

Cottonwood Creek and Tributaries, Idaho Water Quality Monitoring Project, 2015



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Acronyms and Abbreviations

BMP(s)	Best Management Practices	NRCS	Natural Resources Conservation Service
BOR	Bureau of Reclamation	NTU	Nephelometric Turbidity Unit
C	Celsius	OP	Ortho Phosphorus
cfs	Cubic Feet per Second	PCR	Primary Contact Recreation
cfu	Colony Forming Units	QAPP	Quality Assurance Project Plan
cm	Centimeter(s)	QA/QC	Quality Assurance/Quality Control
CMC	Criterion Maximum Concentration	SCC	Soil Conservation Commission
CWA	Clean Water Act	SS	Salmonid Spawning
CWAL	Cold Water Aquatic Life	SWCD	Soil and Water Conservation District
IDEQ	Idaho Department of Environmental Quality	TAS	Treatment in a Manner Similar to a State
DO	Dissolved Oxygen	TDS	Total Dissolved Solids
EPA	Environmental Protection Agency	TMDL	Total Maximum Daily Load
GIS	Geographical Information Systems	TP	Total Phosphorus
HUC	Hydrologic Unit Code	Tribe	Nez Perce Tribe
IDAPA	Idaho Administrative Procedure Act	TSS	Total Suspended Solids
mg/L	Milligrams per Liter	USGS	US Geological Survey
MPN	Most Probable Number	WAG	Watershed Advisory Group
NH₃	Ammonia	WRD	Water Resources Division
NO₃+NO₂	Nitrate-Nitrite		
NPT	Nez Perce Tribe		

Introduction

The Nez Perce Tribe (Tribe) is a federally recognized Indian Tribe with an aboriginal territory of more than 13 million acres extending from northeastern Oregon and southeastern Washington, through north-central Idaho, to southwestern Montana. The Tribe’s 1855 treaty with the United States acknowledged and guaranteed a variety of retained off-reservation fishing, hunting, and gathering rights. The current Nez Perce Tribal Reservation is approximately 770,483 acres in size, and many tribal members continue to practice a subsistence-based lifestyle to this day. Clean water is valued for its cultural, spiritual, and economic uses, and the Tribe has a vested interest in protecting the quality of water both on Reservation and throughout the Clearwater, Snake, and Columbia River Basins.

The Nez Perce Tribe (NPT) Water Resources Division (WRD) applied for and received Treatment in a Manner Similar to a State (TAS) to implement the Clean Water Act §106 Water Quality Monitoring Program in 1990. In 1999, the WRD began collecting water quality data for Reservation waterbodies. Table 1 displays an Atlas of Tribal water resources found within the boundaries of the Reservation of 1863.

Table 1. Atlas of Tribal Water Resources

Topic	Value
Reservation Area (acres)	770,483
Reservation Population (persons)	18,437
Number of watersheds within or intersecting the reservation boundary	19
Total Miles of Rivers and Streams	1,590
- <i>Miles of perennial streams</i>	602*
- <i>Miles of intermittent streams (does not include unnamed streams)</i>	85*
Number of Lakes/Reservoirs/Ponds	8
Acres of Lakes/Reservoirs/Ponds	2,883

*the remaining stream miles are unknown for perennial vs. intermittent

Water Quality Monitoring Program and Assessment Methodology

The purpose of the Nez Perce Tribal water quality monitoring and assessment program is to determine whether water quality criteria are being met and designated uses are being supported in waterbodies across the reservation.

Establishing a baseline of water quality condition for all reservation waters and periodically reassessing the water quality to look at trends are important program objectives, as is utilizing water quality data to identify waters in need of pollutant reduction projects.

Water Quality Limited Segments

The Clean Water Act (CWA) requires restoration and maintenance of the chemical, physical, and biological integrity of the nation's water (Public Law 92-500 Federal Water Pollution Control Act Amendments of 1972). Section §303(d) of the CWA establishes requirements for states and tribes to identify and prioritize waterbodies that are water quality limited (i.e., do not meet water quality standards). Cottonwood Creek was listed on the State of Idaho's 1998 303(d) list for bacteria, dissolved oxygen (DO), flow alteration, habitat alteration, ammonia, nutrients, organics, and sediment.

Sampling Protocols

WRD staff have a Quality Assurance Project Plan (QAPP) which has been reviewed and approved by the US Environmental Protection Agency (EPA). WRD staff follow methods and protocols found in the US Geological Survey (USGS) *National Field Manual for the Collection of Water Quality Data* (TWRI Book 9, 1999-2004) when collecting water quality data in Reservation waters.

Approximately four liters of stream water were collected at each site, using a DH-48 depth-integrating suspended-sediment sampler. The samples were collected and transferred into a 2.5-gallon polyethylene churn splitter. The polyethylene churn splitter was rinsed with ambient water at each location prior to sample collection. The resultant composite sample was thoroughly homogenized before filling the appropriate sample containers. Water quality samples were then shipped to Boise, ID overnight to be analyzed at the Bureau of Reclamation (BOR) Pacific Northwest Regional Laboratory.

Bacteriological samples (*E. coli*) were collected directly from the thalweg into sterile sample containers. These samples were also shipped to Boise, ID overnight to be analyzed at the BOR Pacific Northwest Regional Laboratory where most probable number (MPN) multiple tube fermentation was used to determine *E. coli* levels in the water sample. Bacteriological samples were also analyzed at the WRD lab using a Colilert reactive agent and 97 well trays cooked at 35°C for 24 hours.

A list of parameters, sample sizes, preservation, holding times, and analytical methods is displayed in Table 2. All sample containers were labeled with waterproof markers with the following information: site name and identification, sample identification, date of collection, and time of collection. Samples were placed on ice and shipped to the laboratory the same day as collection. Chain-of-custody forms accompanied each sample shipment.

Table 2. Water quality parameters for laboratory analysis.

Parameters	Sample Size	Preservation	Holding Time	Method
Total Suspended Solids (TSS)	1 qt cubitainer	Store at 4°C	7 days	2540 D
Nitrogen Components: Nitrate+Nitrite (NO ₃ +NO ₂) Ammonia (NH ₃)	1 qt cubitainer	Cool 4°C, H ₂ SO ₄ pH < 2	28 Days	EPA 353.2 EPA 350.1
Total Phosphorus (TP)	100 mL	Cool 4°C, H ₂ SO ₄ pH < 2	28 Days	EPA 365.4
Ortho-phosphate (OP)	100 mL	Store at 4°C	48 Hours	EPA 365.1-PF
<i>Escherichia coli</i> (<i>E. coli</i>)	100 mL	Cool 4°C	30 Hours	MPN

Field Measurements

At each location, dissolved oxygen, specific conductance, pH, temperature, and turbidity were measured in the field. Calibration of all field equipment was in accordance with the manufacturer’s specifications. Field measurement parameters, equipment, and calibration techniques are shown in Table 3.

Table 3. Field Measurements.

Parameters	Instrument	Calibration
Dissolved Oxygen	YSI Model 556 MPS	Ambient air calibration
Temperature	YSI Model 556 MPS	Centigrade thermometer
Specific Conductance	YSI Model 556 MPS	Specific Conductance (25°C standard)
pH	YSI Model 556 MPS	Standard buffer (7,10) bracketing for linearity
Turbidity	Hach Model 2100P	Formazin Primary Standard

All field measurements were recorded in a field notebook along with pertinent observations about the site, including weather conditions, flow rates, personnel on site, and any problems observed that might affect water quality. Continuous water temperature measurements were collected using Onset Water Temperature Pro v2 Data Loggers at three locations on Cottonwood Creek, as well as at the mouths of Magpie and Coyote Creeks.

Flow Measurements

Flow measurements were taken at each site using a Marsh McBirney Flow Mate Model 2000 flow meter. The six-tenths depth method was used. A transect line was established at each monitoring station, across the width of the stream at an angle perpendicular to the flow, for the calculation of cross-sectional area. Discharge was computed by summing the products of the partial areas (partial sections) of the flow cross-sections and the average velocities for each of those sections. Stream discharge was reported as cubic feet per second (cfs).

Quality Assurance and Quality Control (QA/QC)

The BOR Pacific Northwest Regional Laboratory utilizes methods approved and validated by the EPA. A method validation process, including precision and accuracy performance evaluations and method detection limit studies, is an element of the BOR Pacific Northwest Regional Laboratory Standard Methods. Method performance evaluations include quality control samples analyzed with a batch to ensure sample data integrity. Internal laboratory spikes and duplicates are part of the BOR Pacific Northwest Regional Laboratory's quality assurance program. Laboratory QA/QC results generated from this project can be provided upon request.

QA/QC procedures from the field-sampling portion of this project included a duplicate sample and a blank sample (one set per sampling event). The field blanks consisted of

laboratory-grade deionized water, transported to the field and poured off into the appropriate sample containers. The blank sample was used to determine the integrity of the field team's handling of samples, the condition of the sample containers and deionized water supplied by the laboratory, and the accuracy of the laboratory methods. Duplicate samples were obtained by filling two sets of sample containers with homogenized composite water from the same sampling site. The duplicate and blank samples were not identified as such to laboratory personnel to ensure laboratory precision.

Data Handling

All of the field data and analytical data generated from each survey were reviewed in the WRD office by both field staff and the Water Quality Program Coordinator. These duplicate internal reviews ensure that all necessary observations, measurements, and analytical results were properly recorded. The analytical results were evaluated for completeness and accuracy. Any suspected errors were investigated and resolved, if possible. The data were then stored electronically and made available to interested entities upon request.

Cottonwood Creek Monitoring Overview

In 2015, the WRD §106 staff collected water quality data from five different streams in the Cottonwood Creek watershed. Monitoring sites were established at or near the mouth of each respective creek, with additional monitoring sites being established at several locations on the main stem of Cottonwood Creek (Figure 1).

This monitoring program was intended to evaluate water quality in the Cottonwood Creek watershed. Stream survey data was collected previously at the mouth of Cottonwood Creek by WRD staff in 2003-04, and from Magpie, Coyote, and Pickle Canyon Creeks in 2010-11. Monitoring sites that were established during these past monitoring efforts were revisited for the sake of consistency, and in order to perform a trend analysis with the data.

This report reviews monitored results for the following parameters at all monitoring locations:

- Total phosphorus (TP)
- Orthophosphorus (OP)
- Bacteria (*Escherichia coli*)
- Nitrogen components— NO₃+NO₂; NH₃
- Total suspended sediment (TSS)
- Instantaneous water temperature
- Continuous water temperature
- Turbidity
- Dissolved oxygen (DO)
- Percent (%) saturation
- Specific conductance
- Total Dissolved Solids (TDS)

The Bureau of Reclamation (BOR) Pacific Northwest Regional Laboratory, in Boise Idaho, conducted all inorganic parameter testing and bacteria analysis. WRD field staff performed all other measurements.

Monitoring Site Descriptions

Water quality monitoring was previously conducted by the WRD staff in the Cottonwood Creek watershed in 2004 and 2011. Monitoring sites that were established during the past monitoring efforts were revisited for the sake of consistency, and in order to perform a trend analysis with the data. Additional monitoring locations were added to collect and create a more comprehensive baseline database.

*(Spring Creek (Nez 931), a tributary to Lapwai Creek, was also monitored in response to health concerns for tribal members using the creek for cultural purposes (Appendix A)).

1. 01501A: Located on Cottonwood Creek, near mouth (46°29'54.7"N, 116°42'39.0"W).
2. 01508A: Located on Cottonwood Creek, at Cottonwood Creek Rd. crossing (46°25'48.0"N, 116°39'35.0"W).
3. 01514A: Located on Cottonwood Creek, at Tribal Allotment #1801 (46°24'55.9"N, 116°34'08.5"W).
4. 01517A: Located on Cottonwood Creek, in headwaters/near Fairview Road (46°26'32.2"N, 116°32'28.3"W).
5. 04901A: Located on Magpie Creek, near mouth (46°28'32.5"N, 116°40'43.9"W).
6. 01801A: Located on Coyote Creek, near mouth (46°27'22.6"N, 116°39'31.5"W).
7. 07701A: Located on Star Mill Creek, near mouth (46°23'30.5"N, 116°34'00.5"W).
8. 05903A: Located on Pickle Canyon Creek, near mouth (46°22'04.0"N, 116°33'53.1"W).

Cottonwood Creek Watershed Monitoring Sites

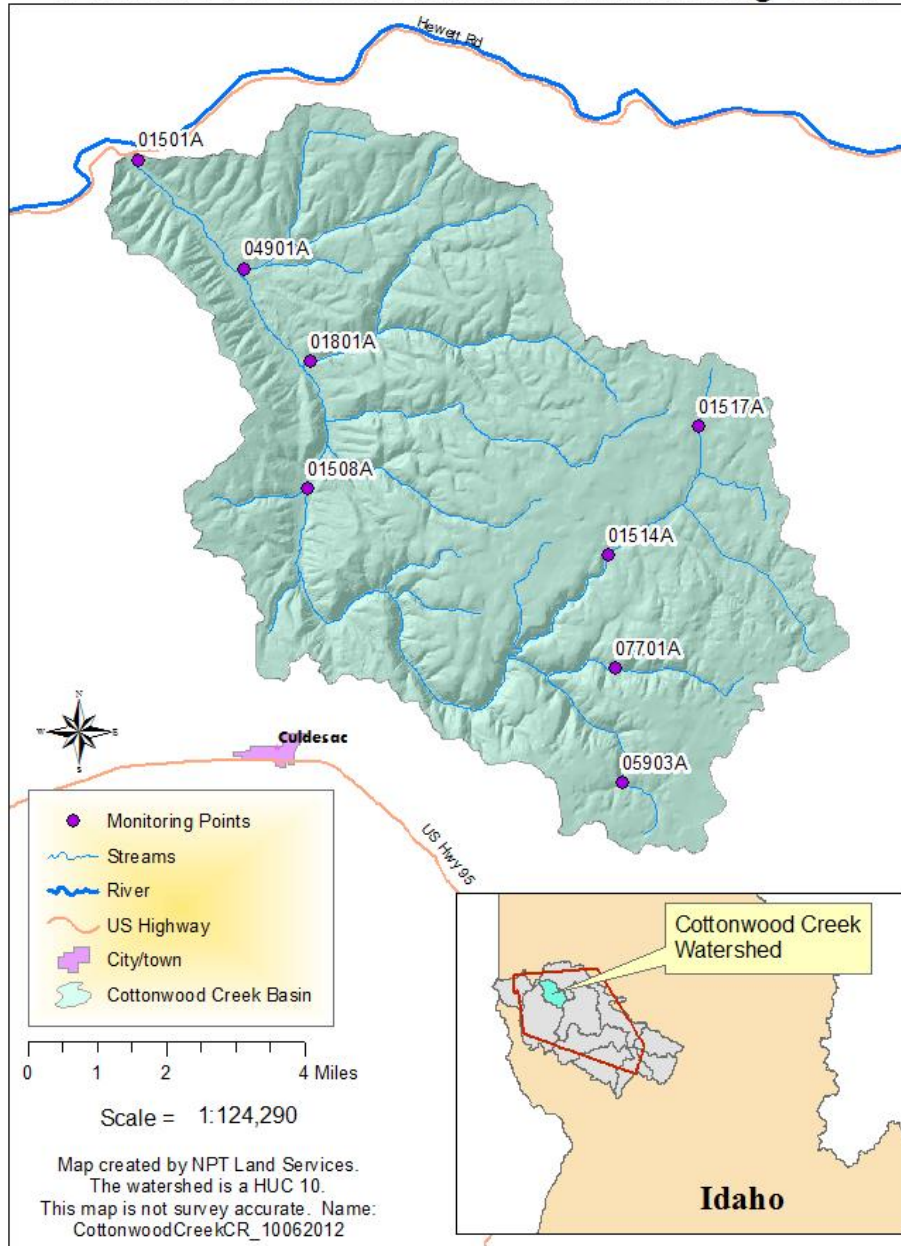


Figure 1. Cottonwood Creek Water Quality Monitoring Sites, 2015

Cottonwood Creek Watershed Description

The Cottonwood Creek watershed (42,700 acres) is located in Nez Perce County and is entirely within the Nez Perce Reservation. The creek originates near Reubens and flows predominantly north for 16 miles before discharging into the Clearwater River near the town of Myrtle. There are four major tributaries to Cottonwood creek: Coyote Creek and Magpie Creek in the lower reaches of the watershed, and Pickle Canyon Creek and Star Mill Creek in the upper reaches. The watershed is composed of upland plateau and steep canyon habitat, with elevations ranging from 853 feet at the confluence with the Clearwater River to 3,642 feet in the uplands. Evidence of frequent high flows and flooding are present from river mile 6 to river mile 9 (Fales et al. 2012).

The dominant land use in Cottonwood Creek watershed is agriculture (61% cropland), with areas of meadow/pastureland (16%) and coniferous forest lands (16%) (Fales et al. 2012). Numerous residences are present in the lower 4 km of the stream where very little overhead canopy is present and grazing is generally heavy. Historically, logging has taken place in the drainage and several old logging roads remain (Kucera 1986). The community of Gifford is located in the upper watershed.

Climate

The Cottonwood Creek watershed is characterized by winter rains and rain-on-snow runoff events. The climate is sub-humid, with cool moist winters and warm dry summers. The average annual precipitation for the drainage ranges from 21 near the mouth to 29 inches in the headwaters (Fales et al. 2012).

Fisheries

The watershed contains several fish species. Kucera and Johnson (1983) found substantial numbers of steelhead/Rainbow Trout and sufficient quantities of spawning gravels. Additionally, Kucera and Johnson (1986) recorded steelhead/Rainbow Trout, Cutthroat Trout, Northern Squawfish, Speckled Dace, Paiute Sculpin, Bridgelip Sucker, and Chiselmouth. Fuller et al. (1984) also noted presence of Cutthroat Trout, Redside Shiner, and numerous crayfish. Nez Perce Tribal Fisheries staff have observed Coho Salmon as well (Chandler 2009).

Table 4. General spawning and incubation periods for select salmonids found in the Clearwater River and its tributaries (Miller et al. 2014).

Spawning and Incubation Periods in the Cottonwood Creek Watershed												
Salmonid Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug*	Sep	Oct*	Nov	Dec
Steelhead/Rainbow Trout		✓	✓	✓	✓	✓	✓	✓				
Coho Salmon	✓	✓	✓	✓						✓	✓	✓

*Salmonid spawning and incubation (SS) target temperature ends August 15 for steelhead incubation and begins October 15 for Coho spawning.

Land Uses/Ownership

The Cottonwood Creek watershed is entirely within the Nez Perce Reservation; however, more than 86% of the watershed is privately owned. The predominant land use in the catchment is agriculture, with about 25,000 acres in cropland, which constitutes 60% of the watershed. The major crops grown are winter wheat and spring cereal grains. Forested areas currently comprise about 6,400 acres, or 16%, of the land in the watershed. Grazing occurs throughout the watershed with the majority of rangeland grazing occurring in the canyon lands and pastured cattle being found in the meadows located closer to the headwaters (Fales et al. 2012).

Pollutants of Concern and Associated Water Quality Criteria

Dissolved Oxygen

Dissolved oxygen (DO) is found in microscopic bubbles of oxygen that are mixed in the water and occur between water molecules. DO is a very important indicator of a waterbody's ability to support aquatic life. Fish "breathe" by absorbing dissolved oxygen through their gills. Oxygen enters the water by absorption directly from the atmosphere or via photosynthesis by aquatic plants and algae. Oxygen is removed from the water by respiration and decomposition of organic matter. The US Environmental Protection Agency (EPA) standard for DO states that dissolved oxygen must exceed 8.0 mg/L for cold water biota, and in addition must exceed 90% saturation during the salmonid spawning and incubation (SS) designated period.

Water Temperature

Water temperature is a very important indicator of overall water quality. Many of the physical, biological, and chemical characteristics of a waterbody are directly affected by temperature. For example, temperature influences the following:

- amount of oxygen that can be dissolved in water,
- photosynthetic rate of algae and larger aquatic plants,
- metabolic rates of aquatic organisms, and
- sensitivity of organisms to toxic wastes, parasites, and diseases.

Cool water can hold more oxygen than warm water because gases are more easily dissolved in cool water. The reduction of oxygen solubility at high water temperatures can compound the stress on fish caused by marginal dissolved oxygen concentrations.

The cold water aquatic life (CWAL) criteria for Idaho streams states that water temperatures must be 22°C or less with a maximum daily average of no greater than 19°C (IDAPA 58.01.02.250.02.b). All of the waterbodies monitored during this project are also listed for salmonid spawning (SS), which means that daily maximum water temperatures must be 13°C or less with a maximum daily average no greater than 9°C during salmonid spawning and incubation periods (IDAPA 58.01.02.250.02.f.ii). For the

analytical purposes of this report the salmonid spawning and incubation period will be considered from October 15 through August 14 (Miller et al. 2014) (Table 4).

Specific Conductance

Specific conductance is a measure of the ability of water to conduct an electrical current. Conductivity increases with increasing concentrations and mobility of dissolved ions. These ions, which come from the breakdown of compounds, conduct electricity because they are negatively or positively charged when dissolved in water. Therefore, conductivity is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution.

No surface water standards or criteria exist that set limits on SC.

pH

pH represents the effective concentration (activity) of hydrogen ions (H⁺) in water. The activity of hydrogen ions can be expressed most conveniently in logarithmic units. pH is defined as the negative logarithm of the activity of H⁺ ions:

$$\text{pH} = -\log [\text{H}^+],$$

where [H⁺] is the concentration of H⁺ ions in moles per liter.

The State of Idaho surface water quality criteria for Aquatic Life Use designations state that Hydrogen Ion Concentration (pH) values must fall within the range of 6.5-9.0 (IDAPA 58.01.02.250.01.a).

Total Suspended Solids and Turbidity

Total suspended solids (TSS) includes both sediment and organic material suspended in water. Suspended sediment can cause problems for fish by clogging gills. In addition, excessive sediment provides a medium for the accumulation and transport of other constituents such as phosphorus and bacteria. Literature suggests that levels below 25 mg/L are ideal for the protection of fisheries and produce no harmful effects on fish or fisheries (DFO 2000). This was the target criterion that was used for data analysis.

The State of Idaho water quality standard for Turbidity states that measurements shall not exceed background turbidity by more than 50 nephelometric turbidity units (NTU) instantaneously or more than 25 NTU for more than ten consecutive days (IDAPA 58.01.02.250.02.e). The 25th percentile of turbidity data collected by EPA over the last decade for Ecoregion 10, ecoregion III was 1.45 NTU (US EPA 2000). So, for the sake of this analysis, any reading over 51.45 NTU will be considered an exceedance over background turbidity levels.

Nitrate+Nitrite (NO₃+NO₂) and Ammonia (NH₃)

Nitrate (NO₃), nitrite (NO₂), and ammonia (NH₃) are considered inorganic forms of nitrogen. Excessive concentrations of nitrate and/or nitrite can be harmful to humans and wildlife. The EPA Ecoregion guidance criterion for NO₃ + NO₂ is 0.072 mg/L (US EPA 2000). The target for the analysis of the data in this report is 0.3 mg/L, which is thought to be more representative of conditions on the ground and was the target criterion used in several regional watershed TMDLs.

High concentrations of nitrate and/or nitrite can produce "brown blood disease" in fish. Nitrite enters the bloodstream through the gills and turns the blood a chocolate-brown color. As in humans, nitrite reacts with hemoglobin to form methemoglobin. Brown blood cannot carry sufficient amounts of oxygen, and affected fish can suffocate despite adequate oxygen concentration in the water. This accounts for the gasping behavior often observed in fish with brown blood disease, even when oxygen levels are relatively high (Mississippi State University, 1998).

Ammonia is the least stable form of nitrogen in water. Ammonia concentrations can affect hatching and growth rates of fish; changes in tissues of gills, liver, and kidneys may occur during structural development. The target criterion for ammonia for this report is not to exceed the calculated criterion maximum concentration (CMC), which is dependent on pH (IDAPA 58.01.02.250.02.d.i).

Phosphorus

In freshwater lakes and rivers, phosphorus is often found to be the growth-limiting nutrient because it occurs in the least amount relative to the needs of plants. If excessive amounts of phosphorus and nitrogen are added to the water, algae and aquatic plants can be produced in large quantities. When these algae die, bacteria decompose them and use up oxygen. As a result, dissolved oxygen concentrations can drop too low for fish to breathe, leading to fish kills. The loss of oxygen in the bottom waters can free phosphorus previously trapped in the sediments, further increasing the available phosphorus.

Phosphorus can exist in inorganic and organic forms, as well as in a dissolved or particulate phase. Some important sources of phosphorus include commercial fertilizers and manure, land application of biosolids, wastewater treatment plant effluent, erosion from livestock grazing, non-agricultural fertilization, and septic systems.

Dissolved inorganic phosphorus, or Orthophosphorus (OP), is a component of the total phosphorus concentration and can be detected separately. Primary sources of OP in aquatic systems are from agricultural run-off, lawn pesticides, and raw sewage. OP is of particular concern in aquatic systems as it is in the form that algae and plants can take up directly. The ratio of Orthophosphorus/Total phosphorus can help determine potential sources of pollution and to what extent they are occurring.

The EPA Ecoregion guidance criterion for phosphorus is 0.03 mg/L (US EPA 2000). The target for the analysis of the data in this report is 0.1 mg/L, which is thought to be more representative of conditions on the ground and was the target criterion used in several regional watershed TMDLs.

Bacteria (*E. coli*)

The coliform bacteria group consists of several genera of bacteria belonging to the family *Enterobacteriaceae*. These mostly harmless bacteria live in soil, water, and the digestive system of animals. *Escherichia coli* (*E. coli*) is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination.

