Assessment of Water Quality in Kootenai River and Moyie River Subbasins (TMDL)

2014 Addendum

Hydrologic Unit Code 17010104—Lower Kootenai
Hydrologic Unit Code 17010105—Moyie

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This document was developed with assistance and advice from the Kootenai Valley Resource Initiative (KVRI), also recognized as the Kootenai/Moyie Watershed Advisory Group. The KVRI formed a subcommittee to focus specifically on total maximum daily load (TMDL) development.

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Cover photo: Grass Creek, courtesy of Robert Steed (Idaho Department of Environmental Quality) 2011.

Table of Contents

List of Tables

List of Figures

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
CGP	Construction General Permit
CW	cold water (beneficial use)
DEQ	Idaho Department of Environmental Quality
DO	dissolved oxygen
DWS	domestic water supply
EPA	United States Environmental Protection Agency
GIS	geographic information systems
HUC	hydrologic unit code
IDAPA	refers to citations of Idaho administrative rules
KVRI	Kootenai Valley Resource Initiative
kWh	kilowatt-hour
LA	load allocation
LC	load capacity
m	meter
mg/L	milligrams per liter
mi	mile
mL	milliliter
MOS	margin of safety
NB	natural background
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
NTU	nephelometric turbidity unit
PCR	primary contact recreation
PNV	potential natural vegetation
SCR	secondary contact recreation
SS	salmonid spawning (beneficial use)
SWPPP	Stormwater Pollution Prevention Plan
TMDL	total maximum daily load
USC	United States Code
US	United States
USDA	United States Department of Agriculture
USFS	United States Forest Service
WAG	watershed advisory group
WLA	wasteload allocation

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Executive Summary

The federal Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the Clean Water Act, 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 Clean Water Act 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 (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 water bodies in Idaho's Integrated Report. 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 17 streams (23 assessment units [AUs]) in the Lower Kootenai River subbasin and 9 streams (11 AUs) in the Moyie River subbasin that have been placed in Category 5 of Idaho's most recent federally approved Integrated Report (DEQ 2011) as a result of exceedance(s) of the Idaho water quality standards for temperature. In the Lower Kootenai River subbasin, 3 additional AUs that were not identified as being impaired by temperature pollution were included in this TMDL addendum as Unlisted but impaired TMDLs (AUs ID17010104PN030_03, ID17010104PN033_03, and ID17010104PN039_02).

This addendum describes the key physical and biological characteristics of the subbasin; water quality concerns and status; pollutant sources; and recent pollution control actions in the Lower Kootenai and Moyie River subbasins, located in northern Idaho (Figure A). For more detailed information about the subbasins and previous TMDLs, see the *Assessment of Water Quality in Kootenai River and Moyie River Subbasins (TMDL)* (KTOI et al. 2006). Figure B displays the AUs addressed in the 2006 TMDL.

The TMDL analysis establishes water quality targets and load capacities, estimates existing pollutant loads, and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards. It also identifies implementation strategies—including reasonable time frames, approach, responsible parties, and monitoring strategies—necessary to achieve load reductions and meet water quality standards.

Subbasin at a Glance

The Lower Kootenai River subbasin (hydrologic unit code [HUC] 17010104) is located in the far north of the Idaho panhandle, bordering both Canada and Montana with small portions in each. The Moyie River subbasin (HUC 17010105) is in the very northeast corner of Idaho, also bordering both Canada and Montana, with small portions in each, and surrounded on the west and south by the Lower Kootenai River subbasin. The Kootenai River flows west-northwest into Idaho from Libby, Montana, turns north after Bonners Ferry, and flows into Canada. The Moyie River, which first flows southward through the Moyie River subbasin, joins the Kootenai River near Moyie Springs, after the Kootenai River has crossed from Montana into Idaho (Figure A).

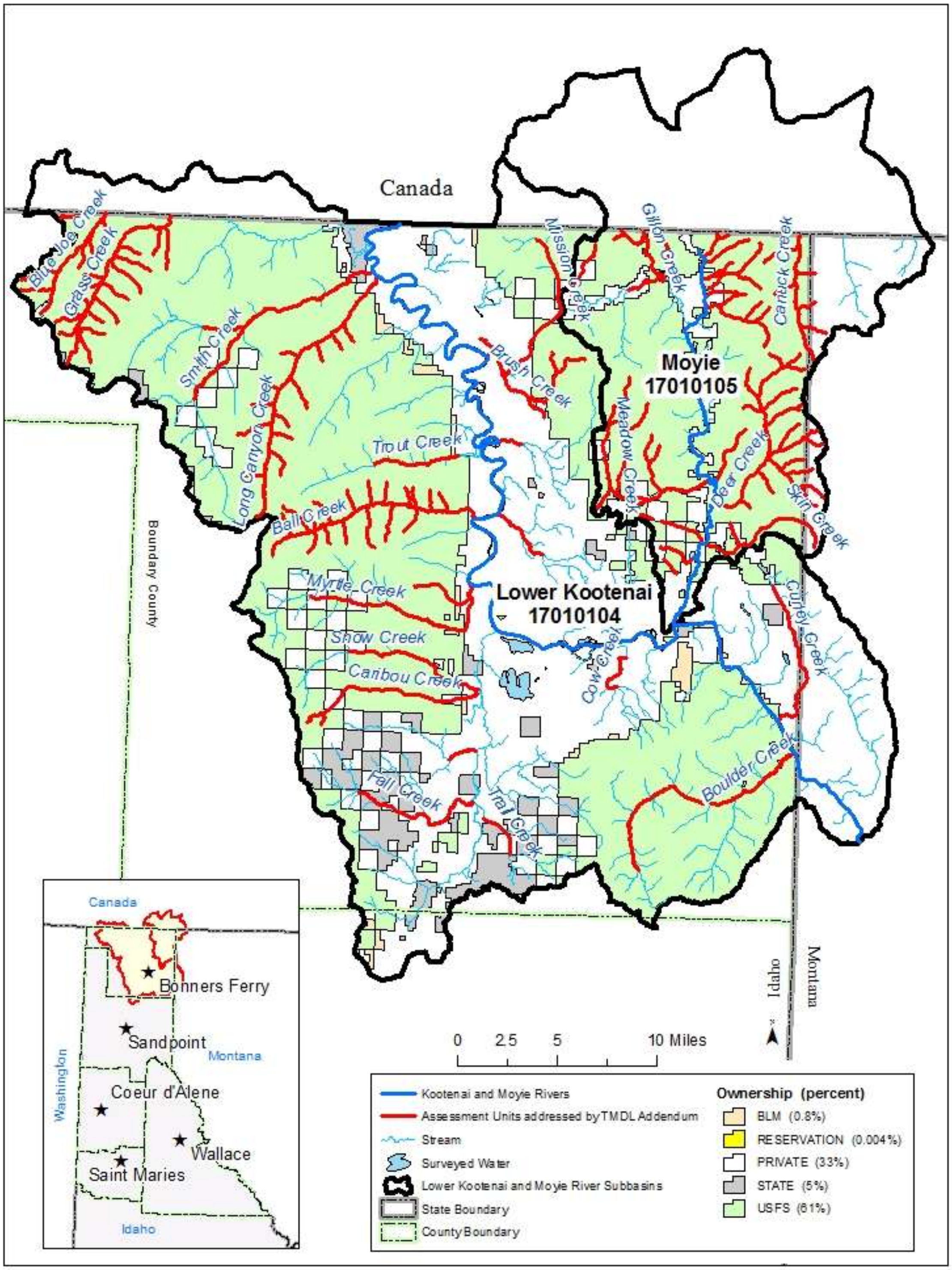

Figure A. Lower Kootenai and Moyie River subbasins.

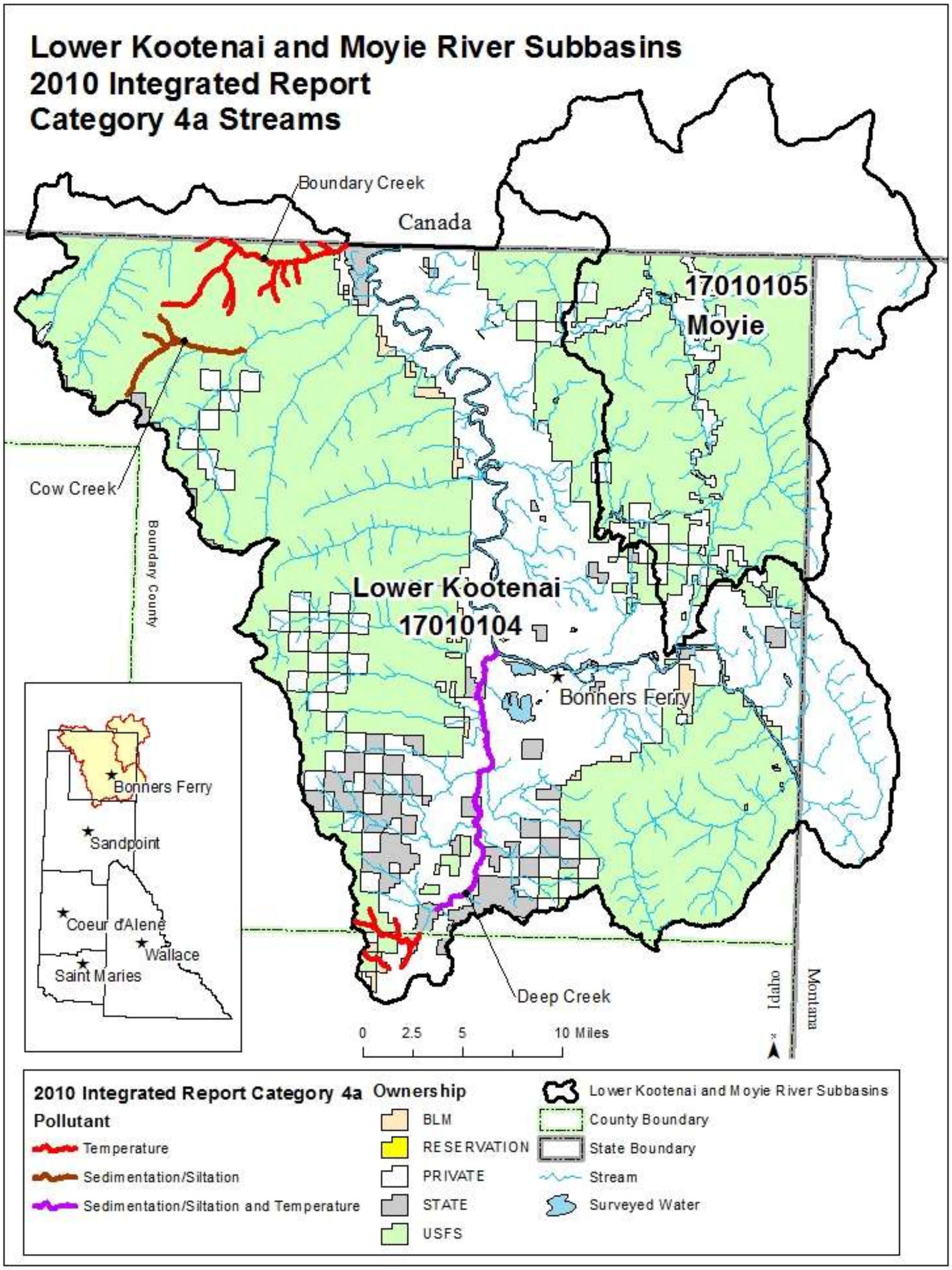

Figure B. Assessment units addressed in the 2006 TMDL and in Category 4a of the 2010 Integrated Report.

Key Findings

The Idaho Department of Environmental Quality (DEQ) has developed temperature TMDLs for 17 streams (23 AUs) in the Lower Kootenai River subbasin and 9 streams (11 AUs) in the Moyie River subbasin that were placed on the 1998 §303(d) list of impaired waters, or subsequent lists, for reasons associated with temperature criteria exceedances (Table A). In the Lower Kootenai River subbasin, 3 additional AUs that were not identified as being impaired by temperature pollution were included in this TMDL addendum as Unlisted but impaired TMDLs (AUs ID17010104PN030_03, ID17010104PN033_03, and ID17010104PN039_02) (Table A).

Effective target shade levels were established for 37 AUs 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's water quality standards (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Tables B and C.

In the Lower Kootenai River subbasin, 4 AUs previously listed for temperature pollution were found through stressor identification likely to be affected by pollutants other than temperature. These AUs will require additional monitoring and investigation. All other AUs in the Lower Kootenai River subbasin lack shade to some degree, although many reaches met reference conditions. Lowland streams affected by agricultural land uses (i.e., Cow, lower Fleming, Rock, and Curley Creeks) tend to be the most affected. Some forested systems (Boulder and Smith Creeks) have substantial hydrologic effects that widen streams and lower near-stream shade quality. Fall Creek appears to be in the best condition of those streams examined in this subbasin.

In the Moyie River subbasin, all AUs examined lack shade and most require substantial reductions in excess loads to meet targets. The Meadow Creek watershed appears to be in the best condition overall with respect to shade; whereas Deer Creek, Round Prairie Creek, and others have patches of shade deficits.

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 A. Water bodies and pollutants for which TMDLs were developed.

Water Body	Assessment Unit Number	Pollutant(s)
Lower Kootenai River Subbasin		
1st- and 2nd-order tributaries to Grass Creek	ID17010104PN003_02	Temperature
Grass Creek (3rd-order portion to Idaho/Canada border)	ID17010104PN003_03	Temperature
Blue Joe Creek (source to Idaho/Canada border)	ID17010104PN004_02	Temperature
Smith Creek (Cow Creek to Kootenai River)	ID17010104PN005_04	Temperature
Cow Creek (source to mouth)	ID17010104PN006_03	Temperature
Smith Creek (source to Cow Creek)	ID17010104PN007_03	Temperature
Long Canyon Creek (source to mouth)	ID17010104PN008_02	Temperature
Trout Creek (3rd-order to branch)	ID17010104PN010_03	Temperature
Upper Ball Creek (source to forest edge)	ID17010104PN011_02	Temperature
Ball Creek (lower portion)	ID17010104PN011_02a	Temperature
Myrtle Creek (Jim Creek to mouth)	ID17010104PN013_03	Temperature
Cascade Creek (source to mouth)	ID17010104PN014_02	Temperature
Lower Snow Creek	ID17010104PN016_03	Temperature
Caribou Creek (source to mouth)	ID17010104PN017_02	Temperature
Ruby Creek (lower, Gold to Deep Creek)	ID17010104PN020_03	Temperature
Fall Creek (lower, 3rd-order portion to Deep Creek)	ID17010104PN021_03	Temperature
Trail Creek (source to Highway)	ID17010104PN026_03	Temperature
Cow Creek (lower, Brush Creek to subsurface flow)	ID17010104PN030_03	Unlisted but impaired
Boulder Creek (East Fork Boulder Creek to mouth)	ID17010104PN032_03	Temperature
Boulder Creek (source to East Fork Boulder Creek)	ID17010104PN033_03	Unlisted but impaired
Curley Creek (lower, unnamed tributary to Kootenai River)	ID17010104PN035_03	Temperature
Fleming Creek (lower)	ID17010104PN036_03	Temperature
Rock Creek (lower)	ID17010104PN037_03	Temperature
Mission Creek (Brush Creek to mouth)	ID17010104PN038_03	Temperature
Brush Creek (source to mouth)	ID17010104PN039_02	Unlisted but impaired
Mission Creek (Idaho/Canada border to Brush Creek)	ID17010104PN040_03	Temperature
Moyie River Subbasin		
1st-order tributaries to Moyie River (Meadow Creek to Moyie Falls Dam)	ID17010105PN002_02	Temperature
Skin Creek (Idaho/Montana border to mouth)	ID17010105PN003_02	Temperature
Deer Creek (source and tributaries)	ID17010105PN004_02	Temperature
Deer Creek (lower)	ID17010105PN004_03	Temperature
Tributaries to Moyie River between Canada border and Round Prairie Creek	ID17010105PN006_02	Temperature
Canuck Creek (Idaho/Montana border to Idaho/Canada border)	ID17010105PN007_02	Temperature
Gillon Creek (Idaho/Canada border to mouth)	ID17010105PN009_02	Temperature
Round Prairie Creek (source to Gillon Creek)	ID17010105PN010_03	Temperature
Miller Creek (source to mouth)	ID17010105PN011_02	Temperature
Meadow Creek (source to Wall Creek)	ID17010105PN012_02	Temperature

Water Body	Assessment Unit Number	Pollutant(s)
Meadow Creek (lower, Wall Creek to mouth)	ID17010105PN012_03	Temperature

Table B. Summary of assessment outcomes for §303(d)-listed assessment units.

Water Body	Assessment Unit Number	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Lower Kootenai River Subbasin					
Ball Creek	ID17010104PN011_02 ID17010104PN011_02a	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Blue Joe Creek	ID17010104PN004_02	Temperature			
Boulder Creek	ID17010104PN032_03	Temperature			
Caribou Creek	ID17010104PN017_02	Temperature			
Curley Creek	ID17010104PN035_03	Temperature			
Dodge Creek	ID17010104PN024_03	Temperature	No	none: additional monitoring	Stressor identification found other pollutant
Fall Creek	ID17010104PN021_03	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Fleming Creek	ID17010104PN036_03	Temperature			
Grass Creek	ID17010104PN003_02 ID17010104PN003_03	Temperature			
Kootenai River Tributaries	ID17010104PN001_02	Temperature	No	none: additional monitoring	Stressor identification found other pollutant
Long Canyon Creek	ID17010104PN008_02	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Mission Creek	ID17010104PN038_03 ID17010104PN040_03	Temperature			
Myrtle Creek	ID17010104PN014_02 ID17010104PN013_03	Temperature			
Rock Creek	ID17010104PN037_03	Temperature			
Ruby Creek	ID17010104PN020_03	Temperature			
Smith Creek	ID17010104PN006_03 ID17010104PN007_03 ID17010104PN005_04	Temperature			
Snow Creek	ID17010104PN016_03	Temperature			
Trail Creek	ID17010104PN026_03	Temperature			
Trout Creek	ID17010104PN010_03	Temperature			
	ID17010104PN010_03a	Temperature	No	none: additional monitoring	Stressor identification found other pollutant
Twentymile Creek	ID17010104PN027_03	Temperature			
Moyie River Subbasin					
Canuck Creek	ID17010105PN007_02	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Deer Creek	ID17010105PN004_02 ID17010105PN004_03	Temperature			
Gillon and Harvey Creeks	ID17010105PN009_02	Temperature			
Miller Creek	ID17010105PN011_02	Temperature			
Meadow Creek	ID17010105PN012_02 ID17010105PN012_03	Temperature			

Water Body	Assessment Unit Number	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Moyie River Tributaries	ID17010105PN002_02 ID17010105PN006_02	Temperature			
Round Prairie Creek	ID17010105PN010_03	Temperature			
Skin Creek	ID17010105PN003_02	Temperature			

Table C. Summary of assessment outcomes for unlisted but impaired assessment units.

Water Body	Assessment Unit Number	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Boulder Creek	ID17010104PN033_03	Temperature	Yes	List for temperature and move to Category 4a	Excess solar load from a lack of existing shade
Brush Creek	ID17010104PN039_02	Temperature	Yes		
Cow Creek	ID17010104PN030_03	Temperature	Yes		

Public Participation

This document was developed with extensive participation by the Kootenai Valley Resource Initiative (KVRI) TMDL committee. The KVRI also serves as the watershed advisory group (WAG).

DEQ has complied with the WAG consultation requirements set forth in Idaho Code §39-3611. DEQ has provided the WAG with all available information concerning applicable water quality standards, water quality data, monitoring, assessments, reports, procedures, and schedules.

DEQ used the knowledge, expertise, experience, and information of the WAG in developing this TMDL. DEQ also provided the WAG with an adequate opportunity to participate in drafting the TMDL and to suggest changes to the document.

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Introduction

This document addresses 34 assessment units (AUs) in the Lower Kootenai and Moyie River subbasins that have been placed in Category 5 of Idaho's most recent federally approved Integrated Report for temperature impairments (DEQ 2011). There are 3 additional AUs in the Lower Kootenai River subbasin that were not identified as being impaired by temperature pollution, but were included in this total maximum daily load (TMDL) addendum as unlisted by impaired TMDLs (AUs ID17010104PN030_03, ID17010104PN033_03, and ID17010104PN039_02). Temperature TMDLs were developed using a potential natural vegetation (PNV) approach.

The purpose of this TMDL addendum is to characterize and document pollutant loads within the Lower Kootenai and Moyie River subbasins (hydrologic units codes [HUCs] 17010104 and 17010105, respectively). The first portion of this document presents key characteristics or updated information for the subbasin assessment, which is divided into four major sections: subbasin characterization (section 1), water quality concerns and status (section 2), pollutant source inventory (section 3), and a summary of past and present pollution control efforts (section 4). While the subbasin assessment is not a requirement of the TMDL, the Idaho Department of Environmental Quality (DEQ) performs the assessment to ensure impairment listings are up-to-date and accurate.

The subbasin assessment is used to develop a TMDL for each pollutant of concern for the Lower Kootenai and Moyie River subbasins. The TMDL (section 5) is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (40 CFR Part 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant.

The Upper Kootenai River subbasin (HUC 17010101) was not addressed by this document because no impairments or §303(d)-listed waters were identified within this small subbasin. The upper Kootenai River flows from Idaho to Montana.

Regulatory Requirements

This document was prepared in compliance with both federal and state regulatory requirements. The federal government, through the United States Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. DEQ implements the Clean Water Act in Idaho, while EPA oversees Idaho and certifies the fulfillment of Clean Water Act requirements and responsibilities.

Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act, in 1972. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 USC §1251). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The Clean Water Act has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to ensure "swimmable and fishable" conditions. These goals relate water quality to more than just chemistry.

The Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the Clean Water Act, 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. DEQ must review those standards every 3 years, and EPA must approve Idaho's water quality standards. Idaho adopts water quality standards to protect public health and welfare, enhance water quality, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

Section 303(d) of the Clean Water Act 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 (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 waters in Idaho's Integrated Report. 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.

DEQ monitors waters, and for those not meeting water quality standards, DEQ must establish a TMDL for each pollutant impairing the waters. However, some conditions that impair water quality do not require TMDLs. EPA considers certain unnatural conditions—such as flow alteration, human-caused lack of flow, or habitat alteration—that are not the result of discharging a specific pollutant as "pollution." TMDLs are not required for water bodies impaired by pollution, rather than a specific pollutant. A TMDL is only required when a pollutant can be identified and in some way quantified.

1 Subbasin Assessment—Subbasin Characterization

The Lower Kootenai River subbasin (HUC 17010104) is located in the far north of the Idaho panhandle, bordering both Canada and Montana with small portions in each. The Moyie River subbasin (HUC 17010105) is in the very northeast corner of Idaho, also bordering both Canada and Montana, with small portions in each, and surrounded on the west and south by the Lower Kootenai River subbasin. The Kootenai River flows west-northwest into Idaho from Libby, Montana, turns north after Bonners Ferry, and flows into Canada. The Moyie River, which first flows southward through the Moyie River subbasin, joins the Kootenai River near Moyie Springs, after the Kootenai River has crossed from Montana into Idaho.

The physical and biological characteristics of the Lower Kootenai and Moyie River subbasins are explained in detail in the *Assessment of Water Quality in Kootenai River and Moyie River Subbasins (TMDL)*, hereafter referred to as the 2006 TMDL (KTOI et al. 2006, section 1.2). An improved map (Figure 1) of the subbasins and AUs has been included in this addendum as an update to the 2006 TMDL. The subbasin and AU map depicts each subbasin as a polygon outlined in black and each AU as a different color. An improved map of annual average precipitation for the Lower Kootenai and Moyie River subbasins has also been included as a supplement to the 2006 TMDL (Figure 2). The annual average precipitation map shows that precipitation amount generally relates to elevation, and the highest precipitation occurs in the headwaters of Cow and Long Canyon Creeks.

The United States Forest Service manages and private entities own the majority of land in the Lower Kootenai and Moyie River subbasins. Most of the privately owned land is in the form of dryland agriculture along the fertile Kootenai River valley. Some of the privately owned land is forested. The Idaho Department of Lands, Bureau of Land Management, United States Fish and Wildlife Service, Idaho Department of Fish and Game, and United States Forest Service manage the remaining public lands.

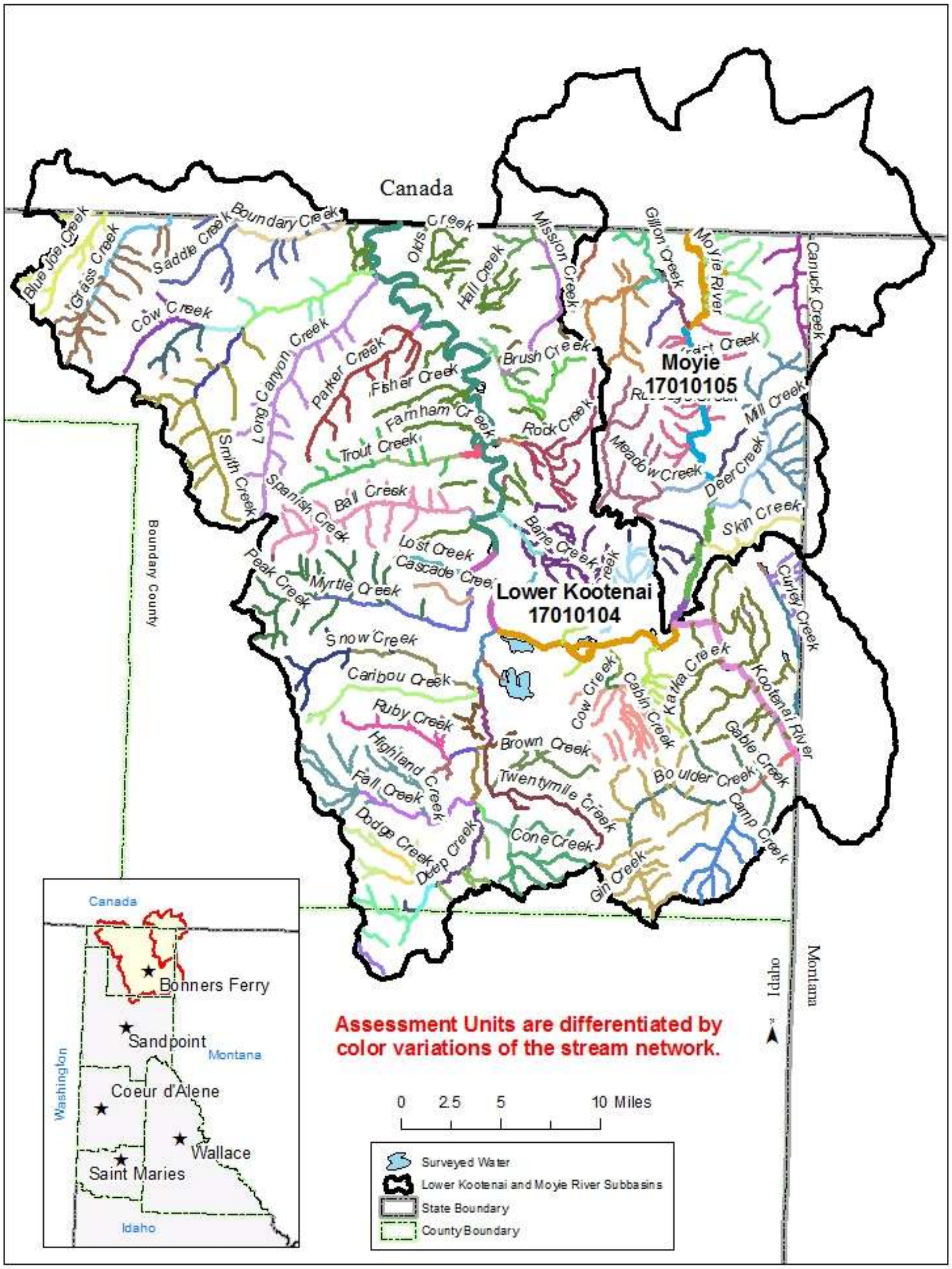

Figure 1. Lower Kootenai and Moyie River subbasins stream network and assessment units.

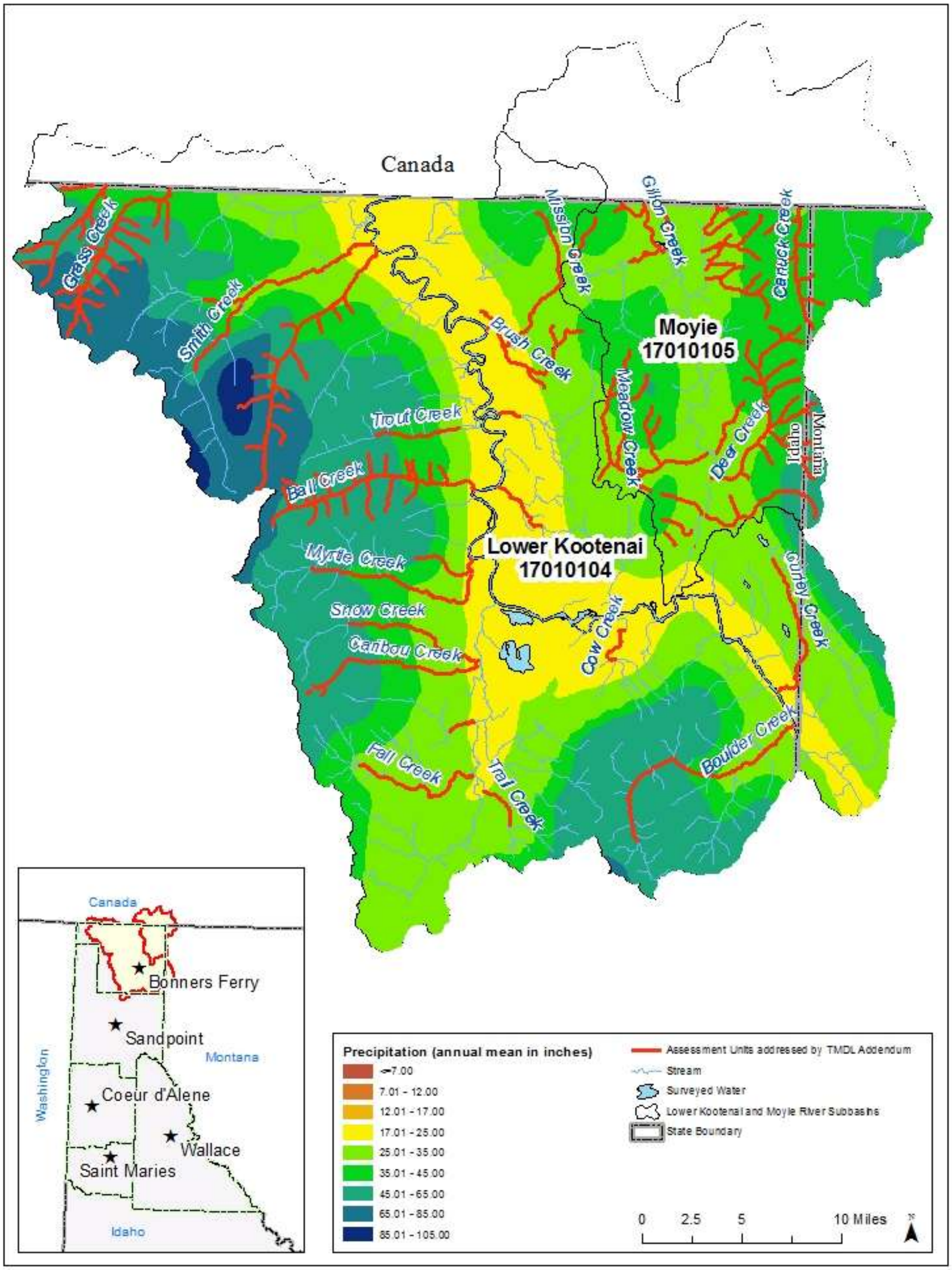

Figure 2. Lower Kootenai and Moyie River subbasins mean annual precipitation.

2 Subbasin Assessment—Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

Section 303(d) of the Clean Water Act states that waters that are unable to support their beneficial uses and do not meet water quality standards must be listed as water quality limited. Subsequently, these waters are required to have TMDLs developed to bring them into compliance with water quality standards. Figure 3 is a schematic diagram showing most of the named streams in the Lower Kootenai and Moyie River subbasins. The schematic diagram shows which streams flow into each other and approximately where they flow into each other. This information is sometimes difficult to ascertain from hydrology maps.

2.1.1 Assessment Units

AUs are groups of similar streams that have similar land use practices, ownership, or land management. However, stream order is the main basis for determining AUs—even if ownership and land use change significantly, the AU usually remains the same for the same stream order.

Using AUs to describe water bodies offers many benefits, primarily that all waters of the state are defined consistently. AUs are a subset of water body identification numbers, which allows them to relate directly to the water quality standards.

2.1.2 Listed Waters

Table 1 and Figure 4 show the pollutants listed and the basis for listing for each §303(d)-listed AU in the subbasins (i.e., AUs in Category 5 of the Integrated Report for any cause).

Table 1. Lower Kootenai and Moyie River subbasins §303(d)-listed assessment units in the subbasins.

Assessment Unit Name	Assessment Unit Number	Listed Pollutants	Listing Basis
Lower Kootenai River Subbasin			
1st- and 2nd-order tributaries Kootenai River (Shorty Island Idaho/Canada border)	ID17010104PN001_02	Combined biota/habitat bioassessments; temperature	2002 Integrated Report listing using DEQ-collected data
1st- and 2nd-order tributaries Grass Creek	ID17010104PN003_02	Benthic-macroinvertebrate bioassessments; temperature	2002 Integrated Report listing using DEQ-collected data
Grass Creek (3rd-order portion to Idaho/Canada border)	ID17010104PN003_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Blue Joe Creek and tributaries	ID17010104PN004_02	Cadmium; lead; zinc; pH; temperature	2002 Integrated Report listing using DEQ-collected data
Smith Creek and Cow Creek tributary	ID17010104PN005_04 ID17010104PN006_03 ID17010104PN007_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Long Canyon Creek and tributaries	ID17010104PN008_02	Temperature	2002 Integrated Report listing using DEQ collected data
Parker Creek (lower portion, agricultural area)	ID17010104PN039_02	Benthic-macroinvertebrate bioassessments	2002 Integrated Report listing using DEQ-collected data
Trout Creek (3rd-order to branch)	ID17010104PN010_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Trout Creek (lower portion below branch)	ID17010104PN010_03a	Benthic-macroinvertebrate bioassessments; temperature	2002 Integrated Report listing using DEQ-collected data
Upper Ball Creek (source to forest edge)	ID17010104PN011_02	Temperature	2002 Integrated Report listing using DEQ-collected data
Ball Creek (lower portion, forest to Kootenai River)	ID17010104PN011_02a	Benthic-macroinvertebrate bioassessments; temperature	2002 Integrated Report listing using DEQ-collected data
Myrtle Creek (Jim Creek to mouth)	ID17010104PN013_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Cascade Creek	ID17010104PN014_02	Temperature	2002 Integrated Report listing using DEQ-collected data
Snow Creek	ID17010104PN016_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Caribou Creek	ID17010104PN017_02	Temperature	2002 Integrated Report listing using DEQ-collected data
Ruby Creek (lower, Gold Creek to Deep Creek)	ID17010104PN020_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Fall Creek (lower, 3rd-order portion to Deep Creek)	ID17010104PN021_03	Temperature	2002 Integrated Report listing using DEQ-collected data

Assessment Unit Name	Assessment Unit Number	Listed Pollutants	Listing Basis
McArthur Lake	ID17010104PN023_0L	Mercury	Mercury listing based on study by Essig and Kosterman (2008). A mercury level of 0.650 mg/kg, which exceeds the human health criterion of 0.3 mg/kg, was reported.
Dodge Creek	ID17010104PN024_03	Benthic-macroinvertebrate bioassessments; temperature	2002 Integrated Report listing using DEQ-collected data
Trail Creek (source to highway)	ID17010104PN026_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Brown Creek (Twentymile Creek to Deep Creek)	ID17010104PN027_03	Benthic-macroinvertebrate bioassessments; temperature	2002 Integrated Report listing using DEQ-collected data
Kootenai River	ID17010104PN001_08 ID17010104PN012_08 ID17010104PN029_08 ID17010104PN031_08	Temperature	2002 Integrated Report listing using DEQ-collected data
Cow Creek (lower, Brush Creek to subsurface flow)	ID17010104PN030_03	Combined biota/habitat bioassessments	2002 Integrated Report listing from BURP monitoring. Aquatic insect and habitat assessment showed the stream aquatic life support status “not fully supporting” beneficial uses.
Boulder Creek (East Fork Boulder Creek to mouth)	ID17010104PN032_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Curley Creek (lower, unnamed tributary to Kootenai River)	ID17010104PN035_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Fleming Creek (lower)	ID17010104PN036_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Rock Creek (lower)	ID17010104PN037_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Mission Creek	ID17010104PN038_03 ID17010104PN040_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Brush Creek	ID17010104PN039_02	Benthic-macroinvertebrate bioassessments	2002 Integrated Report listing from BURP monitoring. Aquatic insect and habitat assessment showed the stream aquatic life support status “not fully supporting” beneficial uses.
Moyie River Subbasin			
Skin Creek	ID17010105PN003_02	Temperature	2002 Integrated Report listing using DEQ-collected data
Deer Creek	ID17010105PN004_02 ID17010105PN004_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Tributaries to Moyie River	ID17010105PN002_02 ID17010105PN006_02	Temperature	2002 Integrated Report listing using DEQ-collected data
Canuck Creek	ID17010105PN007_02	Temperature	2002 Integrated Report listing using DEQ-collected data

Assessment Unit Name	Assessment Unit Number	Listed Pollutants	Listing Basis
Gillon and Harvey Creeks	ID17010105PN009_02	Temperature	2002 Integrated Report listing using DEQ-collected data
Round Prairie Creek	ID17010105PN010_03	Temperature	2002 Integrated Report listing using DEQ-collected data
Miller Creek	ID17010105PN011_02	Temperature	2002 Integrated Report listing using DEQ-collected data
Meadow Creek	ID17010105PN012_02	Benthic-macroinvertebrate bioassessments; temperature	2002 Integrated Report listing using DEQ-collected data
Meadow Creek	ID17010105PN012_03	Temperature	2002 Integrated Report listing using DEQ-collected data

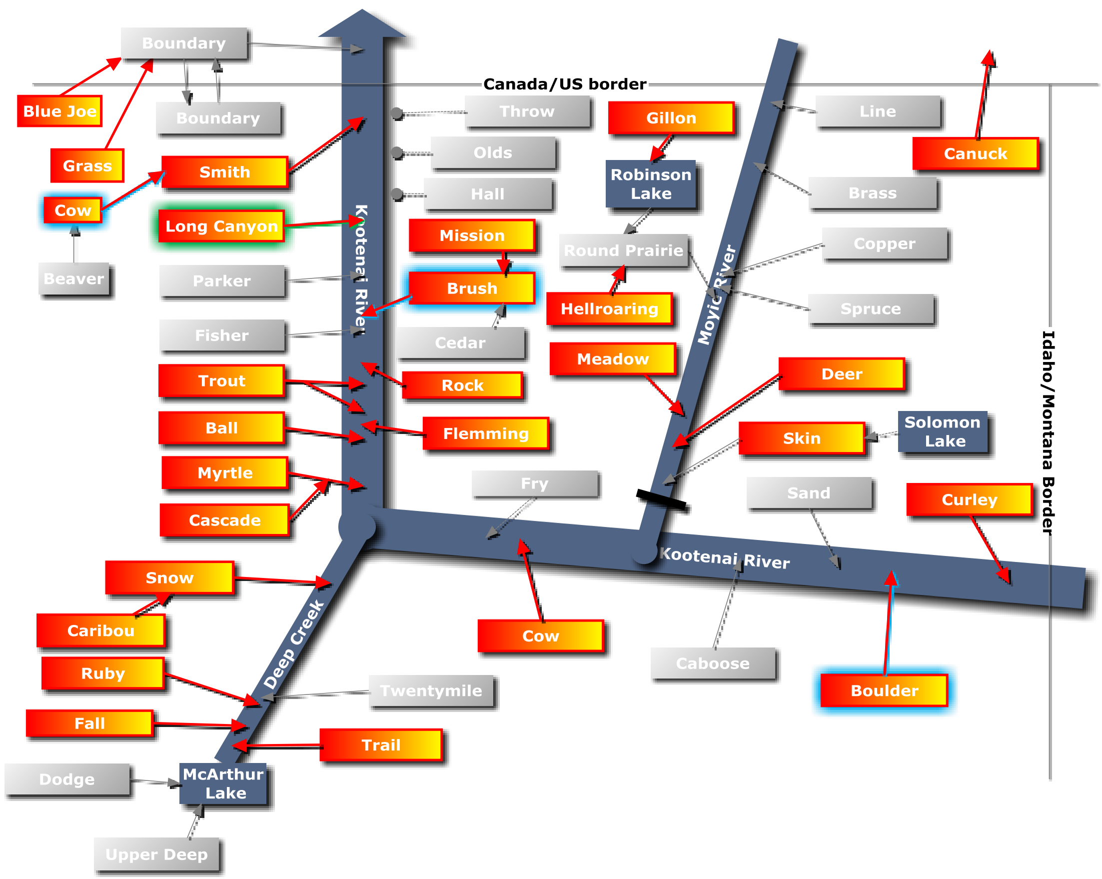

Figure 3. Schematic diagram of streams in Kootenai and Moyie River subbasins.

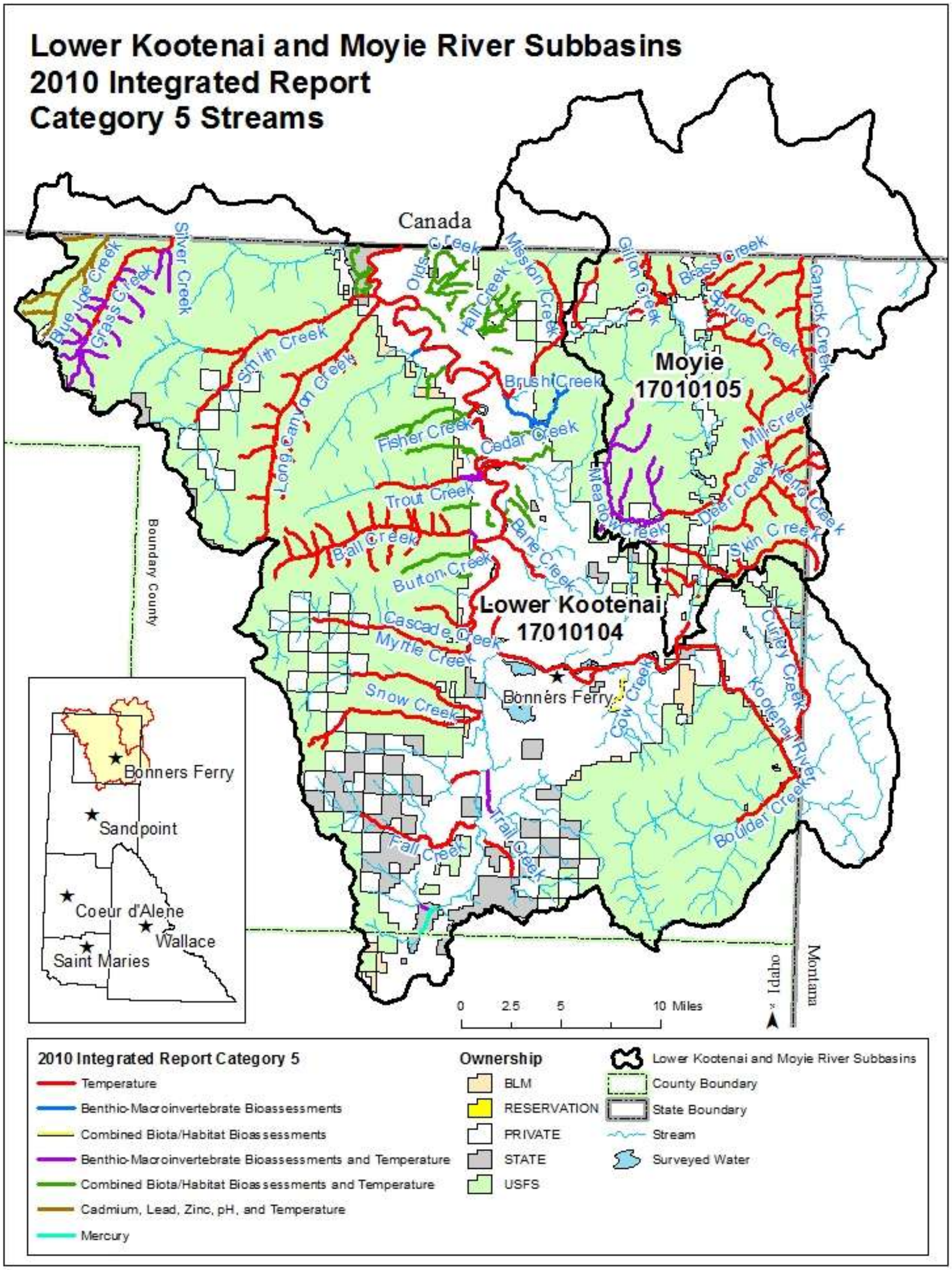

Figure 4. Lower Kootenai and Moyie River subbasins Category 5 streams.

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards (IDAPA 58.01.02) list beneficial uses and set water quality goals for 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 described briefly in the following paragraphs. The *Water Body Assessment Guidance* (Grafe et al. 2002) provides a more detailed description of beneficial use identification for use assessment purposes.

Beneficial uses include the following:

- Aquatic life support—cold water, seasonal cold water, warm water, salmonid spawning, and modified
- Contact recreation—primary (swimming) or secondary (boating)
- Water supply—domestic, agricultural, and industrial
- Wildlife habitats
- Aesthetics

2.2.1 Existing Uses

Existing uses under the Clean Water Act 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" (40 CFR 131.3). The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.051.01). Existing uses need to be protected, whether or not the level of water quality to fully support the uses currently exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that has supported salmonid spawning since November 28, 1975, but does not now due to other factors, such as blockage of migration, channelization, sedimentation, or excess heat.

2.2.2 Designated Uses

Designated uses under the Clean Water Act are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained" (40 CFR 131.3). Designated uses are simply uses officially recognized by the state. In Idaho, these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Multiple uses often apply to the same water; in this case, water quality must be sufficiently maintained to meet the most sensitive use (designated or existing). 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 described in the Idaho water quality standards (IDAPA 58.01.02.100) and specifically listed by water body in sections 110–160.

2.2.3 Presumed Uses

In Idaho, due to a change in scale of cataloging waters in 2000, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations. These undesignated waters ultimately need to be designated for appropriate uses. In the interim, and absent information on existing uses, 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 applies the numeric cold water criteria and primary or secondary contact recreation criteria to undesignated waters. If in addition to these presumed uses, an additional existing use (e.g., salmonid spawning) exists, then the additional numeric criteria for salmonid spawning would also apply (e.g., intergravel dissolved oxygen, temperature) because of the requirement to protect water quality for existing uses. However, if for example, cold water aquatic life is not found to be an existing use, a use designation (rulemaking) to that effect is needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of cold water criteria (IDAPA 58.01.02.101.01).

2.2.4 Beneficial Uses in the Subbasin

Beneficial uses for §303(d)-listed water bodies in the Lower Kootenai and Moyie River subbasins are listed in Table 2. A complete list of beneficial uses in the subbasins can be found in the Idaho water quality standards (IDAPA 58.01.02.110.02 and .110.03).

Table 2. Lower Kootenai and Moyie River subbasins beneficial uses of §303(d)-listed streams.

Assessment Unit Name	Assessment Unit Number	Beneficial Uses[a]	Type of Use
Lower Kootenai River Subbasin			
1st- and 2nd-order tributaries Kootenai River (Shorty Island Idaho/Canada border)	ID17010104PN001_02	CW, SS, PCR, DWS	Designated
1st- and 2nd-order tributaries Grass Creek	ID17010104PN003_02	CW, SS, PCR	Designated
Grass Creek (3rd-order portion to Idaho/Canada border)	ID17010104PN003_03	CW, SS, PCR	Designated
Blue Joe Creek and tributaries	ID17010104PN004_02	CW, SS, PCR	Designated
Smith Creek and Cow Creek tributary	ID17010104PN005_04 ID17010104PN006_03 ID17010104PN007_03	CW, SS, PCR	Designated
Long Canyon Creek and tributaries	ID17010104PN008_02	CW, SS, PCR	Designated
Parker Creek (lower portion, agricultural area)	ID17010104PN039_02	CW, SS, PCR	Designated
Trout Creek	ID17010104PN010_03 ID17010104PN010_03a	CW, SS, PCR	Designated
Ball Creek	ID17010104PN011_02 ID17010104PN011_02a	CW, SS, PCR	Designated
Myrtle Creek (Jim Creek to mouth)	ID17010104PN013_03	CW, SS, PCR	Designated
Cascade Creek	ID17010104PN014_02	CW, SS, PCR	Designated
Snow Creek	ID17010104PN016_03	CW, SS, PCR	Designated
Caribou Creek	ID17010104PN017_02	CW, SS, PCR	Designated
Ruby Creek (lower, Gold Creek to Deep Creek)	ID17010104PN020_03	CW, SS, PCR	Designated
Fall Creek (lower, 3rd-order portion to Deep Creek)	ID17010104PN021_03	CW, SS, PCR	Designated
McArthur Lake	ID17010104PN023_0L	CW	Designated
Dodge Creek	ID17010104PN024_03	CW, SS, PCR	Designated
Trail Creek (source to highway)	ID17010104PN026_03	CW, SS, PCR	Designated
Brown Creek (Twentymile Creek to Deep Creek)	ID17010104PN027_03	CW, SS, PCR	Designated
Kootenai River	ID17010104PN001_08 ID17010104PN012_08 ID17010104PN029_08 ID17010104PN031_08	CW, SS, PCR, DWS	Designated
Cow Creek (lower, Brush Creek to subsurface flow)	ID17010104PN030_03	CW, SS, PCR	Designated
Boulder Creek	ID17010104PN032_03 ID17010104PN033_03	CW, SS, PCR	Designated
Curley Creek (lower, unnamed tributary to Kootenai River)	ID17010104PN035_03	CW, SS, SCR	Designated
Fleming Creek (lower)	ID17010104PN036_03	CW, SS, SCR	Designated
Rock Creek (lower)	ID17010104PN037_03	CW, SS, SCR	Designated
Mission Creek	ID17010104PN038_03 ID17010104PN040_03	CW, SS, PCR	Designated
Brush Creek	ID17010104PN039_02	CW, SS, SCR	Designated

Assessment Unit Name	Assessment Unit Number	Beneficial Uses[a]	Type of Use
Moyie River Subbasin			
Skin Creek	ID17010105PN003_02	CW, SS, PCR	Designated
Deer Creek	ID17010105PN004_02 ID17010105PN004_03	CW, SS, PCR	Designated
Tributaries to Moyie River	ID17010105PN002_02 ID17010105PN006_02	CW, SS, PCR, DWS	Designated
Canuck Creek	ID17010105PN007_02	CW, SS, SCR	Designated
Gillon and Harvey Creeks	ID17010105PN009_02	CW, SS, PCR	Designated
Round Prairie Creek	ID17010105PN010_03	CW, SS, PCR	Designated
Miller Creek	ID17010105PN011_02	CW, SS, PCR	Designated
Meadow Creek	ID17010105PN012_02 ID17010105PN012_03	CW, SS, PCR	Designated

[a] Cold water (CW), salmonid spawning (SS), primary contact recreation (PCR), secondary contact recreation (SCR), domestic water supply (DWS)

2.2.5 Water Quality Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of water quality criteria, which include *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity, and *narrative* criteria for pollutants such as sediment and nutrients (IDAPA 58.01.02.250–251) (Table 3).

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

Parameter	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning[a]
Water Quality Standards: IDAPA 58.01.02.250–251				
Bacteria				
Geometric mean	<126 *E. coli*/100 mL[b]	<126 *E. coli*/100 mL	—	—
Single sample	≤406 *E. coli*/100 mL	≤576 *E. coli*/100 mL	—	—
pH	—	—	Between 6.5 and 9.0	Between 6.5 and 9.5
Dissolved oxygen (DO)	—	—	DO exceeds 6.0 milligrams/liter (mg/L)	**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
Temperature[c]	—	—	22 °C or less daily maximum; 19 °C or less daily average **Seasonal Cold Water**: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °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
Turbidity	—	—	Turbidity shall not exceed background by more than 50 nephelometric turbidity units (NTU) instantaneously or more than 25 NTU for more than 10 consecutive days.	—
Ammonia	—	—	Ammonia not to exceed calculated concentration based on pH and temperature.	—
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Temperature	—	—	—	7-day moving average of 10 °C or less maximum daily temperature for June–September

[a] During spawning and incubation periods for inhabiting species
[b] *Escherichia coli* per 100 milliliters
[c] Temperature exemption: Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth 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.

Idaho 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. The DEQ Coeur d'Alene Regional Office set the general spawning and incubation windows with assistance from the Idaho Department of Fish and Game to better reflect and protect salmonid spawning and incubation in north Idaho, summarized in Appendix A. Six native salmonid species inhabit the Lower Kootenai River subbasin: Bull Trout (*Salvelinus confluentus*), Westslope Cutthroat

Trout (*Oncorhynchus clarki lewisi*), Redband Rainbow Trout (*Oncorhynchus mykiss* ssp.), Kokanee Salmon (*Oncorhynchus nerka*), Pygmy Whitefish (*Prosopium coulteri*), and Mountain Whitefish (*Prosopium williamsoni*). In addition to the endangered White Sturgeon (*Acipenser transmontanus*), the Kootenai River also contains Idaho's only population of native Burbot (*Lota lota*), a species of special concern. The salmonids and burbot species are discussed in more detail in the 2006 TMDL (KTOI et al. 2006, section 1.2.2.4).

Bull Trout is listed as a threatened species by the US Fish and Wildlife Service. To protect the species in Idaho, a recovery plan was developed by the state in which water temperature criteria were set to protect the threatened species (IDAPA 58.01.02.250.02.g). EPA also promulgated bull trout water quality temperature criteria (40 CFR 131.33) (see Appendix A for more detail).

The cold water aquatic life criteria is not discussed in this section because where the cold water aquatic life beneficial use criteria apply, the salmonid spawning criteria also apply and are more protective (i.e., require a lower temperature) than the cold water aquatic life criteria, with the exception of McArthur Lake. When temperature data exceed the more protective criteria (salmonid spawning), the water body is identified as impaired by temperature regardless of whether it fails the cold water aquatic life criteria also.

DEQ allows for minor exceedances of water quality temperature criteria when the exceedance occurs less than 10% of the critical time period and there is no other evidence of thermal inputs (Grafe et al. 2002). Exceptions are also made for water temperature exceedances that occur during periods when air temperatures exceed the 90th percentile of air temperatures recorded in the area (Grafe et al. 2002).

DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.050.02. The procedure relies heavily upon biological parameters and is presented in detail in the *Water Body Assessment Guidance* (Grafe et al. 2002). This guidance requires DEQ to use the most complete data available to make beneficial use support status determinations (Figure 5).

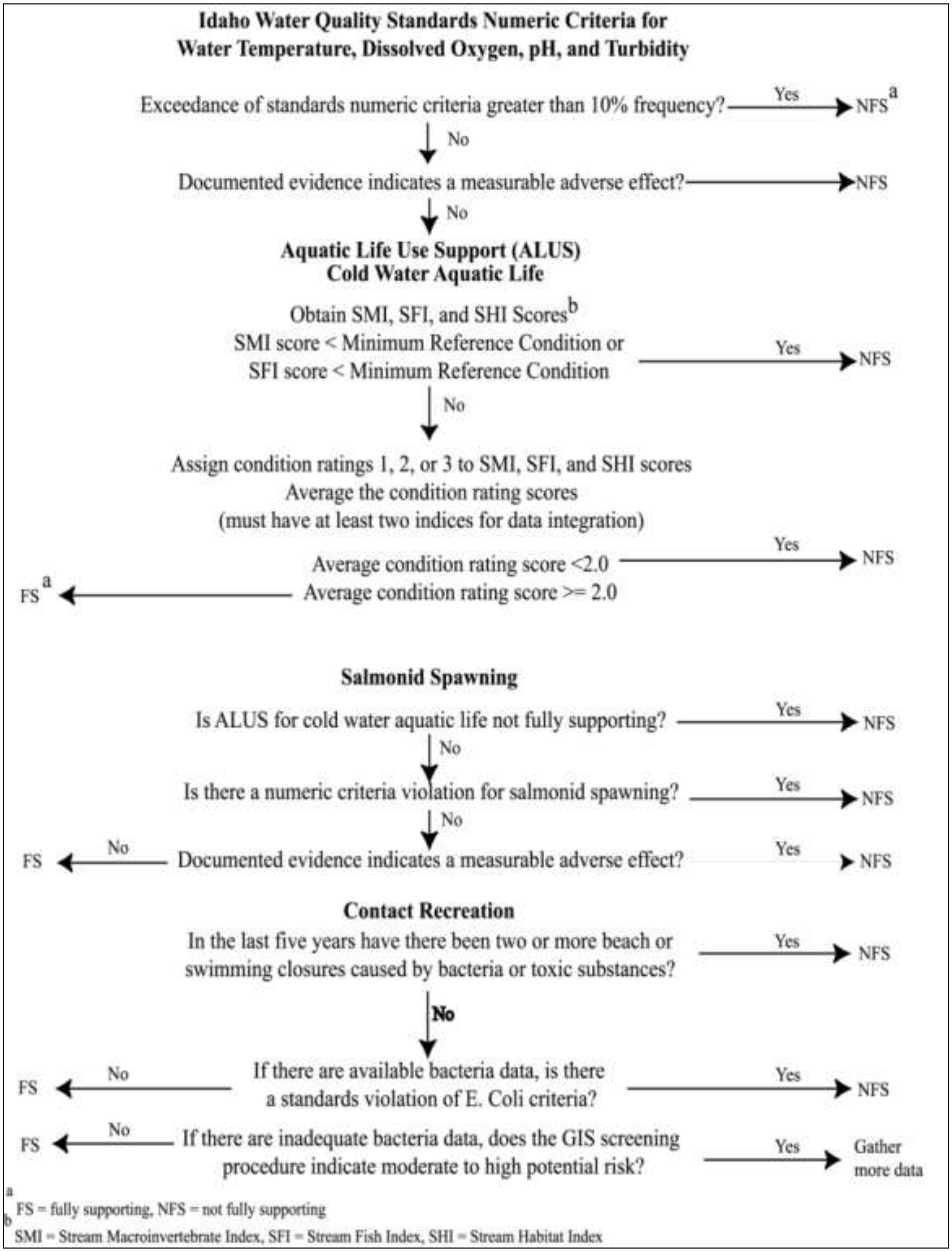

Figure 5. Steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.3 Summary and Analysis of Existing Water Quality Data

A detailed summary and analysis of previous water quality data for the Lower Kootenai and Moyie River subbasins is provided in the 2006 TMDL (KTOI et al. 2006). Data sources are provided in Appendix B. This section describes the temperature monitoring data collected by the KVRI subcommittee volunteers and solar radiation analysis performed by DEQ.

2.3.1 Temperature Monitoring

Starting in 2008, the KVRI TMDL subcommittee initiated annual temperature monitoring. The objective was to collect ambient water temperatures from reference streams within the Lower Kootenai and Moyie River subbasins. DEQ surplus temperature loggers (Onset Hobo®) were deployed and recovered in streams by subcommittee volunteers. The streams monitored can be found in Table 4 and displayed in Figure 6. During some events, multiple loggers were placed at several locations within the stream. The results for the 2008 temperature monitoring were provided in a 2008 report (included as Appendix C). Detailed results for monitoring in 2009–2012 are available in Appendix D.

Table 4. Ambient temperature monitoring, 2008–2012.

	2008			2009			2010			2011			2012		
Location	deployed	recovered	downloaded	deployed	recovered	downloaded	deployed	recovered	downloaded	deployed	recovered	downloaded	deployed	recovered	downloaded
Ball Creek				☑	☐										
Boulder Creek	☑	☑	☐	☑	☑	☑									
Boundary Creek	☑	☑	☑	☑	☑	☑									
Copper Creek	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Deer Creek	☑	☐		☑	☑	☑									
Fall Creek				☑	☑	☑									
Hellroaring Creek	☑	☑	☑	☑	☑	☑									
Long Canyon Creek				☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Meadow Creek	☑	☐		☑	☑	☑									
Mission Creek	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☐	☑	☑	F
Myrtle Creek							☑	☐		☑	☑	☑	☑	☑	F
Rock Creek				☑	☑	F									
Snow Creek							☑	☑	☑	☑	☑	☑	☑	☑	F
Spruce Creek	☑	☑	☑	☑	☑	☑									
Trail Creek	☑	☐		☑	☑	☑	☑	☑	☑						
Twentymile Creek	☑	☑	☑	☑	☑	☐	☑	☑	☑	☑	☑	☑			
Tribal Air Station				☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	F

☑ = event occurred, ☐ = could not find logger or electronic file, F = temperature logger malfunction

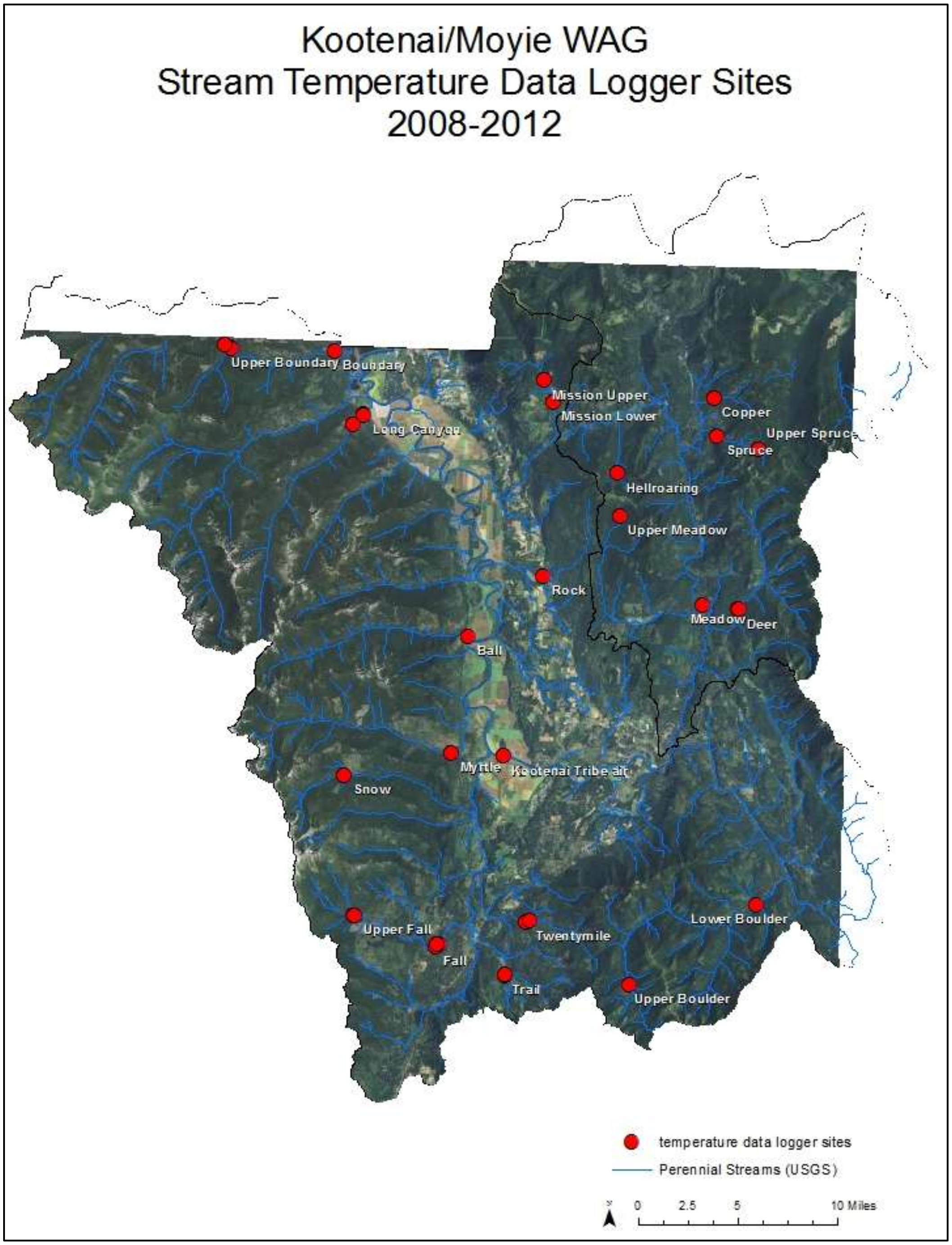

Figure 6. Lower Kootenai and Moyie River subbasins stream temperature logger sites, 2008–2012.

Upon review of the data, it appears that the loggers used for this study had inadequate storage space, which limits the frequency of measurements and the period for which each logger could collect measurements. During the 2012 deployment, the loggers began to systematically fail. Replacement loggers have been acquired by the Kootenai Tribe of Idaho for future monitoring. Future loggers will be placed for a year at a time and collect a measurement every 15 minutes.

2.3.2 Solar Radiation Analysis

DEQ performed this analysis to see if catchment basin solar radiation could be used to correlate to measured stream temperatures.

Using the ArcGIS area solar radiation analysis tools, DEQ modeled incoming solar radiation (insolation) for the catchment basin (i.e., watershed) and stream surface above each temperature data logger site. See Figure 7 for a map of the catchment basins.

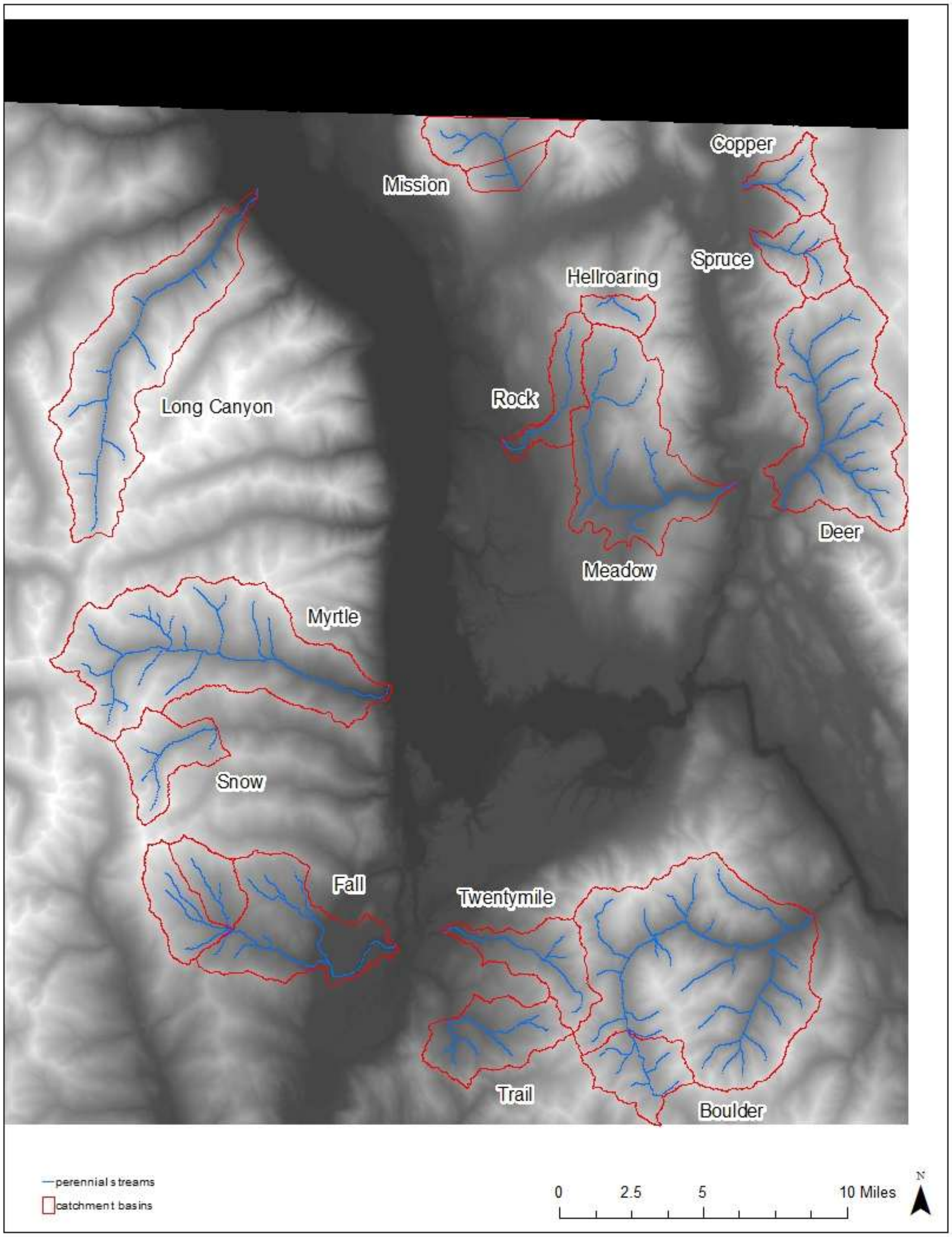

Figure 7. Catchment basins and stream networks defined by the temperature data logger site locations (10-meter digital elevation model background).

The model output is a combination of direct radiation, unimpeded in a direct line from the sun, and diffuse radiation, scattered by atmospheric constituents. The calculation uses an upward-looking hemispherical viewshed based on topography from a 10-meter resolution digital elevation model (DEM) (Figure 8). The process was repeated for every 10 square meter location to produce an insolation map. The annual insolation and summer insolation (June through

September) value was totaled for each catchment basin area. The value is in watt-hours per square meter. A visual display for the month of July is provided in Figure 9.

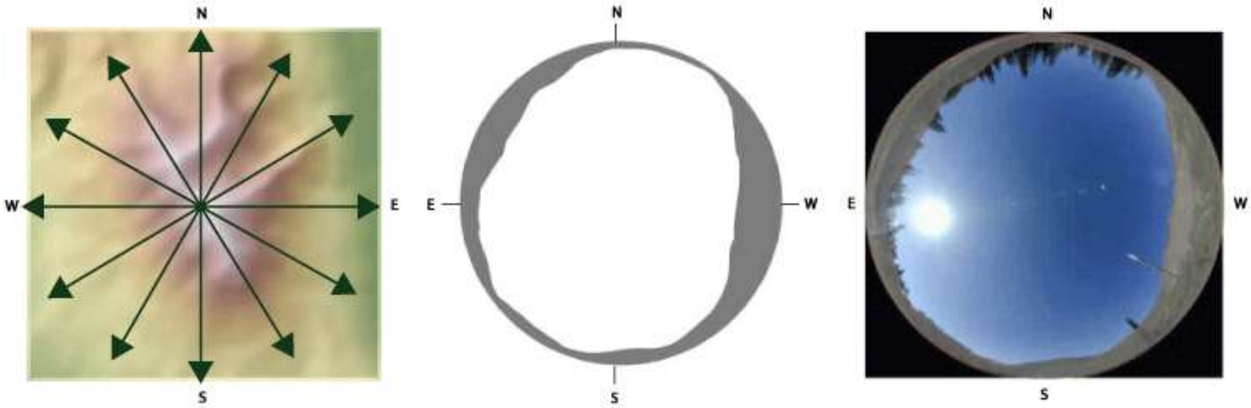

Figure 8. Example of an upward-looking hemispherical viewshed based on topography

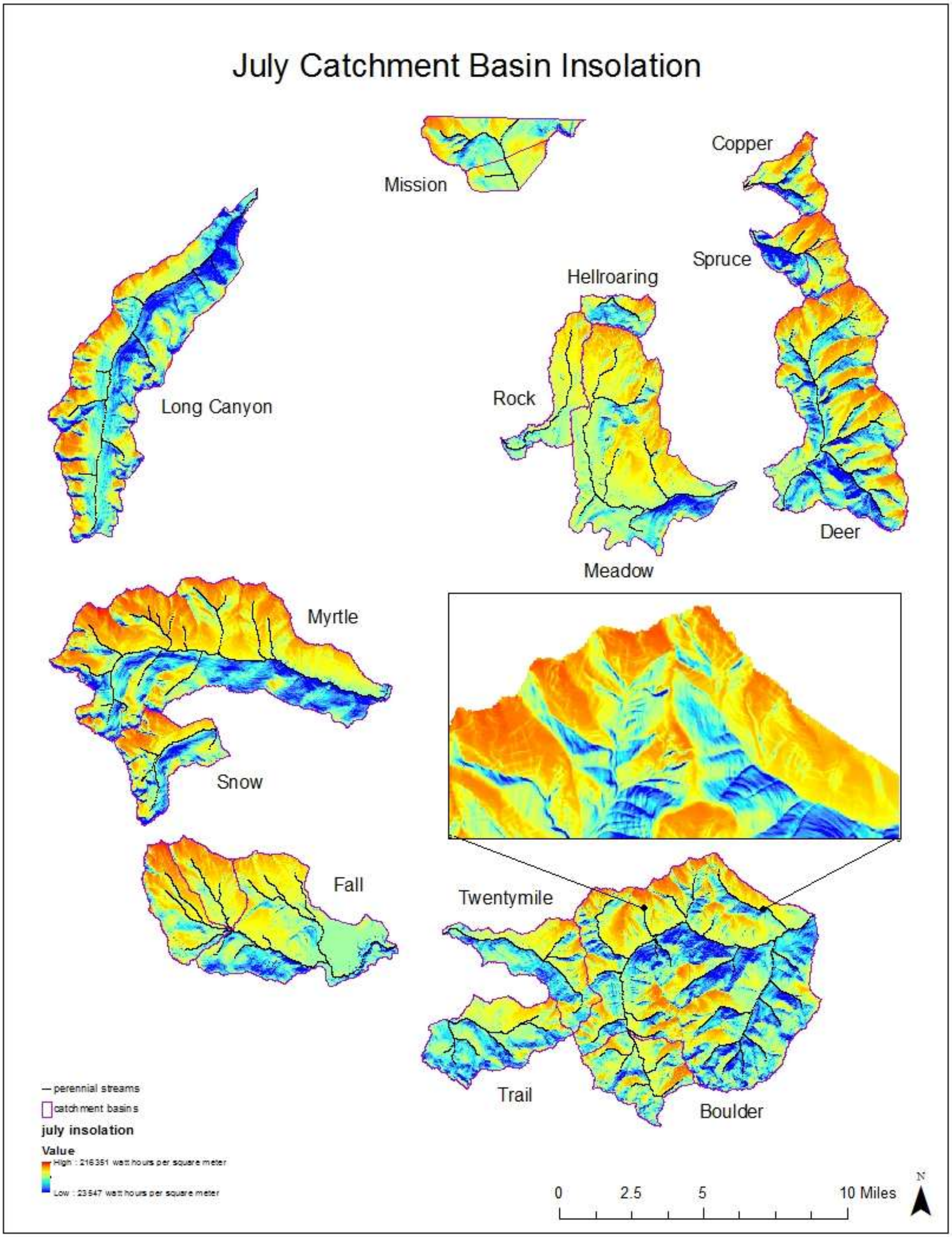

Figure 9. Catchment basin insolation during July.

A general estimate of the stream width was determined using existing wetted edge measurements from DEQ Beneficial Use Reconnaissance Program (BURP) survey sites (Figure 10). Stream widths were used to calculate stream surface area, and this surface area estimate was used to calculate the insolation impacting the stream surface, excluding the influence of vegetation. The annual insolation and summer insolation (June through September) value was totaled for the stream surface area within each catchment basin. The value is in watt-hours per square meter. A visual display for the month of July is provided in Figure 11.

