Hatwai Creek Surface Water Monitoring Report: 2019

State of Idaho
Department of Environmental Quality
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Acknowledgments

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Abbreviations, Acronyms, and Symbols

µm	micrometer
cfs	cubic feet per second
DEQ	Idaho Department of Environmental Quality
E. coli	*Escherichia coli*
EPA	US Environmental Protection Agency
FSP	field sampling plan
HDPE	high density polyethylene
ISWCC	Idaho Soil and Water Conservation Commission
L	liter
mg	milligram
mL	milliliter
mpn	most probable number
N	nitrogen
NO_3	nitrate
NO_2	nitrite
NPSWCD	Nez Perce Soil and Water Conservation District
P	phosphorus
PQL	practical quantitation limit
QA	quality assurance
QC	quality control
QAPP	quality assurance project plan
RL	reporting limit
RPD	relative percent difference
TMDL	total maximum daily load
TP	total phosphorus
WAG	watershed advisory group

1 Introduction

Hatwai Creek is a tributary of the Clearwater River in Nez Perce County, Idaho (Figure 1). The Idaho Department of Environmental Quality (DEQ) previously identified Hatwai Creek as impaired under the Clean Water Act by nutrients (nitrate plus nitrite nitrogen [NO_3+NO_2-N]) and total phosphorus [TP]), bacteria (*Escherichia coli* [*E. coli*]), and temperature. DEQ developed a water quality improvement plan, the *Hatwai Creek Subbasin Assessment and TMDLs (Lower Clearwater HUC 17060306)* (DEQ 2010) that defines pollutant target concentrations that protect aquatic life and surface water recreation uses in Hatwai Creek (Table 1).

Table 1. Pollutant target concentrations defined in the Hatwai Creek TMDLs (DEQ 2010).

Parameter	Target	Basis
NO_3+NO_2-N	0.072 mg N/L	EPA ecoregion III recommended water quality criteria (EPA 2000)
TP	0.03 mg P/L	EPA ecoregion III recommended water quality criteria (EPA 2000)
E. coli	126 mpn/100 mL; geometric mean of at least 5 samples, collected every 3–7 days over a 30-day period	Idaho Water Quality Standards IDAPA 58.01.02.251.01
Temperature	19ºC daily average, 22ºC daily maximum during salmonid spawning: 13ºC daily maximum, 9ºC daily average	Idaho Water Quality Standards IDAPA 58.01.02.250.02a IDAPA 58.01.02.250.02f

Notes: milligram (mg), nitrogen (N), phosphorus (P), liter (L), US Environmental Protection Agency (EPA), most probable number (mpn)

In 2018, DEQ monitored Hatwai Creek water quality to inform a review of the Hatwai Creek total maximum daily loads (TMDLs) (DEQ 2010); monitoring results are described in the *Hatwai Creek Surface Water Quality Monitoring Report: 2018* (DEQ 2018). Nutrient and *E. coli* results exceeded targets, and stream temperatures exceeded water quality standards for protecting salmonid spawning. After obtaining input from the Hatwai Creek Watershed Advisory Group (WAG), DEQ finalized the *Hatwai Creek Subbasin: TMDL Five-Year Review* (DEQ 2019c) and *Hatwai Creek Subbasin Assessment and Total Maximum Daily Loads: 2019 Temperature TMDL* (DEQ 2019b).

During the Hatwai Creek TMDL review process, the Hatwai Creek WAG advised DEQ to conduct additional monitoring to evaluate pollutant sources and guide pollutant reduction efforts. The number of 2018 monitoring sites was limited by private property access. WAG members helped DEQ gain additional property access. In May 2019, DEQ measured concentrations of nutrients, *E. coli*, and stable isotopes of nitrogen and oxygen in NO_3+NO_2-N at six sites to further assess pollutant patterns and potential sources. DEQ also measured stream temperature at three sites from May through August, 2019, and collected data for microbial source tracking analysis at one site. This report documents 2019 monitoring methods and results.

