Lochsa River Subbasin Temperature Total Maximum Daily Loads:

Addendum to the Lochsa River Subbasin Assessment

State of Idaho
Department of Environmental Quality

April 2012
Revised October 2012

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Lewiston Regional Office
Department of Environmental Quality

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Acknowledgments

The Idaho Department of Environmental Quality extends our sincere gratitude to the Clearwater Basin Advisory Group. They have endured years of discussion while water temperature concerns in the Lochsa River watershed were considered.

We also would like to acknowledge Mr. Mark Shumar of DEQ's Technical Services Office for all his work in the completion of this document.

The result is a water quality improvement plan that allows for a focused and achievable cooperative implementation approach to meeting the goals and requirements of the Idaho State Water Quality Standards and the Federal Clean Water Act.

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Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
AU	assessment unit
BMP	best management practice
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CGP	Construction General Permit
CNF	Clearwater National Forest
CWA	Clean Water Act
DEQ	Department of Environmental Quality
EPA	United States Environmental Protection Agency
IDAPA	Refers to citations of Idaho administrative rules
kWh	kilowatt-hour
LA	load allocation
LC	load capacity
m	meter
mi	mile
MOS	margin of safety
NB	natural background
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
PNV	potential natural vegetation
SWPPP	Stormwater Pollution Prevention Plan
TMDL	total maximum daily load
US	United States
U.S.C.	United States Code
WLA	wasteload allocation

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Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently this list must be published every two years and is included as the list of Category 5 waters in the 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 water bodies in twenty (20) assessment units (AUs) of the Lochsa River subbasin that have been placed on Idaho's 2010 §303(d) list. Several unlisted but impaired waters also were evaluated and received temperature TMDLs. This document only addresses the temperature TMDLs. For more information about these watersheds and the subbasin as a whole, see the *Lochsa River Subbasin Assessment* (DEQ 1999).

This TMDL analysis has been developed to comply with Idaho's TMDL requirements. The TMDL analysis and quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards.

Subbasin at a Glance

The Lochsa River subbasin (hydrologic unit code 17060303) is located in the northern portion of Idaho County east of Lewiston, Idaho, and west of Missoula, Montana. The Lochsa River, along with the Selway River, forms the headwaters of the Middle Fork Clearwater River. Twenty AUs are included on the Idaho 2010 §303(d) list for temperature pollution: the Lochsa River (6 AUs), lower tributaries to the Lochsa River (AU# ID17060303CL001_02), Boulder Creek (AU# ID17060303CL010_02 and 04), Storm Creek (AU# ID17060303CL032_03), Fish Creek (AU# ID17060303CL052_02, 03, and 04; ID17060303CL057_02 and 03), Deadman Creek (AU# ID17060303CL061_02), Canyon Creek (AU# ID17060303CL062_03), Pete King Creek (AU# ID17060303CL063_02 and 03), and Walde Creek (AU# ID17060303CL064_02). See Table B.

The Idaho Department of Environmental Quality (DEQ) and US Environmental Protection Agency (EPA) performed a natural conditions evaluation of 6th-field watersheds in the Lochsa River subbasin. This evaluation looked at a number of disturbance variables including road density, stream crossings, and streamside harvest miles. Of these watersheds, 14 failed the natural conditions evaluation because of the extent of harvest and road activities within them. Of the 20 AUs listed for temperature as described above, it was determined that Boulder Creek (2 AUs), Storm Creek (1 AU), and Fish Creek (5 AUs) were not among the 14 disturbed watersheds. No temperature TMDLs were completed for these 8 AUs. However, 6 listed AUs (lower Lochsa River tributaries, Deadman Creek, Canyon Creek, Pete King Creek, and Walde Creek) were among the 14 disturbed watersheds. DEQ has included temperature TMDLs for an

additional 31 AUs in the remaining portions of the 14 disturbed watersheds as potential sources of heat to the Lochsa River. The resulting 37 tributary AUs with temperature TMDLs included in this document are presented in Table A and Figure A. The temperature TMDLs for the 6 AUs representing the Lochsa River itself will be met through temperature reductions accrued through achieving potential natural vegetation (PNV) shade in the TMDLs for the 37 tributary AUs. In addition, the U.S. Forest Service Northern Region along with the Clearwater-Nez Perce National Forest have implemented necessary and reasonable best management practices throughout the 1968 Wild and Scenic Rivers Act designated Lochsa River corridor through the use of scenic easements and the implementation of the Wild and Scenic River Management Plan for the Middle Clearwater River, which includes the Lochsa River. The tributaries represent the primary source of the anthropogenic heat load to the river.

Table A. Tributary watersheds for which temperature TMDLs were developed.

Watershed	Assessment Units
Pete King Creek	**063_02, 063_03, 064_02**
Canyon Creek	062_02, **062_03**
Deadman Creek	059_02, 059_03, 060_02, **061_02**, 060_03
Lower Small Tributaries	**001_02**
Post Office Creek	048_02, 048_03
Squaw Creek	045_02, 045_03, 046_02, 047_02
Badger/Wendover Creeks	044_02, 043_02
Papoose Creek	041_02, 041_03, 042_02
Walton/Cliff Creeks	023_02, 022_02, 020_02a
Crooked Fork	034_05, 038_04, 034_02, 038_02
Colt Killed Creek (White Sand)	024_02, 024_04, 033_02
Brushy Fork	035_02, 035_03, 035_04
Upper Brushy Fork	037_02
Spruce Creek	036_02

Note: AUs in **bold** font are §303(d) listed as of 2010 (DEQ 2011).

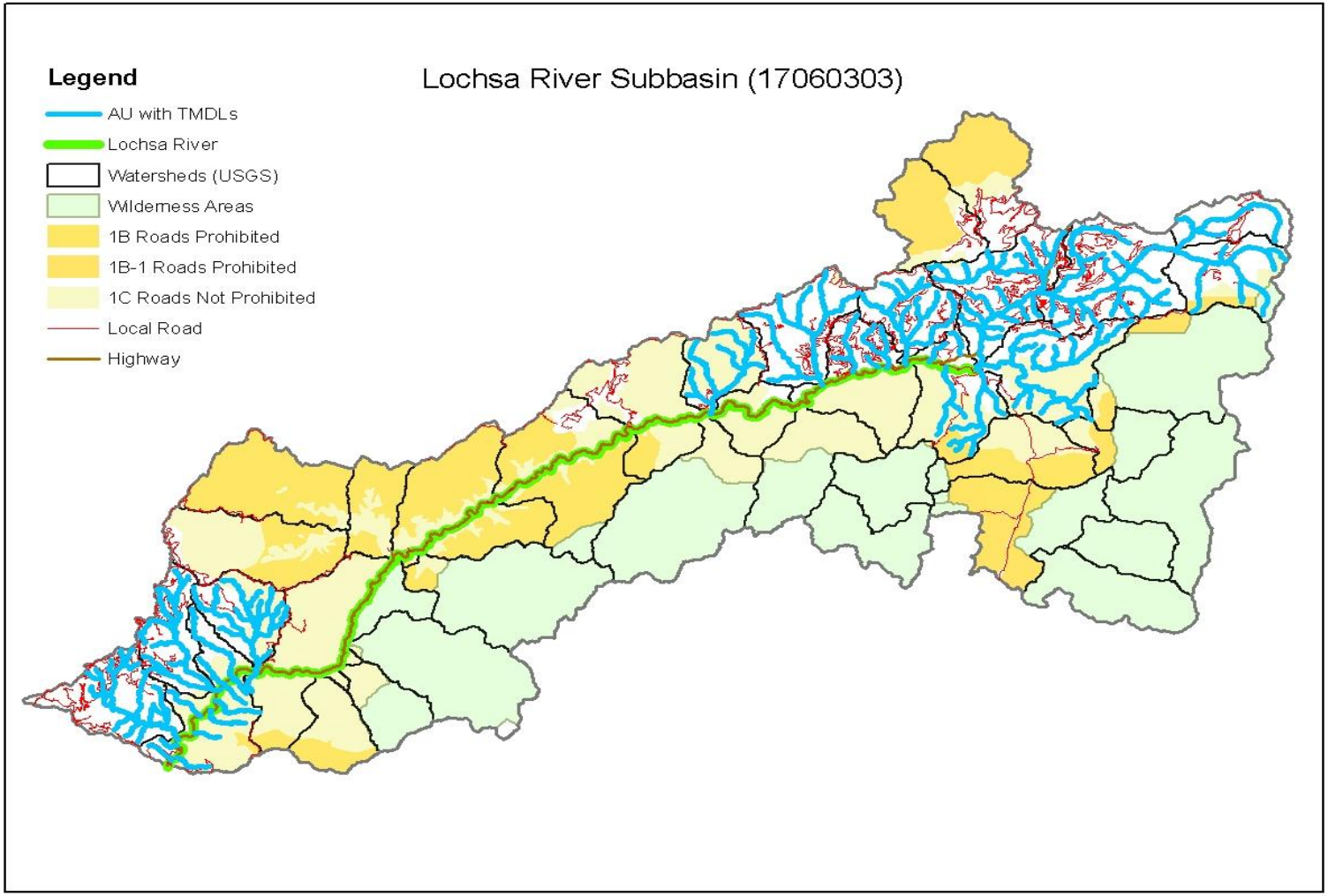

Figure A. Subbasin at a glance.

Key Findings

The 2010 §303(d) list of impaired waters includes 20 AUs in the Lochsa River subbasin listed for reasons associated with temperature criteria violations (Table B); 8 of those AUs were determined to be unimpacted because of low road/harvest densities or roadless/wilderness area designations (DEQ 2011). An additional 6 AUs represent the Lochsa River itself, which Idaho DEQ considers to be at natural shading levels (Wild and Scenic Rivers Management, Appendix A; HDR 2002; DEQ 1999). Excess solar load to the Lochsa River from the lack of shade was determined to result from inputs from 37 tributary AUs (6 of which were §303(d) listed for temperature) in the subbasin (Table A).

Effective shade targets were established for streams in the 37 tributary 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 and partially field verified with Solar Pathfinder data.

Some watersheds, especially in the Brushy Fork portion of the subbasin, lack shade and have relatively large excess loads. There are many more streams in the analysis that either meet target shade levels or are within the same 10% shade class as the PNV target. This analysis shows that the majority of watersheds outside of roadless areas have only been slightly affected by land-clearing activities near riparian areas.

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 revegetation efforts.

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

Water Body Segment/ Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Lower Lochsa River tributaries ID17060303CL001_02	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade
Lochsa River ID17060303CL001_05, ID17060303CL003_05, ID17060303CL008_05, ID17060303CL009_05, ID17060303CL013_05, ID17060303CL020_05	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade in tributary watersheds
Boulder Creek ID17060303CL010_02, ID17060303CL010_04	Temperature	No	Delist	Undisturbed watershed
Storm Creek ID17060303CL032_03	Temperature	No	Delist	Undisturbed watershed
Fish Creek ID17060303CL052_02, ID17060303CL052_03, ID17060303CL052_04, ID17060303CL057_02, ID17060303CL057_03	Temperature	No	Delist	Undisturbed watershed
Deadman Creek ID17060303CL061_02	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade
Canyon Creek ID17060303CL062_03	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade
Pete King Creek ID17060303CL063_02, ID17060303CL063_03	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade
Walde Creek ID17060303CL064_02	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade

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Introduction

This total maximum daily load (TMDL) is an addendum to the *Lochsa River Subbasin Assessment* (DEQ 1999). Please refer to the original subbasin assessment for detailed information about subbasin characteristics, water quality concerns and status, and water quality data summaries and conclusions (DEQ 1999).

This document addresses water bodies in 37 assessment units (AUs) of the Lochsa River subbasin, 20 of which have been placed on Idaho's current §303(d) list (i.e., the 2010 Integrated Report [DEQ 2011]) or are unlisted but impaired waters needing a temperature TMDL. The 2010 Integrated Report listed 20 AUs for temperature impairments in the Lochsa River subbasin. However, DEQ determined that 8 of these AUs were in undisturbed watersheds and should be delisted. Effective shade targets were established for 37 tributary AUs based on the concept of maximum shading under potential natural vegetation (PNV) resulting in natural background temperatures.

1. Subbasin Assessment—Watershed Characterization

According to the 1999 subbasin assessment, the Lochsa River valley has several peculiar geomorphological characteristics (DEQ 1999). Terraces are scarce and inconspicuous. Long river reaches are almost continuous rapids rather than the alternating pools and rapids common to most smaller rivers. Geomorphologically, the Lochsa is primarily (below the confluence of Colt-Killed and Crooked Fork) a dissected upland in which mid-slopes are typically convex rather than concave. This is also in an area where rain-on-snow events are relatively common.

The river topography ranges from elevations of 8,600 feet at the Bitterroot Divide to about 1,400 feet at the Lochsa River mouth. Elevations above 4,000 feet are dominated by snow during winter. Spring runoff generally peaks in late May and ambient air temperatures are highest (exceeding 90 °F) in mid-July through August. In late summer it is not unusual for Lowell, near the mouth of the Lochsa, to report some of the hottest temperature in Idaho. Hot summer temperatures are a major factor influencing stream temperature.

2. Water Quality Concerns and Status

In Idaho's 2010 §303(d) list, 20 AUs covering 9 named river/stream reaches were deemed to be impaired by excess temperature (Table 1). Many of these stream reaches were added by EPA to Idaho's 1998 §303(d) list in 2001 based on one-time temperature readings, despite residing in Wilderness or roadless areas.

Table 1. 2010 Integrated Report §303(d)-listed streams (Category 5).

Water Body	Assessment Unit	Pollutant
Lower Lochsa River tributaries	ID17060303CL001_02	Temperature
Lochsa River	ID17060303CL001_05 ID17060303CL003_05 ID17060303CL008_05 ID17060303CL009_05 ID17060303CL013_05 ID17060303CL020_05	Temperature
Boulder Creek	ID17060303CL010_02 ID17060303CL010_04	Temperature
Storm Creek	ID17060303CL032_03	Temperature
Fish Creek	ID17060303CL052_02 ID17060303CL052_03 ID17060303CL052_04 ID17060303CL057_02 ID17060303CL057_03	Temperature
Deadman Creek	ID17060303CL061_02	Temperature
Canyon Creek	ID17060303CL062_03	Temperature
Pete King Creek	ID17060303CL063_02 ID17060303CL063_03	Temperature
Walde Creek	ID17060303CL064_02	Temperature

Only the main stem Lochsa River's 6 AUs are identified in the Idaho water quality standards as designated for salmonid spawning, cold water aquatic life, primary contact recreation, and drinking water supply. All other streams in the subbasin are presumed to support cold water aquatic life and primary or secondary contact recreation. Salmonid spawning, where found to be an existing use, is also protected.

2.1 Beneficial Uses

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.

Existing Uses

Existing uses under the Clean Water Act (CWA) are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards" (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 section 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 supported salmonid spawning since Nov. 28, 1975 but does not now due to other factors, such as blockage of migration, channelization, sedimentation, or excess heat.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained" (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. Often multiple uses 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 section 100 and specifically listed by water body in tables in in sections 110–160.

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 will apply 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, because of the requirement to protect levels of water quality for existing uses, then the additional numeric criteria for salmonid spawning would also apply (e.g., intergravel dissolved oxygen, temperature). 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 Criteria to Support Beneficial Uses

The Idaho water quality standards (IDAPA 58.01.02.250) identify temperature criteria of 22 °C or less for daily maximum and 19 °C or less for daily average to protect cold water aquatic life. Similarly, the standards identify temperature criteria of 13 °C or less for daily maximum and 9 °C or less for daily average to protect salmonid spawning and incubation, during the time spawning and incubation is occurring.

Two caveats exist in the Idaho water quality standards relative to application of these temperature criteria. A 'hot weather' exemption states that exceeding the water temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the 90th percentile of the 7-day average daily maximum air temperature calculated in the yearly series over the historic record measured at the nearest weather reporting station. The second caveat is Idaho's natural conditions provision, which allows for natural background sources of a pollutant to exceed criteria without being considered a violation of water quality standards. DEQ intends to rely on aspects of the natural background provisions of the water quality standard as they relate to the main stem Lochsa River and its tributaries. DEQ will use its PNV methodology, an application of natural background as a water quality goal, to establish shade targets to improve stream temperatures in tributary streams previously impacted by timber harvest activities and thus reduce heat loading to the main stem as well.

In a December 27, 1997, U.S. Forest Service (USFS) letter to DEQ regarding the USFS analysis of water temperature conditions in the Lochsa River, the following was noted:

> In 1991, during the month of August, the mean maximum daily water temperature was 22.2 degrees Centigrade…The State water quality standard for cold water biota is 22 degrees Centigrade. The Lochsa River only slightly exceeded this standard. In a study by Nick Gearhardt, Forest Hydrologist, Nez Perce National Forest, he found that water temperature in the Lochsa River was slightly *lower* [emphasis added] than that of the Selway River. This was true despite the fact that almost the entire Selway River watershed is wilderness or roadless. Water temperature on these large rivers is almost entirely associated with direct solar radiation and ambient air temperature. Because management activities on large rivers have little control over these inputs we feel the water temperature in the mainstem river is approaching natural levels. We are aware of no recent temperature monitoring on the Lochsa River that would update these findings…The current water temperature on the Lochsa River is a natural [phenomenon] and is not associated with anthropogenic causes.

DEQ concurs with the conclusion of Nick Gearhardt and the USFS regarding the Lochsa River. A graphical representation of the Lochsa and Selway River temperature comparisons from 1999 through 2001 is presented in Figures 1–4. The dampened diurnal cycle in temperatures in the Selway in 2000 is a mystery but may be due to unwitting placement near a groundwater inflow.

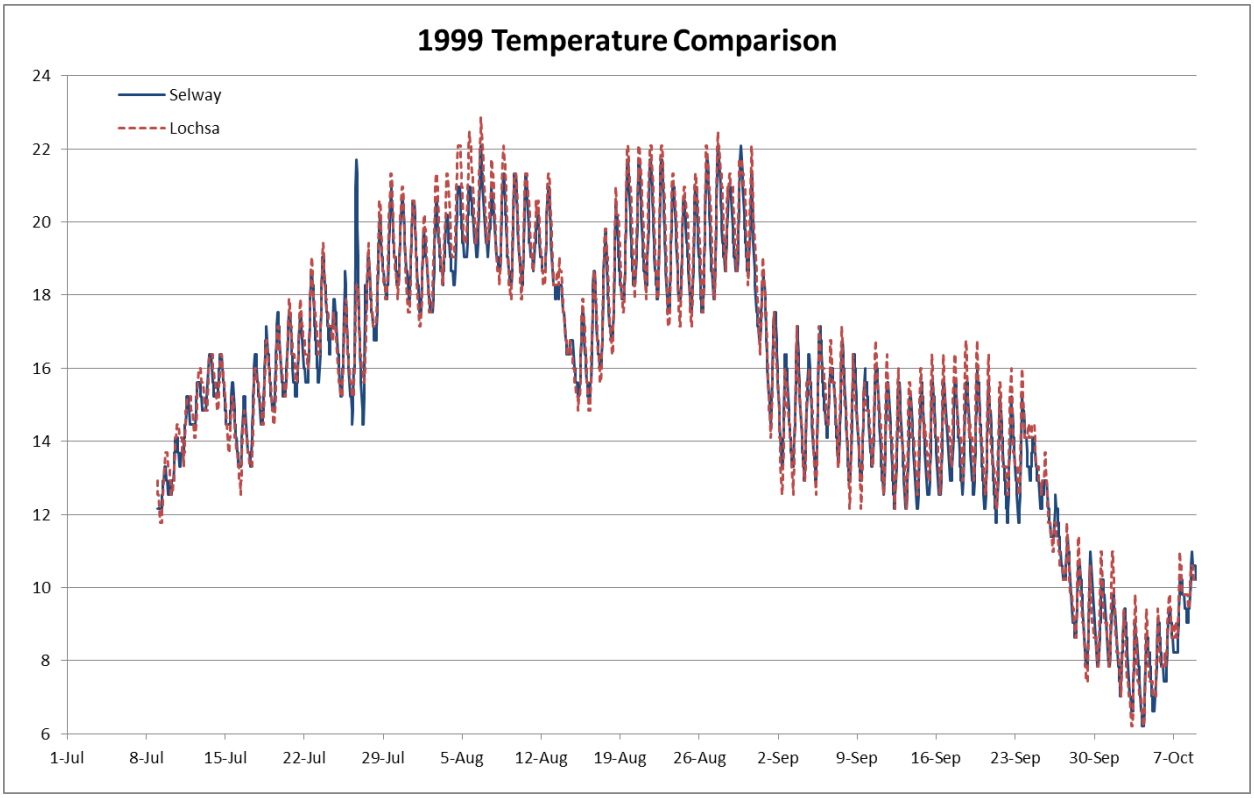

Figure 1. Selway and Lochsa River temperature comparison—1999.

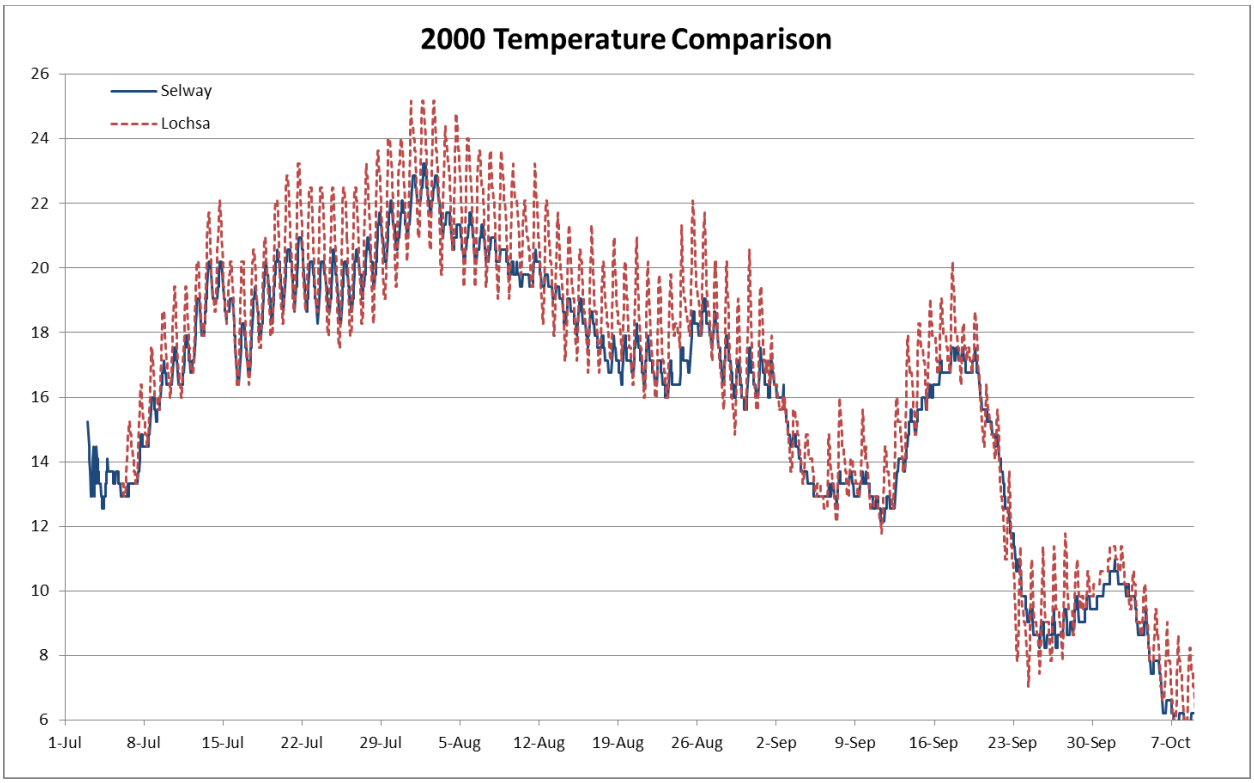

Figure 2. Selway and Lochsa River temperature comparison—2000.

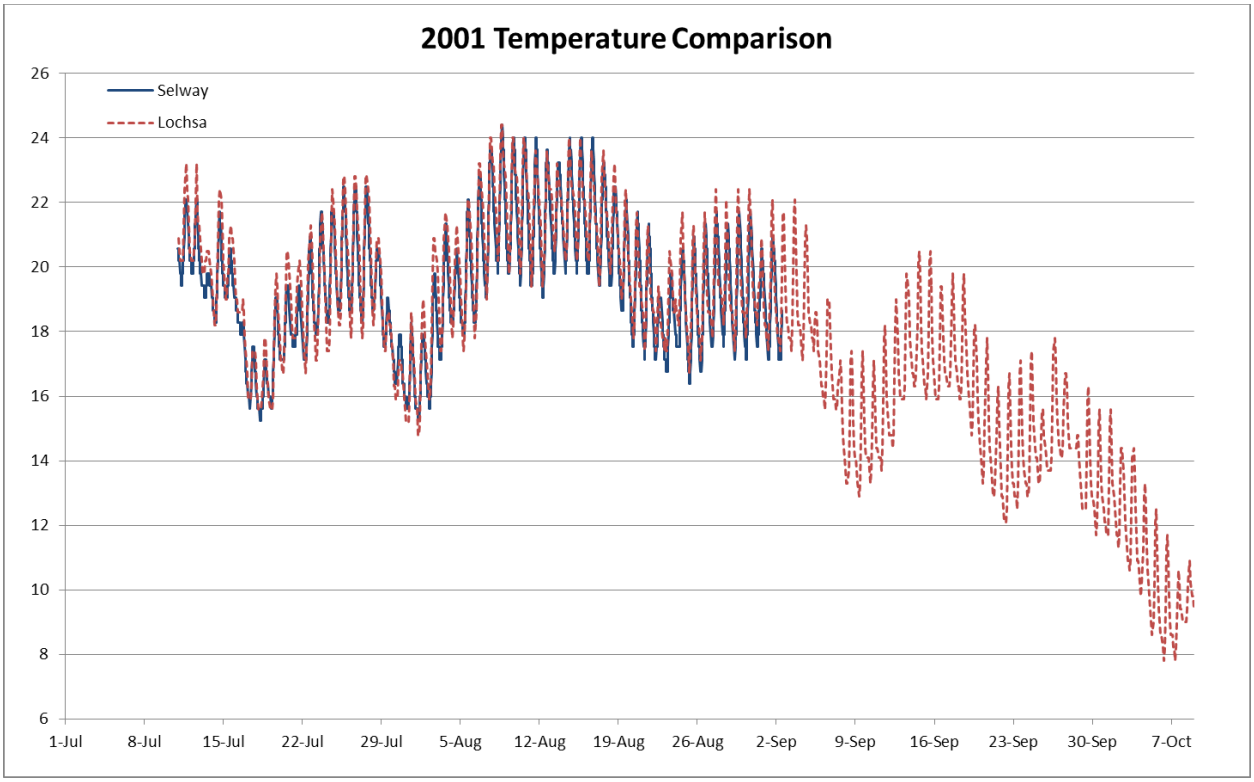

Figure 3. Selway and Lochsa River temperature comparison—2001.

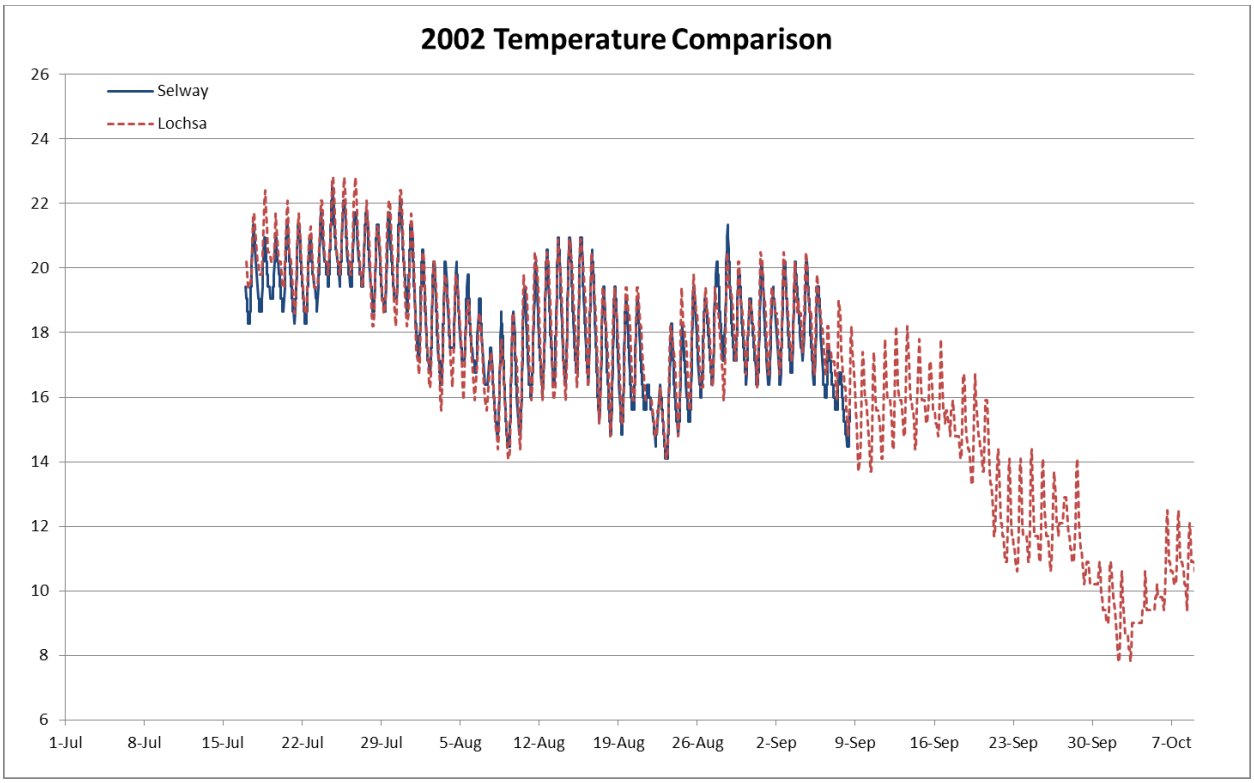

Figure 4. Selway and Lochsa River temperature comparison—2002.

3. Pollutant Source Inventory

The 1999 subbasin assessment discusses temperature in great length (DEQ 1999). Baseline data are presented in Table 6 of that document, covering the period 1956 to 1959, prior to construction of Highway 12, which runs adjacent to or near the river within the canyon corridor. The stream temperature is important because it presents information suggesting that natural stream temperatures exceeded criteria for cold water aquatic life and salmonid spawning prior to constructing and opening of Highway 12 in 1962 when there was very limited access to the basin. The water temperatures also appear to correlate with air temperature data from that time frame (DEQ 1999, 26–39).Minimal anthropogenic activities were occurring in the time of these temperature data, including minimal forest management activities. Similar temperature data from 1991 to 1997 for several tributaries is also presented (DEQ 1999, 31–38). Although temperatures are similarly exceeded, the streams support their beneficial uses that existed as of the November 1975 CWA effective date. "These data that span 40 years and include conditions before opening of all-weather access via Highway 12, strongly support the idea that summer temperatures above state water quality criteria are natural conditions in the subbasin and that aquatic life has successfully adapted to these conditions" (DEQ 1999, 29).

Additionally, modeling and analysis conducted by HDR for DEQ (July 2002) apportioned heat sources between anthropogenic (timber harvest, Highway 12) and natural and determined that much of the departure from potential was due to the natural disturbance of fire (HDR 2002). The influence of anthropogenic disturbances on average temperatures is most apparent in Deadman and Canyon Creeks and least apparent in the main stem Lochsa River.

Among the other conclusions of the HDR model simulations using SNTemp were the following:

Water temperatures in the Lochsa River exceed Idaho cold water aquatic life temperature criteria on a 90th percentile air temperature day.

Allowing passive restoration strategies to generate full potential canopy cover in riparian areas throughout the watershed would decrease average and maximum water temperatures but not enough to satisfy Idaho numeric cold water aquatic life criteria. The passive restoration strategy and modeled scenario presumes that Highway 12 will remain in place (the only realistic scenario).

To satisfy Idaho daily average temperature criteria on a 90th percentile air temperature day without adjusting canopy cover, inflow temperatures for all tributaries to the Lochsa River watershed would have to be reduced by more than 8 °C. This is unrealistic as the water temperatures at the mouths of many tributaries would be as low as 7.7 degrees C or lower in the months of July and August.

