North Fork Coeur d'Alene River
Temperature Total Maximum Daily Loads:

Addendum to the Subbasin Assessment and TMDLs of the NF Coeur d'Alene River

"Draft"

Department of Environmental Quality

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NF Coeur d’Alene River Temperature TMDLs

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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
CWA	Clean Water Act
CWE	cumulative watershed effects
DEQ	Department of Environmental Quality
EPA	United States Environmental Protection Agency
FPA	Idaho Forest Practices Act
FWS	U.S. Fish and Wildlife Service
GIS	Geographical Information Systems
HUC	Hydrologic Unit Code
I.C.	Idaho Code
IDAPA	Refers to citations of Idaho administrative rules
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
LA	load allocation
LC	load capacity
m	meter
mi	mile
mi^2	square miles
MOS	margin of safety
MWMT	maximum weekly maximum temperature
n.a.	not applicable
NA	not assessed
NB	natural background
nd	no data (data not available)
NPDES	National Pollutant Discharge Elimination System
PNV	potential natural vegetation
SBA	subbasin assessment
STATSGO	State Soil Geographic Database
TMDL	total maximum daily load
U.S.	United States

U.S.C. United States Code

USDA United States Department of Agriculture

USDI United States Department of the Interior

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WLA wasteload allocation

WQLS water quality limited segment

WQMP water quality management plan

WQRP water quality restoration plan

WQS water quality standard

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. 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.

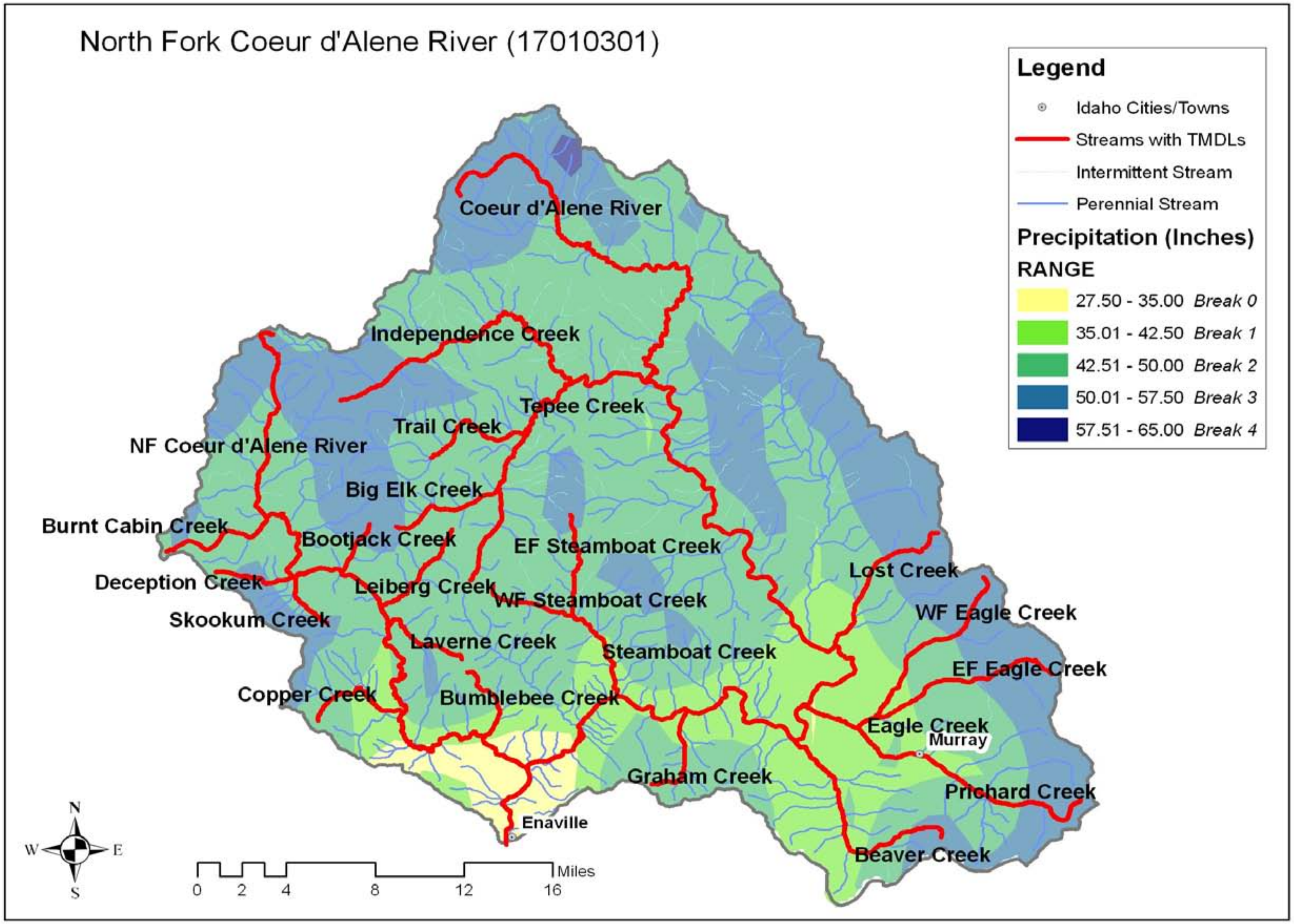
This document addresses 23 water bodies in the Upper Coeur d'Alene (North Fork) River Subbasin that have been placed on Idaho's current §303(d) list. This document only addresses the temperature TMDLs for these streams. For more information about these watersheds and the subbasin as a whole see the Subbasin Assessment and TMDLs of the North Fork Coeur d'Alene River (IDEQ, 2001).

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

Subbasin at a Glance

The Upper Coeur d'Alene River Subbasin (17010301) is located in northern Idaho just north of the Silver Valley. Listed on the Idaho 1998 303d list for temperature pollution was Prichard Creek. The Environmental Protection Agency (EPA) added streams to Idaho's 1998 303d list of impaired waters that exceeded Idaho's temperature criteria. In the Upper Coeur d'Alene Subbasin, Steamboat Creek was among those EPA additions. Idaho's 2002 303d list added a large number of additional streams in this subbasin to the two streams previously listed for temperature (Figure A).

Figure A. Subbasin at a glance.



Key Findings

Twenty three water bodies representing 41 assessment units were placed on the current 303d list of impaired waters for reasons associated with temperature criteria violations (Table A). Effective shade targets were established for these waters based on the concept of maximum shading under potential natural vegetation equals natural background temperature levels. Shade targets were actually derived from effective shade curves developed for similar vegetation types in the Northwest. Existing shade was determined from aerial photo interpretation field verified with solar pathfinder data.

Table A. Streams and pollutants for which TMDLs were developed.

Stream	Pollutant(s)
Beaver Creek	Temperature
Big Elk Creek	Temperature
Bootjack Creek	Temperature
Bumblebee Creek	Temperature
Burnt Cabin Creek	Temperature
Copper Creek	Temperature
Deception Creek	Temperature
EF Eagle Creek	Temperature
EF Steamboat Creek	Temperature
Graham Creek	Temperature
Independence Creek	Temperature
Laverne Creek	Temperature
Leiberg Creek	Temperature
Lost Creek	Temperature
Prichard Creek	Temperature
Skookum Creek	Temperature
Steamboat Creek	Temperature
Tepee Creek	Temperature
Trail Creek	Temperature
WF Eagle Creek	Temperature
WF Steamboat Creek	Temperature
Upper Coeur d'Alene River	Temperature
North Fork Coeur d'Alene River	Temperature

All streams examined show impacts from a lack of riparian shade. A number of streams examined have reductions in solar load needed to achieve targets between 3,000 kWh/day and about 2.7 million kWh/day. The Little North Fork Coeur d'Alene River has an excess solar load of near 1.6 million kWh/day. The North Fork Coeur d'Alene River on the other hand has an excess solar load near 2.7 million kWh/day. Streams with high excess loads include Tepee Cree, Trail Creek, Independence Creek, Prichard Creek, Beaver Creek, and others. Lower Steamboat Creek and Graham Creek are examples of good shade condition watersheds.

Lack of shade and excess solar loads can result from a variety of circumstances, some natural such as wildfires, and some anthropogenic with varying degrees of permanency (e.g. paved roads versus partial vegetation removal). Each reach on each stream needs to be examined for possible corrective implementation. Some problems can be fixed and others cannot, and implementation strategies should take into account these realities.

Table B. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Beaver Creek/ ID17010301PN003_02 ID17010301PN003_03	Temperature	Yes	n.a.	Existing Shade
Big Elk Creek/ ID17010301PN020_02	Temperature	Yes	n.a.	Existing Shade
Bootjack Creek/ ID17010301PN034_02	Temperature	Yes	n.a.	Existing Shade
Bumblebee Creek/ ID17010301PN031_02	Temperature	Yes	n.a.	Existing Shade
Burnt Cabin Creek/ ID17010301PN036_02	Temperature	Yes	n.a.	Existing Shade
Copper Creek/ ID17010301PN039_02 ID17010301PN039_03	Temperature	Yes	n.a.	Existing Shade
Deception Creek/ ID17010301PN037_02	Temperature	Yes	n.a.	Existing Shade
EF Eagle Creek/ ID17010301PN007_02	Temperature	Yes	n.a.	Existing Shade
EF Steamboat Creek/ ID17010301PN028_02	Temperature	Yes	n.a.	Existing Shade
Graham Creek/ ID17010301PN002_02 ID17010301PN002_03	Temperature	Yes	n.a.	Existing Shade
Independence Creek/ ID17010301PN018_02 ID17010301PN018_03	Temperature	Yes	n.a.	Existing Shade
Laverne Creek/ ID17010301PN032_02	Temperature	Yes	n.a.	Existing Shade
Leiberg Creek/ ID17010301PN033_02	Temperature	Yes	n.a.	Existing Shade
Lost Creek/ ID17010301PN009_02 ID17010301PN009_03	Temperature	Yes	n.a.	Existing Shade
Prichard Creek/ ID17010301PN005_02 ID17010301PN005_03 ID17010301PN004_03 ID17010301PN004_04	Temperature	Yes	n.a.	Existing Shade
Skookum Creek/ ID17010301PN038_02 ID17010301PN038_03	Temperature	Yes	n.a.	Existing Shade
Steamboat Creek/ ID17010301PN028_03	Temperature	Yes	n.a.	Existing Shade

Tepee Creek/ ID17010301PN020_02 ID17010301PN020_03 ID17010301PN017_04 ID17010301PN017_05	Temperature	Yes	n.a.	Existing Shade
Trail Creek/ ID17010301PN019_03	Temperature	Yes	n.a.	Existing Shade
WF Eagle Creek/ ID17010301PN008_02	Temperature	Yes	n.a.	Existing Shade
WF Steamboat Creek/ ID17010301PN028_02 ID17010301PN028_03	Temperature	Yes	n.a.	Existing Shade
Upper Coeur d'Alene River/ ID17010301PN015_02 ID17010301PN015_03 ID17010301PN015_04 ID17010301PN013_04 ID17010301PN013_05 ID17010301PN001_05	Temperature	Yes	n.a.	Existing Shade
North Fork Coeur d'Alene River/ ID17010301PN030_02 ID17010301PN030_03 ID17010301PN030_04	Temperature	Yes	n.a.	Existing Shade

5. Total Maximum Daily Loads

A TMDL prescribes an upper limit on discharge of a pollutant from all sources so as to assure water quality standards are met. It further allocates this load capacity (LC) among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, each of which receives a load allocation (LA). Natural background (NB), when present, is considered part of the LA, but is often broken out on its own because it represents 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 (MOS) be a part of the TMDL.

Practically, the margin of safety is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to human-made pollutant sources. This can be summarized symbolically as the equation: LC = MOS + NB + LA + WLA = TMDL. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First the load capacity is determined. Then the load capacity is broken down into its components: the necessary margin of safety is determined and subtracted; then natural background, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation are completed the result is a TMDL, which must equal the load capacity.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. 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, determination of critical conditions can be more complicated than it may appear on the surface.

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 loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow "gross allotment" as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

5.1 In-stream Water Quality Targets

For the Upper Coeur d'Alene River temperature TMDLs we utilize a potential natural vegetation (PNV) approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) which establishes that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered to be 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 which results from attainment of these conditions is consistent with the water quality standards, even though it may exceed 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 this section. For a more complete discussion of shade and its affects on stream water temperature, the reader is referred to the South Fork Clearwater Subbasin Assessment and TMDL (IDEQ, 2004)

<u>Potential Natural Vegetation for Temperature TMDLs</u>

There are several important contributors of heat to a stream including ground water temperature, air temperature and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most likely to be controlled or manipulated. The parameters that affect or control 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 how closely riparian vegetation grows together and water storage in the alluvial aquifer. Streamside vegetation and channel morphology are factors influencing shade, which are most likely to have been influenced by anthropogenic activities, and which can be most readily corrected and addressed by a TMDL.

Depending on how much vertical elevation also surrounds the stream, vegetation further away from the riparian corridor can 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 enjoys in a number of ways. Effective shade, that shade provided by all objects that intercept the sun as it makes its way across the sky, can be measured in a given spot with a solar pathfinder or with optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and the stream's 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 on aerial photography. All of these methods tell us information about how much the stream is covered and how much of it is exposed to direct solar radiation.

Potential natural vegetation (PNV) along a stream is that riparian plant community that has grown to an overall mature state, although some level of natural disturbance is usually included in our development and use of shade targets. The PNV can be removed by disturbance either naturally (wildfire, disease/old age, wind-blown, wildlife grazing) or anthropogenically (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 results in the stream heating up from anthropogenically created additional solar inputs. We can estimate PNV from models of plant community structure (shade curves for specific riparian plant communities), and we can measure existing vegetative cover or shade. Comparing the two will tell us how much excess solar load the stream is receiving, and what potential there is to decrease solar gain. Streams disturbed by wildfire require their own time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing shade or cover was estimated for the 23 water bodies from visual observations of aerial photos. 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 in other TMDLs. A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, the shade decreases as the 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 load from data collected on flat plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this case, an average of two stations (Spokane, WA and Kalispell, MT) 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 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 thus considered to be consistent with the Idaho water quality standards, even though they may exceed numeric criteria.

<u>Pathfinder Methodology</u>

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 spot that the tracing is made. In order to adequately characterize the effective shade on a reach of stream, ten traces should be taken at systematic or random intervals along the length of the stream in question.

At each sampling location the solar pathfinder should be placed in the middle of the stream about the bankfull water level. Follow the manufacturer's instructions (orient to true south and level) for taking traces. Systematic sampling is easiest to accomplish and still not bias the location of sampling. Start at a unique location such as 100 m from a bridge or fence line and then proceed upstream or downstream stopping to take additional traces at fixed intervals (e.g. every 50m, every 50 paces, etc.). One can also randomly locate points of measurement by generating random numbers to be used as interval distances.

It is a good idea to measure bankfull widths and take notes while taking solar pathfinder traces, and to photograph the stream at several unique locations. Pay special attention to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade producing ones) are present. Additionally or as a substitution, one can take densiometer readings at the same location as solar pathfinder traces. This provides the potential to develop relationships between canopy cover and effective shade for a given stream.

Aerial Photo Interpretation

Canopy coverage estimates or expectations of shade based on plant type and density are provided for natural breaks in vegetation density, marked out on a 1:100K or 1:250K hydrography. Each interval is assigned a single value representing the bottom of a 10%-canopy coverage or shade class as described below (*adapted from the CWE process, IDL, 2000).* For example, if we estimate that canopy cover for a particular stretch of stream is somewhere between 50% and 59%, we assign the value of 50% to that section of stream. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and the width of the stream. The typical vegetation type (below) shows the kind of landscape a particular cover class usually falls into for a stream 5m wide or less. For example, if a section of a 5m wide stream is identified as 20% cover class, it is usually because it is in agricultural land, meadows, open areas, or clearcuts. However, that does not mean that the 20% cover class cannot occur in shrublands and forests, because it does on wider streams.

Cover class	Typical vegetation type on 5m wide stream
0 = 0 – 9% cover	agricultural land, denuded areas
10 = 10 –19%	ag land, meadows, open areas, clearcuts
20 = 20 – 29%	ag land, meadows, open areas, clearcuts
30 = 30 – 39%	ag land, meadows, open areas, clearcuts
40 = 40 – 49%	shrublands/meadows
50 = 50 – 59%	shrublands/meadows, open forests
60 = 60 – 69%	shrublands/meadows, open forests
70 = 70 – 79%	forested
80 = 80 – 89%	forested
90 = 90 –100%	forested

It is important to note that the visual estimates made from the aerial photos are strongly influenced by canopy cover. It is not always possible to visualize or anticipate shade characteristics resulting from topography and landform. We assume that canopy coverage and shade are similar based on research conducted by Oregon DEQ. The visual estimates of 'shade' in this TMDL will be field verified with a solar pathfinder. The pathfinder measures effective shade and is taking into consideration other physical features that block the sun from hitting the stream surface (e.g. hillsides, canyon walls, terraces, man-made structures). The estimate of 'shade' made visually from an aerial photo does not always take into account topography or any shading that may occur from physical features other than vegetation. However, research has shown that shade and cover measurements are remarkably similar (OWEB, 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade.

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. Shadow length produced by vegetation covers a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has been eroded away.

The only factor not developed from the aerial photo work presented above is channel width (i.e., NSDZ or Bankfull Width). Accordingly, this parameter must be estimated from available information. We use regional curves for the major basins in Idaho, data compiled by Diane Hopster of Idaho Department of Lands (Figure 1), to estimate natural bankfull width.

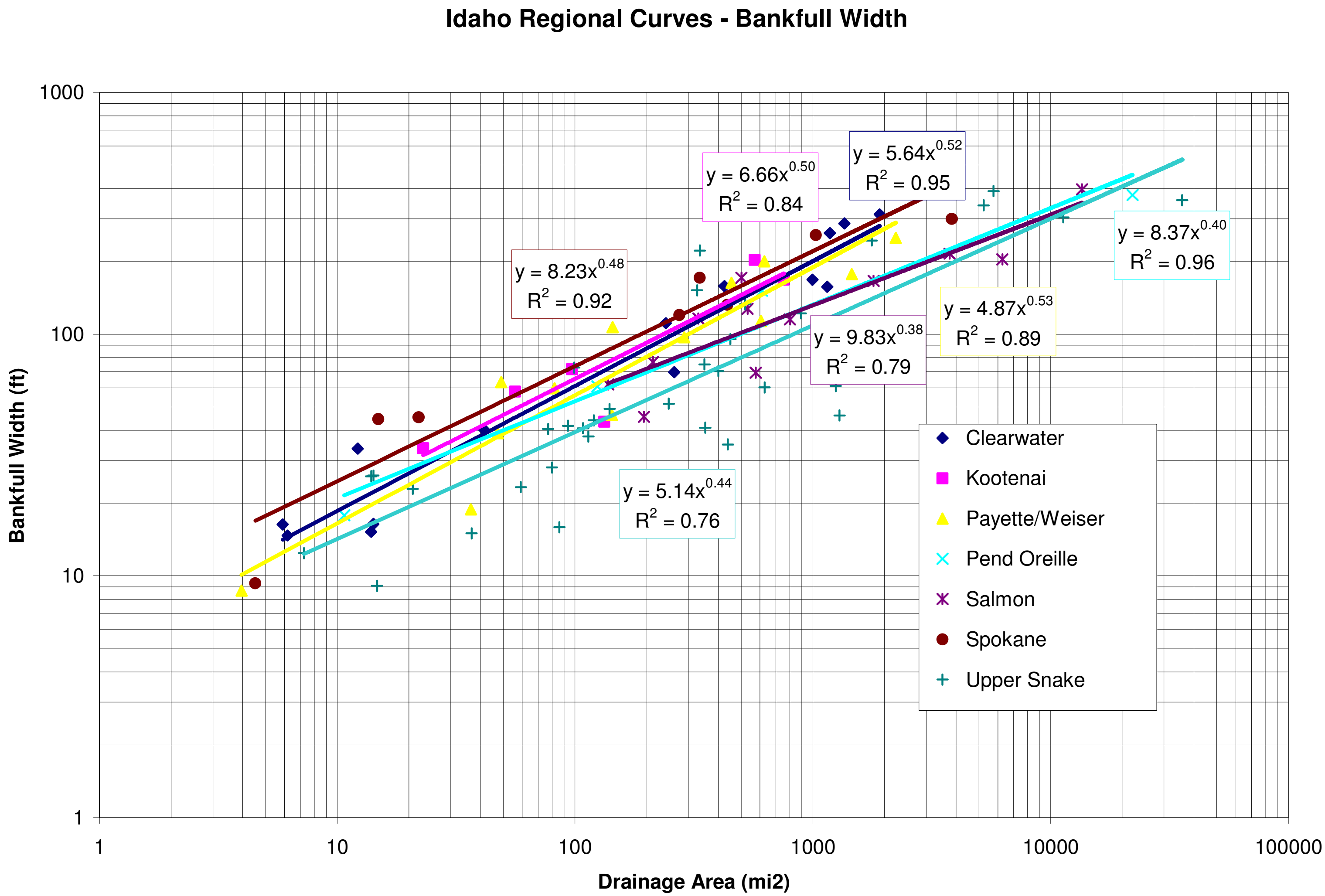
For each stream evaluated in the loading analysis, natural bankfull width is estimated based on drainage area and the Clearwater curve from Figure 1. We compared a number of the northern Idaho regional curves in Figure 1 to regional curves developed by the US Forest Service (E. Lider, pers. comm.) and Watershed Professionals Network, LLC (S. Perkins, pers. comm.) from NF Coeur d'Alene Subbasin data. The Forest Service curve provided to us was a linear function ($Y = 0.3984X + 16.529$); we also calculated a power function for the same USFS data ($Y = 5.0426X^{0.5654}$). The Watershed Professionals Network curve was also a power function ($Y = 9.2596X^{0.4169}$). We also compared curve estimates found in Table 1 to existing bankfull width measurements. We chose the Clearwater regional curve ($Y = 5.64X^{0.52}$) as best representing a natural bankfull width scenario for the North Fork (see Table 1). Although all the curves examined are reasonably close to each other regarding their estimates, each one had portions of them that provided poor fit to existing width estimates. We chose the Clearwater regional curve from Figure 1 to represent natural bankfull width because it best approximated river widths at the mouth of the subbasin above the confluence with the South Fork, and data for the Clearwater regional curve is more inclusive of a natural, wilderness type setting.