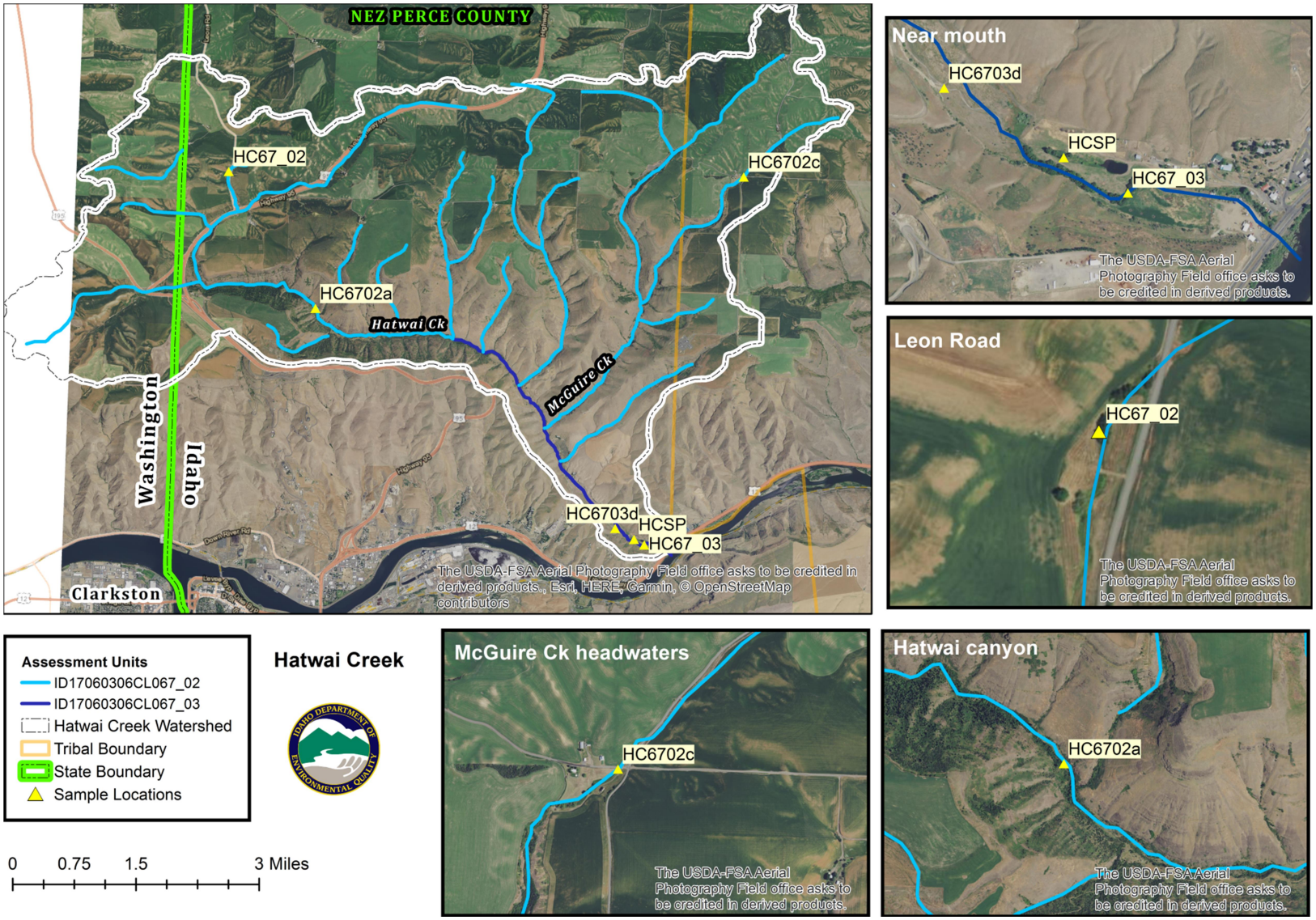

Figure 1. Hatwai Creek watershed and sampling locations.

2 Methods

Before sampling, DEQ developed a quality assurance project plan (DEQ 2019d) and field sampling plan (DEQ 2019a), documenting planned field and laboratory methodology, quality assurance and quality control (QA/QC) procedures, and data quality objectives. A summary of data QA/QC is provided in Appendix A.

On May 20 and 21, 2019, DEQ measured stream flow and collected grab water samples at six sites (Table 2, Figure 1). Stream flow was measured using a portable electromagnetic velocity meter and the velocity-area method. A stream transect was established perpendicular to stream flow and divided into equal-width cells to measure water depth and velocity within each cell. Flow was calculated by summing the product of velocity and area measurements from each cell. Grab water samples were collected from the thalweg by submerging a sample bottle below the stream surface. Analytical methods and sample preservation and holding requirements are provided in Table 2. Parameters sampled at each site are indicated in Table 3.

Table 2. Parameters and analytical methods.

Parameter	Laboratory	Method	Container	Preservative	Holding Time	PQL/RL
E. coli	Nez Perce Tribe Water Resources	9223B	150 mL plastic	Sodium thiosulfate, 4ºC	24 hours	1 mpn/100 mL
Human Bacteroidetes ID: Dorei	Source Molecular	SM-9E21002	150 mL plastic	Sodium thiosulfate, 4ºC	24 hours	Presence/ absence
Cow Bacteroidetes ID: EPA 1	Source Molecular	AM-9E21003	150 mL plastic	Sodium thiosulfate, 4ºC	24 hours	Presence/ absence
NO_3+NO_2-N	Anatek	EPA 353.2	125 mL HDPE	H2SO4 to pH < 2, 4 ºC	28 days	0.1 mg/L
TP	Bureau of Reclamation	EPA 365.1	1 L HDPE cubitainer	—	—	0.01 mg/L
Orthophosphate-P	Bureau of Reclamation	EPA 365.1	1 L HDPE cubitainer	—	48 hours	0.003 mg/L
$\delta^{15}N$ and $\delta^{18}O$ in NO_3+NO_2	UC Davis Stable Isotope Facility	Bacterial denitrification assay[a]	150 mL HDPE	0.2 µm filtered, frozen	6 months	0.4‰ for $\delta^{15}N$[b], 0.5 ‰ for $\delta^{18}O$[b]

a. Accepted precision values
b. *https://stableisotopefacility.ucdavis.edu/no3.html*
Notes: Practical quantitation limit (PQL), reporting limit (RL), high density polyethylene (HDPE), liter (L), micrometer (µm)

DEQ deployed Onset Water Temp Pro V2 temperature loggers to measure stream water temperature at 15-minute intervals at sites HC67_03d and HC67_02 (Figure 1). DEQ staff performed temperature calibration before deployment and an accuracy check after deployment to verify temperature logger accuracy. DEQ followed standard protocols for temperature logger placement and deployment, retrieval, and data processing (DEQ 2013). A METER CTD-10 sensor at HC67_03 has recorded stream temperature at 15-minute intervals since March 2018

(DEQ 2018). Data collected in 2019 were compared to TMDL targets (Table 1) and combined with 2018 and prior data to document patterns and trends.

3 Results

3.1 Stream Flow

Across the sites sampled on May 20 and 21, 2019, stream flow ranged from 0.2–7.06 cubic feet per second (cfs) (Table 3). At site HC67_03 (Figure 1), a continuous record of estimated stream flow is also available. DEQ and the Nez Perce Soil and Water Conservation District (NPSWCD) installed a METER sensor at the site in March 2018. The sensor records water level measurements at 15-minute intervals. Based on flow measurements collected in 2018, DEQ developed an equation relating measured stream flow to water level (a rating curve) (DEQ 2018). Estimated stream flow calculated from the rating curve is plotted in Figure 2. The hydrograph documents seasonal stream flow patterns at site HC67_03.