Air temperature, inflow temperature, and streamflow are the most important input variables that determine water temperature in the Lochsa River.

4. Past and Present Pollution Control Efforts and Implementation

Idaho's Forest Practices Act was codified in the mid-1970s to comply with Section 208 of the Clean Water Act. Since that time, the USFS has been obliterating roads along tributaries in the upper watershed that were built for the purposes of timber harvest (Bruce Sims, USFS Region 1 Hydrologist, personal communication, 2012). Road sediments from unpaved and unhardened roads are known to exacerbate heat loading to adjacent streams.

Timber harvest is no longer occurring on Forest Service managed lands in the subbasin along riparian areas (Jones 1999) as a result of implementing 200 to 300-foot buffer zones for protection of anadromous (PACFISH) and inland (INFISH) fish species. These measures are far more restrictive than those under Idaho's Forest Practices Act. Forest Service timber harvest adjacent to streams has not occurred in over two decades. Timber harvest by Plum Creek, a private timber company, has occurred on their "checkerboard" lands that were part of railroad sections given to the Burlington Northern Railroad by the U.S. federal government, primarily in the Brushy Fork drainage. It is DEQs understanding that Plum Creek's harvest was done under an approved Habitat Conservation Plan under the jurisdiction of the U.S. Fish and Wildlife Service.

The river corridor containing the six main stem AUs that constitute the Lochsa River are within the federally designated Wild and Scenic Rivers System. The Lochsa and Selway Rivers, which are considered part of the Middle Clearwater River, were amongst the original eight rivers designated in the act in 1968, 7 years prior to the enactment of the 1975 Clean Water Act amendments. As part of the management plan put in place in 1968 and continued as part of the most recently adopted 1987 forest plans for the Bitterroot, Clearwater, and Nez Perce National Forests, minimal vegetation disturbance is allowed (Heather Berg, Wild and Scenic Rivers Coordinator, Clearwater-Nez Perce National Forest, Personal Communication, 2012). The act

protects 0.25 miles on each side of the river from intrusions to the extent possible with exceptions made for public health and safety. An emphasis within the Wild and Scenic River Management Plan is on protection of fisheries and water quality in addition to the recreational and aesthetic values of a free-flowing river. Additionally, all private land within the designated Wild and Scenic River corridor are under scenic easements that prohibit vegetation/tree removal (except for safety hazards) and must maintain the integrity of the lands under easement consistent with the time of designation (1968) (Appendix A).

In addition to implementing the intent of the Wild and Scenic Rivers Act and its subsequent management plan, the USFS maintains working agreements with the Idaho Transportation Department (ITD) through memoranda of understanding. Vegetation removal is generally not allowed, though some brush removal for safety is allowed. When ITD and the USFS allowed turnouts along Highway 12 along the Lochsa River to be widened to accommodate the "megaloads" tar sands development equipment, trees were not allowed to be removed (Heather Berg, USFS, Personal Communication, 2012).

5. Total Maximum Daily Loads

A TMDL prescribes an upper limit (i.e., load capacity) on discharge of a pollutant from all sources so as 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 broken out on their own because they represent a part of the load not subject to control. Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (Water Quality Planning and Management, 40 CFR Part 130) require a margin of safety be a part of the TMDL.

Practically, the margin of safety and natural background are both reductions in the load capacity available for allocation to pollutant sources. This 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 the quantification of current pollutant loads by source. This step allows the specification of load reductions as percentages of current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. A load is fundamentally a quantity of a pollutant discharged over some period of time and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for "other appropriate measures" to be used when necessary. These "other measures" must still be quantifiable and relate to water quality standards, but they allow flexibility to deal with pollutant loads 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. For certain pollutants whose effects are long term, such as sediment and nutrients, the US Environmental Protection Agency (EPA) allows for seasonal or annual loads.

5.1 Instream Water Quality Targets

For the Lochsa River subbasin temperature TMDLs, we utilized a PNV approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) establishing 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 the natural level of shade and channel width become the target of the TMDL. 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 B for further discussion of water quality standards and background provisions.

The PNV approach is described below. Additionally, the procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in Shumar and de Varona (2009). For a more complete discussion of shade and its effects on stream water temperature, see *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and de Varona 2009).

Potential Natural Vegetation for Temperature TMDLs

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 one most likely to be controlled. 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 affects the density of riparian vegetation and water storage in the alluvial aquifer. Streamside 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.

Depending on how much vertical elevation surrounds the stream, vegetation further away from the riparian corridor can also provide shade. However, riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. 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 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.

PNV along a stream is that riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets. Vegetation can be removed by disturbance either naturally (e.g., wildfire, disease/old age, wind damage, 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. Anything less than PNV (with the exception of natural levels of disturbance and age distribution) results in the stream heating up from anthropogenically created additional solar inputs.

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

Existing shade was estimated for 37 assessment units (AUs) in the Lochsa River subbasin from visual interpretation of aerial photos taken in 2009. Some of these estimates were field verified by measuring shade with a Solar Pathfinder at systematically located points along the streams (see below for methodology). PNV targets were determined from an analysis of probable vegetation at the streams and comparing that to shade curves developed for similar vegetation communities. 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.

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, the Missoula, Montana, station was used. The difference between existing and potential solar load, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards (see Appendix B).

PNV shade and the associated target solar loads are assumed to be the natural condition; thus, stream temperatures under PNV conditions are assumed to be natural (so long as there are no point sources or any other anthropogenic sources of heat 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.[1]

Aerial Photo Interpretation

Estimates of shade based on plant type and density take into account natural breaks in vegetation density and are marked out as stream segments on a 1:100,000 or 1:250,000 hydrography. 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 stretch of stream was estimated somewhere between 50% and 59%, we assigned a 50% shade class to that section of stream. 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).

Pathfinder Methodology

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 reach, ten traces were taken at systematic 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 (orient to south and level) for taking traces. Systematic sampling was used because it is easiest to accomplish while still not biasing the sampling location. For each sampled reach, the sampler started at a unique location, such as 50 to 100 meters (m) from a bridge or fence line, and then proceeded upstream or downstream stopping to take additional traces at fixed intervals (e.g.,

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

every 50 m, every 50 paces, etc.). One can also 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. 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.

Stream Morphology

Measures of current bankfull width or near-stream disturbance zone width may not reflect widths that were present under PNV. As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallow. Shadows produced by vegetation cover 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.

This width factor (i.e., near-stream disturbance zone or bankfull width) may not be discernable from aerial photo interpretation. Accordingly, this parameter must be estimated from available information. DEQ used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bankfull width (Figure 5).

For each stream evaluated in the load analysis, natural bankfull width was estimated based on the drainage area of the Clearwater curve from Figure 5. The Clearwater curve was ultimately chosen because of its proximity to the Lochsa River watershed. Additionally, existing width data should be evaluated and compared to these curve estimates if such data are available. However, for the Lochsa River watershed, only a few Beneficial Use Reconnaissance Program (BURP) sites exist, and bankfull width data from those sites represent only spot data (three measured widths in a reach only several hundred meters long) that are not always representative of the stream as a whole. In general, we found BURP bankfull width data to agree with bankfull width estimates from the Clearwater basin curve and chose not to make natural widths any smaller than these Clearwater basin estimates. Tables containing natural bankfull width estimates for each stream in each subwatershed are presented in Appendix D (Table D-2). The load analysis tables discussed in section 5.3 and presented in Appendix E contain a natural stream width and an existing stream width for every stream segment in the analysis based on the bankfull width results presented in Table D-2.

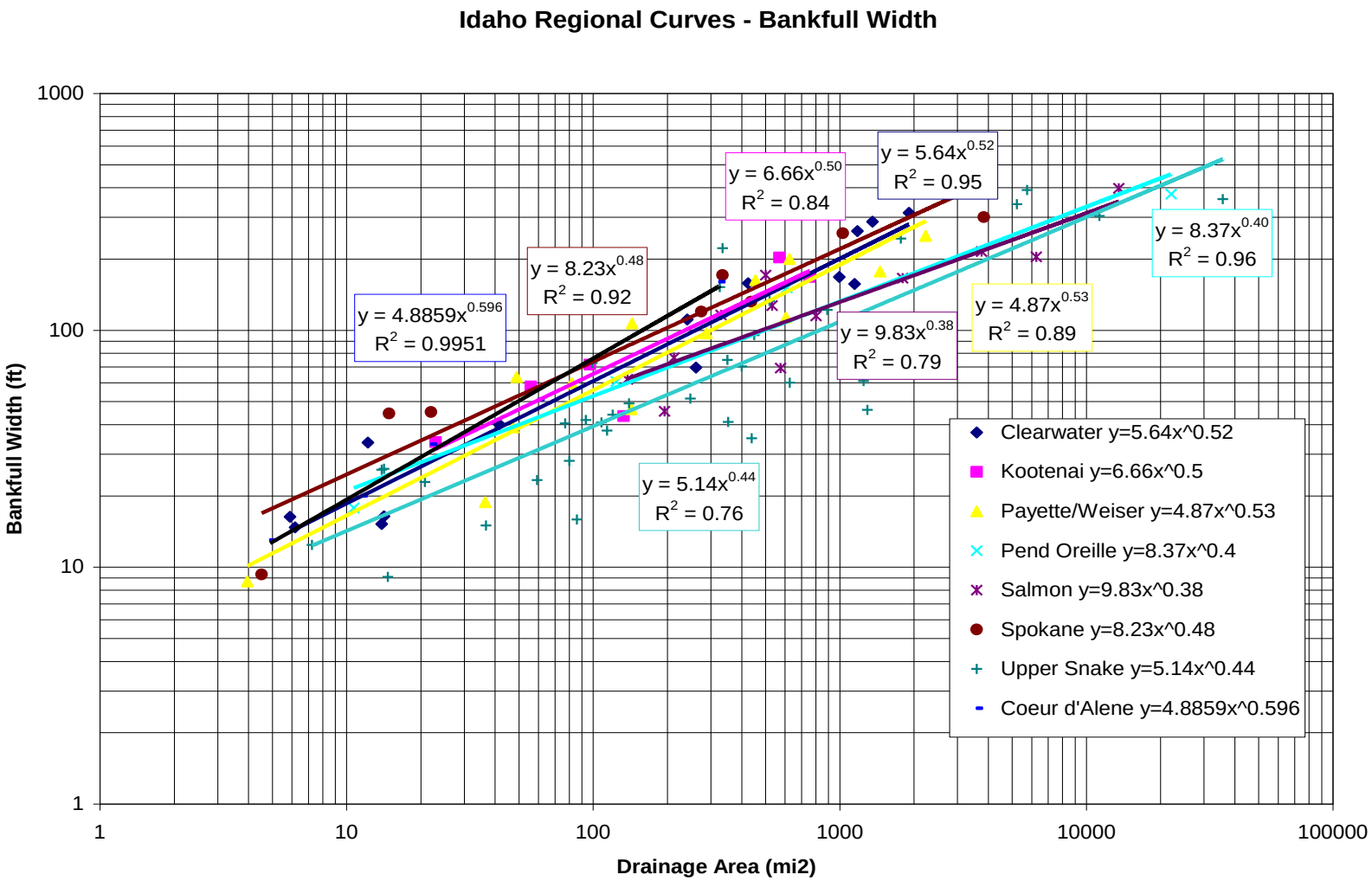

Figure 5. Bankfull width as a function of drainage area.

Design Conditions

The Lochsa River subbasin sits on the divide between the Idaho Batholith Level III Ecoregion and the Northern Rockies Level III Ecoregion to the north (McGrath et al. 2001). The northern portion of the Lochsa River subbasin is within the "Clearwater Mountains and Breaks" Level IV Ecoregion of the Northern Rockies Level III Ecoregion (McGrath et al. 2001). This region is exposed to substantial maritime influence resulting in moist coniferous forests that are transitional in species composition between northern Idaho Panhandle forests and the drier forests of the southern Idaho Batholith. The southern portion of the subbasin and the area around Brushy Fork and Spruce Creek are in the "Lochsa Uplands" Level IV Ecoregion—a moderately dissected landscape of granitic soils mantled with volcanic ash that supports grand fir, Douglas-fir, and western larch. Engelmann spruce and subalpine fir are common at high elevations, and western redcedar can be found on north-facing slopes and in canyons. The Lochsa River valley itself is within the "Lochsa–Selway–Clearwater Canyons" Level IV Ecoregion of the Idaho Batholith. With steeper canyon topography than nearby mountains, this ecoregion can be warmer and drier with increasing depth. The ecoregion is dominated by Douglas-fir, grand fir, western redcedar, western larch, and western white pine with ponderosa pine increasing on lower, drier sites.

The Clearwater National Forest (CNF) identifies three broad groups of forest types based on their land type association classification system:

- Breaklands—forests on steep slopes at lower elevations, with warmer temperature regimes
- Uplands—forests generally above the breaklands in elevation and with more rolling topography; cooler and more mesic than breaklands
- Subalpine—the setting above the uplands with respect to elevation, with mixed topography and generally colder temperatures

Shade curves (described below) used to develop targets for PNV temperature TMDLs in Idaho were developed by the Idaho Department of Environmental Quality (DEQ) and EPA from information about these landtype groups (see Shumar and de Varona 2009).

Target Selection

To determine PNV shade targets for the Lochsa River subbasin, effective shade curves from the CNF section of DEQ's PNV TMDL procedures manual (Shumar and de Varona 2009) were examined. These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. As a stream becomes wider, a given vegetation type loses its ability to shade wider and wider streams. For the Lochsa River subbasin, curves for the most similar vegetation type were selected for shade target determinations.

First, an overlay of CNF landtypes grouped as breaklands, uplands, and subalpine was placed over the stream being examined. Streams in the lower part of the subbasin (Pete King Creek to Deadman Creek) typically originated in upland or breakland landtypes. Streams in the northern subbasin (from Post Office Creek to Crooked Fork) tended to originate in subalpine forests then drain into breakland forests. Brushy Fork and Spruce Creek were almost completely dominated by subalpine forest landtypes.

As streams progress downstream, they would periodically leave the forest groups and enter a region where other nonforest landtypes occur. Visual observations of these regions revealed that stream valleys widened, alder communities tended to dominate the streamside vegetation, and the forest was further away from the stream. In some locations, especially in the upper subalpine zone—such as Packer Meadow on Pack Creek and Elk Meadows on Brushy Fork—large patches of grass meadow existed. Therefore, we developed new shade curves for this region that are based on the CNF upland landtype and the mountain alder (*Alnus incana*) nonforest community of southern Idaho or the CNF subalpine forest type and the graminoid nonforest community of southern Idaho (see Shumar and De Varona 2009 for descriptions of these plant communities).

We split the 41-m riparian buffer width in the model used to create shade curves (described in Shumar and De Varona 2009) such that the first five zones adjacent to the stream are based on the mountain alder community dimensions (55% canopy cover and 5.1 m weighted average height) or the graminoid community dimensions (100% canopy cover and 0.7 m height), and the four remaining zones furthest from the stream utilize the CNF uplands forest dimensions (81% canopy cover and 21 m weighted average height) or the CNF subalpine forest dimensions (78% canopy cover and 21 m height). The resulting shade curves were designated as the CNF Upland Forest – Alder Mixed and the CNF Subalpine Forest – Graminoid Meadow Mixed and can be seen in Appendix D (Figures D-1 and D-2). These shade curves are used for shade targets on those portions of streams in this TMDL where the valley widens and the forest no longer dominates the streamside vegetation.

Monitoring Points

The accuracy of the aerial photo interpretations was field verified with a Solar Pathfinder at 10 sites. Results showed that the original aerial photo interpretation was within 20%, or two shade classes (Table 2). The original aerial photo interpretation overestimated shade by an average of 5% ± 10.2 (mean ± 95% confidence interval) when all 10 sites were examined together. However, sites on Brushy Fork were consistently underestimated in the original interpretation. When examined separately, 4 sites in the Brushy Fork region (includes Spruce Creek) had an average difference of -13% ± 9.4, and the remaining 6 sites had an average difference of 17% ± 4.1. These data were used to calibrate the eye and aerial photo interpretation was repeated. The resulting existing shade values presented in this document represent those adjusted values.

In the future, effective shade monitoring can take place on any reach throughout the 37 AUs and be compared to estimates of existing shade seen in Appendix D (Figures D-4, D-7, and D-10) and described in the load analysis tables in Appendix E. Those areas with the largest disparity between existing shade estimates and target shade levels should be monitored with Solar Pathfinders to verify the existing shade levels and to determine progress towards meeting shade targets. It is important to note that many existing shade estimates have not been field verified and may require adjustment during the implementation process. Stream segment length for each estimate of existing shade varies depending on 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 towards target levels. Ten equally spaced Solar Pathfinder measurements averaged together should suffice to determine new future shade levels within each segment.

Table 2. Solar Pathfinder results from ten sites in the Lochsa River subbasin.

aerial class (%)	pathfinder actual (%)	pathfinder class (%)	delta (%)		Sites
30	32.1	30	0		spruce
20	42.5	40	-20		brushy 1
0	22.7	20	-20		brushy 2
30	48.4	40	-10		brushy 3
50	38	30	20		waw 1
70	65.3	60	10		waw 2
80	69.2	60	20		post office
90	87.7	80	10		apgar
90	76.2	70	20		canyon
80	61.1	60	20		pete king
			5	average	
			16.50	std dev	
			10.23	95%CI	
50	38	30	20		waw 1
70	65.3	60	10		waw 2
80	69.2	60	20		post office
90	87.7	80	10		apgar
90	76.2	70	20		canyon
80	61.1	60	20		pete king
			17	average	
			5.16	std dev	
			4.13	95%CI	
30	32.1	30	0		spruce
20	42.5	40	-20		brushy 1
0	22.7	20	-20		brushy 2
30	48.4	40	-10		brushy 3
			-13	average	
			9.57	std dev	
			9.38	95%CI	

5.2 Load Capacity

The load capacity for a stream under PNV is essentially the solar load allowed under the shade targets specified for the reaches 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 solar radiation 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), then 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 Missoula, Montana. The solar loads used in this TMDL are spring/summer averages (i.e., an average load for the 6-month period from April through September). These months coincide with the time of year when stream temperatures are increasing, deciduous vegetation is in leaf, and fall spawning is occurring. The load analysis tables in Appendix E show the PNV shade targets (identified as target or potential shade) and their corresponding potential summer load (in kilowatt-hours per

square meter per day [kWh/m^2/day] and kilowatt-hours/day [kWh/day]) that serve as the load capacities for the streams. Figures D-3, D-6, and D-9 in Appendix D also show target shade. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table.

The effective shade calculations are based on a 6-month period from April through September. This period coincides with the critical time period when temperatures affect beneficial uses, such as spring and fall salmonid spawning, and when 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. Thus, solar loading in these streams is evaluated from spring (April) to early fall (September).

The AU with the largest potential or target load was the 4th-order segment of Colt Killed Creek (AU# ID17060303CL024_04) with slightly greater than 2 million kWh/day (Table E-6 in Appendix E). The smallest target load was in the Cold Storage Creek AU (AU# ID17060303CL020_02a) with 3,111 kWh/day (Table E-2 in Appendix E).

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" (Water quality planning and management, 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 land area. When 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. 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 load analysis tables in Appendix E and Figures D-4, D-7, and D-10 in Appendix D. Like load capacities (potential loads), existing loads in the load analysis tables are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day).

Like target loads, existing loads in kWh/day are summed for the entire stream or portion of stream examined in a single load analysis table. The difference between potential load and existing load is also summed for the entire table. Should existing load exceed potential load, this difference becomes the excess load (i.e., lack of shade) to be discussed next in the load allocation section.

The AU with the largest existing load was the 4th-order segment of Colt Killed Creek (AU# ID17060303CL024_04) with slightly less than 2.2 million kWh/day (Table E-6 in Appendix E). The smallest existing load was in the Walde Creek AU (AU# ID17060303CL063_03) with 4,620 kWh/day (Table E-32 in Appendix E).

5.4 Load Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve natural background conditions. However, in order 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 reach specific and are dependent upon the target load for a given reach. Load analysis tables in Appendix E show the target or potential shade, which is converted to a potential summer load by multiplying the inverse fraction (1 minus shade fraction) by the average loading measured by a flat-plate collector from April through September. The result is the load capacity of the stream, which 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 3 shows the total existing, total target, and total excess heat loads; the proportion of existing load that is in excess; and average lack of shade for each watershed 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. Table 3 lists the tributaries in order of their excess loads, from highest to lowest. Therefore, large tributaries tend to be listed first and small tributaries last. AUs or watersheds with relatively large excess loads, where the proportion of existing load in excess is 20% or greater, have been color coded as red in Table 3. Those AUs that have a lower proportion in excess are shaded green in Table 3.

Brushy Fork Creek and its tributaries and Crooked Fork and its tributaries are some of the larger water bodies in the analysis and are listed first in Table 3. These water bodies tend to have high excess loads in proportion to existing loads. Other watersheds with high excess loads include the lower Lochsa River tributaries, lower Pete King Creek tributaries, Walde Creek and its tributaries, Parachute Creek, and Cold Storage Creek. These small watersheds that have proportionately high excess loads are not necessarily in bad condition (see Figures D-5, D-8, and D-11 in Appendix D). Much of that excess load results from the slight difference between existing shade, reported as a 10% class interval (e.g., 90%), and target shade, assigned as a specific integer (e.g., 98%). Conversely, some other large water bodies (e.g., Colt Killed Creek, Walton Creek and tributaries, Canyon Creek and tributaries, and lower Pete King Creek) have low excess loads relative to their existing loads despite some areas with a lack of shade greater than 10%. In fact, lower Pete King Creek is one of 5 AUs (along with portions of Deadman Creek, Canyon Creek, Badger Creek, and Cliff Creek) that have no excess load due to heavily vegetated reaches. There are a number of small watersheds that have proportionately low excess loads (less than 10% of existing loads), including Waw'aalamnime Creek and its East Fork, Post Office Creek, East Fork Deadman Creek, Walton Creek, and Beaver Creek.

Although the preceding analysis focuses on total heat loads for streams in this TMDL, it is important to note that differences between existing and target shade, as depicted in the lack-of-shade figures (Figures D-5, D-8, and D-11 in Appendix D), are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize

implementation efforts. Each load analysis table contains a column that lists the lack of shade on the stream. This value is derived from subtracting the target shade from the existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst condition. The average lack of shade listed at the bottom of the column in each load analysis table is also listed in Table 3 and represents a general level of condition for comparison among streams.

The shade deficiencies that result in excess loads are visible in the lack-of-shade figures in Appendix D (Figures D-5, D-8, and D-11). Figure D-5 shows several locations in the Brushy Fork watersheds where shade is lacking by more than 30%. Compared to other watersheds, these watersheds have more stream segments that lack shade by anywhere from 10% to 29%. Figure D-8 shows that upper Papoose Creek has a few locations that also lack considerable shade. Watersheds in the lower portion of the subbasin (Figure D-11) are in relatively good condition with regard to lack of shade.

Table 3. Total solar loads, excess load, and average lack of shade for all waters.

Water Body and Assessment Unit	Total Existing Load (kWh/day)	Total Target Load (kWh/day)	Excess Load (kWh/day and %)	Average Lack of Shade (%)
Brushy Fork Creek (ID17060303CL035_03)	426,608	237,108	189,499 (44%)	-21
Brushy Fork Creek (ID17060303CL035_04)	456,115	313,293	142,822 (31%)	-27
Crooked Fork Creek (ID17060303CL034_05)	1,284,850	1,150,211	134,639 (10%)	-10
Colt Killed Creek (ID17060303CL024_04)	2,171,868	2,037,959	133,909 (6%)	-7
Crooked Fork Creek (ID17060303CL038_04)	646,217	551,912	94,305 (15%)	-14
Brushy Fork tributaries (ID17060303CL035_02)	235,934	144,747	91,186 (39%)	-9
Brushy Fork and tributaries (ID17060303CL037_02)	221,755	155,780	65,974 (30%)	-18
Spruce Creek and tributaries (ID17060303CL036_02)	439,670	374,493	65,177 (15%)	-11
Crooked Fork tributaries (ID17060303CL038_02)	51,761	21,634	30,126 (58%)	-12
Papoose Creek and tributaries (ID17060303CL041_02 & _03)	163,812	134,692	29,120 (18%)	-11
Crooked Fork tributaries (ID17060303CL034_02)	24,822	10,189	14,633 (59%)	-9
Canyon Creek and tributaries (ID17060303CL062_02)	167,233	153,915	13,318 (8%)	-9
Lower Lochsa River tributaries (ID17060303CL001_02)[a]	55,561	42,343	13,218 (24%)	-7
Colt Killed tributaries (ID17060303CL024_02)	88,776	75,760	13,015 (15%)	-7
Waw'aalamnime and East Fork (ID17060303CL045_02 & _03)	154,952	144,324	10,627 (7%)	-8
Walton Creek and tributaries (ID17060303CL023_02)	1,390,059	1,379,546	10,513 (0.8%)	-8
Lower Pete King Creek tributaries (ID17060303CL063_02)[a]	21,120	10,680	10,440 (49%)	-9

Water Body and Assessment Unit	Total Existing Load (kWh/day)	Total Target Load (kWh/day)	Excess Load (kWh/day and %)	Average Lack of Shade (%)
Doe Creek and tributary (ID17060303CL047_02)	58,867	48,740	10,127 (17%)	-7
Walde Creek and tributaries (ID17060303CL064_02)[a]	25,669	16,707	8,961 (35%)	-8
Post Office Creek and tributaries (ID17060303CL048_02 & _03)	118,008	110,355	7,653 (6%)	-7
Parachute Creek (ID17060303CL042_02)	21,571	14,484	7,087 (33%)	-8
West Fork Waw'aalamnime Creek (ID17060303CL046_02)	26,494	20,378	6,116 (23%)	-6
Deadman Creek and tributaries (ID17060303CL061_02)[a]	32,923	28,767	4,156 (13%)	-8
East Fork Deadman Creek and tributaries (ID17060303CL060_02 & _03)	52,844	48,698	4,146 (8%)	-6
Beaver Creek and tributaries (ID17060303CL033_02)	66,479	62,974	3,504 (5%)	-7
Wendover Creek and tributary (ID17060303CL043_02)	12,502	9,611	2,890 (23%)	-5
Cold Storage Creek and others (ID17060303CL020_02a)	5,748	3,111	2,636 (46%)	-6
Deadman Creek and tributaries (ID17060303CL059_02 & _03)	58,322	62,740	0 (0%)	-1
Badger Creek and tributary (ID17060303CL044_02)	19,410	21,072	0 (0%)	-7
Cliff Creek and tributary (ID17060303CL022_02)	14,152	15,880	0 (0%)	-5
Lower Pete King Creek (ID17060303CL063_03)[a]	209,605	253,345	0 (0%)	-2
Canyon Creek (ID17060303CL062_03)[a]	16,764	20,196	0 (0%)	0

[a] §303(d)-listed assessment unit (DEQ 2011)

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

A certain amount of excess load is potentially created by the existing shade/target shade difference inherent in the loading analysis. Because existing shade is reported as a 10% class level and target shade is a unique integer between 0 and 100, there is usually a difference between the two. For example, say a particular stretch of stream has a target shade of 86% based on its vegetation type and natural bankfull width. If existing shade on that stretch of stream were at target level, it would be recorded as 80% existing shade in the loading analysis because it falls

into the 80% shade class. This automatic difference of 6% could be attributed to the margin of safety.

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, then background provisions in Idaho water quality standards addressing such discharges (IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.01) should be involved (see Appendix B).

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.

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 was chosen because it represents the time 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.

Construction Stormwater and TMDL Wasteload Allocations

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. In the past, stormwater was treated as a nonpoint source of pollutants. However, because stormwater can be managed on-site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires an NPDES permit.

The Construction General Permit

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 Construction General Permit (CGP) from EPA after developing a site-specific Stormwater Pollution Prevention Plan (SWPPP).

Stormwater Pollution Prevention Plan

To obtain the CGP, operators must develop a site-specific SWPPP. Operators must document the erosion, sediment, and pollution controls they intend to use; inspect the controls periodically; and maintain best management practices (BMPs) throughout the life of the project.

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. TMDLs developed in the past that did not have a wasteload allocation for construction stormwater activities or new TMDLs will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement appropriate BMPs.

Typically there are specific requirements operators must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post construction stormwater management. Sediment is usually the main pollutant of concern in stormwater from construction sites. The application of specific BMPs from Idaho's *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the CGP, unless local ordinances have more stringent and site-specific standards that are applicable (DEQ 2005).

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 (Appendix E). These tables need to be updated, first to field verify the existing shade levels that have not yet been field verified, and second to monitor progress towards 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 towards achieving desired reductions in solar loads.

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.

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 heat loading. Because implementation is dependent on mature riparian communities to substantially improve stream temperatures, DEQ believes 10–20 years may be a reasonable amount time for achieving water quality standards.

Approach

Water bodies included in this TMDL are within the CNF forest reserves. Implementation of this TMDL will occur through actions required by the CNF's strategic forest plan (i.e., land and

resource management plan) and the Inland Native Fish Strategy included in the plan. This plan, including the Inland Native Fish Strategy, provides protection for resident native fish populations and their habitat by using and applying BMPs for riparian management.

Riparian area management practices will provide a mature canopy cover to address excess solar heat loading to water bodies and are considered to be equivalent to, or compliant with, the TMDL's percent riparian canopy closure surrogate target.

Designated Management Agencies and Responsible Parties

DEQ recognizes the authorities and responsibilities of the CNF and will enlist its involvement and authorities for protecting water quality through implementation of IDAPA 58.01.02 and Clean Water Act Section 401.

Monitoring Strategy

Idaho Code § 39-3611 requires DEQ to review and evaluate each Idaho TMDL, supporting assessment, implementation plan, and all available data periodically, at intervals no greater than 5 years. Such reviews are to be conducted using the BURP protocol and the *Water Body Assessment Guidance* methodology to determine beneficial use attainability and status and whether state water quality standards are being achieved (Grafe et al. 2002).

5.6 Public Participation

DEQ anticipates the implementation of this TMDL with the assistance of the CNF and the Clearwater Basin Advisory Group. Since the water bodies included in this TMDL are within the CNF forest reserves, the CNF is considered instrumental in the success of this TMDL. Members of the Clearwater Basin Advisory Group represent agriculture, local government, Nez Perce Tribe, recreation, forestry, point source discharger, environmental, mining, livestock, and at-large interests. Both the Clearwater Basin Advisory Group and the CNF have been consulted in the development of this TMDL.

This addendum includes the distribution list for the draft document and a summary of public comments in Appendices F and G, respectively. The Clearwater BAG gave their concurrence for submittal to EPA at their May 3, 2012 meeting in Lewiston.

5.7 Conclusions

In the 2010 Integrated Report, 20 AUs were listed for temperature impairments in the Lochsa River subbasin. This TMDL analysis found 8 of these AUs (Boulder, Storm, and Fish Creeks) were unimpaired and should be delisted. TMDLs were developed for the remaining AUs, which should be moved to Category 4a in the next Integrated Report (Table 4).

DEQ also examined additional tributary AUs for their contribution to excess heat loads in the Lochsa River. In total, effective shade targets were established for 37 tributary AUs in the Lochsa River subbasin based on the concept of maximum shading under PNV will result 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 field verified in some locations with Solar Pathfinder data.

Some watersheds, especially in the Brushy Fork portion of the subbasin, lack shade and have relatively large excess loads. There are many more streams in the analysis that either meet target shade levels or are within the same 10% shade class. This analysis shows that the majority of watersheds outside of roadless areas have only been slightly affected by land-clearing activities near riparian areas.

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.

Table 4. Summary of assessment outcomes.

