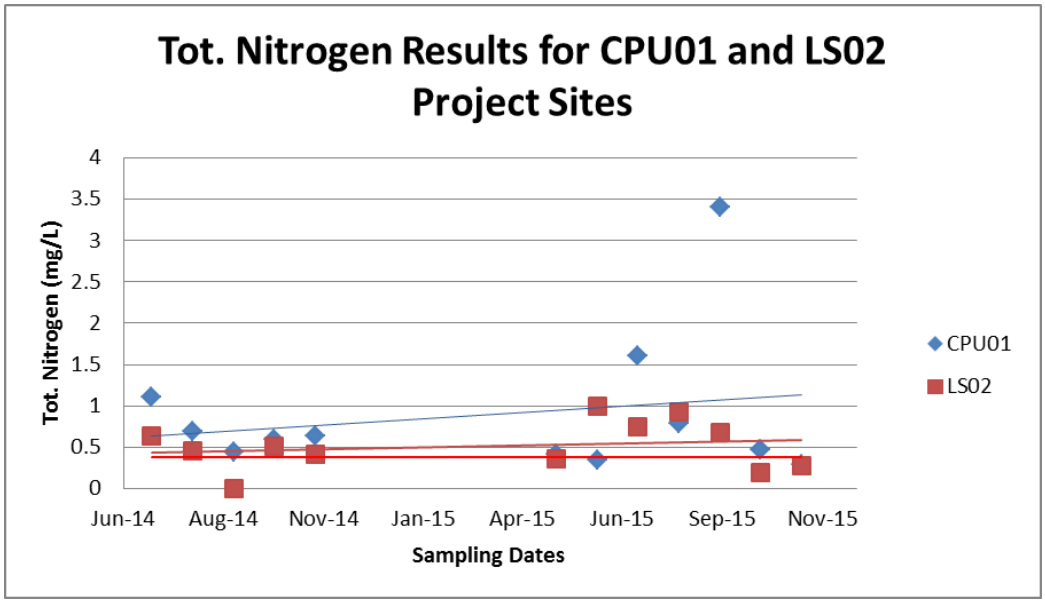


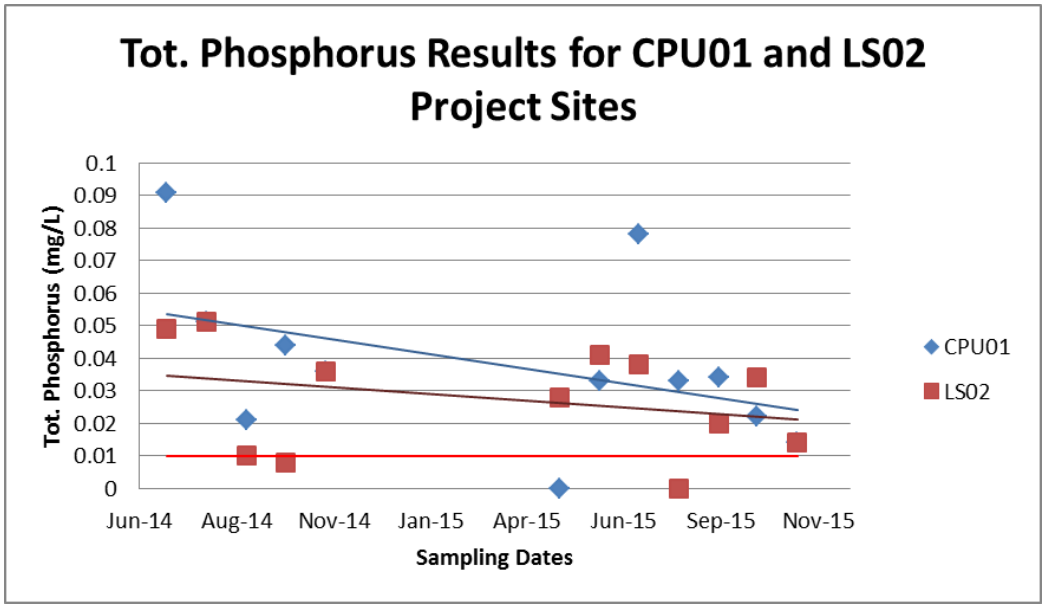

2013-2015 Turbidity Results for LS01
Turbidity (MTU)
20
18
16
14
12
10
8
6
4
2
0
Mar-13
Oct-13
Apr-14
Nov-14
May-15
Dec-15
Sampling Dates
LS01

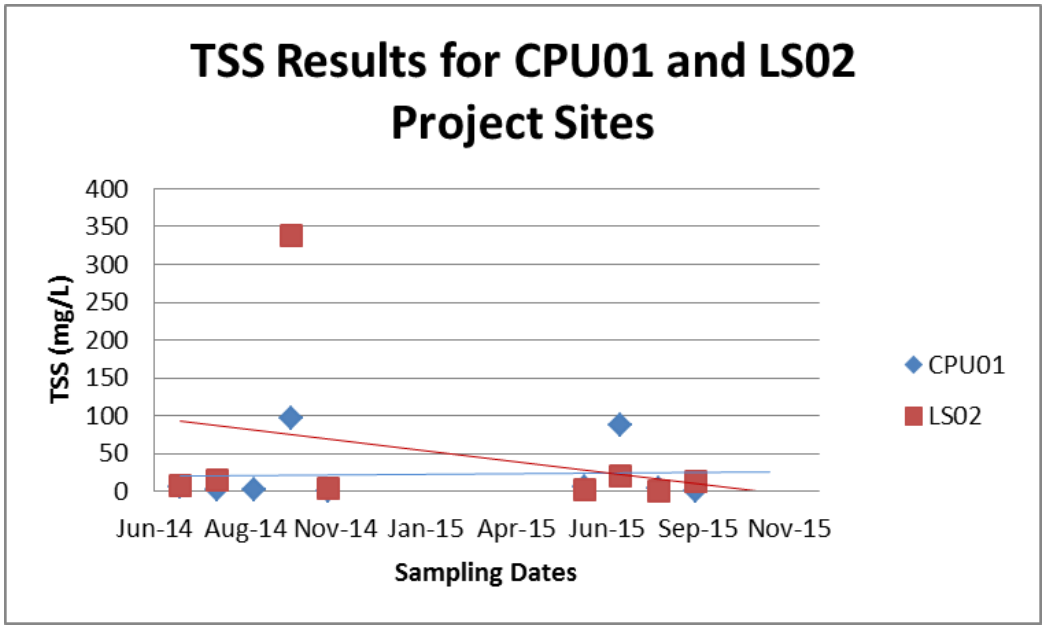

2013-2015 Tot. P Results for LS01
Tot. Phosphorus (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
Mar-13
Oct-13
Apr-14
Nov-14
May-15
Dec-15
Sampling Dates
LS01

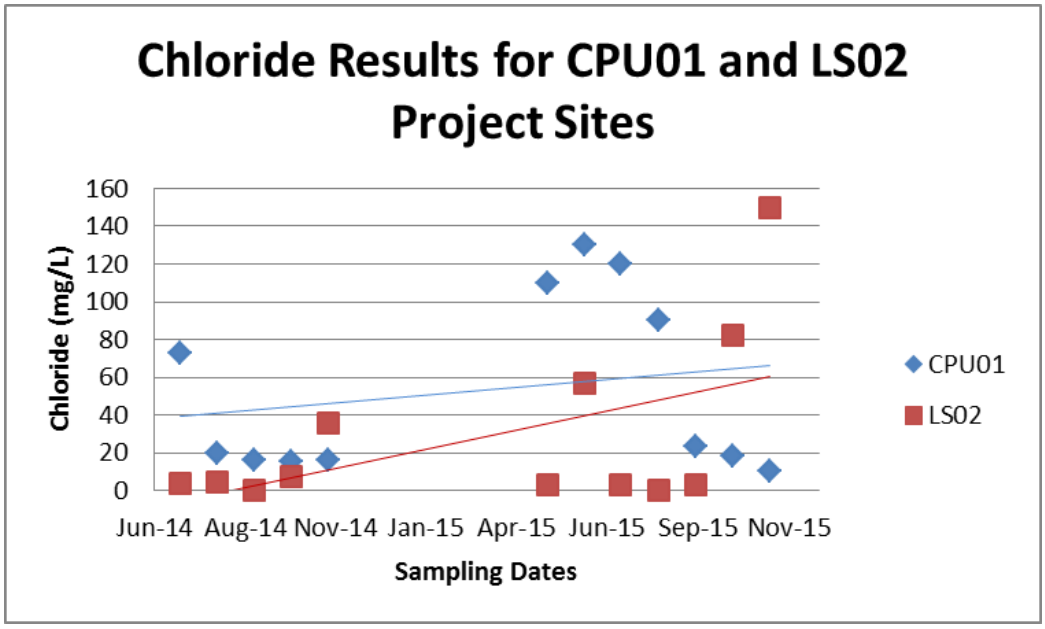

2013-2015 Temperatures for LS01
Temp. (°C)
25
20
15
10
5
0
Mar-13
Oct-13
Apr-14
Nov-14
May-15
Dec-15
Sampling Dates
LS01

