Big Wood River Tributaries Temperature Total Maximum Daily Loads

Addendum to the Big Wood River Watershed Management Plan
HUC 17040219

State of Idaho
Department of Environmental Quality

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2013 Addendum

October 2013

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Acknowledgments

Cover photo of Rock Creek courtesy of Mark Shumar (Idaho Department of Environmental Quality) taken October 3, 2011.

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Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
AU	assessment unit
BLM	Bureau of Land Management
BMP	best management practice
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGP	Construction General Permit
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
EPA	United States Environmental Protection Agency
GIS	geographic information systems
HUC	hydrologic unit code
IDAPA	Refers to citations of Idaho administrative rules
kWh	kilowatt-hour
LA	load allocation
LC	load capacity
m	meter
mi	mile
MOS	margin of safety
NB	natural background
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
PNV	potential natural vegetation
SBA	subbasin assessment
SWPPP	Stormwater Pollution Prevention Plan
TMDL	total maximum daily load
US	United States
USC	United States Code
WAG	watershed advisory group
WLA	wasteload allocation

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Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to CWA Section 303, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. CWA §303(d) establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (§303(d) list) of impaired waters. Currently this list must be published every 2 years and is included as the list of Category 5 waters in *Idaho's 2010 Integrated Report* (DEQ 2011). For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards.

This document addresses three water bodies in the Big Wood River subbasin that have been placed in Category 5 of the 2010 Integrated Report. This document only addresses the temperature TMDLs for two of these assessment units (AUs). More information about these watersheds and the subbasin as a whole is provided in *The Big Wood River Watershed Management Plan* (DEQ 2002).

This TMDL analysis was developed to comply with Idaho's TMDL requirements. A TMDL analysis determines instream water quality targets, calculates load capacities, estimates existing pollutant sources, and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards.

Subbasin at a Glance

The Big Wood River subbasin (hydrologic unit code 17040219) is located in south-central Idaho from its origins above Sun Valley, Idaho, to the Snake River Plain near Gooding, Idaho (Figure A). Listed in Category 5 of the 2010 Integrated Report for temperature pollution were Black Canyon Creek (ID17040219SK030_02), Quigley Creek (ID17040219SK008_02), and Rock Creek (ID17040219SK028_02). Quigley Creek drains from the Pioneer Mountains to the east side of Hailey, Idaho. Rock Creek drains south from Rocky Butte, southwest of Hailey to the backwater of Magic Reservoir near the Highway 20 and Highway 75 junction. Black Canyon Creek emanates from the southern base of Mount Bennett Hills and flows south to Dry Creek north of Gooding, Idaho. No TMDL has been developed for Black Canyon Creek.

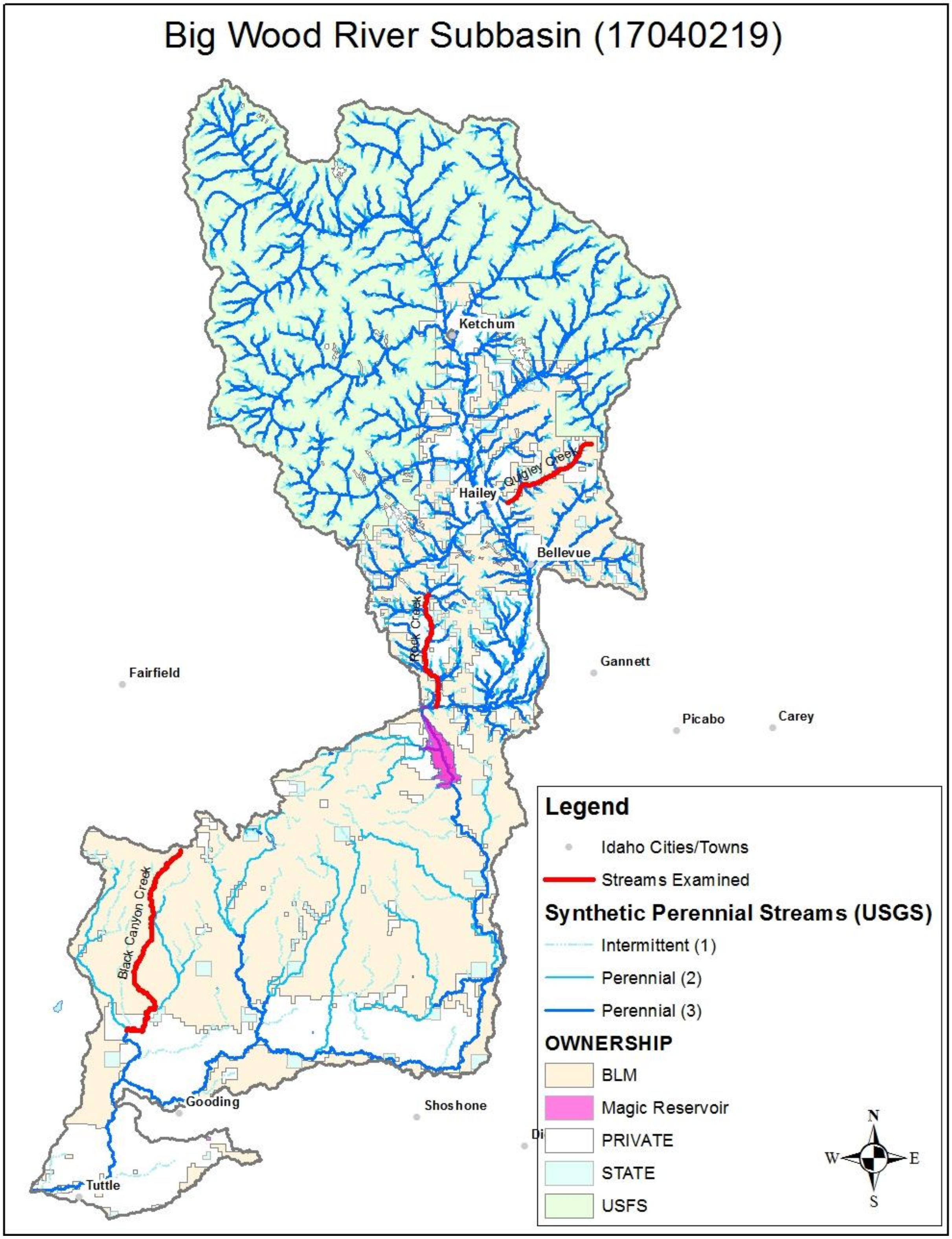

Figure A. Subbasin at a glance.

Key Findings

Three creeks covering four assessment units (AUs) were carried forward to the 2010 §303(d) list of impaired waters. Listed impairments include temperature criteria violations, total suspended solids, and cause unknown (nutrients suspected). The Idaho Department of Environmental Quality (DEQ) has developed temperature TMDLs for two of these waters (Table A). The twos Black Canyon Creek AUs were found to have insufficient water to be assessed, being below 1 cubic feet per second in 90% of available data. No sources or pathways of pollutants were identified for Black Canyon Creek and the two AUs are proposed for delisting in the next Integrated Report cycle.

Effective target shade levels were established for two AUs (Quigley Creek and Rock Creek) based on the concept of maximum shading under potential natural vegetation resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation that was partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in Idaho "Water Quality Standards" (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the 2012 Integrated Report, is presented in Table B.

Both streams examined lack shade to some degree. Quigley Creek and Rock Creek have about one-quarter of their existing solar load as excess load from a lack of shade. Both of these creeks have experienced livestock pasturing and range use over the years.

Table A. Streams and pollutants for which total maximum daily loads were developed.

Stream	Pollutant
Quigley Creek	Temperature
Rock Creek	Temperature

Table B. Summary of assessment outcomes.

Water Body Segment/ Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Quigley Creek ID17040219SK008_02	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Rock Creek ID17040219SK028_02	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Black Canyon Creek ID17040219SK030_02	Temperature TSS Cause Unknown (nutrients suspected)	No	Delist temperature, TSS, and cause unknown. Move to Category 4c as flow altered.	Insufficient water, stable banks, adequate canopy cover, no source or pollutant pathway
Black Canyon Creek ID17040219SK030_03	TSS Cause Unknown (nutrients suspected)	No	Delist cause unknown and TSS. Leave in Category 4c as flow altered	Insufficient water, stable banks, adequate canopy cover, no source or pollutant pathway

Notes: total suspended solids (TSS)

Public Participation

The Wood River Watershed Advisory Group provided DEQ with local knowledge of the watersheds, reviewed beneficial use designations and applicable surface water standards, and also provided comments on the draft documents. Public meetings were held the fourth Tuesday of the month as needed, typically quarterly. The meetings are open to the public and are posted to DEQ's webpage and in DEQ's Twin Falls Regional Office. Six meetings specific to temperature TMDL development have been held and future meetings will be held to discuss TMDL implementation.

The general public was provided the opportunity to comment on this draft document during the public comment period that ran from March 20 through April 19, 2013.

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Introduction

This total maximum daily load (TMDL) is an addendum to *The Big Wood River Watershed Management Plan* (DEQ 2002). The watershed management plan, like all Idaho TMDL documents since 2001 that combine a subbasin assessment (SBA) with a TMDL determination, has five sections: the first four comprise the SBA and the fifth establishes TMDLs.

The Big Wood River subbasin (hydrologic unit code 17040219) is located in south-central Idaho from its origins above Sun Valley, Idaho, to the Snake River Plain near Gooding, Idaho. This document addresses water bodies in four assessment units (AUs) of the Big Wood River subbasin that have been placed in Category 5 of *Idaho's 2010 Integrated Report* (DEQ 2011). Quigley Creek (AU ID17040219SK008_02) drains from the Pioneer Mountains to the east side of Hailey, Idaho. Rock Creek AU (ID17040219SK028_02) drains south from Rocky Butte, southwest of Hailey to the backwater of Magic Reservoir near the Highway 20 and Highway 75 junction. Effective shade targets were established for two AUs based on the concept of maximum shading under potential natural vegetation (PNV) resulting in natural background temperatures. The Black Canyon Creek AUs (ID17040219SK030_02 and SK030_03) includes Dry Creek, Black Canyon Creek, and others tributaries. This south-facing drainage largely drains snowmelt from the southeast end of Bennett Hills and rarely has any water. TMDLs were not developed for Black Canyon Creek.

1. Subbasin Assessment—Watershed Characterization

This document presents an addendum for the Big Wood River SBA/TMDL. This document addresses water bodies in the Big Wood River subbasin that have been placed on Idaho's current §303(d) list.

1.1 Introduction—Regulatory Requirements

This document was prepared in compliance with both federal and state regulatory requirements, as described in the following.

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to CWA Section 303, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible.

Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list §303(d) list of impaired waters. For waters identified on this list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

This document addresses water bodies in the Big Wood River subbasin that have been placed on Idaho's 2010 §303(d) list.

1.2 Public Participation and Comment Opportunities

The development of the Big Wood River subbasin TMDL included the following public participation:

- Presented Potential Natural Vegetation to the Wood River Watershed Advisory Group (WAG), March 28, 2006
- Presented temperature listing and approach to the Wood River WAG, September 26, 2006
- Presented a draft document to the Wood River WAG, April 24, 2007
- Presented to the Wood River WAG, April 24, 2012
- Presented to the Wood River WAG, May 29, 2012
- Presented to the Wood River WAG, February 26, 2013
- Thirty-day public comment period, March 20 - April 19, 2013

A Wood River Watershed Advisory Group member submitted information in 1999-2001 about naturally occurring phenolics in stream water and its effects on aquatic life toxicity and stream temperature. One of his premises was that overstocking in Idaho's forests has led to an increase in phenolic compounds released to streams that may be causing increases in stream temperature. While there is information in the literature (e.g. Polish study, 2006) that suggests naturally occurring phenolics can contribute to aquatic life toxicity, we know of no study that suggests phenolic loads lead to stream temperature increases.

The Wood River WAG submitted a comment letter dated September 18, 2012, supporting further research of phenolics in the Big Wood River Watershed. A similar phenolic acid concern was raised during the development of the *Big Wood River Watershed Management Plan* in 2000–2002. DEQ addressed this concern by convening a team of agency scientists (as a Technical Advisory Committee [TAC] to DEQ). The TAC consisted of representatives from DEQ, IDFG, USGS, USFS, and BLM; and the Idaho Bureau of Laboratories (IDHW). In addition, DEQ contacted fish toxicologists from Purdue University, Colorado State University, and Texas A & M University. The discussion included the methodology that would be associated with the collection and analysis of water samples to specifically define the types of phenolic acids involved (since phenolic acids, as a component of dissolved organic matter, may comprise well over 8,000 naturally occurring compounds with a common structural feature of a phenol); and, to distinguish the phenolic acids from other dissolved organic matter components that are naturally associated with phenolic acids. As noted in the *Big Wood River Watershed Management Plan (pages 32-33 and 173-175).* The idea of temperature rising as the result of an increased phenolic rise is intriguing and one worthy of future study. DEQ has no research capabilities. However, perhaps interest will lead others to pursue this research.

1.3 Physical and Biological Characteristics

A detailed discussion of the physical and biological characteristics of the Big Wood River subbasin is provided in *The Big Wood River Watershed Management Plan* approved by United States Environmental Protection Agency (EPA) in 2002 (DEQ 2002).

1.4 Cultural Characteristics

A detailed discussion of the cultural characteristics of the Big Wood River subbasin is provided in *The Big Wood River Watershed Management Plan* approved by EPA in 2002 (DEQ 2002).

2. Subbasin Assessment—Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

Section 303(d) of the CWA states that waters that are unable to support their beneficial uses and that do not meet water quality standards must be listed as water quality limited waters. Subsequently, these waters are required to have TMDLs developed to bring them into compliance with water quality standards.

2.1.1 Additional Waters Listed Since SBA/TMDL Approval

Table 1 shows the pollutants listed and the basis for listing for each §303(d) listed AU in the Big Wood River subbasin that has been added since the publication of the SBA/TMDL approved by EPA in 2001.

Table 1. Section 303(d) segments in the Big Wood River subbasin.

Water Body Name	Assessment Unit ID Number	2010 §303(d) Boundaries	Pollutants	Listing Basis
Rock Creek	ID17040219SK028_02	Source to mouth	Temperature	Carried from 1998 list, Instantaneous single temp reading.
Quigley Creek	ID17040219SK008_02	Source to mouth	Temperature	Carried from 1998 list as unknown. Later changed to temp.
Black Canyon Creek	ID17040219SK030_02	Source to mouth	Temperature	Failed BURP, Listed in error
Black Canyon Creek	ID17040219SK030_02	Source to mouth	TSS	Failed BURP, Listed in error
Black Canyon Creek	ID17040219SK030_02	Source to mouth	Cause unknown, (nutrients suspected)	Listed in error
Black Canyon Creek	ID17040219SK030_03	Source to mouth	TSS	Failed BURP, Listed in error
Black Canyon Creek	ID17040219SK030_03	Source to mouth	Cause unknown, (nutrients suspected)	Listed in error

Notes: Beneficial Use Reconnaissance Program (BURP); total suspended solids (TSS)

Not all of the water bodies will require a TMDL. However, an investigation, using the available data, was performed before this conclusion was made. Black Canyon Creek was listed in error (Table 1). The main stem of Black Canyon Creek is made up of three AUs: ID17040219SK030_02 (source to mouth), ID17040219SK030_03 (source to mouth) and ID17040219SK030_04 (confluence of Black Canyon Creek and East Fork Black Canyon Creek to mouth; however, it is defined also as source to mouth). At each BURP site conducted on Black Canyon Creek, the creek was described as dry and inaccessible by the BURP visit. Therefore, no BURP assessments were performed because the creek was dry. Consequently, the listing of Black Canyon Creek was listed in error because no BURP assessments could be performed on a dry stream. The stream, during the high flow events of any year, does have water that moves through it. But this water is short-lived. Several agricultural ponds are located along the middle to lower stretches of the creek; and are intended to capture any water that may exist. DEQ conducted multiple site visits of Black Canyon Creek and determined that the stream is (1) dry except during storm events; (2) confined to its channel in the middle to upper stretches with little sediment erosion discharging into the creek; (3) is inaccessible to livestock in the upper stretches; and (4) is flow altered in the middle to lower stretches with agricultural ponds that are strategically placed for water capture after storm events. Therefore, DEQ concludes that Black Canyon Creek 2nd order is flow altered and should be listed in Category 4c, remains flow altered in the 3rd order, has no source or pathway for sediment or nutrients and recommends it be delisted for TSS and nutrients in the next Integrated Report cycle. No TSS data were ever gathered for the 3rd order, hence the listing is in error and mistake.

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards, defined in IDAPA 58.01.02, designate beneficial uses, and set water quality goals for the waters of the state.

Idaho water quality standards require that surface waters of the state be protected for *beneficial uses*, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses as briefly described in the following paragraphs and in Table 2. The *Water Body Assessment Guidance*, second edition (Grafe et al. 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

2.2.1 Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing in-stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.050.02, .02.051.01, and .02.054). Existing uses include uses actually occurring, whether or not the level of quality to support fully the uses exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that could support salmonid spawning, but salmonid spawning is not occurring due to other factors, such as dams blocking migration.

2.2.2 Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho, these designated uses include aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Water quality must be sufficiently maintained to meet the most sensitive use.

Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning.

Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (IDAPA .02.109-.02.160, in addition to citations for existing uses).

2.2.3 Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, the Idaho Department of Environmental Quality (DEQ) presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," DEQ will apply the numeric cold water criteria and primary or secondary contact recreation criteria to undesignated waters.

Table 2. Beneficial uses of §303(d) listed streams.

Water Body/Assessment Unit	Beneficial Uses[a]	Type of Use (state if designated, existing, etc.)
Quigley Creek ID17040219SK008_02	CW, SS, SCR	Existing
Rock Creek ID17040219SK028_02	CW, SCR	Presumed
Black Canyon Creek ID17040219SK030_02	CW, SCR	Presumed
Black Canyon Creek ID17040219SK030_03	CW, SS, SCR	Existing

[a] CW – cold water, SS – salmonid spawning, PCR – primary contact recreation, SCR – secondary contact recreation

2.3 Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of criteria, which include *narrative* criteria for pollutants such as sediment and nutrients and *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity (IDAPA 58.01.02.250).

Table 3 includes the most common numeric criteria used in TMDLs.