Water Body Segment/ Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Lower Lochsa River tributaries ID17060303CL001_02	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade
Lochsa River ID17060303CL001_05, ID17060303CL003_05, ID17060303CL008_05, ID17060303CL009_05, ID17060303CL013_05, ID17060303CL020_05	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade in tributary watersheds
Boulder Creek ID17060303CL010_02, ID17060303CL010_04	Temperature	No	Delist	Undisturbed watershed
Storm Creek ID17060303CL032_03	Temperature	No	Delist	Undisturbed watershed
Fish Creek ID17060303CL052_02, ID17060303CL052_03, ID17060303CL052_04, ID17060303CL057_02, ID17060303CL057_03	Temperature	No	Delist	Undisturbed watershed
Deadman Creek ID17060303CL061_02	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade
Canyon Creek ID17060303CL062_03	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade
Pete King Creek ID17060303CL063_02, ID17060303CL063_03	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade
Walde Creek ID17060303CL064_02	Temperature	Yes	Move to Category 4a	Excess solar load from lack of shade

References Cited

Armantrout, N.B., compiler. 1998. Glossary of aquatic habitat inventory terminology. Bethesda, MD: American Fisheries Society. 136 p.

Clean Water Act (Federal water pollution control act), 33 U.S.C. § 1251-1387. 1972.

DEQ (Idaho Division of Environmental Quality). 1999. Lochsa River subbasin assessment. Lewiston, ID: DEQ, Lewiston Regional Office.

DEQ (Idaho Department of Environmental Quality). 2005. Catalog of stormwater best management practices for Idaho cities and counties. Boise, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2011. Idaho's 2010 Integrated Report. Boise, ID: DEQ.

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. 162 p.

Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. The Idaho Department of Environmental Quality water body assessment guidance, second edition-final. Boise, ID: Department of Environmental Quality. 114 p.

HDR. 2002. Water temperature of the Lochsa River and selected tributaries. Boise, ID: Department of Environmental Quality. Contract #C046. 45 p.

Hughes, R.M. 1995. Defining acceptable biological status by comparing with reference condition. In: Davis, W.S. and T.P. Simon, editors. Biological assessment and criteria: Tools for water resource planning and decision making. Boca Raton, FL: CRC Press. pp. 31–48.

Idaho Code § 39.3611. Development and implementation of total maximum daily load or equivalent processes.

Idaho Code § 39.3615. Creation of watershed advisory groups.

IDAPA 58.01.02. Idaho water quality standards.

IDL (Idaho Department of Lands). 2000. Forest practices cumulative watershed effects process for Idaho. Boise, ID: IDL.

Jones, D. 1999. Hydrology and water quality report for the Lochsa River subbasin analysis. Orofino, ID: Clearwater National Forest. 39 pp.

Karr, J.R. 1991. Biological integrity: A long-neglected aspect of water resource management. Ecological Applications 1:66–84.

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 Service.

OWEB (Oregon's Watershed Enhancement Board). 2001. Addendum to water quality monitoring technical guide book: Chapter 14, stream shade and canopy cover monitoring methods. 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.

USGS (US Geological Survey). 1987. Hydrologic unit maps. Denver, CO: USGS. Water supply paper 2294. 63 p.

Water Environment Federation. 1987. The Clean Water Act of 1987. Alexandria, VA: Water Environment Federation. 318 p.

Water Quality Act of 1987, Public Law 100-4. 1987.

Water quality planning and management, 40 CFR Part 130.

Glossary

§303(d)	Refers to section 303 subsection "d" of the Clean Water Act. 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 U.S. Environmental Protection Agency approval.
Acre-foot	A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
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.
Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.
Assemblage (aquatic)	An association of interacting populations of organisms in a given water body; for example, a fish assemblage or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
Assessment Unit (AU)	A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.
Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.

Beneficial Use

Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, which 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, and wadeable streams and rivers

Benthic

Pertaining to or living on or in the bottom sediments of a water body

Best Management Practices (BMPs)

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

Biological Integrity

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

Biota

The animal and plant life of a given region.

Clean Water Act (CWA)

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

Community

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

Criteria

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

Cubic Feet per Second

A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot

per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.

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

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

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

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

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

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

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

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

Flow
See *Discharge*.

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).

Geographic Information Systems (GIS)
A georeferenced database.

Ground Water
Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to

move under the influence of gravity, and usually emerges again as streamflow.

Habitat

The living place of an organism or community.

Headwater

The origin or beginning of a stream.

Hydrologic Basin

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

Hydrologic Unit

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

Hydrologic Unit Code (HUC)

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

Limnology

The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.

Load Allocation (LA)

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

Load(ing)

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

Load(ing) Capacity (LC)

A determination of 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, and a margin of safety, it becomes a total maximum daily load.

Macroinvertebrate
An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500 micrometer mesh (U.S. #30) screen.

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

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

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

Milligrams per Liter (mg/L)
A unit of measure for concentration. In water, it is essentially equivalent to parts per million (ppm).

Million Gallons per Day (MGD)
A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.

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

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

National Pollutant Discharge Elimination System (NPDES)
A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.

Natural Condition
The condition that exists with little or no anthropogenic influence.

Nitrogen	An element essential to plant growth, and thus is considered a nutrient.
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 or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
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).
Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
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 which alter the functioning of natural processes and produce undesirable environmental and health effects. This

	includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Potential Natural Vegetation (PNV)	A.U. Küchler (1964) defined potential natural vegetation as vegetation that would exist without human interference and would exist 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 which includes recognition of some level of natural disturbance.
Protocol	A series of formal steps for conducting a test or survey.
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.
Reconnaissance	An exploratory or preliminary survey of an area.
Reference	A physical or chemical quantity whose value is known and thus is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.

River	A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A 1st-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
Stormwater Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 4th-field hydrologic units (also see Hydrologic Unit).
Subbasin Assessment (SBA)	A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.

Subwatershed

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

Taxon

Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).

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 bases. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Tributary

A stream feeding into a larger stream or lake.

Wasteload Allocation (WLA)

The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

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

Water Pollution

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

Water Quality

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

Water Quality Criteria

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

Water Quality Limited

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

Water Quality Limited Segment (WQLS)

Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."

Water Quality Standards

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

Water Table

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

Watershed

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

Wetland

An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.

Appendix A. Wild and Scenic River Management of the Lochsa River

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Middle Clearwater Wild and Scenic USFS Plan

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FOREWORD

Public Law 90-542, Wild and Scenic Rivers Act, states in part as follows:

"Sec. 3(a) The following rivers and the land adjacent thereto are hereby designated as components of the national wild and scenic rivers system:

(1) Clearwater, Middle Fork, Idaho - The Middle Fork from the town of Kooskia upstream to the town of Lowell; the Lochsa River from its junction with the Selway at Lowell forming the Middle Fork, upstream to the Powell Ranger Station; and the Selway River from Lowell upstream to its origin; to be administered by the Secretary of Agriculture. . . .

"Sec. 3(b) The agency charged with the administration of each component of the national wild and scenic rivers system designated by subsection (a) of this section shall, within one year from the date of this Act, establish detailed boundaries therefor (which boundaries shall include an average of not more than three hundred and twenty acres per mile on both sides of the river); determine which of the classes outlined in section 2, subsection (b), of this Act best fit the river or its various segments; and prepare a plan for necessary developments in connection with its administration in accordance with such classification. Said boundaries, classification, and development plans shall be published in the Federal Register and shall not become effective until ninety days after they have been forwarded to the President of the Senate and the Speaker of the House of Representatives. . . ."

RIVER PLAN

Middle Fork Clearwater Including the Lochsa and Selway

of the

National Wild and Scenic River System

This is a resume of the management policies and planned development for the Middle Fork Clearwater Wild and Scenic River System. It outlines the basis for management direction throughout the river system, indicates future developments and provides a background for coordinating resource and activity plans for all private and public lands within the Middle Fork System. There is a variety of source material recorded in the Office of the Forest Supervisor, Clearwater National Forest, Orofino, Idaho, that contributed substantially to the management direction for the river system, including the Special Planning Area Multiple Use Management Guide, Recreation Composite Plan, public meeting records, photographs and other related material. Review of the source material at the Forest Supervisors' Offices is invited.

BASIC DATA

The Middle Fork Clearwater River System is formed by two main forks, the Lochsa and Selway Rivers, all which rise on the west slopes of the rugged Bitterroot Mountains. This river system, located in northcentral Idaho, is the major river drainage north of the Salmon River. It has a total drainage area of 3,420 square miles. All of the area considered in this system is located in the County of Idaho, State of Idaho, mostly within the Clearwater Nezperce and Bitterroot National Forests.

Classification

The Middle Fork of the Clearwater River System was determined to contain two of the three river classes defined in the Act, "recreational" and "wild."

The recreational river classification includes the Middle Fork of the Clearwater from Kooskia to Lowell, the Lochsa from Lowell to the Powell Ranger Station, and the Selway from Lowell to Race Creek and from Paradise to the Magruder Ranger Station.

The major factors which led to recreational river classification are roads which parallel these river segments. The roads make the rivers readily accessible. They encroach on the rivers in places. Portions of these rivers also have development along their shorelines in the form of homes and commercial facilities on private lands as well as administrative and recreational facilities on public lands.

Although the Selway from Paradise to the Magruder Ranger Station is classified as recreational river because of the road along it, this segment will continue to be managed to retain its relatively natural appearance. Recreation facilities provided will be modest and consistent with the nature of the environment.

The wild river classification includes the Selway River from Race Creek to Paradise Guard Station and from the Magruder Ranger Station to the headwaters of the Selway in the Salmon River Breaks Primitive Area.

The river segments in this classification have no road access. Access is provided by trail throughout and by five isolated, low-standard airstrips. Two of these were developed by the Forest Service and three by private parties. There are 14,500 acres within the boundaries of the 54 miles classified as

wild river. The recreational river portion of the system contains 41,500 acres along 131 river miles.

Boundary

The boundaries of the river area have been estimated to include, within the statutory limitations of an average of not more than 320 acres per mile, those lands most directly related to the environment of the rivers and their shorelines and to the protection of scenic and recreational values. On surveyed land the boundary follows legal subdivisions. On unsurveyed land outside of wilderness and primitive areas, it follows topographic features where possible. Within wilderness and primitive areas it is 1/4 mile on each side of the river paralleling the river except for the inclusion of private properties. River boundaries are described in the appendix. They are also shown on maps on file and available in the Offices of the Forest Supervisors, Clearwater National Forest, Orofino, Idaho; Nezperce National Forest, Grangeville, Idaho; and Bitterroot National Forest, Hamilton, Montana, and the Regional Forester, Northern Region, Missoula, Montana.

OBJECTIVES

1. Provide the range of quality recreation opportunities most clearly characteristic of and in harmony with the special attributes of each river segment.

2. Protect and enhance aesthetic, scenic, historic, fish and wildlife and other values that will contribute to public use and enjoyment of this free-flowing river and its immediate environment.

3. Provide optimum recreational enjoyment consistent with protection of environmental quality.

4. Manage all uses on those portions of the river within the Selway-Bitterroot Wilderness and the Salmon River Breaks Primitive Area so as also to preserve the wilderness resource.

5. Manage use of river area so as to minimize adverse effects on water quality.

6. Provide coordinated resource use programs which will enhance or be compatible with the foregoing objectives.

7. Strive for continued participation of States, other agencies, local government and private landowners in future planning and administration of the Middle Fork of the Clearwater System.

COORDINATION

Coordination direction is established to insure the proper relation between resource uses, land uses or activities. General coordinating requirements are applicable to the entire area within the river boundaries. Special coordinating requirements which apply only to lands within either the recreational or wild river sections of the river are also listed.

General Coordinating Requirements

Recreation

1. The Forest Service will make the necessary analysis of recreational use to develop criteria for estimating optimum use levels of various segments and establish management accordingly.

2. Locate facilities outside of the immediate foreground of rivers, streams, trails or other natural attractions to allow appropriate use without unacceptable depreciation of the river environment.

3. Visitor use will be distributed or limited as necessary to prevent loss of river values.

4. Identify and protect historic, scenic, geologic, archaeologic and similar sites or areas.

5. Plan and administer commercial services, including outfitters and guides, in such fashion as to serve the public needs while maintaining river values.

6. When planning recreation developments, provide for protection of rivers, streams and underground water supplies from pollution.

7. Design all recreation developments to provide safe and enjoyable public use of the river environment. Developments in wilderness will conform to wilderness requirements.

8. With a few exceptions, public and private recreation developments will ordinarily be confined to complexes, such complexes being spaced to leave large segments of the river undeveloped. Simple float or trail camps may be spaced along the river.

Range

1. Manage grazing along rivers to protect riparian vegetation and to prevent damage to streambanks and channels.

2. Coordinate stock grazing use with recreation by special management practices such as fencing recreation sites and avoiding trailing or other practices which concentrate livestock.

3. Priority will be given to wildlife needs if conflict occurs between wildlife and commercial or recreation stock use.

Timber

1. Consider timber for recreation, watershed protection and esthetic values rather than for commercial production.

2. Commercial timber harvest will generally be confined to areas outside the boundaries of the river area. Commercial operations could be needed to meet objectives under the recreational river coordinating requirements.

3. On National Forest land timber management planning will provide for necessary adjustments in the allowable cut to carry out the management direction for the river area.

Water

1. Permit no permanent alterations of natural channels which significantly affect the free flow of water.

2. Protection of rivers will include controlling pollution, debris accumulation and siltation to the degree necessary to maintain the water quality within defined parameter or measurable units.

3. Optimum flows for environmental needs are to be reserved. Studies will be made to determine optimum flows and whether there

may be opportunities within the wild and recreational river objectives to improve flow.

Wildlife

1. Direct fish management programs toward the maintenance of the anadromous fish run, the native trout fishery and perpetuating endangered species.

2. Wildlife habitat improvement measures will be undertaken to maintain the Clearwater-Selway big game herd to the extent that this can be done without adverse impacts to the river environment and wilderness.

Land Occupancies

1. Present permitted uses on Federal land which are not compatible with river management objectives will be ultimately terminated.

2. All improvements and structures should be designed and located to accomplish their intended use in a way that is compatible with or enhances the river environment.

3. Access to private lands shall be by means which have the least adverse effects on the river environment.

4. Avoid improvements which cause use of resources beyond a reasonable capacity.

5. Limit new commercial service facilities (stores, motels, etc.) to designated complex areas. Lowell and Smith Creek - Syringa area are the two designated areas at present.

Minerals

1. Insure protection of surface resources as provided for under Public Law 90-542 and applicable State laws on private lands or through scenic easements.

2. Recognize rights of mining claiments on claims located before passage of the Wild and Scenic Rivers Act. Gain cooperation of the miner to reduce impacts on the river environment.

Transportation

1. Access roads to serve private lands are to be controlled by scenic easements to insure compatibility with development of the special planning area and with river environment protection.

2. Locate roads and trails to avoid encroachment on river banks and to harmonize with objectives for which the river area is established.

Landownership Adjustment

1. The Forest Service will develop a landownership adjustment plan for non-Federal lands within the river area. This plan will establish prescriptions necessary to conform to the Act, including a listing of constraints, standards and guidelines necessary to insure that the broad objectives for the river will be met.

2. Acquire lands in fee title where needed to fully protect and develop the river environs through a willing buyer-seller relationship.

3. National Forest lands in this special area will not be used as base lands for exchange.

Fire Control

1. Use fire suppression measures and techniques which will have the minimum impact on river area values.

2. Fire may be used as a management tool to maintain natural environmental conditions.

Recreational River Coordinating Requirements

There are, in addition to general coordinating requirements applicable to the entire river area, specific coordinating requirements which apply to lands within the river segments classified as recreational. These specific requirements are listed below.

Recreation

1. Provide appropriate sanitation facilities necessary to meet public health needs and to prevent site deterioration and water pollution.

2. Any recreation developments considered should be located so as to allow appropriate and safe use without unacceptable depreciation of the rivers' environment.

3. Identify, interpret and protect historic, scenic, archaeologic and similar sites.

4. Plan and administer outfitter and guide services to serve public need while at the same time maintaining zone values.

Range

There should be no concentrated domestic stock grazing or holding corrals on the rivers' shorelines on public lands. (This does not pertain to winter feeding of small herds of domestic stock or to pasture grazing on private lands.)

Timber

1. Timber cutting will be done only for the following:

   a. Public safety and/or recreational purposes in selected areas.

   b. Control of fire, insects and disease when such cutting is determined to be the only practical method of control.

   c. Approved road and trail locations.

2. Timber cutting will be compatible with or enhance key recreational and scenic values.

3. The values of standing trees for watershed, aesthetic or other recreational purposes will be considered in the choice of measures for controlling fire, insects and disease.

Water

1. Coordination with all resources, uses and developments will be needed to assure high quality water.

2. Coordination with all agencies, State and Federal, private landowners and water users will be necessary to protect water quality.

3. Modify projects within the river system if necessary to insure high water quality.

4. Gullied, eroding streams, polluted water and vegetation and soil disturbed by humans, domestic animals, wildlife, large burns and landslides are examples of undesirable watershed conditions in classified river areas. Where these conditions have a major impact on river values they should be restored.

5. All watershed improvement projects will be designed as to location, type of treatment and work methods to insure compatibility with the free-flowing intent of the Wild and Scenic Rivers Act.

Wildlife

1. Provide an appropriate habitat to sustain a variety of wildlife for public enjoyment.

2. Permit no predator control stations.

3. Promote visual wildlife enjoyment opportunities for the visitor.

Land Occupancies

1. On private land secure scenic easements to achieve necessary environmental controls. Limit only those uses and developments which interfere with public use and enjoyment of the river or detract from scenic values.

2. All improvements on public lands should be designed, located and constructed to be compatible with or enhance the river environment. They should be the examples of compatibility within the river system.

3. Access to private lands and occupancy roads across public lands shall be by means which have the least adverse effect on the river system and landscape values.

Transportation

1. Design road improvements and construct to the carrying capacity of the zone and optimum enhancement of recreation values.

2. The improvement of existing access, traffic flow patterns and the consideration of alternate routes are factors which will be evaluated in the light of public enjoyment and safe movement.

3. Interior access facilities should be designed, located, constructed and maintained to minimize alteration of the natural landscape and impairment of the scenic values.

4. Coordinate construction and maintenance of roads and trails with need for fish and wildlife harvest. These are key recreation values in the system.

Fire Control

1. Use fire control measures and techniques which achieve fire control objectives with a minimum adverse impact on the river values. Give preference to methods and equipment that will least alter the landscape and related values.

2. Any prescribed burning, hazard reduction and incineration will be on a tightly controlled basis to avoid air pollution problems and protect developments and key resource values.

3. Fire planning and pre-attack planning are to consider wild river values.

4. Fire may be used as a management tool when required to maintain natural ecological or environmental conditions or sustain key values in the river areas.

Wild River Coordinating Requirements

There are, in addition to general coordinating requirements applicable to the entire river area, specific coordinating requirements which apply to lands within the river segments classified as wild. These specific requirements are listed below.

Recreation

1. Within the Selway-Bitterroot Wilderness, only developments which conform with wilderness management standards will be permitted.

2. Continue to allow unrestricted recreation use without number limitations only so long as the wilderness and wild river environment are not harmed.

3. Enforce "pack it in and pack it out" policy for all wild river zone users.

4. Shorelines must remain essentially primitive in wild river zones.

Timber

Timber cutting will not be permitted in the wild river area except when compatible with existing classifications and primitive recreation experience such as clearing trails, control of fire, tent poles, etc.

Land Occupancy

1. No new structure or installation will be permitted within the boundary of the wild river that can be seen from the river or its shorelines unless it can be made inconspicuous or in harmony with the area.

2. Any new improvements on private land will be compatible and in harmony with the surrounding environment. There will be no new habitation or substantial additions to capacity at existing habitations.

Transportation

Trails will be designed to standards consistent with wild river objectives. Within the wilderness they will conform to wilderness requirements.

DEVELOPMENT

The development plan provides for recreation and transportation improvements, landscape rehabilitation, land ownership adjustment including scenic easement acquisition and water quality control. It includes estimated needs for ten years or to the year 1980. There are additional opportunities for development over that projected for the ten-year period. These have been inventoried and will be programed for construction as the need arises.

Recreation developments proposed along the Middle Fork includes two campgrounds (one a private development), a picnic area, three boat launching sites and a visitor center.

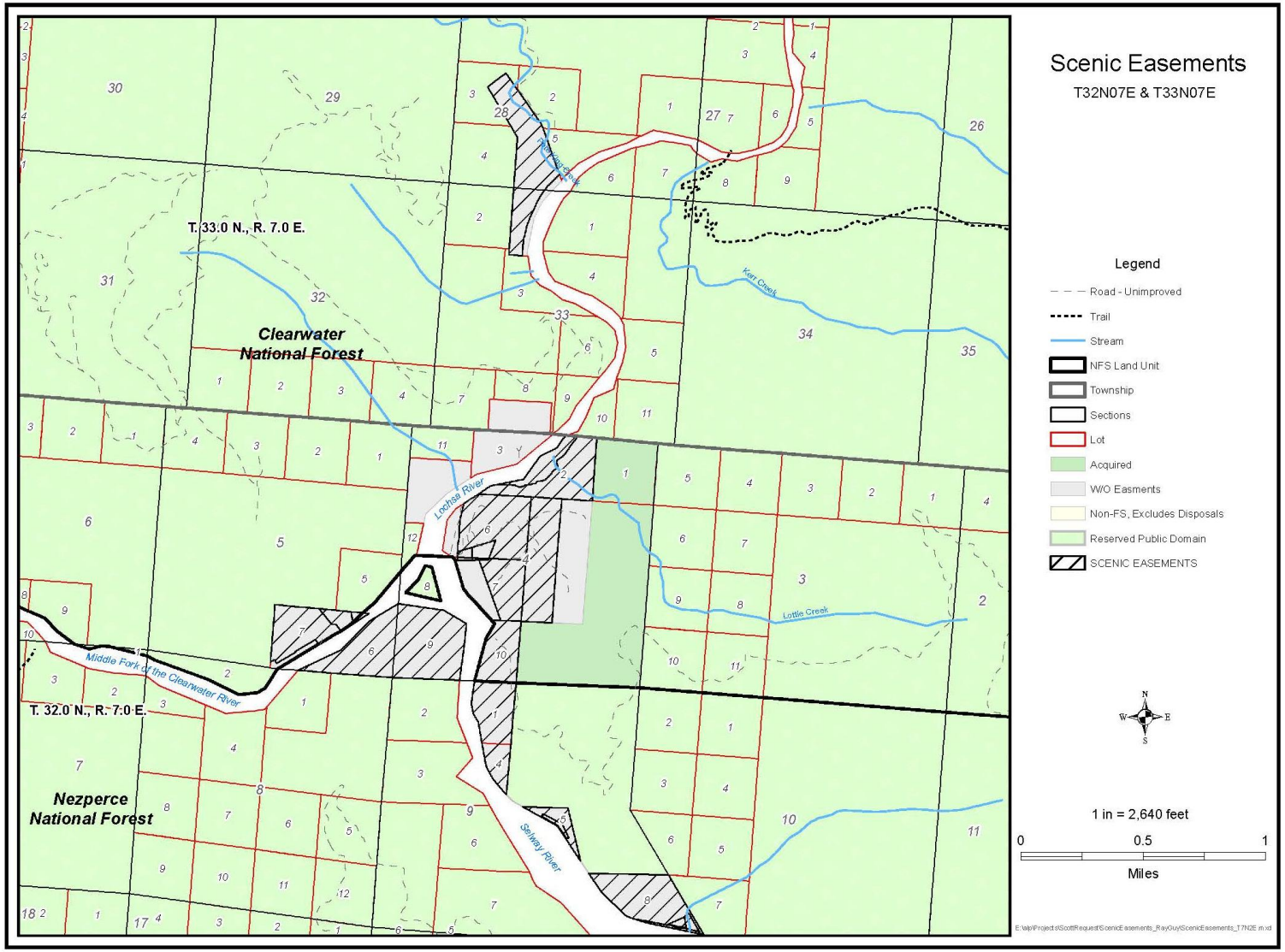
To be provided along the Lochsa are one new campground and the improvement or expansion of six existing campgrounds, an outfitter station and restoration of an historic ranger station.

On the Selway, downriver from the Selway-Bitterroot Wilderness, will be six new small campgrounds and one major campground expansion, two vista points and one boat launching site. In the Magruder area small campgrounds are planned at the Magruder Crossing and at Raven Creek. A few minimum development camping spots will also be provided at selected sites along the river. Any recreational development within the Wilderness will be limited to facilities needed to protect wilderness value.

The estimated recreation development and operation costs for the next ten years are $1,730,000. Needed bridges, roads and trail construction and reconstruction total $315,000. Approximately $150,000 for stabilizing landslides, restoring barrow areas and seeding grass on roadbanks is needed along the Lochsa and lower Selway Rivers. It is estimated that scenic easements necessary to achieve the objectives set forth in the coordinating requirements for private land will cost $1,481,000. The major portion of this money would be used along the Middle Fork Clearwater and lower Selway.

A water monitoring system should be set up to permit frequent checking on the quality and quantity of the water in the river system. It is estimated this monitoring system and its operation will cost $100,000 during the ten-year planning period.

Lochsa River Scenic Easements



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Lochsa Scenic Easement Example Contract

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Tract No. 490

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NATIONAL WILD AND SCENIC RIVERS SYSTEM
RECREATION RIVER AREA EASEMENT

APPROVED AS TO CONSIDERATION DESCRIPTION AND CONDITIONS BY [illegible] DATE 12/8/80

THIS EASEMENT, dated this 12th day of December, 1980, by and between [redacted] an Idaho corporation whose business address is [redacted], hereinafter called the Grantor, and the UNITED STATES of AMERICA, whose post office address is Washington, D. C. 20013, hereinafter called Grantee:

WHEREAS, Public Law 90-542 (82 Stat. 906) provided for the establishment of a Wild and Scenic Rivers System, and designated that portion of the Middle Fork Clearwater River in Idaho from the town of Kooskia upstream to the town of Lowell, the Lochsa River from its junction with the Selway at Lowell forming the Middle Fork upstream to the Powell Ranger Station, and the Selway River from Lowell upstream to its origin as a component of the National Wild and Scenic Rivers System to be administered by the Secretary of Agriculture as part of the National Forest System, and

WHEREAS, the Grantor is the owner of certain land which is in the established boundaries of the Middle Fork Clearwater River Component of the National Wild and Scenic Rivers System, Clearwater National Forest, and located in Idaho County, State of Idaho, and

APPROVED [illegible] OGC 2/19/81

WHEREAS, the Grantee through the Forest Service, in accordance with P.L. 90-542 (82 Stat. 906), desires to administer such land to protect the scenic, recreational, geologic, fish and wildlife, historic, cultural, and other similar values of the free-flowing Middle Fork Clearwater, including the Lochsa and Selway Rivers, and their immediate environments, and to prevent any developments that will tend to mar or detract from their scenic, recreation, geologic, fish and wildlife, historic, cultural, or other similar values, and to that end exercise such reasonable controls over the land within the restricted areas described herein as may be necessary to accomplish such objectives;

NOW, THEREFORE, the Grantor for and in consideration of the sum of $47,400.00, the receipt of which is hereby acknowledged, and in consideration of the covenants herein contained, does hereby grant and convey unto the Grantee and its assigns an easement and right in perpetuity to and over any and all portions of the following described lands:

T. 32 N., R. 7 E., BOISE MERIDIAN

Section 4: Lot 6

EXCEPTING THEREFROM a parcel of land in lots 6 and 7 of section 4, T. 32 N., R. 7 E., Boise Meridian,, described as:

Commencing at a point 910.0 feet east of the quarter corner common to sections 4 and 5, T. 32 N., R. 7 E., Boise Meridian;
thence N. 00°30' E., 172.0 feet;
thence N. 25°17' E., 140.0 feet;
thence S. 86°45' E., 240.0 feet;
thence S. 03°00' W., 298.0 feet;
thence N. 87°00' W., 285.0 feet to the place of beginning.

EXCEPTING ALSO a parcel of land in lot 6 of section 4, T. 32 N., R. 7 E., Boise Meridian, described as:

Beginning at a point on the east fence line of that parcel of land described in that deed recorded in Book 96 of Deeds at page 158 in the records of Idaho County, Idaho, from which point the West Quarter Corner of said section 4 bears S. 87°10' W., 1191.7 feet;

thence N. 03°12' W., 114.50 feet to a 5/8 x 30" rebar;
thence N. 67°16' E., 322.00 feet;
thence S. 06°37' E., 223.81 feet;
thence S. 87°10' W., 317.00 feet to the point of beginning.

EXCEPTING ALSO a parcel of land in lot 6 of section 4, T. 32 N., R. 7 E., Boise Meridian, described as:

Beginning at a point on the south line of said section 4, lot 6, from which point the West Quarter Corner of said section 4 bears S. 87°10' W., 1508.7 feet;
thence N. 87°10' E., 363.00 feet;
thence N. 15°53' E., 440.03 feet to a 5/8" x 36" rebar;
thence S. 67°16' W., 522.61 feet;
thence S. 06°37' E., 223.81 feet to the place of beginning.

EXCEPTING ALSO a parcel of land in lot 6 of section 4, T. 32 N., R. 7 E., Boise Meridian, described as:

Beginning at the North One Quarter Corner for section 4, T. 32 N., R. 7 E., Boise Meridian, which is monumented with a 3" diameter brass cap on a 1" diameter by 3' long galvanized iron pipe;
thence a distance of 2091.34 feet on a bearing of S. 43°13'33" W. to Corner One, a monument and the true point of beginning, said point situate on the left bank of the Lochsa River mean highwater line;
thence 431.06 feet on a bearing of S. 07°38'10" W. to Corner Two, a monument;
thence 155.70 feet on a bearing of S. 00°52'57" E. to Corner Three, a monument;
thence 189.51 feet on a bearing of S. 06°41'38" E. to Corner Four, a monument;
thence 193.22 feet on a bearing of S. 05°40'06" W. to Corner Five, a monument;
thence 126.02 feet on a bearing of N. 85°34'58" W. to Corner Six, a monument;
thence 140.00 feet on a bearing of S. 26°27'00" W. to Corner Seven, a monument;
thence 56.05 feet on a bearing of S. 01°39'59" W. to Corner Eight, a monument, on a 270.37 foot radius curve left and the north Right-of-Way line for the U.S.D.A. Forest Service Road No. 223.1;
thence along the curve arc and said right-of-way line 218.46 feet to Corner Nine, a monument on the Right-of-Way line at Station 0 + 22.41 of said Forest Service Road No. 223.1 and on the left bank of the Lochsa River at the mean highwater line;
thence along the mean highwater line on the left bank of the Lochsa River 482.62 feet on a bearing of N. 03°35'43" E. to Corner Ten;
thence 170.36 feet on a bearing of N. 17°57'16" E. to Corner Eleven;
thence 126.03 feet on a bearing of N. 37°54'52" E. to Corner Twelve;
thence 188.50 feet on a bearing of N. 54°13'56" E. to Corner Thirteen;
thence 290.68 feet on a bearing of N. 57°16'29" E. to the True Point of Beginning.

The easement area contains 33 acres, more or less.

The acquiring agency is the Forest Service, United States Department of Agriculture.

I. USE BY GRANTEE:

The Grantee is hereby granted the right to go upon the land described in this easement for the following purposes:

a. To inspect for violations and to administer this easement.

b. To remove or eliminate any nonconforming advertising displays, signs and billboards, stored or accumulated junk automobiles, and other salvage materials, junk, or debris which may be found on the above-described area.

c. To mark, cut, and remove all dead, dying, diseased, or insect-infested trees and shrubs which in the judgment of the Grantee detract from the aesthetics of the above-described area, and to plant and selectively cut or prune trees and shrubs to restore or maintain the scenic view and to implement disease-prevention measures. The property owner shall be consulted prior to initiation of such operations. Any merchantable timber so cut shall, unless otherwise agreed, be cut into logs of standard lengths for disposal by the landowner.

d. To perform such other scenic, aesthetic, historical, fish and wildlife, and sanitation restoration as may be deemed necessary or desirable. The landowner shall be consulted prior to initiation of such projects.