For the loading analyses, if the stream's existing width is wider than that predicted by the Clearwater curve from Figure 1 displayed in Table 1, then the Figure estimate of bankfull width is used in the loading analysis for natural width. If existing width is smaller, then existing width is used in the loading analysis for natural width. In most cases, the Clearwater Figure estimates are used for natural bankfull width in at least some portion of each stream's loading analysis.

Table 1. Regional Curve Estimates and Existing Measurements of Bankfull Width.

Location	area (sq mi)	Clearwater (m)	CDA USFS (m)	USFS power (m)	CDA WPN (m)	Average existing (m)
Beaver Creek @ mouth	42.3	12	10	13	13	
Beaver Creek bl Trail Creek	36	11	9	12	13	14.85
Beaver Creek bl Deer Creek	17.7	8	7	8	9	
Beaver Creek ab Dobson Gulch	4.9	4	6	4	5	7.95
Beaver Creek ab Carbon Creek	2.66	3	5	3	4	
Big Elk Creek @ mouth	11.6	6	6	6	8	6.8
Big Elk Creek ab First Creek	8.47	5	6	5	7	4.46
Big Elk Creek ab Boundary Creek	6.23	4	6	4	6	5.76
Bootjack Creek @ mouth	4.08	4	6	3	5	
Bootjack Creek ab Smith Creek	2.3	3	5	2	4	
Bumblebee Creek @ mouth	5.81	4	6	4	6	6
Bumblebee Creek ab 3rd tributary	1.62	2	5	2	3	
Burnt Cabin Creek @ mouth	11.3	6	6	6	8	8.25
Burnt Cabin Creek ab Lone Cabin Creek	7.24	5	6	5	6	
Burnt Cabin Creek ab Bottom Creek	4.24	4	6	3	5	
Burnt Cabin Creek bl Lost Mine Creek	1.9	2	5	2	4	
Copper Creek @ mouth	14	7	7	7	8	9
Copper Creek bl Mineral Creek	12.2	6	7	6	8	6.4
Copper Creek ab Mineral Creek	7.45	5	6	5	7	6.3
Copper Creek bl Fisher Creek	6.58	5	6	4	6	
Copper Creek ab Fisher Creek	3.99	4	6	3	5	
Deception Creek @ mouth	5.54	4	6	4	6	
Deception Creek ab Hoodoo Creek	2.96	3	5	3	4	
Graham Creek @ mouth	9.62	6	6	6	7	6.33
Graham Creek ab Deceitful Gulch	6.88	5	6	5	6	
Graham Creek ab East Fork	2.78	3	5	3	4	
Independence Creek @ mouth	59.8	14	12	16	16	17.76
Independence Creek bl North Creek	42	12	10	13	13	
Independence Creek bl Declaration Creek	21.7	9	8	9	10	12.4
Independence Creek ab Declaration Creek	12.6	6	7	6	8	8.1
Laverne Creek @ mouth	6.9	5	6	5	6	8.43
Laverne Creek ab 2nd tributary	3.37	3	5	3	5	
Leiberg Creek @ mouth	12.1	6	7	6	8	9.5
Leiberg Creek bl Lavin Creek	6.34	4	6	4	6	
Leiberg Creek ab Stull Creek	2.25	3	5	2	4	
Lost Creek @ mouth	24.3	9	8	9	11	9
Lost Creek ab EF	13.7	7	7	7	8	
Lost Creek ab Stack Creek	8.51	5	6	5	7	
Lost Creek ab 4th tributary	3.69	3	5	3	5	
Prichard Creek @ mouth	97.8	19	17	21	19	15.65
Prichard Creek ab Eagle Creek	49.7	13	11	14	14	15.5
Prichard Creek bl Butte Gulch	39	12	10	12	13	12.2
Prichard Creek ab Granite Gulch	10.4	6	6	6	7	13.5
Skookum Creek @ mouth	6.35	4	6	4	6	7.05
Skookum Creek ab McCauley/Knight Creeks	4.04	4	6	3	5	
Skookum Creek ab Early Creek	2.07	3	5	2	4	
Steamboat Creek @ mouth	42	12	10	13	13	11.6
Steamboat Creek bl Barrymore Creek	34.6	11	9	11	12	11.6
Steamboat Creek bl EF/WF confluence	23.2	9	8	9	10	11.3
EF Steamboat Creek @ mouth	11	6	6	6	8	
EF Steamboat Creek ab Little EF Creek	6.95	5	6	5	6	
EF Steamboat Creek ab Cabin Creek	4.42	4	6	4	5	
EF Steamboat Creek ab Martin Creek	1.36	2	5	2	3	
WF Steamboat Creek @ mouth	11.5	6	6	6	8	
WF Steamboat Creek bl Comfy Creek	8.21	5	6	5	7	
WF Steamboat Creek ab Comfy Creek	4.04	4	6	3	5	
Tepee Creek @ mouth	144	23	23	26	22	
Tepee Creek ab Independence Creek	73.5	16	14	17	17	
Tepee Creek ab Trail Creek	35.6	11	9	12	13	12.95
Tepee Creek ab Big Elk Creek	14.1	7	7	7	9	3.5
Trail Creek @ mouth	29.7	10	9	10	12	
Trail Creek ab Bear Creek	26	9	8	10	11	
Trail Creek bl Callis Creek	18.5	8	7	8	10	16.25
Trail Creek bl Stewart/Potter confluence	11.5	6	6	6	8	
Eagle Creek @ mouth	44.5	12	10	13	14	20.65
WF Eagle Creek @ mouth	18.9	8	7	8	10	10.85
WF Eagle Creek ab Bobtail Creek	11.9	6	6	6	8	
WF Eagle Creek ab Cottonwood Creek	6.07	4	6	4	6	
EF Eagle Creek @ mouth	22.7	9	8	9	10	
EF Eagle Creek bl 2nd tributary	15	7	7	7	9	11.5
EF Eagle Creek ab Tributary Creek	4.97	4	6	4	6	
Coeur d'Alene River @ SF confluence	896	59	114	72	48	~60
Coeur d'Alene River ab NF CDA River	713	52	92	63	44	
Coeur d'Alene River bl Beaver Creek	581	47	76	56	40	46.03
Coeur d'Alene River ab Prichard Creek	439	41	58	48	36	33
Coeur d'Alene River ab Shoshone Creek	334	35	46	41	32	48.2
Coeur d'Alene River ab Tepee Creek	102	19	17	21	19	
Coeur d'Alene River ab Jordan Creek	70.2	16	14	17	17	13.3
Coeur d'Alene River ab Spruce Creek	26.5	9	8	10	11	6.4
NF Coeur d'Alene River @ mouth	170	25	26	28	24	~24
NF Coeur d'Alene River ab Copper Creek	125	21	20	24	21	
NF Coeur d'Alene River ab Leiberg Creek	95.4	18	17	20	19	22
NF Coeur d'Alene River ab Burnt Cabin Creek	44.5	12	10	13	14	13.2
NF Coeur d'Alene River ab Iron Creek	17.5	8	7	8	9	8.05
NF Coeur d'Alene River bl Honey Creek	4.37	4	6	4	5	

Figure 1. Bankfull Width as a Function of Drainage Area



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Design Conditions

The Interior Columbia Basin Ecosystem Management Project (ICBEMP) identified a number of potential natural vegetation groups for the Columbia Basin region including Idaho, which were mapped and included in their draft and final EIS. The North Fork Coeur d'Alene River region was included in an area known as 'moist forest' from the PNV maps. BLM, Coeur d'Alene Field Office presented a crosswalk of terms used by various agencies for these vegetation units. The 'moist forest' of ICBEMP corresponds with the 'moist' group of vegetation response units of the Idaho Panhandle National Forest and the 'wet/warm conifer' cover type of the BLM Coeur d'Alene Field Office (BLM, 2006). The Idaho Gap Analysis Program of USGS calls this area as containing western red cedar, western hemlock, western red cedar/grand fir, and western red cedar/western hemlock cover types (BLM, 2006). Many of the National Forests involved have further expanded on the ICBEMP vegetation classifications and now represent information as Vegetation Response Units (VRUs) for their planning areas. The Panhandle National Forest has approximately eleven VRUs based on eleven habitat types or HGTs (see Appendix X). These VRUs were used as the basis for developing shade curves used to set target shade levels for the various streams examined. Some streams examined headwater in the warm/dry forests of Group A (VRUs 1, 2, and 3) or into Group C, the cool/wet to moist forests of VRUs 7 and 8. But most are in the moderately warm and moderately cool/moist (Group B) assemblage of forests, which include VRUs 4, 5, and 6. In addition to these forest groups, Appendix X shows shade curves developed for two lower elevation hardwood-conifer mix forests that occur at lower elevation, wider floodplains. The labels for these groups, although identified as Nonforest Group 1 and 2, are perhaps a misnomer because they are a mix of both coniferous and hardwood species and have a substantial tree component.

The 'moist forest' described by ICBEMP and others would be included in Group B of Appendix X containing VRUs 4, 5, and 6. In reality, probably all eleven VRUs are present to some degree in the North Fork Coeur d'Alene region, however, VRUs 5/6 are predominant on north facing slopes and may occupy the most area of land in this subbasin. South facing slopes on the other hand tend to include a variety of VRUs with the near stream vegetation dominated by VRU 2, a 'warm/dry' forest of ponderosa pine, grand fir, Douglas fir, and lodgepole pine.

In general, the higher elevation portions of the streams examined in this temperature TMDL, the portion most often associated with Forest Groups, have VRU 5/6 on north-facing slopes and VRU 2 on south-facing slopes. VRU 5/6 is HGT 5 – moderately cool and moist forest and HGT 6 – moderately cool and wet forest consistent with the 'warm forest' classification of others. As streams transition into the Nonforest Groups the forest VRUs give way to valley bottom VRUs 6 and 6/8 coincident with increases in hardwoods or deciduous tree and shrub vegetation amongst the mixed conifer vegetation types.

Target Selection

To determine potential natural vegetation shade targets for the NF Coeur d'Alene River and tributaries, effective shade curves developed for the Panhandle region of Idaho based on VRUs (see Appendix X) were examined. 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. Appendix X provides an explanation of how shade curves were developed for the Panhandle region of Idaho.

The effective shade calculations are based on a six month period from April through September. This time period coincides with the critical time period when temperatures affect beneficial uses such as spring and fall salmonids spawning and when cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent a period of highest stream temperatures. Solar gains can begin early in the spring and affect not only the highest temperatures reached later on in the summer, but solar loadings affect salmonids spawning temperatures in spring and fall. Thus, solar loading in these streams is evaluated from spring (April) to early fall (September).

Shade Curves

The use of the various shade curves provided in Appendix X is based on an aquatic response unit (ARU) filter (see Table X-3). If the stream order is between 1st and 4th (see Figure 2 for stream orders in the NF Coeur d'Alene Subbasin) and the gradient is ≥ 3% (see Figure 3 for stream gradients in the NF Coeur d'Alene Subbasin), then one of the Forest Group shade curves is used for that section of stream. The decision on which Forest Group shade curve to use for a particular section of stream depends on the predominant VRUs surrounding the stream in that section. Forest Groups encountered in this analysis include A (Table 2), B (Table 3) and C (Table 4), with Forest Group B predominant. Forest Group D did not occur on any streams in this analysis. Target values in tables result from the averaging of three flow direction-based shade curves, one for each cardinal direction (N-S and E-W) and one for the 45 degree angle (see Appendix X).

Table 2. Shade Targets for Forest Group A Vegetation Type at Various Stream Widths

Forest	1m	2m	3m	4m	5m	6m	7m	8m	9m
Group A - VRUs 1, 2, 3	98	97.7	96.3	94.7	92.7	91	88	82.7	77
Target (%)	**98**	**98**	**96**	**95**	**93**	**91**	**88**	**83**	**77**

Table 3. Shade Targets for Forest Group B Vegetation Type at Various Stream Widths

Forest	1m	2m	3m	4m	5m	6m	7m	8m	9m
Group B - VRUs 4,5,6	98	98	96	94	91	89	83	78	73
Target (%)	**98**	**98**	**96**	**94**	**91**	**89**	**83**	**78**	**73**

Forest	10m	11m	12m	13m	14m	15m	20m	24m	25m
Group B - VRUs 4,5,6	68	64	61	57	54	52	41	37	35
Target (%)	**68**	**64**	**61**	**57**	**54**	**52**	**41**	**37**	**35**

Table 4. Shade Targets for Forest Group C Vegetation Type at Various Stream Widths

Forest	1m	2m	3m	4m	5m	6m	7m	8m	9m
Group C - VRUs 7, 8	98	97.3	95	92.3	89.7	85	78.7	73.3	68
Target (%)	**98**	**97**	**95**	**92**	**90**	**85**	**79**	**73**	**68**

If stream orders are between 1st and 4th (Figure 2), but the gradient is < 3% (Figure 3), then the stream falls into the Nonforest Group 1 category from the ARU filter (Appendix X, Table X-3). Generally, the lower portions of most streams fall into the <3% slope class. Shade curves developed for this group includes a variety of coniferous and deciduous vegetation (see Table X-7). Because this is the most common nonforest group used in the analysis, a large number of stream width/target combinations were needed (Table 5).

Table 5. Shade Targets for Nonforest Group 1 Vegetation Type at Various Stream Widths

Non-Forest	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
Group 1 - Hardwoods	98	94	86	78	72	65	60	55	52	48	45	41	39
Target (%)	**98**	**94**	**86**	**78**	**72**	**65**	**60**	**55**	**52**	**48**	**45**	**41**	**39**

Non-Forest	14m	15m	16m	17m	18m	19m	20m	21m	22m	23m	24m	25m
Group 1 - Hardwoods	37	35	33.3	31.8	30.3	29.3	28.3	27	26	25	24	23.3
Target (%)	**37**	**35**	**33**	**32**	**30**	**29**	**28**	**27**	**26**	**25**	**24**	**23**

When stream orders increase to the 5th and 6th level as they do on lower Tepee Creek and the NF Coeur d'Alene River (Figure 2), streams and their associated floodplains become wider and a second group of nonforest vegetation (Nonforest Group 2) is needed for describing shade targets (Table 6).

Table 6. Shade Targets for Nonforest Group 2 Vegetation Type at Various Stream Widths

Non-Forest	10m	11m	12m	17m	18m	19m	20m	21m	22m	23m	24m	25m	26m	27m	28m	29m	30m
Group 2 - Hardwoods	42.7	40.7	37.7	28.9	27.7	26.5	25.3	24.5	23.7	22.8	22	21.2	20.3	19.7	19	18.5	18
Target (%)	**43**	**41**	**38**	**29**	**28**	**27**	**25**	**25**	**24**	**23**	**22**	**21**	**20**	**20**	**19**	**19**	**18**

Non-Forest	31m	32m	33m	34m	35m	38m	41m	44m	46m	47m	48m	49m	50m	51m	52m	59m
Group 2 - Hardwoods	17.5	17	16.5	16	15.8	14.7	13.5	12.7	12.3	12	11.7	11.5	11.3	11.2	11	9.8
Target (%)	**18**	**17**	**17**	**16**	**16**	**15**	**14**	**13**	**12**	**12**	**12**	**12**	**11**	**11**	**11**	**10**

Figure 2. Stream Orders for Streams in the North Fork Coeur d'Alene Subbasin.

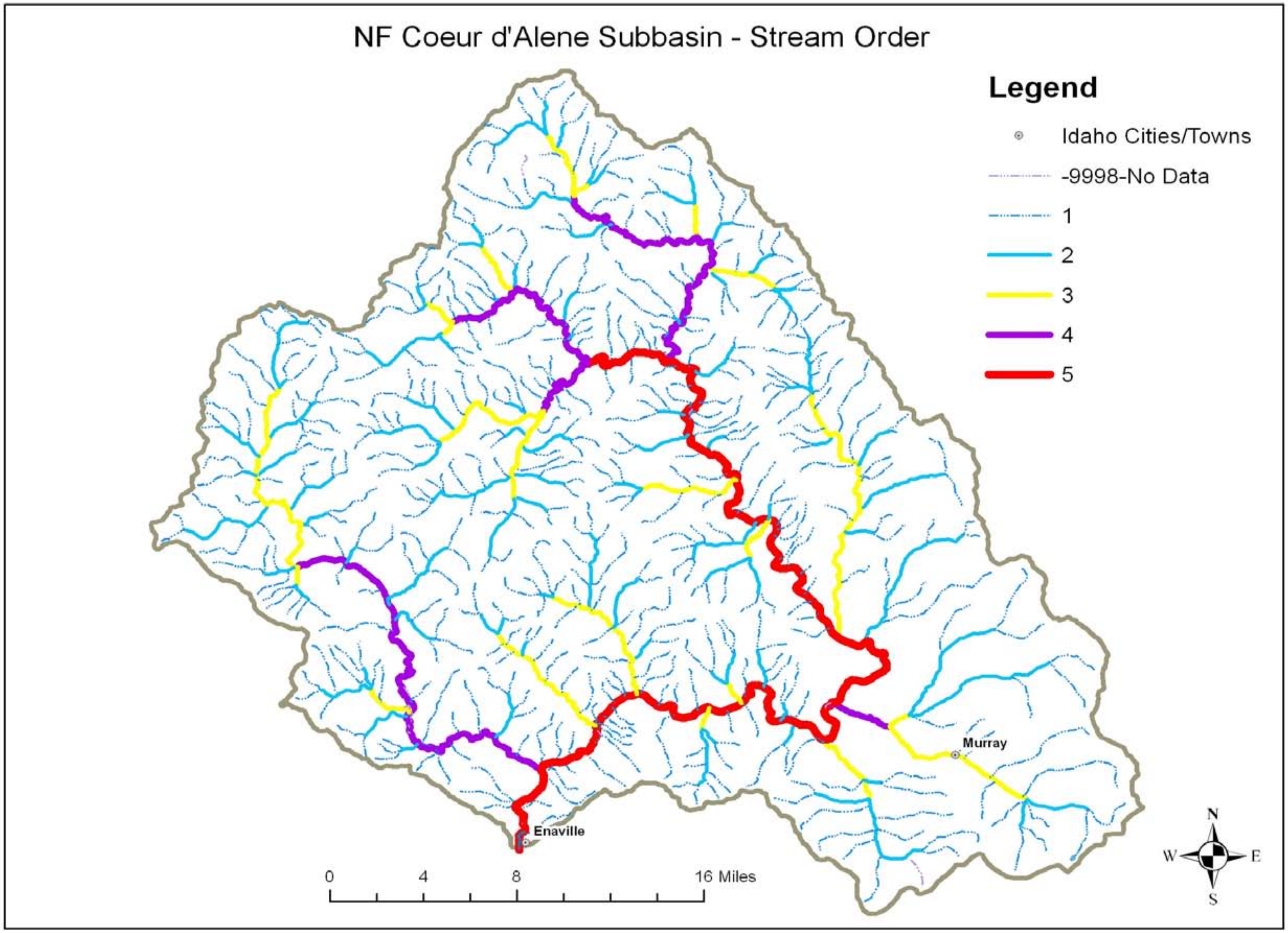
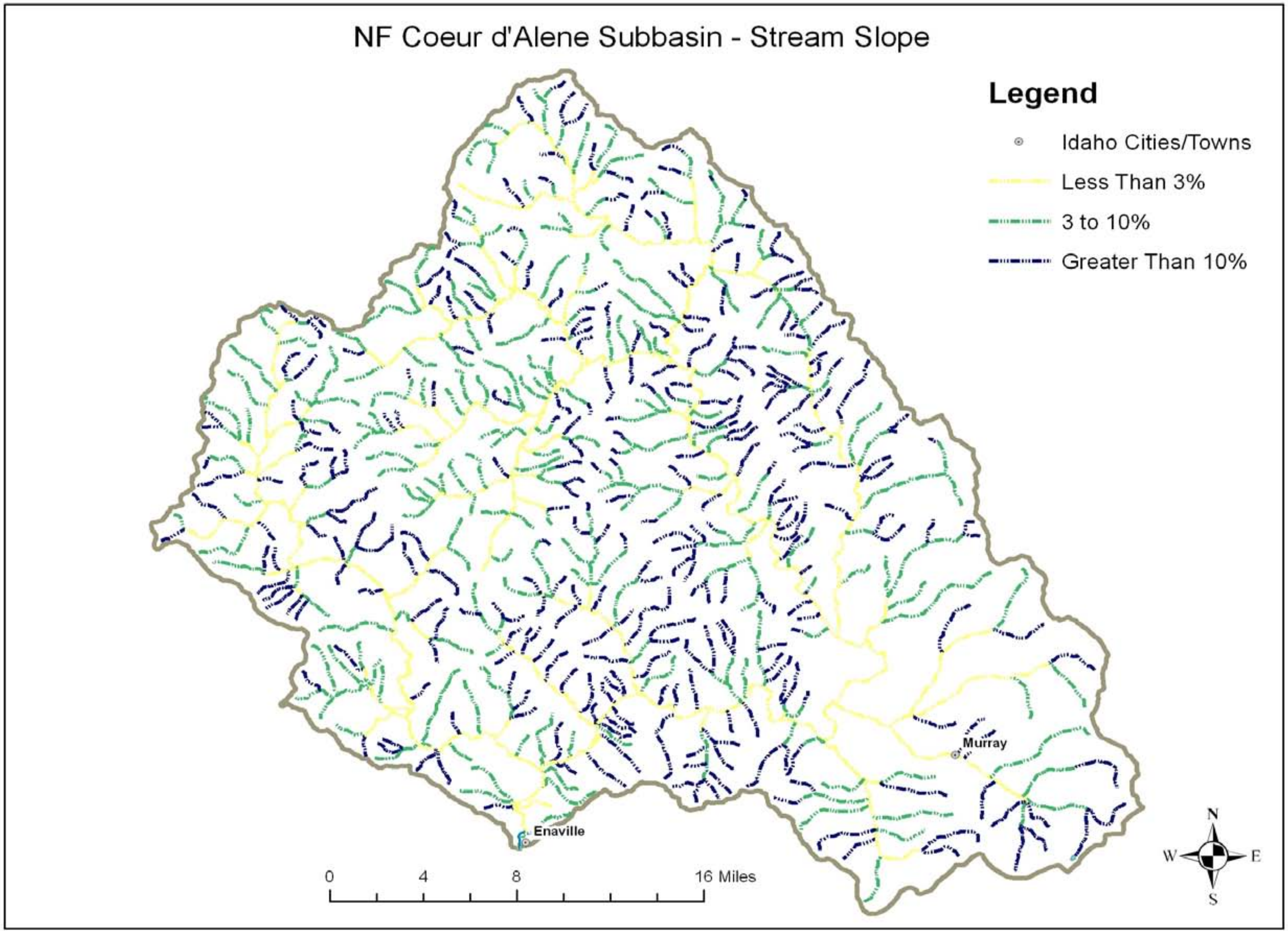


Figure 3. Stream Slopes (Gradients) for Streams in the North Fork Coeur d'Alene Subbasin.