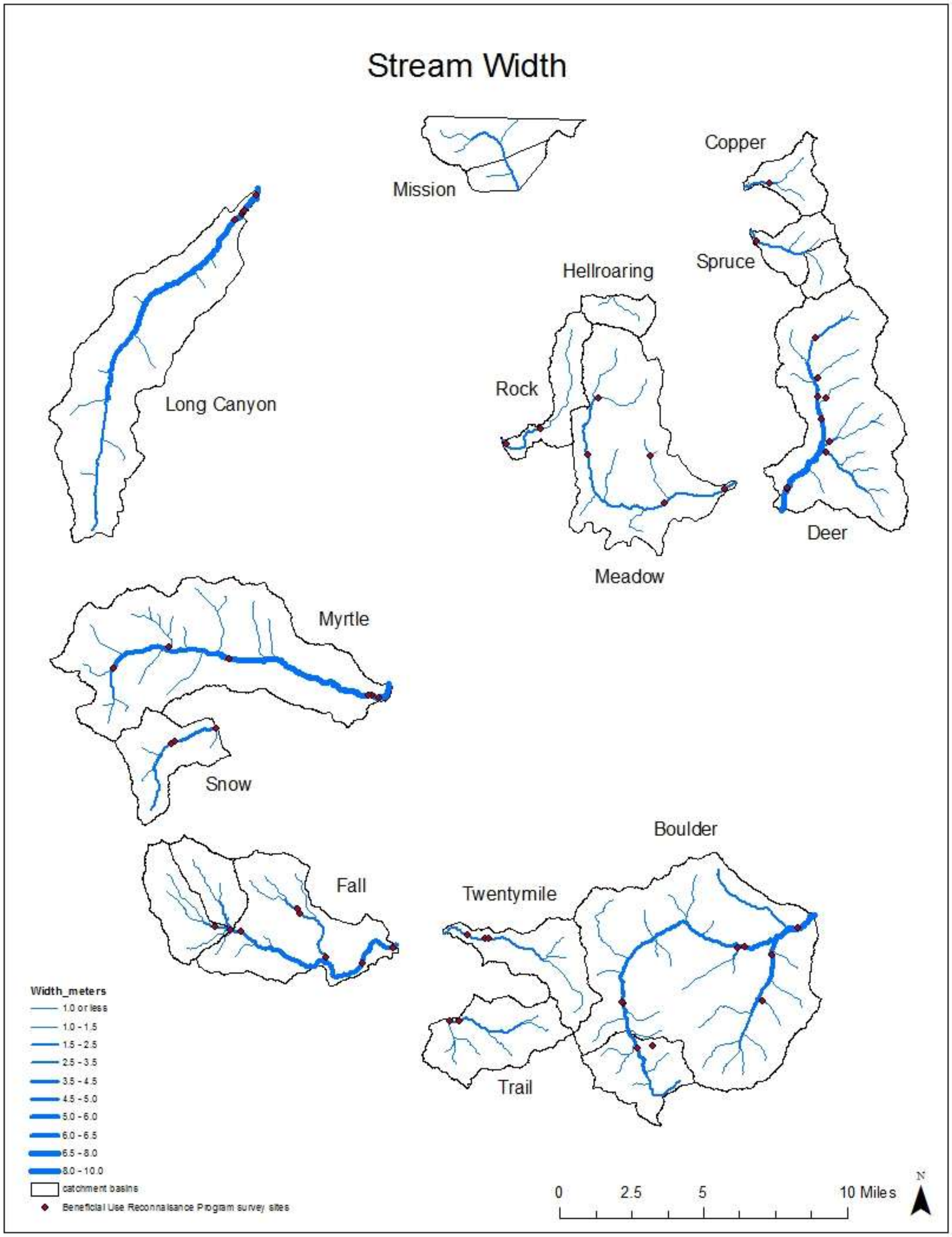

Figure 10. Estimated wetted edge stream width.

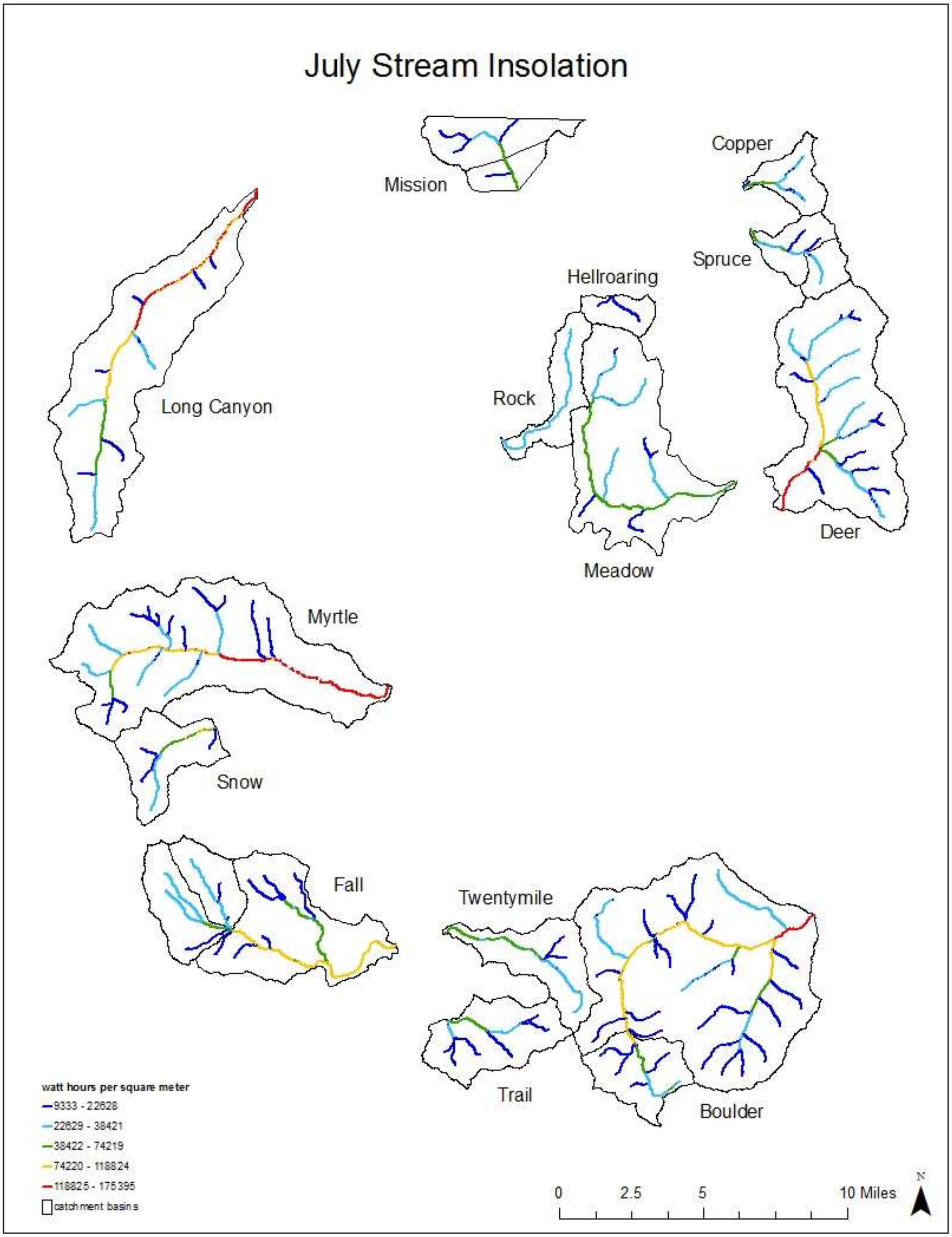

Figure 11. Stream insolation during July.

Aspect, the compass direction that a topographic slope faces, was determined in ArcGIS using the 10-meter resolution DEM (Figure 12). The output value is in degrees from north. The data from the stream channel was reclassified from degrees to the four compass directions: north, south, east, or west (Figure 13). The percent of the stream network within each catchment basin that is north-, south-, east-, or west-facing is listed in Appendix E (*Figure E-1*).

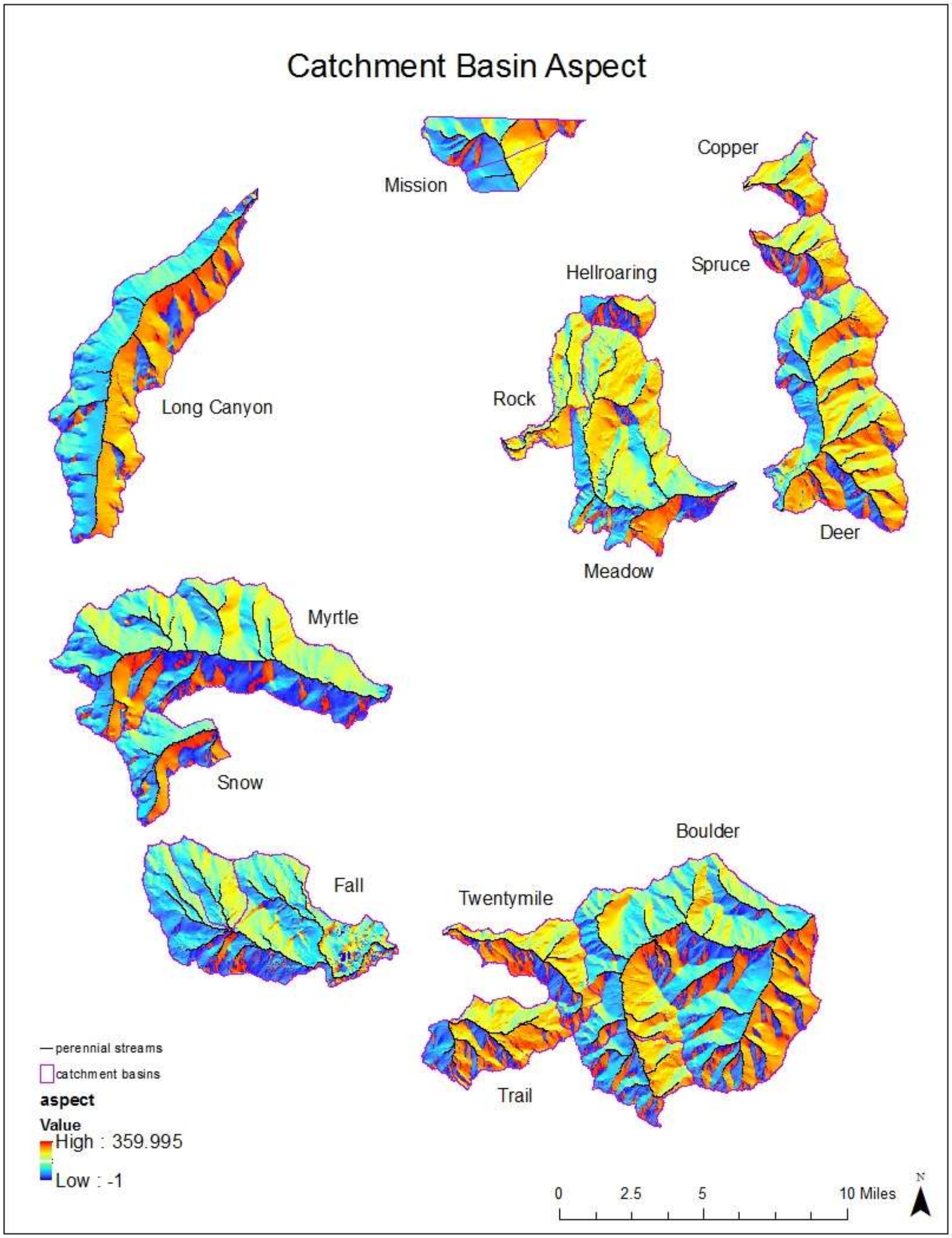

Figure 12. Catchment basin aspect, in degrees from north.

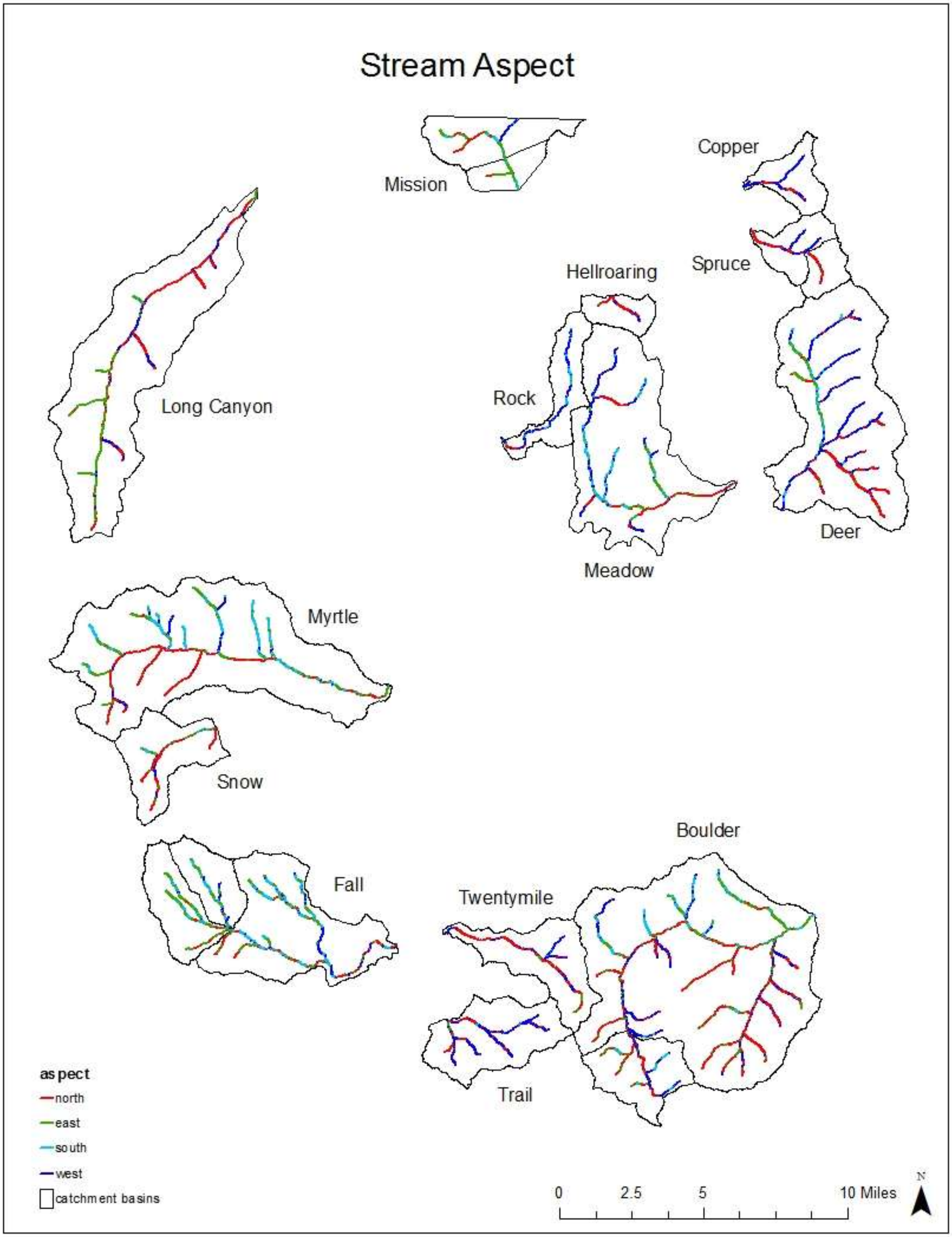

Figure 13. Stream channel aspect (compass direction the slope is facing).

Other modeled variables included the following:

- The stream network miles and catchment basin area in acres were calculated using ArcGIS.
- The slope of the main stem stream channel (Figure 14) for each catchment basin was calculated as the elevation difference divided by the stream length and multiplied by 100%.
- The 10-meter DEM was used to determine the mean elevation of each catchment basin.

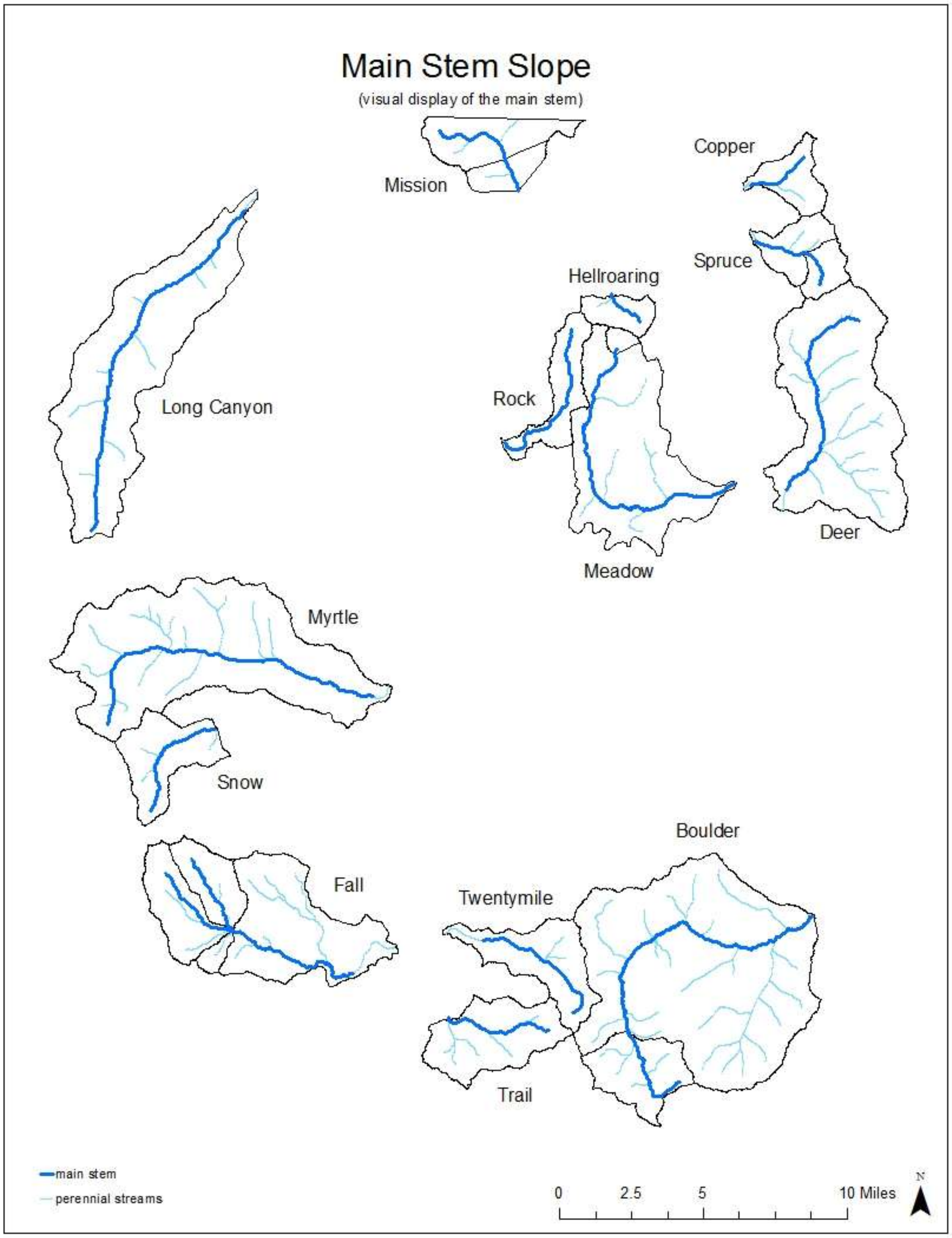

Figure 14. Main stems used for modeling slopes.

The results from the temperature data analysis, the topographically influenced insolation, stream channel aspect, stream network length, catchment basin area, main stem slope, and catchment basin mean elevation are listed in Appendix E, *Figure E-1*. These variables were used in a scatterplot matrix to uncover relationships in the data. The relationship would be revealed as a structured association (e.g., linear, quadratic, exponential) between one variable and another (Figure 15).

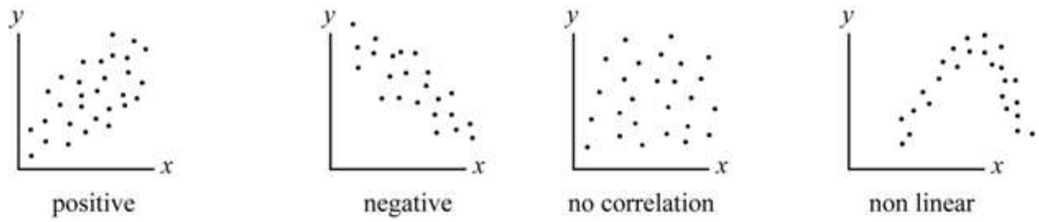

Figure 15. Example scatterplot structured associations.

The scatterplot matrix (Appendix E, *Figure E-2*) revealed no significant association between any of the temperature data variables and the environmental factors (aspect, elevation, stream length, catchment basin area, and topographical shade). The associations that did exist were between temperature data variables. For example, maximum daily maximum temperature (variable 1a) had a strong relationship to maximum daily average temperature (variable 1b). There was also an association with insolation, stream length, and catchment basin area (*Appendix E*).

A reference watershed, Long Canyon Creek, has been identified for the Lower Kootenai and Moyie River subbasins. This reference watershed has very little to no human disturbance. Long Canyon Creek water temperatures are elevated when compared to Idaho water quality standards criteria (although only a partial record is available). The remaining findings from the first 5 years of monitoring were slightly disappointing, but do highlight the complexity of stream temperatures. DEQ believed that a pattern or relationship between measured parameters would be found that could distinguish reference streams, but data have not supported that assumption. The streams that were monitored were in locations where vegetation shading was estimated to be at or near full potential. It appears that environmental factors (aspect, elevation, stream length, catchment basin area, and topographical shade) that are typically thought to affect stream temperatures remain specific to each stream and cannot forecast temperatures in similar streams.

Future monitoring should be continued to better understand stream temperatures in the subbasins. Year-round monitoring will help eliminate the partial records that complicate evaluation against criteria. A monitoring plan to address specific questions may need to be developed, where more control in the monitoring design could eliminate some of the variability that complicates this analysis.

2.3.3 Status of Beneficial Uses

Elevated stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of fish, with coldwater species being the least tolerant of high water temperatures. Elevated stream temperatures can also be harmful to aquatic invertebrates, amphibians, and mollusks, although less is known about these effects.

3 Subbasin Assessment—Pollutant Source Inventory

Pollution within the Lower Kootenai and Moyie River subbasins is primarily from water temperature exceedance due to lack of shade.

3.1 Point Sources

The AUs being evaluated for PNV are not affected by the discharge of any identified point sources.

3.2 Nonpoint Sources

All pollutant sources in the Lower Kootenai and Moyie River subbasins are nonpoint.

4 Subbasin Assessment—Summary of Past Pollution Control Efforts

A detailed summary of past pollution control efforts for the Lower Kootenai and Moyie River subbasins can be found in the 2006 TMDL (KTOI et al. 2006) and the Kootenai/Moyie Implementation Plan (KTOI et al. 2005).

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 quantifying loads and the relation of specific loads to attaining water quality standards, the rules regarding TMDLs (40 CFR Part 130) require a margin of safety be included in 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 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 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. 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 for the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. 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 (40 CFR 130.2). 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, EPA allows for seasonal or annual loads.

5.1 Instream Water Quality Targets

For the 26 AUs in the Lower Kootenai River subbasin and the 11 AUs in the Moyie River subbasin, DEQ used a PNV approach to develop these temperature TMDLs. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) 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. See Appendix A for further discussion of water quality standards and natural background provisions.

The PNV approach is described briefly below. 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

There are several important contributors of 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. We can measure the amount of shade that a stream receives in a number of ways. Effective shade (i.e., that 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 TMDLs

PNV along a stream is that riparian plant community that could theoretically 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/old age, wind damage, flood, landslide, wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, 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) may result in the stream heating up from anthropogenically created additional solar inputs.

PNV (and therefore target shade) can be estimated using models of plant community structure (shade curves for specific riparian plant communities). Existing canopy cover or shade can be measured or estimated. Comparing the two (target and existing shade) determines 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, like channel reconstruction and stabilization.

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, we used the Spokane, Washington, station. 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 (see Appendix A).

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 (so long as no point sources or other anthropogenic sources of heat exist in the watershed) and are considered to be consistent with the Idaho water quality standards, even if they exceed numeric criteria by more than 0.3 °C.

5.1.2.1 Existing Shade Estimates

Existing shade was estimated for the 37 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 somewhere between 50% and 59%, we assigned a 50% shade class to that segment. The estimate is based on a general intuitive observation about the kind of 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 estimates of shade in this TMDL were partially field verified with a Solar Pathfinder, which measures effective shade and takes into consideration other physical features that block the sun from hitting the stream surface (e.g., hillsides, canyon walls, terraces, and man-made structures).

Solar Pathfinder Field Verification

The accuracy of the aerial photo interpretations was field verified with a Solar Pathfinder at 13 sites in the Lower Kootenai River subbasin; no field verification occurred in the Moyie River subbasin. The results of the Lower Kootenai River subbasin field verification were used as a method of “calibration” when performing the aerial photo interpretation in the Moyie River subbasin. The Solar Pathfinder is a device that allows one to trace 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, ten traces are taken at systematic or random intervals along the length of the stream in question.

At each sampling location, the Solar Pathfinder was placed in the middle of the stream at about the bankfull 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 to 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, 50 paces, etc.). Alternatively, one can randomly locate points of measurement by generating random numbers to be used as interval distances.

When possible, the sampler also measured bankfull 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 what kinds of plant species (the large, dominant, shade-producing ones) were present. One 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.

Solar Pathfinder results show that, in general, our original aerial interpretation over-estimated shade by about one shade class (Table 5). The average difference between originally estimated shade classes and Solar Pathfinder measured shade classes was 2% ± 10.45% (shade ± 95% confidence interval). Three of the verification sites fell on the boundary between two shade class segments and were split into two sites for the analysis. Differences at these sites are not always real differences between Solar Pathfinder readings and aerial interpretations but merely alignment issues regarding where one shade class ends and another begins. This information was used to recalibrate existing shade estimates as the original aerial interpretations were re-examined and revised. Existing shade data presented in this TMDL are the results of this recalibration.

Table 5. Solar Pathfinder field verification results.

Aerial Class	Pathfinder Actual	Pathfinder Class	Delta	Stream Site
50	53.5	50	0	Blue Joe, much lower
60	53.5	50	10	Blue Joe, much lower
70	62.5	60	10	Blue Joe, lower
60	47.4	40	20	Blue Joe, middle
0	8.9	0	0	Blue Joe, upper
0	53.2	50	-50	Blue Joe, upper
70	59.3	50	20	Grass, lower
50	59.3	50	0	Grass, lower
60	53.8	50	10	Grass, middle
0	4	0	0	Brush, lower
50	70.9	70	-20	Boulder
80	75	70	10	Snow
80	64.7	60	20	Trail
			2	**Average**
			19.22	**Standard deviation**
			10.45	**95% confidence interval**

5.1.2.2 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 (see 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.

Natural Bankfull Widths

Stream width must be known to calculate target shade since the width of a stream affects the amount of shade the stream receives. Bankfull 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 bankfull 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 such 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 bankfull width may not be discernible from aerial photo interpretation and may not reflect natural bankfull widths, this parameter must be estimated from available information. We used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bankfull width (Figure 16).

For each stream evaluated in the load analysis, natural bankfull width was estimated based on the drainage area of the Kootenai Basin curve from Figure 16. Although estimates from other curves were examined (i.e., Spokane, Pend Oreille, Clearwater), the Kootenai curve was ultimately chosen because of its proximity to the 37 AUs. Existing width data should also be evaluated and compared to these curve estimates if such data are available. However, for the 37 AUs, only a few Beneficial Use Reconnaissance Program (BURP) sites exist, and bankfull 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.

In general, BURP bankfull width data were found to generally agree with natural bankfull width estimates from the Kootenai Basin curve and DEQ chose not to make natural widths any smaller or larger than these Kootenai Basin estimates. Tables containing natural bankfull width estimates for each stream in this analysis are presented in Appendix B. The load analysis tables (in Appendix B) contain a natural bankfull width and an existing bankfull width for every stream segment in the analysis based on the bankfull width results presented in Tables B-2 and B-3, Appendix B. Existing widths and natural widths are the same in load tables when no data support making them differ.

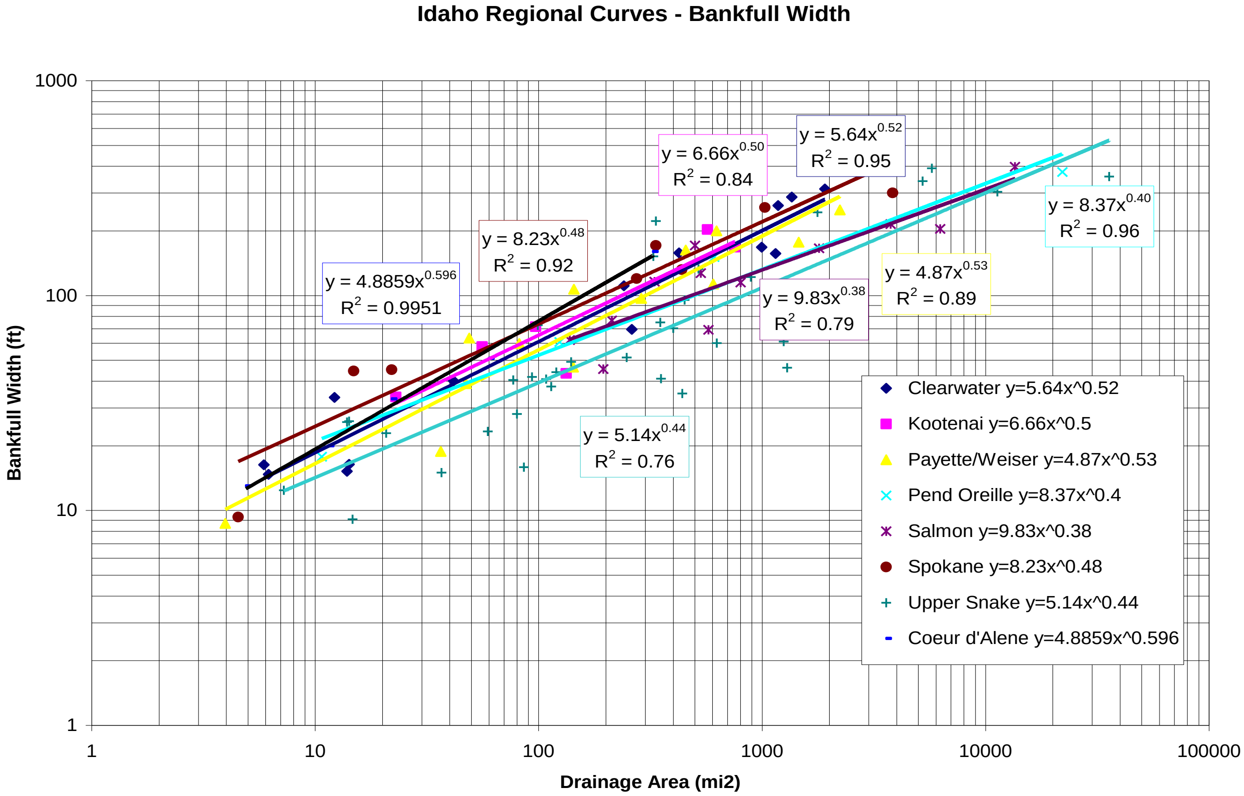

Figure 16. Bankfull width as a function of drainage area.

Design Conditions

The Lower Kootenai River subbasin and the Moyie River subbasin are located in the Northern Rockies level 3 ecoregion of McGrath et al. (2001). Within the Lower Kootenai River subbasin are four level 4 ecoregions including the Kootenai Valley, Selkirk Mountains on the west side, Purcell-Cabinet-Northern Bitterroot Mountains on the east and south sides, and High Northern Rockies at the peaks of mountain ranges. Within the Moyie River subbasin are three level 4 ecoregions including the Kootenai Valley at the mouth of the Moyie River, Purcell-Cabinet-Northern Bitterroot Mountains where the majority of the Moyie River subbasin is located, and high portions of the Northern Rockies at the peaks of mountain ranges.

The Kootenai Valley ecoregion is a broad floodplain that has been extensively leveed and farmed. It exists in the rain shadow of the nearby Selkirk Mountains, resulting in high species diversity from the combination of moist and dry habitats. The Selkirk Mountains are partly glaciated, dissected, and rugged, covered with mixed conifer forests and volcanic ash soils that result in high productivity. Both Pacific and Rocky Mountain tree species exist here and maritime influence is strong, creating wet forests. Boreal influence is also strong, resulting in lower elevation spruce-fir forests. The Purcell-Cabinet-Northern Bitterroot Mountains ecoregion includes ice-shaped terrain covered with volcanic ash and glacial deposits. Some soil instability exists where perched water tables form on till and glaciofluvial deposits. Cedar-hemlock-pine forests predominate with spruce-fir forests at higher elevations. Birch and aspen are common on floodplains and as seral species on moist uplands. The higher portions of the Northern Rockies ecoregion occurs at mountain peaks, especially in the Selkirk Range, and is characterized by a land of deep snow packs, short growing season, rock outcrops, tundra, alpine grasslands, meadows, and wetlands. Trees are scarce and found in cirques and scattered parkland and as krummholz stands.

Riparian areas are dominated by trees and all four conifer forest types (warm-dry, warm-moist, cool-moist, cool-dry) are represented. Lower gradient lowland areas can be dominated by hardwood species. In a few locations, especially along Meadow Creek in the Moyie River subbasin and Curley and Fall Creeks in the Lower Kootenai River subbasin, black hawthorn shrubs dominate the meadow riparian area.

Shade Curve Selection

To determine PNV shade targets for the streams in this analysis, effective shade curves from the Kaniksu National Forest Group and the Hardwood "Non-forest" Group (Shumar and De Varona 2009) were examined and selected (Table 6). The Palouse hawthorn shade curve developed specifically for black hawthorn–dominated meadows of the Palouse region of northern Idaho was applied to specific meadows where that plant community has been identified in the subbasins. The graminoid curve was applied to the grass-dominated meadows identified in the Kootenai and Moyie River subbasins (Figure B-5).

The shade curves are presented in Appendix B (Figures B-1 to B-7). 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 37 AUs, curves for the most similar vegetation type were selected for shade target determinations. Forest types were selected for a given stream based on a vegetation response unit overlay from the Kaniksu National Forest. Additionally, the stream locations where the Hardwood Non-forest Group was applied depended primarily on gradient. Those portions of stream where gradients were less than 3% (Figure 17) were examined in aerial photos and determined to be suitable for hardwood-dominated riparian vegetation. Meadows on Meadow Creek, Gillon Creek, Boulder Creek, Curley Creek, and Fall Creek where black hawthorn dominates were estimated with the Palouse hawthorn type curve. The graminoid type curve was utilized for tributaries of Blue Joe Creek and Meadow Creek.

Table 6. Shade curve types for developing shade targets for the Lower Kootenai River and Moyie River subbasins.

Kaniksu National Forest Types	North Idaho Hardwood "Non-forest"
Group A—warm/dry	Group 1—deciduous/conifer mix
Group B—warm/moist	Palouse hawthorn (Hawthorn)
Group C—cool/moist	Graminoid (Meadow)
Group D—cool/dry	

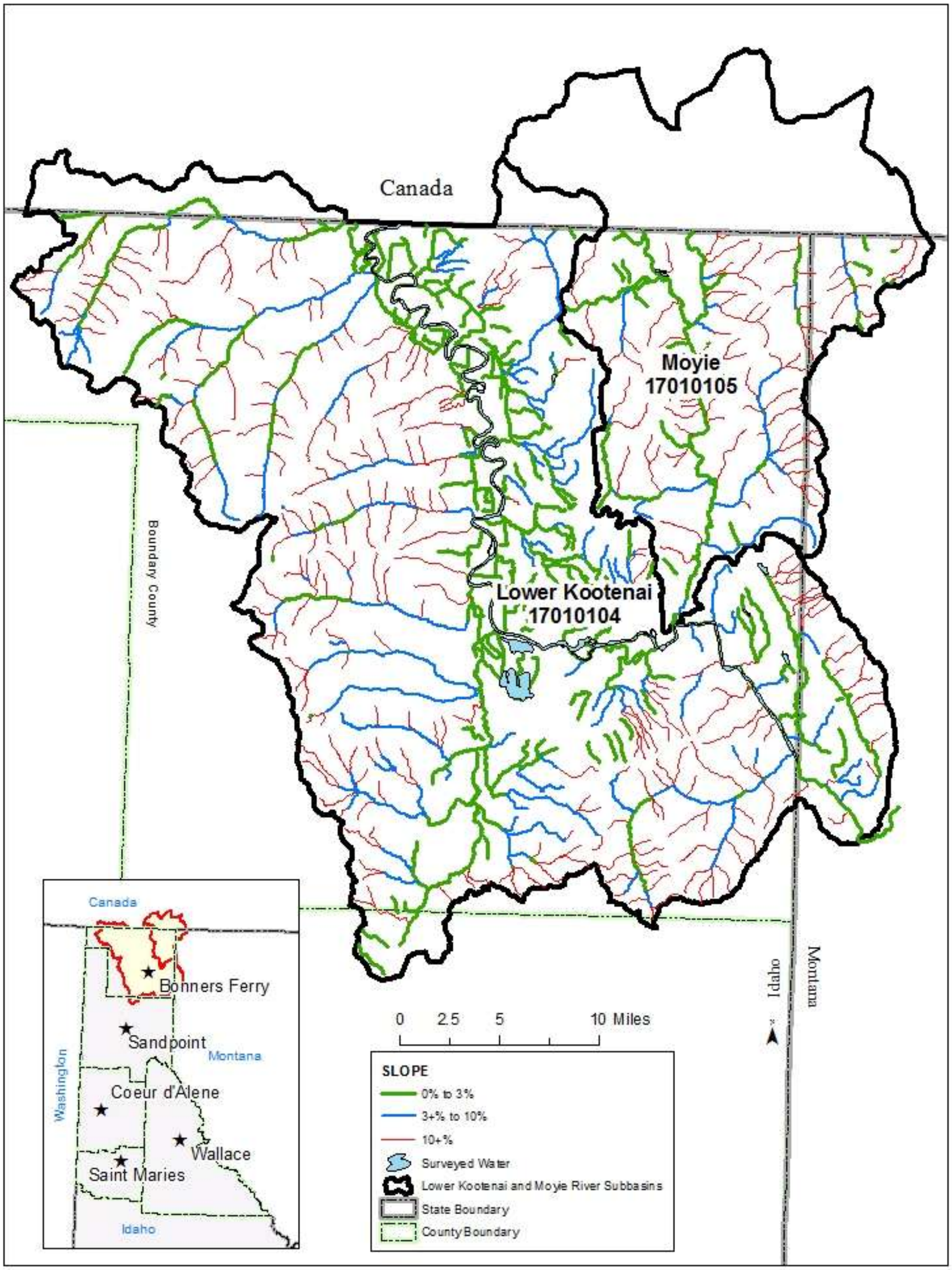

Figure 17. Stream gradients (slopes) for the Lower Kootenai and Moyie River subbasins.

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 by 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., the 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.

We obtained solar load data from flat-plate collectors at the NREL weather station in Spokane, Washington. The solar load data used in this TMDL analysis are spring/summer averages (i.e., an average load for the 6-month period from April through 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.

Tables B-4 to B-38 (Appendix B) and target shade figures within Figures B-8 to B-37 (Appendix B) show the PNV shade targets. The tables also show corresponding target summer loads (in kilowatt-hours per square meter per day [kWh/m^2/day] and 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. Because load calculations involve stream segment area calculations, the segment’s channel width, which typically only has one or two significant figures, dictates the level of significance of the corresponding loads. One significant figure in the resulting load can create rounding errors when existing and target loads are subtracted. The totals row of each load table represents total loads with two significant figures in an attempt to reduce apparent rounding errors.

The AU with the largest target load (i.e., load capacity) was Smith Creek (AU# ID17010104PN005_04) with 530,000 kWh/day (Table 7). The smallest target load was in the Grass Creek AU (AU# ID17010104PN003_02) with 1,400 kWh/day (Table 7).

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(I)). 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. No permitted point sources exist 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 station. Existing shade data are presented in Tables B-4 to B-38 and within Figures B-8 through B-37 (Appendix B). Like load capacities (target loads), existing loads in Tables B-4 to B-38 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. Should existing load exceed target load, this difference becomes the excess load (i.e., lack of shade) to be discussed next in the load allocation section and as depicted in the lack-of-shade figures (within Figures B-8 to B-37).

The AU with the largest existing load was Smith Creek (AU# ID17010104PN005_04) with 1,200,000 kWh/day (Table 7). The smallest existing load was in the Miller Creek AU (AU# ID17010105PN011_02) with 7,800 kWh/day (Table 8).

5.4 Load and Wasteload Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve natural 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 dependent on the target load for a given segment. Tables B-4 to B-38 show the target shade and corresponding target summer load. This target load (i.e., load capacity) is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL is dependent upon 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 7 and Table 8 show the total existing, target, and excess loads and the average lack of shade for each water body examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths. The percentage of the total existing load that is in excess is also listed in the excess load column. This percentage is analogous to a percent load reduction necessary to meet TMDL targets.

Although this TMDL analysis focuses on total solar loads, it is important to note that differences between existing and target shade, as depicted in the lack-of-shade figures (within Figures B-8 to B-37), 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 in Appendix B contains a column that lists the lack of shade on the stream segment. This value is derived by 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 calculated from the column in each load analysis table is also listed in Table 7 and Table 8 and provides a general level of comparison among streams.

Table 7. Total solar loads and average lack of shade for all waters in the Lower Kootenai River subbasin.

Water Body/ Assessment Unit	Total Existing Load (kWh/day)	Total Target Load (kWh/day)	Excess Load (% of Total Existing) (kWh/day)	Average Lack of Shade (%)
Boulder Creek (ID17010104PN033_03 and ID17010104PN032_03)	**1,600,000**	**500,000**	**1,100,000 (69%)**	**-30**
ID17010104PN033_03	1,000,000	240,000	800,000	-32
ID17010104PN032_03	550,000	260,000	290,000	-26
Smith Creek (ID17010104PN007_03 and ID17010104PN005_04) and Cow Creek (ID17010104PN006_03)	**1,700,000**	**680,000**	**1,000,000 (59%)**	**-24**
ID17010104PN007_03	430,000	120,000	310,000	-30
ID17010104PN005_04	1,200,000	530,000	690,000	-21
ID17010104PN006_03	74,000	36,000	37,000	-6
Mission Creek (ID17010104PN040_03 and ID17010104PN038_03)	**510,000**	**330,000**	**180,000 (35%)**	**-23**
ID17010104PN040_03	250,000	240,000	13,000	-19
ID17010104PN038_03	260,000	96,000	160,000	-44
Cascade Creek (ID17010104PN014_02) and Myrtle Creek (ID17010104PN013_03)	**490,000**	**330,000**	**160,000 (33%)**	**-17**
ID17010104PN014_02	12,000	4,300	7,500	-19
ID17010104PN013_03	480,000	320,000	160,000	-17
Blue Joe Creek (ID17010104PN004_02)	**190,000**	**51,000**	**140,000 (74%)**	**-25**
Grass Creek (ID17010104PN003_02 and _03)	**220,000**	**100,000**	**120,000 (55%)**	**-21**
ID17010104PN003_02	13,000	1,400	12,000	-20
ID17010104PN003_03	210,000	98,000	110,000	-21
Long Canyon Creek (ID17010104PN008_02)	**320,000**	**200,000**	**120,000 (38%)**	**-12**
Ball Creek (ID17010104PN011_02 and _02a)	**240,000**	**140,000**	**100,000 (42%)**	**-14**
ID17010104PN011_02	160,000	110,000	50,000	-12
ID17010104PN011_02a	80,000	29,000	52,000	-28
Fall Creek (ID17010104PN021_03)	**320,000**	**300,000**	**26,000 (8%)**	**-8**
Curley Creek (ID17010104PN035_03)	**110,000**	**58,000**	**54,000 (49%)**	**-27**
Snow Creek (ID17010104PN016_03)	**130,000**	**60,000**	**67,000 (52%)**	**-10**
Brush Creek (ID17010104PN039_02)	**120,000**	**54,000**	**61,000 (51%)**	**-22**
Rock Creek (ID17010104PN037_03)	**60,000**	**12,000**	**53,000 (88%)**	**-45**
Cow Creek (ID17010104PN030_03)	**80,000**	**27,000**	**50,000 (63%)**	**-52**
Grass Creek Tributaries (ID17010104PN003_02)	**54,000**	**8,000**	**46,000 (85%)**	**-15**

Water Body/ Assessment Unit	Total Existing Load	Total Target Load	Excess Load (% of Total Existing)	Average Lack of Shade (%)
	(kWh/day)			
Trail Creek (ID17010104PN026_03)	**68,000**	**33,000**	**39,000 (57%)**	**-17**
Ball Creek Tributaries (ID17010104PN011_02)	**35,000**	**7,900**	**28,000 (80%)**	**-10**
Caribou Creek (ID17010104PN017_02)	**65,000**	**37,000**	**28,000 (43%)**	**-18**
Trout Creek (ID17010104PN010_03)	**66,000**	**37,000**	**28,000 (42%)**	**-5**
Bane and Fleming Creeks (ID17010104PN036_03)	**58,000**	**29,000**	**27,000 (47%)**	**-24**
Long Canyon Creek Tributaries (ID17010104PN008_02)	**22,000**	**5,400**	**18,000 (82%)**	**-8**
Ruby Creek (ID17010104PN020_03)	**62,000**	**48,000**	**14,000 (23%)**	**-9**
Blue Joe Creek Tributaries (ID17010104PN004_02)	**15,000**	**5,000**	**10,000 (67%)**	**-11**

Note: Load data are rounded to two significant figures, which may present rounding errors.

Table 8. Total solar loads and average lack of shade for all waters in the Moyie River subbasin.

Water Body/ Assessment Unit	Total Existing Load	Total Target Load	Excess Load (% of Total Existing)	Average Lack of Shade (%)
	(kWh/day)			
Deer Creek watershed (ID17010105PN004_02 and 03)	**270,000**	**150,000**	**130,000 (48%)**	**-11**
Deer Creek (ID17010105PN004_02)	29,000	10,000	18,000 (64%)	-10
Deer Creek (ID17010105PN004_03)	190,000	130,000	72,000 (37%)	-16
Deer Creek tributaries (ID17010105PN004_02)	54,000	14,000	40,000 (74%)	-8
Round Prairie Creek (ID17010105PN010_03)	**180,000**	**91,000**	**82,000 (46%)**	**-36**
Canuck Creek watershed (ID17010105PN007_02)	**78,000**	**27,000**	**51,000 (65%)**	**-11**
Named and unnamed tributaries (ID17010105PN006_02)	**56,000**	**15,000**	**43,000 (77%)**	**-15**
Gillon Creek watershed (ID17010105PN009_02)	**59,000**	**23,000**	**38,000 (64%)**	**-9**
Gillon Creek (ID17010105PN009_02)	55,000	22,000	35,000 (64%)	-10
Harvey Creek (ID17010105PN009_02)	4,400	1,300	3,000 (68%)	-8
Skin Creek (ID17010105PN003_02)	**48,000**	**15,000**	**33,000 (69%)**	**-24**
Named and unnamed tributaries (ID17010105PN002_02)	**17,000**	**4,500**	**13,000 (76%)**	**-12**
Miller Creek (ID17010105PN011_02)	**7,800**	**1,500**	**7,100 (91%)**	**-11**
Meadow Creek watershed (ID17010105PN012_02)	**310,000**	**300,000**	**10,000 (3%)**	**-9**
Meadow Creek (ID17010105PN012_02)	270,000	280,000	0 (0%)	-8
Meadow Creek tributaries (ID17010105PN012_02)	41,000	20,000	20,000 (49%)	-11

Note: Load data are rounded to two significant figures, which may present rounding errors.

All Lower Kootenai River subbasin AUs lack shade and have excess loads, most representing considerable proportions of existing loads (Table 7). The Boulder Creek and Smith Creek AUs have the largest excess loads (near one million kWh/day), whereas some of the smaller AUs (Ruby, Bane and Fleming, and Trout Creeks) have low excess loads by comparison. Some watersheds (e.g., Blue Joe Creek and Grass Creek) have separate load analyses for their main stems versus their tributaries, although both may be in the same AU. For example, the main stem portion of the Blue Joe Creek AU (ID17010104PN004_02) has an excess load of 140,000 kWh/day that is 74% of its total existing load. The tributaries to Blue Joe Creek are within the same AU but their loads were analyzed separately. The excess load for the tributaries was 10,000 kWh/day, or 67% of their total existing load. Fall Creek (AU# ID17010104PN021_03) appears to be in the best condition with only an 8% reduction in solar load needed to achieve target loads.

Excess loads are difficult to evaluate and use for comparison purposes because they vary so much with the width of the stream and the size of the AU. The figures in Appendix B that show shade deficits (lack of shade) are more useful for visually interpreting where problems may occur. In these figures, differences between existing and target shade greater than 20% are considered outside of normal reference conditions as determined by the Idaho Panhandle National Forests (Brandon Glaza, hydrologist Bonners Ferry Ranger District, pers. comm.).

- Figure B-10 shows shade deficits for Blue Joe and Grass Creeks. Many of the tributaries to these two streams are within reference conditions, whereas their main stems lack between 20% and 47% shade in some sections.
- Figure B-13 shows that Fleming Creek (Bane Creek area) and Myrtle Creek lack considerable shade at their lower ends. These AUs tend to be in the lower elevation valleys subject to land use activities such as agriculture. The same is likely true for lower Rock Creek in Figure B-19.
- Mission/Brush Creeks have small shade deficit locations in their middle and upper reaches (Figure B-19).
- In contrast, Figure B-16 shows larger shade deficits in the upper sections of Boulder Creek as well as lower sections. These shade deficits in forested systems seem to be more related to hydraulic conditions that affect channel width and near-stream shade. Channel widths in Boulder Creek appear to be substantially larger than what is predicted by regional hydrology curves (Table B-9).
- Figure B-22 shows very small patches of shade deficit in Ruby, Fall, and Trail Creeks.
- Figure B-25 shows many higher quality streams such as Long Canyon, Trout, and Ball Creeks that are in contrast to deficits seen in Smith Creek.

All AUs in the Moyie River subbasin lack shade, and most have excess loads that represent substantial portions of their existing solar loads (Table 8). The Deer Creek watershed had the largest combined excess load of 130,000 kWh/day from the addition of both the 2nd- and 3rd-order AUs. The largest excess load for a single AU is found in the 3rd-order unit of Round Prairie Creek. The Miller Creek AU had the smallest excess load at 7,100 kWh/day; however, that excess load represented 91% of its existing load. Rounding errors affected these small loads more so than large loads. The Miller Creek AU likely has an excess load that is somewhere between 6,000 and 7,000 kWh/day. The Meadow Creek AU appears to be in the best condition overall as compared to the other AUs in the Moyie River subbasin. The Meadow Creek AU excess load of 10,000 kWh/day was only 3% of its total existing load. Thus, load reductions to meet targets in the Meadow Creek watershed are only 3% compared to the 37%–91% for the other AUs in the analysis. The main stem of Meadow Creek, with its hawthorn-dominated meadows, did not have an excess load.

A certain amount of excess load is potentially created by the existing shade/target shade difference 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, say a particular stream segment has a target shade of 86% based on its vegetation type and natural bankfull 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% existing shade class. There is an automatic difference of 6%, which could be attributed to the margin of safety.

5.4.1 Water Diversion

Stream temperature may be affected by diversions of water for water rights purposes. Diversion of flow 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. Loss of flow 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 Clean Water Act 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, Idaho water quality standards indicate 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… (IDAPA 58.01.02.050.01)

In this TMDL, we have not quantified what impact, if any, diversions are having 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 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.

5.4.3 Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to be inclusive of the 6-month period from April through September. This time period is when the combination of increasing air and water temperatures coincide 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.

5.4.4 Construction Stormwater and TMDL Wasteload Allocation

There are no known National Pollutant Discharge Elimination System (NPDES) permitted point sources in the affected watersheds and thus no wasteload allocations. Should a point source be proposed that would have thermal consequences on these waters, background provisions in Idaho water quality standards addressing such discharges (IDAPA 58.01.02.200.09; IDAPA 58.01.02.401.01) should be involved (see Appendix A).

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).

5.4.4.1 Municipal Separate Storm Sewer Systems

Polluted stormwater runoff is commonly transported through MS4s, from which it is often discharged untreated into local water bodies. An MS4, according to (40 CFR 122.26(b)(8)), is a conveyance or system of conveyances that meets the following criteria:

- Owned by a state, city, town, village, or other public entity that discharges to waters of the U.S.
- Designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.)
- Not a combined sewer
- Not part of a publicly owned treatment works (sewage treatment plant)

To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain an NPDES permit from EPA, implement a comprehensive municipal stormwater management program (SWMP), and use best management practices (BMPs) to control pollutants in stormwater discharges to the maximum extent practicable.

5.4.4.2 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.

5.4.4.3 Construction Stormwater

The Clean Water Act 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.

5.5 Implementation Strategies

Implementation strategies for TMDLs produced using PNV-based shade and solar loads should incorporate the load analysis tables presented in this TMDL (Tables B-4 to B-38). 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. There may be a variety of reasons that 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). It is important that existing shade for each stream segment 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 in Appendix B) should be used to guide and prioritize implementation investigations. 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 is dependent on mature riparian communities to substantially improve stream temperatures, DEQ believes 10–20 years may be a reasonable amount of time for achieving water quality standards. Shade targets will not be achieved all at once. Given their smaller bankfull widths, targets for smaller streams may be reached sooner than those for larger streams.

DEQ and the designated watershed advisory group (WAG) will continue to re-evaluate 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 Responsible Parties

In addition to the designated management agencies, the public, through the WAG and other equivalent processes or organizations, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent practical.

5.5.3 Implementation Monitoring Strategy

Effective shade monitoring can take place on any segment throughout the 26s AU in the Lower Kootenai River subbasin and 11 AUs in the Moyie River subbasin and be compared to existing shade estimates seen within Figures B-8 to B-37 and described in Tables B-4 to B-38. 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.

6 Conclusions

Effective shade targets were established for 26 AUs in the Lower Kootenai River subbasin and 11 AUs in the Moyie River subbasin 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's water quality standards (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Table 9 and Table 10.

In the Lower Kootenai River subbasin, 4 AUs previously listed for temperature pollution were found through stressor identification likely to be affected by pollutants other than temperature. These AUs will require additional monitoring and investigation. All Lower Kootenai River subbasin AUs in this analysis lack shade to some degree, although many reaches meet reference conditions (i.e., have shade deficits less than 20%). Lowland streams affected by agricultural land uses (i.e., Cow, lower Fleming, Rock, and Curley Creeks) tend to be the most affected. Some forested systems (Boulder and Smith Creeks) have substantial hydrologic effects that widen streams and lower near-stream shade quality. Fall Creek appears to be in the best condition of those streams examined in the Lower Kootenai River subbasin.

In the Moyie River subbasin, all AUs lack shade and most require substantial reductions in excess loads to meet targets. The Meadow Creek watershed appears to be in the best condition overall with respect to shade; whereas Deer Creek, Round Prairie Creek, and others have larger patches of shade deficits.

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 9. Summary of assessment outcomes for §303(d)-listed assessment units.

Water Body	Assessment Unit Number	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Lower Kootenai River Subbasin					
Ball Creek	ID17010104PN011_02 ID17010104PN011_02a	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Blue Joe Creek	ID17010104PN004_02	Temperature			
Boulder Creek	ID17010104PN032_03	Temperature			
Caribou Creek	ID17010104PN017_02	Temperature			
Curley Creek	ID17010104PN035_03	Temperature			
Dodge Creek	ID17010104PN024_03	Temperature	No	none: additional monitoring	Stressor identification found other pollutant
Fall Creek	ID17010104PN021_03	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Fleming Creek	ID17010104PN036_03	Temperature			
Grass Creek	ID17010104PN003_02 ID17010104PN003_03	Temperature			
Kootenai River Tributaries	ID17010104PN001_02	Temperature	No	none: additional monitoring	Stressor identification found other pollutant
Long Canyon Creek	ID17010104PN008_02	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Mission Creek	ID17010104PN038_03 ID17010104PN040_03	Temperature			
Myrtle Creek	ID17010104PN014_02 ID17010104PN013_03	Temperature			
Rock Creek	ID17010104PN037_03	Temperature			
Ruby Creek	ID17010104PN020_03	Temperature			
Smith Creek	ID17010104PN006_03 ID17010104PN007_03 ID17010104PN005_04	Temperature			
Snow Creek	ID17010104PN016_03	Temperature			
Trail Creek	ID17010104PN026_03	Temperature			
Trout Creek	ID17010104PN010_03	Temperature			
	ID17010104PN010_03a	Temperature	No	nonte: additional monitoring	Stressor identification found other pollutant
Twentymile Creek	ID17010104PN027_03	Temperature			
Moyie River Subbasin					
Canuck Creek	ID17010105PN007_02	Temperature	Yes	Move to Category 4a	Excess solar load from a lack of existing shade
Deer Creek	ID17010105PN004_02 ID17010105PN004_03	Temperature			
Gillon and Harvey Creeks	ID17010105PN009_02	Temperature			
Miller Creek	ID17010105PN011_02	Temperature			
Meadow Creek	ID17010105PN012_02 ID17010105PN012_03	Temperature			
Moyie River Tributaries	ID17010105PN002_02 ID17010105PN006_02	Temperature			
Round Prairie Creek	ID17010105PN010_03	Temperature			
Skin Creek	ID17010105PN003_02	Temperature			

Table 10. Summary of assessment outcomes for unlisted but impaired assessment units.

Water Body	Assessment Unit Number	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Boulder Creek	ID17010104PN033_03	Temperature	Yes	List for temperature and move to Category 4a	Excess solar load from a lack of existing shade
Brush Creek	ID17010104PN039_02	Temperature	Yes		
Cow Creek	ID17010104PN030_03	Temperature	Yes		

This document was developed with extensive participation by the KVRI TMDL committee with oversight by the KVRI, which serves as the WAG.

DEQ has complied with the WAG consultation requirements set forth in Idaho Code §39-3611. DEQ has provided the WAG with all available information concerning applicable water quality standards, water quality data, monitoring, assessments, reports, procedures, and schedules.

DEQ utilized the knowledge, expertise, experience, and information of the WAG in developing this TMDL. DEQ also provided the WAG with an adequate opportunity to participate in drafting the TMDL and suggest revisions.

The general public will have the opportunity to comment on this draft document during the public comment period. In the final version of this addendum, a distribution list and summary of public comments will be included as Appendices F and G, respectively.

References Cited

Armantrout, N.B., compiler. 1998. *Glossary of Aquatic Habitat Inventory Terminology*. Bethesda, MD: American Fisheries Society.

CFR (Code of Federal Regulation). 1983. "Water Quality Standards." 40 CFR 131.

CFR (Code of Federal Regulation). 1995. "Water Quality Planning and Management." 40 CFR 130.

DEQ (Idaho Department of Environmental Quality). 2005. *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties*. Boise, ID: DEQ. Available at: *http://www.deq.idaho.gov/water-quality/wastewater/stormwater.aspx*.

DEQ (Idaho Department of Environmental Quality). 2011. *Idaho's 2010 Integrated Report*. Boise, ID: DEQ. Available at: *http://www.deq.idaho.gov/water-quality/surface-water/monitoring-assessment/integrated-report.aspx*.

EPA (US Environmental Protection Agency). 1996. *Biological Criteria: Technical Guidance for Streams and Small Rivers*. Washington DC: EPA, Office of Water. EPA 822-B-96-001.

Essig, D. and M.A. Kosterman. 2008. *Arsenic, Mercury, and Selenium in Fish Tissue from Idaho Lakes and Reservoirs: A Statewide Assessment*. Boise, ID: Idaho Department of Environmental Quality.

Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. *Water Body Assessment Guidance,* 2nd ed. Boise, ID: Department of Environmental Quality. 114 p.

Idaho Code. 2012. "Development and Implementation of Total Maximum Daily Load or Equivalent Processes." Idaho Code 39-3611.

IDAPA. 2012. "Idaho Water Quality Standards." Idaho Administrative Code. IDAPA 58.01.02.

IDL (Idaho Department of Lands). 2000. *Forest Practices Cumulative Watershed Effects Process for Idaho*. Boise, ID: IDL.

KTOI, DEQ, and EPA (Kootenai Tribe of Idaho, Idaho Department of Environmental Quality, and US Environmental Protection Agency). 2006. *Assessment of Water Quality in Kootenai River and Moyie River Subbasins (TMDL)*. Coeur d'Alene, ID: DEQ. Available at *http://www.deq.idaho.gov/water-quality/surface-water/tmdls/table-of-sbas-tmdls/kootenai-and-moyie-rivers-subbasins.aspx*.

KTOI, DEQ, and EPA (Kootenai Tribe of Idaho, Idaho Department of Environmental Quality, and US Environmental Protection Agency). 2005. *Draft Kootenai River Total Maximum Daily Load Implementation Plan*. Available at *http://www.deq.idaho.gov/water-quality/surface-water/tmdls/table-of-sbas-tmdls/kootenai-and-moyie-rivers-subbasins.aspx*.

Küchler, A.U. 1964. “Potential Natural Vegetation of the Conterminous United States.” American Geographical Society Special Publication 36.

McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher. 2001. “Ecoregions of Idaho.” Reston, VA: US Geological Survey.

OWEB (Oregon Watershed Enhancement Board). 2001. “Stream Shade and Canopy Cover Monitoring Methods.” In *Water Quality Monitoring Technical Guide Book*, chap. 14. Salem, OR: OWEB.

Poole, G.C. and C.H. Berman. 2001. “An Ecological Perspective on In-Stream Temperature: Natural Heat Dynamics and Mechanisms of Human-Caused Thermal Degradation.” *Environmental Management* 27(6):787–802.

Shumar, M.L. and J. De Varona. 2009. *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual*. Boise, ID: Idaho Department of Environmental Quality.

Strahler, A.N. 1957. “Quantitative Analysis of Watershed Geomorphology.” *Transactions American Geophysical Union* 38:913–920.

US Congress. 1972. Clean Water Act (Federal Water Pollution Control Act). 33 USC §1251–1387.

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.

Ambient

General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996).

Anthropogenic

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

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.

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.

Exceedance

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

Fully Supporting

In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

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 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.

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 discernable 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.

Not Fully Supporting

Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

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.

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.

Riparian

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

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.

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.

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 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 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.

Appendix A. 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 (including westslope cutthroat trout), the default spawning and incubation period recognized by the Idaho Department of Environmental Quality (DEQ) is generally from March 15 to July 1 each year (Grafe et al. 2002). The Coeur d'Alene Regional Office further divided the general spawning and incubation windows with assistance from the Idaho Department of Fish and Game to better reflect and protect salmonid spawning and incubation in north Idaho. The adjusted spawning and incubation windows account for differences in elevation, a watershed characteristic not accounted for originally (Table A-1). Fall spawning can occur as early as August 15 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 the specified time period:

- 13 °C as a maximum daily maximum water temperature

DEQ recently changed the water quality standards with removal of the salmonid spawning 9 °C maximum daily average temperature criterion. This change was adopted by the Idaho Legislature in 2012.

The cold water aquatic life beneficial use, of which salmonid spawning is a subset, identifies water temperatures intended to protect and maintain a viable community for coldwater fish species and for other coldwater species (IDAPA 58.01.02.250.02.b). As per IDAPA 58.01.02.250.02.b., the following water quality criteria need to be met for cold water aquatic life:

- 22 °C maximum daily maximum water temperature
- 19 °C maximum daily average water temperature

Bull Trout (*Salvelinus confluentus*) is listed as a threatened species by the US Fish and Wildlife Service. To protect the species in Idaho, a recovery plan was developed by the state in which water temperature criteria were set to protect the threatened species (IDAPA 58.01.02.250.02.g). The US Environmental Protection Agency (EPA) also promulgated bull trout water quality temperature criteria (40 CFR 131.33). State and federal temperature criteria are summarized in Table A-1.

The cold water aquatic life criteria is not discussed further in this section because where the cold water aquatic life beneficial use criteria apply, the salmonid spawning criteria also apply and are more protective (i.e., require a lower temperature). When temperature data exceed the more protective criteria (salmonid spawning), the water body is identified as impaired by temperature regardless of whether it fails the cold water aquatic life criteria also.

Table A-1. State and federal water temperature standards applicable in the Lower Kootenai and Moyie River subbasins.

Type	Location	Criteria	Dates	
Cold Water Aquatic Life	Applies to the entire Lower Kootenai and Moyie River subbasins	22 ºC (71.6 ºF) Maximum Daily Maximum Temperature 19 ºC (66.2 ºF) Maximum Daily Average Temperature	Applies entire year	
Salmonid Spawning	Applies to the entire Lower Kootenai and Moyie River subbasins where beneficial use is designated or existing	13 ºC (55.4 ºF) Maximum Daily Maximum Temperature 9 ºC (48.2 ºF) Maximum Daily Average Temperature	Spring Spawning >4,000 ft Jun 1–July 31 3,000–4,000 ft May 15–July 15 <3,000 ft May 1–July 1	Fall Spawning Aug 15–Nov 15
Idaho Bull Trout Criteria[a]	Applies to the entire Lower Kootenai and Moyie River subbasins	13 ºC (55.4 ºF) Maximum Weekly Maximum Temperature	Rearing Jun 1–Aug 31	NA
		9 ºC (48.2 ºF) Maximum Daily Average Temperature	NA	Spawning Sep 1–Oct 31
US Environmental Protection Agency Bull Trout Criteria	Lower Kootenai River Subbasin: Ball Creek, Boundary Creek, Brush Creek, Cabin Creek, Caribou Creek, Cascade Creek, Cooks Creek, Cow Creek, Curley Creek, Deep Creek, Grass Creek, Jim Creek, Lime Creek, Long Canyon Creek, Mack Creek, Mission Creek, Myrtle Creek, Peak Creek, Snow Creek, Trout Creek Moyie River Subbasin: Brass Creek, Bussard Creek, Copper Creek, Deer Creek, Faro Creek, Keno Creek, Kreist Creek, Line Creek, McDougal Creek, Mill Creek, Moyie River (above Skin Creek), Placer Creek, Rutledge Creek, Skin Creek, Spruce Creek, West Branch Deer Creek	10 ºC (50 ºF) Maximum Weekly Maximum Temperature	Jun 1–Sep 30	

[a] Current Idaho temperature criteria for bull trout have not been approved or disapproved by the US Environmental Protection Agency.

Natural Background Provisions

For potential natural vegetation temperature total maximum daily loads, it is assumed that natural temperatures may exceed these numeric 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's 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).

Minor Exceedances of Water Quality Standards for Temperature

DEQ allows for minor exceedances of water quality temperature criteria when the exceedance occurs less than 10% of the critical time period and no other evidence of thermal inputs exists (Grafe et al. 2002). Exceptions are also made for water temperature exceedances that occur during periods when air temperatures exceed the 90th percentile of air temperatures recorded in the area (Grafe et al. 2002).

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Appendix B. Data Sources, Bankfull Width Estimates, Target Shade Curves, Load Analysis Tables, and Shade Figures

Data Sources

Table B-1. Data sources for the Lower Kootenai River and Moyie River subbasins TMDL.

Water Body	Data Source	Type of Data	Collection Date
Blue Joe, Grass, Brush, Boulder, Snow, Trail	DEQ Coeur d'Alene Regional Office	Solar Pathfinder effective shade and stream width	Summer/Fall 2011
All 37 AU in analysis	DEQ State Technical Services Office	Aerial photo interpretation of existing shade and stream width estimation	Summer/Fall 2011

Bankfull Width Estimates

Table B-2. Bankfull width estimates from regional curves for various stream locations in the Lower Kootenai River subbasin.

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	Field measure in meters (year)
Blue Joe Creek @ border	10.61	8	7	7	6	
Blue Joe Creek bl 2nd tributary	5.06	5	5	5	4	
Blue Joe Creek ab 1st tributary	1.58	3	3	3	2	
1st tributary to Blue Joe Creek	1.29	3	2	3	2	
2nd tributary to Blue Joe Creek	1.17	3	2	3	2	
3rd tributary to Blue Joe Creek	0.6	2	2	2	1	
4th tributary to Blue Joe Creek	0.7	2	2	2	1	
5th tributary to Blue Joe Creek	0.52	2	1	2	1	
Bog Creek	1.18	3	2	3	2	
Grass Creek @ border	27.42	12	11	10	10	14.7(98), 19(04)
Grass Creek bl 4th tributary	7.32	7	5	6	5	8.0 ab 4th(98)
Grass Creek ab 1st tributary	0.94	2	2	2	2	
1st tributary to Grass Creek	1.92	3	3	3	2	
2nd tributary to Grass Creek	1.86	3	3	3	2	3.2(01)
3rd tributary to Grass Creek	0.79	2	2	2	2	
4th tributary to Grass Creek	1.1	3	2	3	2	
tributary to 4th tributary	0.34	1	1	2	1	
5th tributary to Grass Creek	0.27	1	1	2	1	
6th tributary to Grass Creek	0.32	1	1	2	1	
Search Creek @ mouth	1.96	3	3	3	2	
8th tributary to Grass Creek	0.35	2	1	2	1	
9th tributary to Grass Creek	1.25	3	2	3	2	
10th tributary to Grass Creek	0.31	1	1	2	1	
Marsh Creek @ mouth	2.04	4	3	3	2	
12th tributary to Grass Creek	1.55	3	3	3	2	
13th tributary to Grass Creek	0.48	2	1	2	1	
14th tributary to Grass Creek	0.71	2	2	2	1	
Silver Creek @ mouth	2.16	4	3	3	3	
Smith Creek @ mouth	71.6	19	17	14	16	
Smith Creek bl Cow Creek	56	17	15	13	14	22.7(94)
Smith Creek ab Cow Creek	34	14	12	10	11	
Smith Creek bl West Fork	20.1	11	9	8	8	14.7(98)
Cow Creek @ mouth	22	11	10	9	9	12.8(06), 17.2(01)
Cow Creek bl Beaver Creek	18.6	10	9	8	8	
Long Canyon Creek @ mouth	30.1	13	11	10	10	14.2(94), 13.1(01), 9.9(07), 16.2(08)
Long Canyon Cr bl Parker Lake trib	18.4	10	9	8	8	
Long Canyon Cr bl Smith Lake trib	11.2	8	7	7	6	
Long Canyon Cr ab 1st tributary	3.43	5	4	4	3	
1st tributary to Long Canyon Cr	0.5	2	1	2	1	
2nd tributary to Long Canyon Cr	1.21	3	2	3	2	
3rd tributary to Long Canyon Cr	0.23	1	1	1	1	
Smith Lake trib to Long Canyon Cr	1.61	3	3	3	2	
5th tributary to Long Canyon Cr	0.28	1	1	2	1	
6th tributary to Long Canyon Cr	0.38	2	1	2	1	
7th tributary to Long Canyon Cr	0.28	1	1	2	1	
Parker Lake trib to Long Canyon Cr	1.84	3	3	3	2	
Canyon Lake trib to Long Canyon Cr	0.41	2	1	2	1	
10th tributary to Long Canyon Cr	1.34	3	2	3	2	
11th tributary to Long Canyon Cr	0.61	2	2	2	1	
12th tributary to Long Canyon Cr	0.42	2	1	2	1	
Trout Creek @ canyon mouth	19.5	10	9	8	8	
Trout Creek ab Ham Creek (AU 03)	9.9	8	6	6	6	11.5(01), 8.5 bl Ham(98)
Ball Creek @ mouth	26.8	12	11	10	10	8.7(98), 13.6(01)
Ball Creek bl Scotch Creek	23	11	10	9	9	
Ball Creek bl Swede Creek	19.7	10	9	8	8	
Ball Creek bl French Creek	11	8	7	7	6	
Ball Creek ab Finn Creek	2.76	4	3	4	3	
Finn Creek @ mouth	0.62	2	2	2	1	
Spanish Creek @ mouth	1.27	3	2	3	2	
Dutch Creek @ mouth	0.93	2	2	2	2	

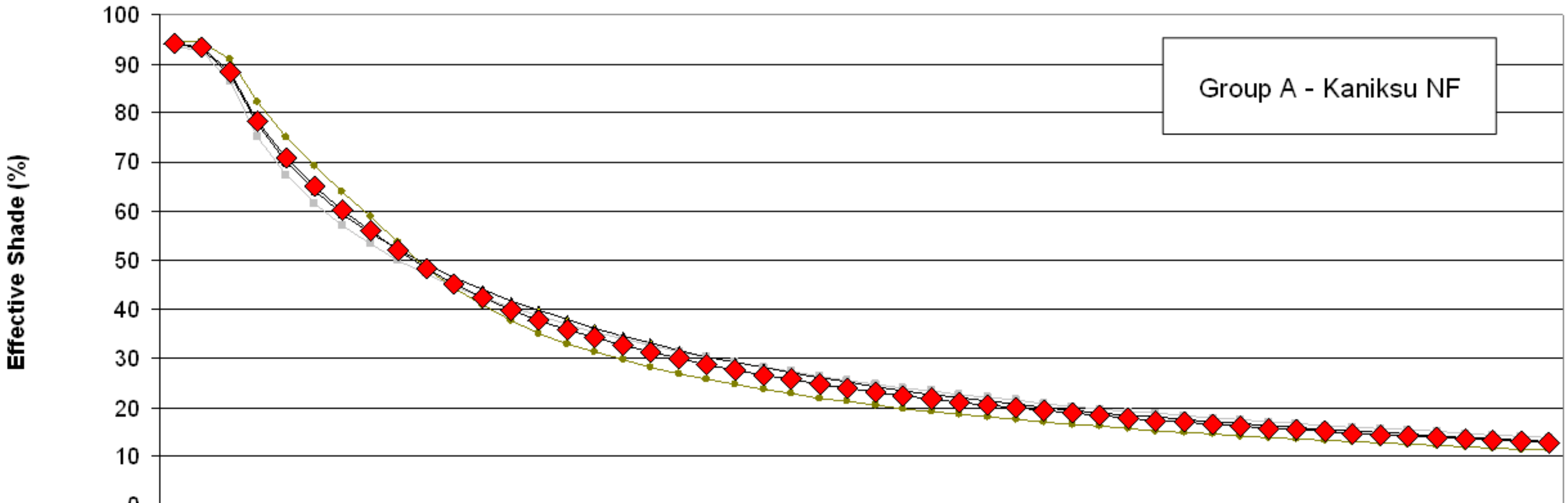
Table B-2 (cont.). Bankfull width estimates from regional curves for various stream locations in the Lower Kootenai River subbasin.