II. USE BY GRANTOR:

In return for the stated consideration, the Grantor assumes the following covenants and restrictions. These covenants and restrictions are imposed upon the occupancy and use of the easement area by the Grantor, all successors and assigns, except that none of these covenants and restrictions shall be deemed or construed as controlling or eliminating any regular use of the land exercised prior to the acquisition of this easement unless such use is acquired by the Grantee. Except as otherwise provided by this easement, the costs of conformance with the terms of Part II of this easement shall be borne by the Grantor.

a. No mining, industrial, or manufacturing activity shall be conducted on the lands within the easement area.

b. The Grantor, all successors and assigns, retains the right to develop the easement area for general crop and livestock farming, limited residential, and light commercial purposes consistent with applicable state and local regulations. Commercial enterprises shall be limited to those which offer necessary services or goods to visitors, through travelers, or local residents. Examples of such enterprises are automobile/truck service and emergency road repair stations, stores, cafes, lodge or motel-type accommodations, landscaped parks for travel trailers and campers, winter sport facilities, and guide and packer services. Excluded are such businesses as amusement parks, used car lots, trailer rental lots, automobile/truck repair shops, automobile wrecking yards, and outdoor "zoos".

c. The construction, erection, or placement of new or additional buildings, structures, or facilities shall be in accordance with plans approved in writing by the Secretary of Agriculture or his duly authorized representative. The plans shall provide for the following:

(1) Adequate waste and sewage disposal facilities to fully comply with applicable state and local regulations for sanitation and water pollution control.

(2) Building architecture to be compatible with the pastoral environment - rustic in nature; harmoniously colored, natural wood finish, or suitable wood substitutes; and nonreflective roofs and sidings.

(3) The use of exterior colors and surfacing that conforms with selected earth-tone colors contained in Munsell's Soil Color Chart or equivalents approved by the Secretary of Agriculture or his duly authorized representative.

(4) A maximum height of thirty (30) feet measured from the natural grade at the middle of the front of the structure to the highest point of the roof or parapet.

(5) Roofs constructed of nonreflective material or painted with earth-tone colors as described in Section (3) above.

(6) Buildings shall not cover more than 30 percent of the easement area or any subdivided parcel thereof.

(7) At least 30 percent of the easement area shall be maintained as green space (i.e., grasses, trees, and shrubs).

(8) The Grantor or its agent shall not move in old houses, cottages, house trailers, fishing or hunting shacks, portable structures, or any other low quality, unattractive or nonpermanent improvement or structure into the easement area. Mobile homes are permitted for permanent residences provided their color, structure, profile, design, and positioning on the property, including landscaping, are harmonious with the rural environment. Written permission shall be obtained from the Secretary of Agriculture or his duly authorized representative prior to the placing of mobile homes on said lands.

(9) All fences, except those utilizing barbed wire for livestock control, shall be constructed from natural or natural-appearing materials unless otherwise approved by the Secretary of Agriculture or his duly authorized representative. Fencing material colors shall conform to those described in Clause II.c.(3) of this easement.

(10) New utilities shall be placed underground.

d. No buildings, structures, or improvements shall be constructed or placed above the elevation of 1,640 feet (MSL) except as approved in writing by the Secretary of Agriculture or his duly authorized representative.

e. If any part of the easement area is subdivided, each parcel shall be subject to the provisions of this easement.

f. Hereafter, signs, billboards, outdoor advertising structures, or advertising of any kind or nature shall be limited to activities conducted, services rendered, or the name of the enterprise on the property. Such advertising shall be in accordance with a signing plan approved in writing by the Secretary of Agriculture or his duly authorized representative. The signing plan shall cover such items as the number, size, height, location and design of the advertising structures and shall comply with the following restrictions:

(1) Signs shall be set back at least 10 feet from the property line.

(2) Moving or intermittent flashing signs are prohibited.

(3) Neon signs and plastic signs with interior lighting are prohibited.

(4) Individual signs shall not exceed sixty (60) square feet in area.

(5) Signs or advertising structures shall not exceed fifteen (15) feet in height as measured from the natural grade at the base of the sign or structure.

(6) Signs may be illuminated only during hours when the establishment is open for business.

g. No changes in the general topography of the landscape or land surface will be permitted except for those caused by the forces of nature, and those authorized in writing by the Secretary of Agriculture or his duly authorized representative. No permission shall be required to drill wells or to lay, operate, maintain, repair, or remove water and sewer pipelines, drains, or other utility lines below the surface of the easement area insofar as such activities do not permanently impair or ruin the natural beauty of said easement area.

h. No trees or shrubs shall be pruned, removed, or destroyed on the land in the easement area except those authorized in writing by the Secretary of Agriculture or his duly authorized representative. Permission need not be obtained to cut dead trees or to remove hazardous trees for reasons of safety, except for those designated by the Grantee as existing or potential osprey nest trees. Likewise, seedling trees or seedling shrubbery may be grubbed up or cut down in accordance with good farm practice on lands presently being cultivated or for residential maintenance purposes. Cultivated crops, including orchard fruit and nut trees, may be pruned, sprayed, harvested, and otherwise maintained in accordance with good farm practice.

i. No dump of trash, ashes, garbage, sewage, sawdust, or any similar unsightly or offensive material shall be placed upon or within the easement area, except as is incidental to the occupation and use of the land for normal agricultural or horticultural purposes.

j. Archaeological or paleontological explorations shall be conducted only by a reputable museum, university, college, or recognized scientific or educational institution as authorized by a permit from the Secretary of Agriculture or his duly authorized representative. All specimens or materials of archaeological or paleontological interest shall be adequately and permanently safeguarded and preserved for scientific study and public observation. The excavated lands or ruins shall be restored to their customary condition or such other steps shall be taken to safeguard and conserve the excavated sites as may be necessary to preserve their residual scientific values.

III. PUBLIC ENTRY:

The granting of this easement is not intended to permit or in any way give the public the right to enter upon said land for any purpose. Where needed, the Grantee may erect appropriate signs indicating the easement area is not open to public entry.

TO HAVE AND TO HOLD the easement hereby granted, unto the Grantee, and its assigns forever. This grant shall be binding upon the successors and assigns of the Grantor and shall constitute a servitude upon the above-described land.

IN WITNESS WHEREOF, the Grantor has caused the aforesaid to be executed in its name and its corporate seal to be hereunto affixed the day and year first above written.

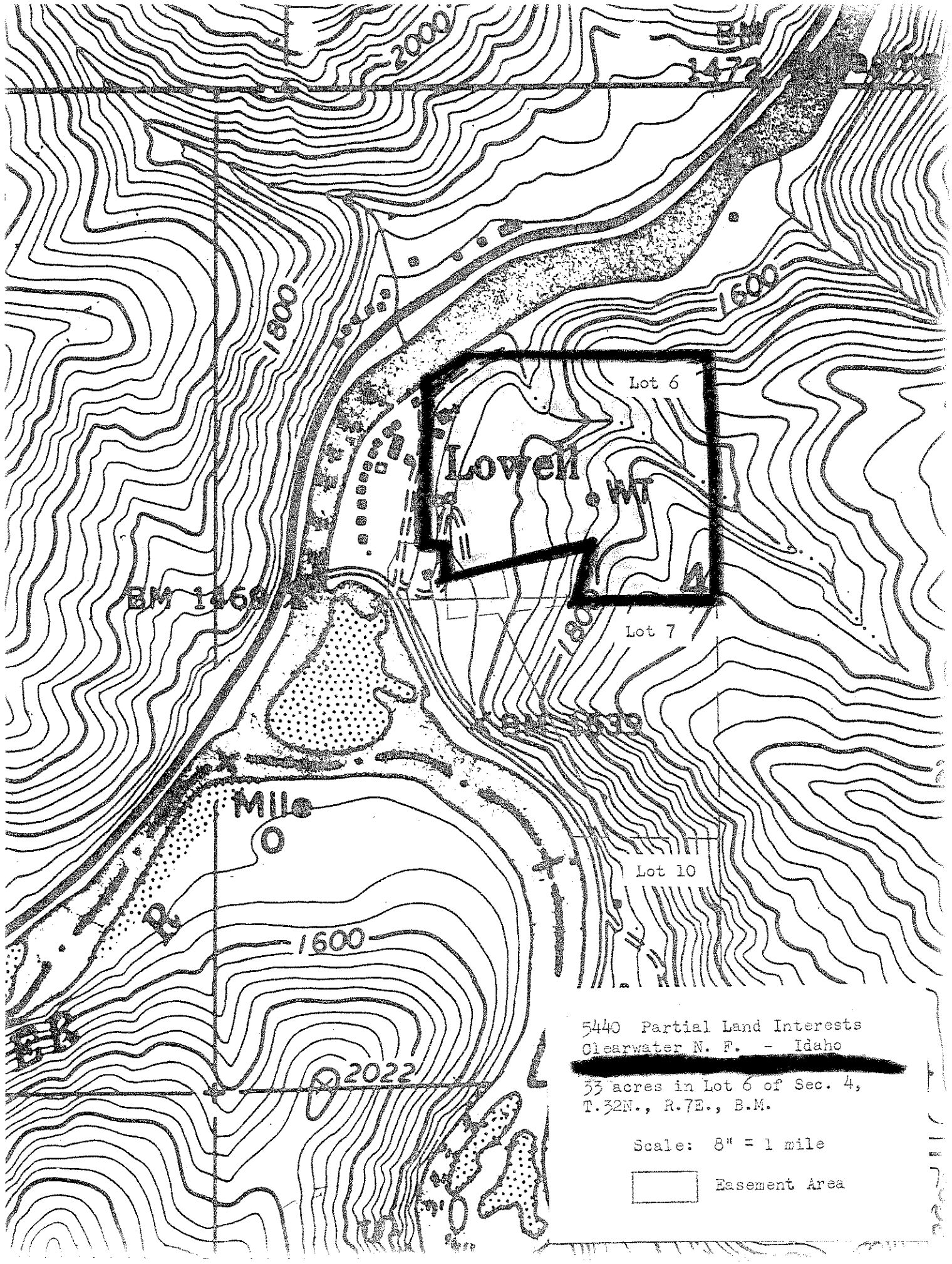
(Seal)

B[redacted]

Attest:

[redacted]

Secretary


2000
BM
1472
1800
1600
Lot 6
Lowell
WT
BM 1468
Lot 7
Mile
O
Lot 10
1600
2022
5440 Partial Land Interests
Clearwater N. F. - Idaho
[redacted]
33 acres in Lot 6 of Sec. 4,
T.32N., R.7E., B.M.
Scale: 8" = 1 mile
Easement Area

Appendix B. State and Site-Specific Standards and Water Quality 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 with species. For spring spawning salmonids, the default spawning and incubation period recognized by the Idaho Department of Environmental Quality (DEQ) is generally from March 15 to July 15 each year (Grafe et al. 2002). Fall spawning can occur as early as September 1 and continue with incubation into the following spring up to June 1. As per IDAPA 58.01.02.250.02.f.ii., the water quality criteria that need to be met during those time periods are as follows:

- 13 ^{o}C as a daily maximum water temperature
- 9 ^{o}C as a daily average water temperature

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

Natural Background Provisions

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

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

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

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Appendix C. Unit Conversion Chart

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Table C-1. Metric–English unit conversions.

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

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day = 1.55 cfs.

[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

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Table D-1. Data sources for 37 assessment units with TMDLs.

Water Body	Data Source	Type of Data	Collection Date
10 sites on 7 water bodies (Spruce Creek, Brushy Fork, Waw'aalamnime Creek, Post Office Creek, Apgar Creek, Canyon Creek, and Pete King Creek)	DEQ Lewiston Regional Office	Pathfinder effective shade and stream width	Fall 2010
All 37 assessment units	DEQ State Technical Services Office	Aerial photo interpretation of existing shade and stream width estimation	Summer 2010

Table D-2. Bankfull width estimates (in meters) for streams in the Lochsa River subbasin TMDL based on drainage area (in square miles) and existing measurements.

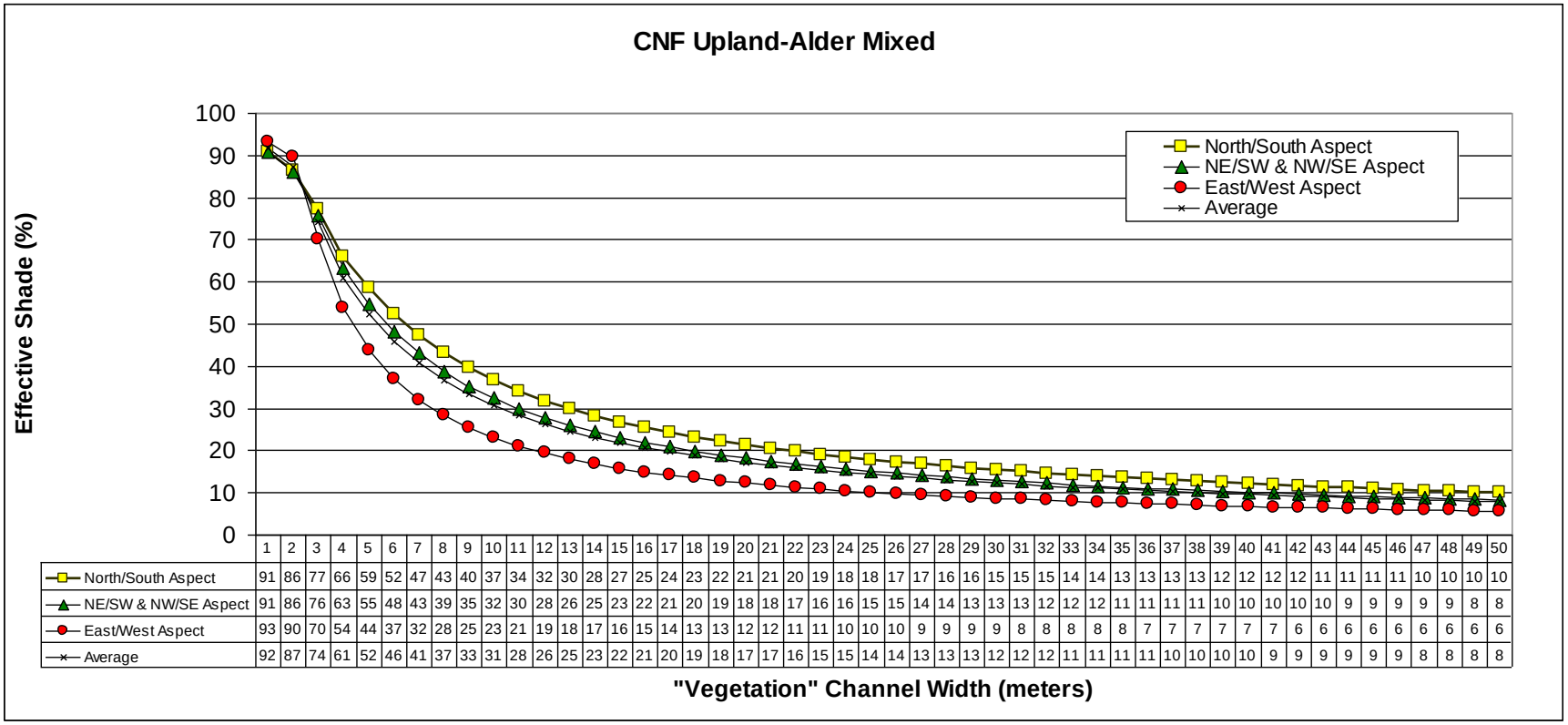
Location	area (sq mi)	Clearwater (m)	Existing in meters (yr)
Pete King Creek ab Walde Creek	7.48	5	
Pete King Creek bl Walde Creek	15.76	7	
Pete King Creek ab Placer Creek	18	8	
Pete King Creek ab Nut Creek	23.73	9	
Pete King Creek @ mouth	27.55	10	10.6(10)
Walde Creek bl 2nd tributary	2.03	2	
Walde Creek @ mouth	8.28	5	
1st tributary to Walde Creek	0.63	1	
2nd tributary to walde Creek	0.6	1	
3rd tributary to Walde Creek	1.02	2	
Polar Creek bl fork	0.9	2	
Polar Creek @ mouth	2.49	3	
1st tributary to Polar Creek	0.53	1	
1st tributary to Pete King Creek	0.56	1	
2nd tributary to Pete King Creek	0.5	1	
3rd tributary to Pete King Creek	0.56	1	
4th tributary to Pete King Creek	0.38	1	
Nut Creek @ mouth	2.37	3	
1st tributary to Nut Creek	0.56	1	
Canyon Creek ab 1st tributary	0.54	1	2.3 bl 1st(02)
Canyon Creek ab Mystery Creek	6.25	4	
Canyon Creek ab SF Canyon Cr	15.04	7	7.8(10)
Canyon Creek @ mouth	19.7	8	
1st tributary to Canyon Creek	0.82	2	
2nd tributary to Canyon Creek	0.68	1	
3rd tributary to Canyon Creek	1.14	2	
Mystery Creek @ mouth	2.58	3	
4th tributary to Canyon Creek	0.8	2	
5th tributary to Canyon Creek	0.35	1	
SF Canyon Creek ab Cabin Creek	1.43	2	
SF Canyon Creek bl Cabin Creek	2.37	3	
SF Canyon Creek @ mouth	4.46	4	
Cabin Creek @ mouth	0.94	2	

Deadman Creek ab 1st tributary	1.28	2	
Deadman Creek ab EF Deadman Cr	6.58	5	
Deadman Creek @ mouth	19.82	8	7.6(05)
1st tributary to Deadman Creek	1.35	2	
2nd tributary to Deadman Creek	1.01	2	
3rd tributary to Deadman Creek	0.5	1	
EF Deadman Creek ab 1st tributary	3.11	3	
EF Deadman Creek ab 5th tributary	8.4	5	
EF Deadman Creek @ mouth	11.14	6	
1st tributary to EF Deadman Cr	1.04	2	
2nd tributary to EF Deadman Cr	0.3	1	
3rd tributary to EF Deadman Cr	0.57	1	
4th tributary to EF Deadman Cr	2.2	3	
5th tributary to EF Deadman Cr	2.35	3	
5th tributary left fork	0.59	1	
5th tributary right fork	0.81	2	
un-named S of Lowell Creek	1.28	2	
Lottie Creek @ mouth	1.34	2	
Lowell Creek @ mouth	0.64	1	
Cat Creek @ mouth	0.95	2	
Rye Patch Creek @ mouth	2.3	3	
Handy Creek @ mouth	2.35	3	
Hellgate Creek @ mouth	1.84	2	
Chance Creek @ mouth	1.54	2	
Apgar Creek @ mouth	1.66	2	3.7(10)
Glade Creek @ mouth	4.97	4	
un-named opposite Glade Creek	0.42	1	
un-named opposite Deadman Creek	0.63	1	
Post Office Creek ab 1st tributary	3.6	3	
Post Office Creek bl 1st tributary	4.99	4	
Post Office Creek ab WF Post Office	11	6	
Post Office Creek ab 4th tributary	16.51	7	
Post Office Creek @ mouth	18.99	8	7.5(10) 9.2(04) 8.8(07)
1st tributary to Post Office Creek	1.39	2	
2nd tributary to Post Office Creek	0.81	2	
3rd tributary to Post Office Creek	1.41	2	
4th tributary to Post Office Creek	1.76	2	
1st tributary to 4th tributary	0.34	1	
WF Post Office Creek @ mouth	4.89	4	

Waw aalamnime Cr ab EF	2.93	3	
Waw aalamnime Cr ab WF	7.84	5	
Waw aalamnime Cr ab Doe Creek	16.95	7	9.8, 8.3(10)
Waw aalamnime Cr @ mouth	26.88	10	
EF Waw aalamnime Cr @ mouth	2.85	3	
WF Waw aalamnime Cr ab Spring Cr	3.02	3	
WF Waw aalamnime Cr @ mouth	5.38	4	
Spring Creek @ mouth	1.44	2	
Doe Creek ab 1st tributary	7.06	5	
Doe Creek @ mouth	9.7	6	
1st tributary to Doe Creek	1.92	2	
Badger Creek ab 1st tributary	4	4	4.2(02)
Badger Creek @ mouth	5.55	4	
1st tributary to Badger Creek	0.95	2	
Cold Storage Creek @ mouth	0.68	1	
Wendover Creek ab WF Wendover	1.09	2	
Wendover Creek @ mouth	3.94	4	6.3(02)
WF Wendover Creek @ mouth	1.95	2	
Un-named E of Papoose Creek	0.82	2	
Un-named ab Powell Pasture	0.99	2	
Cliff Creek @ mouth	6.15	4	
1st tributary to Cliff Creek	0.76	1	
Walton Creek ab 1st tributary	1.17	2	
Walton Creek bl 1st tributary	2.04	2	
Walton Creek bl Kube Creek	5.32	4	
Walton Creek @ mouth	11.13	6	
1st tributary to Walton Creek	0.87	2	
2nd tributary to Walton Creek	0.5	1	
3rd tributary to Walton Creek	1.55	2	
Kube Creek @ mouth	1.02	2	
Papoose Creek bl EF/WF confluence	15.17	7	
Papoose Creek @ mouth	20.8	8	7.4(02)
Parachute Creek @ mouth	4.35	4	3.8(02)
WF Papoose Creek right fork	0.48	1	
WF Papoose Creek left fork	0.93	2	
WF Papoose Creek bl 2nd tributary	4.65	4	
WF Papoose Creek @ confluence	10.66	6	7.4(07)
1st tributary to WF Papoose Cr	1.37	2	
2nd tributary to WF Papoose Cr	0.87	2	
3rd tributary to WF Papoose Cr	2.6	3	
4th tributary to WF Papoose Cr	0.7	1	
EF Papoose Creek ab 1st tributary	2.23	3	
EF Papoose Creek @ confluence	4.51	4	5.2(07)
1st tributary to EF Papoose Cr	0.95	2	

Colt Killed Creek bl Storm Creek	213.94	28	
Colt Killed Creek ab Beaver Creek	228.24	29	
Colt Killed Creek @ mouth	247.19	30	
1st tributary to Colt Killed Creek	0.68	1	
Crab Creek @ mouth	2.48	3	
2nd tributary to Colt Killed Creek	0.56	1	
3rd tributary to Colt Killed Creek	0.51	1	
4th tributary to Colt Killed Creek	1.17	2	
Cabin Creek ab 1st tributary	3.56	3	
Cabin Creek @ mouth	4.69	4	
1st tributary to Cabin Creek	0.46	1	
Beaver Creek ab 1st tributary	2.31	3	
Beaver Creek bl 2nd tributary	6.65	5	
Beaver Creek @ mouth	11.28	6	
1st tributary to Beaver Creek	0.99	2	
2nd tributary to Beaver Creek	1.22	2	
3rd tributary to Beaver Creek	0.85	2	
4th tributary to Beaver Creek	0.82	2	
Crooked Fork bl Boulder Creek	55.43	14	
Crooked Fork bl Haskell Creek	72.41	16	
Crooked Fork ab Brushy Fork	73.69	16	
Crooked Fork bl Brushy Fork	155.03	24	
Crooked Fork @ mouth	169.44	25	
Shotgun Creek ab 1st tributary	1.01	2	
Shotgun Creek @ mouth	5.74	4	
1st tributary to Shotgun Creek	0.73	1	
2nd tributary to Shotgun Creek	0.48	1	
1st tributary to Crooked Fork	0.56	1	
2nd tributary to Crooked Fork	0.92	2	
Rock Creek @ mouth	2.78	3	
Haskell Creek ab 1st tributary	1.58	2	3.1(98)
Haskell Creek @ mouth	3.22	3	
1st tributary to Haskell Creek	0.59	1	
3rd tributary to Crooked Fork	0.85	2	
4th tributary to Crooked Fork	0.6	1	
5th tributary to Crooked Fork	0.65	1	
6th tributary to Crooked Fork	0.71	1	
7th tributary to Crooked Fork	2.11	3	
8th tributary to Crooked Fork	0.94	2	
9th tributary to Crooked Fork	0.56	1	
10th tributary to Crooked Fork	1.39	2	
11th tributary to Crooked Fork	0.61	1	

Brushy Fork ab Elk Meadows	3.9	3	
Brushy Fork ab 1st tributary	11.89	6	
Brushy Fork ab Spruce Creek	16.03	7	
Brushy Fork bl Spruce Creek	40.63	12	15.8, 18.1, 15.1(10)
Brushy Fork ab Twin Creek	51.32	13	
Brushy Fork bl Twin Creek	59.39	14	
Brushy Fork @ mouth	81.34	17	
1st tributary to Brushy Fork	1.46	2	
2nd tributary to Brushy Fork	0.88	2	
3rd tributary to Brushy Fork	1.08	2	
4th tributary to Brushy Fork	1.75	2	
5th tributary to Brushy Fork	0.73	1	
Twin Creek ab Cherokee Creek	5.63	4	
Twin Creek @ mouth	8.07	5	
1st tributary to Twin Creek	0.92	2	
2nd tributary to Twin Creek	0.56	1	
Cherokee Creek ab 1st tributary	1.21	2	
Cherokee Creek @ mouth	2.3	3	
1st tributary to Cherokee Creek	0.59	1	
6th tributary to Brushy Fork	1.71	2	
1st tributary to 6th tributary	0.33	1	
7th tributary to Brushy Fork	2.91	3	
Pack Creek ab Packer Meadows	2.69	3	
Pack Creek ab 1st tributary	7.4	5	5.8(98) 4.4(07)
Pack Creek @ mouth	11.16	6	
1st tributary to Pack Creek	0.8	2	
8th tributary to Brushy Fork	0.34	1	
Spruce Creek bl NF/SF confluence	13.69	7	
Spruce Creek @ mouth	24.6	9	10.8(10)
1st tributary to Spruce Creek	0.65	1	
Shoot Creek @ mouth	5.13	4	
SF Spruce Creek @ wilderness bdy	2.43	3	
SF Spruce Creek @ confluence	8.35	5	
un-connected tributary to SF Spruce	1.22	2	
NF Spruce Creek ab 1st tributary	1.3	2	
NF Spruce Creek @ confluence	5.34	4	
1st tributary to NF Spruce Creek	0.69	1	



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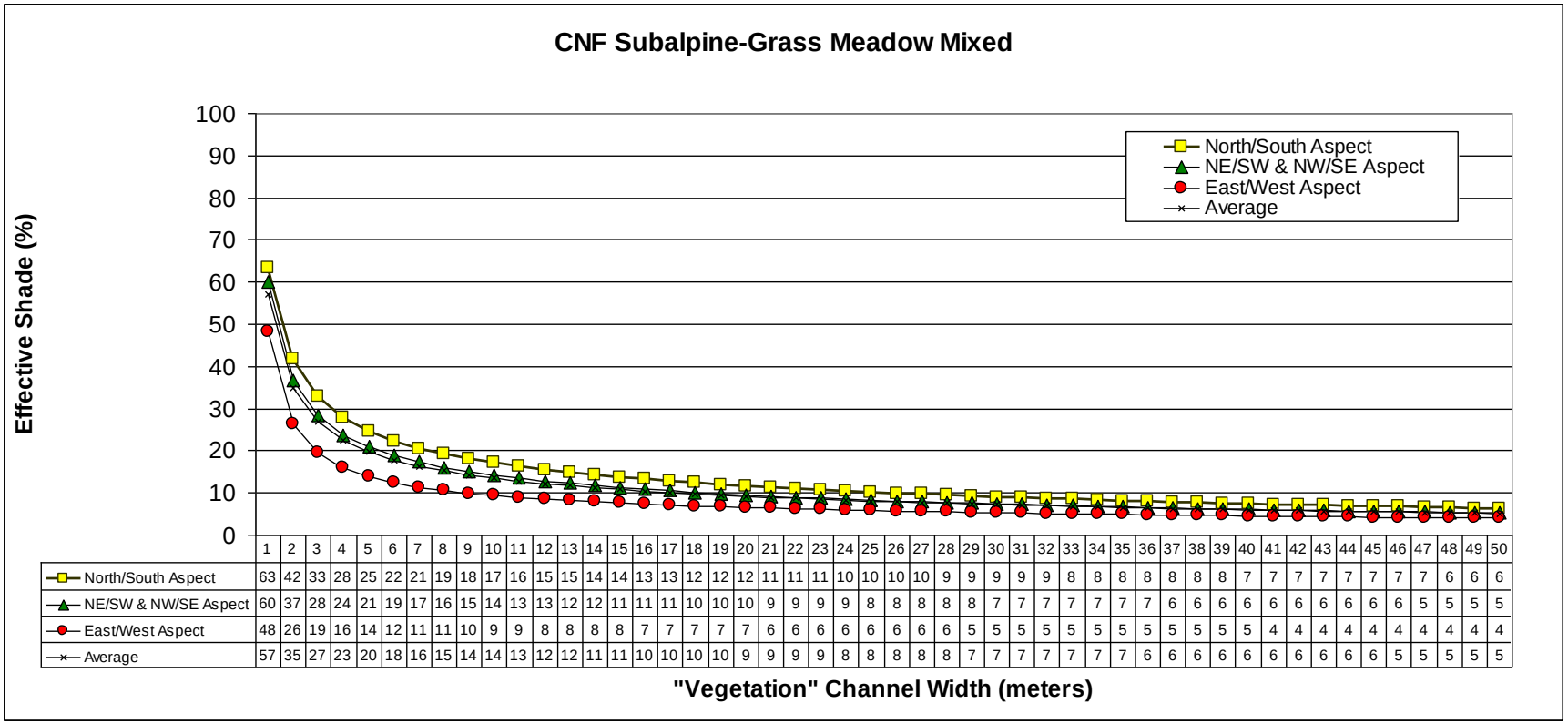
North/South Aspect	91	86	77	66	59	52	47	43	40	37	34	32	30	28	27	25	24	23	22	21	21	20	19	18	18	17	17	16	16	15	15	15	14	14	13	13	13	13	12	12	12	12	11	11	11	11	10	10	10	10
NE/SW & NW/SE Aspect	91	86	76	63	55	48	43	39	35	32	30	28	26	25	23	22	21	20	19	18	18	17	16	16	15	15	14	14	13	13	13	12	12	12	11	11	11	11	10	10	10	10	10	9	9	9	9	9	8	8
East/West Aspect	93	90	70	54	44	37	32	28	25	23	21	19	18	17	16	15	14	13	13	12	12	11	11	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6
Average	92	87	74	61	52	46	41	37	33	31	28	26	25	23	22	21	20	19	18	17	17	16	15	15	14	14	13	13	13	12	12	12	11	11	11	11	10	10	10	10	9	9	9	9	9	9	8	8	8	8

Figure D-1. Shade curve for the Clearwater National Forest (CNF) Upland Forest – Alder Mixed community 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	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	63	42	33	28	25	22	21	19	18	17	16	15	15	14	14	13	13	12	12	12	11	11	11	10	10	10	10	9	9	9	9	9	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7	6	6	6
NE/SW & NW/SE Aspect	60	37	28	24	21	19	17	16	15	14	13	13	12	12	11	11	11	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6	6	5	5	5	5
East/West Aspect	48	26	19	16	14	12	11	11	10	9	9	8	8	8	8	7	7	7	7	7	6	6	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4
Average	57	35	27	23	20	18	16	15	14	14	13	12	12	11	11	10	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5

Figure D-2. Shade curve for the Clearwater National Forest (CNF) Subalpine Forest – Graminoid Meadow Mixed community type.