Figure 1 provides an outline of the stream assessment process for determining support status of the beneficial uses of cold water aquatic life, salmonid spawning, and contact recreation.

Table 3. Selected numeric criteria supportive of designated beneficial uses in Idaho water quality standards.

Designated and Existing Beneficial Uses				
Water Quality Parameter	**Primary Contact Recreation**	**Secondary Contact Recreation**	**Cold Water Aquatic Life**	**Salmonid Spawning (During Spawning and Incubation Periods for Inhabiting Species)**
Water Quality Standards: IDAPA 58.01.02.250				
Bacteria, pH, and, dissolved oxygen	Less than 126 *E. coli*/100 mL[a] as a geometric mean of five samples over 30 days; no sample greater than 406 *E. coli* organisms/100 mL	Less than 126 *E coli*/100 mL as a geometric mean of five samples over 30 days; no sample greater than 576 *E. coli*/100 mL	pH between 6.5 and 9.0 DO[b] exceeds 6.0 mg/L[c]	pH between 6.5 and 9.5 Water Column DO: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater Intergravel DO: DO exceeds 5.0 mg/L for a 1-day minimum and exceeds 6.0 mg/L for a 7-day average
Tempera-ture[d]			22 °C or less daily maximum; 19 °C or less daily average	13 °C or less daily maximum; 9 °C or less daily average Bull trout: not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June–August; not to exceed 9 °C daily average in September and October
			Seasonal Cold Water: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °C or less daily average	

Designated and Existing Beneficial Uses				
Water Quality Parameter	**Primary Contact Recreation**	**Secondary Contact Recreation**	**Cold Water Aquatic Life**	**Salmonid Spawning (During Spawning and Incubation Periods for Inhabiting Species)**
Turbidity			Turbidity shall not exceed background by more than 50 NTU[e] instantaneously or more than 25 NTU for more than 10 consecutive days.	
Ammonia			Ammonia not to exceed calculated concentration based on pH and temperature.	

[a] *Escherichia coli* per 100 milliliters
[b] Dissolved oxygen
[c] Milligrams per liter
[d] Temperature Exemption—Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the 90th percentile of the 7-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.
[e] Nephelometric turbidity units

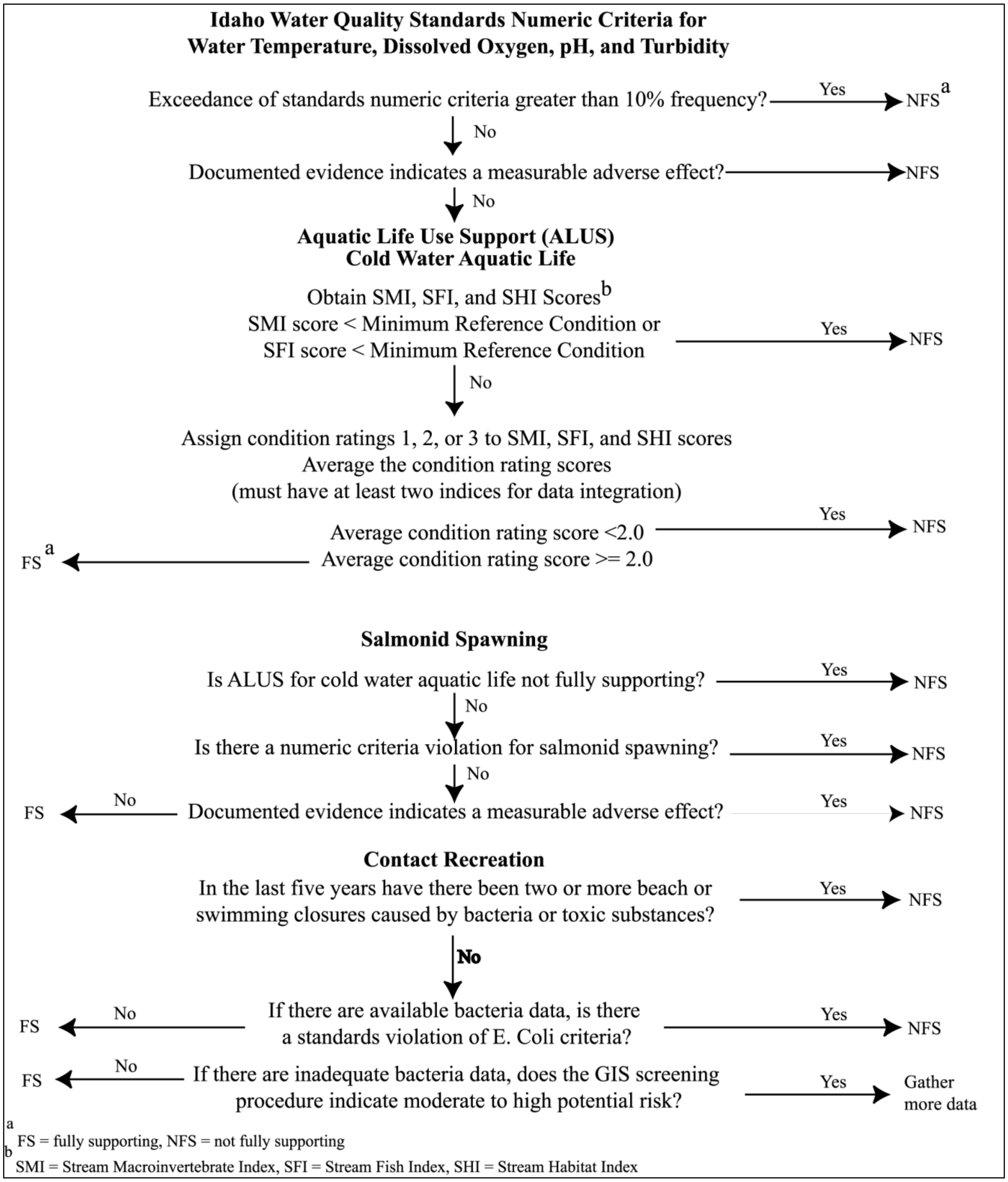

Figure 1. Determination steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.4 Summary and Analysis of Existing Water Quality Data

A detailed summary and analysis of existing water quality data for the Big Wood River subbasin is provided in the Big Wood River SBA/TMDL approved by EPA in 2002:

http://www.deq.idaho.gov/water-quality/surface-water/tmdls/table-of-sbas-tmdls/big-wood-river-subbasin.aspx

2.4.1 Flow Characteristics

A detailed discussion of flow characteristics for the Big Wood River subbasin is provided in the Big Wood River SBA/TMDL approved by EPA in 2002. No flow gages are located in any of the tributaries to Black Canyon Creek AUs. The only available data are limited to flow measurements conducted randomly by the Beneficial Use Reconnaissance Program (BURP) program between 1997 and 2011 (Table 4 and Figure 2). These data were utilized to evaluate flow characteristics specific to Black Canyon Creek and associated tributaries. There is insufficient water in both the second and third order segments of Black Canyon Creek to conduct a TMDL analysis. DEQ attempted to collect additional flow data; however, no flowing water could be found.

Water flow is naturally present in these streams during early snowmelt and rare storm events. Flow has been occasionally measured during the summer BURP season in the 3rd order Dry Creek (Figure 2), presumably during wet years. They are generally dry by April, and any water present from May until late fall is due to irrigation return flow (excess flow, return flow or waste water that collects and travels to the Big Wood Canal Company or American Falls Reservoir District #2 Canal Systems). Dry Creek is generally diverted entirely to Bray Lake until April 1 at which time shares would be allocated to private water right users downstream. Black Canyon Creek and Dry Creek AUs do not contain sufficient water for a TMDL.

Table 4 . Black Canyon Creek and tributaries flow measurements in cubic feet per second.

Burp ID	Stream/Location	Flow	Date Collected
ID170401219SK030_02 Black Canyon Creek—Tributaries and main stem associated with Black Canyon Creek			
1997STWFB012	Hot Creek	0.041	6/23/1997
1997STWFB011	Dry Creek	0.039	6/23/1997
1995STWFA072	Coyote Creek	0.0	Recon
1995STWFA073	Fourmile Creek	0.0	8/17/1995
2003STWFA008	Fourmile Creek	0.0	7/8/2003
2003STWFA009	Coyote Creek	0.0	7/8/2003
2003STWFA007	Black Canyon Creek	0.0	Recon
2003STWFA006	Black Canyon Creek	0.0	7/8/2003
2007STWFA113	East Black Canyon	0.0	4/28/2007*
	Average Flow	0.009	
ID170401219SK030_03 Black Canyon Creek—Tributaries and main stem-+ associated with Black Canyon Creek			
1997STWFA016	Dry Creek	2.11	6/25/1997
2003STWFA004	Dry Creek	0.7	7/3/2003
2003STWFA010	Dry Creek	0.6	7/14/2003
2003STWFA011	Dry Creek	0.2	7/8/2003
2005STWFA003	Dry Creek	1.18	7/5/2005
2005STWFA040	Dry Creek	0.59	8/17/2005
2005STWFA053	Dry Creek	0.0	4/11/2005*
2005STWFA058	Dry Creek	0.0	4/11/2005*
2007STWFA113	East Black Canyon Creek	0.0	9/28/2007
2008STWFA056	Bostrum Canal	0.0	7/30/2008
2010SDEQA019	Dry Creek	0.0	Recon
2011STWFA033	Dry Creek	0.0	8/11/2011
	Average Flow	0.45	

** indicates site visits where BURP methods were not implemented*

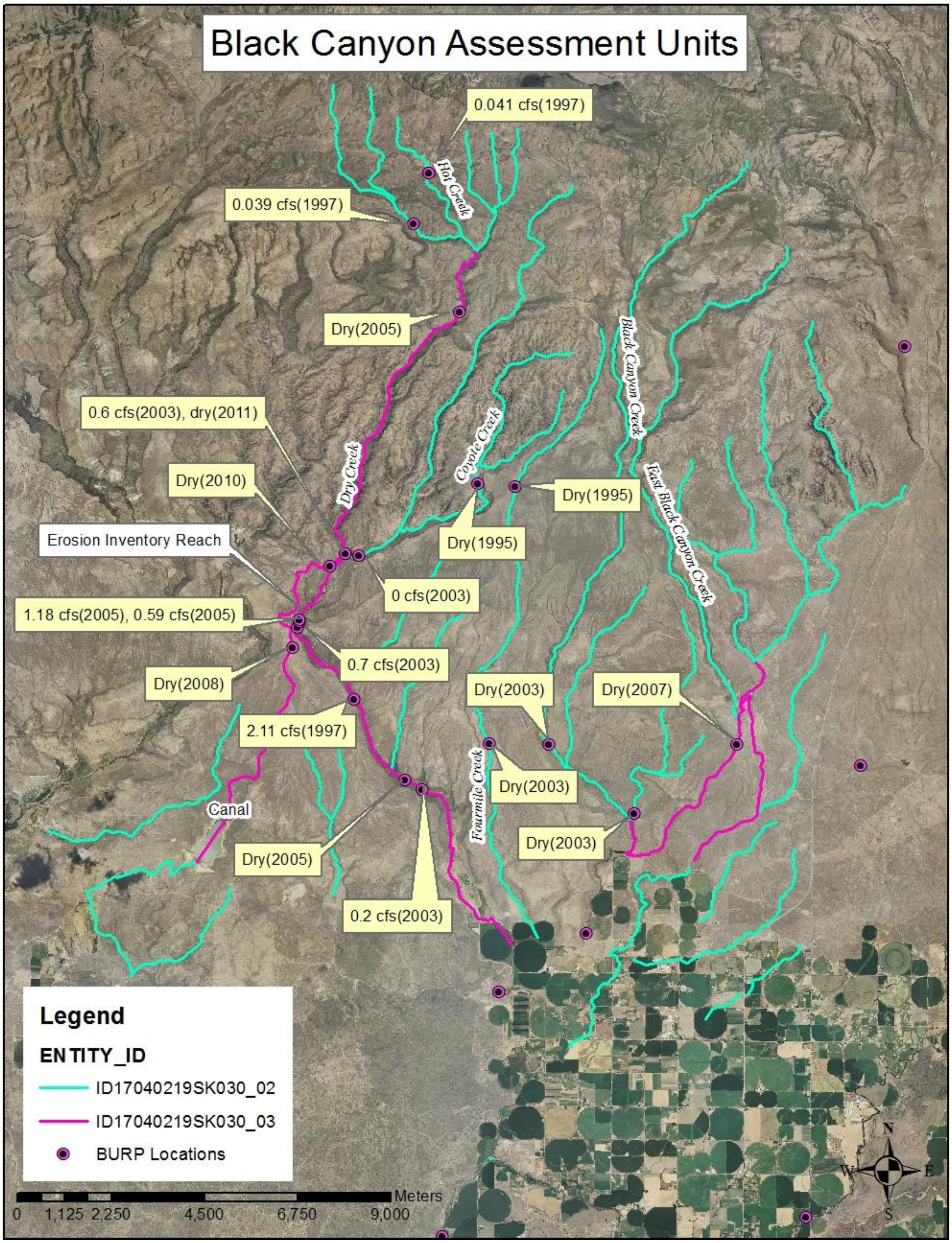

Figure 2. Black Canyon Creek assessment units and BURP flow data.

2.4.2 Water Column Data

Quigley Creek has existing approved TMDLs. Load allocations for total phosphorus, sediment, and *E. coli* were developed for Quigley Creek as part of *The Big Wood River Watershed Management Plan* (DEQ 2002). Water quality monitoring was conducted by DEQ from July 2007 through November 2007 and April 2008 through August 2008 (Table 5).

Table 5. Quigley Creek water quality data for 2007–2008 sampling (n=4).

Water Quality Parameter	Water Quality Metric/Target	Range	Median	Average	% Exceedance
Dissolved oxygen (DO) mg/L	DO > 6.0 mg/L	3.51–4.39	3.96	4.02	100
pH	Between 6.5 and 9.0	7.31–7.88	7.53	7.58	0
Turbidity (Hydrolab)	5 NTUs over natural background	3.9–54.3	4.8	38.03	0
Turbidity (grab sample)	5 NTUs over natural background	0.784–0.918	0.85	0.85	0
Total phosphorus	<0.080 mg/L	0.0090–0.0140	0.01	0.01	0
Total suspended solids	<40.0 mg/L	<2.00–<5.00	<5.00	<2.00	0
E. coli	No single sample >406 cfu/100 mL	<1.0–6.3	2.0	2.93	0

Notes: milligrams per liter (mg/L); nephelometric turbidity unit (NTU); milliliter (mL)

Water quality samples were collected from Quigley Creek (ID17040219SK008_02) above the Bureau of Land Management (BLM) and private property boundary prior to the fork to Towne Creek. Low dissolved oxygen is to be expected on Quigley Creek, where spring sources are present. As ground water reaches the surface through springs and seeps, dissolved oxygen will be low (between 5 to 8 mg/L) until the water is aerated as it moves through the system This is different than a summer scenario of low dissolved oxygen sags that may occur in the warm summer months; or when reduced flows occur mostly in the late spring and summer; or when organic material like leaves is added during periods of leaf fall in the drop in the fall months. Results of pH, turbidity, total phosphorus, TSS, and *E. coli* measurements indicate that water chemistry provides full support of beneficial uses in Quigley Creek. However, additional data would need to be collected before a conclusive analysis can be made. Temperature data for Quigley Creek is located in Appendix A.

Rock Creek has existing approved TMDLs. Load allocations for total phosphorus, sediment and *E. coli* were developed for Rock Creek as part of *The Big Wood River Watershed Management Plan* (DEQ 2002) (Table 6).

Table 6. Rock Creek water quality data for 2007–2009 sampling (n=4).

Water Quality Parameter	Water Quality Metric/Target	Range	Median	Average	% Exceedance
Dissolved oxygen (DO) mg/L	DO > 6.0 mg/L	7.17–12.86	8.63	9.41	0
pH	Between 6.5 and 9.0	7.59–8.74	7.86	8.08	0
Turbidity (Hydrolab)	50 NTUs over natural background	0–154.0	28.90	41.30	16
Turbidity (grab sample)	50 NTUs over natural background	1.45– 6.04	3.89	3.79	0
Total phosphorus	<0.080 mg/L	0.036–0.142	0.14	0.11	66
Total suspended solids	<40.0 mg/L	<2.0–5.0	4.5	4.5	0
E. coli	No single sample >406 cfu/100 mL	15–875	766.0	551.87	66

Notes: milligrams per liter (mg/L); nephelometric turbidity unit (NTU); milliliter (mL)

Data for pathogen, nutrient and sediment water quality parameters was collected above the confluence of Rock Creek and East Fork Rock Creek (ID17040219SK 028_02), road crossing above Hatty Gulch (ID17040219SK028_03), and above the Highway 20 crossing (ID17040219SK 028_03). Water column data was collected March through October from 2007 to 2009.

Due to the low number of samples for turbidity, total phosphorus, and *E. coli* on Rock Creek the data are inclusive. Additional samples need to be collected before a complete analysis can be made. DEQ did not note any nuisance aquatic growths or viable slime mold in Rock Creek in late spring to summer months. Temperature data are summarized in Appendix A for Rock Creek and its tributary, Little Poison Creek.

Because flow is rarely encountered in the Black Canyon Creek AUs, no ambient water quality sampling has taken place. An erosion inventory was conducted on the 3rd order segment of Dry Creek; however, bank stability was 95% with very few eroding banks discovered. Although these AUs are listed for TSS, no TSS data have been found to support that listing. No TSS data have been collected by DEQ because of insufficient flow. No continuous temperature data were found to justify the original listing in 2002. There are no sources or pathways for pollutants such as sediment and nutrients. DEQ has determined these two AU’s for Black Canyon Creek are either ephemeral (2nd order) or flow altered and should be delisted for temperature, TSS, and cause unknown (see Section 2.4.4 for details). The 3rd order of Black Canyon Creek is already listed in Category 4c.

A detailed discussion of other water column data for the Big Wood River subbasin is provided in the Big Wood River SBA/TMDL approved by EPA in 2002.

2.4.3 Biological and Other Data

A detailed discussion of biological and other data for the Big Wood River subbasin is provided in the Big Wood River SBA/TMDL approved by EPA in 2002.