The State of Idaho *E. coli* standard for primary contact is not to exceed 406 colony forming units (cfu)/100 mL at any time and not to exceed 576 cfu/100 mL at any time for secondary contact (IDAPA 58.01.02.251.02.a); however, a single exceedance over the criterion does not constitute a violation of water quality standards (IDAPA 58.01.02.080.03). Five samples must be taken within a 30-day period to assess against the geometric mean criterion of 126 cfu/100 mL to determine a violation.

An assessment of the geometric mean criterion was not conducted during this study due to time considerations and limited resources; however, the instantaneous measurements collected will allow for identification of streams where follow-up monitoring should occur. All streams on the Nez Perce Reservation were evaluated using the primary contact recreation criterion of 406 cfu/100mL. Two samples were taken at each monitoring location during each sampling event; one was analyzed in-house by NPT WRD staff and the other was shipped to the BOR lab for analysis.

Applicable Criterion/Standards and Analysis Techniques

Early studies indicate that water quality in Cottonwood Creek is limited by extreme annual stream flow variation, low summer flow, high in-stream temperatures, and lack of in-stream cover (Kucera et al. 1983). Cottonwood Creek was listed on the State of Idaho's 1998 303(d) list for bacteria, dissolved oxygen (DO), flow alteration, habitat alteration, ammonia, nutrients, organics, and sediment.

The data were analyzed, and descriptive statistics such as maximum, minimum, median, and mean values for each parameter measured were determined. The number of exceedances was calculated based on the number of sampling events whose respective values exceeded water quality targets or criteria. Parameters exceeding target criteria 10% or more of the time will be classified as "not supporting" its associated designated use.

The Nez Perce Tribe does not have approved water quality standards, so target criteria for this water quality assessment are based upon a combination of EPA guidelines, literature review, and State of Idaho water quality standards.

All of the waterbodies in this assessment had the designated beneficial uses of:

- Salmonid Spawning (SS),
- Cold Water Aquatic Life (CWAL),
- Primary Contact Recreation (PCR),
- Agricultural and industrial water supply, and
- Wildlife habitat.

Table 5 shows the first three beneficial uses on the list above, along with associated numeric criteria used to evaluate the support status of these water bodies.

Table 5. Pollutant targets used to measure exceedances.

Parameter	Designated Use	Benchmarks/ Criteria	Citation
pH	All	pH between 6.5 and 9.0	(IDAPA 58.01.02)
Temperature	SS	13 °C or less daily maximum; 9 °C or less daily average	(IDAPA 58.01.02)
	CWAL	22 °C or less daily maximum; 19 °C or less daily average	
Dissolved Oxygen	SS	> 8.0 mg/L and 90% of saturation	(US EPA, 1986)
	CWAL	> 8.0 mg/L	
Turbidity	All	≤ 51.45 NTU	(US EPA, 2000; IDAPA 58.01.02)
Total Suspended Solids	All	≤ 25 mg/L above background for short-term (e.g. <24 hours)	(DFO, 2000)
Ammonia	All	$\leq \text{CMC} = \frac{0.275}{1 + 10^{7.204 - \text{pH}}} + \frac{39.0}{1 + 10^{\text{pH} - 7.204}}$	(IDAPA 58.01.02)
Total Phosphorus	All	≤ 0.1 mg/L	(US EPA, 1986)
NO ₃ +NO ₂	All	≤ 0.3 mg/L	(Cline, 1973)
<i>E. coli</i>	PCR	≤ 406 cfu/ 100 mL instantaneous; 126 cfu/ 100 mL geometric mean*	(Nez Perce Tribe, 2002)

SS: Salmonid Spawning; CWAL: Cold Water Aquatic Life; PCR: Primary Contact Recreation; NTU: nephelometric turbidity units; CMC = Acute Criterion Maximum Concentration (one hour average is not to exceed value).

Data Analysis Results *

Cottonwood Creek – Source to Mouth (01501A, 01508A, 01514A, 01517A).

01501A: Cottonwood Creek at Mouth

The table below presents descriptive statistics for data collected from the monitoring station located on Cottonwood Creek at the mouth.

Table 6. Descriptive statistics for Cottonwood Creek at mouth (01501A), December 2014-December 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

01501A: Cottonwood Cr. (Mouth)	Temp	DO	DO	pH	Turbidity	<i>E-coli</i> (BOR)	<i>E-coli</i> (NPT)	NO ₃ +NO ₂	OP	TP	TSS	Flow
	(°C)	(mg/L)	%	(H+)	(NTU)	(cfu/100mL)	(cfu/100mL)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)
max	21.0	12.4	108.5	8.7	1409.0	11000	> 2420	9.66	0.14	1.60	860	169.4
min	4.2	8.2	91.4	6.7	1.5	20	13	0.26	0.07	0.08	4	0.2
mean	11.9	10.6	97.5	7.9	112.9	1258	337	3.16	0.10	0.25	87	35.9
median	11.2	11.1	97.9	8.0	10.7	210	148	2.38	0.10	0.13	10	8.3
#exceedance	5	0	0	1	1	1	2	11	6	8	3	
%exceedance	35.7%	0.0%	0.0%	10.0%	7.1%	10.0%	15.4%	91.7%	50.0%	66.7%	25.0%	
# sampling events	14	14	14	14	14	10	13	12	12	12	12	17

- Dissolved oxygen (DO) did not drop below the 8.0 mg/L or 90% saturation target criteria during the monitoring period.
- All pH measurements fell within the target criterion range of 6.5-9.0.
- Turbidity exceeded the target criterion once with a reading at 1409 NTU (7.1% exceedance) in early June after a storm event.
- Total suspended solids (TSS) exceeded the 25 mg/L target criterion three times (25.0% exceedance) during the monitoring period.

* Ammonia did not exceed the calculated CMC target criterion in any monitoring locations and is not included in the results.

* Raw data for all monitoring locations is located in Appendix B.

- Instantaneous water temperature exceeded the 13°C target criterion during salmonid spawning (SS) five times (35.7% exceedance).

Instantaneous Water Temperature

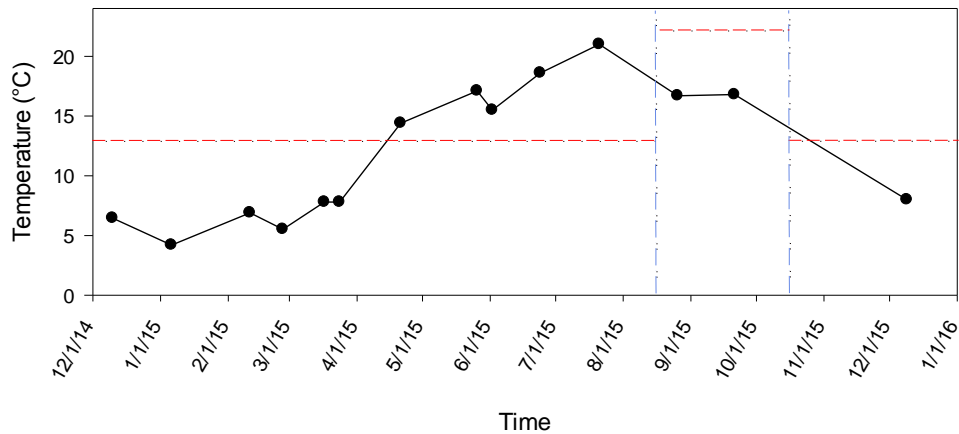


Figure 2. Instantaneous water temperature data from Cottonwood Creek near the mouth (01501A). The dashed red line indicates the target criteria.

- Nitrate+nitrite (NO_3+NO_2) exceeded the 0.3 mg/L target criterion on all but one sampling event (91.7% exceedance). The maximum concentration was almost 10 mg/L, or more than 30 times the target criterion.

Nitrate+Nitrite

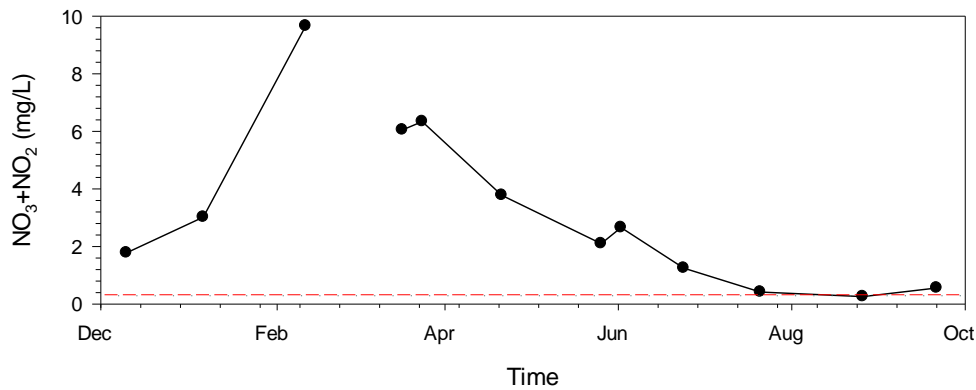


Figure 3. Instantaneous NO_3+NO_2 data from Cottonwood Creek near the mouth (01501A). The dashed red line indicates the target criterion.

- Total phosphorus (TP) exceeded the target criterion of 0.1 mg/L eight times, or 66.7% of sampling events. Orthophosphorus (OP) contributed to the majority of total phosphorus with an average OP:TP ratio of 0.72.

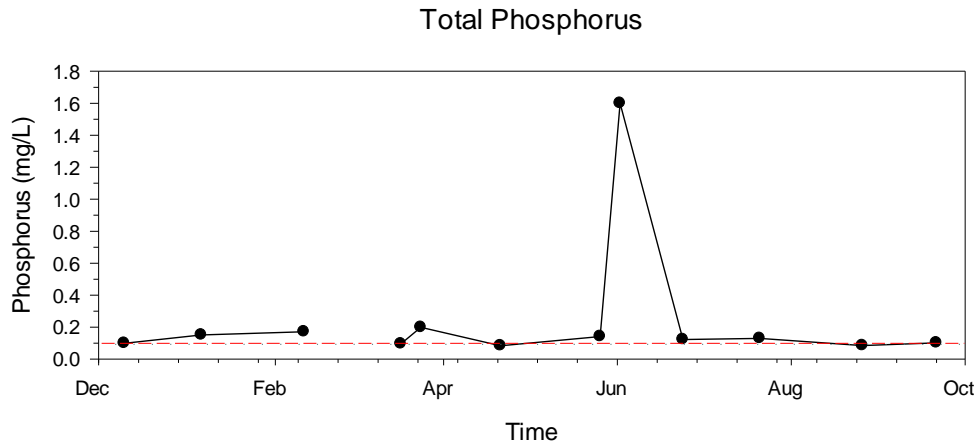


Figure 4. Instantaneous total phosphorus data from Cottonwood Creek near the mouth (01501A). The dashed red line indicates the target criterion.

- A total of three samples exceeded the target criterion of 406 cfu/100mL for primary contact recreation (PCR), two analyzed by NPT and one by the BOR. The highest concentration was recorded on June 2 with a flow of 20.5 cfs. The site was monitored the week before with a flow of only 5.2 cfs, suggesting that the high concentrations were likely a result of storm runoff from upstream grazing fields (Figure 5).

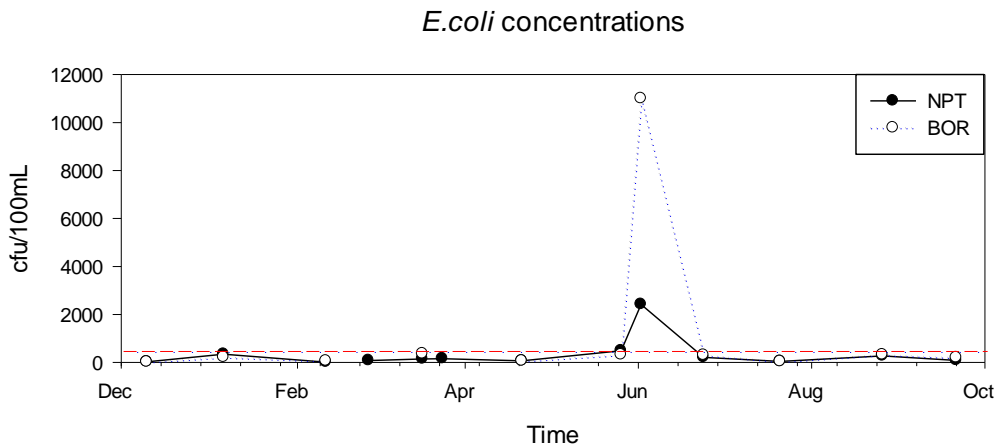


Figure 5. *E. coli* concentrations from Cottonwood Creek near the mouth (01501A). Includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100mL target criterion for PCR.

Continuous Water Temperature Monitoring:

An Onset Water Temperature Pro v2 Data Logger was deployed at the mouth of Cottonwood Creek (01501A) from June-December, 2015 and collected data hourly.

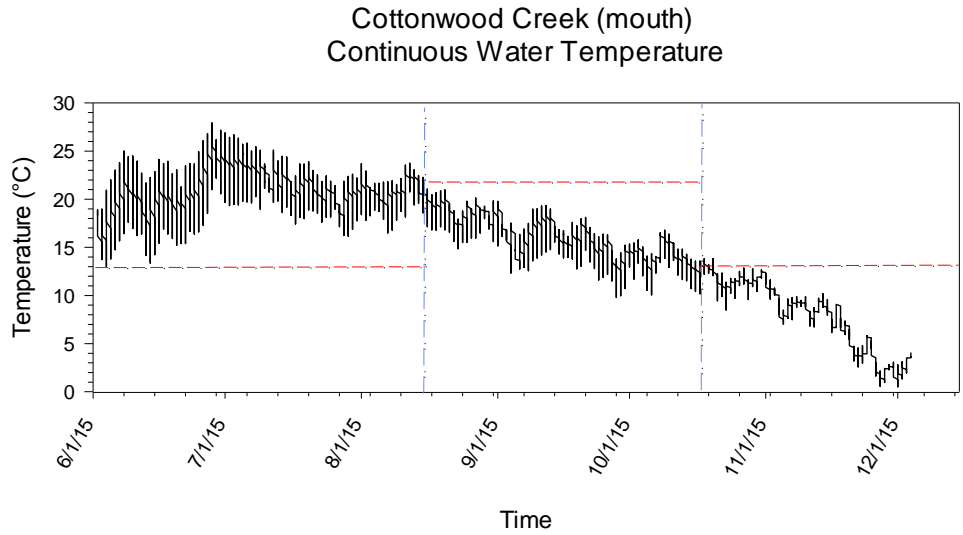


Figure 6. Continuous actual temperature data from Cottonwood Creek near the mouth (01501A), June – December, 2015. The dashed red line indicates the target criteria.

- All temperatures recorded, including daily minimums, maximums, and averages, exceed the Salmonid Spawning (SS) target criteria of 13°C up to August 15, which signifies the end of the SS period (Figures 6 & 7).

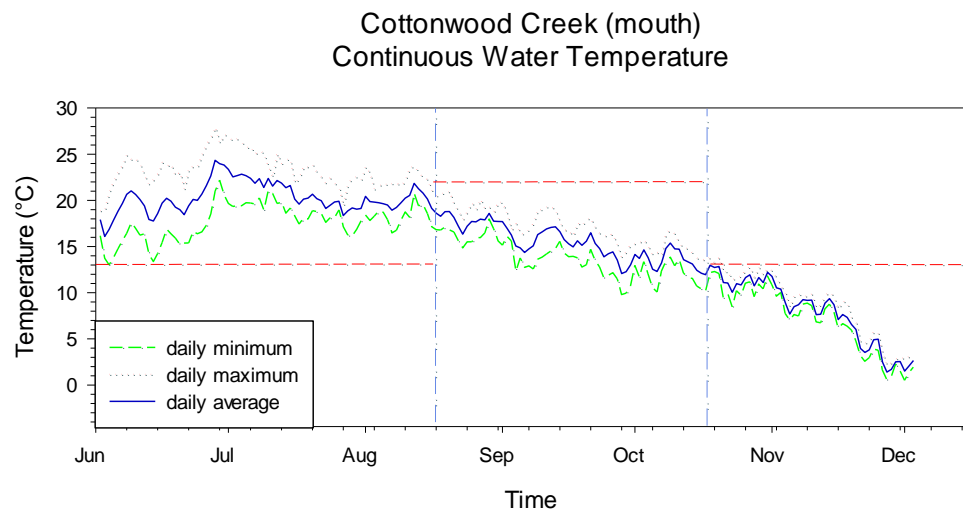


Figure 7. Continuous minimum, maximum, and average temperature data from Cottonwood Creek near the mouth (01501A), June – December, 2015. The dashed red line indicates the target criteria.

- During the entire duration of continuous monitoring, there were 57 (30.6%) and 64 (34.4%) exceedances of the Idaho Cold Water Aquatic Life (CWAL) criteria of 22°C daily max and 19°C daily average, respectively. Additionally, of data collected during the salmonid spawning and incubation period, there were 80 (64.0%) and 98 (78.4%) exceedances of the 13°C daily max and 9°C daily average target criteria, respectively (Table 7).

Table 7. Continuous temperature exceedances for Cottonwood Creek (01501A) from June – December, 2015.

01501A Cottonwood Cr. (mouth)	22°C daily max (CWAL)	19°C daily average (CWAL)	13°C daily max (SS)	9°C daily average (SS)
# Exceedances	57	64	80	98
Sample size	186	186	125	125
% Exceedance	30.6%	34.4%	64.0%	78.4%

Comparison to previous data

In 2004, Cottonwood Creek was sampled at the mouth by WRD staff. These data were used in a comparative analysis with the data collected by the WRD in 2015.

Table 8. Comparison of descriptive statistics from Cottonwood Creek (01501A), 2004 and 2015. Temp: instantaneous water temperature; NO₃+NO₂: nitrate+nitrite; TP: total phosphorus; TSS: total suspended sediments.

01501A: Cottonwood Cr. (Mouth)	Temp		pH		Turbidity		<i>E-coli</i> (NPT)		NO ₃ +NO ₂		TP		TSS	
	(°C)		(H+)		(NTU)		(cfu/100mL)		(mg/L)		(mg/L)		(mg/L)	
Year	2004	2015	2004	2015	2004	2015	2004	2015	2004	2015	2004	2015	2004	2015
max	21.8	21.0	8.4	8.7	4.0	1409.0	2800	>2419	8.88	9.66	0.15	1.60	12	860
min	3.2	4.2	7.0	6.7	0.5	1.5	10	13	0.02	0.26	0.01	0.08	2	4
mean	14.4	11.9	7.7	7.9	1.7	112.9	437	337	1.33	3.16	0.09	0.25	3	87
median	16.3	11.2	7.6	8.0	1.2	10.7	200	148	0.21	2.38	0.09	0.13	2	10
#exceedance	11	5	0	1	0	1	7	2	9	11	8	8	0	3
%exceedance	55.0%	35.7%	0.0%	10.0%	0.0%	7.1%	30.4%	15.4%	37.5%	91.7%	33.3%	66.7%	0.0%	25.0%
# sampling events	20	14	20	14	18	14	23	13	24	12	24	12	23	12

- Median instantaneous temperature dropped from 16.3°C to 11.2°C, and the number of exceedances decreased from 55.0% to 35.7% (Table 8, Figure 8a). Despite the decrease in median temperature and percent exceedance, there is a significant number of exceedances, and, with a maximum temperature of 21°C, the system is still temperature impaired.
- Nitrate+nitrite increased significantly from a median of 0.21 mg/L in 2004 to 2.38 mg/L in 2015, and percent exceedance increased from 37.5% to 91.7% (Table 8, Figure 8b).
- Total phosphorus increased from a median of 0.09 mg/L in 2004 to 0.13 mg/L in 2015. Percent exceedance doubled from 33.3% to 66.7% (Table 8, Figure 8c).

- Median *E. coli* concentrations decreased slightly from 200 cfu/100mL in 2004 to 148 cfu/100mL in 2015. Percent exceedance decreased from 30.4% to 15.4% (Table 8, Figure 8d).

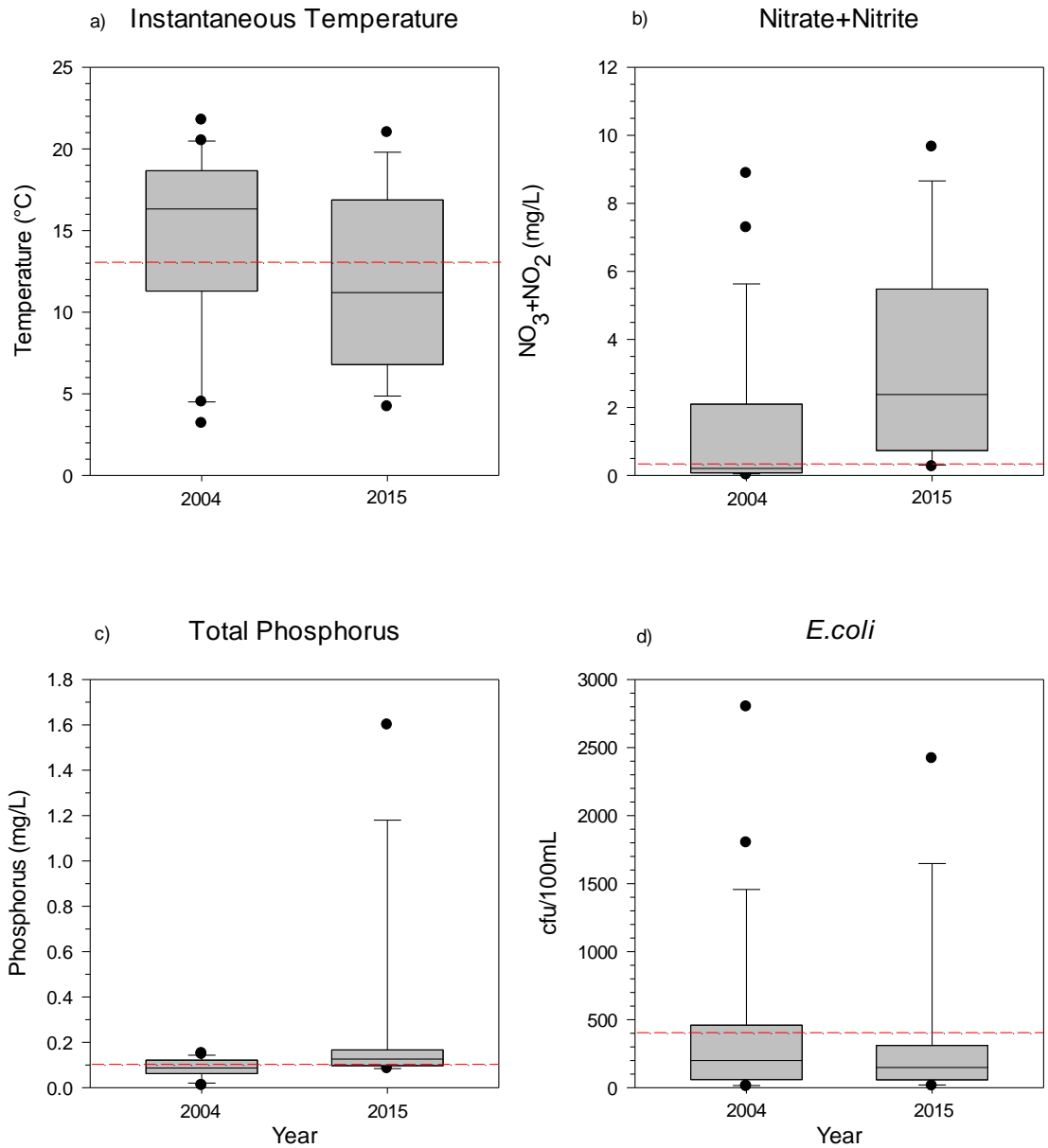


Figure 8. Comparison of instantaneous Cottonwood Creek (01501A) data from 2004 and 2015: (a) temperature measurements, (b) NO₃+NO₂ concentration, (c) total phosphorus concentration, (d) *E. coli* concentration. The dashed red lines indicate associated target criteria.

Summary of data, 2015 Cottonwood Creek (mouth) 01501A

- DO, pH, and turbidity met the associated target criteria or exceeded the target criteria on less than 10% of the sampling events (Table 6).
- TSS exceeded the target criterion of 25.0 mg/L three times (25.0% exceedance) (Table 6), suggesting that this monitoring site is not fully supporting designated beneficial uses (Table 5).
- Instantaneous temperature exceeded the 13°C SS target criterion five times (35.7% exceedance) (Table 6, Figure 2) and continuous temperature monitoring exceeded the 13°C and 9°C SS criteria 80 (64.0%) and 98 (78.4%), respectively, of the 125 days monitored during the salmonid spawning and incubation period. Continuous temperature data also exceeded 22°C CWAL criteria for nearly 1/3 of the days monitored (Table 7, Figures 6 & 7). This monitoring location remains severely temperature impaired and thus is not fully supporting either SS or CWAL designated beneficial uses.
- Nitrogen and phosphorus exceeded target criteria for the majority of sampling events in 2015 (Table 6, Figures 3 & 4), and significantly increased since 2004 (Table 8). This monitoring site is not fully supporting associated designated beneficial uses.
- *E. coli* concentrations did not meet target criteria on a few sampling events; however, not enough data was collected to make a designated beneficial use support determination.

01508A: Cottonwood Creek at Cottonwood Creek Road

The table below presents descriptive statistics for data collected from the monitoring station located on Cottonwood Creek at Cottonwood Creek Road, approximately seven miles upstream of the mouth of Cottonwood Creek.