Legendary Waters Casino Pond & Outfall #1 Results

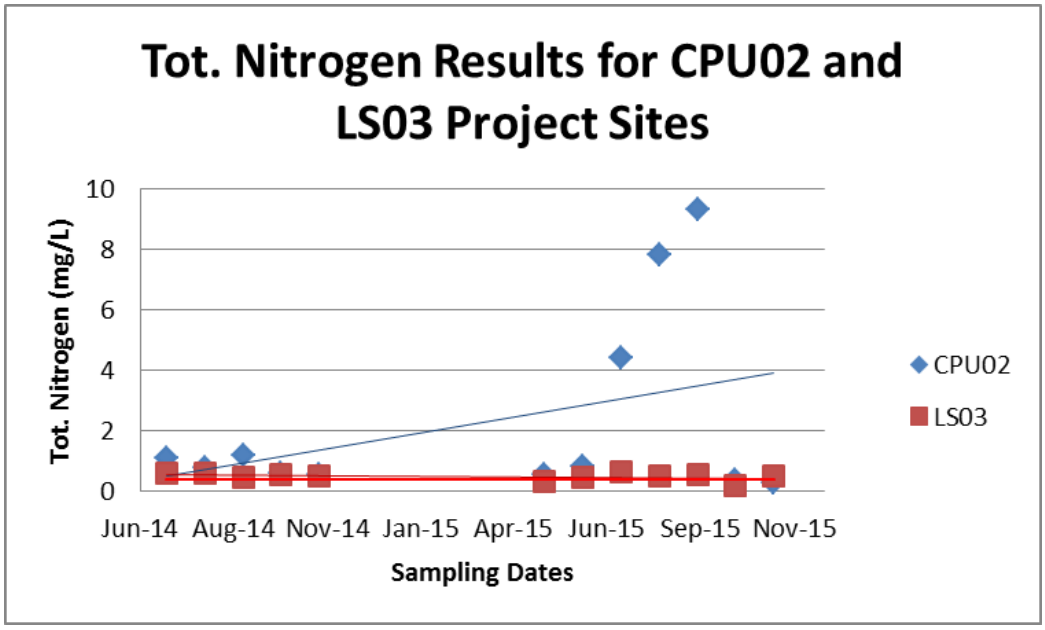


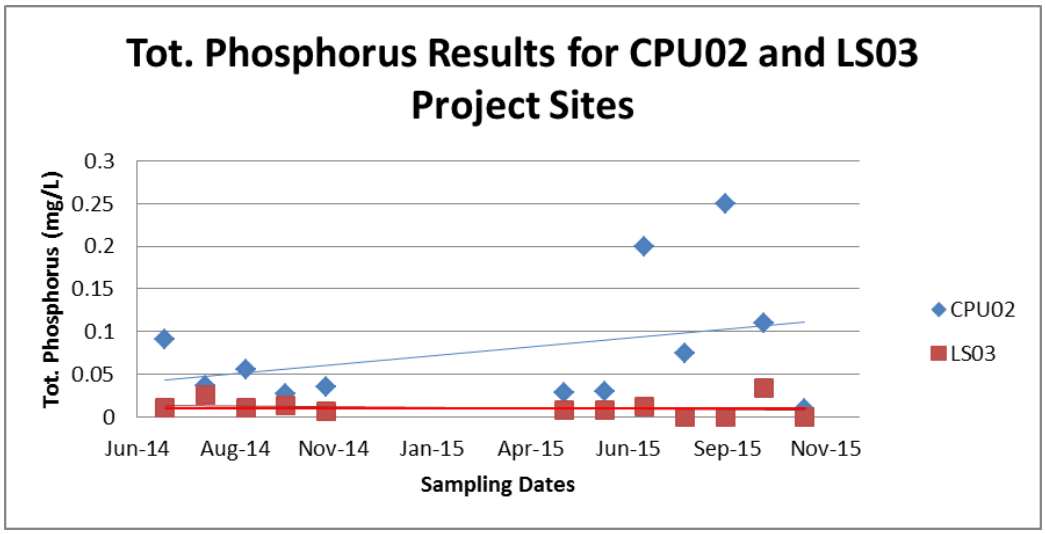


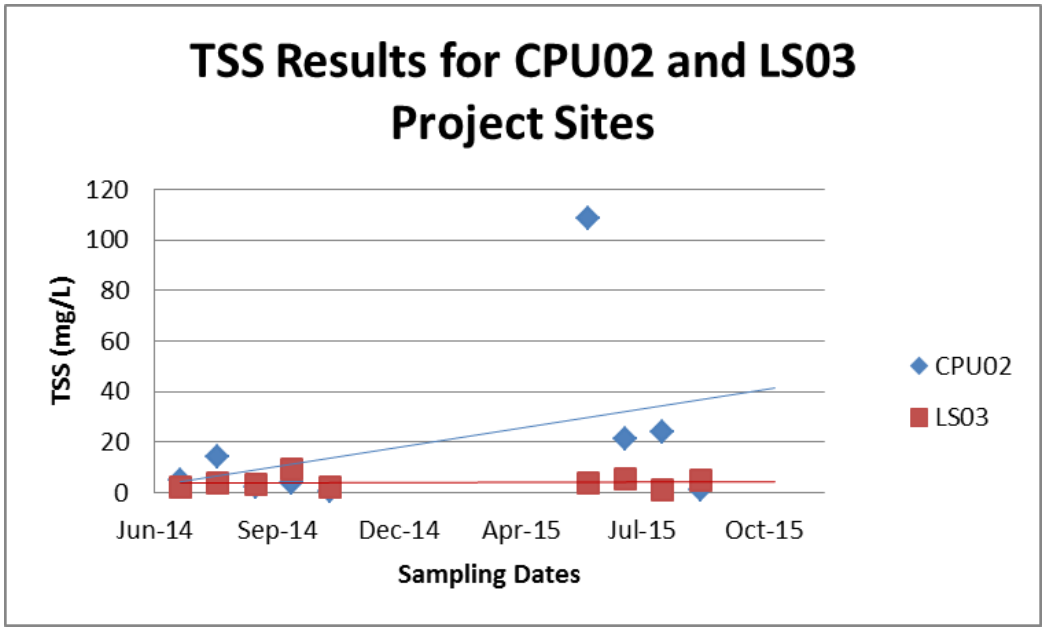

TSS Results for CPU01 and LS02 Project Sites
TSS (mg/L)
400
350
300
250
200
150
100
50
0
Jun-14
Aug-14
Nov-14
Jan-15
Apr-15
Jun-15
Sep-15
Nov-15
Sampling Dates
CPU01
LS02

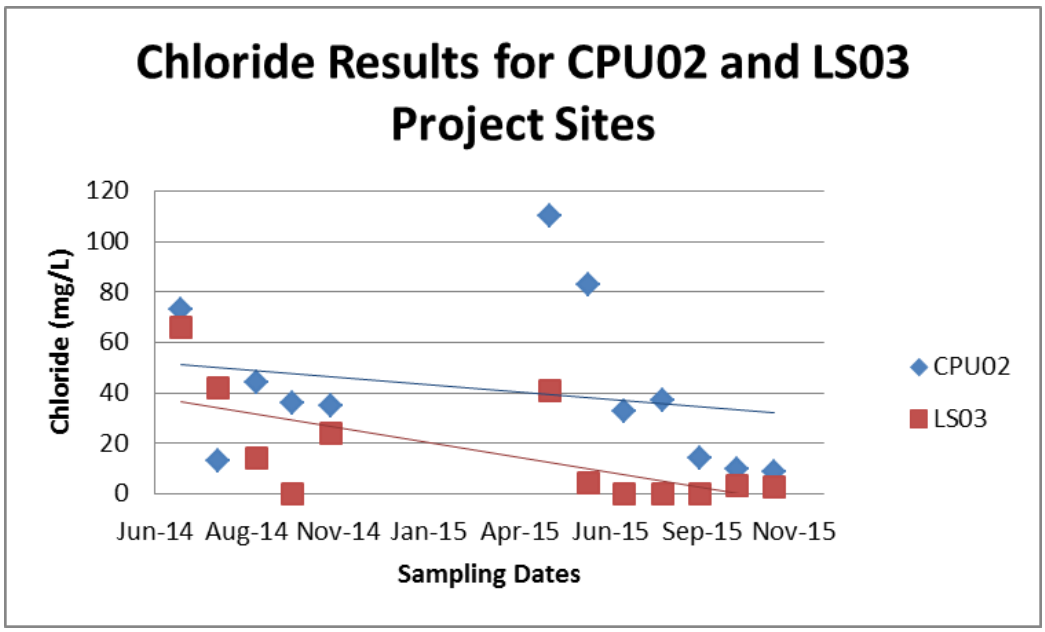

Chloride Results for CPU01 and LS02 Project Sites
Chloride (mg/L)
160
140
120
100
80
60
40
20
0
Jun-14
Aug-14
Nov-14
Jan-15
Apr-15
Jun-15
Sep-15
Nov-15
Sampling Dates
CPU01
LS02