In 2011, DEQ personnel field verified aerial photo interpretations of existing shade using a Solar Pathfinder on four sites, two on Quigley Creek and two on Rock Creek. The Solar Pathfinder recorded an average shade of 37% at the upper Quigley Creek site and 38% at the lower Quigley Creek site. The two Solar Pathfinder sites on Rock Creek recorded average shade as 8% below the East Fork Rock Creek confluence (upper site) and 17% at the lower site below Smith Creek. Aerial photo observations of the Black Canyon 2nd order unit showed adequate canopy cover along streams and no bank instability. Most of these waters drain to desert canyons where access is extremely limited, and riparian vegetation is very thick. It is likely that these waters have adequate shade, and they have no eroding banks.

In 2012, DEQ personnel investigated streambank stability in the 3rd order section of Dry Creek. Banks were 95% stable, which is well above the target level of at least 80%. These results are discussed further below.

TMDLs were recommended for temperature for Quigley Creek and Rock Creek. However, no sediment, nutrient, or temperature TMDLs were recommended for the Black Canyon Creek AU. These are proposed for delisting because there are no sources of nutrients, sediment, TSS, and the temperature listing was an error based on a single reading. The air temperature and water temperature were only 1 °C apart. DEQ does not list temperature for streams with average flows below 1 cfs, nor for a single grab sample.

2.4.4 Black Canyon Assessment Units

The Black Canyon AUs (ID17040219SK030_02 and 03) include the Dry Creek watershed and a number of tributaries to Dry Creek including Hot Creek, Coyote Creek, Black Canyon Creek, and East Black Canyon Creek. The tributaries and a small portion of the headwaters of Dry Creek are in the 2nd order unit, and Dry Creek itself forms most of the 3rd order unit. The watershed exists entirely on lava flows that occur below the Bennett Hills. Over millennia flowing water has cut deep canyons through the lava rock. Dry Creek exists in one such canyon where the 3rd order AU likely encounters ground water base flow deep within the canyon. The smaller tributaries often exist in lesser canyons or on lava surfaces where no ground water is intercepted and periodic flows are typically related to brief snowmelt and rainstorms. The 2nd order unit has no designated uses, therefore, cold water aquatic life and secondary contact recreation are presumed uses. The 3rd order unit is also undesignated but had salmonids detected in several BURP sites, therefore, it has existing uses of cold water aquatic life and salmonid spawning.

The 2nd order unit is entirely ephemeral or episodic in nature. Most BURP visits during the summer sampling period resulted in unsampled dry conditions (Figure 2). Two sites in 1997 were inadvertently sampled despite very low, almost nonexistent flows (Table 4). These sites were likely ephemeral pools in a wet year and should not have been sampled. The 2nd order unit is currently listed for temperature, TSS, and unknown pollutants. No temperature data are available other than instantaneous measurements made at the two 1997 BURP sites. No TSS or unknown pollutant information is available. No sources or pathways for pollutants were observed. The unit was inadvertently listed as a result of these two 1997 BURP sites and should be delisted for these pollutants. Because little or no water is available in this 2nd order unit during critical time periods for beneficial uses, the unit should be identified in

Category 4c for flow alteration. Eventually, the unit needs to receive use designations consistent with its ephemeral nature.

The 3rd order unit includes Dry Creek from its headwaters below Hot Creek to the agricultural lands north of Gooding, Idaho (Figure 2). Two main diversions exist on Dry Creek in this unit, the first occurring below Coyote Creek where an 8-cfs water right diverts water down a canal to Bray Lake (Figure 3). The second water right occurs at the mouth of the canyon near the bottom of the unit (Figure 4). Above the first diversion, Dry Creek exists in a 9-km narrow, deep canyon where riparian vegetation is very thick resulting in near 100% shade based on aerial observations (Figure 5). Below the first diversion is an open valley for about 2.7 km where beaver activity has resulted in ponding (Figure 8). DEQ performed an erosion inventory in this area to determine if sediment impacts may be occurring. The inventory resulted in only 5% bank erosion, less than the 20% target allowed for natural systems, and newly forming beaver ponds appeared to have gravel bottoms suggesting little deposition. Below the open valley, Dry Creek enters a second narrow canyon (6 km) where riparian vegetation provides significant shade (Figure 7). Near the mouth of this lower canyon is the second diversion where an 8-cfs water right removes the last remaining flow from Dry Creek for delivery to agricultural fields. The remaining 4 km of Dry Creek are typically dry to the end of the 3rd order unit.

No evidence exists that temperature and sediment are issues resulting from activities beyond water removal. The 3rd order section of Dry Creek is substantially untouched in narrow, steep canyons where riparian vegetation is thick and shady. No erosion problems were seen in the only reach that was open and accessible to perturbation. Impacts to the unit that were detected in the BURP sites sampled likely occurred as a result of a lack of water, more so than any other perturbation. Therefore, the 3rd order AU of Dry Creek should be delisted for TSS and unknown pollutants and should remain in Category 4c for flow alteration.

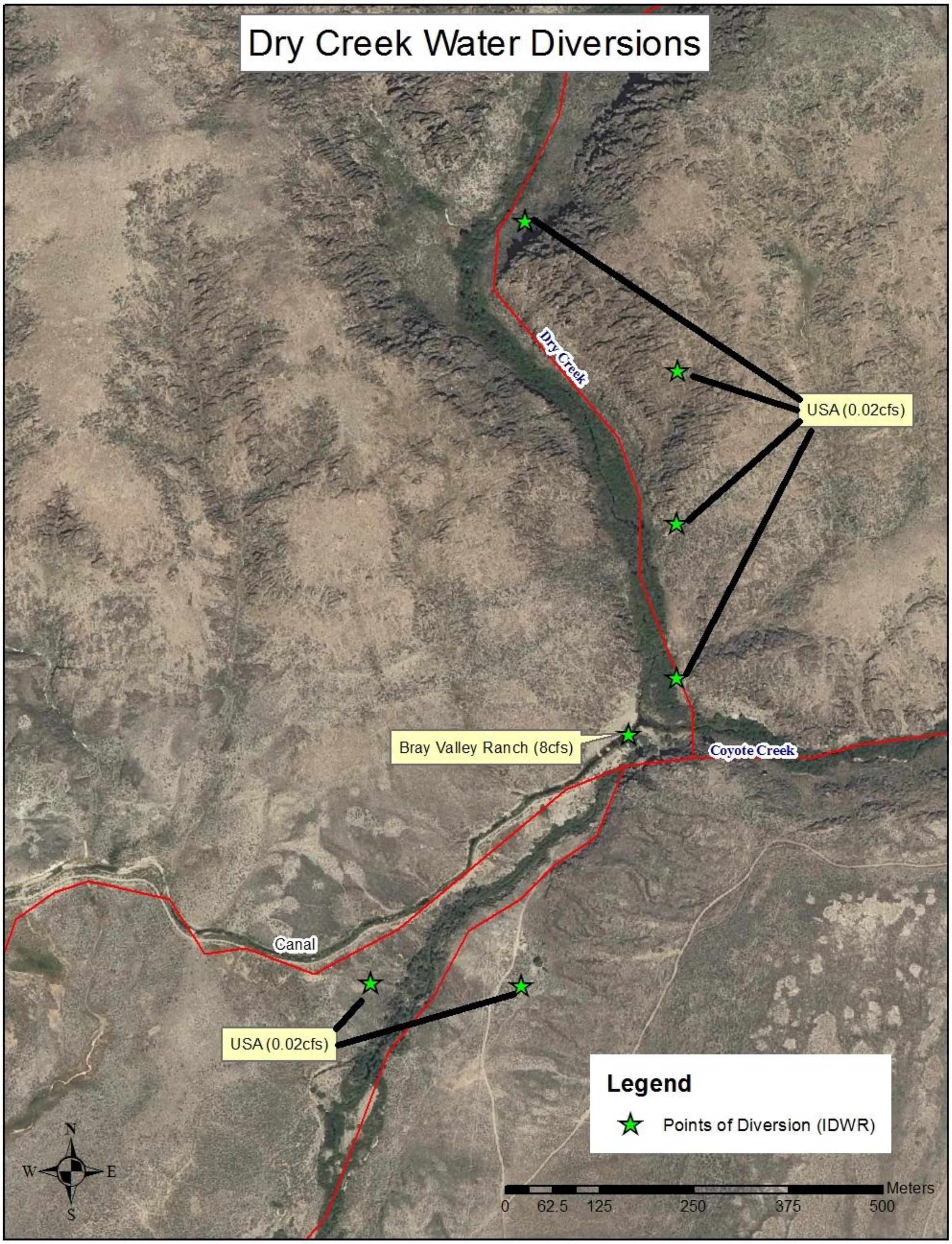

Figure 3. Dry Creek and Bray Lake diversion.

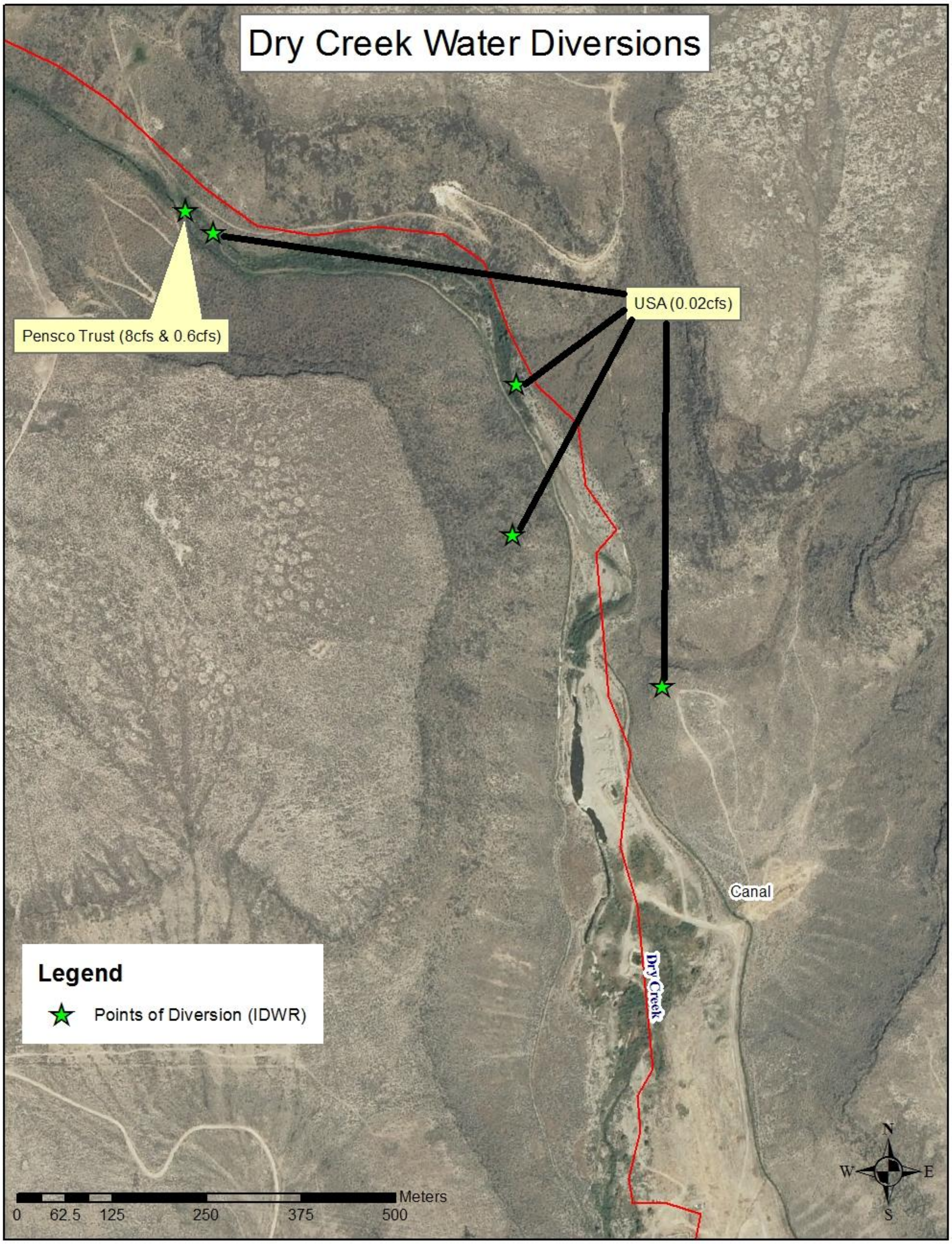

Figure 4. Dry Creek and second (Pensco) diversion.

Figure 5. Dry Creek open valley below first diversion.

Figure 6. Dry Creek upper canyon, above the diversion.

Figure 7. Dry Creek lower canyon, below the diversion.

3. Subbasin Assessment–Pollutant Source Inventory

A detailed discussion of pollutant sources for the Big Wood River subbasin is provided in the Big Wood River SBA/TMDL approved by EPA in 2002:

http://www.deq.idaho.gov/water-quality/surface-water/tmdls/table-of-sbas-tmdls/big-wood-river-subbasin.aspx

Corrections were made to the point source wasteload allocations for *E. coli* using the correct design flow capacity for the three wastewater treatment plants: City of Hailey, City of Ketchum, and the Meadows. These corrections are detailed in the Errata to *The Big Wood River Watershed Management Plan* approved by EPA in 2011:

http://www.deq.idaho.gov/media/757583-big-wood-river-tmdl-errata-1111.pdf

The development of the errata did not change the TMDL reduction of 69% and was to be utilized for National Pollutant Discharge Elimination System (NPDES) permitting purposes for *E. coli.*

4. Monitoring and Status of Water Quality Improvements

A detailed discussion of the monitoring and the status of water quality improvements may be found in the Big Wood River SBA/TMDL approved by EPA in 2002 and the Big Wood River Implementation Plan for Agriculture (Idaho Soil Conservation Commission 2006).

Water quality improvement efforts have occurred in the Big Wood River subbasin. These efforts have included fencing, streambank protection and restoration, water conveyance improvements, planned grazing and numerous projects by United States Forest Service and BLM. However, there is opportunity of further implementation. The following best management practices are suggestions for this subbasin to ensure the TMDLs for sediment, phosphorus, *E. coli,* and temperature are met.

- Streambank protection
- Stream channel stabilization
- Riparian vegetation enhancement
- Fencing
- Livestock exclusion
- Planned grazing systems

The Idaho Association of Soil Conservation Districts and Idaho Soil and Water Conservation Commission had worked with private property owners to convert 2330 acres of gravity irrigation to sprinkler, reducing sediment loadings to the Big Wood River by 69,900 tons/year. Additional water quality improvement projects include ½ mile of stream restoration and wildlife habitat development, 112 acres contracted for CRP and development of sediment catch basins.

IASCD and ISWCC continue to promote conservation projects that improve water quality and have defined “Critical Areas” for best management practice (BMP) implementation based on proximity to a water body of concern, the potential for pollutant transport and delivery to a receiving water body. A more detailed discussion of this topic can be found in the *Big Wood River Implementation Plan for Agriculture* (Idaho Soil and Water Conservation Commission 2006).

5. Total Maximum Daily Loads

A TMDL prescribes an upper limit (i.e., load capacity) on discharge of a pollutant from all sources to ensure water quality standards are met. It further allocates this load capacity among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation, and nonpoint sources, each of which receives a load allocation. Natural background contributions, when present, are considered part of the load allocation but are often treated separately because they represent a part of the load not subject to control. Because of uncertainties about quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (“Water Quality Planning and Management” [40 CFR 130]) require a margin of safety be a part of the TMDL. Practically, the margin of safety and natural background are both reductions in the load capacity available for allocation to pollutant sources.

Load capacity can be summarized by the following TMDL equation:

$$LC = MOS + NB + LA + WLA = TMDL$$

where:

LC = load capacity
MOS = margin of safety
NB = natural background
LA = load allocation
WLA = wasteload allocation

The TMDL equation is written in this order because it represents the logical order in which a load analysis is conducted. First, the load capacity is determined, and then, the load capacity is broken down into its components. After the necessary margin of safety and natural background, if relevant, are quantified, the remainder is allocated among pollutant sources (i.e., the load allocation and wasteload allocation). When the breakdown and allocation are complete, the result is a TMDL, which must equal the load capacity.

The load capacity must be based on critical conditions—the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determining critical conditions can be more complicated than it may appear on the surface.

Another step in a load analysis is quantifying current pollutant loads by source. This step allows the specification of load reductions as percentages from current conditions and considers equities in load reduction responsibility. A load is fundamentally a quantity of pollutant discharged over some period of time and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary. These *other measures* must still be quantifiable and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow “gross allotment” as a load allocation where available data or appropriate predictive techniques limit more accurate estimates, as is the case in this temperature TMDL. For certain pollutants whose effects are long-term, such as temperature, the EPA allows for seasonal or annual loads (40 CFR 130).

5.1 Instream Water Quality Targets

For the Quigley Creek and Rock Creek temperature TMDLs, DEQ used a Potential Natural Vegetation approach. Idaho “Water Quality Standards” (IDAPA 58.01.02.200.09) include a provision that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and for temperature TMDLS, the natural level of shade and channel width become the TMDL target. The instream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria. Appendix B provides further discussion of water quality standards and natural background provisions.

The PNV approach is described briefly in section 5.1.2. The procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in detail in *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and De Varona 2009). The manual also provides a more complete discussion of shade and its effects on stream water temperature.

5.1.1 Factors Controlling Water Temperature in Streams

Several important factors contribute heat to a stream, including ground water temperature, air temperature, and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most controllable. The parameters that affect the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology (i.e., structure) affects riparian vegetation density and water storage in the alluvial aquifer. Riparian vegetation and channel morphology are the factors influencing shade that are most likely to have been influenced by anthropogenic activities and can be most readily corrected and addressed by a TMDL.

Riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. However, depending on how much vertical elevation surrounds the stream, vegetation further away from the riparian corridor can also provide shade. DEQ measures the amount of shade that a stream receives in a number of ways. Effective shade (i.e., shade provided by all objects that intercept the sun as it makes its way across the sky) can be measured in a given location with a Solar Pathfinder or with other optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and stream aspect.

In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream and can be measured using a densiometer or estimated visually either on site or using aerial photography. All of these methods provide information about how much of the stream is covered and how much is exposed to direct solar radiation.