Table 9. Descriptive statistics for Cottonwood Creek at Cottonwood Creek Road (01508A), 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

01508A: Cottonwood Cr. (Cottonwood Cr. Rd.)	Temp	DO	DO	pH	Turbidity	<i>E-coli</i> (BOR)	<i>E-coli</i> (NPT)	NO ₃ +NO ₂	OP	TP	TSS	Flow
	(°C)	(mg/L)	%	(H+)	(NTU)	(cfu/100mL)	(cfu/100mL)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)
max	21.8	11.9	123.7	9.1	23.4	700	727	7.38	0.11	0.38	86	82.6
min	5.3	8.3	76.4	7.1	2.5	4	5	0.78	0.07	0.09	2	0.0
mean	12.7	10.0	94.3	7.7	8.1	151	125	2.89	0.09	0.14	20	13.6
median	11.3	10.0	95.3	7.4	5.1	40	29	2.76	0.08	0.11	5	1.0
#exceedance	2	0	3	1	0	1	1	9	1	5	2	
%exceedance	20.0%	0.0%	30.0%	10.0%	0.0%	11.1%	11.1%	100.0%	11.1%	55.6%	22.2%	
# sampling events	10	10	10	10	10	9	9	9	9	9	9	10

- DO did not drop below the target criterion of 8.0 mg/L; however, DO did drop below 90% saturation criterion on three sampling events (30.0% exceedance) throughout the monitoring period.
- The pH exceeded the criterion range of 6.5-9.0 on one sampling event (10.0% exceedance) during extremely low flow, and before the creek dried up.
- Turbidity did not exceed the target criterion of 51.45 NTU.
- TSS exceeded the target criterion of 25 mg/L twice (22.2% exceedance) during the monitoring period. Both exceedances occurred during relatively low flows.

- Instantaneous water temperature exceeded the target criterion of 13°C for SS twice (20.0% exceedance) during the months of June and July.

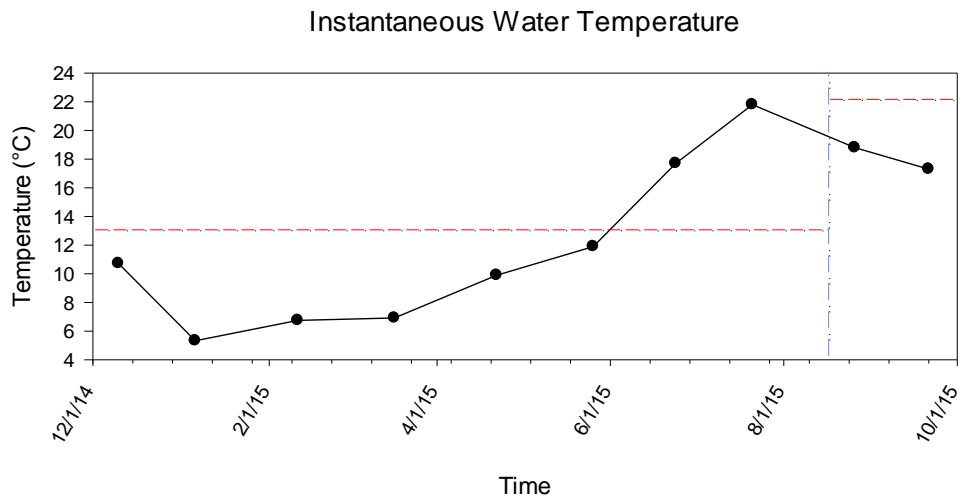


Figure 9. Instantaneous temperature data from Cottonwood Creek at Cottonwood Creek Road (01508A), 2015. The dashed red line indicates the target criteria of 13°C for SS and 22°C for CWAL.

- All NO_3+NO_2 measurements exceeded the target criterion of 0.3 mg/L, with the highest concentrations in February and March, likely associated with spring runoff, before leveling off well above the criterion during base flow later in the year.

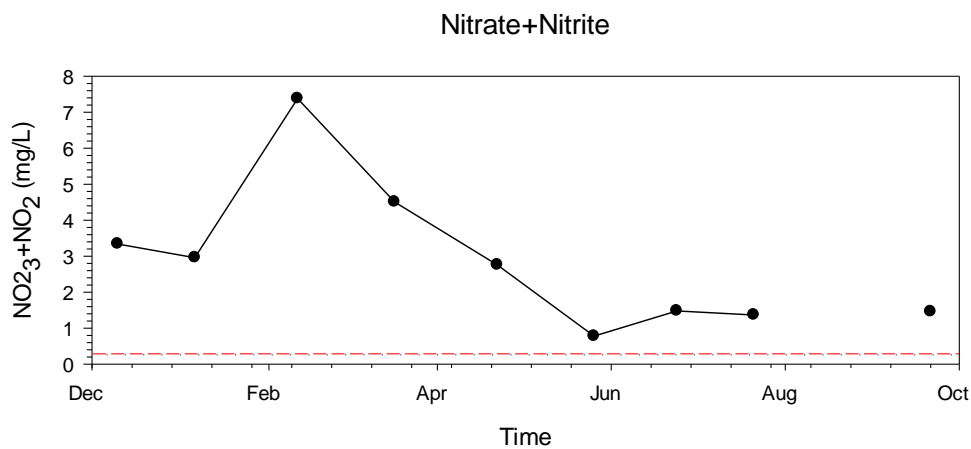


Figure 10. Instantaneous NO_3+NO_2 data from Cottonwood Creek at Cottonwood Creek Road (01508A). The dashed red line indicates the 0.3 mg/L target criterion.

- Total phosphorus (TP) exceeded the target criterion of 0.1 mg/L five times (55.6%) during the monitoring period. Orthophosphorus (OP) exceeded the criterion once (11.1%) and contributed to 73% of the TP.

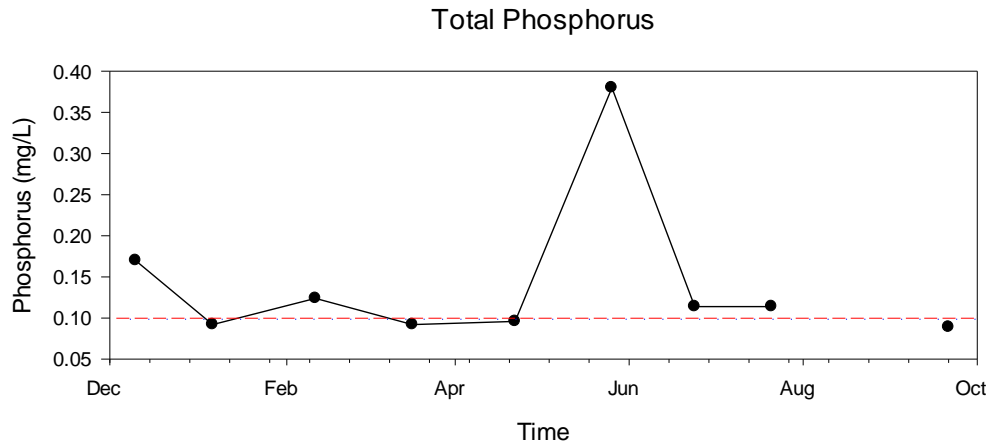


Figure 11. Instantaneous total phosphorus data from Cottonwood Creek at Cottonwood Creek Road (01508A). The dashed red line indicates the 0.1 mg/L target criterion.

- *E. coli* concentrations exceeded the target criterion of 406 cfu/100mL once at the end of July during low flow and the warmest air temperatures. Both samples from this monitoring event (one analyzed by NPT WRD staff, the other by BOR) exceeded the criterion.

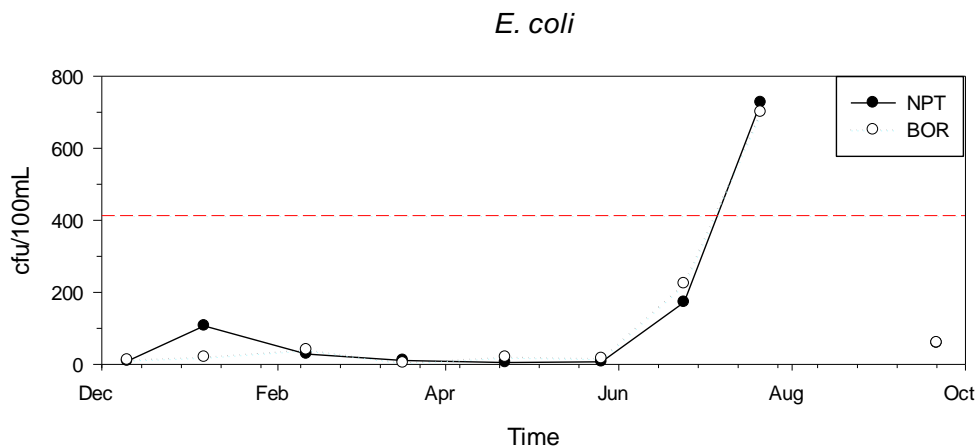


Figure 12. *E. coli* concentrations from Cottonwood Creek at Cottonwood Creek Road (01508A). This table includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100mL target criterion for PCR.

Continuous Water Temperature Monitoring:

An Onset Water Temperature Pro v2 Data Logger was deployed in Cottonwood Creek at Cottonwood Creek Road from June-December, 2015 and collected data hourly.

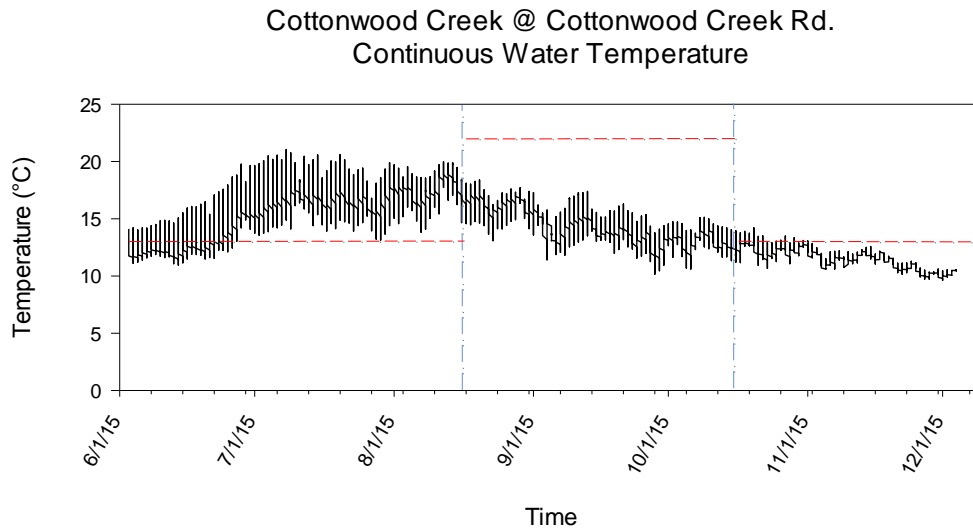


Figure 13. Continuous actual temperature data from Cottonwood Creek at Cottonwood Creek Road (01508A), June – December, 2015. The dashed red line indicates the target criteria.

- During the entire duration of monitoring, there were no exceedances of the CWAL criteria of 22°C daily max and 19°C daily average; however, of data collected during the salmonid spawning and incubation period, there were 87 (70.2%) and 124 (100.0%) exceedances of the 13°C daily max and 9°C daily average target criteria, respectively (Figures 13 & 14, Table 10).

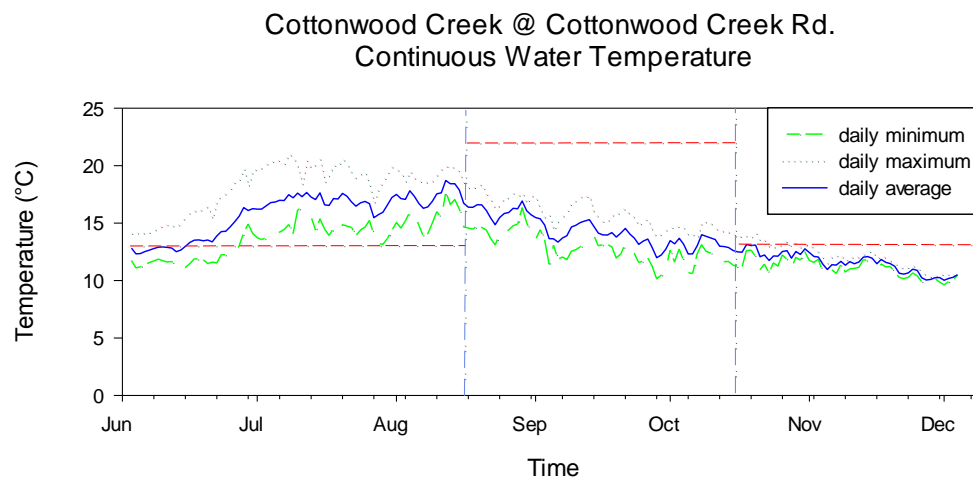


Figure 14. Continuous minimum, maximum, and average temperature data from Cottonwood Creek at Cottonwood Creek Road (01508A), June – December, 2015. The dashed red line indicates the target criteria.

Table 10. Continuous temperature exceedances for Cottonwood Creek at Cottonwood Creek Road (01508A) from June – December, 2015.

01508A Cottonwood Cr. (mouth)	22°C daily max (CWAL)	19°C daily average (CWAL)	13°C daily max (SS)	9°C daily average (SS)
# Exceedances	0	0	87	124
Sample size	185	185	124	124
% Exceedance	0.0%	0.0%	70.2%	100.0%

Summary of Data, 2015 Cottonwood Creek at Cottonwood Creek Road (01508A)

- Turbidity met the associated target criterion (Table 9).
- pH exceeded the target range once during the monitoring period, with a value of 9.07 in July during extremely low flow.
- DO dropped below the 90% target criterion for SS on three sampling occasions (30.0% exceedance) throughout the monitoring period, suggesting that this location is not fully supporting its SS designated beneficial use.
- TSS exceeded the target criterion twice (22.2% exceedance), suggesting the monitoring site is not be fully supporting its designated uses (Table 9).
- Instantaneous water temperature exceeded the target criterion for SS (13°C) twice (20.0% exceedance) and approached the criterion for CWAL (22°C) during July sampling (Table 9, Figure 9). Continuous temperature data did not exceed the CWAL criteria; however, temperature levels did exceed the 13°C daily max and 9°C daily average SS criteria on 87 (70.2% exceedance) and 124 (100.0% exceedance), respectively, of the 124 days monitored during the salmonid spawning and incubation period. This monitoring location is temperature impaired and does not fully support the designated beneficial use of SS.
- NO₃+NO₂ and total phosphorus exceeded the associated target criteria in 100% and 55.6% percent of sampling events, respectively (Table 9, Figures 10 & 11), suggesting that this monitoring location is not fully supporting its designated beneficial uses.
- *E. coli* concentrations exceeded the target criterion of 406 cfu/100mL once at the end of July during low flow and the warmest air temperatures (Table 9, Figure 12); however, not enough data was collected to make an appropriate designated beneficial use support determination.

01514A: Cottonwood Creek at Tribal Allotment #1801 (TA #1801)

The table below presents descriptive statistics for data collected from the monitoring station located on Cottonwood Creek at TA #1801.

Table 11. Descriptive statistics for Cottonwood Creek at TA #1801 (01514A), 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

01514A: Cottonwood Cr. (at TA #1801)	Temp	DO	DO	pH	Turbidity	<i>E-coli</i> (BOR)	<i>E-coli</i> (NPT)	NO ₃ +NO ₂	OP	TP	TSS	Flow
	(°C)	(mg/L)	%	(H+)	(NTU)	(cfu/100mL)	(cfu/100mL)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)
max	23.5	13.9	109.0	8.2	31.9	700	579	10.00	0.08	0.12	54	11.1
min	1.5	8.9	72.9	6.9	3.1	100	51	0.05	0.02	0.05	7	0.1
mean	9.0	10.9	94.4	7.6	19.3	312	237	4.64	0.04	0.09	21	4.7
median	6.8	10.9	94.5	7.6	19.7	200	103	4.48	0.04	0.09	20	4.6
#exceedance	2	0	3	0	0	2	3	5	0	2	1	
%exceedance	25.0%	0.0%	37.5%	0.0%	0.0%	40.0%	37.5%	71.4%	0.0%	28.6%	14.3%	
# sampling events	8	8	8	7	8	5	8	7	7	7	7	8

- DO did not drop below the 8.0 mg/L target criterion; however, DO did drop below the 90% saturation criterion for SS on three sampling occasions (37.5% exceedance).
- The pH remained within the target range of 6.5-9.0 on all sampling events.
- Turbidity did not exceed the target criterion of 51.45 NTU.
- TSS exceeded the target criterion of 25 mg/L once (14.3% exceedance) during low flow conditions.
- Instantaneous water temperature exceeded the SS target criterion twice (25.0% exceedance) and the CWAL target criterion once (12.5% exceedance). These exceedance events were recorded during the last two sampling events at the end of May and June, during low flow and before the stream dried up.

Instantaneous Water Temperature

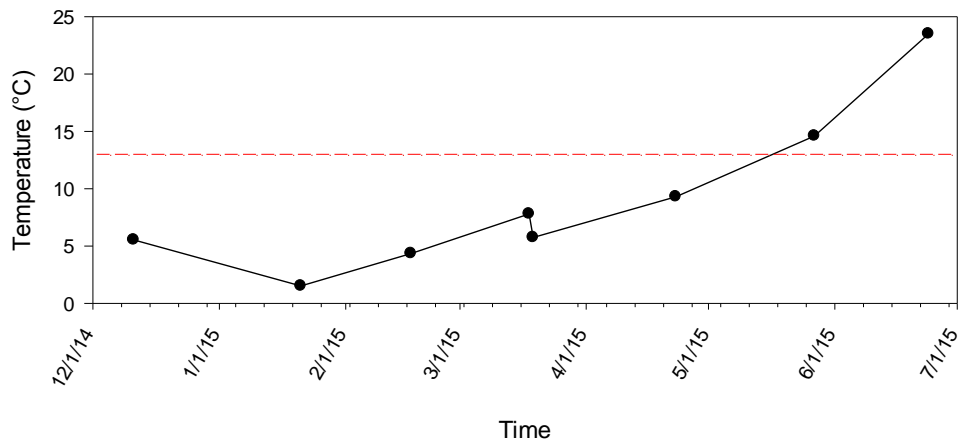


Figure 15. Instantaneous temperature data from Cottonwood Creek at TA #1801 (01514A), 2015. The dashed red line indicates the target criterion of 13°C for SS.

- NO_3+NO_2 exceeded the target criterion of 0.3 mg/L five times (71.4% exceedance) during the monitoring period. The two sampling events that did not exceed the criterion were during low flow and before the stream dried up.

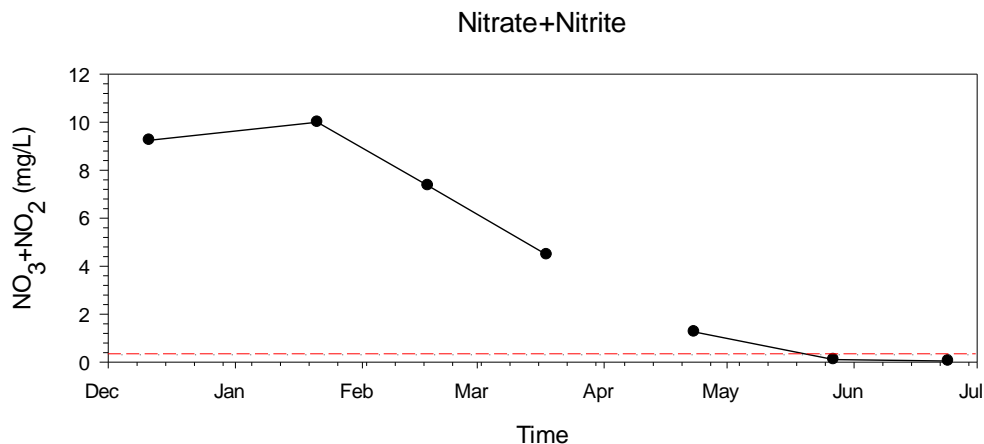


Figure 16. Instantaneous NO_3+NO_2 data from Cottonwood Creek at TA #1801 (01514A). The dashed red line indicates the 0.3 mg/L target criterion.

- TP exceeded the target criterion twice (28.6% exceedance) during the monitoring period. On average, OP contributed to approximately 50% of the total phosphorus recorded.

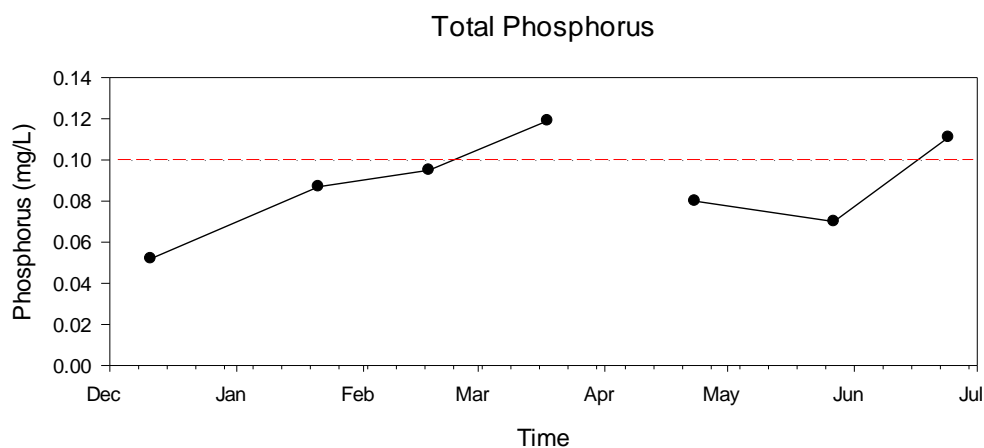


Figure 17. Instantaneous total phosphorus data from Cottonwood Creek at TA #1801 (01514A). The dashed red line indicates the 0.1 mg/L target criterion.

- *E. coli* concentrations exceeded the target criterion of 406 cfu/100mL three times during the monitoring period. The first exceedance was in mid-February and the sample was analyzed only by NPT WRD staff. The other two exceedances were the end of May and June during low flows, warm temperatures, and before the stream dried up. Both samples from the last two monitoring events (one analyzed by NPT WRD staff, the other by BOR) exceeded the criterion (Figure 18).

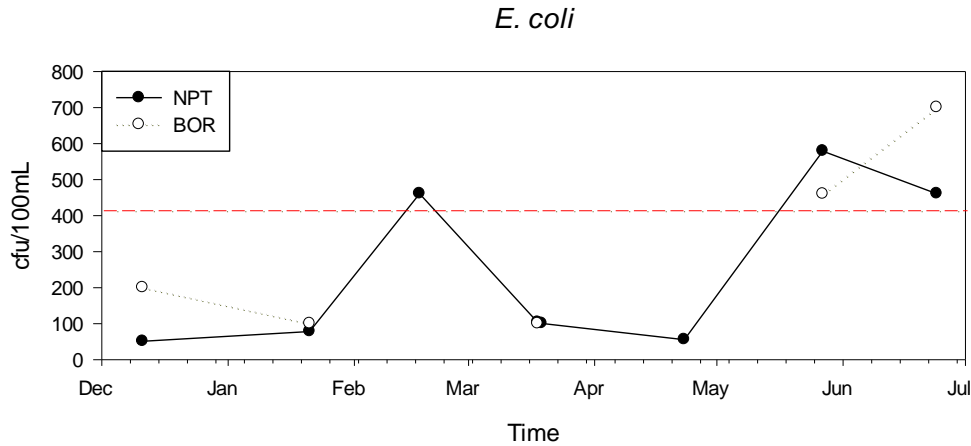


Figure 18. *E. coli* concentrations from Cottonwood Creek at TA #1801 (01514A). This graph includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100mL target criterion for PCR.

Continuous Water Temperature Monitoring:

An Onset Water Temperature Pro v2 Data Logger was deployed in Cottonwood Creek at TA #1801 from June 3, 2015-March 9, 2016 and collected data hourly. During analysis it appeared that the logger began taking defective measurements beginning on February 26, 2016, so data collected after that date were discarded.

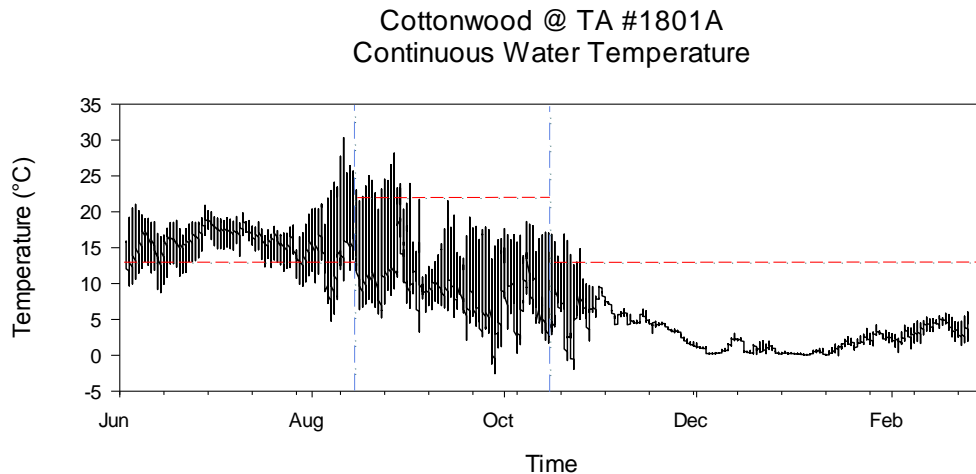


Figure 19. Continuous actual temperature data from Cottonwood Creek at TA #1801 (01514A), June, 2015-February, 2016. The dashed red line indicates the target criteria.