Legendary Waters Casino Pond & Outfall #2 Results

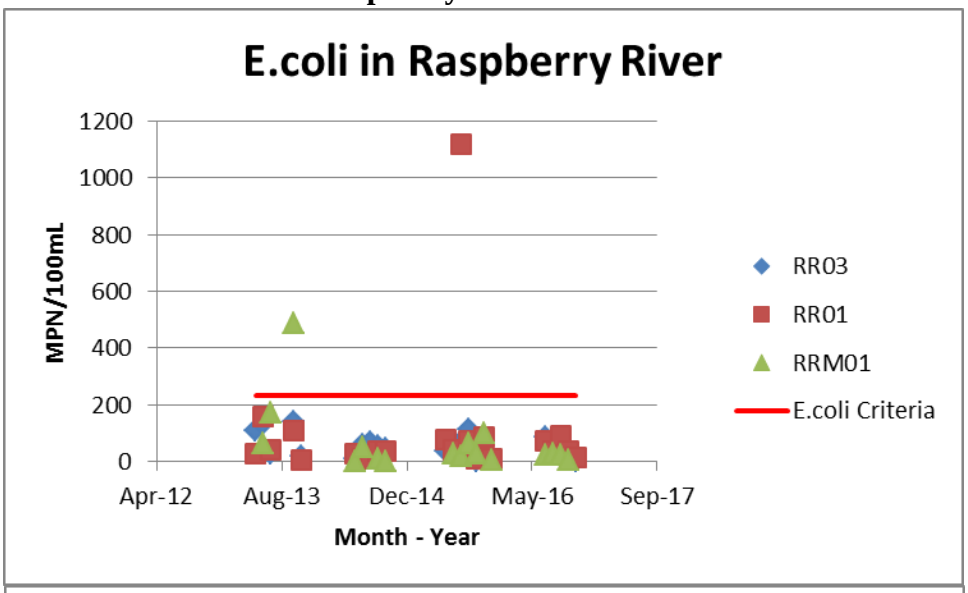


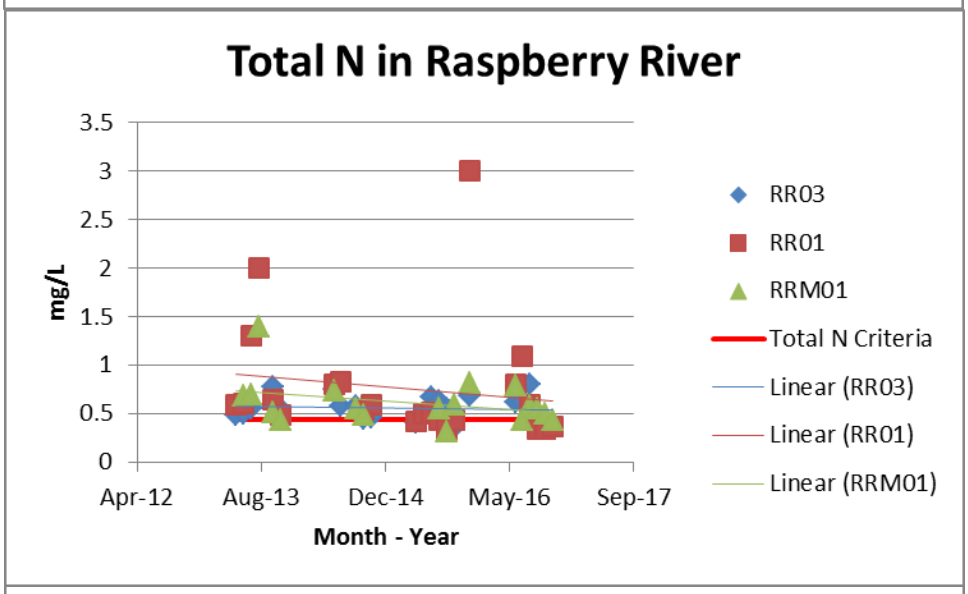


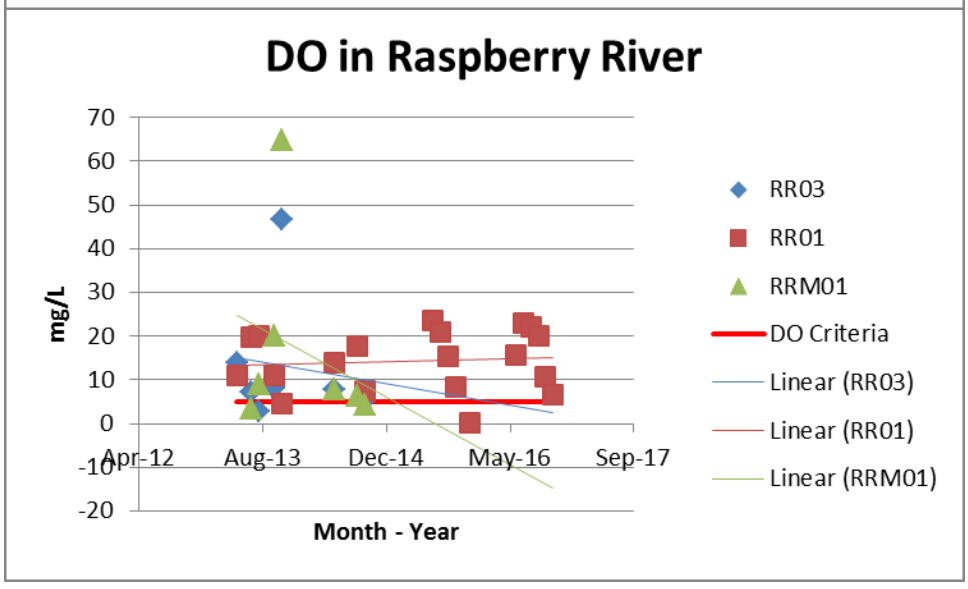

TSS Results for CPU02 and LS03 Project Sites
TSS (mg/L)
120
100
80
60
40
20
0
Jun-14
Sep-14
Dec-14
Apr-15
Jul-15
Oct-15
Sampling Dates
CPU02
LS03

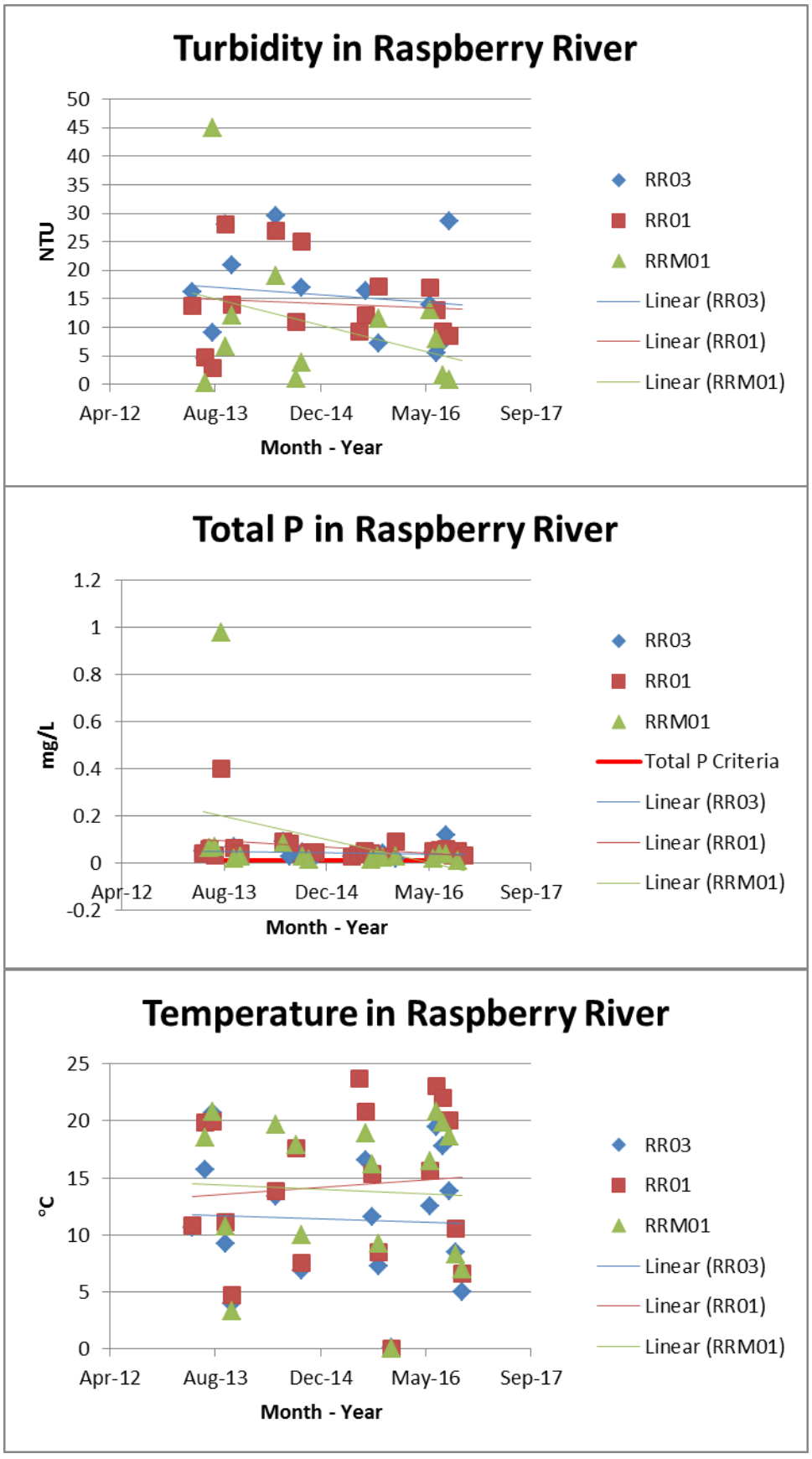

Chloride Results for CPU02 and LS03 Project Sites
Chloride (mg/L)
120
100
80
60
40
20
0
Jun-14
Aug-14
Nov-14
Jan-15
Apr-15
Jun-15
Sep-15
Nov-15
Sampling Dates
CPU02
LS03