5.1.2 Potential Natural Vegetation for Temperature Total Maximum Daily Loads

PNV along a stream is a riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets. Vegetation can be removed by disturbance either naturally (e.g., wildfire, disease or old age, wind damage, and wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, and erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream without any anthropogenic removal of shade-producing vegetation. Vegetation levels less than PNV (with the exception of natural levels of disturbance and age distribution) result in the stream heating up from anthropogenically created additional solar inputs.

DEQ can estimate PNV (and therefore target shade) from models of plant community structure (shade curves for specific riparian plant communities) and can measure or estimate existing canopy cover or shade. Comparing the target and existing shade indicates how much excess solar load the stream is receiving and what potential exists to decrease solar gain. Streams disturbed by wildfire, flood, or some other natural disturbance will be at less than PNV and require time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing and PNV shade was converted to solar loads from data collected on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this case, DEQ used the average from stations in Boise and Pocatello, Idaho. The difference between existing and target solar loads, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards (Appendix B).

PNV shade and the associated solar loads are assumed to be the natural condition; thus, stream temperatures under PNV conditions are assumed to be natural (as long as no point sources or other anthropogenic sources of heat exist in the watershed) and are considered to be consistent with Idaho water quality standards, even if they exceed numeric criteria by more than 0.3 °C.[1]

5.1.2.1 Existing Shade Estimates

Existing shade was estimated for the two AUs from visual interpretation of aerial photos. Estimates of existing shade based on plant type and density were marked out as stream segments on a 1:100,000 or 1:250,000 hydrography taking into account natural breaks in vegetation density. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. Each segment was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects process [IDL 2000]). For example, if shade for a particular stream segment was estimated between 50% and 59%, DEQ assigned a 50% shade class to that segment. The estimate is based on a general intuitive observation about the kind of

[1] A unit conversion chart is provided in Appendix C.

vegetation present, its density, and stream width. Streams where the banks and water are clearly visible are usually in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%, 50%, or 60%).

Visual estimates made from aerial photos are strongly influenced by canopy cover and do not always take into account topography or any shading that may occur from physical features other than vegetation. It is not always possible to visualize or anticipate shade characteristics resulting from topography and landform. However, research has shown that shade and canopy cover measurements are remarkably similar (OWEB 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade. The visual shade estimates in this TMDL were partially field verified with a Solar Pathfinder, which measures effective shade and considers other physical features that block the sun from hitting the stream surface (e.g., hillsides, canyon walls, terraces, and man-made structures).

5.1.3 Solar Pathfinder Field Verification

The accuracy of the aerial photo interpretations was field verified with a Solar Pathfinder at four sites. The Solar Pathfinder is a device that allows tracing the outline of shade-producing objects on monthly solar path charts. The percentage of the sun’s path covered by these objects is the effective shade on the stream at the location where the tracing is made. To adequately characterize the effective shade on a stream segment, 10 traces are taken at systematic or random intervals along the length of the stream in question (Appendix A).

At each sampling location, the Solar Pathfinder was placed in the middle of the stream at about the bank-full water level. Ten traces were taken following the manufacturer’s instructions (i.e., orient to south and level). Systematic sampling was used because it is easiest to accomplish without biasing the sampling location. For each sampled segment, the sampler started at a unique location, such as 50–100 meters (m) from a bridge or fence line, and proceeded upstream or downstream taking additional traces at fixed intervals (e.g., every 50 m or 50 paces). Alternatively, points of measurement can be randomly located by generating random numbers to be used as interval distances.

When possible, the sampler also measured bank-full widths, took notes, and photographed the landscape of the stream at several unique locations while taking traces. Special attention was given to changes in riparian plant communities and to what kinds of plant species (large, dominant, shade-producing species) were present. DEQ can also take densiometer readings at the same location as Solar Pathfinder traces. These readings provide the potential to develop relationships between canopy cover and effective shade for a given stream.

The accuracy of the aerial photo interpretations were field verified with a Solar Pathfinder at four sites, two on Quigley Creek and two on Rock Creek. These Solar Pathfinder data were taken before any aerial photo interpretation of existing shade. Thus, the data were used to calibrate the eye as DEQ initiated the aerial interpretation. The Solar Pathfinder recorded an average shade of 37% at the upper Quigley Creek site and 38% at the lower Quigley Creek site. Both of these sites were located in Geyer willow/sedge communities. The two Solar

Pathfinder sites on Rock Creek recorded average shade as 8% below the East Fork Rock Creek confluence (upper site) and 17% at the lower site below Smith Creek.

5.1.3.1 Target Shade Determination

PNV targets were determined from an analysis of probable vegetation at the streams and comparing that to shade curves developed for similar vegetation communities in Idaho (Shumar and De Varona 2009). A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, shade decreases as vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the more shade the plant community is able to provide at any given channel width.

5.1.4 Natural Bank-Full Widths

Stream width must be known to calculate target shade since the width of a stream affects the amount of shade the stream receives. Bank-full width is used because it best approximates the width between the points on either side of the stream where riparian vegetation starts. Measures of current bank-full width may not reflect widths present under PNV (i.e., natural widths). As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase so that streams become wider and shallower. Shade produced by vegetation covers a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has eroded away.

Since existing bank-full width may not be discernible from aerial photo interpretation and may not reflect natural bank-full widths, this parameter must be estimated from available information. DEQ used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster, Idaho Department of Lands—to estimate natural bank-full width (Figure 8).

For each stream evaluated in the load analysis, natural bank-full width was estimated based on the drainage area of the Upper Snake Basin curve from Figure 8 (Table 7). Although estimates from other curves were examined (i.e., Salmon, Payette/Weiser), the Upper Snake Basin curve was ultimately chosen because of its proximity to the Big Wood River watershed and similarity of climate and geology. Existing width data should also be evaluated and compared to these curve estimates if such data are available. However, for the three tributary watersheds, only a few BURP sites exist, and bank-full width data from those sites represent only spot data (e.g., only three measured widths in a reach just several hundred meters long) that are not always representative of the stream as a whole.

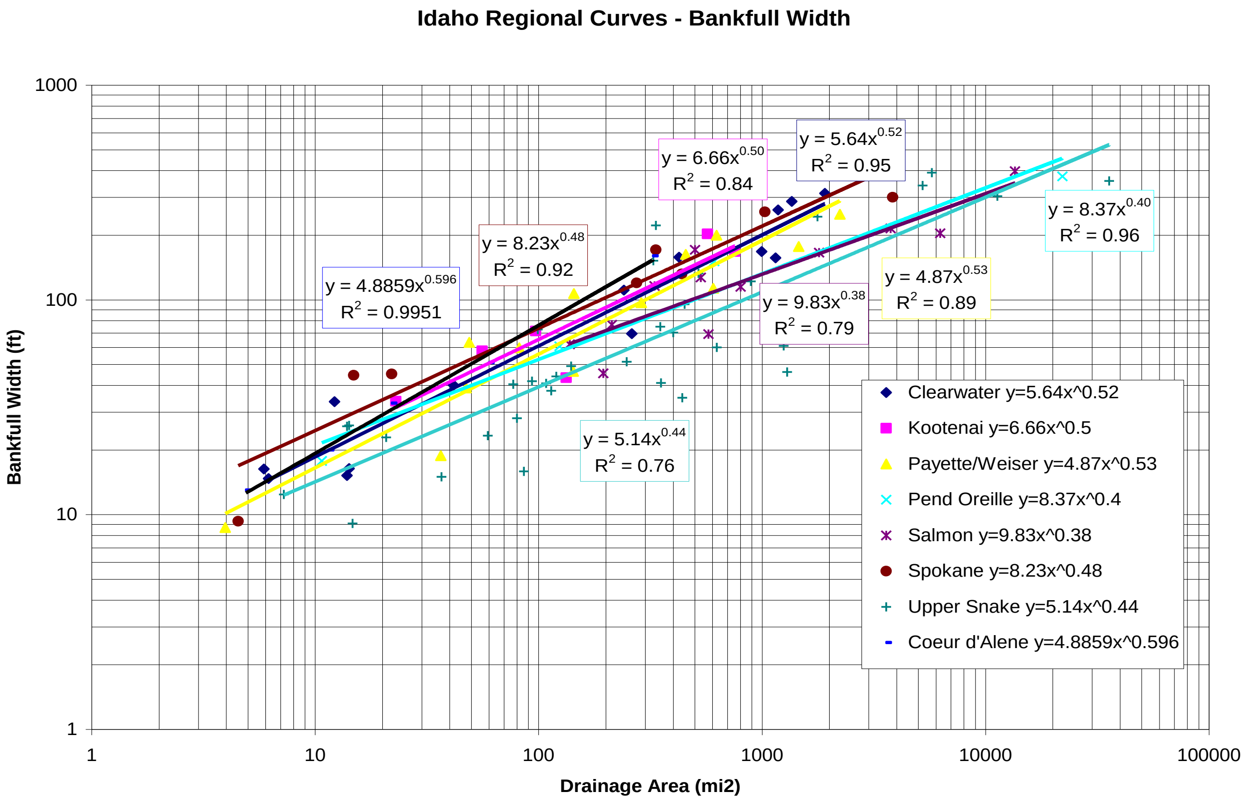

Figure 8. Bank-full width as a function of drainage area.

Table 7. Bank-full width estimates based on drainage area.

Location	Area (mi^2)	Upper Snake Basin (m)	Salmon (m)	Payette/Weiser (m)	BURP (m)
Rock Creek at Magic Reservoir	40.7	8	12	11	—
Rock Creek above Little Rock Creek	34.6	7	12	10	6
Rock Creek above Smith Creek	22.1	6	10	8	2.5
Rock Creek below east /west forks	10.2	4	7	5	5
Rock Creek above east /west forks	5.03	3	6	3	—
Quigley Creek at Hailey end	16.8	5	9	7	—
Quigley Creek above Quigley Pond	12.3	5	8	6	2.4
Quigley Creek below main road fork	4.62	3	5	3	2.2

Notes: square mile (mi^2); meter (m); Beneficial Use Reconnaissance Program (BURP)

In general, DEQ found BURP bank-full width data agreed with natural bank-full width estimates from the Upper Snake Basin curve and chose not to make natural widths any smaller than these Upper Snake Basin estimates. The load analysis tables contain a natural bank-full width and an existing bank-full width for every stream segment in the analysis based on the bank-full width results presented in Table 7. Existing and natural widths are the same in the load analysis tables when there are no data to support making them differ.

5.1.5 Design Conditions

Quigley Creek and Rock Creek originate in the Idaho Batholith level III Ecoregion (McGrath et al. 2001). Quigley Creek may start in the Dry, Partly Wooded Mountains level IV Ecoregion where a mosaic of shrublands, open Douglas-fir (*Pseudotsuga menziesii*) forest, and aspens exists on sedimentary and extrusive rock. This Dry, Partly Wooded Ecoregion as well as the Foothills Shrublands-Grasslands level IV Ecoregion where most of Quigley Creek resides is in the rain-shadow of higher mountains resulting in less precipitation and drier stream systems. The Foothills Shrublands-Grasslands level IV Ecoregion contains hills and benches that are dry, treeless, and covered with shrubs and grasses.

Rock Creek also originates in the Dry, Partly Wooded Mountains level IV Ecoregion but quickly descends into Foothills Shrublands-Grasslands level IV Ecoregion for most of its length. The lowest reaches of Rock Creek enter the Camas Prairie level IV Ecoregion of the Snake River Plain level III Ecoregion. The Camas Prairie is known for its cold, wet valleys used for small grain and alfalfa farming, pasture, range, and wildlife refuge. Surrounding foothills trap mountain runoff resulting in wet soils and localized flooding. Wet bottomlands support grasses and sedges while alluvial fans and terraces are in grasses and sagebrush.

Quigley Creek originates as an ephemeral wash in shrubland/grassland country that does gain water in lower reaches to become at least intermittent and perhaps perennial in wet years where willows dominate the riparian corridor. Most of this water is held in Quigley Pond where it is released for irrigated pasture in lower reaches. Rock Creek is largely perennial and willow-dominated except in its headwaters where ephemeral washes through sagebrush/grass communities are common.

5.1.6 Shade Curve Selection

To determine PNV shade targets for Quigley Creek and Rock Creek, effective shade curves from the southern Idaho nonforest group of riparian plant communities found in Shumar and De Varona 2009 were examined. These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. For the two creeks, curves for the most similar vegetation type were selected for shade target determinations. For Quigley Creek, the headwater ephemeral section is followed by the Geyer willow/sedge community shade curve for the remainder of the stream. There are extensive beaver ponds along Quigley Creek, which when recognized in this analysis were not penalized for lacking shade. Rock Creek also originates in ephemeral areas and transitions to the Geyer willow/sedge community shade curve. However, because Rock Creek has lower elevations than Quigley Creek, the riparian vegetation-type transitions to the yellow willow (*Salix lutea* Nutt.) shade curve at about 5,000 feet.

5.2 Load Capacity

The load capacity for a stream under PNV is essentially the solar loading allowed under the shade targets specified for the segments within that stream. These loads are determined by multiplying the solar load measured with a flat-plate collector (under full sun) for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e., percent open or 100% minus percent shade). In other words, if a shade target is 60% (or 0.6), the solar load hitting the stream under that target is 40% of the load hitting the flat-plate collector under full sun.

DEQ obtained solar load data from flat-plate collectors at the NREL weather stations in Boise and Pocatello, Idaho. The solar load data used in this TMDL analysis are spring and summer averages (i.e., an average load for the 6-month period from April–September). As such, load capacity calculations are also based on this 6-month period, which coincides with the time of year when stream temperatures are increasing, deciduous vegetation is in leaf, and fall spawning is occurring. During this period, temperatures may affect beneficial uses, such as spring and fall salmonid spawning, and cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent the period of highest stream temperatures. However, solar gains can begin early in the spring and affect not only the highest temperatures reached later in the summer but also salmonid spawning temperatures in spring and fall.

Table 8, Table 9, Figure 9, and Figure 12 show the PNV shade targets. The tables also show corresponding target summer loads (in kilowatt-hour per square meter per day [kWh/m^2/day] and kilowatt-hour per day [kWh/day]) that serve as the load capacities for the streams. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table.

The AU with the largest target load (i.e., load capacity) was Rock Creek AU (ID17040219SK028_02) with 390,000 kWh/day (Table 9). The smallest target load was in the Quigley Creek AU (ID17040219SK008_02) with 320,000 kWh/day (Table 8).

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading" (40 CFR 130.2(g)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed) but may be aggregated by type of source or area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations. Currently, no permitted point sources are found in the affected AUs. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat-plate collector at the NREL weather stations. Existing shade data are presented in Table 8, Table 9, Figure 10, and Figure 13. Like load capacities (target loads), existing loads in Table 8 and Table 9 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day). Existing loads in kWh/day are also summed for the entire stream or portion of stream examined in a single load analysis table. The difference between target and existing load is also summed for the entire table. If existing load exceeds target load, this difference becomes the excess load (i.e., lack of shade), which is discussed in section 5.4 and depicted in the lack-of-shade figures (Figure 11 and Figure 14).

The AU with the largest existing load was Rock Creek (ID17040219SK028_02) with 530,000 kWh/day (Table 9). The smallest existing load was in the Quigley Creek AU (ID17040219SK008_02) with 400,000 kWh/day (Table 8).

Table 8. Existing and target solar loads for Quigley Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
008_02	Quigley Creek	1	2400	sage/grass	0%	6.27	1	2,000	10,000	0%	6.27	1	2,000	10,000	0	0%
008_02	Quigley Creek	2	610	sage/grass	0%	6.27	2	1,000	6,000	0%	6.27	2	1,000	6,000	0	0%
008_02	Quigley Creek	3	130	Geyer willow	64%	2.26	3	400	900	50%	3.14	3	400	1,000	100	-14%
008_02	Quigley Creek	4	100	Geyer willow	64%	2.26	3	300	700	20%	5.02	3	300	2,000	1,000	-44%
008_02	Quigley Creek	5	240	Geyer willow	64%	2.26	3	700	2,000	30%	4.39	3	700	3,000	1,000	-34%
008_02	Quigley Creek	6	78	Geyer willow	64%	2.26	3	200	500	10%	5.64	3	200	1,000	500	-54%
008_02	Quigley Creek	7	140	Geyer willow	64%	2.26	3	400	900	50%	3.14	3	400	1,000	100	-14%
008_02	Quigley Creek	8	230	Geyer willow	64%	2.26	3	700	2,000	10%	5.64	3	700	4,000	2,000	-54%
008_02	Quigley Creek	9	260	Geyer willow	64%	2.26	3	800	2,000	40%	3.76	3	800	3,000	1,000	-24%
008_02	Quigley Creek	10	32	beaver pond	0%	6.27	3	100	600	0%	6.27	3	100	600	0	0%
008_02	Quigley Creek	11	160	Geyer willow	64%	2.26	3	500	1,000	50%	3.14	3	500	2,000	1,000	-14%
008_02	Quigley Creek	12	43	beaver pond	0%	6.27	3	100	600	0%	6.27	3	100	600	0	0%
008_02	Quigley Creek	13	320	Geyer willow	64%	2.26	3	1,000	2,000	40%	3.76	3	1,000	4,000	2,000	-24%
008_02	Quigley Creek	14	280	Geyer willow	53%	2.95	4	1,000	3,000	50%	3.14	4	1,000	3,000	0	-3%
008_02	Quigley Creek	15	220	Geyer willow	53%	2.95	4	900	3,000	30%	4.39	4	900	4,000	1,000	-23%
008_02	Quigley Creek	16	150	Geyer willow	53%	2.95	4	600	2,000	10%	5.64	4	600	3,000	1,000	-43%
008_02	Quigley Creek	17	200	Geyer willow	53%	2.95	4	800	2,000	50%	3.14	4	800	3,000	1,000	-3%
008_02	Quigley Creek	18	480	Geyer willow	53%	2.95	4	2,000	6,000	30%	4.39	4	2,000	9,000	3,000	-23%
008_02	Quigley Creek	19	120	Geyer willow	53%	2.95	4	500	1,000	10%	5.64	4	500	3,000	2,000	-43%
008_02	Quigley Creek	20	310	Geyer willow	53%	2.95	4	1,000	3,000	30%	4.39	4	1,000	4,000	1,000	-23%
008_02	Quigley Creek	21	330	Geyer willow	53%	2.95	4	1,000	3,000	10%	5.64	4	1,000	6,000	3,000	-43%
008_02	Quigley Creek	22	220	Geyer willow	45%	3.45	5	1,000	3,000	30%	4.39	5	1,000	4,000	1,000	-15%
008_02	Quigley Creek	23	170	Geyer willow	45%	3.45	5	900	3,000	50%	3.14	5	900	3,000	0	5%
008_02	Quigley Creek	24	100	beaver pond	30%	4.39	5	500	2,000	30%	4.39	5	500	2,000	0	0%
008_02	Quigley Creek	25	120	beaver pond	0%	6.27	5	600	4,000	0%	6.27	5	600	4,000	0	0%
008_02	Quigley Creek	26	60	beaver pond	30%	4.39	5	300	1,000	30%	4.39	5	300	1,000	0	0%
008_02	Quigley Creek	27	140	Geyer willow	45%	3.45	5	700	2,000	30%	4.39	5	700	3,000	1,000	-15%
008_02	Quigley Creek	28	62	Geyer willow	45%	3.45	5	300	1,000	0%	6.27	5	300	2,000	1,000	-45%
008_02	Quigley Creek	29	130	beaver pond	0%	6.27	5	700	4,000	0%	6.27	5	700	4,000	0	0%
008_02	Quigley Creek	30	85	Geyer willow	45%	3.45	5	400	1,000	40%	3.76	5	400	2,000	1,000	-5%
008_02	Quigley Creek	31	360	Geyer willow	45%	3.45	5	2,000	7,000	10%	5.64	5	2,000	10,000	3,000	-35%
008_02	Quigley Creek	32	550	Geyer willow	45%	3.45	5	3,000	10,000	0%	6.27	5	3,000	20,000	10,000	-45%
008_02	Quigley Creek	33	120	Geyer willow	45%	3.45	5	600	2,000	40%	3.76	5	600	2,000	0	-5%
008_02	Quigley Creek	34	79	Geyer willow	45%	3.45	5	400	1,000	0%	6.27	5	400	3,000	2,000	-45%
008_02	Quigley Pond	35	290	water	0%	6.27	100	29,000	182,000	0%	6.27	100	29,000	182,000	0	0%
008_02	Quigley Creek	36	99	Geyer willow	45%	3.45	5	500	2,000	10%	5.64	5	500	3,000	1,000	-35%
008_02a	Quigley Creek	37	2480	Geyer willow	45%	3.45	5	10,000	30,000	10%	5.64	5	10,000	60,000	30,000	-35%
???	Quigley Creek	38	760	Geyer willow	45%	3.45	5	4,000	10,000	10%	5.64	5	4,000	20,000	10,000	-35%
							Totals		320,000					400,000	81,000	