Monitoring Points

The accuracy of the aerial photo interpretations was field verified with a solar pathfinder during the summer of 2007 at various accessible locations representing a variety of existing shade levels (see Figure 5 for locations). Measurements of existing shade taken in the field were compared to aerial photo interpretations of existing shade at these locations. General differences between the two resulted in the aerial interpretation to be adjusted accordingly. These data are included in Appendix C.

Effective shade monitoring can take place on any reach throughout the Upper Coeur d'Alene subbasin and compared to estimates of existing shade seen on Figure 5 and described in Tables 7 through 29. Those areas with the largest disparity between existing shade estimates and shade targets 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 segments for each change in existing shade vary in length 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 within that segment averaged together should suffice to determine new shade levels in the future.

5.2 Load Capacity

The loading capacity for a stream under PNV is essentially the solar loading allowed under the shade targets (Figure 4) specified for the reaches within that stream. These loads are determined by multiplying the solar load to a flat plat collector (under full sun) for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e. the percent open or 1-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 for flat plate collectors from National Renewable Energy Laboratory (NREL) weather stations near by. In this case, data from the Spokane, WA and Kalispell, MT stations were averaged for this analysis. The solar loads used in this TMDL are spring/summer averages, thus, we use an average load for the six month period from April through September. These months coincide with time of year that stream temperatures are increasing and when deciduous vegetation is in leaf. Tables 7 through 29 show the PNV shade targets (identified as Target or Potential Shade) and their corresponding potential summer load (in kWh/m^2/day and kWh/day) that serve as the loading capacities for the streams.

Load capacity varies widely in this analysis depending on the size of the stream with values from 1,948 kWh/day for Bootjack Creek (Table 9) to 17 million kWh/day for the entire length of the North Fork Coeur d'Alene River (Table 29).

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. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat plate collector at the NREL weather stations. Existing shade data are presented in Tables 7 through 29. Like loading capacities (potential loads), existing loads in Tables 7 through 29 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day).

Existing and potential loads in kWh/day can be summed for the entire stream or portion of stream examined in a single loading table. These total loads are shown at the bottom of their respective columns in each 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 to be discussed next in the load allocation section. The percent reduction shown in the lower right corner of each table represents how much total excess load there is in relation to total existing load.

Existing solar loads vary from 12,942 kWh/day on Bootjack Creek (Table 9) to almost 19.8 million kWh/day on the North Fork Coeur d'Alene River (Table 29).

Table 7. Existing and Potential Solar Loads for Beaver Creek.

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)	**Beaver Creek**
Assessment Unit #ID17010301PN003_02													
520	0.9	0.55	0.98	0.11	-0.44	1	1	520	286	520	57.2	-228.8	Forest Group C
530	0.8	1.1	0.98	0.11	-0.99	1	1	530	583	530	58.3	-524.7	
950	0.9	0.55	0.98	0.11	-0.44	2	2	1900	1045	1900	209	-836	Forest Group B
950	0.8	1.1	0.98	0.11	-0.99	3	2	2850	3135	1900	209	-2926	
1990	0.7	1.65	0.96	0.22	-1.43	5	3	9950	16417.5	5970	1313.4	-15104.1	
400	0.2	4.4	0.78	1.21	-3.19	7	4	2800	12320	1600	1936	-10384	Nonforest Group 1
1010	0.4	3.3	0.78	1.21	-2.09	**8**	**4**	8080	26664	4040	4888.4	-21775.6	
410	0.2	4.4	0.72	1.54	-2.86	9	5	3690	16236	2050	3157	-13079	
130	0	5.5	0.72	1.54	-3.96	9	5	1170	6435	650	1001	-5434	
370	0.2	4.4	0.72	1.54	-2.86	9	5	3330	14652	1850	2849	-11803	
1190	0.5	2.75	0.65	1.925	-0.825	10	6	11900	32725	7140	13744.5	-18980.5	
360	0.7	1.65	0.6	2.2	0.55	11	7	3960	6534	2520	5544	-990	
660	0.6	2.2	0.6	2.2	0	11	7	7260	15972	4620	10164	-5808	
300	0.5	2.75	0.55	2.475	-0.275	11	8	3300	9075	2400	5940	-3135	
130	0.7	1.65	0.55	2.475	0.825	12	8	1560	2574	1040	2574	-9.09495E-13	
350	0.5	2.75	0.55	2.475	-0.275	12	8	4200	11550	2800	6930	-4620	
230	0.4	3.3	0.55	2.475	-0.825	12	**8**	2760	9108	1840	4554	-4554	
470	0.3	3.85	0.52	2.64	-1.21	12	9	5640	21714	4230	11167.2	-10546.8	
460	0.4	3.3	0.52	2.64	-0.66	13	9	5980	19734	4140	10929.6	-8804.4	
690	0.2	4.4	0.52	2.64	-1.76	13	9	8970	39468	6210	16394.4	-23073.6	
780	0	5.5	0.48	2.86	-2.64	14	10	10920	60060	7800	22308	-37752	
							Subtotal	**101,270**	**326,288**	**65,750**	**125,928**	**-200,360**	
Assessment Unit #ID17010301PN003_03													
220	0.5	2.75	0.48	2.86	0.11	14	10	3080	8470	2200	6292	-2178	
320	0.2	4.4	0.48	2.86	-1.54	14	10	4480	19712	3200	9152	-10560	
1070	0.1	4.95	0.45	3.025	-1.925	**15**	**11**	16050	79447.5	11770	35604.25	-43843.25	
410	0	5.5	0.45	3.025	-2.475	15	11	6150	33825	4510	13642.75	-20182.25	
1120	0.1	4.95	0.45	3.025	-1.925	15	11	16800	83160	12320	37268	-45892	
180	0	5.5	0.41	3.245	-2.255	16	12	2880	15840	2160	7009.2	-8830.8	
480	0.1	4.95	0.41	3.245	-1.705	16	12	7680	38016	5760	18691.2	-19324.8	
780	0.3	3.85	0.41	3.245	-0.605	16	12	12480	48048	9360	30373.2	-17674.8	
230	0.6	2.2	0.41	3.245	1.045	16	12	3680	8096	2760	8956.2	860.2	
1200	0.2	4.4	0.41	3.245	-1.155	16	**12**	19200	84480	14400	46728	-37752	
							Subtotal	**92,480**	**419,095**	**68,440**	**213,717**	**-205,378**	
							Total	**193,750**	**745,382**	**134,190**	**339,645**	**-405,737**	**-54** **% Reduction**

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Table 8. Existing and Potential Solar Loads for Big Elk Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	**Big Elk Creek**
Assessment Unit # ID17010301PN020_02													
1920	0.9	0.55	0.98	0.11	-0.44	1	1	1920	1056	1920	211.2	-844.8	Forest Group B
890	0.8	1.1	0.98	0.11	-0.99	2	2	1780	1958	1780	195.8	-1762.2	
680	0.8	1.1	0.94	0.33	-0.77	2	2	1360	1496	1360	448.8	-1047.2	Nonforest Group 1
810	0.7	1.65	0.86	0.77	-0.88	3	3	2430	4009.5	2430	1871.1	-2138.4	
1220	0.6	2.2	0.86	0.77	-1.43	3	3	3660	8052	3660	2818.2	-5233.8	
690	0.7	1.65	0.78	1.21	-0.44	**6**	**4**	4140	6831	2760	3339.6	-3491.4	
750	0.6	2.2	0.78	1.21	-0.99	4	4	3000	6600	3000	3630	-2970	
230	0.7	1.65	0.72	1.54	-0.11	**4**	**5**	920	1518	1150	1771	253	
530	0.6	2.2	0.72	1.54	-0.66	5	5	2650	5830	2650	4081	-1749	
210	0.7	1.65	0.72	1.54	-0.11	5	5	1050	1732.5	1050	1617	-115.5	
850	0.6	2.2	0.65	1.925	-0.28	6	6	5100	11220	5100	9817.5	-1402.5	
320	0.5	2.75	0.65	1.925	-0.83	**7**	**6**	2240	6160	1920	3696	-2464	
							Total	**30,250**	**56,463**	**28,780**	**33,497**	**-22,966**	**-41**
													% Reduction

Table 9. Existing and Potential Solar Loads for Bootjack Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	**Bootjack Creek**
Assessment Unit # ID17010301PN034_02													
730	0.9	0.55	0.98	0.11	-0.44	1	1	730	401.5	730	80.3	-321.2	Forest Group B
720	0.7	1.65	0.98	0.11	-1.54	1	1	720	1188	720	79.2	-1108.8	
1290	0.8	1.1	0.98	0.11	-0.99	2	2	2580	2838	2580	283.8	-2554.2	
600	0.7	1.65	0.96	0.22	-1.43	3	**3**	1800	2970	1800	396	-2574	
300	0.8	1.1	0.96	0.22	-0.88	3	3	900	990	900	198	-792	
690	0.7	1.65	0.94	0.33	-1.32	4	**4**	2760	4554	2760	910.8	-3643.2	
							Total	**9,490**	**12,942**	**9,490**	**1,948**	**-10,993**	**-85**
													% Reduction

Table 10. Existing and Potential Solar Loads for Bumblebee Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	**Bumblebee Creek**
Assessment Unit # ID17010301PN031_02													
870	0.8	1.1	0.98	0.11	-0.99	1	1	870	957	870	95.7	-861.3	Forest Group B
1150	0.9	0.55	0.98	0.11	-0.44	2	1	2300	1265	1150	126.5	-1138.5	
300	0.8	1.1	0.98	0.11	-0.99	3	2	900	990	600	66	-924	
630	0.9	0.55	0.98	0.11	-0.44	3	**2**	1890	1039.5	1260	138.6	-900.9	
1560	0.8	1.1	0.96	0.22	-0.88	4	3	6240	6864	4680	1029.6	-5834.4	
270	0.9	0.55	0.96	0.22	-0.33	5	3	1350	742.5	810	178.2	-564.3	
450	0.8	1.1	0.94	0.33	-0.77	5	4	2250	2475	1800	594	-1881	
360	0.7	1.65	0.78	1.21	-0.44	5	4	1800	2970	1440	1742.4	-1227.6	Nonforest Group 1
570	0.6	2.2	0.78	1.21	-0.99	6	4	3420	7524	2280	2758.8	-4765.2	
890	0.6	2.2	0.78	1.21	-0.99	**6**	**4**	5340	11748	3560	4307.6	-7440.4	
							Total	**26,360**	**36,575**	**18,450**	**11,037**	**-25,538**	**-70 % Reduction**

Table 11. Existing and Potential Solar Loads for Burnt Cabin Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	**Burnt Cabin Creek**
Assessment Unit # ID17010301PN036_02													
580	0.8	1.1	0.98	0.11	-0.99	1	1	580	638	580	63.8	-574.2	Forest Group B
740	0.9	0.55	0.98	0.11	-0.44	2	2	1480	814	1480	162.8	-651.2	
200	0.8	1.1	0.98	0.11	-0.99	2	**2**	400	440	400	44	-396	
1630	0.6	2.2	0.86	0.77	-1.43	3	3	4890	10758	4890	3765.3	-6992.7	Nonforest Group 1
570	0.7	1.65	0.86	0.77	-0.88	4	3	2280	3762	1710	1316.7	-2445.3	
740	0.6	2.2	0.78	1.21	-0.99	5	**4**	3700	8140	2960	3581.6	-4558.4	
660	0.7	1.65	0.78	1.21	-0.44	5	4	3300	5445	2640	3194.4	-2250.6	
1010	0.6	2.2	0.72	1.54	-0.66	6	**5**	6060	13332	5050	7777	-5555	
670	0.5	2.75	0.72	1.54	-1.21	7	5	4690	12897.5	3350	5159	-7738.5	
2200	0.6	2.2	0.65	1.925	-0.28	**8**	**6**	17600	38720	13200	25410	-13310	
							Total	**44,980**	**94,947**	**36,260**	**50,475**	**-44,472**	**-47 % Reduction**

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Table 12. Existing and Potential Solar Loads for Copper Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Copper Creek
Assessment Unit # ID17010301PN039_02													
330	0.9	0.55	0.98	0.11	-0.44	1	1	330	181.5	330	36.3	-145.2	Forest Group B
400	0.7	1.65	0.98	0.11	-1.54	2	2	800	1320	800	88	-1232	
220	0.8	1.1	0.96	0.22	-0.88	3	3	660	726	660	145.2	-580.8	
990	0.9	0.55	0.94	0.33	-0.22	4	4	3960	2178	3960	1306.8	-871.2	
90	0.7	1.65	0.94	0.33	-1.32	4	**4**	360	594	360	118.8	-475.2	
470	0.9	0.55	0.91	0.495	-0.06	5	**5**	2350	1292.5	2350	1163.25	-129.25	
2530	0.8	1.1	0.91	0.495	-0.61	5	5	12650	13915	12650	6261.75	-7653.25	
130	0.7	1.65	0.91	0.495	-1.155	**6**	**5**	780	1287	650	321.75	-965.25	
							Subtotal	**21,890**	**21,494**	**21,760**	**9,442**	**-12,052**	
Assessment Unit # ID17010301PN039_03													
650	0.8	1.1	0.65	1.925	0.825	**6**	**6**	3900	4290	3900	7507.5	3217.5	Nonforest Group 1
520	0.6	2.2	0.65	1.925	-0.275	7	6	3640	8008	3120	6006	-2002	
710	0.5	2.75	0.65	1.925	-0.825	8	6	5680	15620	4260	8200.5	-7419.5	
770	0.6	2.2	0.6	2.2	0	8	7	6160	13552	5390	11858	-1694	
300	0.5	2.75	0.6	2.2	-0.55	9	7	2700	7425	2100	4620	-2805	
520	0.6	2.2	0.6	2.2	0	**9**	**7**	4680	10296	3640	8008	-2288	
							Subtotal	**26,760**	**59,191**	**22,410**	**46,200**	**-12,991**	
							Total	**48,650**	**80,685**	**44,170**	**55,642**	**-25,043**	**-31** % Reduction

Table 13. Existing and Potential Solar Loads for Deception Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Deception Creek
Assessment Unit # ID17010301PN037_02													
710	0.9	0.55	0.98	0.11	-0.44	1	1	710	390.5	710	78.1	-312.4	Forest Group B
1540	0.9	0.55	0.98	0.11	-0.44	2	2	3080	1694	3080	338.8	-1355.2	
950	0.7	1.65	0.98	0.11	-1.54	2	2	1900	3135	1900	209	-2926	
590	0.6	2.2	0.96	0.22	-1.98	3	**3**	1770	3894	1770	389.4	-3504.6	
2270	0.7	1.65	0.78	1.21	-0.44	4	**4**	9080	14982	9080	10986.8	-3995.2	Nonforest Group 1
							Total	**16,540**	**24,096**	**16,540**	**12,002**	**-12,093**	**-50** % Reduction

Table 14. Existing and Potential Solar Loads for Graham Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	**Graham Creek**
Assessment Unit # ID17010301PN002_02													
2140	0.9	0.55	0.98	0.11	-0.44	1	1	2140	1177	2140	235.4	-941.6	Forest Group B
280	0.8	1.1	0.98	0.11	-0.99	2	2	560	616	560	61.6	-554.4	
3270	0.9	0.55	0.96	0.22	-0.33	3	**3**	9810	5395.5	9810	2158.2	-3237.3	
330	0.8	1.1	0.94	0.33	-0.77	4	4	1320	1452	1320	435.6	-1016.4	
270	0.9	0.55	0.94	0.33	-0.22	4	4	1080	594	1080	356.4	-237.6	
							Subtotal	**14,910**	**9,235**	**14,910**	**3,247**	**-5,987**	
Assessment Unit # ID17010301PN002_03													
440	0.8	1.1	0.72	1.54	0.44	5	**5**	2200	2420	2200	3388	968	Nonforest Group 1
310	0.9	0.55	0.72	1.54	0.99	5	5	1550	852.5	1550	2387	1534.5	
490	0.6	2.2	0.65	1.925	-0.275	6	6	2940	6468	2940	5659.5	-808.5	
120	0.5	2.75	0.65	1.925	-0.825	6	6	720	1980	720	1386	-594	
370	0.8	1.1	0.65	1.925	0.825	**6**	**6**	2220	2442	2220	4273.5	1831.5	
							Subtotal	**9,630**	**14,163**	**9,630**	**17,094**	**2,932**	
							Total	**24,540**	**23,397**	**24,540**	**20,341**	**-3,056**	**-13** **% Reduction**

Table 15. Existing and Potential Solar Loads for Independence Creek.

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)	**Independence Creek**
Assessment Unit # ID17010301PN018_02													
1250	0.9	0.55	0.98	0.11	-0.44	1	1	1250	687.5	1250	137.5	-550	Forest Group B
330	0.8	1.1	0.98	0.11	-0.99	2	2	660	726	660	72.6	-653.4	
370	0.9	0.55	0.98	0.11	-0.44	3	2	1110	610.5	740	81.4	-529.1	
770	0.8	1.1	0.96	0.22	-0.88	4	3	3080	3388	2310	508.2	-2879.8	
300	0.9	0.55	0.96	0.22	-0.33	5	3	1500	825	900	198	-627	
620	0.6	2.2	0.86	0.77	-1.43	6	4	3720	8184	2480	1909.6	-6274.4	Nonforest Group 1
2590	0.7	1.65	0.72	1.54	-0.11	7	5	18130	29914.5	12950	19943	-9971.5	
810	0.5	2.75	0.65	1.925	-0.83	**8**	**6**	6480	17820	4860	9355.5	-8464.5	
							Subtotal	**35,930**	**62,156**	**26,150**	**32,206**	**-29,950**	
Assessment Unit # ID17010301PN018_03													
2790	0.6	2.2	0.6	2.2	0.00	10	7	**27,900**	**61,380**	**19,530**	**42,966**	**-18,414**	Nonforest Group 1
Assessment Unit # ID17010301PN018_02													
950	0.5	2.75	0.52	2.64	-0.11	**12**	**9**	11400	31350	8550	22572	-8778	Nonforest Group 1
360	0.6	2.2	0.52	2.64	0.44	12	9	4320	9504	3240	8553.6	-950.4	
1700	0.3	3.85	0.48	2.86	-0.99	12	10	20400	78540	17000	48620	-29920	
2020	0.6	2.2	0.45	3.025	0.83	13	11	26260	57772	22220	67215.5	9443.5	
530	0.4	3.3	0.41	3.245	-0.05	14	12	7420	24486	6360	20638.2	-3847.8	
760	0.3	3.85	0.41	3.245	-0.60	14	12	10640	40964	9120	29594.4	-11369.6	
1680	0.1	4.95	0.41	3.245	-1.71	14	**12**	23520	116424	20160	65419.2	-51004.8	
1290	0.2	4.4	0.39	3.355	-1.05	15	13	19350	85140	16770	56263.35	-28876.65	
440	0.1	4.95	0.39	3.355	-1.60	15	13	6600	32670	5720	19190.6	-13479.4	
310	0.2	4.4	0.39	3.355	-1.05	15	13	4650	20460	4030	13520.65	-6939.35	
790	0.1	4.95	0.39	3.355	-1.60	16	13	12640	62568	10270	34455.85	-28112.15	
500	0.2	4.4	0.39	3.355	-1.05	16	13	8000	35200	6500	21807.5	-13392.5	
220	0.1	4.95	0.39	3.355	-1.60	16	13	3520	17424	2860	9595.3	-7828.7	
2300	0	5.5	0.37	3.465	-2.04	17	14	39100	215050	32200	111573	-103477	
340	0.1	4.95	0.37	3.465	-1.49	18	14	6120	30294	4760	16493.4	-13800.6	
730	0	5.5	0.37	3.465	-2.04	18	14	13140	72270	10220	35412.3	-36857.7	
170	0.1	4.95	0.37	3.465	-1.49	18	14	3060	15147	2380	8246.7	-6900.3	
630	0	5.5	0.37	3.465	-2.04	**18**	**14**	11340	62370	8820	30561.3	-31808.7	
							Subtotal	**231,480**	**1,007,633**	**191,180**	**619,733**	**-387,900**	
							Total	**295,310**	**1,131,169**	**236,860**	**694,905**	**-436,264**	**-39 % Reduction**

Table 16. Existing and Potential Solar Loads for Laverne Creek.