- During the entire duration of monitoring, there were 22 (8.2%) and 2 (0.7%) exceedances of the 22°C daily max and 19°C daily average CWAL criteria, respectively. In addition, of data collected during the salmonid spawning and incubation period, there were 81 (39.1%) and 76 (36.7%) exceedances of the 13°C daily max and 9°C daily average target criteria, respectively (Figure 19 & 20, Table 12).

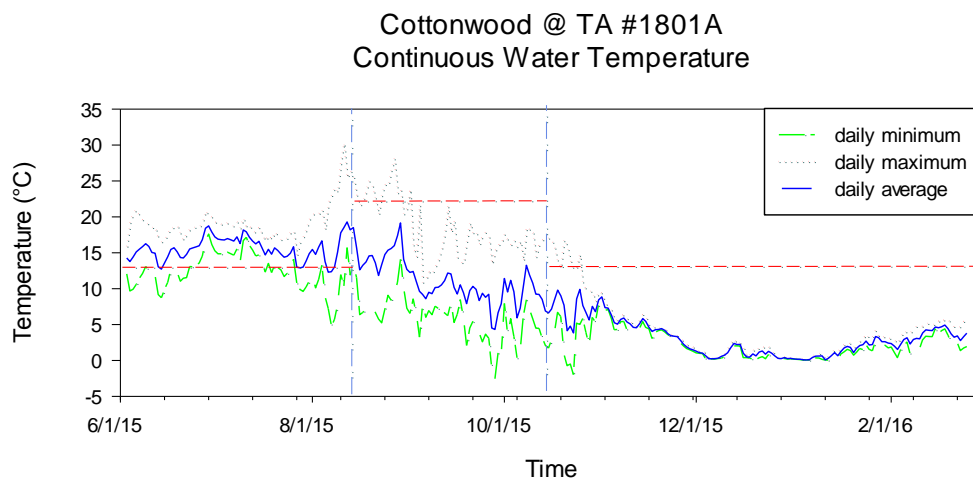


Figure 20. Continuous minimum, maximum, and average temperature data from Cottonwood Creek at TA #1801 (01514A), June, 2015-February, 2016. The dashed red line indicates the target criteria.

Table 12. Continuous temperature exceedances for Cottonwood Creek at TA #1801 (01514A) from June, 2015-February, 2016.

01514A Cottonwood Cr. (mouth)	22°C daily max (CWAL)	19°C daily average (CWAL)	13°C daily max (SS)	9°C daily average (SS)
# Exceedances	22	2	81	76
Sample size	268	268	207	207
% Exceedance	8.2%	0.7%	39.1%	36.7%

Summary of Data, 2015 Cottonwood Creek at TA #1801 (01514A)

- Turbidity and pH met the associated target criteria (Table 11).
- DO dropped below the 90% saturation criterion needed for SS three times (37.5% exceedance) during the monitoring period, suggesting that the SS designated use is not being fully supported (Table 11).
- TSS exceeded the target criterion once (14.3% exceedance) but during extremely low flow in June so a designated use support status determination cannot be definitively made without further investigation (Table 11).

- Instantaneous water temperature exceeded the target criteria for SS (13°C) twice (25.0%) and CWAL (22°C) once (12.5%) during June sampling (Table 11, Figure 15). The exceedances were documented during low flow, high ambient air temperatures, and just before the stream dried up. In addition, continuous temperature data showed exceedances of the 13°C daily max and 9°C daily average on 81 (39.1% exceedance) and 76 (36.7%), respectively, of the 207 days monitored during the salmonid spawning and incubation period. This monitoring location is temperature impaired and does not fully support the designated use of SS. Continuous data also showed several occasions in which the temperature exceeded the CWAL target criteria but percent exceedance did not exceed the 10% threshold (Figures 19 & 20, Table 12).
- NO₃+NO₂ and total phosphorus exceeded the associated target criteria in 71.4% and 28.6% percent of sampling events, respectively, suggesting this monitoring site is not fully supporting the designated uses (Table 11).
- *E. coli* concentrations exceeded the target criterion of 406 cfu/100mL three times during the monitoring period; however, not enough data was collected to make an appropriate designated beneficial use support determination (Table 11).

01517A: Cottonwood Creek in the headwaters near Fairview Road

The table below presents descriptive statistics for data collected from the monitoring station located on Cottonwood Creek near Fairview Road.

Table 13. Descriptive statistics for Cottonwood Creek in the headwaters near Fairview Road (01517A), 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

- DO did not drop below the 8.0 mg/L target criteria during the sampling period; however, % saturation did drop below the 90% target criterion for SS on three of the four sampling events.
- The pH fell below the criterion range of 6.5-9.0 on one sampling event (25.0% exceedance). The pH was measured at 5.59 in February, which is well below the 6.5 minimum target criterion. Field notes from this sampling event document active erosion from a nearby field delivering sediment to the creek.
- Turbidity did not exceed the target criterion of 51.45 NTU.
- TSS exceeded the target criterion of 25 mg/L once (25.0%) during the monitoring period, which occurred during the February sampling event with documented active erosion occurring.
- Instantaneous water temperature did not exceed the 13°C target criterion for SS. The last sample was taken at the end of April, just before the stream dried up.

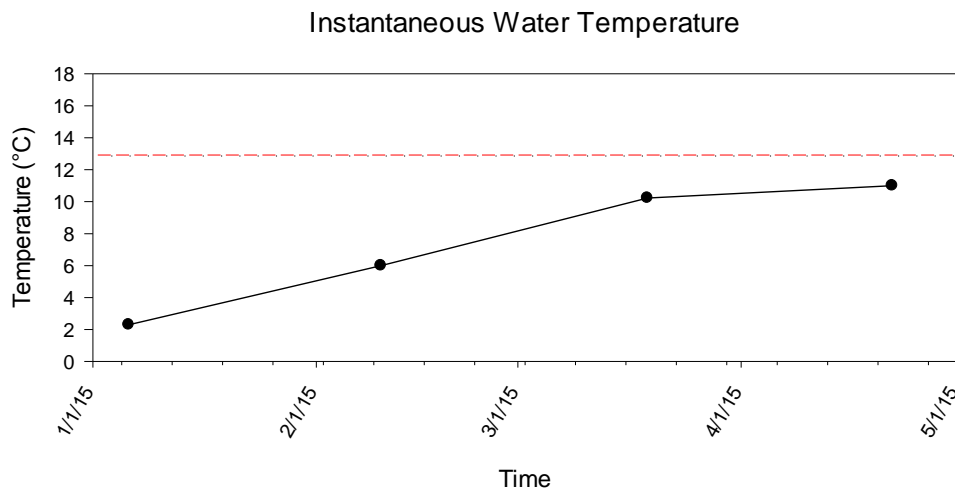


Figure 21. Instantaneous temperature data from Cottonwood Creek near Fairview Road (01517A), 2015. The dashed red line indicates the target criterion of 13°C for SS.

- NO_3+NO_2 was well above the target criterion of 0.3 mg/L for all sampling events. The concentrations ranged from just over 5 mg/L in April to over 25 mg/L (nearly 100 times the target criteria) in January.

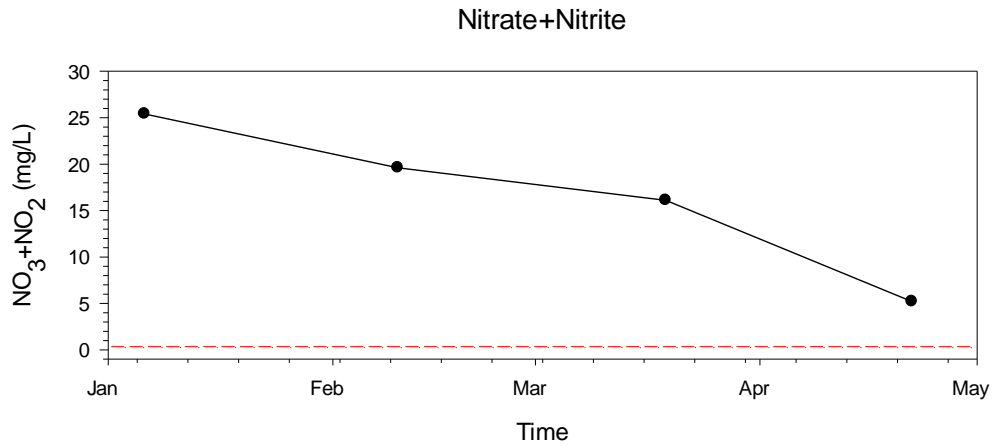


Figure 22. Instantaneous NO_3+NO_2 data from Cottonwood Creek near Fairview Road (01517A). The dashed red line indicates the 0.3 mg/L target criterion.

- Total phosphorus exceeded the target criterion once in February (25.0% exceedance). Orthophosphorous did not exceed the 0.1 mg/L criterion but did contribute an average of 57% to the total phosphorus.

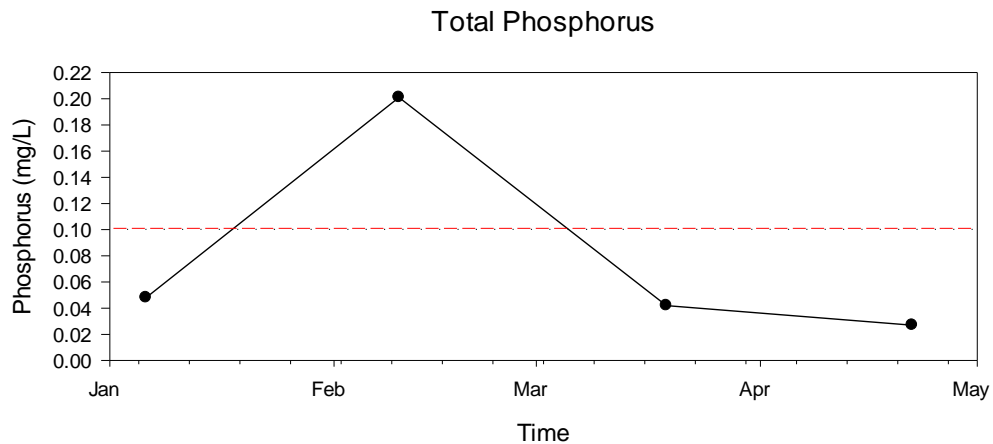


Figure 23. Instantaneous total phosphorus data from Cottonwood Creek near Fairview Road (01517A). The dashed red line indicates the 0.1 mg/L target criterion.

- *E. coli* concentrations were well below the target criterion for all sampling events.

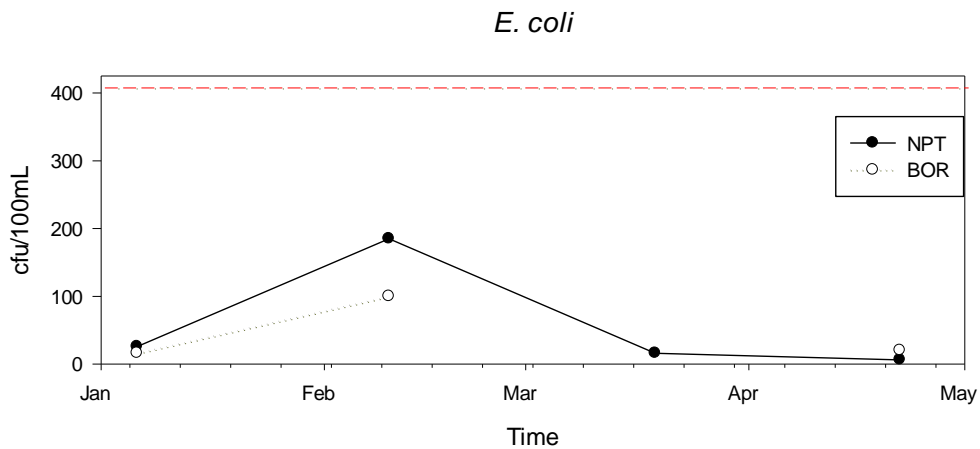


Figure 24. *E. coli* concentrations from Cottonwood Creek near Fairview Road (01517A). This table includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100mL target criterion for PCR.

Summary of Data, 2015 Cottonwood Creek in headwaters near Fairview Road (01517A)

- Turbidity did not exceed the target criterion (Table 13).
- DO dropped below the 90% saturation needed for SS on three of the four sampling events suggesting this location is not fully supporting its SS designated beneficial use (Table 13).
- TSS and pH each exceeded the associated target criterion once (25.0%), with both occurring during the same sampling event in February during the highest recorded flow and documented active field erosion occurring. This could indicate that the monitoring site is not fully supporting designated beneficial uses during spring runoff (Table 13).
- Water temperature did not exceed the SS or CWAL target criteria, likely because the stream dried up before warmer summer air temperatures began (Table 13, Figure 21).
- NO₃+NO₂ exceeded the target criterion in all sampling events, while total phosphorus exceeded only once in February during the highest recorded flow (Table 13, Figures 22 & 23); therefore, this location is not fully supporting the two designated beneficial uses of SS and CWAL.

Cottonwood Creek Source-to-Mouth Summary:

- Instantaneous temperature exceedances were documented at all sites, with the exception of the farthest upstream site (01517A), which dried up before air temperature began rising. All sites containing water exceeded the Salmonid Spawning target criteria in mid-May through August 15, which represents the end of the SS period (Figure 25). Compared to data collected in 2004, water temperature did decrease; however, during continuous temperature monitoring the daily average exceeded State of Idaho criteria approximately 35% of days sampled at the mouth for Cold Water Aquatic Life (CWAL). Continuous temperature data also showed exceedances of the 9°C daily average and 13°C daily maximum target criteria for Salmonid Spawning (SS) 78.4% and 64.0% at the mouth, 100.0% and 70.2% at Cottonwood Creek Road, and almost 36.7% and 39.1% at TA #180, respectively (Tables 7,10,12). Overall, the main stem of Cottonwood Creek is severely temperature impaired and thus, is not fully supporting the designated beneficial uses of SS or CWAL.

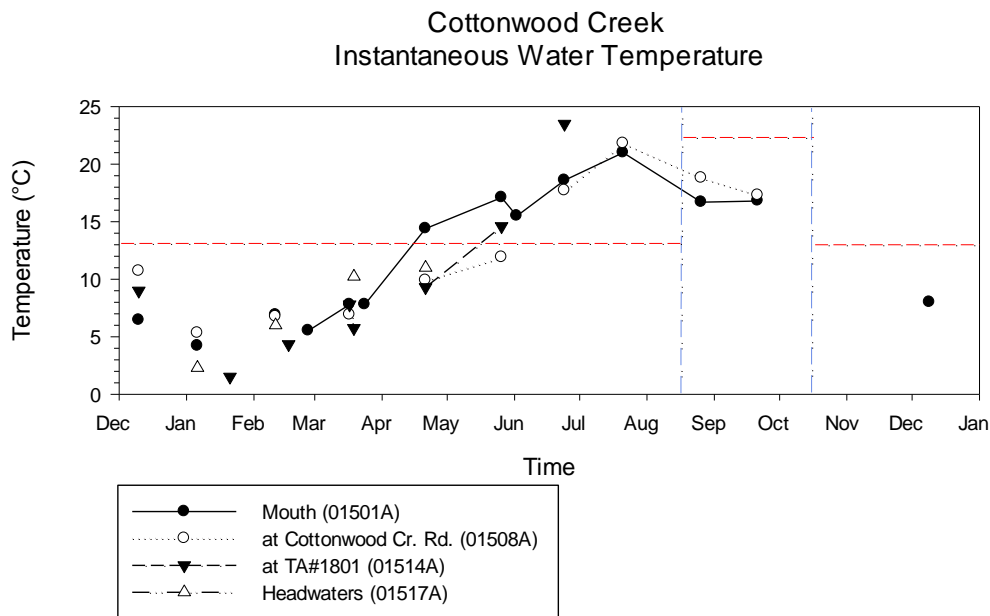


Figure 25. Instantaneous temperature data from all monitoring sites on Cottonwood Creek, 2015. The dashed red lines indicate the target criteria of 13°C for SS and 22°C for CWAL.

- NO_3+NO_2 exceeded the 0.3 mg/L target criterion at all monitoring sites and on all but three sampling events. The highest concentrations were measured during high spring flows, but levels remained above the target criterion as the water level approached base flows in June (Figure 26). In a comparison to data collected in 2004 at the mouth (01501A), median nitrogen levels increased dramatically from 0.21 mg/L to 2.38 mg/L (Table 8, Figure 8). Overall, Cottonwood Creek (source-to-mouth) is not fully supporting its designated beneficial uses of SS and CWAL.

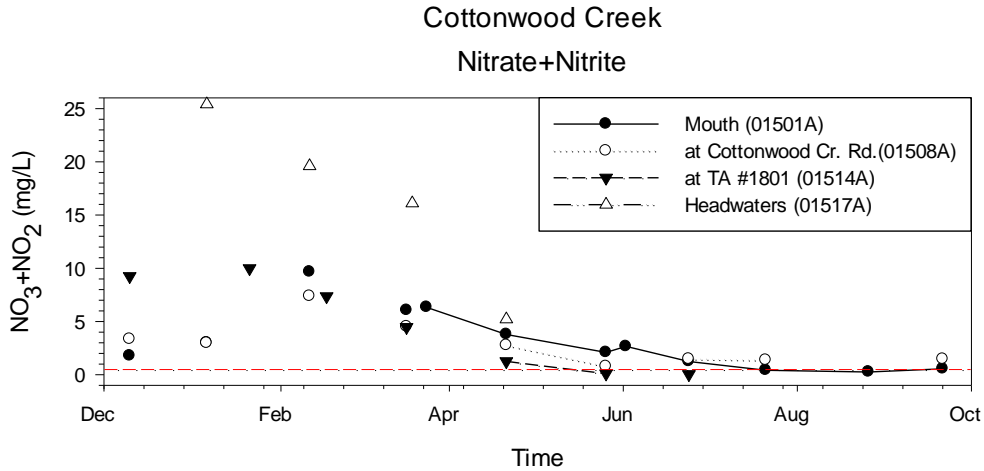


Figure 26. Instantaneous NO_3+NO_2 data from all monitoring sites on Cottonwood Creek. The dashed red line indicates the 0.3 mg/L target criterion.

- Total phosphorus exceeded the target criterion of 0.1 mg/L at all monitoring locations (Figure 27). Median concentration was highest at the mouth (01501A) at 0.13 mg/L and gradually decreased to the headwaters (01517A) where the mean was 0.05 mg/L (Figure 28). Percent exceedance at each site followed a similar trend, with highest values at the mouth, decreasing up the watershed (Figure 30).

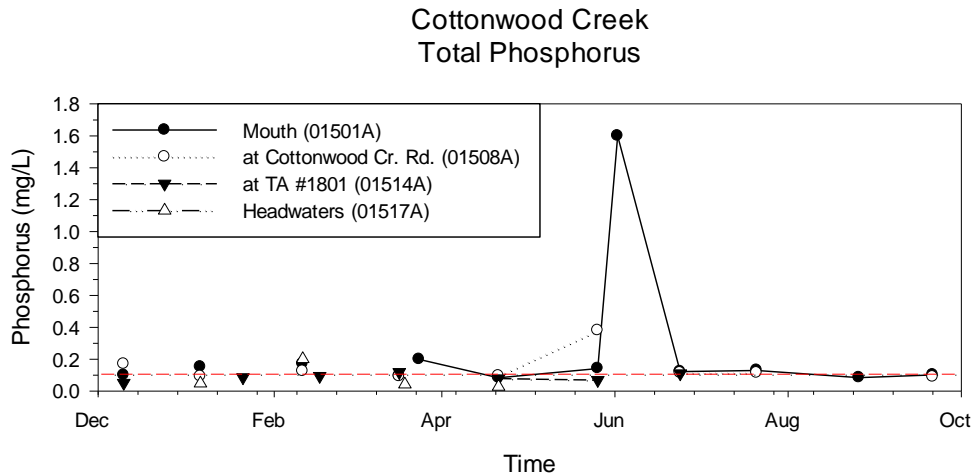


Figure 27. Instantaneous total phosphorus data from all monitoring sites on Cottonwood Creek. The dashed red line indicates the 0.1 mg/L target criterion.

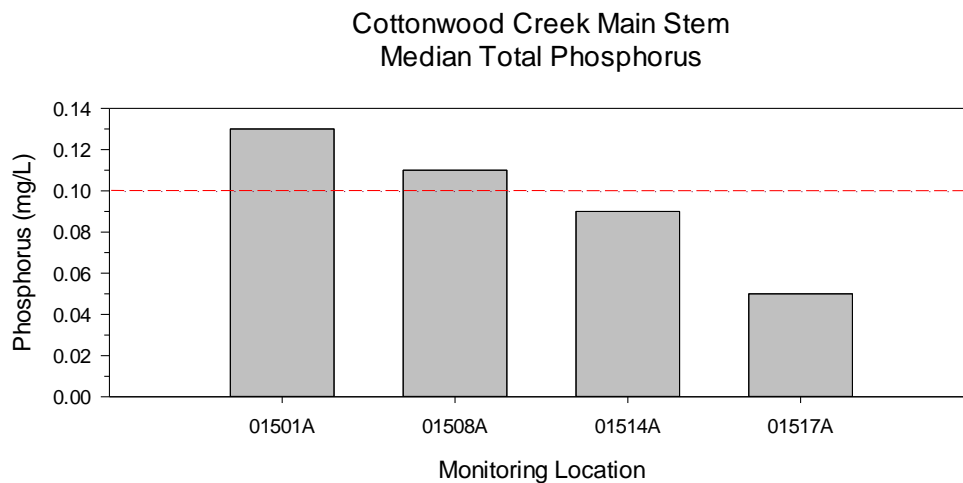


Figure 28. Median total phosphorus data from all monitoring sites on Cottonwood Creek. Sites are arranged from the mouth to the headwaters from left to right, respectively. The dashed red line indicates the 0.1 mg/L target criterion.

- The ratio of orthophosphorus to total phosphorus is substantially higher in the lower watershed than the upper portions (Figure 29). The lower watershed is surrounded by steep canyons with agriculture and cattle grazing making up the majority of land use on the plateau. Orthophosphorus signifies higher concentrations of dissolved phosphorus not associated with sediment load. There seems to be no association between the highest ratios and stream discharge, suggesting that nutrients from the above land uses are leaching into the soils and groundwater, which are then transferred into the stream water.
- Based on phosphorus concentrations, Cottonwood Creek is not fully supporting the designated beneficial uses of SS, and CWAL.

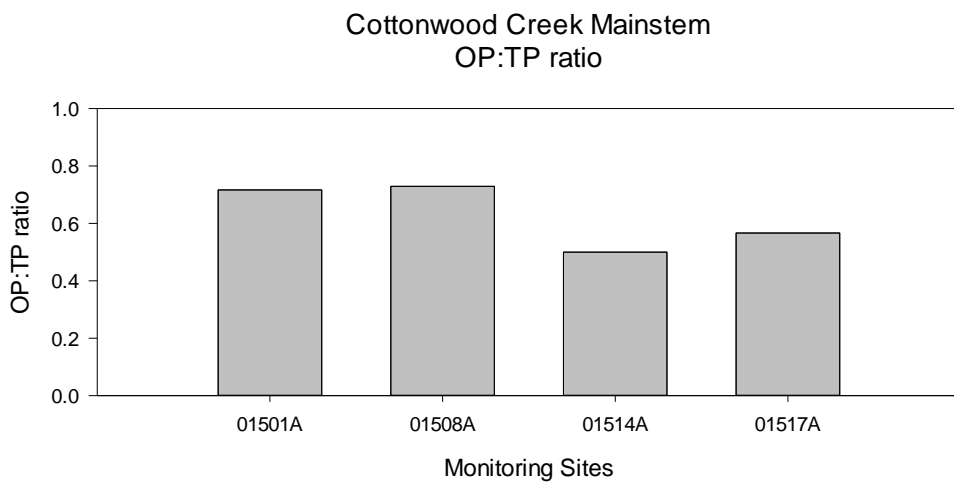


Figure 29. Ratio of orthophosphorus to total phosphorus from all sites in Cottonwood Creek. Sites are arranged from the mouth to the headwaters from left to right, respectively.

- E. coli concentrations had a greater than 10% exceedance of the 406 cfu/ 100mL target criterion for PCR at all sites except the headwaters (01517A). However, a single monthly sample exceedance does not dictate a violation, so no definitive conclusions can be made about the designated beneficial use determination without further investigation.

- Overall, Cottonwood Creek is severely temperature and nutrient impaired, and thus is not fully supporting the designated beneficial uses of SS and CWAL (Figure 30).



Figure 30. Percent exceedance of instantaneous parameters (temperature, nitrate+nitrite, total phosphorus, and *E. coli*). Sites are positioned from mouth to headwaters from left to right respectively. *E. coli* was calculated by including samples analyzed by both the NPT and BOR.

Magpie Creek (04901A, 04901B*, 04903A*, 11001A*).

(*04901A was the only planned monitoring site on Magpie Creek; however, because of extremely high nutrient concentrations, fall samples were taken at additional sites in an attempt to locate non-point source nutrient pollution. Since the additional sites were sampled only once, only 04901A results are displayed in this section; however, conclusive data from the additional sites are included in the discussion. Raw data for the additional sites can be found in Appendix B.)

The table below presents descriptive statistics for data collected from the monitoring station located on Magpie Creek at the mouth.