Notes: All assessment unit (AU) numbers start with ID17040219SK in all load analysis tables (Table 8 and Table 9); meter (m); kilowatt-hour per square meter per day (kWh/m^2/day; square meter (m^2). Red indicates existing load is lower than the target.

Table 9. Existing and target solar loads for Rock Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
028_02	Rock Creek	1	2600	sage/grass	0%	6.27	1	3,000	20,000	0%	6.27	1	3,000	20,000	0	0%
028_02	Rock Creek	2	630	Geyer willow	82%	1.13	2	1,000	1,000	80%	1.25	2	1,000	1,000	0	-2%
028_02	Rock Creek	3	1100	Geyer willow	82%	1.13	2	2,000	2,000	50%	3.14	2	2,000	6,000	4,000	-32%
028_02	Rock Creek	4	120	Geyer willow	64%	2.26	3	400	900	50%	3.14	3	400	1,000	100	-14%
028_02	Rock Creek	5	160	Geyer willow	64%	2.26	3	500	1,000	40%	3.76	3	500	2,000	1,000	-24%
028_02	Rock Creek	6	790	Geyer willow	64%	2.26	3	2,000	5,000	60%	2.51	3	2,000	5,000	0	-4%
028_02	Rock Creek	7	170	Geyer willow	64%	2.26	3	500	1,000	50%	3.14	3	500	2,000	1,000	-14%
028_02	Rock Creek	8	210	Geyer willow	64%	2.26	3	600	1,000	20%	5.02	3	600	3,000	2,000	-44%
028_02	Rock Creek	9	310	Geyer willow	64%	2.26	3	900	2,000	50%	3.14	3	900	3,000	1,000	-14%
028_02	Rock Creek	10	390	yellow willow	39%	3.82	5	2,000	8,000	0%	6.27	5	2,000	10,000	2,000	-39%
028_02	Rock Creek	11	390	yellow willow	39%	3.82	5	2,000	8,000	10%	5.64	5	2,000	10,000	2,000	-29%
028_02	Rock Creek	12	150	yellow willow	39%	3.82	5	800	3,000	30%	4.39	5	800	4,000	1,000	-9%
028_02	Rock Creek	13	150	yellow willow	39%	3.82	5	800	3,000	20%	5.02	5	800	4,000	1,000	-19%
028_02	Rock Creek	14	480	yellow willow	39%	3.82	5	2,000	8,000	0%	6.27	5	2,000	10,000	2,000	-39%
028_02	Rock Creek	15	1030	yellow willow	39%	3.82	5	5,000	20,000	10%	5.64	5	5,000	30,000	10,000	-29%
028_02	Rock Creek	16	400	yellow willow	39%	3.82	5	2,000	8,000	40%	3.76	5	2,000	8,000	0	0%
028_02	Rock Creek	17	470	yellow willow	34%	4.14	6	3,000	10,000	20%	5.02	6	3,000	20,000	10,000	-14%
028_02	Rock Creek	18	440	yellow willow	34%	4.14	6	3,000	10,000	0%	6.27	6	3,000	20,000	10,000	-34%
028_02	Rock Creek	19	150	yellow willow	34%	4.14	6	900	4,000	20%	5.02	6	900	5,000	1,000	-14%
028_02	Rock Creek	20	790	yellow willow	34%	4.14	6	5,000	20,000	10%	5.64	6	5,000	30,000	10,000	-24%
028_02	Rock Creek	21	1360	yellow willow	34%	4.14	6	8,000	30,000	0%	6.27	6	8,000	50,000	20,000	-34%
028_02	Rock Creek	22	590	yellow willow	30%	4.39	7	4,000	20,000	20%	5.02	7	4,000	20,000	0	-10%
028_02	Rock Creek	23	150	yellow willow	30%	4.39	7	1,000	4,000	30%	4.39	7	1,000	4,000	0	0%
028_02	Rock Creek	24	700	yellow willow	30%	4.39	7	5,000	20,000	20%	5.02	7	5,000	30,000	10,000	-10%
028_02	Rock Creek	25	330	yellow willow	30%	4.39	7	2,000	9,000	10%	5.64	7	2,000	10,000	1,000	-20%
028_02	Rock Creek	26	210	yellow willow	30%	4.39	7	1,000	4,000	0%	6.27	7	1,000	6,000	2,000	-30%
028_02	Rock Creek	27	540	yellow willow	30%	4.39	7	4,000	20,000	30%	4.39	7	4,000	20,000	0	0%
028_02	Rock Creek	28	390	yellow willow	30%	4.39	7	3,000	10,000	20%	5.02	7	3,000	20,000	10,000	-10%
028_02	Rock Creek	29	370	yellow willow	30%	4.39	7	3,000	10,000	30%	4.39	7	3,000	10,000	0	0%
028_02	Rock Creek	30	470	yellow willow	27%	4.58	8	4,000	20,000	20%	5.02	8	4,000	20,000	0	-7%
028_02	Rock Creek	31	710	yellow willow	27%	4.58	8	6,000	30,000	0%	6.27	8	6,000	40,000	10,000	-27%
028_02	Rock Creek	32	640	yellow willow	27%	4.58	8	5,000	20,000	10%	5.64	8	5,000	30,000	10,000	-17%
028_02	Rock Creek	33	590	yellow willow	27%	4.58	8	5,000	20,000	0%	6.27	8	5,000	30,000	10,000	-27%
028_02	Rock Creek	34	210	yellow willow	27%	4.58	8	2,000	9,000	10%	5.64	8	2,000	10,000	1,000	-17%
028_02	Rock Creek	35	510	yellow willow	27%	4.58	8	4,000	20,000	0%	6.27	8	4,000	30,000	10,000	-27%
028_02	Rock Creek	36	49	yellow willow	27%	4.58	8	400	2,000	90%	0.63	8	400	300	(2,000)	0%
028_02	Rock Creek	37	310	yellow willow	27%	4.58	8	2,000	9,000	10%	5.64	8	2,000	10,000	1,000	-17%
							Totals		390,000					530,000	140,000	

Notes: meter (m); kilowatt-hour per square meter per day (kWh/m²/day); square meter (m²). Red indicates existing load is lower than the target.

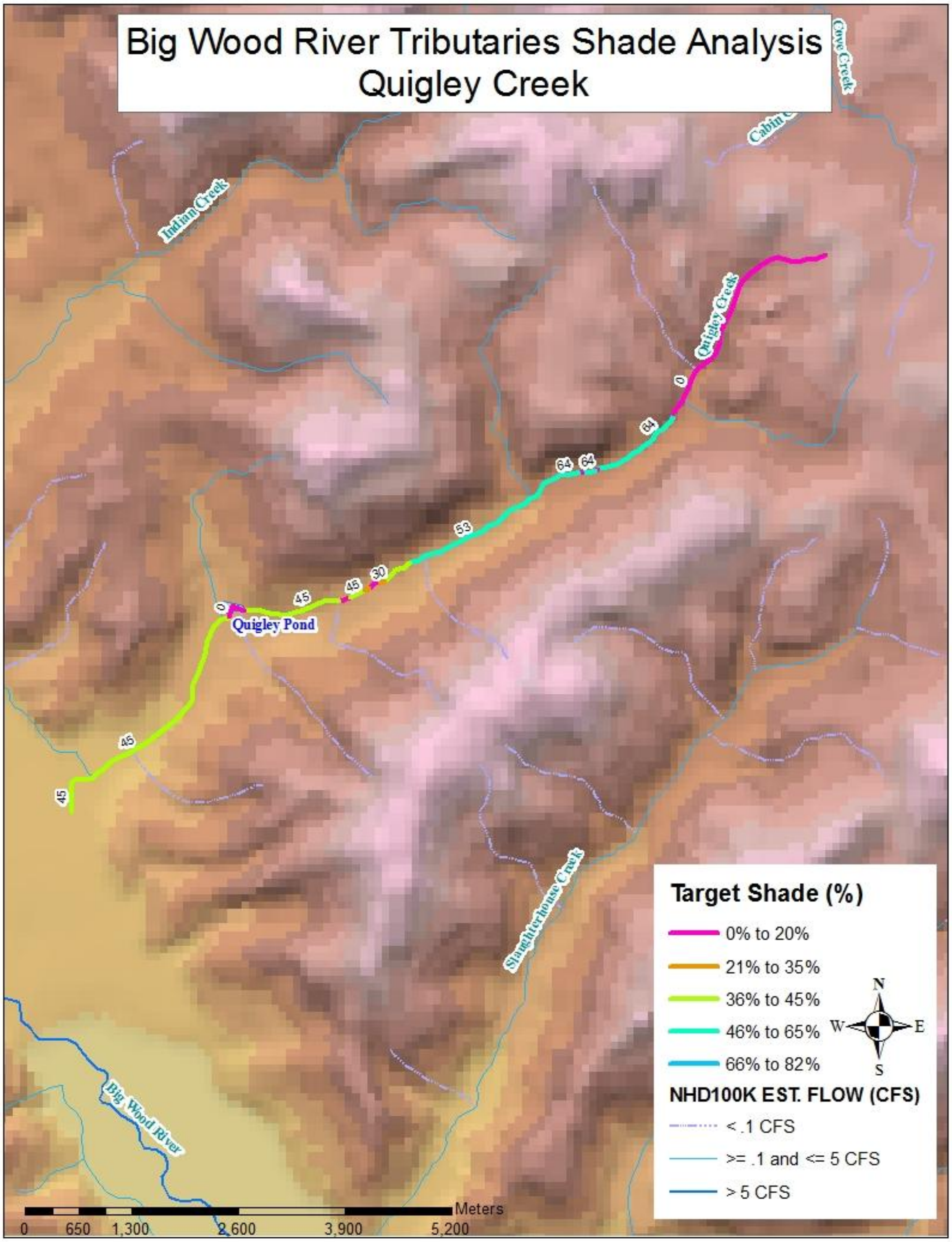

Figure 9. Target shade for Quigley Creek.

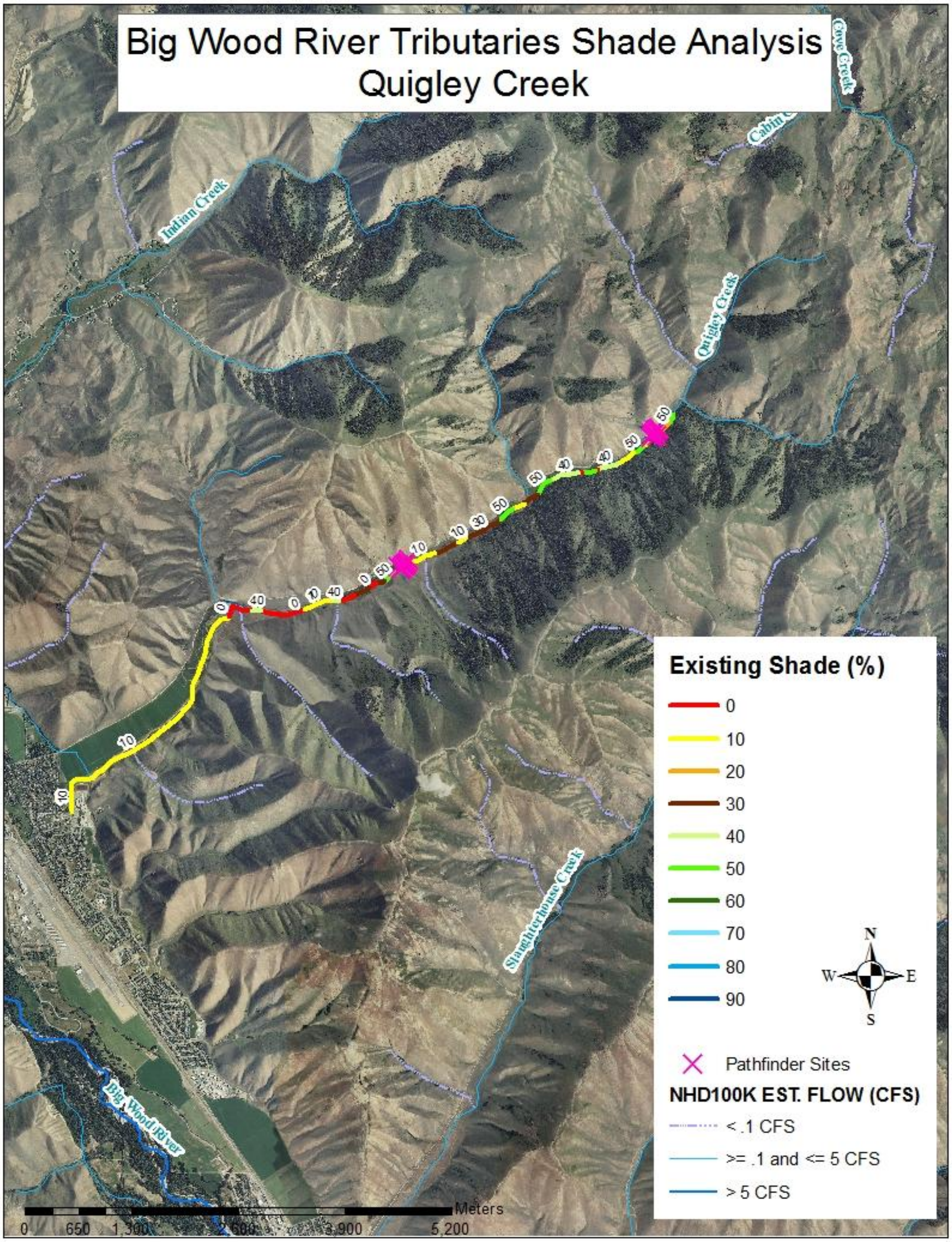

Figure 10. Existing shade estimated for Quigley Creek by aerial photo interpretation.

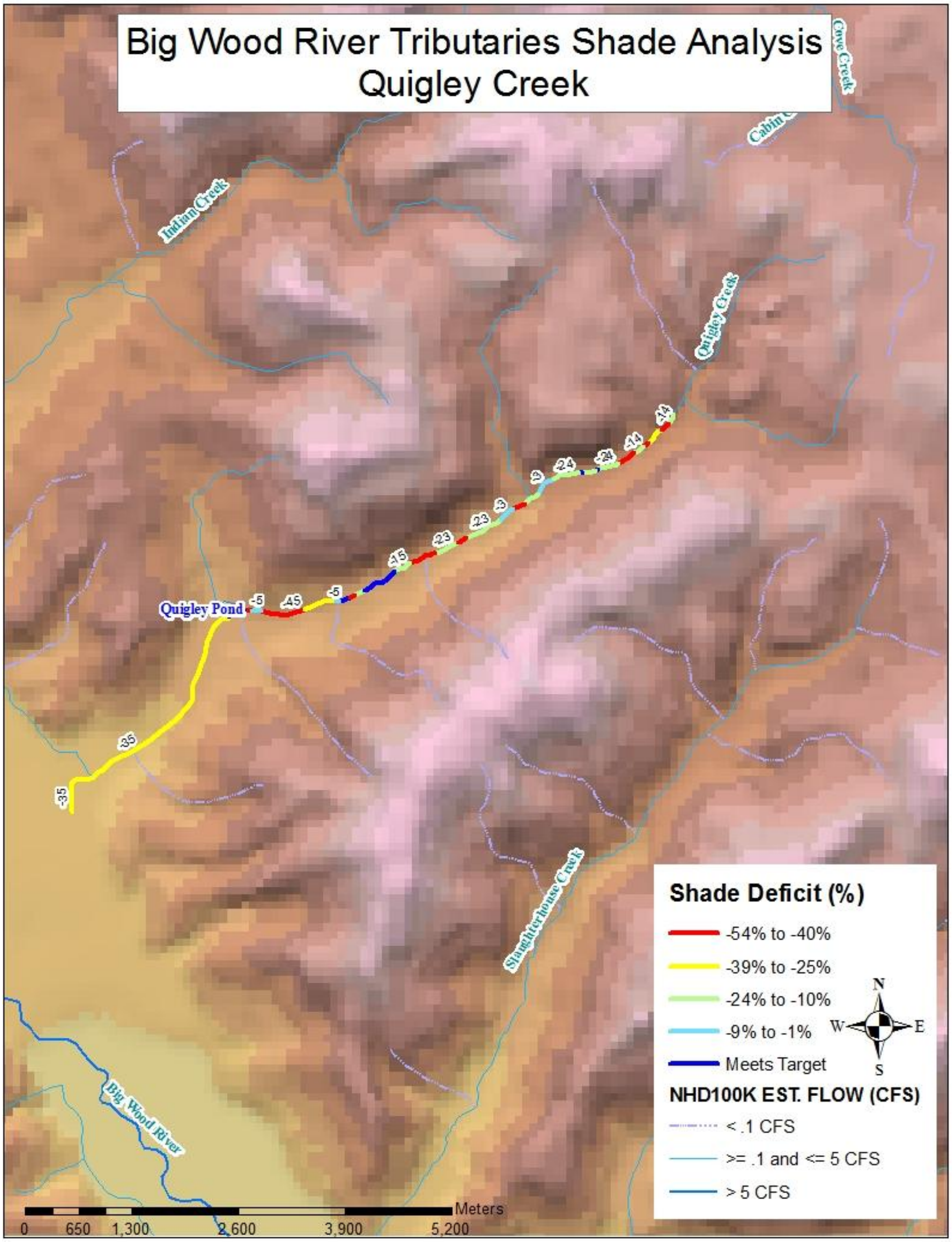

Figure 11. Lack of shade (difference between existing and target) for Quigley Creek.