Estimated flows in Figure 2 may not be accurate where predictions fall outside the range of measured flows used to develop the curve (0.76–12.5 cfs), especially during storm events. The relationship between the 2018 and 2019 water levels and stream flows is uncertain due to changes in stream channel morphology that occur during spring high flows, sensor measurement drift, and other factors. Additional flow measurements are needed to confirm if the rating curve developed in 2018 also yields reasonable estimates of 2019 stream flow.

Table 3. Water chemistry results from May 20 and 21, 2019.

Location	Description	Date	Flow (cfs)	*E. coli* (mpn/100 mL)	Human Gut Bacterial DNA	Cow Gut Bacterial DNA	NO3+NO2-N (mg/L)	TP (mg/L)	δ15N of NO_3+NO_2 (per mil)	δ18O of NO_3+NO_2 (per mil)
HC67_03	3rd-order stream near mouth	5-20	7.06	816	Not detected	Detected	5.66	0.241	6.91	-1.59
HCSP	Spring near mouth	5-20	—	204.6	—	—	6.22	0.148	7.14	-1.79
HC67_03d	3rd-order stream segment	5-20	5.32	727	—	—	5.7	0.26	6.73	-1.76
HC67_02a	2nd-order stream—canyon	5-21	1.76	10.8	—	—	6.51	0.136	7.04	-1.85
HC67_02	1st-order stream—Leon Road	5-20	0.2	53.8	—	—	8.96	0.144	7.97	-2.81
HC67_02c	1st order McGuire Creek	5-20	0.42	57.6	—	—	12.7	0.256	3.84	-3.21

Notes: Deoxyribonucleic acid (DNA), — indicates a sample was not collected.

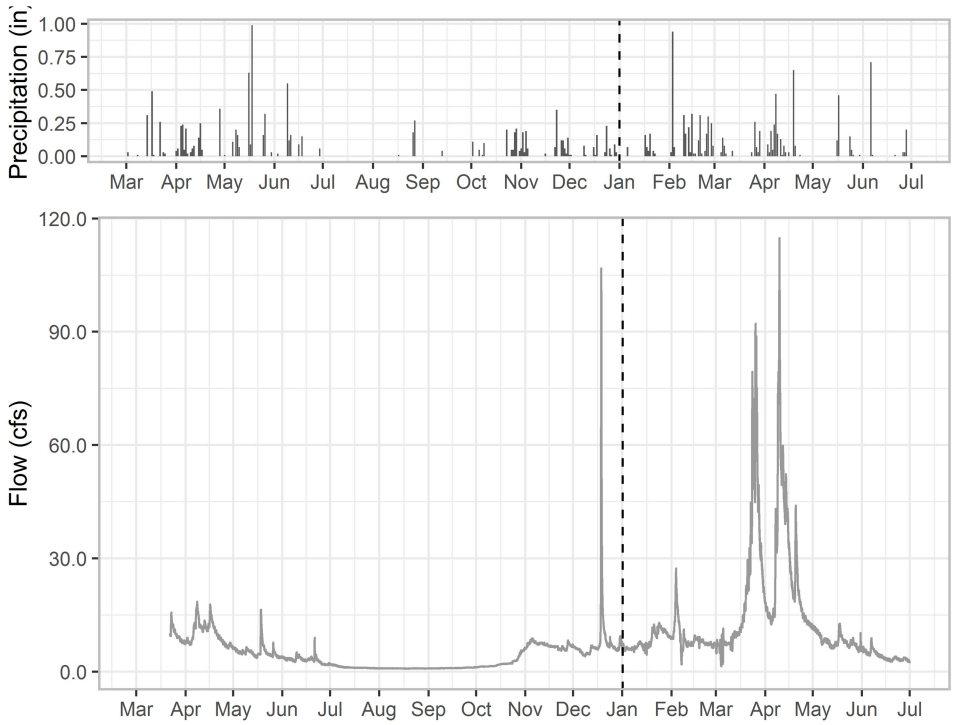

Figure 2. Daily precipitation at the Lewiston airport and estimated Hatwai Creek stream flow near the mouth at HC67_03. The dashed vertical line separates 2018 and 2019.

3.2 *E. coli*

E. coli concentrations exceeded 700 most probable number (mpn) of colony forming units per 100 milliliters (mL) of water (700 mpn/100 mL) in Hatwai Creek near the mouth (HC67_03 and HC67_03d) and ranged from 10.8 to 57.6 mpn/100 mL at sampled tributary stream sites.

At the mouth (HC67_03), 2019 *E. coli* concentrations were similar to geometric mean concentrations observed in spring 2018 (Table 4). At a spring near the mouth (HCSP), concentrations were higher in 2019 than in 2018 (Table 4). At HC67_02, concentrations were higher in 2018 than in 2019. The 2019 results are based on a single sample, whereas the 2018 results (Table 4) and Idaho's water quality standard are the geometric mean of five samples collected over a 30-day period.

Table 4. *E. coli* sampling results from 2018.

Location ID	Description	Monitoring Period	*E. coli* Geometric Mean (mpn/100 mL)
HC67_03	3rd-order stream near mouth	3/6/18 to 4/3/18	645.1
HCSP	Spring near mouth	3/6/18 to 4/3/18	12.6
HC67_03	3rd-order stream near mouth	8/7/18 to 9/4/18	227.8
HC67_02	1st-order stream—Leon Road	8/7/18 to 9/4/18	367.8

Note: DEQ 2019c provides detailed 2018 sampling methods and results.

3.3 Microbial Source Tracking

At the mouth (HC67_03), DEQ used microbial source tracking to test for the presence of human and cattle fecal inputs to Hatwai Creek. The human gastrointestinal tract (*Bacteroides dorei*) test result was negative, suggesting no recent human fecal contamination of sampled water at HC67_03. Water from HC67_03 was also tested for the genetic signature of certain strains of the bacterial genus *Bacteriodes* and *Prevotella* that are specific to the cow gastrointestinal tract. The bacterial genus *Bacteriodes* and *Prevotella* test result was positive, suggesting cows are a source of fecal contamination to HC67_03 in Hatwai Creek. These test results indicate the presence/absence of these specific sources but not their relative (percent) contribution.