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)	Laverne Creek
Assessment Unit # ID17010301PN032_02													
2120	0.9	0.55	0.98	0.11	-0.44	1	1	2120	1166	2120	233.2	-932.8	Forest Group B
1090	0.8	1.1	0.98	0.11	-0.99	3	2	3270	3597	2180	239.8	-3357.2	
290	0.7	1.65	0.96	0.22	-1.43	4	3	1160	1914	870	191.4	-1722.6	
250	0.5	2.75	0.86	0.77	-1.98	4	3	1000	2750	750	577.5	-2172.5	Nonforest Group 1
1270	0.7	1.65	0.78	1.21	-0.44	5	4	6350	10477.5	5080	6146.8	-4330.7	
270	0.8	1.1	0.78	1.21	0.11	6	4	1620	1782	1080	1306.8	-475.2	
310	0.7	1.65	0.91	0.495	-1.16	6	5	1860	3069	1550	767.25	-2301.75	Forest Group B
520	0.8	1.1	0.91	0.495	-0.605	7	5	3640	4004	2600	1287	-2717	
620	0.6	2.2	0.91	0.495	-1.705	7	5	4340	9548	3100	1534.5	-8013.5	
360	0.8	1.1	0.91	0.495	-0.605	8	5	2880	3168	1800	891	-2277	
90	0.4	3.3	0.91	0.495	-2.805	8	5	720	2376	450	222.75	-2153.25	
							Total	**28,960**	**43,852**	**21,580**	**13,398**	**-30,454**	**-69**
													% Reduction

Table 17. Existing and Potential Solar Loads for Leiberg Creek.

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)	Leiberg Creek
Assessment Unit # ID17010301PN033_02													
510	0.9	0.55	0.98	0.11	-0.44	1	1	510	280.5	510	56.1	-224.4	Forest Group B
570	0.7	1.65	0.98	0.11	-1.54	1	1	570	940.5	570	62.7	-877.8	
1020	0.7	1.65	0.98	0.11	-1.54	2	2	2040	3366	2040	224.4	-3141.6	
430	0.6	2.2	0.96	0.22	-1.98	3	3	1290	2838	1290	283.8	-2554.2	
360	0.6	2.2	0.86	0.77	-1.43	3	3	1080	2376	1080	831.6	-1544.4	Nonforest Group 1
1490	0.5	2.75	0.86	0.77	-1.98	4	3	5960	16390	4470	3441.9	-12948.1	
500	0.3	3.85	0.78	1.21	-2.64	5	4	2500	9625	2000	2420	-7205	
750	0.5	2.75	0.78	1.21	-1.54	6	4	4500	12375	3000	3630	-8745	
390	0.3	3.85	0.78	1.21	-2.64	7	4	2730	10510.5	1560	1887.6	-8622.9	
1350	0.4	3.3	0.72	1.54	-1.76	8	5	10800	35640	6750	10395	-25245	
1250	0.3	3.85	0.72	1.54	-2.31	9	5	11250	43312.5	6250	9625	-33687.5	
590	0.2	4.4	0.65	1.925	-2.475	10	6	5900	25960	3540	6814.5	-19145.5	
							Total	**49,130**	**163,614**	**33,060**	**39,673**	**-123,941**	**-76**
													% Reduction

Table 18. Existing and Potential Solar Loads for Lost Creek.

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)	**Lost Creek**
Assessment Unit # ID17010301PN009_02													
480	0.9	0.55	0.98	0.11	-0.44	1	1	480	264	480	52.8	-211.2	Forest Group C
520	0.9	0.55	0.98	0.11	-0.44	1	1	520	286	520	57.2	-228.8	Forest Group B
980	0.8	1.1	0.98	0.11	-0.99	1	1	980	1078	980	107.8	-970.2	
1420	0.9	0.55	0.98	0.11	-0.44	2	2	2840	1562	2840	312.4	-1249.6	
890	0.8	1.1	0.96	0.22	-0.88	3	3	2670	2937	2670	587.4	-2349.6	
670	0.9	0.55	0.96	0.22	-0.33	3	**3**	2010	1105.5	2010	442.2	-663.3	
1530	0.8	1.1	0.94	0.33	-0.77	4	4	6120	6732	6120	2019.6	-4712.4	
860	0.7	1.65	0.94	0.33	-1.32	4	4	3440	5676	3440	1135.2	-4540.8	
350	0.5	2.75	0.91	0.495	-2.255	5	5	1750	4812.5	1750	866.25	-3946.25	
840	0.6	2.2	0.91	0.495	-1.705	5	5	4200	9240	4200	2079	-7161	
150	0.5	2.75	0.91	0.495	-2.255	5	5	750	2062.5	750	371.25	-1691.25	
1020	0.7	1.65	0.91	0.495	-1.155	5	**5**	5100	8415	5100	2524.5	-5890.5	
1050	0.6	2.2	0.65	1.925	-0.275	6	6	6300	13860	6300	12127.5	-1732.5	Nonforest Group 1
140	0.4	3.3	0.6	2.2	-1.1	7	7	980	3234	980	2156	-1078	
510	0.7	1.65	0.6	2.2	0.55	7	7	3570	5890.5	3570	7854	1963.5	
							Subtotal	**41,710**	**67,155**	**41,710**	**32,693**	**-34,462**	
Assessment Unit # ID17010301PN009_03													
340	0.4	3.3	0.6	2.2	-1.1	7	**7**	2380	7854	2380	5236	-2618	
290	0.6	2.2	0.55	2.475	0.275	8	8	2320	5104	2320	5742	638	
420	0.4	3.3	0.55	2.475	-0.825	8	8	3360	11088	3360	8316	-2772	
700	0.8	1.1	0.52	2.64	1.54	9	9	6300	6930	6300	16632	9702	
250	0.7	1.65	0.52	2.64	0.99	9	9	2250	3712.5	2250	5940	2227.5	
130	0.6	2.2	0.52	2.64	0.44	**9**	**9**	1170	2574	1170	3088.8	514.8	
							Subtotal	**17,780**	**37,263**	**17,780**	**44,955**	**7,692**	
							Total	**59,490**	**104,418**	**59,490**	**77,648**	**-26,770**	**-26** **% Reduction**

Table 19. Existing and Potential Solar Loads for Prichard Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	**Prichard Creek**
Assessment Unit # ID17010301PN005_02													
1160	0.9	0.55	0.98	0.11	-0.44	1	1	1160	638	1160	127.6	-510.4	Forest Group B
150	0.3	3.85	0.98	0.11	-3.74	2	1	300	1155	150	16.5	-1138.5	
770	0.9	0.55	0.98	0.11	-0.44	3	1	2310	1270.5	770	84.7	-1185.8	
1500	0.8	1.1	0.98	0.11	-0.99	5	2	7500	8250	3000	330	-7920	
530	0.9	0.55	0.96	0.22	-0.33	6	3	3180	1749	1590	349.8	-1399.2	
370	0.8	1.1	0.96	0.22	-0.88	6	3	2220	2442	1110	244.2	-2197.8	
790	0.9	0.55	0.96	0.22	-0.33	7	3	5530	3041.5	2370	521.4	-2520.1	
160	0.3	3.85	0.94	0.33	-3.52	8	4	1280	4928	640	211.2	-4716.8	
210	0.8	1.1	0.94	0.33	-0.77	8	4	1680	1848	840	277.2	-1570.8	
100	0.5	2.75	0.94	0.33	-2.42	8	4	800	2200	400	132	-2068	
630	0.8	1.1	0.94	0.33	-0.77	9	4	5670	6237	2520	831.6	-5405.4	
120	0.4	3.3	0.91	0.495	-2.805	10	5	1200	3960	600	297	-3663	
190	0.8	1.1	0.91	0.495	-0.605	10	5	1900	2090	950	470.25	-1619.75	
550	0.7	1.65	0.91	0.495	-1.155	11	5	6050	9982.5	2750	1361.25	-8621.25	
410	0.4	3.3	0.89	0.605	-2.695	12	6	4920	16236	2460	1488.3	-14747.7	
160	0.5	2.75	0.89	0.605	-2.145	13	6	2080	5720	960	580.8	-5139.2	
870	0.4	3.3	0.89	0.605	-2.695	**14**	**6**	12180	40194	5220	3158.1	-37035.9	
							Subtotal	**59,960**	**111,942**	**27,490**	**10,482**	**-101,460**	
Assessment Unit # ID17010301PN005_03													
440	0.3	3.85	0.6	2.2	-1.65	13	7	5720	22022	3080	6776	-15246	Nonforest Group 1
530	0.1	4.95	0.55	2.475	-2.475	13	8	6890	34105.5	4240	10494	-23611.5	
580	0.2	4.4	0.52	2.64	-1.76	13	9	7540	33176	5220	13780.8	-19395.2	
1160	0.4	3.3	0.48	2.86	-0.44	12	10	13920	45936	11600	33176	-12760	
460	0.3	3.85	0.45	3.025	-0.825	12	11	5520	21252	5060	15306.5	-5945.5	
							Subtotal	**39,590**	**156,492**	**29,200**	**79,533**	**-76,958**	
Assessment Unit # ID17010301PN004_03													
410	0.4	3.3	0.41	3.245	-0.055	**12**	**12**	4920	16236	4920	15965.4	-270.6	Nonforest Group 1
500	0.1	4.95	0.41	3.245	-1.705	13	12	6500	32175	6000	19470	-12705	
620	0.2	4.4	0.41	3.245	-1.155	13	12	8060	35464	7440	24142.8	-11321.2	
800	0.1	4.95	0.41	3.245	-1.705	13	12	10400	51480	9600	31152	-20328	
530	0.3	3.85	0.41	3.245	-0.605	14	12	7420	28567	6360	20638.2	-7928.8	
440	0.1	4.95	0.41	3.245	-1.705	14	12	6160	30492	5280	17133.6	-13358.4	
380	0	5.5	0.41	3.245	-2.255	14	12	5320	29260	4560	14797.2	-14462.8	
830	0.1	4.95	0.41	3.245	-1.705	14	12	11620	57519	9960	32320.2	-25198.8	
280	0.2	4.4	0.39	3.355	-1.045	15	13	4200	18480	3640	12212.2	-6267.8	
540	0	5.5	0.39	3.355	-2.145	15	13	8100	44550	7020	23552.1	-20997.9	
810	0.1	4.95	0.39	3.355	-1.595	15	13	12150	60142.5	10530	35328.15	-24814.35	
300	0.7	1.65	0.39	3.355	1.705	15	13	4500	7425	3900	13084.5	5659.5	
360	0.6	2.2	0.39	3.355	1.155	15	13	5400	11880	4680	15701.4	3821.4	
720	0.5	2.75	0.39	3.355	0.605	16	13	11520	31680	9360	31402.8	-277.2	
400	0.6	2.2	0.39	3.355	1.155	16	13	6400	14080	5200	17446	3366	
160	0.5	2.75	0.39	3.355	0.605	16	13	2560	7040	2080	6978.4	-61.6	
490	0.6	2.2	0.39	3.355	1.155	16	13	7840	17248	6370	21371.35	4123.35	
270	0.4	3.3	0.39	3.355	0.055	**16**	**13**	4320	14256	3510	11776.05	-2479.95	
							Subtotal	**127,390**	**507,975**	**110,410**	**364,472**	**-143,502**	
Assessment Unit # ID17010301PN004_04													
390	0.1	4.95	0.37	3.465	-1.485	16	14	6240	30888	5460	18918.9	-11969.1	Nonforest Group 1
430	0.2	4.4	0.37	3.465	-0.935	16	14	6880	30272	6020	20859.3	-9412.7	
440	0	5.5	0.37	3.465	-2.035	16	14	7040	38720	6160	21344.4	-17375.6	
1020	0.1	4.95	0.35	3.575	-1.375	16	15	16320	80784	15300	54697.5	-26086.5	
220	0.2	4.4	0.35	3.575	-0.825	16	15	3520	15488	3300	11797.5	-3690.5	
1410	0.1	4.95	0.33	3.685	-1.265	16	16	22560	111672	22560	83133.6	-28538.4	
490	0.2	4.4	0.33	3.685	-0.715	**16**	16	7840	34496	7840	28890.4	-5605.6	
							Subtotal	**70,400**	**342,320**	**66,640**	**239,642**	**-102,678**	
							Total	**297,340**	**1,118,728**	**233,740**	**694,129**	**-424,598**	**-38** **% Reduction**

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Table 20. Existing and Potential Solar Loads for Skookum Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Skookum Creek
Assessment Unit # ID17010301PN038_02													
2040	0.9	0.55	0.98	0.11	-0.44	1	1	2040	1122	2040	224.4	-897.6	Forest Group B
560	0.7	1.65	0.96	0.22	-1.43	3	**3**	1680	2772	1680	369.6	-2402.4	
350	0.4	3.3	0.86	0.77	-2.53	4	3	1400	4620	1050	808.5	-3811.5	Nonforest Group 1
430	0.5	2.75	0.78	1.21	-1.54	5	**4**	2150	5912.5	1720	2081.2	-3831.3	
							Subtotal	**7,270**	**14,427**	**6,490**	**3,484**	**-10,943**	
Assessment Unit # ID17010301PN038_03													
1110	0.5	2.75	0.94	0.33	-2.42	6	4	6660	18315	4440	1465.2	-16849.8	Forest Group B
440	0.4	3.3	0.94	0.33	-2.97	**7**	**4**	3080	10164	1760	580.8	-9583.2	
							Subtotal	**9,740**	**28,479**	**6,200**	**2,046**	**-26,433**	
							Total	**17,010**	**42,906**	**12,690**	**5,530**	**-37,376**	**-87 % Reduction**

Table 21. Existing and Potential Solar Loads for Steamboat Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Steamboat Creek
Assessment Unit # ID17010301PN028_03													
930	0.5	2.75	0.52	2.64	-0.11	**11**	**9**	10230	28132.5	8370	22096.8	-6035.7	Nonforest Group 1
200	0.5	2.75	0.48	2.86	0.11	11	10	2200	6050	2000	5720	-330	
280	0.7	1.65	0.48	2.86	1.21	11	10	3080	5082	2800	8008	2926	
510	0.6	2.2	0.48	2.86	0.66	11	10	5610	12342	5100	14586	2244	
930	0.5	2.75	0.45	3.025	0.275	11	11	10230	28132.5	10230	30945.75	2813.25	
430	0.7	1.65	0.45	3.025	1.375	11	11	4730	7804.5	4730	14308.25	6503.75	
1220	0.5	2.75	0.45	3.025	0.275	**12**	**11**	14640	40260	13420	40595.5	335.5	
540	0.7	1.65	0.45	3.025	1.375	**12**	**11**	6480	10692	5940	17968.5	7276.5	
520	0.5	2.75	0.41	3.245	0.495	12	12	6240	17160	6240	20248.8	3088.8	
300	0.4	3.3	0.41	3.245	-0.055	12	12	3600	11880	3600	11682	-198	
1040	0.3	3.85	0.41	3.245	-0.605	12	12	12480	48048	12480	40497.6	-7550.4	
570	0.4	3.3	0.41	3.245	-0.055	12	12	6840	22572	6840	22195.8	-376.2	
770	0.2	4.4	0.41	3.245	-1.155	**12**	**12**	9240	40656	9240	29983.8	-10672.2	
							Total	**95,600**	**278,812**	**90,990**	**278,837**	**25**	**0 % Reduction**

Table 22. Existing and Potential Solar Loads for EF Steamboat Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	**EF Steamboat Creek**
Assessment Unit # ID17010301PN028_02													
680	0.9	0.55	0.98	0.11	-0.44	1	1	680	374	680	74.8	-299.2	Forest Group B
980	0.9	0.55	0.98	0.11	-0.44	2	2	1960	1078	1960	215.6	-862.4	
290	0.8	1.1	0.98	0.11	-0.99	2	**2**	580	638	580	63.8	-574.2	
1760	0.7	1.65	0.96	0.22	-1.43	3	3	5280	8712	5280	1161.6	-7550.4	
1460	0.7	1.65	0.94	0.33	-1.32	4	**4**	5840	9636	5840	1927.2	-7708.8	
270	0.9	0.55	0.91	0.495	-0.055	5	5	1350	742.5	1350	668.25	-74.25	
370	0.8	1.1	0.91	0.495	-0.605	5	5	1850	2035	1850	915.75	-1119.25	
780	0.9	0.55	0.91	0.495	-0.055	5	**5**	3900	2145	3900	1930.5	-214.5	
360	0.7	1.65	0.65	1.925	0.275	6	6	2160	3564	2160	4158	594	Nonforest Group 1
1010	0.5	2.75	0.65	1.925	-0.825	6	6	6060	16665	6060	11665.5	-4999.5	
780	0.6	2.2	0.65	1.925	-0.275	6	**6**	4680	10296	4680	9009	-1287	
							Total	**34,340**	**55,886**	**34,340**	**31,790**	**-24,096**	**-43 % Reduction**

Table 23. Existing and Potential Solar Loads for WF Steamboat Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	**WF Steamboat Creek**
Assessment Unit # ID17010301PN028_02													
530	0.9	0.55	0.98	0.11	-0.44	1	1	530	291.5	530	58.3	-233.2	Forest Group B
1070	0.7	1.65	0.98	0.11	-1.54	2	2	2140	3531	2140	235.4	-3295.6	
340	0.8	1.1	0.96	0.22	-0.88	3	3	1020	1122	1020	224.4	-897.6	
720	0.7	1.65	0.96	0.22	-1.43	3	3	2160	3564	2160	475.2	-3088.8	
1430	0.9	0.55	0.94	0.33	-0.22	**4**	**4**	5720	3146	5720	1887.6	-1258.4	
							Subtotal	**11,570**	**11,655**	**11,570**	**2,881**	**-8,774**	
Assessment Unit # ID17010301PN028_03													
390	0.8	1.1	0.72	1.54	0.44	**5**	**5**	1950	2145	1950	3003	858	Nonforest Group 1
1790	0.7	1.65	0.65	1.925	0.275	6	6	10740	17721	10740	20674.5	2953.5	
670	0.6	2.2	0.65	1.925	-0.275	**6**	**6**	4020	8844	4020	7738.5	-1105.5	
							Subtotal	**16,710**	**28,710**	**16,710**	**31,416**	**2,706**	
							Total	**28,280**	**40,365**	**28,280**	**34,297**	**-6,068**	**-15 %Reduction**

Table 24. Existing and Potential Solar Loads for Tepee Creek.