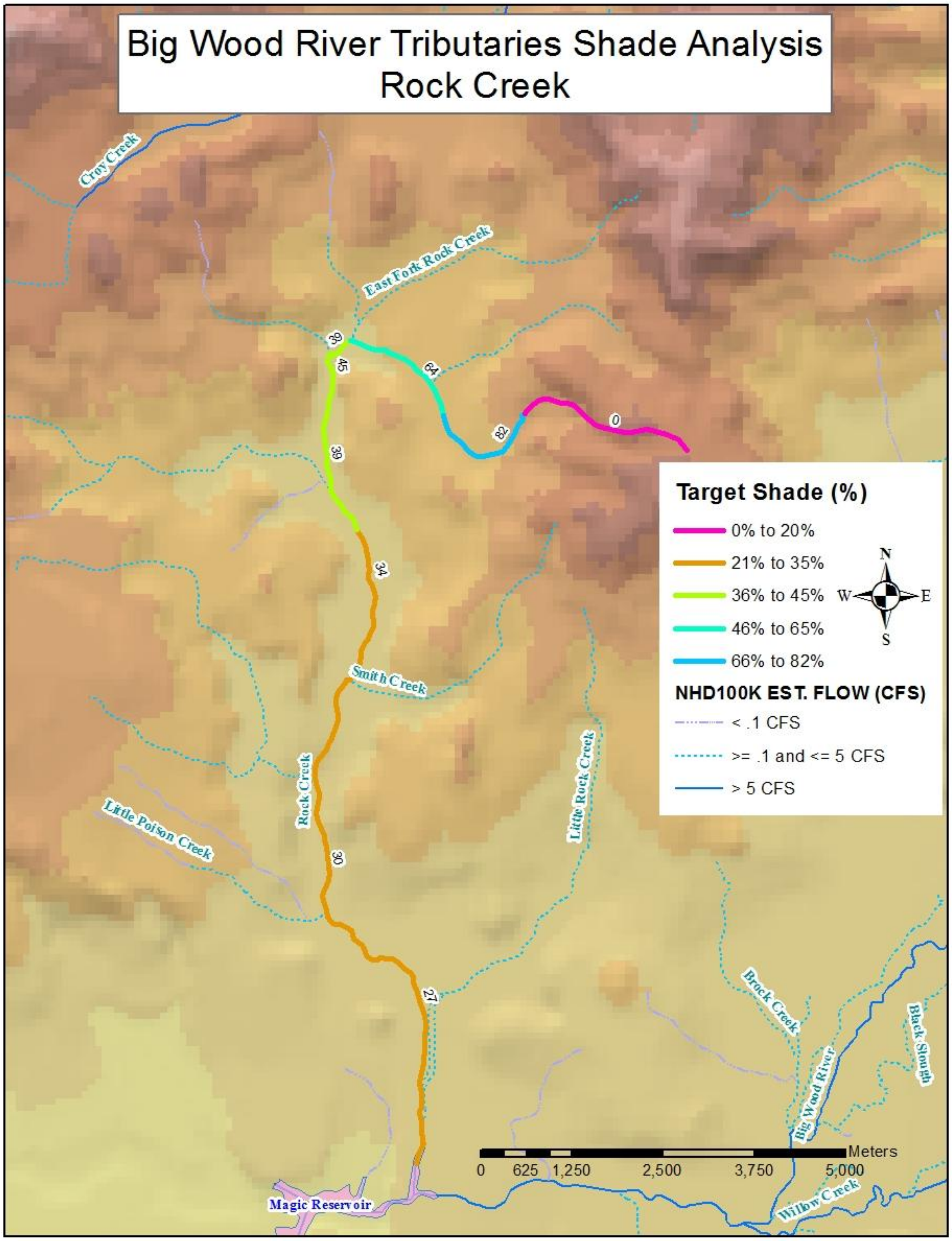

Figure 12. Target shade for Rock Creek.

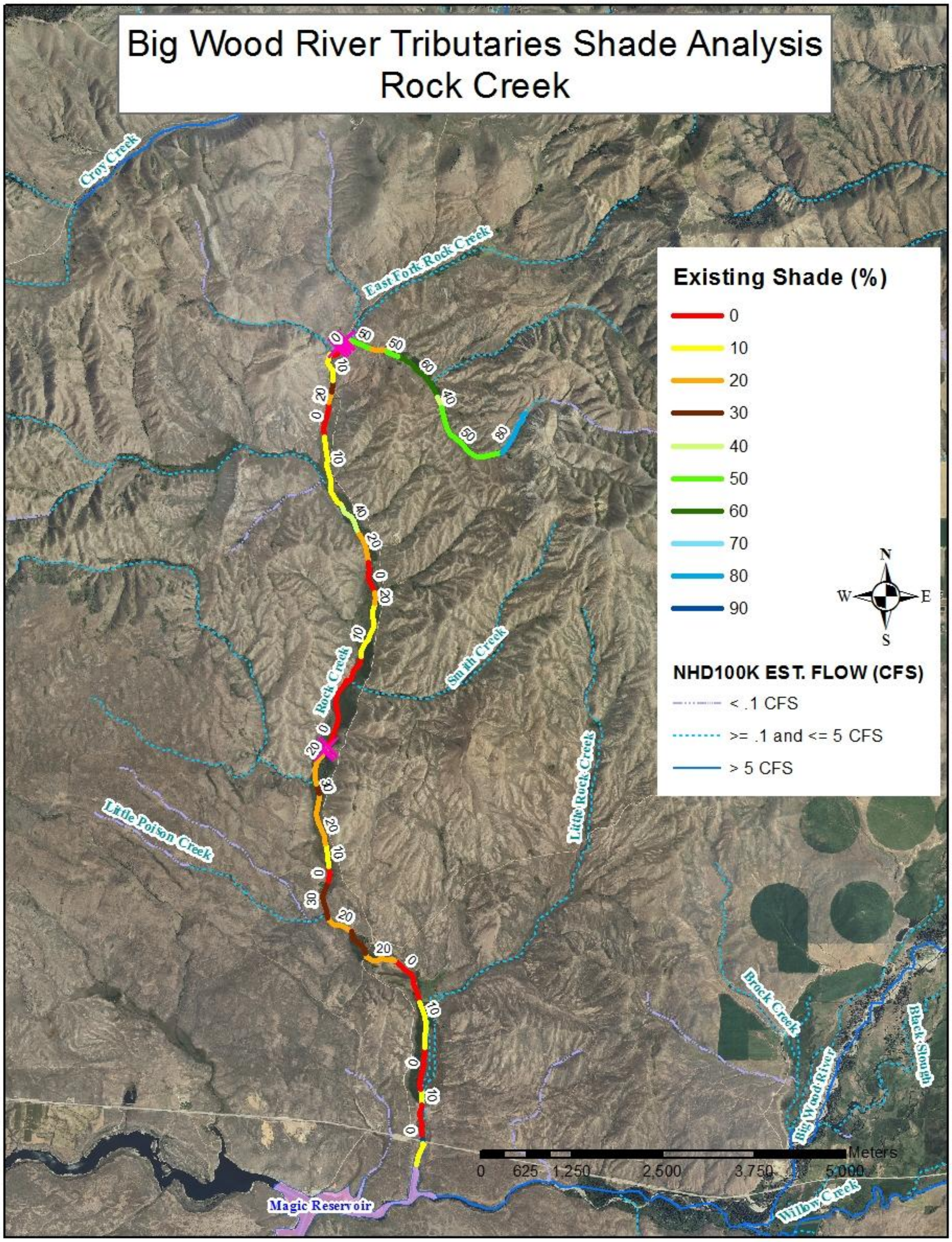

Figure 13. Existing shade estimated for Rock Creek by aerial photo interpretation.

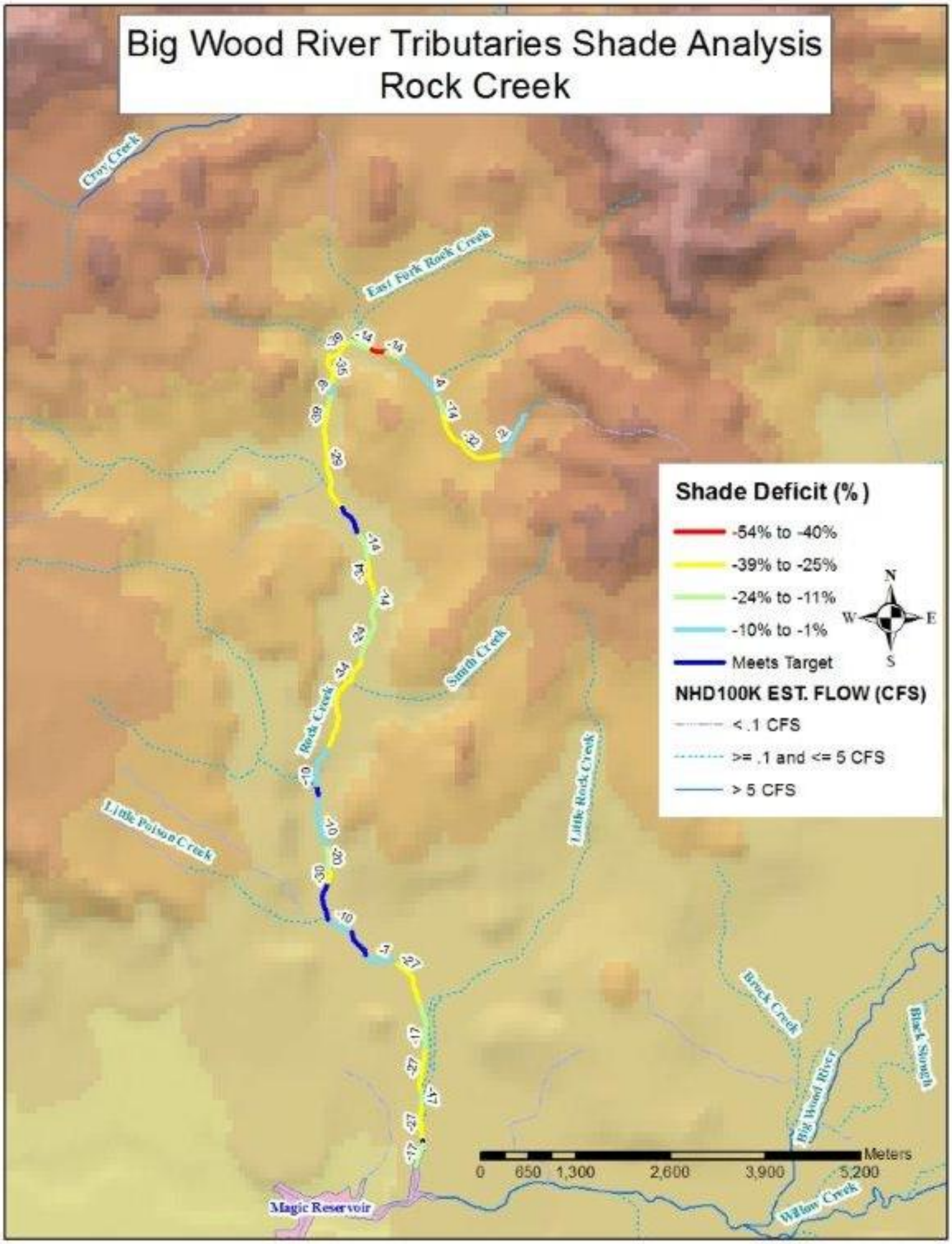

Figure 14. Lack of shade (difference between existing and target) for Rock Creek.

5.4 Load Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream segment-specific and depend on the target load for a given segment. Table 8 and Table 9 show the target shade and corresponding target summer solar load. This target solar load (i.e., load capacity) is needed to achieve background conditions. No opportunity is available to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL mi^2 depends on background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

Table 10 shows the total existing, target, and excess loads and the average lack of shade for each water body examined. Stream size influences the excess load size. Large streams have higher existing and target loads by virtue of their larger channel widths. Table 10 lists the tributaries in order of their excess loads, from highest to lowest. Therefore, large tributaries tend to be listed first and small tributaries last.

Although this TMDL analysis focuses on total solar loads, note that differences between existing and target shade, as depicted in the lack-of-shade figures (Figure 11 and Figure 14), are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table contains a column that lists the lack of shade on the stream segment. This value is derived from subtracting target shade from existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape. The average lack of shade derived from the last column in each load analysis table is also listed in Table 10 and provides a general level of comparison among streams.

Table 10. Total solar loads and average lack of shade for all waters.

Water Body/ Assessment Unit	Total Existing Load	Total Target Load	Excess Load (% Reduction)	Average Lack of Shade (%)
	(kWh/day)			
Rock Creek ID17040219SK028_02	530,000	390,000	140,000 (26%)	-18
Quigley Creek ID17040219SK008_02	400,000	320,000	81,000 (20%)	-21

Notes: Load data are rounded to two significant figures, which may present rounding errors; kilowatt-hour per day.

Quigley Creek and Rock Creek lack shade and have excess solar loads in similar proportion relative to their size. The Rock Creek watershed has slightly greater excess loads likely resulting from its present and historic use as livestock pasture. Quigley Creek is also used extensively for pasture and livestock range.

For a variety of reasons, individual reaches do not meet shade targets, including natural phenomena (e.g., beaver ponds, springs, wet meadows, and past natural disturbances) and/or historic land use activities (e.g., logging, grazing, and mining). Each reach should be field verified to determine if shade differences are real and result from activities that are controllable. Information within this TMDL (maps and load analysis tables) should be used to guide and prioritize implementation investigations. DEQ recognizes that the information within this TMDL may need further adjustment to reflect new information and conditions in the future.

A certain amount of excess load is potentially created by the existing and target shade differences inherent in the load analysis. Because existing shade is reported as a 10% shade class and target shade a unique integer between 0 and 100%, there is usually a difference between the two. For example, a particular stream segment has a target shade of 86% based on its vegetation type and natural bank-full width. If existing shade on that segment were at target level, it would be recorded as 80% in the load analysis because it falls into the 80% shade class. This automatic difference of 6% could be attributed to the margin of safety.

5.4.1 Water Diversion

Stream temperature may be affected by water diversions for water rights purposes. Flow diversion reduces the amount of water exposed to a given level of solar radiation in the stream channel, which can result in increased water temperature in that channel. Flow loss in the channel also affects the ability of the near-stream environment to support shade-producing vegetation, resulting in an increase in solar load to the channel.

Although these water temperature effects may occur, nothing in this TMDL supersedes any water appropriation in the affected watershed. Section 101(g), the Wallop Amendment, was added to the CWA as part of the 1977 amendments to address water rights. It reads as follows:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this chapter. It is the further policy of Congress that nothing in this chapter shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

Additionally, IDAPA 58.01.02.050.01 indicates the following:

> The adoption of water quality standards and the enforcement of such standards is not intended to…interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure….

In this TMDL, DEQ has not quantified what impact, if any, diversions have on stream temperature. Water diversions are allowed for in state statute, and it is possible for a water body to be 100% allocated. Diversions notwithstanding, reaching shade targets as discussed in the TMDL will protect what water remains in the channel and allow the stream to meet water quality standards for temperature. This TMDL will lead to cooler water by achieving shade that would be expected under natural conditions and water temperatures resulting from that shade. DEQ encourages local landowners and holders of water rights to voluntarily do whatever they can to help instream flow for the purpose of keeping channel water cooler for aquatic life.

5.4.2 Wasteload Allocation

There are no known NPDES-permitted point sources in the affected watersheds of Quigley Creek, Rock Creek and Black Canyon Creek and thus no wasteload allocations. However, DEQ conducted a summary review of Idaho's point sources in Blaine County for NPDES permitted facilities. The results are included in Appendix D. If a point source is proposed that would have thermal consequences on these waters, background provisions in IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.01 addressing such discharges should be involved (Appendix B).

5.4.2.1 Construction Stormwater and TMDL Wasteload Allocations

Stormwater runoff is water from rain or snowmelt that does not immediately infiltrate into the ground and flows over or through natural or man-made storage or conveyance systems. When undeveloped areas are converted to land uses with impervious surfaces—such as buildings, parking lots, and roads—the natural hydrology of the land is altered and can result in increased surface runoff rates, volumes, and pollutant loads. Certain types of stormwater runoff are considered point source discharges for Clean Water Act purposes, including stormwater that is associated with municipal separate storm sewer systems (MS4s), industrial stormwater covered under the Multi-Sector General Permit (MSGP), and construction stormwater covered under the Construction General Permit (CGP).