3.4 Nutrients

From May 20 to 21, 2019, NO_3+NO_2-N concentrations ranged from 5.7 to 12.7 mg N/L across sampled sites and greatly exceeded the TMDL target (0.072 mg N/L). Concentrations were greatest at 1st-order stream sites (HC67_02 and HC67_02c). The 2019 NO_3+NO_2-N concentrations were similar to those observed in 2018 at HC67_03, HCSP, and HC67_02 (Figure 3). TP concentrations ranged from 0.136–0.26 mg P/L, were similar to 2018 concentrations (Figure 4) and exceeded the TMDL target (0.02 mg P/L).

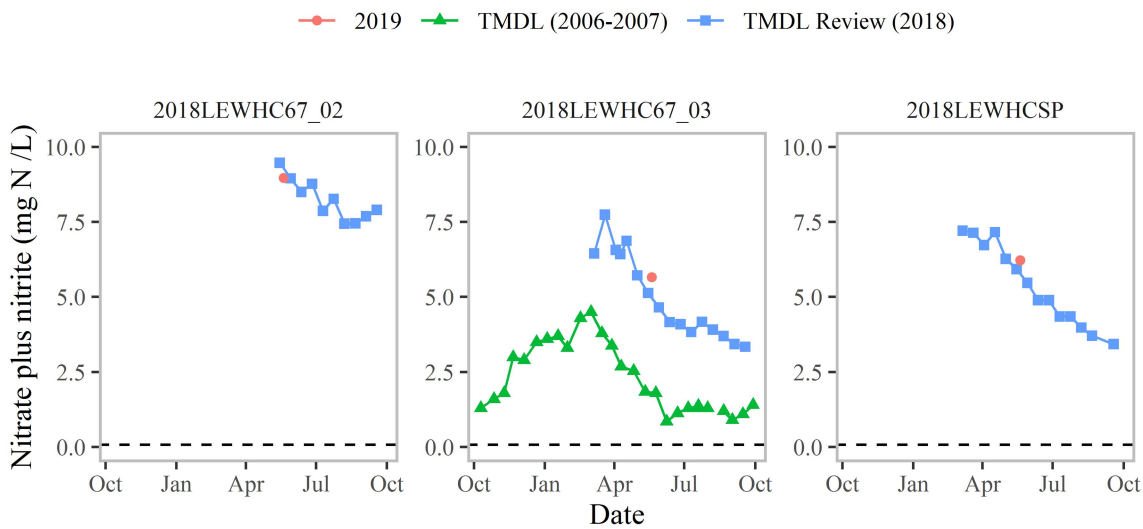

Figure 3. NO_3+NO_2-N patterns at sites sampled in multiple years. The dashed horizontal line is the TMDL target. HC67_02: Leon Road, HC67_03: Hatwai Creek near the mouth, HCSP: spring near the mouth.

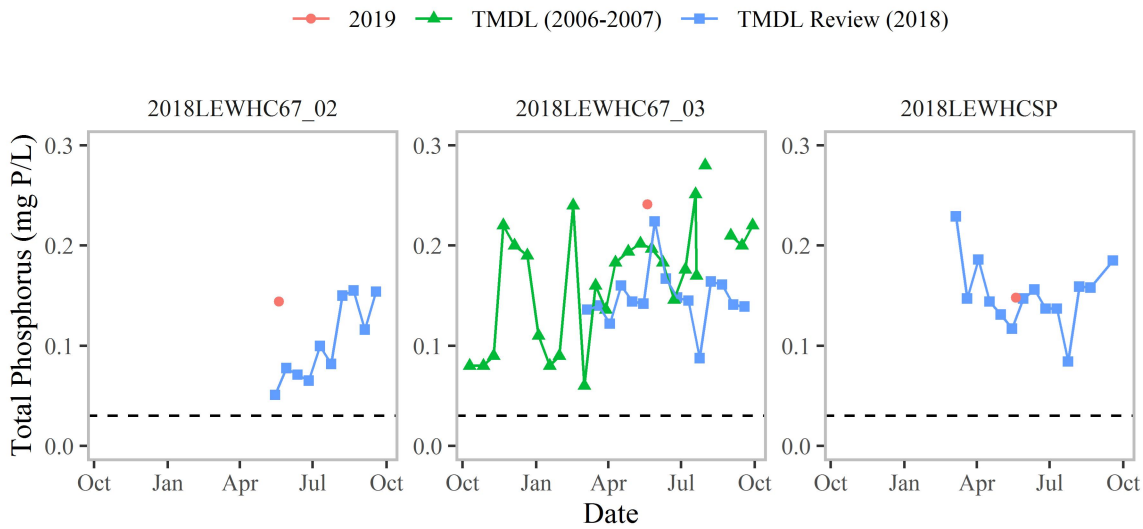

Figure 4. TP patterns at sites sampled in multiple years. The dashed horizontal line is the TMDL target. HC67_02: Leon Road, HC67_03: Hatwai Creek near the mouth, HCSP: spring near the mouth.

3.5 Stable Isotopes

Isotopes are atoms of an element that have the same number of protons but different numbers of neutrons. Ratios of naturally-occurring stable isotopes of nitrogen ($^{15}N/^{14}N = \delta^{15}N$, units = $^{0}/_{00}$ or 'per mil') and oxygen ($^{18}O/^{16}O = \delta^{15}O$, units = $^{0}/_{00}$ or 'per mil') in NO_3+NO_2-N may help indicate potential NO_3+NO_2-N sources. Because some sources have distinct $\delta^{15}N$ and $\delta^{15}O$ values, and $\delta^{15}N$ and $\delta^{15}O$ values often change in predictable ways when N and O undergo chemical and biological (e.g., nitrification and denitrification) processes, these stable isotopes are often used to assess potential nitrate sources and pollutant fate and transport processes. However, $\delta^{15}N$ and $\delta^{15}O$ are not perfect source indicators because some sources have overlapping $\delta^{15}N$ or $\delta^{15}O$ values. In addition, mixing of water from different sources and $\delta^{15}N$ and $\delta^{15}O$ changes during chemical reactions (called fractionation) can affect stable isotope values and obscure nitrate sources.