Table 14. Descriptive statistics for Magpie Creek at mouth (04901A), 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

04901A: Magpie Creek	Temp	DO	DO	pH	Turbidity	<i>E-coli</i> (BOR)	<i>E-coli</i> (NPT)	NO ₃ +NO ₂	OP	TP	TSS	Flow
	(°C)	(mg/L)	%	(H+)	(NTU)	(cfu/100mL)	(cfu/100mL)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)
max	19.8	12.4	98.8	8.8	1591.0	7000	> 2420	12.00	0.30	2.50	1648	7.1
min	4.2	8.3	88.9	7.5	4.3	100	101	5.01	0.14	0.16	11	0.1
mean	12.3	10.2	94.6	8.2	177.4	2210	1310	7.09	0.20	0.56	275	1.3
median	13.3	10.0	94.9	8.2	49.1	1500	1210	5.83	0.21	0.34	88	0.5
#exceedance	4	0	1	0	5	9	10	12	12	12	9	
%exceedance	33.0%	0.0%	8.3%	0.0%	41.7%	90.0%	83.3%	100.0%	100.0%	100.0%	75.0%	
# sampling events	12	12	12	12	12	10	12	12	12	12	12	12

- DO did not drop below the 8.0 mg/L target criterion during the sampling period; however, % DO did drop below the 90% target criterion for SS on one sampling event (8.3% exceedance).
- The pH remained within the criterion range of 6.5-9.0 on all sampling events.
- Turbidity exceeded the target criterion of 51.45 NTU five times (41.7% exceedance) throughout the monitoring period and does not appear to be correlated to high flow events.
- TSS exceeded the target criterion of 25 mg/L on nine sampling events (75.0% exceedance) during the monitoring period.

- Instantaneous water temperature exceeded the target criterion of 13°C for SS four times (33.3% exceedance) (Table 14, Figure 31).

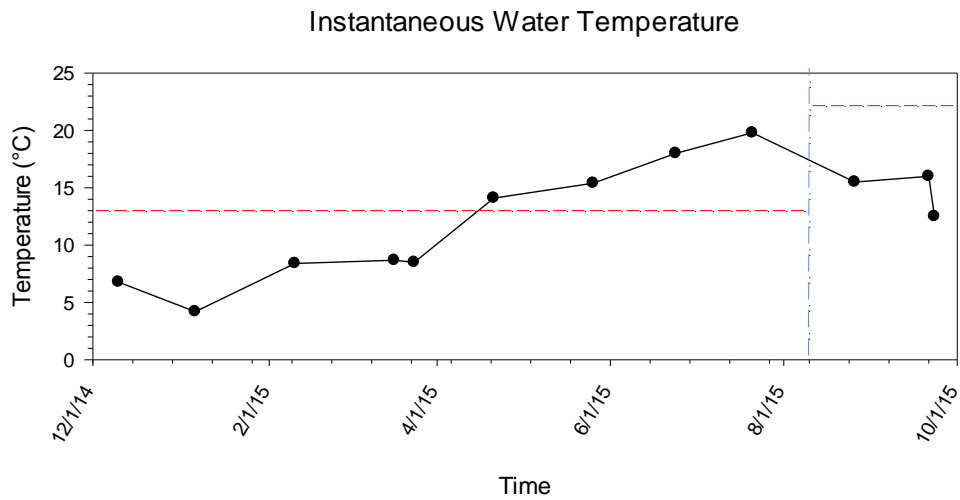


Figure 31. Instantaneous temperature data from Magpie Creek, 2015. The dashed red line indicates the target criteria of 13°C for SS and 22°C for CWAL.

- All NO_3+NO_2 concentrations were well above the target criteria of 0.3 mg/L, with a range of 5.01 mg/L to 12.00 mg/L and a median concentration of 5.83 mg/L. Three sampling events during spring runoff exceeded the maximum 10.0 mg/L drinking water standard in Idaho (Table 14, Figure 32). The additional sampling sites all exceeded the target criterion as well, with the highest concentration of 8.66 mg/L occurring at sampling location 04903A (Appendix B, Table 30).

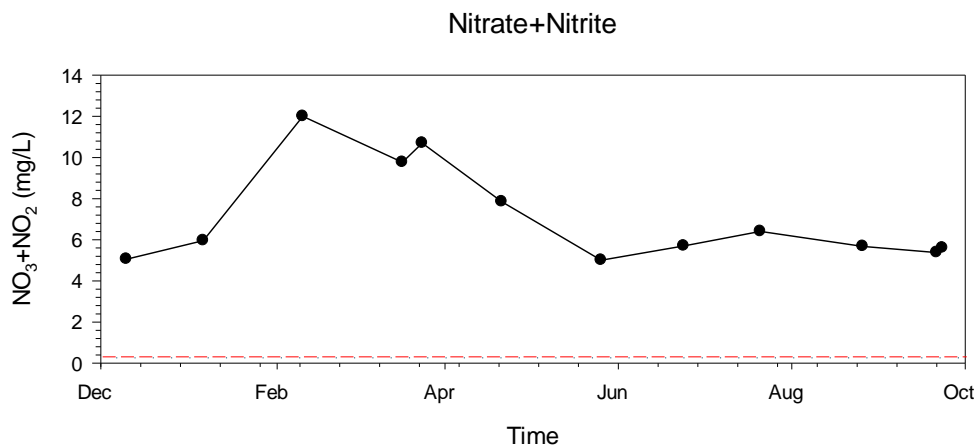


Figure 32. Instantaneous NO_3+NO_2 data from Magpie Creek, 2015. The dashed red line indicates the 0.3 mg/L target criterion.

- Total phosphorus exceeded the 0.1 mg/L target criterion in all sampling events, with a range of 0.16 mg/L to 2.5 mg/L and a median concentration of 0.34 mg/L. Concentrations were highest during spring runoff before leveling out in base flow conditions (Figure 33). Orthophosphorus contributed to approximately 65% of the total phosphorus in the stream. The additional sampling sites all exceeded the target criterion as well, with the highest concentration of 0.24 mg/L occurring at sampling location 11001A, an unnamed tributary to Magpie Creek (Appendix B, Table 30).

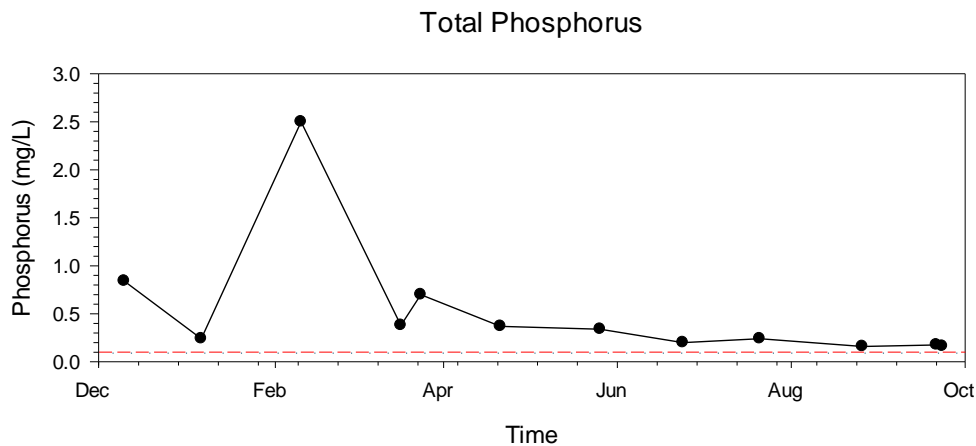


Figure 33. Instantaneous total phosphorus data from Magpie Creek, 2015. The dashed red line indicates the 0.1 mg/L target criterion.

- *E. coli* concentrations exceeded the target criterion of 406 cfu/100mL in 75.0% and 90.9% of samples analyzed by the NPT WRD and BOR, respectively (Figure 34). Throughout the spring and summer, concentrations were well above the target criterion. Also, the additional sampling site 11001A exceeded the target criterion (analyzed by both NPT WRD and BOR), while 4901B concentrations exceeded only in the sample analyzed by NPT WRD staff.

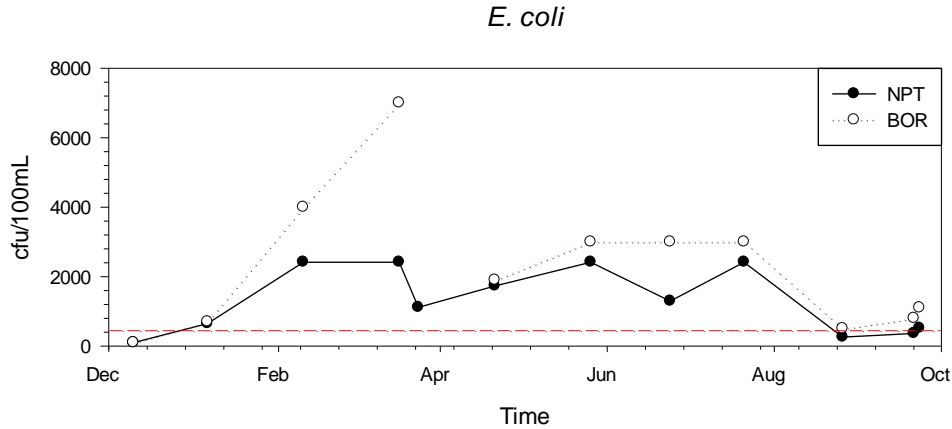


Figure 34. *E. coli* concentrations from Magpie Creek (04901A). This figure includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100mL target criterion for PCR.

Comparison to previous data

Magpie Creek was sampled by NPT WRD staff in 2010-2011. These data were used in a comparative analysis with the data collected by the NPT WRD in 2015.

Table 15. Comparison of summary data from Magpie Creek (04901A), 2011 and 2015. Temp: instantaneous water temperature; NO₃+NO₂: nitrate+nitrite; TP: total phosphorus; TSS: total suspended sediments.

04901A: Magpie Creek	Temp		pH		Turbidity		<i>E. coli</i> (NPT)		NO ₃ +NO ₂		TP		TSS	
	(°C)		(H+)		(NTU)		(cfu/100mL)		(mg/L)		(mg/L)		(mg/L)	
Year	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015
max	14.9	19.8	8.1	8.8	89.0	1591.0	1553	>2420	16.60	12.00	0.45	2.50	185	1648
min	5.1	4.2	7.6	7.5	5.9	4.3	<1	101	3.56	5.01	0.18	0.16	3	11
mean	9.4	12.3	7.8	8.2	36.4	177.4	477	1310	9.16	7.09	0.29	0.56	62	275
median	8.6	13.3	7.9	8.2	28.4	49.1	308	1210	7.38	5.83	0.29	0.34	52	88
#exceedance	2	4	0	0	4	5	4	10	12	12	12	12	9	9
%exceedance	16.7%	33.0%	0.0%	0.0%	33.3%	41.7%	40.0%	83.3%	100.0%	100.0%	100.0%	100.0%	75.0%	75.0%
# sampling events	12.0	12.0	12.0	12.0	12.0	12.0	10	12	12	12	12	12	12.0	12.0

- Instantaneous water temperature increased from a median of 8.6°C in 2011 to 13.3°C in 2015. Percent exceedance also increased from 16.7% to 33.0% (Table 15, Figure 35a).
- Nitrogen concentrations decreased from a median of 7.38 mg/L in 2011 to 5.83 mg/L in 2015; however, all measurements from both monitoring periods were well above the 0.3 mg/L target criterion (Table 15, Figure 35b).
- Total phosphorus concentrations in 2015 were relatively similar to those measured in 2011. The median increased slightly from 0.29 mg/L in 2011 to 0.34 mg/L in 2015; however, all measurements from both monitoring periods were well above the 0.1 mg/L target criterion (Table 15, Figure 35c).

- *E. coli* concentrations increased dramatically from a median of 308 cfu/100mL in 2011 to 1,210 cfu/100mL in 2015 with a corresponding increase in exceedance rates, from 40.0% to 83.3% (Table 15, Figure 35d).

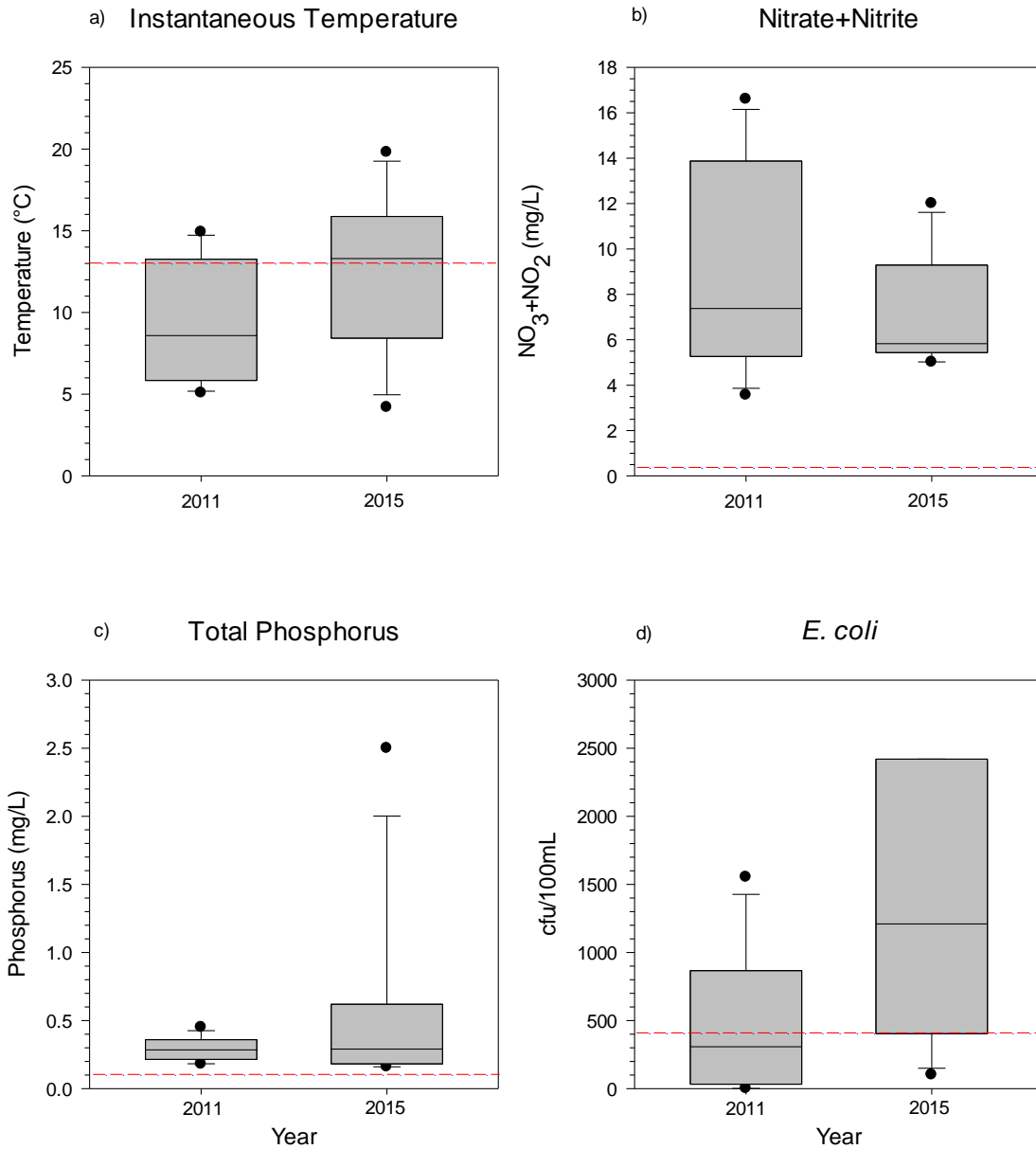


Figure 35. Comparison of Magpie Creek (04901A) data from 2011 and 2015: (a) instantaneous temperature measurements, (b) NO₃+NO₂ levels, (c) total phosphorus levels, and (d) *E. coli* concentrations. The dashed red lines indicate the applicable target criteria.

Continuous Water Temperature Monitoring:

An Onset Water Temperature Pro v2 Data Logger was deployed in Magpie Creek at the mouth from March 24, 2015–October 30, 2015 and collected data every 15 minutes. The stream went subsurface after a storm event in June, exposing the data logger. Data from this period (June 3–23) were discarded from analysis.

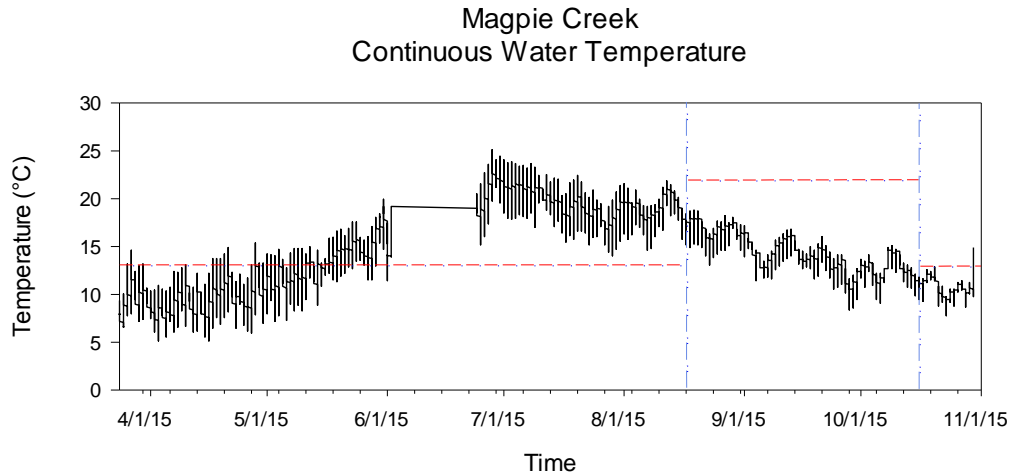


Figure 36. Continuous temperature data from Magpie Creek (04901A), March–October, 2015. The dashed red line indicates the target criteria.

- During the entire duration of monitoring, there were 19 (9.5%) and 27 (13.5%) exceedances of the CWAL criteria of 22°C daily max and 19°C daily average, respectively. In addition, of data collected during salmonid spawning and incubation periods, there were 99 (71.2%) and 124 (89.2%) exceedances of the 13°C daily max and 9°C daily average target criteria, respectively (Figures 36 & 37, Table 16).

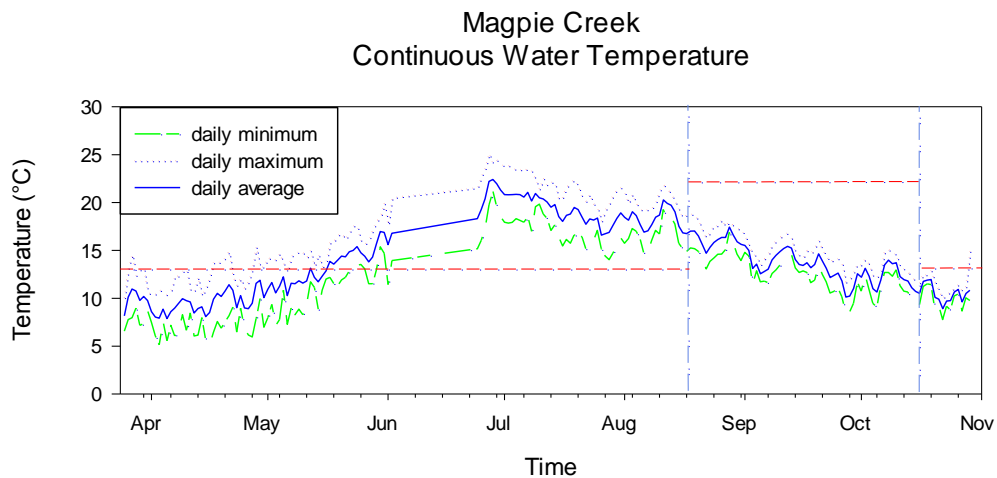


Figure 37. Continuous minimum, maximum, and average temperature data from Magpie Creek (04901A), March–October, 2015. The dashed red line indicates the target criteria.

Table 16. Continuous temperature exceedances for Magpie Creek (04901A), March-October, 2015.

04901A Cottonwood Cr. (mouth)	22°C daily max (CWAL)	19°C daily average (CWAL)	13°C daily max (SS)	9°C daily average (SS)
# Exceedances	19	27	99	124
Sample size	200	200	139	139
% Exceedance	9.5%	13.5%	71.2%	89.2%

Summary of Data, 2015 Magpie Creek at the mouth (04901A)

- TSS and Turbidity exceeded the associated target criteria on numerous occasions (75.0% and 41.7% exceedance, respectively) throughout the monitoring period. Exceedances were measured during diverse stream flows, suggesting large amounts of sediments are entering the system throughout the year (Table 14). Magpie Creek is not fully supporting its designated beneficial uses of SS and CWAL.
- Water temperature increased since previous monitoring, with a median of 8.6°C in 2011 to 13.3°C in 2015 (Table 15). In 2015, instantaneous measurements exceeded the target criterion of 13°C four (33.3% exceedance) times during the salmonid spawning and incubation period (Table 14, Figure 31). Additionally, continuous temperature monitoring showed significant exceedances of criteria for SS, as well as numerous (27 days or 13.5%) exceedances of the 19°C daily average criterion of CWAL (Figures 36 & 37, Table 16). Magpie Creek is severely temperature impaired and does not fully support its designated beneficial uses of SS or CWAL.
- Nitrogen decreased slightly from 2011 monitoring; however, concentrations remained well above the target criterion of 0.3 mg/L, and concentrations frequently exceeded the maximum drinking water concentration of 10 mg/L (Table 15). Magpie Creek is severely nitrogen impaired, and thus does not fully support any of the designated beneficial uses of SS and CWAL.
- Phosphorus increased slightly since the 2011 monitoring period; however, all concentrations from both monitoring periods were well above the 0.1 mg/L target criterion (Table 15). Magpie Creek remains phosphorus impaired and is not fully supporting the designated beneficial uses of SS and CWAL.
- *E. coli* concentrations exceeded the target criterion during both monitoring periods. Concentrations were significantly higher in 2015 than in 2011, suggesting further degradation of water quality and increased fecal pollutions from cattle and wildlife, and possibly septic systems in the drainage; however, not enough data was collected to make a designated beneficial use support determination.

- Overall, Magpie Creek is severely temperature and nutrient impaired and is not fully supporting the designated beneficial uses of SS and CWAL. Additional sampling was not conclusive in helping to locate the sources of excess nutrient sources in this watershed, as all sample sites showed extremely elevated nutrients concentrations; therefore, additional monitoring is recommended.

Coyote Creek (01801A).

The table below contains descriptive statistics for data collected from the monitoring station located on Coyote Creek.

Table 17. Descriptive statistics for Coyote Creek (01801A), 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

01801A: Coyote Creek	Temp	DO	DO	pH	Turbidity	<i>E-coli</i> (BOR)	<i>E-coli</i> (NPT)	NO ₃ +NO ₂	OP	TP	TSS	Flow
	(°C)	(mg/L)	%	(H+)	(NTU)	(cfu/100mL)	(cfu/100mL)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)
max	19.8	12.7	100.5	8.8	301.0	500	461	14.40	0.15	0.73	399	44.8
min	3.0	8.5	88.4	7.2	1.9	8	12	0.15	0.09	0.10	3	0.1
mean	12.4	10.2	95.0	8.1	40.9	254	249	4.60	0.11	0.19	52	5.6
median	13.6	10.0	95.0	8.3	11.4	200	249	3.68	0.11	0.14	14	0.7
#exceedance	3	0	1	0	1	1	2	9	8	10	2	
%exceedance	30.0%	0.0%	10.0%	0.0%	10.0%	11.1%	20.0%	90.0%	80.0%	100.0%	20.0%	
# sampling events	10	10	10	10	10	9	10	10	10	10	10	10

- DO did not drop below the 8.0 mg/L target criterion during the sampling period; however, % DO did drop below the 90% saturation criterion on one sampling event (10.0% exceedance) in December during relatively low flow.
- The pH remained within the target range of 6.5-9.0 on all sampling events.
- Turbidity exceeded the target criterion of 51.45 NTU once (10.0% exceedance) in the February monitoring event during the highest recorded flow.
- TSS exceeded the target criterion of 25 mg/L on two sampling events (20.0% exceedance) during and after the highest recorded flow.
- Instantaneous water temperature exceeded the SS target criterion of 13°C three times (30.0%) (Figure 38).

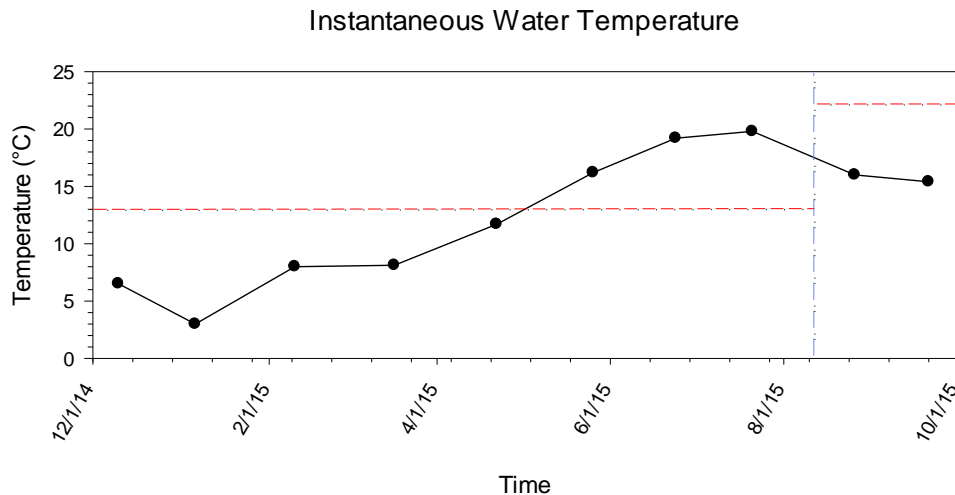


Figure 38. Instantaneous temperature data from Coyote Creek, 2015. The dashed red lines indicate the target criteria of 13°C for SS and 22°C for CWAL.