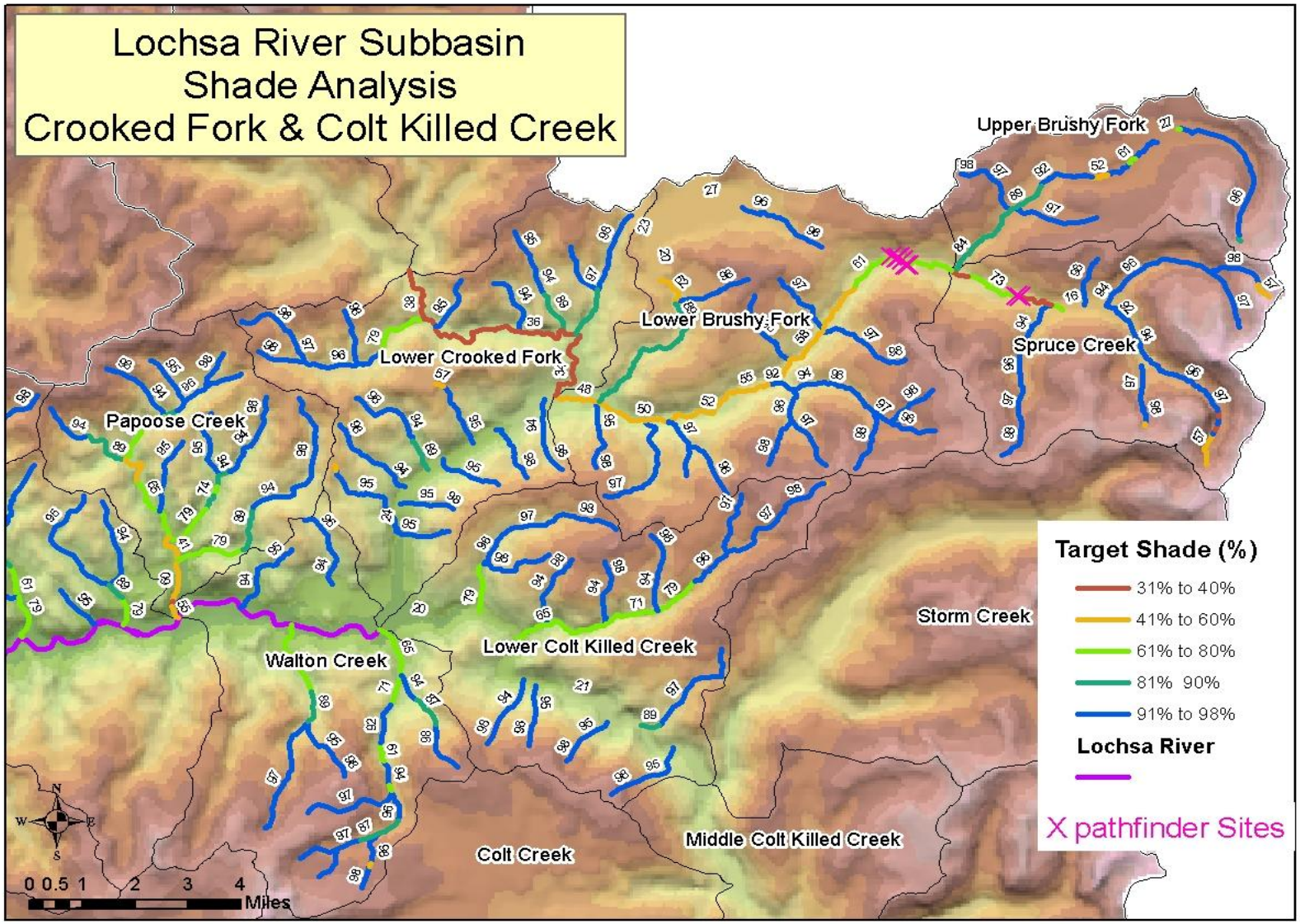


Figure D-3. Target shade for assessment units in the upper Lochsa River subbasin.

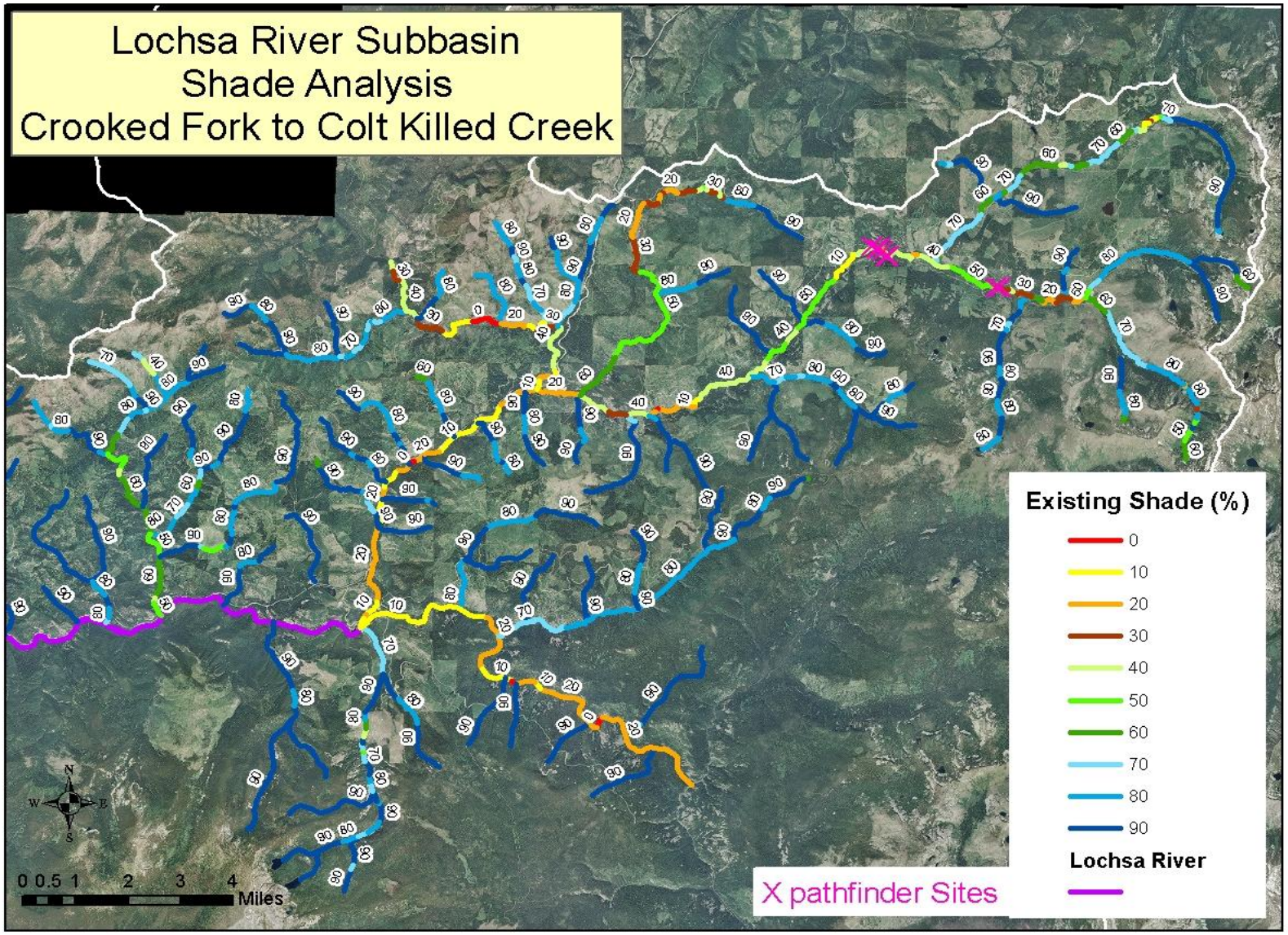


Figure D-4. Existing shade from aerial photo interpretation for assessment units in the upper Lochsa River subbasin.

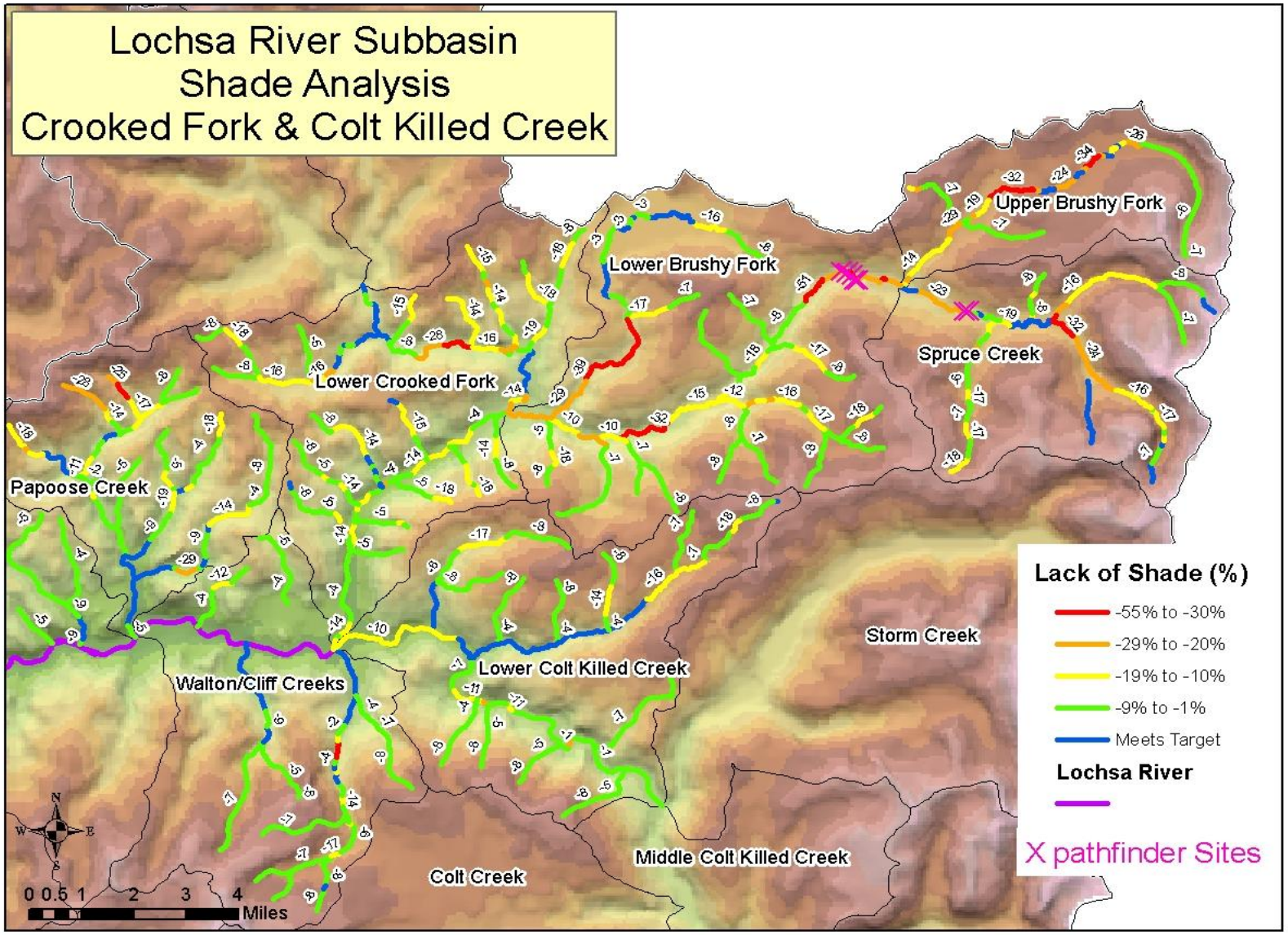


Figure D-5. Lack of shade for assessment units in the upper Lochsa River subbasin.

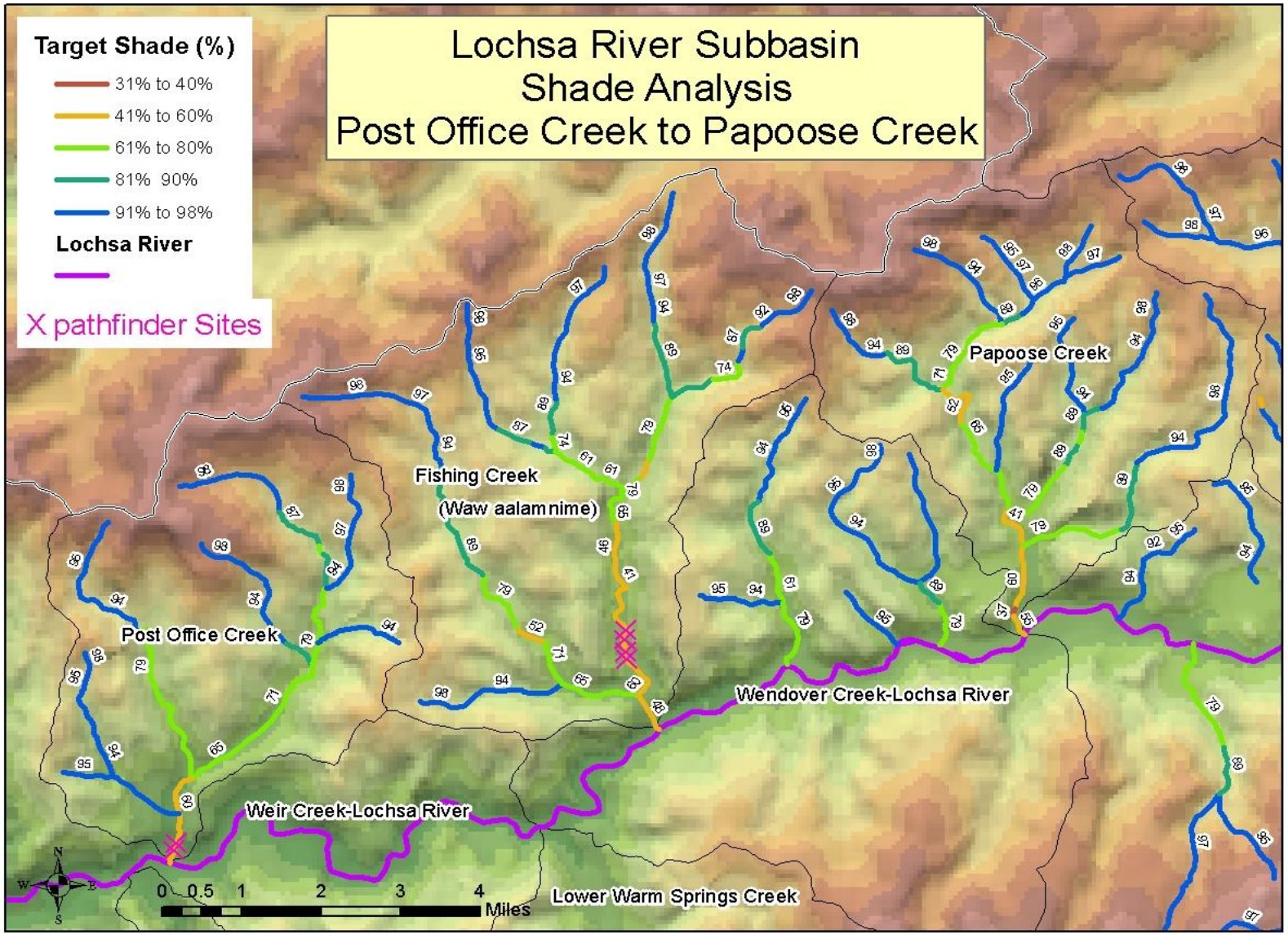


Figure D-6. Target shade for assessment units in the middle Lochsa River subbasin.

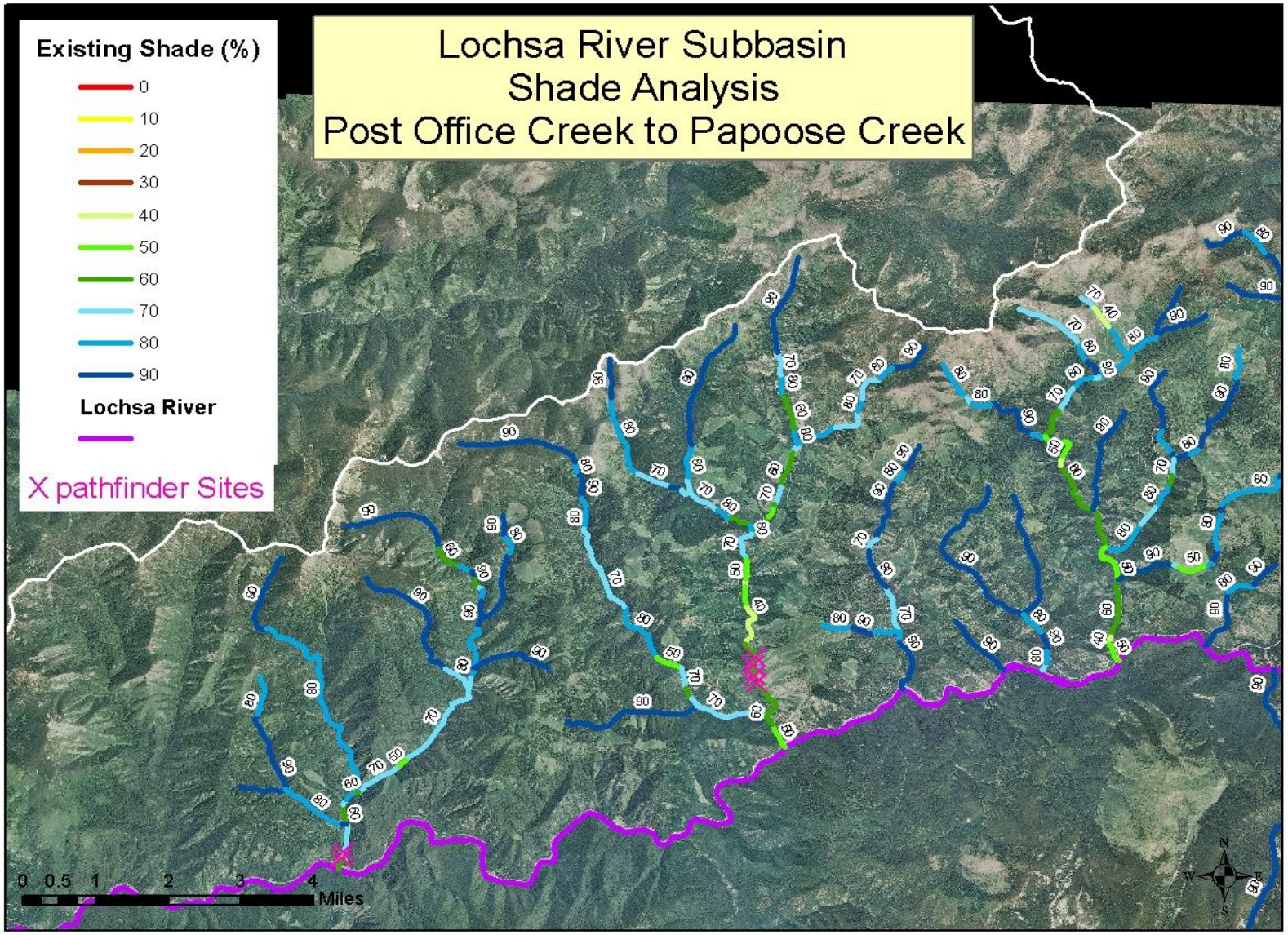


Figure D-7. Existing shade from aerial photo interpretation for assessment units in the middle Lochsa River subbasin.

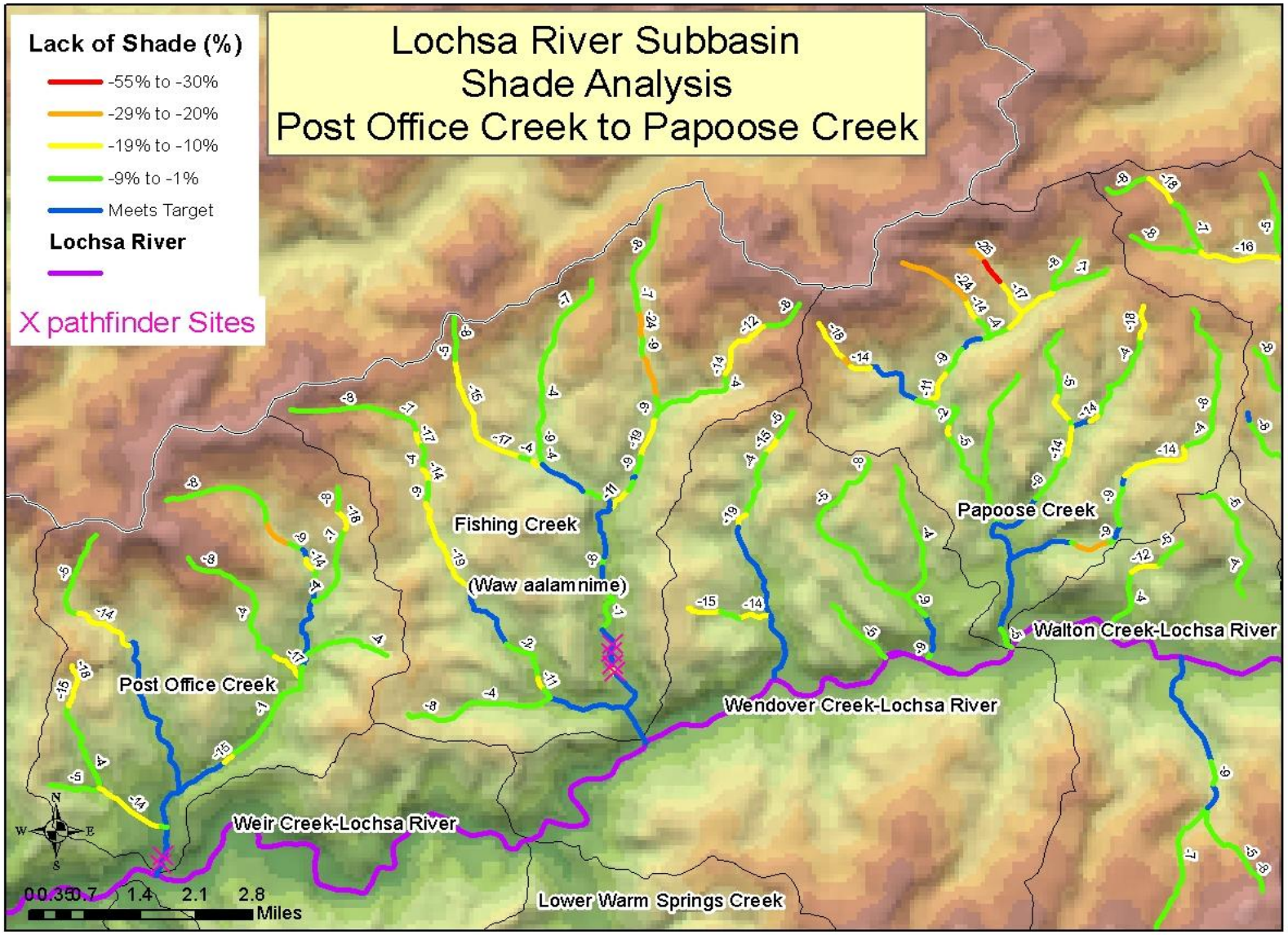


Figure D-8. Lack of shade for assessment units in the middle Lochsa River subbasin.

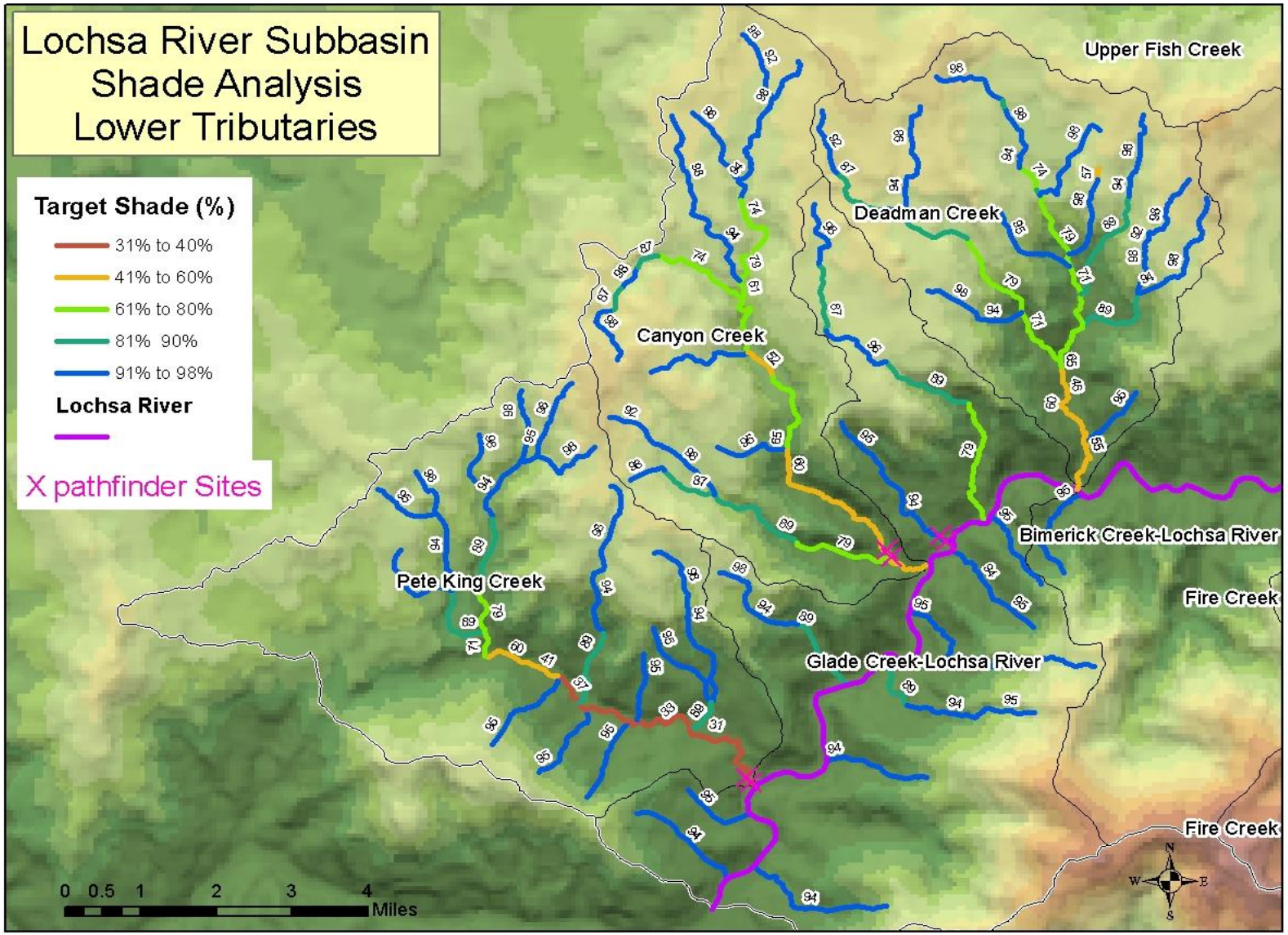


Figure D-9. Target shade for assessment units in the lower Lochsa River subbasin.

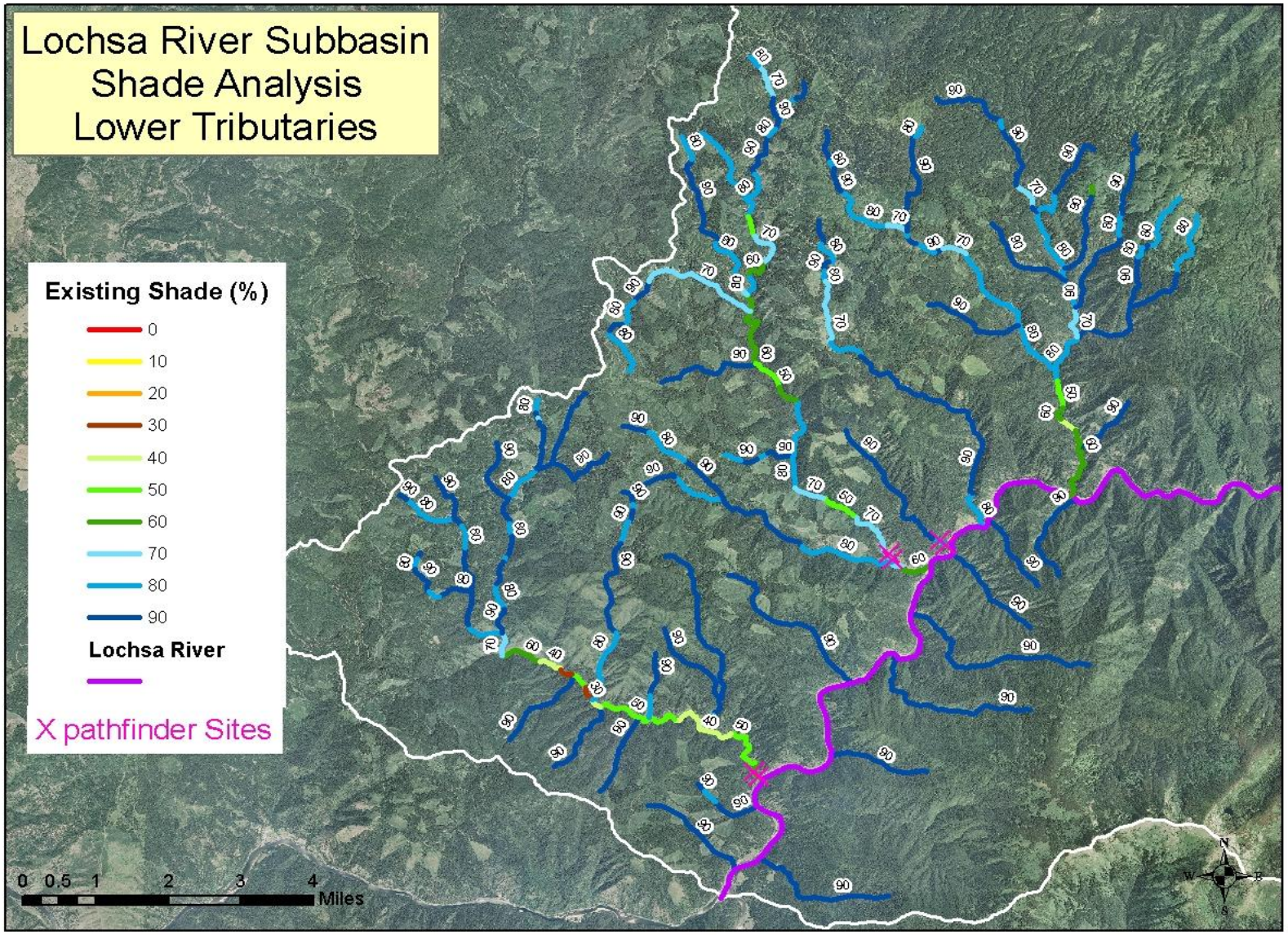


Figure D-10. Existing shade from aerial photo interpretation for assessment units in the lower Lochsa River subbasin.

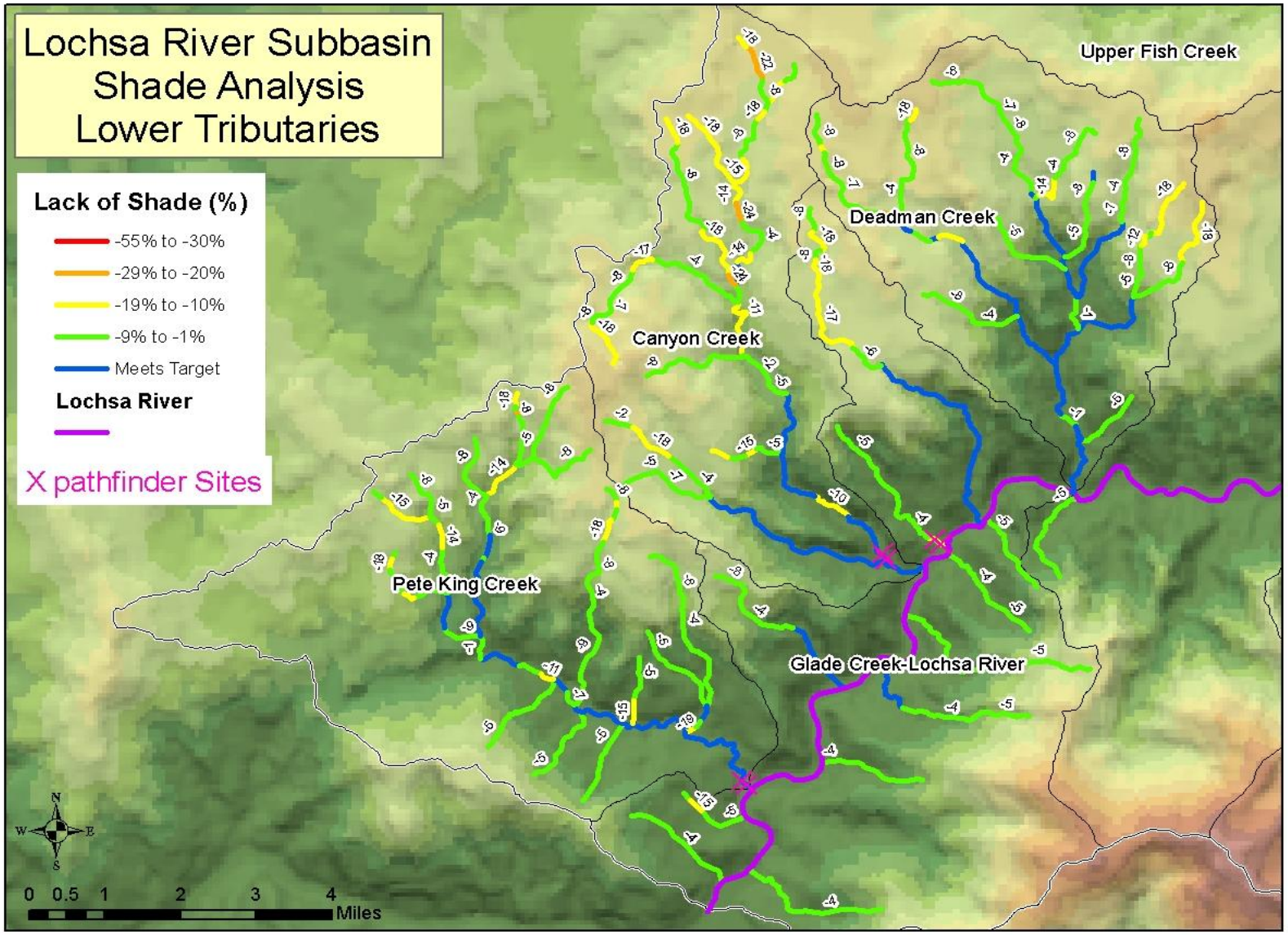


Figure D-11. Lack of shade for assessment units in the lower Lochsa River subbasin.