Stable isotope results from May 2019 suggest NO_3+NO_2-N comes from ammonia fertilizer, soil nitrogen, and waste (manure or septic) sources. All sampled sites had similar values except the 1st-order stream segment on McGuire Creek (HC67_02c), which had more negative $\delta^{15}N$ values, suggesting little or no influence from waste sources.

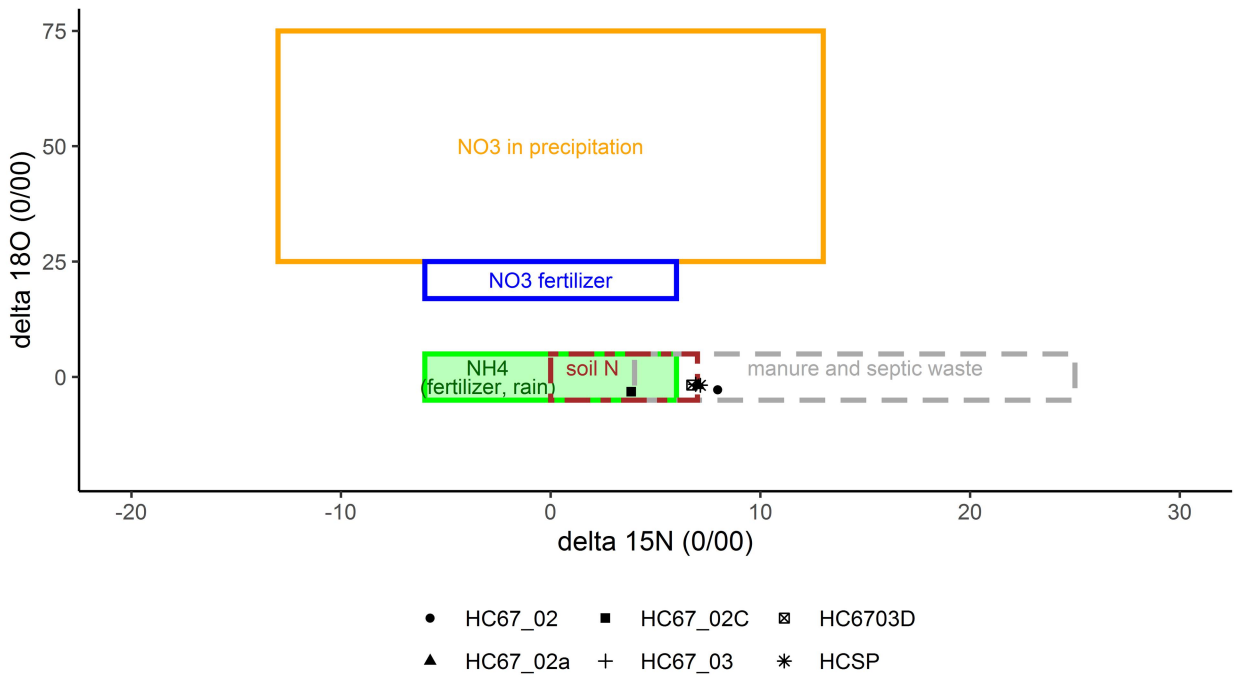

Figure 5. Nitrogen and oxygen stable isotope results and isotope value ranges reported in Xue et al. (2009).

3.6 Temperature

Temperature loggers were deployed May through August 2019, and remained submerged in stream water during the entire monitoring period. Daily average and daily maximum temperatures recorded in a 2nd-order segment within the Hatwai Creek canyon (HC67_02a), in a 3rd-order segment upstream of the mouth (HC6703d) and near the mouth (HC67_03) are presented in Figure 6. Temperatures were consistently lowest at the canyon site and highest at HC6703d (Figure 6). Temperature differences across sites are consistent with the current percent stream shade cover DEQ estimated for each segment in the Hatwai Creek temperature TMDL (DEQ 2019b). DEQ estimated <10% stream shade at the site with highest temperatures (HC67_03d), 71%–80% shade near the mouth (HC67_03), and 81%–90% shade at the canyon site with the lowest temperatures (HC67_02a). Site HC67_03d has nearly no riparian vegetation (photos in Appendix B). Stream channel morphology at HC67_03d likely also contributes to the high (>30°C) summertime daily maximum water temperatures. Stream banks are eroded, causing shallow summertime water depths (<0.5 feet) that make stream water more responsive to daily air temperature fluctuations.