4th tributary to Ball Creek	0.4	2	1	2	1	
5th tributary to Ball Creek	0.46	2	1	2	1	
6th tributary to Ball Creek	0.62	2	2	2	1	
French Creek @ mouth	1.19	3	2	3	2	
8th tributary to Ball Creek	0.64	2	2	2	1	
Swiss Creek @ mouth	1.74	3	3	3	2	
English Creek @ mouth	0.55	2	2	2	1	
11th tributary to Ball Creek	0.64	2	2	2	1	
Swede Creek @ mouth	1.12	3	2	3	2	
13th tributary to Ball Creek	0.31	1	1	2	1	
14th tributary to Ball Creek	0.69	2	2	2	1	
Scotch Creek @ mouth	0.94	2	2	2	2	
16th tributary to Ball Creek	0.43	2	1	2	1	
17th tributary to Ball Creek	0.4	2	1	2	1	
Myrtle Creek @ mouth	43.6	15	13	12	12	
Myrtle Creek @ canyon mouth	36.9	14	12	11	11	12.7(94), 11.5(02)
Myrtle Creek ab Yellow Pine Cr	31.5	13	11	10	10	
Myrtle Creek @ 3890ft	16.2	10	8	8	7	
Myrtle Creek bl Toot Creek (AU 03)	10.9	8	7	7	6	
Cascade Creek @ mouth	3.9	5	4	4	3	4.3(98)
Caribou Creek @ mouth	13.4	9	7	7	7	9.6(01), 7.5(94)
Caribou Creek @ 3040ft	10.2	8	6	6	6	
Caribou Creek @ 4670ft	2.73	4	3	4	3	
Carobou Creek ab 1st tributary	0.47	2	1	2	1	
1st tributary to Caribou Creek	0.93	2	2	2	2	
Snow Creek @ mouth	34.5	14	12	11	11	25.2(01)
Snow Creek ab Caribou Creek	21.2	11	9	9	8	9.1(01)
Snow Creek @ AU 03 top	9.9	8	6	6	6	6.2(01)
Ruby Creek @ mouth	14.7	9	8	7	7	8.5(94)
Ruby Creek bl Gold Creek (AU 03)	13.1	9	7	7	7	
Fall Creek @ mouth	28.3	12	11	10	10	7.4(98)
Fall Creek @ canyon mouth	17	10	8	8	8	
Fall Creek @ top of AU 03	11.7	8	7	7	6	11.6(01)
Trail Creek @ Naples bridge	16	9	8	8	7	
Trail Creek bl Cone Cr (AU 03)	9.8	8	6	6	6	7.3(01)
Cow Creek (030_03) @ mouth	17.7	10	9	8	8	
Cow Creek bl Brush Creek	11.4	8	7	7	6	3.3(98)
Brush Creek @ mouth	6.69	6	5	5	5	
Brush Creek @ top of AU 03	6.6	6	5	5	5	
Boulder Creek @ mouth	63.7	18	16	13	15	
Boulder Creek bl East Fork	50.4	16	14	12	13	
Boulder Creek ab East Fork	34.9	14	12	11	11	
Boulder Creek @ 3400ft	23.7	11	10	9	9	
Boulder Creek ab Cabin Creek	13.3	9	7	7	7	13.8(94), 24.9(01)
Boulder Creek bl Poker Creek (AU03	6.85	6	5	6	5	9.9 ab Poker(01)
Curley Creek @ mouth	20.3	11	9	9	8	
Curley Creek @ lower MT border	19	10	9	8	8	
Curley Creek @ upper MT border	15.8	9	8	8	7	
Curley Creek @ top of AU 03	6.05	6	5	5	4	3.0(98)
Fleming Creek @ mouth	21.7	11	9	9	9	
Fleming Creek bl Bane Creek	19.9	11	9	8	8	
Bane Creek @ mouth	13	9	7	7	7	
Bane Creek @ top of AU 03	11	8	7	7	6	
Rock Creek @ mouth	21.1	11	9	9	8	
Rock Creek @ top of AU 03	15.8	9	8	8	7	
Mission Creek @ mouth	45.6	16	14	12	13	
Mission Creek ab Brush Creek	31	13	11	10	10	
Mission Creek nr Hwy 95	22.8	11	10	9	9	10.1(01)
Mission Creek bl Zion Creek	9.21	7	6	6	5	10.9(94), 9.0(06)
Brush Creek (039_02) @ mouth	11.4	8	7	7	6	
Brush Creek @ Hwy 95	5.17	6	5	5	4	
Brush Creek bl forks	4.24	5	4	5	4	4.7 bl lake(01)
Left fork Brush Creek	0.8	2	2	2	2	
Right fork Brush Creek	3.44	5	4	4	3	
tributary to Brush Creek	0.81	2	2	2	2	

Table B-3. Bankfull width estimates from regional curves for various stream locations in the Moyie River subbasin.

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	Field measure in meters (year)
Miller Creek @ mouth	2.87	4	3	4	3	
Harvey Creek ab tributary	0.87	2	2	2	2	
Gillon Creek bl Harvey Creek						4.54(98)
Round Prairie Creek ab Gillon Cr	22.76	11	10	9	9	
Round Prairie Creek bl Hell Roaring	18.1	10	9	8	8	
tributary to Robinson Creek	0.76	2	2	2	1	
Meadow Creek @ mouth	24.43	12	10	9	9	8.1(94)
Meadow Creek bl Fern Creek	13.55	9	7	7	7	4.03 ab Fern(02), 3.9 ab Wall(02)
Meadow Creek ab East Fork	3.62	5	4	4	3	
EF Meadow Creek @ mouth	3.46	5	4	4	3	
Templeman Creek @ mouth	0.77	2	2	2	2	
Fern Creek @ mouth	1.56	3	3	3	2	
tributary to Meadow Creek	1.89	3	3	3	2	
Wall Creek @ mouth	2.75	4	3	4	3	
tributary to Wall Creek	0.41	2	1	2	1	
Un-named #1 nr Eileen	2.26	4	3	4	3	
Un-named #2	1.46	3	2	3	2	
Un-named #3	0.42	2	1	2	1	
Skin Creek @ mouth	10.36	8	7	6	6	4.7(02)
Skin Creek ab tributary	7.01	6	5	6	5	2.9(98)
tributary to Skin Creek	1.79	3	3	3	2	
Deer Creek @ mouth	31.1	13	11	10	10	12.2(94), 14.6(98) ab Solomon
Deer Creek bl Keno Creek	24.11	12	10	9	9	
Deer Creek bl Mill Creek	12.16	8	7	7	6	6.8(07), 5.6 ab Mill(02)
Deer Creek bl West Branch	6.7	6	5	5	5	6.1(02)
1st tributary to Deer Creek	0.65	2	2	2	1	
2nd tributary to Deer Creek	0.82	2	2	2	2	
West Branch Deer Creek	1.56	3	3	3	2	
Davis Creek @ mouth	2	3	3	3	2	4.6(02)
5th tributary to Deer Creek	0.86	2	2	2	2	
Mill Creek @ mouth	1.39	3	2	3	2	2.2(02)
tributary to Mill Creek	0.08	1	1	1	0	
7th tributary to Deer Creek	0.12	1	1	1	1	
Faro Creek @ mouth	4	5	4	4	4	3.7(02)
Faro Creek ab 2nd tributary	2.75	4	3	4	3	
Faro Creek ab 1st tributary	1.74	3	3	3	2	
1st tributary to Faro Creek	0.83	2	2	2	2	
2nd tributary to Faro Creek	1.06	3	2	3	2	
Keno Creek @ mouth	5.96	6	5	5	4	3.75(02)
Keno Creek bl 2nd tributary	4.26	5	4	5	4	
Keno Creek ab 1st tributary	1.74	3	3	3	2	
1st tributary to Keno Creek	0.98	2	2	3	2	
2nd tributary to Keno Creek	0.89	2	2	2	2	
3rd tributary to Keno Creek	0.68	2	2	2	1	
10th tributary to Deer Creek	1.12	3	2	3	2	
Solomon Creek @ mouth	1.08	3	2	3	2	
Placer Creek @ mouth	3.68	5	4	4	3	4.5(94)
Spruce Creek @ mouth	7.54	7	6	6	5	3.8 ab 3rd tributary(02)
1st tributary to Spruce Creek	0.65	2	2	2	1	
2nd tributary to Spruce Creek	0.74	2	2	2	1	
3rd tributary to Spruce Creek	0.62	2	2	2	1	
un-named stream ab Spruce Cr	1.3	3	2	3	2	
Copper Creek @ mouth	3.93	5	4	4	4	
Copper Creek ab 2nd tributary	3.45	5	4	4	3	6.2(98)
Copper Creek ab 1st tributary	1.39	3	2	3	2	
1st tributary to Copper Creek	1.65	3	3	3	2	
2nd tributary to Copper Creek	0.37	2	1	2	1	
un-named stream bl Copper Creek	0.27	1	1	2	1	
Brass Creek @ mouth	1.79	3	3	3	2	dry(02)
Line Creek ab 1st tributary	0.16	1	1	1	1	
Canuck Creek @ border	15.83	9	8	8	7	8.2(94), 9.5(98) bl 2nd tributary

Target Shade Curves

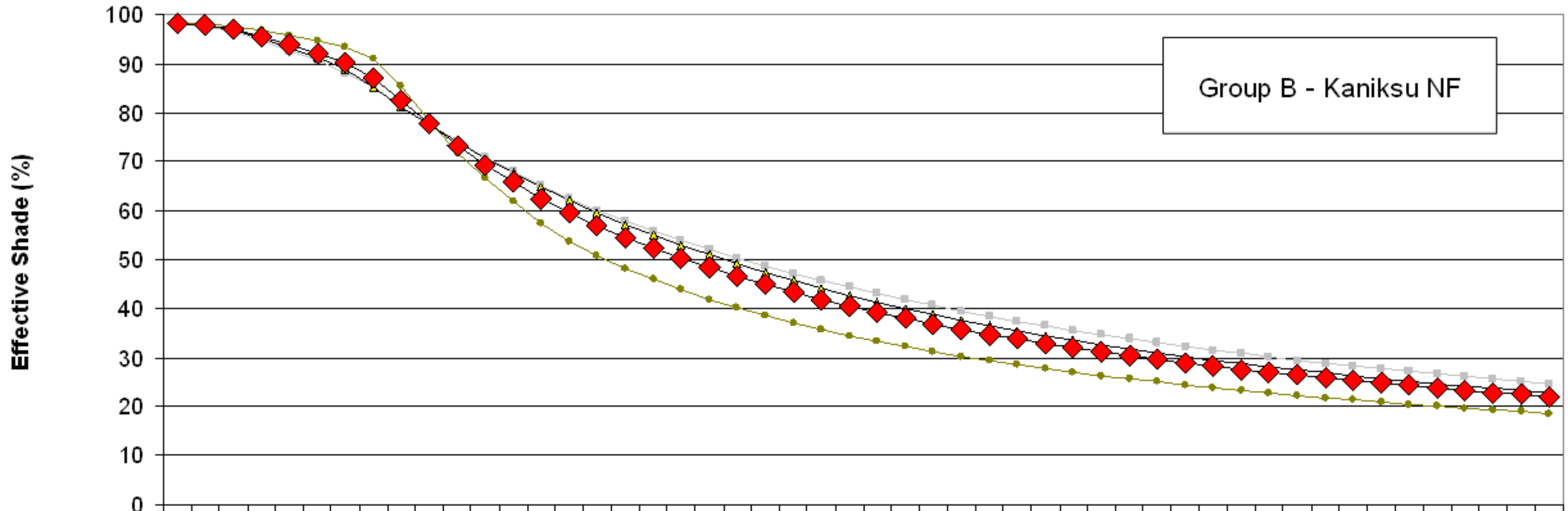


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North - South	94	93	86	75	67	62	57	53	50	47	45	42	40	39	37	35	34	33	31	30	29	28	27	26	25
Northeast/Southwest	94	93	88	78	70	64	60	56	52	49	46	44	42	40	38	36	35	33	32	30	29	28	27	26	25
East - West	95	94	91	82	75	69	64	59	54	48	44	41	38	35	33	31	30	28	27	26	25	24	23	22	21
Average	94	93	88	78	71	65	60	56	52	48	45	42	40	38	36	34	33	31	30	29	28	27	26	25	24

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North - South	25	24	23	23	22	21	21	20	20	19	19	18	18	17	17	17	16	16	16	15	15	15	14	14	14
Northeast/Southwest	24	23	23	22	21	21	20	19	19	18	18	17	17	17	16	16	15	15	15	14	14	14	14	13	13
East - West	20	20	19	19	18	17	17	16	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11
Average	23	22	22	21	20	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	14	13	13	13

"Vegetation" Channel Width (meters) and Calculated Shade Conditions

Figure B-1. Shade curves for the Kaniksu National Forest Group A forest type.

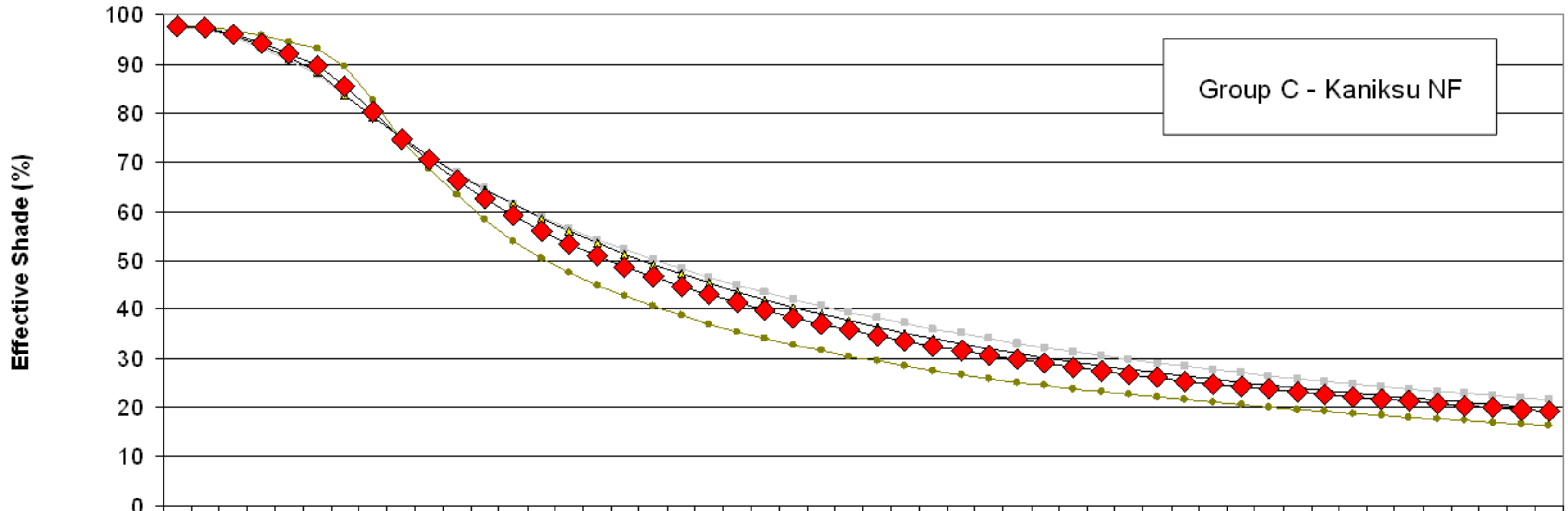


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North - South	98	98	97	95	93	91	88	85	81	77	74	71	68	65	63	60	58	56	54	52	50	49	47	46	44
Northeast/Southwest	98	98	97	95	93	91	89	85	81	77	74	71	68	65	62	60	57	55	53	51	49	47	46	44	43
East - West	98	98	98	97	96	95	93	91	85	78	72	67	62	57	54	51	48	46	44	42	40	39	37	36	34
Average	98	98	97	96	94	92	90	87	83	78	73	69	66	62	59	57	54	52	50	48	47	45	43	42	40

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North - South	43	42	41	40	38	37	37	36	35	34	33	32	32	31	30	29	29	28	28	27	27	26	26	25	25
Northeast/Southwest	41	40	39	38	36	35	34	33	33	32	31	30	29	29	28	27	27	26	26	25	25	24	24	23	23
East - West	33	32	31	30	29	29	28	27	26	26	25	24	24	23	23	22	22	21	21	20	20	20	19	19	19
Average	39	38	37	36	35	34	33	32	31	30	30	29	28	28	27	26	26	25	25	24	24	23	23	22	22

"Vegetation" Channel Width (meters) and Calculated Shade Conditions

Figure B-2. Shade curve for the Kaniksu National Forest Group B forest type.

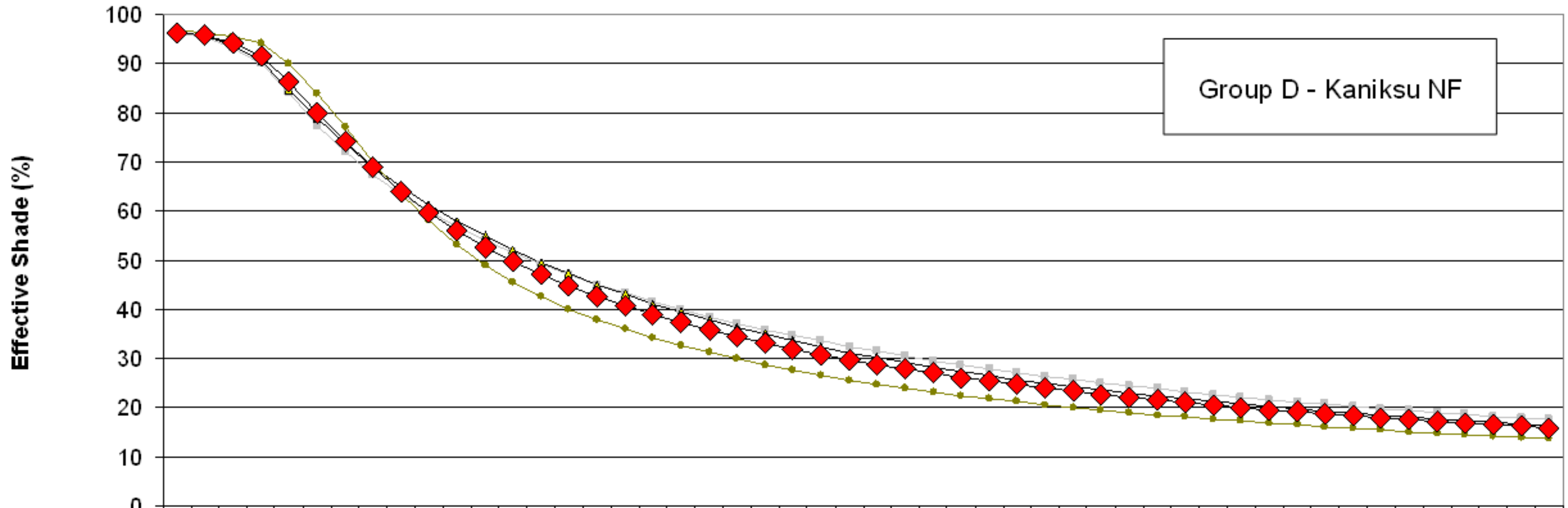


"Vegetation" Channel Width (meters)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North - South	97	97	95	93	91	88	84	79	75	71	68	65	62	59	56	54	52	50	48	47	45	43	42	41	39
Northeast/Southwest	98	97	96	94	91	88	84	79	75	71	68	64	61	59	56	54	51	49	47	45	44	42	40	39	38
East - West	98	98	97	96	95	93	89	83	74	69	63	58	54	51	48	45	43	41	39	37	35	34	33	32	30
Average	98	97	96	94	92	90	86	80	75	70	66	62	59	56	53	51	49	47	45	43	41	40	38	37	36

"Vegetation" Channel Width (meters)	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North - South	38	37	36	35	34	33	32	31	31	30	29	28	28	27	26	26	25	25	24	24	23	23	22	22	22
Northeast/Southwest	36	35	34	33	32	31	30	29	29	28	27	26	26	25	25	24	23	23	22	22	22	21	21	20	20
East - West	29	28	28	27	26	25	24	24	23	23	22	22	21	21	20	20	19	19	18	18	18	17	17	17	16
Average	35	34	33	32	31	30	29	28	27	27	26	25	25	24	24	23	23	22	22	21	21	20	20	20	19

"Vegetation" Channel Width (meters) and Calculated Shade Conditions

Figure B-3. Shade curve for the Kaniksu National Forest Group C forest type.

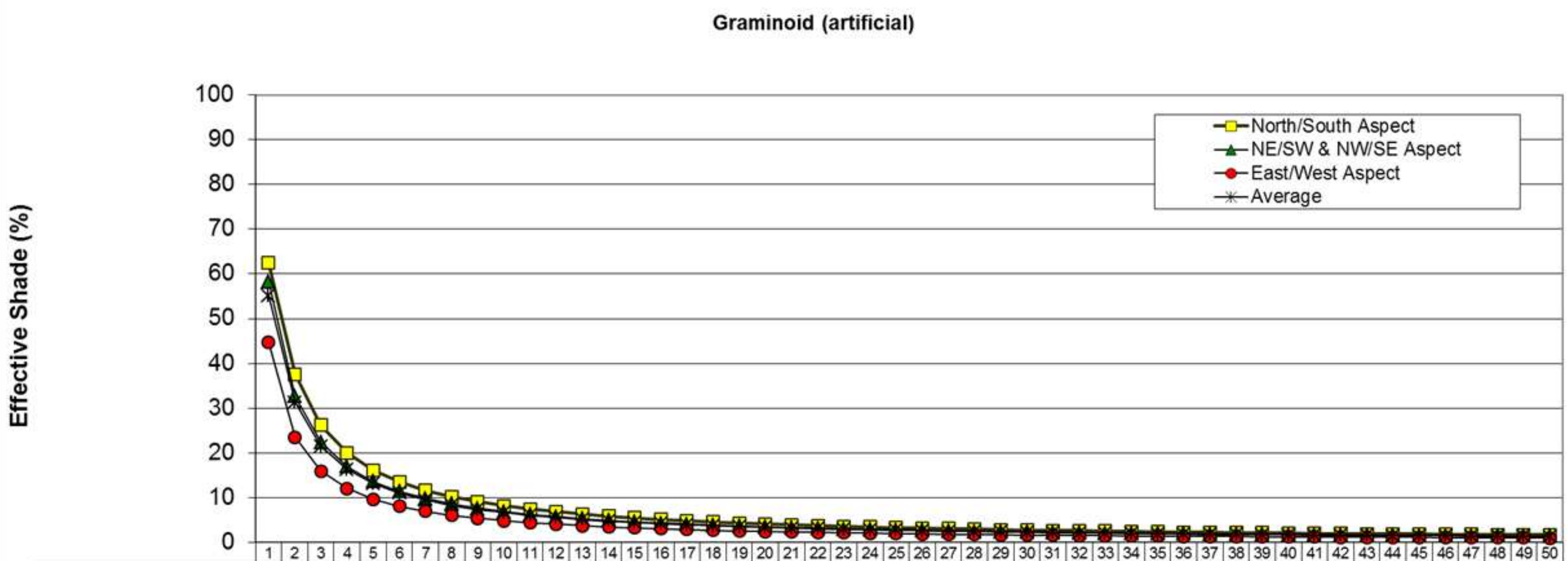


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North - South	96	95	93	90	84	77	72	67	63	60	57	54	51	49	47	45	43	42	40	39	37	36	35	34	32
Northeast/Southwest	96	96	94	91	85	79	74	69	65	61	58	55	52	50	47	45	43	41	39	38	36	35	34	32	31
East - West	97	96	95	94	90	84	77	70	63	58	53	49	45	43	40	38	36	34	33	31	30	29	28	27	26
Average	96	96	94	92	86	80	74	69	64	60	56	53	50	47	45	43	41	39	37	36	34	33	32	31	30

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North - South	31	31	30	29	28	27	26	26	25	24	24	23	23	22	22	21	21	20	20	19	19	19	18	18	18
Northeast/Southwest	30	29	28	27	26	26	25	24	24	23	22	22	21	21	20	20	19	19	18	18	18	17	17	17	16
East - West	25	24	23	22	22	21	21	20	20	19	19	18	18	17	17	16	16	16	15	15	15	15	14	14	14
Average	29	28	27	26	25	25	24	23	23	22	22	21	21	20	20	19	19	18	18	18	17	17	17	16	16

"Vegetation" Channel Width (meters) and Calculated Shade Conditions

Figure B-4. Shade curve for the Kaniksu National Forest Group D forest type.

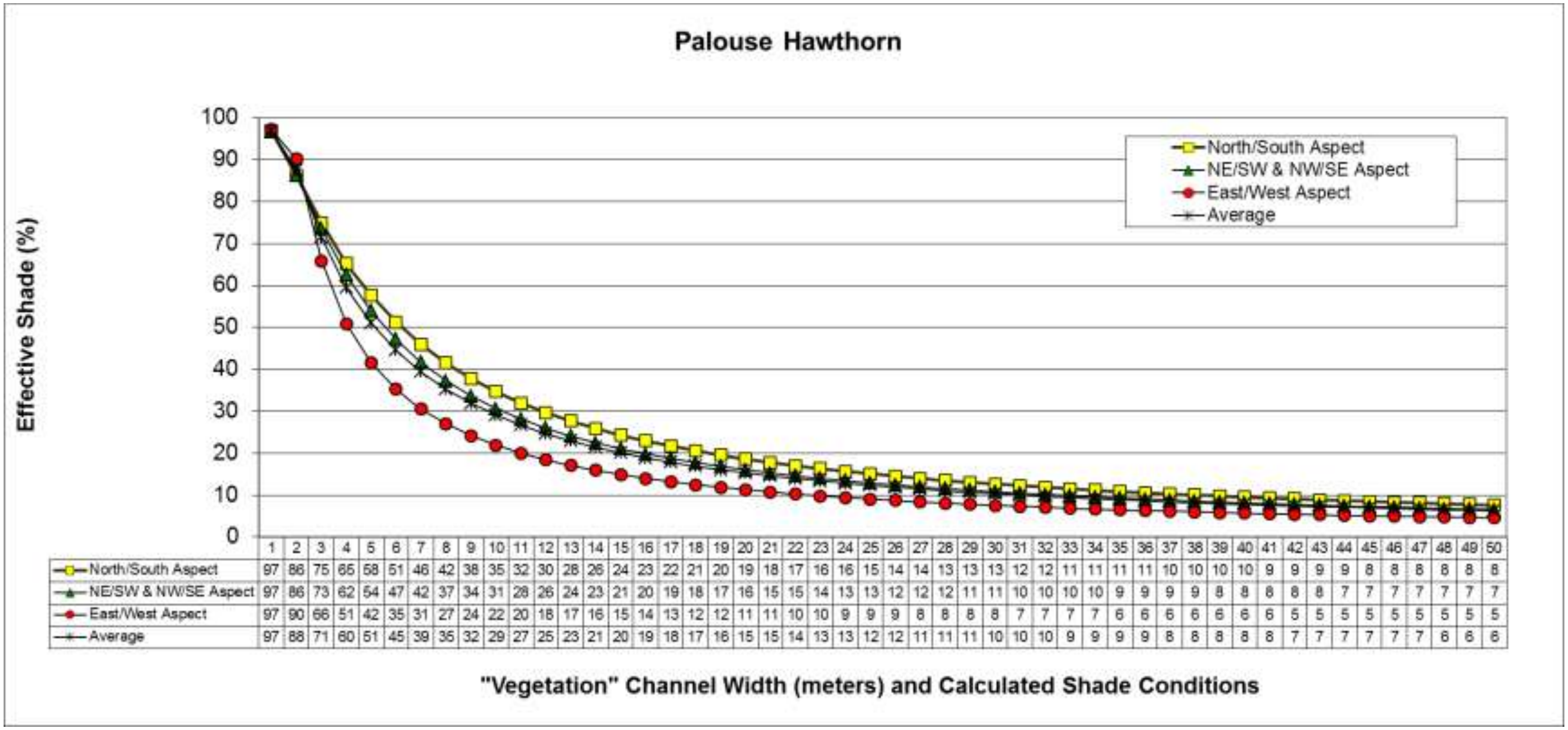


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	62	38	26	20	16	14	12	10	9	8	7	7	6	6	5	5	5	5	4	4	4	4	4	3	3
NE/SW & NW/SE Aspect	58	33	22	17	14	11	10	9	8	7	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3
East/West Aspect	45	23	16	12	10	8	7	6	5	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2
Average	55	31	21	16	13	11	9	8	7	7	6	6	5	5	4	4	4	4	3	3	3	3	3	3	3

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
NE/SW & NW/SE Aspect	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1
East/West Aspect	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1

"Vegetation" Channel Width (meters)

Figure B-5. Shade curve for the Graminoid Meadow type.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	97	86	75	65	58	51	46	42	38	35	32	30	28	26	24	23	22	21	20	19	18	17	16	16	15
NE/SW & NW/SE Aspect	97	86	73	62	54	47	42	37	34	31	28	26	24	23	21	20	19	18	17	16	15	15	14	13	13
East/West Aspect	97	90	66	51	42	35	31	27	24	22	20	18	17	16	15	14	13	12	12	11	11	10	10	9	9
Average	97	88	71	60	51	45	39	35	32	29	27	25	23	21	20	19	18	17	16	15	15	14	13	13	12

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	14	14	13	13	13	12	12	11	11	11	11	10	10	10	10	9	9	9	9	8	8	8	8	8	8
NE/SW & NW/SE Aspect	12	12	12	11	11	10	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	7
East/West Aspect	9	8	8	8	8	7	7	7	7	6	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5
Average	12	11	11	11	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	6	6	6

Figure B-6. Shade curve for the Palouse Hawthorn Meadow vegetation type.

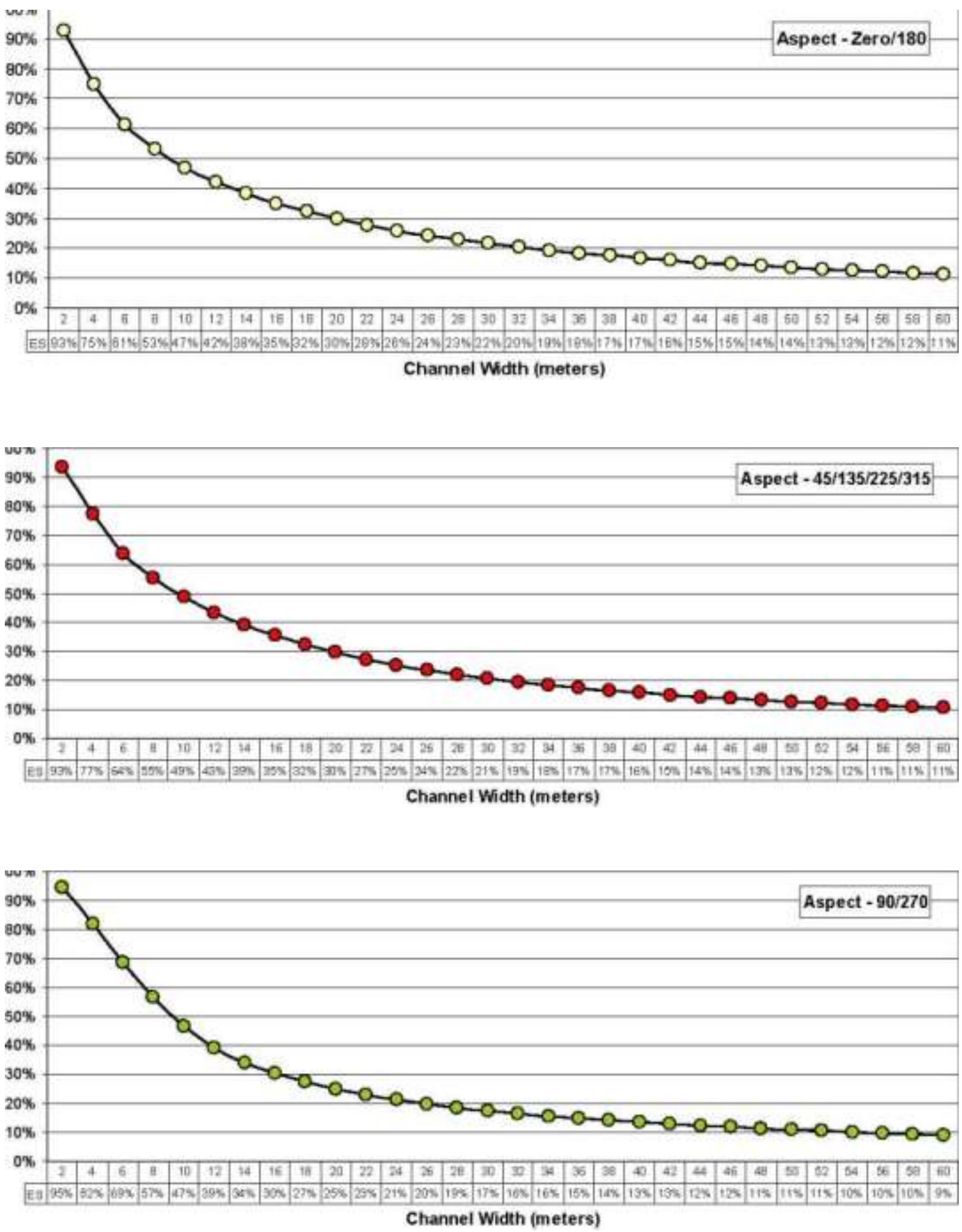


Figure B-7. Shade curves for the North Idaho Hardwood "Non-forest" Group 1 vegetation type.

Load Analysis Tables—Lower Kootenai River Subbasin

Note: All assessment unit (AU) numbers start with ID17010104PN in Tables B-4 through B-26.

Table B-4. Existing and target solar loads for Ball Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
011_02	Ball Creek	2	650	Group C	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
011_02	Ball Creek	3	290	Group C	97%	0.17	2	600	100	80%	1.10	2	600	700	600	-17%
011_02	Ball Creek	4	1500	Group C	96%	0.22	3	5,000	1,000	90%	0.55	3	5,000	3,000	2,000	-6%
011_02	Ball Creek	5	270	Group C	94%	0.33	4	1,000	300	90%	0.55	4	1,000	600	300	-4%
011_02	Ball Creek	6	640	Group B	96%	0.22	4	3,000	700	90%	0.55	4	3,000	2,000	1,000	-6%
011_02	Ball Creek	7	410	Group B	96%	0.22	4	2,000	400	80%	1.10	4	2,000	2,000	2,000	-16%
011_02	Ball Creek	8	210	Group B	94%	0.33	5	1,000	300	80%	1.10	5	1,000	1,000	700	-14%
011_02	Ball Creek	9	110	Group B	94%	0.33	5	600	200	80%	1.10	5	600	700	500	-14%
011_02	Ball Creek	10	980	Group B	94%	0.33	5	5,000	2,000	70%	1.65	5	5,000	8,000	6,000	-24%
011_02	Ball Creek	11	480	Group B	92%	0.44	6	3,000	1,000	70%	1.65	6	3,000	5,000	4,000	-22%
011_02	Ball Creek	12	520	Group B	92%	0.44	6	3,000	1,000	70%	1.65	6	3,000	5,000	4,000	-22%
011_02	Ball Creek	13	510	Group B	92%	0.44	6	3,000	1,000	80%	1.10	6	3,000	3,000	2,000	-12%
011_02	Ball Creek	14	360	Group B	90%	0.55	7	3,000	2,000	80%	1.10	7	3,000	3,000	1,000	-10%
011_02	Ball Creek	15	360	Group B	90%	0.55	7	3,000	2,000	70%	1.65	7	3,000	5,000	3,000	-20%
011_02	Ball Creek	16	260	Group B	90%	0.55	7	2,000	1,000	80%	1.10	7	2,000	2,000	1,000	-10%
011_02	Ball Creek	17	200	Group B	90%	0.55	7	1,000	600	70%	1.65	7	1,000	2,000	1,000	-20%
011_02	Ball Creek	18	170	Group B	90%	0.55	7	1,000	600	80%	1.10	7	1,000	1,000	400	-10%
011_02	Ball Creek	19	1100	Group B	90%	0.55	7	8,000	4,000	80%	1.10	7	8,000	9,000	5,000	-10%
011_02	Ball Creek	20	260	Group B	87%	0.72	8	2,000	1,000	70%	1.65	8	2,000	3,000	2,000	-17%
011_02	Ball Creek	21	1100	Group B	87%	0.72	8	9,000	6,000	70%	1.65	8	9,000	10,000	4,000	-17%
011_02	Ball Creek	22	460	Group B	87%	0.72	8	4,000	3,000	70%	1.65	8	4,000	7,000	4,000	-17%
011_02	Ball Creek	23	120	Group B	87%	0.72	8	1,000	700	20%	4.40	8	1,000	4,000	3,000	-67%
011_02	Ball Creek	24	300	Group B	87%	0.72	8	2,000	1,000	80%	1.10	8	2,000	2,000	1,000	-7%
011_02	Ball Creek	25	910	Group B	83%	0.94	9	8,000	7,000	80%	1.10	9	8,000	9,000	2,000	-3%
011_02	Ball Creek	26	340	Group B	83%	0.94	9	3,000	3,000	90%	0.55	9	3,000	2,000	(1,000)	0%
011_02	Ball Creek	27	330	Group B	83%	0.94	9	3,000	3,000	60%	2.20	9	3,000	7,000	4,000	-23%
011_02	Ball Creek	28	310	Group B	83%	0.94	9	3,000	3,000	70%	1.65	9	3,000	5,000	2,000	-13%
011_02	Ball Creek	29	80	Group B	83%	0.94	9	700	700	80%	1.10	9	700	800	100	-3%
011_02	Ball Creek	30	560	Group B	78%	1.21	10	5,600	6,800	70%	1.65	10	5,600	9,200	2,400	-8%
011_02	Ball Creek	31	390	Group B	78%	1.21	10	3,900	4,700	80%	1.10	10	3,900	4,300	(400)	0%
011_02	Ball Creek	32	370	Group B	78%	1.21	10	3,700	4,500	70%	1.65	10	3,700	6,100	1,600	-8%
011_02	Ball Creek	33	330	Group B	78%	1.21	10	3,300	4,000	80%	1.10	10	3,300	3,600	(400)	0%
011_02	Ball Creek	34	290	Group B	78%	1.21	10	2,900	3,500	70%	1.65	10	2,900	4,800	1,300	-8%
011_02	Ball Creek	35	490	Group B	78%	1.21	10	4,900	5,900	90%	0.55	10	4,900	2,700	(3,200)	0%
011_02	Ball Creek	36	1900	Group B	73%	1.49	11	21,000	31,000	80%	1.10	11	21,000	23,000	(8,000)	0%
011_02a	Ball Creek	1	140	Group B	73%	1.49	11	1,500	2,200	80%	1.10	11	1,500	1,700	(500)	0%
011_02a	Ball Creek	2	230	Group B	73%	1.49	11	2,500	3,700	50%	2.75	12	2,800	7,700	4,000	-23%
011_02a	Ball Creek	3	180	Group B	73%	1.49	11	2,000	3,000	30%	3.85	15	2,700	10,000	7,000	-43%
011_02a	Ball Creek	4	600	Hardwoods 1	45%	3.03	11	6,600	20,000	0%	5.50	18	11,000	61,000	41,000	-45%
							Totals		140,000					240,000	100,000	

Table B-5. Existing and target solar loads for Ball Creek tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
011_02	Finn Creek	1	1500	Group D	96%	0.22	1	2,000	400	90%	0.55	1	2,000	1,000	600	-6%
011_02	Finn Creek	2	250	Group B	98%	0.11	2	500	60	90%	0.55	2	500	300	200	-8%
011_02	Finn Creek	3	260	Group C	97%	0.17	2	500	80	90%	0.55	2	500	300	200	-7%
011_02	Spanish Creek	2	220	Group D	96%	0.22	1	200	40	90%	0.55	1	200	100	60	-6%
011_02	Spanish Creek	4	2300	Group D	96%	0.22	2	5,000	1,000	90%	0.55	2	5,000	3,000	2,000	-6%
011_02	Spanish Creek	5	750	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
011_02	Dutch Creek	1	730	Group C	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
011_02	Dutch Creek	2	600	Group B	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
011_02	Dutch Creek	3	150	Group B	98%	0.11	2	300	30	80%	1.10	2	300	300	300	-18%
011_02	Dutch Creek	4	530	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
011_02	4th to Ball Cr	1	1200	Group D	96%	0.22	1	1,000	200	90%	0.55	1	1,000	600	400	-6%
011_02	4th to Ball Cr	2	120	Group B	98%	0.11	1	100	10	90%	0.55	1	100	60	50	-8%
011_02	4th to Ball Cr	3	130	Group B	98%	0.11	1	100	10	70%	1.65	1	100	200	200	-28%
011_02	4th to Ball Cr	4	380	Group B	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
011_02	5th to Ball Cr	1	740	Group C	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
011_02	5th to Ball Cr	2	920	Group B	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
011_02	6th to Ball Cr	1	1500	Group D	96%	0.22	1	2,000	400	90%	0.55	1	2,000	1,000	600	-6%
011_02	6th to Ball Cr	2	910	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
011_02	French Creek	1	420	Group C	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
011_02	French Creek	2	1500	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
011_02	8th to Ball Cr	1	1000	Group D	96%	0.22	1	1,000	200	90%	0.55	1	1,000	600	400	-6%
011_02	8th to Ball Cr	2	890	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
011_02	Swiss Creek	1	2000	Group C	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
011_02	Swiss Creek	2	1000	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
011_02	Swiss Creek	3	270	Group B	97%	0.17	3	800	100	80%	1.10	3	800	900	800	-17%
011_02	Swiss Creek	4	590	Group B	97%	0.17	3	2,000	300	90%	0.55	3	2,000	1,000	700	-7%
011_02	English Creek	1	710	Group D	96%	0.22	1	700	200	90%	0.55	1	700	400	200	-6%
011_02	English Creek	2	350	Group B	98%	0.11	1	400	40	80%	1.10	1	400	400	400	-18%
011_02	English Creek	3	540	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
011_02	English Creek	4	200	Group B	98%	0.11	2	400	40	70%	1.65	2	400	700	700	-28%
011_02	English Creek	5	140	Group B	98%	0.11	2	300	30	90%	0.55	2	300	200	200	-8%
011_02	11th to Ball Cr	1	360	Group D	96%	0.22	1	400	90	90%	0.55	1	400	200	100	-6%
011_02	11th to Ball Cr	2	150	Group B	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
011_02	11th to Ball Cr	3	170	Group B	98%	0.11	1	200	20	60%	2.20	1	200	400	400	-38%
011_02	11th to Ball Cr	4	1100	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
011_02	Swede Creek	1	200	Group D	96%	0.22	1	200	40	90%	0.55	1	200	100	60	-6%
011_02	Swede Creek	2	1300	Group C	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
011_02	Swede Creek	3	720	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
011_02	Swede Creek	4	830	Group B	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
011_02	Swede Creek	5	110	Group B	98%	0.11	2	200	20	90%	0.55	2	200	100	80	-8%
011_02	13th to Ball Cr	1	190	Group D	96%	0.22	1	200	40	90%	0.55	1	200	100	60	-6%
011_02	13th to Ball Cr	2	1500	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
011_02	14th to Ball Cr	1	1800	Group B	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
011_02	Scotch Creek	1	490	Group C	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
011_02	Scotch Creek	2	1800	Group B	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
011_02	16th to Ball Cr	1	210	Group D	96%	0.22	1	200	40	80%	1.10	1	200	200	200	-16%
011_02	16th to Ball Cr	2	1100	Group A	94%	0.33	1	1,000	300	80%	1.10	1	1,000	1,000	700	-14%
011_02	16th to Ball Cr	3	420	Group A	94%	0.33	1	400	100	90%	0.55	1	400	200	100	-4%
011_02	17th to Ball Cr	1	100	Group D	96%	0.22	1	100	20	80%	1.10	1	100	100	80	-16%
011_02	17th to Ball Cr	2	850	Group A	94%	0.33	1	900	300	80%	1.10	1	900	1,000	700	-14%
011_02	17th to Ball Cr	3	590	Group A	94%	0.33	1	600	200	90%	0.55	1	600	300	100	-4%
011_02	17th to Ball Cr	4	200	Group B	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
							Totals		7,900					35,000	28,000	

Table B-6. Existing and target solar loads for Bane and Fleming Creeks.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
036_03	Bane Creek	1	210	Hardwoods 1	86%	0.77	3	600	500	90%	0.55	3	600	300	(200)	0%
036_03	Bane Creek	2	240	Hardwoods 1	86%	0.77	3	700	500	80%	1.10	3	700	800	300	-6%
036_03	Bane Creek	3	1500	Group A	88%	0.66	3	5,000	3,000	90%	0.55	3	5,000	3,000	0	0%
036_03	Bane Creek	4	50	Group A	88%	0.66	3	200	100	40%	3.30	3	200	700	600	-48%
036_03	Bane Creek	5	960	Group A	88%	0.66	3	3,000	2,000	90%	0.55	3	3,000	2,000	0	0%
036_03	Bane Creek	6	280	Hardwoods 1	86%	0.77	3	800	600	80%	1.10	3	800	900	300	-6%
036_03	Fleming Creek	1	540	Hardwoods 1	86%	0.77	3	2,000	2,000	70%	1.65	3	2,000	3,000	1,000	-16%
036_03	Fleming Creek	2	270	Hardwoods 1	78%	1.21	4	1,000	1,000	60%	2.20	4	1,000	2,000	1,000	-18%
036_03	Fleming Creek	3	60	Hardwoods 1	78%	1.21	4	200	200	30%	3.85	4	200	800	600	-48%
036_03	Fleming Creek	4	60	Hardwoods 1	78%	1.21	4	200	200	80%	1.10	4	200	200	0	0%
036_03	Fleming Creek	5	260	Hardwoods 1	72%	1.54	5	1,000	2,000	30%	3.85	5	1,000	4,000	2,000	-42%
036_03	Fleming Creek	6	410	Hardwoods 1	65%	1.93	6	2,000	4,000	10%	4.95	6	2,000	10,000	6,000	-55%
036_03	Fleming Creek	7	300	Hardwoods 1	65%	1.93	6	2,000	4,000	0%	5.50	6	2,000	10,000	6,000	-65%
036_03	Fleming Creek	8	60	Hardwoods 1	65%	1.93	6	400	800	90%	0.55	6	400	200	(600)	0%
036_03	Fleming Creek	9	310	Hardwoods 1	52%	2.64	9	3,000	8,000	0%	5.50	9	3,000	20,000	10,000	-52%
							Totals		29,000					58,000	27,000	

Table B-7. Existing and target solar loads for Blue Joe Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_02	Blue Joe Creek	1	150	Group C	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
004_02	Blue Joe Creek	2	270	Group C	98%	0.11	1	300	30	0%	5.50	3	800	4,000	4,000	-98%
004_02	Blue Joe Creek	3	210	Group C	98%	0.11	1	200	20	40%	3.30	5	1,000	3,000	3,000	-58%
004_02	Blue Joe Creek	4	110	Group C	98%	0.11	1	100	10	50%	2.75	5	600	2,000	2,000	-48%
004_02	Blue Joe Creek	5	440	Group C	97%	0.17	2	900	100	70%	1.65	5	2,000	3,000	3,000	-27%
004_02	Blue Joe Creek	6	170	Group C	97%	0.17	2	300	50	90%	0.55	5	900	500	500	-7%
004_02	Blue Joe Creek	7	340	Group C	97%	0.17	2	700	100	50%	2.75	6	2,000	6,000	6,000	-47%
004_02	Blue Joe Creek	8	540	Group C	96%	0.22	3	2,000	400	60%	2.20	6	3,000	7,000	7,000	-36%
004_02	Blue Joe Creek	9	160	Group C	96%	0.22	3	500	100	90%	0.55	6	1,000	600	500	-6%
004_02	Blue Joe Creek	10	110	Group C	96%	0.22	3	300	70	0%	5.50	6	700	4,000	4,000	-96%
004_02	Blue Joe Creek	11	290	Group C	94%	0.33	4	1,000	300	80%	1.10	7	2,000	2,000	2,000	-14%
004_02	Blue Joe Creek	12	1000	Group B	96%	0.22	4	4,000	900	80%	1.10	7	7,000	8,000	7,000	-16%
004_02	Blue Joe Creek	13	100	Group B	94%	0.33	5	500	200	80%	1.10	8	800	900	700	-14%
004_02	Blue Joe Creek	14	290	Group B	94%	0.33	5	1,000	300	50%	2.75	8	2,000	6,000	6,000	-44%
004_02	Blue Joe Creek	15	190	Group B	94%	0.33	5	1,000	300	80%	1.10	8	2,000	2,000	0	-14%
004_02	Blue Joe Creek	16	170	Group B	94%	0.33	5	900	300	60%	2.20	8	1,000	2,000	2,000	-34%
004_02	Blue Joe Creek	17	170	Group B	94%	0.33	5	900	300	50%	2.75	8	1,000	3,000	3,000	-44%
004_02	Blue Joe Creek	18	350	Group B	94%	0.33	5	2,000	700	90%	0.55	8	3,000	2,000	1,000	-4%
004_02	Blue Joe Creek	19	210	Group B	94%	0.33	5	1,000	300	80%	1.10	8	2,000	2,000	0	-14%
004_02	Blue Joe Creek	20	140	Group B	94%	0.33	5	700	200	50%	2.75	8	1,000	3,000	3,000	-44%
004_02	Blue Joe Creek	21	270	Group B	94%	0.33	5	1,000	300	80%	1.10	8	2,000	2,000	0	-14%
004_02	Blue Joe Creek	22	440	Hardwoods 1	65%	1.93	6	3,000	6,000	50%	2.75	8	4,000	10,000	4,000	-15%
004_02	Blue Joe Creek	23	240	Group B	92%	0.44	6	1,000	400	60%	2.20	8	2,000	4,000	4,000	-32%
004_02	Blue Joe Creek	24	270	Group B	92%	0.44	6	2,000	900	80%	1.10	8	2,000	2,000	1,000	-12%
004_02	Blue Joe Creek	25	310	Group B	92%	0.44	6	2,000	900	60%	2.20	10	3,000	7,000	6,000	-32%
004_02	Blue Joe Creek	26	170	Hardwoods 1	65%	1.93	6	1,000	2,000	40%	3.30	10	2,000	7,000	5,000	-25%
004_02	Blue Joe Creek	27	200	Hardwoods 1	65%	1.93	6	1,000	2,000	50%	2.75	10	2,000	6,000	4,000	-15%
004_02	Blue Joe Creek	28	210	Hardwoods 1	65%	1.93	6	1,000	2,000	60%	2.20	10	2,000	4,000	2,000	-5%
004_02	Blue Joe Creek	29	290	Hardwoods 1	65%	1.93	6	2,000	4,000	50%	2.75	10	3,000	8,000	4,000	-15%
004_02	Blue Joe Creek	30	430	Group B	90%	0.55	7	3,000	2,000	60%	2.20	10	4,000	9,000	7,000	-30%
004_02	Blue Joe Creek	31	170	Hardwoods 1	60%	2.20	7	1,000	2,000	40%	3.30	10	2,000	7,000	5,000	-20%
004_02	Blue Joe Creek	32	110	Hardwoods 1	60%	2.20	7	800	2,000	40%	3.30	10	1,000	3,000	1,000	-20%
004_02	Blue Joe Creek	33	180	Hardwoods 1	60%	2.20	7	1,000	2,000	50%	2.75	10	2,000	6,000	4,000	-10%
004_02	Blue Joe Creek	34	880	Hardwoods 1	60%	2.20	7	6,000	10,000	40%	3.30	10	9,000	30,000	20,000	-20%
004_02	Blue Joe Creek	35	90	Hardwoods 1	60%	2.20	7	600	1,000	60%	2.20	10	900	2,000	1,000	0%
004_02	Blue Joe Creek	36	250	Hardwoods 1	60%	2.20	7	2,000	4,000	40%	3.30	10	3,000	10,000	6,000	-20%
004_02	Blue Joe Creek	37	120	Hardwoods 1	60%	2.20	7	800	2,000	50%	2.75	10	1,000	3,000	1,000	-10%
004_02	Blue Joe Creek	38	70	Hardwoods 1	60%	2.20	7	500	1,000	60%	2.20	10	700	2,000	1,000	0%
004_02	Blue Joe Creek	39	160	Hardwoods 1	60%	2.20	7	1,000	2,000	40%	3.30	10	2,000	7,000	5,000	-20%
							Totals		51,000					190,000	140,000	

Table B-8. Existing and target solar loads for Blue Joe Creek tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_02	1st to Blue Joe	1	1800	Group C	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
004_02	1st to Blue Joe	2	590	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
004_02	1st to Blue Joe	3	350	Group B	98%	0.11	2	700	80	70%	1.65	2	700	1,000	900	-28%
004_02	1st to Blue Joe	4	100	Group B	98%	0.11	2	200	20	80%	1.10	2	200	200	200	-18%
004_02	2nd to Blue Joe	1	1900	Group C	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
004_02	2nd to Blue Joe	2	1500	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
004_02	3rd to Blue Joe	1	450	Group C	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
004_02	3rd to Blue Joe	2	800	Group B	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
004_02	3rd to Blue Joe	3	800	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
004_02	4th to Blue Joe	1	190	Group B	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
004_02	4th to Blue Joe	2	480	Group B	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
004_02	4th to Blue Joe	3	1200	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
004_02	5th to Blue Joe	1	960	Group B	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
004_02	5th to Blue Joe	2	580	Group B	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
004_02	Bog Creek	1	90	Meadow	55%	2.48	1	90	200	60%	2.20	1	90	200	0	0%
004_02	Bog Creek	2	130	Meadow	55%	2.48	1	100	200	40%	3.30	1	100	300	100	-15%
004_02	Bog Creek	3	80	Hardwood 1	97%	0.17	1	80	10	70%	1.65	1	80	100	90	-27%
004_02	Bog Creek	4	50	Meadow	55%	2.48	1	50	100	40%	3.30	1	50	200	100	-15%
004_02	Bog Creek	5	400	Group B	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
004_02	Bog Creek	6	120	Meadow	55%	2.48	1	100	200	50%	2.75	1	100	300	100	-5%
004_02	Bog Creek	7	620	Hardwood 1	97%	0.17	1	600	100	80%	1.10	1	600	700	600	-17%
004_02	Bog Creek	8	120	Meadow	31%	3.80	2	200	800	60%	2.20	2	200	400	(400)	0%
004_02	Bog Creek	9	120	Hardwood 1	94%	0.33	2	200	70	80%	1.10	2	200	200	100	-14%
004_02	Bog Creek	10	170	Meadow	31%	3.80	2	300	1,000	60%	2.20	2	300	700	(300)	0%
004_02	Bog Creek	11	150	Hardwood 1	94%	0.33	2	300	100	70%	1.65	2	300	500	400	-24%
004_02	Bog Creek	12	460	Hardwood 1	94%	0.33	2	900	300	80%	1.10	2	900	1,000	700	-14%
004_02	Bog Creek	13	370	Hardwood 1	94%	0.33	2	700	200	90%	0.55	2	700	400	200	-4%
							Totals		5,000					15,000	10,000	

Table B-9. Existing and target solar loads for Boulder Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
033_03	Boulder Creek	1	130	Hawthorn	51%	2.70	5	700	2,000	20%	4.40	10	1,000	4,000	2,000	-31%
033_03	Boulder Creek	2	250	Hawthorn	51%	2.70	5	1,000	3,000	0%	5.50	30	8,000	40,000	40,000	-51%
033_03	Boulder Creek	3	180	Hawthorn	51%	2.70	5	900	2,000	30%	3.85	18	3,000	10,000	8,000	-21%
033_03	Boulder Creek	4	270	Hawthorn	51%	2.70	5	1,000	3,000	10%	4.95	20	5,000	20,000	20,000	-41%
033_03	Boulder Creek	5	140	Hawthorn	51%	2.70	5	700	2,000	20%	4.40	20	3,000	10,000	8,000	-31%
033_03	Boulder Creek	6	340	Hawthorn	51%	2.70	5	2,000	5,000	0%	5.50	28	10,000	60,000	60,000	-51%
033_03	Boulder Creek	7	110	Hawthorn	51%	2.70	5	600	2,000	30%	3.85	18	2,000	8,000	6,000	-21%
033_03	Boulder Creek	8	80	Hardwoods 1	72%	1.54	5	400	600	70%	1.65	8	600	1,000	400	-2%
033_03	Boulder Creek	9	590	Hardwoods 1	65%	1.93	6	4,000	8,000	30%	3.85	20	10,000	40,000	30,000	-35%
033_03	Boulder Creek	10	930	Hardwoods 1	65%	1.93	6	6,000	10,000	0%	5.50	30	30,000	200,000	200,000	-65%
033_03	Boulder Creek	11	530	Hardwoods 1	60%	2.20	7	4,000	9,000	10%	4.95	20	10,000	50,000	40,000	-50%
033_03	Boulder Creek	12	640	Group B	90%	0.55	7	4,000	2,000	70%	1.65	12	8,000	10,000	8,000	-20%
033_03	Boulder Creek	13	290	Hardwoods 1	60%	2.20	7	2,000	4,000	0%	5.50	20	6,000	30,000	30,000	-60%
033_03	Boulder Creek	14	240	Hardwoods 1	55%	2.48	8	2,000	5,000	10%	4.95	15	4,000	20,000	20,000	-45%
033_03	Boulder Creek	15	420	Hardwoods 1	55%	2.48	8	3,000	7,000	0%	5.50	20	8,000	40,000	30,000	-55%
033_03	Boulder Creek	16	150	Hardwoods 1	55%	2.48	8	1,000	2,000	10%	4.95	18	3,000	10,000	8,000	-45%
033_03	Boulder Creek	17	210	Hardwoods 1	55%	2.48	8	2,000	5,000	40%	3.30	12	3,000	10,000	5,000	-15%
033_03	Boulder Creek	18	80	Hardwoods 1	55%	2.48	8	600	1,000	0%	5.50	30	2,000	10,000	9,000	-55%
033_03	Boulder Creek	19	450	Hardwoods 1	55%	2.48	8	4,000	10,000	10%	4.95	20	9,000	40,000	30,000	-45%
033_03	Boulder Creek	20	240	Hardwoods 1	52%	2.64	9	2,000	5,000	0%	5.50	30	7,000	40,000	40,000	-52%
033_03	Boulder Creek	21	90	Hardwoods 1	52%	2.64	9	800	2,000	40%	3.30	12	1,000	3,000	1,000	-12%
033_03	Boulder Creek	22	80	Hardwoods 1	52%	2.64	9	700	2,000	0%	5.50	30	2,000	10,000	8,000	-52%
033_03	Boulder Creek	23	230	Hardwoods 1	52%	2.64	9	2,000	5,000	40%	3.30	12	3,000	10,000	5,000	-12%
033_03	Boulder Creek	24	150	Hardwoods 1	52%	2.64	9	1,000	3,000	10%	4.95	20	3,000	10,000	7,000	-42%
033_03	Boulder Creek	25	200	Hardwoods 1	52%	2.64	9	2,000	5,000	50%	2.75	12	2,000	6,000	1,000	-2%
033_03	Boulder Creek	26	380	Group B	83%	0.94	9	3,000	3,000	70%	1.65	10	4,000	7,000	4,000	-13%
033_03	Boulder Creek	27	280	Group B	83%	0.94	9	3,000	3,000	70%	1.65	9	3,000	5,000	2,000	-13%
033_03	Boulder Creek	28	350	Group B	78%	1.21	10	3,500	4,200	60%	2.20	14	4,900	11,000	6,800	-18%
033_03	Boulder Creek	29	330	Group B	78%	1.21	10	3,300	4,000	40%	3.30	20	6,600	22,000	18,000	-38%
033_03	Boulder Creek	30	790	Group B	78%	1.21	10	7,900	9,600	50%	2.75	14	11,000	30,000	20,000	-28%
033_03	Boulder Creek	31	1200	Group B	78%	1.21	10	12,000	15,000	50%	2.75	15	18,000	50,000	35,000	-28%
033_03	Boulder Creek	32	770	Group B	73%	1.49	11	8,500	13,000	60%	2.20	11	8,500	19,000	6,000	-13%
033_03	Boulder Creek	33	1200	Group B	73%	1.49	11	13,000	19,000	70%	1.65	11	13,000	21,000	2,000	-3%
033_03	Boulder Creek	34	1100	Group B	73%	1.49	11	12,000	18,000	50%	2.75	15	17,000	47,000	29,000	-23%
033_03	Boulder Creek	35	230	Group B	69%	1.71	12	2,800	4,800	30%	3.85	18	4,100	16,000	11,000	-39%
033_03	Boulder Creek	36	620	Group B	69%	1.71	12	7,400	13,000	40%	3.30	12	7,400	24,000	11,000	-29%
033_03	Boulder Creek	37	440	Group B	69%	1.71	12	5,300	9,000	30%	3.85	18	7,900	30,000	21,000	-39%
033_03	Boulder Creek	38	820	Group B	69%	1.71	12	9,800	17,000	60%	2.20	12	9,800	22,000	5,000	-9%
033_03	Boulder Creek	39	140	Group B	69%	1.71	12	1,700	2,900	30%	3.85	20	2,800	11,000	8,100	-39%
032_03	Boulder Creek	1	410	Hardwoods 1	37%	3.47	14	5,700	20,000	10%	4.95	30	12,000	59,000	39,000	-27%
032_03	Boulder Creek	2	540	Group B	62%	2.09	14	7,600	16,000	50%	2.75	20	11,000	30,000	14,000	-12%
032_03	Boulder Creek	3	570	Hardwoods 1	37%	3.47	14	8,000	28,000	0%	5.50	30	17,000	94,000	66,000	-37%
032_03	Boulder Creek	4	500	Group B	62%	2.09	14	7,000	15,000	50%	2.75	15	7,500	21,000	6,000	-12%
032_03	Boulder Creek	5	290	Hardwoods 1	35%	3.58	15	4,400	16,000	30%	3.85	20	5,800	22,000	6,000	-5%
032_03	Boulder Creek	6	330	Group B	59%	2.26	15	5,000	11,000	70%	1.65	15	5,000	8,300	(2,700)	0%
032_03	Boulder Creek	7	450	Group B	59%	2.26	15	6,800	15,000	50%	2.75	15	6,800	19,000	4,000	-9%
032_03	Boulder Creek	8	340	Group B	59%	2.26	15	5,100	12,000	30%	3.85	20	6,800	26,000	14,000	-29%
032_03	Boulder Creek	9	210	Group B	22%	4.29	50	11,000	47,000	10%	4.95	50	11,000	54,000	7,000	-12%
032_03	Boulder Creek	10	2500	Group B	57%	2.37	16	40,000	95,000	30%	3.85	16	40,000	150,000	55,000	-27%
032_03	Boulder Creek	11	500	Group B	57%	2.37	16	8,000	19,000	10%	4.95	16	8,000	40,000	21,000	-47%
032_03	Boulder Creek	12	160	Group B	35%	3.58	30	4,800	17,000	0%	5.50	30	4,800	26,000	9,000	-35%
							Totals		550,000					1,600,000	1,000,000	

Table B-10. Existing and target solar loads for Brush Creek and tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
039_02	Brush Creek (lef	1	150	Group A	94%	0.33	1	200	70	90%	0.55	1	200	100	30	-4%
039_02	Brush Creek (lef	2	310	Group B	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
039_02	Brush Creek (lef	4	340	Group B	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
039_02	Brush Creek (lef	5	120	Hardwoods 1	94%	0.33	2	200	70	60%	2.20	2	200	400	300	-34%
039_02	Brush Creek (lef	6	90	Hardwoods 1	94%	0.33	2	200	70	80%	1.10	2	200	200	100	-14%
039_02	Brush Creek (lef	7	90	Hardwoods 1	94%	0.33	2	200	70	70%	1.65	2	200	300	200	-24%
039_02	Brush Creek (lef	8	120	Group B	98%	0.11	2	200	20	90%	0.55	2	200	100	80	-8%
039_02	Brush Creek (lef	9	50	Hardwoods 1	94%	0.33	2	100	30	60%	2.20	2	100	200	200	-34%
039_02	Brush Creek (lef	11	110	Hardwoods 1	94%	0.33	2	200	70	50%	2.75	2	200	600	500	-44%
039_02	Brush Creek (rig	1	1600	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
039_02	Brush Creek (rig	2	970	Group B	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
039_02	Brush Creek (rig	3	520	Group B	97%	0.17	3	2,000	300	90%	0.55	3	2,000	1,000	700	-7%
039_02	Brush Creek (rig	4	150	Hardwoods 1	78%	1.21	4	600	700	50%	2.75	4	600	2,000	1,000	-28%
039_02	Brush Creek	1	150	Hardwoods 1	78%	1.21	4	600	700	50%	2.75	4	600	2,000	1,000	-28%
039_02	Brush Creek	3	860	Group B	96%	0.22	4	3,000	700	80%	1.10	4	3,000	3,000	2,000	-16%
039_02	Brush Creek	4	1200	Group B	96%	0.22	4	5,000	1,000	90%	0.55	4	5,000	3,000	2,000	-6%
039_02	Brush Creek	5	1500	Group B	94%	0.33	5	8,000	3,000	80%	1.10	5	8,000	9,000	6,000	-14%
039_02	Brush Creek	6	200	Group B	92%	0.44	6	1,000	400	80%	1.10	6	1,000	1,000	600	-12%
039_02	Brush Creek	7	450	Hardwoods 1	65%	1.93	6	3,000	6,000	70%	1.65	6	3,000	5,000	(1,000)	0%
039_02	Brush Creek	8	260	Hardwoods 1	65%	1.93	6	2,000	4,000	60%	2.20	6	2,000	4,000	0	-5%
039_02	Brush Creek	9	620	Hardwoods 1	65%	1.93	6	4,000	8,000	70%	1.65	6	4,000	7,000	(1,000)	0%
039_02	Brush Creek	10	230	Hardwoods 1	65%	1.93	6	1,000	2,000	50%	2.75	6	1,000	3,000	1,000	-15%
039_02	Brush Creek	12	340	Hardwoods 1	60%	2.20	7	2,000	4,000	20%	4.40	7	2,000	9,000	5,000	-40%
039_02	Brush Creek	13	920	Hardwoods 1	60%	2.20	7	6,000	10,000	10%	4.95	7	6,000	30,000	20,000	-50%
039_02	Brush Creek	14	360	Hardwoods 1	60%	2.20	7	3,000	7,000	0%	5.50	7	3,000	20,000	10,000	-60%
039_02	Brush Creek	15	40	Hardwoods 1	60%	2.20	7	300	700	90%	0.55	7	300	200	(500)	0%
039_02	Brush Creek	16	350	Hardwoods 1	60%	2.20	7	2,000	4,000	0%	5.50	7	2,000	10,000	6,000	-60%
039_02	trib to Brush Cr	1	470	Group B	98%	0.11	1	500	60	40%	3.30	1	500	2,000	2,000	-58%
039_02	trib to Brush Cr	2	140	Group B	98%	0.11	1	100	10	30%	3.85	1	100	400	400	-68%
039_02	trib to Brush Cr	4	560	Group B	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
039_02	trib to Brush Cr	5	420	Group B	98%	0.11	2	800	90	90%	0.55	2	800	400	300	-8%
039_02	trib to Brush Cr	6	550	Group A	93%	0.39	2	1,000	400	90%	0.55	2	1,000	600	200	-3%
							Totals		54,000					120,000	61,000	

Table B-11. Existing and target solar loads for Caribou Creek and tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
017_02	1st to Caribou	2	370	Group D	96%	0.22	1	400	90	90%	0.55	1	400	200	100	-6%
017_02	1st to Caribou	3	270	Group C	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
017_02	1st to Caribou	5	410	Group C	97%	0.17	2	800	100	80%	1.10	2	800	900	800	-17%
017_02	1st to Caribou	6	200	Group C	97%	0.17	2	400	70	60%	2.20	2	400	900	800	-37%
017_02	1st to Caribou	7	590	Group C	97%	0.17	2	1,000	200	90%	0.55	2	1,000	600	400	-7%
017_02	Caribou Creek	2	250	Group C	98%	0.11	1	300	30	40%	3.30	1	300	1,000	1,000	-58%
017_02	Caribou Creek	3	260	Group C	98%	0.11	1	300	30	60%	2.20	1	300	700	700	-38%
017_02	Caribou Creek	4	270	Group C	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
017_02	Caribou Creek	5	100	Group C	98%	0.11	1	100	10	60%	2.20	1	100	200	200	-38%
017_02	Caribou Creek	6	140	Group C	98%	0.11	1	100	10	80%	1.10	1	100	100	90	-18%
017_02	Caribou Creek	7	220	Group C	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
017_02	Caribou Creek	8	190	Group C	97%	0.17	2	400	70	80%	1.10	2	400	400	300	-17%
017_02	Caribou Creek	9	90	Group C	97%	0.17	2	200	30	30%	3.85	2	200	800	800	-67%
017_02	Caribou Creek	10	1700	Group C	96%	0.22	3	5,000	1,000	80%	1.10	3	5,000	6,000	5,000	-16%
017_02	Caribou Creek	11	320	Group C	94%	0.33	4	1,000	300	90%	0.55	4	1,000	600	300	-4%
017_02	Caribou Creek	12	5300	Group B	94%	0.33	5	30,000	10,000	90%	0.55	5	30,000	20,000	10,000	-4%
017_02	Caribou Creek	13	950	Group B	92%	0.44	6	6,000	3,000	80%	1.10	6	6,000	7,000	4,000	-12%
017_02	Caribou Creek	14	2400	Group B	92%	0.44	6	10,000	4,000	90%	0.55	6	10,000	6,000	2,000	-2%
017_02	Caribou Creek	15	1400	Group B	90%	0.55	7	10,000	6,000	90%	0.55	7	10,000	6,000	0	0%
017_02	Caribou Creek	16	1300	Group B	90%	0.55	7	9,000	5,000	90%	0.55	7	9,000	5,000	0	0%
017_02	Caribou Creek	17	490	Group A	60%	2.20	7	3,000	7,000	50%	2.75	7	3,000	8,000	1,000	-10%
							Totals		37,000					65,000	28,000	

Table B-12. Existing and target solar loads for Cascade and Myrtle Creeks.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
014_02	Cascade Creek	1	1400	Group B	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
014_02	Cascade Creek	1	1400	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
014_02	Cascade Creek	1	1400	Group B	97%	0.17	3	4,000	700	90%	0.55	3	4,000	2,000	1,000	-7%
014_02	Cascade Creek	1	1000	Group B	96%	0.22	4	4,000	900	90%	0.55	4	4,000	2,000	1,000	-6%
014_02	Cascade Creek	2	300	Hardwoods 1	78%	1.21	4	1,000	1,000	80%	1.10	4	1,000	1,000	0	0%
014_02	Cascade Creek	3	180	Hardwoods 1	78%	1.21	4	700	800	40%	3.30	4	700	2,000	1,000	-38%
014_02	Cascade Creek	4	90	Hardwoods 1	78%	1.21	4	400	500	10%	4.95	4	400	2,000	2,000	-68%
013_03	Myrtle Creek	1	1100	Group B	90%	0.55	7	8,000	4,000	70%	1.65	7	8,000	10,000	6,000	-20%
013_03	Myrtle Creek	2	360	Group B	87%	0.72	8	3,000	2,000	60%	2.20	8	3,000	7,000	5,000	-27%
013_03	Myrtle Creek	3	840	Group B	87%	0.72	8	7,000	5,000	70%	1.65	8	7,000	10,000	5,000	-17%
013_03	Myrtle Creek	4	160	Group B	83%	0.94	9	1,000	900	60%	2.20	9	1,000	2,000	1,000	-23%
013_03	Myrtle Creek	5	250	Group B	83%	0.94	9	2,000	2,000	80%	1.10	9	2,000	2,000	0	-3%
013_03	Myrtle Creek	6	1400	Group B	83%	0.94	9	10,000	9,000	70%	1.65	9	10,000	20,000	10,000	-13%
013_03	Myrtle Creek	7	50	Group B	83%	0.94	9	500	500	60%	2.20	9	500	1,000	500	-23%
013_03	Myrtle Creek	8	3500	Group B	78%	1.21	10	35,000	42,000	70%	1.65	10	35,000	58,000	16,000	-8%
013_03	Myrtle Creek	9	1100	Group B	73%	1.49	11	12,000	18,000	80%	1.10	11	12,000	13,000	(5,000)	0%
013_03	Myrtle Creek	10	810	Group B	73%	1.49	11	8,900	13,000	60%	2.20	11	8,900	20,000	7,000	-13%
013_03	Myrtle Creek	11	340	Group B	73%	1.49	11	3,700	5,500	70%	1.65	11	3,700	6,100	600	-3%
013_03	Myrtle Creek	12	1100	Group B	73%	1.49	11	12,000	18,000	50%	2.75	11	12,000	33,000	15,000	-23%
013_03	Myrtle Creek	13	1400	Group B	69%	1.71	12	17,000	29,000	60%	2.20	12	17,000	37,000	8,000	-9%
013_03	Myrtle Creek	14	320	Group B	69%	1.71	12	3,800	6,500	70%	1.65	12	3,800	6,300	(200)	0%
013_03	Myrtle Creek	15	1200	Group B	69%	1.71	12	14,000	24,000	80%	1.10	12	14,000	15,000	(9,000)	0%
013_03	Myrtle Creek	16	220	Group B	69%	1.71	12	2,600	4,400	70%	1.65	12	2,600	4,300	(100)	0%
013_03	Myrtle Creek	17	210	Group B	69%	1.71	12	2,500	4,300	30%	3.85	12	2,500	9,600	5,300	-39%
013_03	Myrtle Creek	18	1900	Hardwoods 1	41%	3.25	12	23,000	75,000	0%	5.50	12	23,000	130,000	55,000	-41%
013_03	Myrtle Creek	19	1100	Hardwoods 1	39%	3.36	13	14,000	47,000	0%	5.50	13	14,000	77,000	30,000	-39%
013_03	Myrtle Creek	20	260	Hardwoods 1	39%	3.36	13	3,400	11,000	10%	4.95	13	3,400	17,000	6,000	-29%
							Totals		330,000					490,000	160,000	

Table B-13. Existing and target solar loads for Brush and Cow Creeks.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
030_03	Brush Creek	1	130	Hardwoods 1	86%	0.77	3	400	300	50%	2.75	3	400	1,000	700	-36%
030_03	Brush Creek	2	150	Hardwoods 1	86%	0.77	3	500	400	30%	3.85	3	500	2,000	2,000	-56%
030_03	Cow Creek	1	300	Hardwoods 1	78%	1.21	4	1,000	1,000	30%	3.85	4	1,000	4,000	3,000	-48%
030_03	Cow Creek	2	220	Hardwoods 1	78%	1.21	4	900	1,000	0%	5.50	4	900	5,000	4,000	-78%
030_03	Cow Creek	3	640	Hardwoods 1	78%	1.21	4	3,000	4,000	70%	1.65	4	3,000	5,000	1,000	-8%
030_03	Cow Creek	4	110	Hardwoods 1	78%	1.21	4	400	500	0%	5.50	4	400	2,000	2,000	-78%
030_03	Cow Creek	5	90	Hardwoods 1	78%	1.21	4	400	500	10%	4.95	4	400	2,000	2,000	-68%
030_03	Cow Creek	6	250	Hardwoods 1	78%	1.21	4	1,000	1,000	90%	0.55	4	1,000	600	(400)	0%
030_03	Cow Creek	7	250	Hardwoods 1	78%	1.21	4	1,000	1,000	10%	4.95	4	1,000	5,000	4,000	-68%
030_03	Cow Creek	8	220	Hardwoods 1	78%	1.21	4	900	1,000	30%	3.85	4	900	3,000	2,000	-48%
030_03	Cow Creek	9	440	Hardwoods 1	78%	1.21	4	2,000	2,000	0%	5.50	4	2,000	10,000	8,000	-78%
030_03	Cow Creek	10	640	Hardwoods 1	72%	1.54	5	3,000	5,000	40%	3.30	5	3,000	10,000	5,000	-32%
030_03	Cow Creek	11	450	Hardwoods 1	72%	1.54	5	2,000	3,000	10%	4.95	5	2,000	10,000	7,000	-62%
030_03	Cow Creek	12	570	Hardwoods 1	65%	1.93	6	3,000	6,000	0%	5.50	6	3,000	20,000	10,000	-65%
								Totals	27,000					80,000	50,000	