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)	Tepee Creek
Assessment Unit # ID17010301PN020_02													
540	0.9	0.55	0.98	0.11	-0.44	1	1	540	297	540	59.4	-237.6	Nonforest Group 1
740	0.8	1.1	0.98	0.11	-0.99	1	1	740	814	740	81.4	-732.6	
520	0.7	1.65	0.98	0.11	-1.54	1	1	520	858	520	57.2	-800.8	
1870	0.8	1.1	0.94	0.33	-0.77	2	2	3740	4114	3740	1234.2	-2879.8	
1360	0.7	1.65	0.86	0.77	-0.88	3	3	4080	6732	4080	3141.6	-3590.4	
1520	0.5	2.75	0.86	0.77	-1.98	3	3	4560	12540	4560	3511.2	-9028.8	
							Subtotal	**14,180**	**25,355**	**14,180**	**8,085**	**-17,270**	
Assessment Unit # ID17010301PN020_03													
1450	0.4	3.3	0.78	1.21	-2.09	**4**	4	5800	19140	5800	7018	-12122	
280	0.6	2.2	0.72	1.54	-0.66	5	5	1400	3080	1400	2156	-924	
250	0.5	2.75	0.72	1.54	-1.21	5	5	1250	3437.5	1250	1925	-1512.5	
300	0.6	2.2	0.72	1.54	-0.66	6	5	1800	3960	1500	2310	-1650	
580	0.4	3.3	0.65	1.925	-1.38	7	6	4060	13398	3480	6699	-6699	
380	0.5	2.75	0.65	1.925	-0.83	8	6	3040	8360	2280	4389	-3971	
280	0.6	2.2	0.6	2.2	0.00	8	7	2240	4928	1960	4312	-616	
630	0.3	3.85	0.6	2.2	-1.65	9	7	5670	21829.5	4410	9702	-12127.5	
1850	0	5.5	0.52	2.64	-2.86	11	9	20350	111925	16650	43956	-67969	
140	0.1	4.95	0.45	3.025	-1.93	**13**	**11**	1820	9009	1540	4658.5	-4350.5	
1330	0	5.5	0.41	3.245	-2.26	14	12	18620	102410	15960	51790.2	-50619.8	
							Subtotal	**66,050**	**301,477**	**56,230**	**138,916**	**-162,561**	
Assessment Unit # ID17010301PN017_04													
190	0.1	4.95	0.41	3.245	-1.71	14	12	2660	13167	2280	7398.6	-5768.4	
2950	0.1	4.95	0.37	3.465	-1.49	16	14	47200	233640	41300	143104.5	-90535.5	
1060	0.1	4.95	0.35	3.575	-1.38	17	15	18020	89199	15900	56842.5	-32356.5	
160	0	5.5	0.35	3.575	-1.93	17	15	2720	14960	2400	8580	-6380	
300	0.1	4.95	0.35	3.575	-1.38	17	15	5100	25245	4500	16087.5	-9157.5	
140	0	5.5	0.33	3.685	-1.82	18	16	2520	13860	2240	8254.4	-5605.6	
180	0.1	4.95	0.33	3.685	-1.27	18	16	3240	16038	2880	10612.8	-5425.2	
440	0	5.5	0.33	3.685	-1.82	18	16	7920	43560	7040	25942.4	-17617.6	
1010	0.1	4.95	0.33	3.685	-1.27	18	**16**	18180	89991	16160	59549.6	-30441.4	
							Subtotal	**107,560**	**539,660**	**94,700**	**336,372**	**-203,288**	
Assessment Unit # ID17010301PN017_05													
320	0	5.5	0.29	3.905	-1.60	19	17	6080	33440	5440	21243.2	-12196.8	Nonforest Group 2
290	0.1	4.95	0.29	3.905	-1.05	19	17	5510	27274.5	4930	19251.65	-8022.85	
500	0	5.5	0.29	3.905	-1.60	19	17	9500	52250	8500	33192.5	-19057.5	
480	0.1	4.95	0.28	3.96	-0.99	20	18	9600	47520	8640	34214.4	-13305.6	
240	0	5.5	0.28	3.96	-1.54	20	18	4800	26400	4320	17107.2	-9292.8	
1030	0.1	4.95	0.27	4.015	-0.94	21	19	21630	107068.5	19570	78573.55	-28494.95	
180	0	5.5	0.25	4.125	-1.38	22	20	3960	21780	3600	14850	-6930	
1060	0.1	4.95	0.25	4.125	-0.83	22	20	23320	115434	21200	87450	-27984	
3330	0	5.5	0.24			25	**23**	83250	457875	76590	0	-457875	
							Subtotal	**167,650**	**889,042**	**152,790**	**305,883**	**-583,160**	
							Total	**355,440**	**1,755,534**	**317,900**	**789,256**	**-966,279**	**-55**
													% Reduction

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Table 25. Existing and Potential Solar Loads for Trail Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Trail Creek
Assessment Unit # ID17010301PN019_03													
590	0.6	2.2	0.65	1.925	-0.28	14	**6**	8260	18172	3540	6814.5	-11357.5	Nonforest Group 1
240	0.7	1.65	0.6	2.2	0.55	15	7	3600	5940	1680	3696	-2244	
1900	0.6	2.2	0.55	2.475	0.27	**16**	**8**	30400	66880	15200	37620	-29260	
1160	0.3	3.85	0.55	2.475	-1.38	16	8	18560	71456	9280	22968	-48488	
280	0.4	3.3	0.55	2.475	-0.83	16	8	4480	14784	2240	5544	-9240	
700	0.3	3.85	0.55	2.475	-1.38	16	8	11200	43120	5600	13860	-29260	
470	0.2	4.4	0.52	2.64	-1.76	16	9	7520	33088	4230	11167.2	-21920.8	
2130	0	5.5	0.52	2.64	-2.86	16	9	34080	187440	19170	50608.8	-136831.2	
680	0.1	4.95	0.52	2.64	-2.31	16	9	10880	53856	6120	16156.8	-37699.2	
370	0	5.5	0.52	2.64	-2.86	16	**9**	5920	32560	3330	8791.2	-23768.8	
230	0.1	4.95	0.52	2.64	-2.31	16	9	3680	18216	2070	5464.8	-12751.2	
1350	0	5.5	0.48	2.86	-2.64	16	**10**	21600	118800	13500	38610	-80190	
							Total	**160,180**	**664,312**	**85,960**	**221,301**	**-443,011**	**-67 % Reduction**

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Table 26. Existing and Potential Solar Loads for WF Eagle Creek.

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)	**WF Eagle Creek**
Assessment Unit # ID17010301PN008_02													
680	0.8	1.1	0.98	0.11	-0.99	1	1	680	748	680	74.8	-673.2	Forest Group B
4550	0.9	0.55	0.94	0.33	-0.22	4	**4**	18200	10010	18200	6006	-4004	
230	0.7	1.65	0.72	1.54	-0.11	5	5	1150	1897.5	1150	1771	-126.5	Nonforest Group 1
230	0.8	1.1	0.72	1.54	0.44	5	5	1150	1265	1150	1771	506	
460	0.7	1.65	0.72	1.54	-0.11	5	5	2300	3795	2300	3542	-253	
280	0.4	3.3	0.72	1.54	-1.76	5	5	1400	4620	1400	2156	-2464	
1050	0.6	2.2	0.72	1.54	-0.66	6	5	6300	13860	5250	8085	-5775	
250	0.4	3.3	0.65	1.925	-1.375	6	6	1500	4950	1500	2887.5	-2062.5	
590	0.7	1.65	0.65	1.925	0.275	6	6	3540	5841	3540	6814.5	973.5	
130	0.5	2.75	0.65	1.925	-0.825	7	6	910	2502.5	780	1501.5	-1001	
1040	0.8	1.1	0.65	1.925	0.825	7	**6**	7280	8008	6240	12012	4004	
390	0.6	2.2	0.6	2.2	0	7	7	2730	6006	2730	6006	0	
160	0.5	2.75	0.6	2.2	-0.55	7	7	1120	3080	1120	2464	-616	
200	0.7	1.65	0.6	2.2	0.55	8	7	1600	2640	1400	3080	440	
270	0.6	2.2	0.6	2.2	0	8	7	2160	4752	1890	4158	-594	
250	0.9	0.55	0.6	2.2	1.65	8	7	2000	1100	1750	3850	2750	
780	0.8	1.1	0.6	2.2	1.1	8	7	6240	6864	5460	12012	5148	
400	0.6	2.2	0.6	2.2	0	9	7	3600	7920	2800	6160	-1760	
180	0.8	1.1	0.6	2.2	1.1	9	7	1620	1782	1260	2772	990	
250	0.6	2.2	0.6	2.2	0	9	7	2250	4950	1750	3850	-1100	
380	0.8	1.1	0.6	2.2	1.1	9	7	3420	3762	2660	5852	2090	
870	0.6	2.2	0.55	2.475	0.275	10	8	8700	19140	6960	17226	-1914	
360	0.5	2.75	0.55	2.475	-0.275	10	8	3600	9900	2880	7128	-2772	
450	0.6	2.2	0.55	2.475	0.275	10	8	4500	9900	3600	8910	-990	
270	0.5	2.75	0.55	2.475	-0.275	11	8	2970	8167.5	2160	5346	-2821.5	
280	0.7	1.65	0.55	2.475	0.825	11	**8**	3080	5082	2240	5544	462	
							Subtotal	**94,000**	**152,543**	**82,850**	**140,979**	**-11,563**	
Assessment Unit # ID17010301PN007_03													**Eagle Creek**
1320	0.2	4.4	0.41	3.245	-1.155	21	12	27720	121968	15840	51400.8	-70567.2	Nonforest Group 1
320	0	5.5	0.41	3.245	-2.255	**21**	**12**	6720	36960	3840	12460.8	-24499.2	
							Subtotal	**34,440**	**158,928**	**19,680**	**63,862**	**-95,066**	
							Total	**128,440**	**311,471**	**102,530**	**204,841**	**-106,630**	**-34 % Reduction**

Table 27. Existing and Potential Solar Loads for EF Eagle Creek.

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)	EF Eagle Creek
Assessment Unit # ID17010301PN007_02													
450	0.9	0.55	0.98	0.11	-0.44	2	1	900	495	450	49.5	-445.5	Forest Group C
1330	0.9	0.55	0.98	0.11	-0.44	2	1	2660	1463	1330	146.3	-1316.7	Forest Group A
1300	0.8	1.1	0.98	0.11	-0.99	3	2	3900	4290	2600	286	-4004	Forest Group B
270	0.7	1.65	0.96	0.22	-1.43	4	3	1080	1782	810	178.2	-1603.8	
410	0.8	1.1	0.94	0.33	-0.77	5	**4**	2050	2255	1640	541.2	-1713.8	
340	0.4	3.3	0.78	1.21	-2.09	6	4	2040	6732	1360	1645.6	-5086.4	Nonforest Group 1
580	0.4	3.3	0.72	1.54	-1.76	7	5	4060	13398	2900	4466	-8932	
570	0.2	4.4	0.65	1.925	-2.475	8	6	4560	20064	3420	6583.5	-13480.5	
2070	0.2	4.4	0.6	2.2	-2.2	**11**	**7**	22770	100188	14490	31878	-68310	
840	0.5	2.75	0.55	2.475	-0.275	12	8	10080	27720	6720	16632	-11088	
640	0.4	3.3	0.55	2.475	-0.825	12	8	7680	25344	5120	12672	-12672	
420	0.6	2.2	0.55	2.475	0.275	12	8	5040	11088	3360	8316	-2772	
540	0.5	2.75	0.55	2.475	-0.275	12	8	6480	17820	4320	10692	-7128	
1800	0.3	3.85	0.55	2.475	-1.375	12	8	21600	83160	14400	35640	-47520	
400	0.5	2.75	0.52	2.64	-0.11	13	9	5200	14300	3600	9504	-4796	
980	0.4	3.3	0.52	2.64	-0.66	13	9	12740	42042	8820	23284.8	-18757.2	
620	0.3	3.85	0.52	2.64	-1.21	13	9	8060	31031	5580	14731.2	-16299.8	
1140	0.4	3.3	0.52	2.64	-0.66	13	9	14820	48906	10260	27086.4	-21819.6	
340	0.2	4.4	0.52	2.64	-1.76	13	**9**	4420	19448	3060	8078.4	-11369.6	
							Total	**140,140**	**471,526**	**94,240**	**212,411**	**-259,115**	**-55 % Reduction**

Table 28. Existing and Potential Solar Loads for Little North Fork Coeur d'Alene River.

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)	**Little NF Coeur d'Alene River**
Assessment Unit # ID17010301PN030_02													
2210	0.9	0.55	0.98	0.11	-0.44	1	1	2210	1215.5	2210	243.1	-972.4	Forest Group B
710	0.8	1.1	0.96	0.22	-0.88	3	3	2130	2343	2130	468.6	-1874.4	
190	0.9	0.55	0.96	0.22	-0.33	3	3	570	313.5	570	125.4	-188.1	
2070	0.8	1.1	0.78	1.21	0.11	4	**4**	8280	9108	8280	10018.8	910.8	Nonforest Group 1
730	0.7	1.65	0.72	1.54	-0.11	5	5	3650	6022.5	3650	5621	-401.5	
420	0.9	0.55	0.72	1.54	0.99	5	5	2100	1155	2100	3234	2079	
370	0.7	1.65	0.72	1.54	-0.11	5	5	1850	3052.5	1850	2849	-203.5	
340	0.9	0.55	0.65	1.925	1.38	6	6	2040	1122	2040	3927	2805	
							Subtotal	**22,830**	**24,332**	**22,830**	**26,487**	**2,155**	
Assessment Unit # ID17010301PN030_03													
690	0.7	1.65	0.65	1.925	0.27	6	6	4140	6831	4140	7969.5	1138.5	Nonforest Group 1
600	0.8	1.1	0.65	1.925	0.83	6	6	3600	3960	3600	6930	2970	
360	0.7	1.65	0.6	2.2	0.55	7	7	2520	4158	2520	5544	1386	
270	0.8	1.1	0.6	2.2	1.10	7	7	1890	2079	1890	4158	2079	
180	0.7	1.65	0.6	2.2	0.55	7	7	1260	2079	1260	2772	693	
180	0.8	1.1	0.6	2.2	1.10	7	7	1260	1386	1260	2772	1386	
660	0.7	1.65	0.6	2.2	0.55	7	7	4620	7623	4620	10164	2541	
580	0.8	1.1	0.55	2.475	1.38	8	8	4640	5104	4640	11484	6380	
920	0.7	1.65	0.55	2.475	0.82	**8**	**8**	7360	12144	7360	18216	6072	
690	0.6	2.2	0.52	2.64	0.44	9	9	6210	13662	6210	16394.4	2732.4	
180	0.7	1.65	0.52	2.64	0.99	9	9	1620	2673	1620	4276.8	1603.8	
160	0.6	2.2	0.52	2.64	0.44	9	9	1440	3168	1440	3801.6	633.6	
600	0.7	1.65	0.48	2.86	1.21	10	10	6000	9900	6000	17160	7260	
300	0.4	3.3	0.48	2.86	-0.44	10	10	3000	9900	3000	8580	-1320	
140	0.2	4.4	0.48	2.86	-1.54	10	10	1400	6160	1400	4004	-2156	
160	0.3	3.85	0.48	2.86	-0.99	10	10	1600	6160	1600	4576	-1584	
330	0.2	4.4	0.45	3.025	-1.38	11	11	3630	15972	3630	10980.75	-4991.25	
940	0.3	3.85	0.45	3.025	-0.82	11	11	10340	39809	10340	31278.5	-8530.5	
360	0.3	3.85	0.41	3.245	-0.60	12	12	4320	16632	4320	14018.4	-2613.6	
410	0.4	3.3	0.41	3.245	-0.05	12	12	4920	16236	4920	15965.4	-270.6	
440	0.3	3.85	0.41	3.245	-0.60	**13**	**12**	5720	22022	5280	17133.6	-4888.4	
1100	0.2	4.4	0.39	3.355	-1.05	13	13	14300	62920	14300	47976.5	-14943.5	
700	0.4	3.3	0.39	3.355	0.06	13	13	9100	30030	9100	30530.5	500.5	
370	0.5	2.75	0.39	3.355	0.61	13	13	4810	13227.5	4810	16137.55	2910.05	
260	0.2	4.4	0.39	3.355	-1.05	14	13	3640	16016	3380	11339.9	-4676.1	
230	0.4	3.3	0.39	3.355	0.06	14	13	3220	10626	2990	10031.45	-594.55	
290	0.5	2.75	0.39	3.355	0.61	14	13	4060	11165	3770	12648.35	1483.35	
440	0.3	3.85	0.37	3.465	-0.39	14	14	6160	23716	6160	21344.4	-2371.6	
830	0.4	3.3	0.37	3.465	0.17	15	14	12450	41085	11620	40263.3	-821.7	
530	0.6	2.2	0.37	3.465	1.27	15	14	7950	17490	7420	25710.3	8220.3	
180	0	5.5	0.37	3.465	-2.04	15	14	2700	14850	2520	8731.8	-6118.2	
500	0.2	4.4	0.37	3.465	-0.94	15	14	7500	33000	7000	24255	-8745	
370	0.1	4.95	0.37	3.465	-1.49	16	14	5920	29304	5180	17948.7	-11355.3	
230	0.2	4.4	0.35	3.575	-0.83	16	15	3680	16192	3450	12333.75	-3858.25	
350	0.4	3.3	0.35	3.575	0.28	16	15	5600	18480	5250	18768.75	288.75	
330	0.2	4.4	0.35	3.575	-0.83	16	15	5280	23232	4950	17696.25	-5535.75	
830	0.1	4.95	0.35	3.575	-1.38	17	15	14110	69844.5	12450	44508.75	-25335.75	
330	0.2	4.4	0.35	3.575	-0.83	17	15	5610	24684	4950	17696.25	-6987.75	
610	0.3	3.85	0.35	3.575	-0.27	17	15	10370	39924.5	9150	32711.25	-7213.25	
450	0.1	4.95	0.33	3.685	-1.27	17	16	7650	37867.5	7200	26532	-11335.5	
110	0.1	4.95	0.33	3.685	-1.27	18	16	1980	9801	1760	6485.6	-3315.4	
							Subtotal	**217,580**	**751,113**	**208,460**	**661,829**	**-89,284**	

Table 28 (cont). Existing and Potential Solar Loads for Little North Fork Coeur d'Alene River.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m²/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m²/day)	Potential Load minus Existing load (kWh/m²/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m²)	Existing Summer Load (kWh/day)	Natural Segment Area (m²)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Little NF Coeur d'Alene River
Assessment Unit # ID17010301PN030_04													
1020	0	5.5	0.33	3.685	-1.82	18	16	18360	100980	16320	60139.2	-40840.8	Nonforest Group 1
480	0.2	4.4	0.33	3.685	-0.72	18	16	8640	38016	7680	28300.8	-9715.2	
190	0.1	4.95	0.33	3.685	-1.27	18	16	3420	16929	3040	11202.4	-5726.6	
530	0.3	3.85	0.33	3.685	-0.17	19	16	10070	38769.5	8480	31248.8	-7520.7	
390	0.2	4.4	0.33	3.685	-0.72	19	16	7410	32604	6240	22994.4	-9609.6	
360	0.3	3.85	0.32	3.74	-0.11	19	17	6840	26334	6120	22888.8	-3445.2	
270	0.2	4.4	0.32	3.74	-0.66	19	17	5130	22572	4590	17166.6	-5405.4	
180	0.3	3.85	0.32	3.74	-0.11	19	17	3420	13167	3060	11444.4	-1722.6	
590	0.1	4.95	0.32	3.74	-1.21	20	17	11800	58410	10030	37512.2	-20897.8	
240	0.2	4.4	0.32	3.74	-0.66	20	17	4800	21120	4080	15259.2	-5860.8	
580	0.3	3.85	0.32	3.74	-0.11	20	17	11600	44660	9860	36876.4	-7783.6	
1610	0.1	4.95	0.3	3.85	-1.10	21	18	33810	167359.5	28980	111573	-55786.5	
620	0.3	3.85	0.3	3.85	0.00	22	18	13640	52514	11160	42966	-9548	
580	0.2	4.4	0.3	3.85	-0.55	22	18	12760	56144	10440	40194	-15950	
940	0.1	4.95	0.3	3.85	-1.10	**22**	**18**	20680	102366	16920	65142	-37224	
470	0.2	4.4	0.29	3.905	-0.50	23	19	10810	47564	8930	34871.65	-12692.35	
270	0.1	4.95	0.29	3.905	-1.05	23	19	6210	30739.5	5130	20032.65	-10706.85	
190	0.2	4.4	0.29	3.905	-0.50	23	19	4370	19228	3610	14097.05	-5130.95	
510	0.1	4.95	0.29	3.905	-1.05	23	19	11730	58063.5	9690	37839.45	-20224.05	
1140	0.2	4.4	0.29	3.905	-0.50	23	19	26220	115368	21660	84582.3	-30785.7	
360	0.3	3.85	0.29	3.905	0.06	23	19	8280	31878	6840	26710.2	-5167.8	
1220	0.2	4.4	0.29	3.905	-0.50	23	19	28060	123464	23180	90517.9	-32946.1	
890	0.2	4.4	0.28	3.96	-0.44	24	20	21360	93984	17800	70488	-23496	
1410	0.5	2.75	0.28	3.96	1.21	24	20	33840	93060	28200	111672	18612	
2170	0.3	3.85	0.28	3.96	0.11	24	20	52080	200508	43400	171864	-28644	
1920	0.2	4.4	0.27	4.015	-0.39	25	21	48000	211200	40320	161884.8	-49315.2	
720	0.3	3.85	0.26	4.07	0.22	26	22	18720	72072	15840	64468.8	-7603.2	
1050	0.1	4.95	0.26	4.07	-0.88	26	22	27300	135135	23100	94017	-41118	
190	0.2	4.4	0.26	4.07	-0.33	26	22	4940	21736	4180	17012.6	-4723.4	
490	0.1	4.95	0.26	4.07	-0.88	26	22	12740	63063	10780	43874.6	-19188.4	
280	0	5.5	0.26	4.07	-1.43	26	22	7280	40040	6160	25071.2	-14968.8	
300	0.1	4.95	0.26	4.07	-0.88	26	22	7800	38610	6600	26862	-11748	
1310	0	5.5	0.25	4.125	-1.38	27	23	35370	194535	30130	124286.25	-70248.75	
540	0.1	4.95	0.25	4.125	-0.83	27	23	14580	72171	12420	51232.5	-20938.5	
1950	0	5.5	0.25	4.125	-1.38	27	23	52650	289575	44850	185006.25	-104568.75	
250	0.1	4.95	0.25	4.125	-0.83	27	23	6750	33412.5	5750	23718.75	-9693.75	
440	0.2	4.4	0.24	4.18	-0.22	28	24	12320	54208	10560	44140.8	-10067.2	
470	0.1	4.95	0.24	4.18	-0.77	28	24	13160	65142	11280	47150.4	-17991.6	
170	0.2	4.4	0.24	4.18	-0.22	28	24	4760	20944	4080	17054.4	-3889.6	
750	0.1	4.95	0.24	4.18	-0.77	28	24	21000	103950	18000	75240	-28710	
480	0	5.5	0.24	4.18	-1.32	28	24	13440	73920	11520	48153.6	-25766.4	
370	0.3	3.85	0.24	4.18	0.33	28	24	10360	39886	8880	37118.4	-2767.6	
190	0.1	4.95	0.24	4.18	-0.77	28	24	5320	26334	4560	19060.8	-7273.2	
380	0.3	3.85	0.24	4.18	0.33	28	24	10640	40964	9120	38121.6	-2842.4	
1030	0.2	4.4	0.24	4.18	-0.22	28	24	28840	126896	24720	103329.6	-23566.4	
220	0.1	4.95	0.23	4.235	-0.72	29	25	6380	31581	5500	23292.5	-8288.5	
940	0.2	4.4	0.23	4.235	-0.17	29	25	27260	119944	23500	99522.5	-20421.5	
780	0	5.5	0.23	4.235	-1.27	29	25	22620	124410	19500	82582.5	-41827.5	
420	0.1	4.95	0.23	4.235	-0.72	29	25	12180	60291	10500	44467.5	-15823.5	
400	0	5.5	0.23	4.235	-1.27	29	25	11600	63800	10000	42350	-21450	
530	0.1	4.95	0.23	4.235	-0.72	29	25	15370	76081.5	13250	56113.75	-19967.75	
1350	0	5.5	0.23	4.235	-1.27	29	**25**	39150	215325	33750	142931.25	-72393.75	
							Subtotal	**865,870**	**4,021,028**	**734,290**	**2,955,648**	**-1,065,380**	
							Total	**1,106,280**	**4,796,473**	**965,580**	**3,643,964**	**-1,152,509**	**-24 % Reduction**

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Table 29. Existing and Potential Solar Loads for the North Fork Coeur d'Alene River.