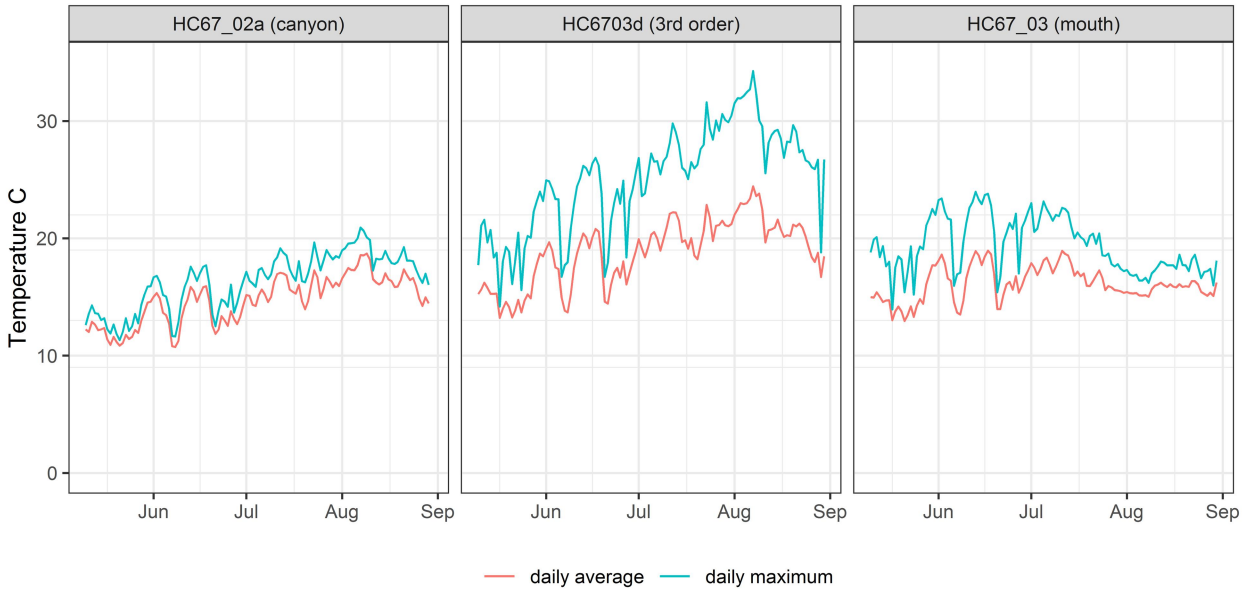

Figure 6. Daily average and daily maximum temperatures at three Hatwai Creek locations May–August 2019.

Temperature criteria for protection of cold water aquatic life (22°C daily maximum, 19°C daily average) were exceeded at the two 3rd-order stream sites (HC67_03d and HC67_03) but not at the canyon site (HC67_02a). Temperature criteria for protection of salmonid spawning (13°C daily maximum, 9°C daily average) were exceeded at all three sites.

At site HC67_03, temperature logger data were recorded by a METER CTD-10 sensor (section 2). Unlike temperature loggers deployed at sites HC67_02a and HC67_03d, the METER CTD-10 sensor was not subjected to rigorous pre- and postdeployment accuracy checks; the METER sensor has been deployed since March 2018. DEQ has not verified the accuracy of sensor temperature measurements. There were 20 days where the METER temperature exceeded the 22°C daily maximum criteria, and 0 days where METER temperature exceeded the 19°C daily average criteria. The highest daily maximum value recorded by the METER sensor was 23.9°C. Daily average and daily maximum temperatures recorded by the METER sensor exceeded criteria for protection of salmonid spawning (13°C daily maximum, 9°C daily average) all days during the observation period, with exceedances of up to 10°C. DEQ has high confidence that salmonid spawning criteria were exceeded, and medium confidence that cold water aquatic life criteria were exceeded. Because both HC67_03, and HC67_03d are located within the 3rd-order assessment unit (ID17060306CL067_03), and the accuracy-verified logger deployed at HC6703d recorded large criteria exceedances, it is clear that both cold water aquatic life and salmonid spawning criteria are exceeded within ID17060306CL067_03.

4 Conclusions

- Multiple lines of evidence indicate cows are a source of bacteria and nutrients to Hatwai Creek. Microbial source tracking analysis confirmed cows are a source of fecal contamination to Hatwai Creek. In addition, nitrogen and oxygen stable isotope analyses demonstrate animal wastes may be a source of nitrogen to Hatwai Creek at multiple watershed locations. Cows are not fenced out from the stream at multiple areas of the lower watershed. Hobby farms with a handful of livestock are located in some upper watershed locations. Best management practices such as off-stream livestock watering are likely needed to reduce *E. coli* and nutrient inputs to Hatwai Creek.

- NO_3+NO_2-N concentrations are elevated throughout the watershed, including in headwater stream segments at Leon Road (HC67_02) and McGuire Creek (HC67_02c) and in a spring near the mouth (HCSP). Cropland is the dominant land use in the upper watershed feeding sampled headwaters stream segments. Reducing nitrogen inputs to ground water and surface water from cropland through agricultural best management practice implementation is likely needed to reduce NO_3+NO_2-N concentrations in Hatwai Creek.

- Stream temperatures exceeded temperature criteria for protection of salmonid spawning in both Hatwai Creek assessment units. Temperature criteria for protection of cold water aquatic life were exceeded in ID17060306CL067_03 but not in ID17060306CL067_02. Stream temperatures were highest at sites where stream shade was lowest. Increasing riparian stream shade would help reduce stream temperatures. The Hatwai Creek temperature TMDL (DEQ 2019b) includes maps documenting the estimated existing stream shade levels that could be used to prioritize riparian planting efforts (Appendix C).

- Idaho Code §39-3602(9) identifies the Idaho Soil and Water Conservation Commission (ISWCC) as the designated management agency for addressing nonpoint source pollution from grazing and agriculture. Idaho Code §39-36-11(10) requires state agencies to work with land owners on a voluntary basis to implement agricultural best management practices. Landowners can work with ISWCC and the Nez Perce Soil and Water Conservation District (NPSWCD) to identify best management practices relevant to their property and apply for funding to install appropriate best management practices.

5 Data Availability

Project data will be publically available through the Water Quality Portal (*www.waterqualitydata.us*), which is a national data repository that houses publically available data. DEQ will also provide project data to interested parties in response to data requests.

6 References

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Appendix A. Quality Assurance/Quality Control

1 Background and Purpose

This appendix reviews quality assurance data collected by the Idaho Department of Environmental Quality (DEQ during the project and evaluates if data quality objectives and criteria were met. Before sampling, field and laboratory methodology, quality assurance and quality control (QA/QC) procedures, and data quality objectives were defined in the *Quality Assurance Project Plan: Multi Parameter Regional Wide Monitoring QAPP for the Lewiston Regional Office* (QAPP) (DEQ 2019d) and *Field Sampling Plan Hatwai Creek 2019 Sampling* (FSP) (DEQ 2019a). The QAPP and FSP specified data quality objectives and criteria for data precision, accuracy, measurement range, representativeness, comparability, and completeness.