- NO_3+NO_2 exceeded the 0.3 mg/L target criterion on nine of the ten sampling events, two of which exceeded Idaho’s maximum drinking water standard of 10 mg/L. The highest concentrations appear to coincide with spring runoff, before leveling off near the target criterion during base flow (Figure 39).

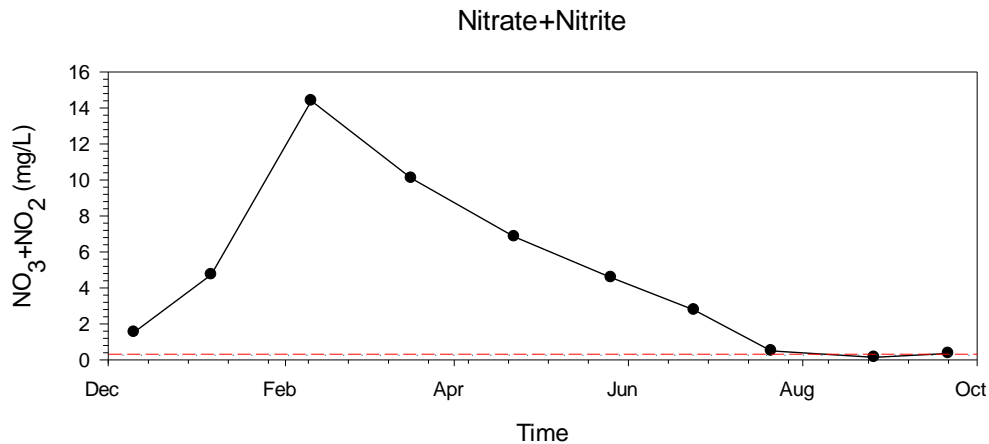


Figure 39. Instantaneous NO_3+NO_2 data from Coyote Creek, 2015. The dashed red line indicates the 0.3 mg/L target criterion.

- All total phosphorus measurements exceeded the 0.1 mg/L target criterion with a range of 0.101 mg/L to 0.73 mg/L and a median of 0.14 mg/L. The highest concentration was measured during the highest recorded flow in February (Figure 40). Orthophosphorus contributed an average of almost 79% to total phosphorus indicating a large amount of total phosphorus is not associated with bank erosion or sediment load.

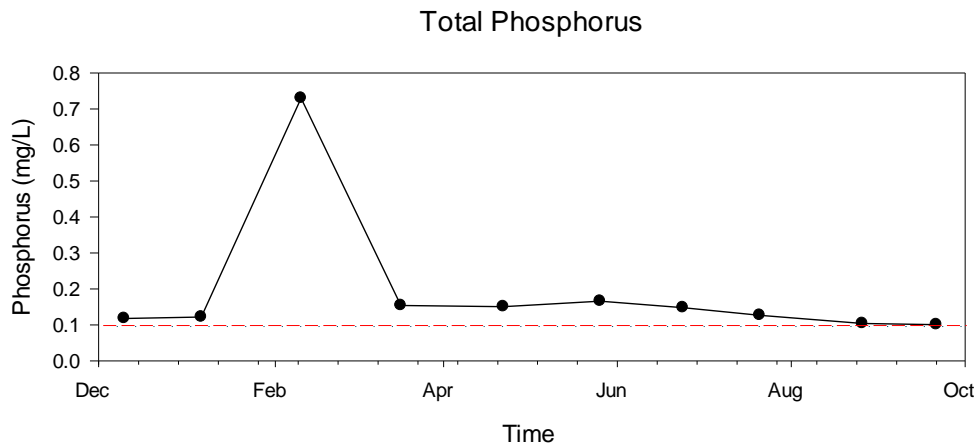


Figure 40. Instantaneous total phosphorus data from Coyote Creek, 2015. The dashed red line indicates the 0.1 mg/L target criterion.

- *E. coli* exceeded the target criterion on three sampling events, but levels were relatively low in this drainage when compared to other sites in the watershed; however, the results from samples run in-house by NPT WRD staff and those analyzed at the BOR laboratory were quite variable, often with, one sample slightly exceeding the criterion, while the other was below. Therefore, no conclusions can be made from this data (Figure 41).

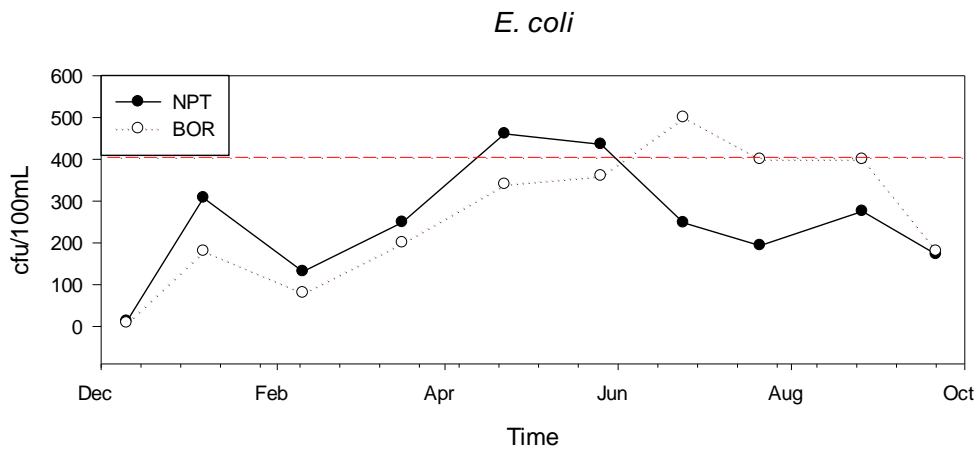


Figure 41. *E. coli* concentrations from Coyote Creek. This figure includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100mL target criterion for PCR.

Comparison to previous data

Coyote Creek was previously sampled by NPT WRD staff in 2010-2011. These data were used in a comparative analysis with the data collected by NPT WRD staff in 2015.

Table 18. Comparison of summary data from Coyote Creek monitoring (01801A), 2011 and 2015. Temp: instantaneous water temperature; NO₃+NO₂: nitrate+nitrite; TP: total phosphorus; TSS: total suspended sediments.

01801A: Coyote Creek	Temp		pH		Turbidity		<i>E. coli</i> (NPT)		NO ₃ +NO ₂		TP		TSS	
	(°C)		(H+)		(NTU)		(cfu/100mL)		(mg/L)		(mg/L)		(mg/L)	
Year	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015
max	16.7	19.8	8.4	8.8	180.0	301.0	>2419.6	461	11.70	14.40	0.60	0.73	144	399
min	4.1	3.0	7.2	7.2	2.1	1.9	<1	12	0.45	0.15	0.11	0.10	1	3
mean	9.2	12.4	7.8	8.1	37.8	40.9	512	249	5.17	4.60	0.25	0.19	35	52
median	7.5	13.6	7.9	8.3	14.6	11.4	38	249	3.74	3.68	0.19	0.14	12	14
#exceedance	2	3	0	0	3	1	3	2	12	9	12	10	3	2
%exceedance	16.7%	30.0%	0.0%	0.0%	25.0%	10.0%	27.3%	20.0%	100.0%	90.0%	100.0%	100.0%	25.0%	20.0%
# sampling events	12	10	12	10	12	10	11	10	12	10	12	10	12	10

- Instantaneous water temperature increased from a median of 7.5°C in 2011 to 13.6°C in 2015 (16.7% to 30.0% exceedance, respectively) (Table 18, Figure 42a).
- Nitrogen concentrations in 2015 were similar to those measured in 2011, with a median of 3.74 mg/L in 2011 to 3.68 mg/L in 2015; however, all measurements, with the exception of one from both monitoring periods, were well above the 0.3 mg/L target criterion, with concentrations exceeding Idaho's maximum drinking water criterion twice during both monitoring periods (Table 18, Figure 42b).
- Total phosphorus concentrations decreased slightly between monitoring periods from a median of 0.19 mg/L in 2011 to 0.14 mg/L in 2015; however, all measurements from both monitoring periods were well above the 0.1 mg/L target criterion (Table 18, Figure 42c).
- *E. coli* concentrations measured in 2011 were relatively low, with the exception of two very high measurements collected during May and June sampling. In contrast, concentrations in 2015 were overall consistently higher than those measured in 2011 with a median increase from 38 cfu/100mL to 249 cfu/100mL; however, exceedances decreased from 27.3% in 2011 to 20.0% in 2015 (Table 18, Figure 42d).

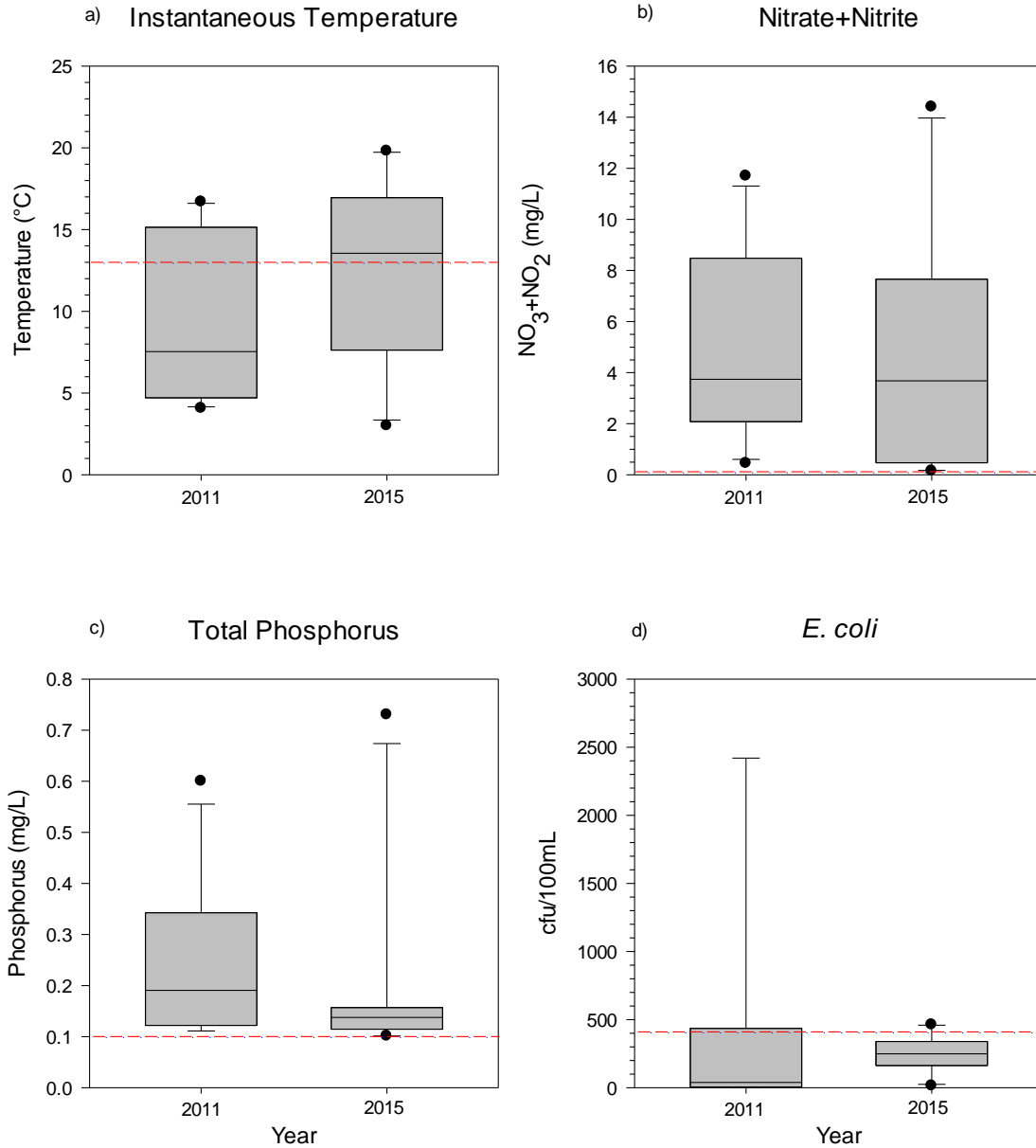


Figure 42. Comparison of Coyote Creek (01801A) data from 2011 and 2015: (a) instantaneous temperature measurements, (b) NO_3+NO_2 levels, (c) total phosphorus levels, and (d) *E. coli* concentrations. The dashed red lines indicate the applicable target criteria.

Continuous Water Temperature Monitoring:

An Onset Water Temperature Pro v2 Data Logger was deployed in Coyote Creek at the mouth from June 2-December 3, 2015 and collected data hourly.

**Coyote Creek
Continuous Water Temperature**

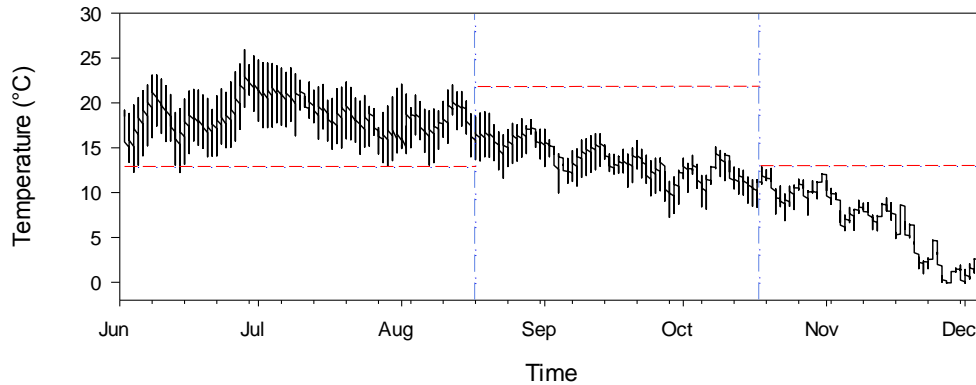


Figure 43. Continuous actual temperature data from Coyote Creek (01801A), June-December, 2015. The dashed red line indicates the target criteria.

- Throughout the duration of monitoring, there were 25 (13.5%) and two (1.1%) exceedances of the CWAL criteria of 22°C daily max and 19°C daily average, respectively. In addition, of data collected during the salmonid spawning and incubation period, there were 74 (59.7%) and 92 (74.2%) exceedances of the 13°C daily max and 9°C daily average target criteria, respectively (Figure 43 & 44, Table 19).

**Coyote Creek
Continuous Water Temperature**

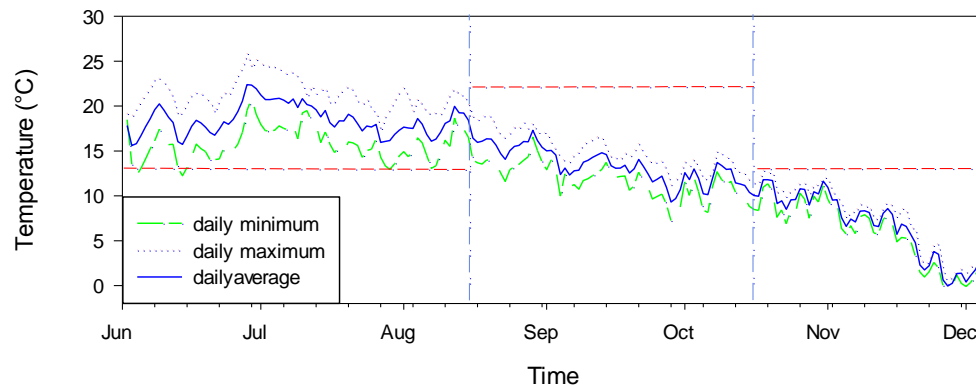


Figure 44. Continuous minimum, maximum, and average temperature data from Coyote Creek (01801A), June-December, 2015. The dashed red line indicates the target criteria.

Table 19. Continuous temperature exceedances for Coyote Creek (01801A), June-December, 2015.

01801A Cottonwood Cr. (mouth)	22°C daily max (CWAL)	19°C daily average (CWAL)	13°C daily max (SS)	9°C daily average (SS)
# Exceedances	25	2	74	92
Sample size	185	185	124	124
% Exceedance	13.5%	1.1%	59.7%	74.2%

Summary of Data, 2015 Coyote Creek at the mouth (01801A)

- Turbidity exceeded the target criteria of 51.45 NTU once (10.0% exceedance) during the monitoring period; however, this exceedance occurred during the highest recorded flow, thus a support status cannot definitively be determined without further investigation (Table 17).
- TSS exceeded the target criteria of 25 mg/L on two sampling events (20.0% exceedance) during the monitoring period; however, these exceedances occurred during and after the highest recorded flow so the support status determination remains unclear and additional monitoring is recommended (Table 17).
- Water temperature significantly since monitoring in 2011 with an increase in medians from 7.5°C in 2011 to 13.6°C in 2015 (Table 18, Figure 42a). In 2015 instantaneous measurements exceeded the target criterion of 13°C three times (30.0% exceedance) during the salmonid spawning and incubation period (Table 17, Figure 38). In addition, continuous temperature monitoring showed exceedances of the 13°C daily maximum and 9°C daily average SS target criteria 74 times (59.7%) and 92 times (74.2%), respectively, as well as 25 (13.5%) exceedances of the 22°C daily maximum target criterion for CWAL (Table 19, Figures 43 & 44). Therefore, Coyote Creek is not fully supporting the designated beneficial uses of SS or CWAL.
- Nitrogen concentrations measured in 2015 were similar to those measured in 2011, with a median of 3.74 mg/L in 2011 to 3.68 mg/L in 2015; however, most concentrations remained well above the target criterion of 0.3 mg/L, and concentrations exceeded Idaho's maximum drinking water standard of 10 mg/L twice. Coyote Creek remains nitrogen impaired, and thus is not fully supporting the designated beneficial uses of SS and CWAL.
- Phosphorus decreased slightly between monitoring periods from a median of 0.19 mg/L in 2011 to 0.14 mg/L in 2015. All concentrations from both monitoring periods were well above the 0.1 mg/L target criterion. This creek is phosphorus impaired and is not fully supporting the designated beneficial uses of SS and CWAL.
- Overall, *E. coli* concentrations increased between sampling periods from a median of 38 cfu/100mL in 2011 to 249 cfu/mL in 2015, despite a decrease in percent exceedances from 27.3% in 2011 to 20.0% in 2015. Not enough data was collected to make a designated beneficial use support determination.

Star Mill Creek (07701A).

The table below contains descriptive statistics for data collected from the monitoring station located on Star Mill Creek.

Table 20. Descriptive statistics for Star Mill Creek (07701A), 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

07701A: Star Mill Creek	Temp	DO	DO	pH	Turbidity	<i>E-coli</i> (BOR)	<i>E-coli</i> (NPT)	NO ₃ +NO ₂	OP	TP	TSS	Flow
	(°C)	(mg/L)	%	(H+)	(NTU)	(cfu/100mL)	(cfu/100mL)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)
max	12.1	12.2	112.6	9.2	14.0	200	228	4.11	0.07	0.17	6	2.0
min	1.2	7.7	71.3	6.7	3.6	< 4.00	3	0.04	0.03	0.04	1	0.0
mean	7.0	10.7	88.7	7.6	8.1	63	51	1.51	0.04	0.07	4	0.7
median	6.6	11.3	87.3	7.5	7.2	24	18	1.02	0.04	0.06	4	0.3
#exceedance	0	1	3	1	0	0	0	4	0	1	0	
%exceedance	0.0%	17.0%	50.0%	16.7%	0.0%	0.0%	0.0%	66.7%	0.0%	16.7%	0.0%	
# sampling events	6	6	6	6	6	4	6	6	6	6	6	6

- DO dropped below the 8.0 mg/L target criterion once (17.0% exceedance) during sampling in late May, just before the stream dried up. DO also dropped below the 90% target criteria for SS on three sampling events (50.0% exceedance).
- The pH exceeded the target range of 6.5-9.0 once during the monitoring period (16.7% exceedance).
- Turbidity and TSS did not exceed the target criteria.
- Instantaneous water temperature did not exceed the 13°C SS target criterion throughout the monitoring period.

Instantaneous Water Temperature

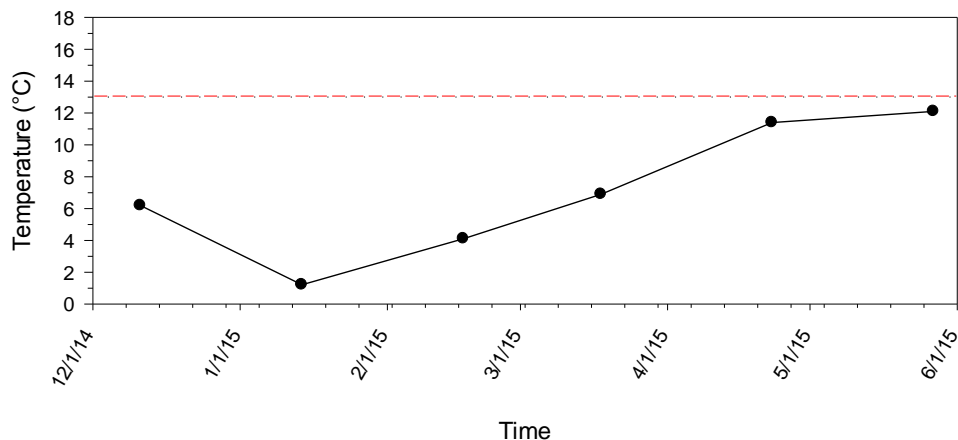


Figure 45. Instantaneous temperature data from Star Mill Creek, 2015. The dashed red line indicates the target criterion of 13°C for SS.

- NO_3+NO_2 concentrations exceeded the 0.3 mg/L target criterion four times (66.7%) during the monitoring period. Concentrations peaked in mid-January before leveling off below the target criterion in late April before the stream dried up.

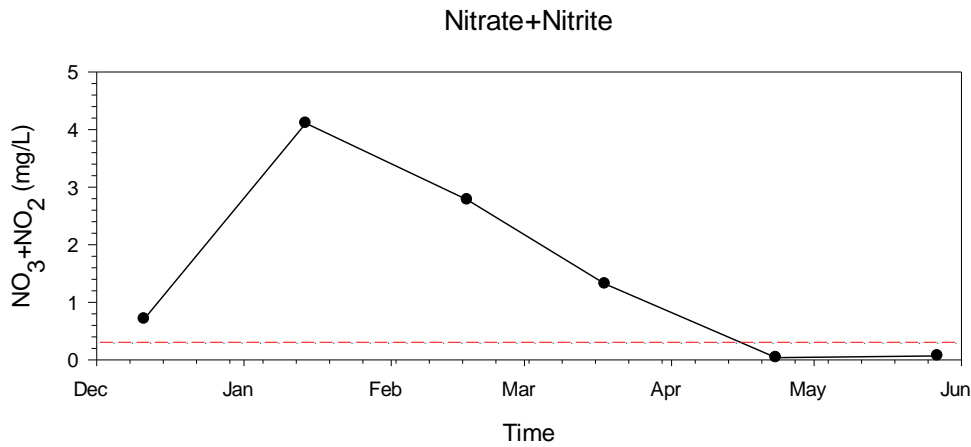


Figure 46. Instantaneous NO_3+NO_2 data from Star Mill Creek, 2015. The dashed red line indicates the 0.3 mg/L target criterion.

- Total phosphorus exceeded the target criterion once in late May during extremely low flow just before the stream dried up. Orthophosphorus contributed an average of 65% to the total phosphorus.

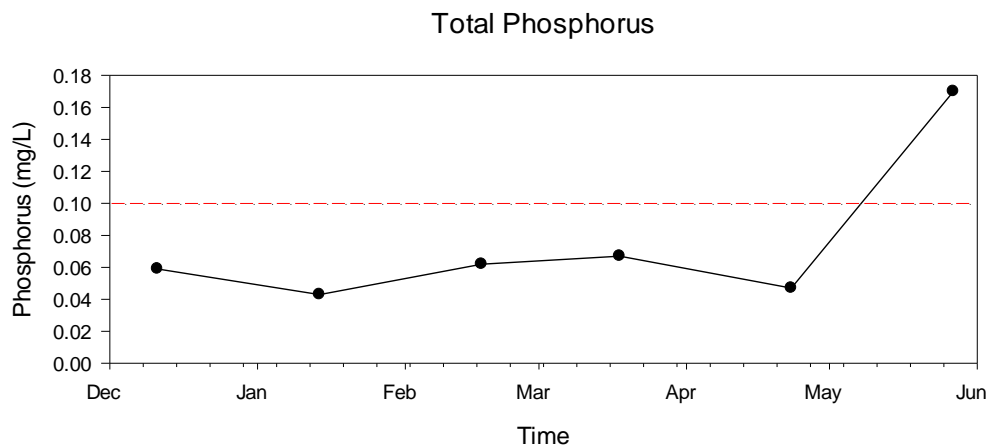


Figure 47. Instantaneous total phosphorus data from Star Mill Creek, 2015. The dashed red line indicates the 0.1 mg/L target criterion.

- *E. coli* samples analyzed by both the NPT and BOR were well below the target criterion throughout the monitoring period.