Table B-14. Existing and target solar loads for Curley Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
035_03	Curley Creek	1	1300	Group B	97%	0.17	3	4,000	700	80%	1.10	3	4,000	4,000	3,000	-17%
035_03	Curley Creek	2	120	Group B	97%	0.17	3	400	70	70%	1.65	3	400	700	600	-27%
035_03	Curley Creek	3	470	Group B	97%	0.17	3	1,000	200	80%	1.10	3	1,000	1,000	800	-17%
035_03	Curley Creek	4	540	Group B	97%	0.17	3	2,000	300	90%	0.55	3	2,000	1,000	700	-7%
035_03	Curley Creek	5	310	Hawthorn	71%	1.60	3	900	1,000	80%	1.10	3	900	1,000	0	0%
035_03	Curley Creek	6	130	Hawthorn	71%	1.60	3	400	600	70%	1.65	3	400	700	100	-1%
035_03	Curley Creek	7	190	Hawthorn	71%	1.60	3	600	1,000	40%	3.30	3	600	2,000	1,000	-31%
035_03	Curley Creek	8	100	Hawthorn	71%	1.60	3	300	500	30%	3.85	3	300	1,000	500	-41%
035_03	Curley Creek	9	70	Hawthorn	71%	1.60	3	200	300	0%	5.50	3	200	1,000	700	-71%
035_03	Curley Creek	10	310	Hawthorn	60%	2.20	4	1,000	2,000	40%	3.30	4	1,000	3,000	1,000	-20%
035_03	Curley Creek	11	800	Hawthorn	60%	2.20	4	3,000	7,000	50%	2.75	4	3,000	8,000	1,000	-10%
035_03	Curley Creek	12	700	Hawthorn	60%	2.20	4	3,000	7,000	40%	3.30	4	3,000	10,000	3,000	-20%
035_03	Curley Creek	13	320	Hawthorn	60%	2.20	4	1,000	2,000	20%	4.40	4	1,000	4,000	2,000	-40%
035_03	Curley Creek	14	400	Hawthorn	60%	2.20	4	2,000	4,000	0%	5.50	4	2,000	10,000	6,000	-60%
035_03	Curley Creek	15	80	Hawthorn	60%	2.20	4	300	700	30%	3.85	4	300	1,000	300	-30%
035_03	Curley Creek	16	240	Hawthorn	51%	2.70	5	1,000	3,000	50%	2.75	5	1,000	3,000	0	-1%
035_03	Curley Creek	17	520	Hawthorn	45%	3.03	6	3,000	9,000	0%	5.50	6	3,000	20,000	10,000	-45%
035_03	Curley Creek	18	210	Hawthorn	51%	2.70	5	1,000	3,000	20%	4.40	5	1,000	4,000	1,000	-31%
MT	Curley Creek	19	3100	NA	0%	5.50	0	0	0	0%	5.50	0	0	0	0	0%
035_03	Curley Creek	31	220	Group B	96%	0.22	4	900	200	90%	0.55	4	900	500	300	-6%
035_03	Curley Creek	32	100	Hardwoods 1	78%	1.21	4	400	500	70%	1.65	4	400	700	200	-8%
035_03	Curley Creek	33	550	Hardwoods 1	78%	1.21	4	2,000	2,000	10%	4.95	4	2,000	10,000	8,000	-68%
035_03	Curley Creek	35	310	Group B	96%	0.22	4	1,000	200	90%	0.55	4	1,000	600	400	-6%
035_03	Curley Creek	36	560	Hardwoods 1	78%	1.21	4	2,000	2,000	50%	2.75	4	2,000	6,000	4,000	-28%
035_03	Curley Creek	37	360	Hardwoods 1	78%	1.21	4	1,000	1,000	10%	4.95	4	1,000	5,000	4,000	-68%
035_03	Curley Creek	38	110	Hardwoods 1	78%	1.21	4	400	500	30%	3.85	4	400	2,000	2,000	-48%
035_03	Curley Creek	39	770	Hardwoods 1	78%	1.21	4	3,000	4,000	10%	4.95	4	3,000	10,000	6,000	-68%
035_03	Curley Creek	40	990	Group A	78%	1.21	4	4,000	5,000	90%	0.55	4	4,000	2,000	(3,000)	0%
							Totals		58,000					110,000	54,000	

Table B-15. Existing and target solar loads for Fall Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
021_03	Fall Creek	1	430	Group B	90%	0.55	7	3,000	2,000	40%	3.30	10	4,000	10,000	8,000	-50%
021_03	Fall Creek	2	1100	Group B	90%	0.55	7	8,000	4,000	70%	1.65	7	8,000	10,000	6,000	-20%
021_03	Fall Creek	3	390	Group B	90%	0.55	7	3,000	2,000	80%	1.10	7	3,000	3,000	1,000	-10%
021_03	Fall Creek	4	250	Group B	90%	0.55	7	2,000	1,000	70%	1.65	7	2,000	3,000	2,000	-20%
021_03	Fall Creek	5	1300	Group B	87%	0.72	8	10,000	7,000	80%	1.10	8	10,000	10,000	3,000	-7%
021_03	Fall Creek	6	1500	Group B	87%	0.72	8	10,000	7,000	90%	0.55	8	10,000	6,000	(1,000)	0%
021_03	Fall Creek	7	630	Group B	87%	0.72	8	5,000	4,000	80%	1.10	8	5,000	6,000	2,000	-7%
021_03	Fall Creek	8	250	Group B	87%	0.72	8	2,000	1,000	70%	1.65	8	2,000	3,000	2,000	-17%
021_03	Fall Creek	9	820	Hawthorn	32%	3.74	9	7,000	30,000	40%	3.30	9	7,000	20,000	(10,000)	0%
021_03	Fall Creek	10	90	Hawthorn	32%	3.74	9	800	3,000	60%	2.20	9	800	2,000	(1,000)	0%
021_03	Fall Creek	11	320	Hawthorn	32%	3.74	9	3,000	10,000	40%	3.30	9	3,000	10,000	0	0%
021_03	Fall Creek	12	70	Hawthorn	32%	3.74	9	600	2,000	60%	2.20	9	600	1,000	(1,000)	0%
021_03	Fall Creek	13	260	Hawthorn	32%	3.74	9	2,000	7,000	20%	4.40	9	2,000	9,000	2,000	-12%
021_03	Fall Creek	14	510	Hawthorn	32%	3.74	9	5,000	20,000	10%	4.95	9	5,000	20,000	0	-22%
021_03	Fall Creek	15	210	Hawthorn	32%	3.74	9	2,000	7,000	20%	4.40	9	2,000	9,000	2,000	-12%
021_03	Fall Creek	16	410	Group A	48%	2.86	10	4,100	12,000	70%	1.65	10	4,100	6,800	(5,200)	0%
021_03	Fall Creek	17	240	Group A	48%	2.86	10	2,400	6,900	80%	1.10	10	2,400	2,600	(4,300)	0%
021_03	Fall Creek	18	170	Group A	48%	2.86	10	1,700	4,900	70%	1.65	10	1,700	2,800	(2,100)	0%
021_03	Fall Creek	19	380	Hawthorn	29%	3.91	10	3,800	15,000	40%	3.30	12	4,600	15,000	0	0%
021_03	Fall Creek	20	330	Hawthorn	29%	3.91	10	3,300	13,000	20%	4.40	14	4,600	20,000	7,000	-9%
021_03	Fall Creek	21	250	Hawthorn	29%	3.91	10	2,500	9,800	10%	4.95	15	3,800	19,000	9,200	-19%
021_03	Fall Creek	22	290	Hawthorn	29%	3.91	10	2,900	11,000	40%	3.30	12	3,500	12,000	1,000	0%
021_03	Fall Creek	23	180	Hawthorn	29%	3.91	10	1,800	7,000	10%	4.95	15	2,700	13,000	6,000	-19%
021_03	Fall Creek	24	100	Hawthorn	29%	3.91	10	1,000	3,900	40%	3.30	12	1,200	4,000	100	0%
021_03	Fall Creek	25	160	Hawthorn	27%	4.02	11	1,800	7,200	10%	4.95	15	2,400	12,000	4,800	-17%
021_03	Fall Creek	26	260	Hawthorn	27%	4.02	11	2,900	12,000	0%	5.50	15	3,900	21,000	9,000	-27%
021_03	Fall Creek	27	330	Hawthorn	27%	4.02	11	3,600	14,000	30%	3.85	12	4,000	15,000	1,000	0%
021_03	Fall Creek	28	170	Hawthorn	27%	4.02	11	1,900	7,600	40%	3.30	11	1,900	6,300	(1,300)	0%
021_03	Fall Creek	29	330	Hawthorn	27%	4.02	11	3,600	14,000	60%	2.20	11	3,600	7,900	(6,100)	0%
021_03	Fall Creek	30	260	Hawthorn	27%	4.02	11	2,900	12,000	40%	3.30	11	2,900	9,600	(2,400)	0%
021_03	Fall Creek	31	130	Hawthorn	27%	4.02	11	1,400	5,600	30%	3.85	11	1,400	5,400	(200)	0%
021_03	Fall Creek	32	820	Hawthorn	27%	4.02	11	9,000	36,000	40%	3.30	11	9,000	30,000	(6,000)	0%
							Totals		300,000					320,000	26,000	

Table B-16. Existing and target solar loads for Grass Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
003_02	Grass Creek	1	130	Group C	98%	0.11	1	100	10	80%	1.10	1	100	100	90	-18%
003_02	Grass Creek	2	560	Group D	96%	0.22	1	600	100	80%	1.10	1	600	700	600	-16%
003_02	Grass Creek	3	210	Group B	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
003_02	Grass Creek	4	830	Group B	98%	0.11	2	2,000	200	70%	1.65	2	2,000	3,000	3,000	-28%
003_02	Grass Creek	5	410	Group B	98%	0.11	2	800	90	80%	1.10	2	800	900	800	-18%
003_02	Grass Creek	6	300	Group B	97%	0.17	3	900	100	90%	0.55	3	900	500	400	-7%
003_02	Grass Creek	7	170	Group B	97%	0.17	3	500	80	80%	1.10	3	500	600	500	-17%
003_02	Grass Creek	8	160	Group B	96%	0.22	4	600	100	80%	1.10	4	600	700	600	-16%
003_02	Grass Creek	9	560	Group B	96%	0.22	4	2,000	400	60%	2.20	4	2,000	4,000	4,000	-36%
003_02	Grass Creek	10	220	Group B	94%	0.33	5	1,000	300	70%	1.65	5	1,000	2,000	2,000	-24%
003_03	Grass Creek	1	370	Group B	94%	0.33	5	2,000	700	70%	1.65	5	2,000	3,000	2,000	-24%
003_03	Grass Creek	2	110	Group B	92%	0.44	6	700	300	60%	2.20	6	700	2,000	2,000	-32%
003_03	Grass Creek	3	180	Group B	92%	0.44	6	1,000	400	80%	1.10	6	1,000	1,000	600	-12%
003_03	Grass Creek	4	120	Group B	92%	0.44	6	700	300	50%	2.75	6	700	2,000	2,000	-42%
003_03	Grass Creek	5	280	Group B	92%	0.44	6	2,000	900	60%	2.20	6	2,000	4,000	3,000	-32%
003_03	Grass Creek	6	630	Group B	92%	0.44	6	4,000	2,000	70%	1.65	6	4,000	7,000	5,000	-22%
003_03	Grass Creek	7	190	Group B	92%	0.44	6	1,000	400	80%	1.10	6	1,000	1,000	600	-12%
003_03	Grass Creek	8	180	Group B	92%	0.44	6	1,000	400	60%	2.20	6	1,000	2,000	2,000	-32%
003_03	Grass Creek	9	950	Group B	90%	0.55	7	7,000	4,000	80%	1.10	7	7,000	8,000	4,000	-10%
003_03	Grass Creek	10	80	Group B	90%	0.55	7	600	300	60%	2.20	7	600	1,000	700	-30%
003_03	Grass Creek	11	350	Group B	90%	0.55	7	2,000	1,000	70%	1.65	7	2,000	3,000	2,000	-20%
003_03	Grass Creek	12	460	Group B	90%	0.55	7	3,000	2,000	80%	1.10	7	3,000	3,000	1,000	-10%
003_03	Grass Creek	13	330	Group B	90%	0.55	7	2,000	1,000	60%	2.20	7	2,000	4,000	3,000	-30%
003_03	Grass Creek	14	230	Group B	90%	0.55	7	2,000	1,000	50%	2.75	7	2,000	6,000	5,000	-40%
003_03	Grass Creek	15	90	Group B	87%	0.72	8	700	500	80%	1.10	8	700	800	300	-7%
003_03	Grass Creek	16	480	Group B	87%	0.72	8	4,000	3,000	60%	2.20	9	4,000	9,000	6,000	-27%
003_03	Grass Creek	17	970	Group B	87%	0.72	8	8,000	6,000	50%	2.75	9	9,000	20,000	10,000	-37%
003_03	Grass Creek	18	640	Group B	87%	0.72	8	5,000	4,000	80%	1.10	9	6,000	7,000	3,000	-7%
003_03	Grass Creek	19	410	Group B	83%	0.94	9	3,700	3,500	80%	1.10	10	4,100	4,500	1,000	-3%
003_03	Grass Creek	20	420	Group B	83%	0.94	9	4,000	4,000	50%	2.75	10	4,000	10,000	6,000	-33%
003_03	Grass Creek	21	170	Group B	83%	0.94	9	2,000	2,000	80%	1.10	10	2,000	2,000	0	-3%
003_03	Grass Creek	22	100	Group B	83%	0.94	9	900	800	60%	2.20	10	1,000	2,000	1,000	-23%
003_03	Grass Creek	23	150	Group B	83%	0.94	9	1,000	900	80%	1.10	10	2,000	2,000	1,000	-3%
003_03	Grass Creek	24	250	Group B	83%	0.94	9	2,000	2,000	50%	2.75	10	3,000	8,000	6,000	-33%
003_03	Grass Creek	25	240	Group B	83%	0.94	9	2,000	2,000	70%	1.65	10	2,000	3,000	1,000	-13%
003_03	Grass Creek	26	500	Group B	83%	0.94	9	5,000	5,000	50%	2.75	11	6,000	20,000	20,000	-33%
003_03	Grass Creek	27	1580	Group B	78%	1.21	10	16,000	19,000	70%	1.65	11	17,000	28,000	9,000	-8%
003_03	Grass Creek	28	370	Group B	78%	1.21	10	3,700	4,500	50%	2.75	12	4,400	12,000	7,500	-28%
003_03	Grass Creek	29	1230	Group B	73%	1.49	11	14,000	21,000	70%	1.65	12	15,000	25,000	4,000	-3%
003_03	Grass Creek	30	340	Group B	73%	1.49	11	3,700	5,500	60%	2.20	12	4,100	9,000	3,500	-13%
							Totals		100,000					220,000	120,000	

Table B-17. Existing and target solar loads for Grass Creek tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
003_02	1st to Grass Cr	1	580	Group C	98%	0.11	1	600	70	60%	2.20	1	600	1,000	900	-38%
003_02	1st to Grass Cr	2	550	Group B	98%	0.11	1	600	70	60%	2.20	1	600	1,000	900	-38%
003_02	1st to Grass Cr	3	600	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
003_02	1st to Grass Cr	4	160	Group B	98%	0.11	2	300	30	60%	2.20	2	300	700	700	-38%
003_02	1st to Grass Cr	5	210	Group B	98%	0.11	2	400	40	90%	0.55	2	400	200	200	-8%
003_02	1st to Grass Cr	6	590	Group B	97%	0.17	3	2,000	300	80%	1.10	3	2,000	2,000	2,000	-17%
003_02	1st to Grass Cr	7	400	Group B	97%	0.17	3	1,000	200	90%	0.55	3	1,000	600	400	-7%
003_02	2nd to Grass Cr	1	250	Group C	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
003_02	2nd to Grass Cr	2	130	Group D	96%	0.22	1	100	20	80%	1.10	1	100	100	80	-16%
003_02	2nd to Grass Cr	3	990	Group B	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
003_02	2nd to Grass Cr	4	310	Group B	98%	0.11	2	600	70	90%	0.55	2	600	300	200	-8%
003_02	2nd to Grass Cr	5	420	Group B	98%	0.11	2	800	90	70%	1.65	2	800	1,000	900	-28%
003_02	2nd to Grass Cr	6	1400	Group B	97%	0.17	3	4,000	700	80%	1.10	3	4,000	4,000	3,000	-17%
003_02	3rd to Grass Cr	1	420	Group C	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
003_02	3rd to Grass Cr	2	160	Group B	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
003_02	3rd to Grass Cr	3	590	Group B	98%	0.11	1	600	70	70%	1.65	1	600	1,000	900	-28%
003_02	3rd to Grass Cr	4	940	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
003_02	4th to Grass Cr	1	410	Group C	98%	0.11	1	400	40	80%	1.10	1	400	400	400	-18%
003_02	4th to Grass Cr	2	880	Group B	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
003_02	4th to Grass Cr	3	1130	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
003_02	4th to Grass Cr	4	160	Group B	98%	0.11	2	300	30	60%	2.20	2	300	700	700	-38%
003_02	1st to 4th trib	1	260	Group D	96%	0.22	1	300	70	70%	1.65	1	300	500	400	-26%
003_02	1st to 4th trib	2	450	Group B	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
003_02	1st to 4th trib	3	610	Group B	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
003_02	1st to 4th trib	4	170	Group B	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
003_02	1st to 4th trib	5	70	Group B	98%	0.11	1	70	8	70%	1.65	1	70	100	90	-28%
003_02	1st to 4th trib	6	60	Group B	98%	0.11	1	60	7	90%	0.55	1	60	30	20	-8%
003_02	5th to Grass Cr	1	590	Group C	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
003_02	5th to Grass Cr	2	940	Group B	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
003_02	5th to Grass Cr	3	170	Group B	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
003_02	6th to Grass Cr	1	440	Group D	96%	0.22	1	400	90	70%	1.65	1	400	700	600	-26%
003_02	6th to Grass Cr	2	740	Group B	98%	0.11	1	700	80	80%	1.10	1	700	800	700	-18%
003_02	6th to Grass Cr	3	530	Group B	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
003_02	Search Creek	2	570	Group C	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
003_02	Search Creek	3	870	Group B	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
003_02	Search Creek	4	400	Group B	98%	0.11	2	800	90	70%	1.65	2	800	1,000	900	-28%
003_02	Search Creek	5	1000	Group B	97%	0.17	3	3,000	500	80%	1.10	3	3,000	3,000	3,000	-17%
003_02	Search Creek	6	270	Group B	97%	0.17	3	800	100	90%	0.55	3	800	400	300	-7%
003_02	8th to Grass Cr	1	1900	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
003_02	9th to Grass Cr	1	400	Group C	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
003_02	9th to Grass Cr	2	500	Group C	98%	0.11	1	500	60	80%	1.10	1	500	600	500	-18%
003_02	9th to Grass Cr	3	130	Group B	98%	0.11	1	100	10	90%	0.55	1	100	60	50	-8%
003_02	9th to Grass Cr	4	320	Group B	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
003_02	9th to Grass Cr	5	860	Group B	98%	0.11	2	2,000	200	70%	1.65	2	2,000	3,000	3,000	-28%
003_02	9th to Grass Cr	6	550	Group B	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
003_02	10th to Grass	1	400	Group D	96%	0.22	1	400	90	90%	0.55	1	400	200	100	-6%
003_02	10th to Grass	2	330	Group B	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
003_02	10th to Grass	3	530	Group B	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
003_02	10th to Grass	4	390	Group B	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
003_02	Marsh Creek	2	1100	Group C	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
003_02	Marsh Creek	3	2400	Group B	98%	0.11	2	5,000	600	80%	1.10	2	5,000	6,000	5,000	-18%
003_02	Marsh Creek	4	370	Group B	97%	0.17	3	1,000	200	90%	0.55	3	1,000	600	400	-7%
003_02	12th to Grass	1	1200	Group C	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
003_02	12th to Grass	2	1800	Group B	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
003_02	12th to Grass	3	260	Group B	97%	0.17	3	800	100	90%	0.55	3	800	400	300	-7%
003_02	13th to Grass	1	400	Group C	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
003_02	13th to Grass	2	1400	Group B	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
003_02	14th to Grass	1	700	Group C	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
003_02	14th to Grass	2	1200	Group B	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
003_02	14th to Grass	3	270	Group B	98%	0.11	2	500	60	80%	1.10	2	500	600	500	-18%
003_02	14th to Grass	4	160	Group B	98%	0.11	2	300	30	90%	0.55	2	300	200	200	-8%
003_02	Silver Creek	1	750	Group C	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
003_02	Silver Creek	2	400	Group B	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
003_02	Silver Creek	3	310	Group B	98%	0.11	2	600	70	80%	1.10	2	600	700	600	-18%
003_02	Silver Creek	4	2100	Group B	97%	0.17	3	6,000	1,000	90%	0.55	3	6,000	3,000	2,000	-7%
							Totals		8,000					54,000	46,000	

Table B-18. Existing and target solar loads for Long Canyon Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
008_02	Long Canyon Cr	1	2800	Group C	97%	0.17	2	6,000	1,000	90%	0.55	2	6,000	3,000	2,000	-7%
008_02	Long Canyon Cr	2	1100	Group C	94%	0.33	4	4,000	1,000	80%	1.10	4	4,000	4,000	3,000	-14%
008_02	Long Canyon Cr	3	2100	Group C	92%	0.44	5	10,000	4,000	80%	1.10	5	10,000	10,000	6,000	-12%
008_02	Long Canyon Cr	4	1600	Group B	92%	0.44	6	10,000	4,000	70%	1.65	6	10,000	20,000	20,000	-22%
008_02	Long Canyon Cr	5	300	Group B	92%	0.44	6	2,000	900	70%	1.65	6	2,000	3,000	2,000	-22%
008_02	Long Canyon Cr	6	290	Hardwoods 1	65%	1.93	6	2,000	4,000	40%	3.30	7	2,000	7,000	3,000	-25%
008_02	Long Canyon Cr	7	100	Group B	92%	0.44	6	600	300	80%	1.10	7	700	800	500	-12%
008_02	Long Canyon Cr	8	860	Group B	90%	0.55	7	6,000	3,000	70%	1.65	7	6,000	10,000	7,000	-20%
008_02	Long Canyon Cr	9	50	Group B	90%	0.55	7	400	200	80%	1.10	7	400	400	200	-10%
008_02	Long Canyon Cr	10	180	Group B	90%	0.55	7	1,000	600	80%	1.10	7	1,000	1,000	400	-10%
008_02	Long Canyon Cr	11	340	Group B	90%	0.55	7	2,000	1,000	70%	1.65	7	2,000	3,000	2,000	-20%
008_02	Long Canyon Cr	12	220	Group B	90%	0.55	7	2,000	1,000	80%	1.10	7	2,000	2,000	1,000	-10%
008_02	Long Canyon Cr	13	130	Group B	90%	0.55	7	900	500	70%	1.65	7	900	1,000	500	-20%
008_02	Long Canyon Cr	14	1200	Group B	87%	0.72	8	10,000	7,000	70%	1.65	8	10,000	20,000	10,000	-17%
008_02	Long Canyon Cr	15	1500	Group B	87%	0.72	8	10,000	7,000	80%	1.10	8	10,000	10,000	3,000	-7%
008_02	Long Canyon Cr	16	410	Group B	83%	0.94	9	4,000	4,000	80%	1.10	9	4,000	4,000	0	-3%
008_02	Long Canyon Cr	17	320	Group B	83%	0.94	9	3,000	3,000	70%	1.65	9	3,000	5,000	2,000	-13%
008_02	Long Canyon Cr	18	530	Group B	83%	0.94	9	5,000	5,000	80%	1.10	9	5,000	6,000	1,000	-3%
008_02	Long Canyon Cr	19	160	Group B	83%	0.94	9	1,000	900	90%	0.55	9	1,000	600	(300)	0%
008_02	Long Canyon Cr	20	320	Group B	83%	0.94	9	3,000	3,000	80%	1.10	9	3,000	3,000	0	-3%
008_02	Long Canyon Cr	21	1700	Group B	83%	0.94	9	20,000	20,000	80%	1.10	10	20,000	20,000	0	-3%
008_02	Long Canyon Cr	22	180	Group B	78%	1.21	10	1,800	2,200	70%	1.65	10	1,800	3,000	800	-8%
008_02	Long Canyon Cr	23	220	Group B	78%	1.21	10	2,200	2,700	90%	0.55	10	2,200	1,200	(1,500)	0%
008_02	Long Canyon Cr	24	1300	Group B	78%	1.21	10	13,000	16,000	80%	1.10	10	13,000	14,000	(2,000)	0%
008_02	Long Canyon Cr	25	1400	Group B	78%	1.21	10	14,000	17,000	70%	1.65	11	15,000	25,000	8,000	-8%
008_02	Long Canyon Cr	26	360	Group B	78%	1.21	10	3,600	4,400	80%	1.10	11	4,000	4,400	0	0%
008_02	Long Canyon Cr	27	100	Group B	78%	1.21	10	1,000	1,200	70%	1.65	11	1,100	1,800	600	-8%
008_02	Long Canyon Cr	28	2000	Group B	78%	1.21	10	20,000	24,000	80%	1.10	12	24,000	26,000	2,000	0%
008_02	Long Canyon Cr	29	590	Group B	73%	1.49	11	6,500	9,700	70%	1.65	13	7,700	13,000	3,300	-3%
008_02	Long Canyon Cr	30	280	Group B	73%	1.49	11	3,100	4,600	60%	2.20	13	3,600	7,900	3,300	-13%
008_02	Long Canyon Cr	31	260	Group B	73%	1.49	11	2,900	4,300	40%	3.30	13	3,400	11,000	6,700	-33%
008_02	Long Canyon Cr	32	150	Group A	45%	3.03	11	1,700	5,100	50%	2.75	13	2,000	5,500	400	0%
008_02	Long Canyon Cr	33	200	Hardwoods 1	45%	3.03	11	2,200	6,700	20%	4.40	13	2,600	11,000	4,300	-25%
008_02	Long Canyon Cr	34	840	Hardwoods 1	45%	3.03	11	9,200	28,000	0%	5.50	13	11,000	61,000	33,000	-45%
							Totals		200,000					320,000	120,000	

Table B-19. Existing and target solar loads for Long Canyon Creek tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
008_02	1st to Long Can	1	1600	Group C	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
008_02	2nd to Long Car	2	600	Group D	96%	0.22	1	600	100	90%	0.55	1	600	300	200	-6%
008_02	2nd to Long Car	3	1500	Group C	97%	0.17	2	3,000	500	90%	0.55	2	3,000	2,000	2,000	-7%
008_02	2nd to Long Car	4	660	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
008_02	3rd to Long Can	1	920	Group D	96%	0.22	1	900	200	90%	0.55	1	900	500	300	-6%
008_02	3rd to Long Can	2	440	Group D	96%	0.22	1	400	90	80%	1.10	1	400	400	300	-16%
008_02	3rd to Long Can	3	420	Group B	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
008_02	Smith Lake trib	2	220	Group D	96%	0.22	1	200	40	90%	0.55	1	200	100	60	-6%
008_02	Smith Lake trib	3	1700	Group C	97%	0.17	2	3,000	500	90%	0.55	2	3,000	2,000	2,000	-7%
008_02	Smith Lake trib	4	1200	Group B	97%	0.17	3	4,000	700	90%	0.55	3	4,000	2,000	1,000	-7%
008_02	5th to Long Can	1	1120	Group C	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
008_02	5th to Long Can	2	680	Group B	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
008_02	6th to Long Can	1	630	Group D	96%	0.22	1	600	100	90%	0.55	1	600	300	200	-6%
008_02	6th to Long Can	2	600	Group C	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
008_02	6th to Long Can	3	660	Group B	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
008_02	7th to Long Can	1	810	Group D	96%	0.22	1	800	200	90%	0.55	1	800	400	200	-6%
008_02	7th to Long Can	2	790	Group B	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
008_02	Parker Lake trib	2	250	Group D	96%	0.22	1	300	70	90%	0.55	1	300	200	100	-6%
008_02	Parker Lake trib	3	2700	Group B	97%	0.17	3	8,000	1,000	90%	0.55	3	8,000	4,000	3,000	-7%
008_02	Canyon Lake tri	2	660	Group C	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
008_02	Canyon Lake tri	3	520	Group A	94%	0.33	1	500	200	90%	0.55	1	500	300	100	-4%
008_02	Canyon Lake tri	4	440	Group B	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
008_02	10th to Long Ca	1	1500	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
008_02	11th to Long Ca	1	1500	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
008_02	12th to Long Ca	1	230	Group C	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
008_02	12th to Long Ca	2	1500	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
							Totals		5,400					22,000	18,000	

Table B-20. Existing and target solar loads for Mission Creek and tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
040_03	Mission Creek	1	190	Group B	92%	0.44	6	1,000	400	40%	3.30	6	1,000	3,000	3,000	-52%
040_03	Mission Creek	2	490	Group B	92%	0.44	6	3,000	1,000	60%	2.20	6	3,000	7,000	6,000	-32%
040_03	Mission Creek	3	220	Group B	92%	0.44	6	1,000	400	30%	3.85	6	1,000	4,000	4,000	-62%
040_03	Mission Creek	4	100	Group B	92%	0.44	6	600	300	50%	2.75	6	600	2,000	2,000	-42%
040_03	Mission Creek	5	160	Group B	92%	0.44	6	1,000	400	70%	1.65	6	1,000	2,000	2,000	-22%
040_03	Mission Creek	6	200	Group B	92%	0.44	6	1,000	400	50%	2.75	6	1,000	3,000	3,000	-42%
040_03	Mission Creek	7	610	Group B	90%	0.55	7	4,000	2,000	80%	1.10	7	4,000	4,000	2,000	-10%
040_03	Mission Creek	8	120	Group B	90%	0.55	7	800	400	60%	2.20	7	800	2,000	2,000	-30%
040_03	Mission Creek	9	1030	Group B	90%	0.55	7	7,000	4,000	80%	1.10	7	7,000	8,000	4,000	-10%
040_03	Mission Creek	10	370	Group B	87%	0.72	8	3,000	2,000	70%	1.65	8	3,000	5,000	3,000	-17%
040_03	Mission Creek	11	470	Group B	87%	0.72	8	4,000	3,000	80%	1.10	8	4,000	4,000	1,000	-7%
040_03	Mission Creek	12	450	Group B	87%	0.72	8	4,000	3,000	70%	1.65	8	4,000	7,000	4,000	-17%
040_03	Mission Creek	13	350	Group B	87%	0.72	8	3,000	2,000	80%	1.10	8	3,000	3,000	1,000	-7%
040_03	Mission Creek	14	1100	Group B	83%	0.94	9	10,000	9,000	70%	1.65	9	10,000	20,000	10,000	-13%
040_03	Mission Creek	15	230	Group B	83%	0.94	9	2,000	2,000	90%	0.55	9	2,000	1,000	(1,000)	0%
040_03	Mission Creek	16	280	Group B	83%	0.94	9	3,000	3,000	70%	1.65	9	3,000	5,000	2,000	-13%
040_03	Mission Creek	17	110	Group B	83%	0.94	9	1,000	900	40%	3.30	9	1,000	3,000	2,000	-43%
040_03	Mission Creek	18	260	Group B	78%	1.21	10	2,600	3,100	70%	1.65	10	2,600	4,300	1,200	-8%
040_03	Mission Creek	19	130	Group B	78%	1.21	10	1,300	1,600	80%	1.10	10	1,300	1,400	(200)	0%
040_03	Mission Creek	20	300	Group B	78%	1.21	10	3,000	3,600	60%	2.20	10	3,000	6,600	3,000	-18%
040_03	Mission Creek	21	210	Group B	78%	1.21	10	2,100	2,500	40%	3.30	10	2,100	6,900	4,400	-38%
040_03	Mission Creek	22	300	Group B	78%	1.21	10	3,000	3,600	30%	3.85	10	3,000	12,000	8,400	-48%
040_03	Mission Creek	23	210	Group B	78%	1.21	10	2,100	2,500	10%	4.95	10	2,100	10,000	7,500	-68%
040_03	Mission Creek	24	460	Group B	78%	1.21	10	4,600	5,600	80%	1.10	10	4,600	5,100	(500)	0%
040_03	Mission Creek	25	890	Group B	78%	1.21	10	8,900	11,000	90%	0.55	10	8,900	4,900	(6,100)	0%
040_03	Mission Creek	26	650	Group B	78%	1.21	10	6,500	7,900	80%	1.10	10	6,500	7,200	(700)	0%
040_03	Mission Creek	27	430	Group A	48%	2.86	10	4,300	12,000	80%	1.10	10	4,300	4,700	(7,300)	0%
040_03	Mission Creek	28	500	Group A	45%	3.03	11	5,500	17,000	70%	1.65	11	5,500	9,100	(7,900)	0%
040_03	Mission Creek	29	670	Group A	45%	3.03	11	7,400	22,000	80%	1.10	11	7,400	8,100	(14,000)	0%
040_03	Mission Creek	30	520	Group A	45%	3.03	11	5,700	17,000	70%	1.65	11	5,700	9,400	(7,600)	0%
040_03	Mission Creek	31	410	Group A	45%	3.03	11	4,500	14,000	80%	1.10	11	4,500	5,000	(9,000)	0%
040_03	Mission Creek	32	90	Group A	45%	3.03	11	990	3,000	0%	5.50	11	990	5,400	2,400	-45%
040_03	Mission Creek	33	60	Group A	45%	3.03	11	660	2,000	90%	0.55	11	660	360	(1,600)	0%
040_03	Mission Creek	34	860	Group A	45%	3.03	11	9,500	29,000	70%	1.65	11	9,500	16,000	(13,000)	0%
040_03	Mission Creek	35	150	Group A	45%	3.03	11	1,700	5,100	50%	2.75	11	1,700	4,700	(400)	0%
040_03	Mission Creek	36	480	Group A	45%	3.03	11	5,300	16,000	70%	1.65	11	5,300	8,700	(7,300)	0%
040_03	Mission Creek	37	230	Group A	45%	3.03	11	2,500	7,600	50%	2.75	11	2,500	6,900	(700)	0%
040_03	Mission Creek	38	170	Hardwoods 1	45%	3.03	11	1,900	5,700	10%	4.95	11	1,900	9,400	3,700	-35%
040_03	Mission Creek	39	290	Hardwoods 1	45%	3.03	11	3,200	9,700	0%	5.50	11	3,200	18,000	8,300	-45%
038_03	Mission Creek	1	780	Hardwoods 1	45%	3.03	11	8,600	26,000	0%	5.50	11	8,600	47,000	21,000	-45%
038_03	Mission Creek	2	50	Hardwoods 1	45%	3.03	11	550	1,700	90%	0.55	11	550	300	(1,400)	0%
038_03	Mission Creek	3	700	Hardwoods 1	45%	3.03	11	7,700	23,000	10%	4.95	11	7,700	38,000	15,000	-35%
038_03	Mission Creek	4	950	Hardwoods 1	37%	3.47	14	13,000	45,000	0%	5.50	14	13,000	72,000	27,000	-37%
038_03	trib to Mission	1	530	Hardwoods 1	97%	0.17	1	500	80	40%	3.30	1	500	2,000	2,000	-57%
038_03	trib to Mission	2	790	Hardwoods 1	97%	0.17	1	800	100	20%	4.40	10	8,000	40,000	40,000	-77%
038_03	trib to Mission	3	570	Hardwoods 1	94%	0.33	2	1,000	300	0%	5.50	20	10,000	60,000	60,000	-94%
038_03	trib to Mission	4	50	Hardwoods 1	94%	0.33	2	100	30	90%	0.55	20	1,000	600	600	-4%
							Totals		330,000					510,000	180,000	

Table B-21. 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	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
037_03	Rock Creek	1	140	Hardwoods 1	78%	1.21	4	600	700	70%	1.65	4	600	1,000	300	-8%
037_03	Rock Creek	2	350	Hardwoods 1	78%	1.21	4	1,000	1,000	60%	2.20	4	1,000	2,000	1,000	-18%
037_03	Rock Creek	3	390	Hardwoods 1	78%	1.21	4	2,000	2,000	40%	3.30	4	2,000	7,000	5,000	-38%
037_03	Rock Creek	4	140	Hardwoods 1	78%	1.21	4	600	700	10%	4.95	4	600	3,000	2,000	-68%
037_03	Rock Creek	5	20	Hardwoods 1	78%	1.21	4	80	100	90%	0.55	4	80	40	(60)	0%
037_03	Rock Creek	6	260	Hardwoods 1	78%	1.21	4	1,000	1,000	10%	4.95	4	1,000	5,000	4,000	-68%
037_03	Rock Creek	7	180	Hardwoods 1	72%	1.54	5	900	1,000	0%	5.50	18	3,000	20,000	20,000	-72%
037_03	Rock Creek	8	100	Hardwoods 1	72%	1.54	5	500	800	10%	4.95	4	400	2,000	1,000	-62%
037_03	Rock Creek	9	500	Hardwoods 1	72%	1.54	5	3,000	5,000	0%	5.50	5	3,000	20,000	20,000	-72%
							Totals		12,000					60,000	53,000	

Table B-22. Existing and target solar loads for Ruby Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
020_03	Ruby Creek	1	190	Hardwoods 1	60%	2.20	7	1,000	2,000	60%	2.20	7	1,000	2,000	0	0%
020_03	Ruby Creek	2	950	Hardwoods 1	60%	2.20	7	7,000	20,000	30%	3.85	7	7,000	30,000	10,000	-30%
020_03	Ruby Creek	3	210	Hardwoods 1	60%	2.20	7	1,000	2,000	60%	2.20	7	1,000	2,000	0	0%
020_03	Ruby Creek	4	110	Hardwoods 1	55%	2.48	8	900	2,000	40%	3.30	8	900	3,000	1,000	-15%
020_03	Ruby Creek	5	290	Hardwoods 1	55%	2.48	8	2,000	5,000	60%	2.20	8	2,000	4,000	(1,000)	0%
020_03	Ruby Creek	6	210	Hardwoods 1	55%	2.48	8	2,000	5,000	40%	3.30	8	2,000	7,000	2,000	-15%
020_03	Ruby Creek	7	150	Hardwoods 1	55%	2.48	8	1,000	2,000	50%	2.75	8	1,000	3,000	1,000	-5%
020_03	Ruby Creek	8	190	Hardwoods 1	55%	2.48	8	2,000	5,000	40%	3.30	8	2,000	7,000	2,000	-15%
020_03	Ruby Creek	9	270	Hardwoods 1	55%	2.48	8	2,000	5,000	60%	2.20	8	2,000	4,000	(1,000)	0%
							Totals		48,000					62,000	14,000	

Table B-23. Existing and target solar loads for Cow and Smith Creeks.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
006_03	Cow Creek	1	1200	Group B	83%	0.94	9	10,000	9,000	80%	1.10	13	20,000	20,000	10,000	-3%
006_03	Cow Creek	2	2200	Group B	78%	1.21	10	22,000	27,000	70%	1.65	15	33,000	54,000	27,000	-8%
007_03	Smith Creek	1	140	Group B	83%	0.94	9	1,000	900	50%	2.75	15	2,000	6,000	5,000	-33%
007_03	Smith Creek	4	640	Group B	83%	0.94	9	6,000	6,000	60%	2.20	15	10,000	20,000	10,000	-23%
007_03	Smith Creek	5	380	Group B	83%	0.94	9	3,000	3,000	50%	2.75	15	6,000	20,000	20,000	-33%
007_03	Smith Creek	6	1200	Group B	83%	0.94	9	10,000	9,000	40%	3.30	16	20,000	70,000	60,000	-43%
007_03	Smith Creek	7	220	Group B	78%	1.21	10	2,200	2,700	60%	2.20	16	3,500	7,700	5,000	-18%
007_03	Smith Creek	8	460	Group B	78%	1.21	10	4,600	5,600	40%	3.30	17	7,800	26,000	20,000	-38%
007_03	Smith Creek	9	540	Group B	78%	1.21	10	5,400	6,500	50%	2.75	17	9,200	25,000	19,000	-28%
007_03	Smith Creek	10	200	Group B	78%	1.21	10	2,000	2,400	40%	3.30	17	3,400	11,000	8,600	-38%
007_03	Smith Creek	11	2000	Group B	73%	1.49	11	22,000	33,000	50%	2.75	18	36,000	99,000	66,000	-23%
007_03	Smith Creek	12	2000	Group B	69%	1.71	12	24,000	41,000	40%	3.30	19	38,000	130,000	89,000	-29%
007_03	Smith Creek	13	240	Group B	69%	1.71	12	2,900	4,900	50%	2.75	20	4,800	13,000	8,100	-19%
005_04	Smith Creek	14	2260	Group B	59%	2.26	15	34,000	77,000	40%	3.30	23	52,000	170,000	93,000	-19%
005_04	Smith Creek	15	4100	Group B	57%	2.37	16	66,000	160,000	30%	3.85	25	100,000	390,000	230,000	-27%
005_04	Smith Creek	16	1000	Group B	57%	2.37	16	16,000	38,000	30%	3.85	26	26,000	100,000	62,000	-27%
005_04	Smith Creek	17	1600	Group B	54%	2.53	17	27,000	68,000	40%	3.30	27	43,000	140,000	72,000	-14%
005_04	Smith Creek	18	1800	Group B	54%	2.53	17	31,000	78,000	50%	2.75	28	50,000	140,000	62,000	-4%
005_04	Smith Creek	19	140	Group B	54%	2.53	17	2,400	6,100	30%	3.85	29	4,100	16,000	9,900	-24%
005_04	Smith Creek	20	1600	Hardwoods 1	32%	3.74	17	27,000	100,000	0%	5.50	30	48,000	260,000	160,000	-32%
							Totals		680,000					1,700,000	1,000,000	

Table B-24. Existing and target solar loads for Snow Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
016_03	Snow Creek	1	450	Group B	92%	0.44	6	3,000	1,000	80%	1.10	8	4,000	4,000	3,000	-12%
016_03	Snow Creek	2	520	Group B	92%	0.44	6	3,000	1,000	90%	0.55	8	4,000	2,000	1,000	-2%
016_03	Snow Creek	3	540	Group B	92%	0.44	6	3,000	1,000	80%	1.10	8	4,000	4,000	3,000	-12%
016_03	Snow Creek	4	1700	Group B	92%	0.44	6	10,000	4,000	90%	0.55	8	10,000	6,000	2,000	-2%
016_03	Snow Creek	5	3500	Group B	90%	0.55	7	20,000	10,000	80%	1.10	9	30,000	30,000	20,000	-10%
016_03	Snow Creek	6	900	Group B	90%	0.55	7	6,000	3,000	70%	1.65	9	8,000	10,000	7,000	-20%
016_03	Snow Creek	7	360	Group B	90%	0.55	7	3,000	2,000	80%	1.10	9	3,000	3,000	1,000	-10%
016_03	Snow Creek	8	3300	Group B	87%	0.72	8	30,000	20,000	90%	0.55	10	30,000	20,000	0	0%
016_03	Snow Creek	9	550	Group B	83%	0.94	9	5,000	5,000	80%	1.10	10	6,000	7,000	2,000	-3%
016_03	Snow Creek	10	130	Group A	52%	2.64	9	1,000	3,000	60%	2.20	12	2,000	4,000	1,000	0%
016_03	Snow Creek	11	270	Hardwoods 1	41%	3.25	12	3,200	10,000	0%	5.50	25	6,800	37,000	27,000	-41%
								Totals	60,000					130,000	67,000	

Table B-25. Existing and target solar loads for Trail Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
026_03	Trail Creek	1	250	Group B	92%	0.44	6	2,000	900	90%	0.55	6	2,000	1,000	100	-2%
026_03	Trail Creek	2	1500	Group B	92%	0.44	6	9,000	4,000	60%	2.20	6	9,000	20,000	20,000	-32%
026_03	Trail Creek	3	120	Group B	92%	0.44	6	700	300	80%	1.10	6	700	800	500	-12%
026_03	Trail Creek	4	690	Group B	90%	0.55	7	5,000	3,000	50%	2.75	7	5,000	10,000	7,000	-40%
026_03	Trail Creek	5	710	Hardwoods 1	60%	2.20	7	5,000	10,000	50%	2.75	7	5,000	10,000	0	-10%
026_03	Trail Creek	6	710	Hardwoods 1	55%	2.48	8	6,000	10,000	40%	3.30	8	6,000	20,000	10,000	-15%
026_03	Trail Creek	7	280	Hardwoods 1	55%	2.48	8	2,000	5,000	50%	2.75	8	2,000	6,000	1,000	-5%
								Totals	33,000					68,000	39,000	

Table B-26. Existing and target solar loads for Trout Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Insolation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
010_03	Trout Creek	1	1200	Group B	92%	0.44	6	7,000	3,000	90%	0.55	10	10,000	6,000	3,000	-2%
010_03	Trout Creek	2	1600	Group B	90%	0.55	7	10,000	6,000	90%	0.55	10	20,000	10,000	4,000	0%
010_03	Trout Creek	3	2000	Group B	87%	0.72	8	20,000	10,000	80%	1.10	10	20,000	20,000	10,000	-7%
010_03	Trout Creek	4	1500	Group B	83%	0.94	9	10,000	9,000	70%	1.65	9	10,000	20,000	10,000	-13%
010_03	Trout Creek	5	1100	Group B	83%	0.94	9	10,000	9,000	80%	1.10	9	10,000	10,000	1,000	-3%
							Totals		37,000					66,000	28,000	

Load Analysis Tables—Moyie River Subbasin

Note: All assessment unit (AU) numbers start with ID17010105PN in Tables B-27 through B-38.

Table B-27. Existing and target solar loads for Canuck Creek and tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
007_02	Canuck Creek	1	800	Group C	98%	0.11	1	800	90	80%	1.10	1	800	900	800	-18%
007_02	Canuck Creek	2	510	Group C	98%	0.11	1	500	60	70%	1.65	2	1,000	2,000	2,000	-28%
007_02	Canuck Creek	3	1400	Group C	97%	0.17	2	3,000	500	80%	1.10	3	4,000	4,000	4,000	-17%
007_02	Canuck Creek	4	540	Group C	96%	0.22	3	2,000	400	90%	0.55	5	3,000	2,000	2,000	-6%
007_02	Canuck Creek	5	1400	Group C	96%	0.22	3	4,000	900	90%	0.55	6	8,000	4,000	3,000	-6%
007_02	Canuck Creek	6	180	Group C	94%	0.33	4	700	200	80%	1.10	7	1,000	1,000	800	-14%
007_02	Canuck Creek	7	170	Group C	94%	0.33	4	700	200	90%	0.55	7	1,000	600	400	-4%
007_02	Canuck Creek	8	150	Group C	94%	0.33	4	600	200	80%	1.10	7	1,000	1,000	800	-14%
007_02	Canuck Creek	9	440	Group C	94%	0.33	4	2,000	700	90%	0.55	8	4,000	2,000	1,000	-4%
007_02	Canuck Creek	10	180	Group B	94%	0.33	5	900	300	80%	1.10	8	1,000	1,000	700	-14%
007_02	Canuck Creek	11	180	Group B	94%	0.33	5	900	300	90%	0.55	8	1,000	600	300	-4%
007_02	Canuck Creek	12	160	Group B	94%	0.33	5	800	300	80%	1.10	8	1,000	1,000	700	-14%
007_02	Canuck Creek	13	210	Group B	94%	0.33	5	1,000	300	90%	0.55	8	2,000	1,000	700	-4%
007_02	Canuck Creek	14	200	Group B	94%	0.33	5	1,000	300	70%	1.65	8	2,000	3,000	3,000	-24%
007_02	Canuck Creek	15	360	Group B	94%	0.33	5	2,000	700	80%	1.10	8	3,000	3,000	2,000	-14%
007_02	Canuck Creek	16	1000	Group B	92%	0.44	6	6,000	3,000	80%	1.10	9	9,000	10,000	7,000	-12%
007_02	Canuck Creek	17	1600	Group B	90%	0.55	7	10,000	6,000	80%	1.10	9	10,000	10,000	4,000	-10%
007_02	Canuck Creek	18	160	Group B	90%	0.55	7	1,000	600	70%	1.65	10	2,000	3,000	2,000	-20%
007_02	Canuck Creek	19	600	Group B	87%	0.72	8	5,000	4,000	80%	1.10	10	6,000	7,000	3,000	-7%
007_02	Canuck Creek	20	840	Group B	87%	0.72	8	7,000	5,000	80%	1.10	10	8,000	9,000	4,000	-7%
007_02	1st to Canuck	1	820	Group D	96%	0.22	1	800	200	80%	1.10	1	800	900	700	-16%
007_02	1st to Canuck	2	990	Group D	96%	0.22	2	2,000	400	90%	0.55	2	2,000	1,000	600	-6%
007_02	1st to Canuck	3	550	Group C	97%	0.17	2	1,000	200	90%	0.55	2	1,000	600	400	-7%
007_02	2nd to Canuck	1	1200	Group D	96%	0.22	1	1,000	200	90%	0.55	1	1,000	600	400	-6%
007_02	2nd to Canuck	2	520	Group C	97%	0.17	2	1,000	200	90%	0.55	2	1,000	600	400	-7%
007_02	3rd to Canuck	1	1100	Group C	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
007_02	3rd to Canuck	2	850	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
007_02	4th to Canuck	1	310	Group D	96%	0.22	1	300	70	90%	0.55	1	300	200	100	-6%
007_02	4th to Canuck	2	740	Group D	96%	0.22	1	700	200	80%	1.10	1	700	800	600	-16%
007_02	4th to Canuck	3	510	Group D	96%	0.22	2	1,000	200	90%	0.55	2	1,000	600	400	-6%
007_02	5th to Canuck	1	880	Group C	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
007_02	5th to Canuck	2	510	Group C	98%	0.11	1	500	60	80%	1.10	1	500	600	500	-18%
007_02	5th to Canuck	3	1500	Group C	97%	0.17	2	3,000	500	90%	0.55	2	3,000	2,000	2,000	-7%
007_02	5th to Canuck	4	500	Group B	97%	0.17	3	2,000	300	90%	0.55	3	2,000	1,000	700	-7%
							Totals		27,000					78,000	51,000	

Table B-28. Existing and target solar loads for Deer Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_02	Deer Creek	1	610	Group D	96%	0.22	1	600	100	90%	0.55	1	600	300	200	-6%
004_02	Deer Creek	2	130	Group D	98%	0.11	1	100	10	90%	0.55	1	100	60	50	-8%
004_02	Deer Creek	3	830	Group B	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
004_02	Deer Creek	4	470	Group B	98%	0.11	2	900	100	90%	0.55	2	900	500	400	-8%
004_02	Deer Creek	6	3300	Group B	97%	0.17	3	10,000	2,000	90%	0.55	3	10,000	6,000	4,000	-7%
004_02	Deer Creek	7	1100	Group B	94%	0.33	5	6,000	2,000	80%	1.10	5	6,000	7,000	5,000	-14%
004_02	Deer Creek	8	90	Group B	94%	0.33	5	500	200	80%	1.10	5	500	600	400	-14%
004_02	Deer Creek	9	550	Group B	92%	0.44	6	3,000	1,000	80%	1.10	6	3,000	3,000	2,000	-12%
004_02	Deer Creek	10	600	Group B	92%	0.44	6	4,000	2,000	90%	0.55	6	4,000	2,000	0	-2%
004_02	Deer Creek	11	270	Group B	92%	0.44	6	2,000	900	80%	1.10	6	2,000	2,000	1,000	-12%
004_02	Deer Creek	12	510	Group B	90%	0.55	7	4,000	2,000	70%	1.65	7	4,000	7,000	5,000	-20%
004_03	Deer Creek	1	150	Group B	90%	0.55	7	1,000	600	70%	1.65	7	1,000	2,000	1,000	-20%
004_03	Deer Creek	2	280	Group B	90%	0.55	7	2,000	1,000	50%	2.75	7	2,000	6,000	5,000	-40%
004_03	Deer Creek	3	890	Group B	87%	0.72	8	7,000	5,000	60%	2.20	8	7,000	20,000	20,000	-27%
004_03	Deer Creek	4	410	Group B	83%	0.94	9	4,000	4,000	70%	1.65	9	4,000	7,000	3,000	-13%
004_03	Deer Creek	5	320	Group B	83%	0.94	9	3,000	3,000	80%	1.10	9	3,000	3,000	0	-3%
004_03	Deer Creek	6	210	Group B	83%	0.94	9	2,000	2,000	70%	1.65	9	2,000	3,000	1,000	-13%
004_03	Deer Creek	7	200	Group B	78%	1.21	10	2,000	2,400	70%	1.65	10	2,000	3,300	900	-8%
004_03	Deer Creek	8	300	Hardwoods 1	48%	2.86	10	3,000	8,600	50%	2.75	10	3,000	8,300	(300)	0%
004_03	Deer Creek	9	870	Group B	78%	1.21	10	8,700	11,000	70%	1.65	10	8,700	14,000	3,000	-8%
004_03	Deer Creek	10	710	Group B	78%	1.21	10	7,100	8,600	70%	1.65	10	7,100	12,000	3,400	-8%
004_03	Deer Creek	11	250	Group B	78%	1.21	10	2,500	3,000	60%	2.20	10	2,500	5,500	2,500	-18%
004_03	Deer Creek	12	630	Group B	78%	1.21	10	6,300	7,600	30%	3.85	10	6,300	24,000	16,000	-48%
004_03	Deer Creek	13	310	Group B	78%	1.21	10	3,100	3,800	50%	2.75	10	3,100	8,500	4,700	-28%
004_03	Deer Creek	14	1200	Group B	73%	1.49	11	13,000	19,000	70%	1.65	11	13,000	21,000	2,000	-3%
004_03	Deer Creek	15	890	Group B	73%	1.49	11	9,800	15,000	70%	1.65	11	9,800	16,000	1,000	-3%
004_03	Deer Creek	16	340	Group B	73%	1.49	11	3,700	5,500	60%	2.20	11	3,700	8,100	2,600	-13%
004_03	Deer Creek	17	1400	Group B	73%	1.49	11	15,000	22,000	70%	1.65	11	15,000	25,000	3,000	-3%
004_03	Deer Creek	18	220	Group B	73%	1.49	11	2,400	3,600	50%	2.75	11	2,400	6,600	3,000	-23%
							Totals		140,000					220,000	90,000	

Table B-29. Existing and target solar loads for Deer Creek tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_02	1st to Deer Cr	1	900	Group C	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
004_02	1st to Deer Cr	2	710	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
004_02	2nd to Deer Cr	1	270	Group D	96%	0.22	1	300	70	90%	0.55	1	300	200	100	-6%
004_02	2nd to Deer Cr	2	150	Group D	96%	0.22	1	200	40	80%	1.10	1	200	200	200	-16%
004_02	2nd to Deer Cr	3	390	Group D	96%	0.22	1	400	90	90%	0.55	1	400	200	100	-6%
004_02	2nd to Deer Cr	4	940	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
004_02	West Branch	1	2800	Group B	98%	0.11	2	6,000	700	90%	0.55	2	6,000	3,000	2,000	-8%
004_02	Davis Creek	1	230	Group D	96%	0.22	1	200	40	90%	0.55	1	200	100	60	-6%
004_02	Davis Creek	2	3200	Group B	98%	0.11	2	6,000	700	90%	0.55	2	6,000	3,000	2,000	-8%
004_02	5th to Deer Cr	1	1800	Group B	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
004_02	Mill Creek	1	550	Group C	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
004_02	Mill Creek	2	3000	Group B	98%	0.11	2	6,000	700	90%	0.55	2	6,000	3,000	2,000	-8%
004_02	trib to Mill Cr	1	310	Group D	96%	0.22	1	300	70	90%	0.55	1	300	200	100	-6%
004_02	7th to Deer Cr	1	770	Group B	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
004_02	Faro Creek	1	640	Group C	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
004_02	Faro Creek	2	860	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
004_02	Faro Creek	3	140	Group C	97%	0.17	2	300	50	90%	0.55	2	300	200	200	-7%
004_02	Faro Creek	4	220	Group B	97%	0.17	3	700	100	90%	0.55	3	700	400	300	-7%
004_02	Faro Creek	5	2100	Group B	97%	0.17	3	6,000	1,000	90%	0.55	3	6,000	3,000	2,000	-7%
004_02	Faro Creek	6	90	Group B	96%	0.22	4	400	90	90%	0.55	4	400	200	100	-6%
004_02	Faro Creek	7	150	Group B	96%	0.22	4	600	100	80%	1.10	4	600	700	600	-16%
004_02	Faro Creek	8	820	Group B	96%	0.22	4	3,000	700	90%	0.55	4	3,000	2,000	1,000	-6%
004_02	1st to Faro Cr	1	150	Group D	96%	0.22	1	200	40	90%	0.55	1	200	100	60	-6%
004_02	1st to Faro Cr	2	850	Group B	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
004_02	1st to Faro Cr	3	130	Group C	97%	0.17	2	300	50	90%	0.55	2	300	200	200	-7%
004_02	1st to Faro Cr	4	400	Group B	98%	0.11	2	800	90	90%	0.55	2	800	400	300	-8%
004_02	2nd to Faro Cr	1	2800	Group B	98%	0.11	2	6,000	700	90%	0.55	2	6,000	3,000	2,000	-8%
004_02	Keno Creek	1	390	Group D	96%	0.22	1	400	90	90%	0.55	1	400	200	100	-6%
004_02	Keno Creek	2	920	Group C	97%	0.17	2	2,000	300	90%	0.55	2	2,000	1,000	700	-7%
004_02	Keno Creek	3	990	Group B	97%	0.17	3	3,000	500	90%	0.55	3	3,000	2,000	2,000	-7%
004_02	Keno Creek	4	1400	Group B	96%	0.22	4	6,000	1,000	90%	0.55	4	6,000	3,000	2,000	-6%
004_02	Keno Creek	5	1000	Group B	96%	0.22	4	4,000	900	80%	1.10	4	4,000	4,000	3,000	-16%
004_02	Keno Creek	6	700	Group B	94%	0.33	5	4,000	1,000	80%	1.10	5	4,000	4,000	3,000	-14%
004_02	Keno Creek	7	510	Group B	94%	0.33	5	3,000	1,000	90%	0.55	5	3,000	2,000	1,000	-4%
004_02	1st to Keno Cr	1	210	Group D	96%	0.22	1	200	40	90%	0.55	1	200	100	60	-6%
004_02	1st to Keno Cr	2	800	Group C	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
004_02	1st to Keno Cr	3	1400	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
004_02	2nd to Keno Cr	1	380	Group D	96%	0.22	1	400	90	90%	0.55	1	400	200	100	-6%
004_02	2nd to Keno Cr	2	1900	Group B	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
004_02	3rd to Keno Cr	1	2500	Group B	98%	0.11	2	5,000	600	90%	0.55	2	5,000	3,000	2,000	-8%
004_02	10th to Deer Cr	1	2200	Group B	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
004_02	Solomon Creek	1	960	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
							Totals		14,000					54,000	40,000	

Table B-30. Existing and target solar loads for Gillon Creek and tributaries.

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
009_02	Gillon Creek	1	450	Hawthorn	51%	2.70	5	2,000	5,000	30%	3.85	5	2,000	8,000	3,000	-21%
009_02	Gillon Creek	3	190	Hawthorn	51%	2.70	5	1,000	3,000	60%	2.20	5	1,000	2,000	(1,000)	0%
009_02	Gillon Creek	4	1400	Group B	94%	0.33	5	7,000	2,000	90%	0.55	5	7,000	4,000	2,000	-4%
009_02	Gillon Creek	5	490	Hardwoods 1	72%	1.54	5	2,000	3,000	70%	1.65	5	2,000	3,000	0	-2%
009_02	Gillon Creek	6	1000	Group B	94%	0.33	5	5,000	2,000	90%	0.55	55	60,000	30,000	30,000	-4%
009_02	Gillon Creek	7	260	Hardwoods 1	72%	1.54	5	1,000	2,000	80%	1.10	5	1,000	1,000	(1,000)	0%
009_02	Gillon Creek	8	300	Group B	94%	0.33	5	2,000	700	90%	0.55	5	2,000	1,000	300	-4%
009_02	Gillon Creek	9	380	Hardwoods 1	72%	1.54	5	2,000	3,000	80%	1.10	5	2,000	2,000	(1,000)	0%
009_02	Gillon Creek	1	30	Hardwoods 1	86%	0.77	3	90	70	30%	3.85	3	90	300	200	-56%
009_02	Gillon Creek	2	50	Hardwoods 1	86%	0.77	3	200	200	80%	1.10	3	200	200	0	-6%
009_02	trib to Robinson	1	2600	Group B	98%	0.11	2	5,000	600	90%	0.55	2	5,000	3,000	2,000	-8%
009_02	trib to Robinson	2	190	Group B	98%	0.11	2	400	40	80%	1.10	2	400	400	400	-18%
							Totals		22,000					55,000	35,000	

Table B-31. Existing and target solar loads for Harvey Creek and tributaries.

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
009_02	Harvey Creek	1	520	Group C	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
009_02	Harvey Creek	2	480	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
009_02	Harvey Creek	3	2100	Group B	97%	0.17	3	6,000	1,000	90%	0.55	3	6,000	3,000	2,000	-7%
009_02	trib to Harvey	1	210	Group C	97%	0.17	2	400	70	90%	0.55	2	400	200	100	-7%
009_02	trib to Harvey	2	300	Group B	98%	0.11	2	600	70	90%	0.55	2	600	300	200	-8%
							Totals		1,300					4,400	3,000	

Table B-32. Existing and target solar loads for Meadow 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 (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m2 /day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
012_02	Meadow Creek	1	470	Group D	96%	0.22	1	500	100	90%	0.55	1	500	300	200	-6%
012_02	Meadow Creek	2	460	Group C	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
012_02	Meadow Creek	3	3600	Group B	97%	0.17	3	10,000	2,000	90%	0.55	3	10,000	6,000	4,000	-7%
012_02	Meadow Creek	4	370	Group B	94%	0.33	5	2,000	700	80%	1.10	5	2,000	2,000	1,000	-14%
012_02	Meadow Creek	5	1500	Group B	94%	0.33	5	8,000	3,000	90%	0.55	5	8,000	4,000	1,000	-4%
012_02	Meadow Creek	6	1300	Hardwood 1	65%	1.93	6	8,000	20,000	70%	1.65	6	8,000	10,000	(10,000)	0%
012_02	Meadow Creek	7	510	Group B	92%	0.44	6	3,000	1,000	90%	0.55	6	3,000	2,000	1,000	-2%
012_02	Meadow Creek	8	130	Hardwood 1	65%	1.93	6	800	2,000	60%	2.20	6	800	2,000	0	-5%
012_02	Meadow Creek	9	620	Hardwood 1	65%	1.93	6	4,000	8,000	40%	3.30	6	4,000	10,000	2,000	-25%
012_02	Meadow Creek	10	90	Group B	92%	0.44	6	500	200	90%	0.55	6	500	300	100	-2%
012_02	Meadow Creek	11	130	Hardwood 1	60%	2.20	7	900	2,000	70%	1.65	7	900	1,000	(1,000)	0%
012_02	Meadow Creek	12	320	Group B	90%	0.55	7	2,000	1,000	90%	0.55	7	2,000	1,000	0	0%
012_02	Meadow Creek	13	290	Hardwood 1	60%	2.20	7	2,000	4,000	50%	2.75	7	2,000	6,000	2,000	-10%
012_02	Meadow Creek	14	320	Hardwood 1	60%	2.20	7	2,000	4,000	60%	2.20	7	2,000	4,000	0	0%
012_02	Meadow Creek	15	450	Group B	90%	0.55	7	3,000	2,000	90%	0.55	7	3,000	2,000	0	0%
012_02	Meadow Creek	16	410	Group B	90%	0.55	7	3,000	2,000	90%	0.55	7	3,000	2,000	0	0%
012_02	Meadow Creek	17	160	Hawthorn	39%	3.36	7	1,000	3,000	80%	1.10	7	1,000	1,000	(2,000)	0%
012_02	Meadow Creek	18	190	Hawthorn	39%	3.36	7	1,000	3,000	60%	2.20	7	1,000	2,000	(1,000)	0%
012_02	Meadow Creek	19	360	Hawthorn	35%	3.58	8	3,000	10,000	20%	4.40	8	3,000	10,000	0	-15%
012_02	Meadow Creek	20	180	Hawthorn	35%	3.58	8	1,000	4,000	50%	2.75	8	1,000	3,000	(1,000)	0%
012_02	Meadow Creek	21	910	Hawthorn	35%	3.58	8	7,000	30,000	70%	1.65	8	7,000	10,000	(20,000)	0%
012_02	Meadow Creek	22	210	Hawthorn	35%	3.58	8	2,000	7,000	20%	4.40	8	2,000	9,000	2,000	-15%
012_02	Meadow Creek	23	480	Hawthorn	35%	3.58	8	4,000	10,000	0%	5.50	8	4,000	20,000	10,000	-35%
012_02	Meadow Creek	24	470	Hawthorn	35%	3.58	8	4,000	10,000	10%	4.95	8	4,000	20,000	10,000	-25%
012_02	Meadow Creek	25	370	Hawthorn	35%	3.58	8	3,000	10,000	20%	4.40	8	3,000	10,000	0	-15%
012_02	Meadow Creek	26	420	Hawthorn	32%	3.74	9	4,000	10,000	30%	3.85	9	4,000	20,000	10,000	-2%
012_02	Meadow Creek	27	190	Hawthorn	32%	3.74	9	2,000	7,000	10%	4.95	9	2,000	10,000	3,000	-22%
012_02	Meadow Creek	28	400	Hawthorn	32%	3.74	9	4,000	10,000	0%	5.50	9	4,000	20,000	10,000	-32%
012_02	Meadow Creek	29	140	Hawthorn	32%	3.74	9	1,000	4,000	40%	3.30	9	1,000	3,000	(1,000)	0%
012_02	Meadow Creek	30	110	Hawthorn	32%	3.74	9	1,000	4,000	0%	5.50	9	1,000	6,000	2,000	-32%
012_02	Meadow Creek	31	130	Hawthorn	32%	3.74	9	1,000	4,000	50%	2.75	9	1,000	3,000	(1,000)	0%
012_02	Meadow Creek	32	470	Hawthorn	32%	3.74	9	4,000	10,000	30%	3.85	9	4,000	20,000	10,000	-2%
012_02	Meadow Creek	33	800	Hawthorn	32%	3.74	9	7,000	30,000	60%	2.20	9	7,000	20,000	(10,000)	0%
012_02	Meadow Creek	34	320	Hawthorn	32%	3.74	9	3,000	10,000	50%	2.75	9	3,000	8,000	(2,000)	0%
012_02	Meadow Creek	35	690	Hawthorn	29%	3.91	10	6,900	27,000	70%	1.65	10	6,900	11,000	(16,000)	0%
012_02	Meadow Creek	36	2000	Group B	78%	1.21	10	20,000	24,000	90%	0.55	10	20,000	11,000	(13,000)	0%
							Totals		280,000					270,000	-9,500	

Table B-33. Existing and target solar loads for Meadow Creek tributaries.

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
012_02	EF Meadow Cr	1	1600	Group C	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
012_02	EF Meadow Cr	2	3000	Group B	97%	0.17	3	9,000	1,000	90%	0.55	3	9,000	5,000	4,000	-7%
012_02	Templeman Cr	2	260	Meadow	16%	4.62	4	1,000	5,000	10%	4.95	4	1,000	5,000	0	-6%
012_02	Templeman Cr	3	440	Meadow	16%	4.62	4	2,000	9,000	20%	4.40	4	2,000	9,000	0	0%
012_02	Templeman Cr	4	1200	Hardwoods 1	94%	0.33	2	2,000	700	90%	0.55	2	2,000	1,000	300	-4%
012_02	Fern Creek	1	360	Group C	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
012_02	Fern Creek	2	3300	Group B	98%	0.11	2	7,000	800	90%	0.55	2	7,000	4,000	3,000	-8%
012_02	Fern Creek	3	450	Hardwoods 1	86%	0.77	3	1,000	800	80%	1.10	3	1,000	1,000	200	-6%
012_02	3rd tributary	1	420	Group B	98%	0.11	1	400	40	70%	1.65	1	400	700	700	-28%
012_02	3rd tributary	2	80	Group B	98%	0.11	1	80	9	90%	0.55	1	80	40	30	-8%
012_02	3rd tributary	3	90	Group B	98%	0.11	1	90	10	70%	1.65	1	90	100	90	-28%
012_02	3rd tributary	4	390	Group B	98%	0.11	1	400	40	80%	1.10	1	400	400	400	-18%
012_02	3rd tributary	5	510	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
012_02	3rd tributary	6	130	Group B	98%	0.11	2	300	30	70%	1.65	2	300	500	500	-28%
012_02	3rd tributary	7	40	Group B	98%	0.11	2	80	9	90%	0.55	2	80	40	30	-8%
012_02	3rd tributary	8	1400	Group B	97%	0.17	3	4,000	700	80%	1.10	3	4,000	4,000	3,000	-17%
012_02	Wall Creek	1	210	Group D	96%	0.22	1	200	40	90%	0.55	1	200	100	60	-6%
012_02	Wall Creek	2	2400	Group B	98%	0.11	2	5,000	600	90%	0.55	2	5,000	3,000	2,000	-8%
012_02	Wall Creek	3	2700	Group B	97%	0.17	3	8,000	1,000	90%	0.55	3	8,000	4,000	3,000	-7%
012_02	trib to Wall Cr	1	1900	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
							Totals		20,000					41,000	20,000	

Table B-34. Existing and target solar loads for Miller 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 (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m2 /day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
011_02	Miller Creek	1	640	Group D	96%	0.22	1	600	100	90%	0.55	1	600	300	200	-6%
011_02	Miller Creek	2	1600	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
011_02	Miller Creek	3	310	Group B	98%	0.11	2	600	70	80%	1.10	2	600	700	600	-18%
011_02	Miller Creek	4	1500	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
011_02	Miller Creek	5	110	Group B	97%	0.17	3	300	50	80%	1.10	3	300	300	300	-17%
011_02	Miller Creek	6	300	Group B	97%	0.17	3	900	100	90%	0.55	3	900	500	400	-7%
011_02	Miller Creek	7	440	Group B	97%	0.17	3	1,000	200	80%	1.10	3	1,000	1,000	800	-17%
011_02	Miller Creek	8	1100	Group B	97%	0.17	3	3,000	500	90%	0.55	3	3,000	2,000	2,000	-7%
							Totals		1,500					7,800	7,100	

Table B-35. Existing and target solar loads for Round Prairie 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 (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m2 /day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
010_03	Round Prairie Cr	1	40	Hardwoods 1	52%	2.64	9	400	1,000	0%	5.50	9	400	2,000	1,000	-52%
010_03	Round Prairie Cr	2	490	Hardwoods 1	52%	2.64	9	4,000	10,000	40%	3.30	9	4,000	10,000	0	-12%
010_03	Round Prairie Cr	3	980	Hardwoods 1	52%	2.64	9	9,000	20,000	0%	5.50	9	9,000	50,000	30,000	-52%
010_03	Round Prairie Cr	4a	940	Hardwoods 1	72%	1.54	5	5,000	8,000	40%	3.30	5	5,000	20,000	10,000	-32%
010_03	Round Prairie Cr	4b	760	Hardwoods 1	72%	1.54	5	4,000	6,000	0%	5.50	5	4,000	20,000	10,000	-72%
010_03	Round Prairie Cr	5	280	Hardwoods 1	48%	2.86	10	2,800	8,000	0%	5.50	10	2,800	15,000	7,000	-48%
010_03	Round Prairie Cr	6	200	Hardwoods 1	48%	2.86	10	2,000	5,700	10%	4.95	10	2,000	9,900	4,200	-38%
010_03	Round Prairie Cr	7	300	Hardwoods 1	48%	2.86	10	3,000	8,600	20%	4.40	10	3,000	13,000	4,400	-28%
010_03	Round Prairie Cr	8	60	Hardwoods 1	48%	2.86	10	600	1,700	40%	3.30	10	600	2,000	300	-8%
010_03	Round Prairie Cr	9	180	Hardwoods 1	48%	2.86	10	1,800	5,100	20%	4.40	10	1,800	7,900	2,800	-28%
010_03	Round Prairie Cr	10	90	Hardwoods 1	48%	2.86	10	900	2,600	10%	4.95	10	900	4,500	1,900	-38%
010_03	Round Prairie Cr	11	80	Hardwoods 1	48%	2.86	10	800	2,300	0%	5.50	10	800	4,400	2,100	-48%
010_03	Round Prairie Cr	12	70	Hardwoods 1	48%	2.86	10	700	2,000	60%	2.20	10	700	1,500	(500)	0%
010_03	Round Prairie Cr	13	350	Hardwoods 1	48%	2.86	10	3,500	10,000	0%	5.50	10	3,500	19,000	9,000	-48%
							Totals		91,000					180,000	82,000	

Table B-36. Existing and target solar loads for Skin Creek and tributaries.

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
003_02	Skin Creek	1	1900	Group C	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
003_02	Skin Creek	2	6800	Group B	97%	0.17	3	20,000	3,000	90%	0.55	3	20,000	10,000	7,000	-7%
003_02	Skin Creek	3	530	Group B	92%	0.44	6	3,000	1,000	90%	0.55	6	3,000	2,000	1,000	-2%
003_02	Skin Creek	4	130	Group B	92%	0.44	6	800	400	80%	1.10	6	800	900	500	-12%
003_02	Skin Creek	5	300	Group B	92%	0.44	6	2,000	900	90%	0.55	6	2,000	1,000	100	-2%
003_02	Skin Creek	6	770	Group B	92%	0.44	6	5,000	2,000	80%	1.10	6	5,000	6,000	4,000	-12%
003_02	Skin Creek	7	510	Group B	90%	0.55	7	4,000	2,000	70%	1.65	7	4,000	7,000	5,000	-20%
003_02	Skin Creek	8	1100	Group B	90%	0.55	7	8,000	4,000	90%	0.55	7	8,000	4,000	0	0%
003_02	trib to Skin Cr	1	600	Hardwoods 1	97%	0.17	1	600	100	30%	3.85	1	600	2,000	2,000	-67%
003_02	trib to Skin Cr	2	930	Hardwoods 1	94%	0.33	2	2,000	700	10%	4.95	2	2,000	10,000	9,000	-84%
003_02	trib to Skin Cr	3	240	Hardwoods 1	86%	0.77	3	700	500	20%	4.40	3	700	3,000	3,000	-66%
003_02	trib to Skin Cr	4	240	Hardwoods 1	86%	0.77	3	700	500	80%	1.10	3	700	800	300	-6%
							Totals		15,000					48,000	33,000	

Table B-37. Existing and target solar loads for named and unnamed tributaries to Moyie River, Canada border to Round Prairie Creek (AU# ID17010105PN006_02).