2 Precision

Precision is a measure of agreement between two measurements of the same property under prescribed conditions. Overall precision was evaluated by calculating the relative percent difference (RPD) of field duplicate samples. All field duplicate samples were collected at site HC67_03 on May 20, 2019. Field duplicate samples were collected for *Escherichia coli (E. coli*), nitrate plus nitrite nitrogen (NO_3+NO_2-N), total phosphorus (TP), and stable isotopes. A field duplicate sample was not collected for microbial source tracking analysis because of the high sample cost.

For *E. coli*, the QAPP specified a RPD goal of ±50% for low-level concentrations (<20 × laboratory reporting limit) and 25% for high-level concentrations (>20 × laboratory reporting limit). For other water chemistry parameters, the QAPP specified a RPD goal of ±25% for low-level concentrations (<20 × minimum detection limit) and ±10% for high-level concentrations (>20 × minimum detection limit).

Table A1. Project field duplicate results.

Parameter	Original Result	Duplicate Result	PQL	RPD (%)
E. coli (mpn/100 mL)	816.4	920.8	1	-12
NO_3+NO_2-N (mg/L)	5.66	5.64	0.1	0.35
TP (mg/L)	0.241	0.241	0.01	0
δ15N (per mil)	6.91	6.9	—	0.14
δ18O (per mil)	-1.59	-1.59	—	0

Notes: Practical quantitation limit (PQL), most probable number (mpn),milliliter (mL), (milligram (mg), liter (L)

For temperature loggers deployed at sites HC67_03d and HC67_02a, temperature logger precision was evaluated by placing temperature loggers in a constant temperature environment. Loggers were placed in room temperature and refrigerated water baths with constant

temperatures before and after deployment. While loggers were placed in constant temperature water baths, temperature values recorded by loggers varied by < 0.026˚C. Considering water temperature fluctuations were much larger than 0.026˚C, this level of precision is considered adequate for this project. Temperature precision was not evaluated for temperature measurements at site HC67_03; temperature was recorded by a METER sensor deployed at the site since March 2018. The project QAPP did not specify precision requirements for temperature data. Duplicate temperature loggers were not deployed in the field during 2019 monitoring. Duplicate temperature loggers were deployed during 2018 temperature monitoring, and DEQ determined temperature logger precision was adequate (DEQ 2019).

3 Accuracy

Accuracy is a measure of the agreement between a known "true" reference value and the associated measured value. Analytical laboratories evaluated laboratory accuracy based on laboratory control samples or matrix spike samples as required by associated analytical methods. Because laboratories did not qualify any results due to laboratory control or matrix spike samples, DEQ assumed laboratory accuracy requirements were met.

To evaluate overall accuracy, DEQ used field blanks, which are samples of a blank matrix, typically deionized water or distilled water, prepared in the field under identical conditions, processed the same, and included for analysis as a regular sample. The blanks are checked for possible contamination during sample collection and processing. Field blanks were collected for *E. coli*, NO_3+NO_2-N, and TP using deionized water at HC67_03 on May 20, 2019. All field blank sample results were below detection and met project data quality objectives.

Field blanks were not collected for microbial source tracking due to high sample costs. Field blanks also were not collected for stable isotope analyses because the UC Davis analytical laboratory requires NO_3+NO_2-N concentrations to be analyzed separately from stable isotope analyses and concentration values to be submitted to the lab with samples (concentrations are used in isotope value calculations). It is therefore not possible to submit stable isotope field blank samples 'blind' to the UC Davis Stable Isotope Facility.

The project QAPP required the accuracy of each temperature logger to be checked by comparing it to a NIST-certified thermometer at two temperatures, both before and after deployment. For temperature loggers deployed at sites HC67_03d and HC67_02a, each temperature logger placed for this project met QAPP specifications. A comparison to a NIST-certified thermometer was not performed for the METER sensor at site HC67_03, which has been deployed there since March 2018.

4 Sample Preservation and Holding Time Requirements

Project sample holding and preservation requirements are provided in Section 2, Methods (Table 2). Sample holding times for orthophosphate were not met because FedEx did not deliver samples to the Bureau of Reclamation laboratory in Boise, Idaho, on time. Samples collected on May 20, 2019, were shipped overnight and scheduled to arrive on May 21, 2019, but FedEx temporarily lost the sample cooler and did not deliver the samples until May 23, 2019. The

Bureau of Reclamation laboratory reported the samples were still cool upon receipt and did not qualify any TP results, but qualified orthophosphate results exceeded the holding time. DEQ rejected all orthophosphate results.

5 Data Representativeness

Data representativeness is the degree to which sample data accurately and precisely represent site conditions. The project QAPP did not provide specific data representativeness criteria but provided general guidelines for evaluating representativeness (DEQ 2019d). Because field sampling and analysis followed standard procedures, procedures were consistent with those during previous sampling, accuracy and precision requirements were met, and there were no issues with laboratory QA review, all project data satisfied representativeness requirements except for orthophosphate samples, which were rejected as noted in section 4.

6 Data Comparability

Comparability is the confidence that one data set can be compared to another data set. The project QAPP did not provide specific comparability criteria, but provided general guidelines for evaluating comparability (DEQ 2019d). Because standard sampling and laboratory procedures were followed, procedures were consistent with those used during previous sampling, and no issues were identified during data verification and validation. All project data satisfied comparability requirements, except for orthophosphate samples, which were rejected as noted in section 4.

8 Data Completeness

Data completeness is the percentage of valid data relative to the total possible valid data points. The QAPP defined a data completeness objective of 80%. Six out of 38 sample results were rejected, so project completeness is 84%, and the project completeness goal was met.