Raspberry River Results

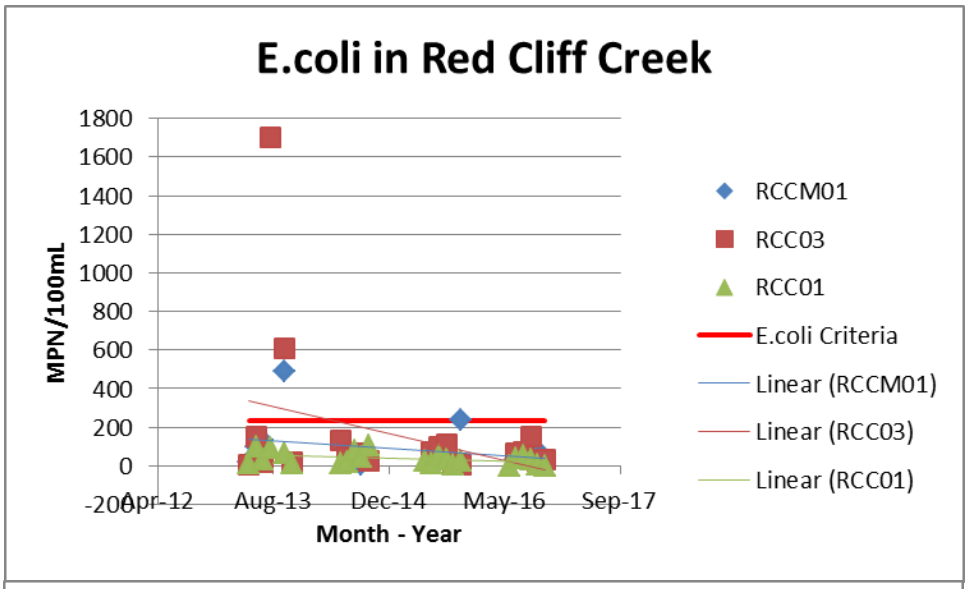


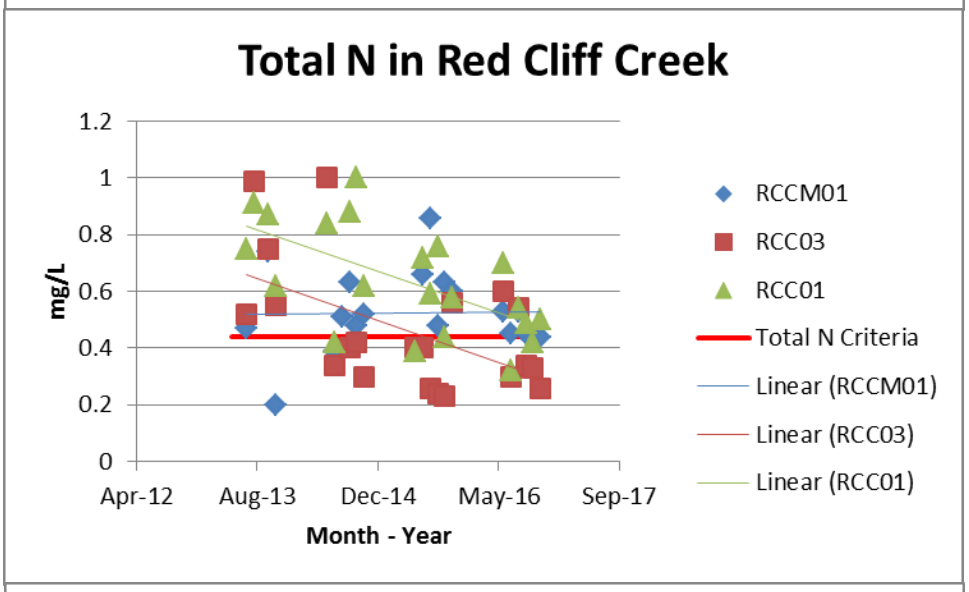


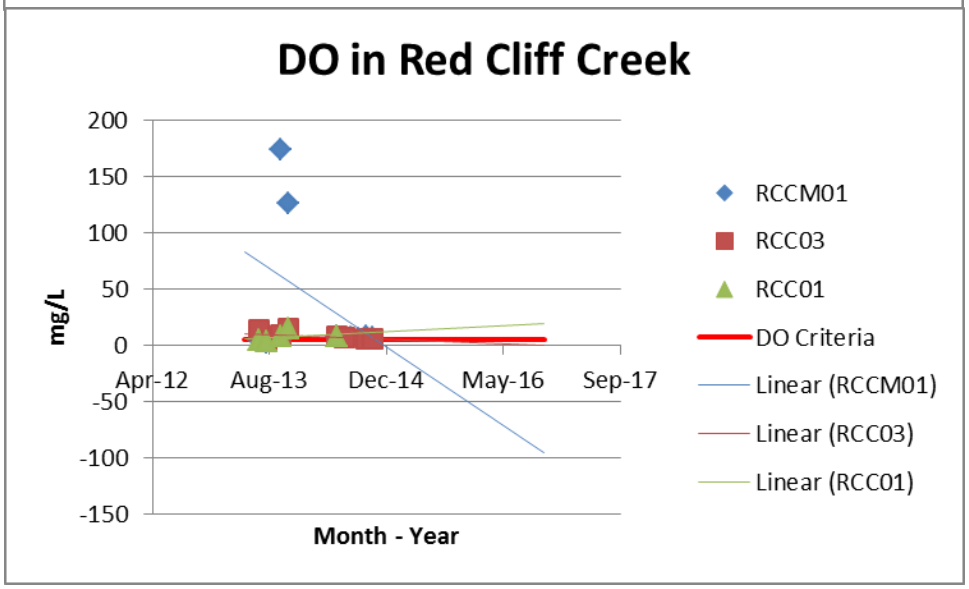


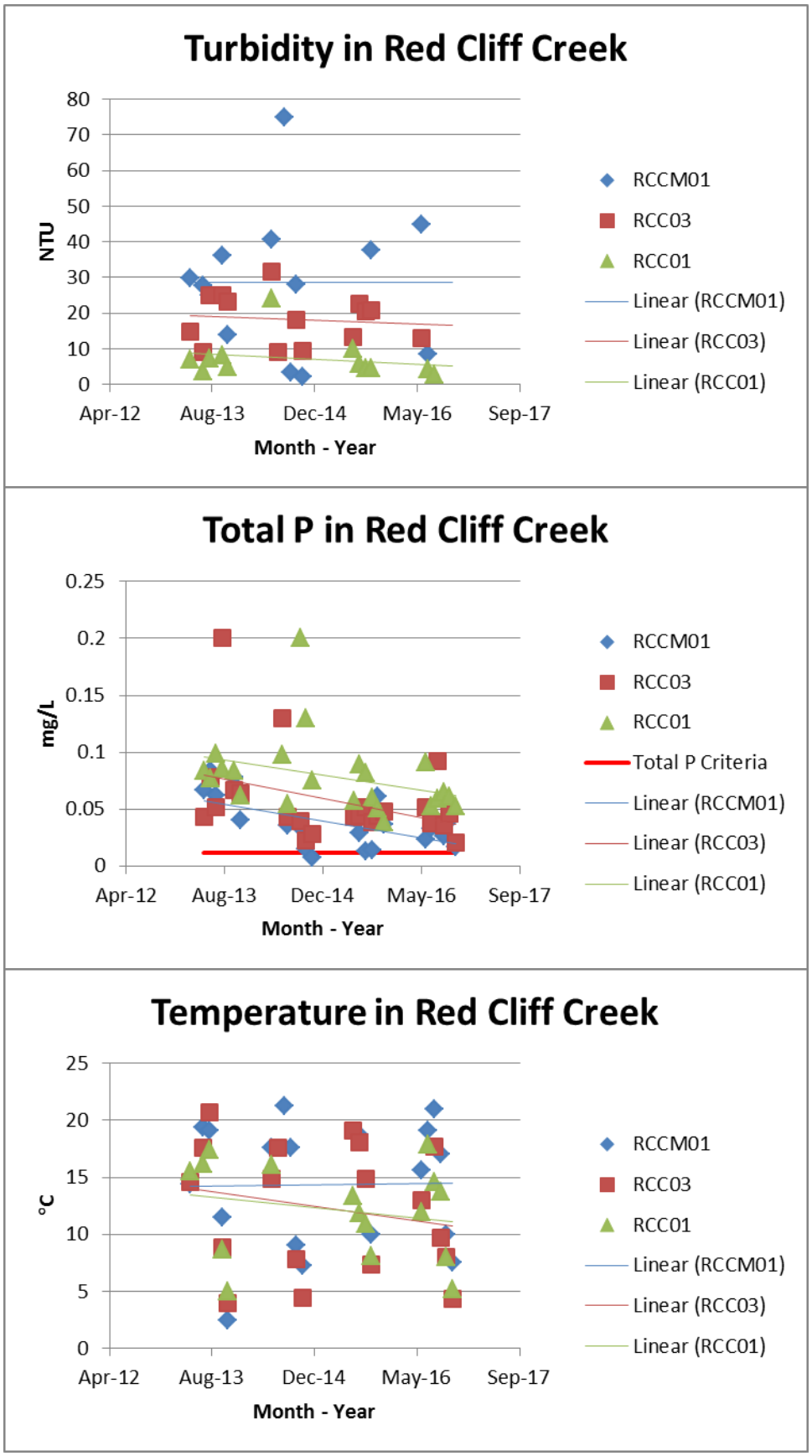

Turbidity in Raspberry River
NTU
50
45
40
35
30
25
20
15
10
5
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
RR03
RR01
RRM01
Linear (RR03)
Linear (RR01)
Linear (RRM01)
Total P in Raspberry River
mg/L
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
RR03
RR01
RRM01
Total P Criteria
Linear (RR03)
Linear (RR01)
Linear (RRM01)
Temperature in Raspberry River
°C
25
20
15
10
5
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
RR03
RR01
RRM01
Linear (RR03)
Linear (RR01)
Linear (RRM01)