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Appendix E. Load Analysis Tables

Table E-1. Existing and potential solar loads for lower Lochsa River tributaries (AU# ID17060303CL001_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Lower Lochsa Tributaries**
AU# ID17060303CL001_02															
2600	0.9	0.55	0.94	0.33	-0.22	2	2	5200	2860	5200	1716	-1144	-4	breakland	un-named/Lowell
3400	0.9	0.55	0.94	0.33	-0.22	2	2	6800	3740	6800	2244	-1496	-4		Lottie Creek
220	0.9	0.55	0.95	0.275	-0.275	1	1	220	121	220	60.5	-60.5	-5		Lowell Creek
340	0.8	1.1	0.95	0.275	-0.825	1	1	340	374	340	93.5	-280.5	-15		
1100	0.9	0.55	0.95	0.275	-0.275	1	1	1100	605	1100	302.5	-302.5	-5		
2300	0.9	0.55	0.94	0.33	-0.22	2	2	4600	2530	4600	1518	-1012	-4		Cat Creek
770	0.9	0.55	0.98	0.11	-0.44	1	1	770	423.5	770	84.7	-338.8	-8	upland	Rye Patch Creek
1700	0.9	0.55	0.94	0.33	-0.22	2	2	3400	1870	3400	1122	-748	-4	breakland	
1800	0.9	0.55	0.89	0.605	0.055	3	3	5400	2970	5400	3267	297	0		
1400	0.9	0.55	0.95	0.275	-0.275	1	1	1400	770	1400	385	-385	-5		Handy Creek
1400	0.9	0.55	0.94	0.33	-0.22	2	2	2800	1540	2800	924	-616	-4		
1500	0.9	0.55	0.89	0.605	0.055	3	3	4500	2475	4500	2722.5	247.5	0		
2600	0.9	0.55	0.95	0.275	-0.275	1	1	2600	1430	2600	715	-715	-5		Hellgate Creek
2500	0.9	0.55	0.94	0.33	-0.22	2	2	5000	2750	5000	1650	-1100	-4		
1300	0.9	0.55	0.95	0.275	-0.275	1	1	1300	715	1300	357.5	-357.5	-5		Chance Creek
1300	0.9	0.55	0.94	0.33	-0.22	2	2	2600	1430	2600	858	-572	-4		
2000	0.9	0.55	0.95	0.275	-0.275	1	1	2000	1100	2000	550	-550	-5		Apgar Creek
1500	0.9	0.55	0.94	0.33	-0.22	2	2	3000	1650	3000	990	-660	-4		
490	0.8	1.1	0.94	0.33	-0.77	3	2	1470	1617	980	323.4	-1293.6	-14		
590	0.9	0.55	0.98	0.11	-0.44	1	1	590	324.5	590	64.9	-259.6	-8	upland	Glade Creek
620	0.8	1.1	0.98	0.11	-0.99	1	1	620	682	620	68.2	-613.8	-18		
270	0.9	0.55	0.98	0.11	-0.44	1	1	270	148.5	270	29.7	-118.8	-8		
260	0.8	1.1	0.98	0.11	-0.99	1	1	260	286	260	28.6	-257.4	-18		
1500	0.7	1.65	0.87	0.715	-0.935	2	2	3000	4950	3000	2145	-2805	-17	alder mix	
860	0.8	1.1	0.98	0.11	-0.99	2	2	1720	1892	1720	189.2	-1702.8	-18	upland	
830	0.9	0.55	0.96	0.22	-0.33	3	3	2490	1369.5	2490	547.8	-821.7	-6		
2200	0.9	0.55	0.89	0.605	0.055	3	3	6600	3630	6600	3993	363	0	breakland	
2100	0.9	0.55	0.79	1.155	0.605	4	4	8400	4620	8400	9702	5082	0		
970	0.8	1.1	0.79	1.155	0.055	4	4	3880	4268	3880	4481.4	213.4	0		
2000	0.9	0.55	0.95	0.275	-0.275	1	1	2000	1100	2000	550	-550	-5		un-named/Glade
2400	0.9	0.55	0.95	0.275	-0.275	1	1	2400	1320	2400	660	-660	-5		un-named/Deadman
							Total	**86,730**	**55,561**	**86,240**	**42,343**	**-13,218**	**-7**		

Table E-2. Existing and potential solar loads for Cold Storage Creek and others (AU# 17060303CL020_02a).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Cold Storage Creek & Others**
AU# ID17060303CL020_02a															
1500	0.9	0.55	0.95	0.275	-0.275	1	1	1500	825	1500	412.5	-412.5	-5	breakland	Cold Storage Cr
670	0.9	0.55	0.95	0.275	-0.275	1	1	670	368.5	670	184.25	-184.25	-5		un-named E of
640	0.8	1.1	0.92	0.44	-0.66	1	1	640	704	640	281.6	-422.4	-12	alder mix	Papoose Cr
1500	0.9	0.55	0.94	0.33	-0.22	2	2	3000	1650	3000	990	-660	-4	breakland	
1400	0.9	0.55	0.95	0.275	-0.275	1	1	1400	770	1400	385	-385	-5		un-named ab
1300	0.9	0.55	0.94	0.33	-0.22	2	2	2600	1430	2600	858	-572	-4		Powell Pasture
							Total	**9,810**	**5,748**	**9,810**	**3,111**	**-2,636**	**-6**		

Table E-3. Existing and potential solar loads for Cliff Creek and tributary (AU# 17060303CL022_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Cliff Creek & Tributary**
AU# ID17060303CL022_02															
630	0.9	0.55	0.98	0.11	-0.44	1	1	630	346.5	630	69.3	-277.2	-8	subalpine	Tributary to
1700	0.9	0.55	0.95	0.275	-0.275	1	1	1700	935	1700	467.5	-467.5	-5	breakland	Cliff Creek
4100	0.9	0.55	0.97	0.165	-0.385	2	2	8200	4510	8200	1353	-3157	-7	subalpine	Cliff Creek
580	0.9	0.55	0.89	0.605	0.055	3	3	1740	957	1740	1052.7	95.7	1	breakland	
510	0.8	1.1	0.89	0.605	-0.495	3	3	1530	1683	1530	925.65	-757.35	-9		
2600	0.9	0.55	0.79	1.155	0.605	4	4	10400	5720	10400	12012	6292	0		
							Total	**24,200**	**14,152**	**24,200**	**15,880**	**1,729**	**-5**		

Table E-4. Existing and potential solar loads for Walton Creek and tributaries (AU# 17060303CL023_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Walton Creek & Tributaries**
AU# ID17060303CL023_02															
540	0	5.5	0	5.5	0	240	240	129600	712800	129600	712800	0	0	lake	1st tributary to Walton Creek
1200	0.9	0.55	0.97	0.165	-0.385	2	2	2400	1320	2400	396	-924	-7	subalpine	
740	0.9	0.55	0.98	0.11	-0.44	1	1	740	407	740	81.4	-325.6	-8		2nd tributary to Walton Creek
120	0.7	1.65	0.57	2.365	0.715	1	1	120	198	120	283.8	85.8	0	meadow	
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	subalpine	
3000	0.9	0.55	0.97	0.165	-0.385	2	2	6000	3300	6000	990	-2310	-7		Kube Creek
1700	0.9	0.55	0.98	0.11	-0.44	1	1	1700	935	1700	187	-748	-8		3rd tributary to Walton Creek
1000	0.8	1.1	0.87	0.715	-0.385	2	2	2000	2200	2000	1430	-770	-7	alder mix	
940	0.9	0.55	0.94	0.33	-0.22	2	2	1880	1034	1880	620.4	-413.6	-4	breakland	
470	0	5.5	0	5.5	0	240	240	112800	620400	112800	620400	0	0	lake	Walton Creek
2100	0.9	0.55	0.97	0.165	-0.385	2	2	4200	2310	4200	693	-1617	-7	subalpine	
520	0.8	1.1	0.87	0.715	-0.385	2	2	1040	1144	1040	743.6	-400.4	-7	alder mix	
310	0.7	1.65	0.87	0.715	-0.935	2	2	620	1023	620	443.3	-579.7	-17		
500	0.8	1.1	0.87	0.715	-0.385	2	2	1000	1100	1000	715	-385	-7		
630	0.9	0.55	0.96	0.22	-0.33	3	3	1890	1039.5	1890	415.8	-623.7	-6	subalpine	
100	0.8	1.1	0.96	0.22	-0.88	3	3	300	330	300	66	-264	-16		
340	0.9	0.55	0.96	0.22	-0.33	3	3	1020	561	1020	224.4	-336.6	-6		
200	0.7	1.65	0.74	1.43	-0.22	3	3	600	990	600	858	-132	-4	alder mix	
360	0.8	1.1	0.94	0.33	-0.77	4	4	1440	1584	1440	475.2	-1108.8	-14	subalpine	
490	0.9	0.55	0.94	0.33	-0.22	4	4	1960	1078	1960	646.8	-431.2	-4		
330	0.7	1.65	0.61	2.145	0.495	4	4	1320	2178	1320	2831.4	653.4	0	alder mix	
120	0.5	2.75	0.61	2.145	-0.605	4	4	480	1320	480	1029.6	-290.4	-11		
180	0.7	1.65	0.61	2.145	0.495	4	4	720	1188	720	1544.4	356.4	0		
210	0.9	0.55	0.94	0.33	-0.22	4	4	840	462	840	277.2	-184.8	-4	subalpine	
280	0.4	3.3	0.92	0.44	-2.86	5	5	1400	4620	1400	616	-4004	-52		
280	0.6	2.2	0.92	0.44	-1.76	5	5	1400	3080	1400	616	-2464	-32		
250	0.8	1.1	0.92	0.44	-0.66	5	5	1250	1375	1250	550	-825	-12		
330	0.9	0.55	0.92	0.44	-0.11	5	5	1650	907.5	1650	726	-181.5	-2		
1000	0.9	0.55	0.71	1.595	1.045	5	5	5000	2750	5000	7975	5225	0	breakland	
1800	0.7	1.65	0.65	1.925	0.275	6	6	10800	17820	10800	20790	2970	0		
							Total	**297,270**	**1,390,059**	**297,270**	**1,379,546**	**-10,513**	**-8**		

Table E-5. Existing and potential solar loads for Colt Killed Creek tributaries (AU# 17060303CL024_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Colt Killed Creek Tributaries**
AU# ID17060303CL024_02															
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8	subalpine	1st tributary
1600	0.9	0.55	0.95	0.275	-0.275	1	1	1600	880	1600	440	-440	-5	breakland	
3600	0.9	0.55	0.97	0.165	-0.385	2	2	7200	3960	7200	1188	-2772	-7	subalpine	Crab Creek
560	0.8	1.1	0.89	0.605	-0.495	3	3	1680	1848	1680	1016.4	-831.6	-9	breakland	
140	0	5.5	0	5.5	0	80	80	11200	61600	11200	61600	0	0	lake	2nd tributary
790	0.9	0.55	0.98	0.11	-0.44	1	1	790	434.5	790	86.9	-347.6	-8	subalpine	
1100	0.9	0.55	0.95	0.275	-0.275	1	1	1100	605	1100	302.5	-302.5	-5	breakland	
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8	subalpine	3rd tributary
860	0.9	0.55	0.95	0.275	-0.275	1	1	860	473	860	236.5	-236.5	-5	breakland	
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	subalpine	4th tributary
1200	0.9	0.55	0.94	0.33	-0.22	2	2	2400	1320	2400	792	-528	-4	breakland	
2100	0.9	0.55	0.98	0.11	-0.44	1	1	2100	1155	2100	231	-924	-8	subalpine	Cabin Creek
1700	0.8	1.1	0.97	0.165	-0.935	2	2	3400	3740	3400	561	-3179	-17		
1200	0.9	0.55	0.96	0.22	-0.33	3	3	3600	1980	3600	792	-1188	-6		
1700	0.8	1.1	0.79	1.155	0.055	4	4	6800	7480	6800	7854	374	0	breakland	
2300	0.9	0.55	0.98	0.11	-0.44	1	1	2300	1265	2300	253	-1012	-8	subalpine	1st to Cabin Cr
							Total	**48,730**	**88,776**	**48,730**	**75,760**	**-13,015**	**-7**		

Table E-6. Existing and potential solar loads for Colt Killed Creek (AU# 17060303CL024_04).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Colt Killed Creek**
AU# ID17060303CL024_04															
4220	0.2	4.4	0.21	4.345	-0.055	28	28	118160	519904	118160	513405.2	-6498.8	-1	breakland	bl Storm Creek
420	0	5.5	0.21	4.345	-1.155	28	28	11760	64680	11760	51097.2	-13582.8	-21		
330	0.2	4.4	0.21	4.345	-0.055	28	28	9240	40656	9240	40147.8	-508.2	-1		
2200	0.2	4.4	0.21	4.345	-0.055	29	29	63800	280720	63800	277211	-3509	-1		
290	0.1	4.95	0.21	4.345	-0.605	29	29	8410	41629.5	8410	36541.45	-5088.05	-11		
580	0.2	4.4	0.21	4.345	-0.055	29	29	16820	74008	16820	73082.9	-925.1	-1		
190	0	5.5	0.21	4.345	-1.155	29	29	5510	30305	5510	23940.95	-6364.05	-21		
1100	0.1	4.95	0.21	4.345	-0.605	29	29	31900	157905	31900	138605.5	-19299.5	-11		
1400	0.2	4.4	0.21	4.345	-0.055	29	29	40600	178640	40600	176407	-2233	-1		
760	0.2	4.4	0.2	4.4	0	30	30	22800	100320	22800	100320	0	0		Crooked Fork
4600	0.1	4.95	0.2	4.4	-0.55	30	30	138000	683100	138000	607200	-75900	-10		confluence
							Total	**467,000**	**2,171,868**	**467,000**	**2,037,959**	**-133,909**	**-7**		

Table E-7. Existing and potential solar loads for Beaver Creek and tributaries (AU# 17060303CL033_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Beaver Creek & Tributaries**
AU# ID17060303CL033_02															
2200	0.9	0.55	0.97	0.165	-0.385	2	2	4400	2420	4400	726	-1694	-7	subalpine	1st tributary
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8		2nd tributary to
920	0.8	1.1	0.94	0.33	-0.77	2	2	1840	2024	1840	607.2	-1416.8	-14	breakland	Beaver Creek
520	0.9	0.55	0.94	0.33	-0.22	2	2	1040	572	1040	343.2	-228.8	-4		
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	subalpine	3rd tributary to
1600	0.9	0.55	0.94	0.33	-0.22	2	2	3200	1760	3200	1056	-704	-4	breakland	Beaver Creek
690	0.9	0.55	0.98	0.11	-0.44	1	1	690	379.5	690	75.9	-303.6	-8	subalpine	4th tributary to
1900	0.9	0.55	0.94	0.33	-0.22	2	2	3800	2090	3800	1254	-836	-4	breakland	Beaver Creek
130	0.6	2.2	0.57	2.365	0.165	1	1	130	286	130	307.45	21.45	0	meadow	Beaver Creek
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	subalpine	
420	0.8	1.1	0.98	0.11	-0.99	1	1	420	462	420	46.2	-415.8	-18		
1500	0.9	0.55	0.97	0.165	-0.385	2	2	3000	1650	3000	495	-1155	-7		
2300	0.8	1.1	0.96	0.22	-0.88	3	3	6900	7590	6900	1518	-6072	-16		
1600	0.8	1.1	0.79	1.155	0.055	4	4	6400	7040	6400	7392	352	0	breakland	
2500	0.8	1.1	0.71	1.595	0.495	5	5	12500	13750	12500	19937.5	6187.5	0		
2500	0.7	1.65	0.65	1.925	0.275	6	6	15000	24750	15000	28875	4125	0		
							Total	**62,420**	**66,479**	**62,420**	**62,974**	**-3,504**	**-7**		

Table E-8. Existing and potential solar loads for Crooked Fork Creek tributaries (AU# 17060303CL034_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Crooked Fork Tributaries**
AU# ID17060303CL034_02															
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	subalpine	3rd tributary to
820	0.8	1.1	0.94	0.33	-0.77	2	2	1640	1804	1640	541.2	-1262.8	-14	breakland	Crooked Fork
650	0.9	0.55	0.94	0.33	-0.22	2	2	1300	715	1300	429	-286	-4		
420	0.8	1.1	0.98	0.11	-0.99	1	1	420	462	420	46.2	-415.8	-18	subalpine	4th tributary to
130	0.9	0.55	0.98	0.11	-0.44	1	1	130	71.5	130	14.3	-57.2	-8		Crooked Fork
570	0.8	1.1	0.98	0.11	-0.99	1	1	570	627	570	62.7	-564.3	-18		
910	0.9	0.55	0.95	0.275	-0.275	1	1	910	500.5	910	250.25	-250.25	-5	breakland	
230	0.6	2.2	0.57	2.365	0.165	1	1	230	506	230	543.95	37.95	0	meadow	5th tributary
1300	0.8	1.1	0.95	0.275	-0.825	1	1	1300	1430	1300	357.5	-1072.5	-15	breakland	
810	0.9	0.55	0.95	0.275	-0.275	1	1	810	445.5	810	222.75	-222.75	-5		
560	0.8	1.1	0.98	0.11	-0.99	1	1	560	616	560	61.6	-554.4	-18	subalpine	6th tributary to
1500	0.9	0.55	0.95	0.275	-0.275	1	1	1500	825	1500	412.5	-412.5	-5	breakland	Crooked Fork
870	0.9	0.55	0.98	0.11	-0.44	1	1	870	478.5	870	95.7	-382.8	-8	subalpine	7th tributary to
1400	0.8	1.1	0.94	0.33	-0.77	2	2	2800	3080	2800	924	-2156	-14	breakland	Crooked Fork
390	0.8	1.1	0.94	0.33	-0.77	2	2	780	858	780	257.4	-600.6	-14		
350	0.9	0.55	0.89	0.605	0.055	3	3	1050	577.5	1050	635.25	57.75	0		
140	0.8	1.1	0.89	0.605	-0.495	3	3	420	462	420	254.1	-207.9	-9		
220	0.9	0.55	0.89	0.605	0.055	3	3	660	363	660	399.3	36.3	0		
280	0.8	1.1	0.89	0.605	-0.495	3	3	840	924	840	508.2	-415.8	-9		
130	0.9	0.55	0.89	0.605	0.055	3	3	390	214.5	390	235.95	21.45	0		
680	0.9	0.55	0.98	0.11	-0.44	1	1	680	374	680	74.8	-299.2	-8	subalpine	8th tributary to
860	0.9	0.55	0.95	0.275	-0.275	1	1	860	473	860	236.5	-236.5	-5	breakland	Crooked Fork
220	0.8	1.1	0.94	0.33	-0.77	2	2	440	484	440	145.2	-338.8	-14		
380	0.9	0.55	0.94	0.33	-0.22	2	2	760	418	760	250.8	-167.2	-4		
320	0.8	1.1	0.94	0.33	-0.77	2	2	640	704	640	211.2	-492.8	-14		
580	0.9	0.55	0.94	0.33	-0.22	2	2	1160	638	1160	382.8	-255.2	-4		
100	0.9	0.55	0.98	0.11	-0.44	1	1	100	55	100	11	-44	-8	subalpine	9th tributary to
190	0.8	1.1	0.98	0.11	-0.99	1	1	190	209	190	20.9	-188.1	-18		Crooked Fork
1400	0.9	0.55	0.95	0.275	-0.275	1	1	1400	770	1400	385	-385	-5	breakland	
160	0.6	2.2	0.57	2.365	0.165	1	1	160	352	160	378.4	26.4	0	meadow	10th tributary to
630	0.9	0.55	0.98	0.11	-0.44	1	1	630	346.5	630	69.3	-277.2	-8	subalpine	
1300	0.9	0.55	0.95	0.275	-0.275	1	1	1300	715	1300	357.5	-357.5	-5	breakland	Crooked Fork
300	0.8	1.1	0.94	0.33	-0.77	2	2	600	660	600	198	-462	-14		
490	0.7	1.65	0.94	0.33	-1.32	2	2	980	1617	980	323.4	-1293.6	-24		
460	0.9	0.55	0.94	0.33	-0.22	2	2	920	506	920	303.6	-202.4	-4		
1700	0.9	0.55	0.95	0.275	-0.275	1	1	1700	935	1700	467.5	-467.5	-5		11th tributary
							Total	**30,800**	**24,822**	**30,800**	**10,189**	**-14,633**	**-9**		

Table E-9. Existing and potential solar loads for Crooked Fork Creek (AU# 17060303CL034_05).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Crooked Fork**
AU# ID17060303CL034_05															
1300	0.2	4.4	0.24	4.18	-0.22	24	24	31200	137280	31200	130416	-6864	-4	breakland	bl Brushy Fork
2700	0.1	4.95	0.24	4.18	-0.77	24	24	64800	320760	64800	270864	-49896	-14		
870	0.2	4.4	0.24	4.18	-0.22	24	24	20880	91872	20880	87278.4	-4593.6	-4		
160	0	5.5	0.24	4.18	-1.32	24	24	3840	21120	3840	16051.2	-5068.8	-24		
550	0.2	4.4	0.24	4.18	-0.22	24	24	13200	58080	13200	55176	-2904	-4		
630	0.1	4.95	0.24	4.18	-0.77	25	25	15750	77962.5	15750	65835	-12127.5	-14		
420	0.2	4.4	0.24	4.18	-0.22	25	25	10500	46200	10500	43890	-2310	-4		
970	0.1	4.95	0.24	4.18	-0.77	25	25	24250	120037.5	24250	101365	-18672.5	-14		
2600	0.2	4.4	0.24	4.18	-0.22	25	25	65000	286000	65000	271700	-14300	-4		
570	0.1	4.95	0.24	4.18	-0.77	25	25	14250	70537.5	14250	59565	-10972.5	-14		
140	0.2	4.4	0.24	4.18	-0.22	25	25	3500	15400	3500	14630	-770	-4		Colt Killed Cr
320	0.1	4.95	0.24	4.18	-0.77	25	25	8000	39600	8000	33440	-6160	-14		confluence
							Total	**275,170**	**1,284,850**	**275,170**	**1,150,211**	**-134,639**	**-10**		

Table E-10. Existing and potential solar loads for Brushy Fork Creek tributaries (AU# 17060303CL035_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Brushy Fork Tributaries**
AU# ID17060303CL035_02															
2300	0.9	0.55	0.97	0.165	-0.385	2	2	4600	2530	4600	759	-1771	-7	subalpine	3rd to Brushy Fk
920	0.9	0.55	0.98	0.11	-0.44	1	1	920	506	920	101.2	-404.8	-8		4th tributary to Brushy Fork
1400	0.8	1.1	0.97	0.165	-0.935	2	2	2800	3080	2800	462	-2618	-17		
630	0.9	0.55	0.97	0.165	-0.385	2	2	1260	693	1260	207.9	-485.1	-7		
2700	0.9	0.55	0.98	0.11	-0.44	1	1	2700	1485	2700	297	-1188	-8		5th to Brushy Fk
1500	0.9	0.55	0.98	0.11	-0.44	1	1	1500	825	1500	165	-660	-8		Twin Creek
580	0.9	0.55	0.97	0.165	-0.385	2	2	1160	638	1160	191.4	-446.6	-7		
850	0.8	1.1	0.97	0.165	-0.935	2	2	1700	1870	1700	280.5	-1589.5	-17		
300	0.9	0.55	0.96	0.22	-0.33	3	3	900	495	900	198	-297	-6		
880	0.8	1.1	0.96	0.22	-0.88	3	3	2640	2904	2640	580.8	-2323.2	-16		
210	0.7	1.65	0.94	0.33	-1.32	4	4	840	1386	840	277.2	-1108.8	-24		
270	0.8	1.1	0.94	0.33	-0.77	4	4	1080	1188	1080	356.4	-831.6	-14		
430	0.7	1.65	0.94	0.33	-1.32	4	4	1720	2838	1720	567.6	-2270.4	-24		
870	0.8	1.1	0.92	0.44	-0.66	5	5	4350	4785	4350	1914	-2871	-12		
270	0.9	0.55	0.98	0.11	-0.44	1	1	270	148.5	270	29.7	-118.8	-8		1st tributary to Twin Creek
860	0.8	1.1	0.98	0.11	-0.99	1	1	860	946	860	94.6	-851.4	-18		
590	0.9	0.55	0.97	0.165	-0.385	2	2	1180	649	1180	194.7	-454.3	-7		
2100	0.9	0.55	0.98	0.11	-0.44	1	1	2100	1155	2100	231	-924	-8		2nd to Twin Cr
1900	0.9	0.55	0.97	0.165	-0.385	2	2	3800	2090	3800	627	-1463	-7		Cherokee Creek
1100	0.9	0.55	0.96	0.22	-0.33	3	3	3300	1815	3300	726	-1089	-6		
1700	0.9	0.55	0.98	0.11	-0.44	1	1	1700	935	1700	187	-748	-8		1st to Cherokee
2100	0.9	0.55	0.98	0.11	-0.44	1	1	2100	1155	2100	231	-924	-8		6th tributary to Brushy Fork
860	0.9	0.55	0.97	0.165	-0.385	2	2	1720	946	1720	283.8	-662.2	-7		
240	0.8	1.1	0.97	0.165	-0.935	2	2	480	528	480	79.2	-448.8	-17		
950	0.9	0.55	0.98	0.11	-0.44	1	1	950	522.5	950	104.5	-418	-8		1st to 6th
3500	0.9	0.55	0.97	0.165	-0.385	2	2	7000	3850	7000	1155	-2695	-7		7th tributary to Brushy Fork
260	0.7	1.65	0.96	0.22	-1.43	3	3	780	1287	780	171.6	-1115.4	-26		
120	0.9	0.55	0.96	0.22	-0.33	3	3	360	198	360	79.2	-118.8	-6		
760	0.9	0.55	0.98	0.11	-0.44	1	1	760	418	760	83.6	-334.4	-8		8th tributary to Brushy Fork
480	0.8	1.1	0.98	0.11	-0.99	1	1	480	528	480	52.8	-475.2	-18		
1100	0.9	0.55	0.95	0.275	-0.275	1	1	1100	605	1100	302.5	-302.5	-5	breakland	
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	subalpine	1st tributary to Pack Creek
1400	0.8	1.1	0.97	0.165	-0.935	2	2	2800	3080	2800	462	-2618	-17		
1900	0.9	0.55	0.98	0.11	-0.44	1	1	1900	1045	1900	209	-836	-8		Pack Creek
1100	0.8	1.1	0.96	0.22	-0.88	3	3	3300	3630	3300	726	-2904	-16		
100	0.3	3.85	0.27	4.015	0.165	3	3	300	1155	300	1204.5	49.5	0	subalpine	
300	0.4	3.3	0.27	4.015	0.715	3	3	900	2970	900	3613.5	643.5	0	meadow	
300	0.3	3.85	0.27	4.015	0.165	3	3	900	3465	900	3613.5	148.5	0	grass mix	
150	0.4	3.3	0.27	4.015	0.715	3	3	450	1485	450	1806.75	321.75	0		
50	0.5	2.75	0.27	4.015	1.265	3	3	150	412.5	150	602.25	189.75	0		
230	0.4	3.3	0.27	4.015	0.715	3	3	690	2277	690	2770.35	493.35	0		
380	0.3	3.85	0.27	4.015	0.165	3	3	1140	4389	1140	4577.1	188.1	0		
200	0.3	3.85	0.23	4.235	0.385	4	4	800	3080	800	3388	308	0		
520	0.2	4.4	0.23	4.235	-0.165	4	4	2080	9152	2080	8808.8	-343.2	-3		
110	0.3	3.85	0.23	4.235	0.385	4	4	440	1694	440	1863.4	169.4	0		
300	0.2	4.4	0.23	4.235	-0.165	4	4	1200	5280	1200	5082	-198	-3		
500	0.3	3.85	0.23	4.235	0.385	4	4	2000	7700	2000	8470	770	0		
1300	0.2	4.4	0.23	4.235	-0.165	4	4	5200	22880	5200	22022	-858	-3		
1400	0.3	3.85	0.2	4.4	0.55	5	5	7000	26950	7000	30800	3850	0		
1200	0.5	2.75	0.52	2.64	-0.11	5	5	6000	16500	6000	15840	-660	-2	alder mix	
3200	0.5	2.75	0.89	0.605	-2.145	6	6	19200	52800	19200	11616	-41184	-39	subalpine	
1700	0.6	2.2	0.89	0.605	-1.595	6	6	10200	22440	10200	6171	-16269	-29		
							Total	**124,760**	**235,934**	**124,760**	**144,747**	**-91,186**	**-9**		

Table E-11. Existing and potential solar loads for Brushy Fork Creek (AU# 17060303CL035_03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Brushy Fork**
AU# ID17060303CL035_03															
510	0.4	3.3	0.61	2.145	-1.155	15	12	7650	25245	6120	13127.4	-12117.6	-21	subalpine	bl Spruce Cr
230	0.2	4.4	0.61	2.145	-2.255	15	12	3450	15180	2760	5920.2	-9259.8	-41		
1100	0.4	3.3	0.61	2.145	-1.155	15	12	16500	54450	13200	28314	-26136	-21		
310	0.2	4.4	0.61	2.145	-2.255	15	12	4650	20460	3720	7979.4	-12480.6	-41		
880	0.4	3.3	0.61	2.145	-1.155	15	12	13200	43560	10560	22651.2	-20908.8	-21		
920	0.1	4.95	0.61	2.145	-2.805	15	12	13800	68310	11040	23680.8	-44629.2	-51		
1800	0.5	2.75	0.58	2.31	-0.44	15	13	27000	74250	23400	54054	-20196	-8		
80	0.5	2.75	0.58	2.31	-0.44	15	13	1200	3300	1040	2402.4	-897.6	-8		
190	0.5	2.75	0.58	2.31	-0.44	15	13	2850	7837.5	2470	5705.7	-2131.8	-8		
690	0.4	3.3	0.58	2.31	-0.99	15	13	10350	34155	8970	20720.7	-13434.3	-18		
600	0.5	2.75	0.58	2.31	-0.44	15	13	9000	24750	7800	18018	-6732	-8		
220	0.5	2.75	0.58	2.31	-0.44	15	13	3300	9075	2860	6606.6	-2468.4	-8		
930	0.4	3.3	0.58	2.31	-0.99	15	13	13950	46035	12090	27927.9	-18107.1	-18		ab Twin Creek
							Total	**126,900**	**426,608**	**106,030**	**237,108**	**-189,499**	**-21**		