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)	**NF Coeur d'Alene River**
Assessment Unit # ID17010301PN015_02													
1060	0.9	0.55	0.98	0.11	-0.44	1	1	1060	583	1060	116.6	-466.4	Forest Group B
2290	0.8	1.1	0.98	0.11	-0.99	2	2	4580	5038	4580	503.8	-4534.2	
1630	0.7	1.65	0.94	0.33	-1.32	2	2	3260	5379	3260	1075.8	-4303.2	Nonforest Group 1
610	0.6	2.2	0.86	0.77	-1.43	3	3	1830	4026	1830	1409.1	-2616.9	
320	0.5	2.75	0.86	0.77	-1.98	3	3	960	2640	960	739.2	-1900.8	
320	0.6	2.2	0.78	1.21	-0.99	4	4	1280	2816	1280	1548.8	-1267.2	
							Subtotal	**12,970**	**20,482**	**12,970**	**5,393**	**-15,089**	
Assessment Unit # ID17010301PN015_03													
210	0.5	2.75	0.78	1.21	-1.54	4	4	840	2310	840	1016.4	-1293.6	Nonforest Group 1
270	0.6	2.2	0.78	1.21	-0.99	4	4	1080	2376	1080	1306.8	-1069.2	
810	0.5	2.75	0.78	1.21	-1.54	4	4	3240	8910	3240	3920.4	-4989.6	
370	0.7	1.65	0.78	1.21	-0.44	4	4	1480	2442	1480	1790.8	-651.2	
2440	0.5	2.75	0.72	1.54	-1.21	5	5	12200	33550	12200	18788	-14762	
1020	0.6	2.2	0.65	1.925	-0.28	6	6	6120	13464	6120	11781	-1683	
1160	0.5	2.75	0.65	1.925	-0.83	6	6	6960	19140	6960	13398	-5742	
							Subtotal	**31,920**	**82,192**	**31,920**	**52,001**	**-30,191**	
Assessment Unit # ID17010301PN015_04													
950	0.4	3.3	0.65	1.925	-1.38	**6**	6	5700	18810	5700	10972.5	-7837.5	Nonforest Group 1
380	0.2	4.4	0.6	2.2	-2.20	7	7	2660	11704	2660	5852	-5852	
960	0.3	3.85	0.6	2.2	-1.65	7	7	6720	25872	6720	14784	-11088	
1140	0.5	2.75	0.6	2.2	-0.55	7	7	7980	21945	7980	17556	-4389	
1480	0.4	3.3	0.55	2.475	-0.83	8	8	11840	39072	11840	29304	-9768	
2620	0.5	2.75	0.52	2.64	-0.11	9	9	23580	64845	23580	62251.2	-2593.8	
2500	0.4	3.3	0.48	2.86	-0.44	10	10	25000	82500	25000	71500	-11000	
920	0.3	3.85	0.45	3.025	-0.82	11	11	10120	38962	10120	30613	-8349	
350	0.4	3.3	0.45	3.025	-0.27	11	11	3850	12705	3850	11646.25	-1058.75	
750	0.3	3.85	0.41	3.245	-0.60	12	12	9000	34650	9000	29205	-5445	
880	0.4	3.3	0.41	3.245	-0.05	12	12	10560	34848	10560	34267.2	-580.8	
							Subtotal	**117,010**	**385,913**	**117,010**	**317,951**	**-67,962**	
Assessment Unit # ID17010301PN013_04													
3440	0.2	4.4	0.39	3.355	-1.05	**13**	13	44720	196768	44720	150035.6	-46732.4	Nonforest Group 1
2480	0.3	3.85	0.37	3.465	-0.39	14	14	34720	133672	34720	120304.8	-13367.2	
470	0.2	4.4	0.35	3.575	-0.83	15	15	7050	31020	7050	25203.75	-5816.25	
800	0.3	3.85	0.35	3.575	-0.27	15	15	12000	46200	12000	42900	-3300	
630	0.2	4.4	0.33	3.685	-0.72	16	16	10080	44352	10080	37144.8	-7207.2	
450	0.3	3.85	0.33	3.685	-0.17	16	16	7200	27720	7200	26532	-1188	
1690	0.2	4.4	0.32	3.74	-0.66	17	17	28730	126412	28730	107450.2	-18961.8	
1150	0.1	4.95	0.3	3.85	-1.10	18	18	20700	102465	20700	79695	-22770	
330	0.2	4.4	0.3	3.85	-0.55	18	18	5940	26136	5940	22869	-3267	
1070	0.1	4.95	0.29	3.905	-1.05	19	19	20330	100633.5	20330	79388.65	-21244.85	
250	0.2	4.4	0.29	3.905	-0.50	19	19	4750	20900	4750	18548.75	-2351.25	
580	0.1	4.95	0.29	3.905	-1.05	20	**19**	11600	57420	11020	43033.1	-14386.9	
							Subtotal	**207,820**	**913,699**	**207,240**	**753,106**	**-160,593**	

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Table 29 (cont.). Existing and Potential Solar Loads for the North Fork Coeur d'Alene River.

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)	NF Coeur d'Alene River
Assessment Unit # ID17010301PN013_05													
630	0	5.5	0.25	4.125	-1.38	20	20	12600	69300	12600	51975	-17325	Nonforest Group 2
220	0.1	4.95	0.25	4.125	-0.83	20	20	4400	21780	4400	18150	-3630	
1400	0	5.5	0.25	4.125	-1.38	21	20	29400	161700	28000	115500	-46200	
380	0.1	4.95	0.25	4.125	-0.83	22	21	8360	41382	7980	32917.5	-8464.5	
430	0	5.5	0.25	4.125	-1.38	22	21	9460	52030	9030	37248.75	-14781.25	
1000	0.2	4.4	0.25	4.125	-0.28	22	21	22000	96800	21000	86625	-10175	
490	0	5.5	0.24	4.18	-1.32	23	22	11270	61985	10780	45060.4	-16924.6	
440	0.2	4.4	0.24	4.18	-0.22	23	22	10120	44528	9680	40462.4	-4065.6	
360	0.1	4.95	0.24	4.18	-0.77	23	22	8280	40986	7920	33105.6	-7880.4	
1490	0	5.5	0.23	4.235	-1.27	24	23	35760	196680	34270	145133.45	-51546.55	
170	0.1	4.95	0.23	4.235	-0.72	25	23	4250	21037.5	3910	16558.85	-4478.65	
700	0	5.5	0.23	4.235	-1.27	25	23	17500	96250	16100	68183.5	-28066.5	
1500	0.1	4.95	0.22	4.29	-0.66	26	24	39000	193050	36000	154440	-38610	
1010	0.2	4.4	0.21	4.345	-0.05	27	25	27270	119988	25250	109711.25	-10276.75	
1270	0	5.5	0.2	4.4	-1.10	28	26	35560	195580	33020	145288	-50292	
590	0.1	4.95	0.2	4.4	-0.55	28	26	16520	81774	15340	67496	-14278	
280	0	5.5	0.2	4.4	-1.10	29	27	8120	44660	7560	33264	-11396	
200	0.1	4.95	0.2	4.4	-0.55	29	27	5800	28710	5400	23760	-4950	
1130	0	5.5	0.2	4.4	-1.10	29	27	32770	180235	30510	134244	-45991	
690	0.2	4.4	0.19	4.455	0.05	30	28	20700	91080	19320	86070.6	-5009.4	
630	0.1	4.95	0.19	4.455	-0.50	30	28	18900	93555	17640	78586.2	-14968.8	
1300	0.2	4.4	0.19	4.455	0.05	31	28	40300	177320	36400	162162	-15158	
3440	0.1	4.95	0.19	4.455	-0.50	33	29	113520	561924	99760	444430.8	-117493.2	
							Subtotal	**531,860**	**2,672,335**	**491,870**	**2,130,373**	**-541,961**	
Assessment Unit # ID17010301PN001_05													
2290	0.2	4.4	0.18	4.51	0.11	35	30	80150	352660	68700	309837	-42823	Nonforest Group 2
1210	0.1	4.95	0.18	4.51	-0.44	36	31	43560	215622	37510	169170.1	-46451.9	
860	0.2	4.4	0.18	4.51	0.11	37	31	31820	140008	26660	120236.6	-19771.4	
1260	0.1	4.95	0.17	4.565	-0.39	38	32	47880	237006	40320	184060.8	-52945.2	
610	0	5.5	0.17	4.565	-0.94	39	32	23790	130845	19520	89108.8	-41736.2	
470	0.1	4.95	0.17	4.565	-0.39	39	33	18330	90733.5	15510	70803.15	-19930.35	
2590	0.2	4.4	0.16	4.62	0.22	40	34	103600	455840	88060	406837.2	-49002.8	
840	0.1	4.95	0.16	4.62	-0.33	41	35	34440	170478	29400	135828	-34650	
1230	0.2	4.4	0.16	4.62	0.22	42	35	51660	227304	43050	198891	-28413	
630	0.1	4.95	0.16	4.62	-0.33	43	**35**	27090	134095.5	22050	101871	-32224.5	
5490	0.2	4.4	0.15	4.675	0.27	**48**	38	263520	1159488	208620	975298.5	-184189.5	
1370	0.1	4.95	0.14	4.73	-0.22	47	**41**	64390	318730.5	56170	265684.1	-53046.4	
5120	0	5.5	0.13	4.785	-0.72	**47**	44	240640	1323520	225280	1077964.8	-245555.2	
4140	0.1	4.95	0.12	4.84	-0.11	**46**	46	190440	942678	190440	921729.6	-20948.4	
880	0	5.5	0.12	4.84	-0.66	47	47	41360	227480	41360	200182.4	-27297.6	
1280	0.1	4.95	0.12	4.84	-0.11	47	47	60160	297792	60160	291174.4	-6617.6	
960	0	5.5	0.12	4.84	-0.66	47	47	45120	248160	45120	218380.8	-29779.2	
1260	0.1	4.95	0.12	4.84	-0.11	47	47	59220	293139	59220	286624.8	-6514.2	
980	0	5.5	0.12	4.84	-0.66	48	48	47040	258720	47040	227673.6	-31046.4	
830	0.1	4.95	0.12	4.84	-0.11	48	48	39840	197208	39840	192825.6	-4382.4	
8020	0	5.5	0.12	4.84	-0.66	49	49	392980	2161390	392980	1902023.2	-259366.8	
420	0.1	4.95	0.11	4.895	-0.05	50	50	21000	103950	21000	102795	-1155	
8030	0	5.5	0.11	4.895	-0.61	51	51	409530	2252415	409530	2004649.35	-247765.65	
660	0.1	4.95	0.11	4.895	-0.05	51	51	33660	166617	33660	164765.7	-1851.3	
1480	0	5.5	0.11	4.895	-0.61	52	52	76960	423280	76960	376719.2	-46560.8	
550	0.1	4.95	0.11	4.895	-0.05	52	52	28600	141570	28600	139997	-1573	
2160	0	5.5	0.11	4.895	-0.61	52	**52**	112320	617760	112320	549806.4	-67953.6	
7420	0	5.5	0.1	4.95	-0.55	59	**59**	437780	2407790	437780	2167011	-240779	
							Subtotal	**3,026,880**	**15,696,280**	**2,876,860**	**13,851,949**	**-1,844,330**	
							Total	**3,928,460**	**19,770,900**	**3,737,870**	**17,110,774**	**-2,660,126**	**-13** **% Reduction**

Figure 4. Target Shade for the Upper Coeur d'Alene River Subbasin.

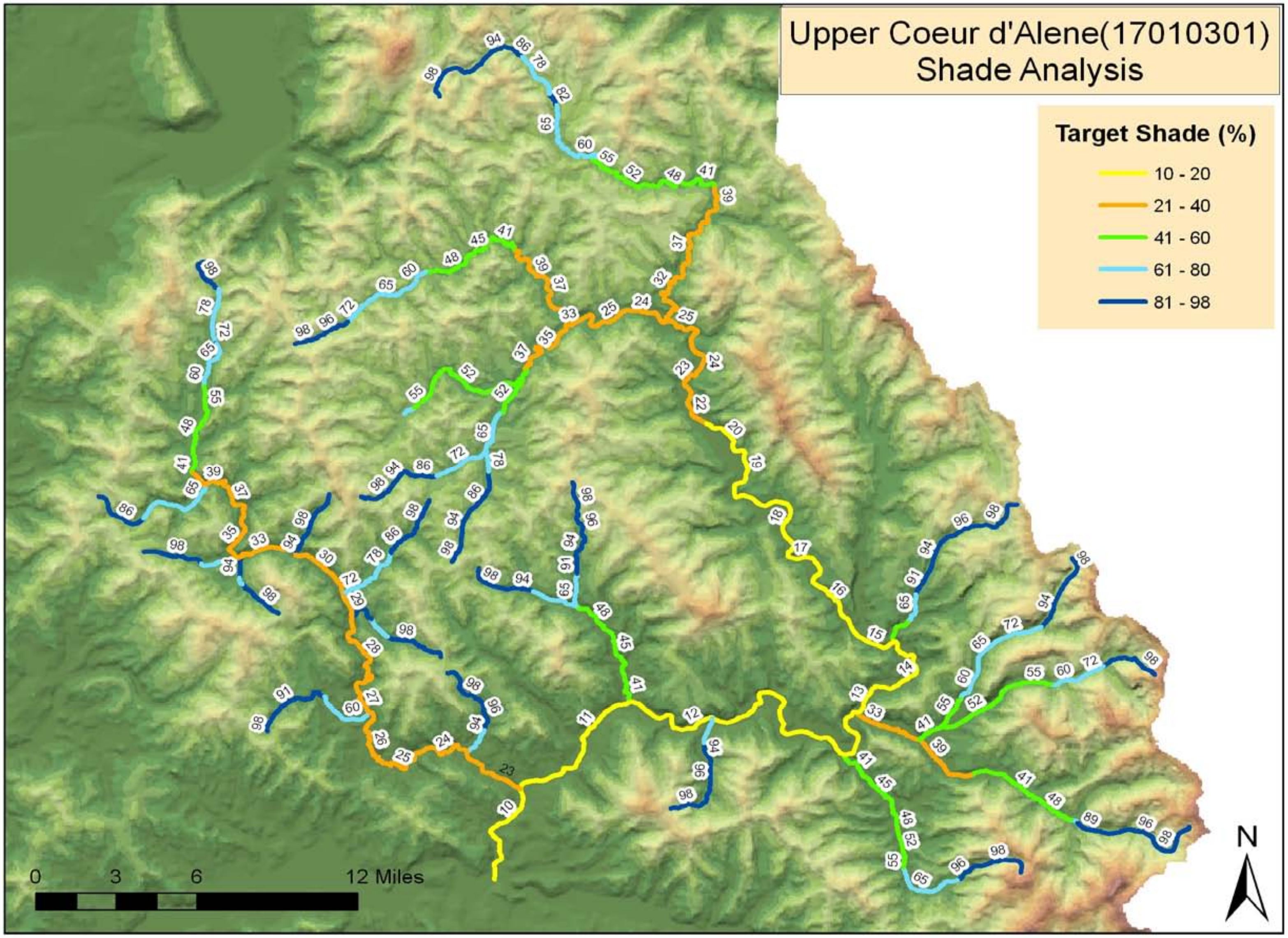

Figure 5. Existing Shade Estimated for Upper Coeur d'Alene River Subbasin by Aerial Photo Interpretation.

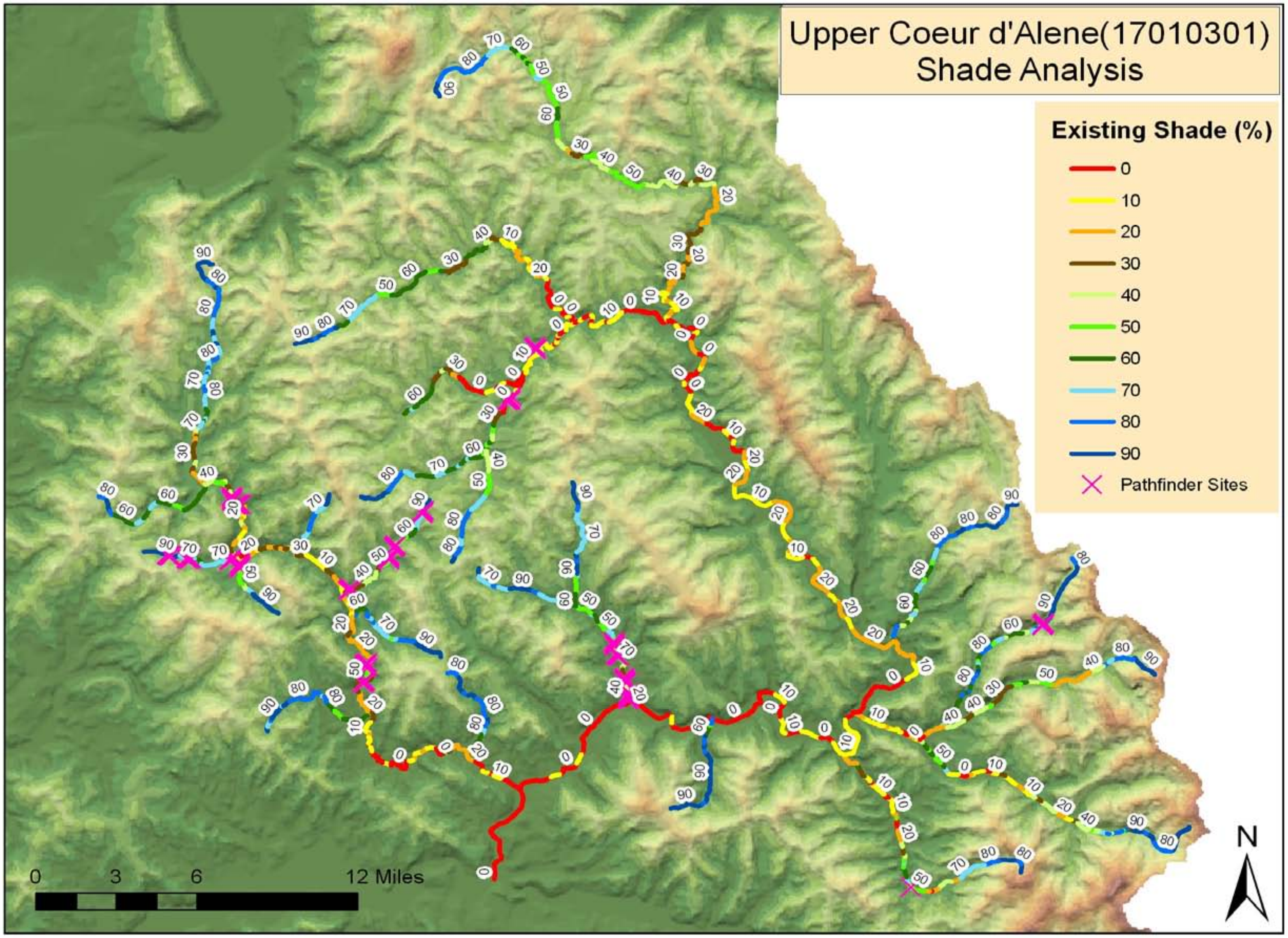

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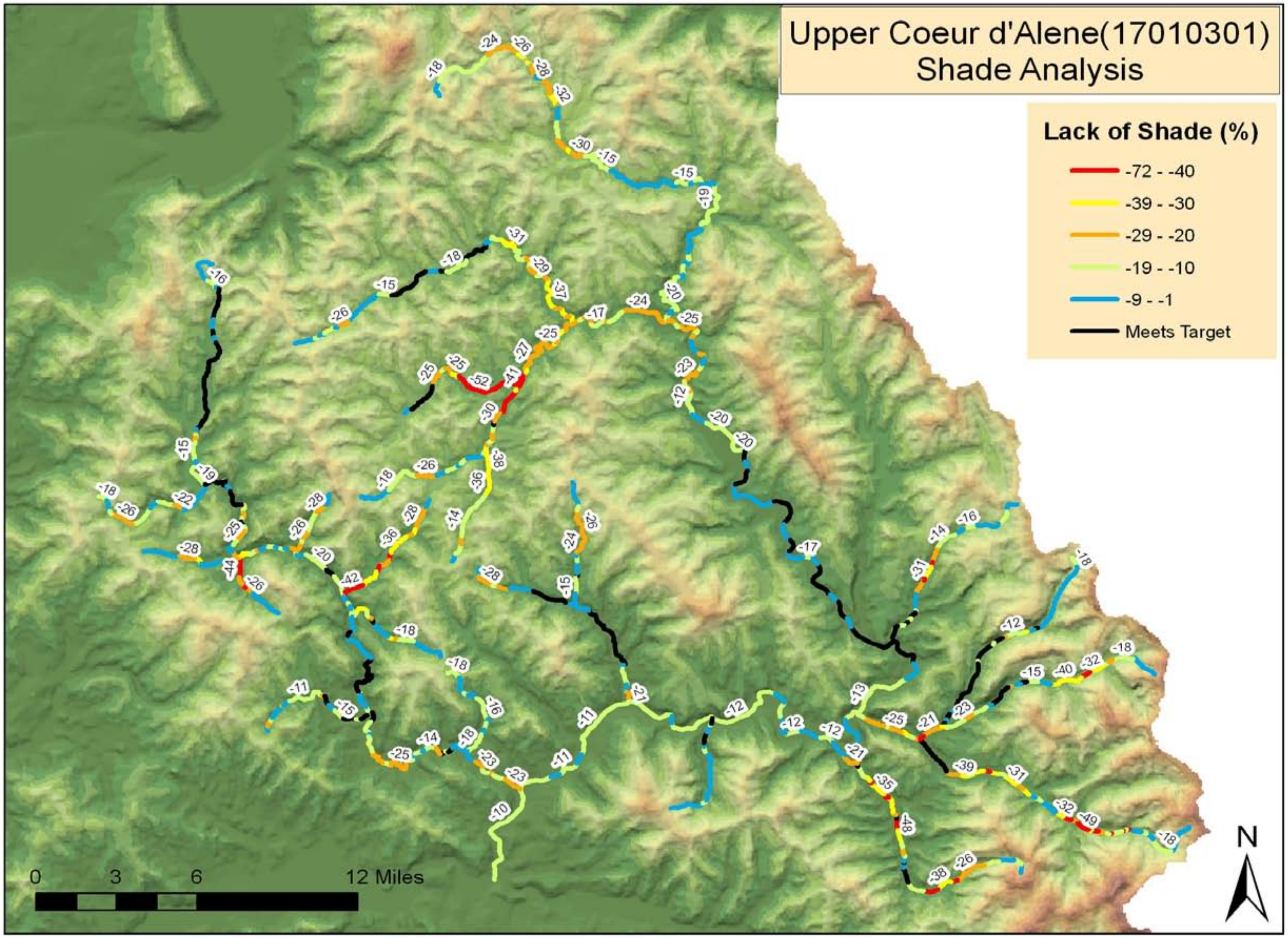
Figure 6. Lack of Shade (Difference Between Existing and Target) for the Upper Coeur d'Alene River Subbasin.