Red Cliff Creek Results

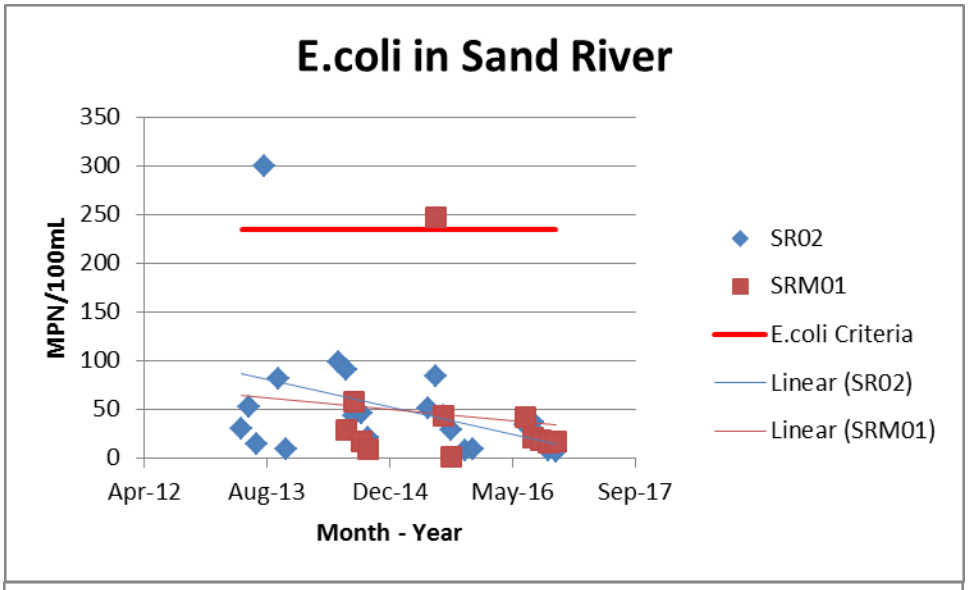


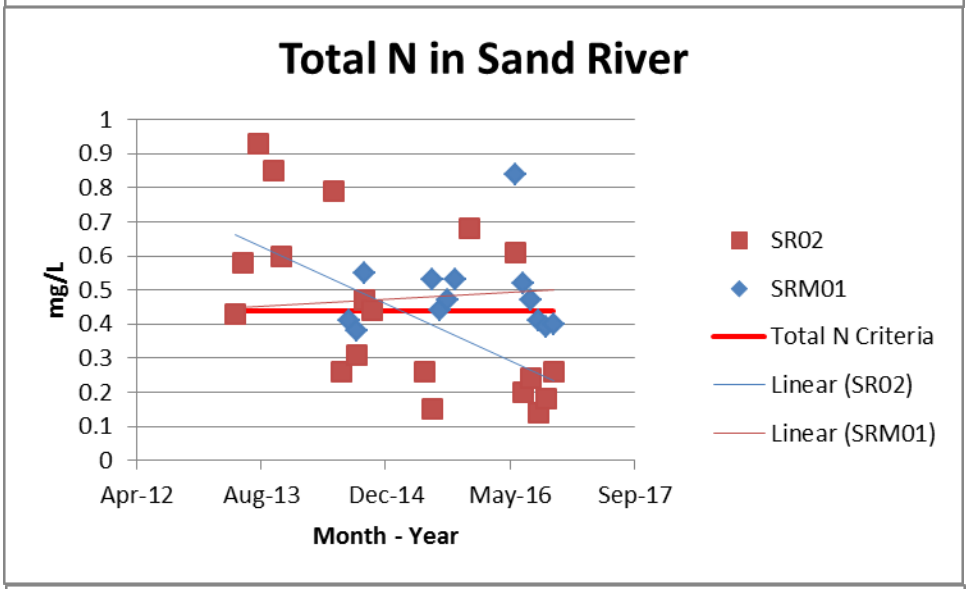


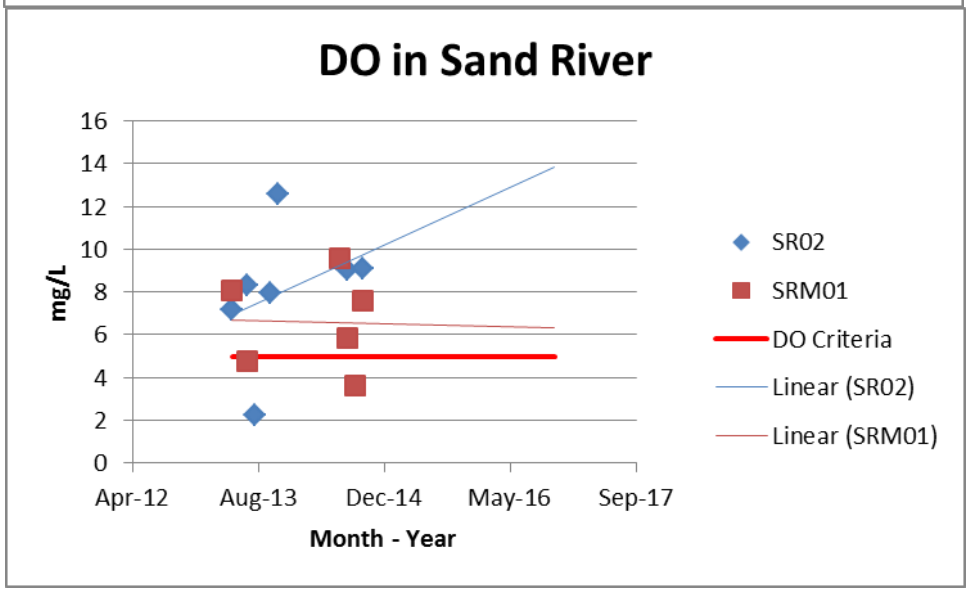


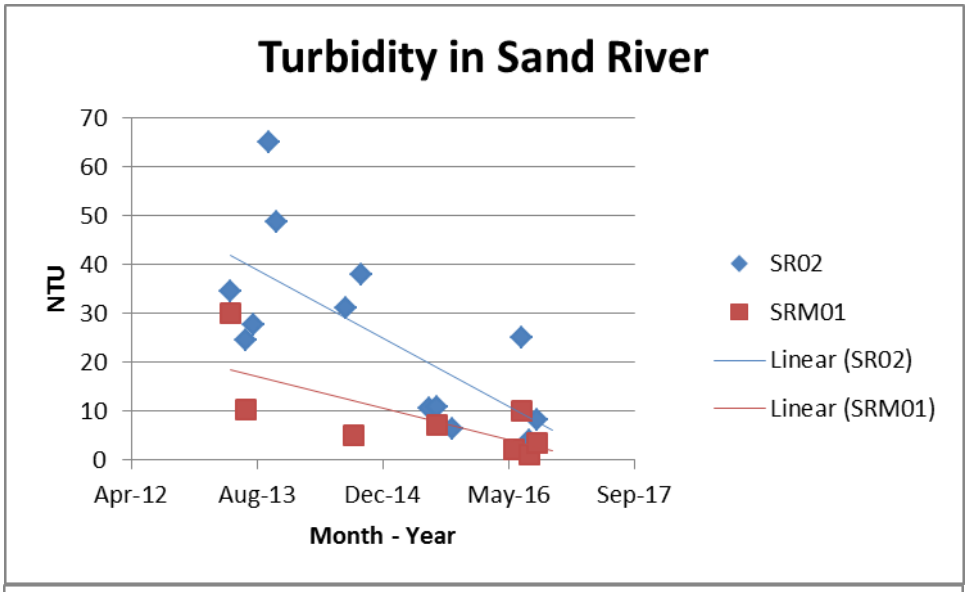

Turbidity in Red Cliff Creek
NTU
80
70
60
50
40
30
20
10
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
RCCM01
RCC03
RCC01
Linear (RCCM01)
Linear (RCC03)
Linear (RCC01)
Total P in Red Cliff Creek
mg/L
0.25
0.2
0.15
0.1
0.05
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
RCCM01
RCC03
RCC01
Total P Criteria
Linear (RCCM01)
Linear (RCC03)
Linear (RCC01)
Temperature in Red Cliff Creek
°C
25
20
15
10
5
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
RCCM01
RCC03
RCC01
Linear (RCCM01)
Linear (RCC03)
Linear (RCC01)