Table E-12. Existing and potential solar loads for Brushy Fork Creek (AU# 17060303CL035_04).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Brushy Fork**
AU# ID17060303CL035_04															
1900	0.4	3.3	0.55	2.475	-0.825	15	14	28500	94050	26600	65835	-28215	-15	subalpine	bl Twin Creek
250	0.1	4.95	0.52	2.64	-2.31	15	15	3750	18562.5	3750	9900	-8662.5	-42		
450	0.2	4.4	0.52	2.64	-1.76	15	15	6750	29700	6750	17820	-11880	-32		
110	0.1	4.95	0.52	2.64	-2.31	15	15	1650	8167.5	1650	4356	-3811.5	-42		
670	0.2	4.4	0.52	2.64	-1.76	15	15	10050	44220	10050	26532	-17688	-32		
120	0	5.5	0.52	2.64	-2.86	15	15	1800	9900	1800	4752	-5148	-52		
240	0.2	4.4	0.52	2.64	-1.76	15	15	3600	15840	3600	9504	-6336	-32		
740	0.4	3.3	0.5	2.75	-0.55	16	16	11840	39072	11840	32560	-6512	-10		
570	0.3	3.85	0.5	2.75	-1.1	16	16	9120	35112	9120	25080	-10032	-20		
1100	0.4	3.3	0.5	2.75	-0.55	16	16	17600	58080	17600	48400	-9680	-10		
110	0.4	3.3	0.48	2.86	-0.44	17	17	1870	6171	1870	5348.2	-822.8	-8		
1300	0.2	4.4	0.48	2.86	-1.54	17	17	22100	97240	22100	63206	-34034	-28		at mouth
							Total	**118,630**	**456,115**	**116,730**	**313,293**	**-142,822**	**-27**		

Table E-13. Existing and potential solar loads for Spruce Creek and tributaries (AU# 17060303CL036_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Spruce Creek & Tributaries**
AU# ID17060303CL036_02															
650	0.6	2.2	0.57	2.365	0.165	1	1	650	1430	650	1537.25	107.25	0	meadow	SF Spruce Creek
440	0.5	2.75	0.57	2.365	-0.385	1	1	440	1210	440	1040.6	-169.4	-7		
180	0.9	0.55	0.98	0.11	-0.44	1	1	180	99	180	19.8	-79.2	-8	subalpine	
200	0.5	2.75	0.35	3.575	0.825	2	2	400	1100	400	1430	330	0	meadow	
240	0.8	1.1	0.97	0.165	-0.935	2	2	480	528	480	79.2	-448.8	-17	subalpine	
210	0.3	3.85	0.35	3.575	-0.275	2	2	420	1617	420	1501.5	-115.5	-5	meadow	
680	0.8	1.1	0.97	0.165	-0.935	2	2	1360	1496	1360	224.4	-1271.6	-17	subalpine	
90	0.2	4.4	0.27	4.015	-0.385	3	3	270	1188	270	1084.05	-103.95	-7	meadow	
1300	0.8	1.1	0.96	0.22	-0.88	3	3	3900	4290	3900	858	-3432	-16	subalpine	
2400	0.7	1.65	0.94	0.33	-1.32	4	4	9600	15840	9600	3168	-12672	-24		
820	0.6	2.2	0.92	0.44	-1.76	5	5	4100	9020	4100	1804	-7216	-32		
2100	0.9	0.55	0.97	0.165	-0.385	2	2	4200	2310	4200	693	-1617	-7		NF Spruce Creek
3200	0.8	1.1	0.96	0.22	-0.88	3	3	9600	10560	9600	2112	-8448	-16		
460	0.7	1.65	0.94	0.33	-1.32	4	4	1840	3036	1840	607.2	-2428.8	-24		
230	0.5	2.75	0.94	0.33	-2.42	4	4	920	2530	920	303.6	-2226.4	-44		
550	0.6	2.2	0.57	2.365	0.165	1	1	550	1210	550	1300.75	90.75	0	meadow	1st tributary to NF Spruce Cr
1800	0.9	0.55	0.98	0.11	-0.44	1	1	1800	990	1800	198	-792	-8		
140	0	5.5	0	5.5	0	100	100	14000	77000	14000	77000	0	0	lake	un-connected bl SF Spruce
60	0.6	2.2	0.57	2.365	0.165	1	1	60	132	60	141.9	9.9	0	meadow	
60	0	5.5	0	5.5	0	50	50	3000	16500	3000	16500	0	0	lake	
850	0.8	1.1	0.98	0.11	-0.99	1	1	850	935	850	93.5	-841.5	-18		
1100	0.9	0.55	0.97	0.165	-0.385	2	2	2200	1210	2200	363	-847	-7		
740	0.9	0.55	0.98	0.11	-0.44	1	1	740	407	740	81.4	-325.6	-8		1st tributary to Spruce Creek
120	0.8	1.1	0.98	0.11	-0.99	1	1	120	132	120	13.2	-118.8	-18		
570	0.9	0.55	0.98	0.11	-0.44	1	1	570	313.5	570	62.7	-250.8	-8		
250	0.8	1.1	0.98	0.11	-0.99	1	1	250	275	250	27.5	-247.5	-18		
200	0	5.5	0	5.5	0	110	110	22000	121000	22000	121000	0	0	lake	Shoot Creek
800	0.8	1.1	0.98	0.11	-0.99	1	1	800	880	800	88	-792	-18		
510	0.9	0.55	0.98	0.11	-0.44	1	1	510	280.5	510	56.1	-224.4	-8		
570	0.8	1.1	0.97	0.165	-0.935	2	2	1140	1254	1140	188.1	-1065.9	-17		
770	0.9	0.55	0.97	0.165	-0.385	2	2	1540	847	1540	254.1	-592.9	-7		
360	0.8	1.1	0.97	0.165	-0.935	2	2	720	792	720	118.8	-673.2	-17		
1100	0.9	0.55	0.96	0.22	-0.33	3	3	3300	1815	3300	726	-1089	-6		
150	0.8	1.1	0.96	0.22	-0.88	3	3	450	495	450	99	-396	-16		
240	0.7	1.65	0.94	0.33	-1.32	4	4	960	1584	960	316.8	-1267.2	-24		
540	0.9	0.55	0.94	0.33	-0.22	4	4	2160	1188	2160	712.8	-475.2	-4		
680	0.8	1.1	0.94	0.33	-0.77	4	4	2720	2992	2720	897.6	-2094.4	-14		
630	0.2	4.4	0.16	4.62	0.22	7	7	4410	19404	4410	20374.2	970.2	0	meadow	Spruce Creek
210	0.3	3.85	0.16	4.62	0.77	7	7	1470	5659.5	1470	6791.4	1131.9	0		
410	0.3	3.85	0.16	4.62	0.77	7	7	2870	11049.5	2870	13259.4	2209.9	0		
550	0.4	3.3	0.16	4.62	1.32	7	7	3850	12705	3850	17787	5082	0		
370	0.6	2.2	0.79	1.155	-1.045	8	8	2960	6512	2960	3418.8	-3093.2	-19	subalpine	
640	0.3	3.85	0.37	3.465	-0.385	8	8	5120	19712	5120	17740.8	-1971.2	-7	alder mix	
170	0.4	3.3	0.37	3.465	0.165	8	8	1360	4488	1360	4712.4	224.4	0		
520	0.3	3.85	0.37	3.465	-0.385	8	8	4160	16016	4160	14414.4	-1601.6	-7		
1600	0.5	2.75	0.73	1.485	-1.265	9	9	14400	39600	14400	21384	-18216	-23	subalpine	
540	0.4	3.3	0.33	3.685	0.385	9	9	4860	16038	4860	17909.1	1871.1	0	alder mix	
							Total	**144,260**	**439,670**	**144,260**	**374,493**	**-65,177**	**-11**		

Table E-14. Existing and potential solar loads for Brushy Fork Creek and tributaries (AU# 17060303CL037_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Brushy Fork & Tributaries**
AU# ID17060303CL037_02															
2700	0.9	0.55	0.97	0.165	-0.385	2	2	5400	2970	5400	891	-2079	-7	subalpine	1st tributary
100	0.8	1.1	0.98	0.11	-0.99	1	1	100	110	100	11	-99	-18		2nd tributary to Brushy Fork
220	0.7	1.65	0.98	0.11	-1.54	1	1	220	363	220	24.2	-338.8	-28		
1800	0.9	0.55	0.97	0.165	-0.385	2	2	3600	1980	3600	594	-1386	-7		
290	0.8	1.1	0.97	0.165	-0.935	2	2	580	638	580	95.7	-542.3	-17		
200	0	5.5	0	5.5	0	90	90	18000	99000	18000	99000	0	0	lake	Brushy Fork
220	0.8	1.1	0.87	0.715	-0.385	2	2	440	484	440	314.6	-169.4	-7	alder mix	
4700	0.9	0.55	0.96	0.22	-0.33	3	3	14100	7755	14100	3102	-4653	-6	subalpine	
410	0.7	1.65	0.96	0.22	-1.43	3	3	1230	2029.5	1230	270.6	-1758.9	-26		
80	0.5	2.75	0.74	1.43	-1.32	3	3	240	660	240	343.2	-316.8	-24	alder mix	
230	0.1	4.95	0.27	4.015	-0.935	3	3	690	3415.5	690	2770.35	-645.15	-17	meadow	
150	0.3	3.85	0.27	4.015	0.165	3	3	450	1732.5	450	1806.75	74.25	0		
370	0.1	4.95	0.27	4.015	-0.935	3	3	1110	5494.5	1110	4456.65	-1037.85	-17		
300	0.4	3.3	0.23	4.235	0.935	4	4	1200	3960	1200	5082	1122	0		
130	0.7	1.65	0.94	0.33	-1.32	4	4	520	858	520	171.6	-686.4	-24	subalpine	
630	0.6	2.2	0.94	0.33	-1.87	4	4	2520	5544	2520	831.6	-4712.4	-34		
170	0.7	1.65	0.94	0.33	-1.32	4	4	680	1122	680	224.4	-897.6	-24		
260	0.6	2.2	0.61	2.145	-0.055	4	4	1040	2288	1040	2230.8	-57.2	-1	alder mix	
890	0.7	1.65	0.94	0.33	-1.32	4	4	3560	5874	3560	1174.8	-4699.2	-24	subalpine	
560	0.6	2.2	0.52	2.64	0.44	5	5	2800	6160	2800	7392	1232	0	alder mix	
180	0.7	1.65	0.92	0.44	-1.21	5	5	900	1485	900	396	-1089	-22	subalpine	
150	0.4	3.3	0.92	0.44	-2.86	5	5	750	2475	750	330	-2145	-52		
1500	0.6	2.2	0.92	0.44	-1.76	5	5	7500	16500	7500	3300	-13200	-32		
730	0.7	1.65	0.89	0.605	-1.045	6	6	4380	7227	4380	2649.9	-4577.1	-19		
200	0.6	2.2	0.89	0.605	-1.595	6	6	1200	2640	1200	726	-1914	-29		
160	0.8	1.1	0.89	0.605	-0.495	6	6	960	1056	960	580.8	-475.2	-9		
180	0.6	2.2	0.89	0.605	-1.595	6	6	1080	2376	1080	653.4	-1722.6	-29		
620	0.6	2.2	0.89	0.605	-1.595	6	6	3720	8184	3720	2250.6	-5933.4	-29		
1900	0.7	1.65	0.84	0.88	-0.77	7	7	13300	21945	13300	11704	-10241	-14		
240	0.6	2.2	0.84	0.88	-1.32	7	7	1680	3696	1680	1478.4	-2217.6	-24		
150	0.7	1.65	0.84	0.88	-0.77	7	7	1050	1732.5	1050	924	-808.5	-14		
							Total	**95,000**	**221,755**	**95,000**	**155,780**	**-65,974**	**-18**		

Table E-15. Existing and potential solar loads for Crooked Fork Creek tributaries (AU# 17060303CL038_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Crooked Fork Tributaries**
AU# ID17060303CL038_02															
1500	0.9	0.55	0.98	0.11	-0.44	1	1	1500	825	1500	165	-660	-8	subalpine	1st tributary
250	0.9	0.55	0.98	0.11	-0.44	1	1	250	137.5	250	27.5	-110	-8		2nd tributary to
1600	0.9	0.55	0.95	0.275	-0.275	1	1	1600	880	1600	440	-440	-5	breakland	Shotgun Creek
960	0.9	0.55	0.98	0.11	-0.44	1	1	960	528	960	105.6	-422.4	-8	subalpine	Shotgun Creek
660	0.8	1.1	0.98	0.11	-0.99	1	1	660	726	660	72.6	-653.4	-18		
1300	0.9	0.55	0.97	0.165	-0.385	2	2	2600	1430	2600	429	-1001	-7		
1700	0.8	1.1	0.96	0.22	-0.88	3	3	5100	5610	5100	1122	-4488	-16		
210	0.7	1.65	0.96	0.22	-1.43	3	3	630	1039.5	630	138.6	-900.9	-26		
310	0.8	1.1	0.96	0.22	-0.88	3	3	930	1023	930	204.6	-818.4	-16		
400	0.7	1.65	0.96	0.22	-1.43	3	3	1200	1980	1200	264	-1716	-26		
480	0.8	1.1	0.79	1.155	0.055	4	4	1920	2112	1920	2217.6	105.6	0	breakland	
310	0.7	1.65	0.79	1.155	-0.495	4	4	1240	2046	1240	1432.2	-613.8	-9		
110	0.8	1.1	0.79	1.155	0.055	4	4	440	484	440	508.2	24.2	0		
170	0.7	1.65	0.79	1.155	-0.495	4	4	680	1122	680	785.4	-336.6	-9		
930	0.8	1.1	0.79	1.155	0.055	4	4	3720	4092	3720	4296.6	204.6	0		
1000	0.8	1.1	0.95	0.275	-0.825	1	1	1000	1100	1000	275	-825	-15		1st tributary to
860	0.9	0.55	0.95	0.275	-0.275	1	1	860	473	860	236.5	-236.5	-5		Crooked Fork
2200	0.8	1.1	0.94	0.33	-0.77	2	2	4400	4840	4400	1452	-3388	-14		2nd tributary
1000	0.8	1.1	0.95	0.275	-0.825	1	1	1000	1100	1000	275	-825	-15		Rock Creek
290	0.9	0.55	0.95	0.275	-0.275	1	1	290	159.5	290	79.75	-79.75	-5		
270	0.7	1.65	0.94	0.33	-1.32	2	2	540	891	540	178.2	-712.8	-24		
530	0.8	1.1	0.94	0.33	-0.77	2	2	1060	1166	1060	349.8	-816.2	-14		
220	0.9	0.55	0.94	0.33	-0.22	2	2	440	242	440	145.2	-96.8	-4		
630	0.7	1.65	0.89	0.605	-1.045	3	3	1890	3118.5	1890	1143.45	-1975.05	-19		
330	0.8	1.1	0.89	0.605	-0.495	3	3	990	1089	990	598.95	-490.05	-9		
450	0.7	1.65	0.89	0.605	-1.045	3	3	1350	2227.5	1350	816.75	-1410.75	-19		
340	0.9	0.55	0.98	0.11	-0.44	1	1	340	187	340	37.4	-149.6	-8	subalpine	1st tributary to
1400	0.8	1.1	0.98	0.11	-0.99	1	1	1400	1540	1400	154	-1386	-18		Haskell Creek
580	0.9	0.55	0.98	0.11	-0.44	1	1	580	319	580	63.8	-255.2	-8		Haskell Creek
820	0.8	1.1	0.98	0.11	-0.99	1	1	820	902	820	90.2	-811.8	-18		
1400	0.9	0.55	0.97	0.165	-0.385	2	2	2800	1540	2800	462	-1078	-7		
670	0.8	1.1	0.89	0.605	-0.495	3	3	2010	2211	2010	1216.05	-994.95	-9	breakland	
760	0.7	1.65	0.89	0.605	-1.045	3	3	2280	3762	2280	1379.4	-2382.6	-19		
260	0.8	1.1	0.89	0.605	-0.495	3	3	780	858	780	471.9	-386.1	-9		
							Total	**48,260**	**51,761**	**48,260**	**21,634**	**-30,126**	**-12**		

Table E-16. Existing and potential solar loads for Crooked Fork Creek (AU# 17060303CL038_04).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Crooked Fork**
AU# ID17060303CL038_04															
310	0.4	3.3	0.38	3.41	0.11	14	14	4340	14322	4340	14799.4	477.4	0	breakland	bl Boulder Cr
400	0.3	3.85	0.38	3.41	-0.44	14	14	5600	21560	5600	19096	-2464	-8		
1200	0.4	3.3	0.38	3.41	0.11	14	14	16800	55440	16800	57288	1848	0		
460	0.4	3.3	0.38	3.41	0.11	14	14	6440	21252	6440	21960.4	708.4	0		
1100	0.3	3.85	0.38	3.41	-0.44	14	14	15400	59290	15400	52514	-6776	-8		
1300	0.1	4.95	0.38	3.41	-1.54	14	14	18200	90090	18200	62062	-28028	-28		
940	0	5.5	0.36	3.52	-1.98	15	15	14100	77550	14100	49632	-27918	-36		
810	0.2	4.4	0.36	3.52	-0.88	15	15	12150	53460	12150	42768	-10692	-16		
290	0.1	4.95	0.36	3.52	-1.43	15	15	4350	21532.5	4350	15312	-6220.5	-26		
200	0.3	3.85	0.36	3.52	-0.33	15	15	3000	11550	3000	10560	-990	-6		
240	0.1	4.95	0.36	3.52	-1.43	15	15	3600	17820	3600	12672	-5148	-26		
470	0.3	3.85	0.36	3.52	-0.33	15	15	7050	27142.5	7050	24816	-2326.5	-6		
1900	0.4	3.3	0.34	3.63	0.33	16	16	30400	100320	30400	110352	10032	0		
220	0.1	4.95	0.34	3.63	-1.32	16	16	3520	17424	3520	12777.6	-4646.4	-24		
490	0.2	4.4	0.34	3.63	-0.77	16	16	7840	34496	7840	28459.2	-6036.8	-14		
290	0.1	4.95	0.34	3.63	-1.32	16	16	4640	22968	4640	16843.2	-6124.8	-24		ab Brushy Fork
							Total	**157,430**	**646,217**	**157,430**	**551,912**	**-94,305**	**-14**		

Table E-17. Existing and potential solar loads for Papoose Creek and tributaries (AU# 17060303CL041_02 & _03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Papoose Creek & Tributaries**
AU# ID17060303CL041_02															
390	0.7	1.65	0.95	0.275	-1.375	1	1	390	643.5	390	107.25	-536.25	-25	breakland	1st tributary to
530	0.4	3.3	0.95	0.275	-3.025	1	1	530	1749	530	145.75	-1603.25	-55		WF Papoose Cr
790	0.8	1.1	0.97	0.165	-0.935	2	2	1580	1738	1580	260.7	-1477.3	-17	subalpine	
980	0.7	1.65	0.98	0.11	-1.54	1	1	980	1617	980	107.8	-1509.2	-28		2nd tributary to
540	0.7	1.65	0.94	0.33	-1.32	2	2	1080	1782	1080	356.4	-1425.6	-24	breakland	WF Papoose Cr
530	0.8	1.1	0.94	0.33	-0.77	2	2	1060	1166	1060	349.8	-816.2	-14		
450	0.9	0.55	0.94	0.33	-0.22	2	2	900	495	900	297	-198	-4		
950	0.8	1.1	0.98	0.11	-0.99	1	1	950	1045	950	104.5	-940.5	-18	subalpine	3rd tributary to
190	0.7	1.65	0.94	0.33	-1.32	2	2	380	627	380	125.4	-501.6	-24	breakland	WF Papoose Cr
410	0.8	1.1	0.94	0.33	-0.77	2	2	820	902	820	270.6	-631.4	-14		
1500	0.9	0.55	0.89	0.605	0.055	3	3	4500	2475	4500	2722.5	247.5	0		
290	0.8	1.1	0.89	0.605	-0.495	3	3	870	957	870	526.35	-430.65	-9		
2500	0.9	0.55	0.95	0.275	-0.275	1	1	2500	1375	2500	687.5	-687.5	-5		4th tributary
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8	subalpine	WF Papoose Cr
1200	0.9	0.55	0.97	0.165	-0.385	2	2	2400	1320	2400	396	-924	-7		
860	0.8	1.1	0.96	0.22	-0.88	3	3	2580	2838	2580	567.6	-2270.4	-16		
400	0.8	1.1	0.96	0.22	-0.88	3	3	1200	1320	1200	264	-1056	-16		
460	0.8	1.1	0.89	0.605	-0.495	3	3	1380	1518	1380	834.9	-683.1	-9	breakland	
200	0.7	1.65	0.79	1.155	-0.495	4	4	800	1320	800	924	-396	-9		
480	0.8	1.1	0.79	1.155	0.055	4	4	1920	2112	1920	2217.6	105.6	0		
620	0.7	1.65	0.79	1.155	-0.495	4	4	2480	4092	2480	2864.4	-1227.6	-9		
200	0.6	2.2	0.79	1.155	-1.045	4	4	800	1760	800	924	-836	-19		
540	0.6	2.2	0.71	1.595	-0.605	5	5	2700	5940	2700	4306.5	-1633.5	-11		
1100	0.5	2.75	0.52	2.64	-0.11	5	5	5500	15125	5500	14520	-605	-2	alder mix	
140	0.4	3.3	0.52	2.64	-0.66	5	5	700	2310	700	1848	-462	-12		
1400	0.6	2.2	0.65	1.925	-0.275	6	6	8400	18480	8400	16170	-2310	-5	breakland	
950	0.6	2.2	0.65	1.925	-0.275	6	6	5700	12540	5700	10972.5	-1567.5	-5		
1600	0.9	0.55	0.95	0.275	-0.275	1	1	1600	880	1600	440	-440	-5		1st tributary to
670	0.8	1.1	0.94	0.33	-0.77	2	2	1340	1474	1340	442.2	-1031.8	-14		EF Papoose Cr
130	0.9	0.55	0.94	0.33	-0.22	2	2	260	143	260	85.8	-57.2	-4		
710	0.8	1.1	0.98	0.11	-0.99	1	1	710	781	710	78.1	-702.9	-18	subalpine	EF Papoose Cr
2000	0.9	0.55	0.94	0.33	-0.22	2	2	4000	2200	4000	1320	-880	-4	breakland	
200	0.8	1.1	0.94	0.33	-0.77	2	2	400	440	400	132	-308	-14		
380	0.9	0.55	0.89	0.605	0.055	3	3	1140	627	1140	689.7	62.7	0		
380	0.7	1.65	0.89	0.605	-1.045	3	3	1140	1881	1140	689.7	-1191.3	-19		
320	0.6	2.2	0.74	1.43	-0.77	3	3	960	2112	960	1372.8	-739.2	-14	alder mix	
540	0.8	1.1	0.89	0.605	-0.495	3	3	1620	1782	1620	980.1	-801.9	-9	breakland	
500	0.7	1.65	0.79	1.155	-0.495	4	4	2000	3300	2000	2310	-990	-9		
1100	0.8	1.1	0.79	1.155	0.055	4	4	4400	4840	4400	5082	242	0		
AU# ID17060303PN041_03															
990	0.5	2.75	0.41	3.245	0.495	7	7	6930	19057.5	6930	22487.85	3430.35	0	alder mix	Papoose Creek
1400	0.6	2.2	0.6	2.2	0	7	7	9800	21560	9800	21560	0	0	breakland	
170	0.4	3.3	0.37	3.465	0.165	8	8	1360	4488	1360	4712.4	224.4	0	alder mix	
470	0.5	2.75	0.55	2.475	-0.275	8	8	3760	10340	3760	9306	-1034	-5	breakland	
							Total	**95,720**	**163,812**	**95,720**	**134,692**	**-29,120**	**-11**		

Table E-18. Existing and potential solar loads for Parachute Creek (AU# 17060303CL042_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Parachute Creek**
AU# ID17060303CL042_02															
2700	0.9	0.55	0.98	0.11	-0.44	1	1	2700	1485	2700	297	-1188	-8	subalpine	Parachute
750	0.9	0.55	0.94	0.33	-0.22	2	2	1500	825	1500	495	-330	-4	breakland	Creek
1600	0.8	1.1	0.94	0.33	-0.77	2	2	3200	3520	3200	1056	-2464	-14		
170	0.9	0.55	0.89	0.605	0.055	3	3	510	280.5	510	308.55	28.05	0		
910	0.8	1.1	0.89	0.605	-0.495	3	3	2730	3003	2730	1651.65	-1351.35	-9		
290	0.9	0.55	0.89	0.605	0.055	3	3	870	478.5	870	526.35	47.85	0		
170	0.8	1.1	0.89	0.605	-0.495	3	3	510	561	510	308.55	-252.45	-9		
700	0.5	2.75	0.79	1.155	-1.595	4	4	2800	7700	2800	3234	-4466	-29		
130	0.7	1.65	0.79	1.155	-0.495	4	4	520	858	520	600.6	-257.4	-9		
1300	0.9	0.55	0.79	1.155	0.605	4	4	5200	2860	5200	6006	3146	0		
							Total	**20,540**	**21,571**	**20,540**	**14,484**	**-7,087**	**-8**		

Table E-19. Existing and potential solar loads for Wendover Creek and tributary (AU# 17060303CL043_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Wendover Creek & Tributary**
AU# ID17060303CL043_02															
190	0.9	0.55	0.98	0.11	-0.44	1	1	190	104.5	190	20.9	-83.6	-8	subalpine	WF Wendover
2000	0.9	0.55	0.95	0.275	-0.275	1	1	2000	1100	2000	550	-550	-5	breakland	Creek
2200	0.9	0.55	0.94	0.33	-0.22	2	2	4400	2420	4400	1452	-968	-4		
3000	0.9	0.55	0.94	0.33	-0.22	2	2	6000	3300	6000	1980	-1320	-4		Wendover Creek
570	0.8	1.1	0.89	0.605	-0.495	3	3	1710	1881	1710	1034.55	-846.45	-9		
500	0.9	0.55	0.79	1.155	0.605	4	4	2000	1100	2000	2310	1210	0		
290	0.8	1.1	0.79	1.155	0.055	4	4	1160	1276	1160	1339.8	63.8	0		
200	0.7	1.65	0.79	1.155	-0.495	4	4	800	1320	800	924	-396	-9		
							Total	**18,260**	**12,502**	**18,260**	**9,611**	**-2,890**	**-5**		

Table E-20. Existing and potential solar loads for Badger Creek and tributary (AU# 17060303CL044_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Badger Creek & Tributary**
AU# ID17060303CL044_02															
700	0.8	1.1	0.95	0.275	-0.825	1	1	700	770	700	192.5	-577.5	-15	breakland	tributary to Badger Creek
400	0.9	0.55	0.94	0.33	-0.22	2	2	800	440	800	264	-176	-4		
690	0.8	1.1	0.94	0.33	-0.77	2	2	1380	1518	1380	455.4	-1062.6	-14		
610	0.9	0.55	0.95	0.275	-0.275	1	1	610	335.5	610	167.75	-167.75	-5		Badger Creek
460	0.8	1.1	0.95	0.275	-0.825	1	1	460	506	460	126.5	-379.5	-15		
1500	0.9	0.55	0.94	0.33	-0.22	2	2	3000	1650	3000	990	-660	-4		
340	0.7	1.65	0.89	0.605	-1.045	3	3	1020	1683	1020	617.1	-1065.9	-19		
940	0.9	0.55	0.89	0.605	0.055	3	3	2820	1551	2820	1706.1	155.1	0		
1100	0.7	1.65	0.61	2.145	0.495	4	4	4400	7260	4400	9438	2178	0	alder mix	
140	0.8	1.1	0.79	1.155	0.055	4	4	560	616	560	646.8	30.8	0	breakland	
1400	0.9	0.55	0.79	1.155	0.605	4	4	5600	3080	5600	6468	3388	0		
							Total	**21,350**	**19,410**	**21,350**	**21,072**	**1,663**	**-7**		

Table E-21. Existing and potential solar loads for Waw'aalamnime Creek and East Fork Waw'aalamnime Creek (AU# 17060303CL045_02 & _03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Waw aalamnime & EF Waw aalamnime**
AU# ID17060303CL045_02															
960	0.9	0.55	0.98	0.11	-0.44	1	1	960	528	960	105.6	-422.4	-8	subalpine	East Fork Waw aalamnime Creek
380	0.8	1.1	0.92	0.44	-0.66	1	1	380	418	380	167.2	-250.8	-12	alder mix	
720	0.7	1.65	0.87	0.715	-0.935	2	2	1440	2376	1440	1029.6	-1346.4	-17		
320	0.8	1.1	0.94	0.33	-0.77	2	2	640	704	640	211.2	-492.8	-14	breakland	
830	0.7	1.65	0.74	1.43	-0.22	3	3	2490	4108.5	2490	3560.7	-547.8	-4	alder mix	
960	0.8	1.1	0.89	0.605	-0.495	3	3	2880	3168	2880	1742.4	-1425.6	-9		
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	subalpine	Waw aalamnime Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7		
540	0.7	1.65	0.94	0.33	-1.32	2	2	1080	1782	1080	356.4	-1425.6	-24	breakland	
420	0.8	1.1	0.89	0.605	-0.495	3	3	1260	1386	1260	762.3	-623.7	-9		
1000	0.6	2.2	0.89	0.605	-1.595	3	3	3000	6600	3000	1815	-4785	-29		
280	0.8	1.1	0.89	0.605	-0.495	3	3	840	924	840	508.2	-415.8	-9		
250	0.7	1.65	0.79	1.155	-0.495	4	4	1000	1650	1000	1155	-495	-9		
850	0.6	2.2	0.79	1.155	-1.045	4	4	3400	7480	3400	3927	-3553	-19		
420	0.7	1.65	0.79	1.155	-0.495	4	4	1680	2772	1680	1940.4	-831.6	-9		
130	0.6	2.2	0.52	2.64	0.44	5	5	650	1430	650	1716	286	0	alder mix	
190	0.5	2.75	0.52	2.64	-0.11	5	5	950	2612.5	950	2508	-104.5	-2		
590	0.6	2.2	0.71	1.595	-0.605	5	5	2950	6490	2950	4705.25	-1784.75	-11	breakland	
							Subtotal	28,900	46,244	28,900	26,683	-19,561	-11		
AU# ID17060303CL045_03															
780	0.7	1.65	0.65	1.925	0.275	6	6	4680	7722	4680	9009	1287	0	breakland	
450	0.5	2.75	0.46	2.97	0.22	6	6	2700	7425	2700	8019	594	0	alder mix	
210	0.4	3.3	0.46	2.97	-0.33	6	6	1260	4158	1260	3742.2	-415.8	-6		
380	0.5	2.75	0.46	2.97	0.22	6	6	2280	6270	2280	6771.6	501.6	0		
1200	0.4	3.3	0.41	3.245	-0.055	7	7	8400	27720	8400	27258	-462	-1		
860	0.6	2.2	0.41	3.245	1.045	7	7	6020	13244	6020	19534.9	6290.9	0		
230	0.3	3.85	0.41	3.245	-0.605	7	7	1610	6198.5	1610	5224.45	-974.05	-11		
950	0.6	2.2	0.6	2.2	0	7	7	6650	14630	6650	14630	0	0	breakland	
220	0.6	2.2	0.48	2.86	0.66	10	10	2200	4840	2200	6292	1452	0		
600	0.5	2.75	0.48	2.86	0.11	10	10	6000	16500	6000	17160	660	0		
							Subtotal	41,800	108,708	41,800	117,641	8,934	-2		
							Total	**70,700**	**154,952**	**70,700**	**144,324**	**-10,627**	**-8**		

Table E-22. Existing and potential solar loads for West Fork Waw'aalamnime Creek and tributary (AU# 17060303CL046_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**West Fork Waw aalamnime**
AU# ID17060303CL046_02															
2300	0.9	0.55	0.97	0.165	-0.385	2	2	4600	2530	4600	759	-1771	-7	subalpine	West Fork
880	0.9	0.55	0.94	0.33	-0.22	2	2	1760	968	1760	580.8	-387.2	-4	breakland	Waw aalamnime
780	0.8	1.1	0.89	0.605	-0.495	3	3	2340	2574	2340	1415.7	-1158.3	-9		Creek
400	0.7	1.65	0.74	1.43	-0.22	3	3	1200	1980	1200	1716	-264	-4	alder mix	
750	0.7	1.65	0.61	2.145	0.495	4	4	3000	4950	3000	6435	1485	9		
270	0.8	1.1	0.79	1.155	0.055	4	4	1080	1188	1080	1247.4	59.4	0	breakland	
570	0.6	2.2	0.61	2.145	-0.055	4	4	2280	5016	2280	4890.6	-125.4	-1	alder mix	
220	0.8	1.1	0.79	1.155	0.055	4	4	880	968	880	1016.4	48.4	0	breakland	
610	0.9	0.55	0.98	0.11	-0.44	1	1	610	335.5	610	67.1	-268.4	-8	subalpine	Spring Creek
280	0.9	0.55	0.95	0.275	-0.275	1	1	280	154	280	77	-77	-5	breakland	
2000	0.8	1.1	0.95	0.275	-0.825	1	1	2000	2200	2000	550	-1650	-15		
780	0.7	1.65	0.87	0.715	-0.935	2	2	1560	2574	1560	1115.4	-1458.6	-17	alder mix	
270	0.9	0.55	0.94	0.33	-0.22	2	2	540	297	540	178.2	-118.8	-4	breakland	
230	0.7	1.65	0.87	0.715	-0.935	2	2	460	759	460	328.9	-430.1	-17	alder mix	
							Total	**22,590**	**26,494**	**22,590**	**20,378**	**-6,116**	**-6**		