5.4.2.1.1 Municipal Separate Storm Sewer Systems

Polluted stormwater runoff is commonly transported through MS4s, from which it is often discharged untreated into local water bodies. No MS4s exist in this HUC.

5.4.2.1.2 Industrial Stormwater Requirements

Stormwater runoff picks up industrial pollutants and typically discharges them into nearby water bodies directly or indirectly via storm sewer systems. When facility practices allow exposure of industrial materials to stormwater, runoff from industrial areas can contain toxic pollutants (e.g., heavy metals and organic chemicals) and other pollutants such as trash, debris, and oil and grease. This increased flow and pollutant load can impair water bodies, degrade biological habitats, pollute drinking water sources, and cause flooding and hydrologic changes, such as channel erosion, to the receiving water body.

Multi-Sector General Permit and Stormwater Pollution Prevention Plans

In Idaho, if an industrial facility discharges industrial stormwater into waters of the U.S., the facility must be permitted under EPA's most recent MSGP. To obtain an MSGP, the facility must prepare a stormwater pollution prevention plan (SWPPP) before submitting a notice of intent for permit coverage. The SWPPP must document the site description, design, and installation of control measures; describe monitoring procedures; and summarize potential pollutant sources. A copy of the SWPPP must be kept on site in a format that is accessible to workers and inspectors and be updated to reflect changes in site conditions, personnel, and stormwater infrastructure.

Industrial Facilities Discharging to Impaired Water Bodies

Any facility that discharges to an impaired water body must monitor all pollutants for which the water body is impaired and for which a standard analytical method exists (see 40 CFR Part 136).

Also, because different industrial activities have sector-specific types of material that may be exposed to stormwater, EPA grouped the different regulated industries into 29 sectors, based on their typical activities. Part 8 of EPA's MSGP details the stormwater management practices and monitoring that are required for the different industrial sectors. EPA anticipates issuing a new MSGP in December 2013. DEQ anticipates including specific requirements for impaired waters as a condition of the 401 certification. The new MSGP will detail the specific monitoring requirements.

TMDL Industrial Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a wasteload allocation for industrial stormwater activities under the MSGP. However, most load analyses developed in the past have not identified sector-specific numeric wasteload allocations for industrial stormwater activities. Industrial stormwater activities are considered in compliance with provisions of the TMDL if operators obtain an MSGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The next MSGP will have specific monitoring requirements that must be followed.

5.4.2.1.3 Construction Stormwater

The CWA requires operators of construction sites to obtain permit coverage to discharge stormwater to a water body or municipal storm sewer. In Idaho, EPA has issued a general permit for stormwater discharges from construction sites.

Construction General Permit and Stormwater Pollution Prevention Plans

If a construction project disturbs more than 1 acre of land (or is part of a larger common development that will disturb more than 1 acre), the operator is required to apply for a CGP from EPA after developing a site-specific SWPPP. The SWPPP must provide for the erosion, sediment, and pollution controls they intend to use; inspection of the controls periodically; and maintenance of BMPs throughout the life of the project. Operators are required to keep a current copy of their SWPPP on site or at an easily accessible location.

TMDL Construction Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a gross wasteload allocation for anticipated construction stormwater activities. Most loads developed in the past did not have a numeric wasteload allocation for construction stormwater activities. Construction stormwater activities are considered in compliance with provisions of the TMDL if operators obtain a CGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The CGP has monitoring requirements that must be followed.

Postconstruction Stormwater Management

Many communities throughout Idaho are currently developing rules for postconstruction stormwater management. Sediment is usually the main pollutant of concern in construction site stormwater. DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005) should be used to select the proper suite of BMPs for the specific site, soils, climate, and project phasing in order to sufficiently meet the standards and requirements of the CGP to protect water quality. Where local ordinances have more stringent and site-specific standards, those are applicable.

5.4.3 Margin of Safety

The margin of safety in this TMDL is considered implicit in the design. Because the target is essentially background conditions, loads (shade levels) are allocated to lands adjacent to these streams at natural background levels. Because shade levels are established at natural background or system potential levels, it is unrealistic to set shade targets at higher, or more conservative, levels. Additionally, existing shade levels are reduced to the next lower 10% shade class, which likely underestimates actual shade in the loading analysis. Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, load allocations are applied to the stream and its riparian vegetation rather than specific nonpoint source activities and can be adjusted as more information is gathered from the stream environment.

5.4.4 Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to include the 6-month period from April through September. This time period is when the combination of increasing air and water temperatures coincides with increasing solar inputs and vegetative shade. The critical time periods are April through June when spring salmonid spawning occurs, July and August when maximum temperatures may exceed cold water aquatic life criteria, and September when fall salmonid spawning is most likely to be affected by higher temperatures. Water temperature is not likely to be a problem for beneficial uses outside of this time period because of cooler weather and lower sun angle.

5.5 Implementation Strategies

Implementation strategies for TMDLs produced using PNV-based shade and solar loads should incorporate the load analysis tables presented in this TMDL (Table 8 and Table 9). These tables need to be updated, first to field verify the remaining existing shade levels and second to monitor progress toward achieving reductions and TMDL goals. Using the Solar Pathfinder to measure existing shade levels in the field is important to achieving both objectives. It is likely that further field verification will find discrepancies with reported existing shade levels in the load analysis tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified. Implementation strategies should include Solar Pathfinder monitoring to simultaneously field verify the TMDL and mark progress toward achieving desired load reductions.

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or significant progress is not being made toward achieving the goals. For a variety of reasons, individual stream segments do not meet shade targets, including natural phenomena (e.g., beaver ponds, springs, wet meadows, and past natural disturbances) and/or historic land-use activities (e.g., logging, grazing, and mining). Existing shade for each stream segment should be field verified to determine if shade differences are real and result from activities that are controllable. Information within this TMDL (maps and load analysis tables) should be used to guide and prioritize implementation investigations. DEQ recognizes the information in this TMDL may need further adjustment to reflect new information and conditions in the future.

5.5.1 Time Frame

Implementation of this TMDL relies on riparian area management practices that will provide a mature canopy cover to shade the stream and prevent excess solar loading. Because implementation depends on mature riparian communities to substantially improve stream temperatures, DEQ believes 10–20 years may be a reasonable amount time for achieving water quality standards. Shade targets will not be achieved all at once. Given their smaller bank-full widths, targets for smaller streams may be reached sooner than those for larger streams.

DEQ and the designated WAG will continue to reevaluate TMDLs on a 5-year cycle. During the 5-year review, implementation actions completed, in progress, and planned will be reviewed, and pollutant load allocations will be reassessed accordingly.

5.5.2 Approach

TMDLs will be implemented by continuing pollution control activities in the watershed. The designated WAG, designated management agencies, local organizations, and other appropriate public process participants are expected to do the following:

- Develop BMPs to achieve load allocations.
- Give reasonable assurance that management actions will meet load allocations through both quantitative and qualitative analysis of management measures.
- Adhere to measurable milestones for progress.
- Develop a timeline for implementation, including cost and funding.
- Develop a monitoring plan to determine if BMPs are being implemented, if individual BMPs are effective, and if load allocations are being met.

The responsible designated management agencies will recommend specific control actions, then submit the implementation plan to DEQ. DEQ will act as a repository for the implementation plan and conduct 5-year reviews of progress toward TMDL goals.

5.5.3 Responsible Parties

In addition to the designated management agencies, the public, through the WAG and other equivalent organizations or processes, will have opportunities to be involved in developing the implementation plan. The following Idaho agencies are responsible for management activities:

- Idaho Soil and Water Conservation Commission for grazing and agricultural activities
- Idaho Transportation Department for public road construction
- Idaho State Department of Agriculture for aquaculture
- DEQ for all other activities

5.5.4 Monitoring Strategy

Effective shade monitoring can take place on any segment throughout the three AUs and be compared to existing shade estimates seen in Figure 10 and Figure 13 and described in Table 8 and Table 9. Those areas with the largest disparity between existing and target shade should be monitored with Solar Pathfinders to verify existing shade levels and determine progress toward meeting shade targets. Since many existing shade estimates have not been field verified, they may require adjustment during the implementation process. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade toward target levels. Ten equally spaced Solar Pathfinder measurements averaged together within that segment should suffice to determine new shade levels in the future.

5.6 Public Participation

The Wood River WAG provided DEQ with local knowledge of the watersheds, reviewed beneficial use designations and applicable surface water standards, and provided comments on the draft documents. Public meetings were held the fourth Tuesday of the month on an as needed basis, typically held quarterly. The meetings are open to the public and are posted to DEQ's webpage and in DEQ's Twin Falls Regional Office. Six meetings relative to temperature TMDL development have been held to date, and future meetings will be held to discuss implementation.

- Presented Potential Natural Vegetation to the Wood River WAG, March 28, 2006
- Presented temperature listing and approach to the Wood River WAG, September 26, 2006
- Presented a draft document to the Wood River WAG, April 24, 2007
- Presented to the Wood River WAG, April 24, 2012
- Presented to the Wood River WAG, May 29, 2012
- Presented to the Wood River WAG, February 26, 2013

Public comment was held on the draft document from March 20 through April 19, 2013. No comments were received (Appendix E). A distribution list is provided in Appendix F.

5.7 Conclusions

Effective shade targets were established for two Big Wood tributary streams based on the concept of maximum shading under PNV resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation and partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in Idaho "Water Quality Standards" (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the 2012 Integrated Report, is presented in Table 11.

All streams examined lack shade to some degree. Quigley Creek and Rock Creek have about one-quarter of their existing solar load as excess load from a lack of shade. Both of these creeks have experienced livestock pasturing and range use over years.

Target shade levels for individual stream segments should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts.

Table 11. Summary of assessment outcomes.

Water Body Segment/ Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Quigley Creek ID17040219SK008_02	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Rock Creek ID17040219SK028_02	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Black Canyon Creek ID17040219SK030_02	Temperature TSS Cause Unknown (nutrients suspected)	No	Delist temperature, TSS, and cause unknown. Move to Category 4c as flow altered.	Insufficient water, stable banks, adequate canopy cover' No source or pollutant pathway
Black Canyon Creek ID 17040219SK030_03	TSS Cause Unknown (nutrients suspected)	No	Delist cause unknown and TSS. Leave in Category 4c as flow altered	Insufficient water, stable banks, adequate canopy cover, No source or pollutant pathway

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Geographic Information System Coverages

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Glossary

§303(d)

Refers to section 303 subsection "d" of the Clean Water Act. Section 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to US Environmental Protection Agency approval.

Alluvium

Unconsolidated recent stream deposition.

Anthropogenic

Relating to, or resulting from, the influence of human beings on nature.

Aquatic

Occurring, growing, or living in water.

Aquifer

An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding water to wells or springs.

Assessment Unit (AU)

A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.

Batholith

A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.

Beneficial Use

Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, that are recognized in water quality standards.

Beneficial Use Reconnaissance Program (BURP)

A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, wadeable streams, and rivers.

Best Management Practices (BMPs)

Structural, nonstructural, or managerial techniques that are effective and practical means to control nonpoint source pollutants.

Biological Integrity

1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).

Biota

The animal and plant life of a given region.

Clean Water Act (CWA)

The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to develop information about, and control the quality of, the nation's water resources.

Community

A group of interacting organisms living together in a given place.

Criteria

In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels and to limit the number of violations per year. The US Environmental Protection Agency develops criteria guidance; states establish criteria.

Cubic Feet per Second (cfs)

A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, one cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.

Designated Uses

Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.

Discharge

The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).

Dissolved Oxygen (DO)

The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.

Disturbance
Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.

Ecosystem
The interacting system of a biological community and its nonliving (abiotic) environmental surroundings.

Environment
The complete range of external conditions, physical and biological, that affect a particular organism or community.

Ephemeral Stream
A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table (American Geological Institute 1962).

Erosion
The wearing away of areas of the earth's surface by water, wind, ice, and other forces.

Exceedance
A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.

Existing Beneficial Use or Existing Use
A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's water quality standards (IDAPA 58.01.02).

Flow
See Discharge.

Geographic Information Systems (GIS)
A georeferenced database.

Ground Water
Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and emerges again as streamflow.

Habitat
The living place of an organism or community.

Headwater
The origin or beginning of a stream.

Hydrologic Basin

The area of land drained by a river system, a reach of a river and its tributaries, a closed basin, or a group of streams forming a drainage area (also see Watershed).

Hydrologic Unit

One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, and cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, 4th-field hydrologic units have been more commonly called subbasins; 5th- and 6th-field hydrologic units have since been delineated for much of the country and are known as watersheds and subwatersheds, respectively.

Hydrologic Unit Code (HUC)

The number assigned to a hydrologic unit. Often used to refer to 4th-field hydrologic units.

Intermittent Stream

1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.

Load Allocation (LA)

A portion of a water body’s load capacity for a given pollutant that is allocated to a particular nonpoint source (by class, type, or geographic area).

Load(ing)

The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.

Load(ing) Capacity (LC)

How much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, a margin of safety, and natural background contributions, it becomes a total maximum daily load.

Margin of Safety (MOS)

An implicit or explicit portion of a water body’s loading capacity set aside to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.

Mean

Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.

Metric

1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.

Monitoring

A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.

Mouth

The location where flowing water enters into a larger water body.

National Pollutant Discharge Elimination System (NPDES)

A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.

Natural Condition

The condition that exists with little or no anthropogenic influence.

Nonpoint Source

A dispersed source of pollutants generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernible point of origin. They include, but are not limited to, irrigated and nonirrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

Not Assessed (NA)

A concept and an assessment category describing water bodies that have been studied but are missing critical information needed to complete a use support assessment.

Nutrient

Parameter

A variable, measurable property whose value is a determinant of the characteristics of a system (e.g., temperature, dissolved oxygen, and fish populations are parameters of a stream or lake).

Perennial Stream

A stream that flows year-around in most years.

Point Source

A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.

Pollutant

Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

Pollution

A very broad concept that encompasses human-caused changes in the environment that alter the functioning of natural processes and produce undesirable environmental and health effects. These changes include human-induced alterations of the physical, biological, chemical, and radiological integrity of water and other media.

Population

A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.

Potential Natural Vegetation (PNV)

A.U. Küchler (1964) defined potential natural vegetation as vegetation that would exist without human interference and if the resulting plant succession were projected to its climax condition while allowing for natural disturbance processes such as fire. Our use of the term reflects Küchler's definition in that riparian vegetation at PNV would produce a system potential level of shade on streams and includes recognition of some level of natural disturbance.

Qualitative

Descriptive of kind, type, or direction.

Quantitative

Descriptive of size, magnitude, or degree.

Reach
A stream section with fairly homogenous physical characteristics.

Reconnaissance
An exploratory or preliminary survey of an area.

Reference Condition

Riparian
Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.

River
A large natural or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.

Runoff
The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to create streams.

Sediments
Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.

Species
1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.

Spring
Ground water seeping out of the earth where the water table intersects the ground surface.

Stream
A natural water course containing flowing water at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.

Stream Order
Hierarchical ordering of streams based on the degree of branching. A 1st-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher-order streams result from the joining of two streams of the same order.

Stormwater Runoff
Rainfall that quickly runs off the land after a storm. In developed watersheds, the water flows off roofs and pavement into storm

drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.

Subbasin

A large watershed of several hundred thousand acres. This is the name commonly given to 4th-field hydrologic units (also see Hydrologic Unit).

Subbasin Assessment (SBA)

A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho. Also refers to the written document that contains the assessment.

Subwatershed

A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th-field hydrologic units.

Surface Runoff

Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.

Surface Water

All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.

Total Maximum Daily Load (TMDL)

A TMDL is a water body’s load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual basis. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Tributary

A stream feeding into a larger stream or lake.

Wasteload Allocation (WLA)

The portion of receiving water’s loading capacity that is allocated to one of its existing or future point sources of pollution.

Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.

Water Pollution

Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.

Water Quality

A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.

Water Quality Criteria

Levels of water quality expected to render a water body suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

Water Quality Limited

A label that describes water bodies for which one or more water quality criteria are not met or beneficial uses are not fully supported (i.e., impaired waters). Water quality limited segments may or may not be on a §303(d) list.

Water Quality Standards

State-adopted and US Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Water Table

The upper surface of ground water; below this point, the soil is saturated with water.

Watershed

1) All the land that contributes runoff to a common point in a drainage network or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region that contributes water to a point of interest in a water body.

Water Body Identification Number (WBID)

A number that uniquely identifies a water body in Idaho and ties in to the Idaho water quality standards and GIS information.

Appendix A. Data Sources and Other Data

Table A-1. Data sources for Big Wood River subbasin tributaries.