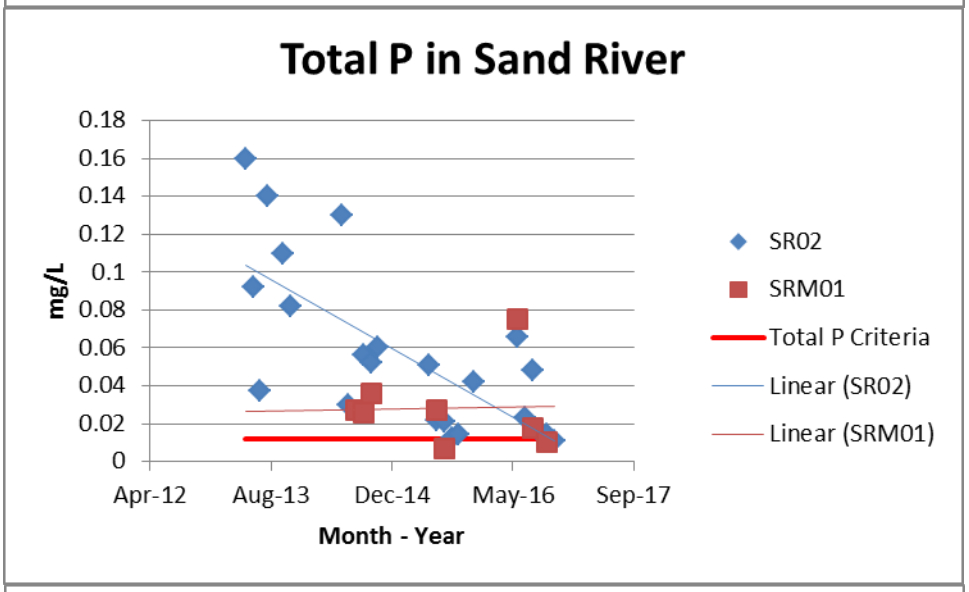
Sand River Results

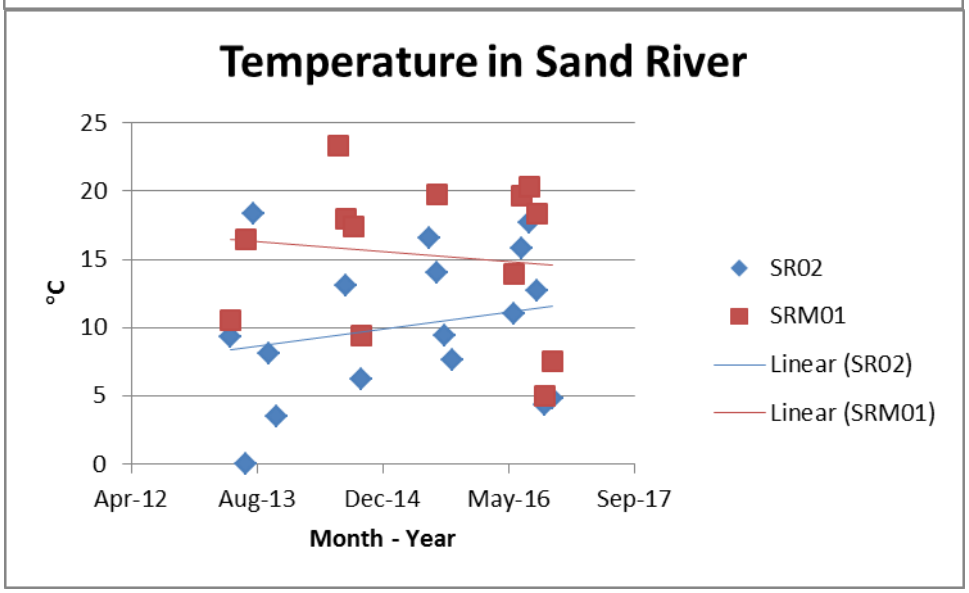




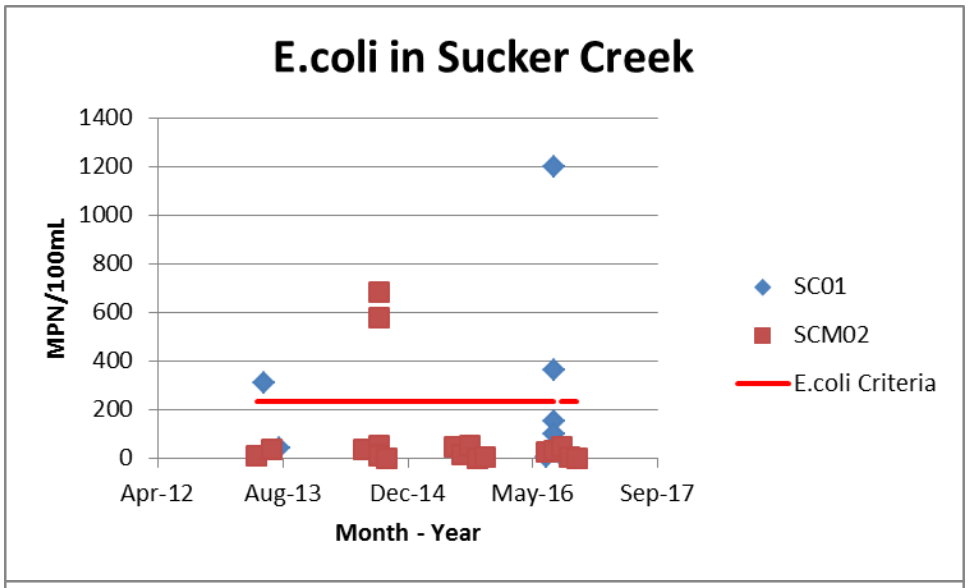


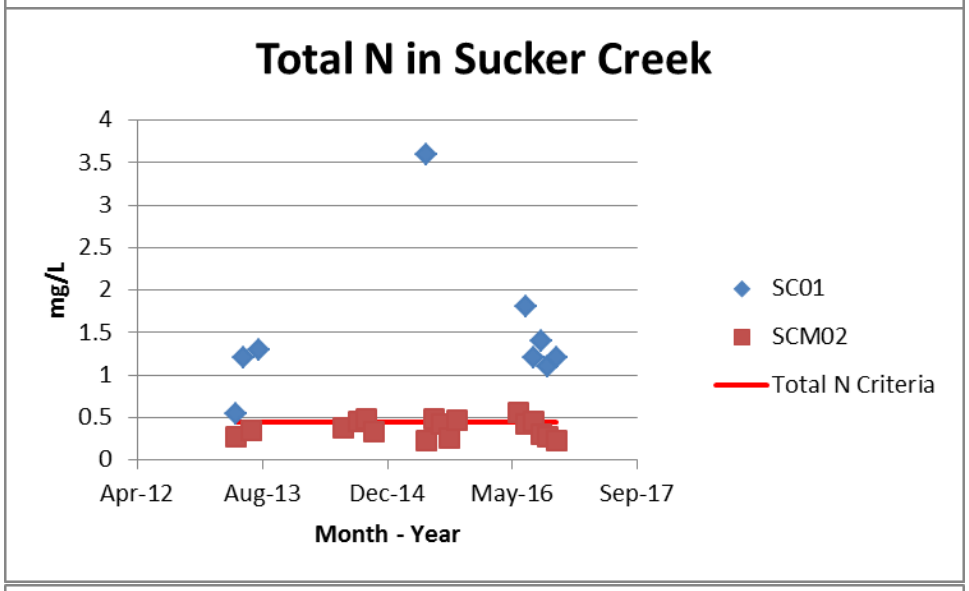

Turbidity in Sand River
NTU
70
60
50
40
30
20
10
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
SR02
SRM01
Linear (SR02)
Linear (SRM01)

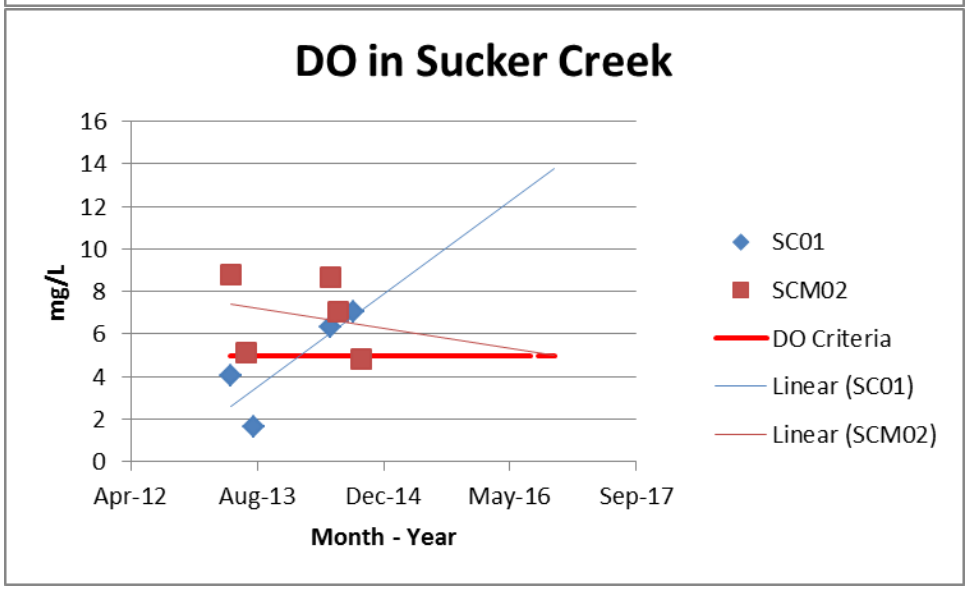

Total P in Sand River
mg/L
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
SR02
SRM01
Total P Criteria
Linear (SR02)
Linear (SRM01)