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
006_02	Spruce Creek	1	570	Group C	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
006_02	Spruce Creek	2	2100	Group B	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
006_02	Spruce Creek	3	1000	Group B	97%	0.17	3	3,000	500	90%	0.55	3	3,000	2,000	2,000	-7%
006_02	Spruce Creek	4	2600	Group B	94%	0.33	5	10,000	3,000	90%	0.55	5	10,000	6,000	3,000	-4%
006_02	Spruce Creek	5	790	Group B	92%	0.44	6	5,000	2,000	90%	0.55	6	5,000	3,000	1,000	-2%
006_02	Spruce Creek	6	260	Group B	92%	0.44	6	2,000	900	50%	2.75	6	2,000	6,000	5,000	-42%
006_02	un-named ab Sp	1	900	Group B	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
006_02	un-named ab Sp	2	170	Group B	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
006_02	un-named ab Sp	3	210	Group B	98%	0.11	1	200	20	50%	2.75	1	200	600	600	-48%
006_02	un-named ab Sp	4	380	Group B	98%	0.11	2	800	90	60%	2.20	2	800	2,000	2,000	-38%
006_02	un-named ab Sp	5	670	Group B	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
006_02	un-named ab Sp	6	110	Group B	98%	0.11	2	200	20	60%	2.20	2	200	400	400	-38%
006_02	un-named ab Sp	7	120	Group B	98%	0.11	2	200	20	0%	5.50	2	200	1,000	1,000	-98%
006_02	un-named ab Sp	8	140	Group B	98%	0.11	2	300	30	40%	3.30	2	300	1,000	1,000	-58%
006_02	1st to Spruce Cr	1	80	Group C	98%	0.11	1	80	9	90%	0.55	1	80	40	30	-8%
006_02	1st to Spruce Cr	2	300	Group C	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
006_02	1st to Spruce Cr	3	960	Group B	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
006_02	1st to Spruce Cr	4	210	Group B	98%	0.11	2	400	40	80%	1.10	2	400	400	400	-18%
006_02	2nd to Spruce C	1	570	Group D	96%	0.22	1	600	100	90%	0.55	1	600	300	200	-6%
006_02	2nd to Spruce C	2	1600	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
006_02	3rd to Spruce Cr	1	1900	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
006_02	3rd to Spruce Cr	2	390	Group B	98%	0.11	2	800	90	80%	1.10	2	800	900	800	-18%
006_02	3rd to Spruce Cr	3	250	Group B	98%	0.11	2	500	60	90%	0.55	2	500	300	200	-8%
006_02	Copper Creek	1	1100	Group D	96%	0.22	1	1,000	200	90%	0.55	1	1,000	600	400	-6%
006_02	Copper Creek	2	300	Group D	96%	0.22	1	300	70	80%	1.10	1	300	300	200	-16%
006_02	Copper Creek	3	270	Group C	98%	0.11	1	300	30	70%	1.65	1	300	500	500	-28%
006_02	Copper Creek	4	520	Group C	97%	0.17	2	1,000	200	90%	0.55	2	1,000	600	400	-7%
006_02	Copper Creek	5	1300	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
006_02	Copper Creek	6	1900	Group B	96%	0.22	4	8,000	2,000	90%	0.55	4	8,000	4,000	2,000	-6%
006_02	Copper Creek	7	1100	Group B	96%	0.22	4	4,000	900	90%	0.55	4	4,000	2,000	1,000	-6%
006_02	1st to Copper Cr	1	280	Group C	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
006_02	1st to Copper Cr	2	440	Group B	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
006_02	1st to Copper Cr	3	290	Group C	97%	0.17	2	600	100	90%	0.55	2	600	300	200	-7%
006_02	1st to Copper Cr	4	1500	Group B	97%	0.17	3	5,000	800	90%	0.55	3	5,000	3,000	2,000	-7%
006_02	2nd to Copper C	1	1900	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
006_02	un-named bl Co	1	100	Group B	98%	0.11	1	100	10	80%	1.10	1	100	100	90	-18%
006_02	un-named bl Co	2	190	Group B	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
006_02	un-named bl Co	3	350	Group B	98%	0.11	1	400	40	80%	1.10	1	400	400	400	-18%
006_02	un-named bl Co	4	1400	Group B	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
006_02	Brass Creek	1	810	Group C	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
006_02	Brass Creek	2	2000	Group B	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
006_02	Brass Creek	3	1400	Group B	97%	0.17	3	4,000	700	90%	0.55	3	4,000	2,000	1,000	-7%
006_02	Line Creek	1	1000	Group B	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
006_02	Line Creek	2	1700	Group B	98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
006_02	Line Creek	3	210	Group B	97%	0.17	3	600	100	70%	1.65	3	600	1,000	900	-27%
006_02	Line Creek	4	90	Group B	97%	0.17	3	300	50	90%	0.55	3	300	200	200	-7%
006_02	1st to Line Cr	1	230	Group A	94%	0.33	1	200	70	90%	0.55	1	200	100	30	-4%
006_02	1st to Line Cr	2	160	Group B	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
							Totals		15,000					56,000	43,000	

Table B-38. Existing and target solar loads for named and unnamed 1st-order tributaries to Moyie River, Meadow Creek to Moyie Falls Dam (AU# ID17010105PN002_02).

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
002_02	Un-named #1	1	4100	Group B	98%	0.11	2	8,000	900	90%	0.55	2	8,000	4,000	3,000	-8%
002_02	Un-named #2	1	130	Group B	98%	0.11	1	100	10	90%	0.55	1	100	60	50	-8%
002_02	Un-named #2	2	340	Group B	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
002_02	Un-named #2	3	2000	Group B	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
002_02	Un-named #2	4	170	Group B	98%	0.11	2	300	30	80%	1.10	2	300	300	300	-18%
002_02	Un-named #2	5	140	Group B	98%	0.11	2	300	30	90%	0.55	2	300	200	200	-8%
002_02	Un-named #2	6	340	Group B	98%	0.11	2	700	80	80%	1.10	2	700	800	700	-18%
002_02	Un-named #2	7	160	Group B	98%	0.11	2	300	30	90%	0.55	2	300	200	200	-8%
002_02	Un-named #2	8	210	Group B	98%	0.11	2	400	40	80%	1.10	2	400	400	400	-18%
002_02	Un-named #3	1	400	Group B	98%	0.11	1	400	40	80%	1.10	1	400	400	400	-18%
002_02	Un-named #3	2	1200	Group B	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
002_02	Placer Creek	1	2900	Group B	98%	0.11	2	6,000	700	90%	0.55	2	6,000	3,000	2,000	-8%
002_02	Placer Creek	2	510	Group B	97%	0.17	3	2,000	300	80%	1.10	3	2,000	2,000	2,000	-17%
002_02	Placer Creek	3	2000	Group B	96%	0.22	4	8,000	2,000	90%	0.55	4	8,000	4,000	2,000	-6%
							Totals		4,500					17,000	13,000	

Shade Figures—Lower Kootenai River Subbasin

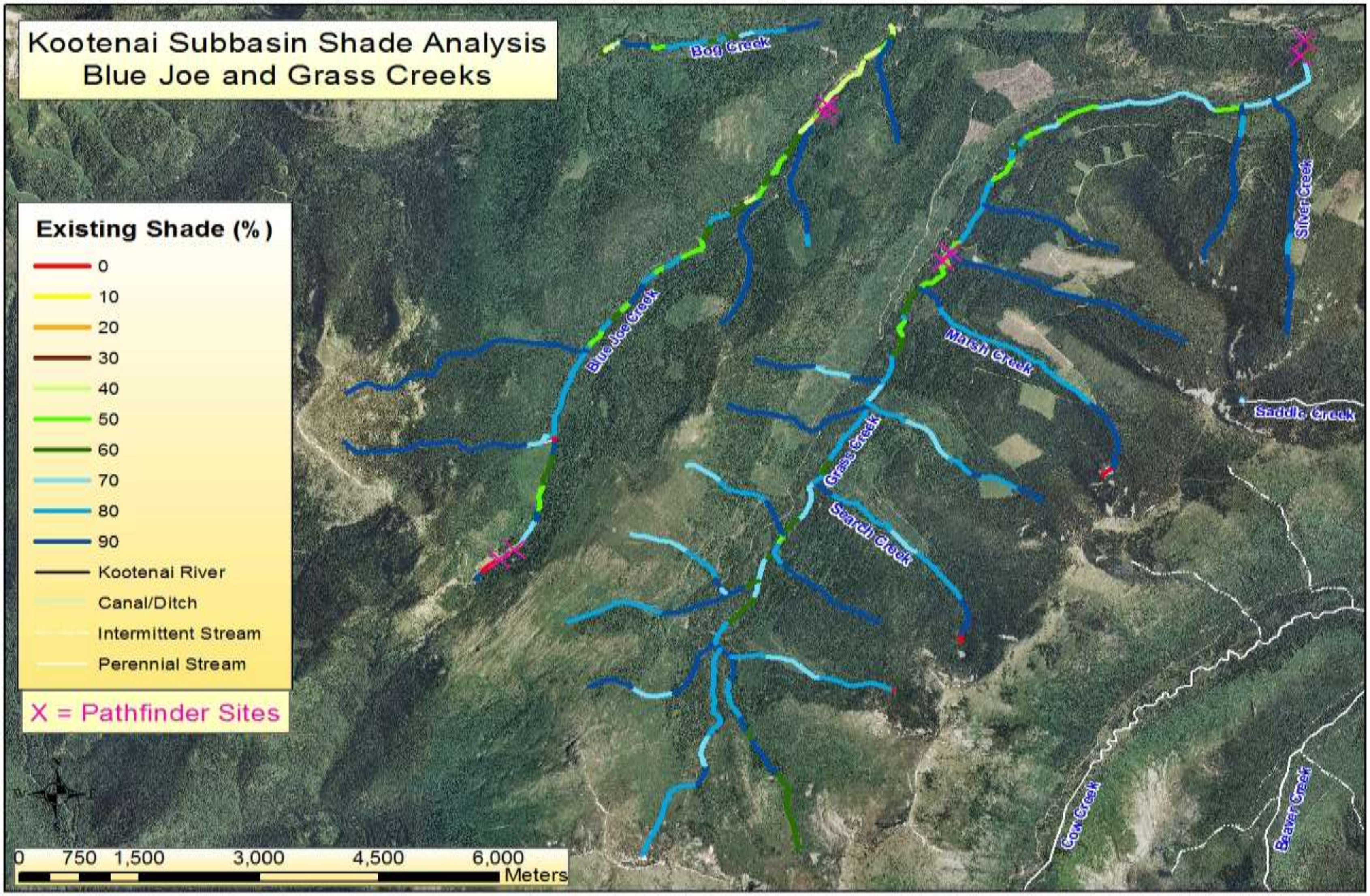


Figure B-8. Existing shade estimated for Blue Joe and Grass Creeks by aerial photo interpretation.

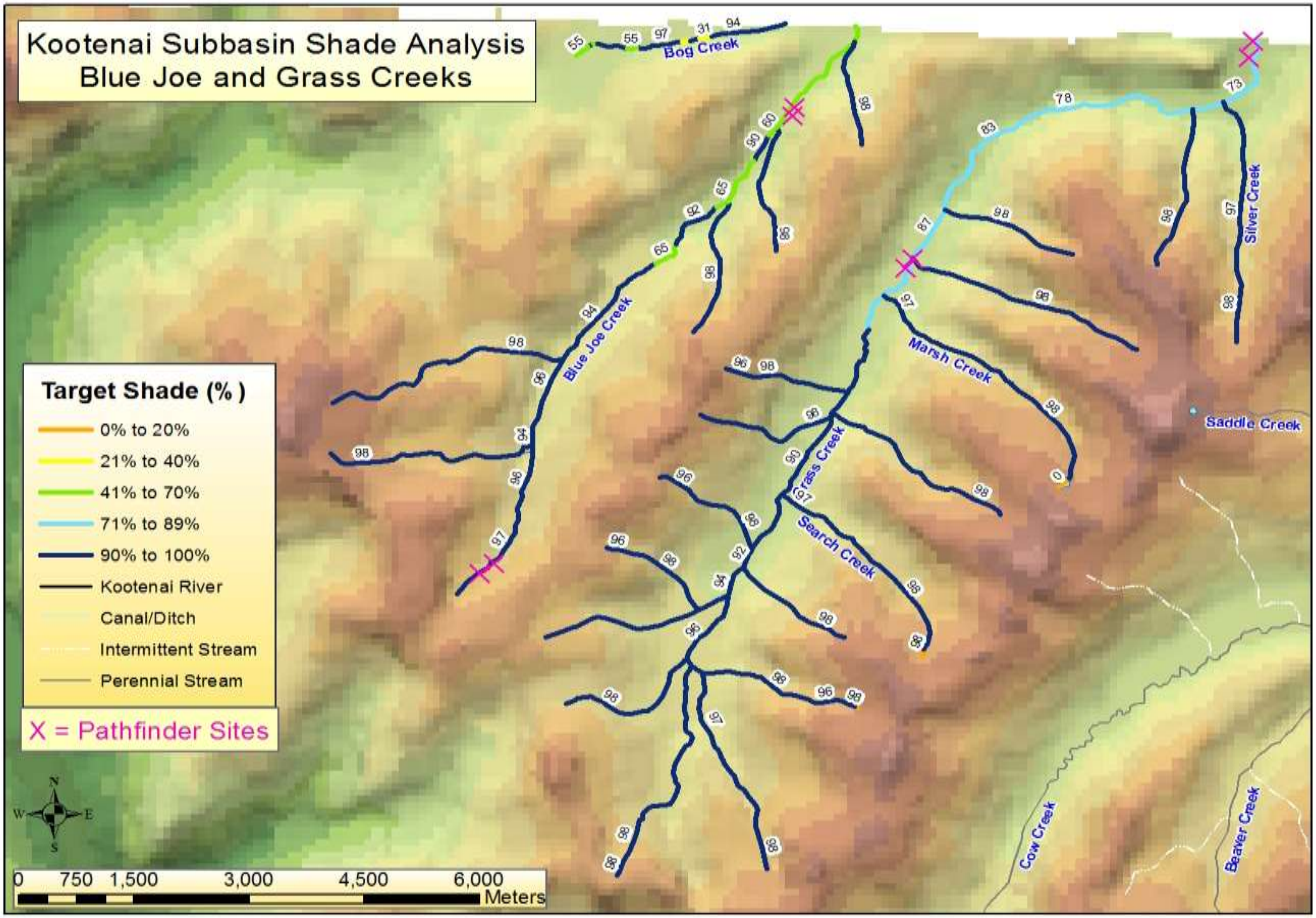


Figure B-9. Target shade for Blue Joe and Grass Creeks.

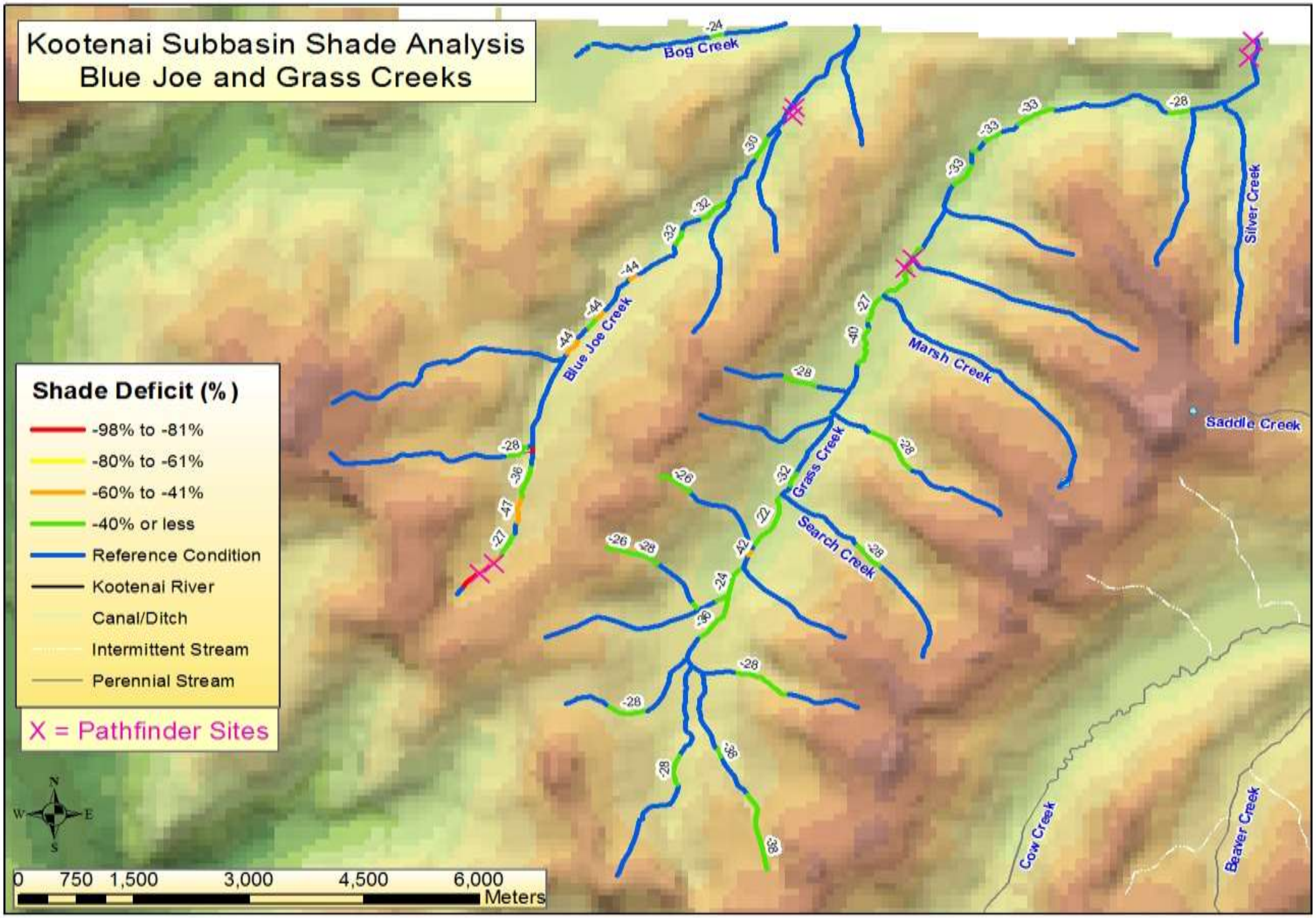


Figure B-10. Lack of shade (difference between existing and target) for Blue Joe and Grass Creeks.

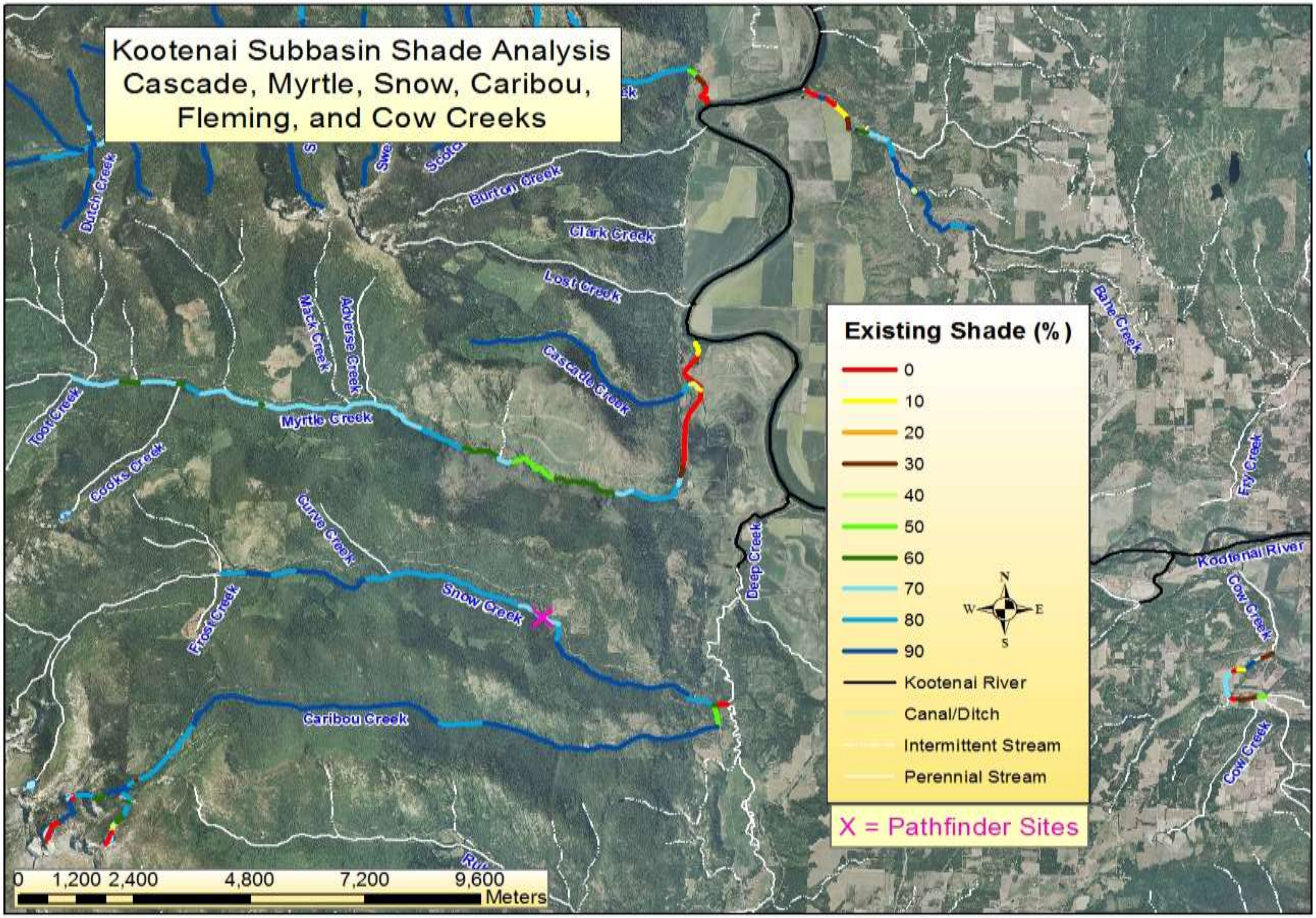


Figure B-11. Existing shade estimated for Cascade, Myrtle, Snow, Caribou, Fleming, and Cow Creeks by aerial photo interpretation.

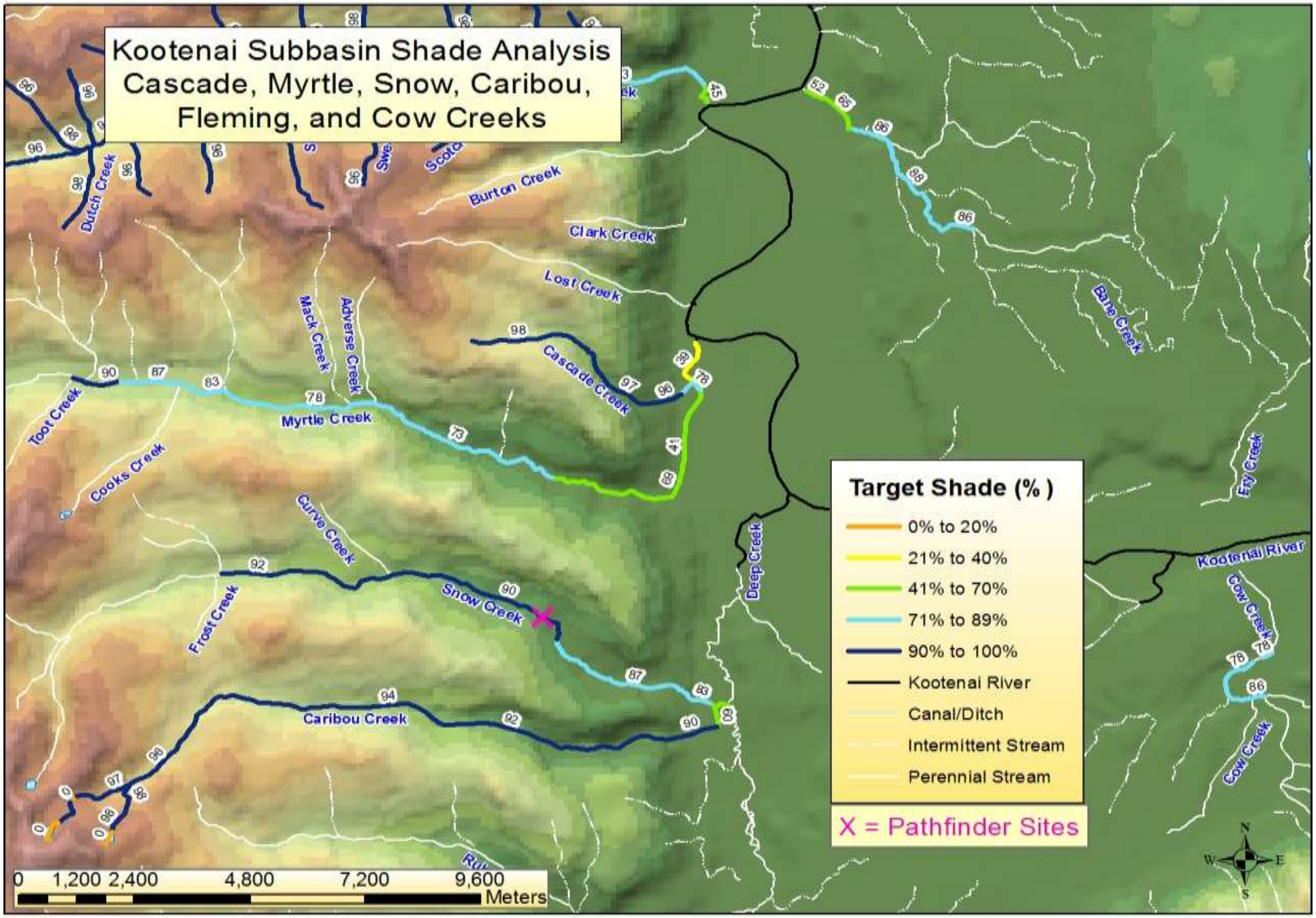


Figure B-12. Target shade for Cascade, Myrtle, Snow, Caribou, Fleming, and Cow Creeks.

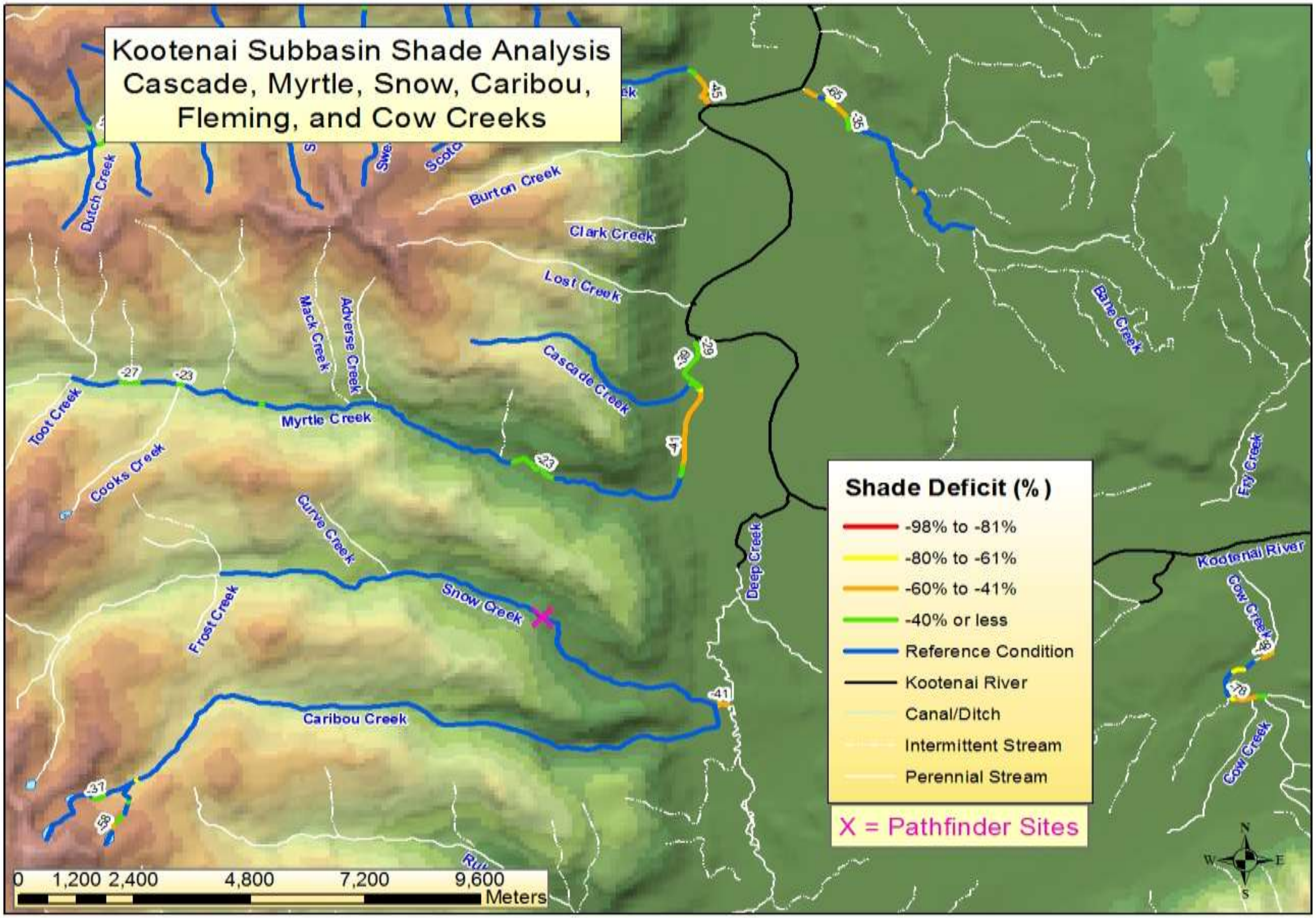


Figure B-13. Lack of shade (difference between existing and target) for Cascade, Myrtle, Snow, Caribou, Fleming, and Cow Creeks.

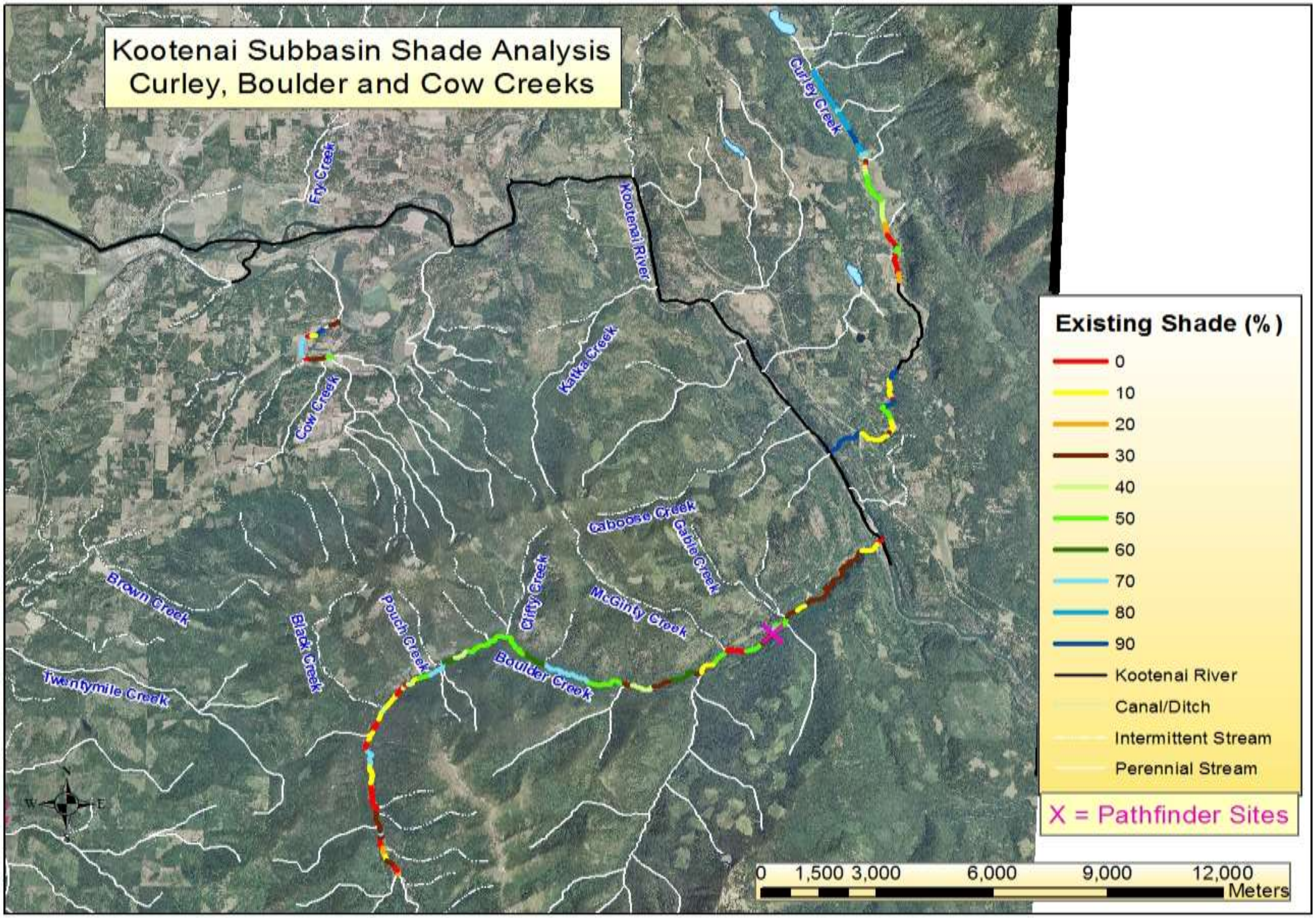


Figure B-14. Existing shade estimated for Curley, Boulder, and Cow Creeks by aerial photo interpretation.

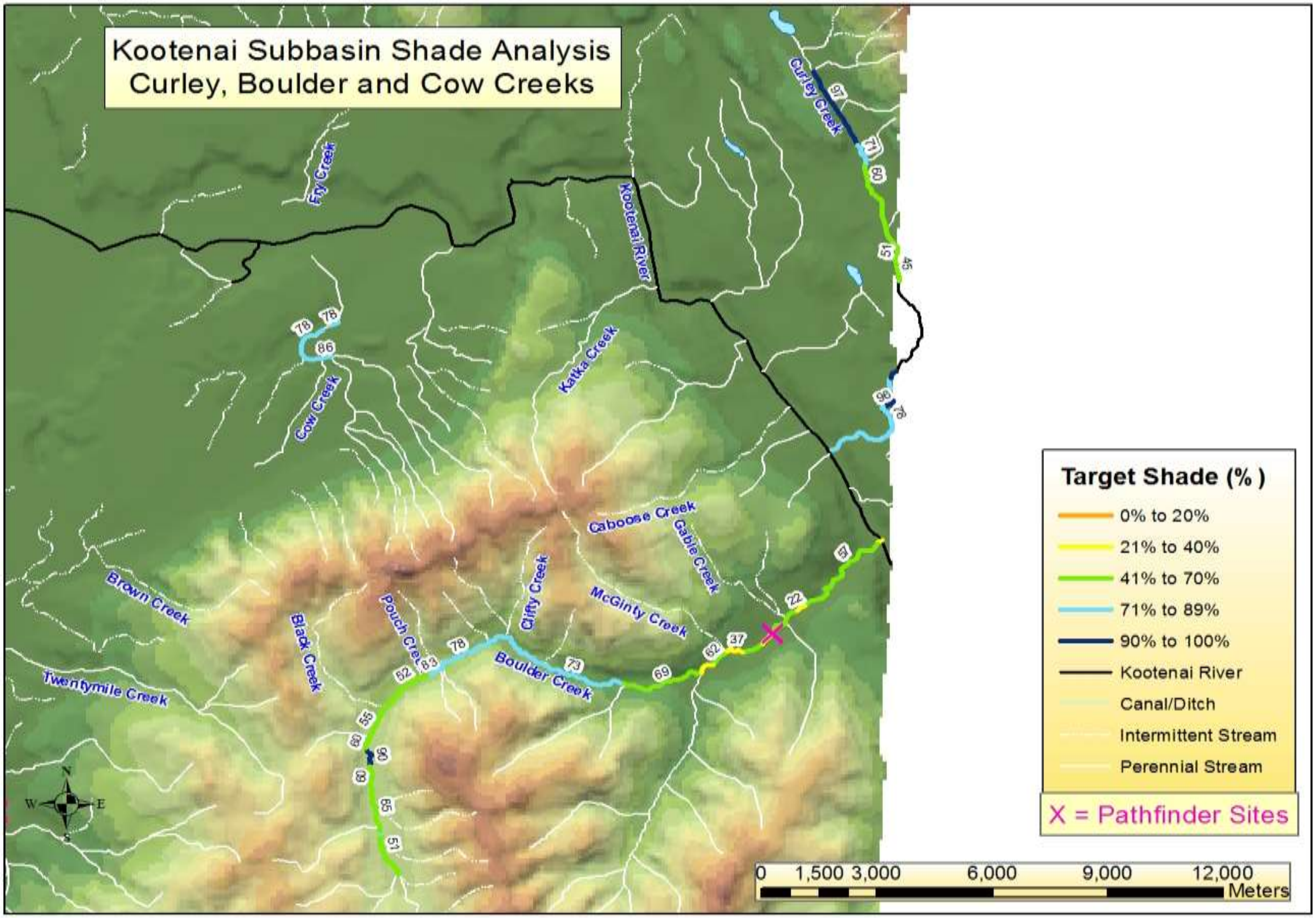


Figure B-15. Target shade for Curley, Boulder, and Cow Creeks.

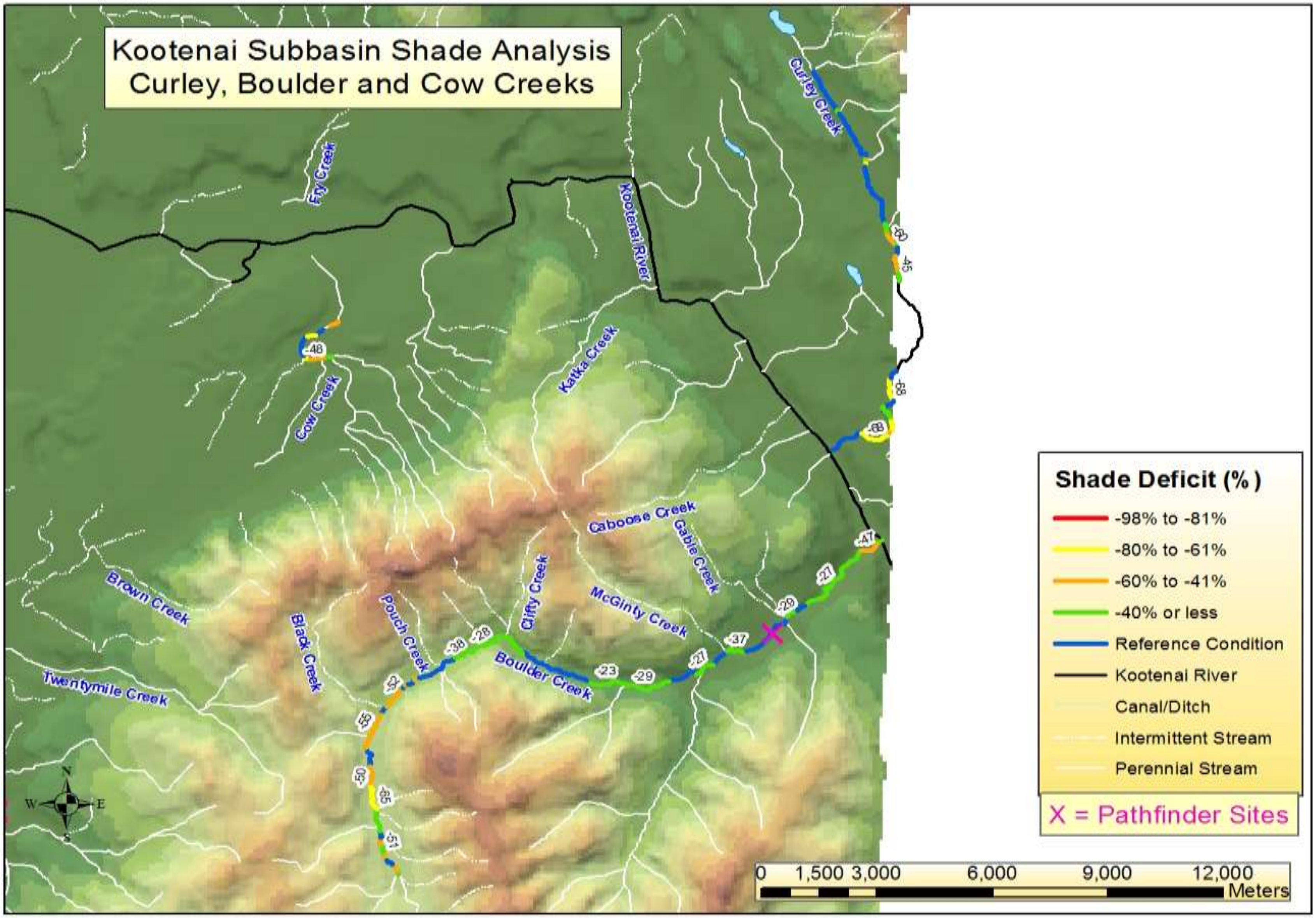


Figure B-16. Lack of shade (difference between existing and target) for Curley, Boulder, and Cow Creeks.

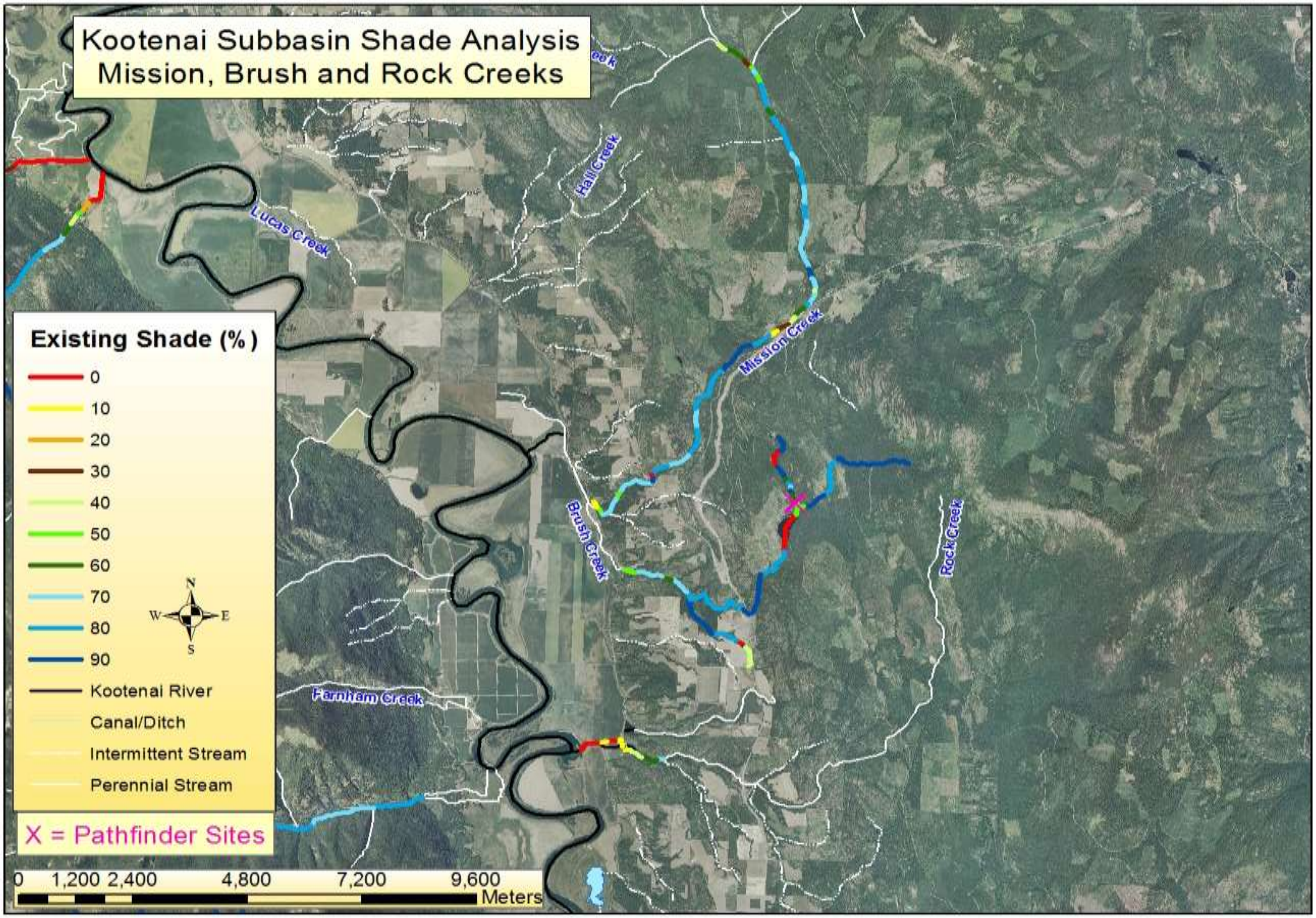


Figure B-17. Existing shade estimated for Mission, Brush, and Rock Creeks by aerial photo interpretation.

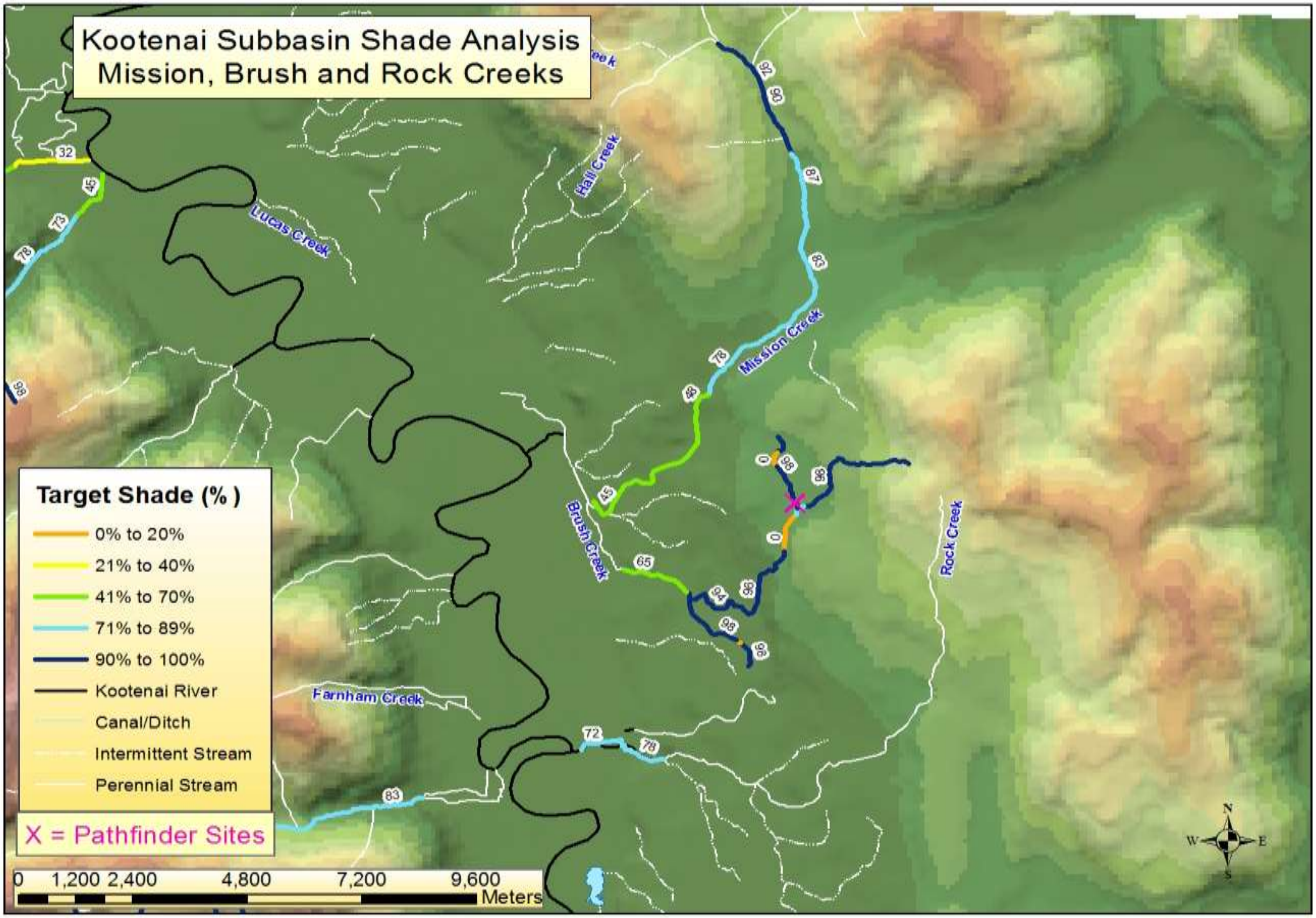


Figure B-18. Target shade for Mission, Brush, and Rock Creeks.

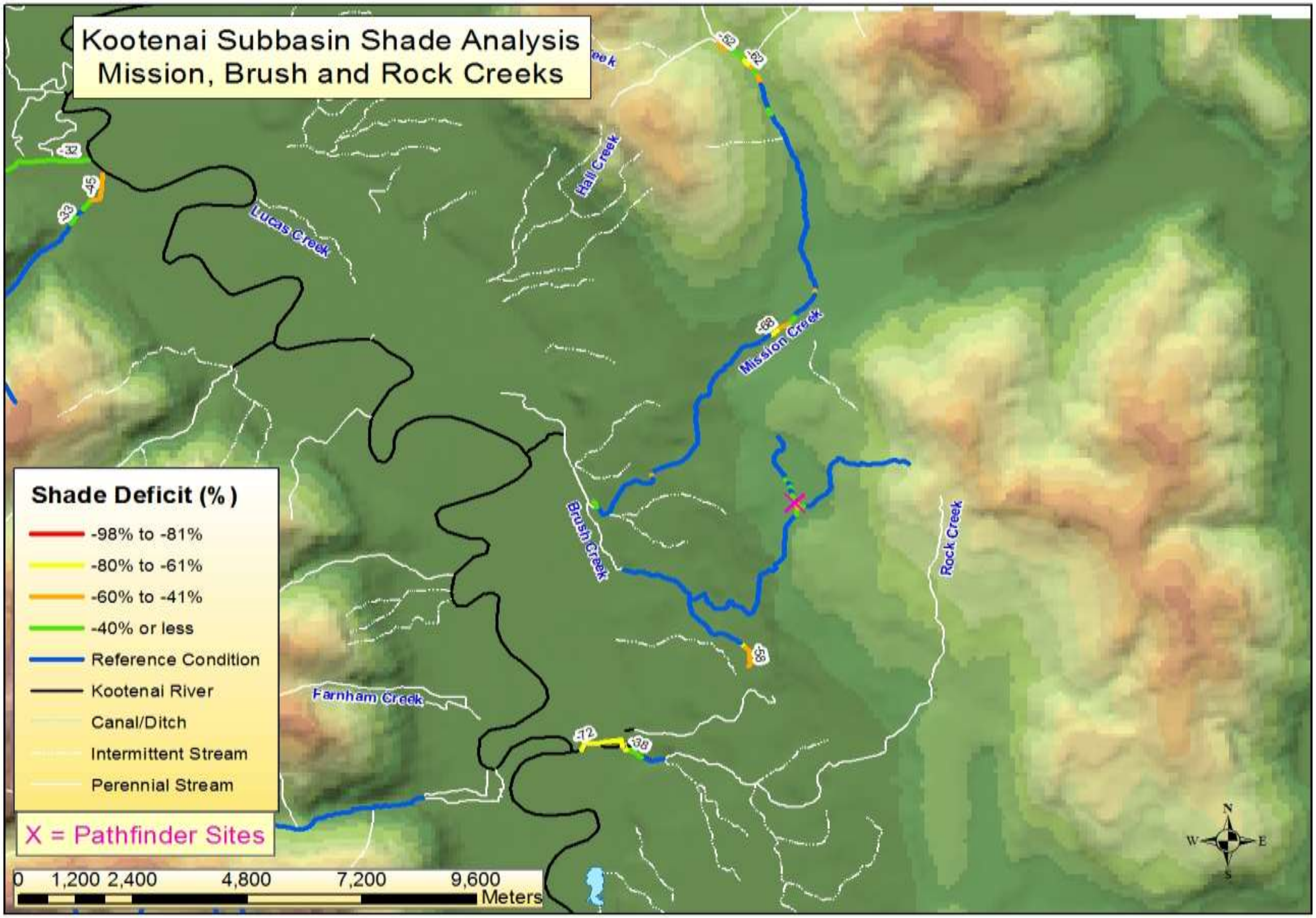


Figure B-19. Lack of shade (difference between existing and target) for Mission, Brush, and Rock Creeks.

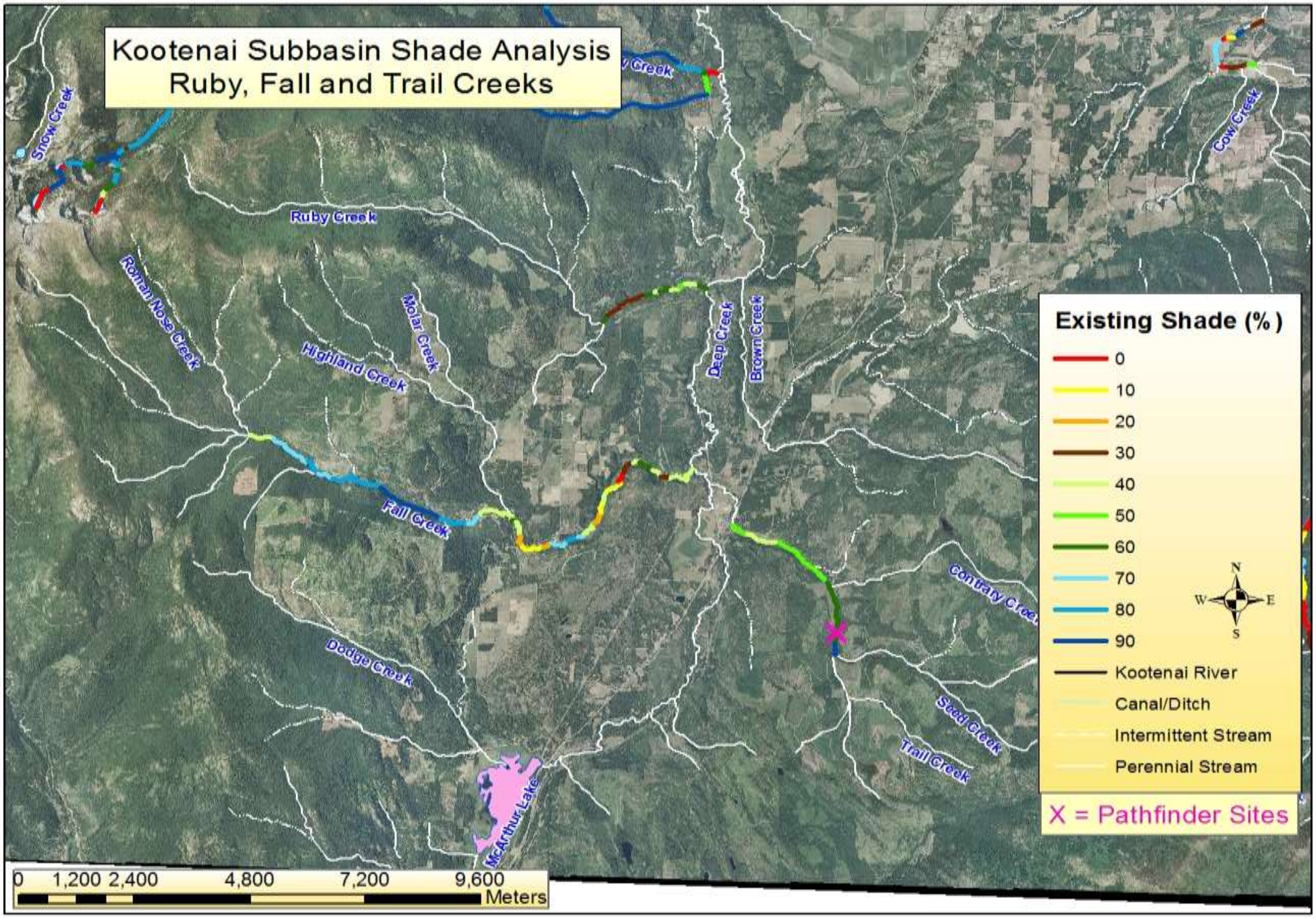


Figure B-20. Existing shade estimated for Ruby, Fall, and Trail Creeks by aerial photo interpretation.

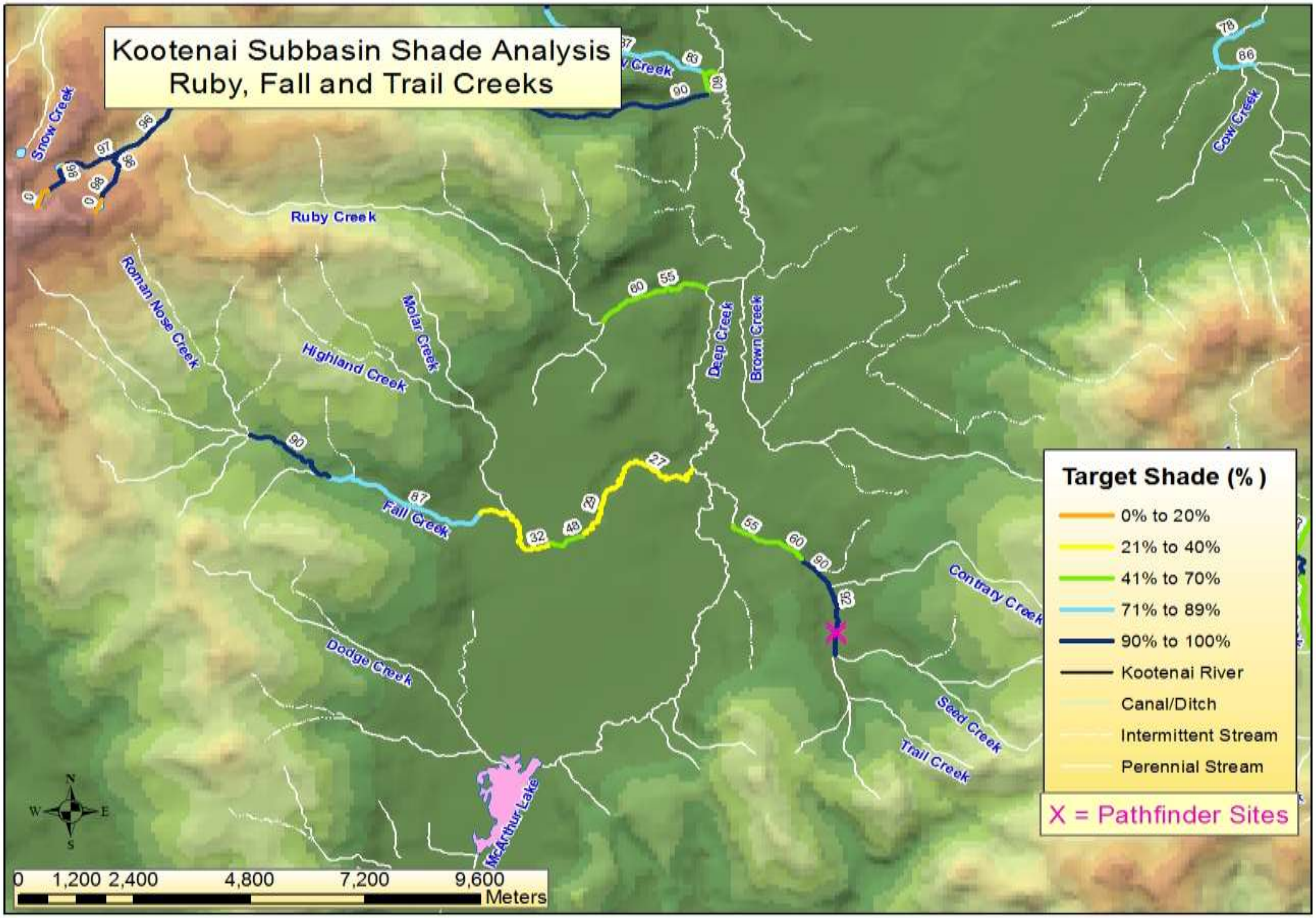


Figure B-21. Target shade for Ruby, Fall, and Trail Creeks.

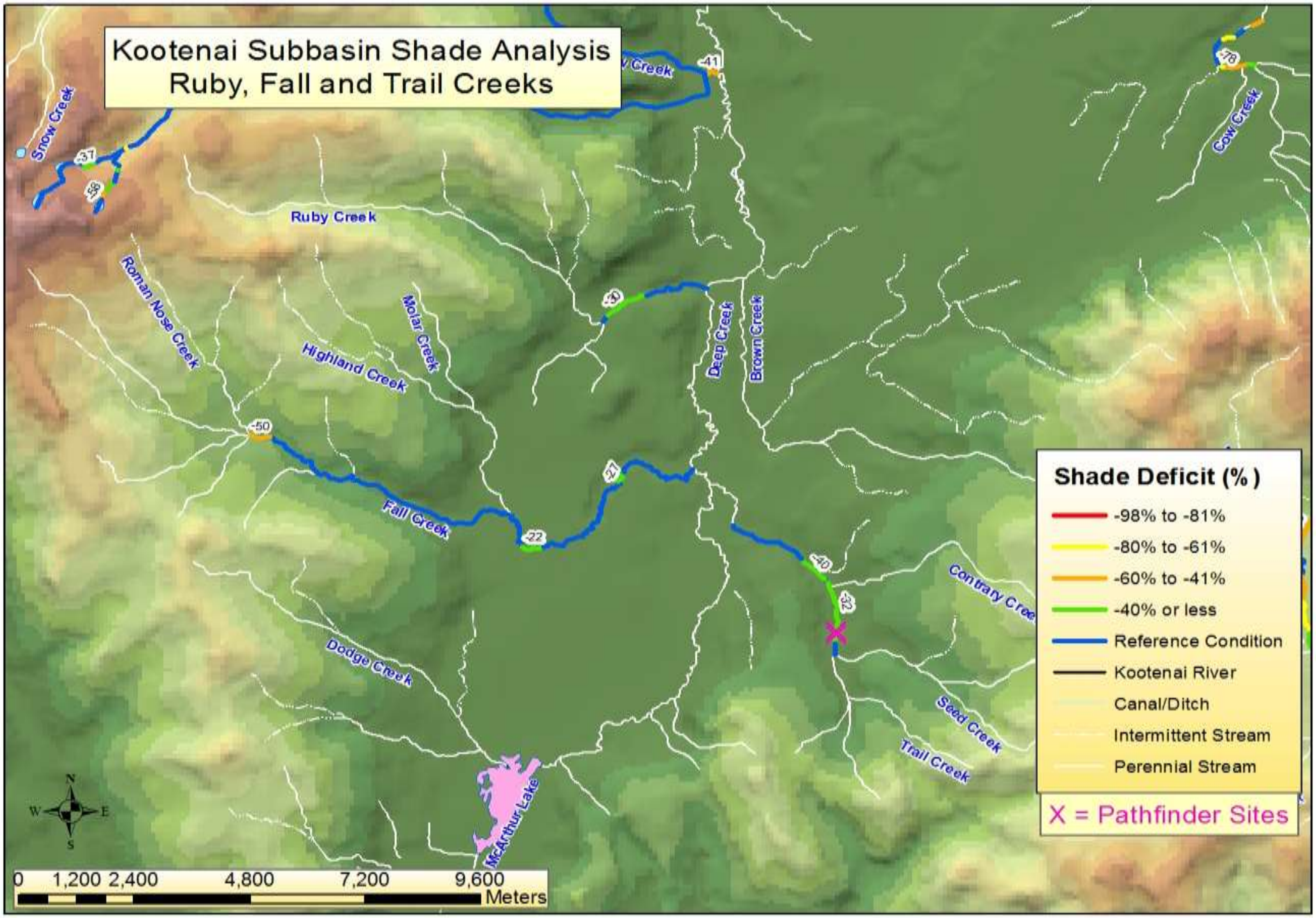


Figure B-22. Lack of shade (difference between existing and target) for Ruby, Fall, and Trail Creeks.

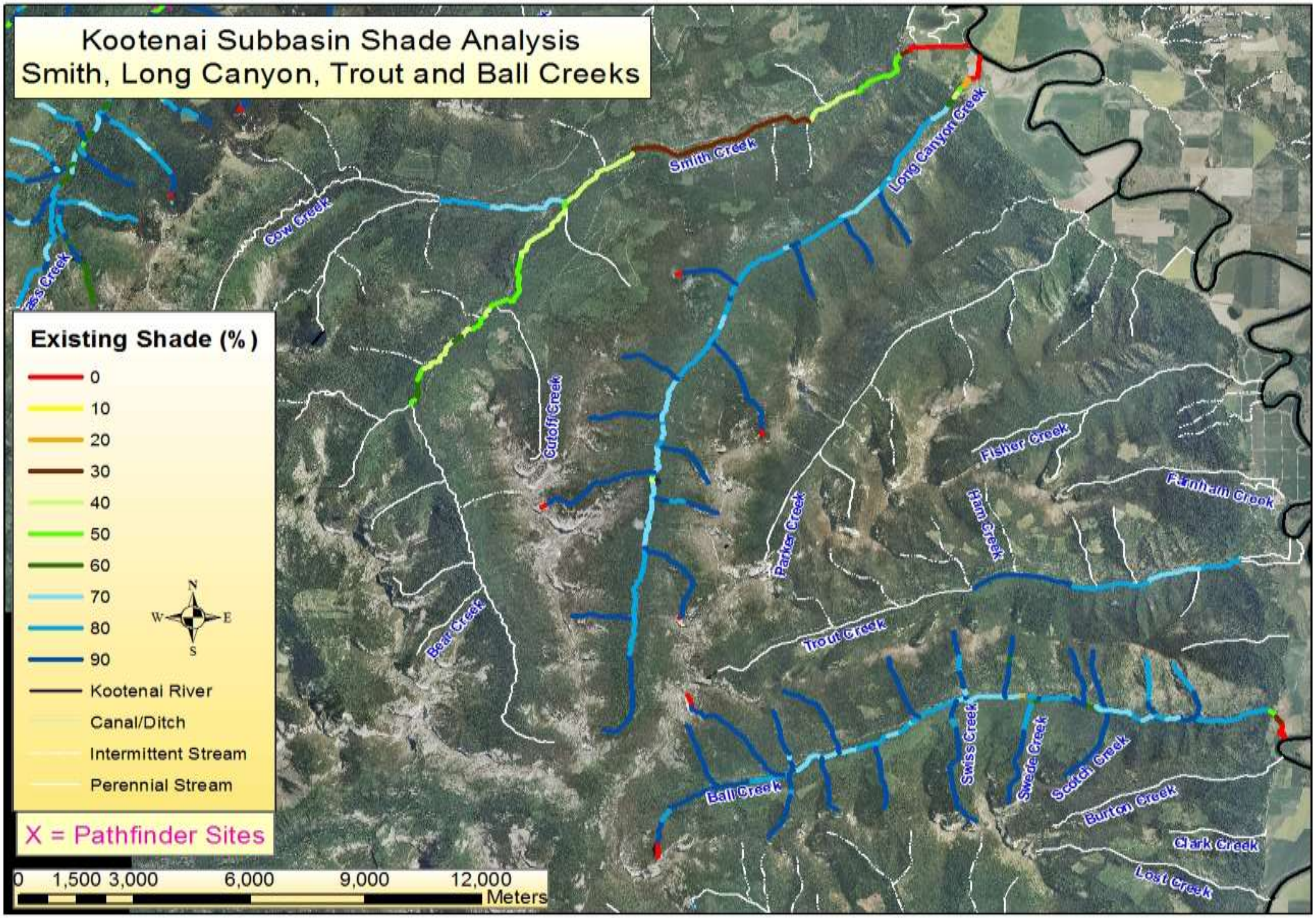


Figure B-23. Existing shade estimated for Smith, Long Canyon, Trout, and Ball Creeks by aerial photo interpretation.

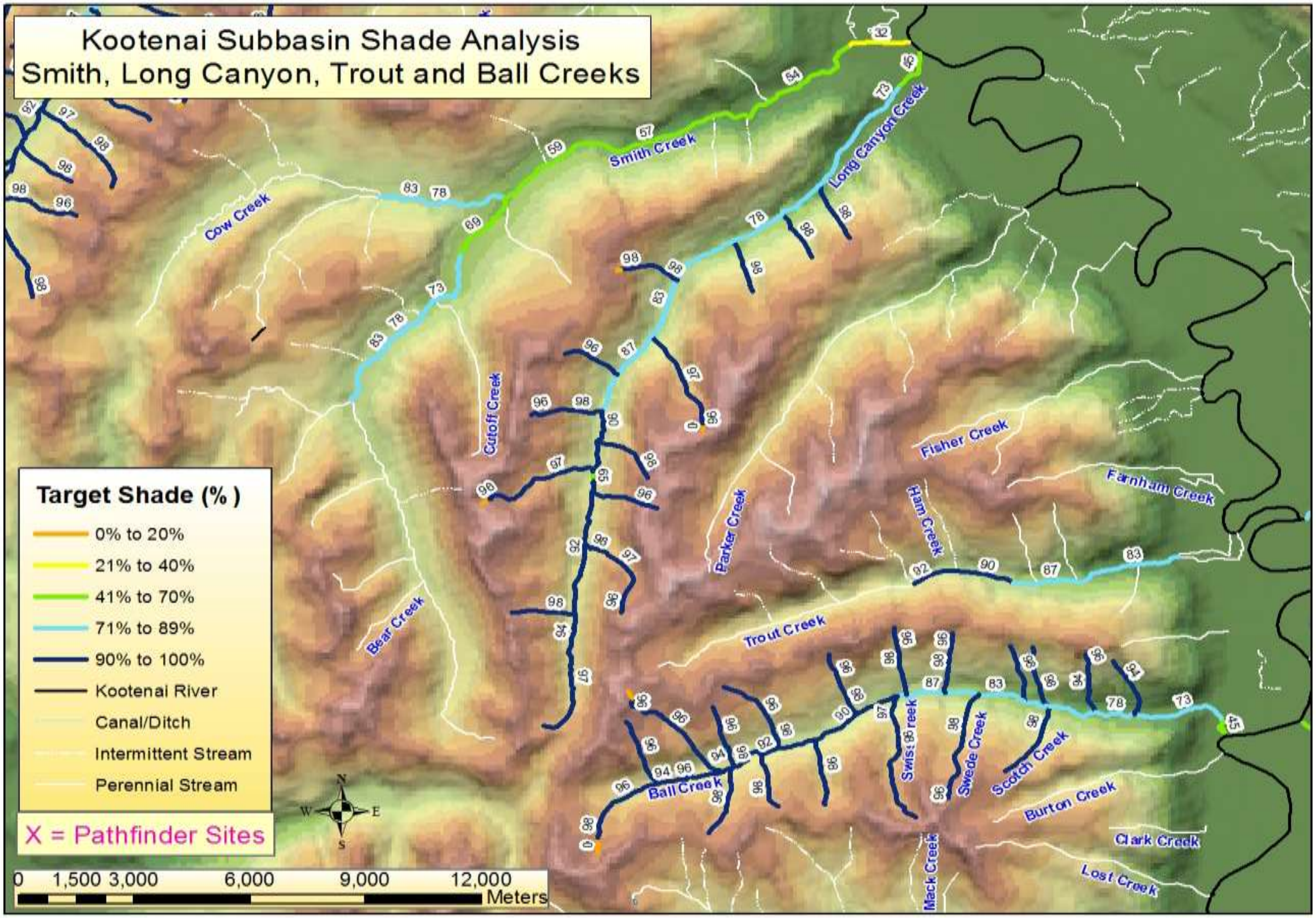


Figure B-24. Target shade for Smith, Long Canyon, Trout, and Ball Creeks.

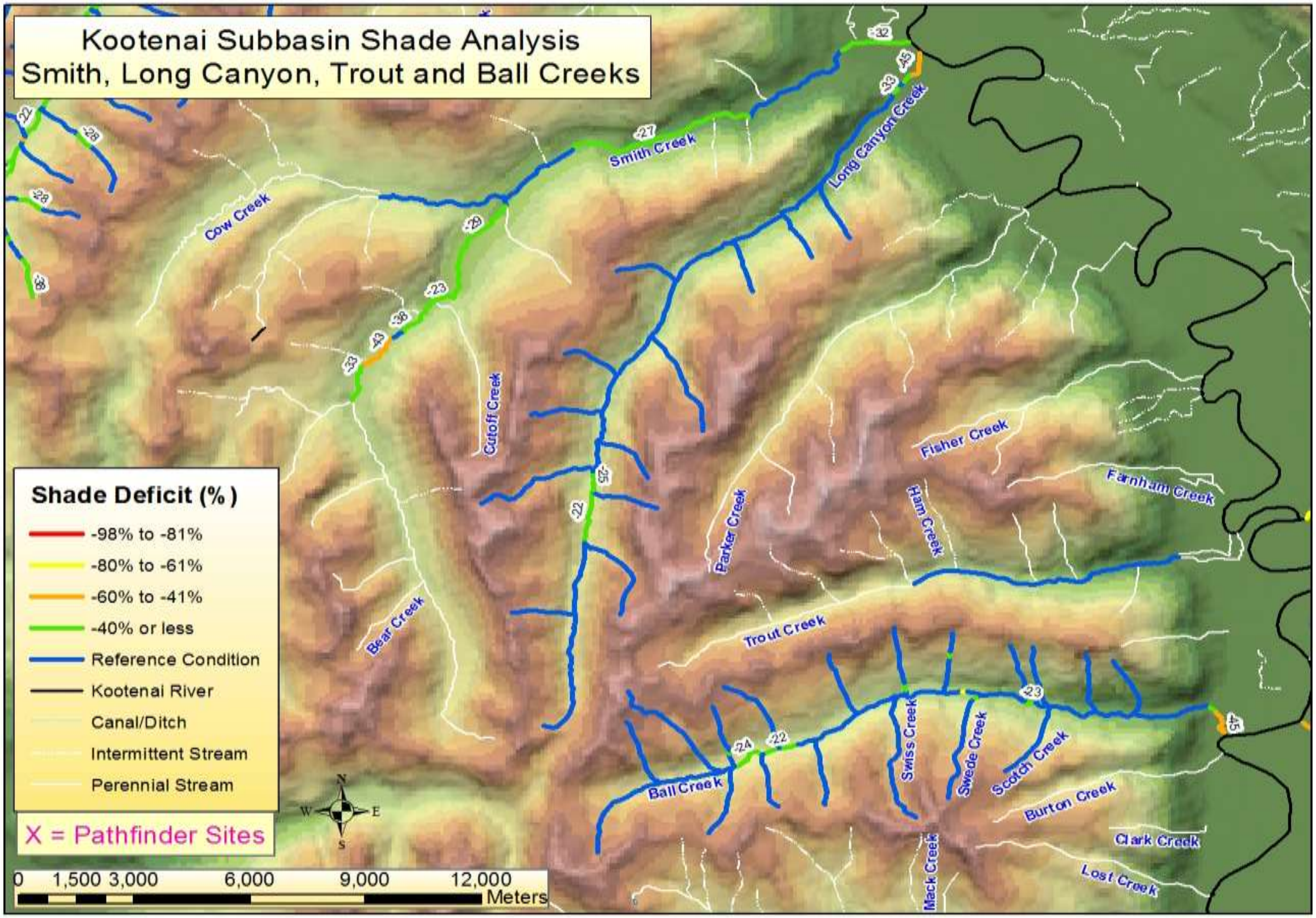


Figure B-25. Lack of shade (difference between existing and target) for Smith, Long Canyon, Trout, and Ball Creeks.