9 Additional Notes

The QAPP and FSP stated *E. coli* would be analyzed at Anatek Laboratory in Moscow, Idaho. *E. coli* samples for this project were analyzed by the Nez Perce Tribe Water Resources using the analytical method specified in the QAPP (APHA method 9223-B). Nez Perce Tribe Water Resources has an US Environmental Protection Agency-approved QAPP for analysis of *E. coli* following APHA method 9223-B (Alicia Helfrick, Nez Perce Tribe Water Resources, personal communication, April 19, 2019). The QAPP and FSP also stated TP and orthophosphate samples would be analyzed by Anatek. Instead, TP and orthophosphate samples were analyzed at the Bureau of Reclamation analytical lab in Boise, Idaho. The analytical laboratories for *E. coli* and phosphorus analyses were changed after the QAPP and FSP were finalized because Nez Perce Tribe Water Resources offered to pay for these analyses, providing DEQ project cost savings.

10 Conclusion

DEQ requires several internal quality assurance procedures. Procedures include consulting with the DEQ QA manager, registering the project in a tracking spreadsheet, completing three standardized QA checklists, and reviewing all QA data points. Six orthophosphate sample results were rejected because the sample holding time was exceeded. Project goals for data accuracy, precision, representativeness, comparability, and completeness were met. DEQ considers all project data, except for the rejected orthophosphate results, adequate for use in this project.

Appendix B. Site Photos

Figure B1. Site HC67_03, 3rd-order stream segment near the mouth, looking downstream (May 29, 2018).

Figure B2. Site HCSP, culvert draining a spring in the lower watershed (May 20, 2019).

Figure B3. Site HC67_03d, 3rd-order stream segment in the lower watershed, looking downstream (May 20, 2019).

Figure B4. Site HC67_02c, 2nd-order stream segment within the Hatwai Creek canyon, looking upstream (May 21, 2019).

Figure B5. Site HC67_02, 1st-order stream segment near Leon Road, looking downstream (May 20, 2019).

Figure B6. The 1st-order stream segment near headwaters of McGuire Creek, looking downstream (May 20, 2019).

Appendix C. Existing Shade Map

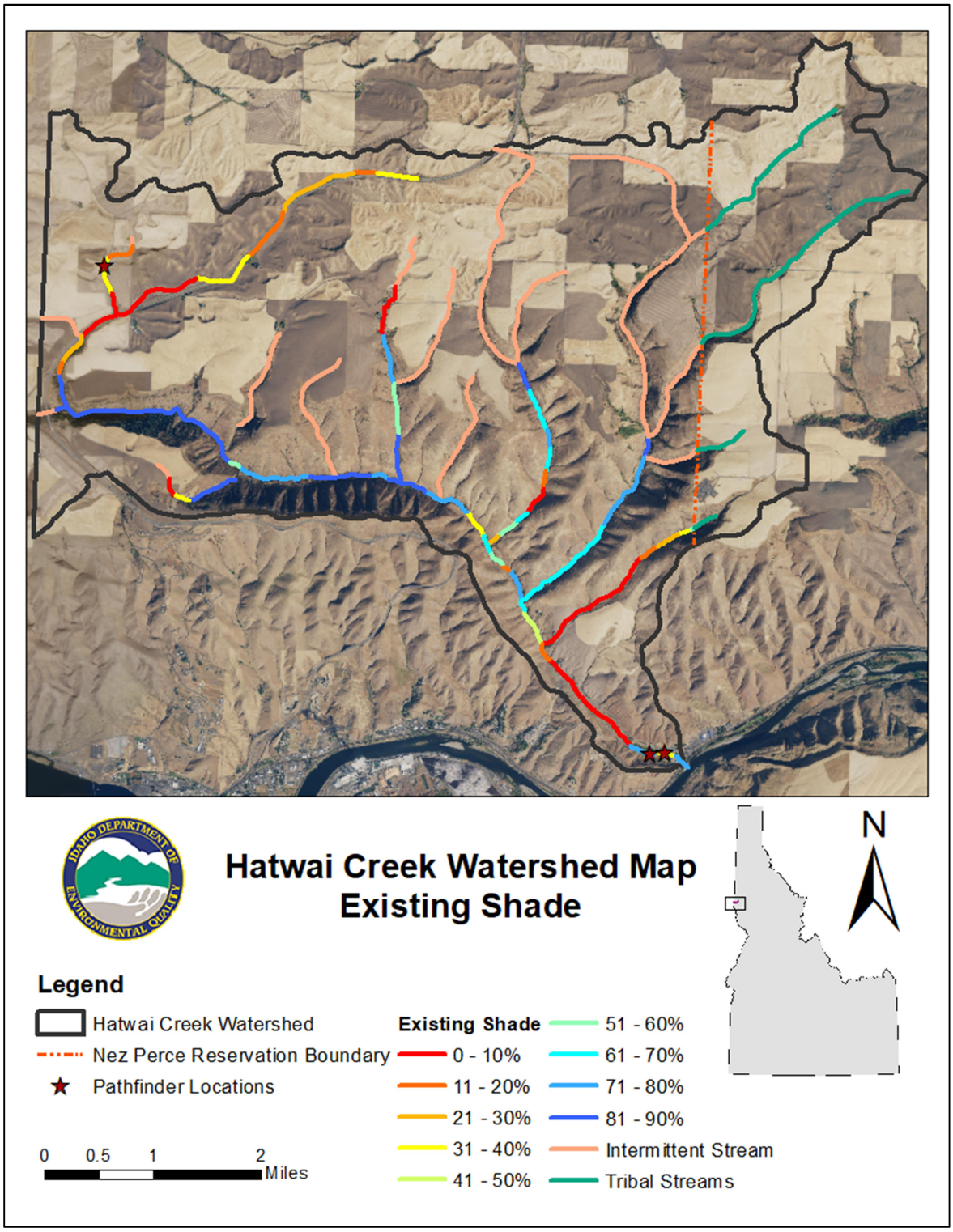

Figure C1. Existing shade estimated for the Hatwai Creek watershed by aerial photo interpretation. Existing shade was not estimated for intermittent or tribal waters.