Table E-23. Existing and potential solar loads for Doe Creek and tributary (AU# 17060303CL047_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Doe Creek & Tributary**
AU# ID17060303CL047_02															
890	0.9	0.55	0.98	0.11	-0.44	1	1	890	489.5	890	97.9	-391.6	-8	subalpine	tributary to
2200	0.9	0.55	0.94	0.33	-0.22	2	2	4400	2420	4400	1452	-968	-4	breakland	Doe Creek
2100	0.9	0.55	0.98	0.11	-0.44	1	1	2100	1155	2100	231	-924	-8	subalpine	Doe Creek
600	0.9	0.55	0.97	0.165	-0.385	2	2	1200	660	1200	198	-462	-7		
370	0.8	1.1	0.97	0.165	-0.935	2	2	740	814	740	122.1	-691.9	-17		
550	0.9	0.55	0.94	0.33	-0.22	2	2	1100	605	1100	363	-242	-4	breakland	
310	0.8	1.1	0.94	0.33	-0.77	2	2	620	682	620	204.6	-477.4	-14		
470	0.8	1.1	0.89	0.605	-0.495	3	3	1410	1551	1410	853.05	-697.95	-9		
2200	0.7	1.65	0.89	0.605	-1.045	3	3	6600	10890	6600	3993	-6897	-19		
1500	0.8	1.1	0.79	1.155	0.055	4	4	6000	6600	6000	6930	330	0		
600	0.5	2.75	0.52	2.64	-0.11	5	5	3000	8250	3000	7920	-330	-2	alder mix	
510	0.7	1.65	0.71	1.595	-0.055	5	5	2550	4207.5	2550	4067.25	-140.25	-1	breakland	
270	0.6	2.2	0.71	1.595	-0.605	5	5	1350	2970	1350	2153.25	-816.75	-11		
210	0.7	1.65	0.71	1.595	-0.055	5	5	1050	1732.5	1050	1674.75	-57.75	-1		
1600	0.7	1.65	0.65	1.925	0.275	6	6	9600	15840	9600	18480	2640	0		
							Total	**42,610**	**58,867**	**42,610**	**48,740**	**-10,127**	**-7**		

Table E-24. Existing and potential solar loads for Post Office Creek and tributaries (AU# 17060303CL048_02 & _03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Post Office Creek & Tributaries**
AU# ID17060303CL048_02															
450	0.9	0.55	0.98	0.11	-0.44	1	1	450	247.5	450	49.5	-198	-8	subalpine	1st tributary to Post Office
500	0.8	1.1	0.98	0.11	-0.99	1	1	500	550	500	55	-495	-18		
1100	0.9	0.55	0.97	0.165	-0.385	2	2	2200	1210	2200	363	-847	-7		
720	0.9	0.55	0.94	0.33	-0.22	2	2	1440	792	1440	475.2	-316.8	-4	breakland	
1800	0.9	0.55	0.94	0.33	-0.22	2	2	3600	1980	3600	1188	-792	-4		2nd tributary
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	subalpine	3rd tributary to Post Office
1800	0.9	0.55	0.94	0.33	-0.22	2	2	3600	1980	3600	1188	-792	-4	breakland	
720	0.7	1.65	0.87	0.715	-0.935	2	2	1440	2376	1440	1029.6	-1346.4	-17	alder mix	
2000	0.9	0.55	0.95	0.275	-0.275	1	1	2000	1100	2000	550	-550	-5		WF Post Office
1300	0.8	1.1	0.94	0.33	-0.77	2	2	2600	2860	2600	858	-2002	-14		
3700	0.8	1.1	0.79	1.155	0.055	4	4	14800	16280	14800	17094	814	0		
310	0.8	1.1	0.98	0.11	-0.99	1	1	310	341	310	34.1	-306.9	-18	subalpine	4th tributary to Post Office
600	0.8	1.1	0.95	0.275	-0.825	1	1	600	660	600	165	-495	-15	breakland	
2000	0.9	0.55	0.94	0.33	-0.22	2	2	4000	2200	4000	1320	-880	-4		
1500	0.8	1.1	0.94	0.33	-0.77	2	2	3000	3300	3000	990	-2310	-14		
110	0.9	0.55	0.94	0.33	-0.22	2	2	220	121	220	72.6	-48.4	-4		
1000	0.9	0.55	0.95	0.275	-0.275	1	1	1000	550	1000	275	-275	-5		1st trib to 4th
2600	0.9	0.55	0.98	0.11	-0.44	1	1	2600	1430	2600	286	-1144	-8	subalpine	Post Office Creek
640	0.6	2.2	0.87	0.715	-1.485	2	2	1280	2816	1280	915.2	-1900.8	-27	alder mix	
310	0.8	1.1	0.89	0.605	-0.495	3	3	930	1023	930	562.65	-460.35	-9	breakland	
210	0.9	0.55	0.89	0.605	0.055	3	3	630	346.5	630	381.15	34.65	0		
210	0.6	2.2	0.74	1.43	-0.77	3	3	630	1386	630	900.9	-485.1	-14	alder mix	
130	0.7	1.65	0.89	0.605	-1.045	3	3	390	643.5	390	235.95	-407.55	-19	breakland	
230	0.8	1.1	0.89	0.605	-0.495	3	3	690	759	690	417.45	-341.55	-9		
410	0.9	0.55	0.89	0.605	0.055	3	3	1230	676.5	1230	744.15	67.65	0		
190	0.9	0.55	0.79	1.155	0.605	4	4	760	418	760	877.8	459.8	0		
1450	0.8	1.1	0.79	1.155	0.055	4	4	5800	6380	5800	6699	319	0		
2600	0.7	1.65	0.71	1.595	-0.055	5	5	13000	21450	13000	20735	-715	-1		
210	0.5	2.75	0.65	1.925	-0.825	6	6	1260	3465	1260	2425.5	-1039.5	-15		
1100	0.7	1.65	0.65	1.925	0.275	6	6	6600	10890	6600	12705	1815	0		
170	0.6	2.2	0.6	2.2	0	7	7	1190	2618	1190	2618	0	0		
160	0.8	1.1	0.6	2.2	1.1	7	7	1120	1232	1120	2464	1232	0		
140	0.7	1.65	0.6	2.2	0.55	7	7	980	1617	980	2156	539	0		
480	0.6	2.2	0.6	2.2	0	7	7	3360	7392	3360	7392	0	0		
AU# ID17060303CL048_03															
770	0.7	1.65	0.55	2.475	0.825	8	8	6160	10164	6160	15246	5082	0		
340	0.6	2.2	0.55	2.475	0.275	8	8	2720	5984	2720	6732	748	0		
							Total	**94,490**	**118,008**	**94,490**	**110,355**	**-7,653**	**-7**		

Table E-25. Existing and potential solar loads for Deadman Creek and tributaries (AU# 17060303CL059_02 & _03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Deadman Creek & Tributaries**
AU# ID17060303CL059_02															
1600	0.9	0.55	0.95	0.275	-0.275	1	1	1600	880	1600	440	-440	-5	breakland	3rd to Deadman
AU# ID17060303CL059_03															Deadman Creek
260	0.8	1.1	0.65	1.925	0.825	6	6	1560	1716	1560	3003	1287	0		
670	0.5	2.75	0.46	2.97	0.22	6	6	4020	11055	4020	11939.4	884.4	0	alder mix	
350	0.6	2.2	0.6	2.2	0	7	7	2450	5390	2450	5390	0	0	breakland	
450	0.4	3.3	0.41	3.245	-0.055	7	7	3150	10395	3150	10221.75	-173.25	-1	alder mix	
390	0.6	2.2	0.6	2.2	0	7	7	2730	6006	2730	6006	0	0	breakland	
1300	0.6	2.2	0.55	2.475	0.275	8	8	10400	22880	10400	25740	2860	0		
							Total	**25,910**	**58,322**	**25,910**	**62,740**	**4,418**	**-1**		

Table E-26. Existing and potential solar loads for Deadman Creek and tributaries (AU# 17060303CL061_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Deadman Creek & Tributaries**
AU# ID17060303CL061_02															
780	0.9	0.55	0.98	0.11	-0.44	1	1	780	429	780	85.8	-343.2	-8	upland	1st to Deadman
170	0.8	1.1	0.92	0.44	-0.66	1	1	170	187	170	74.8	-112.2	-12	alder mix	
560	0.9	0.55	0.98	0.11	-0.44	1	1	560	308	560	61.6	-246.4	-8	upland	
1600	0.8	1.1	0.87	0.715	-0.385	2	2	3200	3520	3200	2288	-1232	-7	alder mix	
480	0.7	1.65	0.94	0.33	-1.32	2	2	960	1584	960	316.8	-1267.2	-24	breakland	
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	upland	2nd to Deadman
1000	0.9	0.55	0.94	0.33	-0.22	2	2	2000	1100	2000	660	-440	-4	breakland	
270	0.8	1.1	0.98	0.11	-0.99	1	1	270	297	270	29.7	-267.3	-18	upland	Deadman Creek
1600	0.9	0.55	0.98	0.11	-0.44	1	1	1600	880	1600	176	-704	-8		
920	0.9	0.55	0.94	0.33	-0.22	2	2	1840	1012	1840	607.2	-404.8	-4	breakland	
140	0.8	1.1	0.89	0.605	-0.495	3	3	420	462	420	254.1	-207.9	-9		
280	0.9	0.55	0.89	0.605	0.055	3	3	840	462	840	508.2	46.2	0		
470	0.8	1.1	0.89	0.605	-0.495	3	3	1410	1551	1410	853.05	-697.95	-9		
220	0.9	0.55	0.89	0.605	0.055	3	3	660	363	660	399.3	36.3	0		
540	0.7	1.65	0.89	0.605	-1.045	3	3	1620	2673	1620	980.1	-1692.9	-19		
2200	0.8	1.1	0.79	1.155	0.055	4	4	8800	9680	8800	10164	484	0		
1400	0.8	1.1	0.71	1.595	0.495	5	5	7000	7700	7000	11165	3465	0		
							Total	**33,430**	**32,923**	**33,430**	**28,767**	**-4,156**	**-8**		

Table E-27. Existing and potential solar loads for East Fork Deadman Creek and tributaries (AU# 17060303CL060_02 & _03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**EF Deadman Creek & Tributaries**
AU# ID17060303CL060_02															
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	upland	1st tributary to
430	0.9	0.55	0.94	0.33	-0.22	2	2	860	473	860	283.8	-189.2	-4	breakland	EF Deadman
800	0.8	1.1	0.94	0.33	-0.77	2	2	1600	1760	1600	528	-1232	-14		
100	0.9	0.55	0.94	0.33	-0.22	2	2	200	110	200	66	-44	-4		
240	0.6	2.2	0.57	2.365	0.165	1	1	240	528	240	567.6	39.6	0	meadow	2nd tributary to
920	0.9	0.55	0.98	0.11	-0.44	1	1	920	506	920	101.2	-404.8	-8	upland	EF Deadman
1100	0.9	0.55	0.95	0.275	-0.275	1	1	1100	605	1100	302.5	-302.5	-5	breakland	
2300	0.9	0.55	0.95	0.275	-0.275	1	1	2300	1265	2300	632.5	-632.5	-5		3rd tributary to EF
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	upland	4th tributary to
720	0.9	0.55	0.94	0.33	-0.22	2	2	1440	792	1440	475.2	-316.8	-4	breakland	EF Deadman
530	0.8	1.1	0.87	0.715	-0.385	2	2	1060	1166	1060	757.9	-408.1	-7	alder mix	
2200	0.9	0.55	0.89	0.605	0.055	3	3	6600	3630	6600	3993	363	0		
470	0.8	1.1	0.98	0.11	-0.99	1	1	470	517	470	51.7	-465.3	-18	subalpine	5th tributary to
1000	0.8	1.1	0.98	0.11	-0.99	1	1	1000	1100	1000	110	-990	-18	upland	EF Deadman
170	0.9	0.55	0.98	0.11	-0.44	1	1	170	93.5	170	18.7	-74.8	-8		(left fork)
260	0.8	1.1	0.92	0.44	-0.66	1	1	260	286	260	114.4	-171.6	-12	alder mix	
630	0.9	0.55	0.98	0.11	-0.44	1	1	630	346.5	630	69.3	-277.2	-8		
610	0.9	0.55	0.95	0.275	-0.275	1	1	610	335.5	610	167.75	-167.75	-5	breakland	
1600	0.8	1.1	0.98	0.11	-0.99	1	1	1600	1760	1600	176	-1584	-18	upland	(right fork)
750	0.9	0.55	0.98	0.11	-0.44	2	2	1500	825	1500	165	-660	-8		
670	0.9	0.55	0.94	0.33	-0.22	2	2	1340	737	1340	442.2	-294.8	-4	breakland	
1900	0.9	0.55	0.89	0.605	0.055	3	3	5700	3135	5700	3448.5	313.5	0		(below forks)
1700	0.9	0.55	0.98	0.11	-0.44	1	1	1700	935	1700	187	-748	-8	upland	EF Deadman
140	0.8	1.1	0.87	0.715	-0.385	2	2	280	308	280	200.2	-107.8	-7	alder mix	Creek
1100	0.9	0.55	0.98	0.11	-0.44	2	2	2200	1210	2200	242	-968	-8	upland	
440	0.9	0.55	0.94	0.33	-0.22	2	2	880	484	880	290.4	-193.6	-4	breakland	
690	0.7	1.65	0.74	1.43	-0.22	3	3	2070	3415.5	2070	2960.1	-455.4	-4	alder mix	
140	0.9	0.55	0.89	0.605	0.055	3	3	420	231	420	254.1	23.1	0	breakland	
1800	0.8	1.1	0.79	1.155	0.055	4	4	7200	7920	7200	8316	396	0		
700	0.8	1.1	0.71	1.595	0.495	5	5	3500	3850	3500	5582.5	1732.5	0		
800	0.7	1.65	0.71	1.595	-0.055	5	5	4000	6600	4000	6380	-220	-1		
AU# ID17060303CL060_03															
1000	0.8	1.1	0.65	1.925	0.825	6	6	6000	6600	6000	11550	4950	0		
							Total	**60,250**	**52,844**	**60,250**	**48,698**	**-4,146**	**-6**		

Table E-28. Existing and potential solar loads for Canyon Creek and tributaries (AU# 17060303CL062_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Canyon Creek & Tributaries**
AU# ID17060303CL062_02															
250	0.8	1.1	0.98	0.11	-0.99	1	1	250	275	250	27.5	-247.5	-18	upland	1st to Canyon Creek
890	0.7	1.65	0.92	0.44	-1.21	1	1	890	1468.5	890	391.6	-1076.9	-22	alder mix	
530	0.9	0.55	0.98	0.11	-0.44	2	2	1060	583	1060	116.6	-466.4	-8	upland	
1300	0.8	1.1	0.98	0.11	-0.99	1	1	1300	1430	1300	143	-1287	-18		2nd to Canyon Creek
610	0.8	1.1	0.95	0.275	-0.825	1	1	610	671	610	167.75	-503.25	-15	breakland	
580	0.8	1.1	0.98	0.11	-0.99	1	1	580	638	580	63.8	-574.2	-18	upland	3rd to Canyon Creek
2400	0.9	0.55	0.98	0.11	-0.44	1	1	2400	1320	2400	264	-1056	-8		
380	0.8	1.1	0.98	0.11	-0.99	2	2	760	836	760	83.6	-752.4	-18		
970	0.8	1.1	0.94	0.33	-0.77	2	2	1940	2134	1940	640.2	-1493.8	-14	breakland	
240	0.7	1.65	0.94	0.33	-1.32	2	2	480	792	480	158.4	-633.6	-24		
1200	0.8	1.1	0.98	0.11	-0.99	1	1	1200	1320	1200	132	-1188	-18	upland	Mystery Creek
360	0.9	0.55	0.98	0.11	-0.44	1	1	360	198	360	39.6	-158.4	-8		
640	0.8	1.1	0.87	0.715	-0.385	2	2	1280	1408	1280	915.2	-492.8	-7	alder mix	
620	0.9	0.55	0.98	0.11	-0.44	2	2	1240	682	1240	136.4	-545.6	-8		
540	0.7	1.65	0.87	0.715	-0.935	2	2	1080	1782	1080	772.2	-1009.8	-17	alder mix	
2200	0.7	1.65	0.74	1.43	-0.22	3	3	6600	10890	6600	9438	-1452	-4		
880	0.9	0.55	0.98	0.11	-0.44	1	1	880	484	880	96.8	-387.2	-8	upland	4th to Canyon Creek
1500	0.9	0.55	0.94	0.33	-0.22	2	2	3000	1650	3000	990	-660	-4	breakland	
350	0.8	1.1	0.98	0.11	-0.99	1	1	350	385	350	38.5	-346.5	-18	upland	5th to Canyon Creek
210	0.9	0.55	0.98	0.11	-0.44	1	1	210	115.5	210	23.1	-92.4	-8		
160	0.9	0.55	0.95	0.275	-0.275	1	1	160	88	160	44	-44	-5	breakland	
290	0.8	1.1	0.95	0.275	-0.825	1	1	290	319	290	79.75	-239.25	-15		
620	0.9	0.55	0.95	0.275	-0.275	1	1	620	341	620	170.5	-170.5	-5		
550	0.9	0.55	0.98	0.11	-0.44	1	1	550	302.5	550	60.5	-242	-8	upland	SF Canyon Creek
270	0.9	0.55	0.95	0.275	-0.275	1	1	270	148.5	270	74.25	-74.25	-5	breakland	
1300	0.8	1.1	0.87	0.715	-0.385	2	2	2600	2860	2600	1859	-1001	-7	alder mix	
2300	0.9	0.55	0.89	0.605	0.055	3	3	6900	3795	6900	4174.5	379.5	0		
2200	0.8	1.1	0.79	1.155	0.055	4	4	8800	9680	8800	10164	484	0		
600	0.9	0.55	0.92	0.44	-0.11	1	1	600	330	600	264	-66	-2	alder mix	Cabin Creek
240	0.8	1.1	0.92	0.44	-0.66	1	1	240	264	240	105.6	-158.4	-12		
820	0.8	1.1	0.98	0.11	-0.99	1	1	820	902	820	90.2	-811.8	-18	upland	
700	0.9	0.55	0.98	0.11	-0.44	2	2	1400	770	1400	154	-616	-8		
600	0.9	0.55	0.94	0.33	-0.22	2	2	1200	660	1200	396	-264	-4	breakland	
480	0.9	0.55	0.98	0.11	-0.44	1	1	480	264	480	52.8	-211.2	-8	upland	Canyon Creek
660	0.8	1.1	0.98	0.11	-0.99	1	1	660	726	660	72.6	-653.4	-18		
240	0.9	0.55	0.98	0.11	-0.44	1	1	240	132	240	26.4	-105.6	-8		
210	0.8	1.1	0.98	0.11	-0.99	1	1	210	231	210	23.1	-207.9	-18		
1100	0.9	0.55	0.98	0.11	-0.44	2	2	2200	1210	2200	242	-968	-8		
710	0.8	1.1	0.94	0.33	-0.77	2	2	1420	1562	1420	468.6	-1093.4	-14	breakland	
570	0.8	1.1	0.94	0.33	-0.77	2	2	1140	1254	1140	376.2	-877.8	-14		
470	0.5	2.75	0.74	1.43	-1.32	3	3	1410	3877.5	1410	2016.3	-1861.2	-24	alder mix	
1000	0.7	1.65	0.74	1.43	-0.22	3	3	3000	4950	3000	4290	-660	-4		
480	0.6	2.2	0.74	1.43	-0.77	3	3	1440	3168	1440	2059.2	-1108.8	-14		
600	0.8	1.1	0.79	1.155	0.055	4	4	2400	2640	2400	2772	132	0	breakland	
450	0.6	2.2	0.61	2.145	-0.055	4	4	1800	3960	1800	3861	-99	-1	alder mix	
1600	0.6	2.2	0.71	1.595	-0.605	5	5	8000	17600	8000	12760	-4840	-11	breakland	
810	0.5	2.75	0.52	2.64	-0.11	5	5	4050	11137.5	4050	10692	-445.5	-2	alder mix	
540	0.6	2.2	0.65	1.925	-0.275	6	6	3240	7128	3240	6237	-891	-5	breakland	
1500	0.8	1.1	0.65	1.925	0.825	6	6	9000	9900	9000	17325	7425	0		
730	0.8	1.1	0.6	2.2	1.1	7	7	5110	5621	5110	11242	5621	0		
690	0.7	1.65	0.6	2.2	0.55	7	7	4830	7969.5	4830	10626	2656.5	0		
910	0.5	2.75	0.6	2.2	-0.55	7	7	6370	17517.5	6370	14014	-3503.5	-10		
1100	0.7	1.65	0.6	2.2	0.55	7	7	7700	12705	7700	16940	4235	0		
360	0.7	1.65	0.6	2.2	0.55	7	7	2520	4158	2520	5544	1386	0		
							Total	**118,140**	**167,233**	**118,140**	**153,915**	**-13,318**	**-9**		

Table E-29. Existing and potential solar loads for Canyon Creek and tributaries (AU# 17060303CL062_03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Canyon Creek & Tributaries**
AU# ID17060303CL062_03															
270	0.7	1.65	0.55	2.475	0.825	8	8	2160	3564	2160	5346	1782	0	breakland	Canyon
750	0.6	2.2	0.55	2.475	0.275	8	8	6000	13200	6000	14850	1650	0		Creek
							Total	**8,160**	**16,764**	**8,160**	**20,196**	**3,432**	**0**		

Table E-30. Existing and potential solar loads for lower Pete King Creek tributaries (AU# 17060303CL063_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Lower Pete King Creek Tributaries**
AU# ID17060303CL063_02															
2200	0.9	0.55	0.95	0.275	-0.275	1	1	2200	1210	2200	605	-605	-5	breakland	1st to Pete King
410	0.9	0.55	0.98	0.11	-0.44	1	1	410	225.5	410	45.1	-180.4	-8	upland	Placer Creek
150	0.8	1.1	0.98	0.11	-0.99	1	1	150	165	150	16.5	-148.5	-18		
280	0.9	0.55	0.98	0.11	-0.44	1	1	280	154	280	30.8	-123.2	-8		
550	0.8	1.1	0.98	0.11	-0.99	1	1	550	605	550	60.5	-544.5	-18		
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8		
1500	0.9	0.55	0.94	0.33	-0.22	2	2	3000	1650	3000	990	-660	-4	breakland	
1500	0.8	1.1	0.89	0.605	-0.495	3	3	4500	4950	4500	2722.5	-2227.5	-9		
240	0.8	1.1	0.89	0.605	-0.495	3	3	720	792	720	435.6	-356.4	-9		
2000	0.9	0.55	0.95	0.275	-0.275	1	1	2000	1100	2000	550	-550	-5		2nd to Pete King
2000	0.9	0.55	0.95	0.275	-0.275	1	1	2000	1100	2000	550	-550	-5		3rd to Pete King
1000	0.9	0.55	0.95	0.275	-0.275	1	1	1000	550	1000	275	-275	-5		4th to Pete King
520	0.8	1.1	0.95	0.275	-0.825	1	1	520	572	520	143	-429	-15		
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8	upland	Nut Creek
2900	0.9	0.55	0.94	0.33	-0.22	2	2	5800	3190	5800	1914	-1276	-4	breakland	
420	0.9	0.55	0.89	0.605	0.055	3	3	1260	693	1260	762.3	69.3	0		
140	0.8	1.1	0.89	0.605	-0.495	3	3	420	462	420	254.1	-207.9	-9		
270	0.7	1.65	0.89	0.605	-1.045	3	3	810	1336.5	810	490.05	-846.45	-19		
2200	0.9	0.55	0.95	0.275	-0.275	1	1	2200	1210	2200	605	-605	-5		1st to Nut Creek
							Total	**29,920**	**21,120**	**29,920**	**10,680**	**-10,440**	**-9**		

Table E-31. Existing and potential solar loads for lower Pete King Creek (AU# 17060303CL063_03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Lower Pete King Creek**
AU# ID17060303CL063_03															
960	0.6	2.2	0.6	2.2	0	7	7	6720	14784	6720	14784	0	0	breakland	bl Walde Creek
520	0.4	3.3	0.41	3.245	-0.055	7	7	3640	12012	3640	11811.8	-200.2	-1	alder mix	
300	0.3	3.85	0.41	3.245	-0.605	7	7	2100	8085	2100	6814.5	-1270.5	-11		
450	0.5	2.75	0.37	3.465	0.715	8	8	3600	9900	3600	12474	2574	0		
340	0.3	3.85	0.37	3.465	-0.385	8	8	2720	10472	2720	9424.8	-1047.2	-7		
260	0.4	3.3	0.37	3.465	0.165	8	8	2080	6864	2080	7207.2	343.2	0		bl Placer Creek
1000	0.5	2.75	0.37	3.465	0.715	8	8	8000	22000	8000	27720	5720	0		
1000	0.5	2.75	0.33	3.685	0.935	9	9	9000	24750	9000	33165	8415	0		
840	0.4	3.3	0.33	3.685	0.385	9	9	7560	24948	7560	27858.6	2910.6	0		
860	0.4	3.3	0.31	3.795	0.495	10	10	8600	28380	8600	32637	4257	0		bl Nut Creek
1300	0.5	2.75	0.31	3.795	1.045	10	10	13000	35750	13000	49335	13585	0		
530	0.6	2.2	0.31	3.795	1.595	10	10	5300	11660	5300	20113.5	8453.5	0		
							Total	**72,320**	**209,605**	**72,320**	**253,345**	**43,740**	**-2**		

Table E-32. Existing and potential solar loads for Walde Creek (AU# 17060303CL063_03).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Walde Creek & Tributaries**
AU# ID17060303CL063_03															
560	0.7	1.65	0.71	1.595	-0.055	5	5	2800	4620	2800	4466	-154	-1	breakland	Walde Creek
							Total	**2,800**	**4,620**	**2,800**	**4,466**	**-154**	**-1**		

Table E-33. Existing and potential solar loads for Walde Creek and tributaries (AU# 17060303CL064_02).

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**shade curves**	**Walde Creek & Tributaries**
AU# ID17060303CL064_02															
990	0.9	0.55	0.98	0.11	-0.44	1	1	990	544.5	990	108.9	-435.6	-8	upland	1st to Walde Creek
720	0.9	0.55	0.95	0.275	-0.275	1	1	720	396	720	198	-198	-5	breakland	
340	0.8	1.1	0.98	0.11	-0.99	1	1	340	374	340	37.4	-336.6	-18	upland	2nd to Walde Creek
140	0.9	0.55	0.98	0.11	-0.44	1	1	140	77	140	15.4	-61.6	-8		
80	0.7	1.65	0.98	0.11	-1.54	1	1	80	132	80	8.8	-123.2	-28		
210	0.9	0.55	0.98	0.11	-0.44	1	1	210	115.5	210	23.1	-92.4	-8		
940	0.9	0.55	0.95	0.275	-0.275	1	1	940	517	940	258.5	-258.5	-5	breakland	
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	upland	3rd to Walde Creek
570	0.9	0.55	0.94	0.33	-0.22	2	2	1140	627	1140	376.2	-250.8	-4	breakland	
590	0.9	0.55	0.98	0.11	-0.44	1	1	590	324.5	590	64.9	-259.6	-8	upland	Polar Creek
570	0.9	0.55	0.95	0.275	-0.275	1	1	570	313.5	570	156.75	-156.75	-5	breakland	
190	0.9	0.55	0.98	0.11	-0.44	1	1	190	104.5	190	20.9	-83.6	-8	upland	
1300	0.8	1.1	0.95	0.275	-0.825	1	1	1300	1430	1300	357.5	-1072.5	-15	breakland	
250	0.9	0.55	0.94	0.33	-0.22	2	2	500	275	500	165	-110	-4		
520	0.8	1.1	0.94	0.33	-0.77	2	2	1040	1144	1040	343.2	-800.8	-14		
1100	0.9	0.55	0.94	0.33	-0.22	2	2	2200	1210	2200	726	-484	-4		
790	0.9	0.55	0.89	0.605	0.055	3	3	2370	1303.5	2370	1433.85	130.35	0		
880	0.8	1.1	0.89	0.605	-0.495	3	3	2640	2904	2640	1597.2	-1306.8	-9		
150	0.9	0.55	0.98	0.11	-0.44	1	1	150	82.5	150	16.5	-66	-8	upland	1st to Polar Creek
260	0.8	1.1	0.98	0.11	-0.99	1	1	260	286	260	28.6	-257.4	-18		
680	0.9	0.55	0.98	0.11	-0.44	1	1	680	374	680	74.8	-299.2	-8		
260	0.8	1.1	0.98	0.11	-0.99	1	1	260	286	260	28.6	-257.4	-18		
670	0.9	0.55	0.98	0.11	-0.44	1	1	670	368.5	670	73.7	-294.8	-8		
120	0.9	0.55	0.95	0.275	-0.275	1	1	120	66	120	33	-33	-5	breakland	
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	upland	Walde Creek
770	0.9	0.55	0.95	0.275	-0.275	1	1	770	423.5	770	211.75	-211.75	-5	breakland	
380	0.9	0.55	0.94	0.33	-0.22	2	2	760	418	760	250.8	-167.2	-4		
980	0.8	1.1	0.94	0.33	-0.77	2	2	1960	2156	1960	646.8	-1509.2	-14		
690	0.9	0.55	0.94	0.33	-0.22	2	2	1380	759	1380	455.4	-303.6	-4		
290	0.8	1.1	0.89	0.605	-0.495	3	3	870	957	870	526.35	-430.65	-9		
550	0.9	0.55	0.89	0.605	0.055	3	3	1650	907.5	1650	998.25	90.75	0		
110	0.8	1.1	0.89	0.605	-0.495	3	3	330	363	330	199.65	-163.35	-9		
570	0.9	0.55	0.89	0.605	0.055	3	3	1710	940.5	1710	1034.55	94.05	0		
670	0.8	1.1	0.79	1.155	0.055	4	4	2680	2948	2680	3095.4	147.4	0		
630	0.9	0.55	0.79	1.155	0.605	4	4	2520	1386	2520	2910.6	1524.6	0		
							Total	**34,830**	**25,669**	**34,830**	**16,707**	**-8,961**	**-8**		

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Appendix F. Distribution List

Department of Environmental Quality—Lewiston Regional Office, 1118 F Street, Lewiston, Idaho 83501

Department of Environmental Quality—State Office, 1410 North Hilton, Boise, Idaho 83706

US Environmental Protection Agency—Idaho Operations Office, 1435 North Orchard, Boise, Idaho 83706

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Appendix G. Public Comments

Public Comments

A 30 day public comment period was provided for the draft of the Lochsa River Subbasin Temperature Total Maximum Daily Loads: Addendum to the Lochsa River Subbasin Assessment from July 29 through August 29, 2011. Notice was provided to the general public through the Lewiston Morning Tribune and the document was made available through the Lewiston and State Offices of the Department of Environmental Quality, the Lewiston City Library, and through DEQ's website at www.deq.idaho.gov/public/comment.cfm.

The received comments and DEQ's responses are recorded in this appendix:

1) It is unclear whether the Forest Service will need to obtain NPDES permits or will BMPs be sufficient for road decommissioning?

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a) DEQ response: Thank you for taking the time to review the document. A detailed TMDL Implementation Plan will be developed after approval of this TMDL. The USEPA authorizes and issues NPDES permits based on, in part, TMDL wasteload allocations. Compliance with the stormwater wasteload allocation included in this TMDL is based on the implementation of BMPs included in a Storm Water Pollution Prevention Plan developed for the road decommissioning project.

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