Shade Figures—Moyie River Subbasin

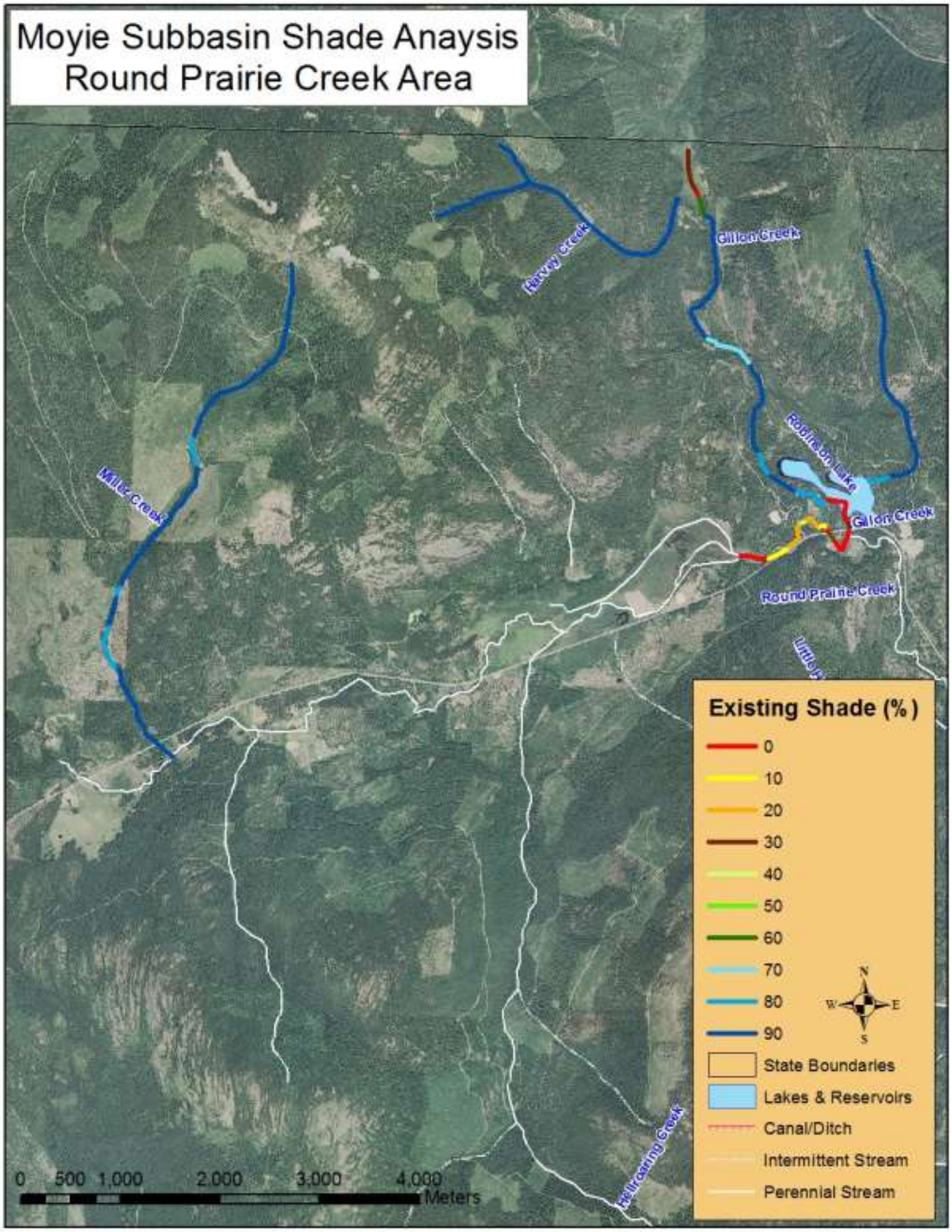


Figure B-26. Existing shade estimated for Round Prairie Creek area by aerial photo interpretation.

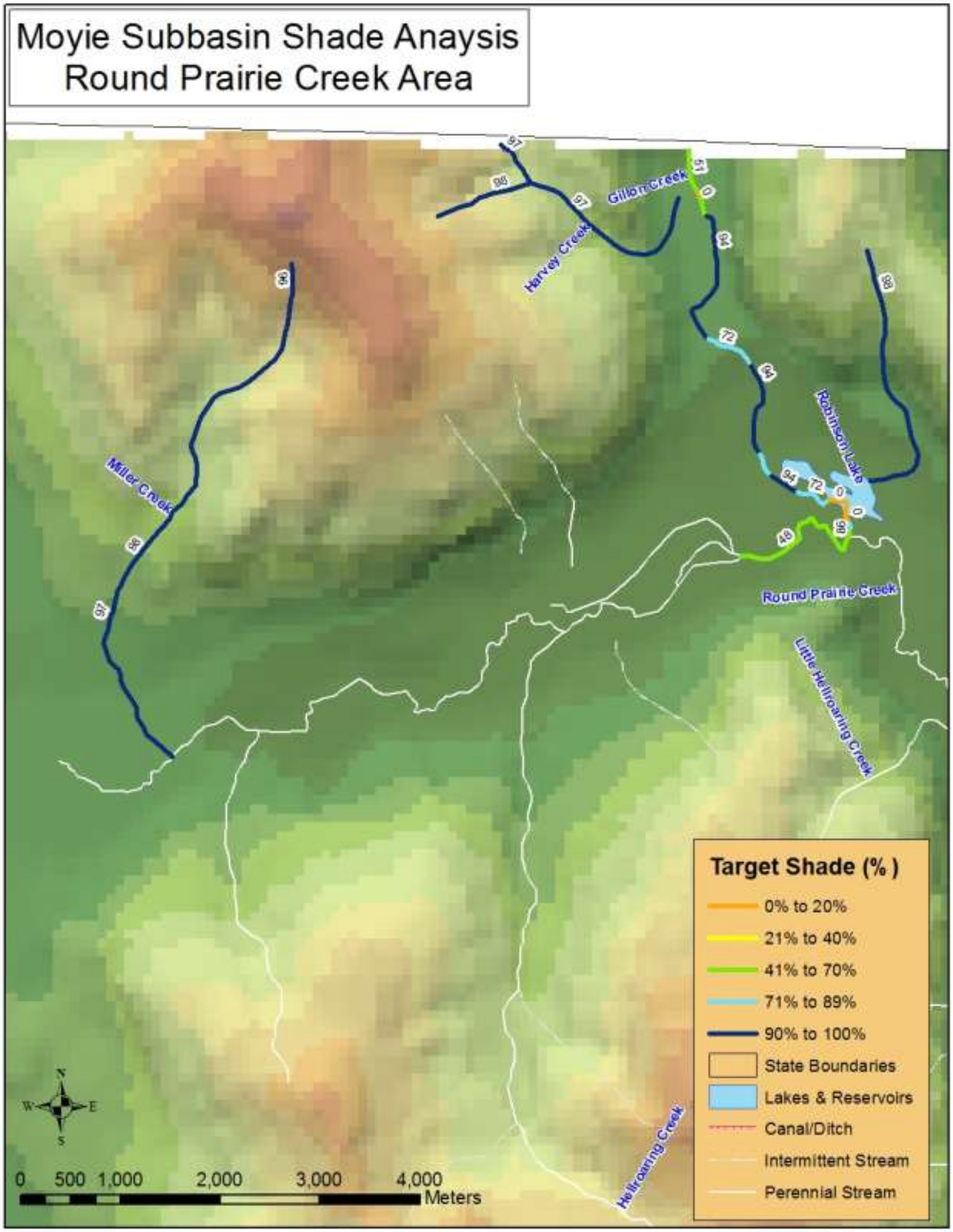


Figure B-27. Target shade for Round Prairie Creek area.

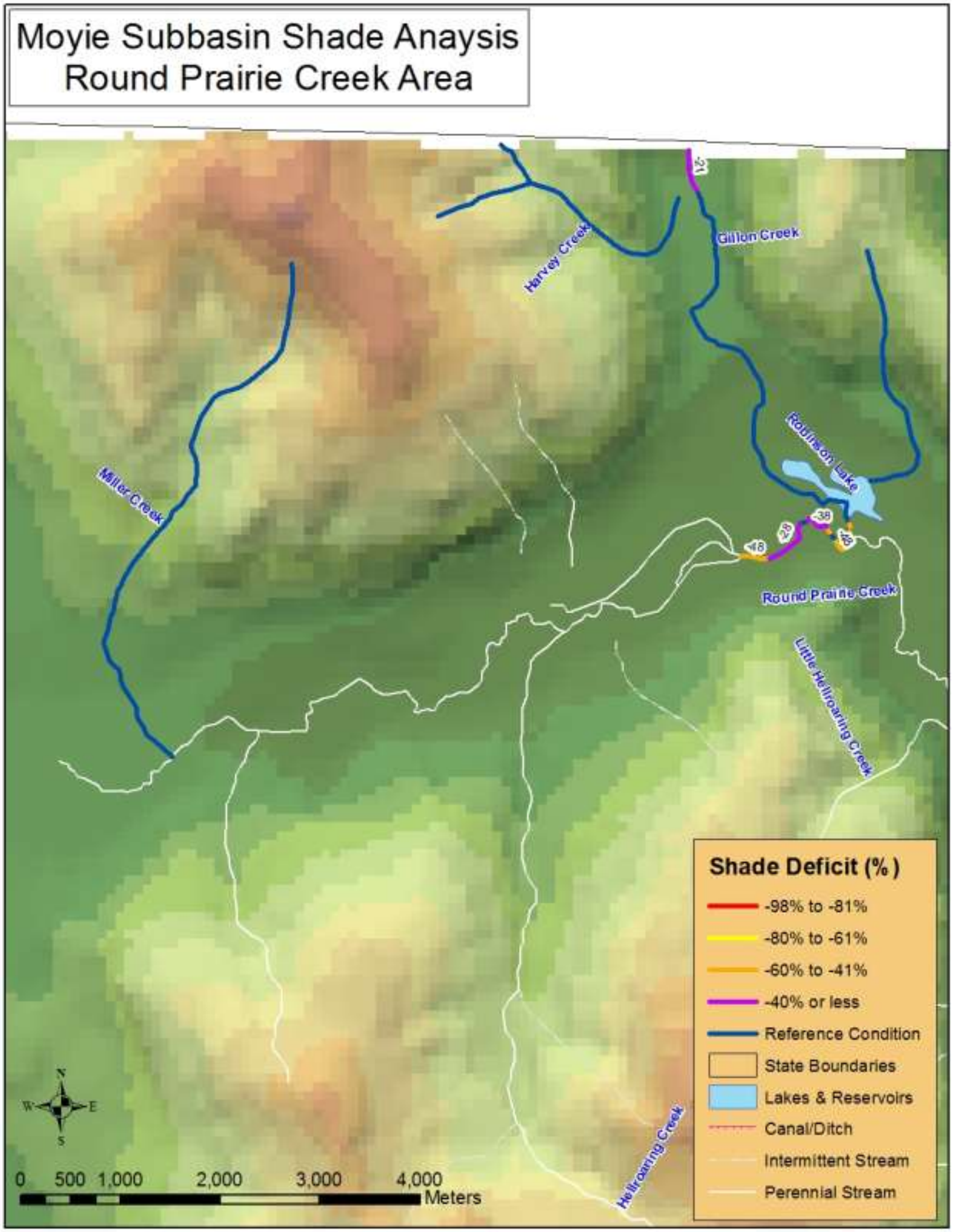


Figure B-28. Lack of shade (difference between existing and target) for Round Prairie Creek area.

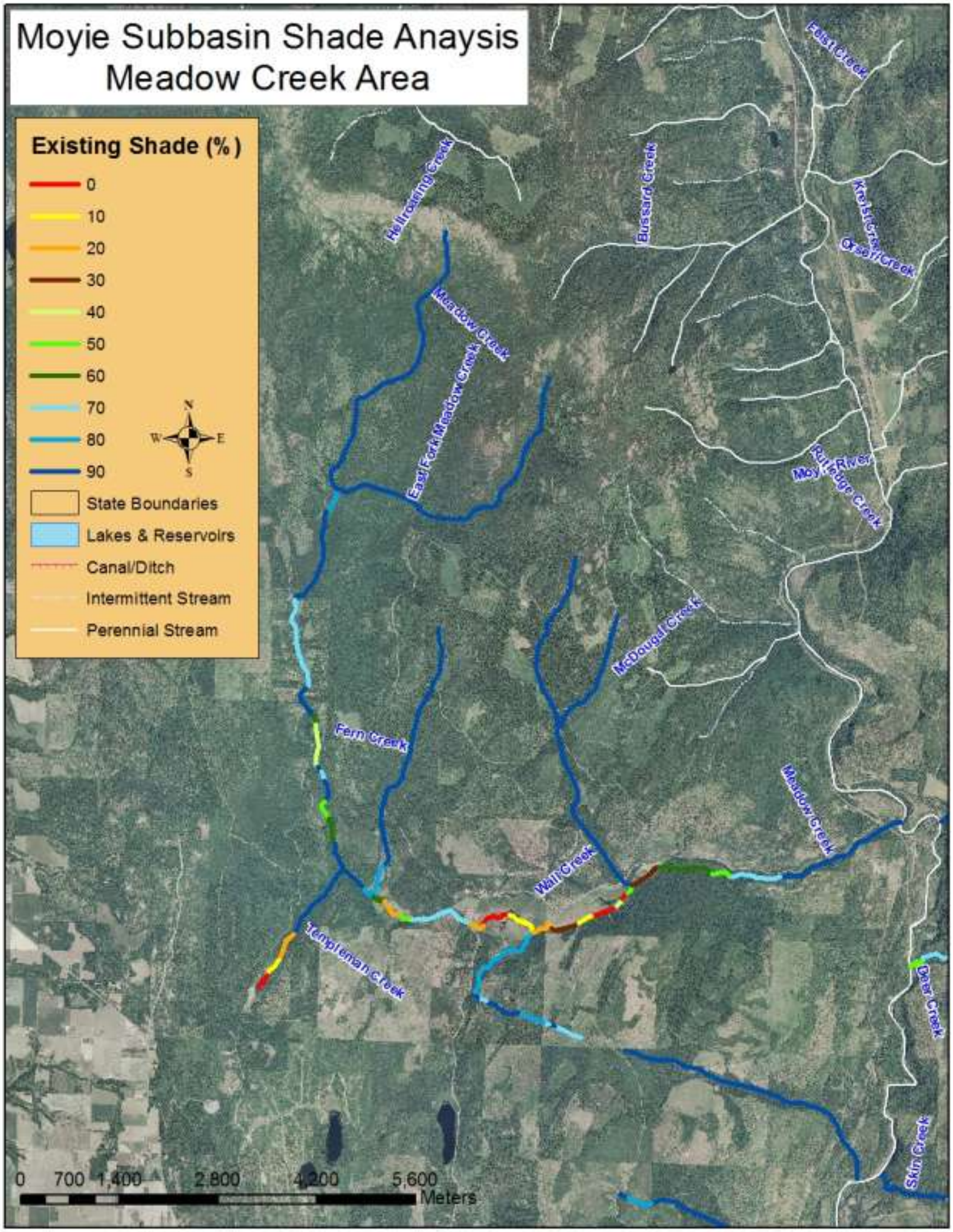


Figure B-29. Existing shade estimated for Meadow Creek area by aerial photo interpretation.

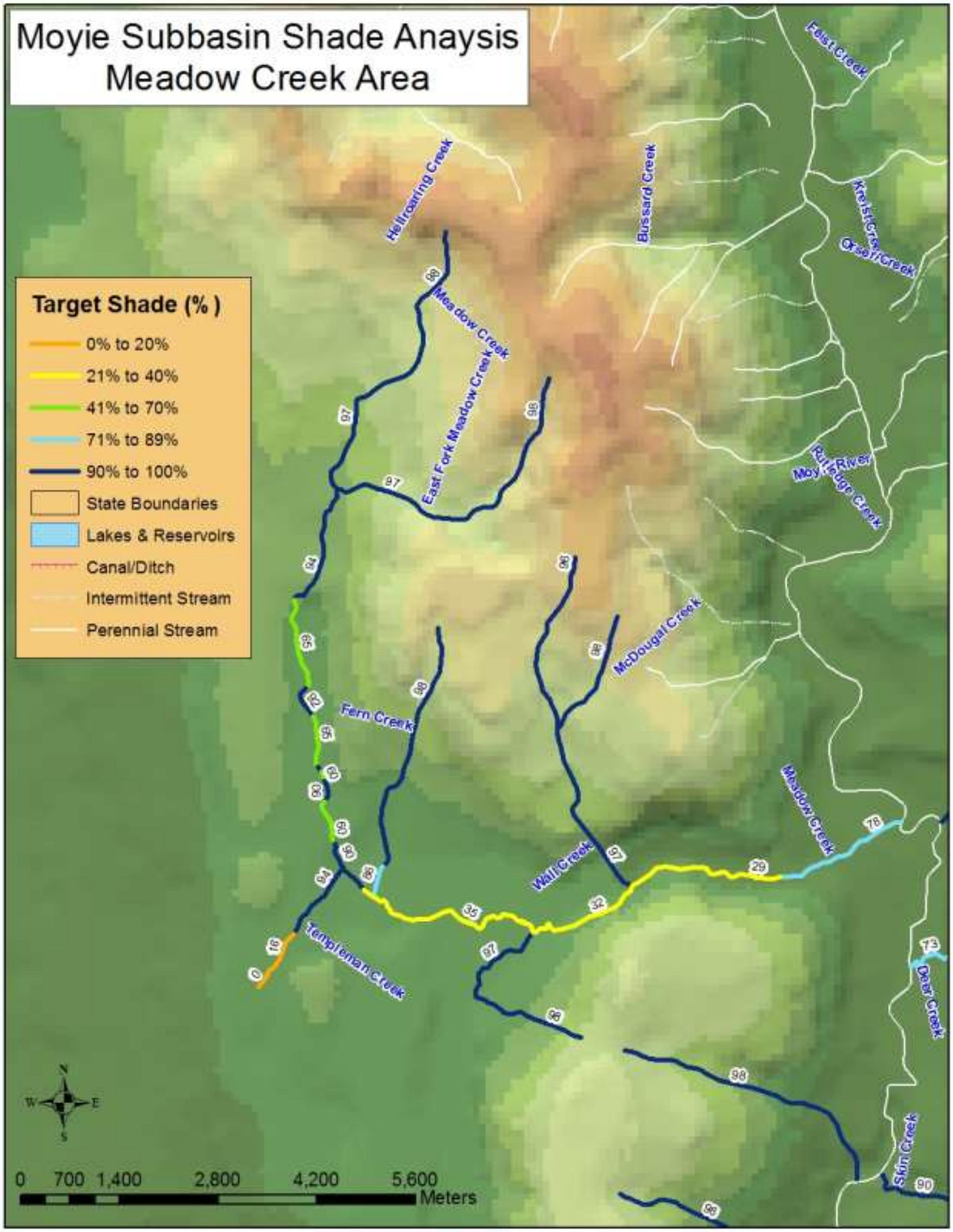


Figure B-30. Target shade for Meadow Creek area.

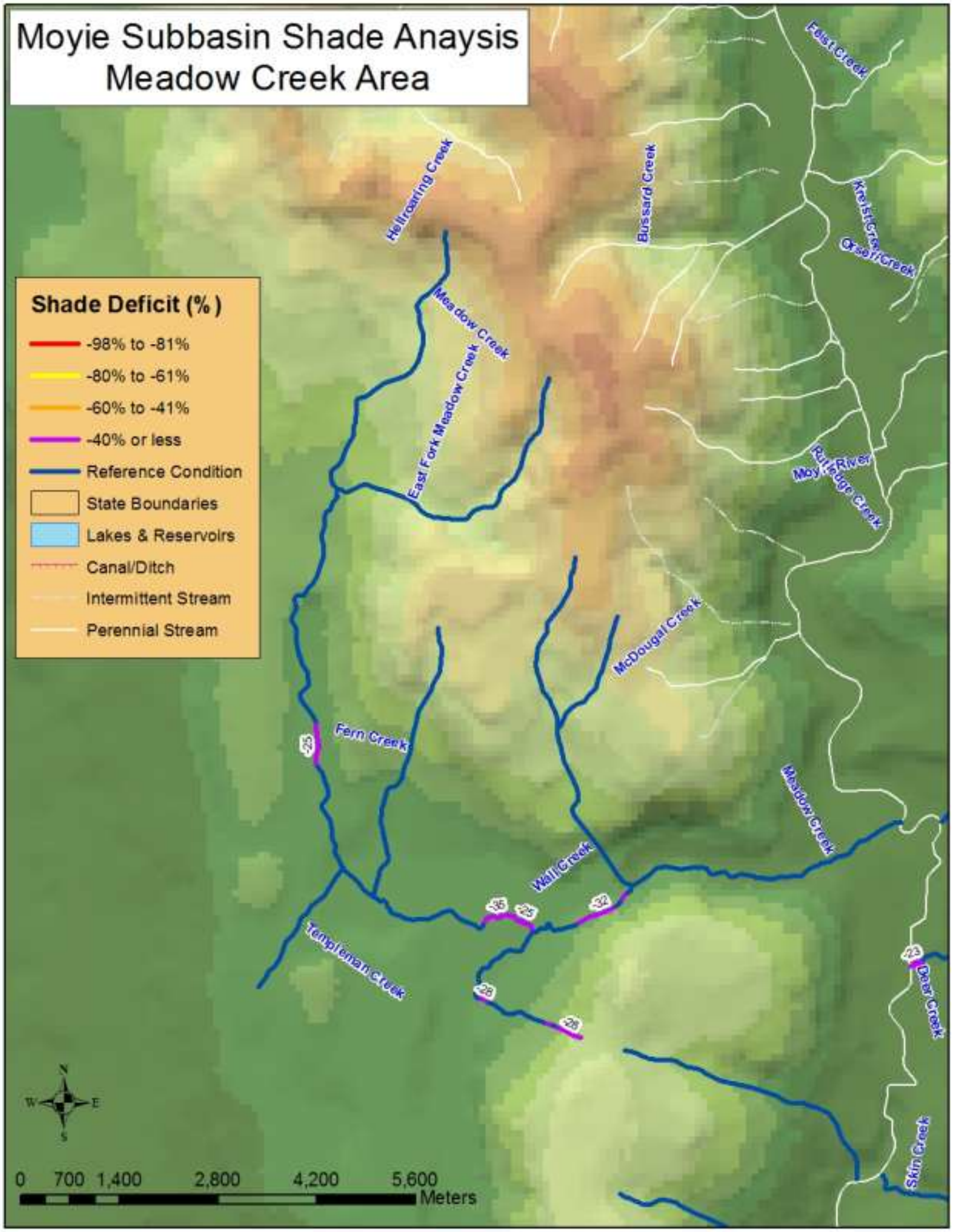


Figure B-31. Lack of shade (difference between existing and target) for Meadow Creek area.

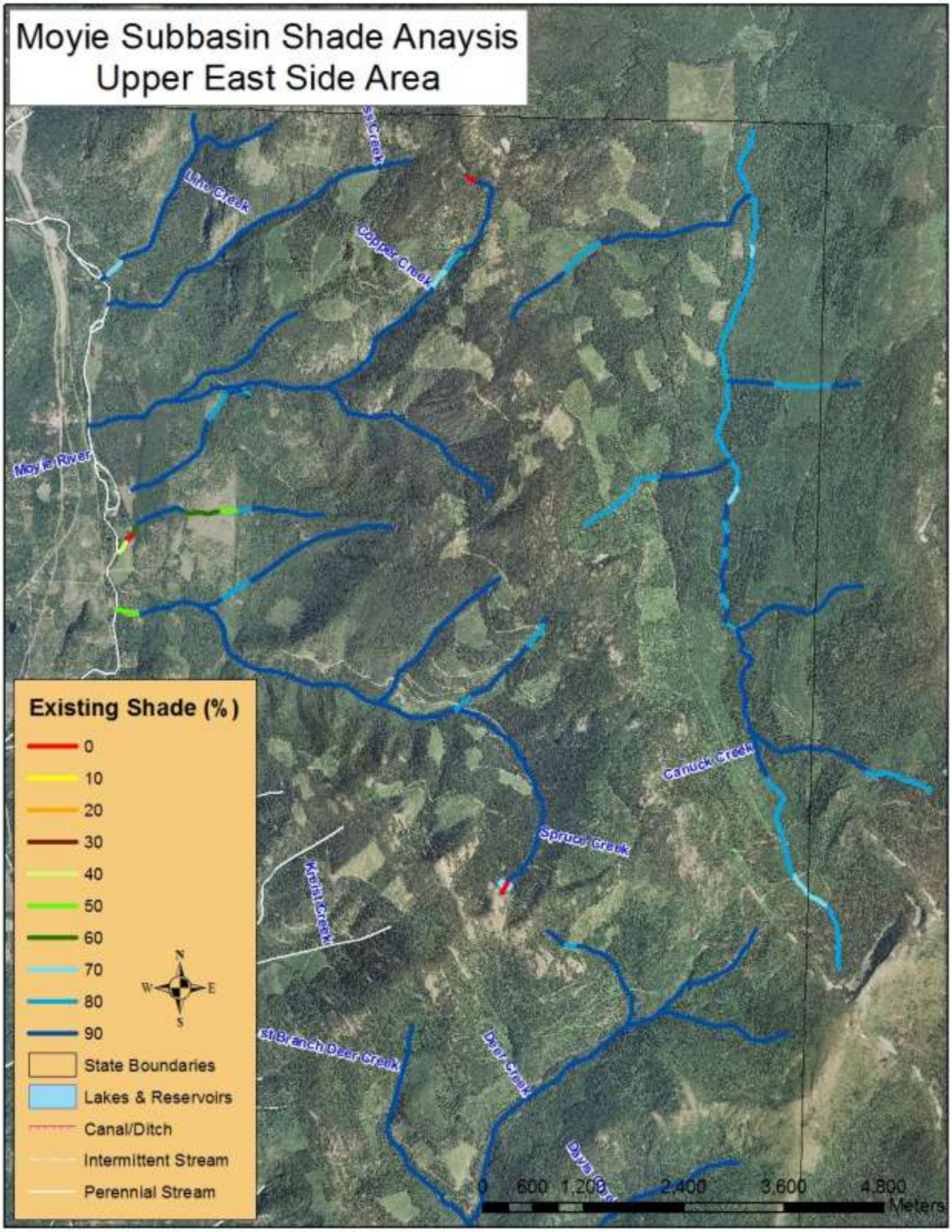


Figure B-32. Existing shade estimated for upper east side area by aerial photo interpretation.

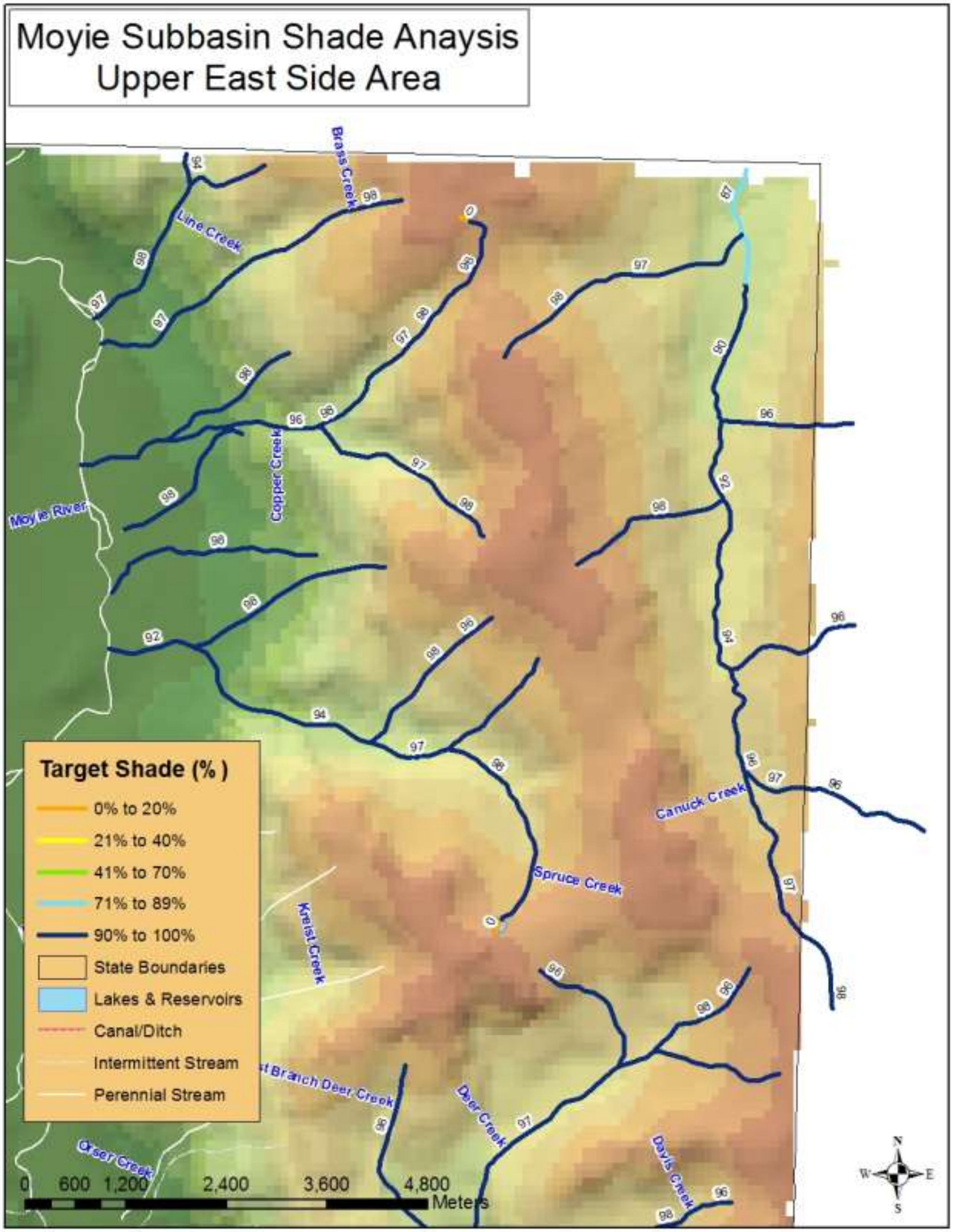


Figure B-33. Target shade for upper east side area.

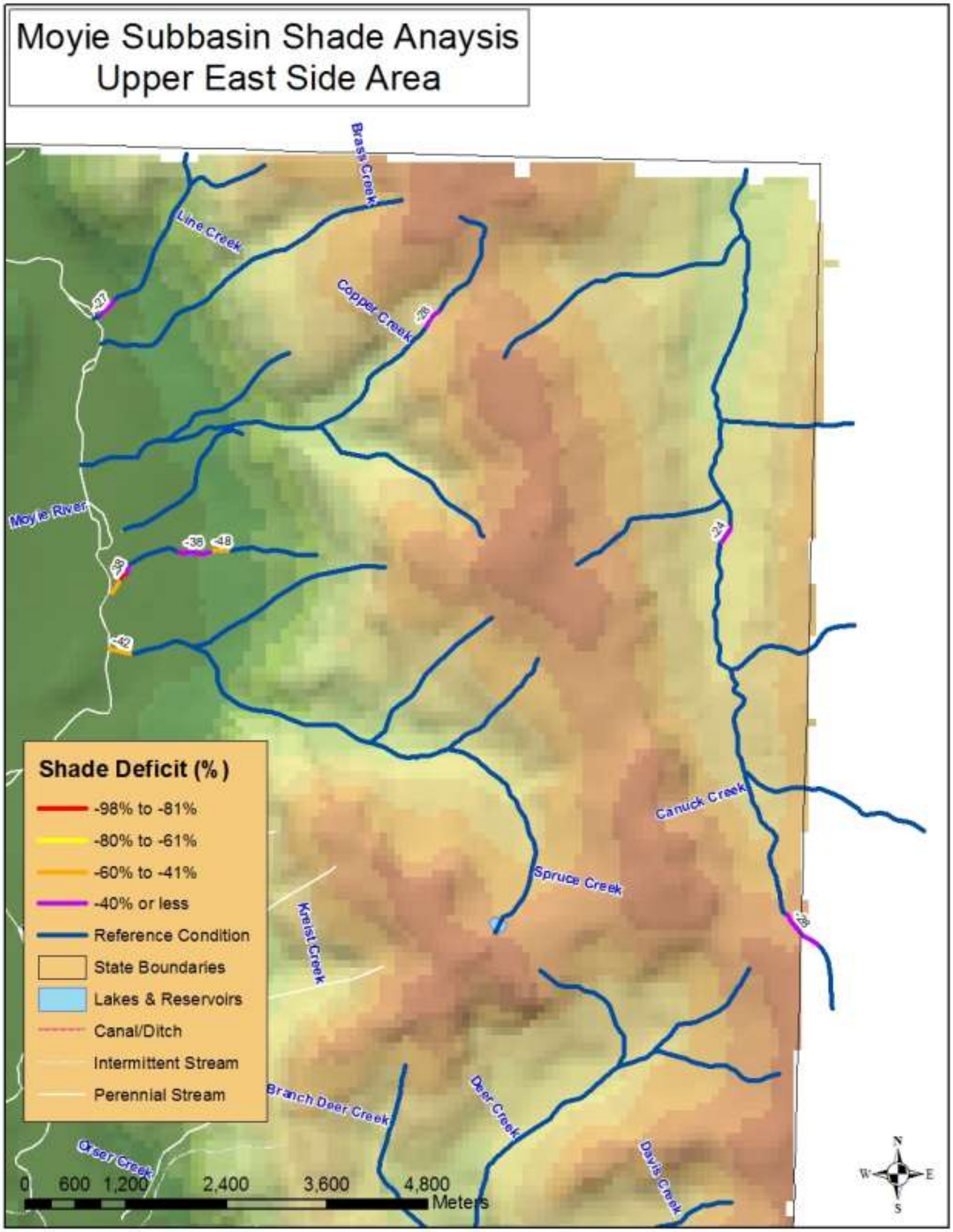


Figure B-34. Lack of shade (difference between existing and target) for upper east side area.

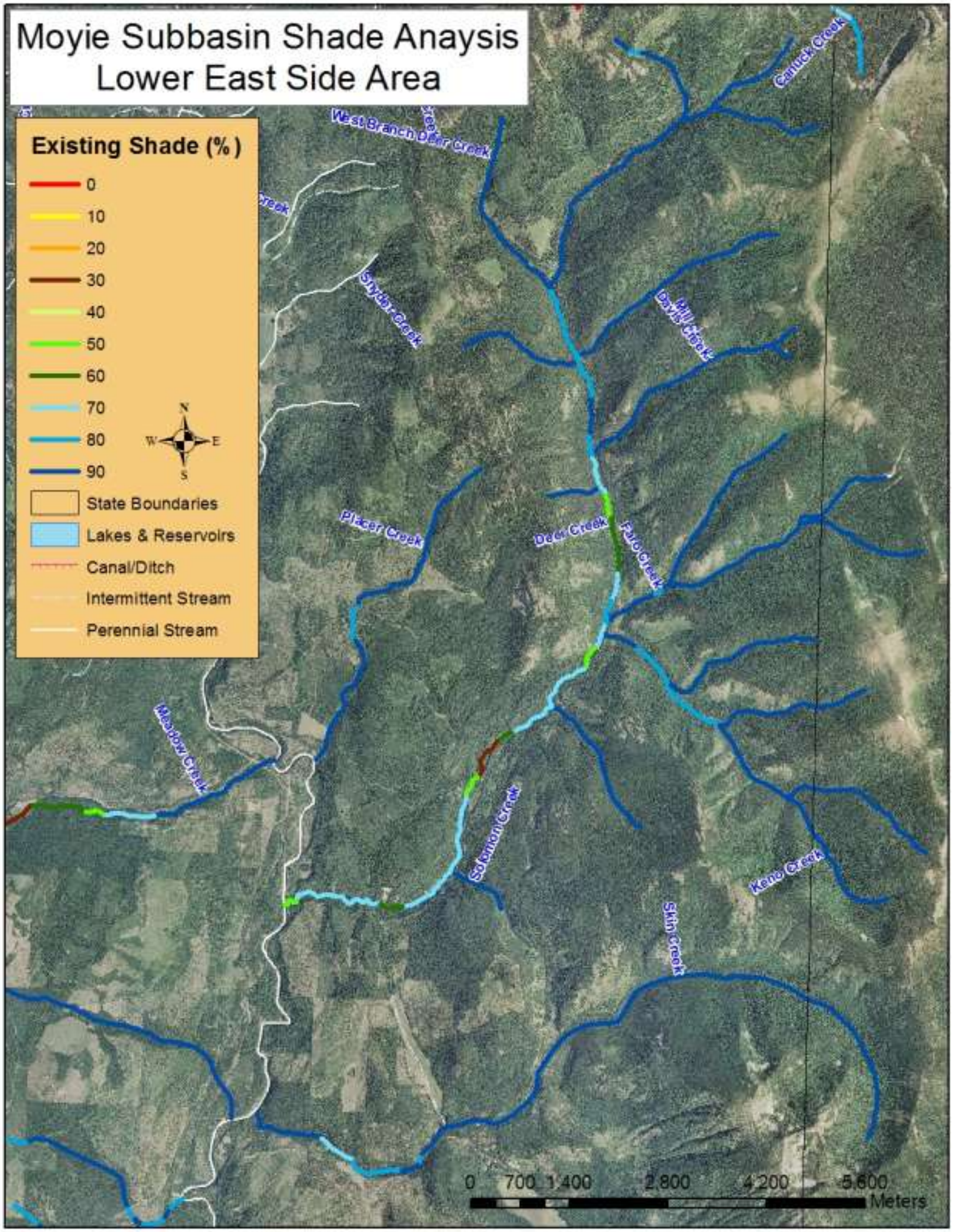


Figure B-35. Existing shade estimated for lower east side area by aerial photo interpretation.

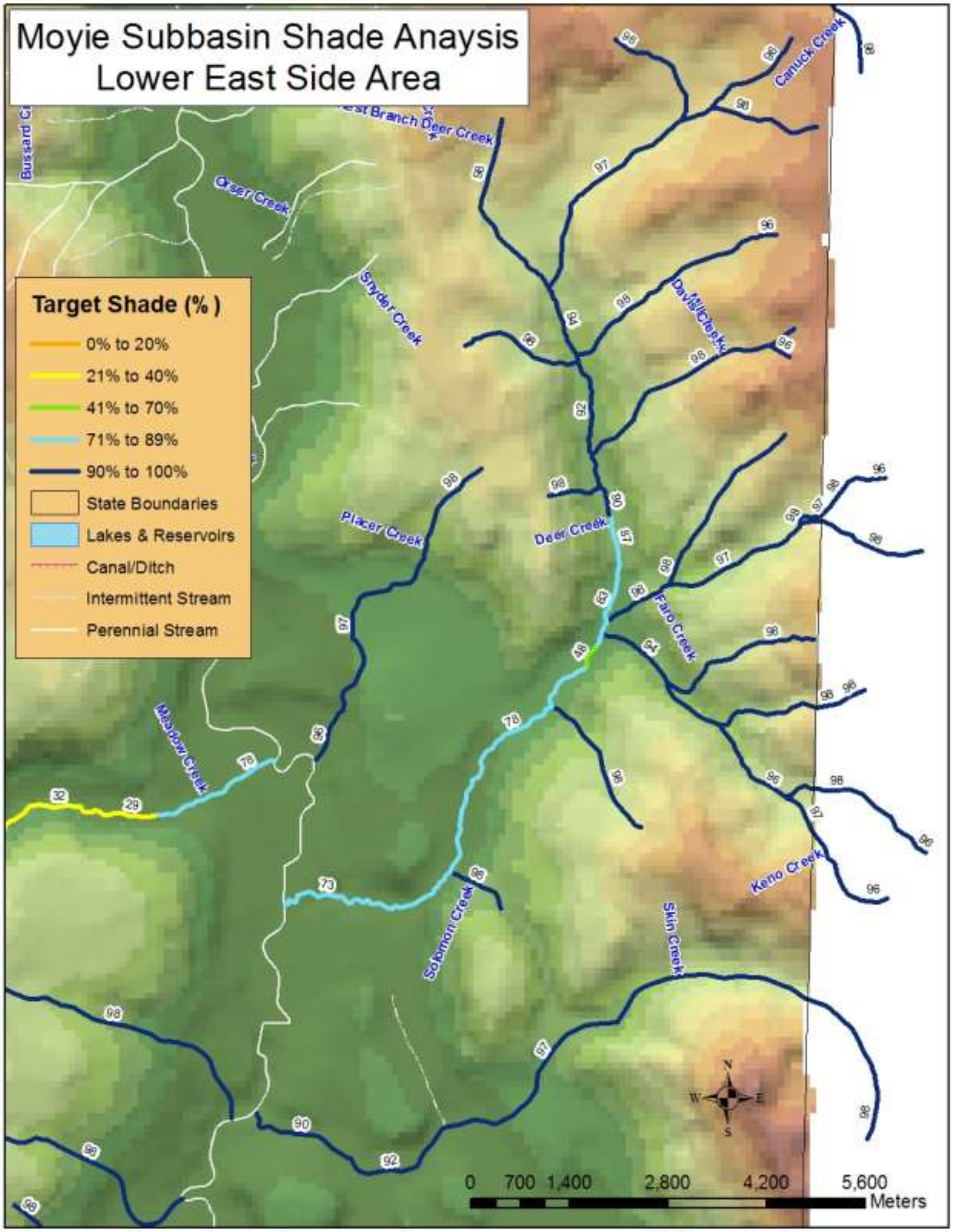


Figure B-36. Target shade for lower east side area.

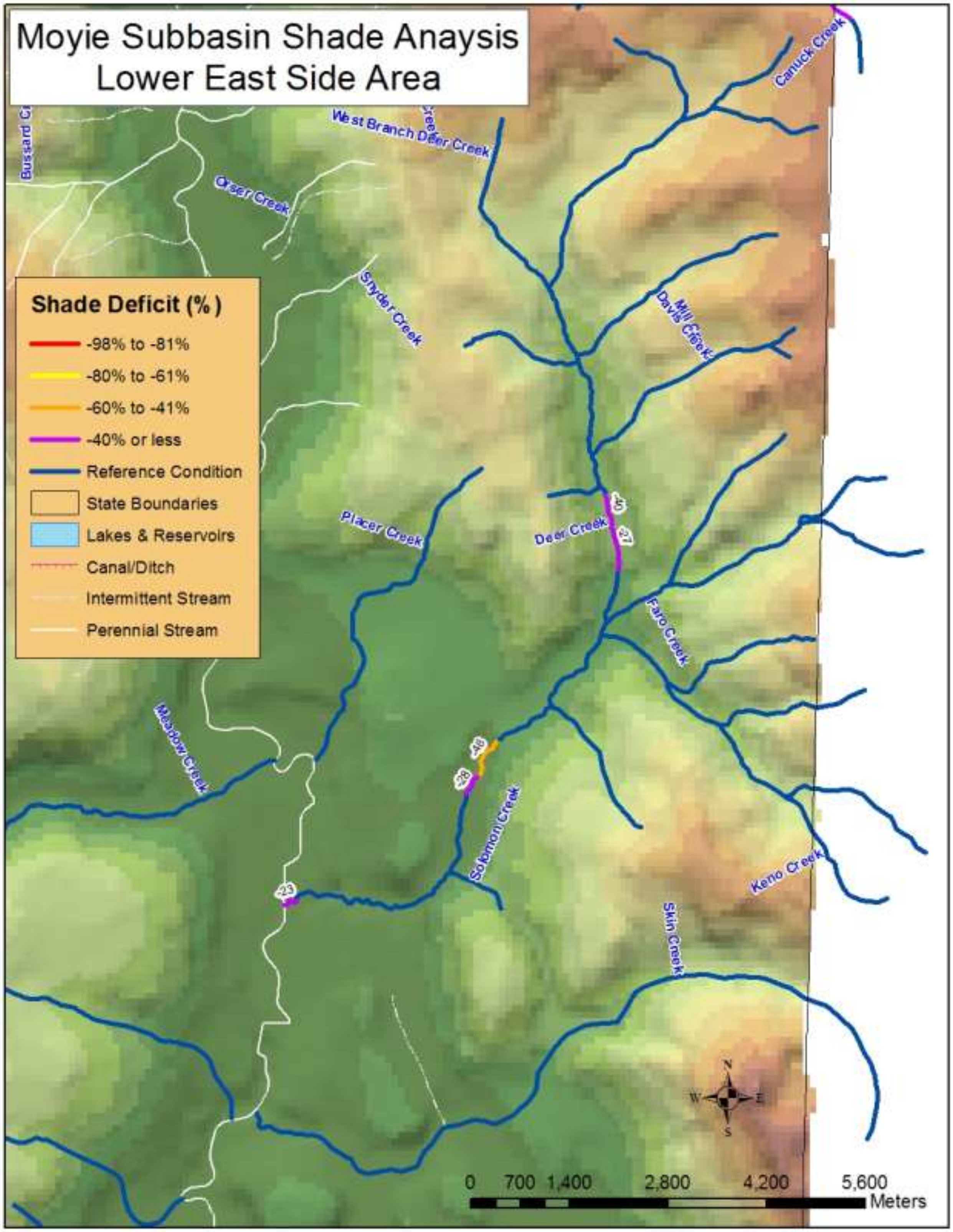


Figure B-37. Lack of shade (difference between existing and target) for lower east side area.

Appendix C. Temperature Monitoring Results, 2008

Figure 1. Kootenai River watershed (17010104) and Moyie River watershed (17010105) temperature data logger locations.

BOUNDARY CREEK

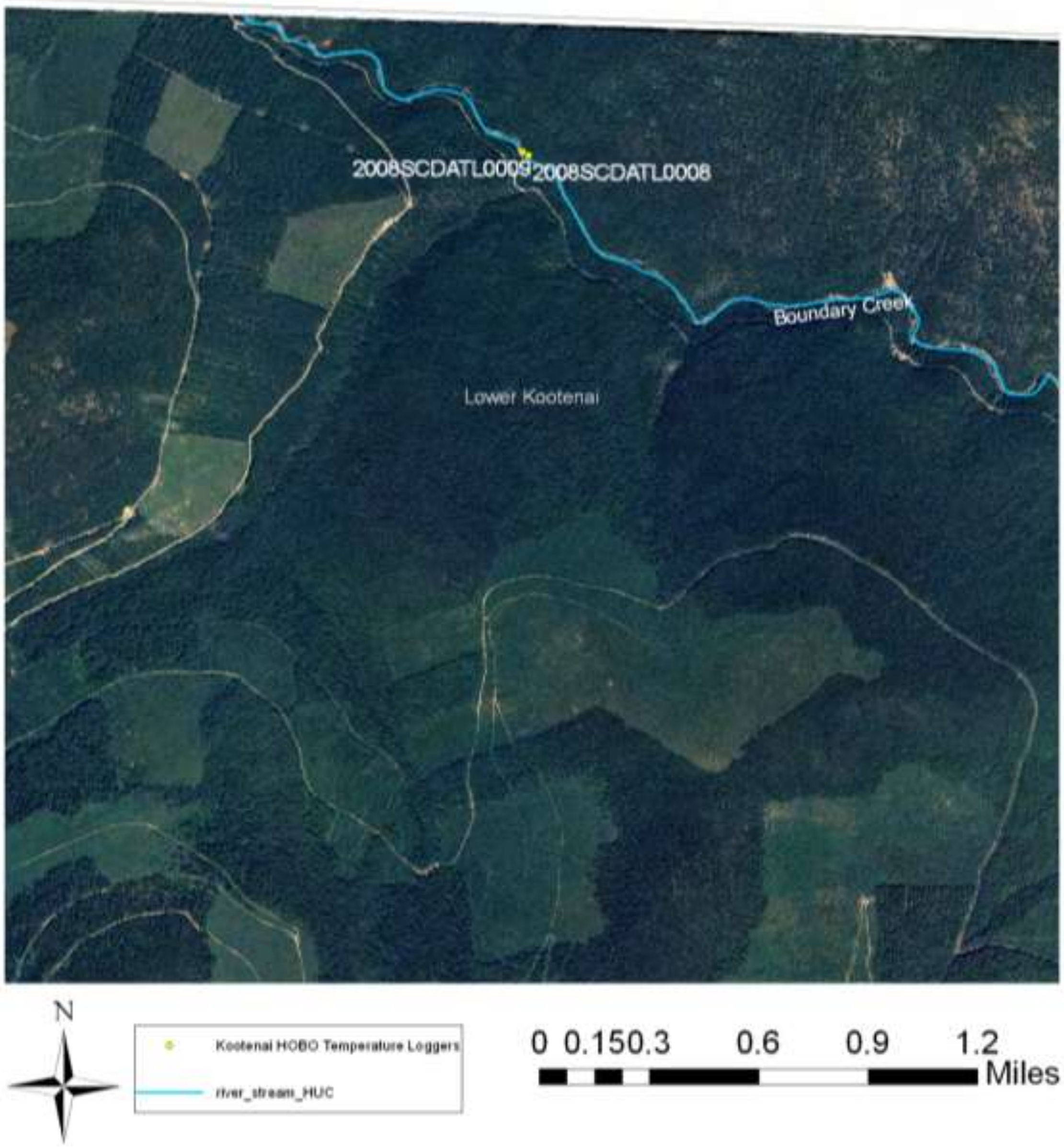


Figure 2. Boundary Creek temperature logger locations

Boundary Creek lies within the lower Kootenai River watershed. Two temperature loggers were deployed on upper Boundary Creek to record ambient temperature conditions. Data logger 2008SCDATL0008 recorded temperature in Boundary Creek at an elevation of 970 m. Data logger 2008SCDATL0009 recorded temperature at an elevation of 997 m (Figure 2). Temperature profiles are provided in Figure 3 and Figure 4. Table 1 provides deployment dates for the temperature loggers deployed on Boundary Creek.

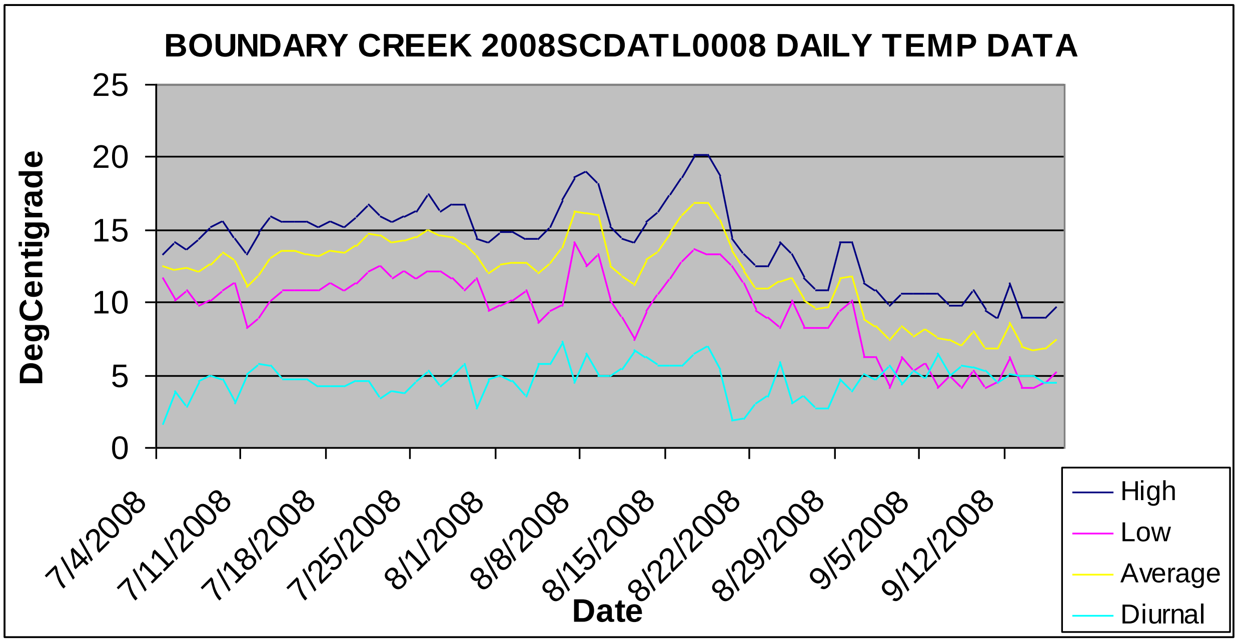


Figure 3. Temperature profile for 2008SCDATL0008 Upper Boundary Creek

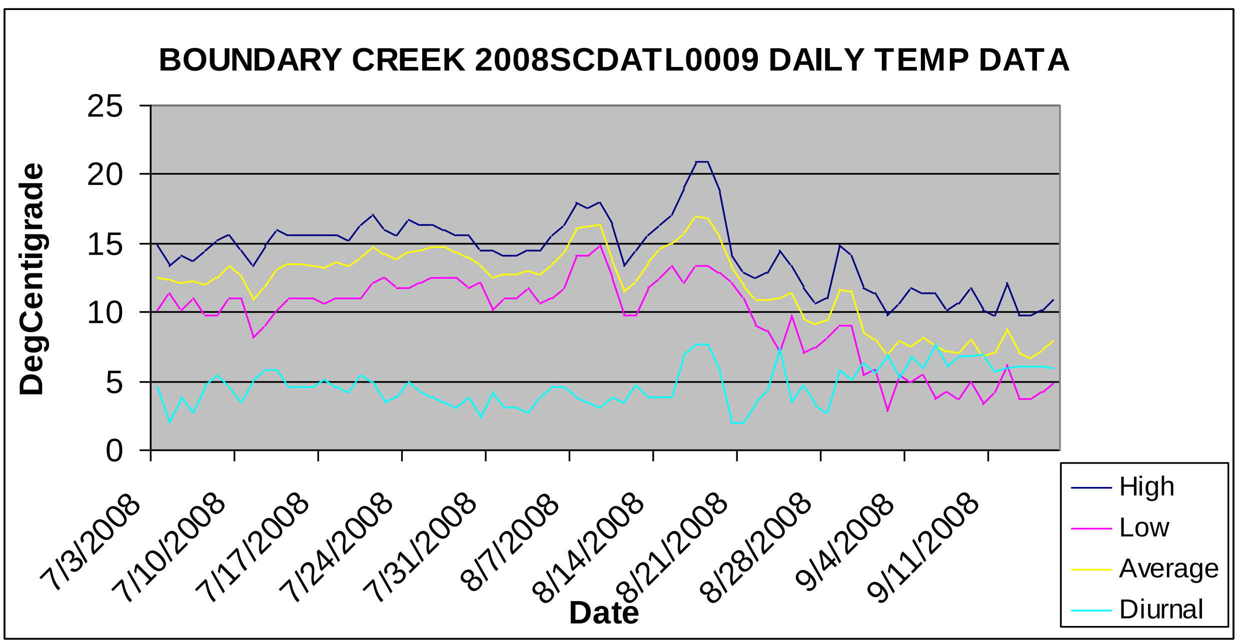


Figure 4. Temperature profile for 2008SCDATL0009 Upper Boundary Creek

FALL CREEK

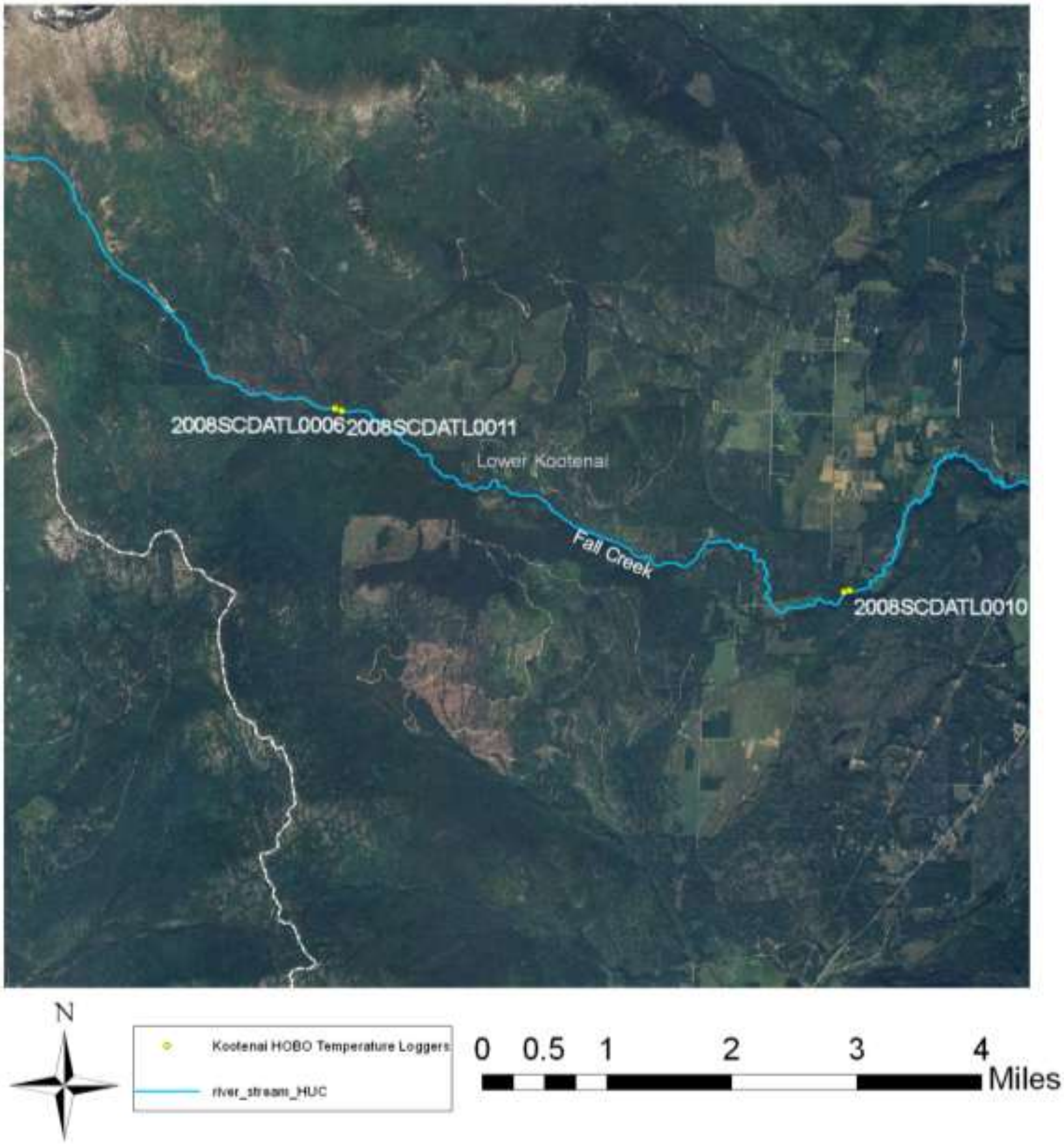


Figure 5. Fall Creek temperature logger locations

Four temperature loggers were deployed on upper and lower Fall Creek reaches in the lower Kootenai River watershed (Figure 5). One data logger (Serial ID #125202) did not record any temperature data and was excluded from the temperature analysis. The temperature logger 2008SCDATL0006 was recording temperature in Fall Creek at an elevation of 994 m. The temperature logger 2008SCDATL00011 was recording temperature in Fall Creek at an elevation of 990 m and a temperature logger was placed in the lower reach of Fall Creek at an elevation of 630 m.

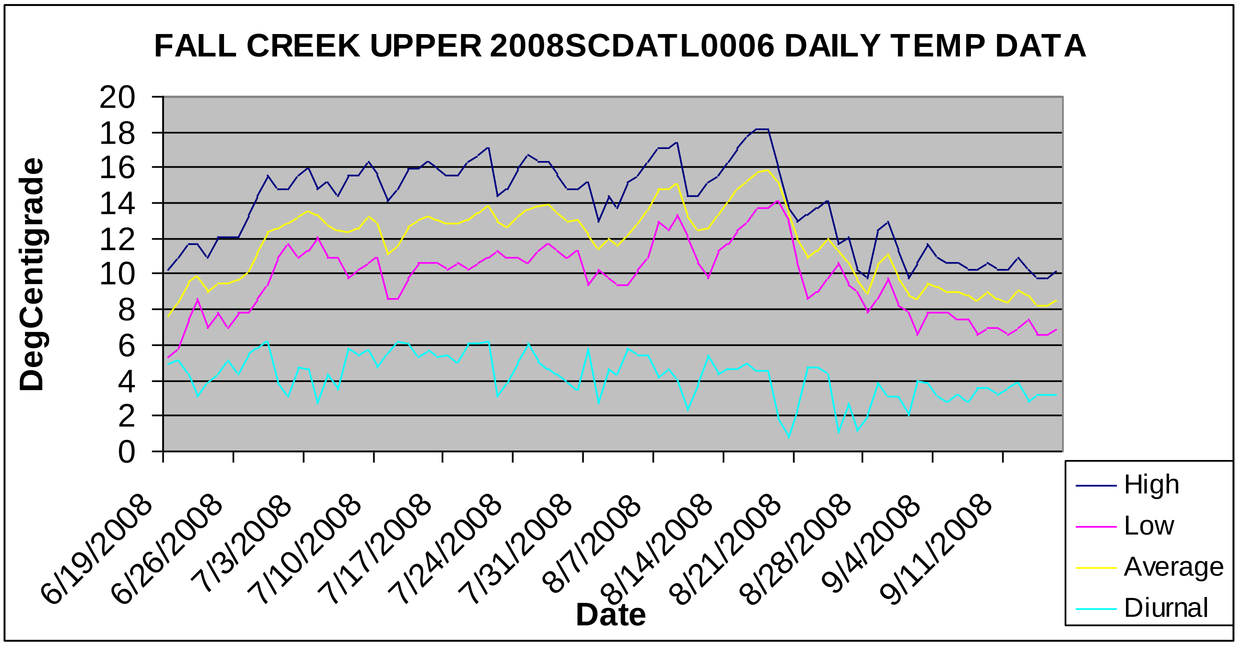


Figure 6. Temperature profile for 2008SCDATL0006 Upper Fall Creek

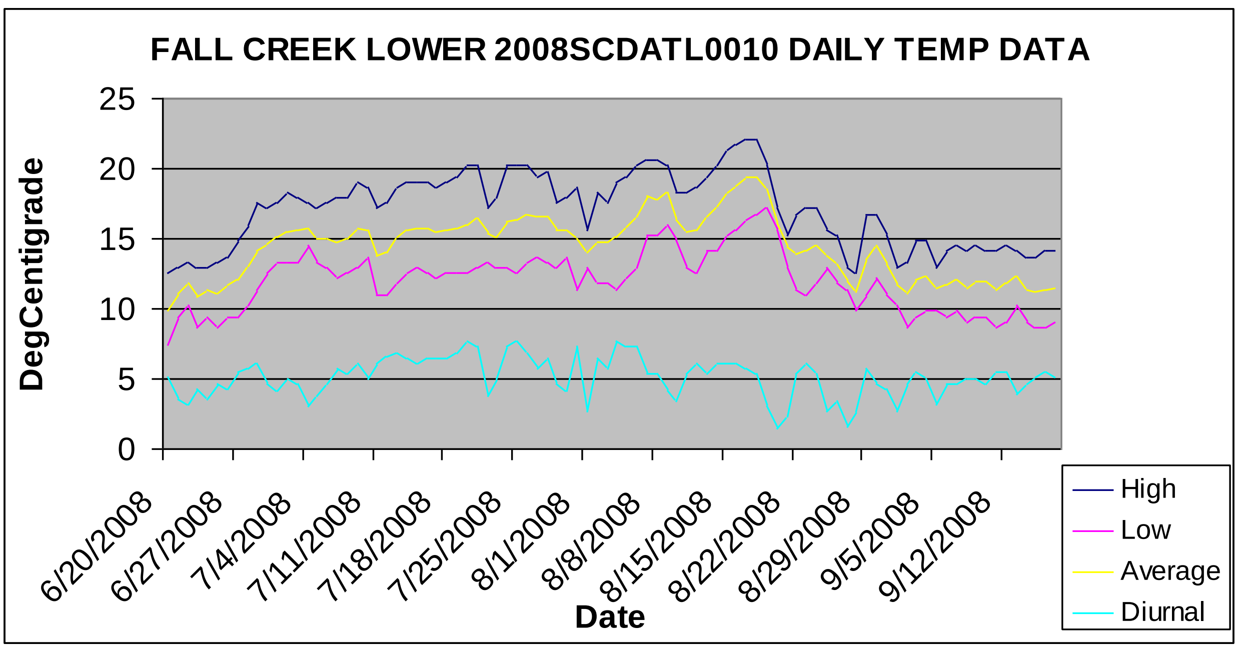


Figure 7. Temperature profile for 2008SCDATL0010 Lower Fall Creek

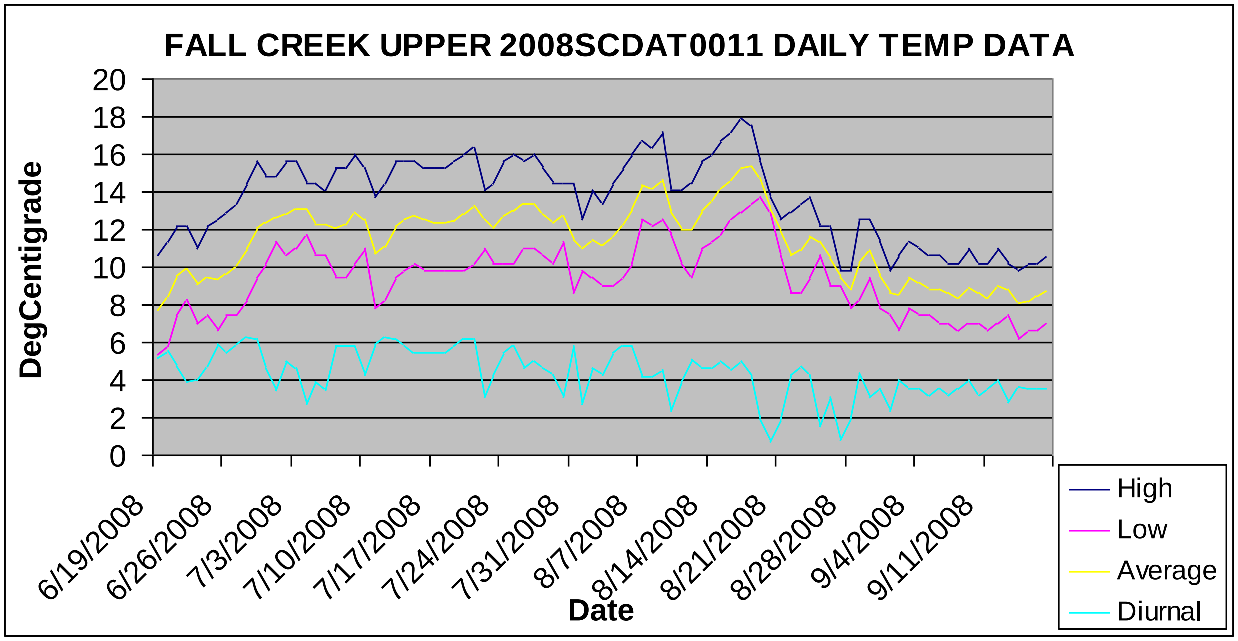


Figure 8. Temperature profile for 2008SCDATL0011 Lower Fall Creek

MISSION CREEK

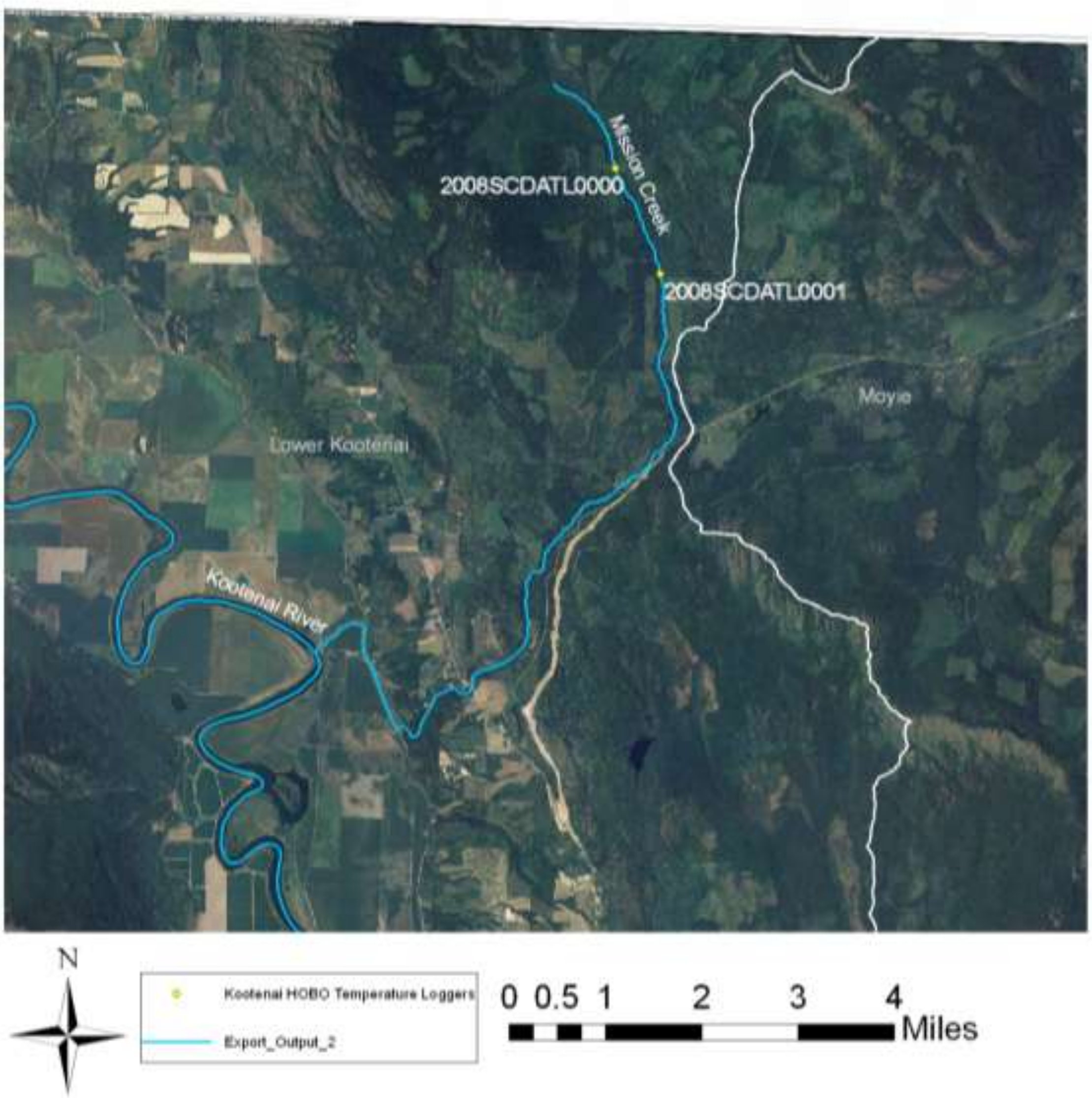


Figure 9. Mission Creek temperature logger locations

Two temperature loggers were deployed on Mission Creek in the lower Kootenai watershed (Figure 9). The temperature logger 2008SCDATL0000 was recording temperature at an elevation of 1015 m and the temperature logger 2008SCDATL0001 was placed at an elevation of 959 m. The temperature profiles are provided in Figure 10 and Figure 11.

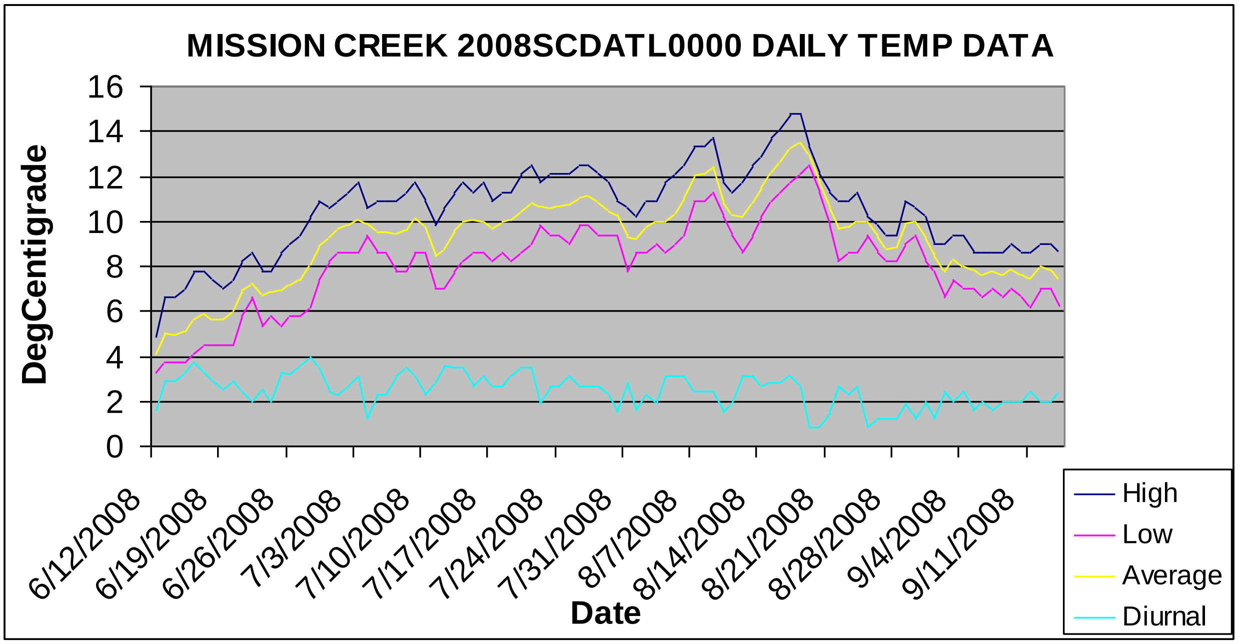


Figure 10. Temperature profile for 2008SCDATL0000 Mission Creek

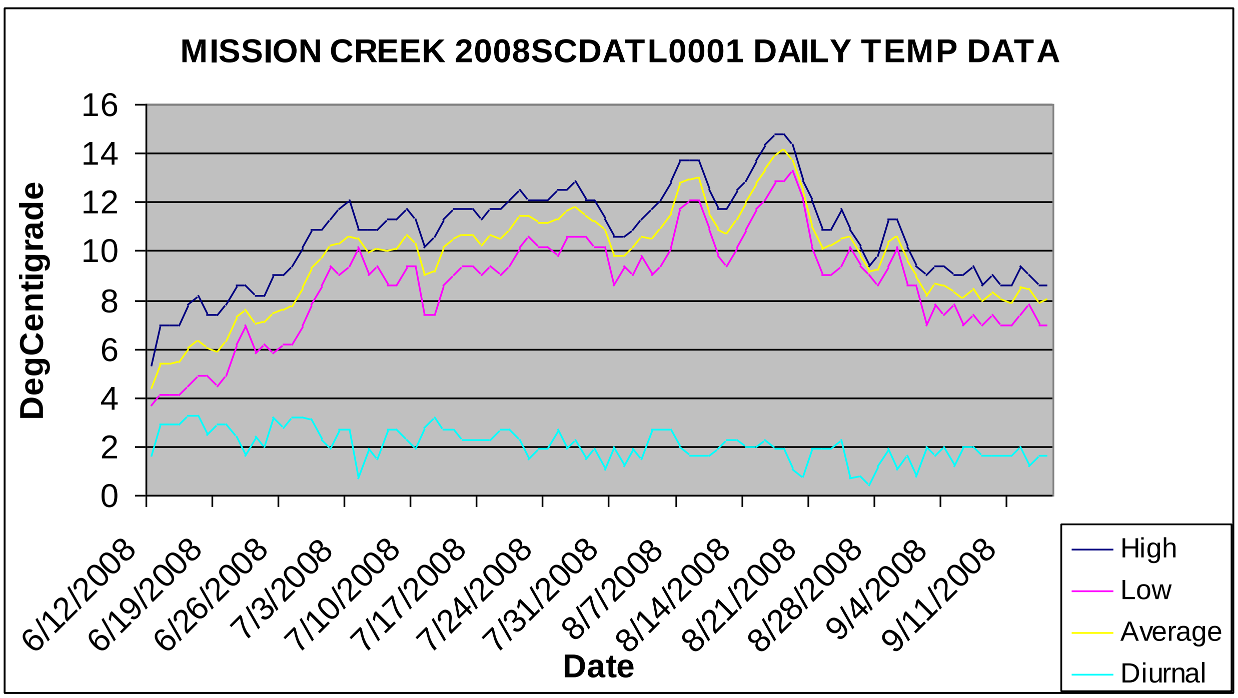


Figure 11. Temperature profile for 2008SCDATL0001 Mission Creek

SPRUCE CREEK

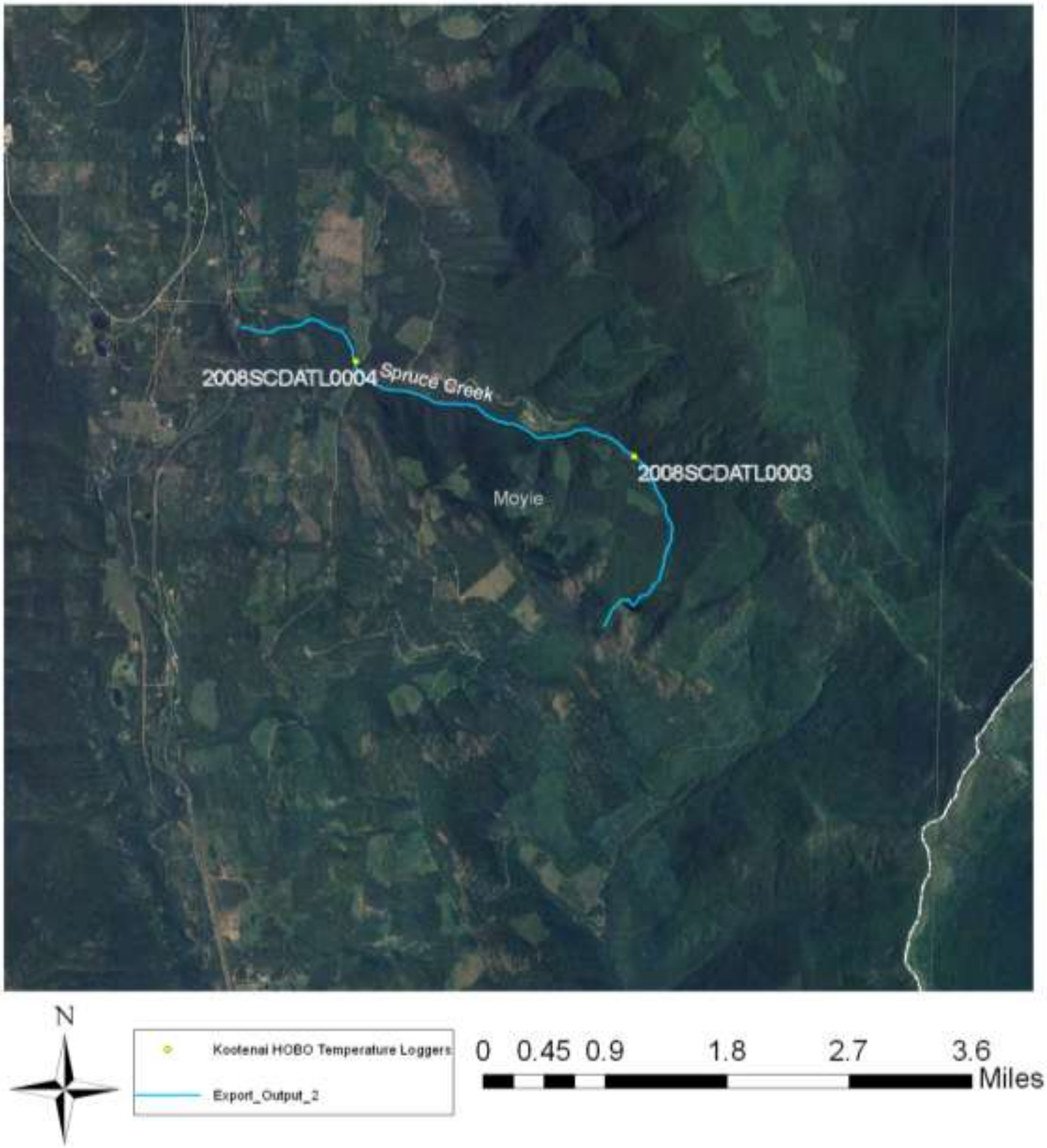


Figure 12. Spruce Creek temperature logger locations

Two temperature loggers were deployed on Spruce Creek which drains into the Moyie River watershed (Figure 12). The temperature logger 2008SCDATL0003 was placed in Spruce Creek at an elevation of 1363 m. This temperature logger recorded temperatures at the highest elevation of all (12) loggers deployed for this project. The temperature logger 2008SCDATL0004 was recording temperature at an elevation of 913 m. Temperature profiles are provided in Figure 13 and Figure 14.