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5.4 Load Allocation

Because this TMDL is based on potential natural vegetation, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, in order to reach that objective, load allocations are assigned to non point source activities that have or may affect riparian vegetation and shade as a whole. Load allocations are therefore stream reach specific and are dependent upon the target load for a given reach. Tables 7 through 29 show the target or potential shade which is converted to a potential summer load by multiplying the inverse fraction (1-shade fraction) by the average loading to a flat plate collector for the months of April through September. That is the loading capacity of the stream and it is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its loading capacity. Additionally, because this TMDL is dependent upon background conditions for achieving WQS, all tributaries to the waters examined here need to be in natural conditions in order to prevent excess heat loads to the system.

Table 30 shows the total existing, total target, and the excess heat load (kWh/day) experienced by each water body examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths as compared to smaller streams. Table 30 lists the tributaries in order of their excess loads highest to lowest. Therefore, large tributaries tend to be listed first and small tributaries are listed last.

The NF Coeur d'Alene River and the Little NF Coeur d'Alene River have the largest excess loads because of their large size. The North Fork's excess load is only 13% of its total existing load. The Little North Fork has an excess load that is 24% of its total existing load. Other streams with large excess loads include (with excess as a percent of total in parentheses) Tepee Creek (55%), Trail Creek (67%), Independence Creek (39%), Prichard Creek (38%), and Beaver Creek (54%). Smaller streams have smaller excess loads, however they may have excess loadings proportionally equivalent to the larger streams. Bootjack Creek, the smallest stream examined, is a good example with 85% of its total existing load is an excess load. Only lower Steamboat Creek showed no excess load and is essentially at target conditions (although the West Fork and, especially the East Fork of Steamboat Creek do lack shade and have excess loads). Graham Creek is also in relatively good condition with only 13% of its total existing load as excess.

A certain amount of excess load and hence percent reduction is created by the method difference inherent in the loading analysis. Because existing shade is reported as a 10% class level and target shade is a unique integer, there is always a difference between them. 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 that existing shade class. There is an automatic difference of 6% which could be attributed to the margin of safety.

Although the following analysis dwells on total heat loads for streams in this TMDL, it is important to note that differences between existing shade and target shade, as depicted in Figure 6 (and expanded in Figures in Appendix C), are the key to successfully restoring these waters to achieving WQS. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should key in on the largest differences between existing and target shade as locations to prioritize implementation efforts. In order to facilitate viewing these differences in shade levels on individual streams, additional figures are provided in Appendix C that enlarges the view of various portions of the watershed.

Table 30. Total Existing, Total Target and Excess Solar Loads for All Tributaries.

Water Body	Total Existing Load (kWh/day)	Total Target Load (kWh/day)	Excess Load (kWh/day)
North Fork Coeur d'Alene River	19,770,900	17,110,774	2,660,126
Little NF Coeur d'Alene River	4,796,473	3,643,964	1,152,509
Tepee Creek	1,755,534	789,256	966,279
Trail Creek	664,312	221,301	443,011
Independence Creek	1,131,169	694,905	436,264
Prichard Creek	1,118,728	694,129	424,598
Beaver Creek	745,382	339,645	405,737
EF Eagle Creek	471,526	212,411	259,115
Leiberg Creek	163,614	39,673	123,941
WF Eagle Creek (incl. Eagle Cr.)	311,471	204,841	106,630
Burnt Cabin Creek	94,947	50,475	44,472
Skookum Creek	42,906	5,530	37,376
Laverne Creek	43,852	13,398	30,454
Lost Creek	104,418	77,648	26,770
Bumblebee Creek	36,575	11,037	25,538
Copper Creek	80,685	55,642	25,043
EF Steamboat Creek	55,886	31,790	24,096
Big Elk Creek	56,463	33,497	22,966
Deception Creek	24,096	12,002	12,093
Bootjack Creek	12,942	1,948	10,993
WF Steamboat Creek	40,365	34,297	6,068
Graham Creek	23,397	20,341	3,056
Steamboat Creek	278,812	278,837	0

Wasteload Allocation

There are no known NPDES permitted point sources in the affected watersheds. Thus, there are no wasteload allocations either. Should a point source be proposed that would have thermal consequence on these waters, then background provisions addressing such discharges in Idaho water quality standards (IDAPA 58.01.02.200.09 & IDAPA 58.01.02.401.03) 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% class interval, which likely underestimates actual shade in the loading analysis.

Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to be inclusive of the six month period from April through September. This time period was chosen because it represents the time period when the combination of increasing air and water temperatures coincides with increasing solar inputs and increasing vegetative shade. The critical time period is June when spring salmonids spawning is occurring, July and August when maximum temperatures exceed cold water aquatic life criteria, and September during fall salmonids spawning. 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 Storm Water and TMDL Waste Load Allocations

Construction Storm Water

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge storm water to a water body or to a municipal storm sewer. In Idaho, EPA has issued a general permit for storm water discharges from construction sites. In the past storm water was treated as a non-point source of pollutants. However, because storm water can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires a National Pollution Discharge Elimination System (NPDES) Permit.

The Construction General Permit (CGP)

If a construction project disturbs more than one acre of land (or is part of larger common development) that will disturb more than one acre), the operator is required to apply for permit coverage from EPA after developing a site-specific Storm Water Pollution Prevention Plan.

Storm Water Pollution Prevention Plan (SWPPP)

In order to obtain the Construction General Permit operators must develop a site-specific Storm Water Pollution Prevention Plan. The operator must document the erosion, sediment, and pollution controls they intend to use, inspect the controls periodically and maintain the best management practices (BMPs) through the life of the project

Construction Storm Water Requirements

When a stream is on Idaho's § 303(d) list and has a TMDL developed DEQ now incorporates a gross waste load allocation (WLA) for anticipated construction storm water activities. TMDLs developed in the past that did not have a WLA for construction storm water activities will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate Best Management Practices.

Typically there are specific requirements you must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post-construction storm water management. Sediment is usually the main pollutant of concern in storm water from construction sites. The application of specific best management practices from *Idaho's Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the General Construction Permit, unless local ordinances have more stringent and site specific standards that are applicable.

5.5 Implementation Strategies

Implementation strategies for TMDLs produced using potential natural vegetation-based shade and solar loading should incorporate the loading tables presented in this TMDL. These tables need to be updated, first to field verify the existing shade levels that have not yet been field verified, and secondly to monitor progress towards achieving reductions and the goals of the TMDL. 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 loading 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 the TMDL goals are not being met or significant progress is not being made toward achieving the goals.

Time Frame

Approach

Responsible Parties

Monitoring Strategy

5.6 Conclusions

The North Fork Coeur d'Alene River subbasin has a number of water bodies that are 303d listed for temperature problems. We examined 23 waters and produced temperature TMDLs based on meeting riparian shade targets as a surrogate for temperature. Targets were derived from shade curves produced for vegetation response units of the Idaho Panhandle National Forest and from other TMDLs in Idaho. Existing shade levels for these streams were estimated from aerial photos and portions were field verified with solar pathfinders during the summer of 2007.

All streams examined show impacts from a lack of riparian shade. A number of streams examined have reductions in solar load needed to achieve targets. Excess loads vary from 3,000 kWh/day for the smallest stream to more than 2.6 million kWh/day for the main river itself. The Little North Fork Coeur d'Alene River has an excess solar load of near 1.5 million kWh/day. Streams with high reductions needed include Tepee Creek, Trail Creek, Independence Creek, Prichard Creek, Beaver Creek, and others. Lower Steamboat Creek and Graham Creek are examples of good shade condition watersheds.

Lack of shade and excess solar loads can result from a variety of circumstances, some natural such as wildfires, and some anthropogenic with varying degrees of permanency (e.g. paved roads versus partial vegetation removal). Each reach on each stream needs to be examined for possible corrective implementation. Some problems can be fixed and others cannot, and implementation strategies should take into account these realities.

Table 31. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Beaver Creek/ ID17010301PN003_02 ID17010301PN003_03	Temperature	Yes	n.a.	Existing Shade
Big Elk Creek/ ID17010301PN020_02	Temperature	Yes	n.a.	Existing Shade
Bootjack Creek/ ID17010301PN034_02	Temperature	Yes	n.a.	Existing Shade
Bumblebee Creek/ ID17010301PN031_02	Temperature	Yes	n.a.	Existing Shade
Burnt Cabin Creek/ ID17010301PN036_02	Temperature	Yes	n.a.	Existing Shade
Copper Creek/ ID17010301PN039_02 ID17010301PN039_03	Temperature	Yes	n.a.	Existing Shade
Deception Creek/ ID17010301PN037_02	Temperature	Yes	n.a.	Existing Shade
EF Eagle Creek/ ID17010301PN007_02	Temperature	Yes	n.a.	Existing Shade
EF Steamboat Creek/ ID17010301PN028_02	Temperature	Yes	n.a.	Existing Shade
Graham Creek/ ID17010301PN002_02 ID17010301PN002_03	Temperature	Yes	n.a.	Existing Shade
Independence Creek/ ID17010301PN018_02 ID17010301PN018_03	Temperature	Yes	n.a.	Existing Shade
Laverne Creek/ ID17010301PN032_02	Temperature	Yes	n.a.	Existing Shade
Leiberg Creek/ ID17010301PN033_02	Temperature	Yes	n.a.	Existing Shade
Lost Creek/ ID17010301PN009_02 ID17010301PN009_03	Temperature	Yes	n.a.	Existing Shade

Prichard Creek/ ID17010301PN005_02 ID17010301PN005_03 ID17010301PN004_03 ID17010301PN004_04	Temperature	Yes	n.a.	Existing Shade
Skookum Creek/ ID17010301PN038_02 ID17010301PN038_03	Temperature	Yes	n.a.	Existing Shade
Steamboat Creek/ ID17010301PN028_03	Temperature	Yes	n.a.	Existing Shade
Tepee Creek/ ID17010301PN020_02 ID17010301PN020_03 ID17010301PN017_04 ID17010301PN017_05	Temperature	Yes	n.a.	Existing Shade
Trail Creek/ ID17010301PN019_03	Temperature	Yes	n.a.	Existing Shade
WF Eagle Creek/ ID17010301PN008_02	Temperature	Yes	n.a.	Existing Shade
WF Steamboat Creek/ ID17010301PN028_02 ID17010301PN028_03	Temperature	Yes	n.a.	Existing Shade
Upper Coeur d'Alene River/ ID17010301PN015_02 ID17010301PN015_03 ID17010301PN015_04 ID17010301PN013_04 ID17010301PN013_05 ID17010301PN001_05	Temperature	Yes	n.a.	Existing Shade
North Fork Coeur d'Alene River/ ID17010301PN030_02 ID17010301PN030_03 ID17010301PN030_04	Temperature	Yes	n.a.	Existing Shade

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GIS Coverages

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Other Related Documents

Glossary

305(b)
Refers to section 305 subsection "b" of the Clean Water Act. The term "305(b)" generally describes a report of each state's water quality and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.

§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.

Adsorption
The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules

Aeration
A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.

Aerobic
Describes life, processes, or conditions that require the presence of oxygen.

Adfluvial
Describes fish whose life history involves seasonal migration from lakes to streams for spawning.

Adjunct
In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.

Alevin

A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.

Algae

Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.

Alluvium

Unconsolidated recent stream deposition.

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).

Anadromous

Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the saltwater but return to fresh water to spawn.

Anaerobic

Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.

Anoxia

The condition of oxygen absence or deficiency.

Anthropogenic

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

Anti-Degradation

Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.61).

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 Database (ADB)	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.
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.
Assimilative Capacity	The ability to process or dissipate pollutants without ill effect to beneficial uses.
Autotrophic	An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.
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.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.

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

Benthic Organic Matter.

The organic matter on the bottom of a water body.

Benthos

Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.

Best Management Practices (BMPs)

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

Best Professional Judgment

A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.

Biochemical Oxygen Demand (BOD)

The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.

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).

Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.
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.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria, *E. Coli*, and Pathogens).
Colluvium	Material transported to a site by gravity.
Community	A group of interacting organisms living together in a given place.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (µ) mhos/centimeter at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
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.

Cultural Eutrophication

The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).

Culturally Induced Erosion

Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).

Debris Torrent

The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.

Decomposition

The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.

Depth Fines

Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 millimeters depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 centimeters).

Designated Uses

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

Discharge

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

Dissolved Oxygen (DO)	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.
Disturbance	Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.
E. coli	Short for *Escherichia coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, but their presence in water is often indicative of fecal contamination. *E. coli* are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.
Ecology	The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.
Ecological Indicator	A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.
Ecological Integrity	The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving water body.
Endangered Species	Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.

Environment

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

Eocene

An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.

Eolian

Windblown, referring to the process of erosion, transport, and deposition of material by the wind.

Ephemeral Stream

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

Erosion

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

Eutrophic

From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.

Eutrophication

1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.

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 and Wastewater Treatment Requirements* (IDAPA 58.01.02).

Exotic Species

A species that is not native (indigenous) to a region.

Extrapolation

Estimation of unknown values by extending or projecting from known values.

Fauna

Animal life, especially the animals characteristic of a region, period, or special environment.

Fecal Coliform Bacteria

Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria, *E. coli*, and Pathogens).

Fecal Streptococci

A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.

Feedback Loop

In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.

Fixed-Location Monitoring

Sampling or measuring environmental conditions continuously or repeatedly at the same location.

Flow

See *Discharge*.

Fluvial

In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.

Focal

Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.

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).

Fully Supporting Cold Water

Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions.

Fully Supporting but Threatened

An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.

Geographical Information Systems (GIS)
A georeferenced database.

Geometric Mean
A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.

Grab Sample
A single sample collected at a particular time and place. It may represent the composition of the water in that water column.

Gradient
The slope of the land, water, or streambed surface.

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 stream flow.

Growth Rate
A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.

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 Cycle
The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.

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, fourth 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 fourth field hydrologic units.

Hydrology

The science dealing with the properties, distribution, and circulation of water.

Impervious

Describes a surface, such as pavement, that water cannot penetrate.

Influent

A tributary stream.

Inorganic

Materials not derived from biological sources.

Instantaneous

A condition or measurement at a moment (instant) in time.

Intergravel Dissolved Oxygen

The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.

Intermittent Stream

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

Interstate Waters

Waters that flow across or form part of state or international boundaries, including boundaries with Native American nations.

Irrigation Return Flow

Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.

Key Watershed

A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical to the long-term persistence of regionally important trout populations.

Knickpoint

Any interruption or break of slope.

Land Application

A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.

Limiting Factor

A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.

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.

Loam

Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.

Loess	A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.
Lotic	An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.
Luxury Consumption	A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.
Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.
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.
Mass Wasting	A general term for the down slope movement of soil and rock material under the direct influence of gravity.
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.
Median	The middle number in a sequence of numbers. If there is an even number of numbers, the median is the average of the two

middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 6 is the median of 1, 2, 5, 7, 9, 11.

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.

Miocene

Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.

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 Pollution 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.

Nodal

Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.

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 Assessed (NA)

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

Not Attainable

A concept and an assessment category describing water bodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).

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).

Not Fully Supporting Cold Water

At least one biological assemblage has been significantly modified beyond the natural range of its reference condition.

Nuisance

Anything that is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

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.

Nutrient Cycling

The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).

Oligotrophic

The Greek term for "poorly nourished." This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.

Organic Matter

Compounds manufactured by plants and animals that contain principally carbon.

Orthophosphate

A form of soluble inorganic phosphorus most readily used for algal growth.

Oxygen-Demanding Materials

Those materials, mainly organic matter, in a water body that consume oxygen during decomposition.

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.

Partitioning

The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.

Pathogens

A small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa) that can cause sickness or death. Direct measurement of pathogen levels in surface water is difficult. Consequently, indicator bacteria that are often associated with pathogens are assessed. *E. coli*, a type of fecal coliform bacteria, are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.

Perennial Stream

A stream that flows year-around in most years.

Periphyton

Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.

Pesticide

Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.

pH	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phased TMDL	A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the term "physical/chemical."
Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
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.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training (Rand 1995). The goal of QA is to assure the data provided are of the quality needed and claimed (EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples (Rand 1995). QC is implemented at the field or bench level (EPA 1996).
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.

Representative Sample
A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.

Resident
A term that describes fish that do not migrate.

Respiration
A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.

Riffle
A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.

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

Riparian Habitat Conservation Area (RHCA)
A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams:

- 300 feet from perennial fish-bearing streams
- 150 feet from perennial non-fish-bearing streams
- 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.

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.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
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.
Stagnation	The absence of mixing in a water body.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
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 first-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.

Storm Water 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.

Stressors

Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.

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.

Surface Fines

Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 millimeters depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

Surface Runoff

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

Surface Water

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

Suspended Sediments

Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.

Taxon

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

Tertiary

An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.

Thalweg

The center of a stream's current, where most of the water flows.

Threatened Species

Species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

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.

Total Dissolved Solids

Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.

Total Suspended Solids (TSS)

The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Franson et al. 1998) call for using a filter of 2.0 microns or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

Toxic Pollutants

Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.

Tributary

A stream feeding into a larger stream or lake.

Trophic State

The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.

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Turbidity

A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.

Vadose Zone

The unsaturated region from the soil surface to the ground water table.

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 Column
Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

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 Management Plan

A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.

Water Quality Modeling

The prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.

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.

Water Body Identification Number (WBID)

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

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.

Young of the Year

Young fish born the year captured, evidence of spawning activity.

Appendix A. Unit Conversion Chart

Table A-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 = 35.31cfs	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

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

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

Appendix B. State and Site-Specific Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

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

> 13°C as a daily maximum water temperature,
>
> 9°C as a daily average water temperature.

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

Natural Background Provisions

For potential natural vegetation temperature TMDLs, it is assumed that natural temperatures may exceed these criteria during these 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. As per IDAPA 58.01.02.200.09:

> *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, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401.*

Section 401 relates to point source wastewater treatment requirements. In this case if temperature criteria for any aquatic life use is exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3°C (IDAPA 58.01.02.401.03.a.v.).

Appendix C. Data Sources and Lack of Shade Maps

Table C-1. Data sources for NF Coeur d'Alene Subbasin TMDLs.