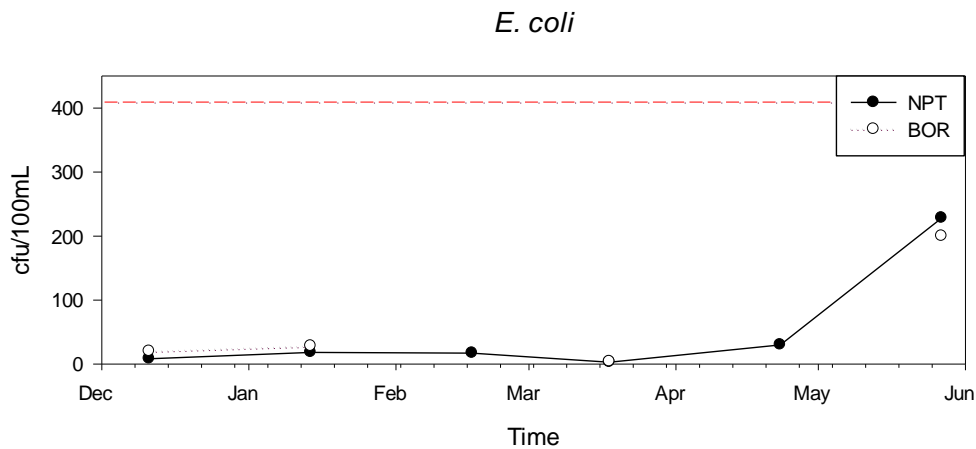


Figure 48. *E. coli* concentrations from Star Mill Creek. The figure includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100mL target criterion for PCR.

Summary of Data, 2015 Star Mill Creek at the mouth (07701A)

- Turbidity and TSS met the associated target criteria throughout the monitoring period.
- pH exceeded the target range on one sampling event with a value of 9.2 in April.
- DO was below the 8.0 mg/L target criterion once in late May. This concentration was measured during the last sampling event during extremely low flows and just before the stream dried up for the summer months. Additionally, DO dropped below the 90% criterion needed for SS three times throughout the study. Two of these events occurred during extremely low flow so a support status determination cannot be made without further investigation.
- Instantaneous water temperature did not exceed the target criterion throughout the monitoring period. However, as water levels decreased and air temperature began to increase in late April-May, water temperatures began to approach the target criterion.
- NO₃+NO₂ concentrations exceeded target criterion four times (66.7% exceedance) during the monitoring period. The highest concentration was over 4 mg/L in mid-January, decreasing to below the target criterion in the April and May sampling events. Overall, NO₃+NO₂ concentrations were very high for the majority of the monitoring period. Thus, this monitoring location is nitrogen impaired and does not fully support the designated beneficial uses of SS and CWAL.

- Total phosphorus exceeded the target criterion once, or 16.7%, during the monitoring period. On average, orthophosphorus contributed to 65% of the total phosphorus, suggesting the majority of nutrients were originating from surrounding agriculture and/or grazing pastures. Overall, this monitoring location had greater than 10% exceedance of the target criterion; however, it occurred during low flow before drying up for the summer months, so no definitive conclusions can be made for a designated beneficial use determination.
- All *E. coli* concentrations were well below the target criterion; however, not enough data was collected to make a designated beneficial use support determination.

Pickle Canyon Creek (05903A)

The table below contains descriptive statistics for data collected from the monitoring station located near the mouth of Pickle Canyon Creek.

Table 21. Descriptive statistics for Pickle Canyon Creek (05903A), 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

05903A: Pickle Canyon Creek	Temp	DO	DO	pH	Turbidity	<i>E-coli</i> (BOR)	<i>E-coli</i> (NPT)	NO ₃ +NO ₂	OP	TP	TSS	Flow
	(°C)	(mg/L)	%	(H+)	(NTU)	(cfu/100mL)	(cfu/100mL)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)
max	7.0	12.1	90.7	7.5	21.8	100	55	2.55	0.05	0.10	10	3.6
min	1.6	11.0	87.0	6.4	9.1	12	5	0.14	0.04	0.04	<1	0.1
mean	3.9	11.5	88.9	7.0	15.4	64	29	1.07	0.04	0.08	5	1.2
median	3.4	11.4	88.8	7.1	16.0	80	36	0.76	0.04	0.09	3	0.6
#exceedance	0	0	4	1	0	0	0	4	0	0	0	
%exceedance	0.0%	0.0%	80.0%	20.0%	0.0%	0.0%	0.0%	80.0%	0.0%	0.0%	0.0%	
# sampling events	5	5	5	5	5	3	5	5	5	5	5	5

- DO did not drop below 8.0 mg/L during the monitoring period; however, DO did fall below the 90% saturation criterion for SS on four sampling events (80.0% exceedance).
- pH fell below the target range of 6.5 to 9.0 on one occasion in mid-March with a value of 6.38.
- Turbidity did not exceed 51.45 NTU during the monitoring period.
- TSS did not exceed the 25 mg/L target criterion.
- Instantaneous water temperature was well below the 13°C target criterion for SS throughout the monitoring period as the stream dried up shortly after the April sampling event.

Instantaneous Water Temperature

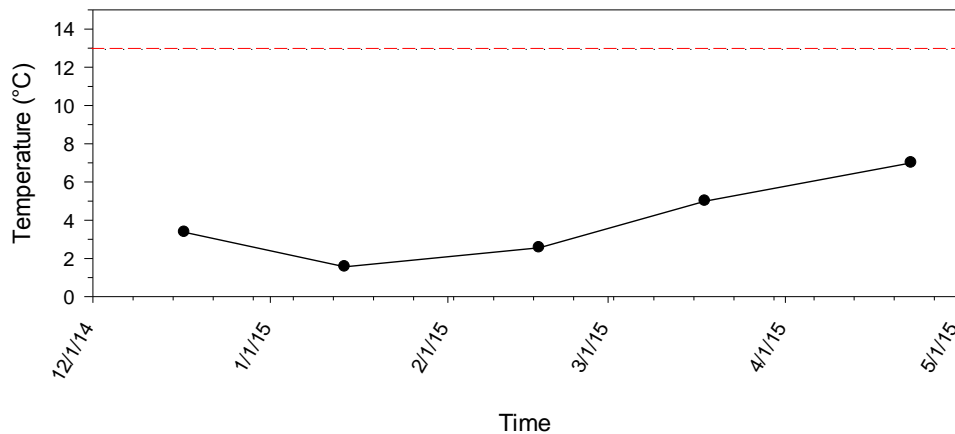


Figure 49. Instantaneous temperature data from Pickle Canyon Creek, 2015. The dashed red line indicates the target criterion of 13°C for SS.

- NO_3+NO_2 concentrations exceeded the 0.3 mg/L target criterion on all but one sampling event (80% exceedance). The highest concentration was recorded in mid-January at 0.76 mg/L, and then decreased until the stream dried up shortly after the April sampling event (Figure 42).

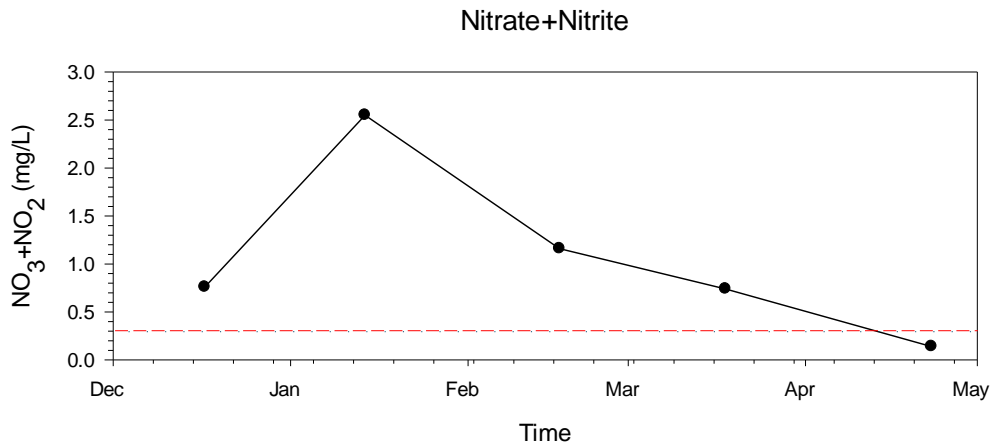


Figure 50. Instantaneous NO_3+NO_2 data from Pickle Canyon Creek, 2015. The dashed red line indicates the 0.3 mg/L target criterion.

- Total phosphorus did not exceed the 0.1 mg/L target criterion during the monitoring period, however, several measurements were at or approaching the target criterion with values of 0.10, 0.098, and 0.090.

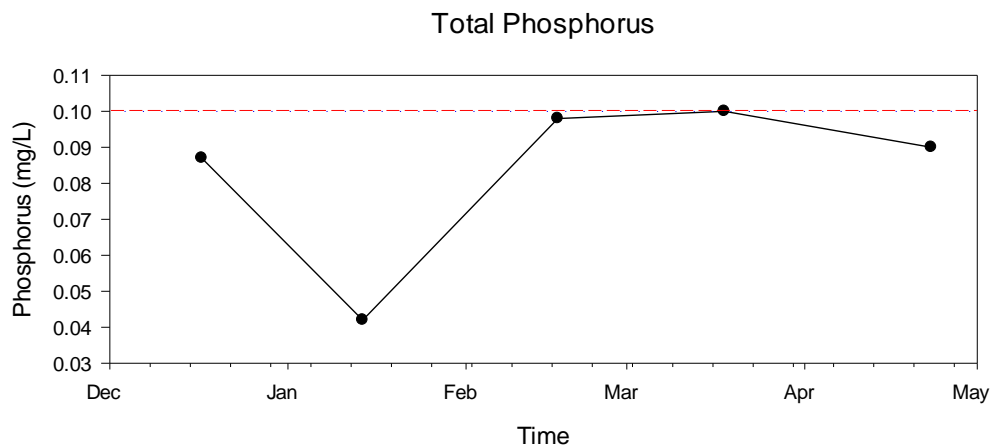


Figure 51. Instantaneous total phosphorus data from Pickle Canyon Creek, 2015. The dashed red line indicates the 0.1 mg/L target criterion.

- All *E. coli* concentrations were well below the target criterion of 406 cfu/100mL.

E. coli

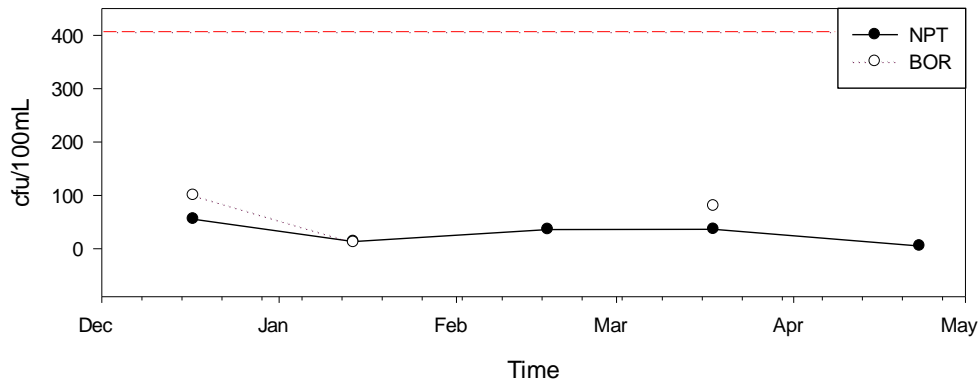


Figure 52. *E. coli* concentrations from Pickle Canyon Creek, 2015. The figure includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100 mL target criterion for PCR.

Comparison to previous data

Pickle Canyon Creek was sampled in 2010-2011 by NPT WRD staff. These data were used in a comparative analysis with the data collected by NPT WRD staff in 2015.

Table 22. Comparison of summary data from Pickle Canyon Creek (05903A), 2011 and 2015. Temp: instantaneous water temperature; NO₃+NO₂: nitrate+nitrite; TP: total phosphorus; TSS: total suspended sediments.

05903A: Pickle Canyon Creek	Temp		pH		Turbidity		<i>E. coli</i> (NPT)		NO ₃ +NO ₂		TP		TSS	
	(°C)		(H+)		(NTU)		(cfu/100mL)		(mg/L)		(mg/L)		(mg/L)	
Year	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015
max	8.0	7.0	6.8	7.5	23.9	21.8	51	55	8.24	2.55	0.13	0.10	2	10
min	1.0	1.6	5.4	6.4	5.9	9.1	2	5	0.22	0.14	0.06	0.04	<1	<1
mean	4.0	3.9	5.9	7.0	17.2	15.4	21	29	1.96	1.07	0.09	0.08	2	5
median	3.2	3.4	5.9	7.1	19.1	16.0	11	36	0.51	0.76	0.09	0.09	2	3
#exceedance	0	0	4	1	0	0	0	0	3	4	1	0	0	0
%exceedance	0.0%	0.0%	80.0%	20.0%	0.0%	0.0%	0.0%	0.0%	60.0%	80.0%	20.0%	0.0%	0.0%	0.0%
# sampling events	5	5	5	5	5	5	3	5	5	5	5	5	5	5

- Instantaneous water temperature remained similar between years with a median of 3.2°C in 2011 and 3.4°C in 2015. There were no exceedances for SS or CWAL in either year in which sampling occurred (Table 22, Figure 53a).
- Nitrogen concentrations increase slightly from a median of 0.51 mg/L to 0.76 mg/L (Table 22, Figure 53b).
- Total phosphorus concentrations remained stable between monitoring periods with medians of 0.09 mg/L in both years. There were no documented exceedances in 2015 (Table 22, Figure 53c).
- *E. coli* concentrations remained at low levels, and no exceedances were documented (Table 22, Figure 53d).

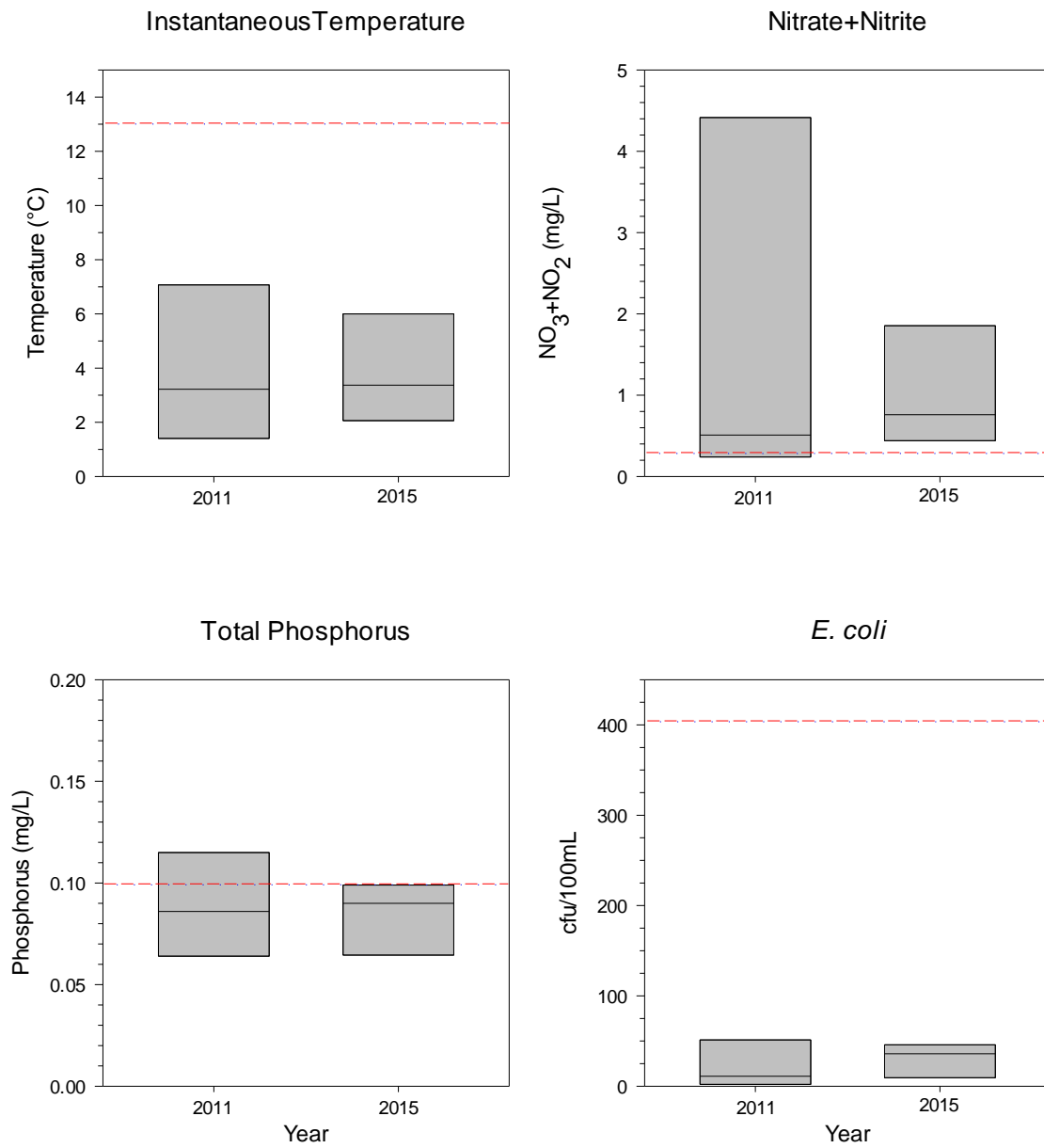


Figure 53. Comparison of Pickle Canyon Creek (05903A) data from 2011 and 2015: (a) instantaneous temperature measurements, (b) NO₃+NO₂ levels, (c) total phosphorus levels, and (d) *E. coli* concentrations. The dashed red lines indicate the applicable target criteria.

Summary of Data, 2015 Pickle Canyon Creek at the mouth (05903A)

- Turbidity and TSS met the associated target criteria throughout the monitoring period (Table 21).
- pH was below the target range once in mid-March during highest recorded flows (Table 21). Potentially, this could be a result of snow melt which tends to be slightly more acidic than normal precipitation. One exceedance during highest recorded flow is not sufficient for a support status to be determined.
- DO did not fall below the 8.0 mg/L target criterion; however, DO did drop below the 90% saturation criterion for SS on four of the five sampling events. Thus, this location is not fully meeting its designated beneficial use of SS (Table 21).
- Instantaneous water temperature did not exceed the target criteria during the monitoring period (Table 21, Figure 49). This monitoring location is the only one sampled that definitively supports SS and CWAL based on temperature; however, the stream dried up before May making it improbable that many of the temperature sensitive species are present at this location.
- NO_3+NO_2 concentrations exceeded target criterion four times (80.0% exceedance) during the monitoring period. The highest concentration was recorded in mid-January then decreased to below the target criterion in April just before drying up for the summer months (Table 21, Figure 50). Overall, NO_3+NO_2 concentrations were very high for the majority of the monitoring period. Thus, this monitoring location is nitrogen impaired and does not fully support the designated beneficial uses of SS and CWAL.
- Total phosphorus did not exceed the target criterion (Table 21, Figure 51). However, the stream dried up before the heaviest cattle use occurs during hot summer temperatures. Potentially, total phosphorus levels could exceed the target criterion in milder, wetter years, and additional monitoring should be conducted in the future.
- All *E. coli* concentrations were well below the target criterion; however, not enough data were collected to make a designated beneficial use support determination (Table 21, Figure 52).

Designated Beneficial Use Support Status

Designated beneficial use support status determinations for Cottonwood Creek and its tributaries have been developed based on the water quality data collected during this study. Table 23 lists the waterbodies and their designated beneficial use status. For PCR, five samples taken within 30 days must exceed the target criterion. In this study, bacteria samples were taken only once per month; therefore, support determination could not be assigned for PCR designated use.

Table 23. Designated beneficial use support status for assessed waterbodies.

Waterbody Name	Total Stream Miles	Designated Uses	Use Support Decision	Parameter/ Indicator
Cottonwood Creek (source to mouth)	16.65	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Fully Supporting	Temperature, NO ₃ +NO ₂ , TP, TSS
		Salmonid Spawning	Not Fully Supporting	Temperature, NO ₃ +NO ₂ , TP, DO, TSS
Coyote Creek	5.31	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Fully Supporting	NO ₃ +NO ₂ , TP
		Salmonid Spawning	Not Fully Supporting	Temperature, NO ₃ +NO ₂ , TP

Waterbody Name	Total Stream Miles	Designated Uses	Use Support Decision	Parameter/ Indicator
Magpie Creek	3.87	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Fully Supporting	NO ₃ +NO ₂ , TP, TSS
		Salmonid Spawning	Not Fully Supporting	Temperature, NO ₃ +NO ₂ , TP, TSS
Pickle Canyon Creek	3.24	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Fully Supporting	NO ₃ +NO ₂
		Salmonid Spawning	Not Fully Supporting	NO ₃ +NO ₂ , DO
Star Mill Creek	3.92	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Fully Supporting	NO ₃ +NO ₂
		Salmonid Spawning	Not Fully Supporting	NO ₃ +NO ₂

DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; TP: total phosphorus; TSS: total suspended solids.

Conclusions

The monitoring program for the main stem and tributaries of Cottonwood Creek was successfully carried out as planned. Protocols were followed, QA/QC standards were met, and specific information per parameter for each subwatershed was collected.

Nutrients, sediments, and excessive stream temperatures were the primary pollutants documented within the Cottonwood Creek watershed during this study.

Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Aquatic insects are sensitive to temperature and will move in a stream in order to find their optimal temperature. Temperature is also critical for fish spawning and embryo development. If stream temperatures are outside of optimal levels for prolonged periods of time, organisms become stressed and may die or be unable to reproduce. Salmonid spawning is a designated beneficial use for Cottonwood Creek and its tributaries, and there is a relatively stringent temperature requirement associated with that designated use. Almost every site exceeded the salmonid spawning and incubation temperature criteria to some degree during the course of this study.

High phosphorus concentration is a persistent issue throughout the watershed. The only site that did not exceed the 0.1 mg/L target criterion during the monitoring period was Pickle Canyon Creek (05903A), which is a tributary of Cottonwood Creek located in the headwater region, though it is important to note that the phosphorus levels were at or just below the target criterion and the creek dried up early in the year.

Orthophosphorus, or dissolved phosphorus, was a major contributor to total phosphorus loads in all sites, with a minimum contribution of 50% in Cottonwood Creek at Tribal Allotment #1801 (01514A) to nearly 80% in Coyote Creek. This suggests that the majority of total phosphorus is coming from nearby agriculture fields and grazing allotments, rather than a result of erosion and sediment input. The high level of total phosphorus is potentially contributing to excessive growth of algae and other aquatic plants that cause the depletion of dissolved oxygen when they decompose, which can result in the disappearance of intolerant aquatic insect species and fish.

NO₃+NO₂ levels were also high in the entire Cottonwood Creek catchment area. Concentrations exceeded the 0.3 mg/L target criterion in nearly all sampling events at each monitoring location and ranging from 67% exceedance in Star Mill Creek to 100% in three of the seven other locations. In addition, concentrations at three sites exceeded the Idaho safe drinking water standard of 10 mg/L, and two more sites were at or near the standard. The Cottonwood Creek watershed is severely nutrient impaired and needs to be addressed immediately with the implementation of best management practices (BMPs).

Even with the relatively high levels of nutrients seen in this study, there was only one documented instance where DO levels dropped below the 8.0 mg/L target criterion; however, every monitoring site except Cottonwood Creek at the mouth (01501A) had at least one sampling event in which the percent saturation of dissolved oxygen dropped below the 90% saturation required for salmonid spawning. This drop in percent saturation of dissolved oxygen, coupled with excessive nutrient loading, is a concern for future water quality as temperatures continue to rise as a result of climate change.

Escherichia coli (*E. coli*) is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Bacteria levels were relatively low in the headwaters of Cottonwood Creek; however, concentrations exceeded the target criterion at all monitoring locations in the lower portions of the watershed. Magpie Creek was by far the worst with over 80% exceedance, and should be a focal location for BMP implementation to address excessive bacteria concentrations.

Total suspended solids (TSS) include both sediment and organic material suspended in water. TSS can cause problems for fish by clogging gills and for aquatic plants by limiting growth because of reduced light penetration. In addition, TSS provides a medium for the accumulation and transport of other constituents such as nitrogen, phosphorus, and bacteria. Sediment was generally high throughout the watershed with more than 10% exceedance at all monitoring locations except Star Mill Creek and Pickle Canyon Creek. Magpie Creek was the most impaired monitoring location with a 75% exceedance and maximum value of nearly 1,650 mg/L. Focus should be put on Magpie Creek for implementation of erosion-control BMPs.

Recommendations

Significant erosion is currently evident along a number of streams within the Cottonwood Creek watershed and treatment should be applied to those undergoing the most severe erosion. Nutrients are a major problem in this watershed and controlling erosion would certainly help to decrease TP levels. Every stream, including the main stem of Cottonwood Creek, is water quality limited and will benefit from strategic implementation of BMPs to reduce sediment, nutrients, bacteria, and thermal loading.

Magpie Creek in particular appears to be the tributary that is contributing the highest sediment, nutrient, and bacteria loads to the main stem of Cottonwood Creek and should be prioritized for implementation of BMP measures. Additional sampling was done in an attempt to locate focal points of nutrient loading in Magpie Creek (Appendix B); however, the data show impairment of all additional sample sites, with extremely high concentrations of nitrogen and phosphorus. Recommended BMPs include: fencing the riparian area to keep cattle away from the creek, adding stream stabilization structures, and revegetating the streambank and riparian area to help reduce sediment loading. In addition, several homes are spread throughout the watershed and likely use private septic systems. Testing the creek for human-related water quality parameters (caffeine, hormones, pharmaceuticals, etc.) above and below each residence is recommended to determine if any septic systems are a source of nutrient and bacteria pollution.