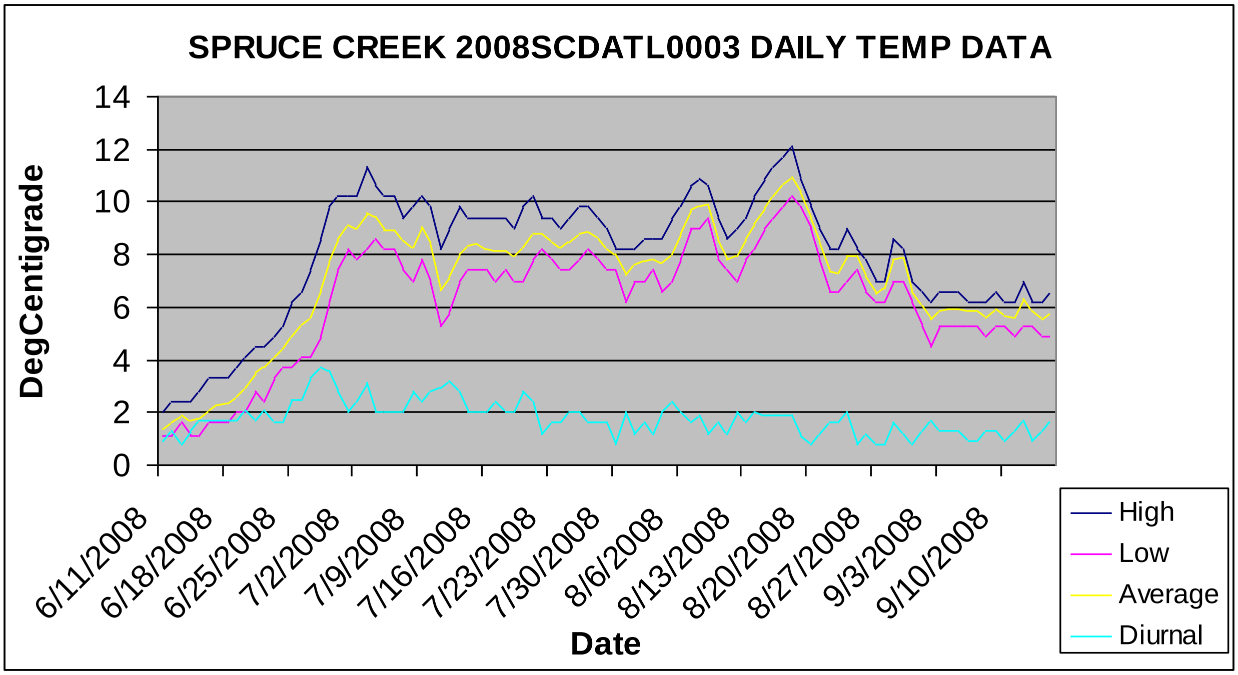


Figure 13. Temperature profile for 2008SCDATL0003 Spruce Creek

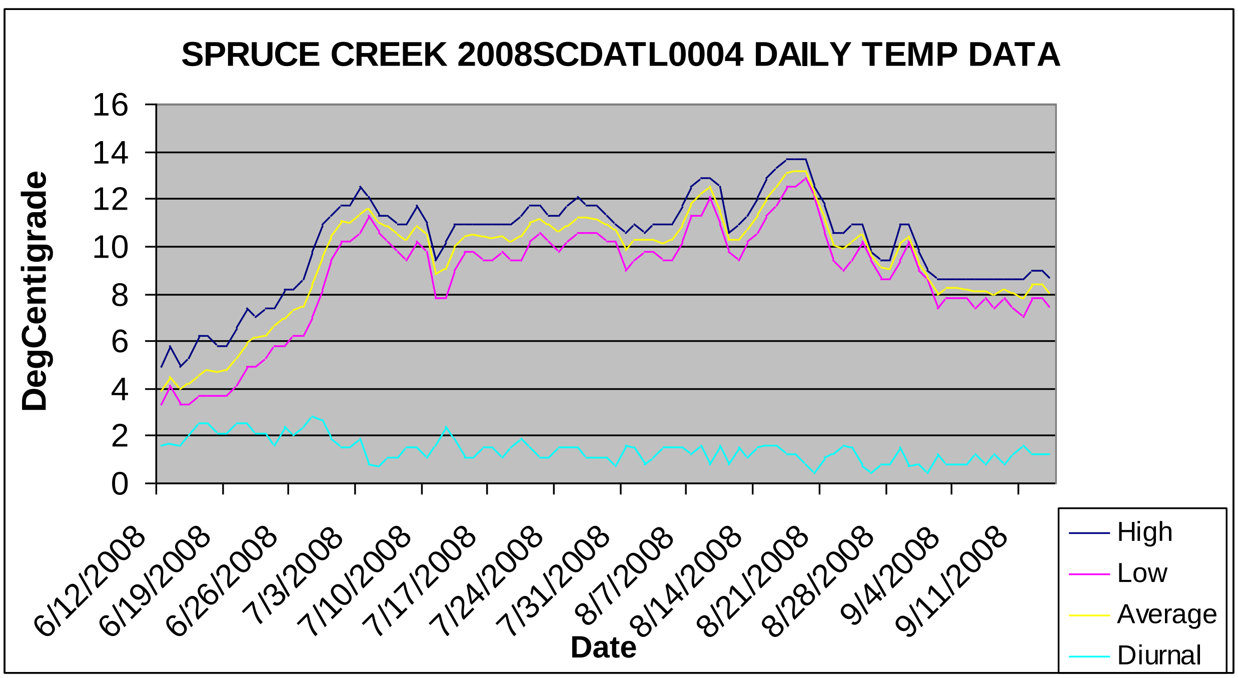


Figure 14. Temperature profile for 2008SCDATL0004 Spruce Creek

COPPER CREEK

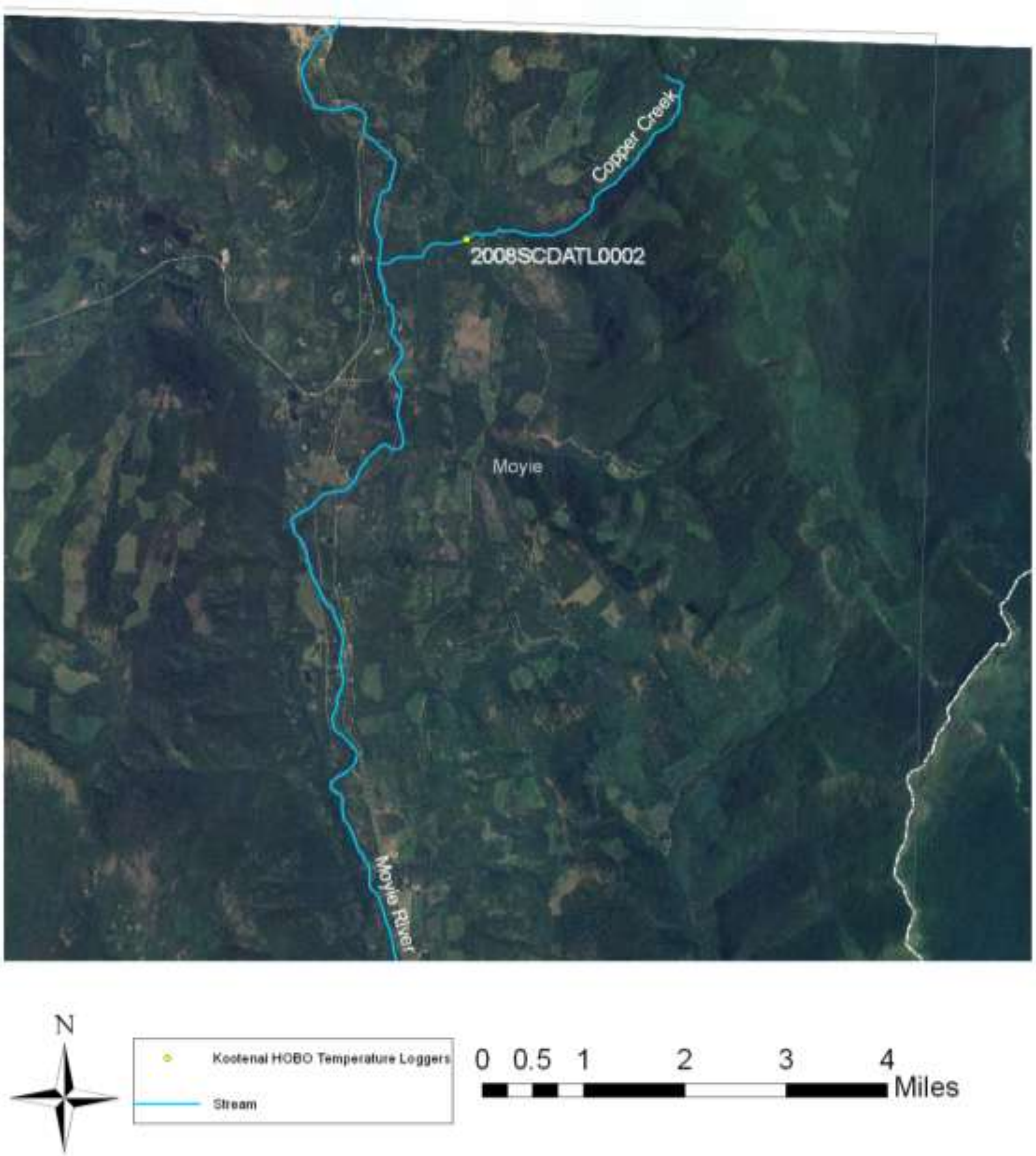


Figure 15. Temperature logger location on Copper Creek

One temperature logger was deployed on the lower reach of Copper Creek which flows into the Moyie River (Figure 15). The temperature logger 2008SCDATL0002 was placed in Copper Creek at an elevation of 866 m. The temperature profile for this logger on Copper Creek is provided in Figure 16.

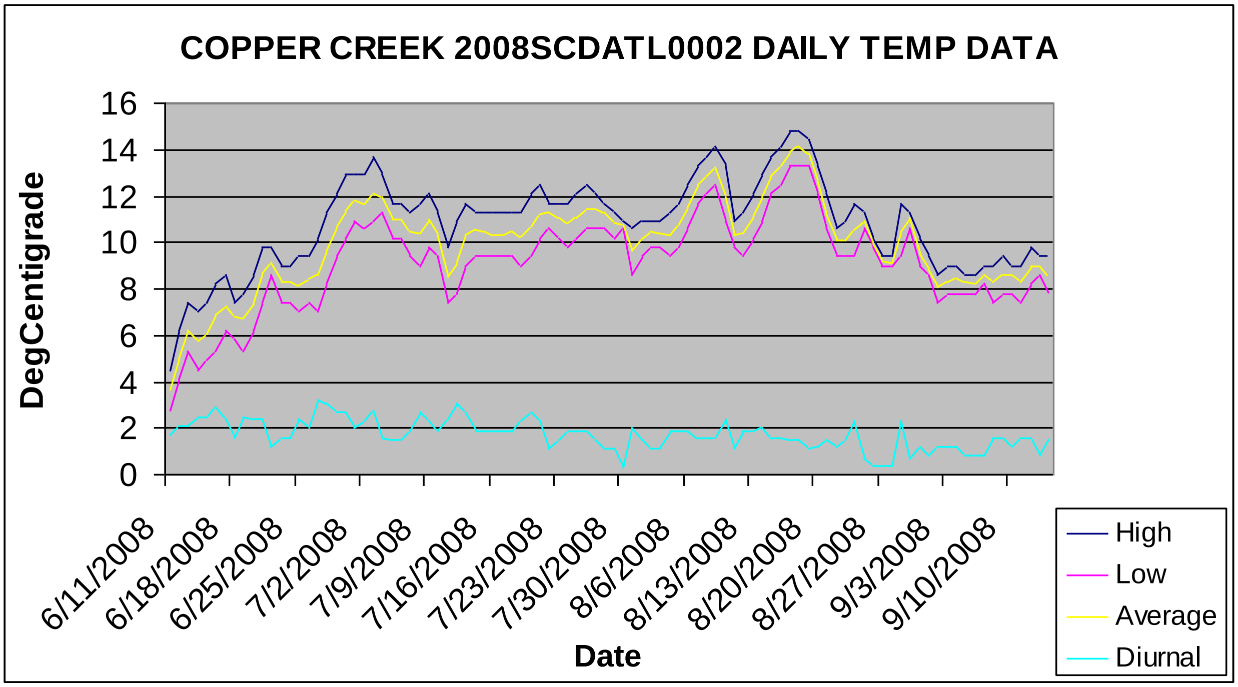


Figure 16. Temperature profile for 2008SCDATL0002 Copper Creek

HELLROARING CREEK

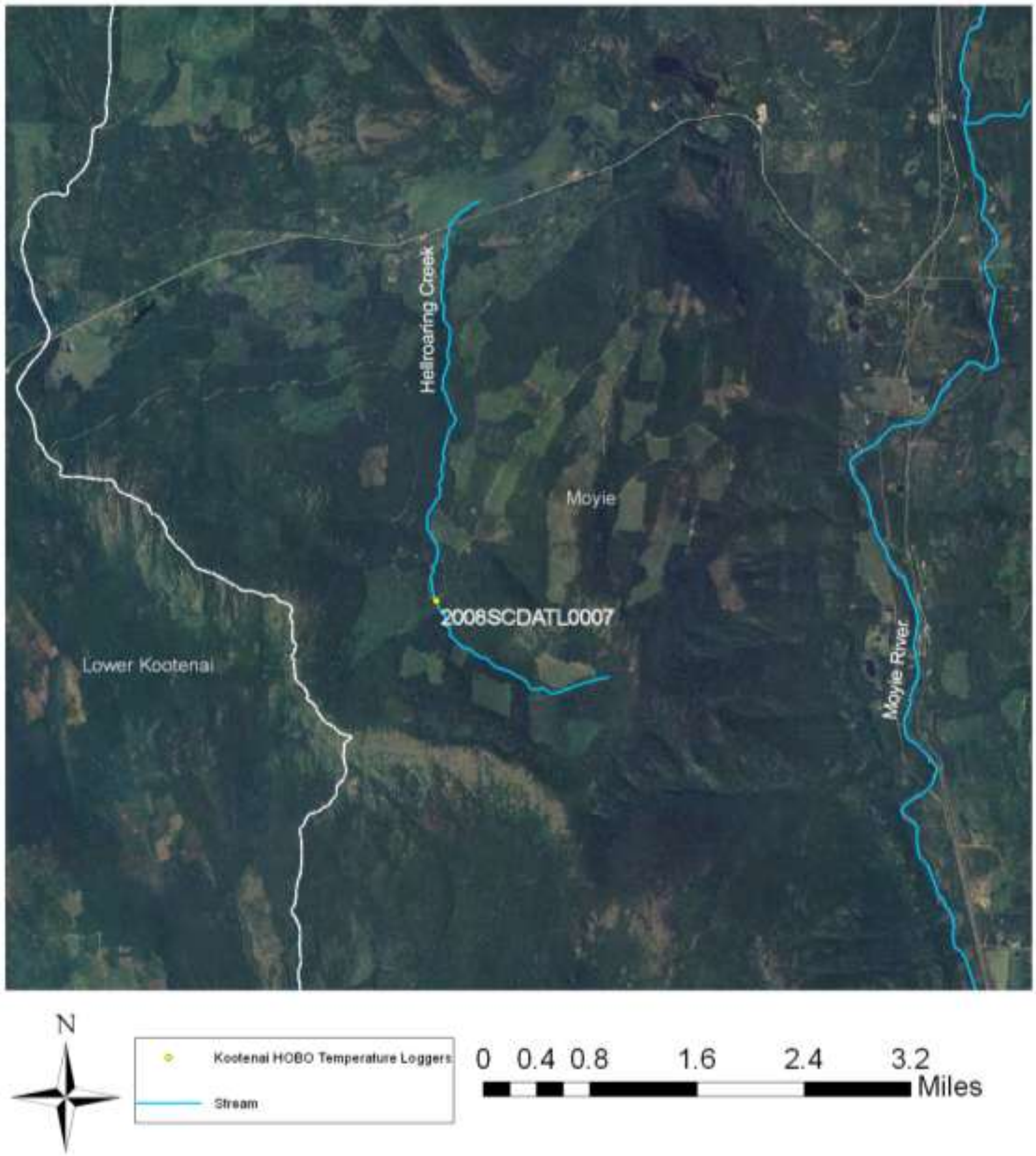


Figure 17. Temperature logger location on Hellroaring Creek

One temperature logger was placed in Hellroaring Creek (Figure 17). The temperature logger 2008SCDATL0007 was placed at an elevation of 1228 m. The temperature profile for 2008SCDATL0007 is provided in Figure 18.

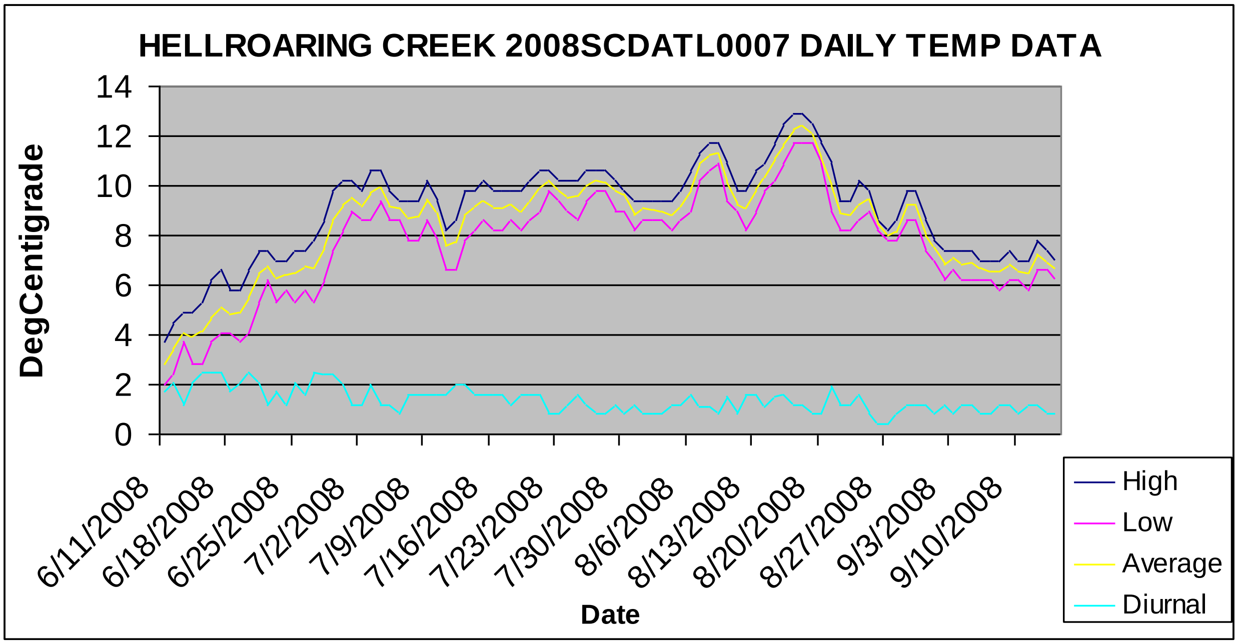


Figure 18. Temperature profile for 2008SCDATL0007 Hellroaring Creek

TWENTYMILE CREEK

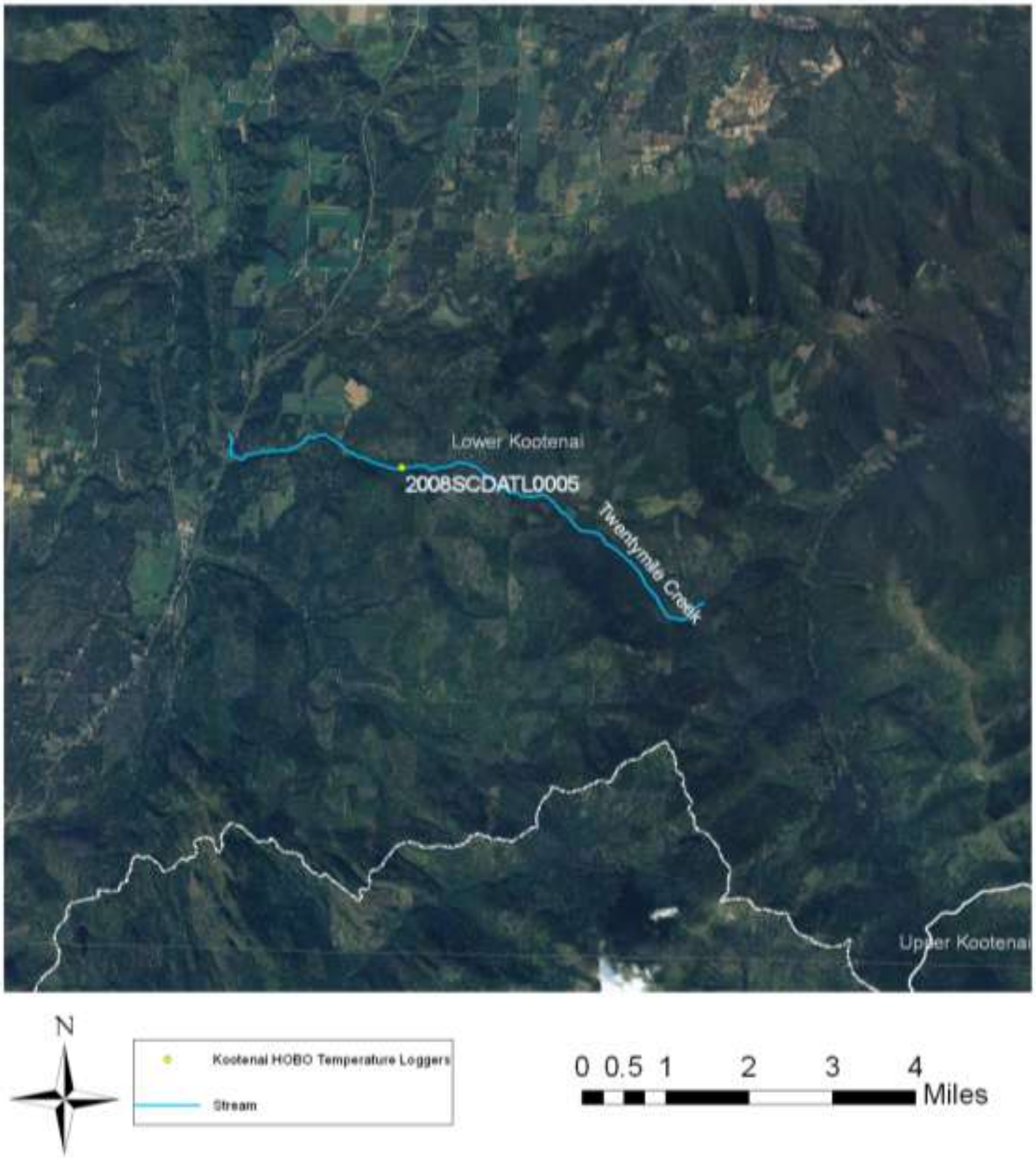


Figure 19. Temperature logger location on Twentymile Creek

Twentymile Creek is in the Kootenai River watershed and had one temperature logger deployed along the lower reach (Figure 19). The temperature logger 2008SCDATL0005 was placed in Twentymile Creek at an elevation of 825 m. The temperature profile for 2008SCDATL0005 is provided in Figure 20.

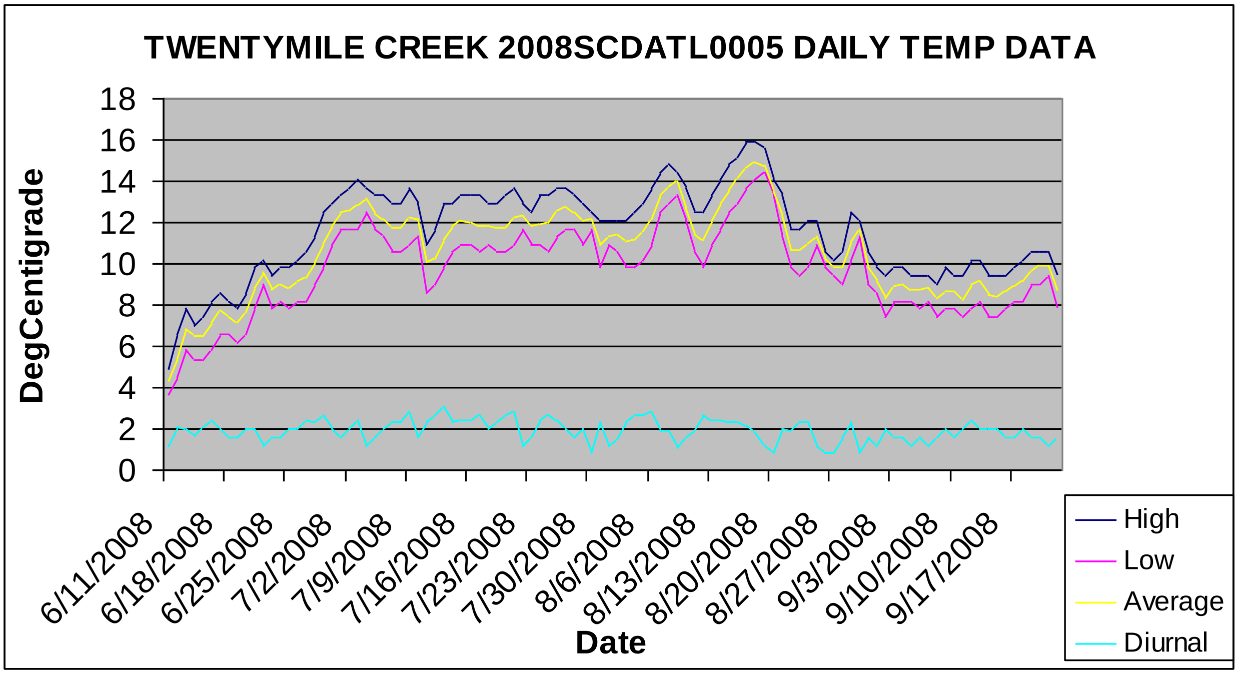


Figure 20. Temperature profile for 2008SCDATL0005 Twentymile Creek

SUMMARY OF DATA

Table 1. Summary of Kootenai River watershed temperature logger deployment dates and identification numbers.

Site ID	Stream	Dates Deployed	Serial ID
2008SCDATL0009	Boundary upper	7/3/2008 to 9/16/2008	457077
2008SCDATL0008	Boundary upper	7/4/2008 to 9/16/2008	180158
2008SCDATL0000	Mission Creek	6/12/2008 to 9/14/2008	180206
2008SCDATL0001	Mission Creek	6/12/2008 to 9/15/2008	125200
2008SCDATL0006	Fall Creek upper	6/19/2008 to 9/16/2008	174831
2008SCDATL0011	Fall Creek upper	6/19/2008 to 9/17/2008	457070
2008SCDATL0010	Fall Creek upper	6/20/2008 to 9/17/2008	457108
2008SCDATL0005	Twentymile Creek	6/11/2008 to 9/22/2008	174818
2008SCDATL0002	Copper Creek	6/11/2008 to 9/14/2008	125208
2008SCDATL0007	Hellroaring creek	6/11/2008 to 9/14/2008	174854
2008SCDATL0003	Spruce Creek	6/11/2008 to 9/15/2008	174779
2008SCDATL0004	Spruce creek	6/12/2008 to 9/14/2008	174800

Table 2. Summary of maximum and average temperature ranges for the Kootenai River watershed.

2008 SCDATL-	**Stream Name**	**Elevation (m)**	**Days Evaluated**	**MDMT**	**MWMT**	**MDAT**	**MWAT**
0009	Boundary	997	76	20.95	18.39	16.93	15.44
0008	Boundary	970	75	20.20	18.13	16.89	15.35
0000	Mission	1015	86	14.80	13.73	13.47	12.52
0001	Mission	959	87	14.80	13.99	14.12	13.21
0006	Fall Creek	994	88	18.20	17.01	15.87	14.89
0011	Fall Creek	990	89	17.90	16.65	15.37	14.41
0010	Fall Creek	630	89	22.09	21.00	19.44	18.32
0005	Twentymile	825	94	15.90	15.09	14.91	14.08
0002	Copper	866	86	14.80	14.00	14.12	13.23
0007	Hellroaring	1228	86	12.90	12.16	12.40	11.56
0003	Spruce	1363	87	12.10	10.99	10.92	10.07
0004	Spruce	913	86	13.70	13.13	13.17	12.50
Averages		**979**	**85.8**	**16.5**	**15.4**	**14.8**	**13.8**

Table 2 shows the temperature summaries for all streams included in the Kootenai and Moyie River watershed study. The stream with the highest elevation (Spruce Creek) exhibited the lowest maximum daily maximum temperature (MDMT). The stream with the lowest elevation (Fall Creek) exhibited the highest MDMT. Similarly, the maximum daily average temperature

(MDAT) was highest in the stream with temperature loggers at the lowest elevation and lowest MDAT in the streams at higher elevations. Only Fall Creek (2008SCDATL0010) at 630 m elevation exceeded the Idaho cold water biota standards of 22° C instantaneous temperature measurement (Table 3).

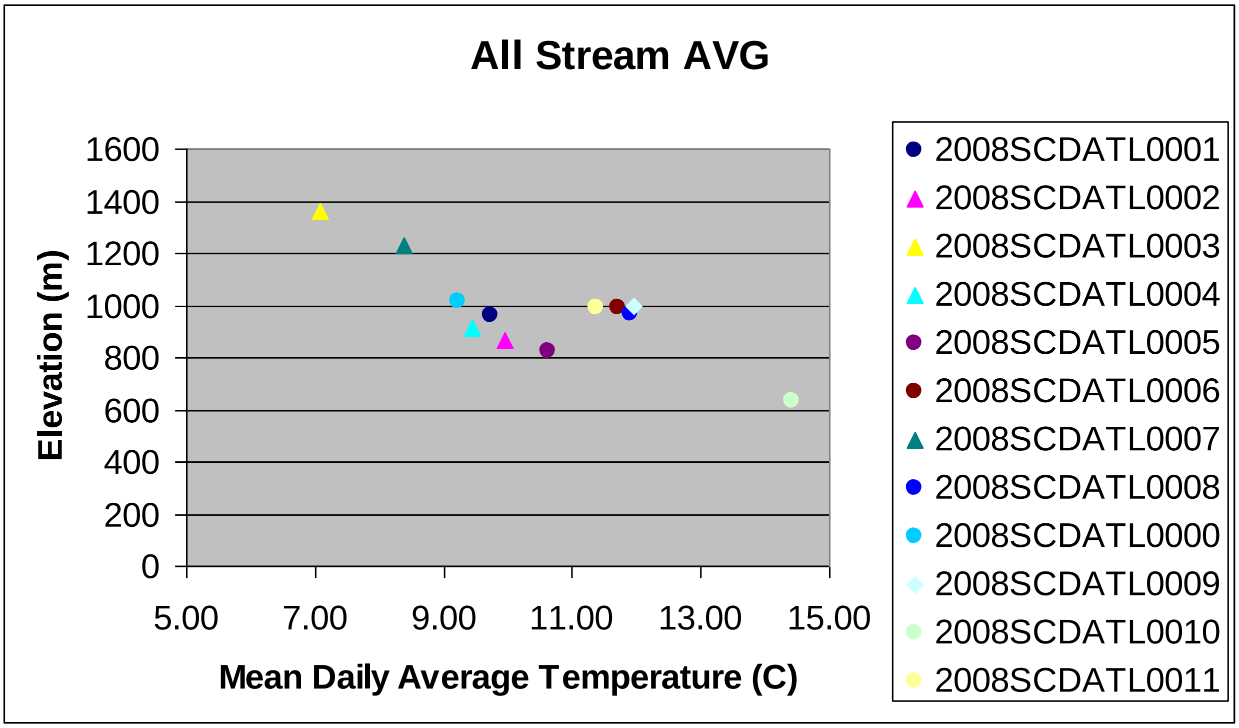


Figure 21. Mean Daily average temperature for all streams

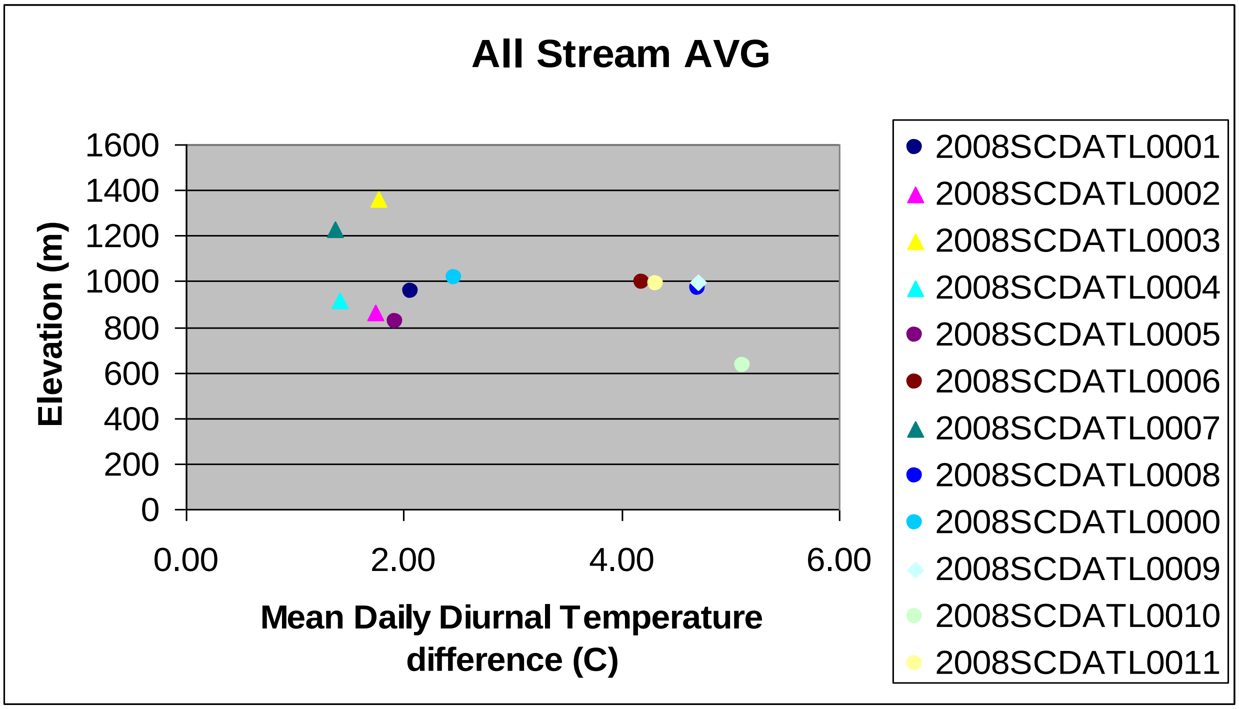


Figure 22. Mean Daily Diurnal Temperature difference for all streams

Figure 21 shows the MDAT for all streams included in this project. There appears to be two distinct linear relationships occurring between MDAT and elevation. There is a correlation with temperature loggers from Boundary and Fall Creeks which plot with a unique MDAT versus elevation trend. These two streams are the western most streams and exhibit similar elevation (excluding 2008SCDATL0010 at 630 m). Similarly, Boundary and Fall Creeks exhibit a unique relationship between mean daily diurnal temperatures and elevation (Figure 22). This relationship could be related to the location of Boundary and Fall Creeks, which are west of the Kootenai river.

EXCEEDANCE CRITERIA EVALUATION

Table 3. Exceedances for Spring Idaho Salmonid Spawning

				Spring Idaho Salmonid Spawning		
2008 SCDATL –	**Stream Name**	**Elevation (m)**	**Days Evaluated**	**Days Evaluated**	**13 C Instantaneous (%)**	**9 C Average Spring (%)**
0009	Boundary upper	997	5/15-7/15	13	**100**	**100**
0008	Boundary upper	970	5/15-7/15	12	**100**	**100**
0000	Mission Creek	1015	5/15-7/15	34	0	**41**
0001	Mission Creek	959	5/15-7/15	34	0	**47**
0006	Fall Creek	994	5/15-7/15	27	**70**	**93**
0011	Fall Creek	990	5/15-7/15	27	**70**	**93**
0010	Fall Creek	630	5/1-7/1	12	**67**	**100**
0005	Twentymile	825	5/1-7/1	21	5	**33**
0002	Copper Creek	866	5/1-7/1	21	0	**24**
0007	Hellroaring	1228	6/1-7/31	51	0	**47**
0003	Spruce Creek	1363	6/1-7/31	51	0	8
0004	Spruce creek	913	5/1-7/1	20	0	**15**
Percentage of sites which exceed standards					**42**	**92**

Table 4. Exceedances of the Idaho Bull trout criteria

			Idaho Bull Trout			
2008 SCDATL -	**Stream Name**	**Elevation (m)**	**Days Evaluated**	**13 C Juvnl MWMT (%)**	**Days Evaluated**	**9 C Spawning Daily Ave (%)**
0009	Boundary	997	31	**84**	16	0
0008	Boundary	970	31	**84**	16	0
0000	Mission Creek	1015	31	**16**	14	0
0001	Mission Creek	959	31	**19**	15	0
0006	Fall Creek	994	31	**84**	16	**19**
0011	Fall Creek	990	31	**81**	17	**18**
0010	Fall Creek	630	31	**100**	17	**100**
0005	Twentymile	825	31	**55**	22	**27**
0002	Copper Creek	866	31	**16**	14	0
0007	Hellroaring	1228	31	0	14	0
0003	Spruce Creek	1363	31	0	15	0
0004	Spruce creek	913	31	6	14	0
Percentage of sites which exceed standards				**75**		**33**

Table 5. Exceedances of the EPA Bull trout criteria

2008 SCDATL -	Stream Name	Elevation (m)	EPA Bull Trout 10 C 7-Day Avg (%)	# of 7-Day Avg's
0009	Boundary upper	997	**77**	70
0008	Boundary upper	970	**77**	69
0000	Mission Creek	1015	**38**	89
0001	Mission Creek	959	**58**	90
0006	Fall Creek	994	**76**	84
0011	Fall Creek	990	**75**	85
0010	Fall Creek	630	**100**	87
0005	Twentymile	825	**64**	98
0002	Copper Creek	866	**64**	90
0007	Hellroaring	1228	**18**	90
0003	Spruce Creek	1363	1	91
0004	Spruce creek	913	**57**	89
Percentage of sites which exceed standards			**92**	

Table 6. Exceedances of the Idaho Cold water criteria

			Seasonal Cold Water Exceedance (%)		Idaho Cold Water Biota Exceedance (%)	
2008 SCDATL –	**Stream Name**	**Days Evaluated**	**26 C Instantaneous (%)**	**23 C Average (%)**	**22 C Instantaneous (%)**	**19 C Average (%)**
0009	Boundary	76	0	0	0	0
0008	Boundary	75	0	0	0	0
0000	Mission	86	0	0	0	0
0001	Mission	87	0	0	0	0
0006	Fall Creek	88	0	0	0	0
0011	Fall Creek	89	0	0	0	0
0010	Fall Creek	89	0	0	2	2
0005	Twentymile	94	0	0	0	0
0002	Copper	86	0	0	0	0
0007	Hellroaring	86	0	0	0	0
0003	Spruce	87	0	0	0	0
0004	Spruce creek	86	0	0	0	0
Percentage of sites which exceed standards					**0.1**	**0**

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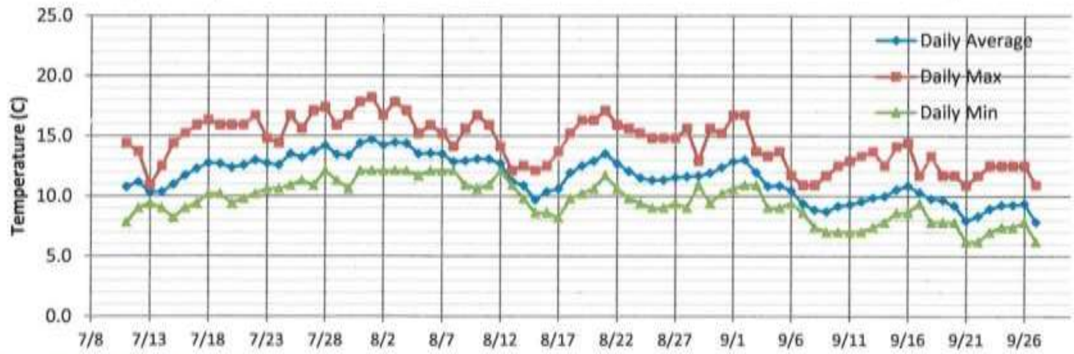
Appendix D. Temperature Monitoring Results, 2009–2012

Temperature Logger Summary Report

prepared: 4/6/2013

stream: Boulder Creek (upper) | latitude: 48.541600 | elevation (ft): 4031
site id: 2009SCROK010 | longitude: -116.224410 | ● ID BT ● Spring Spawn
settings: sampled every 120 min. | period: 07/11 - 09/27 | ○ EPA BT ● Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 18.2, criteria is: 22	na	7/11/2009	9/27/2009	78	93	Partial
	MDAT = 14.7, criteria is: 19	na	7/11/2009	9/27/2009	78	93	Partial
SS →	MDMT = 17.8, criteria is: 13	Spring	7/11/2009	7/31/2009	19	60	Partial
→	MDAT = 14.4, criteria is: 9	Spring	7/11/2009	7/31/2009	19	60	Partial
ID BT #	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A
→	MDAT = 14.7, criteria is: 9	Rearing	7/11/2009	8/31/2009	50	91	Partial
EPA BT	na						

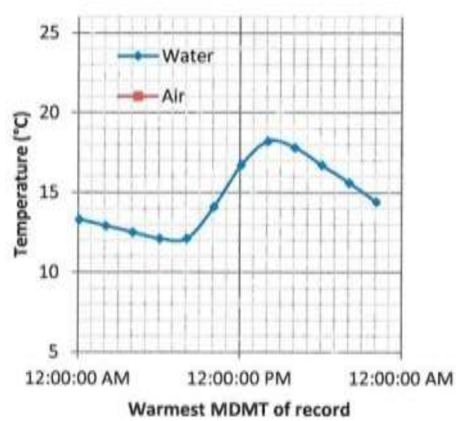
Other Evaluation

Air logger at station	no
Average amplitude of record	5.34 water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	6.1	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	2.0	na	na
Duration of minimum temps	4.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



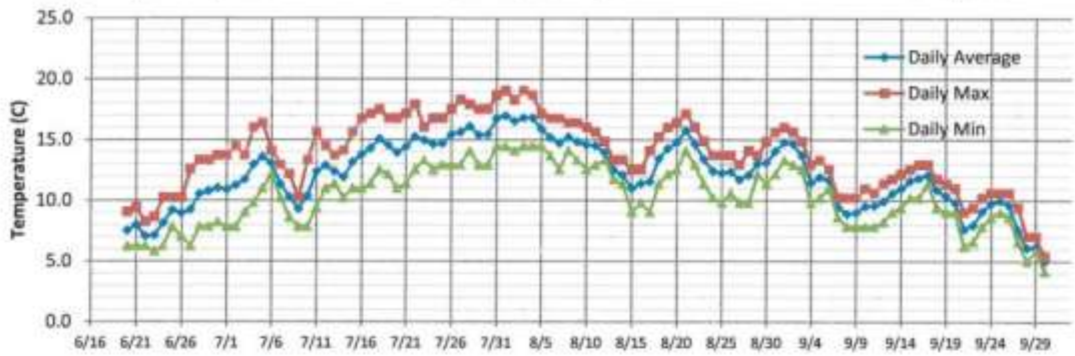
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Boundary Creek
site id: 2009SCROK019
settings: sampled every 120 min.

latitude: 48.996722
longitude: -116.691944
period: 06/20 - 09/26

elevation (ft): 3278
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 19, criteria is: 22	na	6/20/2009	9/26/2009	98	93	Full
	MDAT = 17, criteria is: 19	na	6/20/2009	9/26/2009	98	93	Full
SS →	MDMT = 17.1, criteria is: 13	Fall	8/15/2009	9/26/2009	42	92	Partial
→	MDAT = 15.8, criteria is: 9	Fall	8/15/2009	9/26/2009	42	92	Partial
ID BT →	MWMT = 18.8, criteria is: 13	Rearing	6/20/2009	8/31/2009	71	91	Partial
→	MDAT = 17, criteria is: 9	Rearing	6/20/2009	8/31/2009	71	91	Partial
EPA BT →	MDAT = 18.8, criteria is: 10	na	6/20/2009	9/26/2009	98	121	Partial

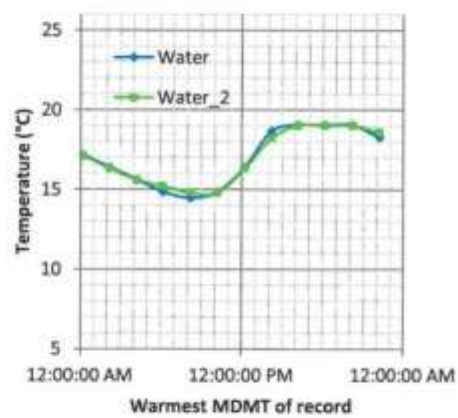
Other Evaluation

Air logger at station	no	
Average amplitude of record	4.15	water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	4.6	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	6.0	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



Temperature Logger Summary Report

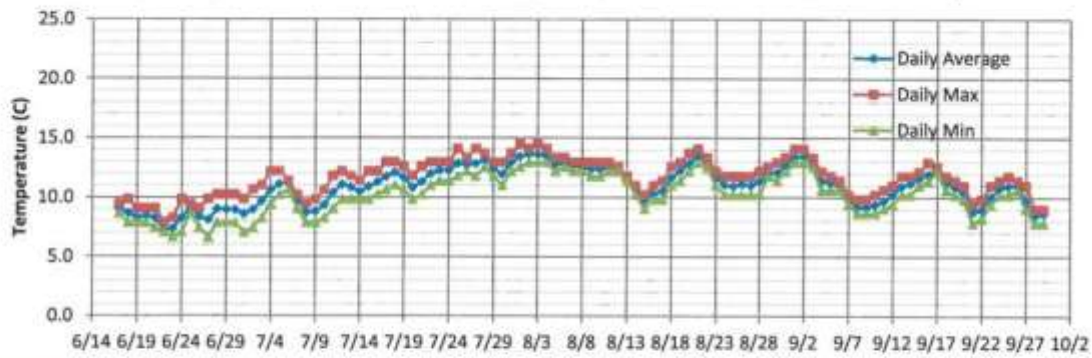
prepared: 4/6/2013

stream: Copper Creek (lower)
site id: 2009SCROK005
settings: sampled every 120 min.

latitude: 48.970028
longitude: -116.148889
period: 06/17 - 09/29

elevation (ft): 2978

- ID BT
- EPA BT
- Spring Spawn
- Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 14.5, criteria is: 22	na	6/17/2009	9/29/2009	104	93	Full
	MDAT = 13.6, criteria is: 19	na	6/17/2009	9/29/2009	104	93	Full
SS →	MDMT = 14.1, criteria is: 13	Fall	8/15/2009	9/29/2009	45	92	Partial
→	MDAT = 13.5, criteria is: 9	Fall	8/15/2009	9/29/2009	45	92	Partial
ID BT →	MWMT = 14.3, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
→	MDAT = 13.6, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT →	MDAT = 14.3, criteria is: 10	na	6/17/2009	9/29/2009	104	121	Partial

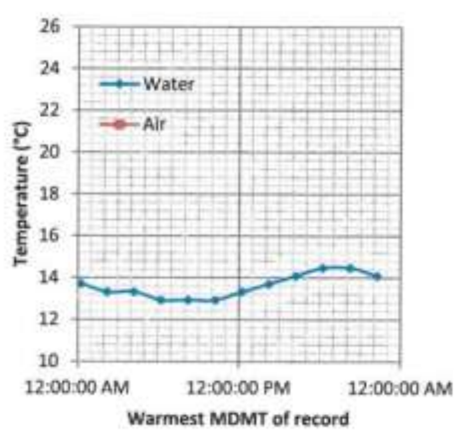
Other Evaluation

Air logger at station	no	
Average amplitude of record	1.95	water (°C)

Warmest MDMT date: 8/3/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.5	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	4.0	na	na
Duration of minimum temps	6.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



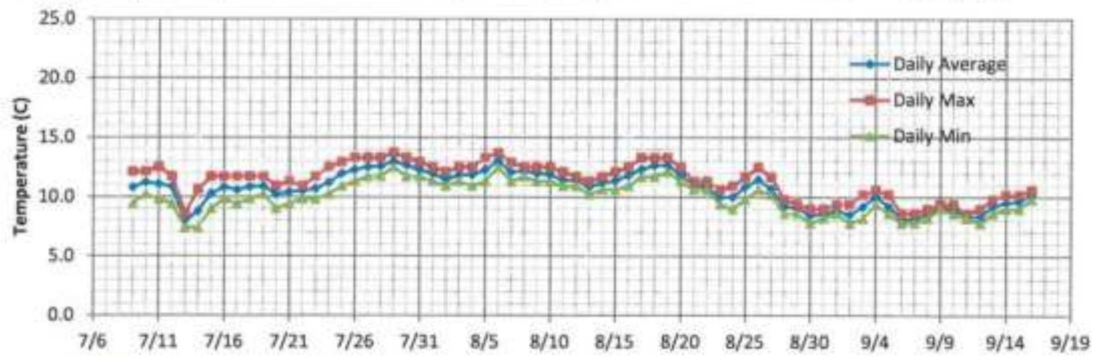
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Copper Creek
site id: 2010SCROK005
settings: sampled every 120 min.

latitude: 48.970017
longitude: -116.148883
period: 07/09 - 09/16

elevation (ft): 2981
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 13.7, criteria is: 22	na	7/9/2010	9/16/2010	69	93	Partial
	MDAT = 13, criteria is: 19	na	7/9/2010	9/16/2010	69	93	Partial
SS →	MDMT = 13.3, criteria is: 13	Fall	8/15/2010	9/16/2010	32	92	Partial
→	MDAT = 12.7, criteria is: 9	Fall	8/15/2010	9/16/2010	32	92	Partial
ID BT →	MWMT = 13.2, criteria is: 13	Rearing	7/9/2010	8/31/2010	52	91	Partial
→	MDAT = 13, criteria is: 9	Rearing	7/9/2010	8/31/2010	52	91	Partial
EPA BT →	MDAT = 13.2, criteria is: 10	na	7/9/2010	9/16/2010	69	121	Partial

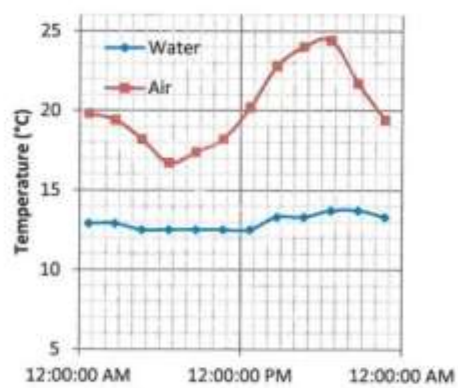
Other Evaluation

Air logger at station	yes	
Average amplitude of record	1.88	water (°C)

Warmest MDMT date: 7/29/2010

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.2	7.7	0.16
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	4.0	2.0	0.50
Duration of minimum temps	10.0	2.0	0.20

Water response time	6	(hours)
how many air degrees	5.4	(°C)
Temperature lag effect	32.40	(°C hours)

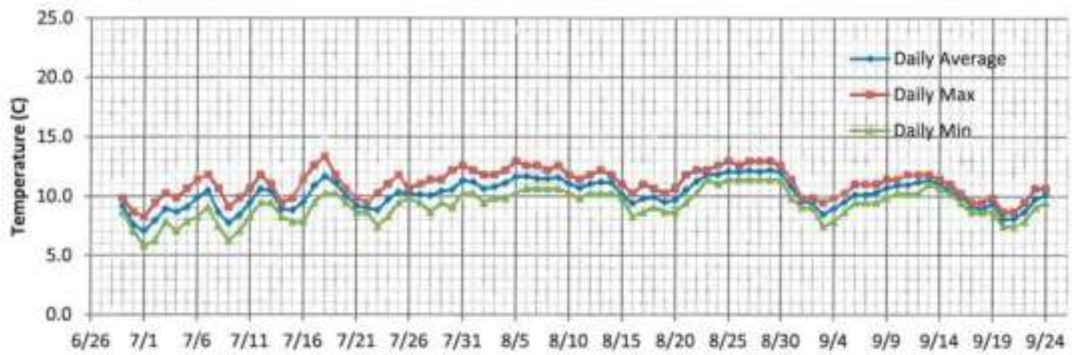


Warmest MDMT of record

Temperature Logger Summary Report

prepared: 4/6/2013

stream: Copper Creek
site id: 2011SCROK005
settings: sampled every 30 min.
latitude: 48.970017
longitude: -116.148883
period: 06/29 - 08/07
elevation (ft): 2981
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 13.3, criteria is: 22	na	6/29/2011	8/7/2011	39	93	Partial
	MDAT = 12.2, criteria is: 19	na	6/29/2011	8/7/2011	39	93	Partial
SS	MDMT = 8.6, criteria is: 13	Spring	6/29/2011	7/1/2011	1	60	Partial
	MDAT = 7.6, criteria is: 9	Spring	6/29/2011	7/1/2011	1	60	Partial
ID BT	MWMT = 12.5, criteria is: 13	Rearing	6/29/2011	8/7/2011	39	91	Partial
	→ MDAT = 11.7, criteria is: 9	Rearing	9/1/2011	8/7/2011	-25	91	Partial
EPA BT	→ MDAT = 12.5, criteria is: 10	na	6/29/2011	8/7/2011	39	121	Partial

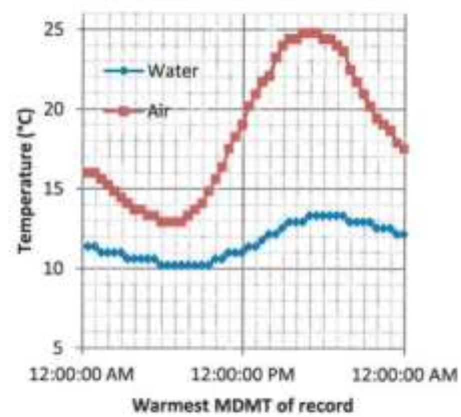
Other Evaluation

Air logger at station	yes	
Average amplitude of record	2.31	water (°C)

Warmest MDMT date: 7/18/2011

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	3.1	6.1	0.51
	water (hr)	air (hr)	ratio
Duration of maximum temps	3.0	1.5	0.50
Duration of minimum temps	4.0	2.0	0.50

Water response time	2	(hours)
how many air degrees	2.3	(°C)
Temperature lag effect	4.60	(°C hours)



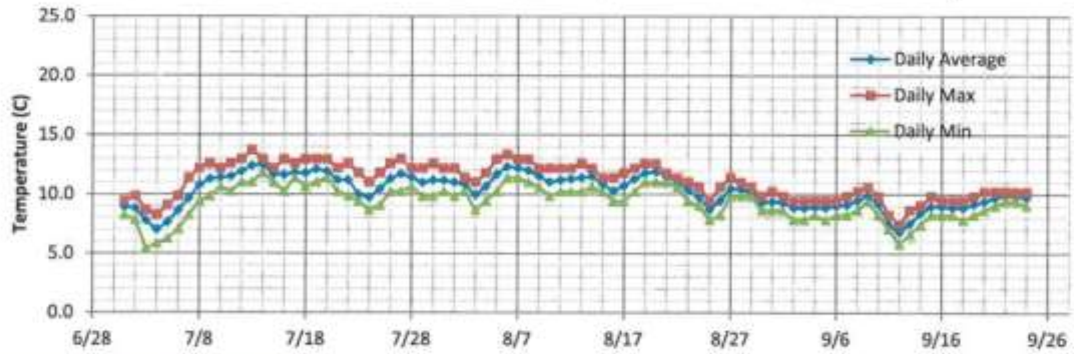
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Copper Creek
site id: 2012SCROK004
settings: sampled every 30 min.

latitude: 48.970017
longitude: -116.148883
period: 07/01 - 09/16

elevation (ft): 2978
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 13.7, criteria is: 22	na	7/1/2012	9/16/2012	77	93	Partial
	MDAT = 12.5, criteria is: 19	na	7/1/2012	9/16/2012	77	93	Partial
SS	MDMT = 12.6, criteria is: 13	Fall	8/15/2012	9/16/2012	32	92	Partial
	→ MDAT = 11.9, criteria is: 9	Fall	8/15/2012	9/16/2012	32	92	Partial
ID BT	→ MWMT = 13, criteria is: 13	Rearing	7/1/2012	8/31/2012	60	91	Partial
	→ MDAT = 12.5, criteria is: 9	Rearing	7/1/2012	8/31/2012	60	91	Partial
EPA BT	→ MDAT = 13, criteria is: 10	na	7/1/2012	9/16/2012	77	121	Partial

air logger did not record data

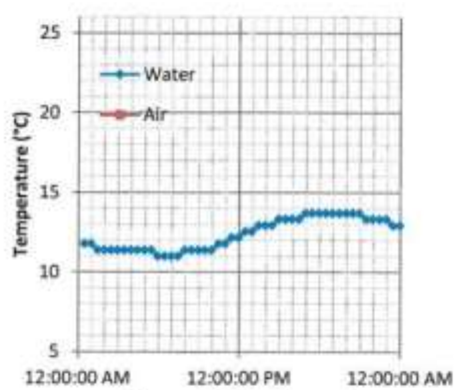
Other Evaluation

Air logger at station	no	
Average amplitude of record	2.23	water (°C)

Warmest MDMT date: 7/13/2012

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	2.7	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	4.5	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



Warmest MDMT of record

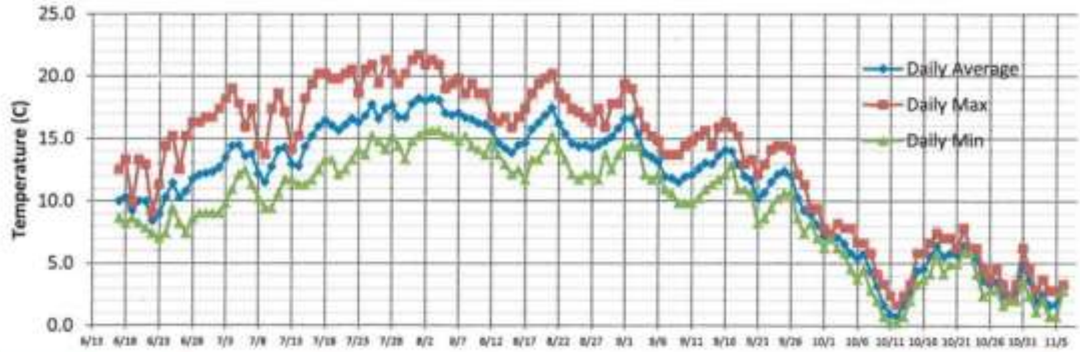
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Deer Creek
site id: 2009SCROK022
settings: sampled every 120 min.

latitude: 48.817202
longitude: -116.115635
period: 06/17 - 11/06

elevation (ft): 2727
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 21.7, criteria is: 22	na	6/17/2009	11/6/2009	142	93	Full
	MDAT = 18.2, criteria is: 19	na	6/17/2009	11/6/2009	142	93	Full
SS →	MDMT = 20.2, criteria is: 13	Fall	8/15/2009	11/6/2009	83	92	Partial
→	MDAT = 17.4, criteria is: 9	Fall	8/15/2009	11/6/2009	83	92	Partial
ID BT →	MWMT = 21.3, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
→	MDAT = 18.2, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT →	MDAT = 21.3, criteria is: 10	na	6/17/2009	9/30/2009	104	121	Partial

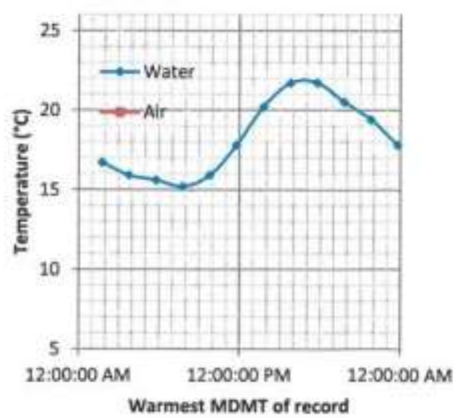
Other Evaluation

Air logger at station	no	
Average amplitude of record	5.85	water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	6.5	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	4.0	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



Temperature Logger Summary Report

prepared: 4/6/2013

stream: Fall Creek (above falls)
site id: 2009SCROK017
settings: sampled every 120 min.

latitude: 48.566889
longitude: -116.436306
period: 06/18 - 09/22

elevation (ft): 2147
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn

Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	→ MDMT = 22.8, criteria is: 22	na	6/18/2009	9/22/2009	96	93	Full
	→ MDAT = 19.8, criteria is: 19	na	6/18/2009	9/22/2009	96	93	Full
SS	→ MDMT = 20.9, criteria is: 13	Fall	8/15/2009	9/22/2009	38	92	Partial
	→ MDAT = 18.5, criteria is: 9	Fall	8/15/2009	9/22/2009	38	92	Partial
ID BT	→ MWMT = 22.3, criteria is: 13	Rearing	6/18/2009	8/31/2009	73	91	Partial
	→ MDAT = 19.8, criteria is: 9	Rearing	6/18/2009	8/31/2009	73	91	Partial
EPA BT	na						

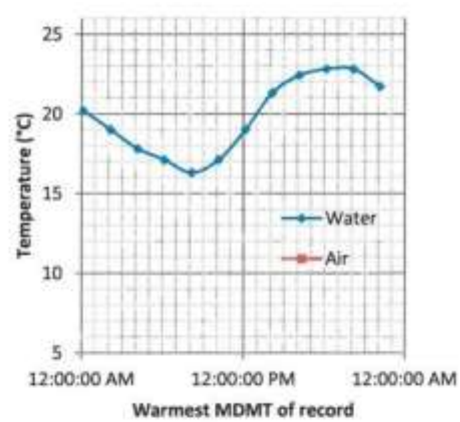
Other Evaluation

Air logger at station	no	
Average amplitude of record	4.99	water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	6.5	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	4.0	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



Temperature Logger Summary Report

prepared: 4/6/2013

stream: Fall Creek (lower)
site id: 2009SCROK024
settings: sampled every 120 min.

latitude: 48.567278
longitude: -116.433861
period: 06/18 - 09/22

elevation (ft): 2052
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn

Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 21.7, criteria is: 22	na	6/18/2009	9/22/2009	96	93	Full
	→ MDAT = 19.4, criteria is: 19	na	6/18/2009	9/22/2009	96	93	Full
SS	→ MDMT = 19.4, criteria is: 13	Fall	8/15/2009	9/22/2009	38	92	Partial
	→ MDAT = 18, criteria is: 9	Fall	8/15/2009	9/22/2009	38	92	Partial
ID BT	MWMT = 21.3, criteria is: 13	Rearing	7/9/2010	8/31/2010	52	91	Partial
	→ MDAT = 19.4, criteria is: 9	Rearing	6/18/2009	8/31/2009	73	91	Partial
EPA BT	na						

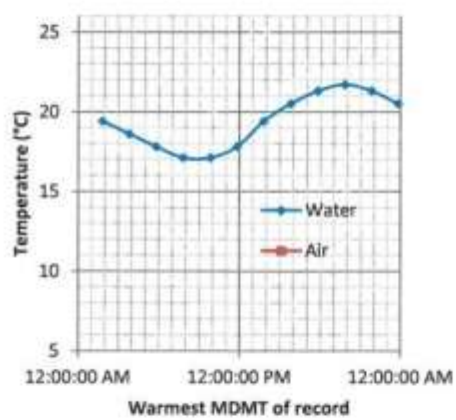
Other Evaluation

Air logger at station	no	
Average amplitude of record	5.01	water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	4.6	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	2.0	na	na
Duration of minimum temps	4.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



Temperature Logger Summary Report

prepared: 4/6/2013

stream: Fall Creek_sundance
site id: 2009SCROK016
settings: sampled every 120 min.

latitude: 48.585972
longitude: -116.527361
period: 06/18 - 09/21

elevation (ft): 3290
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn

Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 19.4, criteria is: 22	na	6/18/2009	9/21/2009	95	93	Full
	MDAT = 16.4, criteria is: 19	na	6/18/2009	9/21/2009	95	93	Full
SS →	MDMT = 17.1, criteria is: 13	Fall	8/15/2009	9/21/2009	37	92	Partial
→	MDAT = 15.1, criteria is: 9	Fall	8/15/2009	9/21/2009	37	92	Partial
ID BT →	MWMT = 18.8, criteria is: 13	Rearing	6/18/2009	8/31/2009	73	91	Partial
→	MDAT = 16.4, criteria is: 9	Rearing	6/18/2009	8/31/2009	73	91	Partial
EPA BT	na						

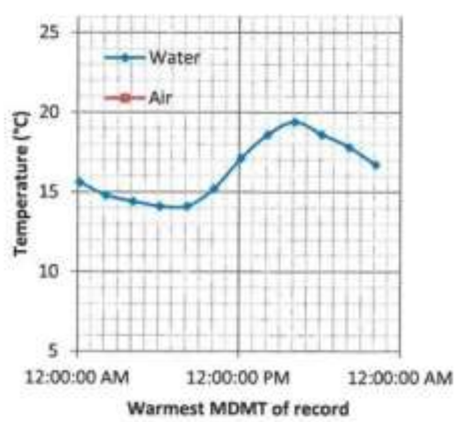
Other Evaluation

Air logger at station	no	
Average amplitude of record	4.65	water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	5.3	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	2.0	na	na
Duration of minimum temps	4.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



Temperature Logger Summary Report

prepared: 4/6/2013

stream: Fall Creek
site id: 2009SCROK015
settings: sampled every 120 min.

latitude: 48.586444
longitude: -116.526917
period: 06/18 - 09/21

elevation (ft): 3291
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn

Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 18.2, criteria is: 22	na	6/18/2009	9/21/2009	95	93	Full
	MDAT = 15.4, criteria is: 19	na	6/18/2009	9/21/2009	95	93	Full
SS →	MDMT = 16.7, criteria is: 13	Fall	8/15/2009	9/21/2009	37	92	Partial
→	MDAT = 14.5, criteria is: 9	Fall	8/15/2009	9/21/2009	37	92	Partial
ID BT →	MWMT = 17.6, criteria is: 13	Rearing	6/18/2009	8/31/2009	73	91	Partial
→	MDAT = 15.4, criteria is: 9	Rearing	6/18/2009	8/31/2009	73	91	Partial
EPA BT	na						

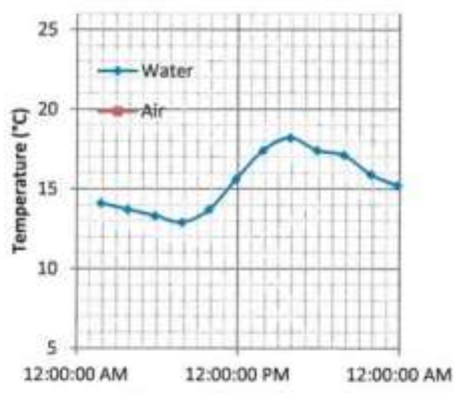
Other Evaluation

Air logger at station: no
Average amplitude of record: 4.51 water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	5.3	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	2.0	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



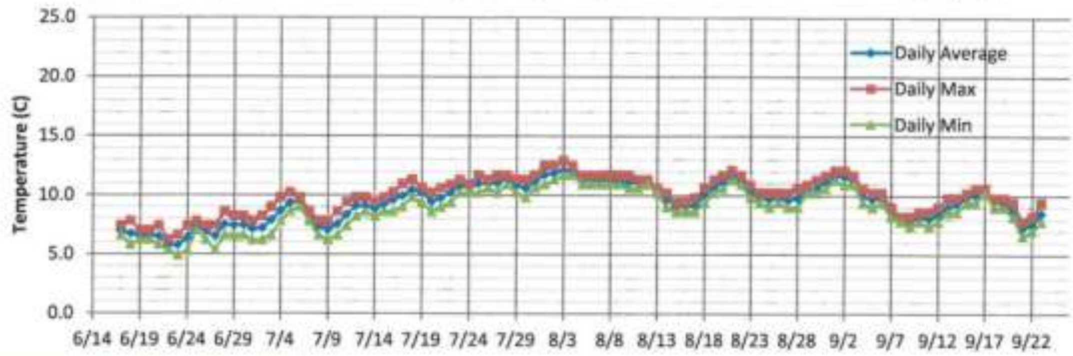
Warmest MDMT of record

Temperature Logger Summary Report

prepared: 4/6/2013

stream: Hellroaring Creek
site id: 2009SCROK021
settings: sampled every 120 min.
latitude: 48.912694
longitude: -116.252583
period: 06/17 - 09/23
elevation (ft): 4031

- ID BT
- EPA BT
- Spring Spawn
- Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 12.9, criteria is: 22	na	6/17/2009	9/23/2009	98	93	Full
	MDAT = 12.1, criteria is: 19	na	6/17/2009	9/23/2009	98	93	Full
SS	MDMT = 12.1, criteria is: 13	Fall	8/15/2009	9/23/2009	39	92	Partial
	→ MDAT = 11.7, criteria is: 9	Fall	8/15/2009	9/23/2009	39	92	Partial
ID BT	MWMT = 12.6, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
	→ MDAT = 12.1, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT	→ MDAT = 12.6, criteria is: 10	na	6/17/2009	9/23/2009	98	121	Partial

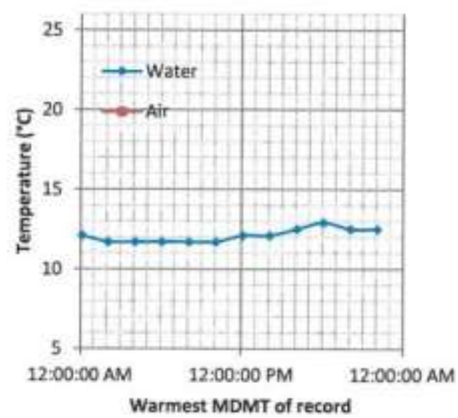
Other Evaluation

Air logger at station	no	
Average amplitude of record	1.52	water (°C)

Warmest MDMT date: 8/3/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.2	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	2.0	na	na
Duration of minimum temps	10.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