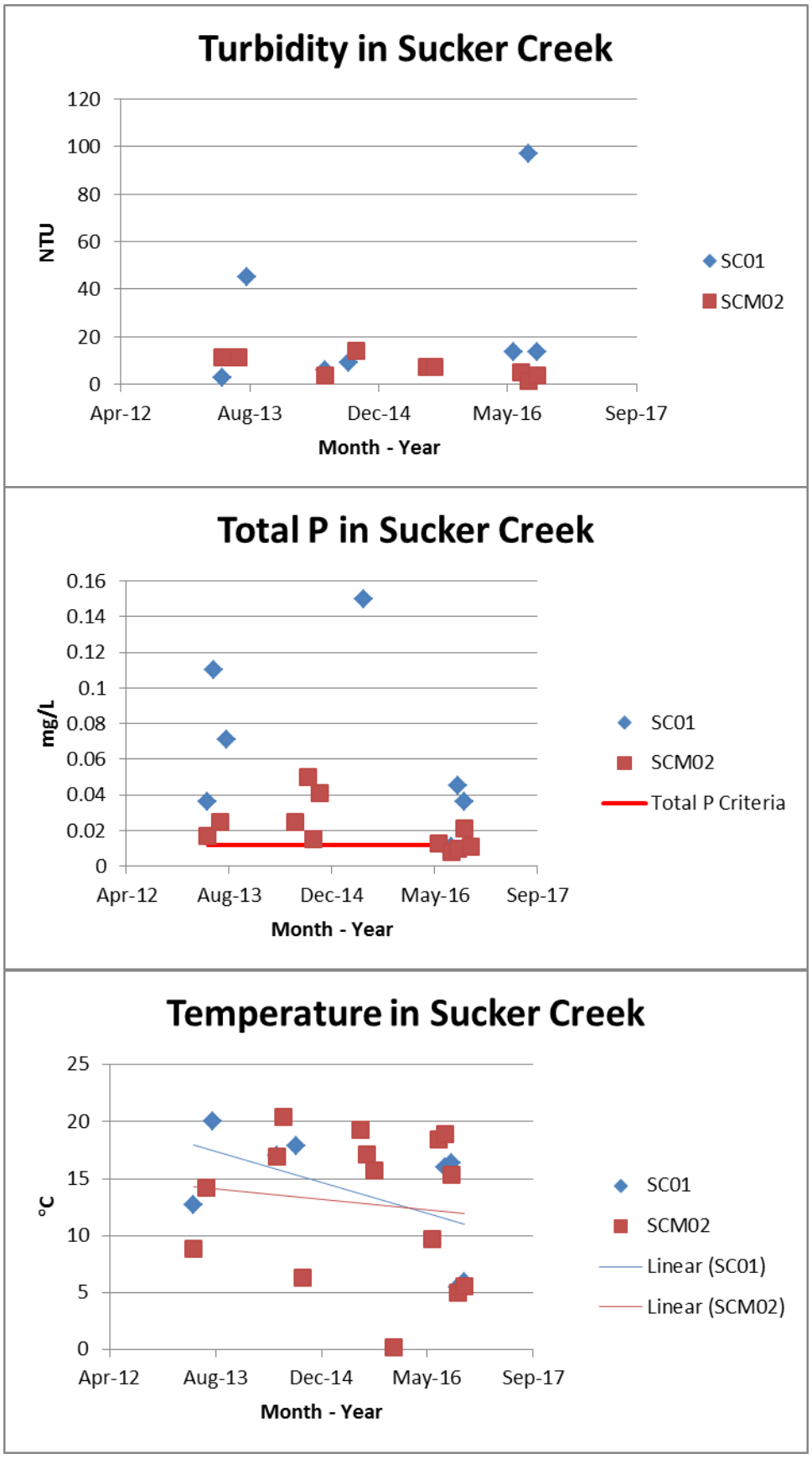

Temperature in Sand River
°C
25
20
15
10
5
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
SR02
SRM01
Linear (SR02)
Linear (SRM01)

Sucker Creek Results





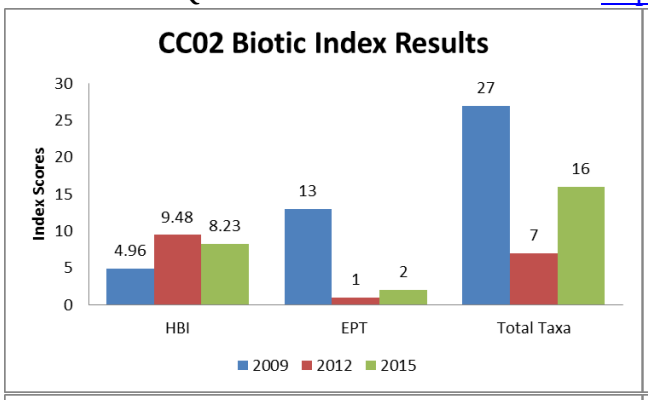


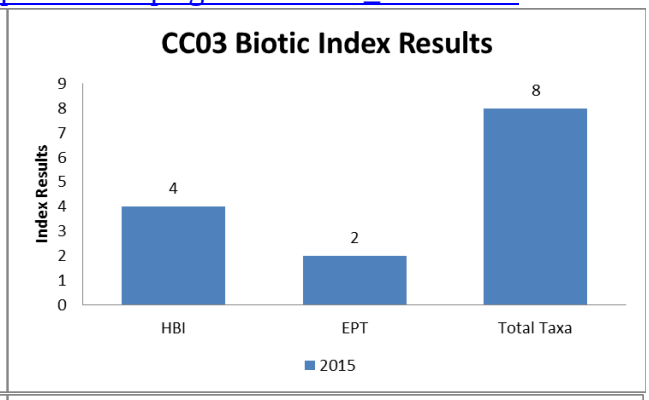

Turbidity in Sucker Creek
120
100
80
60
40
20
0
NTU
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
SC01
SCM02
Total P in Sucker Creek
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/L
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
SC01
SCM02
Total P Criteria
Temperature in Sucker Creek
25
20
15
10
5
0
°C
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Month - Year
SC01
SCM02
Linear (SC01)
Linear (SCM02)

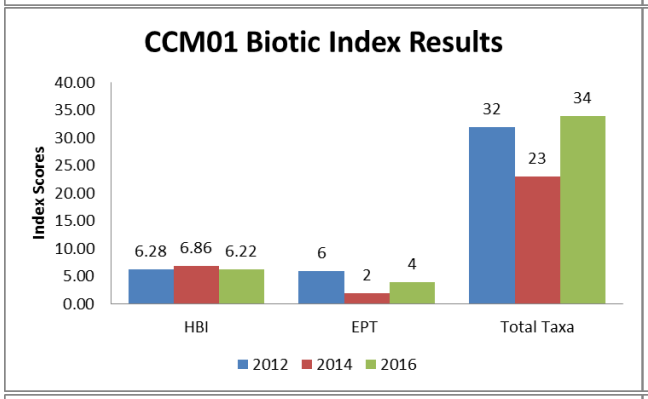
Appendix E

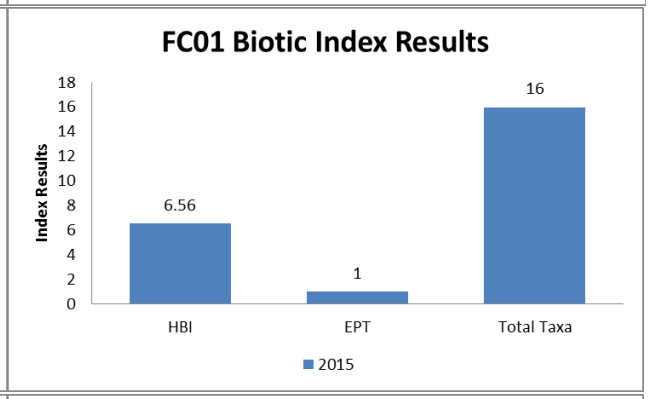
Red Cliff Water Resource Program's CWA 106 Biological Water Quality Monitoring Data Graphs

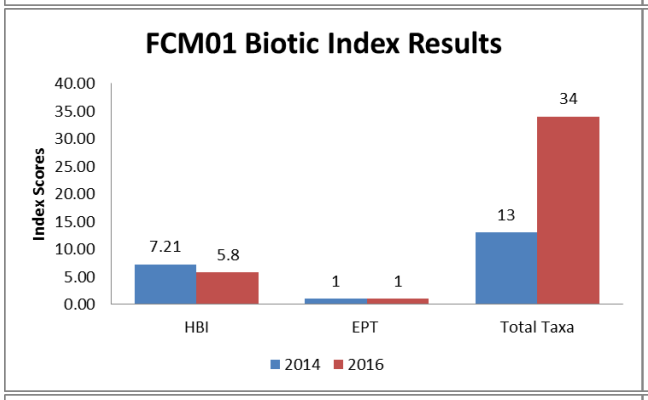
Qualitative data can be found at: http://www3.epa.gov/storet/dw_home.html