Coyote Creek also contributes a great deal of sediment, nutrients, and bacteria to Cottonwood Creek. Recommended BMPs are the same as for Magpie Creek: fencing the riparian area to keep cattle away from the creek, adding stream stabilization structures, and revegetating the streambank and riparian area to help reduce sediment transport.

Excessive stream temperatures will be a difficult issue to overcome. Perhaps the most effective strategy would be to work toward the establishment of natural full potential canopy shade. Reducing sediment loads within critical reaches will assist in reducing stream temperatures as well, since suspended particles absorb more heat.

Continued implementation of targeted stream restoration efforts to reduce sediment loads, and lower nutrients, bacteria levels, and temperatures will be important. Based on stream inventory and prioritization efforts, stakeholders (NPT, Natural Resources Conservation Service (NRCS), Soil Conservation Commission (SCC), Idaho Department of Environmental Quality (IDEQ), Soil and Water Conservation Districts (SWCDs), and private land owners) should fund, devise, and construct high quality stream improvements designed to promote water quality enhancement.

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Appendix A: Spring Creek (Nez 931)

The table below contains descriptive statistics for data collected from the monitoring station located on Spring Creek. Spring Creek runs into Lapwai Creek in Lapwai, Idaho near Garden Gulch Road. Water from Spring Creek is used for a Nez Perce Tribal sweathouse located just upstream of the mouth. This monitoring location was added as a result of water quality safety concerns from sweathouse participants, particularly *E. coli* concentrations.

Table 24. Descriptive statistics for Spring Creek (Nez 931), January-September, 2015. Temp: instantaneous water temperature; DO: dissolved oxygen; NO₃+NO₂: nitrate+nitrite; OP: orthophosphorus; TP: total phosphorus; TSS: total suspended sediments.

Nez 931: Spring Creek	Temp	DO	DO	pH	Turbidity	<i>E-coli</i> (BOR)	<i>E-coli</i> (NPT)	NO ₃ +NO ₂	OP	TP	TSS	Flow
	(°C)	(mg/L)	% sat.	(H+)	(NTU)	(cfu/100mL)	(cfu/100mL)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)
max	13.6	9.8	87.2	8.1	19.7	600	225	2.60	0.08	0.21	50	2.7
min	8.1	8.1	76.8	6.9	1.5	8	5	0.50	0.06	0.07	3	0.7
mean	11.4	8.9	81.1	7.4	6.9	143	92	1.40	0.07	0.13	23	1.4
median	11.3	9.0	82.0	7.5	3.4	84	95	1.18	0.07	0.10	11	1.4
#exceedance	1	0	10	0	0	1	0	9	0	4	4	
%exceedance	10.0%	0.0%	100.0%	0.0%	0.0%	11.1%	0.0%	100.0%	0.0%	44.4%	44.4%	
# sampling events	10	10	10	10	10	9	10	9	9	9	9	10

- pH remained within the target range during the monitoring period.
- Turbidity did not exceed the associated target criterion during the monitoring period.
- TSS exceeded the target criterion of 25mg/L on four sampling events (44.4% exceedance).
- DO did not exceed the 8.0 mg/L target criterion; however, percent DO did drop below the 90% saturation criterion for SS in all ten sampling events.

- Temperature exceeded the SS target criterion once in July (10.0% exceedance).

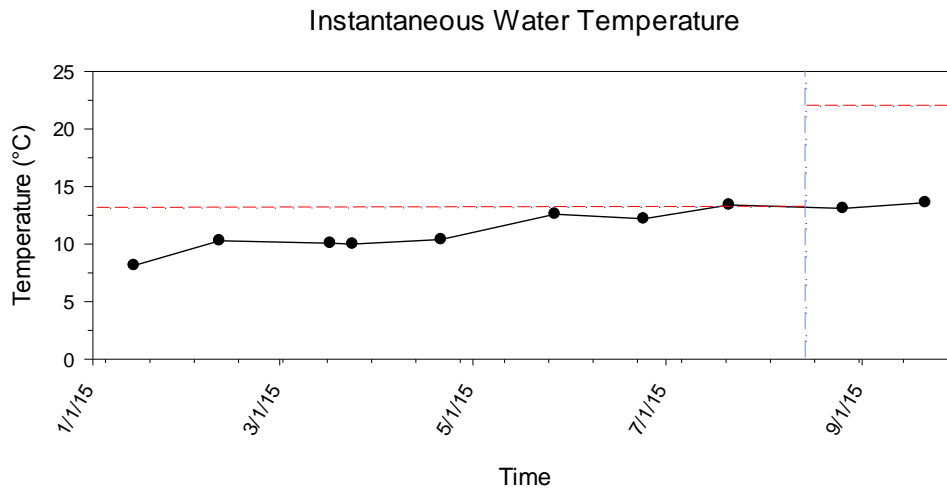


Figure 54. Instantaneous water temperature data from Spring Creek, 2015. The dashed red lines indicate the target criteria.

- NO_3+NO_2 exceeded the 0.3 mg/L target criterion in all sampling events. Concentrations were highest during spring runoff.

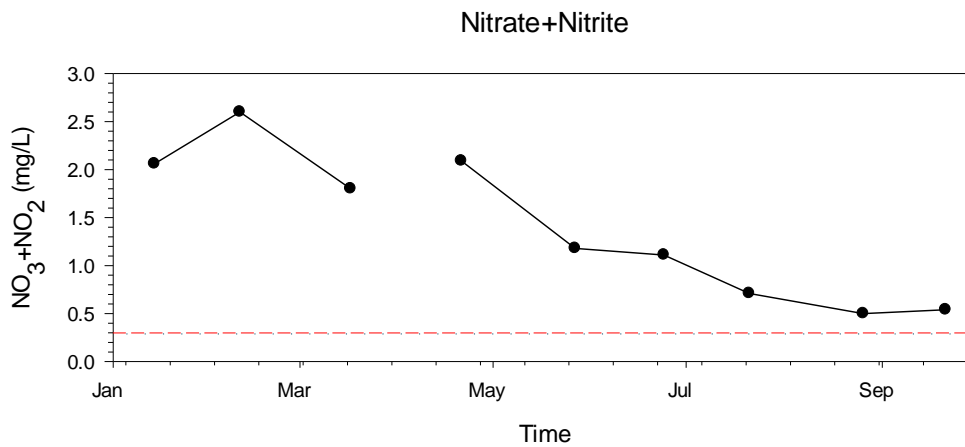


Figure 55. NO_3+NO_2 data from Spring Creek, 2015. The dashed red line indicates the target criterion of 0.3 mg/L.

- Total phosphorus exceeded the 0.1 mg/L criteria on four sampling events (44.4% exceedance). Concentrations were highest during spring runoff and hovered just under the target criteria during base flow later in the year.

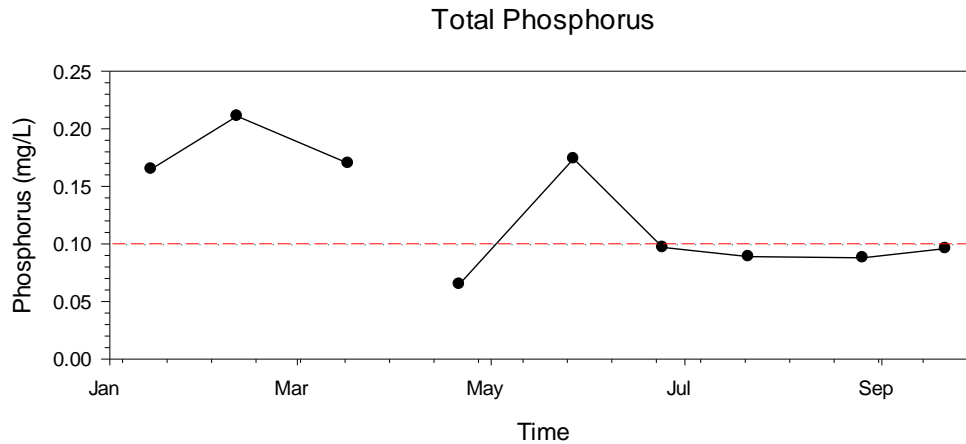


Figure 56. Total Phosphorus data from Spring Creek, 2015. The dashed red line indicates the target criterion of 0.1 mg/L.

- *E. coli* concentrations were relatively low throughout the monitoring period. The only sample that exceeded 406 cfu/100mL occurred mid-June and only the sample analyzed by BOR exceeded the criterion.

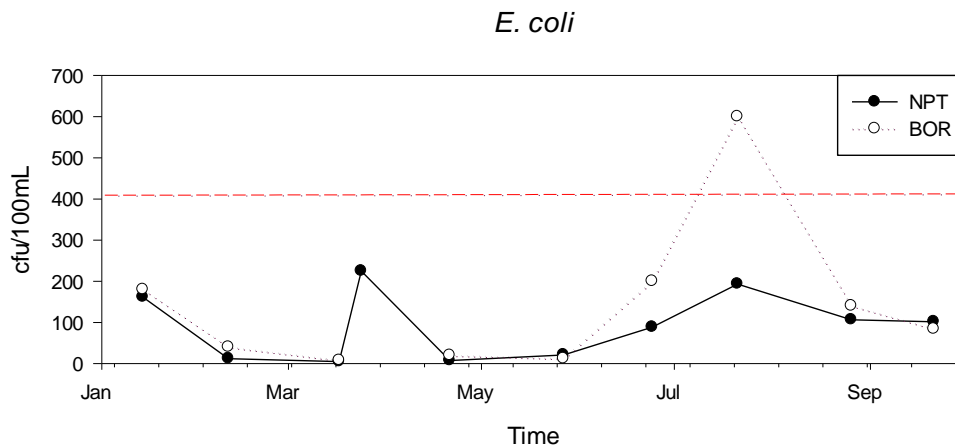


Figure 57. *E. coli* concentrations from Spring Creek, 2015. This figure includes data from samples processed by NPT WRD staff and the BOR laboratory. The dashed red line indicates the 406 cfu/100mL target criterion for PCR.

Summary of Data, 2015 Spring Creek at the mouth (Nez 931)

- Turbidity and pH met the associated target criteria throughout the monitoring period.
- TSS exceeded the 25mg/L target criterion on four sampling events (44.4% exceedance), so Spring Creek is not fully supporting the designated beneficial uses of CWAL and SS.

- DO did not exceed the 8.0 mg/L target criterion; however, DO did drop below the 90% saturation needed for SS on all sampling events. Thus, this location is not fully supporting its designated beneficial use of SS.
- Instantaneous water temperature exceeded the target criteria once (10% exceedance) during the monitoring period. This occurred on the warmest day of sampling in mid-July.
- NO_3+NO_2 and total phosphorus concentrations exceeded target criteria on 100.0% and 44.4% of sampling events, respectively. This location is severely nutrient impaired and does not fully support the designated beneficial uses of SS and CWAL.
- Most *E. coli* concentrations were well below the target criteria. Not enough data was collected to make a designated beneficial use support determination; however, this location was sampled due to health concerns for tribal members from high *E. coli* concentrations. Results indicate there is no immediate threat to tribal health.

Appendix B: Raw Data

Table 25. Raw data for Cottonwood Creek at Mouth (01501A).

01501A: Cottonwood Creek (mouth)															
Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO) (mg/L)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH ₃ -Diss	TSS	Velocity-discharge
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs
12/10/2014	11:35	6.5	286	95.6	11.3	7.6	1.5	29	20	1.78	0.09	0.099	0.02	7	4.5
1/6/2015	10:45	4.2	204	98.0	12.4	6.7	19.8	345	220	3.02	0.108	0.152	< 0.01	44	25.5
2/11/2015	11:30	6.9	198	97.5	11.7	7.6	25.0	13	60	9.66	0.105	0.171	< 0.01	22	144.3
2/11/2015	14:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	136.5
2/26/2015	10:00	5.5	204	98.1	12.1	7.4	12.7	82	N/A	N/A	N/A	N/A	N/A	N/A	37.4
3/17/2015	10:00	7.8	206	98.8	11.6	7.4	9.7	148	360	6.05	0.075	0.096	0.03	7	29.5
3/24/2015	10:10	7.8	160	97.8	11.7	8.0	48.5	161	N/A	6.34	0.103	0.199	0.03	42	169.4
4/21/2015	12:50	14.4	195	108.5	11.0	8.7	4.6	68	60	3.78	0.068	0.084	0.02	4	18.3
5/26/2015	11:10	17.1	275	98.8	9.5	8.2	11.7	488	320	2.1	0.11	0.142	0.03	24	5.2
6/2/2015	11:00	15.5	210	92.7	9.3	7.8	1409.0	> 2420	11000	2.66	0.139	1.6	< 0.01	860	20.5
6/24/2015	10:40	18.6	325	102.0	9.5	8.2	5.5	214	300	1.25	0.098	0.123	0.02	11	2.1
7/21/2015	11:30	21.0	340	92.7	8.2	8.6	3.9	47	40	0.42	0.118	0.13	0.02	6	0.2
8/26/2015	10:40	16.7	318	91.4	8.9	8.2	3.1	276	320	0.26	0.073	0.085	< 0.01	9	0.5
9/21/2015	11:30	16.8	320	99.0	9.6	8.4	4.5	88	200	0.56	0.085	0.102	< 0.01	8	1.2
10/30/2015	3:20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.3
11/10/2015	14:20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.9
12/9/2015	10:15	8.0	286	94.10	11.14	8.06	20.60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.3

Table 26. Raw data for Cottonwood Creek at Cottonwood Creek Road (01508A).

01508A: Cottonwood Creek (at Cottonwood Creek Road)

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO) (mg/L)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH3-Diss	TSS	Velocity-discharge
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs
12/10/2014	14:45	10.7	242	77.1	8.5	7.4	23.4	10	12	3.34	0.086	0.17	< 0.01	57	0.8
1/6/2015	14:00	5.3	121	95.2	11.9	7.3	9.7	107	20	2.96	0.082	0.092	< 0.01	8	26.0
2/11/2015	12:40	6.8	155	95.7	11.4	7.2	17.8	29	40	7.38	0.069	0.124	< 0.01	9	82.6
3/17/2015	12:45	6.9	148	95.4	11.5	7.5	8.4	11	4	4.51	0.077	0.092	0.02	5	16.5
4/22/2015	10:50	9.9	140	98.2	11.1	7.1	5.5	5	< 20	2.76	0.08	0.096	0.01	4	8.3
5/26/2015	13:45	11.9	185	76.4	8.3	7.4	3.2	8	16	0.78	0.092	0.38	0.01	86	1.2
6/24/2015	14:15	17.7	240	89.7	8.6	7.5	4.8	173	224	1.48	0.097	0.114	< 0.01	5	0.3
7/21/2015	13:50	21.8	265	100.9	8.9	9.1	3.6	727	700	1.37	0.108	0.114	< 0.01	2	0.0
8/26/2015	12:55	18.8	316	123.7	11.5	8.5	2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0
9/21/2015	14:15	17.3	324	90.8	8.7	8.0	2.5	59	60	1.46	0.08	0.089	< 0.01	2	0.0

Table 27. Raw data for Cottonwood Creek at TA #1801 (01514A).

01514A: Cottonwood Creek (@ TA#1801)

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO) (mg/L)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH3-Diss	TSS	Velocity-discharge
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs
12/11/2014	12:30	5.5	189	72.9	8.9	7.6	3.1	51	200	9.25	0.033	0.052	0.02	7	0.1
1/21/2015	12:00	1.5	158	99.0	13.9	7.5	21.0	79	100	10	0.08	0.087	0.04	10	11.1
2/17/2015	14:00	4.4	151	90.0	11.5	7.1	18.0	461	N/A	7.36	0.041	0.095	0.02	12	7.1
3/18/2015	13:35	7.8	N/A	89.4	10.6	N/A	23.3	104	100	4.48	0.055	0.119	0.04	23	10.0
3/19/2015	12:30	5.8	125	89.4	10.6	6.9	24.1	101	N/A	N/A	N/A	N/A	N/A	N/A	7.1
4/23/2015	13:50	9.3	95	100.4	11.5	8.2	18.4	56	N/A	1.26	0.039	0.08	0.01	20	2.2
5/27/2015	11:40	14.6	100	109.0	11.1	8.1	14.3	579	460	0.11	0.015	0.07	0.03	23	0.2
6/24/2015	13:15	23.5	115	105.0	8.9	7.7	31.9	461	700	0.05	0.039	0.111	< 0.01	54	0.1

Table 28. Raw data for Cottonwood Creek at the headwaters near Fairview Road (01517A).

01517A: Cottonwood Creek (headwaters near Fairview Rd.)															
Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO) (mg/L)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH ₃ -Diss	TSS	Velocity-discharge
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs
1/6/2015	12:10	2.3	280	75.3	10.1	7.3	6.4	26	16	25.4	0.033	0.048	0.02	4	N/A
2/10/2015	10:20	6.0	260	86.7	10.6	5.6	38.7	185	100	19.6	0.098	0.201	0.06	61	7.2
3/19/2015	13:35	10.2	246	89.9	10.1	6.8	4.9	16	N/A	16.1	0.021	0.042	0.02	6	0.3
4/22/2015	13:55	11.0	175	104.4	11.5	7.6	4.3	6	20	5.2	0.016	0.027	0.02	3	0.0

Table 29. Raw data for Magpie Creek at Mouth (04901A).

04901A: Magpie Creek															
Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO) (mg/L)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH ₃ -Diss	TSS	Velocity-discharge
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs
12/10/2014	12:50	6.8	443	88.9	10.7	8.0	99.0	101	100	5.06	0.176	0.84	0.03	461	0.3
1/6/2015	11:45	4.2	376	96.7	12.4	7.7	33.4	649	700	5.96	0.207	0.241	0.02	78	0.7
2/10/2015	11:15	8.4	364	98.8	11.4	7.5	1591.0	> 2420	4000	12	0.3	2.5	0.04	1648	7.1
3/17/2015	11:00	8.7	414	97.6	11.2	7.8	52.4	> 2420	7000	9.77	0.215	0.38	0.02	88	1.1
3/24/2015	12:30	8.5	360	98.8	11.6	8.1	159.0	1120	N/A	10.7	0.25	0.7	0.02	621	4.0
4/21/2015	14:15	14.1	345	95.9	9.9	8.2	49.5	1733	1900	7.85	0.21	0.37	0.02	92	1.1
5/26/2015	12:30	15.4	395	96.2	9.6	8.3	48.7	> 2420	3000	5.01	0.22	0.34	0.01	88	0.9
6/24/2015	11:30	18.0	435	91.1	8.6	8.3	9.3	1300	3000	5.7	0.19	0.2	< 0.01	11	0.3
7/21/2015	12:20	19.8	400	91.4	8.3	8.8	12.0	2420	3000	6.41	0.21	0.24	< 0.01	154	0.2
8/26/2015	11:45	15.5	402	93.9	9.4	8.4	5.8	261	500	5.68	0.14	0.16	< 0.01	26	0.2
9/21/2015	13:05	16.0	419	92.5	9.1	8.6	4.3	365	800	5.38	0.142	0.176	< 0.01	23	0.1
9/23/2015	10:10	12.5	410	93.8	10.0	8.3	64.3	517	1100	5.6	0.146	0.162	< 0.01	12	0.2

Table 30. Raw data for additional Magpie Creek sample locations.

	Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH3-Diss	TSS	Velocity- discharge
			°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs
04901B: Magpie Creek	9/23/2015	10:45	13.0	422	92.3	9.7	8.2	2.6	727	100	5.64	0.145	0.14	< 0.01	3	N/A
04903A: Magpie Creek	9/23/2015	11:15	14.2	440	90.9	9.3	8.1	3.9	172	200	8.66	0.159	0.16	< 0.01	7	N/A
11001A Unnamed Trib. to Magpie Creek	9/23/2015	10:50	12.0	348	92.1	9.9	8.1	29.5	2420	5000	6.63	0.142	0.24	< 0.01	67	N/A

Table 31. Raw data for Coyote Creek at Mouth (01801A).

01801A: Coyote Creek

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH3-Diss	TSS	Velocity- discharge
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs
12/10/2014	14:00	6.5	258	88.4	10.7	7.9	2.6	12	8	1.54	0.099	0.118	< 0.01	12	0.5
1/6/2015	12:50	3.0	211	96.5	12.7	7.6	24.5	308	180	4.74	0.122	0.122	0.01	20	3.0
2/10/2015	12:10	8.0	239	97.7	11.4	7.2	301.0	131	80	14.4	0.148	0.73	0.03	399	44.8
3/17/2015	11:40	8.1	250	97.0	11.3	7.7	28.9	249	200	10.1	0.101	0.154	0.02	29	4.1
4/22/2015	12:25	11.7	245	100.5	10.9	8.3	22.4	461	340	6.85	0.105	0.151	0.02	23	2.5
5/26/2015	13:00	16.2	280	93.0	9.1	8.2	16.7	436	360	4.58	0.13	0.166	0.03	16	1.0
6/24/2015	12:25	19.2	285	98.1	9.1	8.3	6.0	248	500	2.78	0.128	0.148	< 0.01	6	0.3
7/21/2015	12:45	19.8	265	93.5	8.5	8.8	2.0	194	400	0.51	0.124	0.127	< 0.01	5	0.1
8/26/2016	12:15	16.0	291	93.4	9.2	8.4	1.9	276	400	0.15	0.1	0.104	< 0.01	3	0.1
9/21/2015	13:30	15.4	310	92.3	9.2	8.5	2.6	172	180	0.36	0.091	0.101	< 0.01	4	0.2

Table 32. Raw data for Star Mill Creek at Mouth (07701A).

07701A: Star Mill Creek																
Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO) (mg/L)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH3-Diss	TSS	Velocity-discharge	
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs	
12/11/2014	11:30	6.2	104	78.6	9.5	7.5	3.6	9	20	0.71	0.053	0.059	0.01	6	0.0	
1/14/2015	13:30	1.2	120	79.5	11.0	6.7	5.1	18	28	4.11	0.042	0.043	0.01	1	0.5	
2/17/2015	12:30	4.1	97	95.2	12.2	7.5	14.0	17	N/A	2.78	0.032	0.062	0.01	3	1.6	
3/18/2015	12:20	6.9	95	95.1	11.6	7.5	9.4	3	< 4	1.32	0.031	0.067	0.03	6	2.0	
4/23/2015	12:45	11.4	75	112.6	12.2	9.2	5.0	30	N/A	0.04	0.03	0.047	0.01	3	0.2	
5/27/2015	10:40	12.1	115	71.3	7.7	7.1	11.4	228	200	0.07	0.072	0.17	0.02	5	0.0	

Table 33. Raw data for Pickle Canyon Creek (05903A).

05903A: Pickle Canyon Creek																
Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO) (mg/L)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH3-Diss	TSS	Velocity-discharge	
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs	
12/17/2014	12:30	3.4	85	87.0	11.4	6.9	13.6	55	100	0.76	0.048	0.087	< 0.01	< 1	0.1	
1/14/2015	12:00	1.6	108	88.8	12.1	7.1	9.1	14	12	2.55	0.04	0.042	0.01	< 1	0.6	
2/17/2015	11:00	2.6	88	88.0	11.7	7.2	16.0	36	N/A	1.16	0.044	0.098	0.02	3	1.1	
3/18/2015	11:00	5.0	87	89.9	11.3	6.4	21.8	36	80	0.74	0.046	0.1	0.03	9	3.6	
4/23/2015	11:00	7.0	70	90.7	11.0	7.5	16.3	5	N/A	0.14	0.043	0.09	0.02	10	0.5	

Table 34. Raw data for Spring Creek upstream of sweathouse (Nez 931).

Nez 931: Spring Creek															
Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO)	Dissolved oxygen (DO) (mg/L)	pH	Turbidity	Escherichia coli (NPT)	Escherichia coli (BOR)	NO ₃ /NO ₂	Ortho-P	T-Phos	NH3-Diss	TSS	Velocity- discharge
		°C	µS	% Sat	mg/L	H ⁺	NTU	#/100mL	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	cfs
1/14/2015	10:15	8.1	253	82.1	9.4	6.9	16.1	162	180	2.06	0.08	0.165	0.02	50	2.1
2/10/2015	13:40	10.3	263	83.5	9.4	7.0	10.5	12	40	2.6	0.078	0.211	< 0.01	46	1.6
3/17/2015	13:50	10.1	243	82.3	9.3	7.2	19.7	5	8	1.8	0.073	0.17	0.02	28	1.8
3/24/2015	13:35	10.0	255	87.2	9.8	7.7	3.0	225	N/A	N/A	N/A	N/A	N/A	N/A	2.7
4/21/2015	9:50	10.4	310	83.5	9.3	7.0	1.5	7	20	2.09	0.056	0.065	0.02	3	1.9
5/27/2015	13:55	12.6	245	81.9	8.7	7.5	7.5	21	12	1.18	0.067	0.174	0.02	50	1.2
6/24/2015	9:20	12.2	265	76.8	8.3	7.5	3.3	89	200	1.11	0.072	0.097	< 0.01	11	0.9
7/21/2015	10:17	13.4	245	78.1	8.2	8.1	1.8	194	600	0.71	0.084	0.089	< 0.01	4	0.7
8/26/2015	9:40	13.1	239	77.4	8.1	7.6	3.6	107	140	0.5	0.073	0.088	< 0.01	6	0.7
9/21/2015	10:15	13.6	246	77.9	8.1	7.7	1.8	102	84	0.54	0.074	0.096	< 0.01	5	0.7