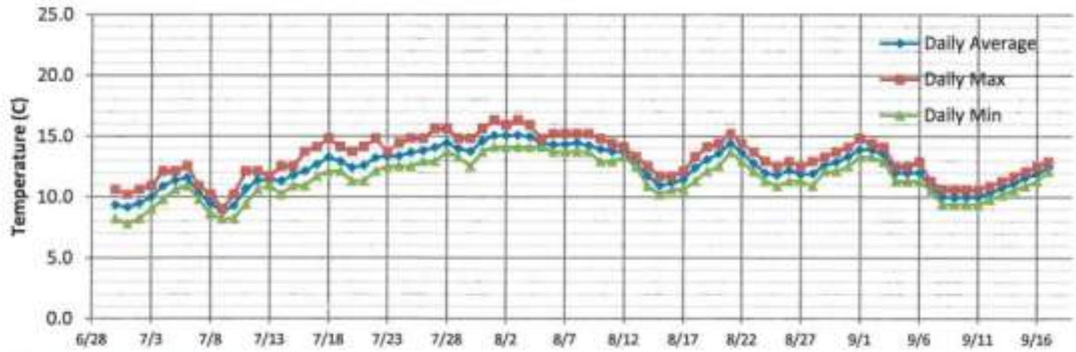
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Long Canyon Creek_1
site id: 2009SCROK001
settings: sampled every 120 min.

latitude: 48.950167
longitude: -116.536042
period: 06/30 - 09/17

elevation (ft): 1824
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 16.3, criteria is: 22	na	6/30/2009	9/17/2009	79	93	Partial
	MDAT = 15.1, criteria is: 19	na	6/30/2009	9/17/2009	79	93	Partial
SS →	MDMT = 15.2, criteria is: 13	Fall	8/15/2009	9/17/2009	33	92	Partial
→	MDAT = 14.4, criteria is: 9	Fall	8/15/2009	9/17/2009	33	92	Partial
ID BT #	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A
→	MDAT = 15.1, criteria is: 9	Rearing	6/30/2009	8/31/2009	61	91	Partial
EPA BT #	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A

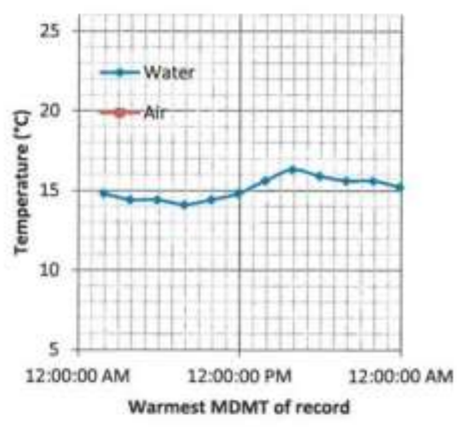
Other Evaluation

Air logger at station	no	
Average amplitude of record	1.99	water (°C)

Warmest MDMT date: 8/3/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	2.2	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	2.0	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



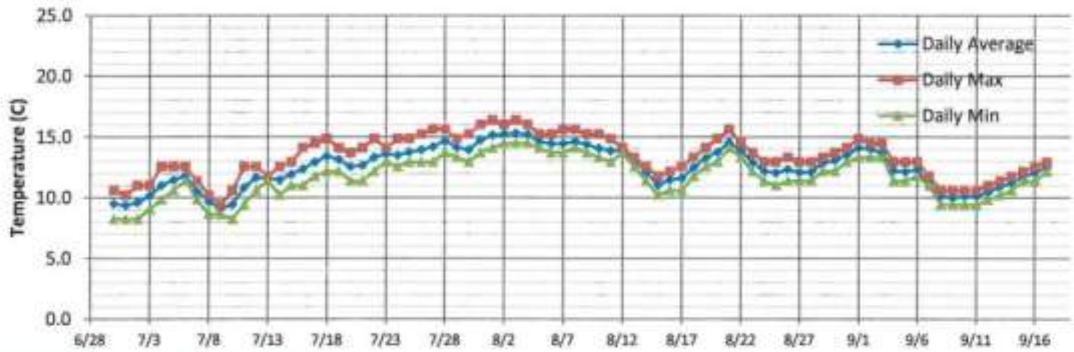
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Long Canyon Creek_2
site id: 2009SCROK014
settings: sampled every 120 min.

latitude: 48.949667
longitude: -116.536452
period: 06/30 - 09/17

elevation (ft): 1838
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 16.4, criteria is: 22	na	6/30/2009	9/17/2009	79	93	Partial
	MDAT = 15.3, criteria is: 19	na	6/30/2009	9/17/2009	79	93	Partial
SS →	MDMT = 15.6, criteria is: 13	Fall	8/15/2009	9/17/2009	33	92	Partial
→	MDAT = 14.6, criteria is: 9	Fall	8/15/2009	9/17/2009	33	92	Partial
ID BT →	MWMT = 16.2, criteria is: 13	Rearing	6/30/2009	8/31/2009	61	91	Partial
→	MDAT = 15.3, criteria is: 9	Rearing	6/30/2009	8/31/2009	61	91	Partial
EPA BT →	MDAT = 16.2, criteria is: 10	na	6/30/2009	9/17/2009	79	121	Partial

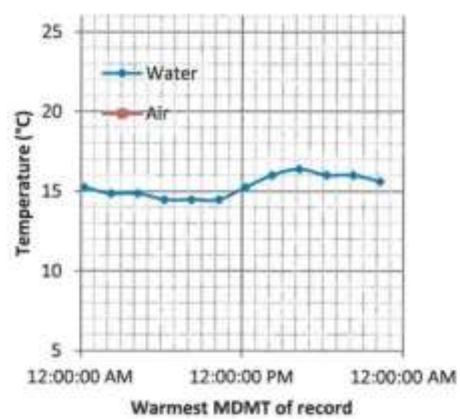
Other Evaluation

Air logger at station	no	
Average amplitude of record	2.10	water (°C)

Warmest MDMT date: 8/3/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.9	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	2.0	na	na
Duration of minimum temps	6.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



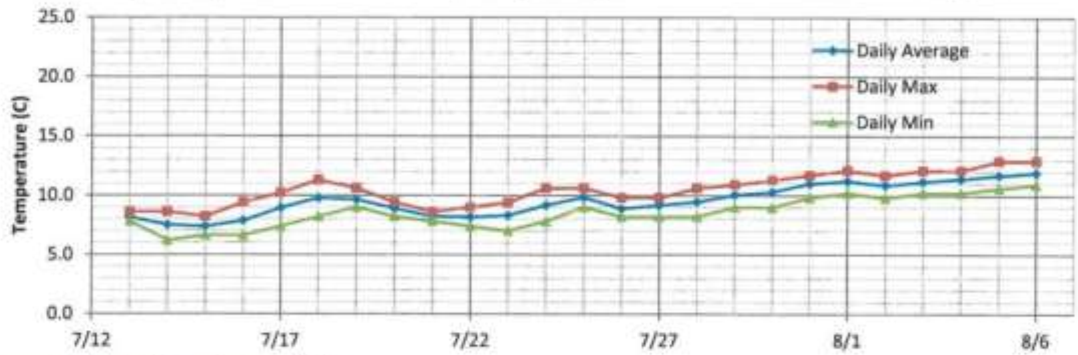
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Long Canyon Creek
site id: 2011SCROK001
settings: sampled every 30 min.

latitude: 48.943900
longitude: -116.548630
period: 07/13 - 08/06

elevation (ft): 2159
- ID BT
- Spring Spawn
- EPA BT
- Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 12.9, criteria is: 22	na	7/13/2011	8/6/2011	24	93	Partial
	MDAT = 11.9, criteria is: 19	na	7/13/2011	8/6/2011	24	93	Partial
SS	MDMT = 0, criteria is: 13	Fall	8/15/2011	8/6/2011	-9	92	Partial
	MDAT = 0, criteria is: 9	Fall	8/15/2011	8/6/2011	-9	92	Partial
ID BT	MWMT = 12.2, criteria is: 13	Rearing	7/13/2011	8/6/2011	24	91	Partial
	→ MDAT = 11.9, criteria is: 9	Rearing	9/1/2011	8/6/2011	-26	91	Partial
EPA BT	→ MDAT = 12.2, criteria is: 10	na	7/13/2011	8/6/2011	24	121	Partial

Not enough samples to evaluate criteria

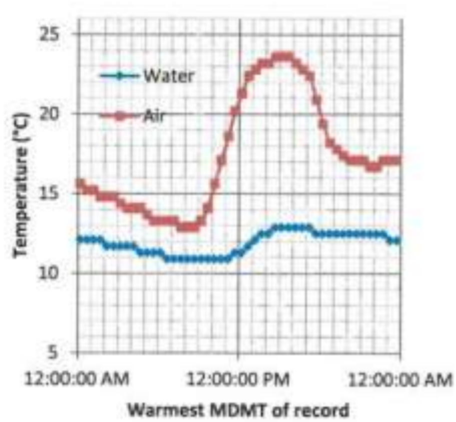
Other Evaluation

Air logger at station	yes	
Average amplitude of record	1.96	water (°C)

Warmest MDMT date: 8/6/2011

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.2	7.3	0.16
	water (hr)	air (hr)	ratio
Duration of maximum temps	2.0	0.5	0.25
Duration of minimum temps	5.0	1.5	0.30

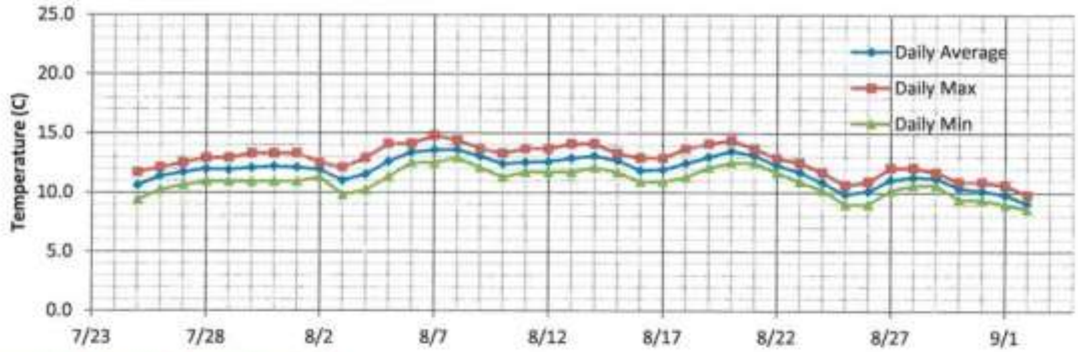
Water response time	2.5	(hours)
how many air degrees	6.9	(°C)
Temperature lag effect	17.25	(°C hours)



Temperature Logger Summary Report

prepared: 4/6/2013

stream: Long Canyon Creek | latitude: 48.943900 | elevation (ft): 2204
site id: 2012SCROK006 | longitude: -116.548630 | • ID BT • Spring Spawn
settings: sampled every 60 min. | period: 07/25 - 09/02 | • EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 14.8, criteria is: 22	na	7/25/2012	9/2/2012	39	93	Partial
	MDAT = 13.6, criteria is: 19	na	7/25/2012	9/2/2012	39	93	Partial
SS →	MDMT = 14.4, criteria is: 13	Fall	8/15/2012	9/2/2012	18	92	Partial
→	MDAT = 13.5, criteria is: 9	Fall	8/15/2012	9/2/2012	18	92	Partial
ID BT →	MWMT = 14, criteria is: 13	Rearing	7/25/2012	8/31/2012	36	91	Partial
→	MDAT = 13.6, criteria is: 9	Rearing	7/25/2012	8/31/2012	36	91	Partial
EPA BT →	MDAT = 14, criteria is: 10	na	7/25/2012	9/2/2012	39	121	Partial

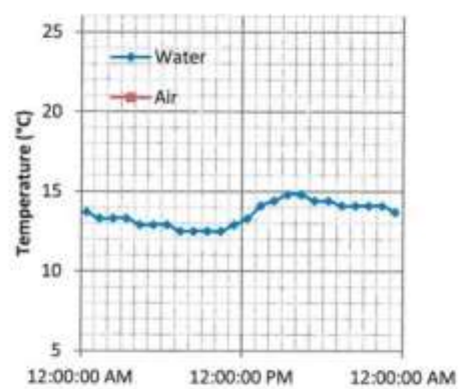
Other Evaluation

Air logger at station	no	
Average amplitude of record	1.90	water (°C)

Warmest MDMT date: 8/7/2012

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	2.3	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	2.0	na	na
Duration of minimum temps	4.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



Warmest MDMT of record

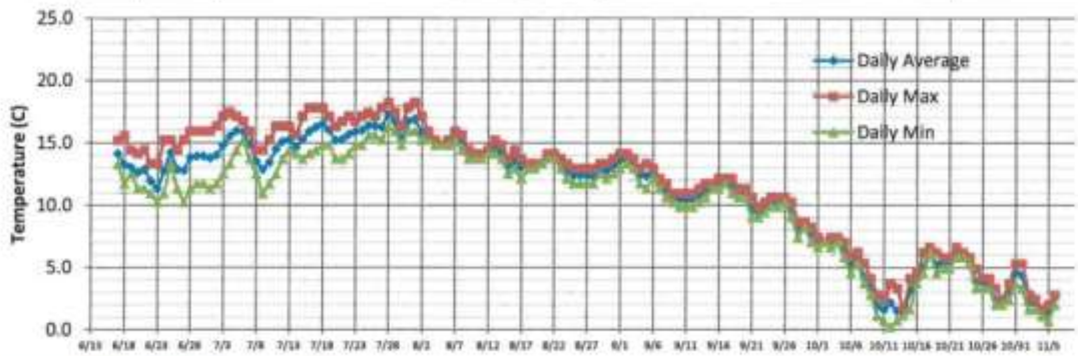
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Meadow Creek
site id: 2009SCROK023
settings: sampled every 120 min.

latitude: 48.819498
longitude: -116.155872
period: 06/17 - 11/06

elevation (ft): 2400
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 18.2, criteria is: 22	na	6/17/2009	11/6/2009	142	93	Full
	MDAT = 17.2, criteria is: 19	na	6/17/2009	11/6/2009	142	93	Full
SS →	MDMT = 15.9, criteria is: 13	Spring	6/17/2009	7/1/2009	13	60	Partial
→	MDAT = 14.2, criteria is: 9	Spring	6/17/2009	7/1/2009	13	60	Partial
ID BT →	MWMT = 17.6, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
→	MDAT = 17.2, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT	na						

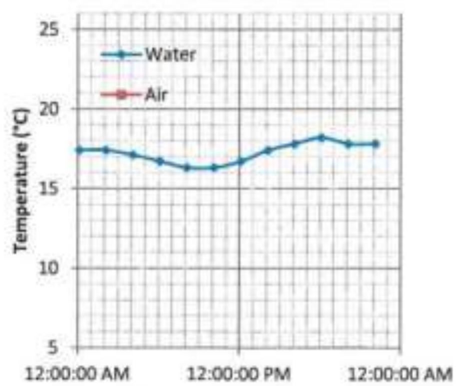
Other Evaluation

Air logger at station	no	
Average amplitude of record	3.34	water (°C)

Warmest MDMT date: 7/28/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.9	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	2.0	na	na
Duration of minimum temps	4.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



Warmest MDMT of record

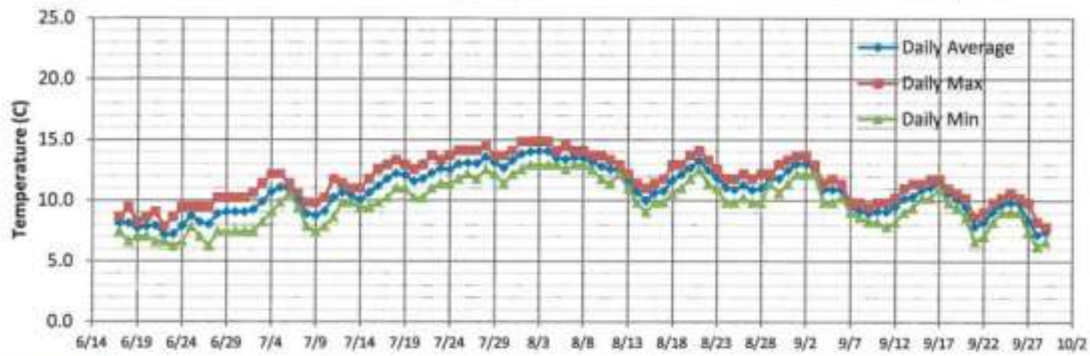
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Mission Creek
site id: 2009SCROK006
settings: sampled every 120 min.

latitude: 48.963583
longitude: -116.327139
period: 06/17 - 09/23

elevation (ft): 3145
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 14.9, criteria is: 22	na	6/17/2009	9/23/2009	98	93	Full
	MDAT = 14.1, criteria is: 19	na	6/17/2009	9/23/2009	98	93	Full
SS →	MDMT = 14.1, criteria is: 13	Fall	8/15/2009	9/23/2009	39	92	Partial
→	MDAT = 13.3, criteria is: 9	Fall	8/15/2009	9/23/2009	39	92	Partial
ID BT →	MWMT = 14.9, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
→	MDAT = 14.1, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT →	MDAT = 14.9, criteria is: 10	na	6/17/2009	9/23/2009	98	121	Partial

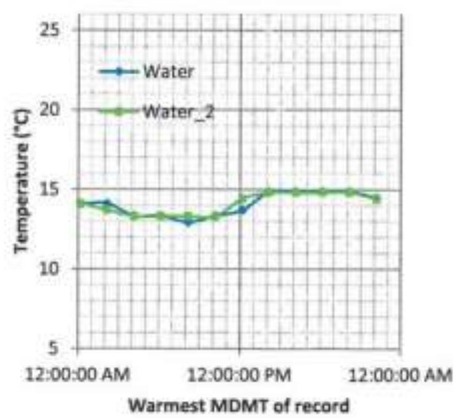
Other Evaluation

Air logger at station	no	
Average amplitude of record	2.30	water (°C)

Warmest MDMT date: 8/3/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.9	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	8.0	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



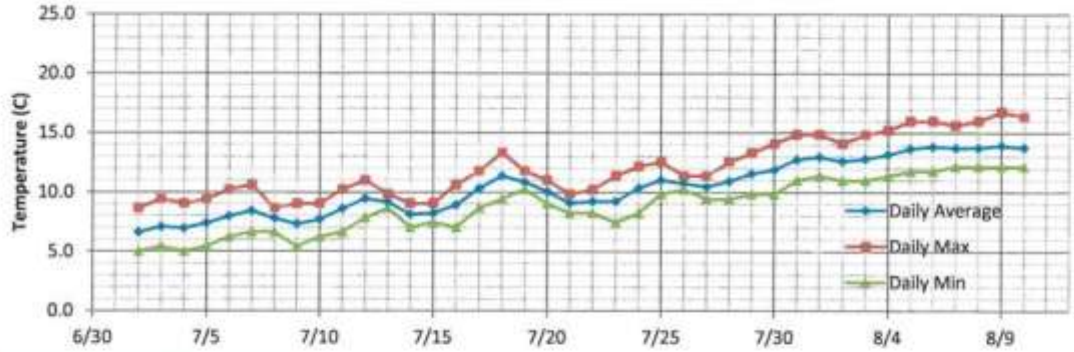
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Myrtle Creek
site id: 2011SCROK004
settings: sampled every 30 min.

latitude: 48.707317
longitude: -116.426533
period: 07/02 - 08/10

elevation (ft): 2025
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 16.8, criteria is: 22	na	7/2/2011	8/10/2011	39	93	Partial
	MDAT = 13.9, criteria is: 19	na	7/2/2011	8/10/2011	39	93	Partial
SS	MDMT = 0, criteria is: 13	Fall	8/15/2011	8/10/2011	-5	92	Partial
	MDAT = 0, criteria is: 9	Fall	8/15/2011	8/10/2011	-5	92	Partial
ID BT →	MWMT = 15.7, criteria is: 13	Rearing	7/2/2011	8/10/2011	39	91	Partial
→	MDAT = 13.9, criteria is: 9	Rearing	9/1/2011	8/10/2011	-22	91	Partial
EPA BT →	MDAT = 15.7, criteria is: 10	na	7/2/2011	8/10/2011	39	121	Partial

logger dewatered after 8/10

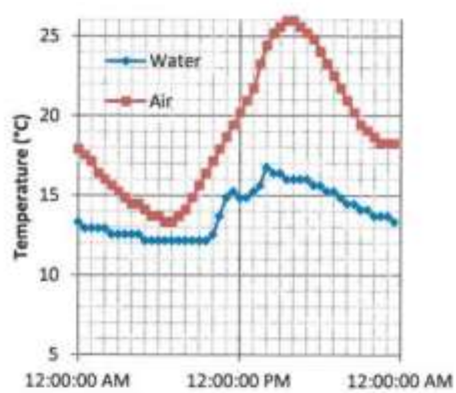
Other Evaluation

Air logger at station	yes	
Average amplitude of record	2.93	water (°C)

Warmest MDMT date: 8/9/2011

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	4.6	6.1	0.75
	water (hr)	air (hr)	ratio
Duration of maximum temps	0.5	1.0	2.00
Duration of minimum temps	5.0	1.0	0.20

Water response time	2.5	(hours)
how many air degrees	3.44	(°C)
Temperature lag effect	8.60	(°C hours)



Warmest MDMT of record

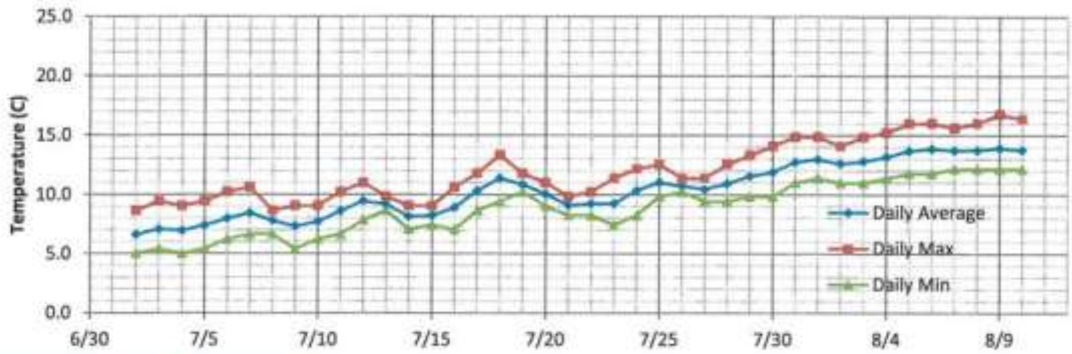
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Myrtle Creek
site id: 2012SCROK002
settings: sampled every 30 min.

latitude: 48.707317
longitude: -116.426533
period: 07/02 - 08/10

elevation (ft): 2025
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 16.8, criteria is: 22	na	7/2/2011	8/10/2011	39	93	Partial
	MDAT = 13.9, criteria is: 19	na	7/2/2011	8/10/2011	39	93	Partial
SS	MDMT = 0, criteria is: 13	Fall	8/15/2011	8/10/2011	-5	92	Partial
	MDAT = 0, criteria is: 9	Fall	8/15/2011	8/10/2011	-5	92	Partial
ID BT #	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A
	→ MDAT = 13.9, criteria is: 9	Rearing	9/1/2011	8/10/2011	-22	91	Partial
EPA BT #	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A

logger dewatered after 8/10

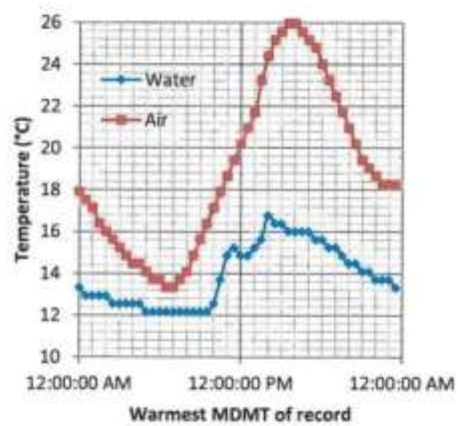
Other Evaluation

Air logger at station	yes	
Average amplitude of record	2.93	water (°C)

Warmest MDMT date: 8/9/2011

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	4.6	6.1	0.75
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	0.5	1.0	2.00
Duration of minimum temps	5.0	1.0	0.20

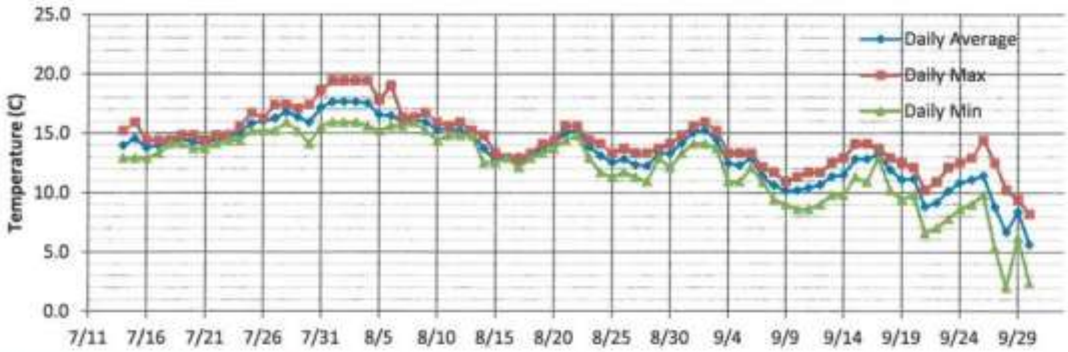
Water response time	2.5	(hours)
how many air degrees	3.44	(°C)
Temperature lag effect	8.60	(°C hours)



Temperature Logger Summary Report

prepared: 4/6/2013

stream: Rock Creek
site id: 2009SCROK011
settings: sampled every 120 min.
latitude: 48.836610
longitude: -116.331830
period: 07/14 - 09/30
elevation (ft): 2095
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 19.4, criteria is: 22	na	7/14/2009	9/30/2009	78	93	Partial
	MDAT = 17.6, criteria is: 19	na	7/14/2009	9/30/2009	78	93	Partial
SS →	MDMT = 15.9, criteria is: 13	Fall	8/15/2009	9/30/2009	46	92	Partial
→	MDAT = 15.2, criteria is: 9	Fall	8/15/2009	9/30/2009	46	92	Partial
ID BT #	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A
→	MDAT = 17.6, criteria is: 9	Rearing	7/14/2009	8/31/2009	47	91	Partial
EPA BT	na						

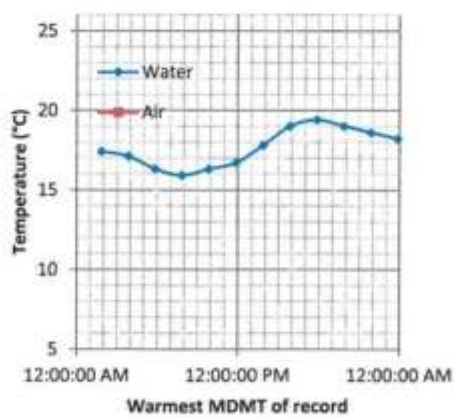
Other Evaluation

Air logger at station	no	
Average amplitude of record	1.94	water (°C)

Warmest MDMT date: 8/2/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	3.5	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	2.0	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



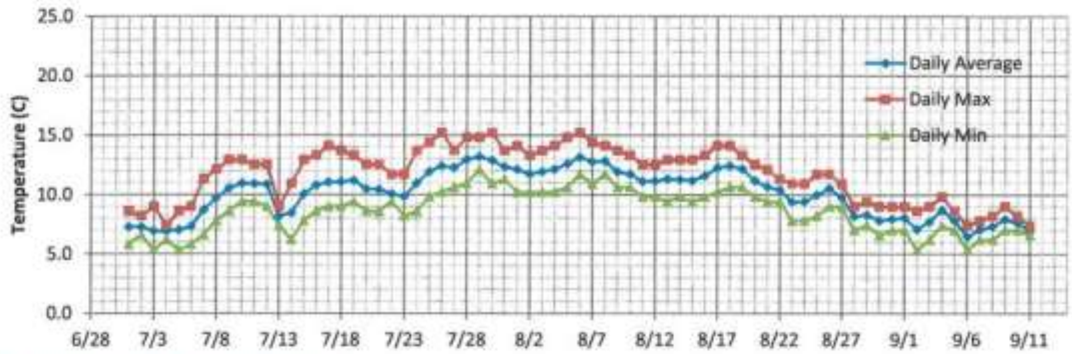
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Snow Creek
site id: 2010SCROK003
settings: sampled every 60 min.

latitude: 48.687717
longitude: -116.543633
period: 07/01 - 09/11

elevation (ft): 3989
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 15.2, criteria is: 22	na	7/1/2010	9/11/2010	72	93	Partial
	MDAT = 13.2, criteria is: 19	na	7/1/2010	9/11/2010	72	93	Partial
SS →	MDMT = 14.1, criteria is: 13	Fall	8/15/2010	9/11/2010	27	92	Partial
→	MDAT = 12.4, criteria is: 9	Fall	8/15/2010	9/11/2010	27	92	Partial
ID BT →	MWMT = 14.6, criteria is: 13	Rearing	7/1/2010	8/31/2010	60	91	Partial
→	MDAT = 13.2, criteria is: 9	Rearing	7/1/2010	8/31/2010	60	91	Partial
EPA BT →	MDAT = 14.6, criteria is: 10	na	7/1/2010	9/11/2010	72	121	Partial

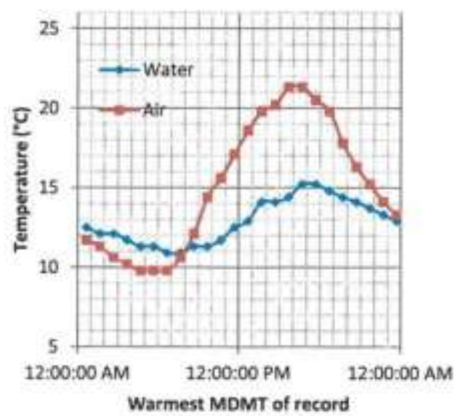
Other Evaluation

Air logger at station	yes	
Average amplitude of record	3.69	water (°C)

Warmest MDMT date: 7/30/2010

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	4.3	11.5	0.37
	water (hr)	air (hr)	ratio
Duration of maximum temps	2.0	2.0	1.00
Duration of minimum temps	2.0	3.0	1.50

Water response time	1	(hours)
how many air degrees	1.5	(°C)
Temperature lag effect	1.50	(°C hours)



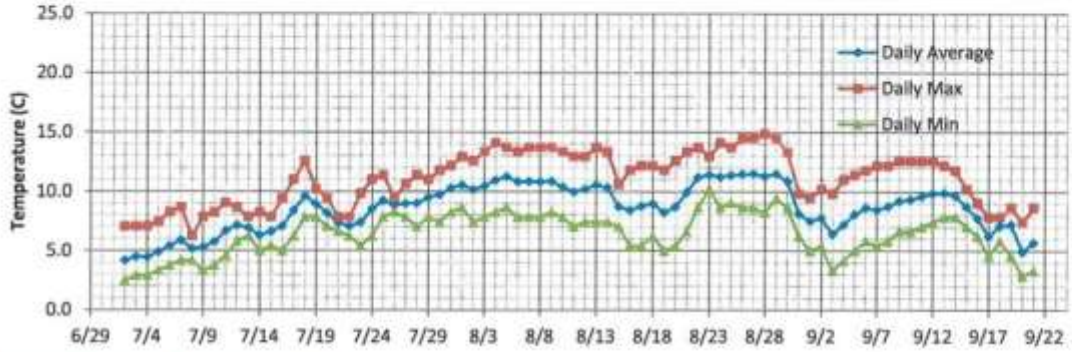
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Snow Creek
site id: 2011SCROK003
settings: sampled every 30 min.

latitude: 48.687717
longitude: -116.543633
period: 07/02 - 08/10

elevation (ft): 3989
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 14.9, criteria is: 22	na	7/2/2011	8/10/2011	39	93	Partial
	MDAT = 11.5, criteria is: 19	na	7/2/2011	8/10/2011	39	93	Partial
SS	MDMT = 9, criteria is: 13	Spring	7/2/2011	7/15/2011	12	60	Partial
	MDAT = 7.1, criteria is: 9	Spring	7/2/2011	7/15/2011	12	60	Partial
ID BT →	MWMT = 13.7, criteria is: 13	Rearing	7/2/2011	8/10/2011	39	91	Partial
→	MDAT = 11.2, criteria is: 9	Rearing	9/1/2011	8/10/2011	-22	91	Partial
EPA BT →	MDAT = 13.7, criteria is: 10	na	7/2/2011	8/10/2011	39	121	Partial

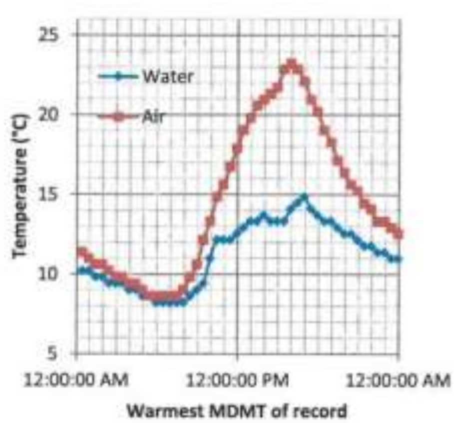
Other Evaluation

Air logger at station	yes	
Average amplitude of record	3.48	water (°C)

Warmest MDMT date: 8/28/2011

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	6.6	9.3	0.71
	water (hr)	air (hr)	ratio
Duration of maximum temps	0.5	0.5	1.00
Duration of minimum temps	2.5	2.5	1.00

Water response time	0.5	(hours)
how many air degrees	0.79	(°C)
Temperature lag effect	0.39	(°C hours)



Temperature Logger Summary Report

prepared: 4/6/2013

stream: Snow Creek
site id: 2012SCROK001
settings: sampled every 60 min.

latitude: 48.687717
longitude: -116.543633
period: 07/06 - 08/31

elevation (ft): 4005
• ID BT • Spring Spawn
• EPA BT • Fall Spawn

Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL →	MDMT = 22.1, criteria is: 22	na	7/6/2012	8/31/2012	56	93	Partial
	MDAT = 13.9, criteria is: 19	na	7/6/2012	8/31/2012	56	93	Partial
SS →	MDMT = 22.1, criteria is: 13	Fall	8/15/2012	8/31/2012	16	92	Partial
→	MDAT = 13.9, criteria is: 9	Fall	8/15/2012	8/31/2012	16	92	Partial
ID BT →	MWMT = 21.3, criteria is: 13	Rearing	7/6/2012	8/31/2012	55	91	Partial
→	MDAT = 13.9, criteria is: 9	Rearing	9/1/2012	8/31/2012	-1	91	Partial
EPA BT →	MDAT = 21.3, criteria is: 10	na	7/6/2012	8/31/2012	56	121	Partial

Other Evaluation

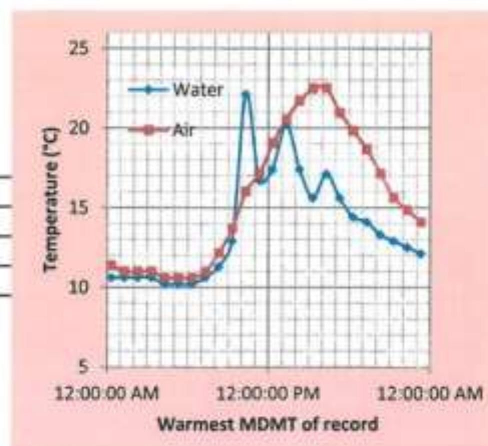
Air logger at station	yes	
Average amplitude of record	6.56	water (°C)

Warmest MDMT date: 8/19/2012

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	11.9	11.9	1.00
	water (hr)	air (hr)	ratio
Duration of maximum temps	1.0	2.0	2.00
Duration of minimum temps	3.0	3.0	1.00

Water response time	0	(hours)
how many air degrees	0	(°C)
Temperature lag effect	0.00	(°C hours)

Logger Failed - Do not use data



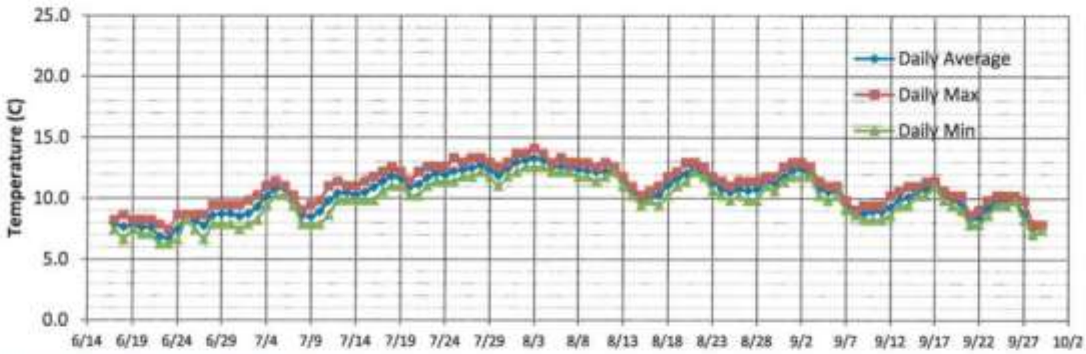
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Spruce Creek (lower)
site id: 2009SCROK020
settings: sampled every 120 min.

latitude: 48.943167
longitude: -116.143472
period: 06/17 - 09/23

elevation (ft): 3025
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 14.1, criteria is: 22	na	6/17/2009	9/23/2009	98	93	Full
	MDAT = 13.3, criteria is: 19	na	6/17/2009	9/23/2009	98	93	Full
SS	MDMT = 12.9, criteria is: 13	Fall	8/15/2009	9/23/2009	39	92	Partial
	→ MDAT = 12.5, criteria is: 9	Fall	8/15/2009	9/23/2009	39	92	Partial
ID BT	→ MWMT = 13.8, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
	→ MDAT = 13.3, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT	→ MDAT = 13.8, criteria is: 10	na	6/17/2009	9/23/2009	98	121	Partial

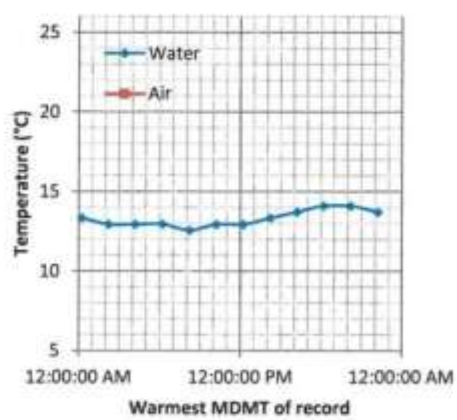
Other Evaluation

Air logger at station	no	
Average amplitude of record	1.47	water (°C)

Warmest MDMT date: 8/3/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.5	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	4.0	na	na
Duration of minimum temps	2.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



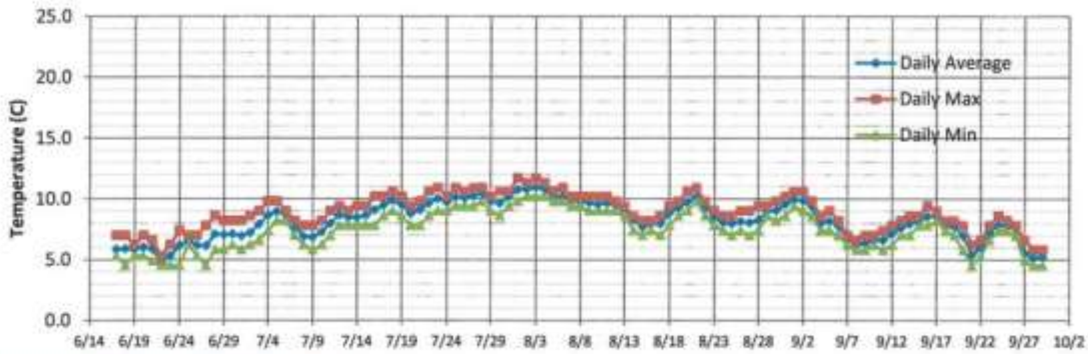
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Spruce Creek (upper)
site id: 2009SCROK018
settings: sampled every 120 min.

latitude: 48.934028
longitude: -116.097750
period: 06/17 - 09/23

elevation (ft): 4560
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 11.7, criteria is: 22	na	6/17/2009	9/23/2009	98	93	Full
	MDAT = 10.9, criteria is: 19	na	6/17/2009	9/23/2009	98	93	Full
SS	MDMT = 10.9, criteria is: 13	Fall	8/15/2009	9/23/2009	39	92	Partial
	→ MDAT = 10.4, criteria is: 9	Spring	6/17/2009	7/31/2009	43	60	Partial
ID BT	MWMT = 11.5, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
	→ MDAT = 10.9, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT	→ MDAT = 11.5, criteria is: 10	na	6/17/2009	9/23/2009	98	121	Partial

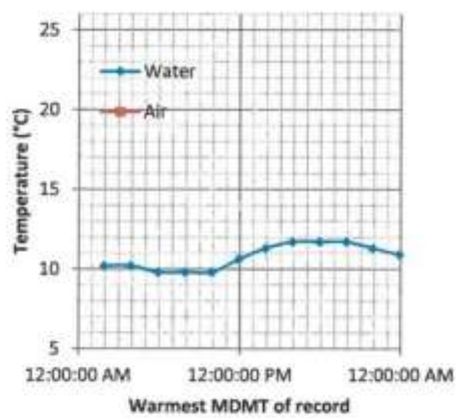
Other Evaluation

Air logger at station	no	
Average amplitude of record	1.91	water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.9	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	6.0	na	na
Duration of minimum temps	6.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



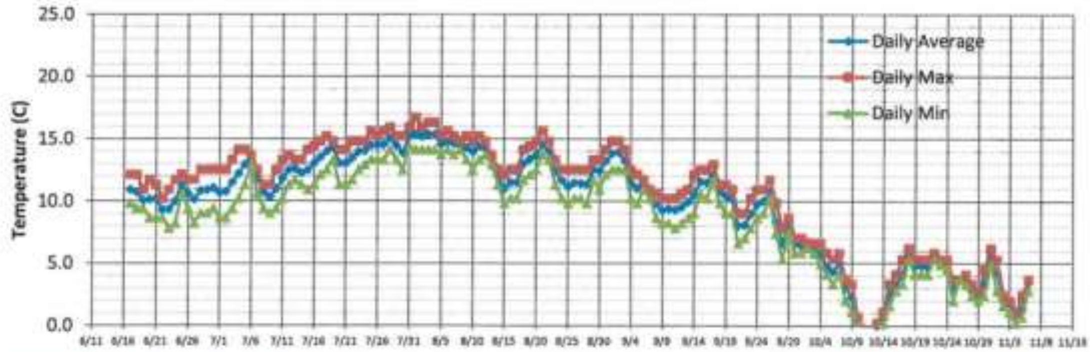
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Trail Creek
site id: 2009SCROK008
settings: sampled every 120 min.

latitude: 48.546130
longitude: -116.360470
period: 06/17 - 09/03

elevation (ft): 2465
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 16.7, criteria is: 22	na	6/17/2009	9/3/2009	78	93	Partial
	MDAT = 15.4, criteria is: 19	na	6/17/2009	9/3/2009	78	93	Partial
SS →	MDMT = 15.6, criteria is: 13	Fall	8/15/2009	9/3/2009	19	92	Partial
→	MDAT = 14.5, criteria is: 9	Fall	8/15/2009	9/3/2009	19	92	Partial
ID BT →	MWMT = 16.3, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
→	MDAT = 15.4, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT	na						

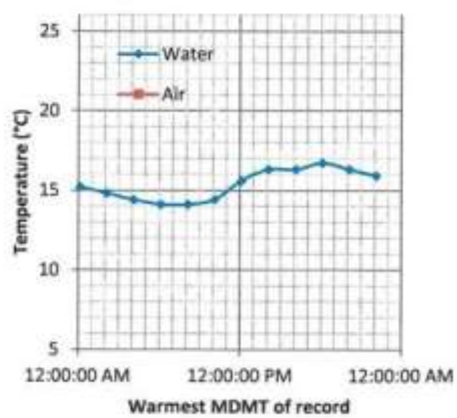
Other Evaluation

Air logger at station	no	
Average amplitude of record	2.78	water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	2.6	na	na
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	2.0	na	na
Duration of minimum temps	4.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



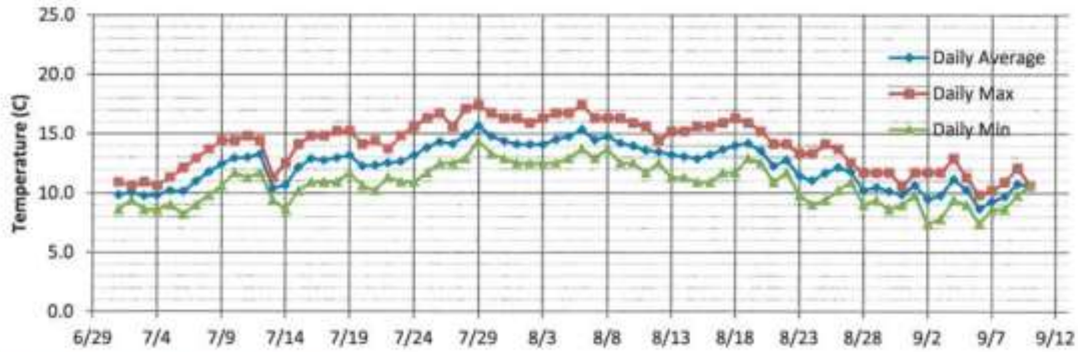
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Trail Creek
site id: 2010SCROK008
settings: sampled every 60 min.

latitude: 48.546130
longitude: -116.360470
period: 07/01 - 09/10

elevation (ft): 2460
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 17.4, criteria is: 22	na	7/1/2010	9/10/2010	71	93	Partial
	MDAT = 15.6, criteria is: 19	na	7/1/2010	9/10/2010	71	93	Partial
SS →	MDMT = 16.3, criteria is: 13	Fall	8/15/2010	9/10/2010	26	92	Partial
→	MDAT = 14.2, criteria is: 9	Fall	8/15/2010	9/10/2010	26	92	Partial
ID BT →	MWMT = 16.9, criteria is: 13	Rearing	7/1/2010	8/31/2010	60	91	Partial
→	MDAT = 15.6, criteria is: 9	Rearing	7/1/2010	8/31/2010	60	91	Partial
EPA BT	na						

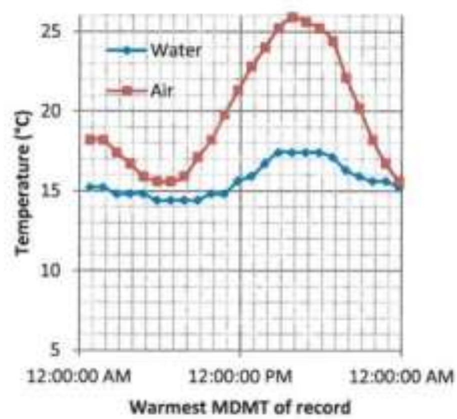
Other Evaluation

Air logger at station	yes	
Average amplitude of record	3.32	water (°C)

Warmest MDMT date: 7/29/2010

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.2	5.7	0.21
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	1.0	1.0	1.00
Duration of minimum temps	4.0	2.0	0.50

Water response time	2	(hours)
how many air degrees	2.3	(°C)
Temperature lag effect	4.60	(°C hours)



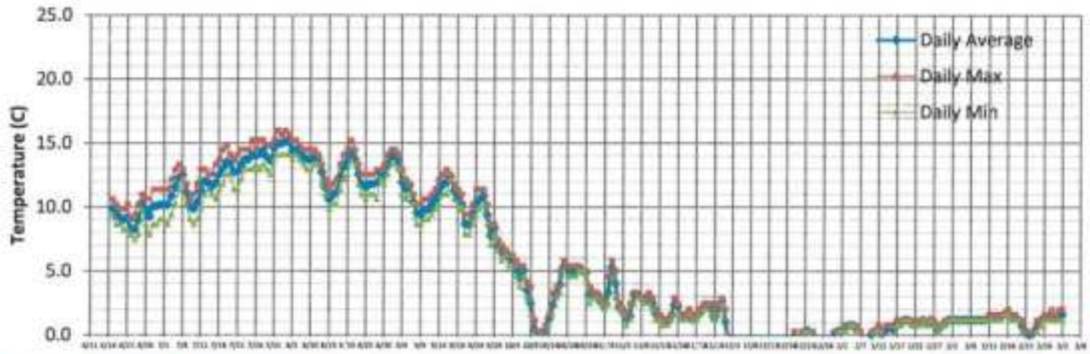
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Twentymile Creek
site id: 2009SCROK007
settings: sampled every 120 min.

latitude: 48.585860
longitude: -116.339250
period: 06/17 - 09/03

elevation (ft): 2541
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 16, criteria is: 22	na	6/17/2009	9/3/2009	78	93	Partial
	MDAT = 15.1, criteria is: 19	na	6/17/2009	9/3/2009	78	93	Partial
SS →	MDMT = 15.2, criteria is: 13	Fall	8/15/2009	9/3/2009	19	92	Partial
→	MDAT = 14.2, criteria is: 9	Fall	8/15/2009	9/3/2009	19	92	Partial
ID BT →	MWMT = 15.8, criteria is: 13	Rearing	6/17/2009	8/31/2009	74	91	Partial
→	MDAT = 15.1, criteria is: 9	Rearing	6/17/2009	8/31/2009	74	91	Partial
EPA BT	na						

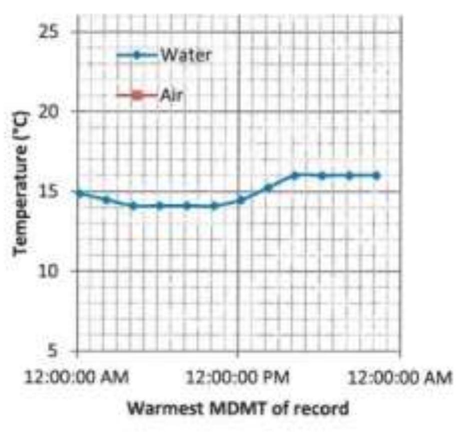
Other Evaluation

Air logger at station: no
Average amplitude of record: 2.06 water (°C)

Warmest MDMT date: 8/1/2009

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.9	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	8.0	na	na
Duration of minimum temps	8.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



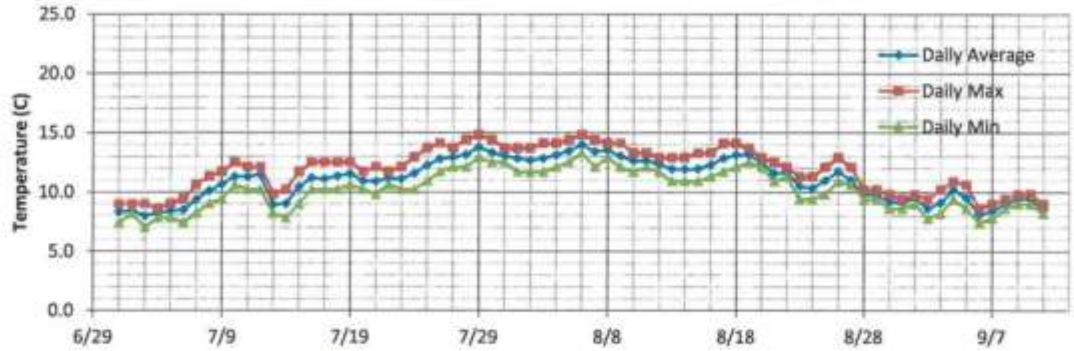
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Twentymile Creek
site id: 2010SCROK007
settings: sampled every 60 min.

latitude: 48.586860
longitude: -116.339250
period: 07/01 - 09/11

elevation (ft): 2606
• ID BT • Spring Spawn
○ EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 14.8, criteria is: 22	na	7/1/2010	9/11/2010	72	93	Partial
	MDAT = 14, criteria is: 19	na	7/1/2010	9/11/2010	72	93	Partial
SS →	MDMT = 14.1, criteria is: 13	Fall	8/15/2010	9/11/2010	27	92	Partial
→	MDAT = 13.2, criteria is: 9	Fall	8/15/2010	9/11/2010	27	92	Partial
ID BT →	MWMT = 14.4, criteria is: 13	Rearing	7/1/2010	8/31/2010	60	91	Partial
→	MDAT = 14, criteria is: 9	Rearing	7/1/2010	8/31/2010	60	91	Partial
EPA BT	na						

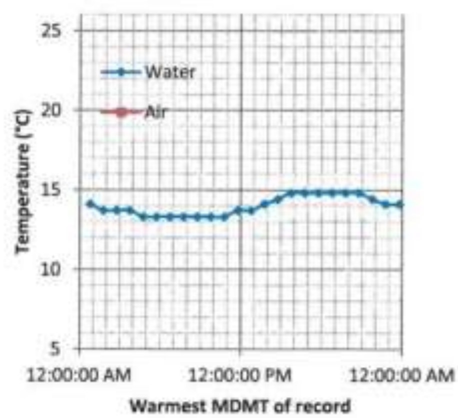
Other Evaluation

Air logger at station	no	
Average amplitude of record	1.96	water (°C)

Warmest MDMT date: 8/6/2010

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.5	na	na
	water (hr)	air (hr)	ratio
Duration of maximum temps	6.0	na	na
Duration of minimum temps	7.0	na	na

Water response time	na	(hours)
how many air degrees	na	(°C)
Temperature lag effect	na	(°C hours)



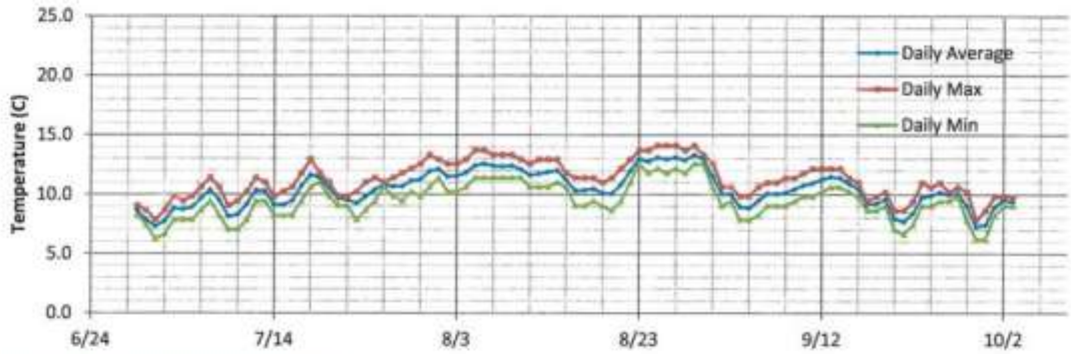
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Twentymile Creek
site id: 2011SCROK007
settings: sampled every 30 min.

latitude: 48.586850
longitude: -116.334920
period: 06/29 - 09/14

elevation (ft): 2606
● ID BT ● Spring Spawn
○ EPA BT ● Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 14.1, criteria is: 22	na	6/29/2011	9/14/2011	77	93	Partial
	MDAT = 13.3, criteria is: 19	na	6/29/2011	9/14/2011	77	93	Partial
SS →	MDMT = 14.1, criteria is: 13	Fall	8/15/2011	9/14/2011	30	92	Partial
→	MDAT = 13.3, criteria is: 9	Fall	8/15/2011	9/14/2011	30	92	Partial
ID BT →	MWMT = 14, criteria is: 13	Rearing	6/29/2011	8/31/2011	62	91	Partial
→	MDAT = 13.3, criteria is: 9	Rearing	6/29/2011	8/31/2011	62	91	Partial
EPA BT	na						

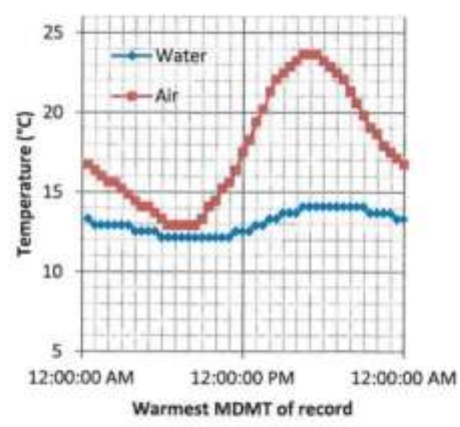
Other Evaluation

Air logger at station	yes	
Average amplitude of record	1.77	water (°C)

Warmest MDMT date: 8/27/2011

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	1.9	4.6	0.42
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	5.0	1.5	0.30
Duration of minimum temps	5.5	2.5	0.45

Water response time	2.5	(hours)
how many air degrees	3.06	(°C)
Temperature lag effect	7.65	(°C hours)



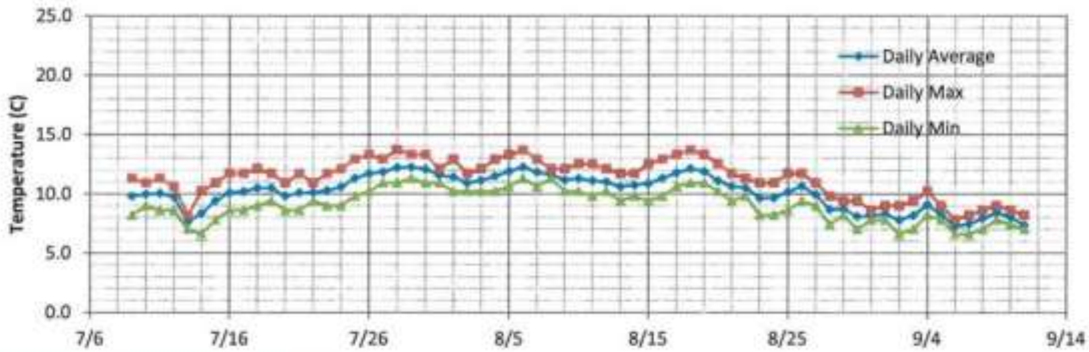
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Upper Mission
site id: 2010SCROK006
settings: sampled every 60 min.

latitude: 48.979733
longitude: -116.337067
period: 07/09 - 09/11

elevation (ft): 3368
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 13.7, criteria is: 22	na	7/9/2010	9/11/2010	64	93	Partial
	MDAT = 12.3, criteria is: 19	na	7/9/2010	9/11/2010	64	93	Partial
SS →	MDMT = 13.7, criteria is: 13	Fall	8/15/2010	9/11/2010	27	92	Partial
→	MDAT = 12.1, criteria is: 9	Fall	8/15/2010	9/11/2010	27	92	Partial
ID BT →	MWMT = 13.3, criteria is: 13	Rearing	7/9/2010	8/31/2010	52	91	Partial
→	MDAT = 12.3, criteria is: 9	Rearing	7/9/2010	8/31/2010	52	91	Partial
EPA BT →	MDAT = 13.3, criteria is: 10	na	7/9/2010	9/11/2010	64	121	Partial

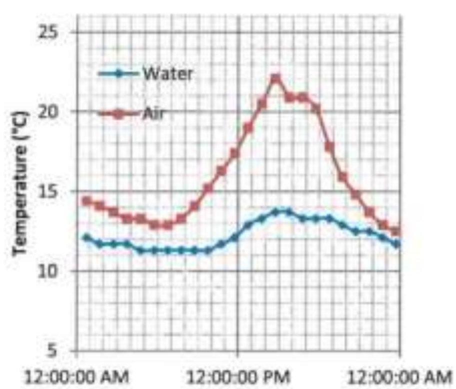
Other Evaluation

Air logger at station	yes	
Average amplitude of record	2.51	water (°C)

Warmest MDMT date: 8/6/2010

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	2.4	9.6	0.25
	water (hr)	air (hr)	ratio
Duration of maximum temps	2.0	1.0	0.50
Duration of minimum temps	6.0	1.0	0.17

Water response time	3	(hours)
how many air degrees	3	(°C)
Temperature lag effect	9.00	(°C hours)

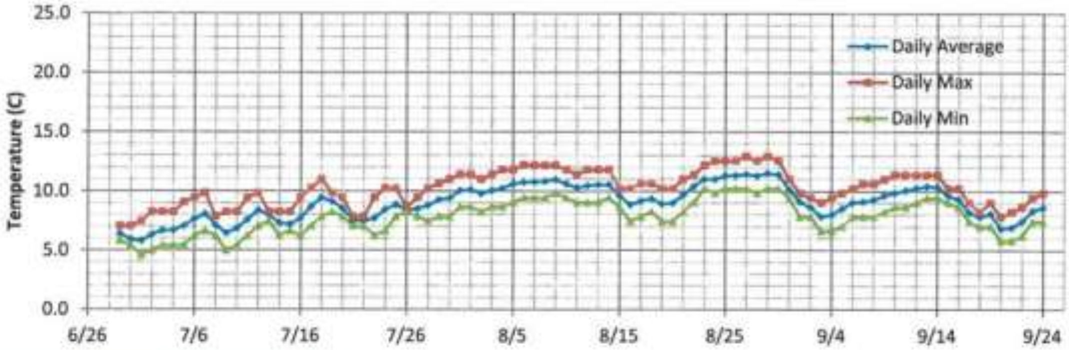


Warmest MDMT of record

Temperature Logger Summary Report

prepared: 4/6/2013

stream: Upper Mission | latitude: 48.979733 | elevation (ft): 3368
site id: 2011SCROK006 | longitude: -116.337017 | • ID BT • Spring Spawn
settings: sampled every 30 min. | period: 06/29 - 09/14 | • EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 12.9, criteria is: 22	na	6/29/2011	9/14/2011	77	93	Partial
	MDAT = 11.5, criteria is: 19	na	6/29/2011	9/14/2011	77	93	Partial
SS	MDMT = 12.9, criteria is: 13	Fall	8/15/2011	9/14/2011	30	92	Partial
	→ MDAT = 11.5, criteria is: 9	Fall	8/15/2011	9/14/2011	30	92	Partial
ID BT	MWMT = 12.7, criteria is: 13	Rearing	6/29/2011	8/31/2011	62	91	Partial
	→ MDAT = 11.5, criteria is: 9	Rearing	6/29/2011	8/31/2011	62	91	Partial
EPA BT	→ MDAT = 12.7, criteria is: 10	na	6/29/2011	9/14/2011	77	121	Partial

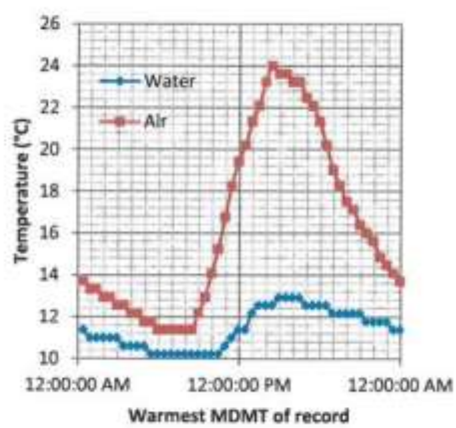
Other Evaluation

Air logger at station	yes	
Average amplitude of record	2.41	water (°C)

Warmest MDMT date: 8/27/2011

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	2.7	8.0	0.34
	water (hr)	**air (hr)**	**ratio**
Duration of maximum temps	2.0	0.5	0.25
Duration of minimum temps	5.5	3.0	0.55

Water response time	2	(hours)
how many air degrees	4.6	(°C)
Temperature lag effect	9.20	(°C hours)



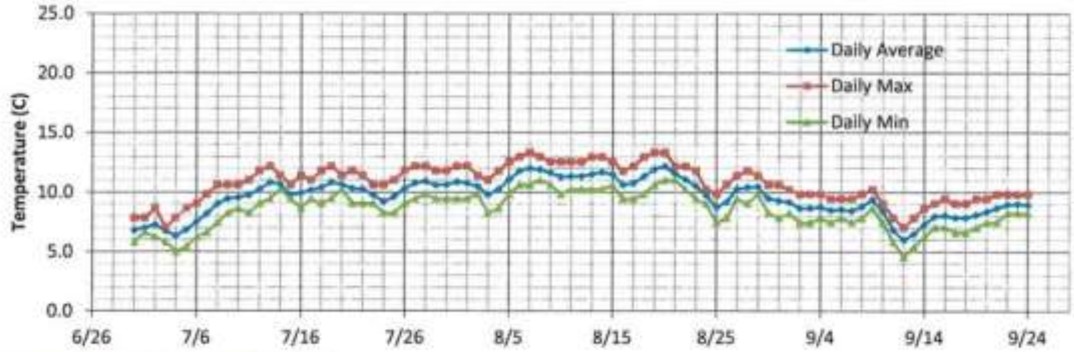
Temperature Logger Summary Report

prepared: 4/6/2013

stream: Upper Mission Creek
site id: 2012SCROK003
settings: sampled every 30 min.

latitude: 48.979472
longitude: -116.338083
period: 06/30 - 09/24

elevation (ft): 3373
• ID BT • Spring Spawn
• EPA BT • Fall Spawn



Numeric Criteria Evaluation (°C)

Use	Comment	Period	Logger Start Date	Logger End Date	Logger No. days	Critical time period days	Type of Record
CWAL	MDMT = 13.3, criteria is: 22	na	6/30/2012	9/24/2012	86	93	Partial
	MDAT = 12.2, criteria is: 19	na	6/30/2012	9/24/2012	86	93	Partial
SS →	MDMT = 13.3, criteria is: 13	Fall	8/15/2012	9/24/2012	40	92	Partial
→	MDAT = 12.2, criteria is: 9	Fall	8/15/2012	9/24/2012	40	92	Partial
ID BT	MWMT = 12.8, criteria is: 13	Rearing	6/30/2012	8/31/2012	61	91	Partial
→	MDAT = 12.2, criteria is: 9	Rearing	6/30/2012	8/31/2012	61	91	Partial
EPA BT →	MDAT = 12.8, criteria is: 10	na	6/30/2012	9/24/2012	86	121	Partial

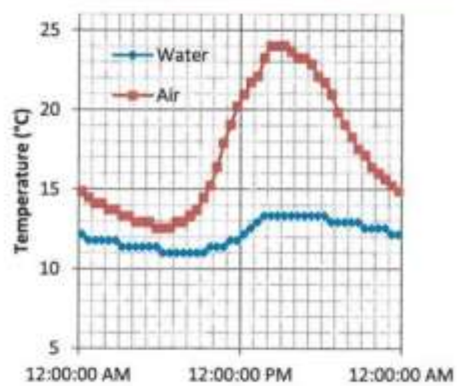
Other Evaluation

Air logger at station	yes	
Average amplitude of record	2.27	water (°C)

Warmest MDMT date: 8/20/2012

	water (°C)	air (°C)	ratio
Amplitude on warmest MWMT	2.3	11.5	0.20
	water (hr)	air (hr)	ratio
Duration of maximum temps	5.0	1.5	0.30
Duration of minimum temps	3.5	1.5	0.43

Water response time	2.5	(hours)
how many air degrees	2.3	(°C)
Temperature lag effect	5.75	(°C hours)



Warmest MDMT of record

Appendix E. Temperature Analysis Scatterplot, Data Variables, and Definitions

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Temperature Logger Data

		1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	1k	1l	1m	1n	1o	1p	1q	1r	1s	1t	1u	1v	1w	1x
Site_ID	Stream_Name	MDMT	MDAT	MDMT_Fall	MDMT_Spring	MDAT_Fall	MDAT_Spring	MWMT_Rearing	MWMT_Spawning	MDAT_Rearing	MDAT_Spawning	MDAT_SPA	Avg_amp	MDMT_amp_w	MDMT_amp_s	MDMT_amp_r	Dur_max_w	Dur_max_s	Dur_max_r	Dur_min_w	Dur_min_s	Dur_min_r	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Catchment Basin and Stream Data

		2a	2b	2c	2d	3a	3b	3c	3d	4a	4b	4c	4d
Site_ID	Stream_Name	insolation_catchment_annual	insolation_catchment_summer	insolation_stream_annual	insolation_stream_summer	stream_aspect_north	stream_aspect_east	stream_aspect_south	stream_aspect_west	stream_network_miles	catchment_basin_acres	mainstem_slope_percent	mean_basin_elevation_meters
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure E-1. List of comparison variables.

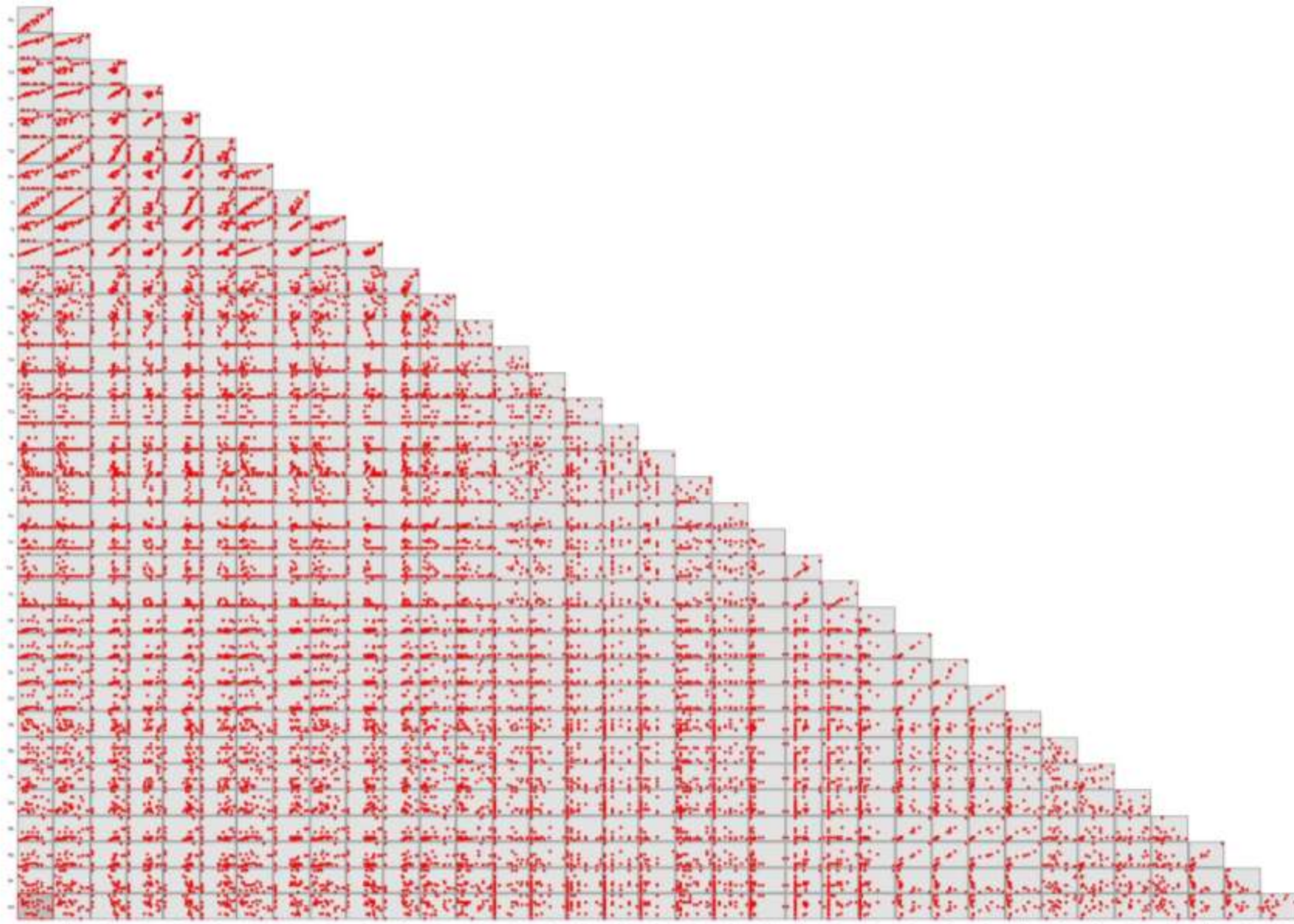

Figure E-2. Correlation scatter plot matrix.

Table E-1. Explanation of the coded titles for the data variables.

Code	Name	Explanation
1a	MDMT	Maximum daily maximum temperature (°C) for cold water aquatic life criteria of 22 °C
1b	MDAT	Maximum daily average temperature (°C) for cold water aquatic life criteria of 19 °C
1c	MDMT_Fall	Maximum daily maximum temperature (°C) during fall salmonid spawning
1d	MDMT_Spring	Maximum daily maximum temperature (°C) during spring salmonid rearing
1e	MDAT_Fall	Maximum daily average temperature (°C) during fall salmonid spawning
1f	MDAT_Spring	Maximum daily average temperature (°C) during spring salmonid rearing
1g	MWMT_Rearing	Maximum weekly maximum temperature during Bull Trout rearing period (°C)
1h	MWMT_Spawning	Maximum weekly maximum temperature during Bull Trout spawning period (°C)
1i	MDAT_Rearing	Maximum daily average temperature during Bull Trout rearing period (°C)
1j	MDAT_Spawning	Maximum daily average temperature during Bull Trout spawning period (°C)
1k	MDAT_EPA	Maximum daily average temperature during EPA Bull Trout period (°C)
1l	Avg_amp	Average amplitude (°C)—This is the average difference between daily high and daily low stream temperature for the period of record.
1m	MDMT_amp_w	MDMT amplitude water (°C)—This is the difference between the high and low stream temperature on the warmest MDMT date of the record.
1n	MDMT_amp_a	MDMT amplitude air (°C)—This is the difference between the high and low air temperature on the warmest MDMT date of the record.
1o	MDMT_amp_r	MDMT amplitude ratio (°C)—This is the ratio of the high stream/air temperature and low stream/air temperature on the warmest MDMT date of the record (MDMT_amp_w/MDMT_amp_a)
1p	Dur_max_w	Duration of maximum daily stream temperature on the warmest MDMT date of the record (hours)
1q	Dur_max_a	Duration of maximum daily air temperature on the warmest MDMT date of the record (hours)
1r	Dur_max_r	Ratio of the maximum daily stream/air temperature durations on the warmest MDMT date of the record (Dur_max_w/Dur_max_a)
1s	Dur_min_w	Duration of minimum daily stream temperature on the warmest MDMT date of the record (hours)
1t	Dur_min_a	Duration of minimum daily air temperature on the warmest MDMT date of the record (hours)
1u	Dur_min_r	Ratio of the minimum daily stream/air temperature durations on the warmest MDMT date of the record (Dur_min_w/Dur_min_a)
1v	wtime	Water response time (hours)—This is the difference in the amount of time it takes stream temperature to start to rise compared to air temperature. Calculated from the warmest MDMT date of the record.
1w	noairdegree	Number of Air Degrees (°C)—This is the number of air degrees that accumulated before stream temperature started to increase. Calculated from the warmest MDMT date of the record.
1x	lag_effect	Temperature lag effect (°C hours, wtime*noairdegree)—How stream temperature was affected by air temperature. A stream whose temperature is controlled by air temperature would have a smaller lag_effect value than one whose temperature is independent of air temperatures. Calculated from the warmest MDMT date of the record.
2a	Insolation_catchment_annual	Annual insolation in watt-hours per square meter for the catchment basin area (topographic only, excludes the influence of vegetation)

Code	Name	Explanation
2b	Insolation_catchment_summer	Insolation in watt-hours per square meter during June, July, August, and September for the catchment basin area (topographic only, excludes the influence of vegetation)
2c	Insolation_stream_annual	Annual insolation in watt-hours per square meter on the catchment basin stream network (topographic only, excludes the influence of vegetation)
2d	Insolation_stream_summer	Insolation in watt hours per square meter on the catchment basin stream network during June, July, August, and September (topographic only, excludes the influence of vegetation)
3a	stream_aspect_north	Percentage of the stream channel, within the catchment basin, that has a north-facing aspect
3b	stream_apsect_east	Percentage of the stream channel, within the catchment basin, that has an east-facing aspect
3c	stream_aspect_south	Percentage of the stream channel, within the catchment basin, that has a south-facing aspect
3d	stream_aspect_west	Percentage of the stream channel, within the catchment basin, that has a west-facing aspect
4a	stream_network_miles	Total miles of perennial streams within the catchment basin
4b	catchment_basin_acres	The size of the catchment basin (acres)
4c	mainstem_slope_percent	The elevation difference of the main stem divided by the main stem stream length and multiplied by 100%
4d	mean_basin_elevation_meters	Mean elevation (meters) for the catchment basin

Appendix F. Distribution List

[To be added following the public comment period.]

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Appendix G. Public Comments

[To be added following the public comment period.]

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