Water Body	Data Source	Type of Data	Collection Date
Quigley Creek, Rock Creek	DEQ Twin Falls Regional Office	Solar Pathfinder effective shade and stream width	October 2011
Quigley Creek, Rock Creek, Black Canyon Creek	DEQ State Technical Services Office	Aerial photo interpretation of existing shade and stream width estimation	September 2011
Rock Creek	DEQ IDASA Database	Temperature	2011

Notes: Idaho Department of Environmental Quality (DEQ); Idaho Database Assessment Supplemental Application (IDASA)

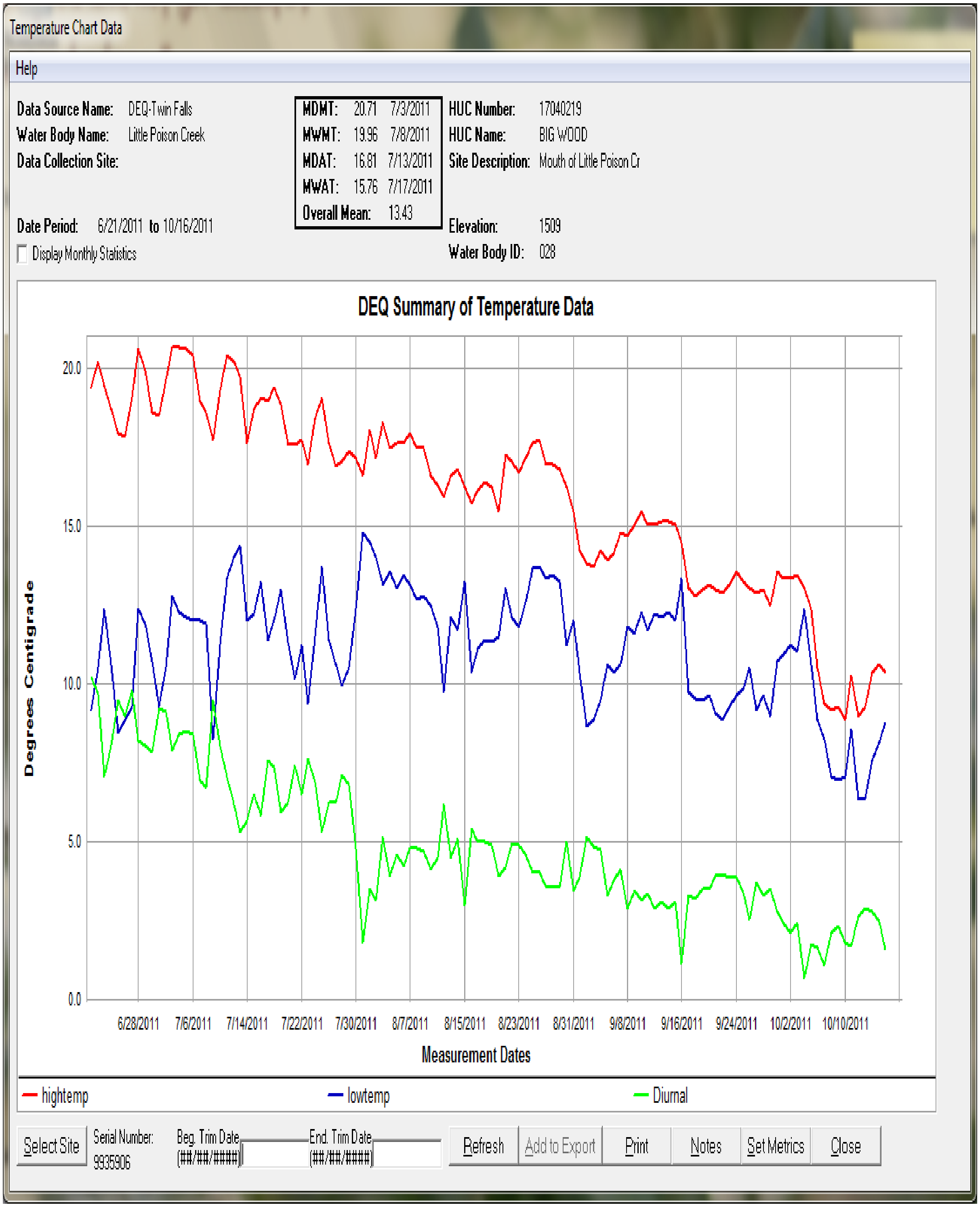

Figure A-1. Big Wood River temperature data summary at Little Poison Creek.

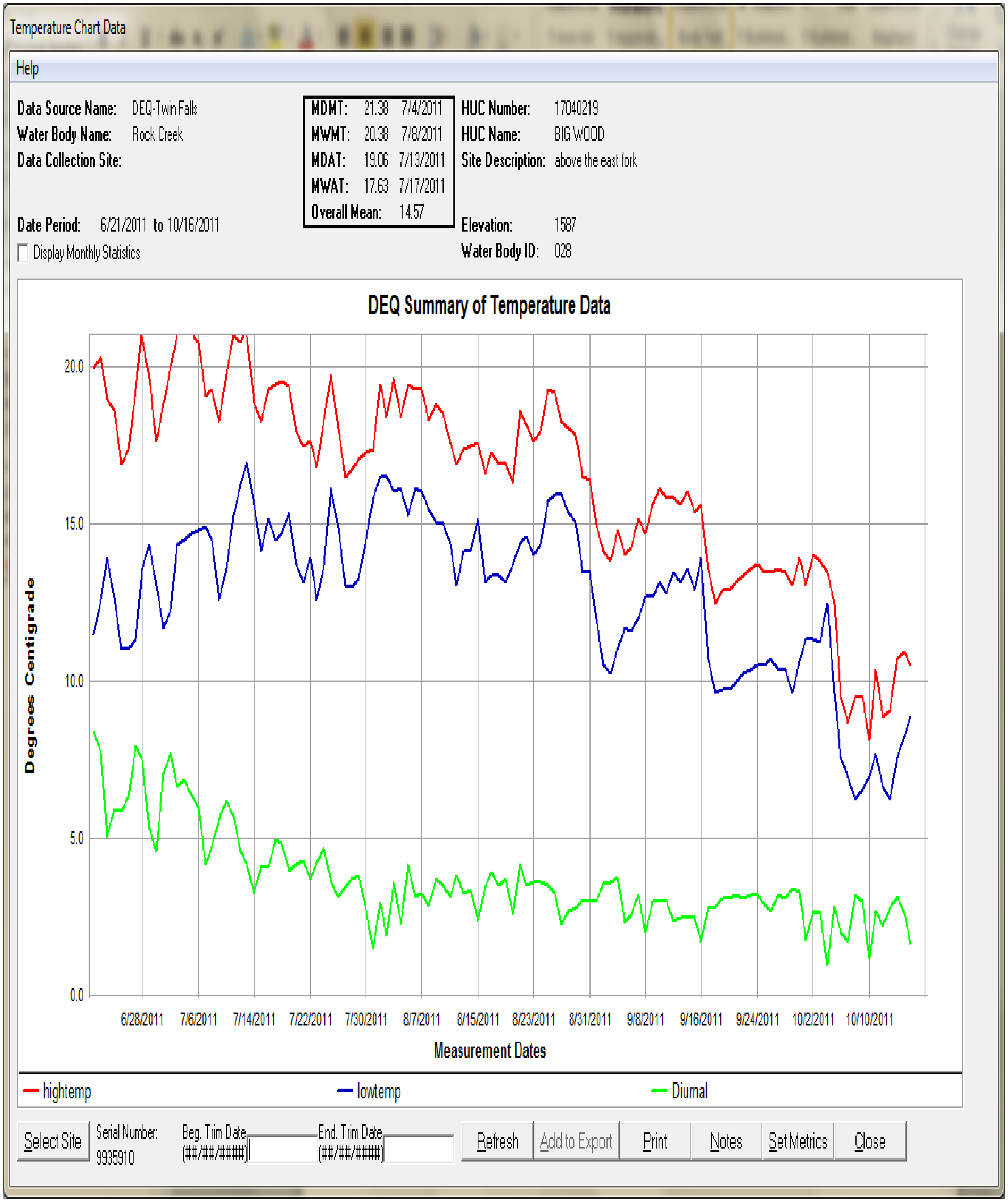

Figure A-2. Big Wood River temperature data summary at Rock Creek.

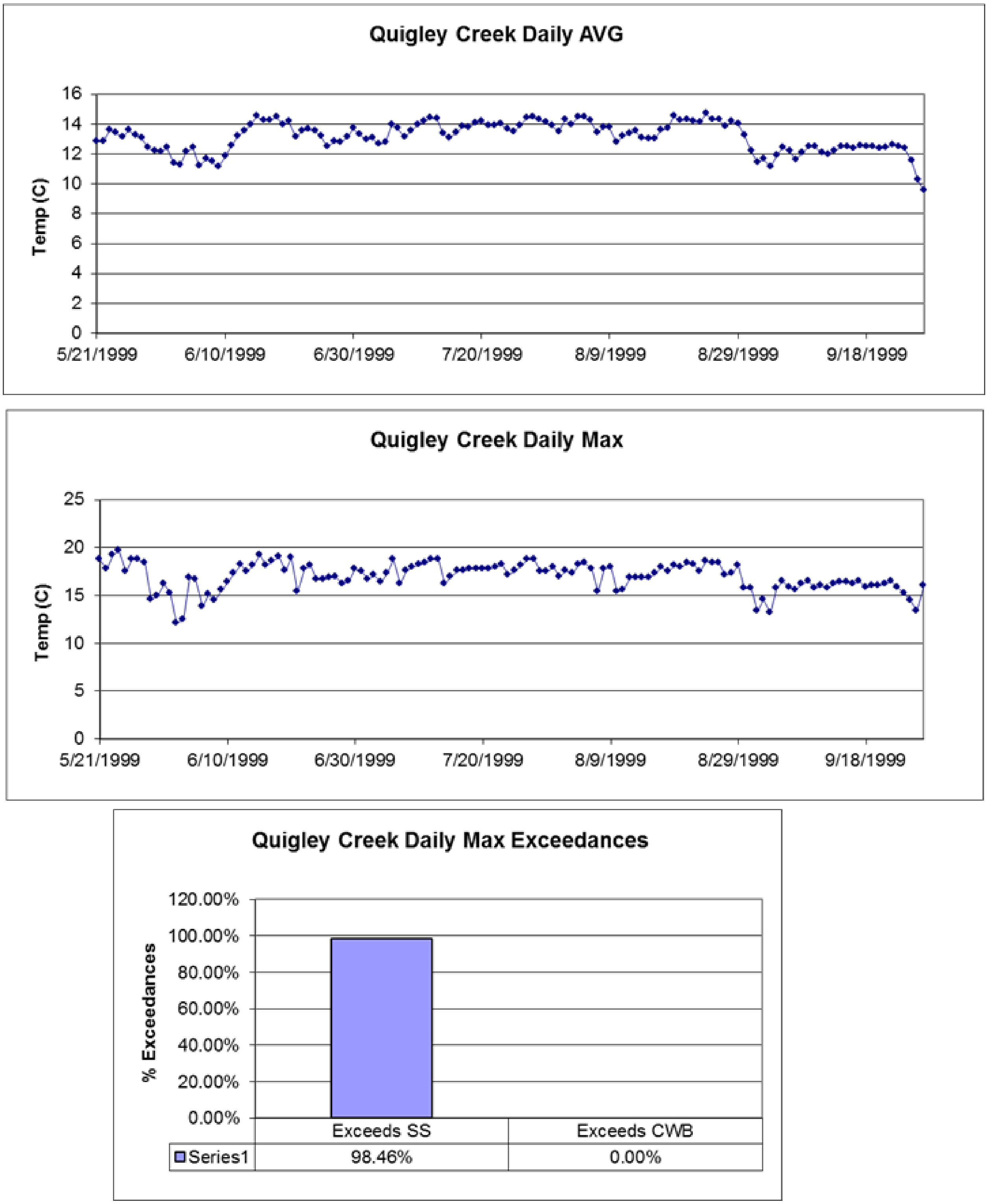

Figure A-3. Big Wood River temperature data summary at Quigley Creek.

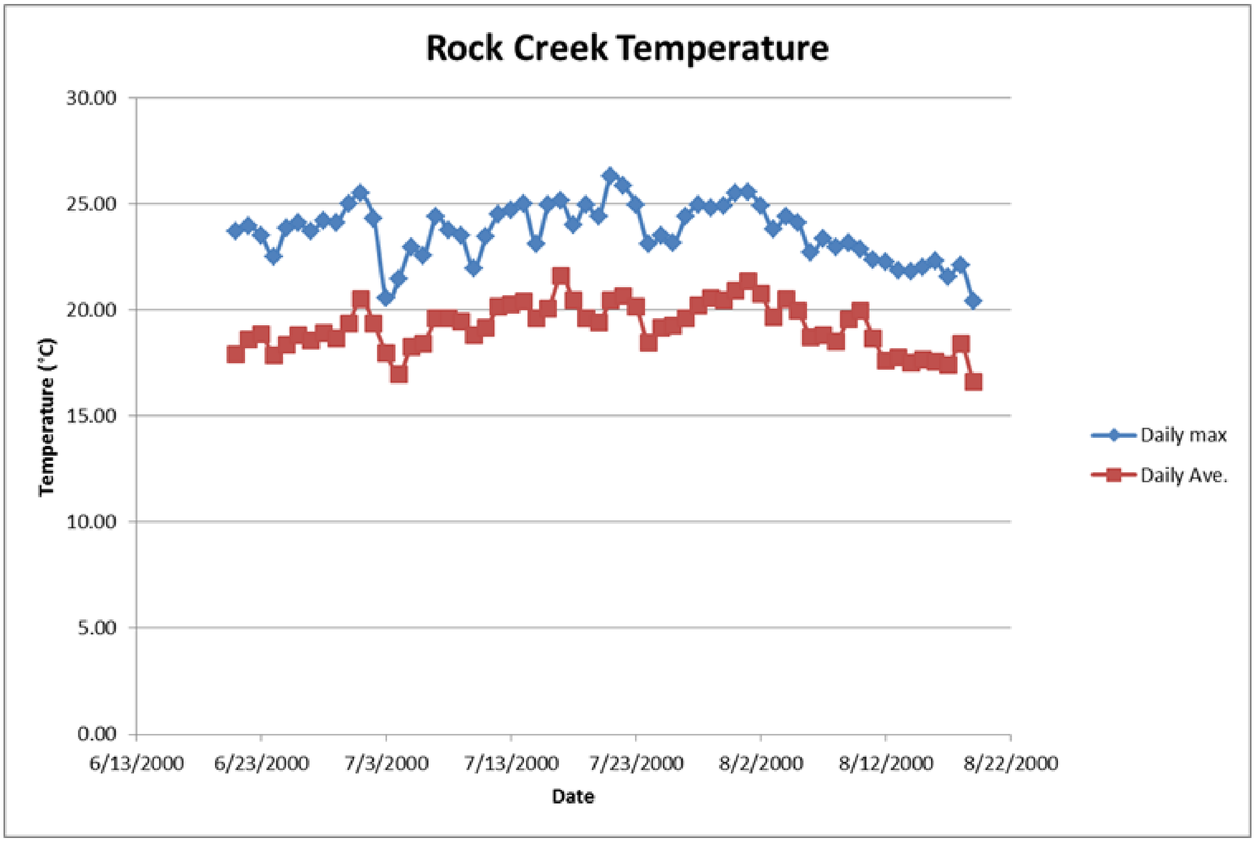

Figure A-4. Big Wood River temperature data summary at Rock Creek.

Daily Average (19) exceedances = 55%

Daily Maximum (22) exceedances = 88%

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Appendix B. State and Site-Specific Water Quality Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

Water quality standards for temperature are specific numeric values not to be exceeded during the salmonid spawning and egg incubation period, which varies by species. For spring-spawning salmonids, the default spawning and incubation period recognized by the Idaho Department of Environmental Quality (DEQ) is generally March 15 to July 15 (Grafe et al. 2002). Fall spawning can occur as early as September 1 and continue with incubation into the following spring up to June 1. As per IDAPA 58.01.02.250.02.f.ii., the following water quality criteria need to be met during that time period:

- 13 °C as a daily maximum water temperature
- 9 °C as a daily average water temperature

For the purposes of a temperature TMDL, the highest recorded water temperature in a recorded data set (excluding any high water temperatures that may occur on days when air temperatures exceed the 90th percentile of the highest annual maximum weekly maximum air temperatures) is compared to the daily maximum criterion of 13 °C. The difference between the two water temperatures represents the temperature reduction necessary to achieve compliance with temperature standards.

Natural Background Provisions

For potential natural vegetation temperature TMDLs, it is assumed that natural temperatures may exceed these criteria during certain time periods. If potential natural vegetation targets are achieved yet stream temperatures are warmer than these criteria, it is assumed that the stream's temperature is natural (provided there are no point sources or human-induced ground water sources of heat) and natural background provisions of Idaho water quality standards apply:

> When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from natural background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401. (IDAPA 58.01.02.200.09)

Section 401 relates to point source wastewater treatment requirements. In this case, if temperature criteria for any aquatic life use are exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3 °C (IDAPA 58.01.02.401.01.c).

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Appendix C. Unit Conversion Chart

Table C-1. Metric–English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square feet (ft^2) Square miles (mi^2)	Hectares (ha) Square meters (m^2) Square kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (gal) Cubic feet (ft^3)	Liters (L) Cubic meters (m^3)	1 gal = 3.78 L 1 L= 0.26 gal 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 gal = 11.35 L 3 L = 0.79 gal 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic feet per second (cfs)[a]	Cubic meters per second (m^3/sec)	1 cfs = 0.03 m^3/sec 1 m^3/sec = 35.31 cfs	3 cfs = 0.09 m^3/sec 3 m^3/sec = 105.94 cfs
Concentration	Parts per million (ppm)	Milligrams per liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lb)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lb	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day = 1.55 cfs.
[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

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Appendix D. Point Source NPDES Facilities by Industry

Table D-1 summarizes the point source National Pollutant Discharge Elimination System (NPDES) facilities (by industry) that may reside in the affected areas of Quigley Creek, Rock Creek, and Black Canyon Creek. The Idaho Department of Environmental Quality notes that the three wastewater treatment plant facilities (i.e., City of Ketchum, City of Hailey and The Meadows) do not reside in the affected areas. Be aware that there may be NPDES facilities that reside in Blaine County, but these facilities do not reside in the three affected areas of this potential natural vegetation total maximum daily load.

Table D-1. NPDES point sources on affected areas described.

NPDES Facility Name	Quigley Creek	Rock Creek	Black Canyon Creek
Wastewater treatment plants	None	None	None
Small section dredge mining[a]	None	None	None
Confined animal feeding operation[b]	None	None	None
Aquaculture fish farms[c]	None	None	None
Groundwater remediation facilities[d]	None	None	None
Municipal separate storm sewer systems (MS4s)[e]	None	None	None
Stormwater NPDES facility/location[f]	1 facility	None	None

a. Small section dredge mining is not prohibited under United States Environmental Protection Agency's General Dredging Permit in the three affected areas. However, there is no information to indicate that dredging is occurring in these affected areas.
b. If confined animal feeding operations (CAFO) occur, they would fall below the allowed General CAFO Permit. This includes feedlots and dairies. However, there is no information to indicate that dredging is occurring in these affected areas.
c. There are no known aquaculture facilities.
d. There are no known groundwater remediation facilities that exist in the affected areas.
e. Since no municipalities or wastewater treatment facilities exist in the affected areas, there are no known MS4 facilities.
f. One facility on Quigley Creek: IDR10B188 (Quigley Canyon Water Tank, 1 mile up Quigley Canyon, Hailey, Idaho) – effective May 9, 2006, terminated on September 11, 2007.

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Appendix E. Public Comments

Members of the Big Wood River Subbasin WAG received a draft of this TMDL for review and comment on February 26, 2013. On February 20, 2013, the TMDL was released for a 30-day public comment period from March 20 through April 19, 2013. No comments were received.

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Appendix F. Distribution List

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