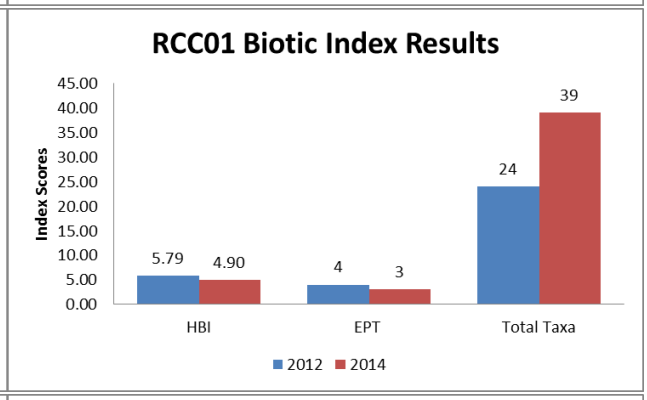


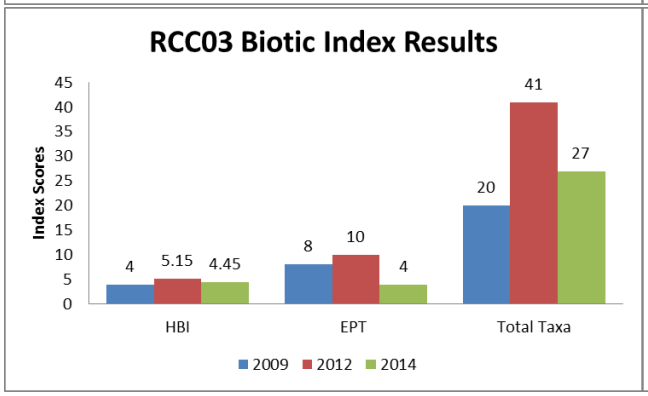


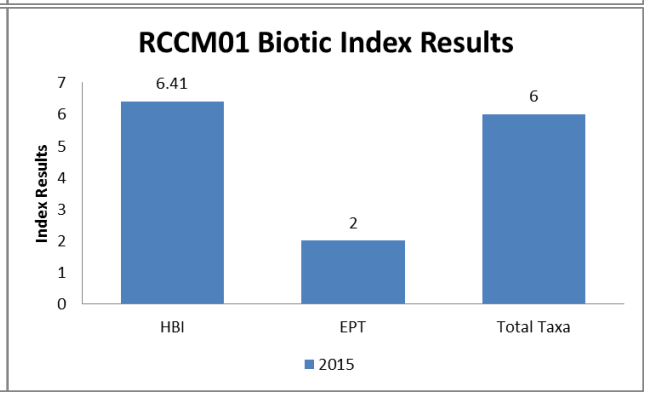


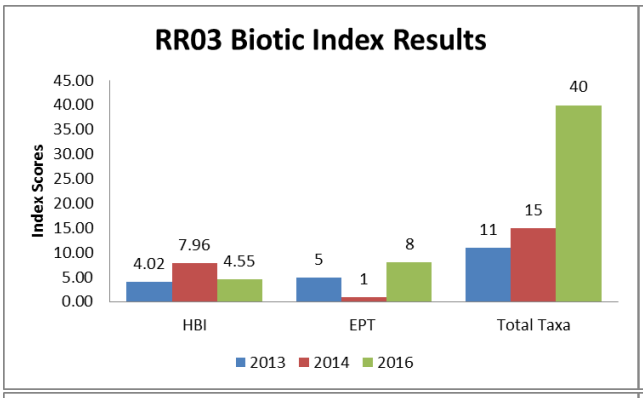


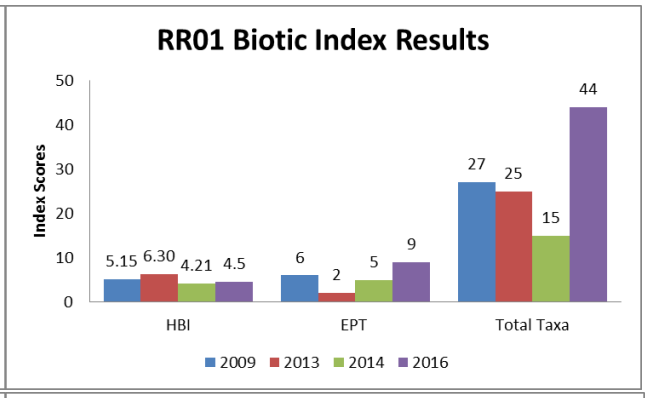


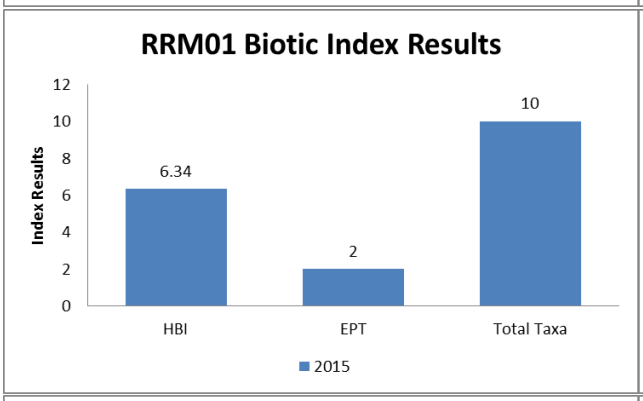


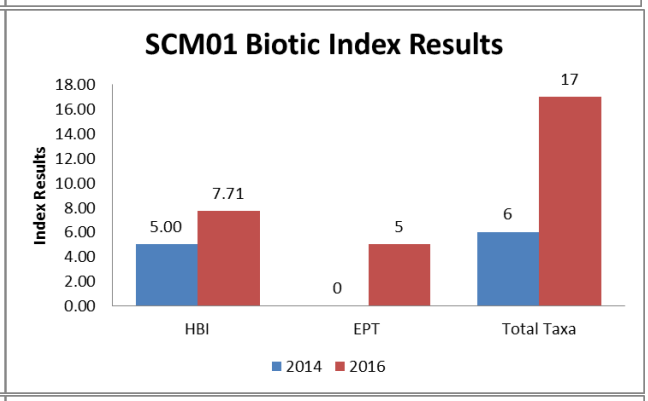


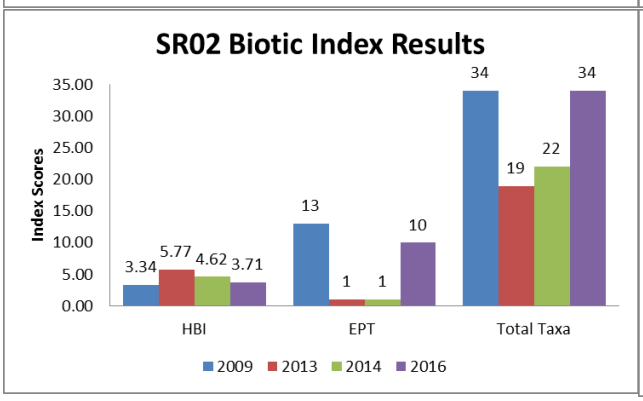


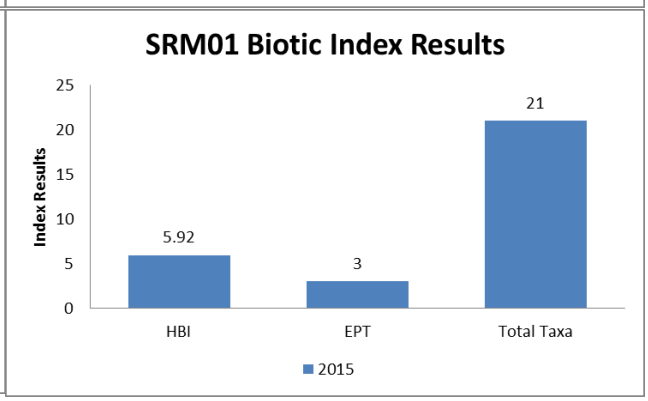

RR03 Biotic Index Results
Index Scores
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
4.02
7.96
4.55
5
1
8
11
15
40
HBI
EPT
Total Taxa
2013
2014
2016


RR01 Biotic Index Results
Index Scores
50
40
30
20
10
0
5.15
6.30
4.21
4.5
6
2
5
9
27
25
15
44
HBI
EPT
Total Taxa
2009
2013
2014
2016


RRM01 Biotic Index Results
Index Results
12
10
8
6
4
2
0
6.34
2
10
HBI
EPT
Total Taxa
2015


SCM01 Biotic Index Results
Index Results
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
5.00
7.71
0
5
6
17
HBI
EPT
Total Taxa
2014
2016


SR02 Biotic Index Results
Index Scores
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
3.34
5.77
4.62
3.71
13
1
1
10
34
19
22
34
HBI
EPT
Total Taxa
2009
2013
2014
2016


SRM01 Biotic Index Results
Index Results
25
20
15
10
5
0
5.92
3
21
HBI
EPT
Total Taxa
2015