Water Body	Data Source	Type of Data	When Collected
Beaver Creek, Deception Creek, Leiberg Creek, Little NF CDA River, Skookum Creek, Steamboat Creek, Tepee Creek, WF Eagle Creek	DEQ Regional Office	Pathfinder effective shade and stream width	Summer 2007
All Rivers and tributaries examined	DEQ State Technical Services Office	Aerial Photo Interpretation of existing shade and stream width estimation	2006 -2007
	DEQ IDASA Database	Temperature	

Figure C-1. Lack of Shade (Difference Between Existing and Target) for the Lost Creek to Beaver Creek Area.

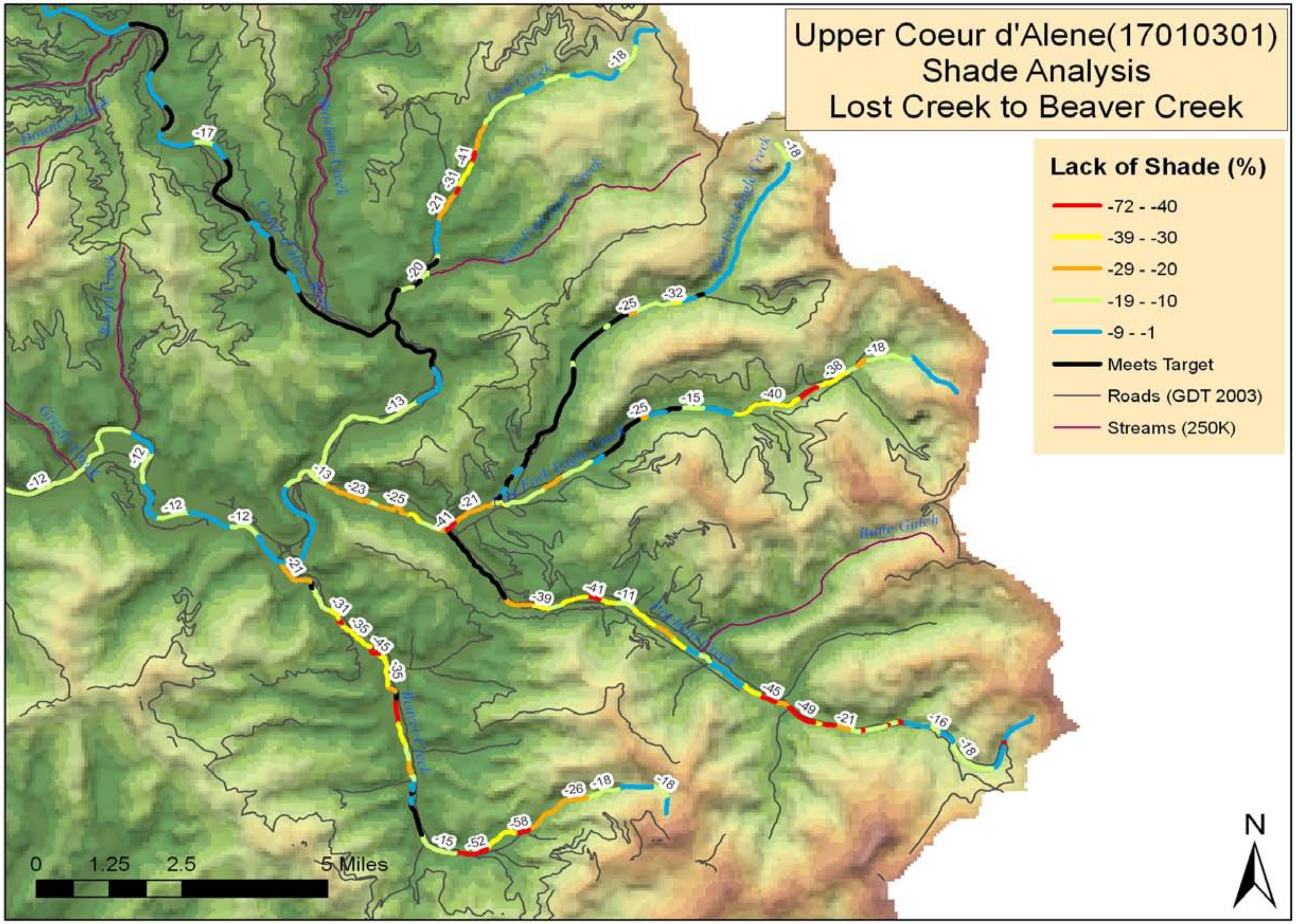

Figure C-2. Lack of Shade (Difference Between Existing and Target) for the Deception Creek to Steamboat Creek Area.

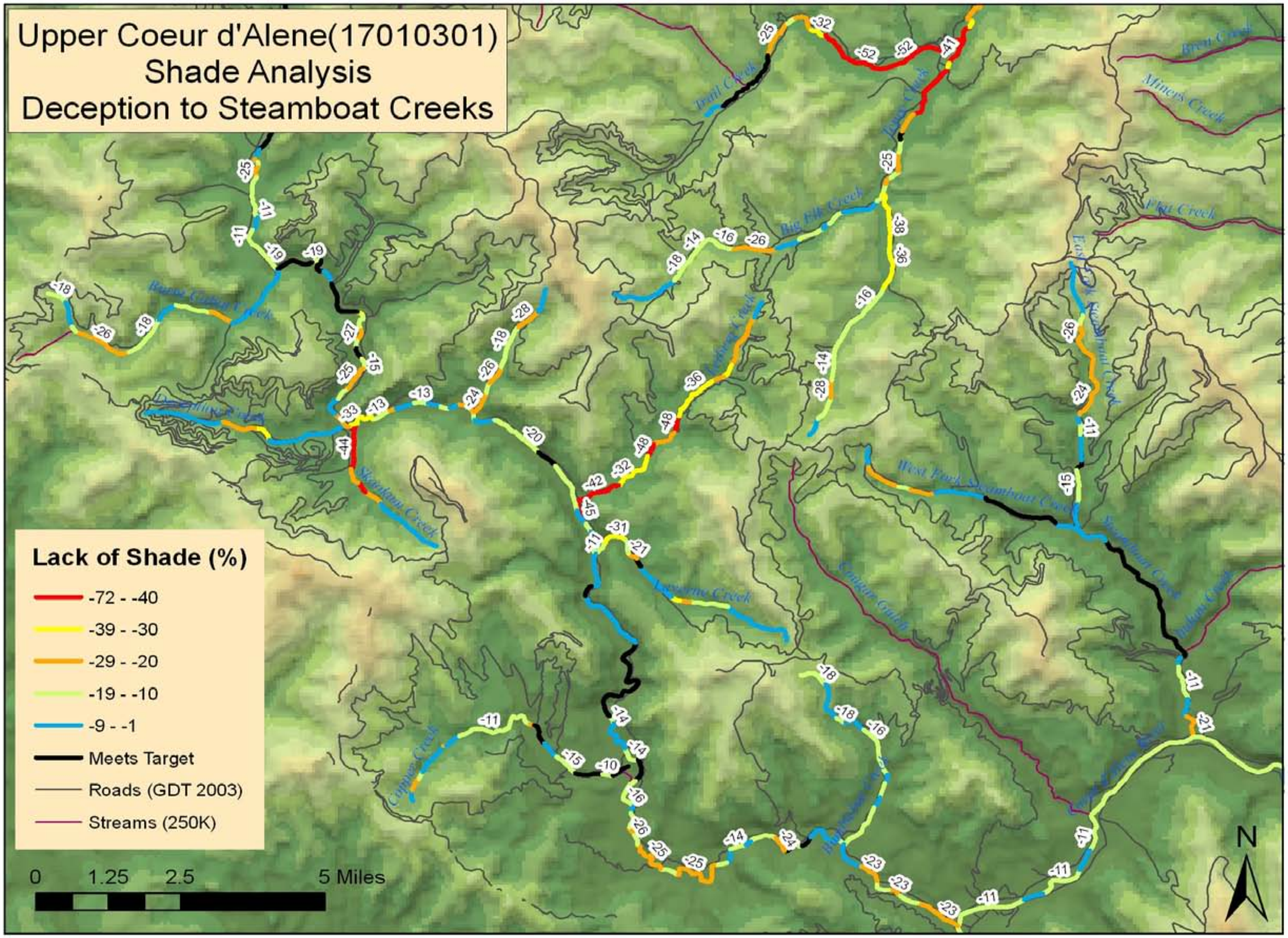

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Figure C-3. Lack of Shade (Difference Between Existing and Target) for the Lower NF Coeur d'Alene River Area.

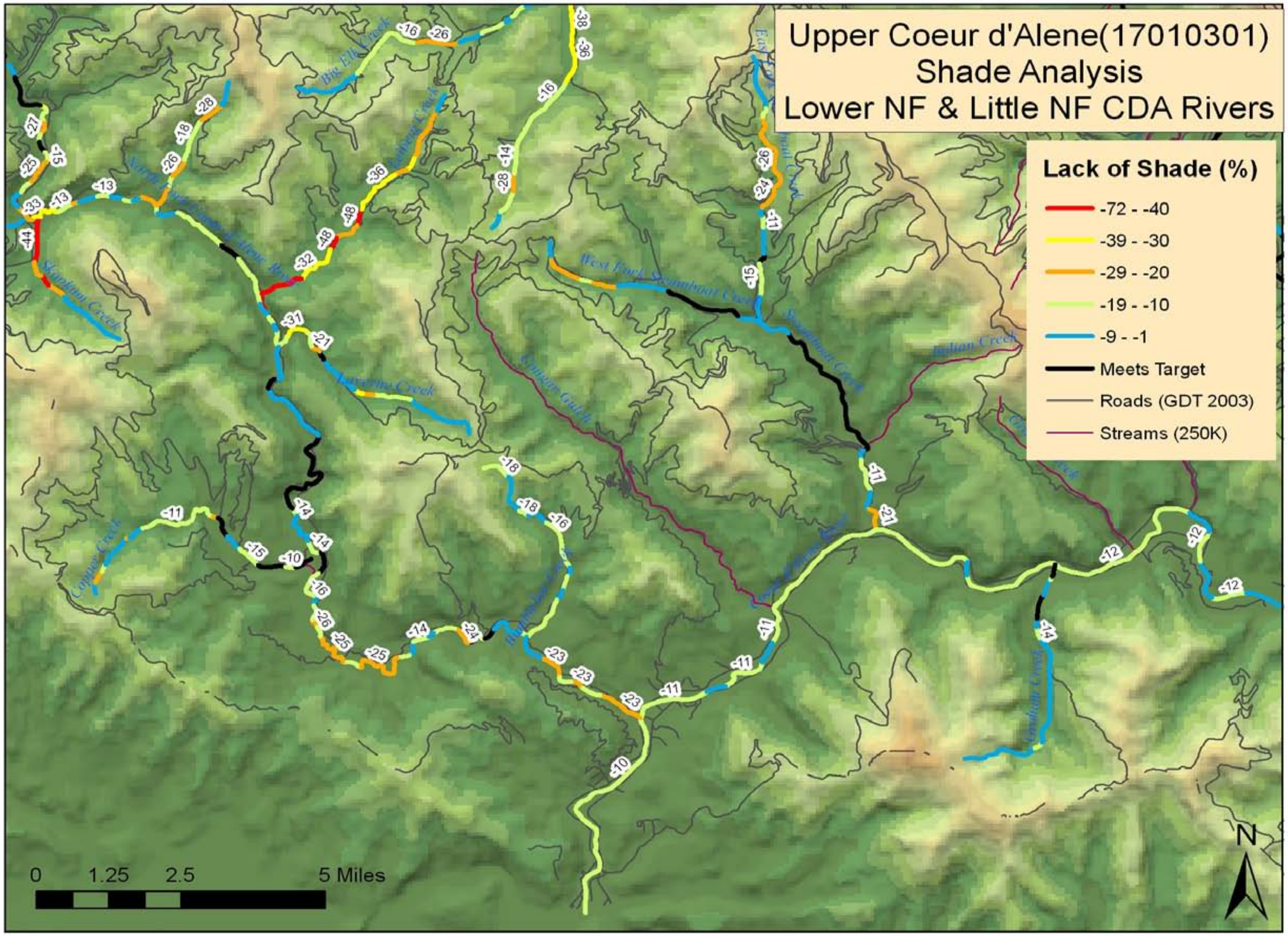


Figure C-4. Lack of Shade (Difference Between Existing and Target) for the Upper Little NF Coeur d'Alene River Area.

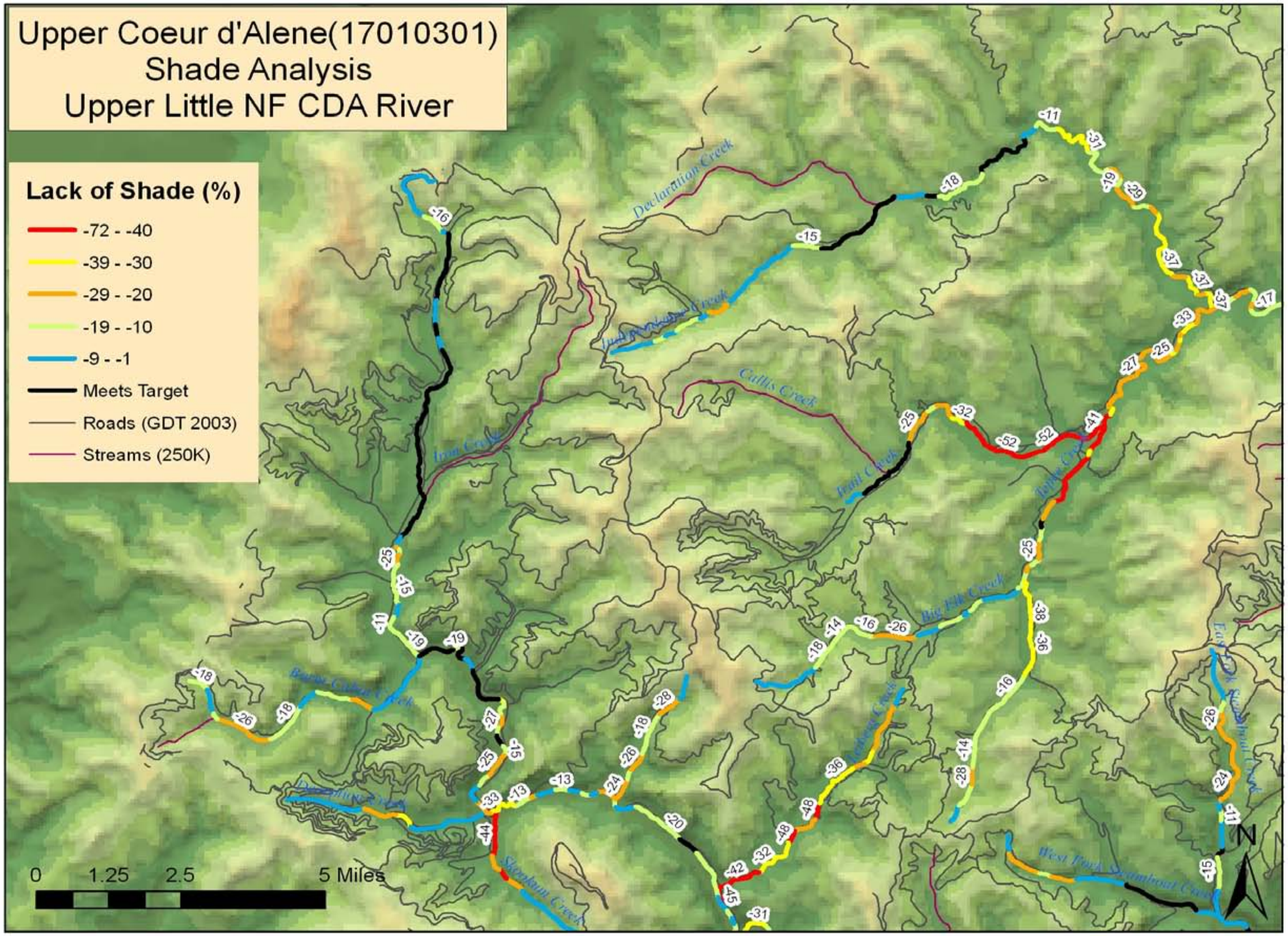
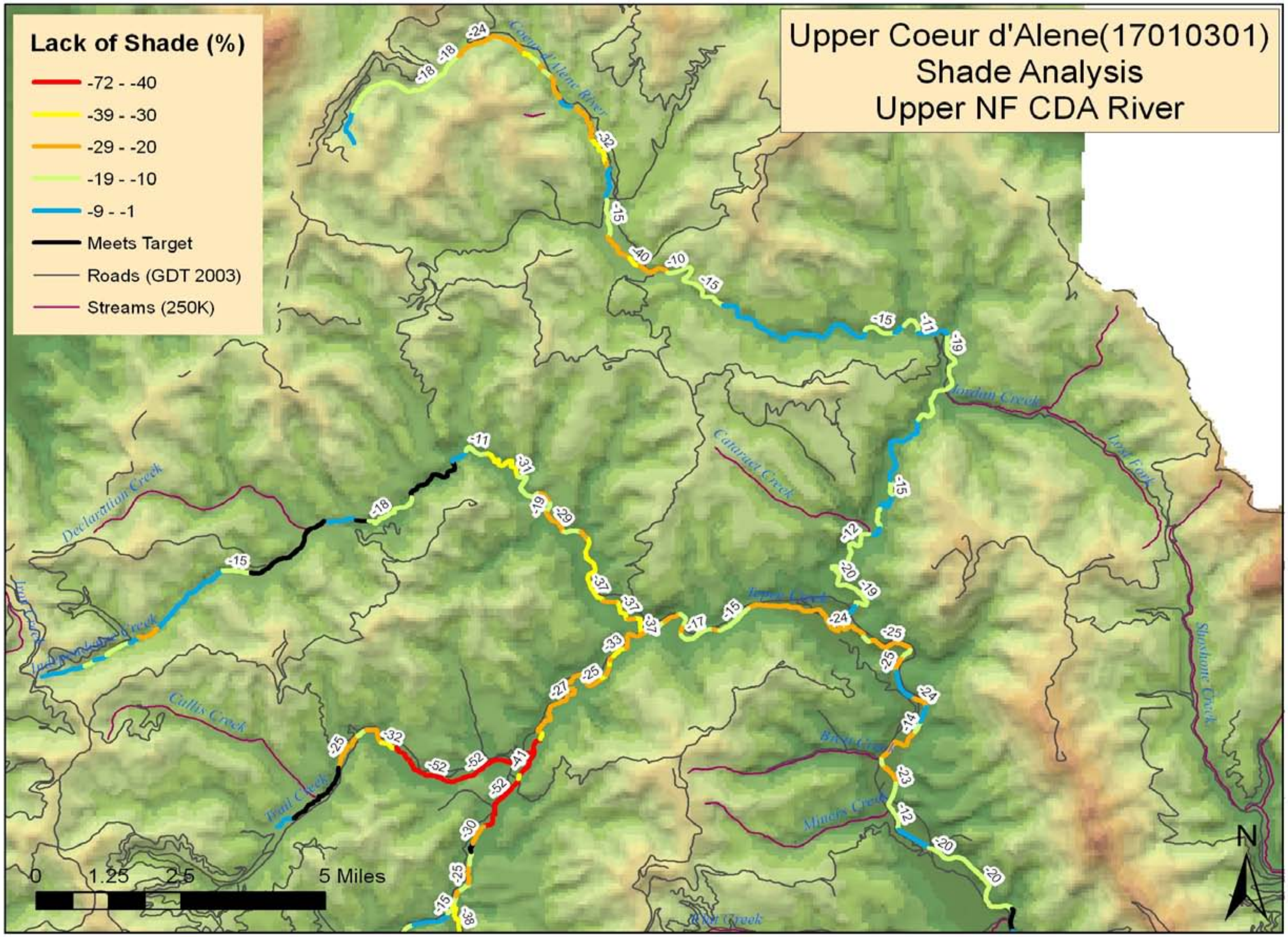


Figure C-5. Lack of Shade (Difference Between Existing and Target) for the Upper NF Coeur d'Alene River Area.



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Relationship Between Pathfinder Measured Existing Shade and Original Aerial Photo Interpretation.

aerial class	pathfinder actual	pathfinder class	delta		
30	44.6	40	-10		Little NF 1
30	67	60	-30		Little NF 2
10	58.1	50	-40		Little NF 3
10	39.2	30	-20		Little NF 4
20	52	45	-25	average	
11.55	12.66	12.91	12.91	std dev	
11.32	12.40	12.65	12.65	95%CI	

70	77.2	70	0		Deception1
80	69.6	70	10		Deception2
80	95.2	90	-10		Deception3
77	81	77	0	average	
5.77	13.15	11.55	10.00	std dev	
6.53	14.88	13.07	11.32	95%CI	

20	24.2	20	0		Steamboat
20	36.2	30	-10		Steamboat
40	73.4	70	-30		Steamboat
40	56.4	50	-10		Steamboat
30	48	43	-13	average	
11.55	21.76	22.17	12.58	std dev	
11.32	21.33	21.73	12.33	95%CI	

90	67.9	60	30		Leiberg 1
60	55.2	50	10		Leiberg 2
50	36	30	20		Leiberg 3
60	33.8	30	30		Leiberg 4
65	48	43	23	average	
17.32	16.26	15.00	9.57	std dev	
16.97	15.94	14.70	9.38	95%CI	

50	58	50	0	Beaver
90	90.2	90	0	WF Eagle
0	12.1	10	-10	Tepee 1
0	4.2	0	0	Tepee 2

Appendix D. Distribution List

Appendix E. Public Comments

Appendix X. System Potential Effective Shade